Narrabri to North Star Phase 2

Preferred Infrastructure Report (PIR)

Noise mitigation options assessment report

February 2024

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Prepared for

Australian Rail Track Corporation

Prepared by

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Glossary

Abbreviations

AHIMS	Aboriginal Heritage Information Management System
ARTC	Australian Rail Track Corporation
CIZ	Construction impact zone
DPE	NSW Department of Planning and Environment (formerly DPIE)
DPIE	NSW Department of Planning, Industry and Environment
EIS	Environmental Impact Statement
IRDJV	Inland Rail Design Joint Venture
km	Kilometre/s
L_{Aeq}	Single measurement representing a varying sound source over given time
L_{AFmax}	The maximum Sound Level with 'A' Frequency weighting
m	Metre/s
N2NS	Narrabri to North Star
PAD	Potential archaeological deposit
PIR	Preferred Infrastructure Report
RAP	Registered Aboriginal Party
RBL	Rating background level
RING	Rail Infrastructure Noise Guideline (NSW EPA, 2013)
SEARs	Secretary's Environmental Assessment Requirements
SPL	Sound pressure level
SSI	State significant infrastructure
SWL	Sound power level
TP	Technical Paper
WSP | MM	WSP Australia | Mott MacDonald Joint Venture (IRDJV)

Definitions

The Department	NSW Department of Planning and Environment
Directly impacted receiver	Those receivers within the area of interest who are predicted to exceed RING trigger values.
Indirectly impacted receiver	Those receivers within the area of interest who are not predicted to exceed RING trigger values.
Locomotive	The power source/moving force for the train or cars. Required to push or pull the other cars in the train.
Mitigation	Actions or measures to reduce the impacts of the proposal.
Potential archaeological deposit (PAD)	A location that is considered to have a potential for sub-surface cultural material. This is determined from a visual inspection of the site, background research of the area and the landform's cultural importance.
Preferred infrastructure report (PIR)	A report prepared by an SSI proponent at the request of the Planning Secretary that outlines any proposed changes to the SSI to minimise its environmental impact or to deal with any other issue raised during the assessment of the application concerned (see the *State Significant Infrastructure Guidelines—Preparing a Preferred Infrastructure Report* (DPE, 2022).
Proposal	N2NS Phase 2 section of the Inland Rail program
Planning Secretary	Secretary of the Department of Environment and Planning
Sensitive receivers	Land uses that are sensitive to potential flooding, noise, air and visual impacts, such as residential dwellings, schools and hospitals.
Sound power level (SWL)	The inherent noise of the source and is the total power radiated by the source, in dB. Sound power level does not vary with distance from the noise source or within a different acoustic environment.
Sound pressure level (SPL)	The level of sound measured on a sound level meter and expressed in decibels. $L_P = 10 \log_{10}(P/Po)^2$ where P is the rms sound pressure in Pascal and Po is the reference sound pressure conventionally chosen as 20 µPa for airborne sound. Lp varies with distance from a noise source.
Train	A connected series of railway vehicles.
Wagon	Unpowered railway vehicles used to transport cargo.
Visual amenity	The value of a particular area or view in terms of what is seen.

1 Introduction

1.1 Project description

1.1.1 Narrabri to North Star Phase 2

The proposal involves an upgrade of the existing rail track and formation between Moree and Camurra North, and greenfield construction of track and formation to bypass the Camurra hairpin.

Key features of the proposal are:

- enhancement of about 13.7 km of existing track through minor adjustments to the vertical and horizontal alignment, and the greenfield construction of about 1.6 km of new rail corridor, including rail embankments
- demolition and reconstruction of eight underbridges at the Mehi River, Gwydir River, Skinners Creek, Duffys Creek and at four other un-named water courses
- installation of approximately 1,600 new flood relief box culverts along the formation, including a concrete weir up to 1.2 m in height within the upstream apron of some culverts
- three new signalised level crossings at Gwydirfield Road (LX562), the Rocks Road (LX563) and Back Pally Road (LX564) replacing the existing level crossings; shifting of level crossing LX563 approximately 650 m south
- realignment and changes to private level crossings including closure of LX3070 and LX3071 (replaced with new private level crossing ID# 80901) and closure of LX3068
- new turnout between the Gwydir River and Back Pally Road, immediately north of the new Gwydir underbridge, to provide a connection to the Inland Rail/North Star line to the east and the Weemelah line to the west
- provision of an emergency services access (underpass) adjacent to the south bank of the Mehi River providing an additional connection for emergency services between east and west Moree
- provision of a low earthen bund within the rail corridor between Moree station and south of the Alice Street level crossing
- retention of the Camurra hairpin formation to aid in better balancing of modelled flood scenarios
- reconstruction of a new rail spur for the Weemelah line.

Associated works would include installation of signalling systems, signage, fencing, drainage, the relocation of services and utilities where necessary and the formation of rail maintenance access roads (RMARs) within the rail corridor adjacent to the line. The construction and operation of the proposal would also require the following ancillary facilities:

- construction access and haul roads linking to the surrounding public road network
- construction storage and laydown areas
- associated earthworks for the construction of pads for piling rigs and cranes at underbridge locations.

Additional facilities could also include mobile batch plant, accommodation for construction workers and construction water supply and storage.

The proposal would also require the permanent acquisition and temporary occupation of land along the alignment.

1.1.2 Environmental Impact Statement

An Environmental Impact Statement (EIS) was prepared in 2021 to address the Planning Secretary's Environmental Assessment Requirements (SEARs) issued by the then NSW Department of Planning, Industry and Environment (DPIE) for the proposal on 14 October 2020.

The exhibition of the EIS for N2NS Phase 2 ended on 9th November 2022. The Department reviewed the EIS and submissions received and has sought independent expert hydrology and acoustic advice.

1.2 Preferred Infrastructure Report

Section 5.17(6)(b) of the *Environmental Planning and Assessment Act 1979*, provides that '*The Planning Secretary may require the proponent to submit to the Planning Secretary a preferred infrastructure report that outlines any proposed changes to the State significant infrastructure to minimise its environmental impact or to deal with any other issue raised during the assessment of the application concerned*'.

On 2 March 2023 the Planning Secretary directed ARTC to submit a Preferred Infrastructure Report (PIR), in addition to a Response to Submissions Report, that includes the following requirements:

> *1. Assess and prepare a report on the effectiveness and feasibility of potential noise mitigation measures including at-source barriers (including noise walls and wheel walls), at-property noise mitigation and other alternative options for residences in Moree bounded by the Gwydir Highway, Newell Highway, Oak Street and River Street. The hydrology, visual and social impacts of the selected measure/s must also be assessed.*
>
> *2. Prepare a report documenting the process and outcomes of direct and targeted engagement with the affected community about the report in item 1, including community preferences for noise mitigation measures.*
>
> *3. Prepare a report/s justifying the selected noise mitigation measure/s and demonstrating how community preferences for noise mitigation have influenced the selected noise mitigation measures.*

The assessment of noise mitigation measures and their environmental impacts (i.e. this report) must be provided to the Department prior to consultation with the community.

This *Noise Mitigation Options Assessment Report* was prepared in response to item 1 of the PIR request. Table 1.1 identifies where the requirements are addressed within this report.

Table 1.1 PIR requirements addressed in this report

PIR requirements	Location in report where issue is addressed
Assess and prepare a report on the effectiveness and feasibility of potential noise mitigation options including:	
— at source barriers	Section 5.1, Section 6.1, Section 8.1
— noise walls (including wheel walls)	Section 5.1.8, Section 6.2, Section 8.2
— at-property treatment	Section 5.3, Section 6.3, Section 8.3
— other alternative options.	Section 4.5, Section 6.1, Section 8.1
Assess other environmental impacts of the proposed mitigation measures including:	
— hydrology	Section 7.4
— visual impacts; and	Section 7.2
— social impacts	Section 7.3

It is noted that the PIR does not specify whether 'noise' refers to airborne noise or ground-borne noise. The EIS concluded that ground-borne noise is not an issue for the proposal; therefore, it is understood the PIR only applies to rail airborne noise.

1.3 Purpose and structure of the Noise Mitigation Options Assessment Report

This *Noise Mitigation Options Assessment Report* is prepared by IRDJV to support the PIR and addresses the first PIR requirement, as listed in Section 1.2.

The structure of this report and a summary of the assessment process contained within this report is as follows:

- Section 1 – Introduction – A project description and outline of the PIR request, which forms the basis for this report.
- Section 2 – Legislation and guidelines – Describes the legislative and policy context, including relevant noise trigger levels against which the noise mitigation options are assessed.
- Section 3 – Existing environment – Describes the existing noise environment of the assessment area and identifies sensitive receivers.
- Section 4 – Rail airborne noise assessment – Describes the updated vertical alignment, noise sources, methodology and unmitigated airborne noise impacts predicted to be generated by the operation of the proposal.
- Section 4.5 – Potential noise mitigation measures – Identifies of a range of mitigation measures in accordance with the Rail Infrastructure Noise Guideline (RING)(NSW EPA, 2013). Includes a preliminary assessment based on whether mitigations are considered feasible and reasonable, narrowing down options for further assessment.
- Section 6 – Noise mitigation options – Design and testing of mitigation options in accordance with the RING, PIR request, and the results of the preliminary assessment in Section 5. Quantifies the predicted noise outcomes for several noise mitigation measures and further narrows down options for continued assessment.
- Section 7 – Environmental assessment of noise mitigation options – Additional assessments, including social, visual and heritage, were undertaken to further consider the impacts of the noise mitigation options.
- Section 8 – Summary – Reviews the combined noise mitigation and environmental impacts for each option considered in Section 7.
- Section 9 – Residual noise impact – Describes the potential for residual noise impacts following the implementation of noise mitigation measures.
- Section 10 – Community consultation process and reporting – Details the proposed community consultation process, designed to present the outcomes of this *Noise Mitigation Options Assessment Report*.
- Section 11 – Conclusion – Overview of the key findings of this *Noise Mitigation Options Assessment Report*, including a recommendation in accordance with the RING.
- Section 12 – References – Lists documents and guidelines referred to within the report.
- Appendices – Tabulated noise modelling results and noise contour maps.

