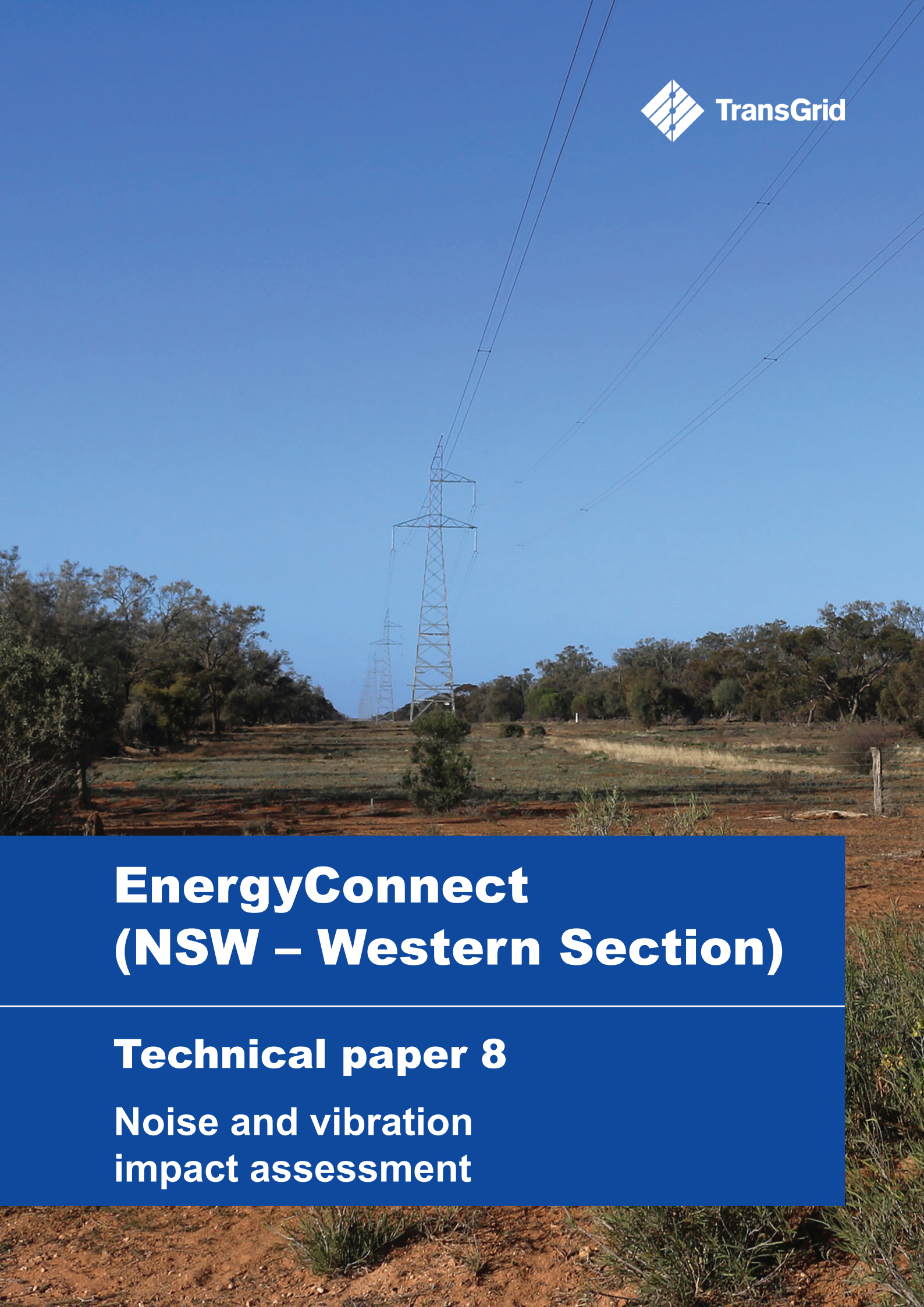

TransGrid

EnergyConnect (NSW – Western Section)

Technical paper 8

Noise and vibration impact assessment

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Technical paper 8 – Noise and vibration impact assessment

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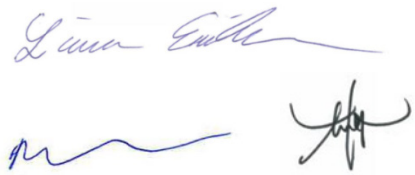
Prepared by:	Linnea Eriksson; Rebecca Warren; Zhang Lai	21/10/2020	
Reviewed by:	Ben Ison	21/10/2020	
Approved by:	Caitlin Bennett	21/10/2020	

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GLOSSARY AND ABBREVIATIONS

ANL	Amenity noise level
ANZECC	Australian New Zealand Environment and Conservation Council
AS	Australian Standard
Assessment period	The period in a day over which assessments are made
AVTG	Assessing Vibration: a Technical Guideline
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L_{90} noise level (see below).
BS	British Standard
CEMP	Construction Environmental Management Plan
CNVMP	Construction Noise and Vibration Management Plan
dB	Decibel
dBA	Decibel (A-weighted)
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
DEFRA	Department for Environment, Food and Rural Affairs (United Kingdom)
DIN 4150	German Standard DIN 4150-3: Structural vibration – Effects of vibration on structures
DPIE	Department of Planning, Industry and Environment
EIS	Environmental impact statement
EnergyConnect	EnergyConnect is a proposed new electricity interconnector between Wagga Wagga in New South Wales and Robertstown in South Australia, with an added connection into north-west Victoria. EnergyConnect is a joint project between TransGrid and ElectraNet, who operate the transmission networks in New South Wales (NSW) and South Australia (SA), respectively.
EPA	Environment Protection Authority
eVDV	Estimated vibration dose value
ICNG	Interim Construction Noise Guideline
ISO	International Organization for Standardization
LGA	Local Government Area
L_1	Statistical noise descriptor: noise level not exceeded for 1% of the measurement period. Typically used to represent the maximum noise level, excluding a few non-typical extraneous events.

L_{10}	Statistical noise descriptor: noise level not exceeded for 10% of the measurement period. Typically used to represent the upper noise level.
L_{90}	Statistical noise descriptor: noise level not exceeded for 90% of the measurement period. Typically used to represent the background noise level.
L_{eq}	Equivalent noise level: equivalent energy averaged noise level which over a defined time period would contain the same energy as the time varying signal over the same time period.
L_{max}	Maximum noise level: maximum rms noise level.
NCA	Noise catchment area
NML	Noise Management Level
NPfI	NSW Noise Policy for Industry
NSW	New South Wales
NVIA	Noise and vibration assessment
OOHW	Outside of hours work
PPV	Peak particle velocity
PNTL	Project noise trigger level
proponent, the	The proposal is proposed to be undertaken by NSW Electricity Networks Operations Pty Ltd as a trustee for NSW Electricity Operations Trust (referred to as TransGrid). TransGrid is the operator and manager of the main high voltage (HV) transmission network in NSW and the Australian Capital Territory (ACT), and is the Authorised Network Operator (ANO) for the purpose of an electricity transmission or distribution network under the provisions of the Electricity Network Assets (Authorised Transactions) Act 2015.
proposal, the	The proposal is known as 'EnergyConnect (NSW – Western Section)'. The key components of the proposal include: — a new 330 kilovolt (kV) double circuit transmission line and associated infrastructure, extending around 135 kilometres between the SA/NSW border near Chowilla and the existing Buronga substation — an upgrade of the existing 22 kilometres long 220kV single circuit transmission line between the Buronga substation and the NSW/Victoria border at Monak (near Red Cliffs, Victoria) to a 220kV double circuit transmission line — an expansion and upgrade of the existing Buronga substation from an operating capacity of 220kV to a combined operating voltage 220kV/330kV. This would include capacity to safeguard the future connection of the Eastern section of EnergyConnect — new and/or upgrade of access tracks as required.
proposal study area	The study area for this EIS, which comprises a one kilometre wide corridor between the SA/NSW border near Chowilla and Buronga substation and a 200 metre wide corridor between Buronga substation and the NSW/Victoria border at Monak, near Red Cliffs. Encompasses an indicative disturbance area and a buffer zone, which has been applied to identify the constraints nearby to the proposal which may or may not be indirectly impacted by the proposal.
RBL	Rating Background Level

EXECUTIVE SUMMARY

ENERGYCONNECT (NSW – WESTERN SECTION)

TransGrid (electricity transmission operator in New South Wales (NSW)) and ElectraNet (electricity transmission operator in South Australia (SA)) are seeking regulatory and environmental planning approval for the construction and operation of a new High Voltage (HV) interconnector between NSW and SA, with an added connection to north-west Victoria. Collectively, the proposed interconnector is known as EnergyConnect.

The proposal, focusing on the western section of EnergyConnect in NSW (and the subject of this technical paper), would involve the construction and operation of new 330kV transmission lines between the SA/NSW border and Buronga, an upgrade and expansion of the existing Buronga substation from an operating voltage of 220kV to 330kV and an upgrade of the existing 220kV transmission line between Buronga substation and the border of NSW and Victoria.

OVERVIEW OF ENVIRONMENTAL ASSESSMENT RESULTS

CONSTRUCTION

CONSTRUCTION NOISE – TRANSMISSION LINE ACTIVITIES

To assess the potential noise impacts during construction, a number of scenarios comprising typical plant and equipment have been developed. Noise impacts have been conservatively assessed assuming all plant is operational simultaneously, and given works would more progressively along the alignment, noise impacts at discrete sensitive receivers would be transitionary. Based on the anticipated construction activities and staging, affectation distances to achieve compliance with relevant criteria have been presented. The number of affected sensitive receivers within these affectation areas have then been identified. Up to six receivers were identified experiencing noise levels above NMLs during standard construction hours construction works, increasing to 22 receivers for out of hours work (OOHW). Mitigation and management measures have been outlined as a result of these findings, to be further developed as construction planning progresses, including the development of an Out of Hours Protocol for works outside standard construction hours. The locations of proposed temporary batching plants along the transmission line corridor would be located at suitable offset distances to ensure compliance with relevant NMLs at the nearest sensitive receivers.

CONSTRUCTION NOISE – BURONGA SUB STATION UPGRADE AND EXPANSION ACTIVITIES

Based on the staging and construction activities modelled, no impacts are anticipated as a result of construction of the Buronga substation during either standard hours or OOHW at the nearest receiver.

CONSTRUCTION TRAFFIC NOISE

Construction traffic on public roads has the potential to generate noise impacts at the nearest sensitive receivers.

Noise impacts on sub-arterial and arterial roads are expected to be marginal. Noise levels on regional roads have the potential to experience notable increases in traffic. Construction road traffic noise levels are predicted to comply with relevant RNP noise criteria at all proposal affected roads, nonetheless noise mitigation and management measures have been recommended in this report as a matter of best practice.

CONSTRUCTION VIBRATION

The potential for vibration related construction impacts have been assessed to identify any potential risks to building occupants and to avoid damage to buildings and other structures. Due to the linear nature of construction works, impacts have been assessed based on assessment of buffer distances from the transmission line corridor along the length of the transmission line. The minimum working distances were identified for each construction phase, to identify the number of potentially affected receivers and structures. No receivers were identified within the minimum working distances for cosmetic damage, human response and heritage sensitivity to any offsite sensitive receivers. Impacts presented are indicative and would vary depending on the final determined location of construction equipment and local geotechnical conditions.

No vibration related impacts are anticipated as a result of construction works at the Buronga substation.

Further assessment would be necessary if blasting is required, to demonstrate that blasting and associated activities would not generate unacceptable noise and vibration impacts at residences or other noise sensitive receivers.

OPERATION

OPERATIONAL NOISE – TRANSMISSION LINE

This report has considered the potential for audible noise impacts associated with the operation of high voltage transmission line due to corona discharges, and the potential risk has been quantified in terms of audible noise risk contours along the transmission line corridor. The assessment outlines the number of potential sensitive receivers within each of these audible risk zones and found that a buffer distance of up to 548 metres from the transmission line corridor for the 330kV transmission line component would be required to meet the relevant noise goals. Three potential exceedances at sensitive receiver locations are identified and a range of noise mitigation measures have been identified that would be considered during detailed design.

The proposed 220kV transmission line component between Buronga substation and the Victorian/NSW border has been determined to have no exceedances at sensitive receivers as potential audible noise was predicted to be less than 35 dBA directly under the transmission lines.

OPERATIONAL NOISE – BURONGA SUBSTATION

Operational noise impacts associated with the proposed upgrade and expansion of the Buronga substation are predicted to comply with relevant *Noise Policy for Industry* (EPA 2017) noise limits at the nearest sensitive receivers under calm and noise enhancing meteorological conditions.

OPERATIONAL VIBRATION

No operational vibration impacts are predicted from the proposal as no operational plant has the potential to generate vibration impacts.

CUMULATIVE IMPACTS

This assessment has found that there is minimal potential for cumulative noise impact as a result of the proposal and identified nearby existing and future developments.

CONCLUSION

The proposal would result in construction noise and vibration impacts at a number of sensitive receivers, which would require management and mitigation of impacts at sensitive receivers along the transmission line corridor. The required mitigation would be subject to further investigation and refinement as the design and construction methodology determination progresses. Due to the relative increase in traffic noise levels on some roads resulting from construction traffic, noise mitigation measures have also been recommended.

The assessment has identified that up to three sensitive receivers along the 330kV transmission line section of the transmission line corridor could be impacted by operational phase audible noise. The final alignment of the transmission line would determine the final predicted noise levels, and any required mitigation. Mitigation measures would be confirmed during detailed design.

Operational impacts from the upgraded and expanded Buronga substation are predicted to comply with relevant noise limits at the nearest sensitive receivers without further mitigation measures being required.

1 INTRODUCTION

1.1 OVERVIEW OF ENERGYCONNECT

TransGrid (electricity transmission operator in New South Wales (NSW)) and ElectraNet (electricity transmission operator in South Australia (SA)) are seeking regulatory and environmental planning approval for the construction and operation of a new High Voltage (HV) interconnector between NSW and SA, with an added connection to north-west Victoria. Collectively, the proposed interconnector is known as EnergyConnect.

EnergyConnect comprises several components or 'sections' (shown on Figure 1.1). The Western Section (referred to as 'the proposal') is the subject of this technical paper.

EnergyConnect aims to secure increased electricity transmission between SA, NSW and SA in the near term, while facilitating the longer-term transition of the energy sector across the National Electricity Market (NEM) to low emission energy sources.

EnergyConnect has been identified as a priority transmission project in the NSW Transmission Infrastructure Strategy (Department of Planning and Environment, 2018), linking the SA and NSW energy markets and would assist in transporting energy from the South-West Renewable Energy Zone to major demand centres.

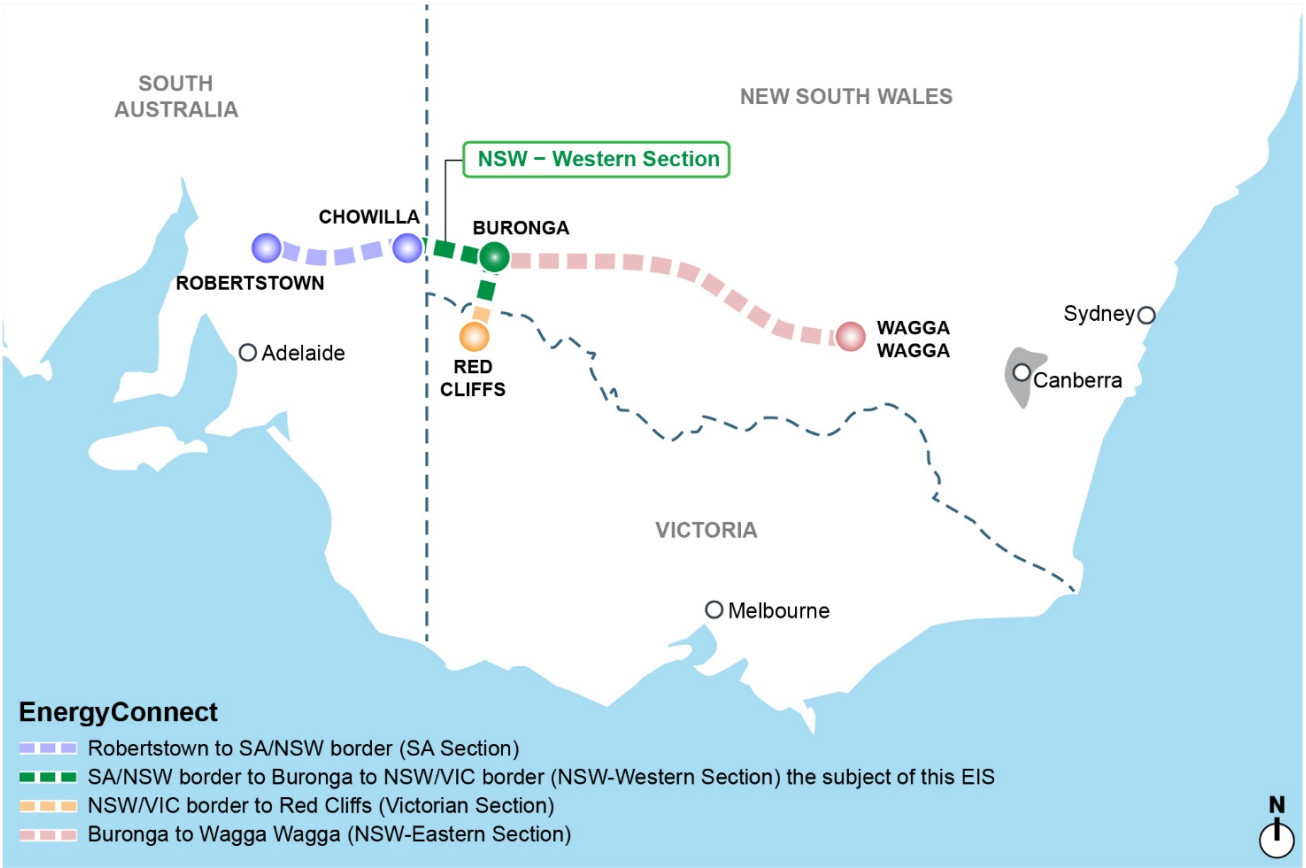


Figure 1.1 Overview of EnergyConnect

1.2 THE PROPOSAL

TransGrid is seeking approval under Division 5.2, Part 5 of the *Environmental Planning and Assessment Act 1979* (the EP&A Act) to construct and operate the proposal. The proposal has been declared as Critical State significant infrastructure under Section 5.13 of the EP&A Act.

The proposal was also declared a controlled action on 26 June 2020 and requires a separate approval under the (Commonwealth) *Environment Protection and Biodiversity Conservation Act 1999*. The proposal is subject to the bilateral assessment process that has been established between the Australian and NSW governments.

The proposal is located in regional western NSW within the Wentworth Local Government Area (LGA), approximately 800 kilometres west of Sydney at its nearest extent. The proposal spans between the SA/NSW border near Chowilla and Buronga and the NSW/Victoria border at Monak, near Red Cliffs. It traverses around 160 kilometres in total.

1.2.1 KEY PROPOSAL FEATURES

The key components of the proposal include:

- a new 330 kilovolt (kV) double circuit transmission line and associated infrastructure, extending around 135 kilometres between the SA/NSW border near Chowilla and the existing Buronga substation
- an upgrade of the existing 24 kilometre long 220kV single circuit transmission line between the Buronga substation and the NSW/Victoria border at Monak (near Red Cliffs, Victoria) to a 220kV double circuit transmission line, and the decommissioning of the 220kV single circuit transmission line (known as Line 0X1)
- a significant upgrade and expansion of the existing Buronga substation to a combined operating voltage 220kV/330kV
- new and/or upgrade of access tracks as required
- a minor realignment of the existing 0X2 220kV transmission line, in proximity to the Darling River
- ancillary works required to facilitate the construction of the proposal (e.g. laydown and staging areas, concrete batching plants, brake/winch sites, site offices and accommodation camps).

An overview of the proposal is provided in Figure 1.2. The final alignment and easement of the transmission line would be confirmed during detailed design and would be located within the transmission line corridor as shown in Figure 1.2.

Subject to approval, construction of the proposal would commence in mid-2021. The construction of the transmission lines would take approximately 18 months. The Buronga substation upgrade and expansion would be delivered in two components and would be initially operational by 2022, with site decommissioning and rehabilitation to be completed by mid-2024.The final construction program would be confirmed during detailed design.

The proposal is further described in Chapter 5 and Chapter 6 of the Environmental Impact Statement (EIS).

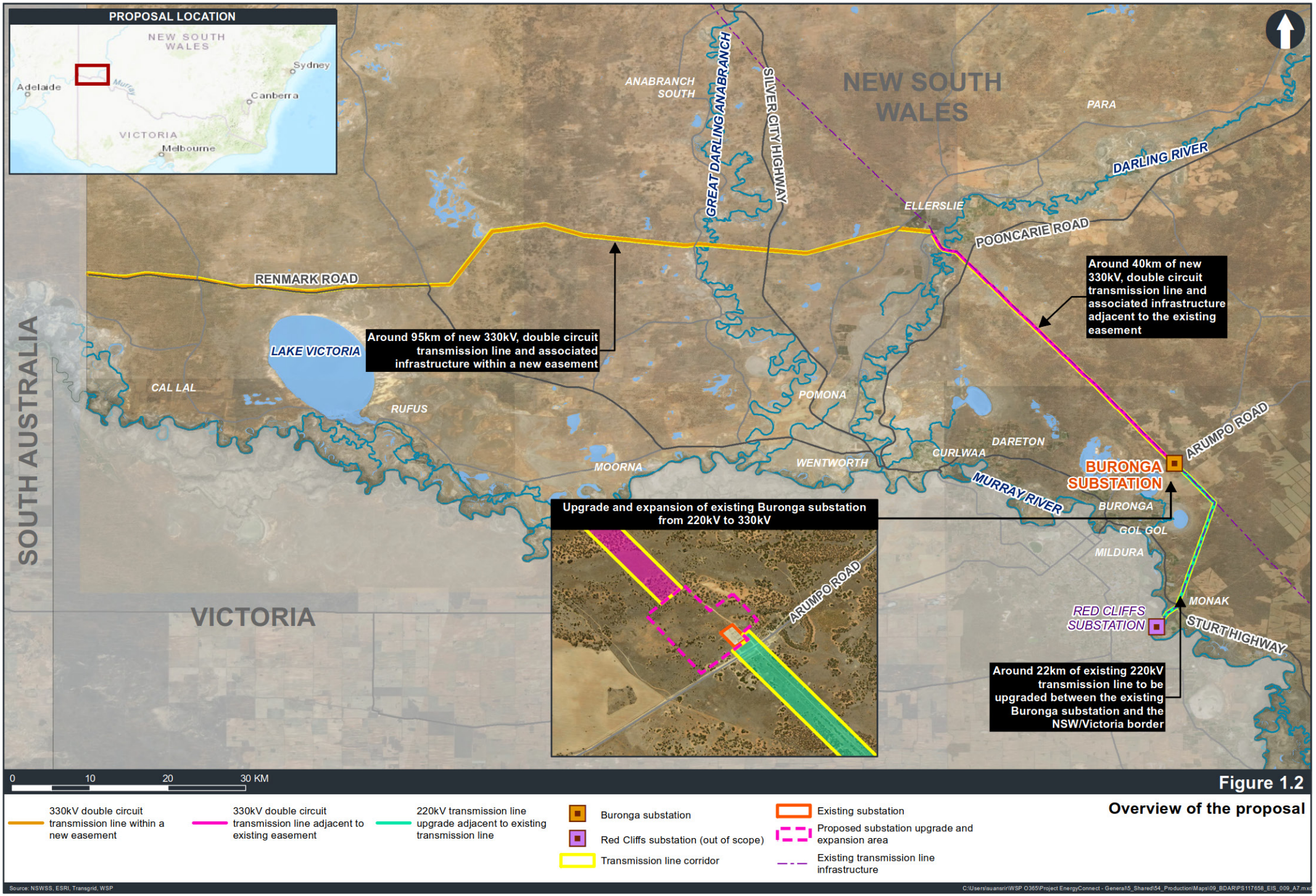


Figure 1.2

Overview of the proposal

1.2.2 PROPOSAL NEED

The proposal is required to complete the missing transmission link between the SA and NSW transmission networks. The upgrade to the existing transmission line between Buronga and Red Cliffs would also enhance the capacity of the network to provide electricity between NSW and Victoria.

This connection would relieve system constraints and allow for NSW, SA and Victorian consumers to benefit from significant amounts of low-cost, large-scale solar generation in south-west NSW. The proposal is an essential component of EnergyConnect.

1.3 PURPOSE OF THIS TECHNICAL REPORT

This technical paper is one of a number of technical papers that form part of the EIS for the proposal. The NSW Department of Planning, Industry and Environment (DPIE) has provided the Secretary's Environmental Assessment Requirements (SEARs) for the EIS.

The purpose of this technical paper is to identify and assess the potential impacts of the proposal in relation to noise and vibration). It responds directly to the SEARs (refer to Section 1.3.1).

1.3.1 SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

The SEARs specific to this assessment and where these aspects are addressed in this technical report are outlined in Table 1.1.

Table 1.1 Secretary's environmental assessment requirements – noise and vibration

REFERENCE	SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS	WHERE ADDRESSED
Key issue: Noise and vibration	An assessment of the construction, operational and road noise, vibration and blasting impacts of the project.	Section 5 presents an assessment of construction noise impact Section 6 presents an assessment of operational noise impact Sections 5.4 and 6.4 presents an assessment of road noise impact Section 5.3 presents an assessment of construction vibration (and blasting) impact

1.4 STRUCTURE OF THIS REPORT

The structure and content of this report is as follows:

- *Chapter 1 – Introduction:* Outlines the background and need for the proposal and the purpose of this report.
- *Chapter 2 – Legislative and policy context:* Outlines the key legislative requirements and policy guidelines relating to the proposal.
- *Chapter 3 – Methodology:* Provides an outline of the methodology used for the preparation of this noise and vibration impact assessment.
- *Chapter 4 – Existing environment:* Describes the existing noise environment.
- *Chapter 5 – Assessment of construction impacts:* Describes the potential construction impacts associated with the proposal.
- *Chapter 6 – Assessment of operational impacts:* Describes the potential operational impacts associated with the proposal.
- *Chapter 7 – Cumulative impacts:* Outlines the potential cumulative impacts with respect to other known developments within the vicinity of the proposal.
- *Chapter 8 – Mitigation measures:* Outlines the proposed mitigation measures for the proposal.
- *Chapter 9 – Conclusion:* Provides a conclusion of the potential impacts of the proposal on noise and vibration impacts.
- *Chapter 10 – References*: Identifies the key reports and documents used to generate this report.

Appendices to this report includes:

- **Appendix A** – Noise monitoring graphs
- **Appendix B** – Construction noise mapping
- **Appendix C –** Transmission lines operational noise mapping
- **Appendix D –** Substation impact mapping.

1.5 REPORT TERMINOLOGY

The following terms are discussed throughout this report and are defined as:

- **Proposal study area** – the proposal, including transmission line corridor, Buronga substation upgrade and expansion, access tracks, and the main construction compounds and accommodation camps at Buronga and Anabranch South would be contained within the proposal study area. The proposal study area comprises of a one kilometre wide corridor between the SA/NSW border near Chowilla and Buronga and a 200 metre wide corridor between Buronga and the NSW/VIC border at Monak, near Red Cliffs, and is used in the environmental assessment to provide a broader understanding of the constraints and conditions of the locality.

- **Transmission line corridor** – the corridor in which the final easement and transmission line is expected to be contained within. It would consist of a 200 metre corridor along the transmission line component of the proposal. Transmission line construction activities would be contained within this area, but some access tracks may extend beyond this corridor.

- **Transmission line assessment corridor –** the assessment corridor for the operations of the transmission line. It would consist of a 120 metre corridor along the transmission line component of the proposal, including 40 metre on either edge for easement to extend beyond the infrastructure components and for the easement.

1.6 LIMITATIONS

The following limitations apply to this assessment:

- Construction assessment:
  - a semi quantitative assessment of impacts has been completed which provides a conservative assessment whereby the full construction equipment fleet is assumed to be operational at any one time. This provides predicted noise levels as a worst case. The approach taken for the construction assessment provides a highly conservative and high level assessment and this has been adopted as suitable approach based on the sparsely populated nature of the potentially impacted area
  - the construction methodology and program are indicative and subject to further refinement once the construction contractor is engaged
  - vibration sensitive receivers have been based on available mapping and classification data and the heritage assessment for the transmission line corridor.
  - a qualitative assessment of blasting impact has been presented for future investigation during detailed design.
- Operational assessment:
  - existing and proposed plant and equipment locations and operating specifications have been provided by TransGrid
  - transmission lines: To allow flexibility in the detailed design process, this assessment assumed the transmission line and easement could be located anywhere within the transmission line corridor. Impacts are presented based on this potential worst case scenario. Final design of the transmission line alignment would determine the final impact levels which would be expected to be reduced from the worst case scenario presented
  - the estimation of noise impact was based on operational information provided by TransGrid and noise modelling inputs as advised by Beca Pty Ltd (*Project EnergyConnect Audible Noise and Radio Frequency Interference Study* (Beca Pty Ltd, 4 September 2020).
- *Traffic volumes:* This report relies on traffic data sets provided in the traffic assessment for the proposal within Technical paper 9 (Traffic and transport impact assessment (WSP, 2020)).
- *Meteorology*: For the purposes of this assessment, worst case noise enhancing meteorological conditions were considered. Where noise impacts can be adequately managed under these conditions, further assessment is not required as compliance can be inferred under other meteorological conditions.

2 LEGISLATIVE, POLICY CONTEXT, ASSESSMENT CRITERIA

The relevant noise and vibration legislation, policy and guidance for the noise and vibration assessment of the proposal are presented in Table 2.1. A full description and application of relevant policies are presented in the respective assessment chapters of this report (refer to Sections 5 and 6).

Table 2.1 Relevant legislation and policy

ACOUSTIC ASPECT	DESCRIPTION	RELEVANT ASSESSMENT GUIDELINES
Airborne noise	Construction noise	*Interim Construction Noise Guideline* (ICNG) (DECCW, 2009) *Construction Noise and Vibration Guideline* (CNVG) (Roads and Maritime 2016)
	Construction traffic noise	*NSW Road Noise Policy* (RNP) (DECCW, 2011)
	Sleep disturbance from construction noise	*Interim Construction Noise Guideline* (DECCW, 2009) *NSW Road Noise Policy* (DECCW, 2011)
	Operational industrial noise	*Noise Policy for Industry* (NPfI) (EPA 2017)
	Operational road traffic noise	*NSW Road Noise Policy* (DECCW, 2011)
	Sleep disturbance from operational noise	*Noise Policy for Industry* (EPA 2017)
	Existing ambient, background and industrial noise levels	*Noise Policy for Industry* (EPA, 2017) *Australian Standard AS 1055: Description and measurement of environmental noise* *ISO 8297 – Determination of Sound Power Levels of Multisource Industrial Plants for Evaluation of Sound Pressure Levels in the Environment (Engineering Method)*
Vibration	Human comfort	*Assessing Vibration: A Technical Guideline* (AVTG) (2006)
	Construction vibration effect on structures (structural or cosmetic damage)	*German Standard DIN 4150-3: Structural Vibration - effects of vibration on structures* *Australian Standard AS2187.2-2006 Explosives – Storage, Transport and Use provides guidance for the assessment of cosmetic damage to buildings caused by vibration* *British Standard BS 7385-2:1993 – Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration* (1993)
Blasting	Blasting overpressure and ground vibration	*ANZECC Technical Basis for Guidelines to Minimise Annoyance Due to Blast Overpressure and Ground Vibration* *AS 2187.2 Explosives – Storage, Transport and use Part 2: Use of Explosives*
Management	Mitigation and management of construction noise and vibration issues	*Interim Construction Noise Guideline* (DECCW, 2009) *Construction Noise and Vibration Guideline* (Roads and Maritime 2016) *Noise Policy for Industry* (EPA, 2017)

3 METHODOLOGY

This section outlines the methodology adopted for assessing the proposal's potential for noise and vibration impacts. The assessment has been completed in accordance with relevant policies and guidelines outlined in Table 2.1.

3.1 DETERMINING THE EXISTING ENVIRONMENT

Potential receivers were confirmed by review of GIS layers, review of recent aerial photography and receivers validated by TransGrid's land agents (JLL).

The existing acoustic environment was characterised by a combination of long term (unattended) and short term (attended) noise measurements in accordance with the *Australian Standard 1055:1997 – Acoustics – Description and Measurement of Environmental Noise (AS 1055)* and the NPfI. Unattended noise monitoring was carried out between 26 May and 10 June 2020, and short term attended measurements in the afternoon of 26 May 2020. Short term measurements were undertaken over 15-minute intervals with a Type 1 sound level meter (NTi Audio XL2-TA, S.N. A2A-12627-E0) on 26 May 2020. Field calibration was checked before and after each measurement occasion with no drift (±0.0 dB) observed. Monitoring was completed in accordance with *AS1055.1 Part 1: General procedures.*

Due to the spatial distribution and varying types of noise emission and operating conditions within the Buronga substation site, and the distance to the nearest receiver, measurements of existing sound pressure levels were assessed at various distances around the substation site to estimate the average sound power level around the site. Existing substation operations measurements were conducted at various locations around the boundary of the substation in accordance with *ISO 8297 - Determination of Sound Power Levels of Multisource Industrial Plants for Evaluation of Sound Pressure Levels in the Environment (Engineering Method)*. In accordance with the standard, noise measurements were taken with a Type 1 sound level meter (NTi Audio XL2-TA, S.N. A2A-12627-E0) on 26 May 2020. Measurements were taken of the sound pressure level on a measurement contour around the plant over an identified measurement area, and measurements taken to estimate the average sound power level (SWL) over the substation area.

Meteorological conditions for the transmission line corridor were considered to identify appropriate noise modelling inputs for temperature and humidity. The likelihood of weather conditions which may increase noise levels at sensitive receivers in the transmission line corridor were also considered.

3.2 DETERMINING THE APPROACH TO AREAS FOR ASSESSMENT

3.2.1 CONSTRUCTION ASSESSMENT

3.2.1.1 TRANSMISSION LINES AND TEMPORARY BATCHING PLANTS

To allow flexibility in the detailed design process, the assessment has assumed the transmission line and associated construction works could be located anywhere within the transmission line corridor. Based on this, the disturbance area for transmission line, construction activities is within the transmission line corridor.

Part of the construction works for the transmission line would involve the decommissioning of redundant 220kV towers, which would involve similar equipment and methodology to the earthworks and civil construction works phase. As a result both activities has been assessed under these two construction scenario (being earthworks and civil construction).

Temporary batching plants would be established at several locations within the transmission line corridor. As these locations are yet to be finalised, and to allow flexibility in the design process, an indicative offset distance to compliance with relevant noise goals has been presented.

3.2.1.2 BURONGA SUBSTATION UPGRADE AND EXPANSION AND CONSTRUCTION COMPOUNDS

The location of the Buronga substation upgrade and expansion and the main compound and accommodation camp locations at Anabranch South and Buronga are confirmed. These specific locations have been used to determine potential impacts from the construction activities at these locations.

An assessment for the Wentworth main construction compound and accommodation camp site (if required) would be conducted once the site location has been confirmed and necessary approvals obtained. This would occur prior to the commencement of construction of this site.

3.2.2 OPERATIONAL ASSESSMENT

3.2.2.1 TRANSMISSION LINES

As the final transmission line alignment is subject to detailed design, a conservative worst case impact assessment approach has been applied to enable for flexibility in detailed design with consideration of the potential noise and vibration impacts. The approach has assumed that the transmission line alignment could occur anywhere within the transmission line corridor. Any sensitive receiver within the transmission line corridor has therefore been assessed for impacts as have sensitive receivers located within an additional 1.7 kilometres of the transmission line corridor.

3.2.2.2 BURONGA SUBSTATION UPGRADE AND EXPANSION

The location of the Buronga substation upgrade and expansion used in the assessment is shown on Figure 1.2.

3.2.2.3 POSSIBLE PERMANENT ACCESS TRACKS

It is understood that permanent access tracks may be constructed to support ongoing maintenance operations for the proposal and for access and egress of emergency vehicles. Requirements for these are however yet to be determined and identified.

The general expectations are that these permanent access tracks are likely to carry volume of vehicles and only be used occasionally. Any possible risk of operational noise impact is therefore expected to be minimal.

3.3 ESTABLISHING CONSTRUCTION AND OPERATION NOISE AND VIBRATION CRITERIA

Construction and operational noise and vibration criteria have been established after review of relevant noise and vibration legislation, policy and guidance. A high level assessment of blasting criteria has been presented. Criteria is based on the documents outlined in Section 2.

3.3.1 CONSTRUCTION NOISE OBJECTIVES

The ICNG details construction noise and vibration criteria for general construction activities. The ICNG uses Noise Management Levels (NMLs) to determine the noise level at which reasonable and feasible noise management and mitigation should be implemented for the proposal. These management levels are presented in Section 5.2.

The CNVG has been utilised to provide details into the application of the requirements of the ICNG, including methods for noise assessment, and suggests noise management measures based on the length of the work, number of people affected and the time the works occur. The CNVG is commonly used outside major road project assessments as it has been rigorously peer reviewed and approved by the EPA.

For sleep disturbance associated with construction activities during the night (10 pm to 7 am Monday to Saturday, 10 pm to 8 am Sunday), guidance in the ICNG refers to the RNP for criteria. This is discussed in Section 5.2.1.1.

3.3.2 OPERATIONAL NOISE CRITERIA

Assessment of on-site noise sources is guided by NPfI, which is applicable to industrial noise sources from activities such as the proposal, under Schedule 1 of the *Protection of the Environment Operations Act 1997* (POEO Act).

The assessment procedure for industrial noise sources outlines two components:

- controlling intrusive noise impacts in the short-term for residences
- maintaining noise level amenity for particular land uses for residences and other land uses.

In assessing the noise impact of industrial sources, both components must be taken into account for residential receivers. In most cases, only one will become the limiting criterion and form the proposal trigger levels for the industrial source under assessment. As the upgraded substation facility would operate 24 hours a day, the night-time criteria are likely to be the controlling time criteria. Further, consideration of sleep disturbance is required in terms of night time operations of noise sources with regard to sensitive residential receivers.

The criteria derivation is presented in Section 6.1.1.

3.3.3 ROAD TRAFFIC NOISE CRITERIA

Road traffic noise criteria are presented in the RNP for arterial, sub-arterial and local roads affected by additional traffic from land use developments and construction activities. Further, the RNP states that consideration of mitigation is required where additional construction related traffic or operational off-site traffic on existing roads creates an increase of more than 2 dB at existing sensitive receivers. This is discussed in detail in Section 6.4.

3.4 DEVELOPING EQUIPMENT SOUND POWER LEVEL PROFILES

3.4.1 CONSTRUCTION

Construction fleet and staging was sourced from the program provided by TransGrid. Sound power level profiles associated with the construction fleet were developed outlining the equipment used at each construction stage, utilisation and number of plant. Sound power levels for individual plant items were sourced from the former Roads and Maritime Services' Construction Noise Estimator (part of the CNVG), which provides regulator-accepted sound power information for construction equipment, to estimate the construction sound power level for each construction scenario.

3.4.2 OPERATIONS – BURONGA SUBSTATION UPGRADE AND EXPANSION

Sound power levels associated with the existing Buronga substation and proposed substation upgrade and expansion equipment were provided by TransGrid. Existing operational sound power levels at the Buronga substation were verified using site specific attended measurements (refer to Sections 6.1.3.1 and 6.1.4.1).

3.4.3 OPERATIONS – TRANSMISSION LINE

Audible noise associated with the operation of high voltage transmission line is primarily due to corona discharges from transmission lines. The sound power levels adopted for the assessment of the 330kV transmission line were sourced from the audible risk assessment completed (*Project EnergyConnect Audible Noise and Radio Frequency Interference Study* (Beca Pty Ltd, 4 September 2020)) (refer to Section 6.2).

3.5 CONSTRUCTION NOISE AND VIBRATION IMPACTS

3.5.1 CONSTRUCTION NOISE ASSESSMENT

Prediction of construction noise impacts from the proposed construction activities has been conservatively calculated using simple noise attenuation techniques, with reference to the Construction Noise Estimator (part of the CNVG). This tool allows for high level qualitative assessment of noise impact and determination of a conservative affectation distance for certain types of construction activities. This method does not take into account likely reductions in noise due to air absorption, topographical screening, absorption or meteorological influences. This method is highly conservative, and where potential impacts are identified; further assessment is warranted to manage noise impacts.

Construction noise and vibration impacts for the Anabranch South and Buronga main construction compound and accommodation camp sites are discussed in Section 5.2.

3.5.2 CONSTRUCTION VIBRATION ASSESSMENT

Construction vibration can lead to:

- cosmetic building damage (and structural damage in extreme cases)
- loss of amenity due to perceptible vibration, termed human comfort
- impacts on the condition and structural integrity of key infrastructure.

Where vibration intensive plant such as vibratory rollers, hydraulic hammers, bored piling rigs or jackhammers are used, vibration must be managed to minimise disturbance to building occupants and to avoid damage to buildings and other structures.

Section 5.3 outlines the assessment of construction vibration and identifies minimum working distances for certain vibration generating activities with regard to the AVaTG and BS7385. These distances were utilised to present offset distances to compliance for various vibration-generating plant.

3.5.3 CONSTRUCTION BLASTING ASSESSMENT

During construction, there is the potential for blasting to be required as the project progresses. No information is available at the time of writing of this report, however there is the potential for blast overpressure and groundborne vibration at the nearest sensitive receivers, which may result in impacts on human amenity or structural impacts to buildings and infrastructure.

Where required, impacts from blasting would require assessment with regard to the Australian and New Zealand Environment Conservation Council's (ANZECC) Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (ANZECC, 1990) and the AS 2187.2 Explosives – Storage, Transport and use Part 2: Use of Explosives.

3.5.4 CONSTRUCTION TRAFFIC NOISE ASSESSMENT

Construction traffic volumes and access routes have been assessed for key haulage routes to the nearest potentially affected residential receivers. A number of assumptions have been made for the purposes of assessing construction traffic noise impacts, with reference to Technical paper 9. An assessment of construction road traffic noise impacts has been conducted using elementary noise prediction methods, as discussed in Section 6.4.

3.6 OPERATIONAL NOISE IMPACTS

3.6.1 BURONGA SUBSTATION UPGRADE AND EXPANSION

A quantitative assessment of operational noise impacts on surrounding receivers has been completed with relation to the existing and future operations of the substation. Impacts were modelled for typical operations under calm and worst-case meteorological conditions to estimate noise impacts at the nearest receivers.

A noise model was created using SoundPLAN 8 modelling software to predict the noise generated during typical operation conditions for both standard and noise-enhancing meteorological conditions at the nearest sensitive receivers. The CONCAWE algorithm was adopted to assess the noise impacts from industrial noise sources.

Key modelling parameters and assumptions are shown in Table 3.1.

Table 3.1 Operational noise modelling inputs and assumptions

PARAMETER	MODELLING INPUT
Ground absorption	Ground absorption factors are set to 0 for all roads, hardstand and 0.75 for grass/vegetation and 1 for water.
Terrain data	Terrain data have been provided by NSW Six Maps.
Ground absorption	The rural land surrounding the facility has been modelled with a ground cover factor of 0.75 representative of 'mixed' ground. Bodies of water modelled assuming a 0.1 ground absorption.
Meteorological conditions	Standard conditions: Stability category D, 0.5 m/s wind from source to receiver. Night: Stability category F, 2 m/s wind from noise source to receiver.
Buildings	Sensitive receivers are generally modelled as points only (free-field levels).
Receiver height	The receiver heights are set at 1.5 metres above ground level.
Location of noise sources	Existing operations modelled as constant noise source across existing site boundary area, based on measured noise levels (refer to Section 4.3.4 of report). Future noise sources were modelled at representative point source locations within the future site boundary.
Modelled sound power levels	As described in Section 5.2.2.1 and Appendix B-1. Noise sources modelled at 5 m height.
Assessment duration	15 minutes
Assumed hours of operations	It is assumed that all activities would occur at any time of day (day, evening, night).
Attention-drawing characteristics	It is assumed that received noise levels at sensitive receivers may incur annoyance penalty as described in Section 6.1.1.5.

This assessment is presented in Section 6.1.2.

3.6.2 TRANSMISSION LINE

A semi-quantitative assessment of operational noise impacts on surrounding receivers has been completed with relation to the operation of the transmission line. This approach is considered conservative and allows for alignment to occur anywhere in the proposal study area and consider the potential impacts based on an alignment anywhere in this area as the final design is still being developed.

To assess the risk of this noise impact, an audible risk assessment associated with the transmission lines was completed for the proposal, as outlined in the *Project EnergyConnect Audible Noise and Radio Frequency Interference Study* (Beca Pty Ltd, 4 September 2020), referenced in this report. Audible noise risk scenarios were developed to quantify the number of receivers within audible risk zones. This assessment is presented in Section 6.2.

3.7 ASSESSMENT OF POTENTIAL CUMULATIVE IMPACT

A qualitative assessment of potential cumulative impacts is required to consider how the proposal would interact with other possible noise-generating developments planned near the proposal. This assessment is guided by provisions in the NPfI. The assessment considers both existing and future potentially noise-generating developments as discussed in the following sections and in Section 7.

3.7.1 EXISTING NOISE-GENERATING DEVELOPMENTS

3.7.1.1 EXISTING BURONGA SUBSTATION

As discussed in Section 3.6.1, noise assessment of the proposed substation upgrade and expansion considers noise levels associated with existing operations. Details of the noise monitoring conducted and noise modelling results are discussed in Section 4.3.4 and Section 6.1.

3.7.1.2 EXISTING TRANSMISSION LINES

The assessment considers the potential cumulative noise impacts of high voltage transmission lines being located and operating adjacent to each other.

3.7.2 POSSIBLE FUTURE NOISE-GENERATING DEVELOPMENTS

The cumulative assessment has qualitatively considered the impact of identified future developments in the area in conjunction with impacts from the proposal.

3.8 NOISE AND VIBRATION IMPACT MITIGATION AND MANAGEMENT MEASURES

Noise and vibration impact mitigation and management measures were developed for construction and operational components of the proposal.

4 EXISTING NOISE ENVIRONMENT

The noise environment varies over the transmission line corridor, however affected land uses are generally characterised as rural noise amenity areas, primarily dominated by agricultural and rural residential land uses along the alignment and in the vicinity of the existing Buronga substation. The primary activities which dominate the local noise environment are natural noises including insect and cicada noise and local traffic influences.

4.1 NOISE SENSITIVE RECEIVERS

The locations of sensitive receivers and attended monitoring locations are shown in Figure 4.1. Table 4.1 details the sensitive receivers in proximity to the transmission line corridor.

Further detailed sensitive receiver mapping is provided in Appendix B and Appendix C.

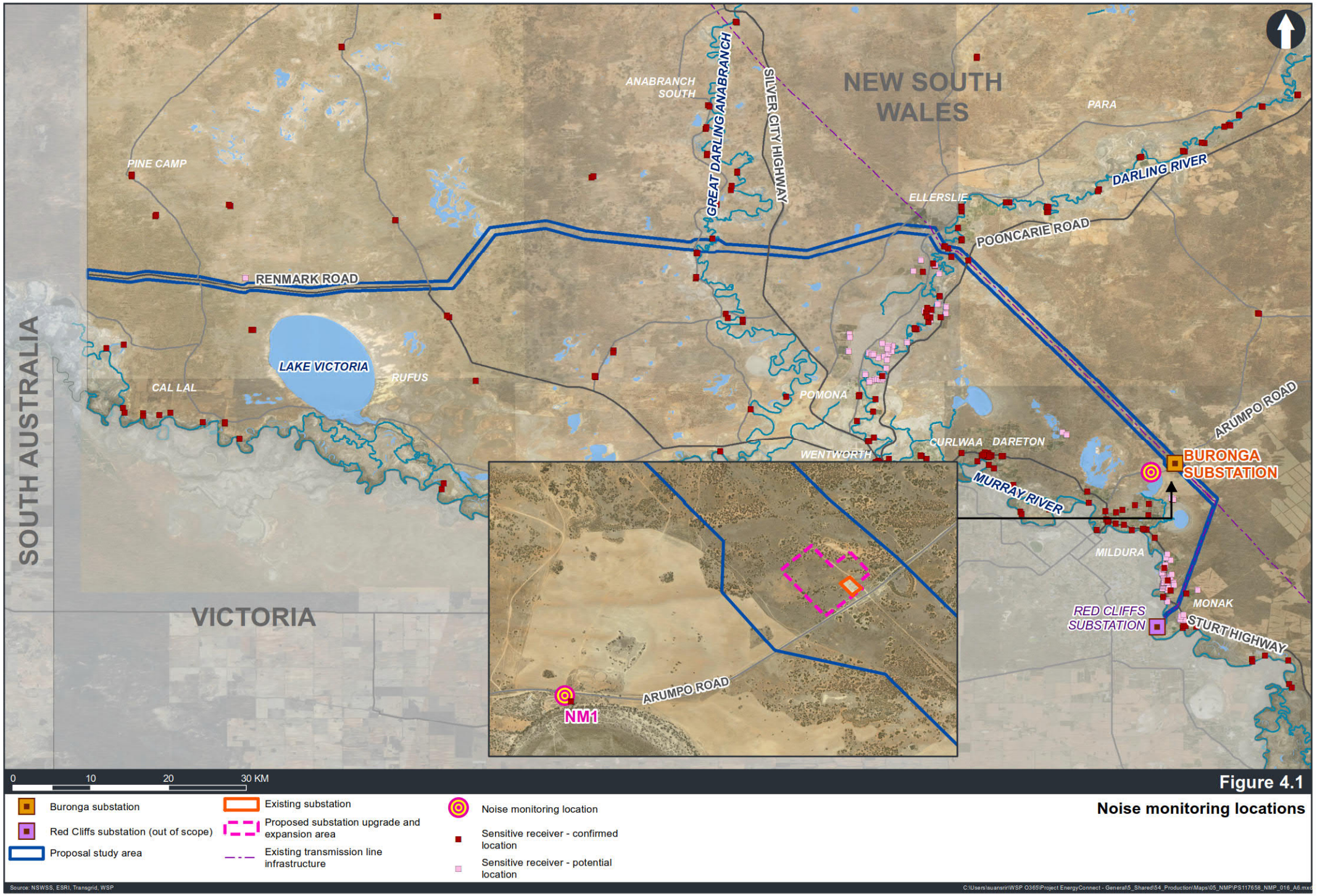


Figure 4.1

Noise monitoring locations

Table 4.1 Sensitive receivers along the transmission line corridor and within a 1.5 kilometres buffer from the transmission line corridor

RECEIVER ID	ADDRESS	RECEIVER TYPE	APPROXIMATE DISTANCE TO TRANSMISSION LINE CORRIDOR BOUNDARY (METRES)
R1489	Hazeldell Homestead at 2042 Low Darling Road	Residential Dwelling (verified)	210
R2022	Lot 2 DP1189519	Residential Dwelling (verified)	130
R2023	Lot 2 DP1189519	Residential Dwelling (verified)	280
R3627	Lot 1 DP1180587	Utility facility (verified)	165
R3627	Ellerslie substation	Utility facility (verified)	165
R986	Trentham cliffs, NSW 2738	Industry facility (potential)	1,400
R980	88 Alfred Elms Road	Residential Dwelling (potential)	1,010
R979	87 Alfred Elms Road	Residential Dwelling (potential)	1,105
R963	59 Chanters Lane	Industry facility (verified)	1,150
R960, R961	Trentham Cliffs, NSW 2738	Residential Dwelling (potential)	1,100
R959	6187 Sturt Highway	Residential Dwelling (potential)	1,185
R958	Monak, NSW 2738	Residential Dwelling (potential)	1,140
R957	Monak, NSW 2738	Residential Dwelling (potential)	1,110
R956	Monak, NSW 2738	Residential Dwelling (potential)	1,370
R647	Trentham cliffs, NSW 2738	Industry facility (potential)	380
R3433	59 Chanters Lane	Residential Dwelling (potential)	1,150
R3385	3080 Anabranch Mail Road	Residential Dwelling (verified)	720
R2103	Ellerslie, NSW 2648	Education facility (verified)	1,600
R2035	Anabranch South, NSW 2648	Residential Dwelling (verified)	1,065
R1968	Pine Camp, NSW 2648	Residential Dwelling (potential)	1,080
R1967	Pine Camp, NSW 2648	Residential Dwelling (potential)	1,015
R1965	Wentworth, NSW 2648	Residential Dwelling (verified)	620
R1548	Anabranch South, NSW 2648	Residential Dwelling (verified)	1,130
R13972	240B Ellerslie Road	Education facility (verified)	1,550
R13650	248A Ellerslie Road	Community facility (verified)	1,450

4.2 VIBRATION SENSITIVE RECEIVERS

Vibration sensitive receivers include all regularly occupied buildings. At sufficient levels, vibration can lead to cosmetic (and possibly structural) building damage as well as cause disturbance to occupants.