2 Legislation and guidelines

Airborne noise is the term given to the noise which travels through the air. This is the main form of noise that would occur from operation of the proposal.

The SEARs require rail noise to be assessed and managed in accordance with the *Rail Infrastructure Noise Guideline* (NSW EPA, 2013) (RING) which provides non-mandatory noise assessment criteria, referred to as "noise trigger levels", for sensitive receivers.

Should rail noise levels be predicted to exceed the noise trigger levels, an investigation into noise impacts and implementation of feasible and reasonable measures is required. The objective being the control of rail noise to meet the noise trigger levels and to minimise potential noise impacts at sensitive receivers.

The RING includes specific noise trigger levels for the redevelopment of existing rail infrastructure. A project is considered 'redevelopment of a heavy rail line' where any rail infrastructure is to be developed on land that:

- is located within an existing and operational rail corridor where a rail line is or has been operational; or
- is immediately adjacent to an existing operational rail line which may result in widening of an existing rail corridor.

The RING notes that a disused heavy rail line that is brought back into use should be assessed as a redevelopment. The majority of the upgraded alignment is located within the existing operational rail corridor; therefore, despite infrequent traffic, it is considered a redevelopment of an existing rail line for the purpose of the operational noise assessment.

The rail airborne noise trigger levels for heavy rail for residential land uses are provided in Table 2.1. These trigger levels represent external noise and are assessed for a height of 1.5 m above ground, at a location 1 m in front of the most affected building façade. The triggers take into account two criteria:

- the increase in noise levels compared to the existing noise levels and
- an absolute trigger level.

Different trigger levels apply for non-residential sensitive receivers. However, only residential receivers have been identified in the study area (as defined in Section 3). Therefore, only the noise triggers levels for residential land uses are considered for this assessment.

Table 2.1 Rail airborne noise trigger levels for residential land uses

Type of development	Noise trigger levels, dBA	
	Day (7 am 10 pm)	Night (10 pm 7 am)
Redevelopment of existing rail line	Development increases existing L_{Aeq}, rail noise levels by 2 dB or more, or existing L_{Amax} rail noise levels by 3 dB or more ***and*** predicted rail noise levels exceed:	
	65 $L_{Aeq,15h}$ or 85 L_{AFmax}	60 $L_{Aeq,9h}$ or 85 L_{AFmax}

3 Existing environment

The area under investigation is described in the PIR as the area bounded by the Gwydir Highway, Newell Highway, Oak Street and River Street. To ensure all potential exceedances are considered, this has been expanded to include the area immediately to the west bounded by McElhone Street, Warialda Street, and Alice Street. Sensitive receiver locations in the study area are shown on Figure 3.1. Receivers within this study area who are predicted to exceed RING trigger values are referred to as 'directly impacted receivers", those who are not predicted to exceed RING trigger values are referred to as 'indirectly impacted receivers'.

3.1 Residential land uses

Residential receivers in the study area are predominantly closely spaced, single storey dwellings. The nearest receiver (NNS_Rx1989) is approximately 20 m from the tracks.

Two receivers located less than 20 m from the tracks are to be demolished pending acquisition (NNS_Rx1957 - 73 Morton Street) and resumption of an ARTC lease (NNS_Rx1959 – 287 Morton Street). Demolition is required for corridor widening purposes and is unrelated to potential noise mitigation works. A third receiver at 296 Morton Street (NNS_Rx1955) has been demolished. These are not considered further.

Further, inspection of the most recent satellite imagery and local information received, has confirm that receiver NNS_Rx1965 has since been demolished. It is noted that the slab appears to still remain in place, and as such, the receiver is still considered in the assessment in the event it is proposed to be rebuilt. In the event NNS_Rx1965 is not rebuilt, no additional impacts or exceedances are predicted as the proposed noise mitigation options achieve compliance at the adjacent properties and at the most impacted façade facing the tracks.

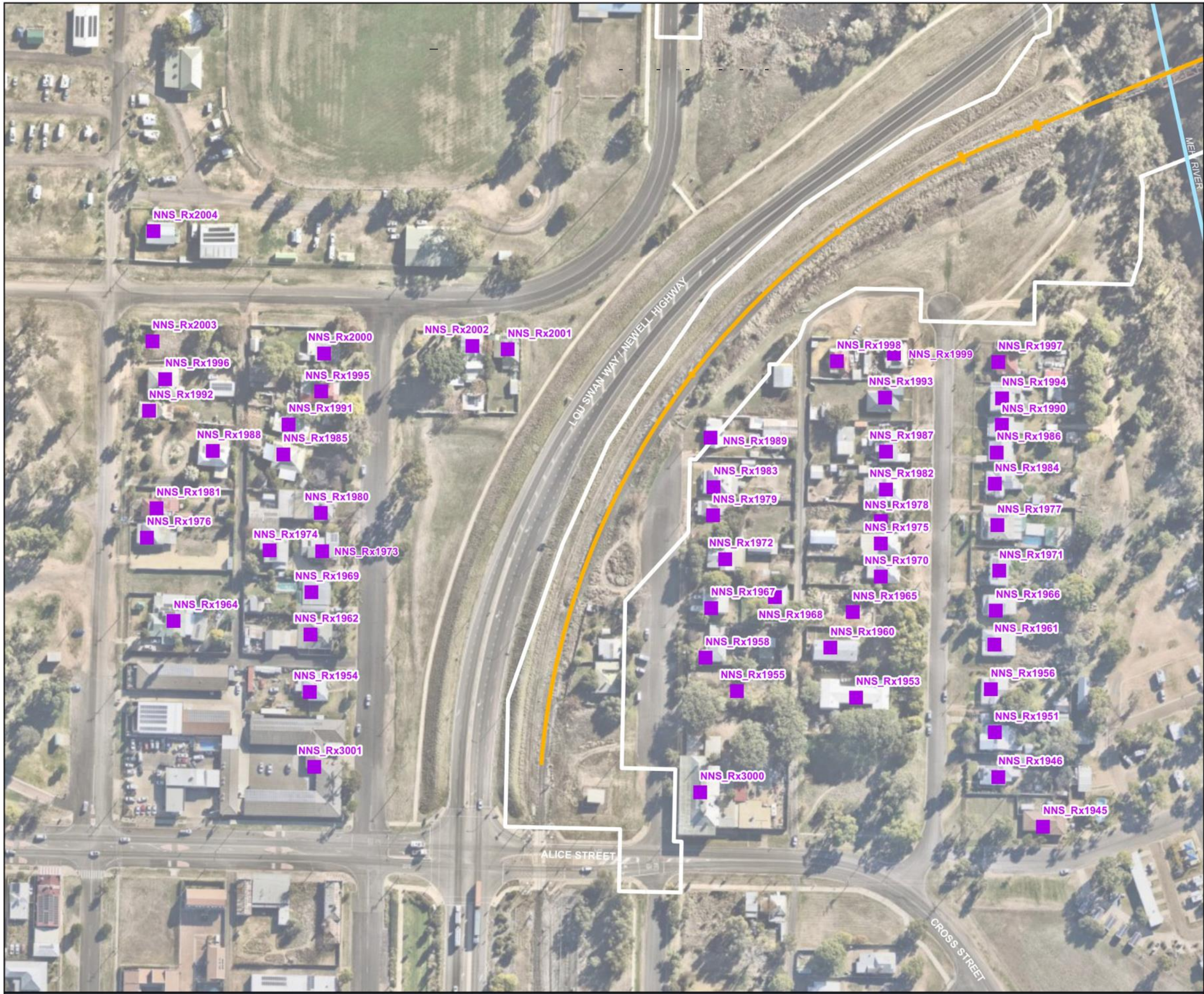
The Moree Hotel at the corner of Morton Street and Gwydir Highway has also recently been purchased. The owner intends on refurbishing the hotel and may seek to use it for short-term accommodation in the future. Short-term accommodations are not considered as residential land uses; however, it is understood that the owner has a permanent place of residence on the first floor of the hotel. As such, the hotel is included in this assessment (NNS_Rx3000).

Similarly, the short-term accommodation at the Econo Lodge Moree Spa Motor Inn at the corner of Gosport Street and Alice Street is not considered, but the owner's primary place of residence (east of the building facing Gosport Street) is considered as a residential receiver for the purpose of this assessment (NNS_Rx3001).

WSP | MOTT MACDONALD

Noise Mitigation Options Assessment Report

Figure 3.1
Sensitive receivers



Legend

- Sensitive receiver
- The proposal
- River
- Construction impact zone

0 40 80 Metres

Coordinate system: GDA 1994 MGA Zone 55

Scale ratio correct when printed at A3

1:1,800 Date: 26/10/2023

Data sources: - nearmap

3.2 Other sensitive land uses

No sensitive land uses other than residential have been identified in the study area.

3.3 Background noise levels

Baseline noise monitoring was undertaken in 2020 for the preparation of the EIS to quantify and characterise the existing noise environment at the sensitive receivers adjacent to the proposal. The surveys combined long term monitoring of noise levels (unattended monitoring) and short-term noise surveys (attended measurements) to identify and measure noise levels from local noise sources.

An unattended noise logger was placed in the front yard of the property located at 3 Oak Street, Moree. The equipment was located more than 3.5 m from any sound reflective surface and is therefore considered to be in free-field, as per Australian Standard *AS1055:2018 - Acoustics—Description and measurement of environmental noise*. This property is located in an isolated cul-de-sac, and therefore, is considered a conservative location to represent receivers in the study area. Attended measurements were conducted during the installation of the noise logger.

Noise monitoring results are reported using two metrics:

- $L_{Aeq,15min}$ – a short-term measure; the average received sound energy over time (15 minutes), and
- Rating Background Levels (RBLs) - a measure of the long-term background noise environment.

Table 3.1 summarises the unattended noise monitoring results.