Vibration can also affect sensitive structures, which could include heritage listed buildings.

Three listed non-Aboriginal heritage sites have curtilages that are located partially within the proposal study area. No heritage sites are within one kilometre of the proposal study area. Of the three sites, all are partially located in the transmission line corridor, but no structural components are identified within the transmission line corridor. Non-Aboriginal heritage items located within the transmission line corridor are presented in Table 4.2 and are presented in Appendix B.

Table 4.2 Heritage listed items within the proposal study area and an additional one kilometre buffer zone

SITE NAME[1]	ITEM ID	CATEGORY	SIGNIFICANCE
Sturts Billabong	I27	Historic Landscape	Local
Nulla Nulla Woolshed	I81	Woolshed (Built)	Local
Nulla Nulla Homestead	I82	Residential Dwelling (Built)	Local

(1) Source: Heritage Assessment (Navin Officer Heritage Consultants 2020)

(2) No elements comprising structural components identified within the transmission line corridor.

4.3 NOISE MONITORING

4.3.1 NOISE MONITORING LOCATIONS

Noise monitoring locations selected for the assessment were considered to be representative of the existing background noise environment in the vicinity of the Buronga substation. Due to the largely rural nature of the background noise environment along the proposal study area, it is considered that the background noise environment adopted would be representative of that along the full proposal study area extent.

Table 4.3 summarises the noise monitoring locations selected for the proposal, presented in Figure 4.1.

Table 4.3 Noise monitoring locations

ID	NOISE MONITORING LOCATION	APPROXIMATE ADDRESS / DESCRIPTION	ID	NOISE MONITORING LOCATION
NM1	Site boundary	694 Arumpo Rd, Wentworth NSW 2648	NM1	Site boundary

4.3.2 UNATTENDED MONITORING

Unattended monitoring results are summarised in Table 4.4 with daily logger charts presented in Appendix A.

Table 4.4 Unattended noise measurement results

ID	RATING BACKGROUND LEVEL, (RBL) DBA			AMBIENT NOISE LEVEL DBA LEQ,15,MIN		
	Day(1)	Evening(1)	Night(1)	Day(1)	Evening(1)	Night(1)
NM1	35 (24)(2)	(30) 21(2)	(30) 22(2)	45	39	34

(1) Time periods defined as – Day: 7 am to 6 pm Monday to Saturday, 8 am to 6 pm Sunday; Evening: 6 pm to 10 pm; Night: 10 pm to 7 am Monday to Saturday, 10 pm to 8 am Sunday

(2) Where background levels are below the minimum assumed RBLs outlined in the NPfI, they have been adjusted to 35 dBA during the day period, and 30 dBA during the evening and night periods in accordance with the NPfI.

4.3.3 ATTENDED MONITORING

To characterise the existing noise environment, short term (attended) noise measurements were undertaken at representative locations as summarised in Table 4.5.

Weather conditions during monitoring were observed to be suitable for monitoring, with 2.5–3 metre per second southerly winds and light cloud cover observed.

Table 4.5 Attended noise measurement results

ID	DATE AND TIME	MEASURED NOISE LEVEL			COMMENTS
		$L_{90,15min}$	$L_{90,15min}$	$L_{90,15min}$	
NM1 roadside	5/26/2020 4:11 PM	23	58	81	Background: rural noise environment. Sources: Bird noise – 33–35 dBA, car passby – 81 dBA, dogs barking, light winds – 24–25 dBA
NM1 roadside	5/26/2020 4:30 PM	23	36	55	Background: rural noise environment. Sources: Bird noise – 33–35 dBA, car passby – 81 dBA, dogs barking, light winds – 24–25 dBA

Background noise levels were observed to be low during the daytime period and dominated by rural and natural sounds, typical of a rural land use area. Background noise levels of less than 30 dBA were observed during both readings, which are consistent with the findings of the unattended noise monitoring program.

4.3.4 EXISTING SUBSTATION SOUND POWER LEVELS

A site investigation was conducted to assess the existing operating sound power level of the Buronga substation.

The average operating sound power level of the existing plant was estimated during daytime (afternoon) and night time (evening) operations, with results presented in Table 4.6.

Table 4.6 Measured sound power level of existing plant

EQUIPMENT	AVERAGE SOUND POWER LEVEL – SWL (dBA, PER m^2) $L_{eq,15,min}$
Overall existing site (afternoon)	109
Overall existing site (evening)	87

The very low background noise levels during the evening period resulted in invalidation of evening measurement results in accordance with the ISO 8297 methodology. As such the afternoon measurement has been considered representative of site operations for the purpose of this assessment.

4.3.5 METEOROLOGY

Certain meteorological conditions can enhance the propagation of noise, and their influence is required to be accounted for where they are found to be a feature of the transmission line corridor. These are summarised in Table 4.7.

Table 4.7 Standard and noise enhancing meteorological conditions

METEOROLOGICAL CONDITIONS	METEOROLOGICAL CONDITIONS
Standard meteorological conditions	Day/evening/night: Stability categories A-D with wind speed up to 0.5 m/s at 10 m above ground level.
Noise-enhancing meteorological conditions	Day/evening/night: Stability categories A-D with light winds (up to 3 m/s at 10 m above ground level). Night: Stability categories A-D with light winds (up to 3 m/s at 10 m above ground level) and/or stability category F with winds up to 2 m/s at 10 m above ground level.

Where the occurrence of noise-enhancing conditions is 'significant', noise levels from the development must also be assessed under these conditions as defined in the NPfI.

For the purposes of this assessment, standard and noise-enhancing meteorological conditions were considered. A conservative approach considering F class temperature inversions and two metres per second wind speeds were adopted during the night time period. Where noise impacts are predicted under these situations, a further assessment requirement is triggered.

5 ASSESSMENT OF CONSTRUCTION IMPACTS

This section presents the assessment of construction noise, construction vibration and construction traffic noise associated with the proposal. The ICNG and RNP contain applicable goals for the construction of the proposal. The CNVG outlines detail into the application of the requirements of the ICNG. This section has considered the impacts of the Buronga substation and transmission line construction activities associated with the proposal separately.

5.1 CONSTRUCTION APPROACH

5.1.1 INDICATIVE CONSTRUCTION PROGRAM

The indicative timing for the work phases for the proposal is shown in Figure 5.1.

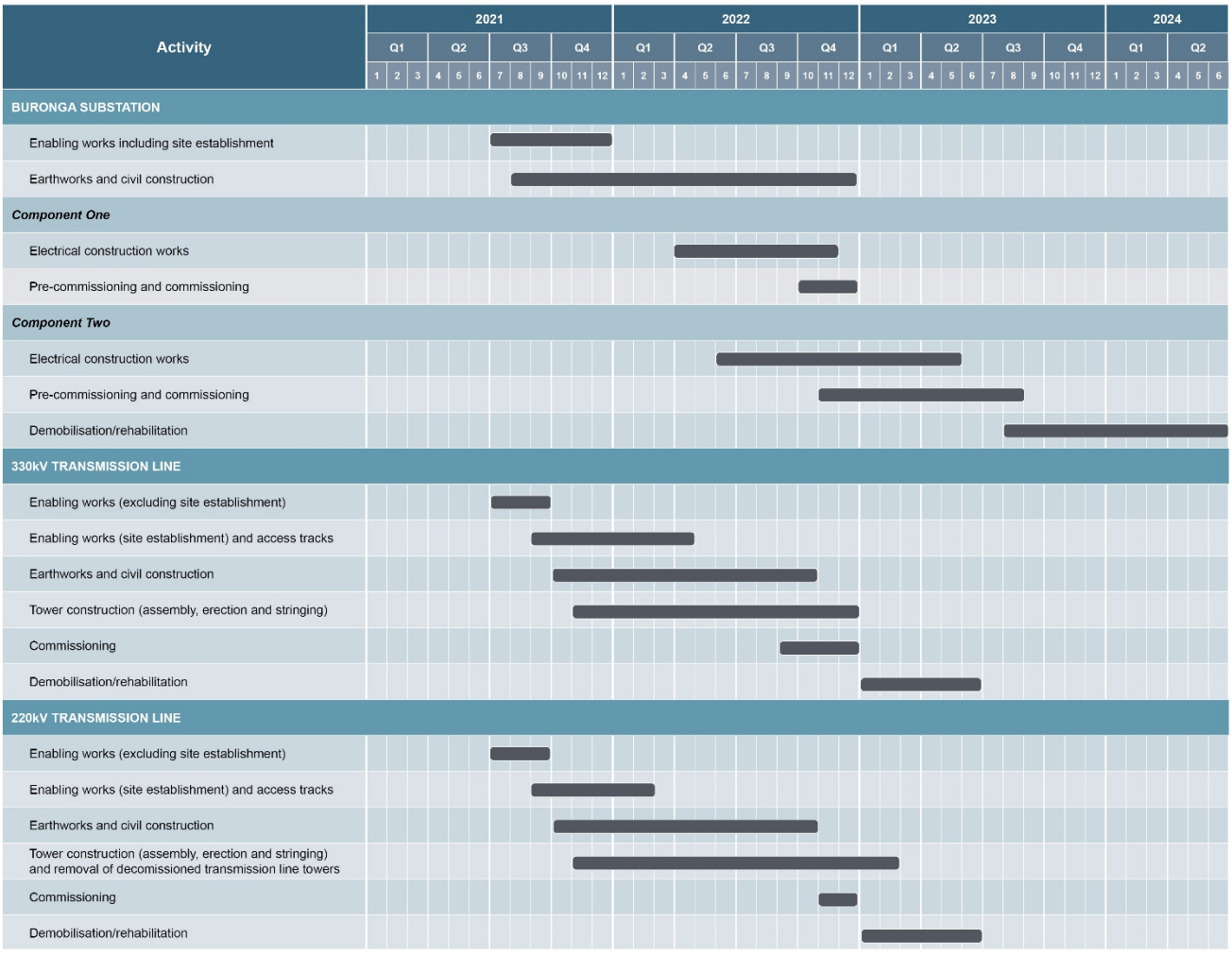


Figure 5.1 Indicative construction program

5.1.2 CONSTRUCTION ACTIVITIES AND WORKFORCE ESTIMATES

5.1.2.1 BURONGA SUBSTATION UPGRADE AND EXPANSION WORKS

Table 5.1 lists the proposed work phase and key activities required to construct the proposed Buronga substation upgrade and expansion.

Table 5.1 Buronga substation upgrade and expansion work phase and key construction activities

WORK PHASE	KEY CONSTRUCTION ACTIVITIES
Enabling works	Works include: — dilapidation surveys — road surveys — tower/easement survey and LiDAR — flora/fauna/heritage surveys — geotechnical investigations.
Earthworks and civil construction works	Site establishment, substation bench, footings and civil infrastructure (drainage/utilities) — clearing grubbing — vegetation removal — strip topsoil — major earthworks fill using site won (borrow pit) material and imported fill — potential stabilisation of material insitu — installation of utilities infrastructure (drainage, conduit runs) — footings and foundations for equipment (piled and reinforced concrete (RC)) — building installation — spray seals, surfacing, white lining, barrier installation — access road installation — security fence install
Electrical construction works	Installation of electrical plant, equipment and connections. — local earthworks — pit and conduit installation including in-situ RC pits — lifting and installation of large equipment — installation and fitout of buildings.
Pre-commissioning	— predominantly electrical work but defect rectification could include any of the activities listed in stage 4.
Demobilisation and rehabilitation	— predominantly electrical work but defect rectification could include any of the activities listed in stage 4.

5.1.2.2 TRANSMISSION LINE CONSTRUCTION WORKS

Table 5.2 lists the proposed work phase and key activities required to construct the proposed transmission line construction works.

Table 5.2 Work phase and key construction activities for transmission line construction

WORK PHASE	KEY CONSTRUCTION ACTIVITIES
Enabling works	Works include: — dilapidation surveys — road surveys — tower/easement survey and LiDAR — flora/fauna/heritage surveys — geotechnical investigations.
Site establishment and access tracks	— clearing/grubbing — vegetation removal — mulching — grading/improving access routes.
Earthworks and civil construction works	Installation of foundations and temporary works for following activities: — levelling ground — crane pad temp. works (improving ground or installing temporary pads) — bored piling, install reinforcement and concreting — RC pad footings — concrete/steel driven piles — installation of screw piles — spreading excavated material.
Tower assembly	— assembly of steel structure on ground.
Tower erection	— lifting the assembled pieces into position (may be in one piece or may be multiple lifts).
Tower stringing	— pull line pulled between structures in up to 10 kilometre runs — line could be pulled by vehicle or drone — winches and cable trucks used to pull conductors — connections between conductors at breaks in line and changes in direction.
Commissioning / energisation	— predominantly electrical works.
Decommissioning[1]	— removal of redundant 220kV transmission line structures in discrete locations.
Demobilisation and rehabilitation	— site rehabilitation — removal of temporary works — seeding/stabilising — minor landscaping — removal of materials — defect rectification — inspections — road repairs as required.

(1) The decommissioning of redundant 220kV towers would involve similar equipment and methodology to the earthworks and civil construction works phase. As a result, these impact have been assessed under the same construction stage.

5.1.2.3 MAIN CONSTRUCTION COMPOUNDS AND ACCOMMODATION CAMPS

Table 5.3 lists the proposed work phase and key activities associated with the construction compounds and accommodation camps.

Table 5.3 Work phase and key construction activities for the construction compounds and accommodation camps

WORK PHASE	KEY CONSTRUCTION ACTIVITIES
Enabling works	Works include: — dilapidation surveys — road surveys — tower/easement survey and LiDAR — flora/fauna/heritage surveys — geotechnical investigations.
Compound and laydown areas	Establishment of the compound/laydown: — clearing grubbing — vegetation removal — taking deliveries — earthworks to establish hardstand — installation of utilities infrastructure (drainage, conduit runs, sewerage) — installation of site/accommodation sheds — installation of roofs and walkways — spray seals, white lining, barrier installation — installation of workshops, containers, canopies — furnishing and utilities connections.
Operation of the compound – standard hours	Activities include: — office works — staff/worker meetings/briefings — material handling — logistics (loading/unloading trucks) — taking deliveries — de-stuffing/re-distribution of materials — staff training — maintenance.
Operation of the compound – outside standard hours	As above on Saturday and Sundays- however following the OOHW protocol for night works.
Operation of the accommodation camp	Accommodation facility operations. heating, cooling, lighting.
Demobilisation / rehabilitation	— site rehabilitation — removal of temporary works — seeding/stabilising — minor landscaping — removal of materials — defect rectification — inspections — road repairs as required.

5.1.3 CONSTRUCTION HOURS

5.1.3.1 BASE HOURS

Extended construction hours are proposed given the distance to sensitive receivers for the majority of the proposal study area. Construction work would be carried out seven days per week (Monday to Sunday) between 7 am and 7 pm. This would include some works occurring outside of standard ICNG construction hours of Monday to Friday 7 am to 5 pm and Saturdays from 8 am to 1 pm (refer to Figure 5.2). Base works occurring outside ICNG standard hours are indicated with a shaded background.

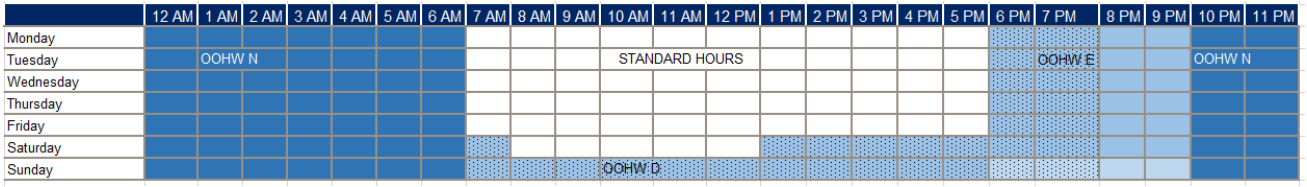


Figure 5.2 ICNG standard hours

As works are generally during daytime and evening shoulder periods, the potential for adverse noise impacts associated with works outside standard ICNG construction hours are generally considered to constitute a low risk. However, as the proposed base hours include periods outside standard ICNG construction hours, an Out of Hours Work Protocol will be required to ensure that noise impacts are adequately managed where works are in the vicinity of sensitive receivers. The Out of Hours Work Protocol is discussed in Section 8.

The accommodation camp facilities would be operational 24 hours a day, seven days a week.

5.1.3.2 WORKS OUTSIDE BASE HOURS

A series of works outside base hours are also anticipated including (but not limited to) the following:

- transmission line construction where this would occur as a crossing of a main road. These locations are expected to have restricted construction hours requiring some night works for activities such as conductor stringing over the crossing(s)
- transmission line cutover and commissioning
- the delivery of equipment or materials outside standard hours requested by police or other authorities for safety reasons (such as the delivery of transformer units)
- substation assembly (oil filling of the transformers)
- connection of the new 330kV substation to the existing 220kV substation which is likely to require longer working hours
- emergency work to avoid the loss of lives and/or property and/or to prevent environmental harm
- work timed to correlate with system planning outages
- situations where agreement is reached with affected receivers.

Following appointment of the construction contractor a program would be determined to identify the required night work periods (including dates and durations).

Except for emergencies, construction works would be carried out in accordance with the Out of Hours Work Protocol and would not take place outside the base construction hours without prior notification in line with that protocol. As these works may occur during more sensitive evening and night time periods, the potential for impacts is of higher risk and will require detailed management procedures to manage impacts.

5.1.4 CONSTRUCTION COMPOUNDS AND ACCESSES

Three main construction compounds and accommodation camp sites are identified for the proposal. Large laydown areas for the transmission lines steel, conductors and hardware would be contained these sites with some smaller ancillary facilities at other worksites along the transmission line corridor.

The main construction compound and accommodation camp sites would be located at:

- Anabranch South, NSW (access via Renmark Road/Tooperoopna Road/Anabranch Mail Road)
- Buronga substation, NSW (via Pumps Road, Calder Highway, Silver City Highway, Arumpo Road)
- Wentworth, NSW (location to be confirmed).

Two of the site locations have been determined to be located at Anabranch South on Silver City Highway, approximately 30 kilometres north of Wentworth, and adjacent to the existing Buronga substation. Construction noise and vibration impacts for the Anabranch South and Buronga substation compound areas are located within the proposal study area. The nearest receivers to the Anabranch South and Buronga construction compounds and accommodation camp sites are approximately four kilometres and 1.8 kilometres respectively from the proposed site boundaries.

An assessment for the Wentworth main construction compound and accommodation camp site would be conducted once the site has been confirmed, and necessary approvals obtained. This would be completed prior to the commencement of construction of this site.

Temporary batching plants would be established at several locations outside the main construction compounds but within the transmission line corridor. As these locations are yet to be finalised, and to allow flexibility in the design process, an indicative offset distance to compliance with relevant noise goals has been presented.

5.1.5 VEHICLE GENERATION

During construction, the proposal would generate a peak of approximately 250 light vehicle movements per day and approximately 80 heavy vehicle movements (including mini buses) per day. This would include:

- 15 to 80 (peak) heavy vehicles per day including articulated vehicles and rigid vehicles which would include the transporting of earthworks from quarries and prefabricated materials from shipping ports
- 10 per cent of total heavy vehicle movements as oversized/overmass vehicles (this equates to one to three OSOM vehicles)
- 10 per cent of total heavy vehicle movements including cranes/other large equipment requiring transportation.

5.1.6 HAULAGE ROUTES

The local haulage routes between the construction work areas are expected to include:

- Buronga substation to the 330kV transmission line work site areas in the west via Wentworth – travel from Arumpo Road and Silver City Highway (B79) to Wentworth, before turning onto Renmark Road and travelling towards the western worksite areas in the transmission line corridor
- Buronga substation to 220kV transmission line work sites (near Monak) – travel from Arumpo Road, onto Silver City Highway (B79) and the to the Sturt Highway (A20), exiting at the worksite areas in the transmission line corridor.

5.2 CONSTRUCTION NOISE

5.2.1 CONSTRUCTION NOISE MANAGEMENT LEVELS

As discussed in Section 3.3.1, construction noise management levels are derived using noise management levels in accordance with the ICNG, with further guidance provided by the CNVG.

Table 5.4 defines how the noise management levels are applied for residential receivers. They are based on existing RBLs in the vicinity of transmission line corridor plus an additional allowance of 10 dB during the recommended standard hours for construction work and 5 dB outside these standard hours. Residential receivers are deemed likely to be affected by noise where the NML is exceeded. If the predicted noise levels exceed 75 dBA, then residents are deemed to be 'highly affected' and require additional considerations to mitigate potential impacts.

Table 5.4 Construction noise management levels for residential receivers and working hours (Source: Table 2 of the NSW ICNG)

WORKING HOURS	NML dBA $L_{eq,15\ min}$[1,2]	HOW NML ARE APPLIED
Recommended standard hours (SH)[3]: — Monday – Friday: 7 am – 6 pm — Saturday: 8 am – 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured dBA $L_{eq,15\ min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: — 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) — if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times
Periods outside recommended standard hours of work (OOHW)	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent of any development works for the proposal should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB above the noise affected level, the proponent of any development works proposal should negotiate with the community.

(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.

(2) The RBL is the overall background noise level representing each assessment period (day/evening/night) over the whole monitoring period. The term RBL is described in detail in the NSW NPfI.

(3) Recommended standard hours for normal construction work, excluding blasting, as per ICNG Table 1.

Source: ICNG.

Table 5.5 provides a summary of the applicable NML based on the background noise monitoring conducted (refer Section 4.3.2).

Table 5.5 Construction NML for residential receivers

RECEIVER	RBL (SECTION 4.3.2)	NOISE MANAGEMENT LEVELS, $L_{eq\ 15\ min}$ dBA			
		Day (SH)	Day (OOHW)	Evening (OOHW)	Night (OOHW)
NM1	All residences	45	40	35	35

(1) SH = recommended standard working hours, OOHW = outside of recommended standard hours work as defined in Table 5.4.

Table 5.6 lists the NMLs that have been adopted for non-residential sensitive receivers, such as commercial, industrial or education. The NMLs apply when the premises are in use during any assessment period.

Table 5.6 Construction NML for non-residential receivers

LAND USE	NOISE MANAGEMENT LEVELS, $L_{eq\ 15\ min}$ dBA)
Classrooms at schools and other educational institutions	Internal noise level – 45
Industrial	External noise level – 75

(1) SH = recommended standard working hours, OOHW = outside of recommended standard hours work as defined in Table 5.4.

Some non-residential receiver types are assessed using criteria specified as internal (rather than external) NMLs. As the acoustic performance of the building envelopes of these receivers is not known accurately, an external to internal correction of 10 dB has been applied. This is generally accepted as the minimum noise reduction that is typically provided by standard building facades, allowing for windows being open for ventilation. Further, a community facility has been identified adjacent an educational receiver, therefore the same criteria has been applied for conservativeness.

The residential NMLs applied in this assessment are more stringent than the non-residential criteria outlined in the ICNG. This assessment will focus on the residential criteria for conservativeness and simplicity of assessment.

5.2.1.1 SLEEP DISTURBANCE

Although all construction activities are currently proposed to be conducted during daytime hours, a discussion of potential sleep disturbance impacts has been provided in the event that some activities are deemed necessary to occur outside of the standard hours period. In the event such works are proposed, an assessment of sleep disturbance would be required, however generally sleep disturbance impacts are not anticipated under the proposed working hours.

Construction noise during the night (10 pm to 7 am Monday to Saturday, 10 pm to 8 am Sunday) has the potential to cause sleep disturbance at nearby residences. Guidance in the ICNG refers to the RNP for criteria relevant to the assessment of sleep disturbance.

The RNP suggests a screening level of $L_{1,1min}$ equivalent to the RBL + 15 dB. Where this level is exceeded, further analysis should be carried out. Section 5.4 of the RNP then goes on to state that:

> *Maximum internal noise levels below 50 to 55 dBA L_{max} would be unlikely to result in people's sleep being disturbed; and*
>
> *If the noise exceeds 65 to 70 dBA L_{max} once or twice each night, the disturbance would be unlikely to have any notable health or wellbeing effects.*

The guidance within the RNP indicates that internal noise levels of 50 to 55 dBA L_{max} are unlikely to cause sleep awakenings. It follows that at levels above 55 dBA L_{max}, sleep disturbance would be considered likely. Assuming receivers may have windows partially open for ventilation, a +10 dB inside to outside correction has been adopted as indicated in the ICNG.

As a result, external noise level screening criteria of RBL+15 dB and L_{max} 65 dBA would apply to assess sleep disturbance.

5.2.2 CONSTRUCTION NOISE ASSESSMENT

5.2.2.1 CONSTRUCTION STAGES

To assess the potential noise impacts during construction, a number of scenarios comprising typical plant and equipment have been developed based on the indicative staging information provided by TransGrid. Details of the individual plant items are presented in Appendix B-1, including assumptions on the number of plant items per works stage, based on the indicative staging information presented in Section 5.1.1.

5.2.2.2 PREDICTED NOISE CONSTRUCTION LEVELS

TRANSMISSION LINE WORKS

Given the linear nature of the construction works for the transmission line, noise levels have been calculated assuming all construction activities occur simultaneously, and results presented as a range based on the proximity to sensitive receivers. Table 5.7 presents the noise level range for each construction scenario based on the proximity of the works to sensitive receivers identified in Table 4.1, and compares predicted noise levels to the relevant ICNG NMLs for standard hours of work and OOHW periods.

For the purposes of assessing the potential impacts of the base construction hours (Section 5.1.3.1) the same construction activities have been assumed to occur throughout all of the base period hours (i.e. no difference between the normal standard hours and out of hours period hours).

These levels have been derived from the former Roads and Maritime Services' Construction Noise Estimator. This tool is an industry accepted method which is accepted by regulatory authorities on most major infrastructure developments. The equipment and plant are considered suitable for this type of work, and provides a conservative estimation of noise impacts as it does not include screening impacts from terrain, and assumes plant is operational 100 per cent of the time. This method is considered suitable due to the sparsity of sensitive receivers and large construction footprint, and facilitates the understanding of mitigation and management requirements from construction works.

The decommissioning of redundant 220kV towers would involve the permanent diversion of the existing 220kV line and would be completed using similar equipment and methodology to the earthworks and civil construction works phase. Therefore impacts during these stages would be similar to those predicted during the earthworks and civil construction phase and have not been re-assessed.

The noise levels presented are conservative, assuming all plant identified in Appendix B-1 is operational at any one time. Noise levels would be expected to be generally be well below these predicted noise levels at any identified receiver. Further, not all of the receivers would be expected to be impacted at the one time given their spread of locations along the transmission line corridor and that the works would be transitionary (i.e. they would progress along transmission line corridor to build the transmission line progressively). Predicted impacts at sensitive receivers would be confirmed during detailed design, and reasonable and feasible mitigation would be implemented where exceedances of NMLs are predicted, including periods of respite for works conducted outside standard construction hours. Management and mitigation requirements have been assessed further, and are presented in Section 8 and presented graphically in Appendix B-2.

Table 5.7 Predicted noise level ranges per construction work phase – Transmission line construction works

CONSTRUCTION WORK PHASE	PERIOD	ICNG NML, $L_{eq\ 15\ min}$ dBA[1]	PREDICTED NOISE LEVEL RANGE, $L_{eq\ 15\ min}$ dBA[1]	EXCEEDANCE OF ICNG NMLS, $L_{eq\ 15\ min}$ dBA[1]	HIGHLY NOISE AFFECTED NML 75dBA OR GREATER $L_{eq\ 15min}$
Enabling works	SH Day	45	25–59	Up to 14	–
	OOHW D	40		Up to 19	–
	OOHW E/N	35		Up to 24	–
Site establishment and access tracks	SH Day	45	35–69	Up to 24	–
	OOHW D	40		Up to 29	–
	OOHW E/N	35		Up to 34	–
Earthworks and civil construction works[4]	SH Day	45	37–71	Up to 26	–
	OOHW D	40		Up to 31	–
	OOHW E/N	35		Up to 36	–
Tower assembly	SH Day	45	28–62	Up to 17	–
	OOHW D	40		Up to 22	–
	OOHW E/N	35		Up to 27	–
Tower erection	SH Day	45	29–63	Up to 18	–
	OOHW D	40		Up to 23	–
	OOHW E/N	35		Up to 28	–
Tower stringing	SH Day	45	29–63	Up to 18	–
	OOHW D	40		Up to 23	–
	OOHW E/N	35		Up to 28	–
Commissioning / energisation	SH Day	45	38–60	Up to 15	–
	OOHW D	40		Up to 20	–
	OOHW E/N	35		Up to 25	–
Demobilisation and rehabilitation	SH Day	45	29–63	Up to 18	–
	OOHW D	40		Up to 23	–
	OOHW E/N	35		Up to 28	–

(1) SH Day = recommended standard working hours, OOHW E/N = outside of recommended standard hours work as defined in Table 5.4.

(2) The RBL is the overall background noise level representing each assessment period (day/evening/night) over the whole monitoring period.

(3) ICNG NMLs defined in Table 5.5.

(4) Decommissioning of redundant 220kV transmission towers would use similar equipment to that assessed in the 'earthworks and civil construction works' scenario, and as such, as not been assessed as a separate scenario.

The results in Table 5.7 indicate that the construction of the transmission line has the potential to result in exceedances of NMLs for all construction stages, during the progressive works along the transmission line alignment. The potentially impacted receivers are predominately located in proximity to the transmission line corridor where it passes across the Great Darling Anabranch and the Darling River, and in areas in proximity to the Murray River (refer to Appendix B-1). Further assessment of the level of these exceedances, affected receivers and recommended mitigation measures are presented in Section 8.1.1.

Temporary batching plants would be established at several locations within the transmission line alignment. The locations are to be finalised as the design progresses, however based on the equipment list presented in Appendix B-1, indicative offset distance to compliance with relevant noise goals have been determined. Temporary batching plants would involve a similar equipment as the operation of the site compounds (refer to Table 5.3), and based on continuous operation of this equipment, temporary batching plants should be established at least 460 metres from the nearest sensitive receivers to ensure compliance with the most stringent NML.

BURONGA SUBSTATION UPGRADE AND EXPANSION

Table 5.8 presents the range of predicted noise levels from the construction works at Buronga substation to the nearest receiver during standard hours of work and OOHW periods. These distances have been calculated consistent with the method for the transmission line calculations.

The nearest receiver to the Buronga substation is located approximately 2.3 kilometres from the boundary of the substation upgrade and expansion site. Based on the distances to sensitive receivers, no receivers are predicted to be adversely impacted by construction associated with the Buronga substation upgrade and expansion.

Table 5.8 Predicted noise level ranges per construction work phase – Buronga substation upgrade and expansion

CONSTRUCTION WORK PHASE	PERIOD	ICNG NML, $L_{eq\ 15\ min}$ dBA[1]	PREDICTED NOISE LEVEL RANGE, $L_{eq\ 15\ min}$ dBA[1]	EXCEEDANCE OF ICNG NMLS, $L_{eq\ 15\ min}$ dBA[1]	HIGHLY NOISE AFFECTED NML 75dBA OR GREATER $L_{eq\ 15min}$
Enabling works	SH Day	45	Less than 30	–	–
	OOHW D	40		–	–
	OOHW E/N	35		–	–
Earthworks and civil construction works	SH Day	45	Less than 30	–	–
	OOHW D	40		–	–
	OOHW E/N	35		–	–
Electrical construction works	SH Day	45	Less than 30	–	–
	OOHW D	40		–	–
	OOHW E/N	35		–	–
Pre-commissioning and commissioning	SH Day	45	Less than 30	–	–
	OOHW D	40		–	–
	OOHW E/N	35		–	–
Demobilisation / rehabilitation	SH Day	45	Less than 30	–	–
	OOHW D	40		–	–
	OOHW E/N	35		–	–

(1) SH Day = recommended standard working hours, OOHW E/N = outside of recommended standard hours work as defined in Table 5.4.

(2) The RBL is the overall background noise level representing each assessment period (day/evening/night) over the whole monitoring period.

(3) ICNG NMLs defined in Table 5.5.

MAIN CONSTRUCTION COMPOUNDS AND ACCOMMODATION CAMPS

Table 5.9 presents the range of predicted noise levels from the construction works at the main construction compounds and accommodation camps to the nearest receiver during standard hours of work and OOHW periods. These noise levels have been calculated consistent with the method for the transmission line calculations.

As the closest receiver to either the Buronga and Anabranch South main construction compounds and accommodation camps is approximately 1.8 kilometres away. Based on the distances to sensitive receivers, no receivers are predicted to be adversely impacted by construction or operation activities associated with these sites.

Depending on the location of the Wentworth site, impacts may occur at nearby receivers which would be qualified once the site has been selected and assessed.

Table 5.9 Predicted noise level ranges per construction work phase – main construction compound and accommodation sites

CONSTRUCTION WORK PHASE	PERIOD	ICNG NML, $L_{eq\ 15\ min}$ dBA[1]	PREDICTED NOISE LEVEL RANGE, $L_{eq\ 15\ min}$ dBA[1]	EXCEEDANCE OF ICNG NMLS, $L_{eq\ 15\ min}$ dBA[1]	HIGHLY NOISE AFFECTED NML 75dBA OR GREATER $L_{eq\ 15min}$
Enabling works	SH Day	45	Less than 30	–	–
	OOHW D	40		–	–
	OOHW E/N	35		–	–
Enabling works - site establishment	SH Day	45	Less than 30	–	–
	OOHW D	40		–	–
	OOHW E/N	35		–	–
Operation of the compound	SH Day	45	Less than 30	–	–
	OOHW D	40		–	–
	OOHW E/N	35		–	–
Operation of the accommodation camp	SH Day	45	Less than 30	–	–
	OOHW D	40		–	–
	OOHW E/N	35		–	–
Demobilisation / rehabilitation	SH Day	45	Less than 30	–	–
	OOHW D	40		–	–
	OOHW E/N	35		–	–

(1) SH Day = recommended standard working hours, OOHW E/N= outside of recommended standard hours work as defined in Table 5.4.

(2) The RBL is the overall background noise level representing each assessment period (day/evening/night) over the whole monitoring period.

(3) ICNG NMLs defined in Table 5.5.

POTENTIAL RISK FROM CONCURRENT CONSTRUCTION ACTIVITIES

There is the potential for concurrent construction activities occurring in proximity to sensitive receivers as a result of the construction of the transmission line, substation and the two main construction compounds. Based on the results of the above assessment, and considering the proximity of the nearest receivers to Buronga substation and main construction compound and accommodation camp sites, the risk of notable construction impacts at the nearest receivers to Buronga substation and Anabranch South (located at 1.8 kilometres and four kilometres from the respective compounds) would be low, with concurrent noise levels remaining below relevant construction NMLs.

5.3 CONSTRUCTION VIBRATION

5.3.1 VIBRATION IMPACTS

Construction vibration can lead to:

- cosmetic building damage (and structural damage in extreme cases)
- loss of amenity due to perceptible vibration, termed human comfort
- impacts on the condition and structural integrity of key infrastructure.

Importantly, cosmetic damage is regarded as minor in nature; it is readily repairable and does not affect a building's structural integrity. It is described as hairline cracks on drywall surfaces, hairline cracks in mortar joints and cement render, enlargement of existing cracks, and separation of partitions or intermediate walls from load bearing walls. If there is no significant risk of cosmetic building damage, then structural damage is not considered a significant risk and is not assessed.

5.3.2 COSMETIC DAMAGE

Australian Standard AS2187.2-2006 *Explosives – Storage, Transport and Use* provides guidance for the assessment of cosmetic damage to buildings caused by vibration. This section of the standard is based on the British Standard BS 7385-2:1993 – *Evaluation and measurement for vibration in buildings* and is used as a guide to assess the likelihood of building damage from ground vibration including piling, compaction, construction equipment and road and rail traffic. Guide to damage levels from groundborne vibration. Table 5.10 presents the guideline limits for cosmetic damage for short term vibration.

Table 5.10 Transient vibration guide values for cosmetic damage (BS 7385)

TYPE OF BUILDING	PEAK COMPONENT PARTICLE VELOCITY IN FREQUENCY RANGE OF PREDOMINANT PULSE	
	4 – 15 Hz	15 Hz AND ABOVE
Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
Unreinforced or light framed structures 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

Note: values referred to are at the base of the building

The guidance values in Table 5.10 relate predominantly to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings. Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 5.10 may need to be reduced by up to 50 per cent.

5.3.3 HUMAN COMFORT

Table 5.11 presents the limits (vibration dose values (VDVs)) above which it is considered there is a risk that the amenity and comfort of people occupying buildings would be affected by vibration from construction works. These limits are taken from the *NSW Assessing vibration: a technical guideline* (AVTG).

Table 5.11 Vibration limits (human exposure) for intermittent vibration

LOCATION	VDV DAY (7 am – 10 pm)		VDV NIGHT (10 pm – 7 am)	
	Preferred	Maximum	Preferred	Maximum
Critical areas	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Schools, educational institution	0.40	0.80	0.40	0.80
Places of worship	0.40	0.80	0.40	0.80

The vibration guideline also specifies limits for continuous and impulsive vibration. These vibration limits are expressed in acceleration (m/s^2) and peak particle velocity (mm/s) as presented in Appendix C of AVTG, reproduced in Table 5.12.

Table 5.12 Preferred and maximum values for continuous and impulsive vibration

LOCATION	ASSESSMENT PERIOD	RMS ACCELERATION m/s^2				PEAK PARTICLE VELOCITY (mm/s)	
		Preferred values		Maximum values		Pref. values	Max. values
		Z-Axis	X and Y Axes	Z-Axis	X and Y Axes		
Continuous vibration							
Critical areas	All	0.0050	0.0036	0.010	0.0072	0.14	0.28
Residences	Day 7 am – 10 pm	0.010	0.0071	0.020	0.017	0.28	0.56
	Night 10 pm – 7 am	0.007	0.005	0.014	0.010	0.20	0.40
Schools, educational institutions	All	0.020	0.014	0.040	0.028	0.56	1.1
Places of worship	All	0.020	0.014	0.040	0.028	0.56	1.1
Impulsive vibration							
Critical area	All	0.0050	0.0036	0.010	0.0072	0.14	0.28
Residences	Day 7 am – 10 pm	0.3	0.21	0.60	0.42	8.6	17.0
	Night 10 pm – 7 am	0.10	0.071	0.20	0.14	2.8	5.6
Educational institutions	All	0.64	0.46	1.28	0.92	18.0	36.0
Places of worship	All	0.64	0.46	1.28	0.92	18.0	36.0

5.3.4 HERITAGE RECEIVERS

Guidance for more sensitive structures or vibration sensitive activities is outlined in the German Guideline, DIN 4150-3 *Structural vibration Part 3: Effects of vibration on structures* (DIN 4150-3:1999-02). Structural damage within such structures may reasonably be expected to be avoided where vibration velocities within the structure do not exceed three millimetres per second (mm/s) for vibration frequencies between 1 to 10 Hz.

5.3.5 CONSTRUCTION VIBRATION ASSESSMENT

Where vibration intensive plant such as vibratory rollers, hydraulic hammers, bored piling rigs or jackhammers are used, vibration must be managed to minimise disturbance to building occupants and to avoid damage to buildings and other structures.

The CNVG summarises the relevant minimum working distances for certain vibration generating activities with regard to cosmetic damage and human comfort impacts outlined in the AVaTG and BS7385. Table 5.13 indicates the minimum working distances for typical items of vibration intensive plant that must be complied with unless otherwise approved by the regulator or approved by environmental license.

Table 5.13 Minimum working distances for vibration intensive plant

PLANT ITEM	RATING/DESCRIPTION	MINIMUM WORKING DISTANCE (METRES)		
		Cosmetic damage (BS 7385)[1]	Heritage (DIN 4150-3)	Human response (DECCW)[1]
Vibratory roller	<50 kN (typically 1-2 t)	5	11	15 to 20
	<100 kN (typically 2-4 t)	6	13	20
	<200 kN (typically 4-6 t)	12	15	40
	<300 kN (typically 7-13 t)	15	30	100
	>300 kN (typically 13-18 t)	20	40	100
	>300 kN (> 18 t)	25	50	100
Small hydraulic hammer	300 kg – 5 to 12 t excavator	2	5	7
Medium hydraulic hammer	900 kg – 12 to 18t excavator	7	15	23
Large hydraulic hammer	1600 kg – 18 to 34 t excavator	22	44	73
Vibratory pile driver	Sheet piles	2 to 20	5	20
Pile boring	≤800 mm	2	5	n/a
Jackhammer	Hand held	1	3	Avoid contact with structure

Source: adapted from CNVG, Roads and Maritime 2013.

(1) The minimum working distances presented are indicative and would vary depending on the item of plant and local geotechnical conditions. The cosmetic damage thresholds apply to typical buildings under typical geotechnical conditions and vibration monitoring is recommended at specific sites.

In relation to human response, the nominated minimum working distances relate to continuous vibration. For most construction activities, vibration emissions are intermittent and higher vibration levels over shorter periods are acceptable. Additional assessment should be undertaken where the human response criteria are exceeded.

The nearest sensitive receiver to the Buronga substation upgrade and expansion works is approximately 2.3 kilometres from the site. As a result, no vibration related impacts are anticipated as a result of construction works at the substation.

With regard to the transmission line construction affectation area, the nearest sensitive receivers to the works are the Buronga and Ellerslie substation facilities, located within approximately 70 metres of the construction footprint. As a result, there may be exceedances of human comfort criteria within the facilities themselves, however vibration levels are expected to remain below the levels for building damage. Given the active roles of most staff at these sites, human comfort impacts are expected to be minor. All other sensitive receivers are located outside the minimum safe working distances for vibration generating plant.

5.3.5.1 SUMMARY OF VIBRATION ASSESSMENT

Due to the linear nature of construction works along the length of the transmission line, impacts have been assessed based on assessment of buffer distances from the transmission line corridor. The resulting vibration buffer distances, and receivers identified within these affectation areas, are presented in Appendix B-2.

With regard to cosmetic damage, a minimum working distance buffer of 20 metres from sensitive receivers has been adopted for general construction activities. An additional minimum working buffer distance of 100 metres from sensitive receivers is also applicable for human response for construction works involving large vibratory rolling equipment and large hydraulic hammers. The minimum working distances in Table 5.13 relate to continuous vibration as it relates to human comfort impacts. For most construction activities, vibration emissions are intermittent in nature and for this reason, higher vibration levels, occurring over shorter periods are permitted.

No works are proposed within the minimum working distances for cosmetic damage, human response and heritage sensitivity, based on the assessment of the safe working distances for vibration generating plant within the transmission line corridor to relevant vibration sensitive receivers. Best practice vibration impact management measures to manage the potential for any structural damage and human comfort impacts are presented in Section 8.1.3.

5.4 CONSTRUCTION BLASTING

5.4.1 CRITERIA

Where required, impacts from blasting would require assessment with regard to the Australian and New Zealand Environment Conservation Council's (ANZECC) Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (ANZECC, 1990) and AS 2187.2 Explosives – Storage, Transport and use Part 2: Use of Explosives.

The criteria outlined by the Australian and New Zealand Environment and Conservation Council (ANZECC) in Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (ANZECC, 1990) are applicable. These guidelines provide recommended maximum levels and blast overpressure and ground vibration to maintain the amenity of residents, and are presented in Table 5.14.

Table 5.14 ANZECC recommended vibration and air blast criteria

ISSUE	MEASURE	CRITERION FOR 95% OF BLASTS	CRITERION FOR 100% OF BLASTS
Vibration	mm/s PPV	5	10
Air blast	dBL Peak	115	120

Source: Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (ANZECC, 1990)

The guidelines also provide a long-term goal of two millimetres per second for peak particle vibration velocity.

The criterion for ground vibration is designed to preserve amenity, and is more stringent than relevant criteria designed to protect against structural damage for most structures. However, for 'structures which may be particularly susceptible to ground vibration', Australian Standard 2187.2 1893 *Explosives – Storage, Transport and Use* recommends a criterion of five millimetres per second peak particle velocity.

Where blasting is to occur in the vicinity of heritage structures, relevant ground vibration criteria would be adopted based on German Standard DIN 4150-3 (refer to Section 5.3.4).

5.4.2 FUTURE ASSESSMENT CONSIDERATIONS

At this stage, no details of any proposed blasting locations are available. Once this information is provided, an assessment of the following would be required for including as part of a Blast Management Strategy:

- proposed blast locations
- blast methodology, including charge, delay interval and spacing
- calculated vibration and overpressure
- distance limits for specific Maximum Interval Charge (MIC).

Based on the outcomes of this assessment, management and mitigation may be required at the nearest affected sensitive receivers.

A blasting vibration and overpressure assessment would be required as part of any potential blast design, and a Blast Management Strategy would be prepared in accordance with Section 4 of AS 2187.2-2006 for inclusion in the CNVMP. This strategy would be developed to demonstrate that blasting and associated activities would not generate unacceptable noise and vibration impacts at residences or other sensitive receivers.

5.5 CONSTRUCTION ROAD TRAFFIC NOISE

5.5.1 CRITERIA

Traffic impacts associated with construction vehicles are assessed using guidance from the RNP. The RNP provides guidance on the assessment of noise impacts on sensitive receivers from additional road traffic generated by the proposal operating on a public road network. Traffic impacts within the transmission line corridor are assessed as part of the overall construction noise assessment conducted in line with the ICNG.

The RNP makes a distinction between the assessment of freeway/arterial/sub-arterial roads and local roads. Freeway/ arterial/sub-arterial roads are assessed over day (7 am to 10 pm) and night (10 pm to 7 am) periods.

Table 5.15 presents a summary of applicable road traffic criteria for residential receivers.

The application notes from the RNP detail the requirements for operation-generated traffic noise as follows:

> *For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies where the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion.*

Therefore, if the road traffic noise levels increase by more than 2 dBA as a result of the proposed construction traffic, and the criteria outlined in Table 5.15 are exceeded, mitigation options should be investigated.

Table 5.15 Road traffic noise criteria for receivers on existing roads affected by the additional traffic from land use developments

ROAD TYPE	EXTERNAL ROAD TRAFFIC NOISE CRITERIA[1]	
	Day 7 am – 10 pm	Night 10 pm – 7 am
Freeway/arterial/sub-arterial roads	60 dB $L_{Aeq\ 15hr}$	55 dB $L_{Aeq\ 9hr}$
Local roads	55 dB $L_{Aeq\ 1hr}$	50 dB $L_{Aeq\ 1hr}$

(1) Façade corrected noise levels.

5.5.2 OVERVIEW

The key roads and the prospective haulage routes in the traffic and transport study area are discussed in the Technical paper 9 (WSP 2020) and include national and state roads (Silver City Highway through Buronga, the Sturt Highway from Buronga to Wagga Wagga) and regional roads including Arumpo Road, Renmark Road and Pooncarie Road/Wentworth Street.

Construction related vehicle movements have the potential to generate noise impacts at the nearest sensitive receivers associated with the construction program. Roads potentially impacted by such movements during construction of the proposal are classified as sub-arterial and arterial roads, as defined by the RNP.

Construction vehicle movements would comprise vehicles transporting equipment, waste, materials and spoil, as well as staff vehicles. Larger volumes of heavy vehicles would occur during the main civil construction works associated with the construction of the new substation. Minor volumes of materials are also expected to be excavated for utility relocations and construction of the transmission line towers/pole foundations.

As discussed in Section 5.1.1, a peak of 250 light vehicle movements per day is anticipated for construction of the proposal, and heavy vehicles by a peak of 80 heavy vehicles.

5.5.3 EXISTING TRAFFIC VOLUMES AND HEAVY VEHICLE ASSUMPTIONS

The existing traffic counts and heavy vehicle percentages for key roads in the region are summarised in Table 5.16 based on information provided in the traffic assessment for the proposal (refer to Technical paper 9).

Table 5.16 Existing traffic volumes and heavy vehicle percentages

ROAD TYPE	EXISTING COUNTS		SOURCE
	Volumes (vehicles per day)	Heavy vehicle percentage (%)	
Silver City Highway – 220 m East of Mourquong Road	2,230	9	Transport for NSW (Station ID:98038)
Arumpo Road	36,000	14	Wentworth Shire Council counts (2012 data)
Renmark Road	670	24	Wentworth Shire Council counts (2012 data)
Gol Gol North 12600 (12.5% HV)	12,600	12.5	Wentworth Shire Council counts (2012 data)

Although the existing traffic counts are dated between 2010 and 2012, it is highly unlikely that the traffic growth to the current year of 2020 would have a significant effect on road capacity.

A summary of estimated existing traffic volumes on haulage routes is presented in Table 5.17, based on data from Technical paper 9.

Table 5.17 Existing daily volumes

ROAD NAME AND LOCATION	POSTED SPEED (KM PER HOUR)	VOLUME (VEHICLES PER DAY)	SOURCE
Silver City Highway (B79). Ellerslie - between Broken Hill and Wentworth (from Broken Hill to Perry Street in Wentworth)	100	358	Transport for NSW, 2010
Silver City Highway (B79). Wentworth Town Centre (from Perry Street in Wentworth to Delta Road in Wentworth)	60	2,559	Transport for NSW, 2012
Silver City Highway (B79). Mourquong – between Dareton and Buronga (from Fletchers Lake Road to Corbett Avenue)	100	2,228	Transport for NSW, 2010
Silver City Highway (B79). Within Buronga town centre (from Corbett Avenue to Sturt Highway)	60	5,478	Transport for NSW, 2010
Sturt Highway (A20) George Chaffey Bridge – between Mildura and Silver City Highway, Buronga	100	10,593	Transport for NSW, 2010
Sturt Highway (A20) within Buronga (between Silver City Highway and Knights Road in Gol Gol)	60	2,730 (eastbound only)	Transport for NSW, 2010
Arumpo Road (north of Mourquong Road, Mourquong)	80	327	Transport for NSW, 2010
Renmark Road	100	<50	Wentworth Shire Council, 2012

No data was available for other local roads in the region, however it is considered that local roads would not be used by construction traffic due to heavy vehicle route limitations.

5.5.4 ESTIMATED FUTURE TRAFFIC VOLUMES

The proposal would generate a peak of 250 light vehicle movements per day and 80 heavy vehicle movements per day on the road network. Table 5.18 presents the construction traffic noise assessment for the proposal on the key haulage routes.

Given the number of vehicles on the Silver City Highway and Sturt Highway (both designated NSW Heavy Vehicle routes), noise impacts along these roads would be expected to be marginal. Noise level increases are predicted to be generally limited to below 2 dB on sub-arterial roads. The exception to this would be on the Silver City Highway (between Broken Hill to Perry Street), which is seen to experience nearly a doubling in traffic volumes. However, noise impacts are still predicted to be below road noise criteria. Regional roads such as Arumpo Road and Renmark Road are predicted to experience notable increases in traffic noise levels as a result of the proposal, with increases of 2.6 dB and 7.1 dB respectively, but would remain below road noise criteria.

The results in Table 5.18 indicate that construction road traffic noise levels are predicted to comply with relevant RNP noise criteria at all proposal affected roads. Therefore, no additional noise mitigation or management measures are required at these locations as relates to RNP management levels.

However, due to the relative increase in traffic noise levels compared to existing on Silver City Highway (Broken Hill to Perry Street), Arumpo Road and Renmark Road, noise mitigation measures have been recommended in Section 8 as a matter of best practice.

Table 5.18 Predicted road traffic noise levels and impacts

ROAD NAME AND LOCATION	DISTANCE TO NEAREST RECEIVER (METRES)	RNP CLASSIFICATION	RNP MANAGEMENT LEVELS[1]	PREDICTED NOISE LEVEL OF BASE TRAFFIC, dBA	PREDICTED NOISE LEVEL OF BASE TRAFFIC WITH CONSTRUCTION TRAFFIC, dBA	INCREASE IN NOISE LEVEL GENERATED BY CONSTRUCTION TRAFFIC, dB	INCREASE COMPLIANT WITH RNP MANAGEMENT LEVEL?
Silver City Highway (B79). Ellerslie – between Broken Hill and Wentworth (from Broken Hill to Perry Street in Wentworth)	1000	Sub-arterial	60	29	32	2.9	YES
Silver City Highway (B79). Wentworth Town Centre (from Perry Street in Wentworth to Delta Road in Wentworth)	100	Sub-arterial	60	47	48	0.5	YES
Silver City Highway (B79). Mourquong – between Dareton and Buronga (from Fletchers Lake Road to Corbett Avenue)	100	Sub-arterial	60	50	50	0.7	YES
Silver City Highway (B79). within Buronga Town Centre (from Corbett Avenue to Sturt Highway)	20	Sub-arterial	60	59	59	0.2	YES
Sturt Highway (A20) George Chaffey Bridge – between Mildura and Silver City Highway, Buronga	20	Sub-arterial	60	64	64	0.1	YES
Sturt Highway (A20) within Buronga (between Silver City Highway and Knights Road in Gol Gol)	20	Sub-arterial	60	56	56	0.5	YES
Arumpo Road (north of Mourquong Road, Mourquong)	100	Sub-arterial	60	41	44	2.6	YES
Renmark Road	800	Sub-arterial	60	24	31	7.1	YES

(1) Day 7 am – 10 pm, night 10 pm – 7am.

6 ASSESSMENT OF OPERATIONAL IMPACTS

This section presents the assessment of operational noise and traffic noise associated with the proposal. Relevant noise goals are outlined in the NPfI. Impacts have been separated into operational noise impacts associated with the transmission line and substation for the purpose of this assessment.

6.1 NOISE – BURONGA SUBSTATION UPGRADE AND EXPANSION

6.1.1 OPERATIONAL NOISE CRITERIA

6.1.1.1 PROJECT INTRUSIVENESS NOISE LEVEL

The proposal intrusiveness noise level for residential receivers prescribed in the NSW NPfI is summarised as:

$$L_{Aeq;\ 15\ minute} \leq \text{Rating Background Level } (L_{90}) + 5\ dBA$$

The proposal intrusiveness noise level has been established for the proposal based on the RBLs as outlined in Section 4.3.2 in accordance with the NSW NPfI and is presented in Table 6.1.

Table 6.1 Established Project Intrusiveness Noise Level (dB $L_{eq\ 15,min}$)

RECEIVER LOCATION	TIME PERIOD[1]	RBL dBA	PROJECT INTRUSIVENESS NOISE LEVEL (RBL + 5 dB)
Residences near substation	Day	35[2]	40
	Evening	30[2]	35
	Night	30[2]	35

(1) Day: the period from 7 am to 6 pm Monday to Saturday; or 8 am to 6 pm on Sundays and public holidays; evening: the period from 6 pm to 10pm; night: the remaining periods.

(2) In accordance with NPfI, where the measured rating background level is less than 30 dBA for the evening and night periods, it is set to 30 dBA. When it is found to be less than 35 dBA for the day period, it is set to 35 dBA.

6.1.1.2 PROJECT AMENITY NOISE LEVELS

To limit continuing increases in ambient noise levels (i.e. background noise level creep), the maximum amenity noise level within an area from industrial noise sources should not normally exceed the amenity noise levels prescribed in the NSW NPfI.

The recommended amenity noise levels represent the objective for total industrial noise at a receiver location, whereas the proposal amenity noise level represents the objective for noise from a single industrial development at a receiver location, defined as the recommended noise levels listed below (Table 2.2 of NPI) minus 5 dBA.

The amenity criteria has been established at the identified receivers near the proposal near the Buronga substation based on the anticipated designation of 'rural residential' land use at receivers. The established amenity criteria applicable to the proposal are presented in Table 6.2.

Table 6.2 Established Proposal Amenity Noise Level

LOCATION	TYPE OF RECEIVER	RECOMMENDED AMENITY NOISE LEVEL (ANL) dB $L_{eq,period}$[3]	PROJECT AMENITY NOISE LEVEL (ANL -5 dB) dB $L_{EQ,PERIOD}$[1,2,3]	PROJECT ADJUSTED ANL dBA $L_{eq,period}$		
				Day	Evening	Night
All residences	Residential – rural	Day: 50 Evening: 45 Night: 40	Day: 45 Evening: 40 Night: 35	45	40	35

(1) A -5 dB factor is applied to ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area.

(2) Amenity levels for non-residential receivers apply when the premises are in use.

(3) Day: the period from 7 am to 6 pm Monday to Saturday; or 8 am to 6 pm on Sundays and public holidays; evening: the period from 6 pm to 10 pm; night: the remaining periods

6.1.1.3 PROPOSAL NOISE TRIGGER LEVELS

In assessing the noise impact of the proposal on surrounding residential receivers, both the intrusiveness and amenity criterion must be considered. In most cases, only one criterion will become the limiting criterion and form the proposal noise trigger levels (PNTL) for the industrial source under assessment.

To standardise the time periods for the intrusiveness and amenity noise levels, the following conversion between $L_{eq\ period}$ and $L_{eq\ 15\ min}$ have been applied (as per Section 2.2 of the NSW NPfI):

$$\mathbf{L_{eq\ 15min} = L_{eq\ period} + 3\ dB}$$

In accordance with Section 2.2 of the NSW NPfI, all project noise trigger levels and limits are expressed as $L_{Aeq,15min}$, unless otherwise expressed. A summary of all relevant criteria is presented in Table 6.3.

Table 6.3 Summary of Project Noise Trigger Levels (PNTL)

RECEIVER LOCATION	ASSESSMENT/ RECEIVER TYPE	PROJECT NOISE TRIGGER LEVELS DBA $L_{eq,15\ min}$		
		Day[1]	Evening[1]	Night[1]
All residences	*Intrusiveness*	*40*	*35*	*35*
	Amenity	*48*	*43*	*38*
	PNTL – Residential	**40**	**35**	**35**

(1) Day: the period from 7 am to 6 pm Monday to Saturday; or 8 am to 6 pm on Sundays and public holidays; evening: the period from 6 pm to 10 pm; night: the remaining periods.

(2) $L_{eq,\ 15min} = L_{eq,\ period} + 3$ dB

(3) Existing background noise levels measured as discussed in Section 4.3.

Operation of some equipment at the expanded Buronga substation is expected to fluctuate due to load in the electricity network. However, for conservative assessment purposes, all equipment is assumed to operate concurrently at any time. The noise assessment is therefore limited to the most stringent evening/night time PNTL of 35 dBA $L_{eq,,15min}$. It is also understood that in some cases, substation noise would remain relatively constant despite the fluctuating loads.

6.1.1.4 MAXIMUM NOISE LEVEL ASSESSMENT AND SLEEP DISTURBANCE

The potential for impacts from transient maximum noise level events and sleep disturbance impacts due to operations during the night-time period is detailed in the NPfI. The maximum noise level event criteria for operational noise within the transmission line corridor at the nearest residential locations are the following:

- $L_{eq,\ 15min}$ 40 dBA or the rating background level plus 5 dB, whichever is the greater, and/or
- L_{Fmax} 52 dBA or the rating background level plus 15 dB, whichever is the greater.

Where maximum noise levels at a residential location exceed the criteria, a detailed maximum noise level event assessment should be undertaken.

Based on the measurements detailed in Section 4.3.2, external maximum noise level event criteria are as follows for all residential receivers:

- $L_{eq,15min}$ 40 dBA and L_{Fmax} 52 dBA.

6.1.1.5 MODIFYING FACTORS FOR ANNOYING CHARACTERISTICS

Certain noise characteristics have a higher potential to cause annoyance, generally requiring additional considerations. Tonality, low frequency emphasis and intermittency are generally considered to be attention-drawing and can cause greater disturbance. On the other hand, short-term single noise events are likely to be less disturbing and may warrant some relaxation in the applicable noise criteria.

Electrical substations typically exhibit a dominant low frequency characteristic (and tonal in the low frequency range) and typically require application of modifying factors summarised in Fact Sheet C of the NPfI (EPA 2017), summarised in Table 6.4. Based on spectral data collected as part of the attended monitoring (Section 4.3.3), a 5 dB penalty is deemed applicable to all predicted noise levels.

Table 6.4 Noise Policy for Industry (2017) – modifying factor corrections

FACTOR	ASSESSMENT / MEASUREMENT	WHEN TO APPLY	CORRECTION (ADDED/ SUBTRACTED TO THE MEASURED / PREDICTED LEVEL)[1]	COMMENTS
Tonal Noise	One-third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: — 5 dB or more if the centre frequency of the band containing the tone is in the range of 500 to 10000 Hz. — 8 dB or more if the centre frequency of the band containing the tone is 160 to 400 Hz inclusive. — 15 dB or more if the centre frequency of the band containing the tone is in the range of 25 to 125 Hz.	+5 dB[2]	Third octave measurements should be undertaken using unweighted or Z-weighted measurements. Note: Narrow-band analysis using the reference method in ISO1996-2:2007, Annex C may be required by the consent/ regulatory authority where it appears that a tone is not being adequately identified, e.g. where it appears that the tonal energy is at or close to the third octave band limits of contiguous bands.

FACTOR	ASSESSMENT / MEASUREMENT	WHEN TO APPLY	CORRECTION (ADDED/ SUBTRACTED TO THE MEASURED / PREDICTED LEVEL)[1]		COMMENTS
Low-frequency noise	Measurement of C-weighted and A-weighted level	Measure to assess C- and A-weighted levels over same time period. Correction to be applied if the difference between the two levels is 15 dB or more and: — where any of the one-third octave noise levels are exceeded by up to and including 5 dB and cannot be mitigated, a 2 dBA positive adjustment applies for the evening and night periods — where any of the one-third octave noise levels are exceeded by up to and including 5 dB and cannot be mitigated, a 2 dBA positive adjustment applies for the daytime period.	+5 dB[2]		A difference of 15 dB or more between C- and A-weighted measurements identifies the potential for an unbalance spectrum and potential increased annoyance. The values in Table C2 are derived from Moorhouse (2011) for DEFRA fluctuating low-frequency noise criteria with corrections to reflect external assessment locations.
Intermittent Noise	Subjectively assessed but should be assisted with measurement to gauge extent of change in noise level.	The source noise heard at the receiver varies by more than 5 dBA and the intermittent nature of the noise is clearly audible.	+5 dB, applied for night time only		Adjustment to be applied for night-time only.
Duration	Single-event noise duration	One event in any 24-hour period, with duration as below.	**Night**	**Day and evening**	The project noise trigger level may be increased by an adjustment depending on duration of noise (see Table C3).
		1 to 2.5 hours	0	-2	
		15 min to 1 hour	0	-5	
		6 min to 15 min	-2	-7	
		1.5 min to 6 min	-5	-15	
		Less than 1.5 min	-10	-20	

(1) Where two or more modifying factors are present, the maximum correction is limited to 10 dB.

(2) Where a source emits noise which has both tonal and low-frequency components, only one 5 dB correction should be applied.

6.1.1.6 EFFECTS OF METEOROLOGY ON NOISE LEVELS

The impacts of meteorology on noise impacts in the locality of the proposal are discussed in Section 4.3.5. For the purposes of this assessment, worst case meteorological conditions were considered. Where noise impacts are predicted under these situations, further assessment is triggered.

6.1.2 SENSITIVE RECEIVERS

Details of the nearest sensitive receivers and their distance to the expanded Buronga substation boundary are summarised in Table 6.5.

Table 6.5 Sensitive receivers in proximity to the Buronga substation

ID	ADDRESS / DESCRIPTION	CONFIRMED RECEIVER STATUS	APPROX. DISTANCE TO PROPOSED SUBSTATION BOUNDARY (METRES)
R2026	694 Arumpo Road	Residential dwelling (verified)	2,340
R2027	Opp 694 Arumpo Road	Residential dwelling (potential)	2,070
R2028	16A Drovers Drive Mallee	Residential dwelling (potential)	4,220
R2029	16B Drovers Drive Mallee	Residential dwelling (potential)	4,380

The locality of the Buronga substation is presented in Figure 6.1.

Figure 6.1

Existing Buronga substation and locality and nearest confirmed sensitive receivers

6.1.3 ASSESSMENT SCENARIOS

6.1.3.1 EXISTING OPERATIONS

The existing noise-generating items on site are summarised in Table 6.6. A site layout presenting existing noise source locations is presented in Figure 6.1.

Table 6.6 Existing noise generating equipment at Buronga substation

EQUIPMENT	NUMBER OF PLANT
Reactor	2
Generator (Synchcon) machines	2
Generator (Synchcon) machines	1
Generator (Synchcon) TX	2
Generator (Synchcon) TX	1

Source: TransGrid.

6.1.3.2 PROPOSED UPGRADE AND EXPANSION

The proposed noise-generating items as part of the Buronga substation upgrade and expansion are summarised in Table 6.7. The maximum height of the new equipment is expected to be 65 metres.

Table 6.7 Proposed future noise generating equipment at Buronga substation

EQUIPMENT	NUMBER OF PLANT
Antenna (PhaseShift)	5
Power transformer (200kV)	3
Reactor (60MVAr)	2
Reactor (50MVAR)	2
Capacitor bank (50MVAR)	2
Generator (Synchcon) TX (100MVAR)	2
Generator (Synchcon) Machine (100MVAR)	2
Heating, ventilation and air conditioning (HVAC)	2

Source: TransGrid.

6.1.3.3 SHORT TERM IMPULSIVE MAXIMUM NOISE EVENT

The discussion provided in section 5.2.2.1, Appendix B-1 provides a summary of noise sources that are generally steady state in nature during operation. In addition, electrical substations are also likely to contain circuit breakers. When triggered, these events emit a short-term impulsive noise. Such events have the potential to disturb sleep when triggered at night and is typically assessed using the L_{max} noise levels.

For this assessment, the SWL for such event is assumed to be 123 dBA L_{max}. This noise level has a significant low frequency noise component and as such is corrected to 128 dBA as a result of low frequency noise penalties, in accordance with the NPfI methodology.

6.1.4 NOISE ASSESSMENT

6.1.4.1 EXISTING NOISE SOURCES AND MEASURED SOUND POWER LEVELS

Sound power levels for the existing noise-generating substation activities are presented in Table 6.8.

Table 6.8 Existing noise generating equipment at Buronga substation

EQUIPMENT	NUMBER OF PLANT	SWL (dBA, each) $L_{eq,15,min}$
Reactor	2	90
Generator (Synchcon) machines	2	85
Generator (Synchcon) machines	1	85
Generator (Synchon) TX	2	90
Generator (Synchon) TX	1	90
Overall SWL	**-**	**98**

Source: TransGrid.

Overall existing sound power levels of the plant were measured on site under two operating conditions during the afternoon and evening as discussed in Section 4.3.4. The overall measured sound power level under both operating scenarios are presented in Table 6.9.

Table 6.9 Measured sound power level of existing plant

EQUIPMENT	SWL (dBA, per m^2) $L_{eq,15,min}$
Overall existing site (afternoon)	109

(1) Measured noise levels as discussed in Section 4.3.4.

6.1.4.2 FUTURE NOISE SOURCES AND SOUND POWER LEVELS

Sound power levels for the existing and future noise-generating substation activities are presented in Table 6.10. Future noise-generating source sound power levels were provided by TransGrid for identified noisy equipment.

Table 6.10 Future proposed noise generating equipment at Buronga substation expansion

EQUIPMENT	NUMBER	SWL (dBA, each) $L_{eq,\ 15,min}$
Antenna (PhaseShift)	5	95
Power transformer (200kV)	3	95
Reactor (60MVAr)	2	88
Reactor (50MVAR)	2	86
Capacitor bank (50MVAR)	2	90
Generator (Synchcon) TX (100MVAR)	2	90
Generator (Synchcon) Machine (100MVAR)	2	95
Heating, ventilation and air conditioning (HVAC)	2	75
Overall SWL	–	**106**

Source: TransGrid.

6.1.5 SUBSTATION OPERATIONAL NOISE PREDICTIONS

The predicted noise levels at the nearest receivers were modelled for existing and proposed future operations for a typical 15-minute scenario. The assessment considered calm and worst-case meteorological conditions as discussed in Section 4.3.5 for day and night time periods, and compares predicted noise levels with relevant operational noise criteria.

The predicted noise levels associated with existing and proposed operations of the Buronga substation upgrade and expansion are summarised in Table 6.11.

As discussed in Section 4.3.5, standard and noise enhancing conditions have been assessed in this report, considering calm daytime conditions (standard) and night time (noise-enhancing) conditions.

Table 6.11 Buronga substation – predicted operational noise levels at surrounding sensitive receivers

ID	ADDRESS / DESCRIPTION	PREDICTED NOISE LEVELS, EXISTING OPERATIONS dBA $L_{eq,15min}$		PREDICTED NOISE LEVELS, FUTURE OPERATIONS dBA $L_{eq,15min}$		COMPLIANCE WITH NOISE LIMITS	
		Day, calm	Night, noise enhancing	Day, calm	Night, noise enhancing	Day, calm	Night, noise enhancing
PNTL		**40**	**35**	**40**	**35**	**40**	**35**
R1	694 Arumpo Road	<20	<20	20	<20	Y	Y
R2	Opp 694 Arumpo Road	<20	<20	20	<20	Y	Y
R3	16A Drovers Drive Mallee	27	30	30	28	Y	Y
R4	16B Drovers Drive Mallee	25	28	28	26	Y	Y

(1) Day: the period from 7 am to 6 pm Monday to Saturday; or 8 am to 6 pm on Sundays and public holidays; evening: the period from 6 pm to 10 pm; night: the remaining periods.

These results show that under all meteorological conditions noise levels associated with the existing and future substation activities are predicted to comply with relevant noise limits for day and night time periods.

6.1.6 SUBSTATION MAXIMUM NOISE EVENTS AND SLEEP DISTURBANCE

The predicted noise impacts associated with maximum noise events have been assessed for day and night periods in accordance with the NPfI. Noise impacts were assessed based on the sources of transient noise described in Section 6.1.3.3 for day and night time periods and compared to relevant maximum noise level event criteria, which is applicable to transient noise impacts and sleep disturbance.

The predicted maximum noise levels associated with existing and proposed operations of the Buronga substation upgrade and expansion are summarised in Table 6.12.

Table 6.12 Buronga substation existing operations– predicted noise impacts (maximum noise level events and sleep disturbance) at surrounding sensitive receivers

ID	ADDRESS / DESCRIPTION	PREDICTED MAXIMUM NOISE LEVELS, EXISTING OPERATIONS dBA L_{max}		PREDICTED MAXIMUM NOISE LEVELS, FUTURE OPERATIONS dBA L_{max}		COMPLIANCE WITH NOISE LIMITS	
		Day, calm	Night, noise enhancing	Day, calm	Night, noise enhancing	Day, calm	Night, noise enhancing
PNTL		**52**	**52**	**52**	**52**	**52**	**52**
R1	694 Arumpo Road	23	23	25	26	Y	Y
R2	Opp 694 Arumpo Road	23	24	26	27	Y	Y
R3	16A Drovers Drive Mallee	33	35	36	38	Y	Y
R4	16B Drovers Drive Mallee	31	33	34	36	Y	Y

(1) Day: the period from 7 am to 6 pm Monday to Saturday; or 8 am to 6 pm on Sundays and public holidays; evening: the period from 6 pm to 10 pm; night: the remaining periods.

These results show that under all meteorological conditions noise levels associated with the existing and future expanded substation activities, maximum noise level events are predicted to comply with relevant maximum noise level event criteria for day and night time periods, therefore no impacts from short term events or night time sleep disturbance are anticipated.

The proposed upgrade and expansion of Buronga substation is predicted to meet the operational and maximum noise level event criteria at the nearest identified receivers.

6.2 NOISE – TRANSMISSION LINES

6.2.1 OVERVIEW

TransGrid is proposing to construct a new 330kV transmission line between the NSW/SA border and Buronga substation and a 220kV transmission line between the Buronga substation and the Victorian border (near Monak at the Murray River).

Operation of high voltage transmission lines carry the risk of generating audible noise during certain meteorological conditions e.g. wet weather. To assess the risk of this noise impact, an audible risk assessment associated with the transmission lines was completed for the proposal (*Project EnergyConnect Audible Noise and Radio Frequency Interference Study (*Beca Pty Ltd, 4 September 2020)). This report forms the basis of this noise assessment for the 330kV line and 220kV line.

Audible noise associated with the operation of high voltage transmission line is primarily due to corona discharges on transmission lines. Such phenomenon is driven by conductor's Surface Voltage Gradient (SVG) and accumulation of pollution and water droplets on the transmission lines conductor surface. Corona discharge noise is therefore more prominent during weather conditions with rain, mist or fog.

Such audible noise is understood to be typically characterized a broadband crackling noise with a possible more prominent tonal component at 100Hz. Such noise occurrence would apply to the proposed new transmission lines as well as existing transmission lines which run parallel to the proposed new transmission lines, where cumulative noise impact requires consideration.

As discussed in Section 3.7.1.2, noise levels associated with the existing and proposed 220kV transmission lines are expected to be minor. The Beca study identified that the 220kV transmission line is expected to result in a sound pressure level of ≤35 dBA directly below the line. This noise level complies with the project noise trigger level of 35 dBA and further operational noise assessment of this transmission line section between Buronga substation and Victorian/NSW border is therefore not necessary.

6.2.2 ADOPTED AUDIBLE NOISE RISK SCENARIOS – 330KV LINE

For the purpose of assessing the 330kV transmission line audible risk zones, the following scenarios have been adopted (as assessed by Beca, 2020):

- Concept 330kV tower, base case, during wet weather condition
- Concept 330kV tower, base case plus one per cent increase in SVG, during wet weather condition
- Concept 330kV tower, base case, during fair weather condition.

It should be noted that the allowance of one per cent increase in SVG discussed above is understood to be caused by a 0.5 metre reduction in phase and circuit spacings, which could occur during detailed design optimization process for the transmission line structures.

Table 6.13 outlines the audible risk zones that were calculated for each scenario by determining the distance from the centre of the indicative proposed transmission line easement beyond which the project noise trigger level of 35 dBA would be met at surrounding receivers. This is based on the assumption that transmission lines are carrying a full load, which represent the worst case scenario. The proposal's noise trigger level of 35 dBA was determined in accordance with the NPfI as discussed in Section 6.1.1.3. This represents the most onerous intrusiveness noise level (per defined by NPfI) and is expected to be applicable for the proposal due to the rural nature of the transmission line corridor.

A preliminary assessment of cumulative noise assessment was also considered by WSP for when new and existing transmission run parallel to each other. At the distances indicated below, cumulative noise impact is insignificant and was considered to be acceptable using the process suggested by NPfI.

Table 6.13 Transmission lines audible noise risk zone distances

SCENARIO	AUDIBLE NOISE RISK ZONE - DISTANCE FROM 330KV TRANSMISSION LINE CENTRELINE(METRES)
Base case, wet weather	442
Base case plus 1% increase in SVG, wet weather	548
Base case, fair weather	<40 (i.e. within the easement designated for the transmission lines and towers)

The Beca study identified the following meteorological statistics as being applicable for the Buronga area:

- an average of 104 rain days per year
- mean rain rate of 0.16 mm/hour
- one day per year with mist.

6.2.3 AUDIBLE NOISE RISK RESULTS

The number of potential sensitive receivers within each of these audible risk zones has been calculated for each scenario. The results are provided in Table 6.14. It should be noted that the audible noise impact is dependent on a receiver's setback distance from the centreline of the transmission lines, which is yet to be fixed. Noting that for this assessment the boundary of the identified transmission line corridor is representative of the potential outermost location of easement boundary for the transmission line, the following process is adopted to allow a conservative approach:

- the worst case/shortest buffer distance is determined by measuring the perpendicular distance between the building and the nearest boundary of the transmission line corridor, plus 40 metres to account for the easement
- the best case/longest buffer distance is determined by measuring the perpendicular distance between the building and the furthest boundary of the transmission line corridor, minus 40 metres to account for the easement.

Table 6.14 Number of potential sensitive receivers within audible noise risk zone

SCENARIO	NUMBER OF POTENTIAL SENSITIVE RECEIVERS WITHIN AUDIBLE NOISE RISK ZONE (CONFIRMED AND POTENTIAL RECEIVER CATEGORISATION)
Base case, wet weather	3
Base case plus 1% increase in SVG, wet weather	3
Base case, fair weather	0

Based on the noise modelling completed by Beca, the estimated sound pressure levels at the identified exceeding receivers are summarised in Table 6.15.

Table 6.15 Estimated sound pressure levels for transmission lines audible noise during wet weather

ADDRESS/ LOT OF IDENTIFIED SENSITIVE RECEIVERS	BUILDING ID	APPROXIMATE DISTANCE TO POSSIBLE TRANSMISSION LINE CENTRELINE		WORST ESTIMATED SOUND PRESSURE LEVELS		LEVEL OF EXCEEDANCE 35 dB $L_{Aeq\ 15min}$ PNTL
		Minimum (metres)	Maximum (metres)	Base case (compliant at 442 metres)	Base case +1% SVG (compliant at 548 metres)	
Hazeldell Homestead at 2042 Low Darling Road Wentworth, Lot 3 DP1189519	R1489 R2023	240 300	360 420	39 38	41 39	Up to 6 dB
Low Darling Road Wentworth, Lot 2 DP1189519	R2022	140	260	42	44	Up to 9 dB

The assessment findings can be summarised as follows for operational noise associated with 330kV transmission lines:

- In fair weather conditions all sensitive receivers are expected to be compliant with the PNTL (noting that this assumes all sensitive receivers would be located outside of the easement (>40 metres from the transmission line) which would be an operational requirement).
- During wet weather conditions the level of noise impact would be highly dependent on the final selected alignment and the separation distances able to be achieved between the sensitive receivers and the transmission line:
  - three properties are identified to be at-risk of exceeding the PNTL. The worst case estimated sound pressure levels (based on the shortest possible buffer distances) at the identified three properties exceed the PNTL by 9 dB. The identified sensitive receivers are isolated properties in their locations
  - any sensitive receiver is expected to be compliant with the PNTL under wet weather conditions if a setback between the receiver and the transmission line centreline is able to be:
    - ≥442 metres if the base case design is adopted
    - ≥548 metres if the base case plus one per cent increase in SVG design is adopted.
- Based on analysis conducted by Beca on historical meteorological data, audible noise corona discharge noise is predicted to occur for up to about 30 per cent of days in the year during wet and misty conditions based on the meteorological conditions identified for the area. Noting that these conditions can occur for only short durations on these days.
- During heavier rain events, general ambient noise levels in the environment would also likely be higher and therefore potentially have a masking effect over any possible corona discharge noise. Noise disturbance under such circumstances is therefore likely to be low risk.

Based on these predicted, potential exceedances, operational noise mitigation options to reduce potential noise impacts at these properties have been presented in Section 8.

6.2.4 IMPACT CONTOURS

The map series attached in Appendix C provides representation of the locations of the potential receivers which are identified in Table 6.15.

6.3 NOISE – TRANSMISSION LINE MAINTENANCE

The following maintenance activities are generally required for the transmission lines during ongoing operation:

- annual fly over by a light aircraft as part of seasonal bushfire prevention survey
- routine asset inspection on a six yearly cycle for self-supporting towers and three yearly cycle for guyed structures by a light vehicle (four wheel drive with a crew of up to three personnel), by driving from public roads to the easement by property owner access tracks, then generally from structure to structure along the easement. Structures would be inspected both from the ground and by personnel climbing the structure
- routine/planned line maintenance (three to six year cycle) by four-wheel drive light vehicles, elevated work platform and medium sized truck with five to 10 personnel to rectify any defects found from routine inspections
- ad hoc fault and emergency fly over by a light aircraft to assess asset condition during unplanned outage (e.g. due to weather, failure of assets). This is expected to be a rare (once per year) event. Subsequent to completion of damage assessment, a crew of up to 10 personnel would require access for repair of any damaged assets using light four-wheel drive vehicles, elevated work platforms and a medium sized truck
- fault and emergency crew, this is a rare (once per year) event, by light four-wheel drive, elevated work platform and medium sized truck with five to 10 personnel
- vegetation clearance crew, which would occur every five years (excluding rectification works) with a crew of around six personnel.

As described above, any maintenance activities required for the transmission lines are expected to be infrequent (up to once yearly). If and when required, these activities are also expected to be either transient/ of short duration (e.g. flyover, drive-by) or local to a specific section/ transmission line structure. Possible risk of noise impacts associated with these activities is therefore expected to minimal.

6.4 OPERATIONAL ROAD TRAFFIC NOISE

6.4.1 ROAD TRAFFIC NOISE CRITERIA

Activities associated with the operation of the proposal would generate additional vehicle movements on surrounding roads which have the potential to impact sensitive receivers along identified access routes.

The application notes from the RNP detail the requirements for operation-generated traffic noise as follows:

> For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies where the noise level without the development is within 2 dB of, or exceeds the relevant day or night noise assessment criterion.

The consideration of mitigation is required where additional construction related traffic or operational off-site traffic on existing roads creates an increase of more than 2 dB at existing sensitive receivers.

Arterial and sub-arterial roads are assessed over day (7 am to 10 pm) and night (10 pm to 7 am) periods and local roads are assessed over a one hour period (typically the peak hour) within the respective day and night periods. Table 6.16 presents a summary of noise level criteria for the arterial, sub-arterial and local roads affected by additional traffic from land use developments and construction activities.

Table 6.16 Road traffic noise criteria for receivers on existing roads affected by the additional traffic from land use developments

ROAD TYPE	EXTERNAL ROAD TRAFFIC NOISE CRITERIA[1]	
	Day 7 am – 10 pm	Night 10 pm – 7 am
Freeway/arterial/sub-arterial roads	60 dB $L_{eq,15hr}$	55 dB $L_{eq,9hr}$
Local roads	55 dB $L_{eq,1hr}$	50 dB $L_{eq,1hr}$

(1) Façade corrected noise levels

6.4.2 ASSESSMENT

Road traffic noise impacts associated with the operation of the Buronga substation are expected to be caused by ongoing access and maintenance to the substation facility. The existing unsealed road entry from Arumpo Road would be maintained for external access. Occasional access would also be required along the transmission line.

As discussed in Technical paper 9, traffic generated during the operation of the proposal would vary depending on the activity, for example, the workforce required at the Buronga substation would range from 20 workers to 10 workers depending on the activity. It is assumed vehicle movements would be primarily light vehicles, with very limited heavy vehicle trips generated from the operational and maintenance activities.

To provide a conservative assessment, it has been assumed that maintenance activities would generate a daily peak of 50 workers (equalling 100 light vehicle movements), travelling to the Buronga substation and to other sections along the transmission line corridor. The majority of days would however be expected to have a much lower volume of vehicle trips. Depending on the origin, these vehicles would be expected to travel along Arumpo Road, Silver City Highway and Sturt Highway. As discussed in Technical paper 9, these volumes would add a negligible impact to the road network.

As discussed in Section 5.4, existing traffic volumes on the Silver City Highway and Sturt Highway exceed 2,230 vehicles per day; an increase of 100 vehicles would present less than a four per cent increase in traffic volumes on these roads. To achieve a 2 dB increase in traffic noise, an increase in traffic volume of 60 per cent would be required, therefore these levels are predicted to result in negligible changes to the noise environment at the nearest receivers.

Traffic volumes on Arumpo Road are estimated to be in the order of about 327 vehicles per day; an increase of 50 light vehicles per day would equate to an increase of approximately 30 per cent compared to existing, therefore road traffic noise levels are predicted to result in negligible changes to the noise environment at the nearest receivers.

6.5 VIBRATION

No operational vibration impacts are predicted from the proposal as no operational plant has the potential to generate vibration impacts.

7 CUMULATIVE NOISE IMPACTS

7.1 OVERVIEW

Cumulative impact assessment means the consideration of other nearby development projects along with the proposal. Projects with the potential for cumulative impacts with the proposal were identified through a review of publicly available information and environmental impact assessments from the following databases:

- NSW Major Projects website (NSW Government, searched June 2020)
- Wentworth Shire Council website (Wentworth Shire Council, searched June 2020)
- Australian Government – Department of Environment and Energy, EPBC Public notices list (Australian Government, searched June 2020).

Three proposed developments have been identified and these include:

- Copi Mineral Sands Mine
- Buronga Solar Farm; and
- Buronga – Gol Gol residential expansion.

With regard to industrial noise assessments, the NPfI provides a mechanism for assessing the potential for cumulative impacts as a result of multiple industrial activities at a sensitive receiver. This is achieved by prescribing amenity criteria for specific land use types and prescribing individual proposal amenity noise levels for an individual development, to ensure compliance with the objective for total industrial noise at a receiver location. This is discussed in details in Section 6.1.1.2.

The potential for cumulative operational noise impacts is discussed in Sections 7.2 and 7.3. Possible cumulative construction impacts are discussed in Section 7.4.

7.2 EXISTING NOISE-GENERATING DEVELOPMENTS

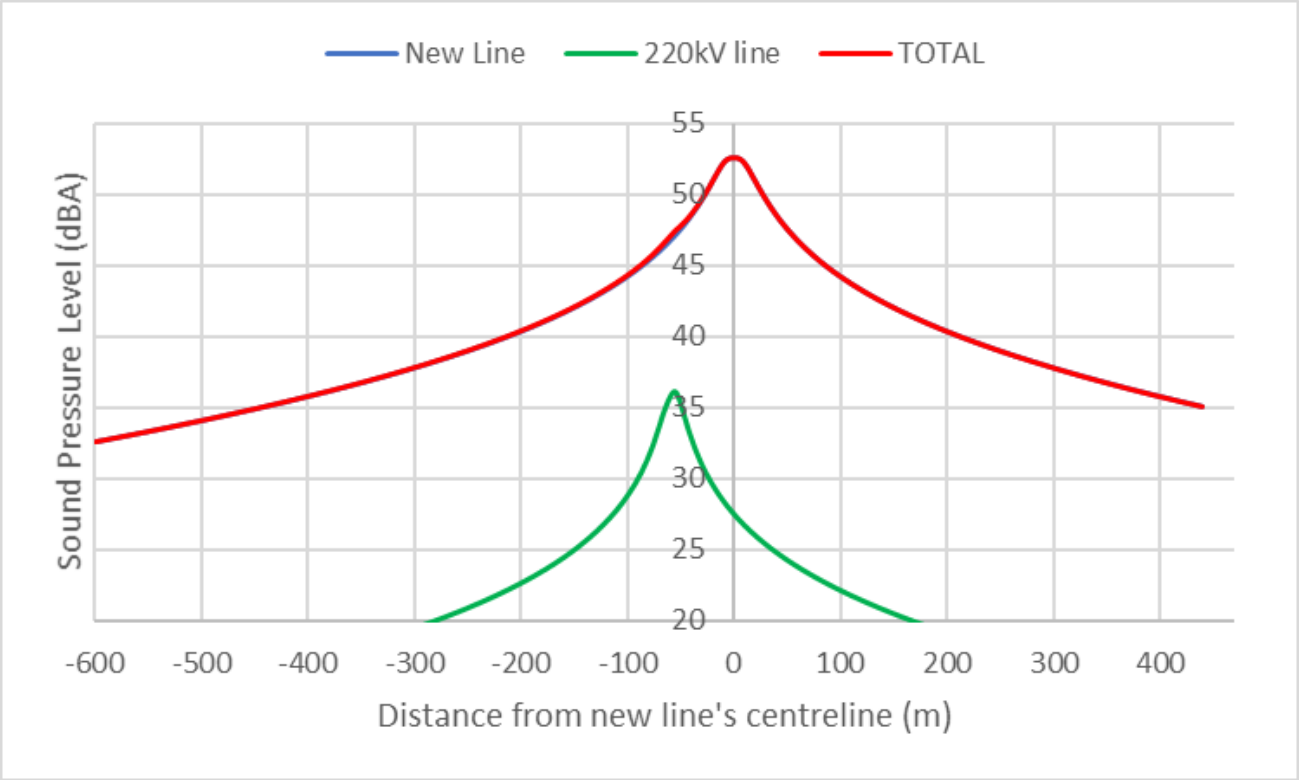
7.2.1 EXISTING BURONGA SUBSTATION

In the case of substation operations, noise levels are predicted to comply with relevant PTNLs (as discussed in Section 6.1.1.3, therefore compliance with project specific amenity levels can be inferred. Section 2.4 of the NPfI states that where compliance with the Project Amenity level can be demonstrated, no additional consideration of potential cumulative noise impacts is required.

7.2.2 EXISTING TRANSMISSION LINES

Assessment was undertaken on the potential cumulative noise impacts of high voltage transmission lines being located and operating adjacent to each other.

A section of the proposed 330kV transmission line would run in close proximity, and parallel, to existing 220kV transmission lines northwest of the Buronga substation. Noise modelling conducted by Beca (2020) indicated that the 220kV transmission lines are expected to have a significantly lower noise impact than the 330kV transmission lines. Sound pressure levels predicted for the 220kV transmission lines are typically more than 10 dB lower than that associated with 330kV lines (refer Figure 7.1). Possible audible noise outside of the easement is therefore expected to be entirely dominated by the proposal with existing transmission lines providing negligible noise contribution.



Note: predicted sound pressure level curve for the new 330kV line generally overlaps the cumulative sound pressure level curve (i.e. red line overlaps blue line)

Figure 7.1 Predicted sound pressure levels of 330kV and 220kV transmission lines, base case (source: Beca)

A section of the proposed 220kV transmission line is expected to run parallel to a section of existing 220kV transmission lines as they come out from the south east of Buronga substation and travel in a south east direction. As discussed in Section 6.2, noise levels associated with existing 220kV transmission line are typically negligible outside of the designated easement. They are therefore expected to have negligible contribution to any cumulative operational noise impact near the transmission line corridor.

7.3 POSSIBLE FUTURE NOISE-GENERATING DEVELOPMENTS

7.3.1 COPI MINERAL SANDS MINE

The Copi Mineral Sands development, located around 25 kilometres north of the proposed alignment, involves an open cut mineral sands mine and associated infrastructure to extract and process up to 1.5 million tonnes per annum (Mtpa) for up to six years, transporting the heavy mineral concentrate via road for off-site processing; and progressively rehabilitating the site.

This development is in the early stages of planning but the impacts of the project would largely be isolated from the proposal (due to relatively large separation distance). This site is therefore not expected to affect receivers near the transmission line corridor.

7.3.2 BURONGA SOLAR FARM

The Buronga Solar Farm development included a 400 MW solar farm with energy storage and associated infrastructure located adjacent to the Buronga substation.

Typical noise generating equipment may include electrical transformers, inverters, solar panel sun tracking mechanism, and service vehicles.

The predicted noise levels associated with the upgraded and expanded Buronga substation are well within the PNTL. The proposed solar farm would be expected to be less noise-generating than the Buronga substation and therefore can be considered as low risk.

7.3.3 BURONGA – GOL GOL RESIDENTIAL EXPANSION

Wentworth Shire Council are planning new subdivisions to provide approximately 500 new large residential housing allotments in the Buronga – Gol Gol growth area, approximately 10 kilometres to the west of the transmission line corridor. Due to the nature of the proposed development (being for residential use), it is not likely to represent a notable noise generator. There is also a relatively large separation distance to the transmission line corridor. The proposal is therefore not expected to generate adverse noise impacts at this possible residential subdivision .

7.4 CUMULATIVE CONSTRUCTION IMPACTS

With regard to cumulative impacts resulting from concurrent construction activities, it is considered there is a low risk of potential impact due to the separation distances between the proposal and the possible other developments identified above with the exception of the Buronga Solar Farm. Given the remote nature of the proposal, any significant overlap between construction works is considered unlikely, and where they occur, impacts would generally either result in a minor increase in noise level at the receiver or be masked by the works in closer proximity.

In terms of transmission line, potential cumulative construction noise impacts are not expected to be significant due to their transient nature, associated short duration of localised impacts when in proximity to other construction sources, and distances to possible future noise-generating developments. It is considered any construction impacts from non-proposal works would be marginal compared to the proposal.

In terms of Buronga substation construction, the cumulative impacts associated with the proposal construction and any simultaneous construction from the Buronga Solar Farm are anticipated to be low risk due to the distance to the nearest identified receiver (around 1.8 kilometres to the south-west). Any possible increase in construction noise impact due to concurrent activities on both sites would be limited to 3 dB. Based on predicted noise levels as presented in Table 5.8, this possible cumulative construction noise impact would remain under the applicable NMLs.

The risk of cumulative construction noise impact is therefore generally expected to be minor and would not significantly influence consideration of mitigation (as discussed in Chapter 8).

7.5 SUMMARY

Potential cumulative noise impacts during construction are considered to be low risk.

Additional noise risk due to possible cumulative noise impact during operations is expected to be minor.

8 MITIGATION ASSESSMENT

8.1 CONSTRUCTION

Construction noise should be managed by a detailed CNVMP to be prepared by the successful construction contractor prior to commencement of works on site. This would utilise updated information in relation to the proposed construction methodology, locations of works sites (with a confirmed transmission line alignment route), activities, durations and equipment type and numbers.

The CNVMP would consider the following as a minimum:

- identify nearby residences and other sensitive land uses
- develop noise management levels consistent with the ICNG
- develop vibration limits consistent with AVaTG
- assess the potential impacts from the proposed construction methods and staging
- where management levels are exceeded examine feasible and reasonable noise mitigation and develop associated noise and vibration monitoring programs, as required
- develop reactive and proactive strategies for dealing with any noise complaints
- assign roles and responsibilities for noise and complaints management.

8.1.1 CONSTRUCTION NOISE MITIGATION

As a result of the modelled exceedance of the ICNG NMLs, reasonable and feasible mitigation measures to minimise noise levels from construction work have been investigated. The CNVG provides standard actions and mitigation measures for implementation on construction projects, which are considered to be applicable here.

The mitigation measures referenced in the following sections are in addition to standard mitigation measures that would be implemented as part of the construction environmental management plan for the works, as outlined in Appendix B of the CNVG. Standard noise management and mitigation practices would be further qualified during detailed design.

8.1.1.1 CNVG AFFECTATION DISTANCES

In addition to the provision of standard mitigation measures to be considered to manage impacts, the requirement for additional mitigation measures has been evaluated in this section with reference to the CNVG. The CNVG provides a methodology for assessing the distance to compliance of construction activities to achieve the ICNG NMLs. Where exceedances are identified, further mitigation would be required as outlined.

The distances to compliance have been derived from the former Roads and Maritime Services' Construction Noise Estimator and indicate the distance at which compliance would be achieved, and noise mitigation measures for exceedances. This tool is an industry accepted method which is accepted by regulatory authorities on most major infrastructure developments. The equipment and plant are considered suitable for this type of work, and provides a conservative estimation of noise impacts as it does not include screening impacts from terrain, and assumes plant is operational 100 per cent of the time. This method is considered suitable due to the sparsity of sensitive receivers and large construction footprint, and facilitates the understanding of mitigation and management requirements from construction works.

TRANSMISSION LINE WORKS

Table 8.1 presents the affected distance to compliance from the transmission line construction works to achieve compliance with relevant noise limits during standard hours of work and OOHW periods.

Table 8.1 also outlines the distances at which noise level exceedances would exceed background noise levels by a noticeable, clearly audible and moderately intrusive extent, and the associated mitigation measures triggered, in accordance with the CNVG.

For the purposes of assessing the potential impacts of the base construction hours (Section 5.1.3.1), the same construction activities have been assumed to occur throughout all of the base period hours (i.e. no difference between the normal standard hours and out of hours period hours). Based on this assumption, affectation distances ('affected distances') to achieve compliance with relevant ICNG NMLs are presented in Table 8.1, and associated mitigation requirements for works within these affectation distances per guidance from CNVG.

Table 8.1 Predicted CNVG distances to compliance per construction work phase – Transmission line construction works

CONSTRUCTION WORK PHASE	PERIOD	ICNG NOISE MANAGEMENT LEVEL, $L_{eq\ 15\ min}$ dBA[1]	AFFECTED DISTANCE (METRES)	CNVG AFFECTED DISTANCES - $L_{eq\ 15min}$ NOISE LEVEL ABOVE BACKGROUND (L_{90})						HIGHLY NOISE AFFECTED NML 75 dBA OR GREATER $L_{eq\ 15min}$
				5 to 10 dB		10 to 20 dB		20 to 30 dB	> 30 dB	
				Noticeable		Clearly audible		Moderately intrusive	Highly intrusive	
				Within distance (metres)	Mitigation level (dBA)	Within distance (metres)	Mitigation level (dBA)	Within distance (metres)	Mitigation level (dBA)	Within distance (metres)
Enabling works	SH Day	45	390	- [4]	-	265	50	125	60	40	70	25
	OOHW D	40	565	- [4]	-	390	45	185	55	75	65	25
	OOHW E/N	35	815	815	35	565	40	265	50	125	60	25
Site establishment and access tracks	SH Day	45	700	- [4]	-	485	50	230	60	105	70	60
	OOHW D	40	1010	- [4]	-	700	45	335	55	155	65	60
	OOHW E/N	35	1430	1430	35	1010	40	485	50	230	60	60
Earthworks and civil construction works[4]	SH Day	45	700	- [4]	-	485	50	230	60	105	70	60
	OOHW D	40	1010	- [4]	-	700	45	335	55	155	65	60
	OOHW E/N	35	1430	1430	35	1010	40	485	50	230	60	60
Tower assembly	SH Day	45	420	- [4]	-	290	50	135	60	45	70	25
	OOHW D	40	605	- [4]	-	420	45	195	55	85	65	25
	OOHW E/N	35	875	875	35	605	40	290	50	135	60	25
Tower erection	SH Day	45	420	- [4]	-	290	50	135	60	45	70	25
	OOHW D	40	605	- [4]	-	420	45	195	55	85	65	25
	OOHW E/N	35	875	875	35	605	40	290	50	135	60	25
Tower stringing	SH Day	45	420	- [4]	-	290	50	135	60	45	70	25
	OOHW D	40	605	- [4]	-	420	45	195	55	85	65	25
	OOHW E/N	35	875	875	35	605	40	290	50	135	60	25
Commissioning / energisation	SH Day	45	265	- [4]	-	185	50	75	60	25	70	15
	OOHW D	40	390	- [4]	-	265	45	125	55	35	65	15
	OOHW E/N	35	565	565	35	390	40	185	50	75	60	15
Demobilisation and rehabilitation	SH Day	45	420	- [4]	-	290	50	135	60	45	70	25
	OOHW D	40	605	- [4]	-	420	45	195	55	85	65	25
	OOHW E/N	35	875	875	35	605	40	290	50	135	60	25

(1) SH day = recommended standard working hours, OOHW E/N= outside of recommended standard hours work as defined in Table 5.4.