Table 3.1 Unattended noise monitoring results

RBL, dBA			Ambient noise levels $L_{Aeq,15min}$, dBA		
Day 7 am 6 pm	Evening 6 pm 10 pm	Night 10 pm 7 am	Day 7 am 6 pm	Evening 6 pm 10 pm	Night 10 pm 7 am
36	36	27	51	50	47

Attended measurements found that the acoustic environment is controlled by natural sounds (bird chirping – 48 dBA), with distant road traffic noise audible from the Newell Highway (47 dBA, up to 57 dBA for truck pass-bys). The study area is generally characterised by low background noise levels; the Newell Highway is the main noise source with sparse vehicle movements outside peak hours.

Additional information such as daily noise levels, meteorological conditions, equipment and calibration can be found in EIS Technical Paper 11 *Operational Noise and Vibration Impact Assessment*.

4 Rail airborne noise assessment

The assessment methodology and inputs, with the exception of the rail alignment, for the rail airborne noise assessment undertaken for this report are consistent with those outlined in EIS Technical Paper 11.

4.1 New rail vertical alignment

The new vertical rail alignment used for noise assessments within this report is marginally different from the vertical alignment considered in Technical Paper 11 of the EIS. A new grade of up to 1.25 in 100, compared to 1 in 100 in the EIS, has been adopted to allow for additional clearance when crossing the Mehi River and Gwydirfield Road as a stakeholder request made during the public exhibition period. Increasing the grade is relevant to noise as locomotives are expected to change notch when travelling northbound. An increase in notch results in an increase in engine revolutions per minute, which translates to increased engine noise emissions of up to 5 dBA for L_{Aeq} and L_{Amax}.

The alignment is considered ascending northbound, and descending southbound.

4.2 Modelling methodology

The existing and proposed rail alignments were modelled in SoundPLAN Version 8.2 using the Nordic Rail Prediction Method (Kilde Report 130).

A 3-dimensional representation of the physical environment within the proposal site was simulated. Modelling inputs included topography (e.g. existing traffic noise mounds), ground and air absorption, locations of sensitive receivers, noise sources, and other infrastructure surrounding the proposal.

In accordance with the RING, meteorological conditions are modelled at zero wind speed, zero degrees Celsius per 100 m atmospheric temperature gradient, 15 degrees Celsius, and 70 per cent relative humidity.

The modelling parameters are shown in Table 4.1.

Table 4.1 Noise modelling parameters

Parameter	Modelling input
Ground absorption	0.5 in Moree
Receivers	Each identified sensitive receiver was assigned a discrete identification number Only receivers to the east of the tracks in the Moreton, Oak and River Streets area, and to the west bounded by McElhone Street, Warialda Street, and Alice Street are considered for this assessment
Buildings	Building footprints provided as a geospatial dataset by ARTC
Assessment location	Noise levels predicted as façade corrected levels at 1 m from the most affected façade
Receiver height	Ground floor: 1.5 m above ground level, first floor: 4.5 m above ground level

4.3 Modelling scenarios and inputs

4.3.1 Years

The RING requires noise to be assessed at the project opening year and for a future design year (typically 10 years after opening). For the Inland Rail project, including the N2NS P2 proposal, ARTC has determined the assessment year for project opening to be 2025 and the design year as 2040. The Inland Rail Review notes the target completion of this project is subject to further consideration.

To model a ‘no build’ scenario, the EIS used train movements recorded in 2020; for consistency, this will be applied to represent the existing movements in Submissions Report and PIR documents. There is no predicted change in current train numbers unless and until Inland Rail commences.

For consistency across all Inland Rail projects, the design year has been maintained as 2040. This establishes a conservative base for assessment; however, as mentioned, it is anticipated that there would be minimal to no change in train volumes until Inland Rail becomes operational.

The following years are considered in the rail noise modelling for the preparation of this report:

- 2020 – The ‘no build’ scenario. The existing section is modelled with grain trains and no change to the rail vertical alignment.
- 2040 – ‘design year’. The proposal is modelled with the proposed traffic and conditions for year 2040.

Modelling of the ‘opening year’ train movements has not been undertaken for this report. Predicted noise impacts for opening year are 2 to 3 dBA less than predicted for the design year due to lower train numbers. Noise impacts will occur from the opening year, however noise mitigation measures which achieve compliance with the criteria for the design year would, by default, also achieve compliance for the opening year when less train movements are predicted. As such, the design year scenario (rather than the opening year scenario) is the most conservative scenario and is adopted for the design of noise mitigation measures.

It should be noted that non-Inland rail train movements (i.e. seasonal grain trains) may re-commence use of the rail line prior to the ‘opening year’. Some noise impacts may, therefore be experienced prior to the commencement of Inland Rail operations, but only as a result of current use profiles.

4.3.2 Rail traffic

For modelling purposes, an estimate of proposed traffic flows is calculated. These estimates are shown alongside the existing rail traffic flows in Table 4.2. It is noted that the resulting estimate, a total of 27 trains per day, exceeds the forecasted levels of traffic in the EIS; this is a result of rounding up during calculations to full integers (i.e. whole trains) and is not representative of the actual rail traffic on the line for the design year (i.e. 20 trains over 24 hours). Again, this approach is considered the most conservative and provides for a worst-case scenario.

For each service type, it is assumed that half of the total number of trains are travelling northbound with the other half travelling southbound. For odd numbers of trains, the remaining train was assumed to be travelling northbound, to maintain rounded numbers. This is a conservative approach as trains travelling northbound are ascending, resulting in increased locomotive noise emissions.

For the design year 2040, a total of 15 trains are considered to pass during daytime periods and a total of 12 trains are considered during the night-time. The night-time noise criteria are 5 dBA more stringent than the daytime noise criteria, and the number of equivalent train movements per hour is greater. As such, the night-time period is the most stringent and the noise model for the assessment focuses on this period. Therefore, achieving compliance during night-time will, by default, achieve compliance during daytime. Similarly, achieving compliance for the design year 2040 will achieve compliance for the opening year. In every consideration, the most conservative approach has been adopted.

Table 4.2 Existing and proposed rail traffic flows

Train type	Day (7 am 10 pm)		Night (10 pm 7 am)	
	2020	2040	2020	2040
Inland Rail Express	0	2	0	2
Inland Rail Superfreighter	0	6	0	6
Grain	<1	3	<1	4
Freight	0	2	0	0
Passenger	0	2	0	0

Existing traffic is infrequent and seasonal and for much of the year residents do not experience rail passbys on this part of the line. However, as the rail line is existing (i.e. not a new development), the modelling of zero trains is not considered to represent a reasonable assessment approach. Therefore, to allow for an assessment of the relative increase in noise levels generated by the proposal, one grain train was modelled during the day and night period for the year 2020. This was considered a minimum allowance for modelling purposes.

4.3.3 Speeds

Noise modelling is based on forecasted speeds for each train type, as provided by ARTC. Forecasted speeds range between 55 km/h and 60 km/h in the study area and consider train driver behaviour and rolling stock performance. The trains are starting to accelerate (or finishing, to decelerate) in the section modelled, being 1 km to the north and 1 km to the south of the study area.

The exact speed profile for grain trains for year 2020 is unknown, and as such, these have been assumed to travel at the current posted speed of 30 km/h through Moree. Grain trains are modelled at 55 km/h to 60 km/h for the design year.

4.3.4 Consists, lengths and types

'Consists' refers to the number of locomotives required to pull a train (refer to the glossary for definitions of 'train', 'locomotive' and 'wagon'). The consists, lengths and types for trains expected to operate on the Inland Rail network are detailed in Table 4.3.

Table 4.3 Consists, lengths and types

Train type	Locomotive			Wagon
	Class	Number	Length	Length
Inland Rail Express	NR	3	22 m	1680 m
Inland Rail Superfreighter	SCT	2	21 m	1700 m
Grain	PR22L	3	18 m	560 m (NSW grain) 800 m (QLD grain)
Freight	82	2	22 m	580 m

4.3.5 Locomotives and wagons noise source levels

Noise source levels for locomotives and wagons expected to operate on the Inland Rail network are detailed in Table 4.4. Locomotive noise is generated by the locomotive exhaust, approximately 4 m above the tracks while wagon noise is generated by the rolling contact between the wheel and rail, predominantly emanating from the top of the rail. Source levels are provided at 80 km/h and measured at 15 m from the track centreline and at 1.5 m above the top of the rail. L_{Amax} levels are 95th percentile levels. Downhill segments are considered to have a negative grade greater than 1 in 100. Uphill segments are considered to have a positive grade greater than 1 in 100. These noise source levels are corrected to account for different speeds and distances as per the implementation of the Nordic Rail Prediction Method (Kilde Report 130) in SoundPLAN Version 8.2.

Table 4.4 Locomotives and wagons noise source levels

Source	Source elevation	Gradient	Source levels, dBA	
			Sound exposure level	L_{Amax}
Locomotive – NR	4 m above top of the rail	Flat	85	90
		Downhill	84	90

Source	Source elevation	Gradient	Source levels, dBA	
			Sound exposure level	L_{Amax}
		Uphill	90	94
Locomotive – SCT	4 m above top of the rail	Flat	84	88
		Downhill	84	91
		Uphill	89	92
Locomotive – PR22L	4 m above top of the rail	Flat	84	91
		Downhill	84	94
		Uphill	89	94
Locomotive – 82	4 m above top of the rail	Flat	83	89
		Downhill	84	94
		Uphill	88	94
Wagons – 1000 m of wagons	Top of the rail	–	100	90

The noise levels presented in Table 4.4 do not take into account the effects of braking (bunching) and accelerating (stretching). Trains are starting to slowly accelerate (or finishing, to decelerate) 1 km to the north and south of the area under investigation. As such, bunching and stretching noise sources would not occur and were therefore not required to be modelled for this assessment.

4.3.6 Track features

Correction factors for track features such as curves, track types, turnouts, crossings and bridges are listed in Table 4.5.

Table 4.5 Correction for track features

Feature	Correction factor
Curve radius < 300 m	+ 8 dBA for L_{Aeq}, + 21 dBA for L_{Amax}
Curve radius 300 m to 500 m	+ 3 dBA for L_{Aeq},
Curve radius > 500 m	No correction
Track – Continuous welded rail	No correction
Track – Mechanical or uneven glued jointed	+ 3 dBA over 10 m
Track – Slab track	+ 2 dBA
Fixed nose turnout	+ 6 dBA over 10 m
Diamond crossing	+10 dBA over 10 m
Bridge – Open transom, fabricated steel web, no side screens	+ 10 dBA
Bridge – Open transom, fabricated web forming side screens	+ 8 dBA
Bridge – Ballasted, steel box girder, no side screens	+ 4 dBA
Bridge – Ballasted, fabricated web forming side screens	+ 4 dBA
Bridge – Concrete trackbed, concrete box girder, no side screens	+ 3 dBA
Bridge – Ballasted, concrete span, no side screens	No correction
Bridge – Concrete trackbed, concrete box girder, concrete side screens	- 2 dBA
Bridge – Ballasted, concrete span, concrete side screens	- 5 dBA

All bridges are ballasted with concrete spans and no side screens. No correction is considered for bridges.

All track types are continuously welded rail. No correction is considered for tracks.

All curves have a radius greater than 500 m. No correction is considered for wheel squeal.

4.3.7 Crossing loops

A crossing loop is a place on a single line railway where trains travelling in opposite directions can pass each other. The use of crossing loops leads to bunching and stretching noise. The nearest crossing loop, Tycannah Creek loop, is located approximately 5 km to the south of the proposal. Irrespective of whether the trains stop at this loop, they run at the same speed once in Moree. Therefore, crossing loops do not contribute any noise to the study area and are not considered within this report.

4.3.8 Train horns and level crossing bells

Horn noise is generated by the horn, located on top of the locomotive, approximately 4 m above the tracks while bell noise is generated by the pedestrian and level crossing warning bells, located at the intersection with Alice Street/ Gwydir Highway.

Train horn noise was modelled as 90 dBA SPL at 100 m. For L_{Aeq} calculations, horns are assumed to be used for a maximum duration of 1 second per pass-by at the public level crossing only, approximately 100 m before the level crossings.

Level crossing warning bell noise was modelled as 105 dBA SPL at 3 m from the source. For L_{Aeq} calculations, warning bells are generally activated 30 seconds prior to a train entering the level crossing and remain audible throughout the train pass-by.

Level crossing pedestrian bell noise was modelled as 107 dBA SPL at 1 m from the source. For L_{Aeq} calculations, pedestrian bells are assumed to operate 30 seconds prior to a train entering the level crossing and remain audible throughout the train pass-by.

4.4 Predicted unmitigated noise levels

Table 4.6 summarises the results of noise modelling undertaken to ascertain which sensitive receivers may experience exceedances in a scenario where no noise mitigation measures are implemented. The results are shown for the night-time scenario, as night-time noise criteria are more stringent than the daytime noise criteria.

Cells shaded in orange show predicted exceedances (for all noise sources assessed together) of the relevant trigger levels (60 dBA $L_{Aeq, 9h}$ and 85 dBA L_{Amax} - see Table 2.1). The individual noise contributions of wagons, locomotives, horns and bells are also presented.

All tabulated results, including L_{Aeq} and L_{Amax} descriptors for the current year and the design year are detailed in Appendix A. Noise contour maps are provided in Appendix B.

Table 4.6 Noise sensitive receivers predicted to exceed – No mitigation

Unmitigated	Predicted night time $L_{Aeq,9h}$, dBA					Predicted night time L_{Amax}, dBA				
	Wagons	Locos	Horns	Bells	All sources	Wagons	Locos	Horns	Bells	All sources
NNS_Rx1953	56	51	50	58	60	78	82	87	68	87
NNS_Rx1954	52	49	50	60	61	73	78	86	70	86
NNS_Rx1958	60	54	56	61	65	81	85	93	71	93
NNS_Rx1960	57	52	50	58	61	78	82	87	68	87

Unmitigated	Predicted night time $L_{Aeq,9h}$, dBA					Predicted night time L_{Amax}, dBA				
	Wagons	Locos	Horns	Bells	All sources	Wagons	Locos	Horns	Bells	All sources
NNS_Rx1962	52	50	50	59	60	74	79	87	69	87
NNS_Rx1965	55	52	50	57	60	77	82	87	67	87
NNS_Rx1967	60	55	56	60	64	82	86	93	70	93
NNS_Rx1968	57	52	51	59	61	79	85	88	68	88
NNS_Rx1969	53	51	50	60	61	74	81	86	70	86
NNS_Rx1972	61	55	53	59	64	82	88	91	69	91
NNS_Rx1973	51	49	49	57	59	72	80	86	67	86
NNS_Rx1979	62	57	52	57	65	84	90	89	67	90
NNS_Rx1983	64	58	51	54	65	85	92	88	64	92
NNS_Rx1989	65	60	49	55	66	87	95	86	65	95
NNS_Rx1998	61	56	45	53	63	83	89	82	63	89
NNS_Rx1999	59	54	44	52	61	81	86	81	62	86
NNS_Rx3000	60	55	56	68	69	82	86	93	78	93
NNS_Rx3001	54	50	51	63	64	75	81	86	74	86

Results show that 18 residential receivers are predicted to exceed the L_{Amax} noise trigger level of 85 dBA (5 west of the highway, 13 on the east), 14 of them would also exceed the L_{Aeq} noise trigger level of 60 dBA (2 west of the highway, 12 on the east). For reference, receiver locations are shown on Figure 3.1.

Figure 4.1 provides examples of different sound levels to help the reader better understand potential impacts.

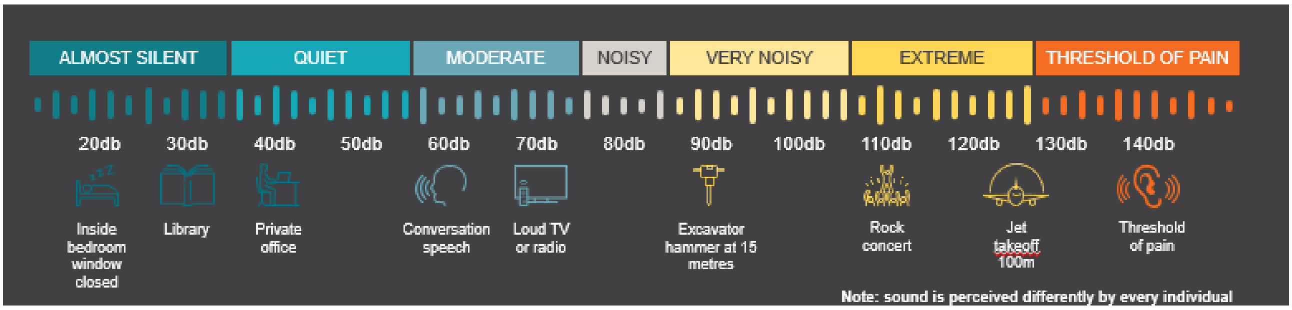


Figure 4.1 Common noise levels

Results also show that wagons and bells are the primary contributors to the L_{Aeq} descriptor, and locomotives and horns are the main contributors to the L_{Amax} descriptor. These four noise sources require mitigation to achieve compliance at all receivers for both descriptors.

Given the location of sensitive receivers (to the east and west of the alignment), and the locations and heights of noise sources controlling the exceedances at these receivers, it is expected that implementation of multiple noise mitigation measures may be required to achieve compliance.

4.5 Noise model validation

The noise model used for the EIS and this report has not been validated for the N2NS SP2 section of the Inland Rail project. This section details the reasons, consequences, and proposed way forward to minimise the risks of designing noise mitigation measures with a non-validated model.

4.5.1 Conservatism within the noise model

The model incorporates a number of layers of conservatism such as:

- an inflated number of trains – rounding up of train numbers results in a 35% higher number of train movements for the design year compared to ARTC's forecasted movements (refer Section 4.3.2). This results in an overprediction of noise levels by up to +1.3 dBA;
- reflective ground – a ground absorbtion level of 0.5 was selected for the study area. However, the Nordic Rail Prediction Method / Kilde Report 130 as implemented in SoundPLAN 8.2 for rail sources considers ground absorption of 0.5 or lower as fully reflective hard surfaces. This results in overprediction of noise levels by up to +3 dBA (refer Section 6.3.1.3).

4.5.2 Pre-construction noise monitoring

Pre-construction rail noise monitoring was not undertaken as the existing dominant noise source, grain trains, are only operating along this section of the alignment infrequently and intermittently. As such, their exact contribution cannot be validated. In addition, grain trains are not predicted to be the future dominant noise source and would therefore not form a representative basis for model validation.

The noise modelling methodology is the same as that adopted in other sections of the Inland Rail project, where validation of the modelling methodology and source levels has been undertaken. At these other locations, the models were found to be appropriate. The relative simplicity of the landscape in the study area in Moree i.e. flat topography as well as the short distance between the sources and receivers minimises the likelihood of error.

A sensitivity analysis presenting the potential risk of underpredictions for the assessment is presented in Section 6.3.1.3.

4.5.3 Post-construction noise monitoring and operational noise compliance report

Operational noise would be monitored within 12 months of the commencement of Inland Rail services to compare actual noise performance with predicted levels detailed in Technical Paper 11 and this report. The model will be validated using these measurements and, if calibration is required, outcomes will be detailed in an operational noise compliance report (ONCR).

ARTC is committed to ensuring RING trigger levels are achieved for all sensitive receivers; and accepts responsibility for reasonable and feasible additional noise mitigation, as required, to achieve compliance. While acknowledging it would be more difficult and less efficient to install mitigation post construction of the project, undertaking corrective actions as part of the ONCR to ensure noise mitigation measures (including noise barriers) are compliant with the RING is possible. Some corrective actions would be subject to constraints. For example, it may be possible to extend the barriers to the north, and it may be possible to raise the height of the western barrier. However, it is unlikely that the eastern barrier could be raised beyond 6 m due to engineering constraints, and extending the eastern barrier further south would compromise the safety of pedestrians and road traffic users of the level crossing and intersection. In accordance with the RING hierarchy, where compliance cannot be achieved with at source or transmission path mitigations, at-property treatments would be applied.