(2) The RBL is the overall background noise level representing each assessment period (day/evening/night) over the whole monitoring period.

(3) Detail on expected perception of NML exceedances are outlined in the CNVG.

(4) No mitigation is required according to the CNVG for noise levels below 20 dB above the background level during Standard Hours (daytime) construction periods.

(5) Decommissioning of redundant 220kV transmission towers would use similar equipment to that assessed in the 'earthworks and civil construction works' scenario, and as such, as not been assessed as a separate scenario.

Given the linear nature of the construction works for the transmission line, these affectation areas have been considered along the length of the transmission line corridor to identify potential receivers located within this area which may be impacted by the works. These affectation areas are presented in Appendix B-2. The noise levels presented are conservative, assuming all plant identified in Appendix B-1 is operational at any one time.

Noise levels would be expected to be generally be well below these predicted noise levels at any identified receiver. Further, not all of the receivers would be expected to be impacted at the one time given their spread of locations along the transmission line corridor and that the works would be transitionary (i.e. they would progress along transmission line corridor to build the transmission line progressively).

However, number of receivers lie within the affectation area for various phases of works, as summarised in Table 8.2 for standard hours, as follows:

- up to six sensitive receivers exceeding noise management levels during daytime standard construction hours)
- up to eight sensitive receivers exceeding noise management levels during daytime works outside standard construction hours
- up to seven sensitive receivers exceeding noise management levels for the majority of scenarios during the evening and night time period, except for two scenarios (establishment, and earthworks and civil construction) in which up to 22 sensitive receivers would exceed noise management levels.

The potentially impacted receivers are predominately located in proximity to the transmission line corridor where it passes across the Great Darling Anabranch and the Darling River, and in areas in proximity to the Murray River.

These receivers lie within the affectation zone for construction work phases, and trigger mitigation as indicated.

As outlined in Section 5.1.4, temporary batching plants along the transmission line alignment should be established at least 460 metres from the nearest sensitive receivers to ensure compliance with the most stringent NML.

Table 8.2 Number of receivers identified within affectation zones – Transmission line works – Standard hours[1]

WORK PHASE	AFFECTED DISTANCE (METRES)	NUMBER OF AFFECTED RECEIVERS	MITIGATION REQUIREMENT[2]	RECEIVER ID[3]
Enabling works	390	5	Notification	R647, R3627, R2023, R1489, R2022
Site establishment and access tracks	700	6	Notification	R647, R3627, R2023, R1489, R1965, R2022
Earthworks and civil construction works	700	6	Notification	R647, R3627, R2023, R1489, R1965, R2022
Tower assembly	420	5	Notification	R647, R3627, R2023, R1489, R2022
Tower erection	420	5	Notification	R647, R3627, R2023, R1489, R2022
Tower stringing	420	5	Notification	R647, R3627, R2023, R1489, R2022
Commissioning/energisation	265	5	Notification	R647, R3627, R2023, R1489, R2022
Demobilisation and rehabilitation	420	5	Notification	R647, R3627, R2023, R1489, R2022

(1) Standard hours: 7 am to 6 pm Monday to Friday, Saturday: 8 am to 1 pm.

(2) Notification - as defined in the CNVG. Noting this would be required for each of the receivers only when they are potentially going to be impacted by works near to them (i.e. when construction works are occurring near them in the program).

(3) Receivers presented in Appendix B-2.

The number of receivers located within the affectation areas for the construction activities identified are summarised in Table 8.3 for daytime out of work hours. The relevant mitigation requirements are also presented.

Table 8.3 Number of receivers identified within affectation zones – Transmission line works – OOHW (day)[2]

WORK PHASE	AFFECTED DISTANCE (METRES)	NUMBER OF AFFECTED RECEIVERS	MITIGATION REQUIREMENT[2]	RECEIVER IDS[3]
Enabling works	565	5	Notification (N), Respite period -1 (R1), Duration Respite (DR)	R647, R3627, R2023, R1489, R2022
Site establishment and access tracks	1010	8	N, R1, DR	R647, R3627, R2023, R1489, R2022, R3385, R1965, R980
Earthworks and civil construction works	1010	8	N, R1, DR	R647, R3627, R2023, R1489, R2022, R3385, R1965, R980
Tower assembly	605	5	N, R1, DR	R647, R3627, R2023, R1489, R2022
Tower erection	605	5	N, R1, DR	R647, R3627, R2023, R1489, R2022
Tower stringing	605	5	N, R1, DR	R647, R3627, R2023, R1489, R2022
Commissioning/energisation	390	5	N, R1, DR	R647, R3627, R2023, R1489, R2022
Demobilisation and rehabilitation	605	5	N, R1, DR	R647, R3627, R2023, R1489, R2022

(1) Standard hours: 7 am to 6 pm Monday to Friday, Saturday: 8 am to 1 pm. OOHW: All hours outside standard hours.

(2) Notification, Respite period, Duration Respite - as defined in the CNVG. Noting this would be required for each of the receivers only when they are potentially going to be impacted by works near to them (i.e. when construction works are occurring near them in the program).

(3) Receivers presented in Appendix B-2.

The number of receivers located within the affectation areas for the construction activities identified are summarised in Table 8.4 for evening/night time out of work hours. The relevant mitigation requirements are also presented.

Table 8.4 Number of receivers identified within affectation zones – Transmission line works – OOHW (evening/ night)[2]

WORK PHASE	AFFECTED DISTANCE (METRES)	NUMBER OF AFFECTED RECEIVERS	MITIGATION REQUIREMENT[2]	RECEIVER IDS[3]
Enabling works	815	7	Notification (N), Respite period -1 (R1) Duration Respite (DR)	R647, R3627, R3385, R2023, R2022, R1965, R1489
Site establishment and access tracks	1430	22	N, R1, DR	R986, R980, R979, R963, R961, R960, R959, R958, R957, R956, R647, R3627, R3433, R3385, R2035, R2023, R2022, R1968, R1967, R1965, R1548, R1489
Earthworks and civil construction works	1430	22	N, R1, DR	R986, R980, R979, R963, R961, R960, R959, R958, R957, R956, R647, R3627, R3433, R3385, R2035, R2023, R2022, R1968, R1967, R1965, R1548, R1489
Tower assembly	875	7	N, R1, DR	R647, R3627, R3385, R2023, R2022, R1965, R1489
Tower erection	875	7	N, R1, DR	R647, R3627, R3385, R2023, R2022, R1965, R1489
Tower stringing	875	7	N, R1, DR	R647, R3627, R3385, R2023, R2022, R1965, R1489
Commissioning/ energisation	565	7	N, R1, DR	R647, R3627, R3385, R2023, R2022, R1965, R1489
Demobilisation and rehabilitation	875	7	N, R1, DR	R647, R3627, R3385, R2023, R2022, R1965, R1489

(1) Standard hours: 7 am to 6 pm Monday to Friday, Saturday: 8 am to 1 pm. OOHW: All hours outside standard hours.

(2) Notification, Respite period, Duration Respite - as defined in the CNVG. Noting this would be required for each of the receivers only when they are potentially going to be impacted by works near to them (i.e. when construction works are occurring near them in the program).

(3) Receivers presented in Appendix B-2.

MAIN CONSTRUCTION COMPOUNDS AND ACCOMMODATION CAMPS

Table 8.5 presents the affected distance to compliance from the construction works from construction compounds to achieve compliance with relevant noise limits during standard hours of work and OOHW periods. These distances have been calculated consistent with the method for the transmission line calculations.

The nearest receiver is located approximately 1.8 kilometres from the main construction compound and camp site footprint for the Anabranch South and Buronga sites. Based on the distances to sensitive receivers, no receivers are predicted to be adversely impacted by construction or operation activities associated with the main construction compounds and accommodation camps. As outlined in Section 5.1.4, the site for the Wentworth main construction compound and accommodation camp is yet to be determined. Depending on the selected site, additional mitigation and management may be required with considering of the affectation distances detailed in Table 8.5.

Table 8.5 Predicted CNVG distances to compliance per construction work phase – Main construction compound and accommodation camp works

CONSTRUCTION WORK PHASE	PERIOD	ICNG NOISE MANAGEMENT LEVEL, $L_{eq\ 15\ min}$ dBA[1]	AFFECTED DISTANCE (M)	CNVG AFFECTED DISTANCES - $L_{eq(15min)}$ NOISE LEVEL ABOVE BACKGROUND (L_{90})						HIGHLY NOISE AFFECTED NML 75 dBA OR GREATER $L_{eq(15min)}$
				5 to 10 dB		10 to 20 dB		20 to 30 dB	> 30 dB	
				Noticeable		Clearly audible		Moderately intrusive	Highly intrusive	
				Within distance (metres)	Mitigation level (dBA)	Within distance (metres)	Mitigation level (dBA)	Within distance (metres)	Mitigation level (dBA)	Within distance (metres)	Mitigation level (dBA)	Within distance (metres)
Enabling works	SH Day	45	390	- [4]	-	265	50	125	60	40	70	25
	OOHW D	40	565	- [4]	-	390	45	185	55	75	65	25
	OOHW E/N	35	815	815	35	565	40	265	50	125	60	25
Enabling works – site establishment	SH Day	45	700	- [4]	-	485	50	230	60	105	70	60
	OOHW D	40	1010	- [4]	-	700	45	335	55	155	65	60
	OOHW E/N	35	1430	1430	35	1010	40	485	50	230	60	60
Operation of the compound	SH Day	45	390	- [4]	-	265	50	125	60	40	70	25
	OOHW D	40	565	- [4]	-	390	45	185	55	75	65	25
	OOHW E/N	35	815	815	35	565	40	265	50	125	60	25
Operation of the accommodation camp	SH Day	45	265	- [4]	-	185	50	75	60	25	70	15
	OOHW D	40	390	- [4]	-	265	45	125	55	35	65	15
	OOHW E/N	35	565	565	35	390	40	185	50	75	60	15
Demobilisation/ rehabilitation	SH Day	45	420	- [4]	-	290	50	135	60	45	70	25
	OOHW D	40	605	- [4]	-	420	45	195	55	85	65	25
	OOHW E/N	35	875	875	35	605	40	290	50	135	60	25

(1) SH = recommended standard working hours, OOHW = outside of recommended standard hours work as defined in Table 5.4.

(2) The RBL is the overall background noise level representing each assessment period (day/evening/night) over the whole monitoring period.

(3) Detail on expected perception of NML exceedances are outlined in the CNVG.

(4) No mitigation is required according to the CNVG for noise levels below 20 dB above the background level during Standard Hours (daytime) construction periods.

8.1.1.2 TRANSMISSION LINE SUMMARY

This assessment indicates that construction noise impacts are predicted to be noticeable for certain construction staging and activities, assuming simultaneous operation of plant and an assumed closeness to sensitive receivers.

Where this occurs, there is the potential for noise impacts at the nearest sensitive receivers. The construction schedule and equipment and worksite locations are subject to further specification as detailed planning progresses, however, the CNVMP would identify measures to schedule these activities appropriately to reduce potential for noise impacts.

Impacts and associated mitigation measures from transmission line construction works have been assessed by determining the distances to compliance from the transmission line corridor with relevant NMLs for standard construction hours and OOHW. As a result, mitigation is triggered by distance to the transmission line corridor for works during standard construction hours and OOHW.

The following measures are recommended to mitigate and manage the potential for construction noise impacts during transmission line works. These measures are derived with reference to the ICNG.

Table 8.6 Construction noise mitigation measures – transmission line

CONTROL MEASURE	DETAILS
Source controls	— Mitigation of specific noise sources using portable temporary screens, on site structures or other items, where possible — Maximising the offset distance between noisy plant items and sensitive receivers — Orienting equipment away from sensitive receivers — Using noise source controls, such as the use of residential class mufflers, to reduce noise from all plant including cranes, excavators and trucks — Using lower powered or reduced size equipment where noise benefits are available, where practical — Using spotters, “smart” reversing alarms, or broadband reversing alarms in place of traditional beeper reversing alarms — Operating machinery in a manner which reduces maximum noise level events including shaking excavator bucket, loading trucks — Turning off machinery when not in use — Specific controls including scheduling activities to avoid numerous noise intensive activities operating on site simultaneously.
Administration controls	— Limiting noise-intensive works to standard construction hours, as far as practicable, particularly use of piling, dozers, jackhammers when working in the vicinity of sensitive receivers — Minimise the number of noisy plant operating at one time and schedule high noise generating activities to the middle of the day away from more sensitive early morning and late afternoon periods when working in the vicinity of sensitive receivers — Selecting plant and equipment based on noise emission levels — Using alternative construction methods to minimise noise levels — Site awareness training / environmental inductions that include a section on noise mitigation techniques / measures to be implemented when on site and accessing the site — Ensuring equipment is well maintained and not generating excessive noise — Avoid dropping materials and tools or dragging materials across hard surfaces.

CONTROL MEASURE	DETAILS
Community management	— Notifying receivers potentially affected by the works via letter box drop. This should be completed at least five days prior to works starting. This should inform potentially impacted residents of the nature of works, expected noise levels and duration and contact details — Keeping the community informed in relation to noise intensive activities in the immediate area — Providing consultation where prolonged or consecutive periods of construction works are planned — Where highly noise affected noise levels are predicted at potentially impacted residences, the requirement for respite periods should be assessed, including potential restrictions to the hours of certain activities, in consultation with the community — Noise monitoring at the nearest receivers for comparison against the noise management levels where highly noise affected levels are predicted, or periods of OOHW are required in the vicinity of sensitive receivers.
OOHW	— Any works undertaken outside standard working hours would be in accordance with the ICNG and the CNVG — Any work out of hours proposed within the identified affectation distances to sensitive receivers should be limited to activities which do not create noise impacts to surrounding receivers, particularly concrete saws, jackhammers, piling rigs and excavators — An out of hours works protocol should be developed for the works and included as part of the CNVMP. This would include the following measures: — identification of standard hours, OOHW and noise and vibration intensive works periods — identification of relevant noise management levels and affected receivers — identification of roles and responsibilities — outline relevant noise management safeguards and other reasonable and feasible mitigation measures, including respite periods and duration respites where works are within the identified affectation distances for sensitive receivers — outline relevant community consultation procedures, including letterbox drops, notification protocols, and site contact information for the works — outline the methodology to be employed for handling and investigating any complaints should they arise, including documentation and feedback mechanisms — identification of a site contact person to follow up on complaints and site signage erected to advise of persons name and contact details.

8.1.2 OUT OF HOURS WORKS PROTOCOL

Extended construction hours are proposed given the distance to sensitive receivers for the majority of the proposal study area. Base construction hours are from 7 am to 7 pm Monday to Sunday inclusive.

An Out of Hours Works Protocol is to be developed as part of the detailed design methodology to manage the potential impacts of these extended hours outside standard ICNG construction hours (refer to 5.2.1).

The Out of Hours Works Protocol will be applied where confirmed noise levels exceed NMLs at sensitive receivers outside standard ICNG construction hours.

Works outside standard ICNG construction hours require further assessment and management to ensure that noise impacts are adequately managed where works are in the vicinity of sensitive receivers.

This protocol will be developed as part of the detailed design of the proposal, and will include the following considerations for any works to be conducted outside ICNG standard hours:

- location of works
- plant and equipment
- intensity of equipment and potential for noise impact at nearest sensitive receivers.

Where base works are to occur outside ICNG standard hours and noise impacts are likely to be audible at sensitive receivers, detailed modelling will be completed to quantify the noise impact at affected receivers, determine the extent of exceedances, and determine reasonable and feasible noise mitigation and management measures, as outlined in Table 8.7.

Table 8.7 Construction mitigation measures for implementation in Out of Hours Works Protocol

OOHW PROTOCOL PERIOD	MITIGATION REQUIREMENT[1]	RISK FACTOR[2,3,4]	MEASURE DETAIL
Daytime and evening shoulder works — 6 pm – 10 pm weekdays — 1 pm – 10 pm Saturdays — 8 am – 6 pm Sunday and Public Holiday	Notification (N), Respite period -1 (R1), Duration Respite (DR)	Low	Notification – The notification may consist of a letterbox drop (or equivalent) detailing work activities, time periods over which these will occur, impacts and mitigation measures. Notification should be a minimum of 5 working days prior to the start of works. Respite Period 1 – Out of hours (evening) construction noise 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 6 evenings per month. Duration Respite (DR) – Respite offers and respite periods 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 NML to demonstrate support for Duration Respite. Where there are few receivers above the NML each of these receivers should be visited to discuss the project to gain support for Duration Respite.

OOHW PROTOCOL PERIOD	MITIGATION REQUIREMENT[1]	RISK FACTOR[2,3,4]	MEASURE DETAIL
Evening shoulder and night time works — 10 pm – 7 am weekday nights — 10 pm – 8 am Saturday nights — 6 pm – 7 am Sunday and Public Holidays nights	Notification (N), Respite period -1, 2 (R1, R2), Duration Respite (DR)	Medium High	Per measures for Daytime/evening shoulder works, plus: Respite Period 2 – Night time construction noise 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 6 nights per month. Where possible, high noise generating works shall be completed before 11 pm.

(1) As defined in the CNVG. Noting this would be required for each of the receivers only when they are potentially going to be impacted by works near to them (i.e. when construction works are occurring near them in the program).

(2) As defined in the CNVG. Low risk factors are:

- No sleep disturbance
- 18:00 – 22:00 weekdays
- 13:00 – 22:00 Saturdays
- 08:00 – 18:00 Sunday & Public Holiday
- 1 or 2 occurrences (exceedances)
- No impulsive or tonal noise vibration

(3) As defined in the CNVG. Medium risk factors are:

- Sleep disturbance risk
- 22:00 -07:00 weekday nights
- 22:00 – 08:00 Saturday nights
- 18:00 – 07:00 Sunday & Public Holidays nights

(4) High risk factors are:

- Prolonged work (i.e. > 1 week)
- Sleep disturbance possible
- Impulsive noise or vibration likely (e.g. vibratory rolling or rock breaking).

8.1.2.1 BURONGA SUBSTATION UPGRADE AND EXPANSION SUMMARY

Standard construction noise measures are to be incorporated into the CNVMP for the upgrade and expansion works at Buronga substation.

8.1.2.2 MAIN CONSTRUCTION COMPOUND AND ACCOMMODATION CAMP SITE SUMMARY

Standard construction noise measures are to be incorporated into the CNVMP for the works at Buronga and Anabranch South compounds. Further mitigation assessment would be required as part of the CNVMP upon confirmation of the site location for Wentworth construction compound.

8.1.2.3 CONSTRUCTION TRAFFIC NOISE

While no exceedances of RNP noise management levels are predicted, the following noise mitigation and management measures are recommended to manage exceedances of relative increase criteria as a result of construction traffic:

- development of a traffic noise management plan to manage noise impacts to be included in the CNVMP. This traffic management plan would consider:
- designation of dedicated traffic routes
- traffic management strategies such as sign-posting and bollards to ensure speed limits are respected
- driver training and measures to ensure driver awareness and adherence to speed limits and designated routes
- limiting traffic movements to daytime periods as far as possible
- minimising traffic movements by ensuring full loads.

The most effective management measure to reduce construction traffic noise is the restriction of heavy vehicle movements to standard (daytime) hours where feasible.

These measures are subject to review during design development. Further modelling of these changes would be undertaken during the design development, when construction traffic volumes and routes are finalised.

8.1.3 CONSTRUCTION VIBRATION MITIGATION

8.1.3.1 TRANSMISSION LINE

Where activities using significant sources of vibration (i.e. hydraulic hammers, vibratory rollers, bored piling rigs or jackhammers) occur within or near minimum working distances to sensitive receivers, the potential for impacts at sensitive receivers are likely to be increased. Whilst this assessment has not identified any risks as a result of the proposed construction activities, these impacts should be re-evaluated where there are proposed changes to works or methods. Further, management and mitigation measures are proposed as a matter of best practice to minimise the potential for any risk. Heritage listed structures that are potentially at risk of structural damage or cosmetic damage should be identified and impacts confirmed by the contractor prior to the commencement of construction works. The CNVMP should confirm impacts at these locations before the commencement of construction activities and after construction is completed.

Assessing Vibration a Technical Guideline (AVTG) (DEC 2006) provides general guidance for limiting vibration impacts during construction. Relevant recommendations have been reproduced in Table 8.8, and should be considered as appropriate where potential for impacts are present.

Table 8.8 Construction vibration mitigation – transmission line

CONTROL MEASURE	DETAILS
Source controls	— Substitution of methods of high vibration/impact emission to lower vibration/impact methods i.e. use smaller machine or lower mode — Sequencing operations so that vibration-causing activities do not occur simultaneously — Keeping equipment well maintained — Locating high vibration sources as far away from sensitive receiver areas where possible — Do not conduct vibration intensive works within the building damage distances outlined in this report. Where possible, avoid the use of vibration intensive plant within the nominated human comfort distances.

CONTROL MEASURE	DETAILS
Administration controls	— Vibration sensitive heritage structures which have potential to be impacted by the proposal works to be confirmed by the contractor prior to the commencement of construction works. CNVMP to outline management of impacts at these locations before commencement and after construction is completed — Scheduling the use of vibration-causing equipment at the least sensitive times of the day (wherever possible) — Undertaking trial measurements to establish the site specific vibration propagation from high risk activities to establish site specific offset distances required — Where vibration monitoring is undertaken and criteria exceedances are identified, management measures should be implemented immediately to ensure vibration compliance is achieved — Dilapidation surveys to be completed where works are identified to occur within structural damage minimum working distances outlined in this report.
Consultation	— Informing nearby receivers about the nature of construction stages and the vibration-generating activities.

8.1.3.2 BURONGA SUBSTATION UPGRADE AND EXPANSION

As no exceedances have been identified, mitigation is not proposed at this site.

8.1.4 CONSTRUCTION BLASTING MITIGATION

Where required, impacts from blasting would require assessment with regard to the Australian and New Zealand Environment Conservation Council's (ANZECC) Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (ANZECC, 1990) and the AS 2187.2 Explosives – Storage, Transport and use Part 2: Use of Explosives.

Detailed assessment would be required to identify the impacts of blasting on nearest sensitive receivers. The blasting assessment and Blasting Management Strategy would assess the proposed design with the objective of ensuring compliance with the following limits:

— maximum blast overpressure: 115 dBL; and
— maximum peak particle vibration velocity: five millimetres per second.

The above targets should be met for all but five per cent of blasts, and in no case should the blast overpressure exceed 120 dBL or peak particle velocity exceed 10 millimetres per second. The guidelines also provide a long-term goal of two millimetres per second for peak particle vibration velocity. The criterion for heritage receivers is five millimetres per second peak particle velocity.

Prior to each blast, the contractor would complete a Blast Management Strategy, outlining the location, depths and Maximum Instantaneous Charge for each location to ensure that vibration and overpressure impacts do not exceed relevant criteria.

8.2 OPERATIONS

8.2.1 330kV TRANSMISSION LINE

Due to the potential predicted exceedances of the PNTL due to operation of the 330kV transmission lines, consideration of mitigation strategies to reduce the likely noise impact is required. As discussed in Section 6.2.1, audible noise risk associated with the proposed 220kV line is expected to be insignificant and carries minimal noise impact risk.

Regarding mitigation investigation, NPfI states that:

> "*Where the project noise trigger level is exceeded, assess the feasible and reasonable mitigation measures that could be implemented to reduce noise down towards the relevant project noise trigger level. If it is reasonable to achieve these levels, the proponents should do so. If not, then achievable noise levels should be identified. It is not mandatory to achieve the trigger levels but the assessment should provide justification if they cannot be met. An assessment of the acceptability of residual impacts should also be provided.*"

Guidance is provided in NPfI in regard to definition of 'feasible' and 'reasonable' mitigation as well as a generic list of mitigation measures.

From an acoustic perspective, possible strategies to mitigate noise are typically investigated in the following order (decreasing preference):

1 land use planning and provision of appropriate buffer distances
2 noise control at the noise source
3 noise control along the noise transfer path
4 noise control at the receiver.

8.2.1.1 LAND USE PLANNING AND PROVISION OF APPROPRIATE BUFFER DISTANCES

From an acoustic perspective, consideration to provide greater buffer distances between noise-generating developments where possible is recommended. This can have its limitations and should be considered with factors other than acoustics. As previously discussed, a buffer distance of up to 548 metres from the centreline of the 330kV transmission line is required to meet the PNTL. When designing the final alignment, achieving separation between the transmission line and the identified sensitive receivers to distances greater than the buffer distances is encouraged wherever possible.

In many cases it is however not considered feasible and reasonable to solely rely on buffer distances to improve the overall acoustic outcome as this could likely preclude significant land areas from future development.

8.2.1.2 NOISE CONTROL AT THE NOISE SOURCE

Generally, noise control at the source is considered as most effective in improving the overall acoustic outcome at sensitive receivers. Noise control options for transmission lines are however expected to be limited. From the Beca (2020) study, it is understood that the implementation of specific types of transmission line conductors (larger conductors) can in some circumstances reduce noise impacts, however, for the proposal these options are not currently identified as feasible and reasonable.

8.2.1.3 NOISE CONTROL ALONG THE NOISE TRANSFER PATH

This typically involves the investigation and implementation of noise barriers (in the form of walls or earth mound) to block direct line of sight between noise sources and receivers. Noise barriers are most effective when closer to the noise source or receiver. Implementation of noise barrier is considered more feasible and reasonable to provide protection for groups of closely spaced receivers and not considered cost-effective for isolated receivers.

Noise barriers are not considered feasible and reasonable for the proposed transmission lines for the following reasons:

- all identified exceeding receivers are generally isolated in nature
- the transmission line is an elevated noise source with long horizontal extent.

8.2.1.4 NOISE CONTROL AT THE RECEIVER

Subsequent to complete consideration of all source and pathway feasible and reasonable noise mitigation measures (as discussed in the preceding subsections), the NPfI allows for receiver property treatment to be considered for any residual noise impacts. The NPfI stated that receiver-based treatment is typically only applicable for isolated residences in rural areas and may include upgrade of various construction elements of the dwellings and voluntary property acquisition.

Due to rural nature and isolated receivers, accepting any possible exceedance of the external PNTL at the existing residential receivers and pursuing receiver-based treatment is likely to be considered feasible and reasonable to managed transmission lines audible noise. Provided that the required assessment and investigation process as per the NPfI is followed and appropriate community consultation is undertaken, a suitable acoustic outcome can likely be achieved.

There is precedence elsewhere in Australia where impacted properties receive building façade upgrade to improve sound insulation as well as installation of air conditioning and/or natural ventilation systems as a form of noise mitigation.

In accordance with NPfI, a residual noise impact is defined as '*receivers with exceedances of the project noise trigger levels under the best-achievable acoustic outcome from a development*'. Residual noise impacts are identified after all source and pathway feasible and reasonable noise mitigation measures have been considered. The significance of the residual impact and the need to assess receiver-based treatment options would need to be considered as part of the detailed design process once the locations of the alignment is confirmed. The significance of residual noise impacts in accordance with NPfI and the possible associated level of receiver-based treatment they receive are summarised in Table 8.9 and Table 8.10.

The currently predicted residual noise impact are presented in Table 6.15. Upon detailed design of alignment and full feasible and reasonable assessment of mitigation options, residual impact should be further considered to determine the appropriate mitigation treatment required.

Table 8.9 Significance of residual noise impacts – NPfI

IF THE PREDICTED NOISE LEVEL MINUS THE PROJECT NOISE TRIGGER LEVEL IS:	AND THE TOTAL CUMULATIVE INDUSTRIAL NOISE LEVEL IS:	THEN THE SIGNIFICANCE OF RESIDUAL NOISE LEVEL IS:
≤ 2 dB	Not applicable	Negligible
≥ 3 but ≤ 5 dB	< recommended amenity noise level or > recommended amenity noise level, but the increase in total cumulative industrial noise level resulting from the development is less than or equal to 1 dB	Marginal
≥ 3 but ≤ 5 dB	> recommended amenity noise level and the increase in total cumulative industrial noise level resulting from the development is more than 1 dB	Moderate
> 5 dB	≤ recommended amenity noise level	Moderate
> 5 dB	> recommended amenity noise level	Significant

Table 8.10 Examples of receiver-based treatments to mitigate residual noise impacts (NPfI)

SIGNIFICANCE OF RESIDUAL NOISE LEVEL	EXAMPLE OF POTENTIAL TREATMENT
Negligible	The exceedances would not be discernible by the average listener and therefore would not warrant receiver-based treatments or controls.
Marginal	Provide mechanical ventilation/comfort condition systems to enable windows to be closed without compromising internal air quality/amenity.
Moderate	As for 'marginal', but also upgraded façade elements, such as windows, doors or roof insulation, to further increase the ability of the building façade to reduce noise levels.
Significant	May include suitable commercial agreements where considered feasible and reasonable.

8.2.2 *BURONGA SUBSTATION UPGRADE AND EXPANSION*

Mitigation is not required on the assumption that the detailed design is sufficiently consistent with the assumptions in this report. Any modifications to plant or layout must be assessed to confirm that overall site operations are not significantly acoustically different to that assessed in this report.

8.3 MITIGATION SUMMARY

A summary of the proposed mitigation measures for the project is presented in Table 8.11.

Table 8.11 Summary of noise and vibration mitigation measures

COMPONENT	MEASURE	TIMING	APPLICABLE LOCATION(S)
NV1	An Operational Noise Review will be completed to confirm the noise impacts from the proposal and refine the operational mitigation measures to ensure compliance with operational noise trigger levels.	Detailed design	All locations
NV2	Where exceedances of the project specific trigger noise levels are predicted, feasible and reasonable operational noise mitigation measures will be further investigated during detailed design, in consultation with the affected receivers. This may include (in order of priority): — land use planning and provision of appropriate buffer distances to increase the distance between the final transmission line alignment and the surrounding sensitive receivers and ultimately minimise the number of sensitive receivers within the audible risk noise zones — noise control at the noise source — noise control along the noise transfer path, such as noise barriers — noise control at the receiver, such as 'at property' treatment to upgrade aspects of the dwellings including the façade or ventilation systems.	Detailed design	Transmission line (330kV only)

COMPONENT	MEASURE	TIMING	APPLICABLE LOCATION(S)
NV3	Construction methodologies and measures that minimise noise and vibration levels during construction will be investigated during detailed design and implemented where feasible and reasonable. This will be supported through the completion of additional assessments (where impacts to sensitive receivers could occur) based on the final construction methodology. This will: — consider the proposed layouts of work areas or construction compounds — the noise and vibration generating activities that will take place — assess the predicted noise and vibration levels against the relevant management levels — incorporate feasible and reasonable mitigation and management measures in accordance with the ICNG.	Detailed design	All locations
NV4	Further engagement and consultation with affected receivers will be carried out to understand their preferences for mitigation and management measures where exceedances of noise management levels are predicted. Based on this consultation, appropriate mitigation and management options will be considered and implemented where feasible and reasonable to minimise the impacts.	Detailed design and construction	All locations
NV5	A CNVMP would be prepared by the construction contractor prior to construction works and would (as a minimum): — examine feasible and reasonable noise mitigation where management levels are exceeded — examine feasible and reasonable noise measures to manage traffic noise impacts on public roads where exceedances above 2 dB are identified — develop associated noise and vibration monitoring programs, as required — develop proactive and reactive strategies for dealing with any noise complaints — outline community consultation measures including notification requirements. This CNVMP would be implemented for the duration of construction.	Detailed design and construction	All locations

COMPONENT	MEASURE	TIMING	APPLICABLE LOCATION(S)
NV6	An Out of Hours Works Protocol will be implemented and will include: — details of what works are required outside ICNG standard construction hours — noise management safeguards and other reasonable and feasible mitigation measures, including respite periods and duration respites where works are within the identified affectation distances leading to NML exceedances for sensitive receivers — community consultation procedures, including letterbox drops, notification protocols, and site contact information for the works — complaints handling procedures.	Detailed design and construction	All locations
NV7	Where noise intensive equipment is to be used near sensitive receivers, the works will be scheduled for standard construction hours, where possible.	Construction	All locations
NV8	Where works are required within the minimum working distances for vibration: — different construction methods with lower source vibration levels will be investigated and implemented, where feasible — attended vibration measurements will be undertaken at the start of the works to determine actual vibration levels at the structure. Works will cease if the monitoring indicates vibration levels are likely to, or do, exceed the relevant criteria. Further assessment to be completed during detailed design.	Construction	All locations
NV11	Temporary batching plants along the transmission line corridor will be positioned to ensure compliance with NMLs at the nearest sensitive receivers.	Construction	Transmission line
NV12	If blasting is required, a blasting vibration and overpressure assessment will be completed to demonstrate that blasting and associated activities will not exceed noise and vibration criteria at residences or other sensitive receivers. Based on outcomes of this assessment, a blast management strategy will be implemented that details how blasting will be carried out in a manner that complies with relevant noise and vibration limits, and notification requirements with landholders.	Construction	Blasting

9 CONCLUSION

9.1 CONSTRUCTION IMPACTS

Construction of the transmission line would result in construction noise impacts at a number of receivers. Up to six receivers were identified to experience noise levels above NMLs during standard construction hours construction works, and increase to 22 receivers when works are carried out outside standard construction hours. Mitigation and management measures have been outlined as a result of these findings, to be further developed as construction planning progresses, including the development of an Out of Hours Protocol for works outside standard construction hours. The locations of proposed temporary batching plants along the alignment are to be situated outside the recommended offset to ensure compliance with relevant NMLs at the nearest sensitive receivers.

No noise or vibration impacts are anticipated as a result of construction works at the Buronga substation due to the distance between the proposed expansion area and the nearest sensitive receiver.

Further assessment would be necessary if blasting is required, to demonstrate that blasting and associated activities would not generate unacceptable noise and vibration impacts at residences or other noise sensitive receivers.

The risk for adverse impact resulting from concurrent construction activities occurring in proximity to sensitive receivers as a result of the construction of the transmission line, Buronga substation and main construction compounds is considered to be low.

The proposal is not predicted to result in construction vibration impacts in terms of cosmetic damage, human response and heritage sensitivity to any external sensitive receivers. Vibration management and mitigation measures have been recommended to manage vibration risk associated with the proposal.

Construction traffic impacts have been assessed and while impacts would comply with relevant management levels, noise management and mitigation have been recommended to reduce relative noise increases at receivers on some proposal-affected roads. Local roads would not be used as a main thoroughfare for construction traffic due to heavy vehicle route limitations, therefore impacts on local roads are not expected.

9.2 OPERATIONAL IMPACTS

Operational noise impacts are predicted to comply with relevant noise limits at the nearest sensitive receivers for the Buronga substation operations.

Operational noise of the transmission lines was also assessed, and the potential risk has been quantified based on noise modelling conducted by Beca. This assessment has identified up to three sensitive receivers located within audible risk zones of up to 548 metres from the centreline of the 330kV transmission lines. These three receivers are at risk of exceeding the project noise trigger level per the Noise Policy for Industry and would require consideration of mitigation during detailed design.

It is also noted that the 220kV transmission line is not expected to cause adverse noise impacts as potential audible noise was predicted to be less than 35 dBA directly under the transmission lines.

Noise assessments have been undertaken for the road traffic generation and general maintenance activities associated with the Buronga substation and transmission lines. The associated noise risks are generally expected to be minimal.

No operational vibration impacts are anticipated as a result of the proposal.

9.3 CUMULATIVE IMPACTS

This assessment has found that there is minimal potential for cumulative noise impact as a result of the proposal and identified nearby existing and future developments.

10 LIMITATIONS

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11 REFERENCES

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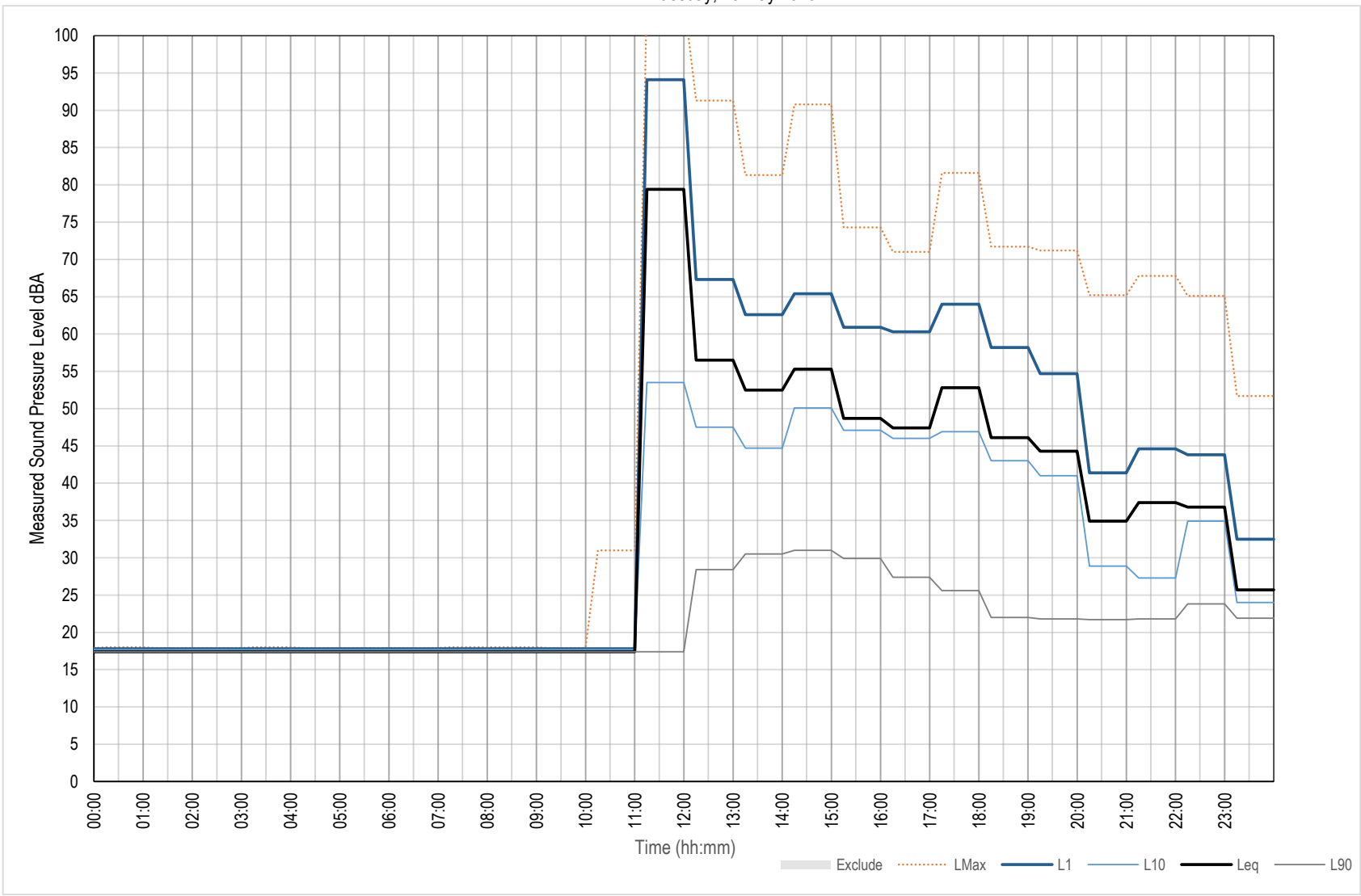
APPENDIX A

NOISE MONITORING GRAPHS

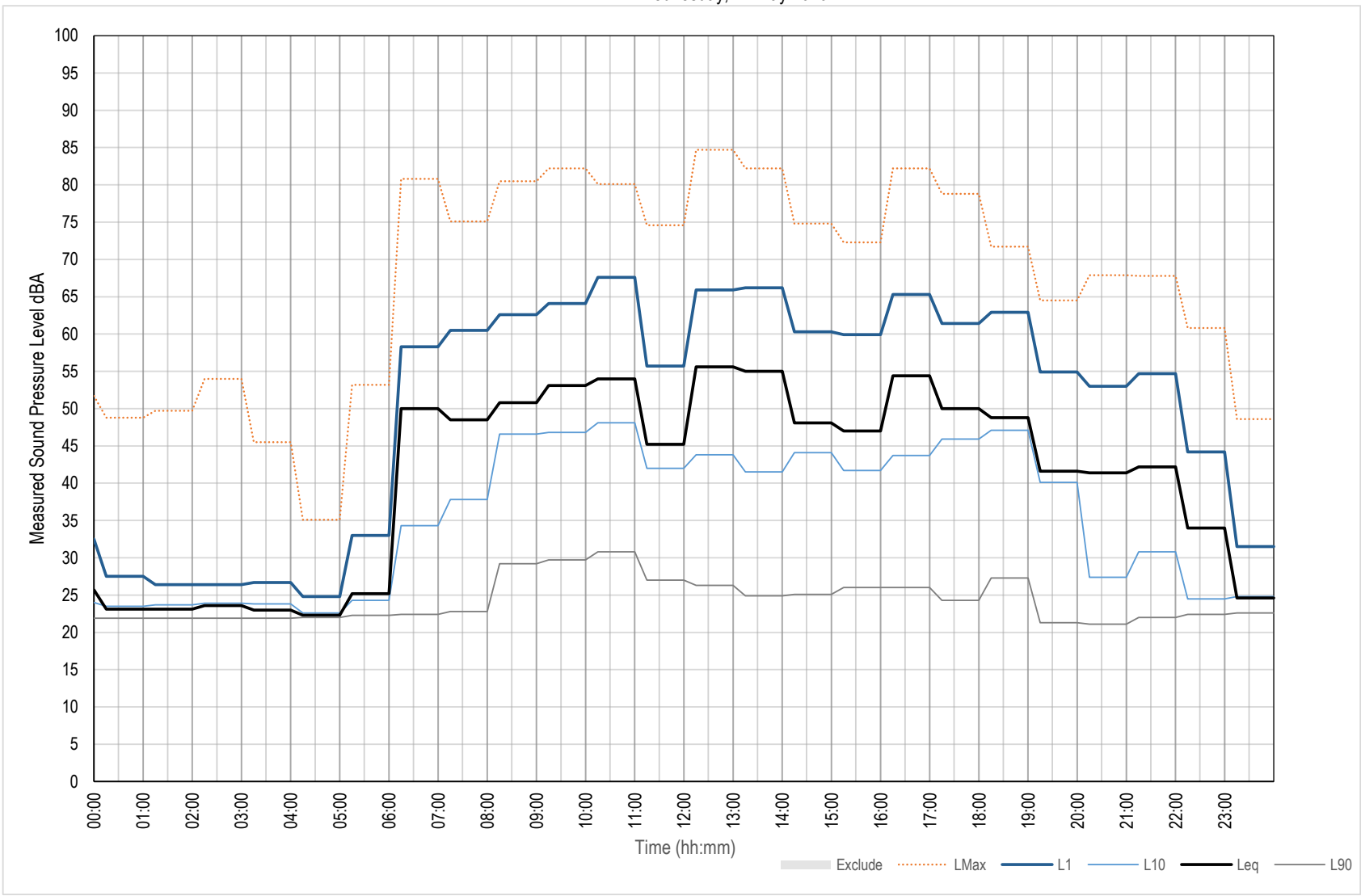
Measured Noise Levels - Buronga - Farm house

Tuesday, 26 May 2020



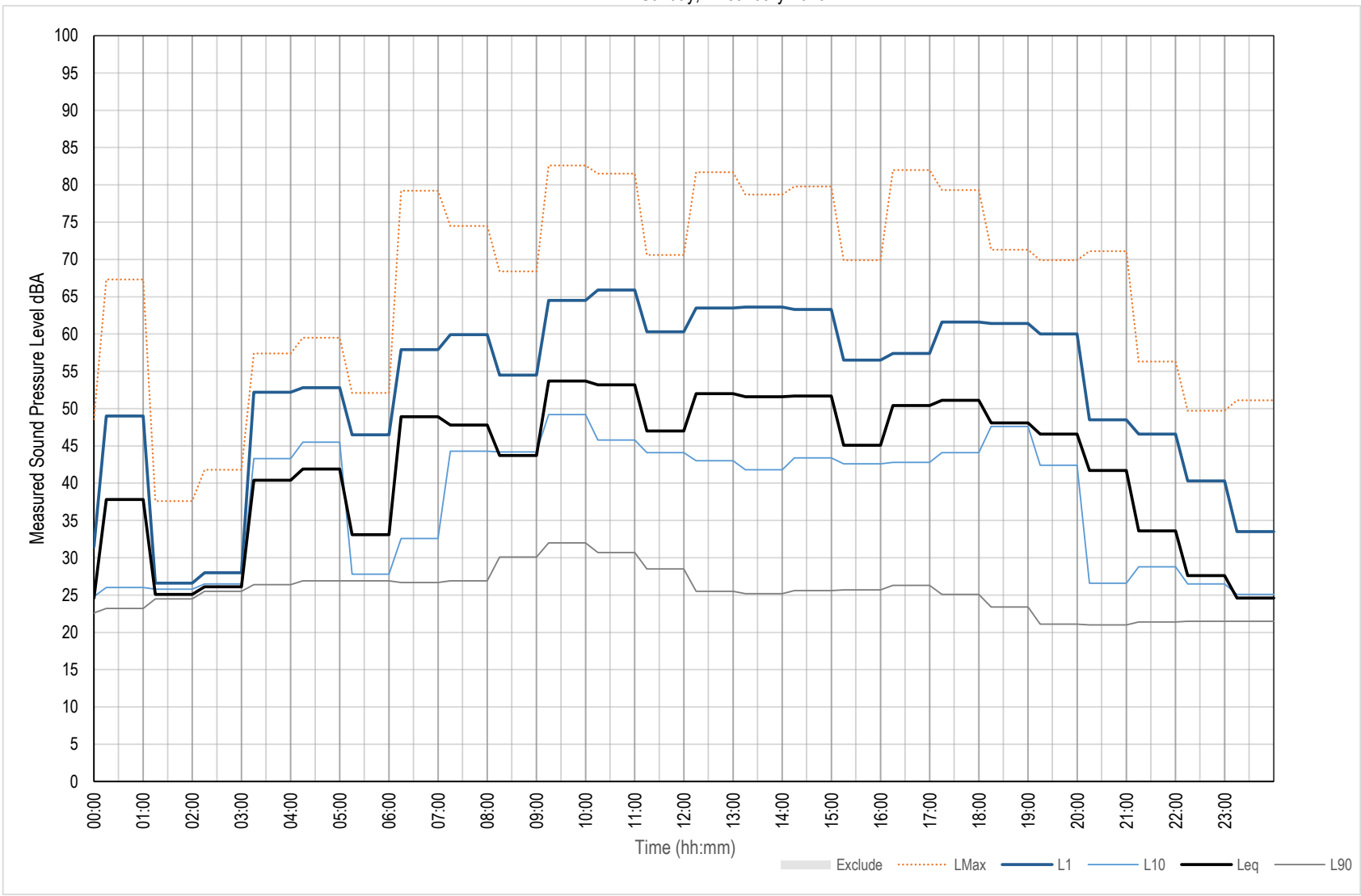
Measured Noise Levels - Buronga - Farm house

Wednesday, 27 May 2020



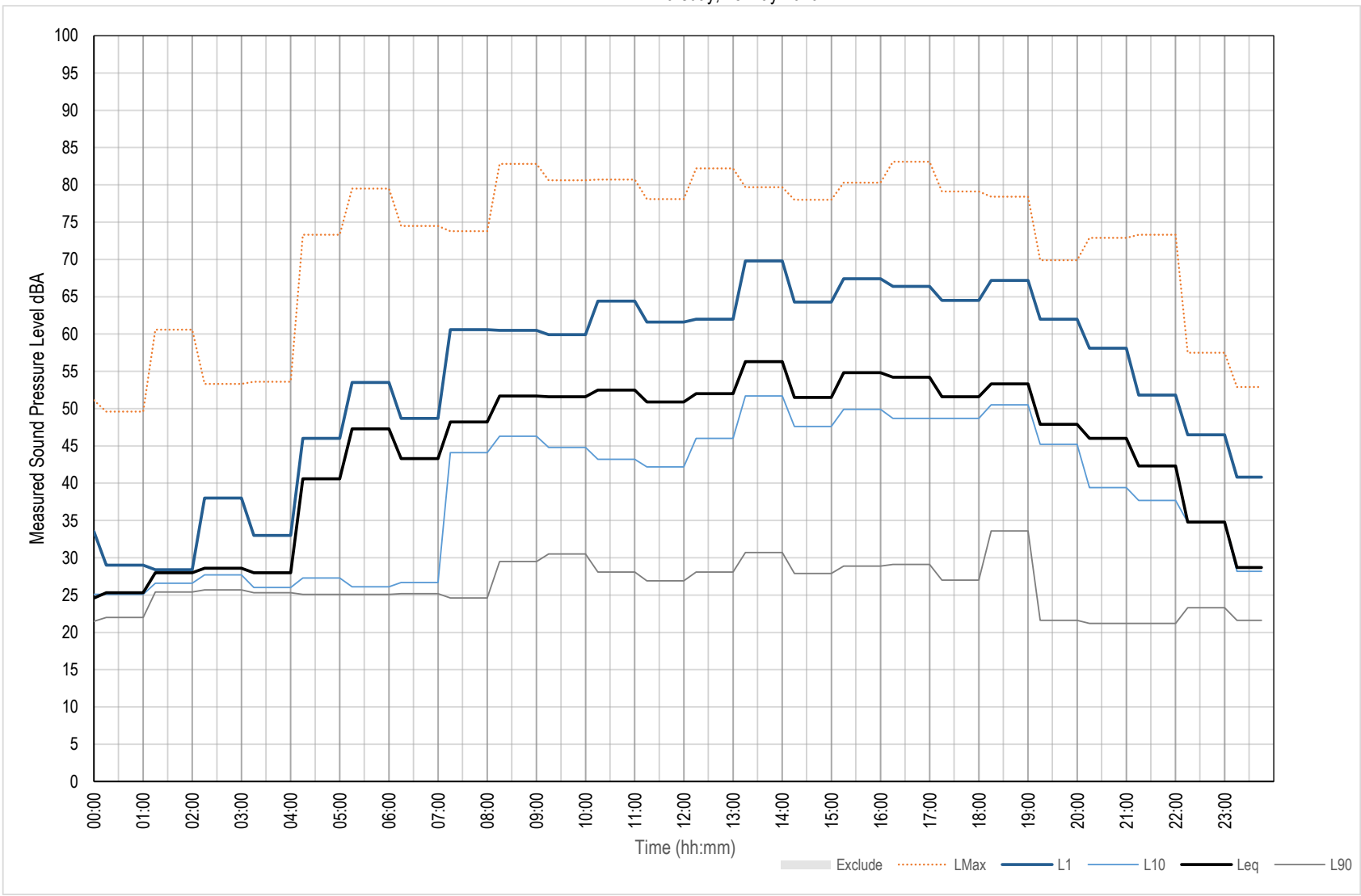
Measured Noise Levels - Buronga - Farm house

Sunday, 12 January 2020



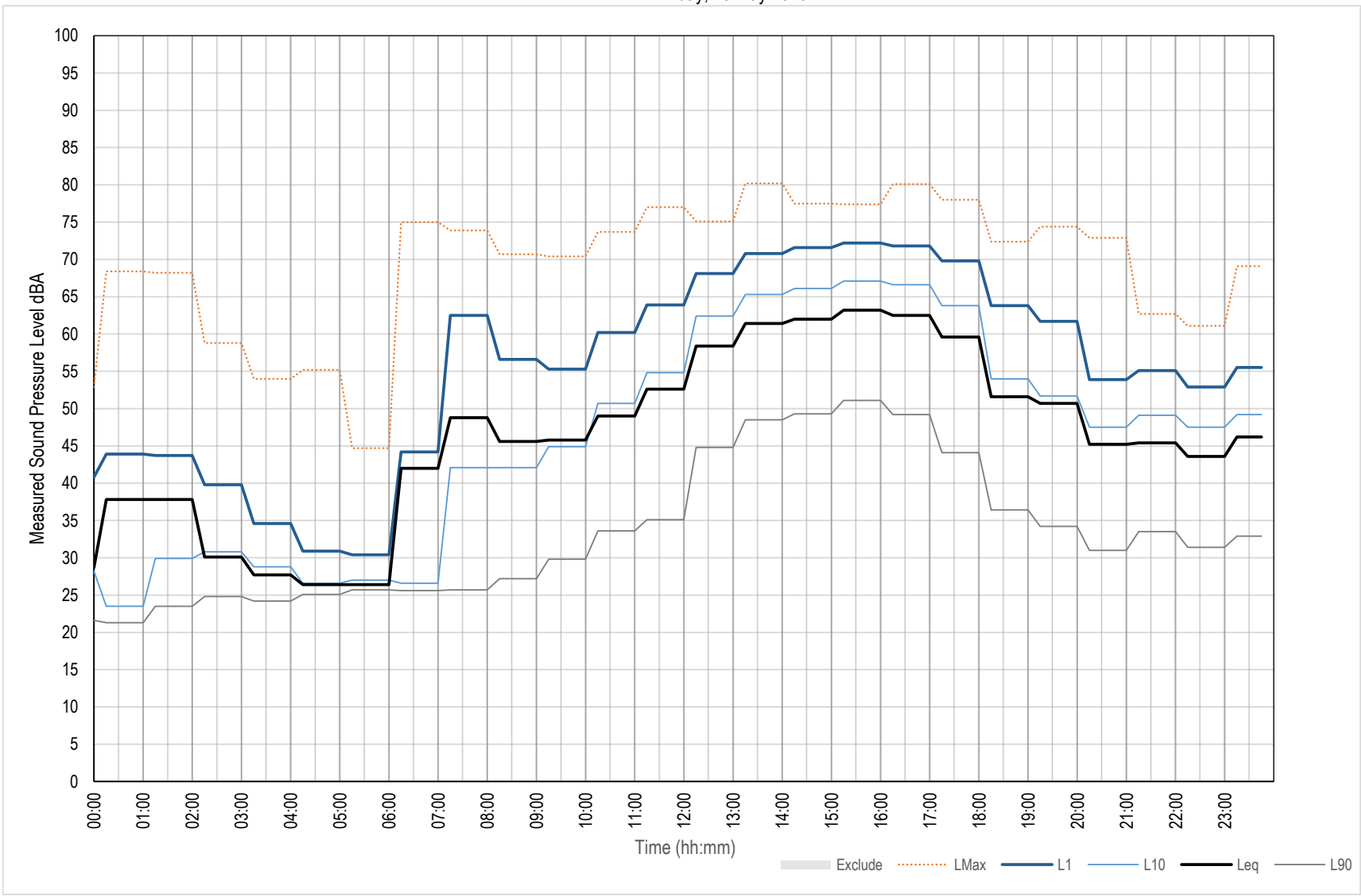
Measured Noise Levels - Buronga - Farm house

Thursday, 28 May 2020



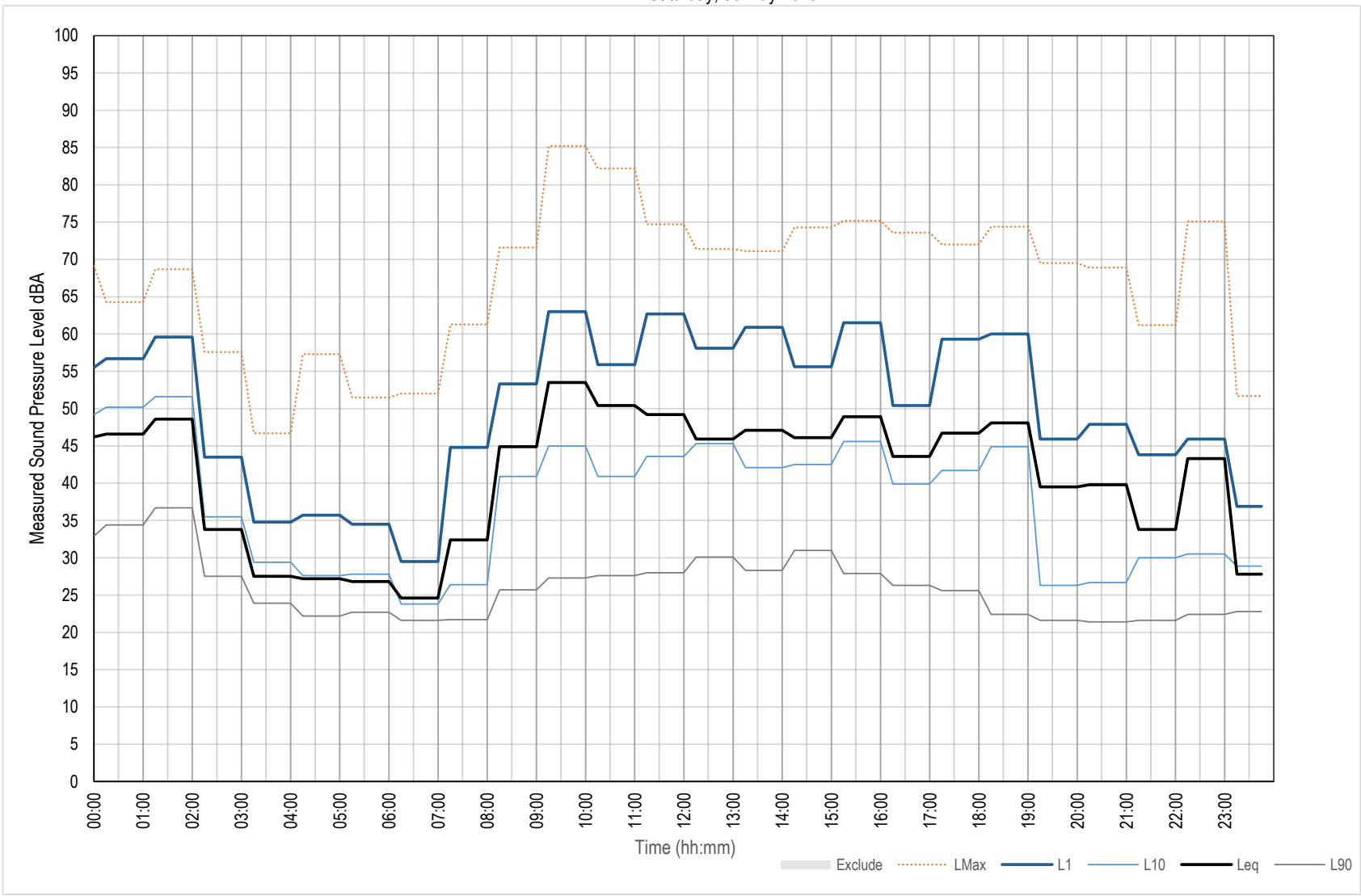
Measured Noise Levels - Buronga - Farm house

Friday, 29 May 2020



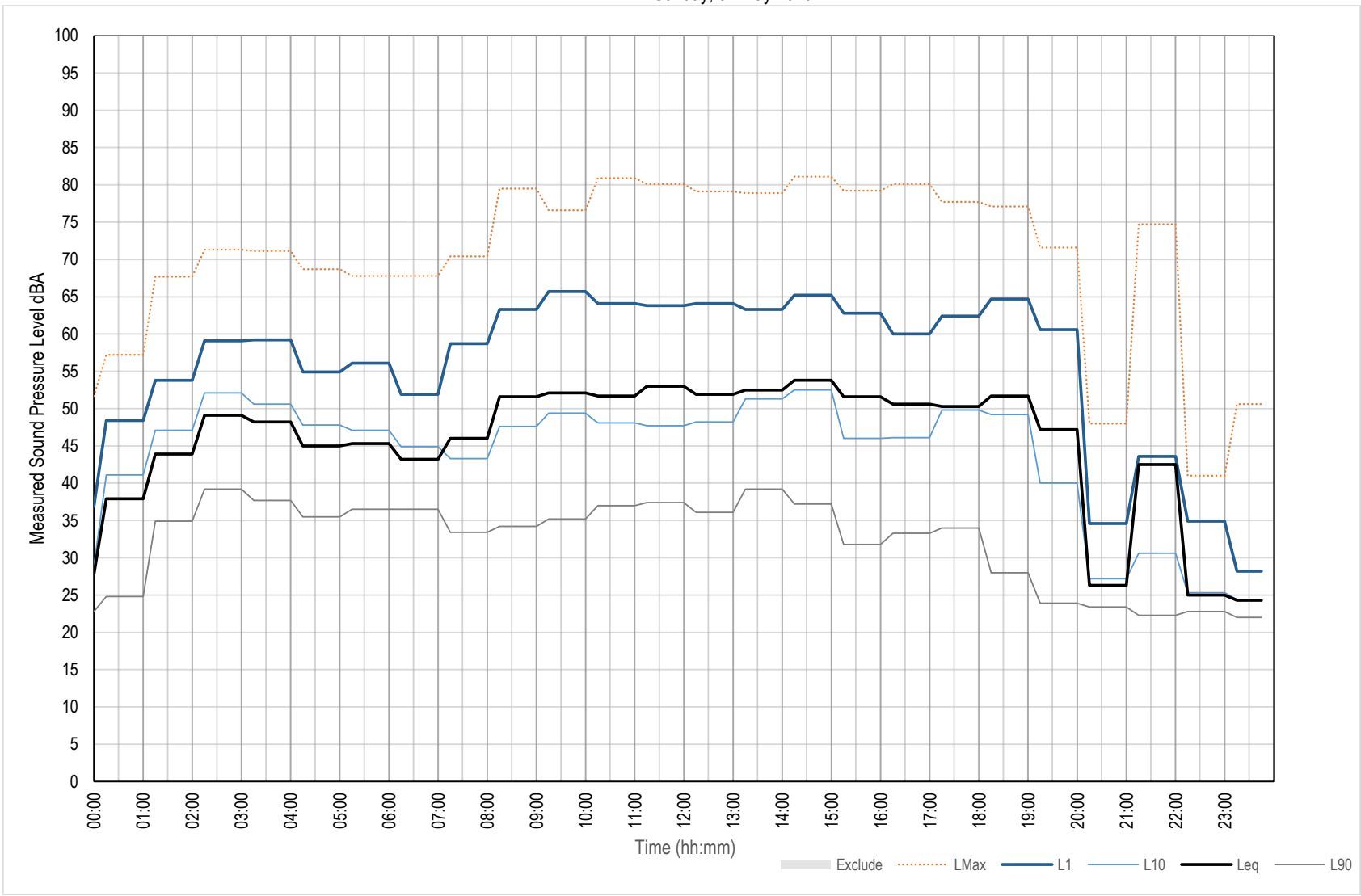
Measured Noise Levels - Buronga - Farm house

Saturday, 30 May 2020



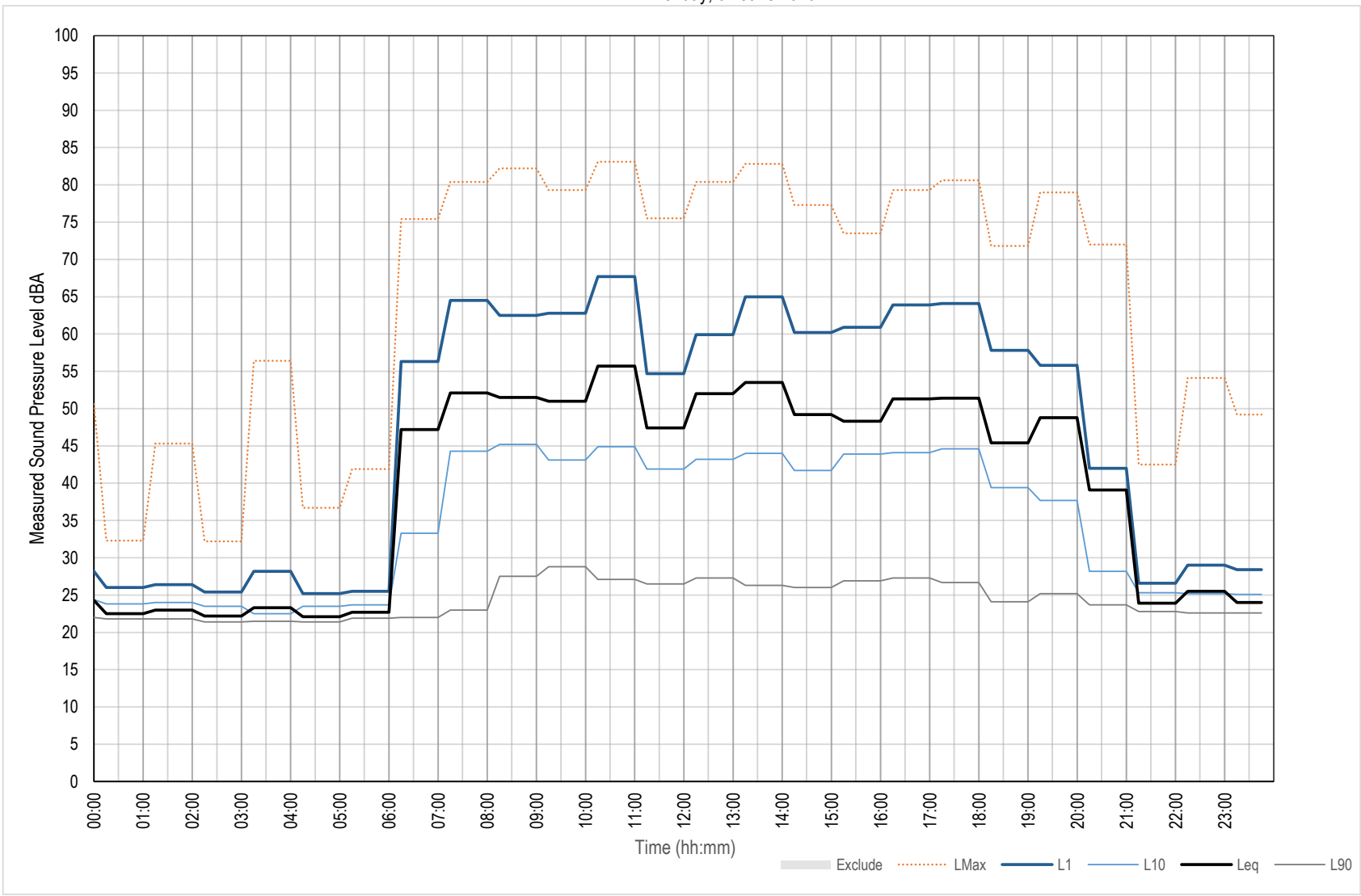
Measured Noise Levels - Buronga - Farm house

Sunday, 31 May 2020



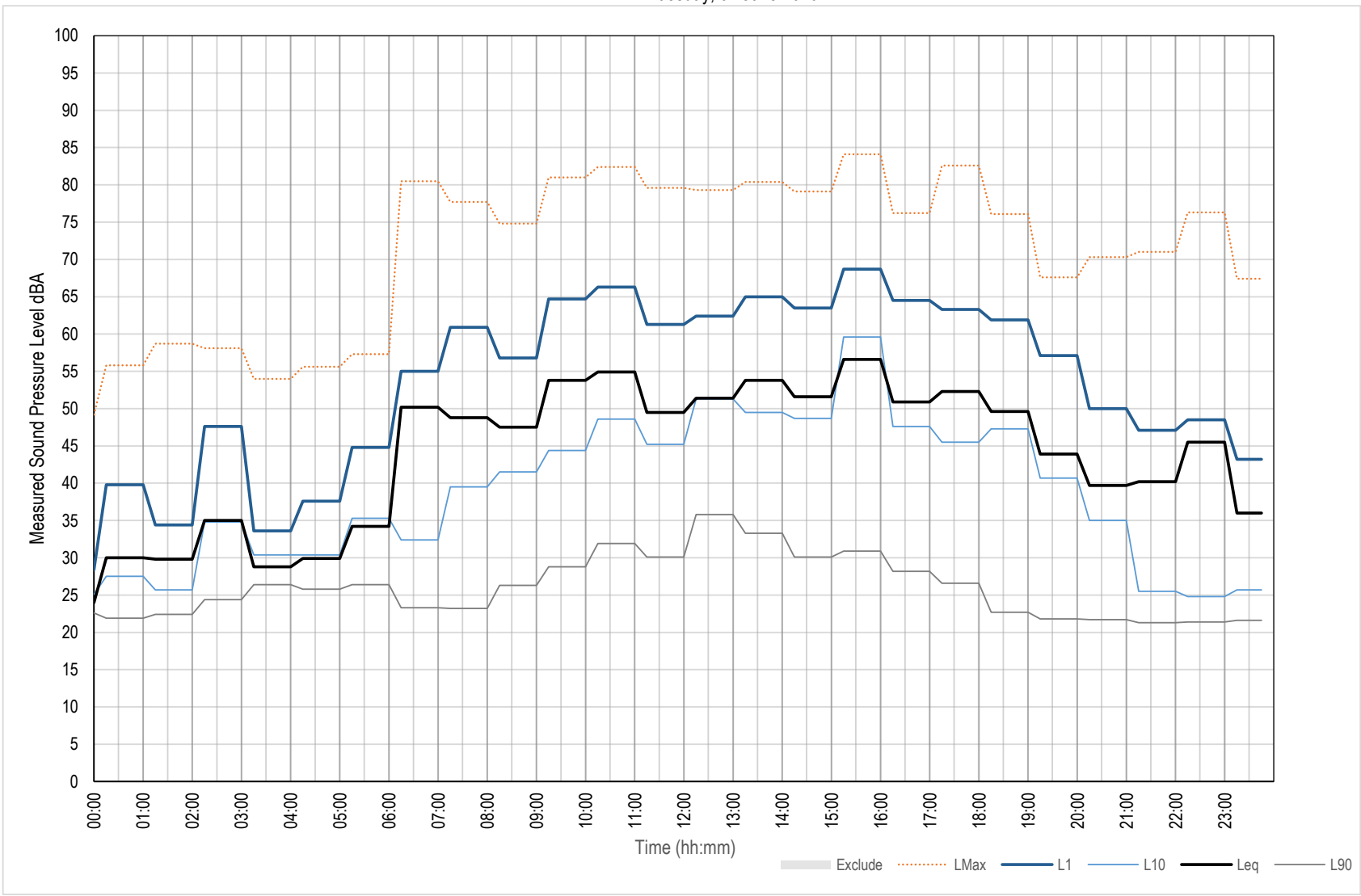
Measured Noise Levels - Buronga - Farm house

Monday, 01 June 2020



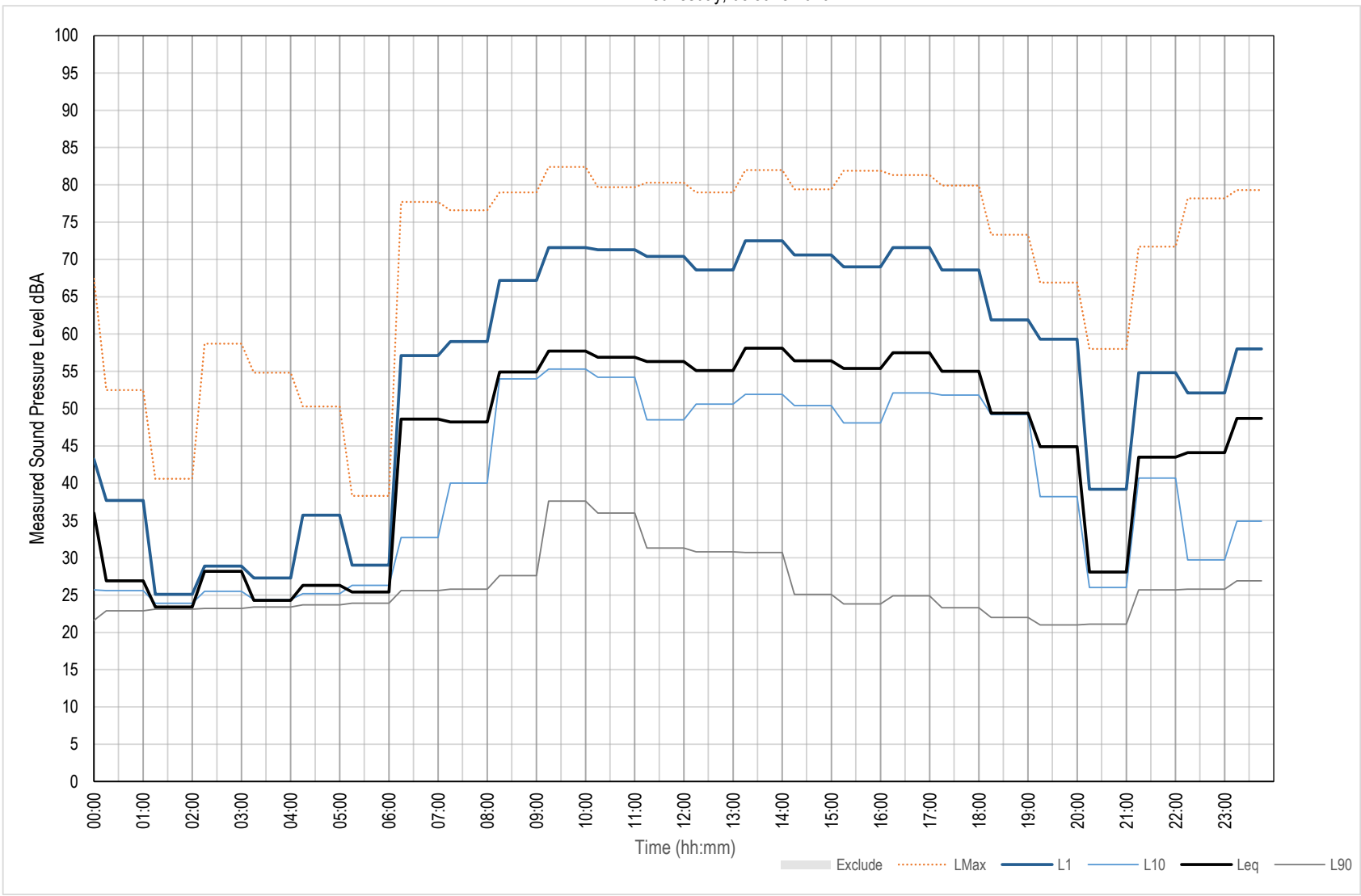
Measured Noise Levels - Buronga - Farm house

Tuesday, 02 June 2020



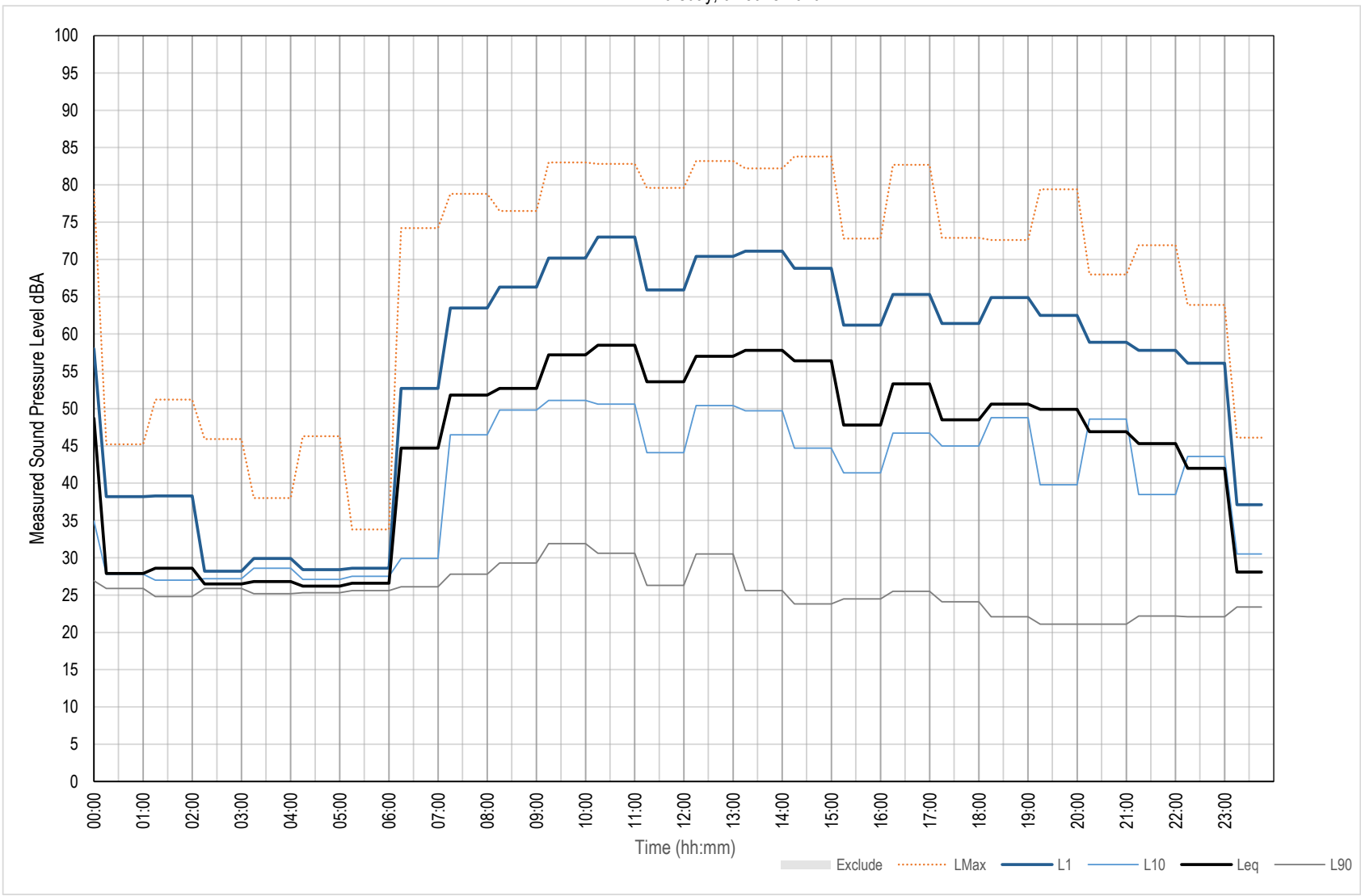
Measured Noise Levels - Buronga - Farm house

Wednesday, 03 June 2020



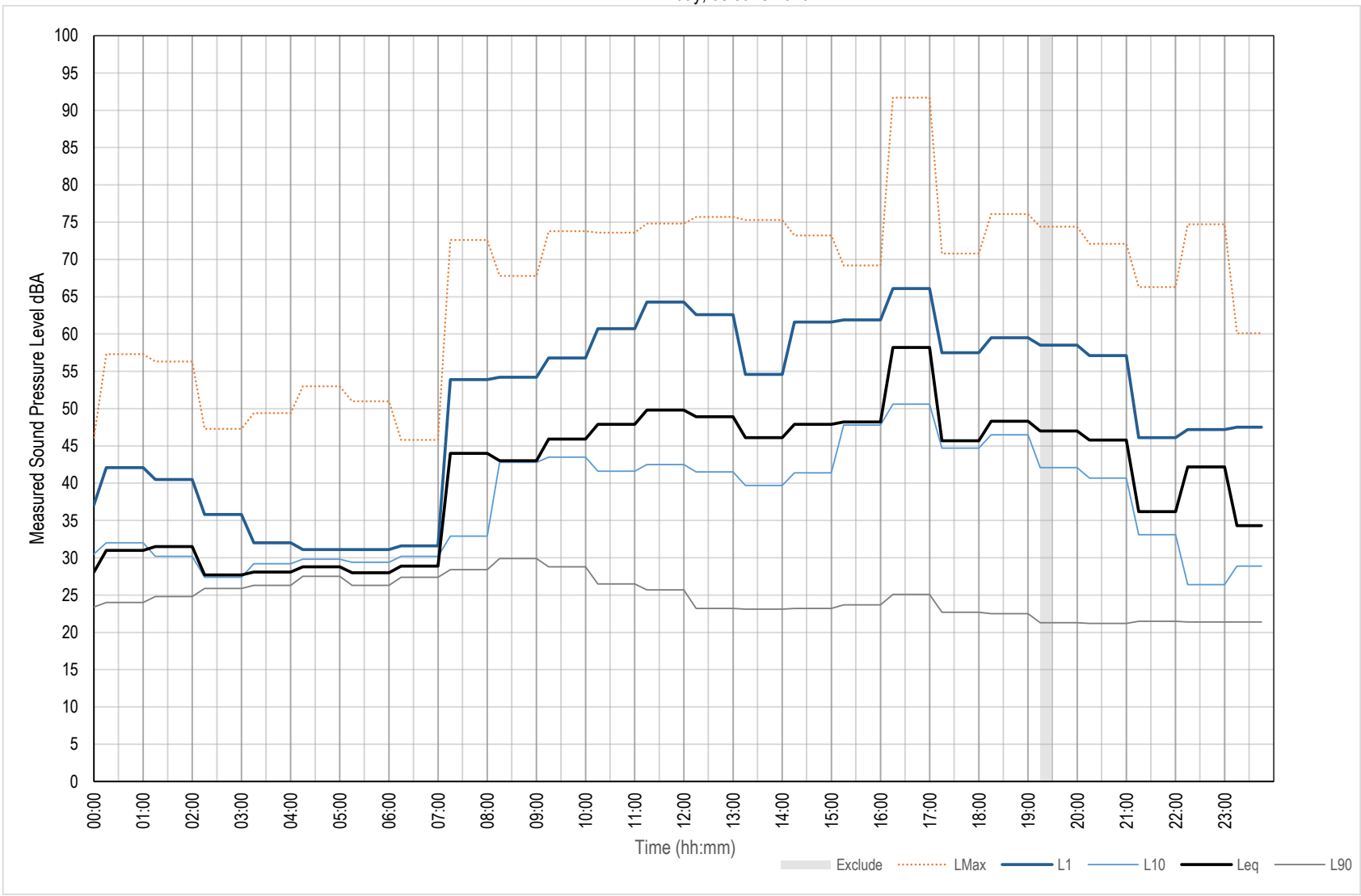
Measured Noise Levels - Buronga - Farm house

Thursday, 04 June 2020



Measured Noise Levels - Buronga - Farm house

Friday, 05 June 2020



APPENDIX B

CONSTRUCTION NOISE ASSESSMENT APPENDICES

APPENDIX B-1
CONSTRUCTION NOISE SCENARIOS (DETAIL)

Table B.1 Construction stages and equipment sound power levels – Buronga substation construction

STAGE	SCENARIO	ACTIVITY EXPLANATION	EQUIPMENT	NO OF PLANT PER 15 MINUTE PERIOD	INDIVIDUAL EQUIPMENT MAXIMUM L_{EQ} SOUND POWER LEVEL dBA
1	Enabling works	Works include: — dilapidation surveys — road surveys — tower/easement survey and LiDAR — flora/fauna/heritage surveys — geotechnical investigations	Flatbed Hi - Ab truck	1	107
			Watercart	1	107
			Geotech boring rig (Geotech only)	1	112
			Light vehicles	2	88
2	Earthworks and Civil Construction Works	Site establishment, substation bench, footings and civil infrastructure (drainage/utilities) — clearing grubbing — vegetation removal — strip topsoil — major earthworks fill using site won (borrow pit) material and imported fill — potential stabilisation of material insitu. — installation of utilities infrastructure (drainage, conduit runs) — footings and foundations for equipment (piled and reinforced concrete (RC)) — building installation — spray seals, surfacing, white lining, barrier installation — access road installation — security fence install	Flatbed Hi - Ab truck	1	107
			Concrete agitator	0.5	109
			Concrete pump	0.5	102
			Bob cat	1	104
			10-15 tonne roller	1	109
			Watercart	1	107
			Piling rig	0.5	116
			CAT 140M grader	0.5	113
			D8 Dozer	0.5	116
			30-45 tonne excavator	1	110
			20 tonne excavator	1	110
			12-15 tonne excavator	1	104
			7-10 tonne excavator	1	104
			5 tonne excavator	1	100
			Excavator with hammer	0.5	119
			12-15 tonne franna crane	0.5	98
			15-25 tonne franna crane	0.5	98
			70 tonne crane	0.5	113
			>200 tonne crane	0.5	113
			Scraper	2	110
			Backhoe	1	111
			Pneumatic jackhammer	0.5	115
			Dumper truck	2	110
			Elevated working platforms	0.5	98
			Chainsaw	3	114
			Mulcher/Chipper	2	116

STAGE	SCENARIO	ACTIVITY EXPLANATION	EQUIPMENT	NO OF PLANT PER 15 MINUTE PERIOD	INDIVIDUAL EQUIPMENT MAXIMUM L_{EQ} SOUND POWER LEVEL dBA
3	Electrical Construction Works	Installation of electrical plant, equipment and connections. — local earthworks — pit and conduit installation including insitu RC pits — lifting and installation of large equipment — installation an d fitout of buildings	Flatbed Hi - Ab truck	1	107
			Cable truck	2	108
			Concrete agitator	0.5	109
			Concrete pump	0.5	102
			Bob cat	1	104
			Watercart	1	107
			20 tonne excavator	1	110
			15-25 tonne franna crane	1	98
			70 tonne crane	0.5	113
			≥200 tonne crane	0.5	113
			Stringing Winches	4	103
			Backhoe	1	111
			Elevated working platforms	4	98
4	Pre-commissioning and commissioning	Predominantly electrical work but defect rectification could include any of the activities listed in stage 4	Flatbed Hi - Ab truck	1	107
			Cable truck	1	108
			Concrete agitator	0.5	109
			Concrete pump	0.5	102
			Bob cat	1	104
			Watercart	1	107
			CAT 140M grader	0.5	113
			20 tonne excavator	0.5	110
			5 tonne excavator	0.4	100
			15-25 tonne franna crane	1	98
			70 tonne crane	0.5	113
			≥200 tonne crane	0.5	113
			Stringing Winches	4	103
			Backhoe	1	111
			Elevated working platforms	4	98

STAGE	SCENARIO	ACTIVITY EXPLANATION	EQUIPMENT	NO OF PLANT PER 15 MINUTE PERIOD	INDIVIDUAL EQUIPMENT MAXIMUM L_{EQ} SOUND POWER LEVEL dBA
5	Demobilisation and rehabilitation	Predominantly electrical work but defect rectification could include any of the activities listed in stage 4	Flatbed Hi - Ab truck	1	107
			Concrete agitator	0.5	109
			Concrete pump	0.5	102
			Bob cat	1	104
			Watercart	1	107
			CAT 140M grader	0.5	113
			20 tonne excavator	0.5	110
			5 tonne excavator	0.4	100
			15-25 tonne franna crane	0.5	98
			70 tonne crane	0.5	113
			Backhoe	0.5	111
			Elevated working platforms	2	98

Source: TransGrid

Table B.2 Construction stages and equipment sound power levels – Transmission Line Construction

STAGE	SCENARIO	ACTIVITY EXPLANATION	EQUIPMENT	NO OF PLANT PER 15 MINUTE PERIOD	INDIVIDUAL EQUIPMENT MAXIMUM L_{EQ} SOUND POWER LEVEL dBA
1	Enabling works	Works include: — dilapidation surveys — road surveys — tower/easement survey and LiDAR — flora/fauna/heritage surveys — geotechnical investigations	Flatbed Hi - Ab truck	1	107
			Watercart	1	107
			Geotech boring rig (Geotech only)	1	112
			Light vehicles	2	88
2	Site establishment and access tracks	— clearing/grubbing — vegetation removal — mulching — grading/improving access routes	Flatbed Hi - Ab truck	2	107
			Concrete agitator	0.5	109
			Concrete pump	0.5	102
			Bob cat	2	104
			10-15 tonne roller	1	109
			Watercart	2	107
			CAT 140M grader	0.5	113
			D8 Dozer	0.5	116
			30-45 tonne excavator	0.5	110
			20 tonne excavator	0.5	110
			Chainsaw	4	114
			Mulcher/Chipper	2	116

STAGE	SCENARIO	ACTIVITY EXPLANATION	EQUIPMENT	NO OF PLANT PER 15 MINUTE PERIOD	INDIVIDUAL EQUIPMENT MAXIMUM L_{EQ} SOUND POWER LEVEL dBA
3	Earthworks and Civil Construction Works Decommissioning of redundant 220kV transmission line structures in discrete locations	Installation of foundations and temporary works for following activities. — levelling ground — crane pad temp. works (improving ground or installing temporary pads) — bored piling, install reinforcement and concreting — RC pad footings — concrete/steel driven piles — installation of screw piles — spreading excavated material	Scraper	3	
			Semi Trailer	1	108
			Flatbed Hi - Ab truck	1	107
			Concrete agitator	0.5	109
			Concrete pump	0.4	102
			Bob cat	2	104
			10-15 tonne roller	1	109
			Watercart	3	107
			Piling rig	4	116
			CAT 140M grader	0.5	113
			D8 Dozer	1	116
			30-45 tonne excavator	1	110
			20 tonne excavator	0.5	110
			12-15 tonne excavator	1	104
			7-10 tonne excavator	1	104
			5 tonne excavator	1	100
			Excavator with hammer	0.5	119
			Scraper	0.5	110
			15-25 tonne franna crane	1	98
			Backhoe	1	111
			Pneumatic jackhammer	1	115
			Dumper truck	2	110
			Elevated working platforms	1	98
			Geotech boring rig	0.5	112
4	Tower Assembly	Assembly of steel structure on ground	Semi Trailer	1	108
			Bob cat	1	104
			Watercart	1	107
			15-25 tonne franna crane	1	98
			≥200 tonne crane	1	113
			Stringing Winches	2	103
			Backhoe	1	111
			Elevated working platforms	4	98

STAGE	SCENARIO	ACTIVITY EXPLANATION	EQUIPMENT	NO OF PLANT PER 15 MINUTE PERIOD	INDIVIDUAL EQUIPMENT MAXIMUM L_{EQ} SOUND POWER LEVEL dBA
5	Tower Erection	Lifting the assembled pieces into position (may be in one piece or may be multiple lifts)	Flatbed Hi - Ab truck	1	107
			Cable truck	1	108
			Concrete agitator	0.5	109
			Concrete pump	0.5	102
			Bob cat	1	104
			Watercart	1	107
			15-25 tonne franna crane	1	98
			70 tonne crane	0.5	113
			≥200 tonne crane	0.5	113
			Stringing Winches	4	103
			Backhoe	1	111
			Elevated working platforms	4	98
6	Tower Stringing	Pull line pulled between structures in up to 10km runs Line could be pulled by vehicle or drone Winches and cable trucks used to pull conductors Connections between conductors at breaks in line and changes in direction	Semi Trailer	1	108
			Cable truck	3	108
			Watercart	1	107
			20 tonne excavator	1	110
			15-25 tonne franna crane	1	98
			70 tonne crane	1	113
			Stringing Winches	2	103
			Elevated working platforms	4	98
			Drone		81
7	Commissioning/Energisation	Predominantly electrical works	Cable truck	1	108
			Stringing Winches	1	103
			Elevated working platforms	2	98

STAGE	SCENARIO	ACTIVITY EXPLANATION	EQUIPMENT	NO OF PLANT PER 15 MINUTE PERIOD	INDIVIDUAL EQUIPMENT MAXIMUM L_{EQ} SOUND POWER LEVEL dBA
8	Demobilisation and rehabilitation	Site rehabilitation Removal of temporary works Seeding/stabilising Minor landscaping Removal of materials Defect rectification Inspections Road repairs as required	Semi Trailer	1	108
			Flatbed Hi - Ab truck	1	107
			Concrete agitator	0.5	109
			Concrete pump	0.5	102
			Bob cat	1	104
			10-15 tonne roller	0.5	109
			Watercart	1	107
			CAT 140M grader	0.5	113
			30-45 tonne excavator	0.5	110
			20 tonne excavator	0.5	110
			5 tonne excavator	0.5	100
			15-25 tonne franna crane	0.5	98
			Backhoe	1	111
			Dumper truck	0.5	110
			Elevated working platforms	1	98

Source: TransGrid

Table B.3 Construction stages and equipment sound power levels – main construction compounds and accommodation camps

STAGE	SCENARIO	ACTIVITY EXPLANATION	EQUIPMENT	NO OF PLANT PER 15 MINUTE PERIOD	INDIVIDUAL EQUIPMENT MAXIMUM L_{EQ} SOUND POWER LEVEL dBA
1a	Enabling works	Works include: — dilapidation surveys — road surveys — tower/easement survey and LiDAR — flora/fauna/heritage surveys — geotechnical investigations	Flatbed Hi - Ab truck	1	107
			Watercart	1	107
			Geotech boring rig (Geotech only)	1	112
			Light vehicles	2	88
1b	Enabling works – site establishment	Establishment of the compound/laydown: — clearing grubbing — vegetation removal — taking deliveries — earthworks to establish hardstand — installation of utilities infrastructure (drainage, conduit runs, sewerage) — installation of site/accommodation sheds — installation of roofs and walkways — spray seals, white lining, barrier installation — installation of workshops, containers, canopies — furnishing and utilities connections	Flatbed Hi - Ab truck	1	107
			Concrete agitator	0.5	109
			Concrete pump	0.5	102
			Bob cat	1	104
			10-15 tonne roller	1	109
			Watercart	1	107
			CAT 140M grader	0.5	113
			D8 Dozer	0.5	116
			30-45 tonne excavator	1	110
			20 tonne excavator	1	110
			12-15 tonne excavator	1	104
			7-10 tonne excavator	1	104
			5 tonne excavator	1	100
			Excavator with hammer	0.5	119
			12-15 tonne franna crane	0.5	98
			15-20 tonne franna crane	0.5	98
			70 tonne crane	0.2	113
			Backhoe	1	111
			Pneumatic jackhammer	0.5	115
			Dumper truck	2	110
			Elevated working platforms	0.5	98
			Chainsaw	0.1	114
			Mulcher/Chipper	0.1	116

STAGE	SCENARIO	ACTIVITY EXPLANATION	EQUIPMENT	NO OF PLANT PER 15 MINUTE PERIOD	INDIVIDUAL EQUIPMENT MAXIMUM L_{EQ} SOUND POWER LEVEL dBA
2a	Operation of the compound – standard hours	Activities include: — office works — staff/worker meetings/briefings — material handling — logistics (loading/unloading trucks) — taking deliveries — de-stuffing/re-distribution of materials — staff training — maintenance	Front end loader Excavator (tracked) 35t Road truck Light vehicles Power generator Concrete batching plant	1 1 1 1 1	91 110 108 88 103
2b	Operation of the compound – outside standard hours	As above Saturday and Sundays As above but following the OOHW protocol for night works			
3	Operation of the accommodation camp		Generators Once/twice a week: Bin/Skip collection Sewer/cess pump out Deliveries (food/water)		
4	Demobilisation / rehabilitation	Site rehabilitation Removal of temporary works Seeding/stabilising Minor landscaping Removal of materials Defect rectification Inspections Road repairs as required	Semi Trailer Flatbed Hi - Ab truck Concrete agitator Concrete pump Bob cat 10-15 tonne roller Watercart CAT 140M grader 30-45 tonne excavator 20 tonne excavator 5 tonne excavator 15-25 tonne franna crane 70 tonne crane Backhoe Dumper truck Elevated working platforms	1 1 0.5 0.5 1 0.5 1 0.5 0.5 0.5 0.5 0.5 0.2 1 0.5 1	108 107 109 102 104 109 107 113 110 110 100 98 113 111 110 98

APPENDIX B-2
CONSTRUCTION NOISE MAPPING – TRANSMISSION LINE

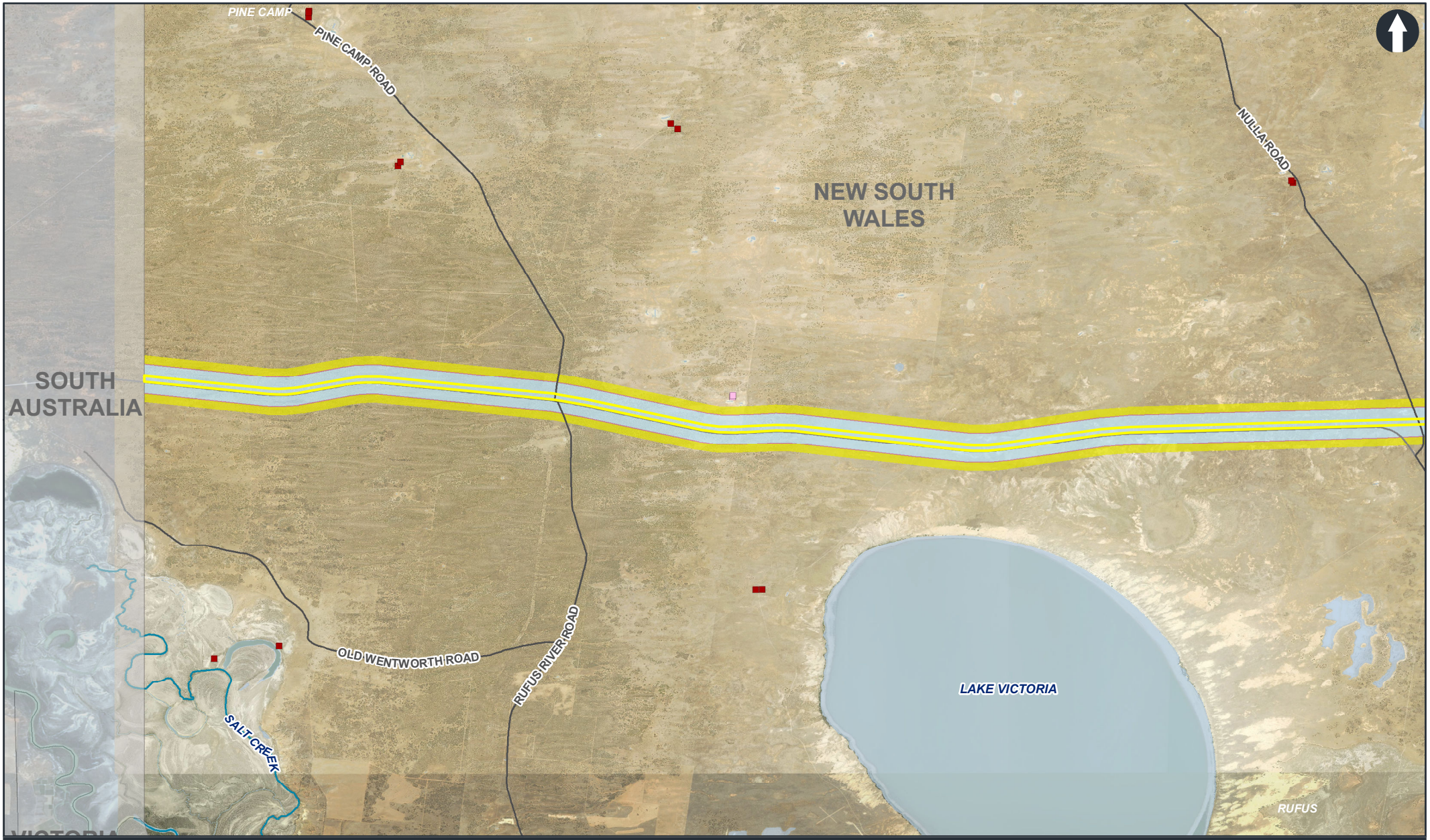


Figure B2.A

Construction noise - transmission line works – distance to compliance for works stages - Standard Hours