5 Potential mitigation measures

Section 3.1 of the RING states the following:

> *Where the noise trigger levels are exceeded, assess the feasible and reasonable mitigation measures that could be implemented to reduce noise down towards the relevant absolute trigger level. If it is reasonable to achieve these levels, the proponents should do so. If not, then project-specific 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.*

For the redevelopment of an existing rail line, mitigation strategies should be considered in a hierarchical approach:

- controlling noise at the source
- once the controls at the source are exhausted, controlling the transmission of noise
- once source and transmission controls are exhausted, considering mitigation measures at the noise-sensitive receivers.

In addition, the RING defines feasible and reasonable as follows:

> *A feasible mitigation measure is a noise mitigation measure that can be engineered and is practical to build, given project constraints such as safety, maintenance and reliability requirements. It may also include options such as amending operational practices (e.g., changing timetable schedules) to achieve noise reduction.*
>
> *Selecting reasonable measures from those that are feasible, involves judging whether the overall noise benefits outweigh the overall adverse social, economic and environmental effects, including the cost of the mitigation measure. To make such a judgement, the following should be considered:*
>
> - *noise impact*
> - *noise mitigation benefits*
> - *cost effectiveness of noise mitigation; and*
> - *community views.*

In accordance with the above, a preliminary assessment of potential noise mitigation options, building on the assessment in Technical Paper 11, and based upon guidance from Appendix 6 of the RING is provided in Table 5.1, and detailed further below. Note that where an option is assessed as not feasible, it is considered unnecessary to look at whether the option is reasonable.

Table 5.1 Noise mitigation options decision-making matrix

Hierarchy	Option	Feasibility	Reasonable	Further consideration recommended
Controlling noise at source	Alternative alignment	No	n/a	No
	Controlling rail traffic volumes	No	n/a	No
	Controlling rail traffic speed	No	n/a	No
	Rail dampers	Yes	Yes	Yes
	Track lubrication	No	n/a	No
	Crossing bell suppression	Yes	Yes	Yes
	Horn mitigation	No	No	No
	'Residential area' signs	Yes	Yes	Yes

Hierarchy	Option	Feasibility	Reasonable	Further consideration recommended
Controlling the transmission of noise	Barriers	Yes	Yes	Yes
Mitigation measures at the noise-sensitive receivers	At-property	Yes	Yes	Yes

5.1 Controlling noise at the source

Methods to control the source of the noise offer the greatest benefit to the largest number of receivers and should therefore be considered before other options.

5.1.1 Alternative alignment

As outlined in EIS Section 6.4.1, extensive assessment of alignment options has been undertaken since the route selection processed commenced in 2006. This process considered 8 options for the N2NS Phase 2 section including 5 Moree bypass options. A multi-criteria assessment identified that the Moree connectivity option was the preferred solution based on technical viability, safety considerations, operational approach, constructability and schedule, environmental impacts, community and property impacts, approvals and stakeholder engagement, and construction costs. No further re-alignment is feasible.

5.1.2 Controlling rail traffic volumes

A reduction in nighttime train movements, or a restriction of movements to less sensitive hours, would remove or reduce night time sleep disturbance. However, a key purpose of the proposal is to improve freight journey times and increase the capacity of the line, and such restrictions would impact journey times and reduce the capacity of the line, compromising the feasibility of the proposal. Therefore, it is not considered feasible to restrict the operating hours or reduce volumes during night-time.

5.1.3 Controlling rail traffic speeds

The posted speed though Moree is 60 km/h. Trains are predicted to travel between 55 and 60 km/h. Reducing the speed by an additional 10 km/h would reduce the wagons and locomotives noise contributions by 1.8 to 2.4 dB. It is noted that the purpose of the proposal is to increase capacity and operating speeds on the Moree to Camurra section. Train speeds through sections of Inland Rail have been designed to meet these purposes, and as such cannot be reduced. It is therefore not considered feasible to decrease the maximum operating speeds.

5.1.4 Rail dampers

Rail dampers are elements attached to the sides of the rails which improve the ability of the rails to decay noise-inducing vibrations resulting from the rolling contact between the wheel and rail. These noise reduction benefits are limited to reduction of wagon noise where it is dominated by the wheel/rail interaction. A range of other noise sources (locomotive engines and exhausts, noise radiating from freight wagon bodies, braking noise, level crossing bell noise and horn noise) would not be mitigated by the use of dampers. Additionally, rail dampers require routine maintenance and may therefore result in significant maintenance cost over the lifetime of the rail track. Rail dampers are considered feasible and reasonable, but the associated impact is expected to be low.

5.1.5 Track lubrication

Track lubrication strategies are useful to reduce noise from rail squeal on sections of alignment with tight curves. Rail squeal is unlikely to occur in the study area due to the large curve radius through Moree town, which essentially eliminates the risk of rail squeal. Track lubrication is therefore not feasible.

5.1.6 Crossing bell suppression

Level crossing bells consists of two different types: warning crossing bells (for road traffic) and pedestrian crossing bells. The sound power level of warning crossing bells is approximately 7 dBA higher than pedestrian bells, and as such, is the controlling noise source.

In accordance with ARTC *ESD-03-01 Level Crossing Design*, it is permissible to suppress the road warning bells at night between the hours of 10 pm and 6 am if:

- the road crossing is provided with booms, and
- dedicated pedestrian audible warning devices are switched on in lieu of the road warning bells during the nominated time (10 pm to 6 am).

Pedestrian audible warning devices are not to be silenced.

The suppression of road warning bells at night is already implemented at the Alice Street level crossing, and as such, is considered both feasible and reasonable.

5.1.7 Horn mitigation

Although drivers are trained to minimise unnecessary use of train horns as part of operating conditions, horns are important safety devices and are expected to be used at all public level crossings. It is therefore not considered feasible to suppress horns.

Wayside horns may be considered in lieu of traditional horns. A wayside horn is an automated audible warning located at a level crossing. Instead of the train operator sounding the train horn on approach to a level crossing, the wayside horn automatically sounds to provide a targeted audible noise event for vehicles and pedestrians at the crossing. Use of a wayside horn can remove the need for a train operator to sound the train horn adjacent to sensitive receivers. This will result in a noticeable reduction of the horn contribution to the overall noise levels at sensitive receivers. However, under current ARTC network rules, it is mandatory for train drivers to sound their horns as an operational requirement, rendering the introduction of wayside horns redundant.

5.1.8 Residential area reminder signage

Signage may be used to remind train drivers that they are in or approaching a residential area, with the desired outcome being a change in train driver horn use e.g. use of a single blast and/or shorter blasts. This is a relatively simple mitigation measure to install and maintain, and a previous study undertaken by ARTC indicated that such signage may have positive outcomes. However, results may vary by train driver, and it is not possible to apportion a quantifiable acoustic impact and will therefore not be included in assessments within this report. Nevertheless, due to the inexpensive nature and negligible impacts associated with signage, it is recommended that this option be presented to the community for consideration.

5.2 Controlling noise on the transmission path

Once options to control noise at the source are exhausted, options to control the transmission of noise should be considered. Noise can reach a listener either directly (in a straight line between the source and receiver) or indirectly by reflection or diffraction. By introducing a noise barrier between the noise source and the receiver, the amount of noise reaching the receiver can be significantly reduced.

A noise barrier is an artificial physical screen located between the source of the noise and a receiver, which interrupts the path of the noise. A specifically located fence/wall can act as a noise barrier. The physical screen must possess sufficient mass to attenuate the noise.

Noise barriers are typically constructed on the edge of rail corridors, shielding sensitive receivers from the noise generated by the operation of rail vehicles. Noise barriers can achieve a 10 to 15 dBA attenuation, particularly where the line of sight between the sensitive receptor and the noise source is fully impeded by the barrier; however, some diffracted noise would still be expected. Effectiveness is also dependant on distance from the noise source, materials used (absorptive or reflective) and the density of the barrier.

Barriers can differ in height to address different sources of noise e.g. a low barrier can mitigate noise from wheels, a higher barrier may help to mitigate noise from train horns or engines.

Provision of a noise barrier is considered feasible.

Construction costs and visual impacts are usually high making noise barriers more suitable to areas where noise attenuation is required for a larger number of receivers. Due to the residential nature of the study area, a noise barrier is also considered reasonable and therefore suitable for further assessment.

5.3 Controlling noise at the receiver

Once options for controlling noise at the source and transmission have been exhausted, the final mitigation strategies to be considered are those which control noise at the sensitive receivers. This is commonly referred to as 'at-property' or 'architectural' treatment.

The intrusion of rail noise within an affected property can be minimised by at-property treatment. Examples include installing thicker window glazing, roof insulation, door and window acoustic seals, mechanical/forced ventilation, and/or boundary fencing.

Appropriately designed measures, where windows are closed, can mitigate noise by up to 15 dB. However, the actual performance of these treatments is subject to the condition and design of the residence. Generally speaking, at-property treatments only provide noise mitigation for indoor areas; however, some outdoor noise mitigation may be provided by fencing upgrades to an 'acoustic' fence design at the boundary of individual receivers. At-property treatment is often the most practical option where individual receivers require noise mitigation and other mitigation options are not considered feasible and reasonable.

At-property treatments are considered suitable for further assessment. Further detailed discussion on these potential treatments are included in Section 6.3.

6 Noise mitigation options assessment

This section includes the results of noise modelling undertaken for selected noise mitigation options which were identified as potentially feasible and reasonable in Section 4.5. These options include rail dampers, warning bell suppression, the construction of noise barriers (1 m, 3 m, 4 m, 5 m and RING optimised versions were investigated) and at-property treatments.

Noise levels and mitigation options presented in this report are based on the tender design and may be changed following completion of final project design.

6.1 Controlling noise at the source

6.1.1 Bell suppression

As per Section 5.1, it is permitted to switch off warning bells at night. Table 6.1 summarises the predicted mitigated noise levels for the night-time period for the noise sensitive receivers listed in Table 4.6 with warning bells suppressed as a potential mitigation measure. The individual contributions of wagons, locomotives, horns and pedestrian bells are also presented (pedestrian bells cannot be switched off and are therefore still included as a noise source). Shaded cells show predicted exceedances of the relevant trigger levels (60 dBA $L_{Aeq, 9h}$ and 85 dBA L_{Amax}, see Table 2.1).

All tabulated results, including L_{Aeq} and L_{Amax} descriptors for the current year and the design year are detailed in Appendix A. Noise contour maps are provided in Appendix B.

Table 6.1 Noise sensitive receivers predicted to exceed – Warning bell suppression

Warning bell suppression	Predicted night time $L_{Aeq,9h}$, dBA					Predicted night time L_{Amax}, dBA				
	Wagons	Locos	Horns	Bells	All sources	Wagons	Locos	Horns	Bells	All sources
NNS_Rx1953	56	51	50	50	58	78	82	87	59	87
NNS_Rx1954	52	49	50	52	56	73	78	86	61	86
NNS_Rx1958	60	54	56	54	63	81	85	93	64	93
NNS_Rx1960	57	52	50	50	59	78	82	87	61	87
NNS_Rx1962	52	50	50	51	57	74	79	87	61	87
NNS_Rx1965	55	52	50	49	58	77	82	87	60	87
NNS_Rx1967	60	55	56	53	63	82	86	93	63	93
NNS_Rx1968	57	52	51	52	59	79	85	88	61	88
NNS_Rx1969	53	51	50	51	57	74	81	86	61	86
NNS_Rx1972	61	55	53	51	63	82	88	91	61	91
NNS_Rx1973	51	49	49	48	55	72	80	86	58	86
NNS_Rx1979	62	57	52	50	64	84	90	89	60	90
NNS_Rx1983	64	58	51	47	65	85	92	88	57	92
NNS_Rx1989	65	60	49	48	66	87	95	86	58	95
NNS_Rx1998	61	56	45	46	63	83	89	82	56	89
NNS_Rx1999	59	54	44	44	61	81	86	81	54	86
NNS_Rx3000	60	55	56	61	64	82	86	93	71	93
NNS_Rx3001	54	50	51	55	58	75	81	86	65	86

Switching the warning bells off at night alone would not be sufficient to achieve compliance at all residential receivers. A total of 18 receivers would still exceed the L_{Amax} noise trigger level of 85 dBA, and 9 receivers would still exceed the L_{Aeq} noise trigger level of 60 dBA.

However, this mitigation significantly reduces the contribution of the bell source to the overall noise level, leading to noise reductions of up to 6 dBA for the L_{Aeq} descriptor and a 2 dBA average reduction for the 18 receivers predicted to exceed.

6.1.2 Rail dampers

Rail dampers generally produce a noise reduction in the order of 2 to 5 dBA depending on the rail roughness. For smooth tracks, a 2 dBA reduction of the noise emitted by the wagon sources is anticipated.

Table 6.2 summarises the predicted mitigated noise levels for the night-time period for the noise sensitive receivers listed in Table 4.6, with a 2 dBA reduction applied to wagon noise only. The individual contributions of wagons, locomotives, horns and bells are also presented. Shaded cells show predicted exceedances of the relevant trigger levels (60 dBA $L_{Aeq, 9h}$ and 85 dBA L_{Amax}, see Table 2.1).

All tabulated results, including L_{Aeq} and L_{Amax} descriptors for the current year and the design year are detailed in Appendix A. Noise contour maps are provided in Appendix B.

Table 6.2 Noise sensitive receivers predicted to exceed – Rail dampers only

Rail dampers only	Predicted night time $L_{Aeq,9h}$, dBA					Predicted night time L_{Amax}, dBA				
	Wagons	Locos	Horns	Bells	All sources	Wagons	Locos	Horns	Bells	All sources
NNS_Rx1953	54	51	50	58	60	76	82	87	68	87
NNS_Rx1954	50	49	50	60	61	71	78	86	70	86
NNS_Rx1958	58	54	56	61	64	79	85	93	71	93
NNS_Rx1960	55	52	50	58	61	76	82	87	68	87
NNS_Rx1962	50	50	50	59	60	72	79	87	69	87
NNS_Rx1965	53	52	50	57	60	75	82	87	67	87
NNS_Rx1967	58	55	56	60	64	80	86	93	70	93
NNS_Rx1968	55	52	51	59	61	77	85	88	68	88
NNS_Rx1969	51	51	50	60	61	72	81	86	70	86
NNS_Rx1972	59	55	53	59	63	80	88	91	69	91
NNS_Rx1973	49	49	49	57	59	70	80	86	67	86
NNS_Rx1979	60	57	52	57	64	82	90	89	67	90
NNS_Rx1983	62	58	51	54	64	83	92	88	64	92
NNS_Rx1989	63	60	49	55	65	85	95	86	65	95
NNS_Rx1998	59	56	45	53	61	81	89	82	63	89
NNS_Rx1999	57	54	44	52	60	79	86	81	62	86
NNS_Rx3000	58	55	56	68	68	80	86	93	78	93
NNS_Rx3001	52	50	51	63	64	73	81	86	74	86

Rail dampers alone would not be sufficient to achieve compliance at all residential receivers. A total of 18 receivers would still exceed the L_{Amax} noise trigger level of 85 dBA, and 13 receivers would still exceed the L_{Aeq} noise trigger level of 60 dBA.

6.1.3 Summary

The noise assessment of the two at source mitigation measures initially assessed as feasible and reasonable concludes that rail dampers would provide an insignificant level of mitigation and should therefore not be considered further (see Table 6.3).

However, switching off warning crossing bells at night is predicted to reduce overall noise levels by up to 6 dBA at the southern end of the study area, and is already implemented at the Alice Street level crossing. This mitigation measure is recommended and is factored into noise predictions in Section 6.2 and Section 6.3.

Table 6.3 Noise sensitive receivers predicted to exceed by controlling noise at the source

	Predicted night time $L_{Aeq,9h}$, dBA		Predicted night time L_{Amax}, dBA	
	Bell	Dampers	Bell	Dampers
NNS_Rx1953	58	60	57	87
NNS_Rx1954	56	61	57	86
NNS_Rx1958	63	64	87	93
NNS_Rx1960	59	61	86	87
NNS_Rx1962	57	60	93	87
NNS_Rx1965	58	60	87	87
NNS_Rx1967	63	64	87	93
NNS_Rx1968	59	61	87	88
NNS_Rx1969	57	61	93	86
NNS_Rx1972	63	63	88	91
NNS_Rx1973	55	59	86	86
NNS_Rx1979	64	64	91	90
NNS_Rx1983	65	64	86	92
NNS_Rx1989	66	65	90	95
NNS_Rx1998	63	61	92	89
NNS_Rx1999	61	60	95	86
NNS_Rx3000	64	68	89	93
NNS_Rx3001	58	64	86	86

6.2 Controlling noise on the transmission path

This section considers a range of noise barriers to control noise on the transmission path.

Barrier heights specified in this report are measured from the top of the rail. Noise barriers are constructed on the formation and therefore a 5 m high noise barrier would be approximately 5.5 m high when making allowance for the ballast and sleepers.

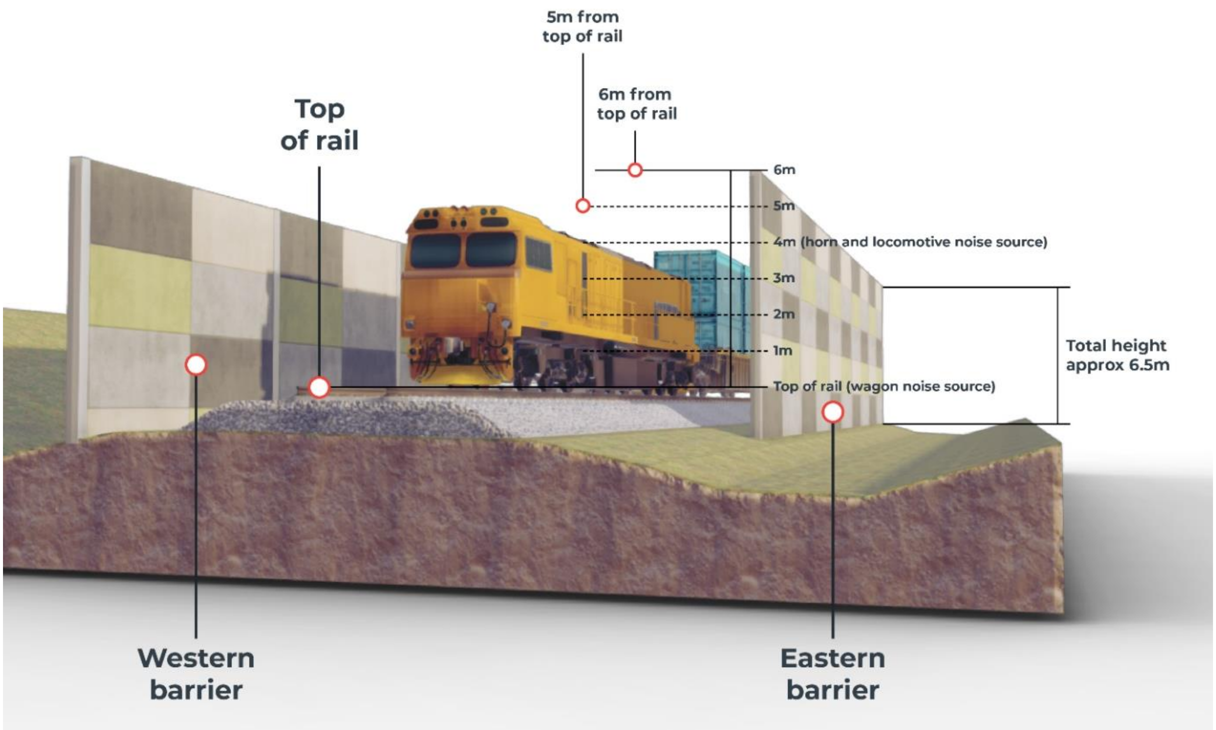


Figure 6.1 Cross section indicating proposed location of noise barriers in relation to tracks and modelled height of noise sources. The full height of the barriers would depend on the shape of the formation relative to the tracks, and therefore it is considered more accurate to describe the barriers with reference to the top of rail.