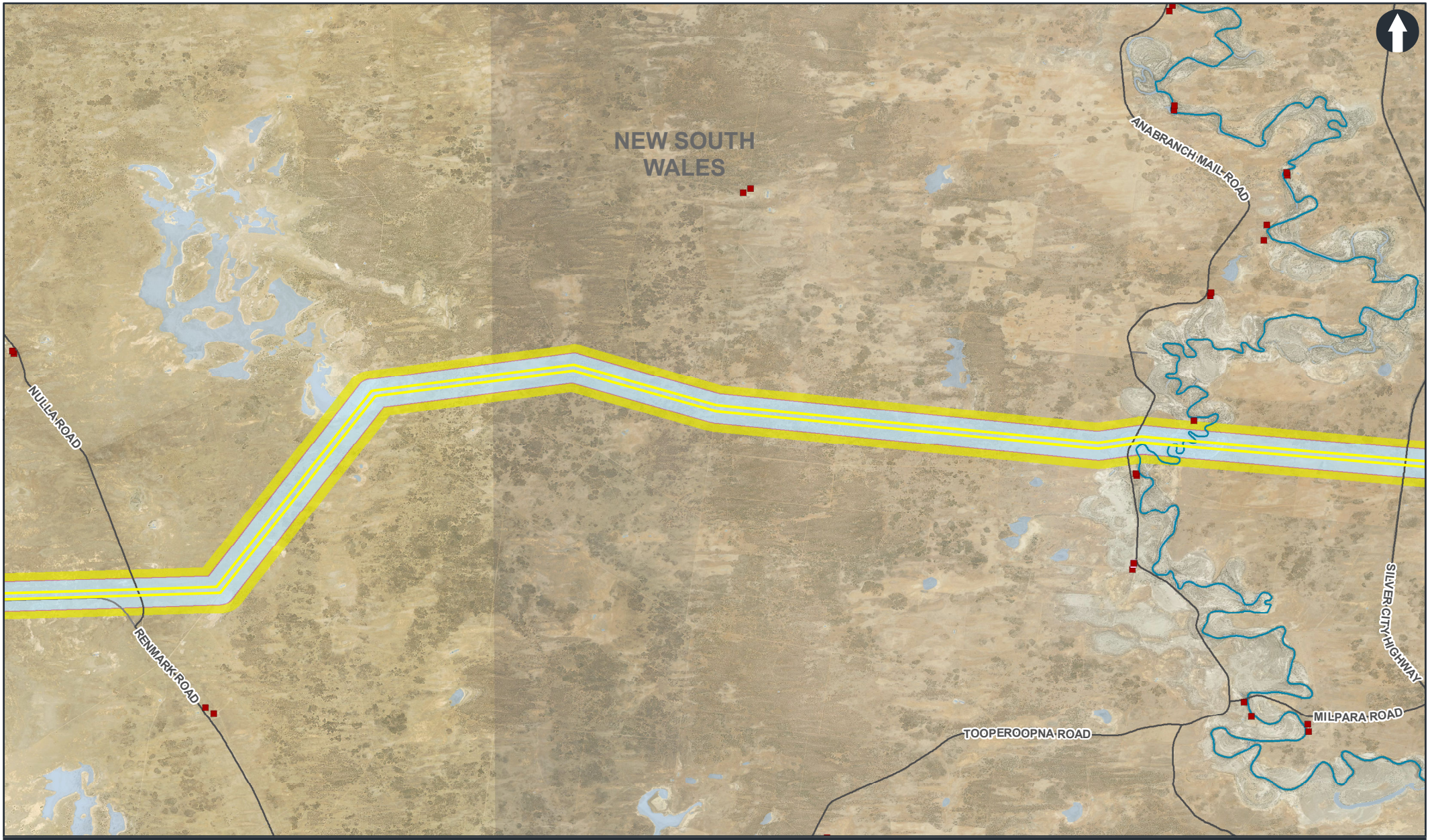


Figure B2.B

Construction noise - transmission line works – distance to compliance for works stages - Standard Hours

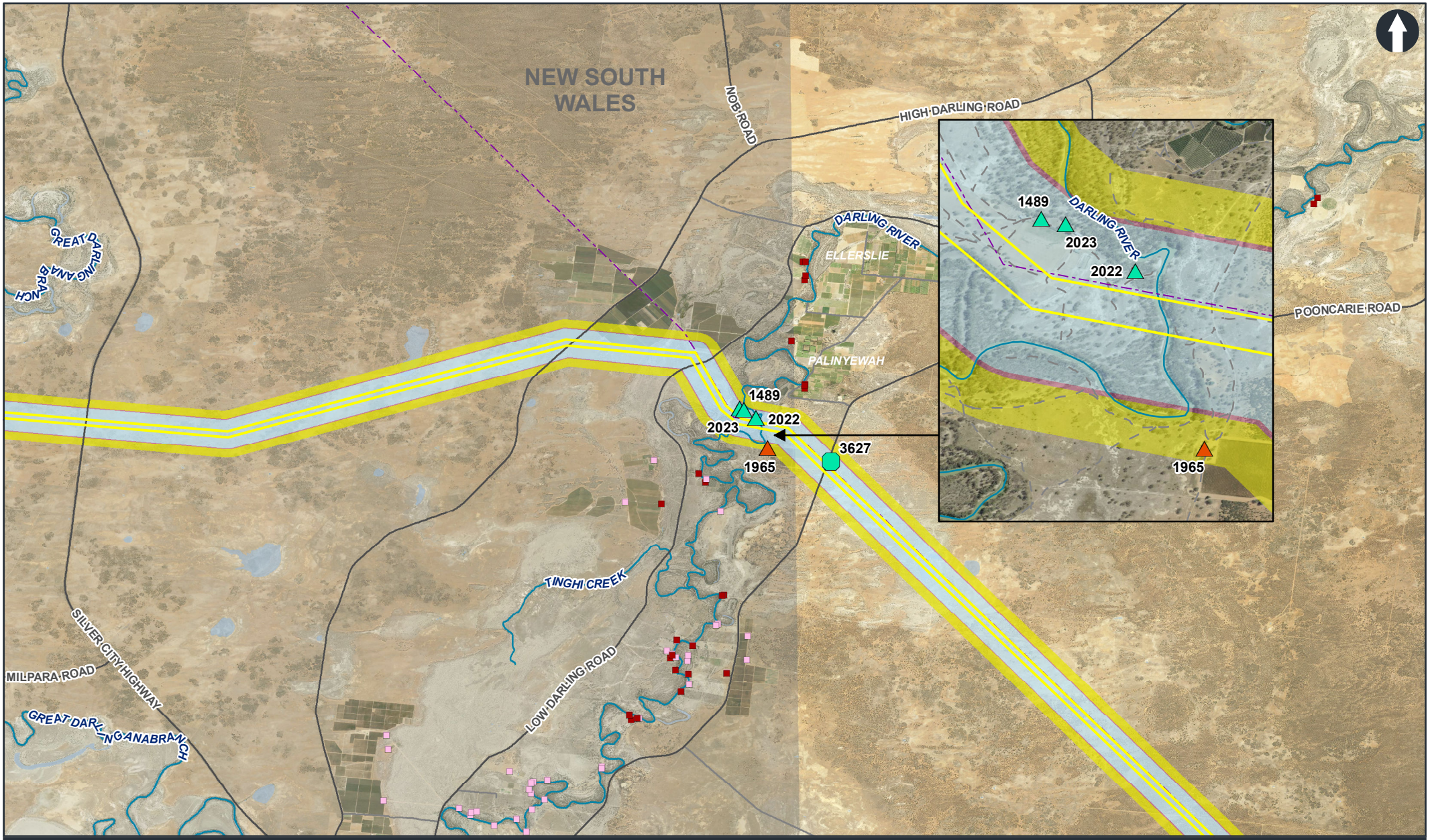


Figure B2.C

Construction - transmission line works – distance to compliance for works stages - Standard Hours

- Transmission line corridor
- Existing transmission line infrastructure
- Residential dwelling within 390m buffer
- Utility facility within 390m buffer
- Residential dwelling within 700m buffer
- Sensitive receiver outside noise buffer - confirmed location
- Sensitive receiver outside noise buffer - potential location

Construction noise buffer

- 390m construction noise buffer
- 420m construction noise buffer
- 700m construction noise buffer

Source: NSWSS, ESRI, Transgrid, WSP, BOM

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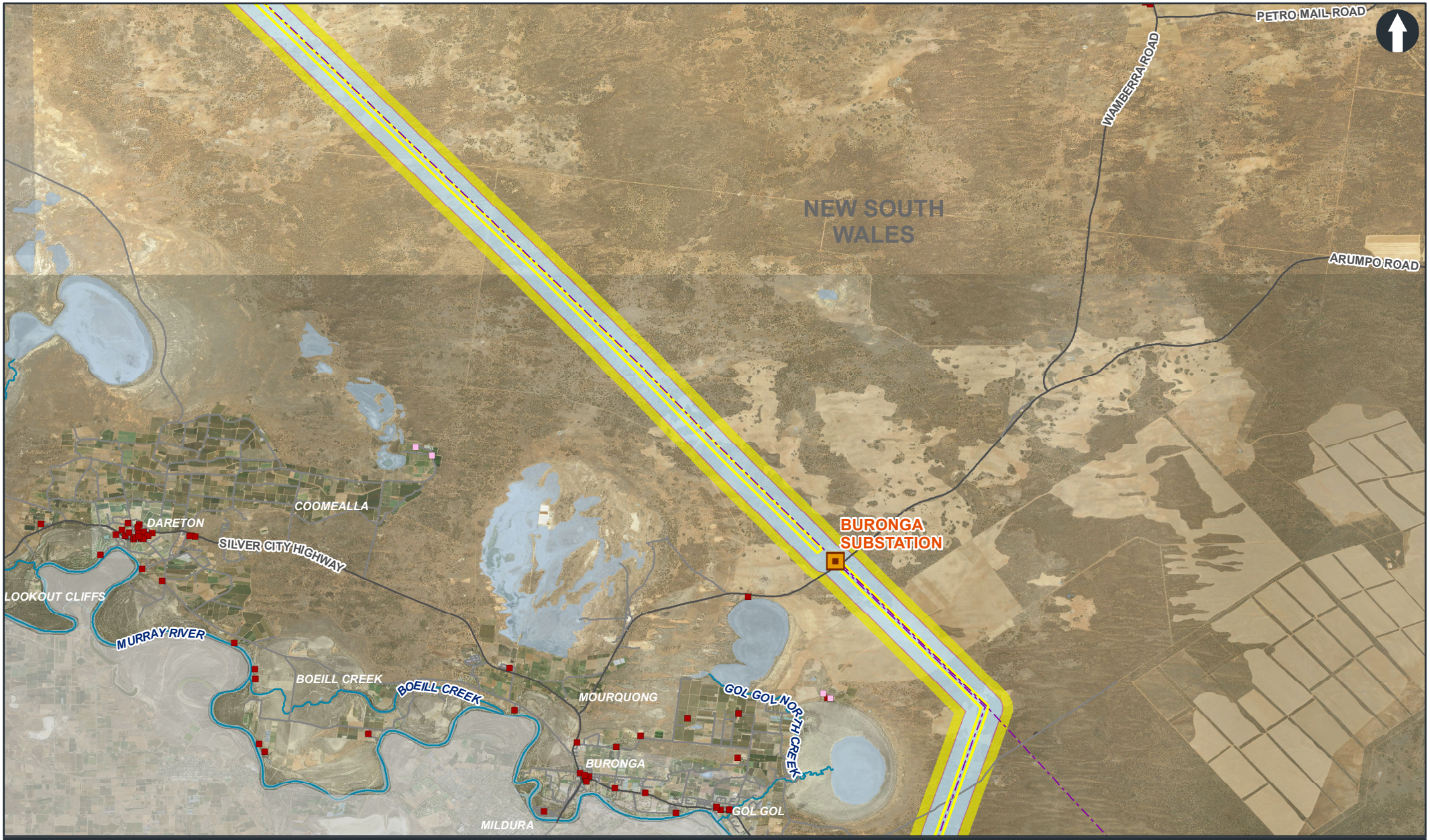

Figure B2.D

Construction noise - transmission line works – distance to compliance for works stages - Standard Hours

- Buronga substation
- Sensitive receiver outside noise buffer - confirmed location
- Sensitive receiver outside noise buffer - potential location
- Transmission line corridor
- Existing transmission line infrastructure

Construction noise buffer

- 390m construction noise buffer
- 420m construction noise buffer
- 700m construction noise buffer

Source: NSWSS, ESRI, Transgrid, WSP, BOM

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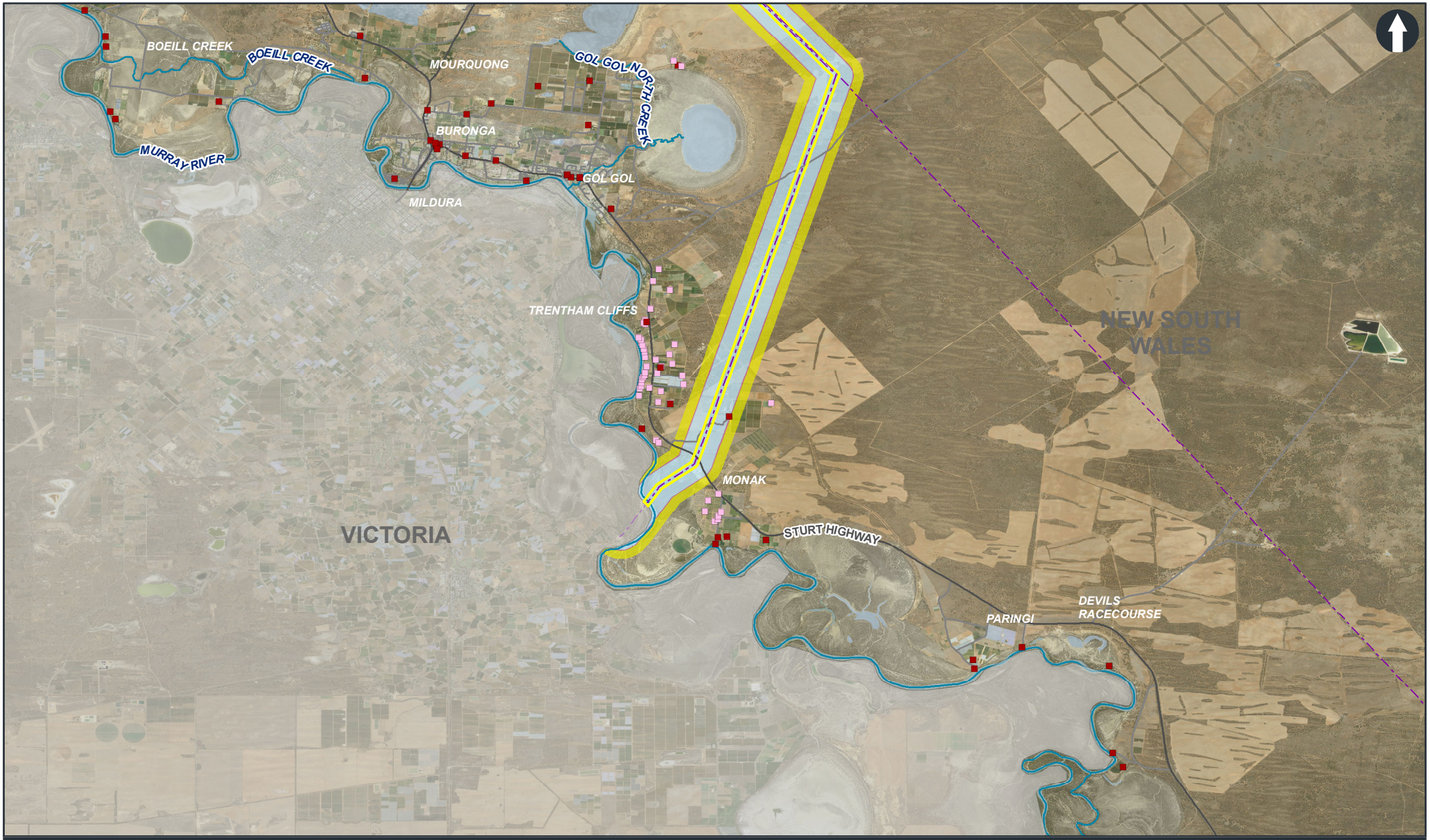

Figure B2.E

Transmission line corridor

Existing transmission line infrastructure

Sensitive receiver outside noise buffer - confirmed location

Sensitive receiver outside noise buffer - potential location

Construction noise buffer

390m construction noise buffer

420m construction noise buffer

700m construction noise buffer

Construction noise - transmission line works – distance to compliance for works stages - Standard Hours

Source: NSWSS, ESRI, Transgrid, WSP, BOM

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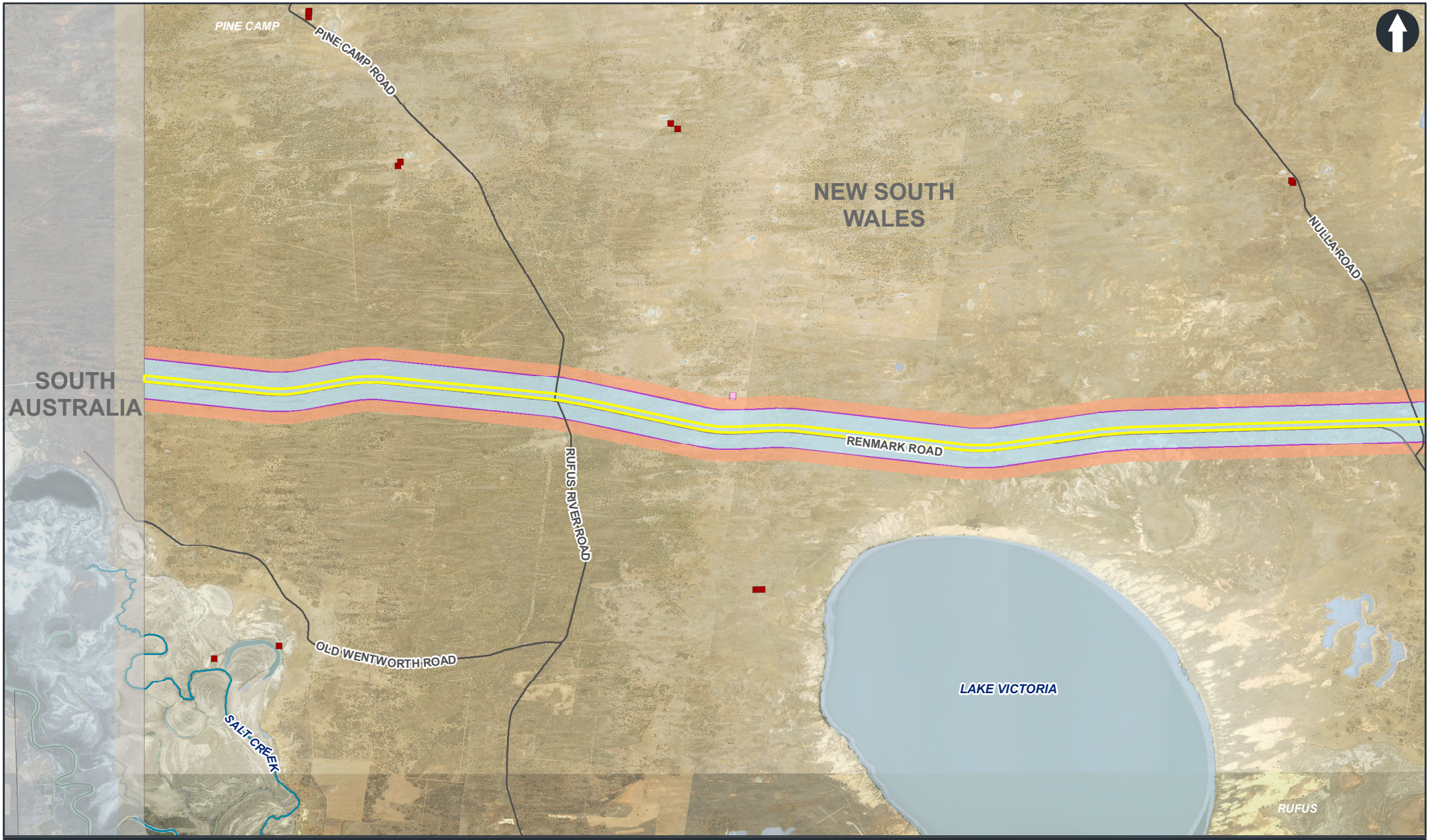

Figure B2.F

Construction noise - transmission line works – distance to compliance for works stages - OOHW (Day)

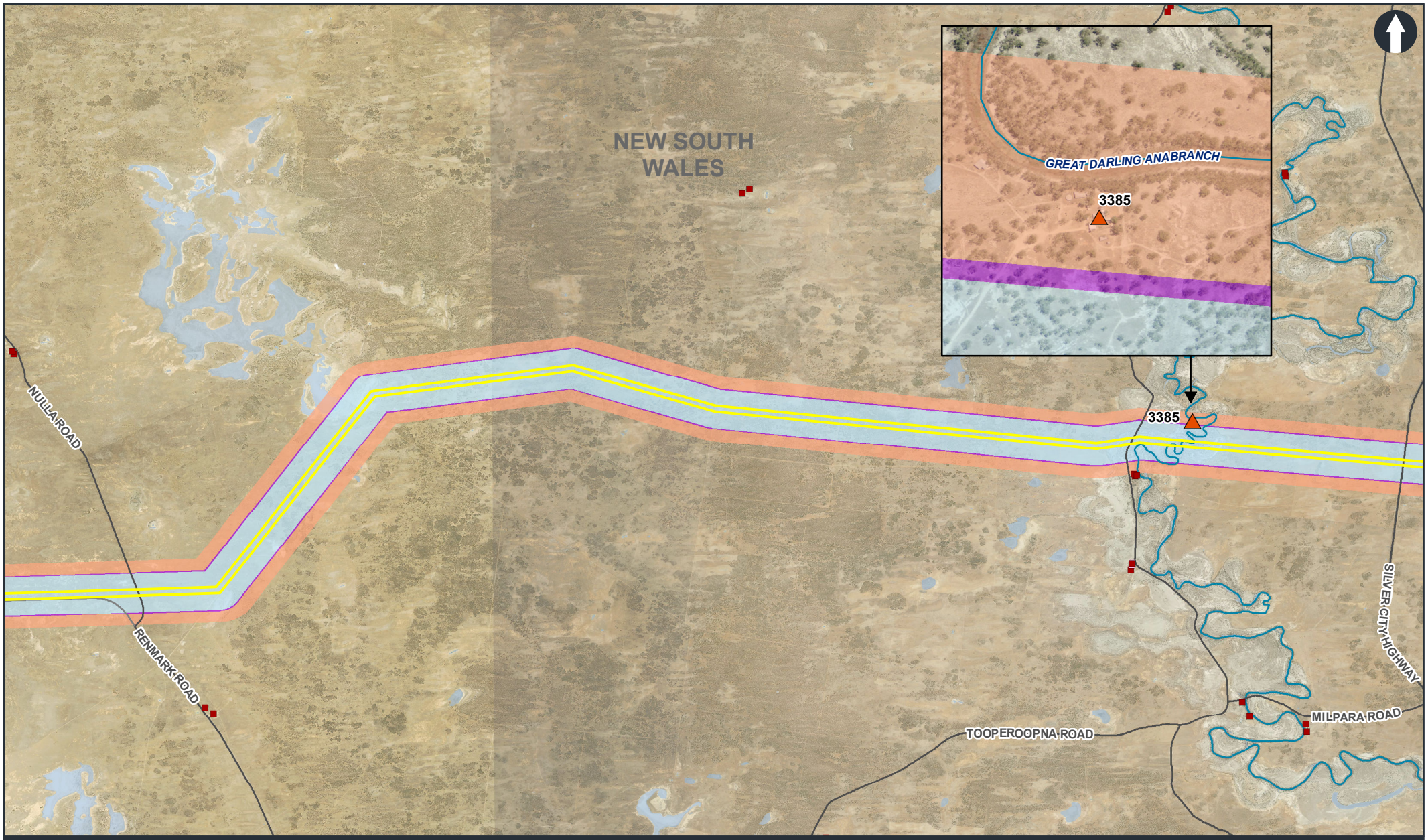

Figure B2.G

Construction noise - transmission line works – distance to compliance for works stages - OOHW (Day)

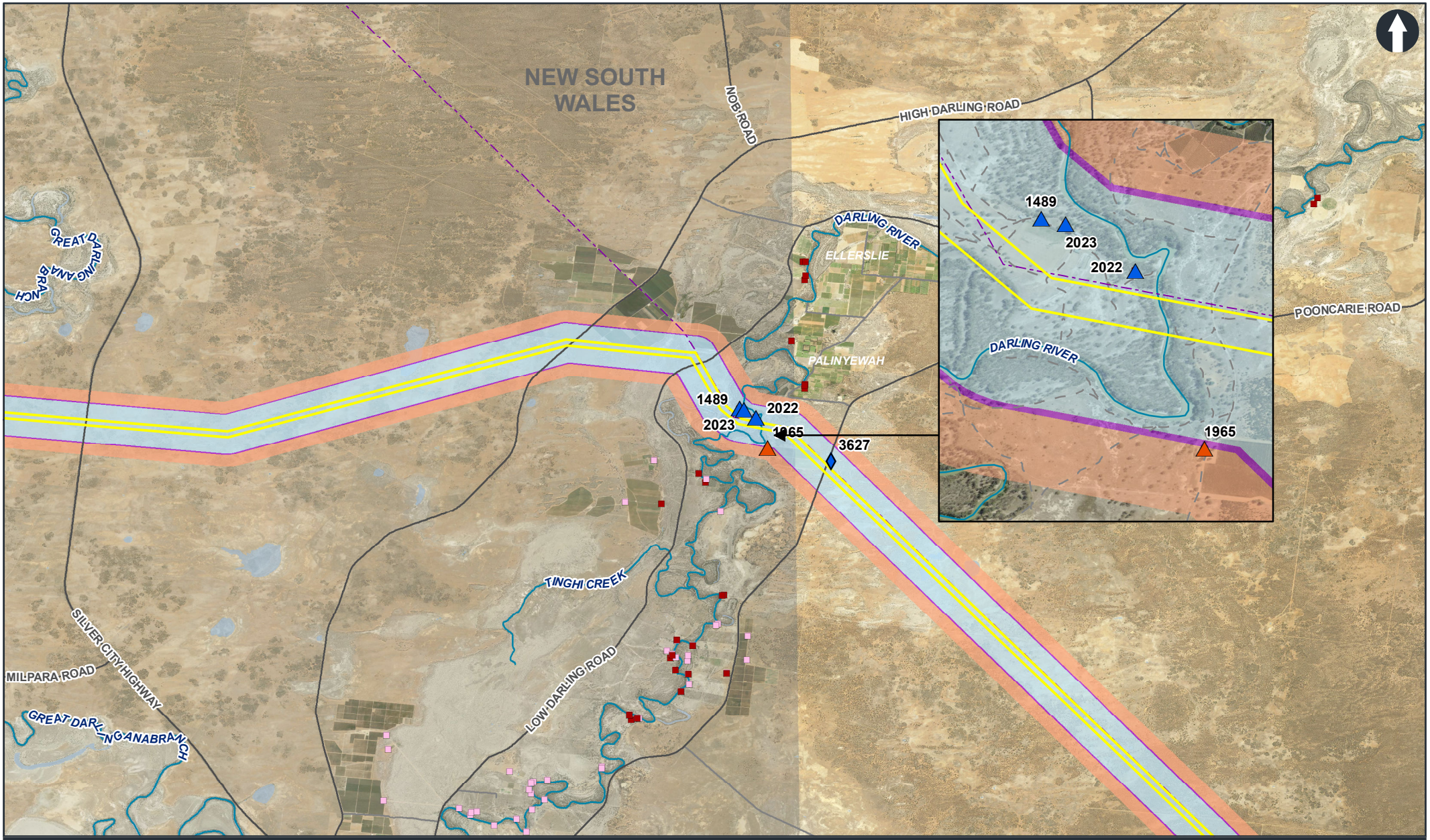

Figure B2.H

Construction noise - transmission line works – distance to compliance for works stages - OOHW (Day)

- Transmission line corridor
- Existing transmission line infrastructure
- Residential dwelling within 565m buffer
- Utility facility within 565m buffer
- Residential dwelling within 1010m buffer
- Sensitive receiver outside noise buffer - confirmed location
- Sensitive receiver outside noise buffer - potential location

Construction noise buffer

- 565m construction noise buffer
- 605m construction noise buffer
- 1010m construction noise buffer

Source: NSWSS, ESRI, Transgrid, WSP, BOM

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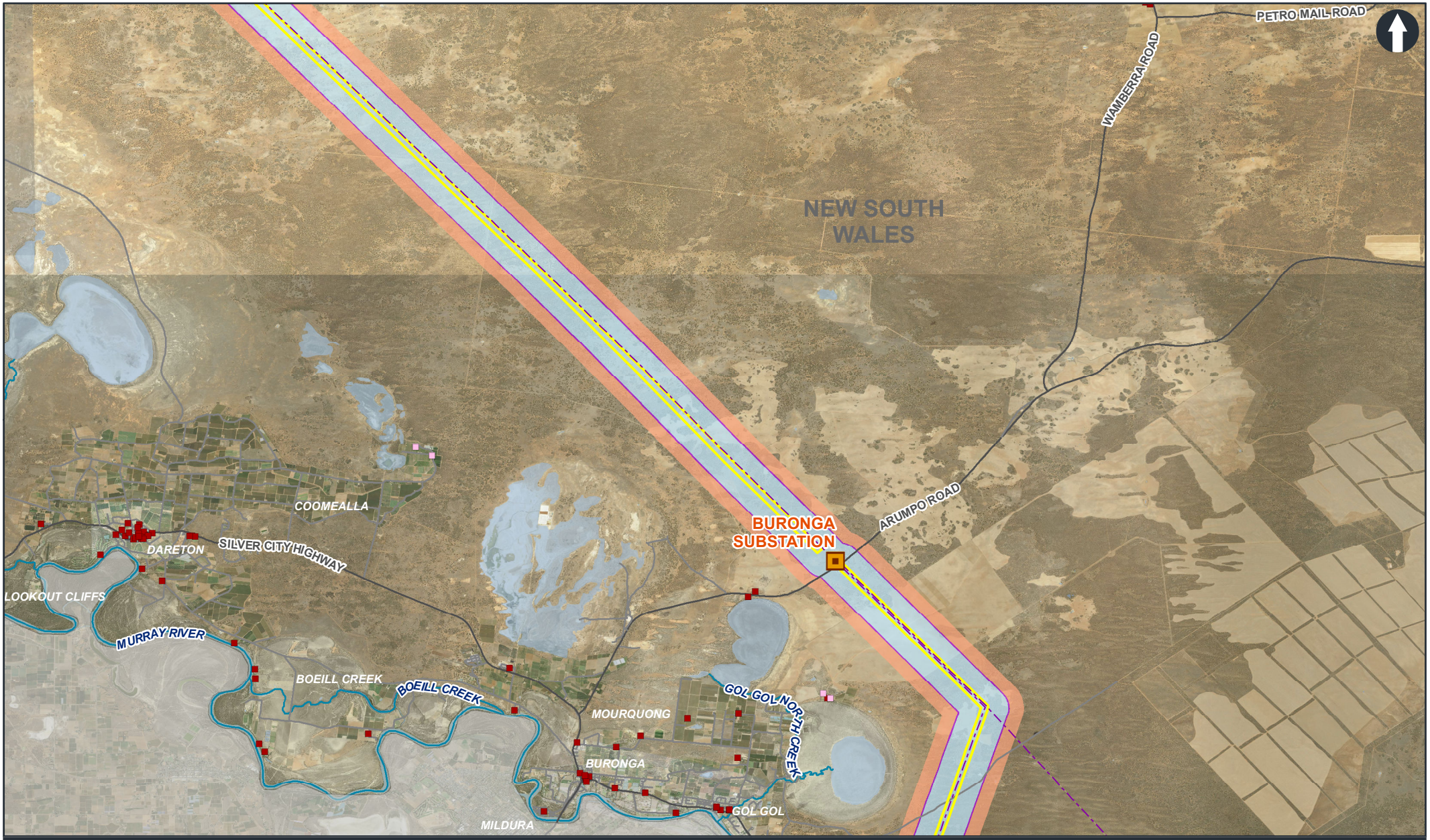

Figure B2.I

Construction noise - transmission line works – distance to compliance for works stages - OOHW (Day)

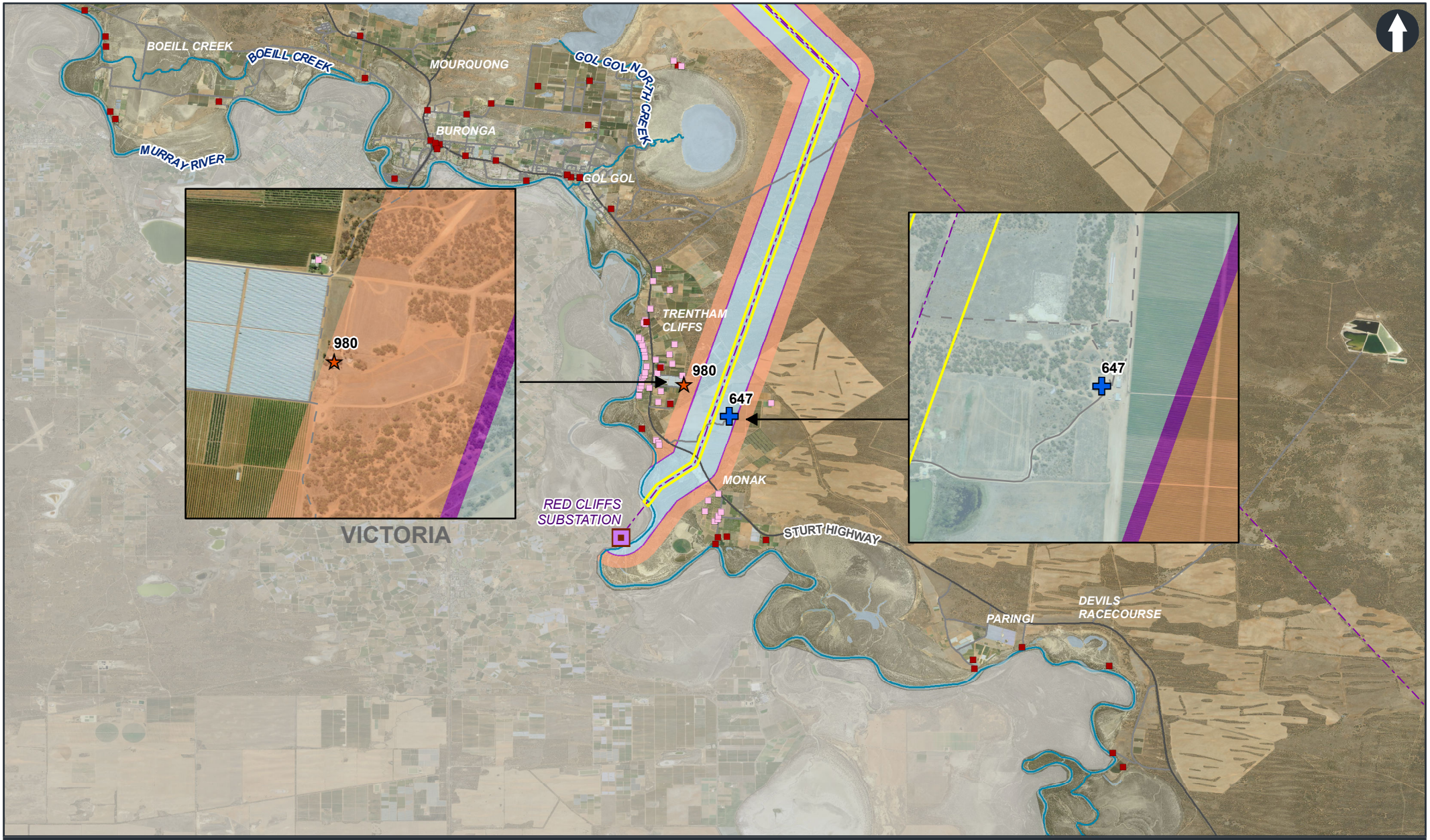

Figure B2.J

Construction noise - transmission line works – distance to compliance for works stages - OOHW (Day)

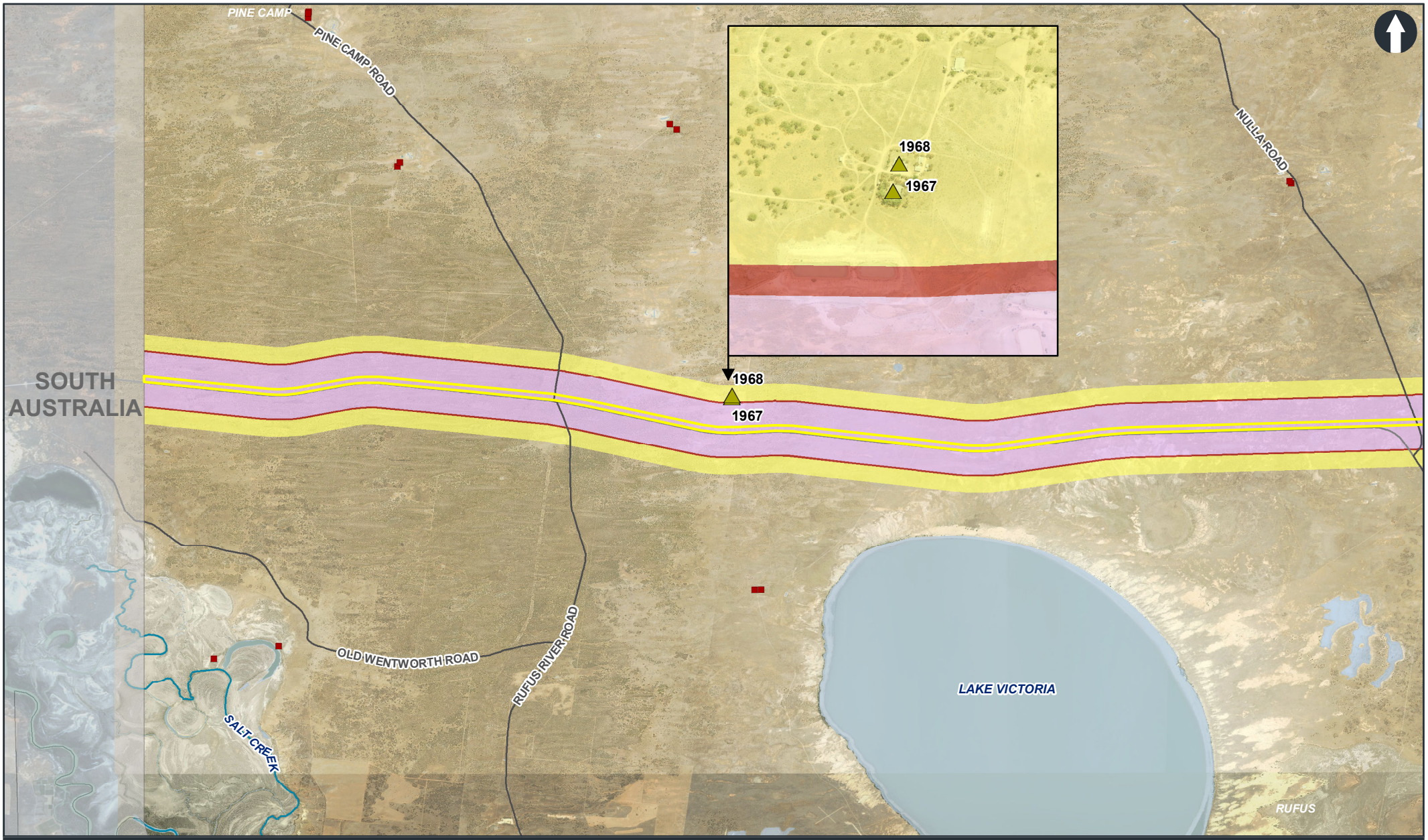

Figure B2.K

Construction noise - transmission line works – distance to compliance for works stages - OOHW (Night)

- Transmission line corridor
- Existing transmission line infrastructure
- Residential dwelling within 1430m buffer
- Sensitive receiver outside noise buffer - confirmed location
- Sensitive receiver outside noise buffer - potential location

Construction noise buffer

- 815m construction noise buffer
- 875m construction noise buffer
- 1430m construction noise buffer

Source: NSWSS, ESRI, Transgrid, WSP, BOM

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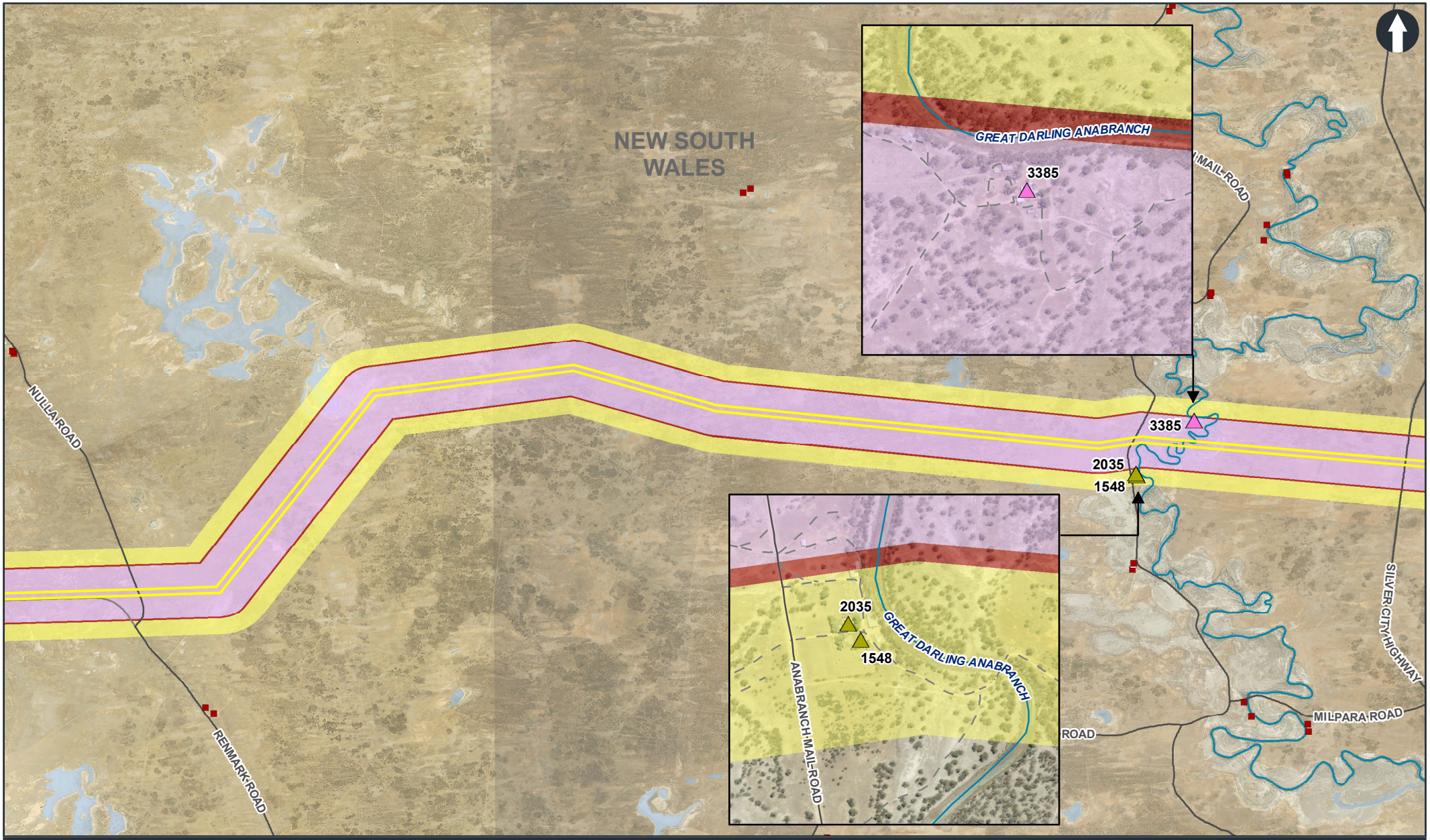

Figure B2.L

Construction noise - transmission line works – distance to compliance for works stages - OOHW (Night)

- Transmission line corridor
- Existing transmission line infrastructure
- Residential dwelling within 815m buffer
- Residential dwelling within 1430m buffer
- Sensitive receiver outside noise buffer - confirmed location
- Sensitive receiver outside noise buffer - potential location

Construction noise buffer

- 815m construction noise buffer
- 875m construction noise buffer
- 1430m construction noise buffer

Source: NSWSS, ESRI, Transgrid, WSP, BOM

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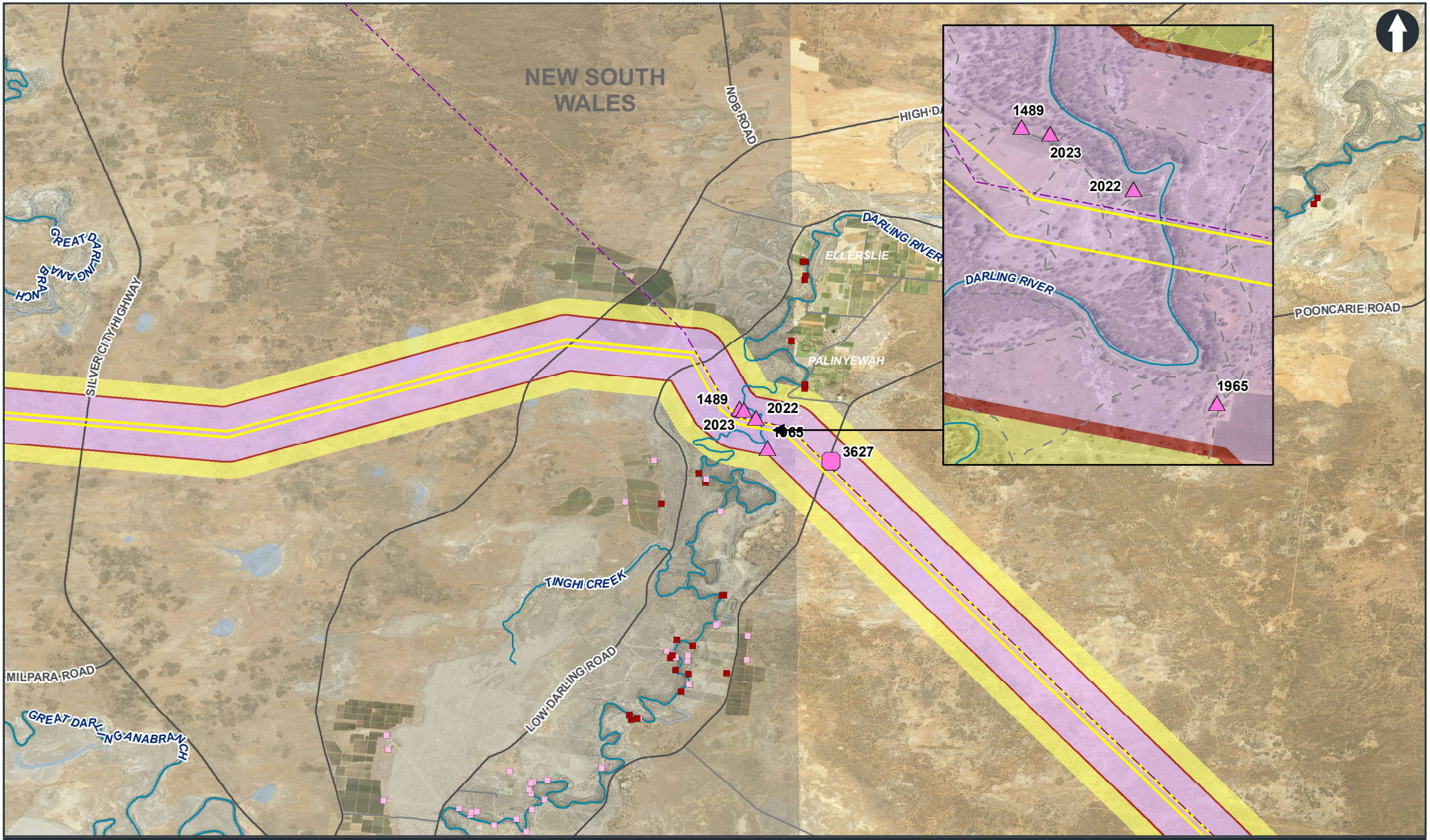

Figure B2.M

Construction noise - transmission line works – distance to compliance for works stages - OOHW (Night)

- Transmission line corridor
- Existing transmission line infrastructure
- Residential dwelling within 815m buffer
- Utility facility within 815m buffer
- Sensitive receiver outside noise buffer - confirmed location
- Sensitive receiver outside noise buffer - potential location

Construction noise buffer

- 815m construction noise buffer
- 875m construction noise buffer
- 1430m construction noise buffer

Source: NSWSS, ESRI, Transgrid, WSP, BOM

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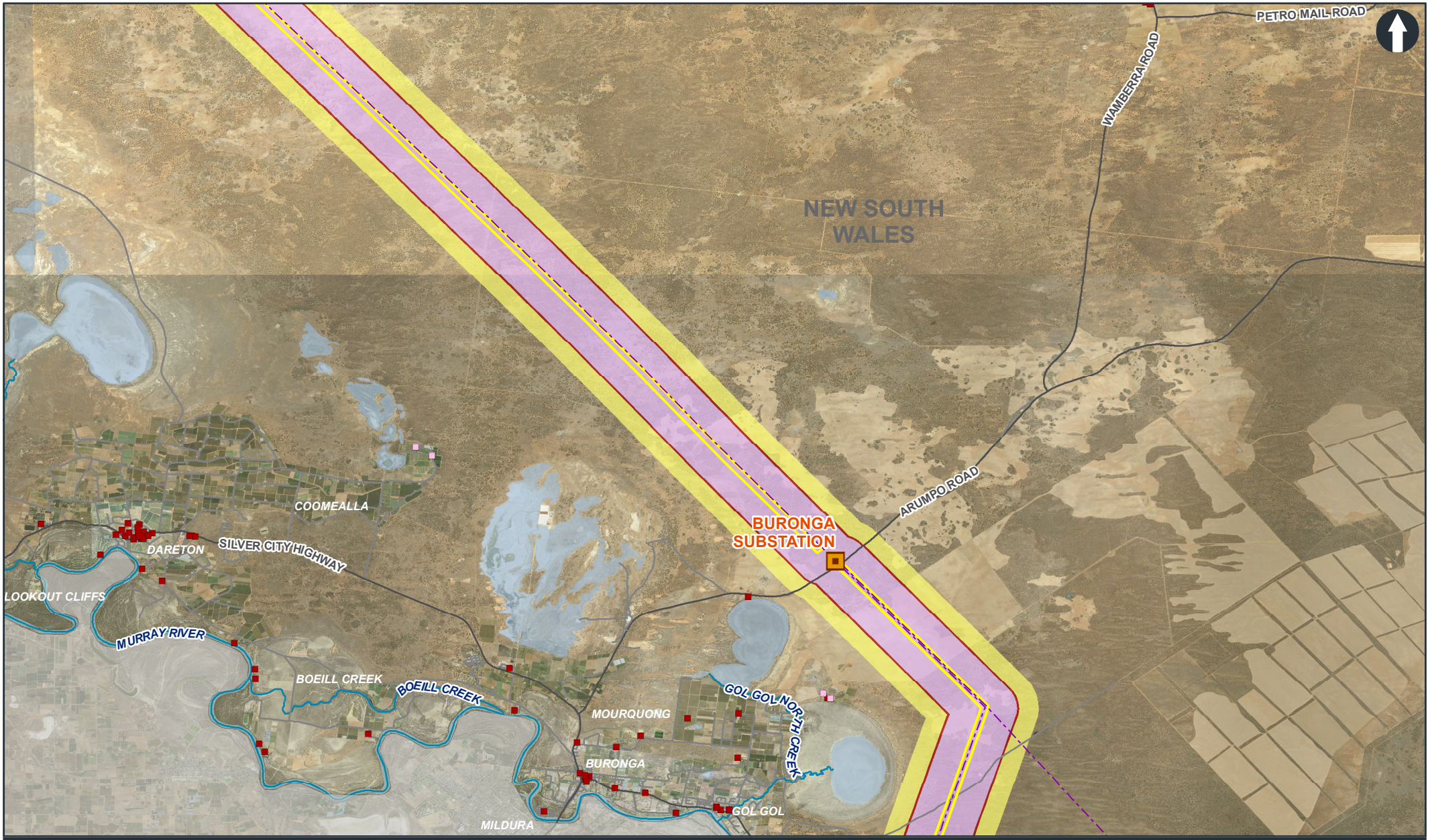