6.2.1 Noise barriers in the rail corridor

6.2.1.1 5 m high barriers

As a requirement of the PIR, noise modelling was undertaken for a 5 m high noise barrier. Modelling suggested that 320 m would be the optimum length required to protect the amenity of the eastern sensitive receivers identified in the PIR request. The eastern barrier is not proposed to extend further south as exceedances in the south are triggered by the fixed pedestrian crossing bells which cannot be shielded by the noise barrier (see receiver NNS_Rx3000 in Table 6.4). Additionally, extending the wall would compromise the safety of pedestrians and road traffic users of the level crossing and intersection. It is not proposed to extend the barrier further to the north as other receivers to the north-east were predicted to comply without a noise barrier.

The single barrier option does not protect receivers to the west of the tracks, therefore a second barrier would also be required. Modelling suggested that 120 m would be appropriate for this western barrier; a 5 m western barrier at this length achieves compliance for western receivers therefore a longer barrier is not necessary, a shorter barrier would reduce the noise mitigation efficacy.

A representation of noise barrier locations is presented in Figure 6.2. The indicative barrier design assumes the following:

- Noise barriers are located within the rail corridor boundary.
- Noise barriers are:
  - Eastern: 5 m high (from top of rail) and 320 m long, located on top of the embankment.
  - Western: 5 m high (from top of rail) and 120 m long, located on top of the embankment.
- Noise barriers are continuous and free of gaps.

Noise Mitigation Options Assessment Report

Figure 6.2
Noise barriers

Legend

- Sensitive receiver
- The proposal
- Noise barriers
- River
- Construction impact zone

0 40 80 Metres

Coordinate system: GDA 1994 MGA Zone 55

Scale ratio correct when printed at A3

1:1,800 Date: 15/12/2023

Data sources: -DCS, nearmap

Table 6.4 summarises the predicted mitigated noise levels for the night-time period for the noise sensitive receivers listed in Table 4.6. The individual contributions of wagons, locomotives, horns, and bells are also presented. Cells shaded in orange show predicted residual exceedances of trigger levels (60 dBA $L_{Aeq,\ 9h}$ and 85 dBA L_{Amax}, see Table 2.1). Warning bells are switched off at night as per Section 6.1.3.

All tabulated results, including L_{Aeq} and L_{Amax} descriptors for the current year and the design year are detailed in Appendix A. Noise contour maps are provided in Appendix B.

Table 6.4 Noise sensitive receivers predicted to exceed – 5 m noise barriers

5 m noise barriers	Predicted night time $L_{Aeq,9h}$, dBA					Predicted night time L_{Amax}, dBA				
	Wagons	Locos	Horns	Bells	All sources	Wagons	Locos	Horns	Bells	All sources
NNS_Rx1953	54	50	47	50	56	75	83	83	59	83
NNS_Rx1954	51	49	47	52	56	73	78	81	61	81
NNS_Rx1958	56	52	51	54	60	78	85	87	64	87
NNS_Rx1960	53	49	47	50	56	74	81	83	61	83
NNS_Rx1962	52	50	46	51	56	74	78	81	61	81
NNS_Rx1965	51	49	46	49	55	72	80	83	60	83
NNS_Rx1967	55	52	51	53	59	77	84	88	63	88
NNS_Rx1968	52	50	47	52	56	74	83	84	61	84
NNS_Rx1969	52	50	46	51	57	74	81	80	61	81
NNS_Rx1972	55	52	50	51	58	77	84	86	61	86
NNS_Rx1973	51	49	45	48	55	72	81	80	58	81
NNS_Rx1979	54	51	48	50	57	76	81	85	60	85
NNS_Rx1983	54	52	48	47	57	76	82	85	57	85
NNS_Rx1989	55	52	47	48	58	77	83	84	58	84
NNS_Rx1998	54	50	44	46	56	76	81	80	56	81
NNS_Rx1999	55	50	43	44	56	76	82	79	54	82
NNS_Rx3000	59	54	52	61	64	81	87	88	71	88
NNS_Rx3001	54	50	48	55	58	75	81	83	65	83

The results from the modelled 5 m high noise barriers (measured from top of rail, actual height approximately 5.5 m) indicated that this solution would not be sufficient to achieve compliance at all residential receivers. A total of 4 receivers would still exceed the L_{Amax} noise trigger level of 85 dBA, and 1 receiver would still exceed the L_{Aeq} noise trigger level of 60 dBA.

To provide alternative options for public consultation, 4 m, 3 m and 1 m high noise barriers are also investigated, as per the PIR requirements, in the following sections.

6.2.1.2 4 m high noise barriers

The noise barriers presented in this section are the same as the barriers presented in Section 6.1, with a height of 4 m (measured from the top of the rail, actual height approximately 4.5 m).

Table 6.5 summarises the predicted mitigated noise levels for the night-time period for the noise sensitive receivers listed in Table 4.6. The individual contributions of wagons, locomotives, horns and bells are also presented. Cells shaded in orange show predicted residual exceedances of trigger levels (60 dBA $L_{Aeq,\ 9h}$ and 85 dBA L_{Amax}, see Table 2.1). Warning bells are switched off at night as per Section 6.1.3.

All tabulated results, including L_{Aeq} and L_{Amax} descriptors for the current year and the design year are detailed in Appendix A. Noise contour maps are provided in Appendix B.

Table 6.5 Noise sensitive receivers predicted to exceed – 4 m noise barriers

4 m noise barriers	Predicted night time $L_{Aeq,9h}$, dBA					Predicted night time L_{Amax}, dBA				
	Wagons	Locos	Horns	Bells	All sources	Wagons	Locos	Horns	Bells	All sources
NNS_Rx1953	54	51	49	50	57	75	83	86	59	86
NNS_Rx1954	52	50	50	52	56	73	79	86	61	86
NNS_Rx1958	56	54	54	54	61	78	85	91	64	91
NNS_Rx1960	53	52	49	50	57	75	83	86	61	86
NNS_Rx1962	52	50	50	51	57	74	80	86	61	86
NNS_Rx1965	51	51	49	49	56	73	81	86	60	86
NNS_Rx1967	56	55	53	53	60	77	87	90	63	90
NNS_Rx1968	53	52	50	52	57	74	85	87	61	87
NNS_Rx1969	53	51	49	51	57	74	82	86	61	86
NNS_Rx1972	55	54	52	51	59	77	86	89	61	89
NNS_Rx1973	51	50	49	48	55	72	81	85	58	85
NNS_Rx1979	55	54	51	50	59	76	86	88	60	88
NNS_Rx1983	55	55	50	47	59	77	87	87	57	87
NNS_Rx1989	56	55	49	48	59	77	87	85	58	87
NNS_Rx1998	54	53	45	46	57	76	85	81	56	85
NNS_Rx1999	55	53	44	44	57	77	83	81	54	83
NNS_Rx3000	59	55	54	61	64	81	87	91	71	91
NNS_Rx3001	54	50	50	55	58	75	81	85	65	85

The results from the modelled 4 m high (relative to top of the rail) noise barriers indicated that this solution would not be sufficient to achieve compliance at all residential receivers. A total of 14 receivers would still exceed the L_{Amax} noise trigger level of 85 dBA, and 2 receivers would still exceed the L_{Aeq} noise trigger level of 60 dBA.

6.2.1.3 3 m high noise barriers

The noise barriers presented in this section are the same as the barriers presented in Section 6.1, with a height of 3 m measured from the top of the rail (actual height approximately 3.5 m).

Table 6.6 summarises the predicted mitigated noise levels for the night-time period for the noise sensitive receivers listed in Table 4.6. The individual contributions of wagons, locomotives, horns and bells are also presented. Cells shaded in orange show predicted residual exceedances of trigger levels (60 dBA $L_{Aeq,\ 9h}$ and 85 dBA L_{Amax}, see Table 2.1). Warning bells are switched off at night as per Section 6.1.3.

All tabulated results, including L_{Aeq} and L_{Amax} descriptors for the current year and the design year are detailed in Appendix A. Noise contour maps are provided in Appendix B.

Table 6.6 Noise sensitive receivers predicted to exceed – 3 m noise barriers

3 m noise barriers	Predicted night time $L_{Aeq,9h}$, dBA					Predicted night time L_{Amax}, dBA				
	Wagons	Locos	Horns	Bells	All sources	Wagons	Locos	Horns	Bells	All sources
NNS_Rx1953	54	51	50	50	57	76	82	87	59	87
NNS_Rx1954	52	49	50	52	57	74	78	86	61	86
NNS_Rx1958	56	55	56	54	61	78	85	93	64	93
NNS_Rx1960	53	52	50	50	57	75	82	87	61	87
NNS_Rx1962	53	50	50	51	57	74	79	87	61	87
NNS_Rx1965	52	52	50	49	57	73	82	87	60	87
NNS_Rx1967	56	55	56	53	61	78	86	93	63	93
NNS_Rx1968	53	52	51	52	57	75	85	88	61	88
NNS_Rx1969	53	50	50	51	57	75	81	86	61	86
NNS_Rx1972	56	55	53	51	60	77	88	91	61	91
NNS_Rx1973	51	49	49	48	56	73	80	86	58	86
NNS_Rx1979	55	57	52	50	60	77	90	89	60	90
NNS_Rx1983	56	58	50	47	61	77	92	87	57	92
NNS_Rx1989	57	59	49	48	61	79	93	86	58	93
NNS_Rx1998	55	56	45	46	59	77	89	82	56	89
NNS_Rx1999	55	54	44	44	58	77	86	81	54	86
NNS_Rx3000	60	55	56	61	64	81	86	93	71	93
NNS_Rx3001	54	50	51	55	58	76	81	86	65	86

Modelling of 3 m high (relative to top of the rail) noise barriers indicated that this solution would not be sufficient to achieve compliance at all residential receivers. A total of 18 receivers would still exceed the L_{Amax} noise trigger level of 85 dBA, and 5 receivers would still exceed the L_{Aeq} noise trigger level of 60 dBA.