Figure B2.N

Transmission line corridor

Existing transmission line infrastructure

Buronga substation

Sensitive receiver outside noise buffer - confirmed location

Sensitive receiver outside noise buffer - potential location

Construction noise buffer

815m construction noise buffer

875m construction noise buffer

1430m construction noise buffer

Construction noise - transmission line works – distance to compliance for works stages - OOHW (Night)

Source: NSWSS, ESRI, Transgrid, WSP, BOM

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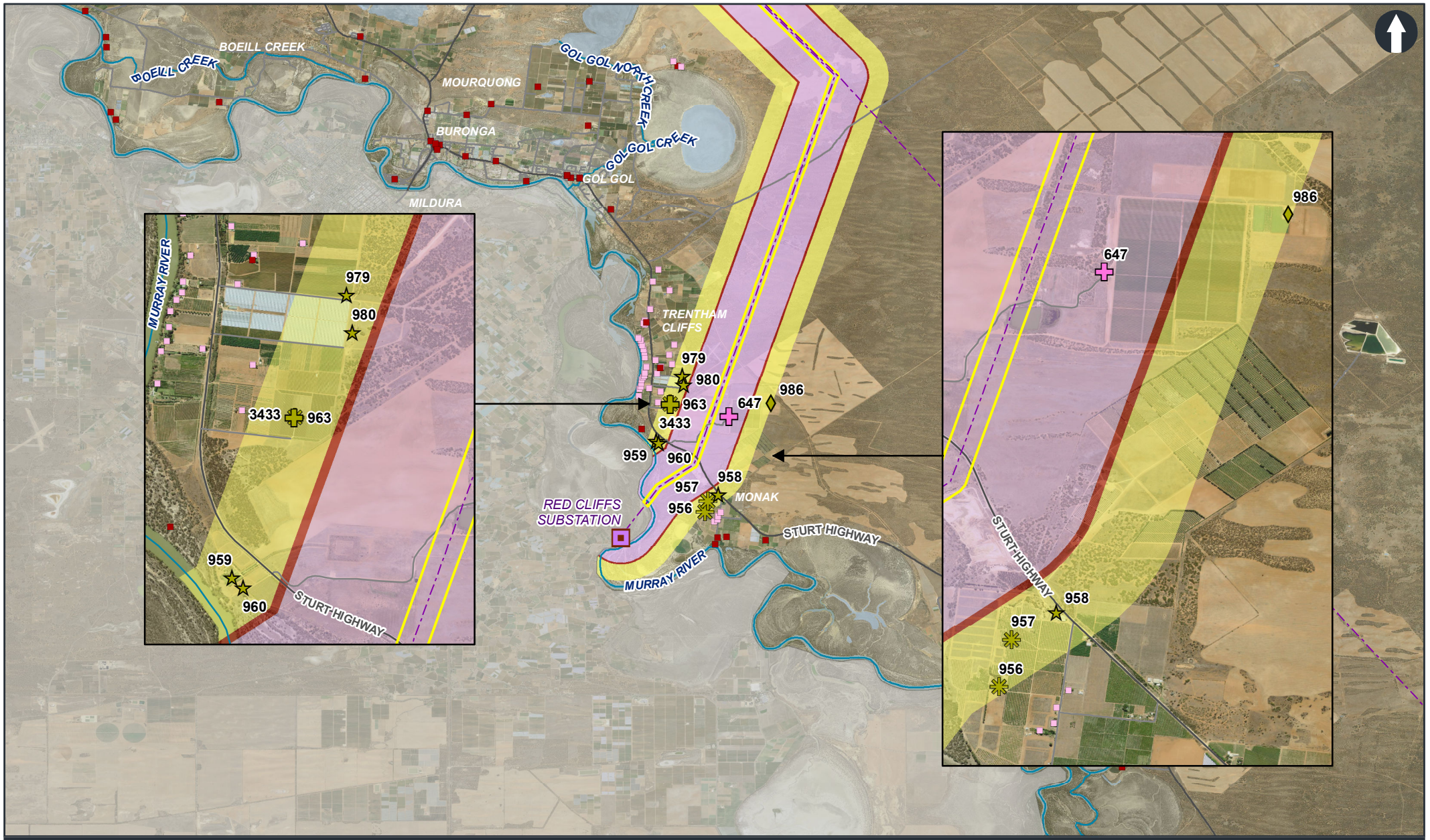


Figure B2.O

Construction noise - transmission line works – distance to compliance for works stages - OOHW (Night)

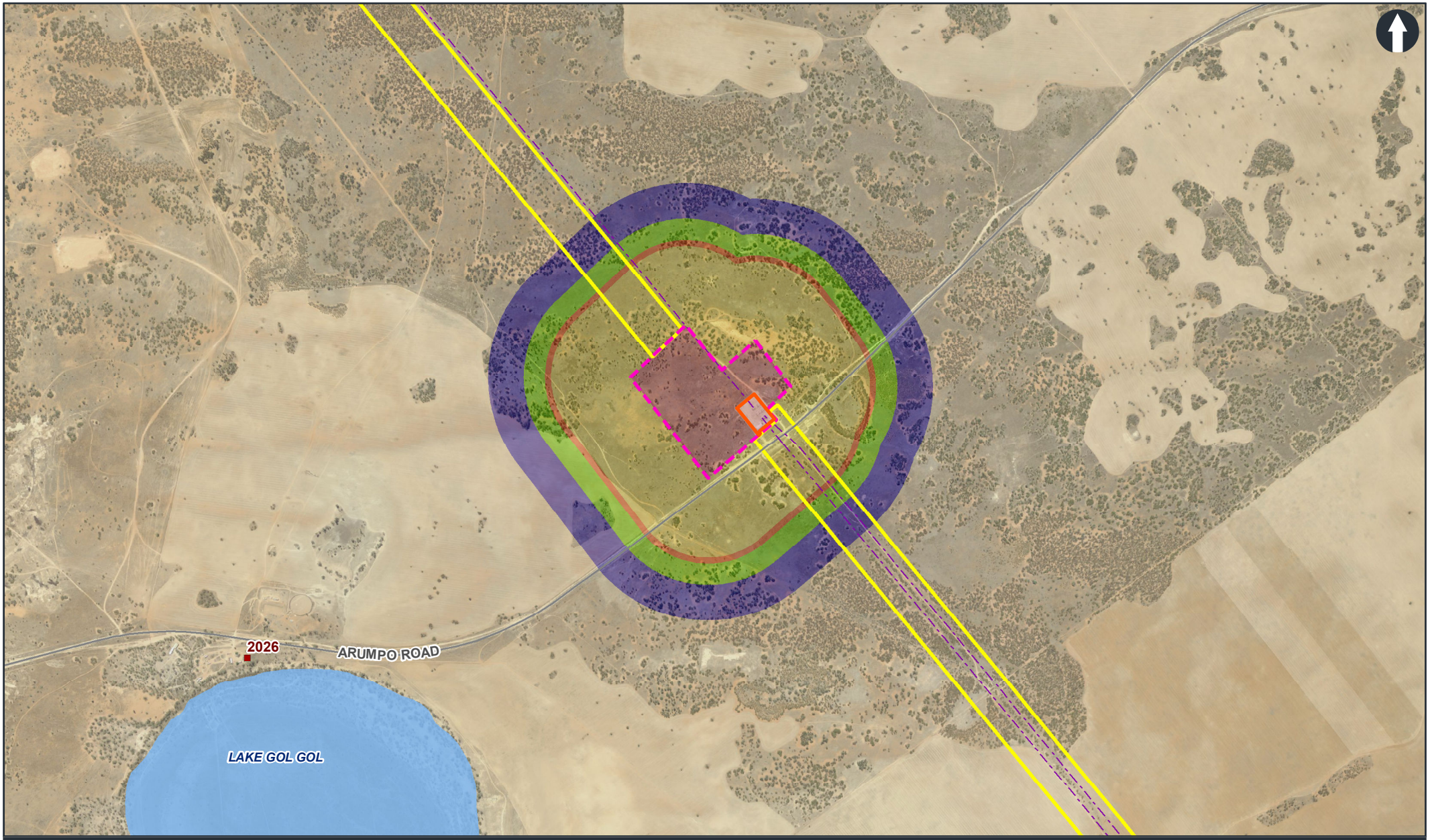


Figure B2.P

Construction noise - substation works – distance to compliance for works stages - Standard Hours

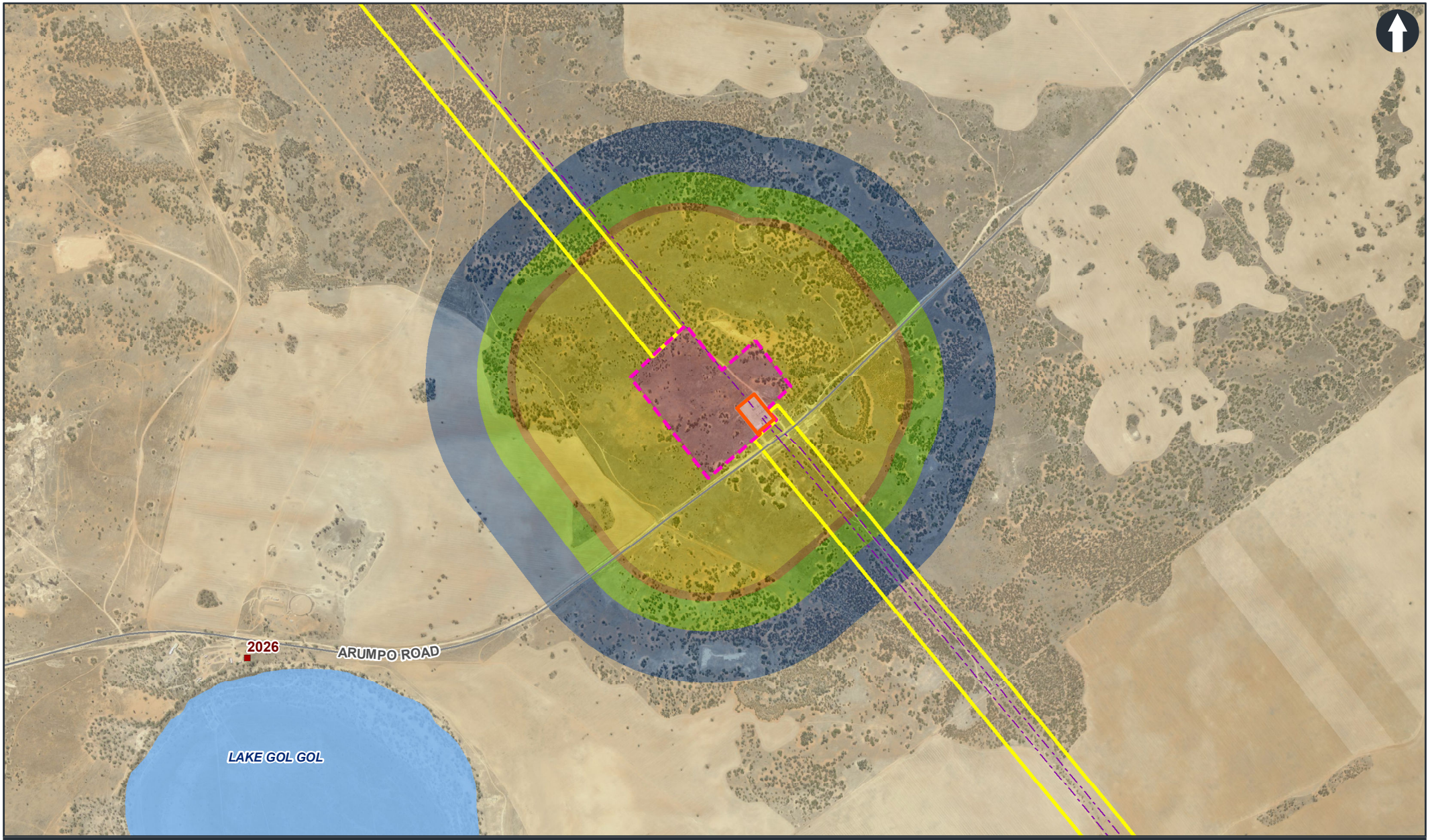


Figure B2.Q

Construction noise - substation works – distance to compliance for works stages - OOHW (Day)

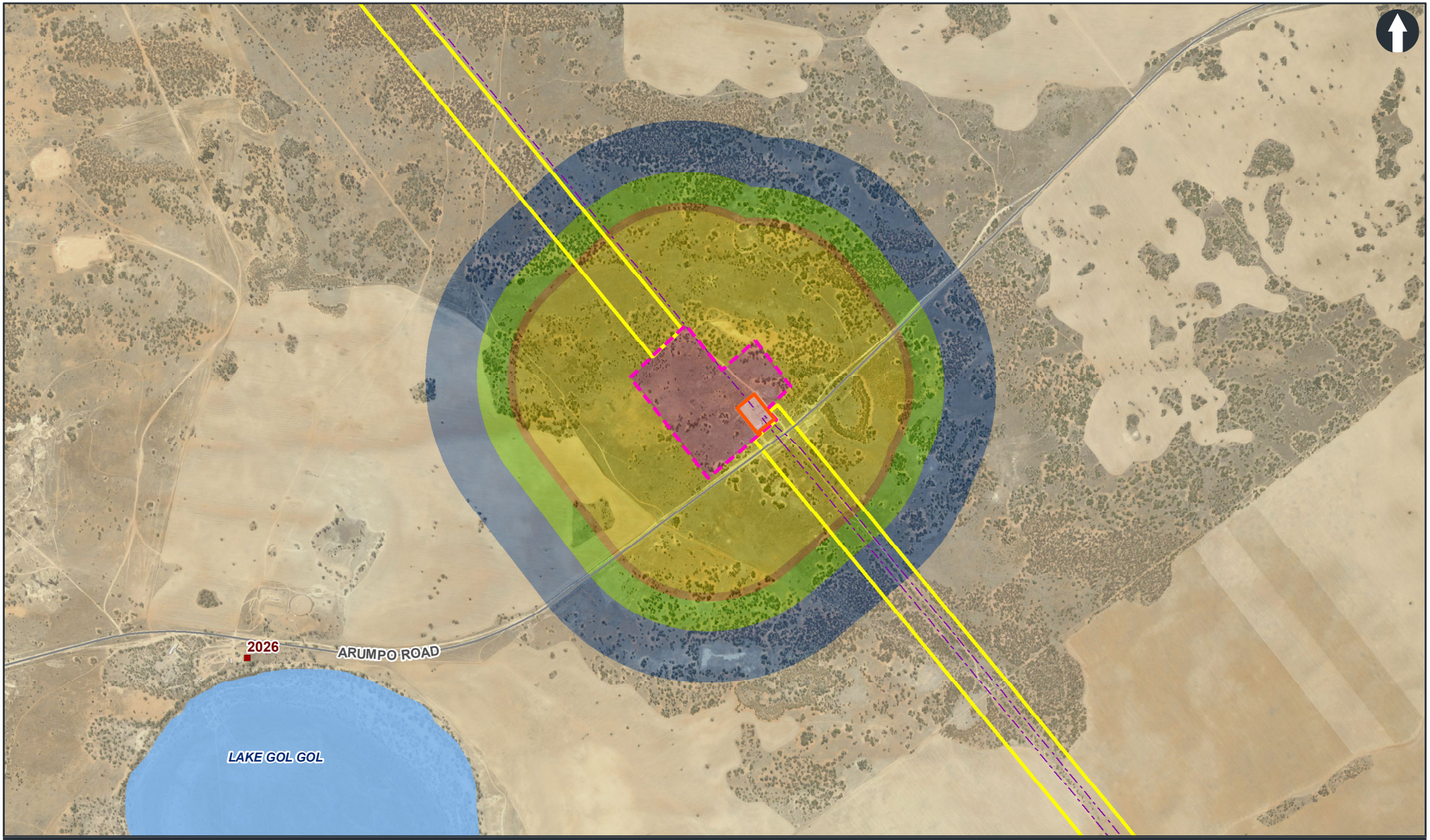


Figure B2.R

Construction noise - compound works – distance to compliance for works stages - OOHW (Night)

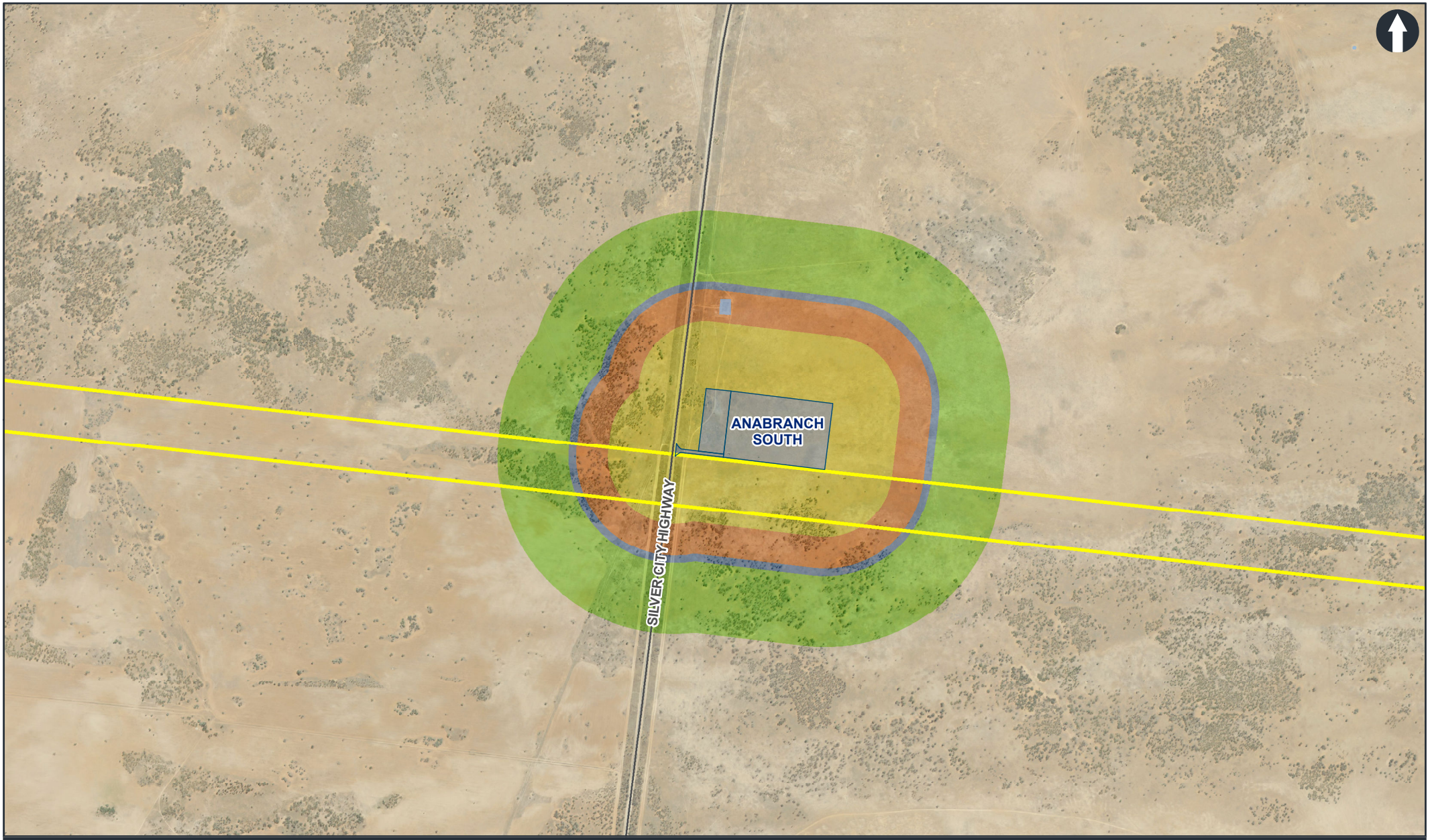


Figure B2.S

Construction noise - compound works – distance to compliance for works stages - Standard Hours

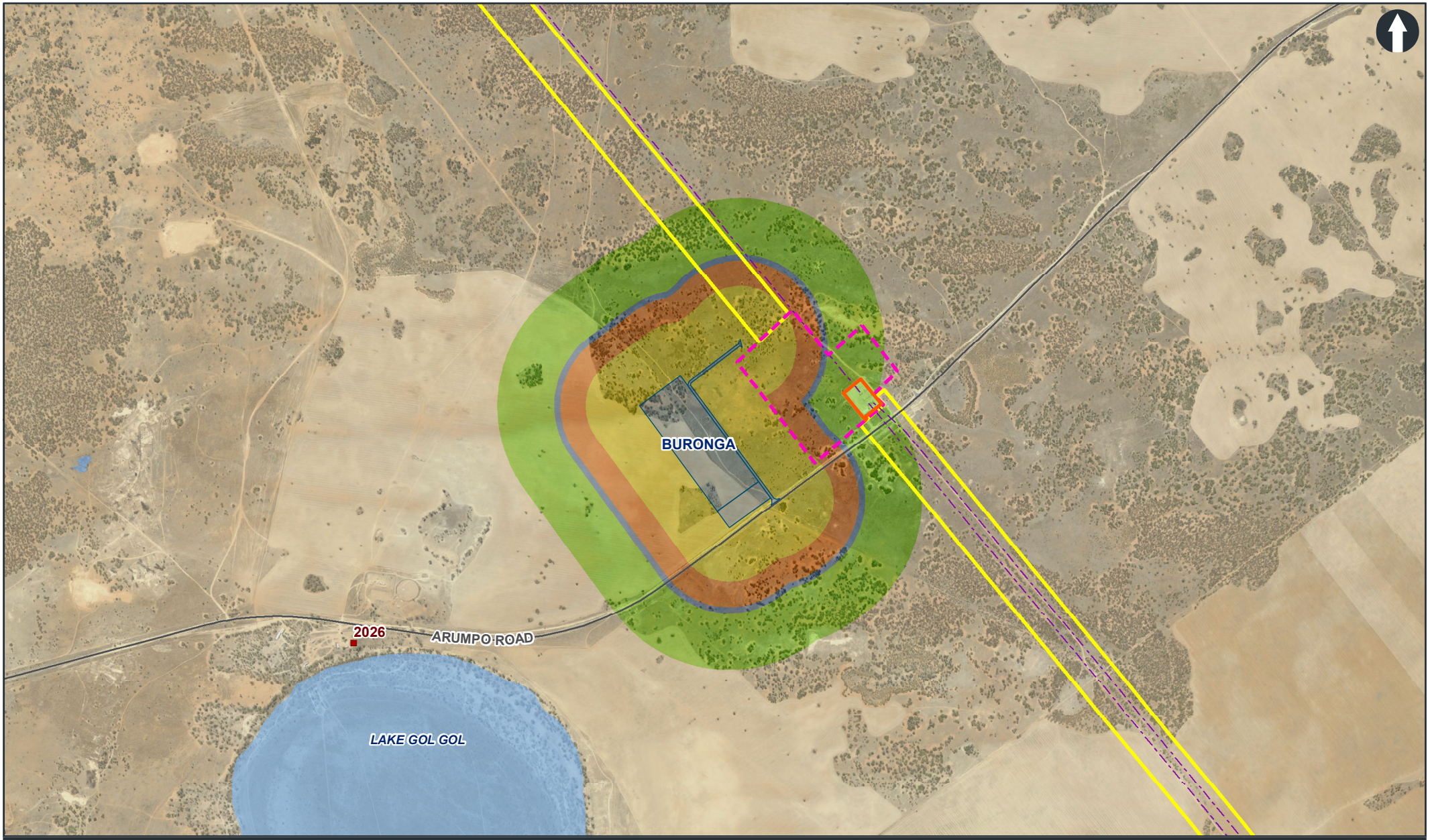


Figure B2.T

Construction noise - compound works – distance to compliance for works stages - Standard Hours

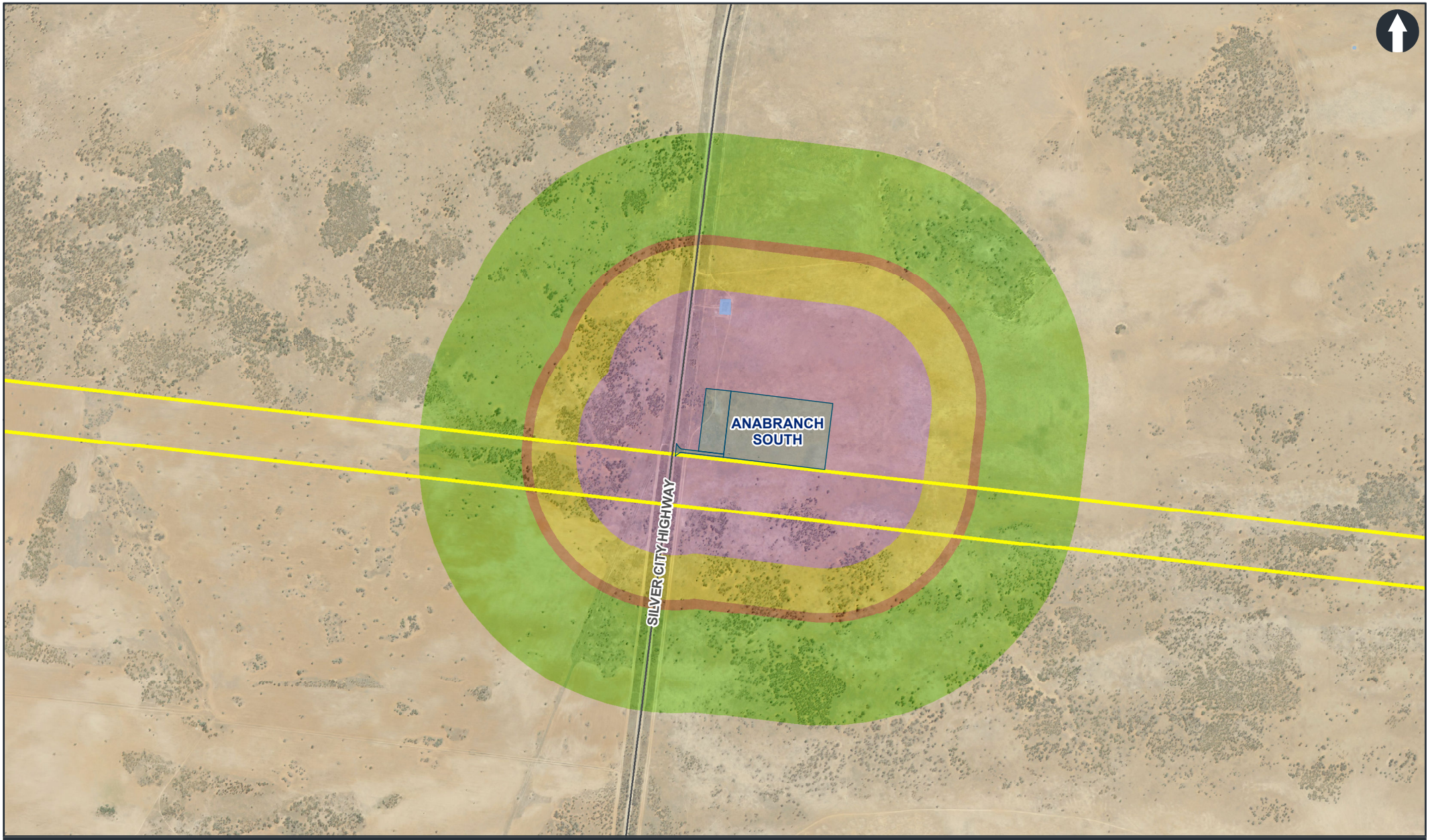


Figure B2.U

Construction noise - compound works – distance to compliance for works stages - OOHW (Day)

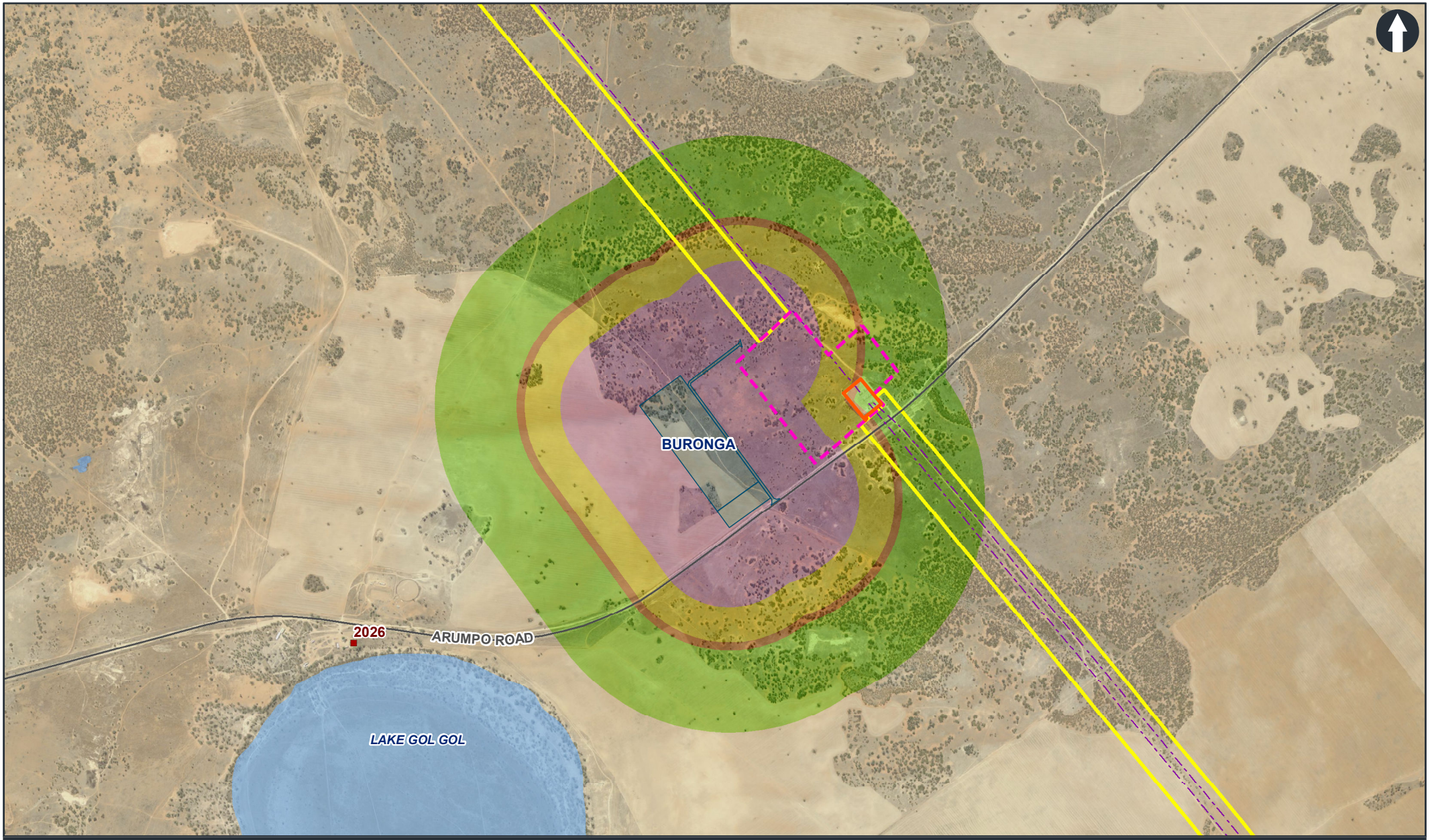
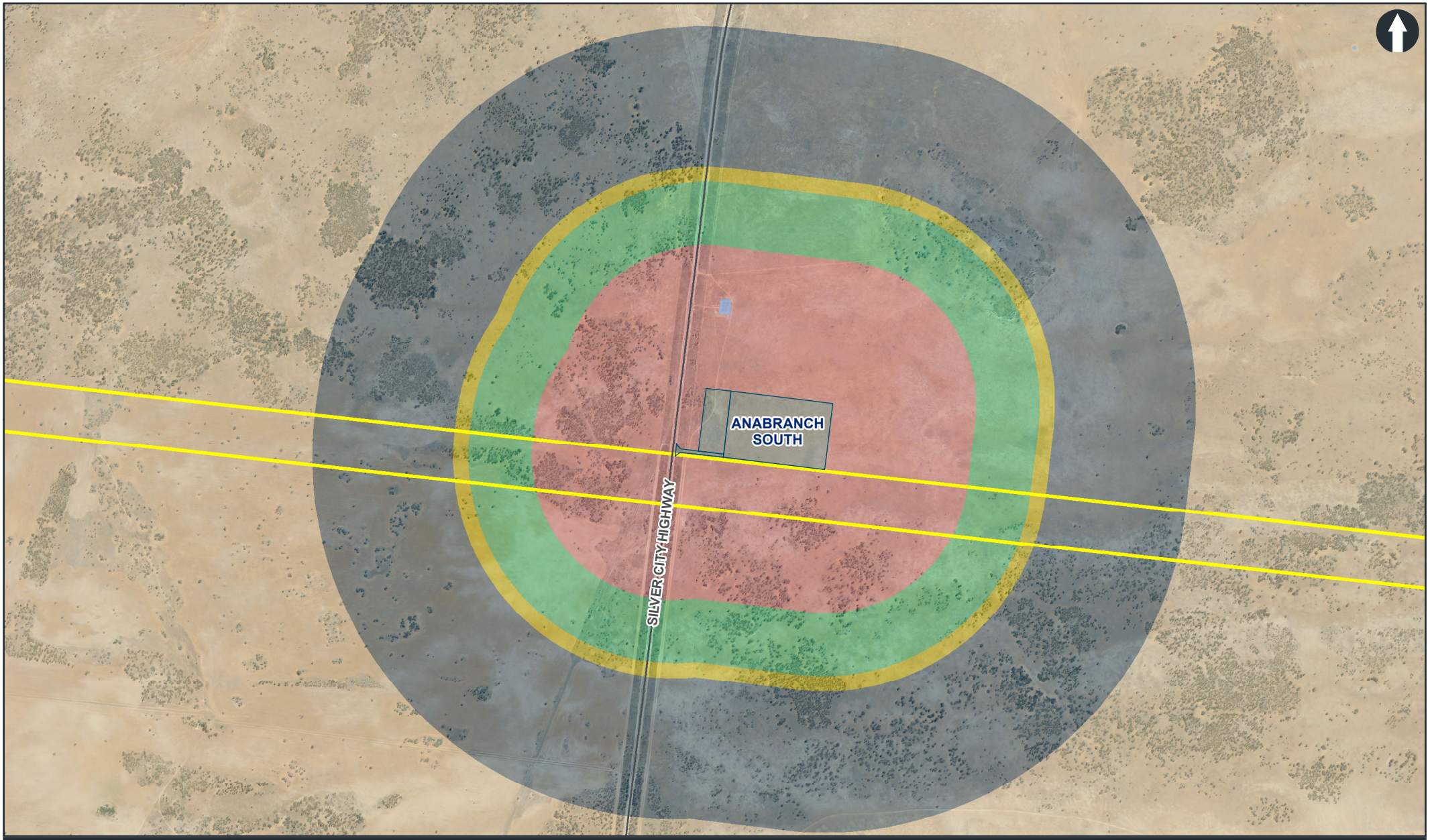


Figure B2.V

Construction noise - compound works – distance to compliance for works stages - OOHW (Day)



0 250 500 750 M

Transmission line corridor

Construction compound and camp site

Construction noise buffer

565m construction noise buffer

815m construction noise buffer

875m construction noise buffer

1430m construction noise buffer

Source: NSWSS, ESRI, Transgrid, WSP

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Figure B2.W

Construction noise - compound works – distance to compliance for works stages - OOHW (Night)

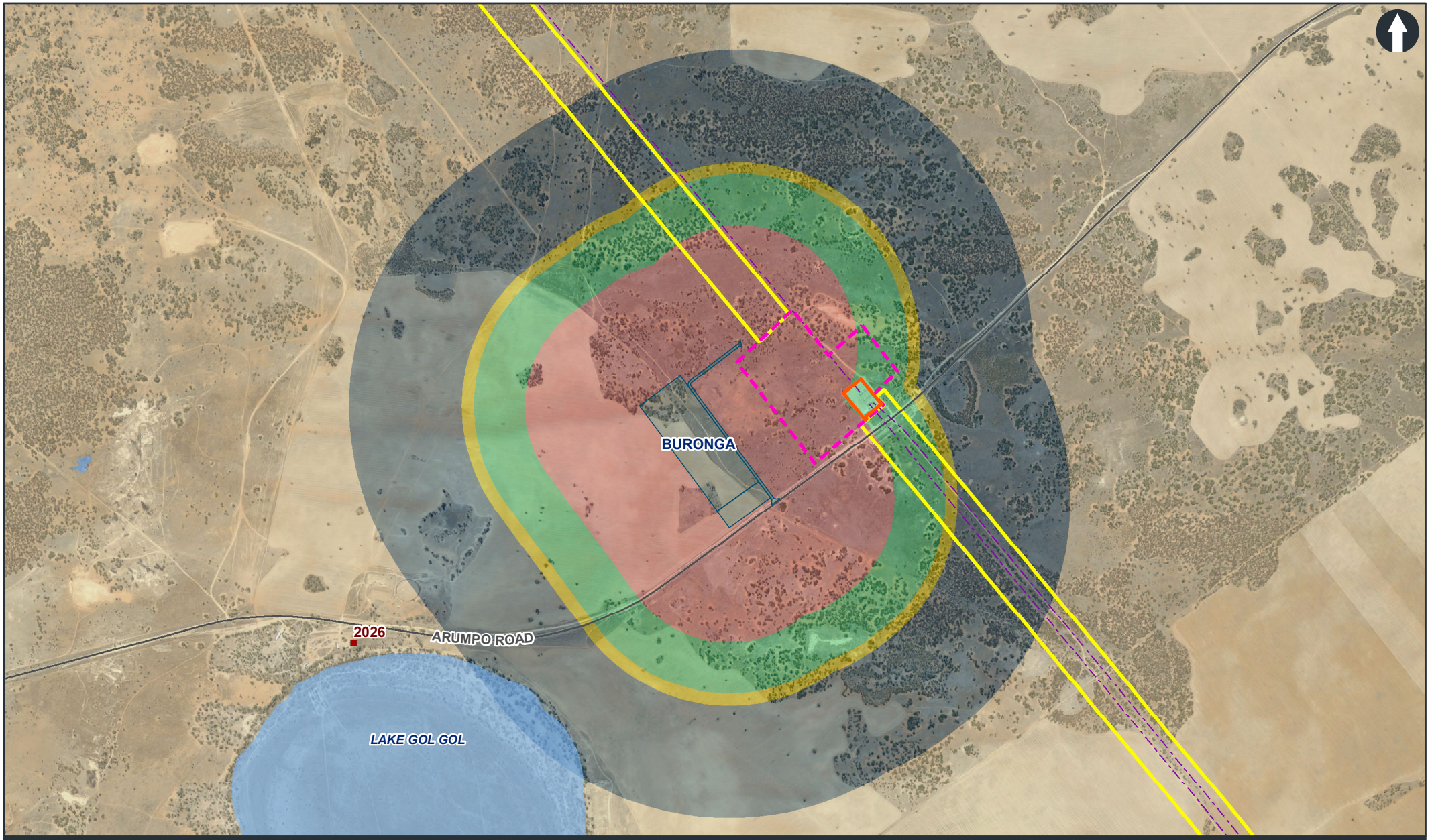

Figure B2.X

Construction noise - compound works – distance to compliance for works stages - OOHW (Night)

APPENDIX B-3
CONSTRUCTION VIBRATION MAPPING – TRANSMISSION LINE

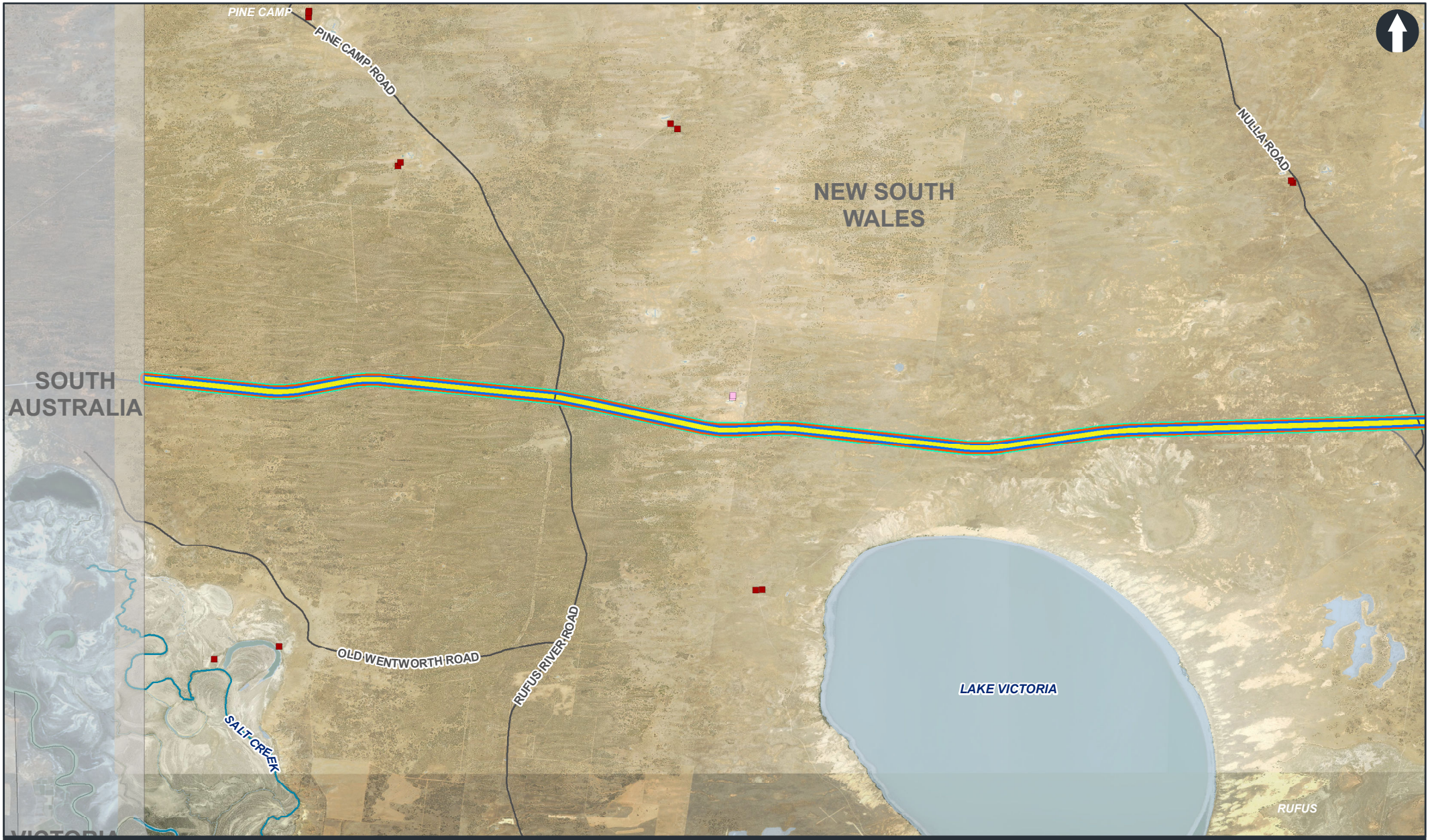

Figure B3.A

Construction vibration buffer distances - transmission line

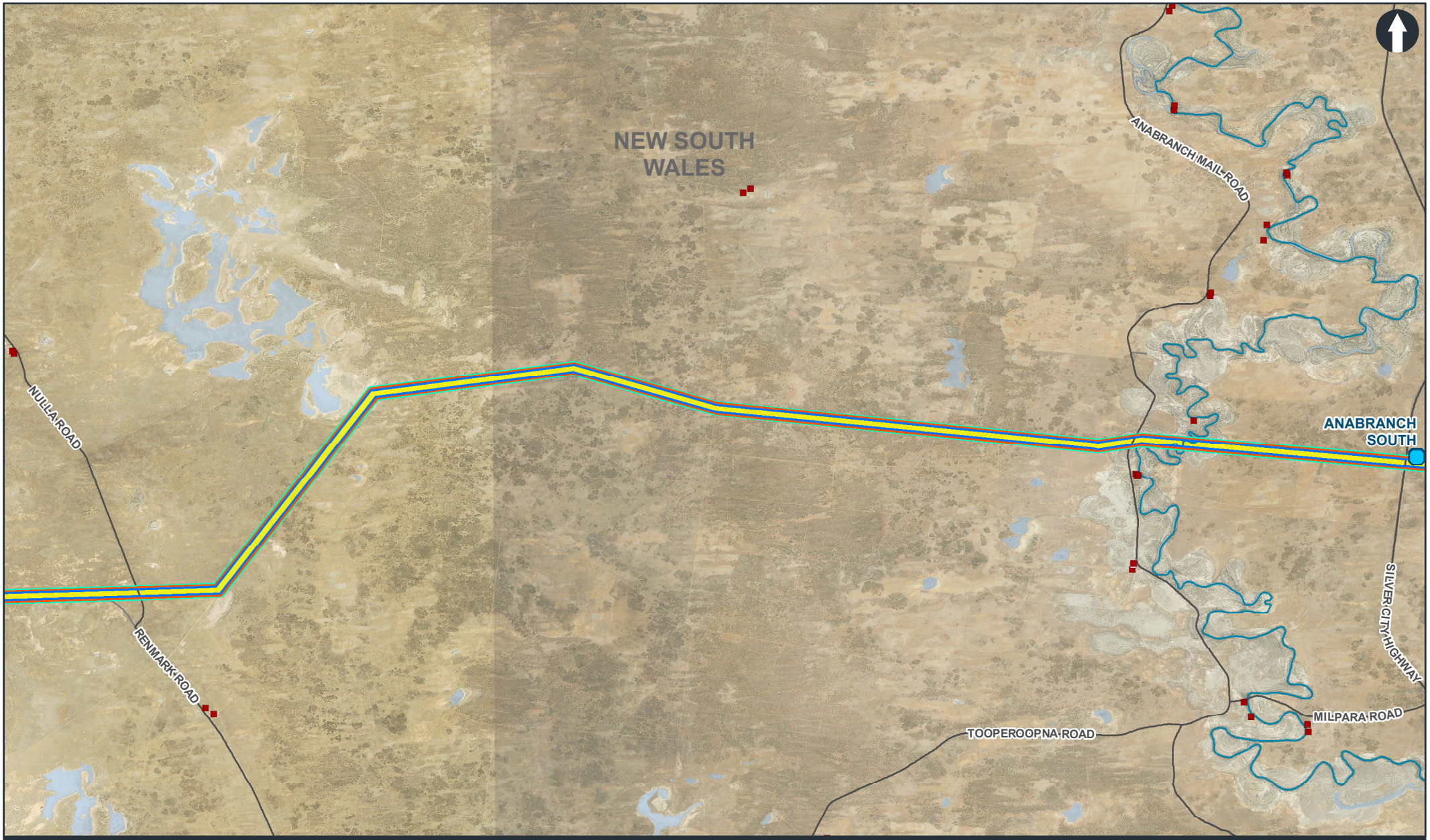

Figure B3.B

Construction vibration buffer distances - transmission line

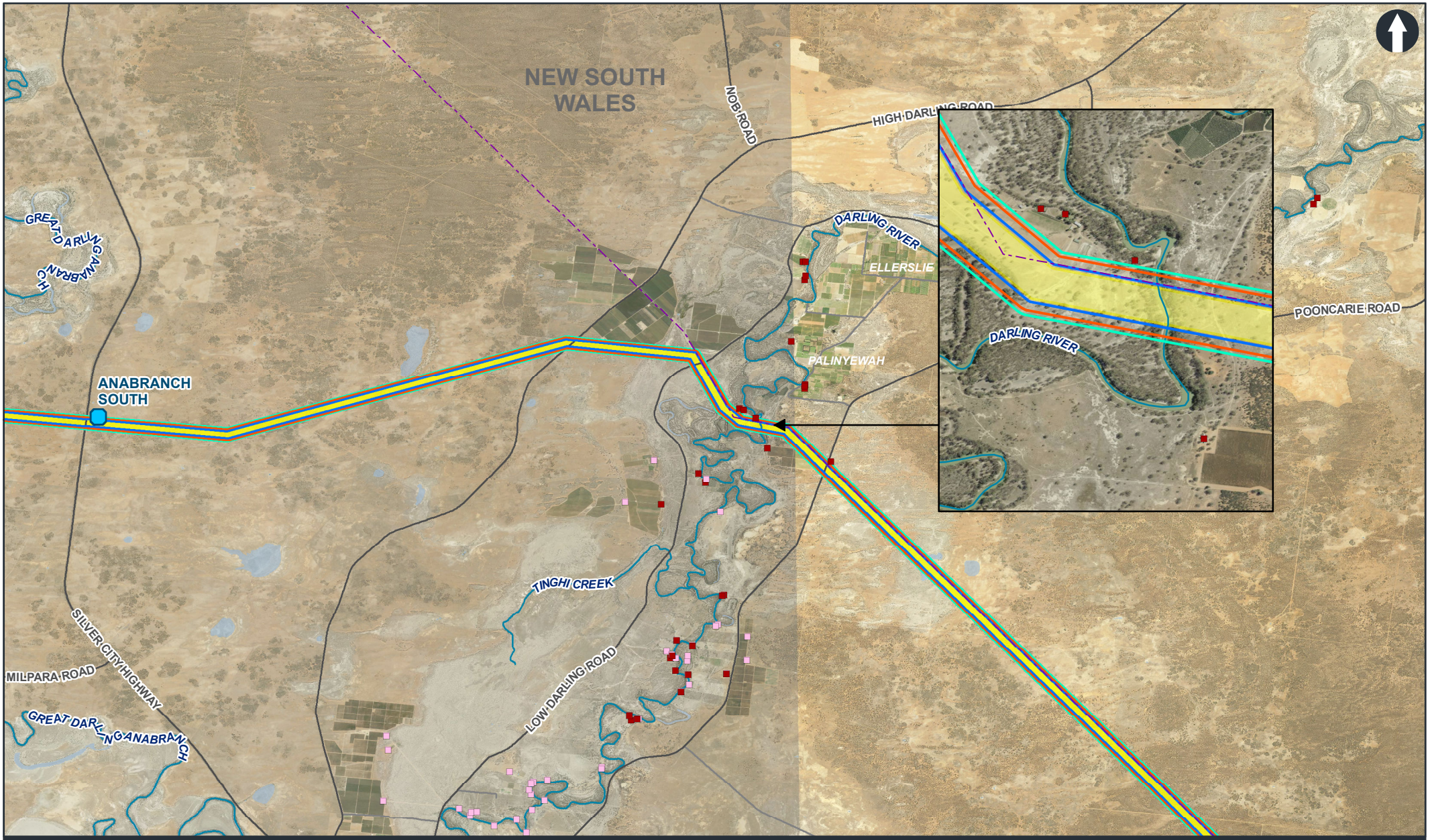

Figure B3.C

Construction vibration buffer distances - transmission line

- Transmission line corridor
- Existing transmission line infrastructure
- Sensitive receiver outside vibration buffer - confirmed location
- Sensitive receiver outside vibration buffer - potential location
- Construction compound and camp
- 20m cosmetic damage buffer
- 73m human response buffer
- 100m human response buffer

Source: NSWSS, ESRI, Transgrid, WSP, BOM

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Figure B3.D

Construction vibration buffer distances - transmission line

Figure B3.E

Construction vibration buffer distances - transmission line

- Transmission line corridor
- Existing transmission line infrastructure
- Red Cliffs substation (out of scope)
- Sensitive receiver outside vibration buffer - confirmed location
- Sensitive receiver outside vibration buffer - potential location
- Construction compound and camp
- 20m cosmetic damage buffer
- 73m human response buffer
- 100m human response buffer

Source: NSWSS, ESRI, Transgrid, WSP, BOM

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APPENDIX C

TRANSMISSION LINES OPERATIONAL NOISE MAPPING

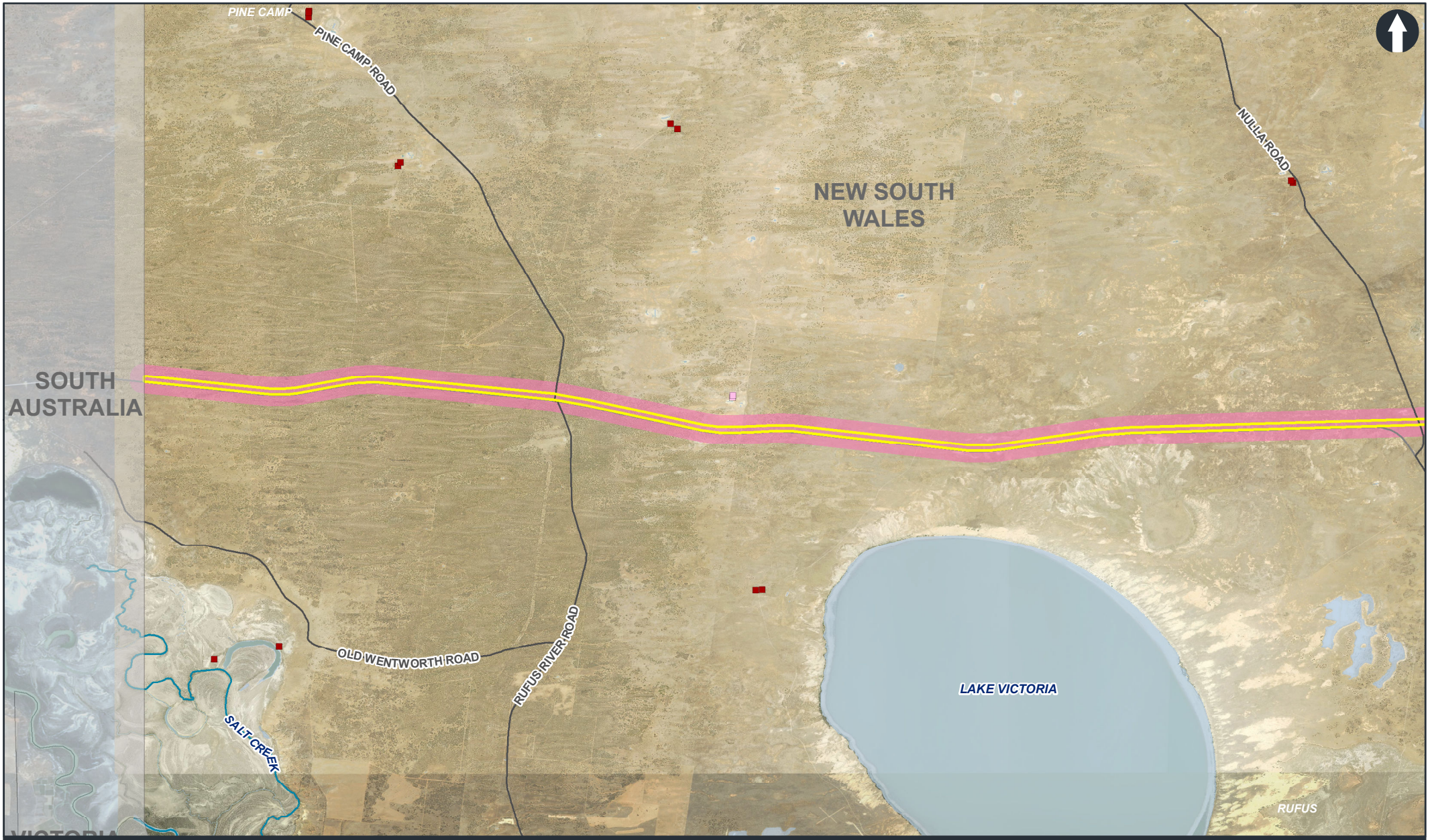

Figure C2.A

330kV transmission lines audible noise risk zone
Base case, wet weather

- Transmission line corridor
- Existing transmission line infrastructure
- Sensitive receiver outside noise buffer - confirmed location
- Sensitive receiver outside noise buffer - potential location
- Audible noise buffer compliant to PNTL at 442 metres from transmission lines centerline from transmission lines centerline

Source: NSWSS, ESRI, Transgrid, WSP, BOM

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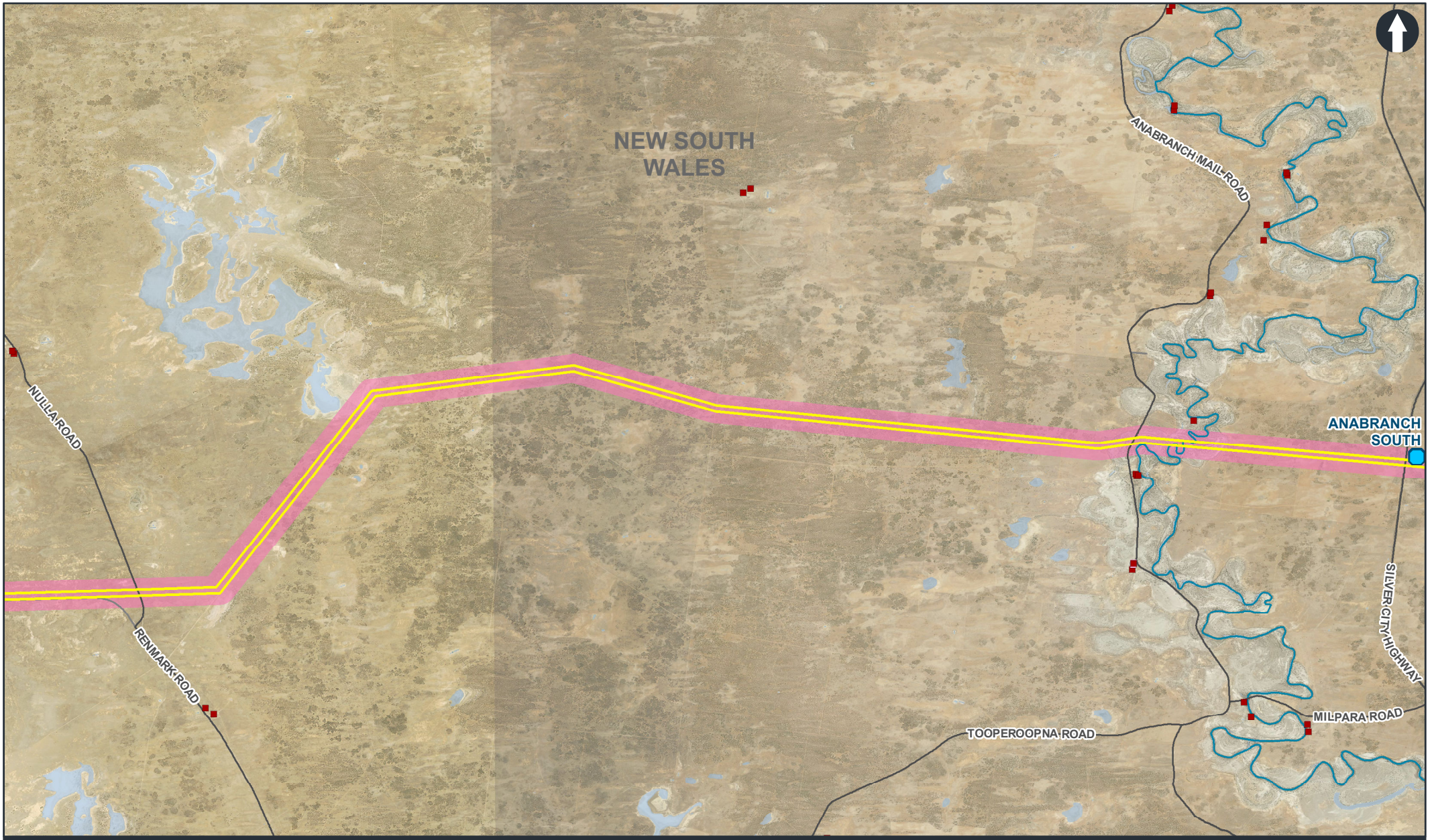

Figure C2.B

330kV transmission lines audible noise risk zone
Base case, wet weather

- Transmission line corridor
- Existing transmission line infrastructure
- Sensitive receiver outside noise buffer - confirmed location
- Sensitive receiver outside noise buffer - potential location
- Construction compound and camp location
- Audible noise buffer compliant to PNTL at 442 metres from transmission lines centerline from transmission lines centerline

Source: NSWSS, ESRI, Transgrid, WSP, BOM

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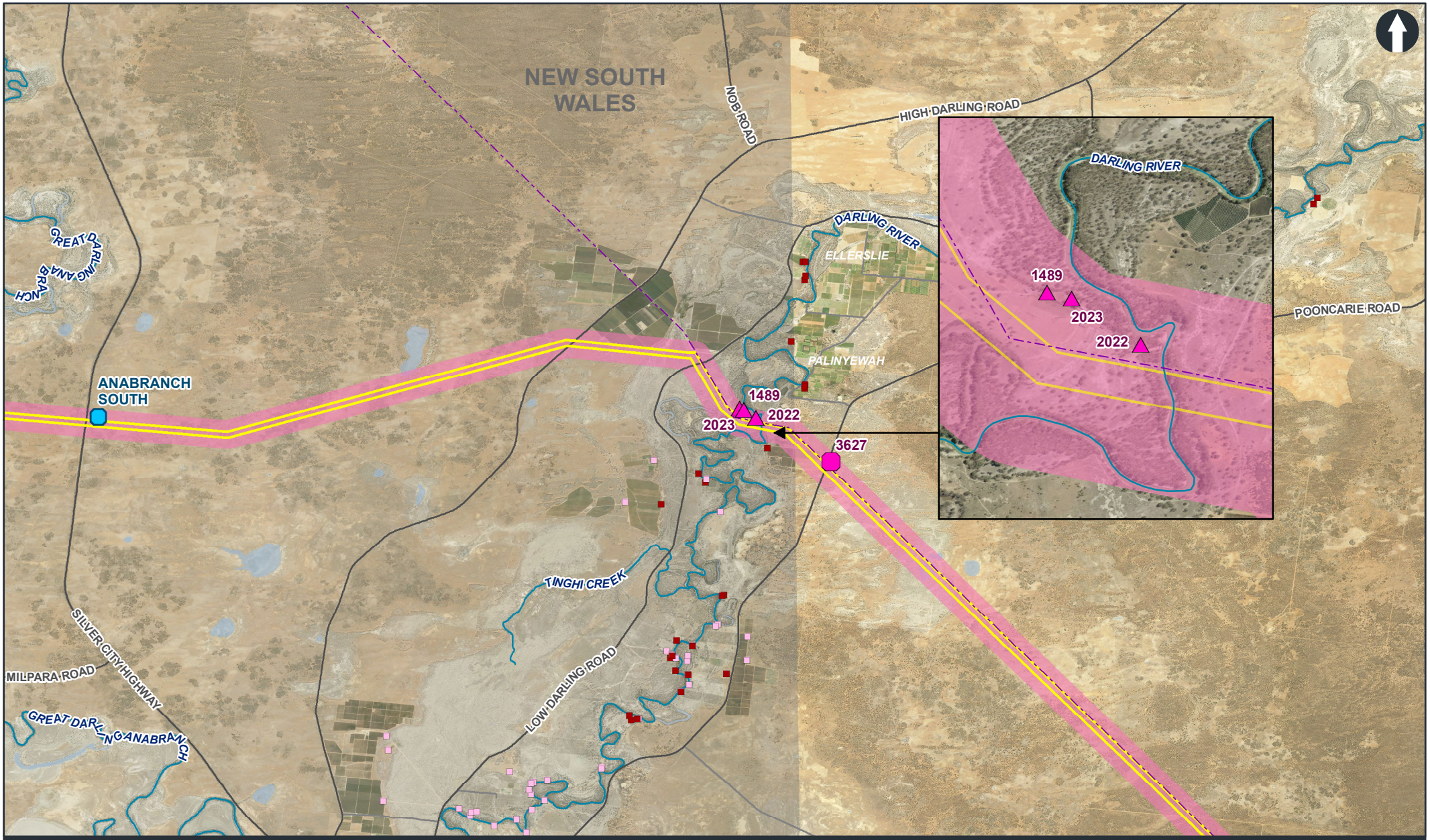

Figure C2.C

330kV transmission lines audible noise risk zone
Base case, wet weather

- Transmission line corridor
- Existing transmission line infrastructure
- Sensitive receiver outside noise buffer - confirmed location
- Sensitive receiver outside noise buffer - potential location
- Construction compound and camp location
- Audible noise buffer compliant to PNTL at 442 metres from transmission lines centerline from transmission lines centerline
- Residential dwelling within 442m buffer
- Utility facility within 442m buffer

Source: NSWSS, ESRI, Transgrid, WSP, BOM

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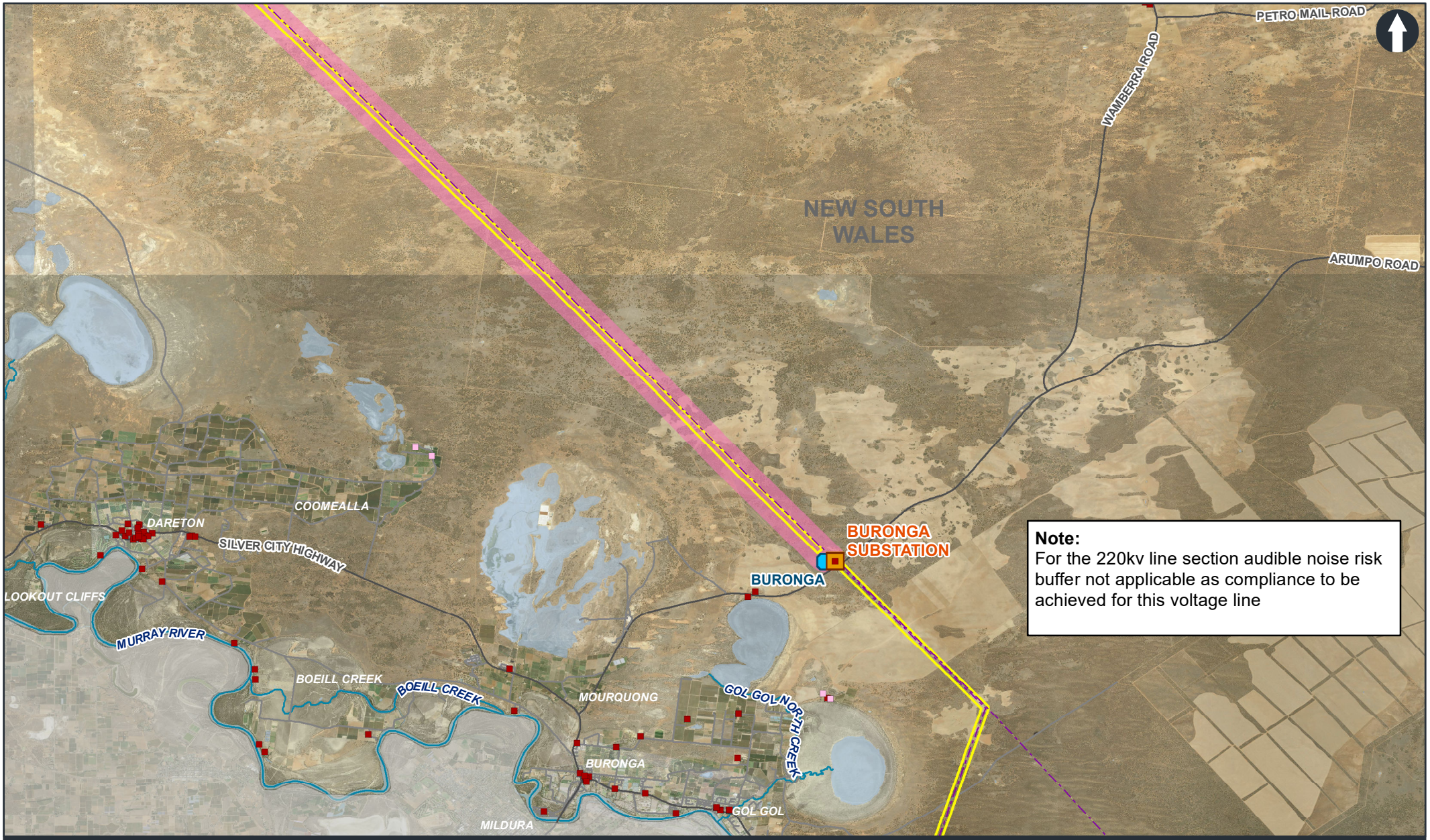

Note:
For the 220kv line section audible noise risk buffer not applicable as compliance to be achieved for this voltage line

Transmission line corridor
Existing transmission line infrastructure
Buronga substation
Sensitive receiver outside noise buffer - confirmed location
Sensitive receiver outside noise buffer - potential location
Construction compound and camp location
Audible noise buffer compliant to PNTL at 442 metres from transmission lines centerline from transmission lines centerline

Source: NSWSS, ESRI, Transgrid, WSP, BOM

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Figure C2.D

330kV transmission lines audible noise risk zone
Base case, wet weather

Figure C2.E

330kV transmission lines audible noise risk zone
Base case, wet weather

- Transmission line corridor
- Existing transmission line infrastructure
- Red Cliffs substation (out of scope)
- Sensitive receiver outside noise buffer - confirmed location
- Sensitive receiver outside noise buffer - potential location
- Audible noise buffer compliant to PNTL at 442 metres from transmission lines centerline from transmission lines centerline

Source: NSWSS, ESRI, Transgrid, WSP, BOM

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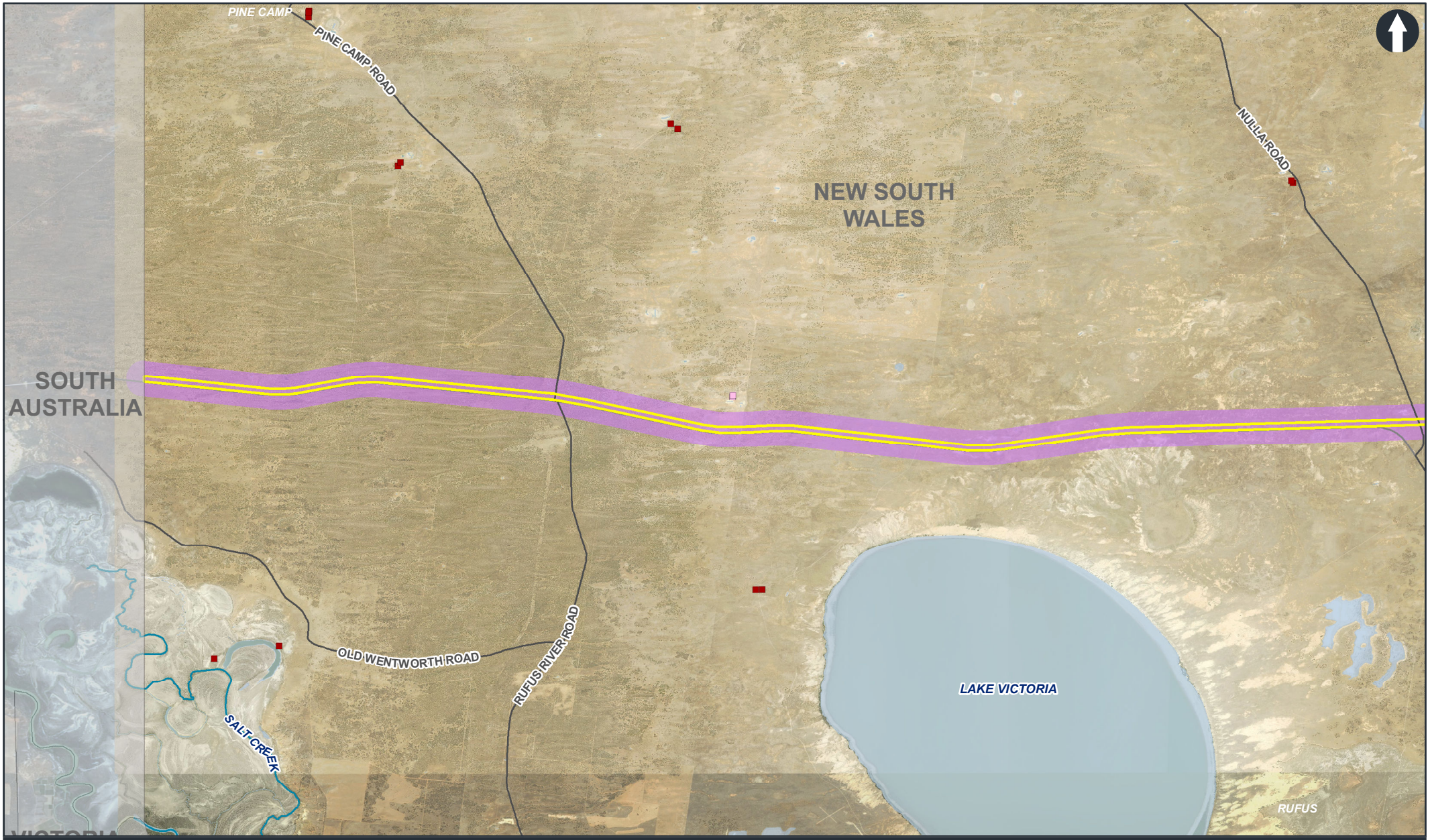

Figure C2.A

330kV transmission lines audible noise risk zone
Base case + 1% SVG, wet weather

- Transmission line corridor
- Existing transmission line infrastructure
- Sensitive receiver outside noise buffer - confirmed location
- Sensitive receiver outside noise buffer - potential location
- Audible noise buffer compliant to PNTL at 548 metres from transmission lines centerline from transmission lines centerline

Source: NSWSS, ESRI, Transgrid, WSP, BOM

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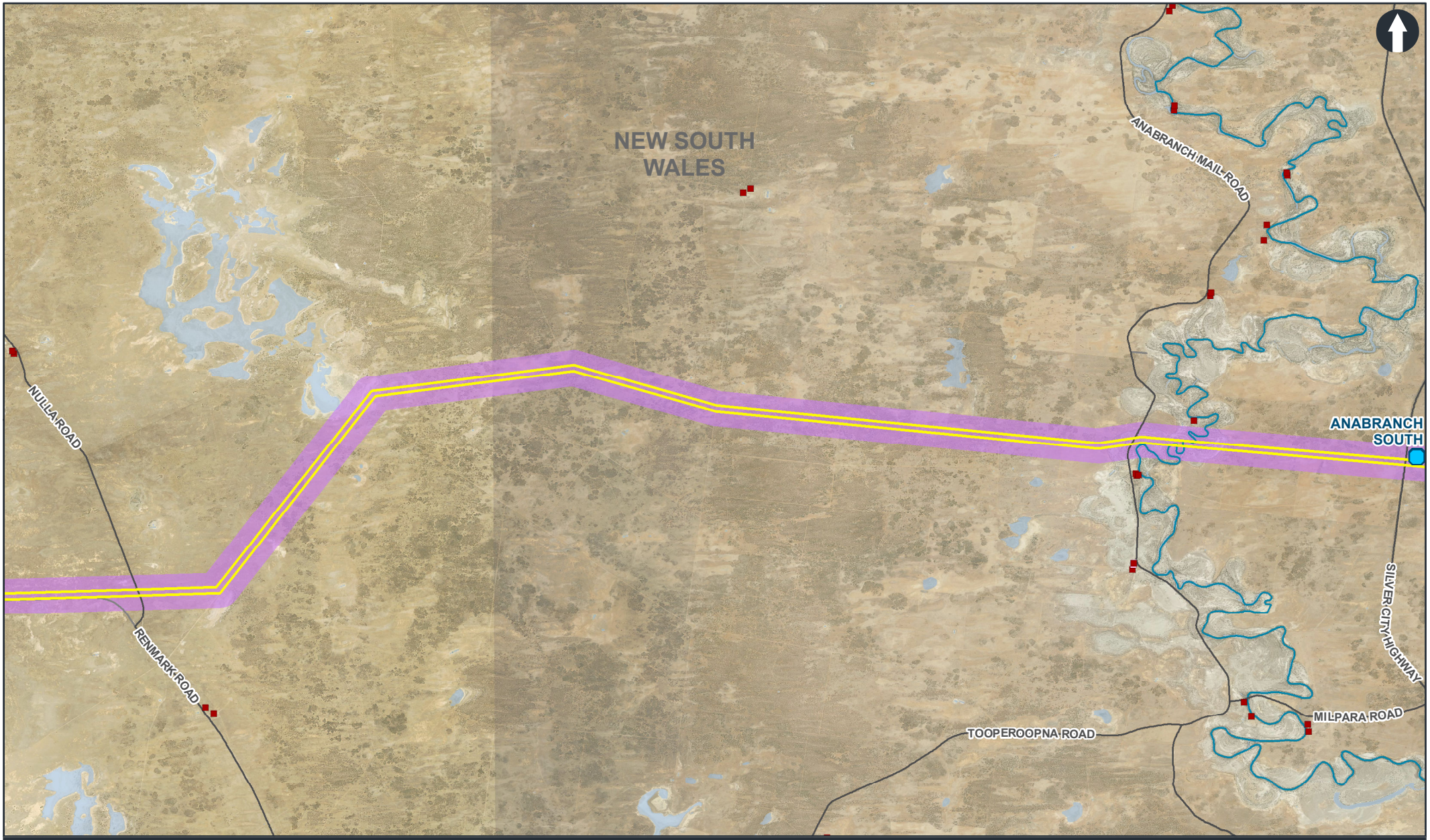

Figure C2.B

330kV transmission lines audible noise risk zone
Base case + 1% SVG, wet weather

- Transmission line corridor
- Existing transmission line infrastructure
- Sensitive receiver outside noise buffer - confirmed location
- Sensitive receiver outside noise buffer - potential location
- Construction compound and camp location
- Audible noise buffer compliant to PNTL at 548 metres from transmission lines centerline from transmission lines centerline

Source: NSWSS, ESRI, Transgrid, WSP, BOM

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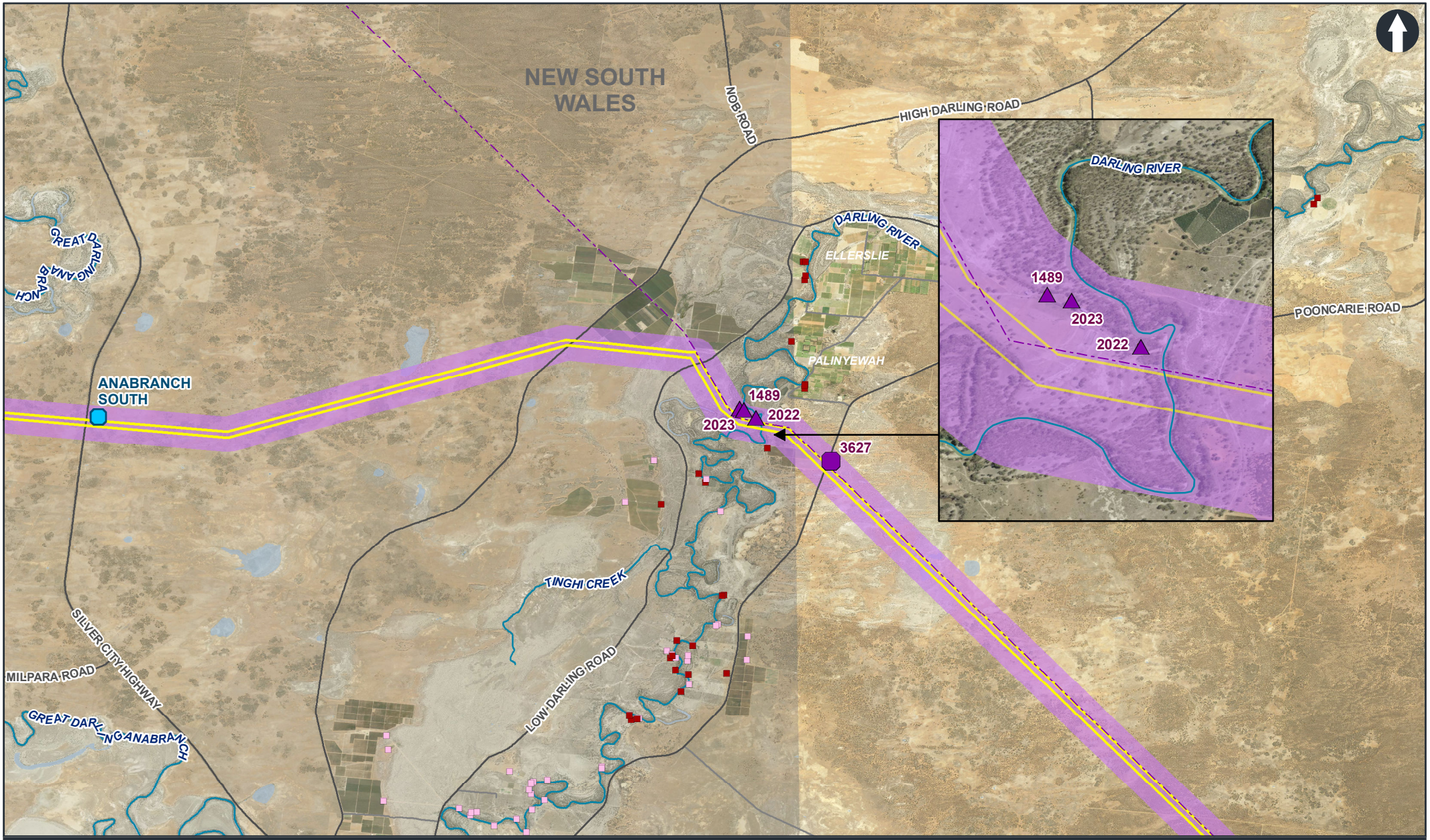

Figure C2.C

330kV transmission lines audible noise risk zone
Base case + 1% SVG, wet weather

- Transmission line corridor
- Existing transmission line infrastructure
- Sensitive receiver outside noise buffer - confirmed location
- Sensitive receiver outside noise buffer - potential location
- Construction compound and camp location
- Audible noise buffer compliant to PNTL at 548 metres from transmission lines centerline from transmission lines centerline
- Residential dwelling within 548m buffer
- Utility facility within 548m buffer

Source: NSWSS, ESRI, Transgrid, WSP, BOM

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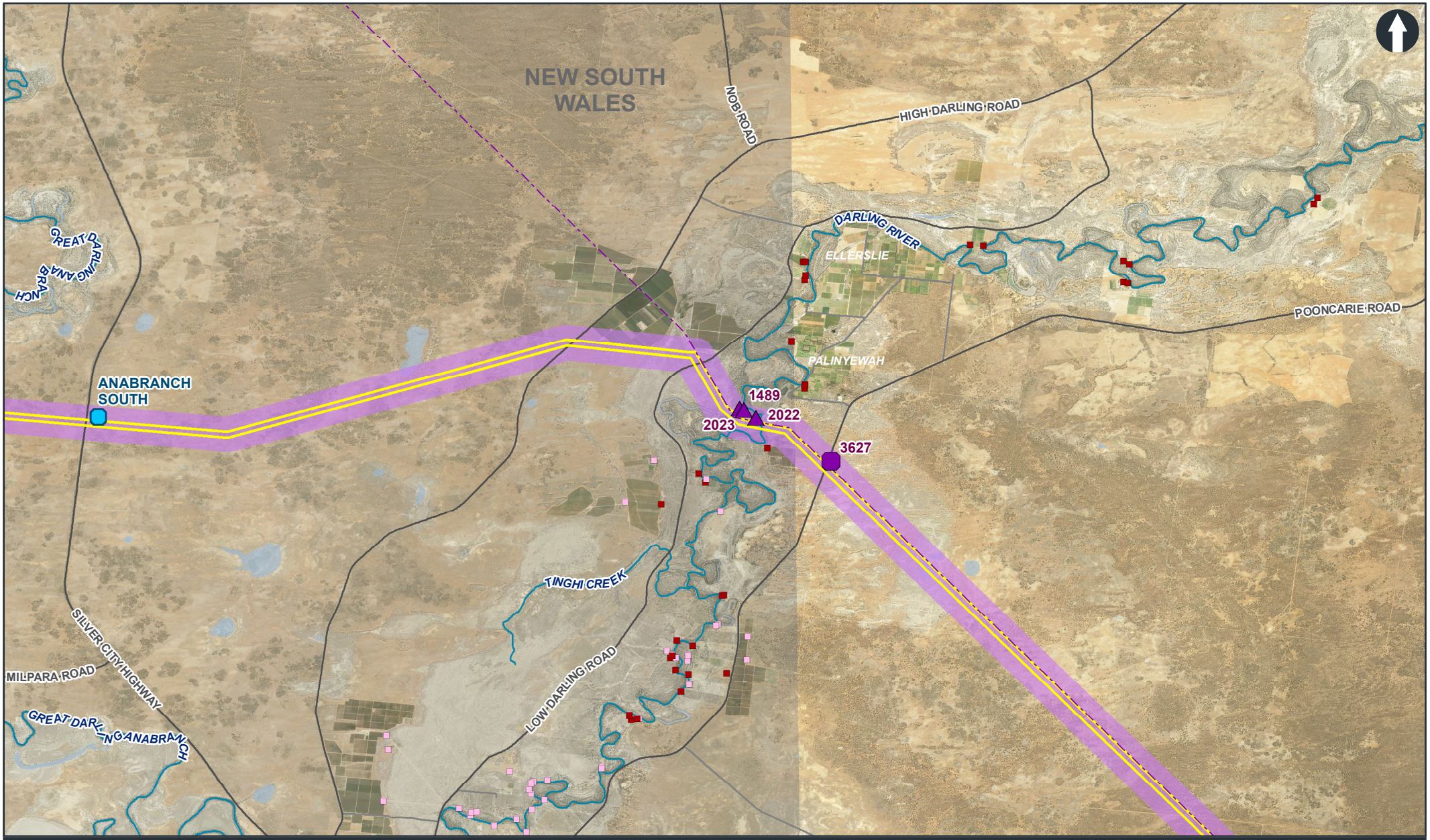

Figure C2.C

330kV transmission lines audible noise risk zone
Base case + 1% SVG, wet weather

- Transmission line corridor
- Existing transmission line infrastructure
- Sensitive receiver outside noise buffer - confirmed location
- Sensitive receiver outside noise buffer - potential location
- Construction compound and camp location
- Audible noise buffer compliant to PNTL at 548 metres from transmission lines centerline from transmission lines centerline
- Residential dwelling within 548m buffer
- Utility facility within 548m buffer

Source: NSWSS, ESRI, Transgrid, WSP, BOM

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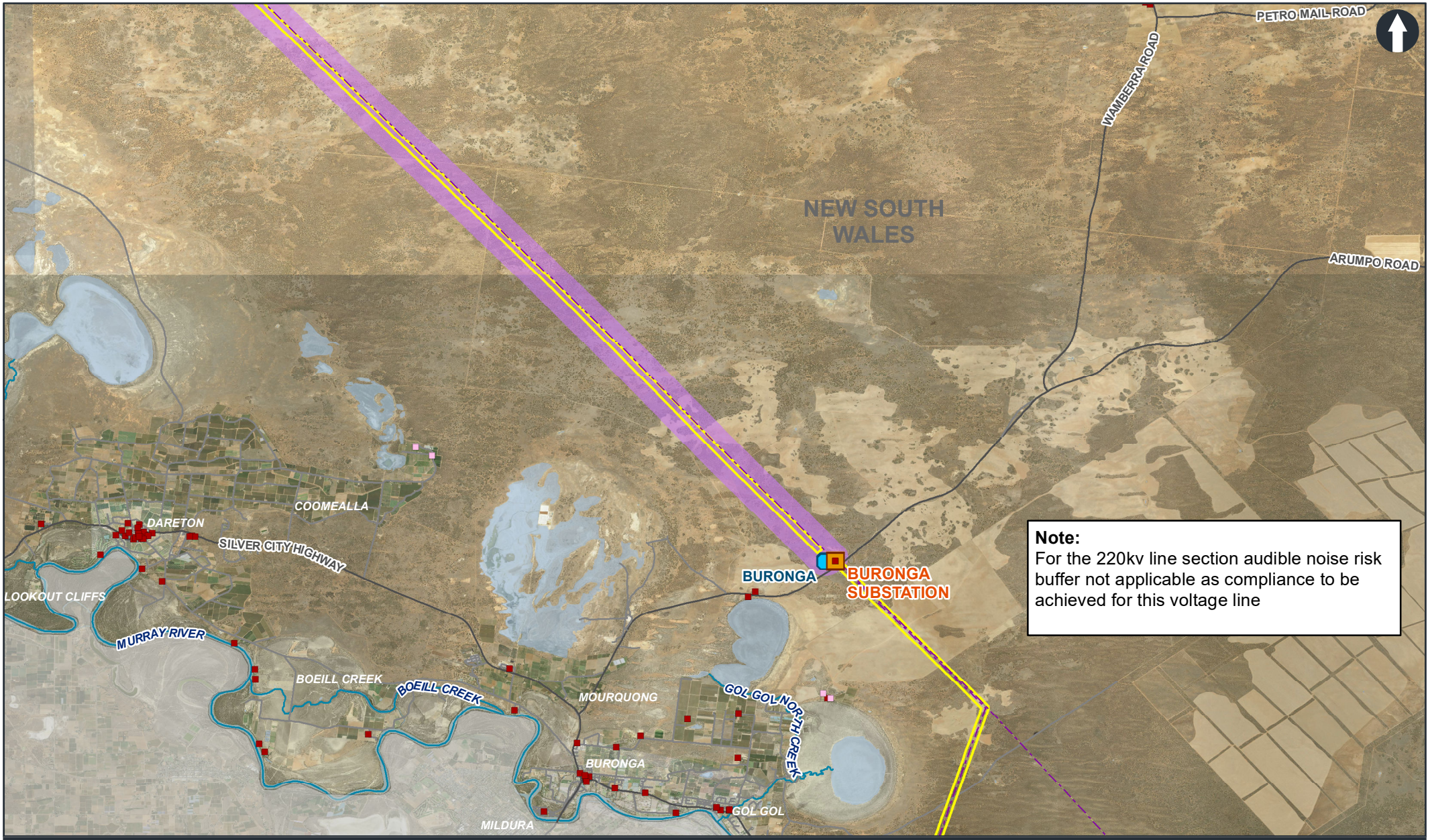

Figure C2.D

330kV transmission lines audible noise risk zone
Base case + 1% SVG, wet weather

Figure C2.E

330kV transmission lines audible noise risk zone
Base case + 1% SVG, wet weather

- Transmission line corridor
- Existing transmission line infrastructure
- Red Cliffs substation (out of scope)
- Sensitive receiver outside noise buffer - confirmed location
- Sensitive receiver outside noise buffer - potential location
- Audible noise buffer compliant to PNTL at 548 metres from transmission lines centerline from transmission lines centerline

Source: NSWSS, ESRI, Transgrid, WSP, BOM

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APPENDIX D

SUBSTATION IMPACT MAPPING

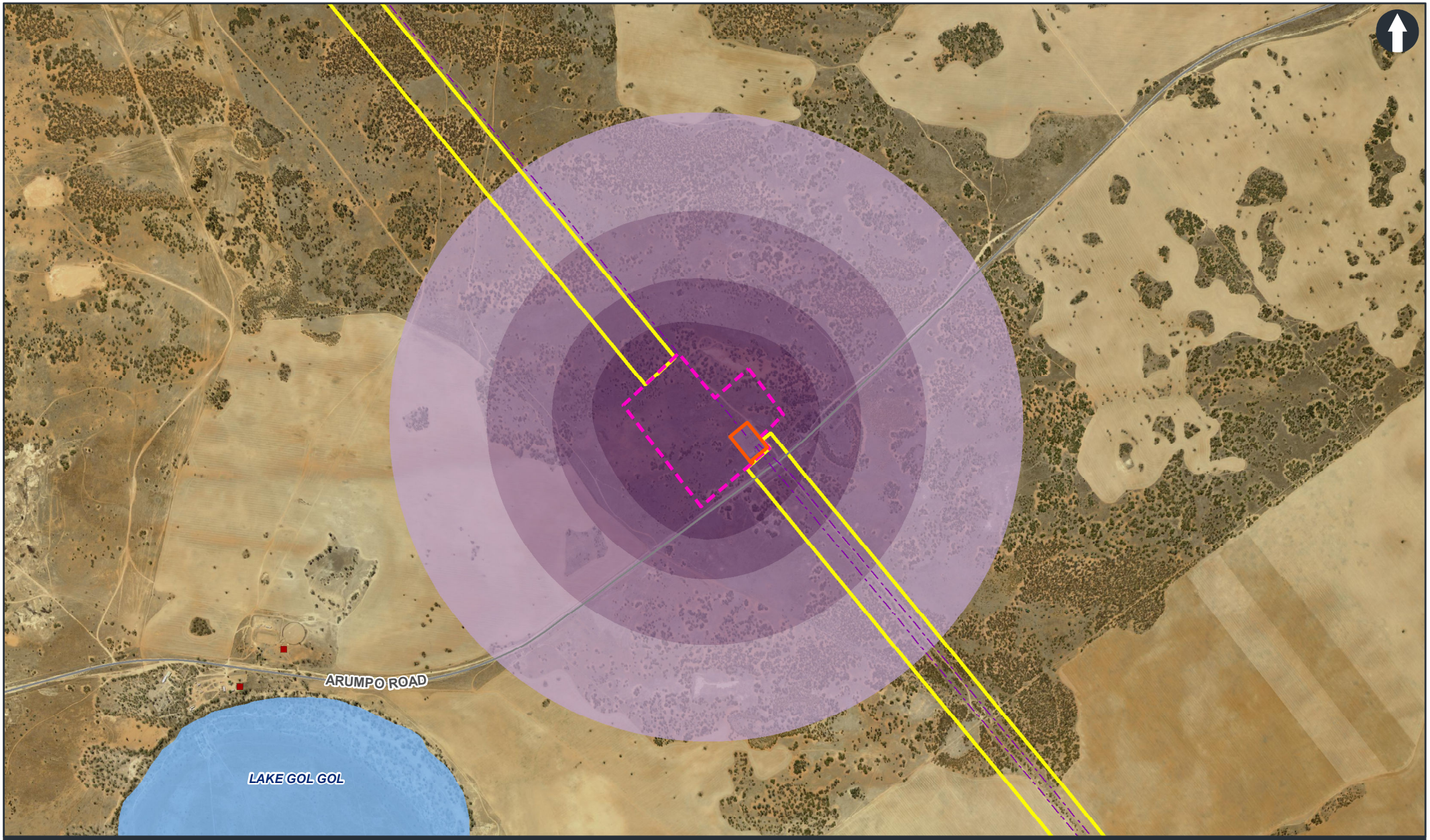

Figure D1

Operational noise levels – Substation future operations - day

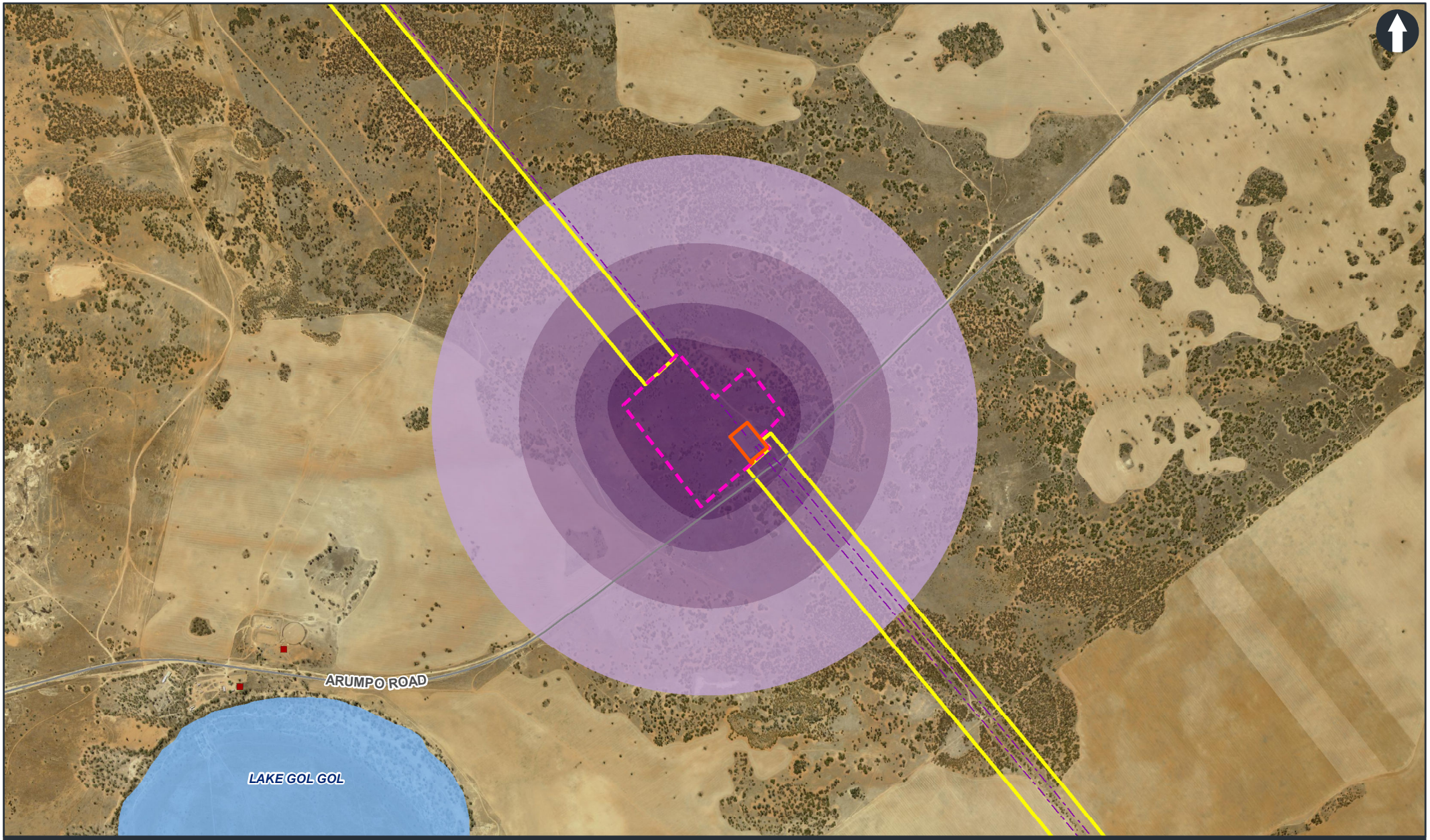

Figure D2

Operational noise levels – Substation future operations - night

ABOUT US

WSP is one of the world's leading engineering professional services consulting firms. We are dedicated to our local communities and propelled by international brainpower. We are technical experts and strategic advisors including engineers, technicians, scientists, planners, surveyors, environmental specialists, as well as other design, program and construction management professionals. We design lasting Property & Buildings, Transportation & Infrastructure, Resources (including Mining and Industry), Water, Power and Environmental solutions, as well as provide project delivery and strategic consulting services. With 43,600 talented people in more than 550 offices across 40 countries, we engineer projects that will help societies grow for lifetimes to come.

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