6.2.1.4 1 m high noise barriers ('wheel walls')

The noise barriers presented in this section are the same as the barriers presented in Section 6.1, with a height of 1 m (measured from the top of the rail, actual height approximately 1.5 m), and are located closer to the tracks (2 m from the rail centreline).

Table 6.7 summarises the predicted mitigated noise levels for the night-time period for the noise sensitive receivers listed in Table 4.6. The individual contributions of wagons, locomotives, horns and bells are also presented. Cells shaded in orange show predicted residual exceedances of relevant trigger levels (60 dBA $L_{Aeq,\,9h}$ and 85 dBA L_{Amax}, see Table 2.1). Warning bells are switched off at night as per Section 6.1.3.

All tabulated results, including L_{Aeq} and L_{Amax} descriptors for the current year and the design year are detailed in Appendix A. Noise contour maps are provided in Appendix B.

Table 6.7 Noise sensitive receivers predicted to exceed – Wheel walls

Wheel walls	Predicted night time $L_{Aeq,9h}$, dBA					Predicted night time L_{Amax}, dBA				
	Wagons	Locos	Horns	Bells	All sources	Wagons	Locos	Horns	Bells	All sources
NNS_Rx1953	56	51	50	50	59	78	82	87	59	87
NNS_Rx1954	52	49	50	52	57	74	78	86	61	86
NNS_Rx1958	59	54	56	54	62	81	85	93	64	93
NNS_Rx1960	56	52	50	50	59	78	81	87	61	87
NNS_Rx1962	53	50	50	51	57	75	79	87	61	87
NNS_Rx1965	55	52	50	49	58	77	82	87	60	87
NNS_Rx1967	60	55	56	53	63	82	86	93	63	93
NNS_Rx1968	57	52	51	52	59	79	85	88	61	88
NNS_Rx1969	53	50	50	51	57	75	81	86	61	86
NNS_Rx1972	60	55	53	51	62	81	88	91	61	91
NNS_Rx1973	52	49	49	48	56	73	80	86	58	86
NNS_Rx1979	60	57	52	50	62	82	90	89	60	90
NNS_Rx1983	61	58	51	47	63	82	92	88	57	92
NNS_Rx1989	61	60	49	48	64	83	95	86	58	95
NNS_Rx1998	58	56	45	46	60	80	89	82	56	89
NNS_Rx1999	57	54	44	44	59	79	86	81	54	86
NNS_Rx3000	61	55	56	61	64	83	86	93	71	93
NNS_Rx3001	54	50	51	55	58	76	81	86	65	86

Low-level noise barriers would not be sufficient to achieve compliance at all residential receivers. A total of 18 receivers would still exceed the L_{Amax} noise trigger level of 85 dBA, and 7 receivers would still exceed the L_{Aeq} noise trigger level of 60 dBA.

6.2.1.5 RING optimised noise barriers

In order to achieve compliance for all sensitive receivers except for the Moree Hotel, the western noise barrier would need to be 120 m long and 4.5 m high from top of rail (approximately 5 m from ground level), and the eastern noise barrier would need to be 320 m long and would vary in height from 6 m in the south to 4 m in the north (approximately 6.5 m to 4.5 m from ground level). A representation of the location of the optimised noise barriers and the proposed heights are presented in Figure 6.3. Further investigations into the most appropriate placement for the barriers would be refined during detailed design, this would include consideration of locating a partial height western barrier atop the existing traffic bund. The final placement will be subject to geotechnical studies, agreement from the appropriate landowner, design constraints, safety and maintenance requirements and noise mitigation efficacy.

Noise Mitigation Options Assessment Report

Figure 6.3
RING optimised noise barriers

Legend

- The proposal
- River
- Construction impact zone

RING optimised noise barriers - height

- 4m
- 4.5m
- 5m
- 6m

0 40 80 Metres

Coordinate system: GDA 1994 MGA Zone 55

Scale ratio correct when printed at A3

1:1,800 Date: 15/12/2023

Data sources: - DCS, nearmap

Table 6.8 summarises the predicted mitigated noise levels (RING optimised barriers) for the night-time period for the noise sensitive receivers listed in Table 4.6. The individual contributions of wagons, locomotives, horns and bells are also presented. Shaded cells indicate predicted residual exceedances. In this scenario, warning bells remain switched off at night as per Section 6.1.3.

All tabulated results, including L_{Aeq} and L_{Amax} descriptors for the current year and the design year are detailed in Appendix A. Noise contour maps are provided in Appendix B.

Table 6.8 Noise sensitive receivers predicted to exceed – RING optimised noise barriers

RING optimised barrier	Predicted night time $L_{Aeq,9h}$, dBA					Predicted night time L_{Amax}, dBA				
	Wagons	Locos	Horns	Bells	All sources	Wagons	Locos	Horns	Bells	All sources
NNS_Rx1953	54	49	45	50	56	75	83	81	59	83
NNS_Rx1954	52	50	48	52	56	73	80	84	61	84
NNS_Rx1958	56	51	48	54	59	78	85	83	64	85
NNS_Rx1960	53	49	45	50	56	74	81	79	61	81
NNS_Rx1962	52	50	48	51	57	74	80	84	61	84
NNS_Rx1965	51	49	43	49	55	72	80	79	60	80
NNS_Rx1967	55	51	48	53	59	77	84	84	63	84
NNS_Rx1968	52	50	45	52	55	74	83	80	61	83
NNS_Rx1969	53	51	48	51	57	74	81	83	61	83
NNS_Rx1972	55	52	47	51	58	77	84	83	61	84
NNS_Rx1973	51	50	47	48	55	72	81	83	58	83
NNS_Rx1979	54	51	46	50	57	76	81	82	60	82
NNS_Rx1983	54	52	45	47	57	76	83	82	57	83
NNS_Rx1989	55	52	45	48	58	77	85	81	58	85
NNS_Rx1998	54	53	42	46	57	76	85	77	56	85
NNS_Rx1999	55	52	40	44	57	77	83	76	54	83
NNS_Rx3000	59	54	50	61	64	81	87	86	71	87
NNS_Rx3001	54	51	49	55	58	75	81	84	65	84

The RING optimised noise barriers would achieve compliance at all residential receivers with the exception of the Moree Hotel, which includes a permanent place of residence on the first floor.

6.2.2 Summary

As summarised in Table 6.9, use of at-source mitigation (warning bell suppression), plus either wheel walls, 3 m, 4 m or 5 m high noise barriers would not be sufficient to control exceedances of both descriptors. Exceedances of the L_{Amax} descriptor, controlled by the horns are predicted even with 5 m high noise barriers.

Table 6.9 Summary of noise mitigation measures – Controlling noise transmission

	Predicted night time $L_{Aeq,9h}$, dBA					Predicted night time L_{Amax}, dBA				
	5 m	4 m	3 m	1 m	RO*	5 m	4 m	3 m	1 m	RO*
NNS_Rx1953	56	57	57	59	56	83	86	87	87	83

	Predicted night time $L_{Aeq,9h}$, dBA					Predicted night time L_{Amax}, dBA				
	5 m	4 m	3 m	1 m	RO*	5 m	4 m	3 m	1 m	RO*
NNS_Rx1954	56	56	57	57	56	81	86	86	86	84
NNS_Rx1958	60	61	61	62	59	87	91	93	93	85
NNS_Rx1960	56	57	57	59	56	83	86	87	87	81
NNS_Rx1962	56	57	57	57	57	81	86	87	87	84
NNS_Rx1965	55	56	57	58	55	83	86	87	87	80
NNS_Rx1967	59	60	61	63	59	88	90	93	93	84
NNS_Rx1968	56	57	57	59	55	84	87	88	88	83
NNS_Rx1969	57	57	57	57	57	81	86	86	86	83
NNS_Rx1972	58	59	60	62	58	86	89	91	91	84
NNS_Rx1973	55	55	56	56	55	81	85	86	86	83
NNS_Rx1979	57	59	60	62	57	85	88	90	90	82
NNS_Rx1983	57	59	61	63	57	85	87	92	92	83
NNS_Rx1989	58	59	61	64	58	84	87	93	95	85
NNS_Rx1998	56	57	59	60	57	81	85	89	89	85
NNS_Rx1999	56	57	58	59	57	82	83	86	86	83
NNS_Rx3000	64	64	64	64	64	88	91	93	93	87
NNS_Rx3001	58	58	58	58	58	83	85	86	86	84

*RING optimised

Warning bell suppression plus the RING optimised barrier design would achieve RING trigger value compliance at all residential receivers with the exception of the Moree Hotel, which includes a permanent place of residence on the first floor facing the tracks. Noise impacts at the Moree Hotel are unable to be mitigated (i.e. compliance with the relevant trigger levels cannot be achieved) by a noise barrier; the main contributing noise source is the level crossing bells, which cannot be shielded by a barrier without compromising the safety of pedestrians and road traffic users of the level crossing and intersection.

6.3 Controlling noise at the receiver

As outlined in Section 5.3, once options for controlling noise at the source and the transmission path have been exhausted, the final mitigation strategy to be considered is measures at noise impacted receivers.

At-property (or 'architectural') treatment typically consists of upgrades to building façades that are adversely impacted by rail noise. Façade upgrades may include upgraded glazing and acoustic seals for the windows and solid core doors with acoustic seals. Ventilation upgrades may include the provision of mechanical ventilation or air-conditioning for habitable spaces (or replacement of older existing systems). The objective of these treatments is to reduce internal rail noise levels at noise-impacted properties.

At-property treatment may also include an upgrade or construction of a property fence. This may be the only treatment applied to buildings that are unsafe or in a state of disrepair. Examples of at-property treatments are shown in Figure 6.4.

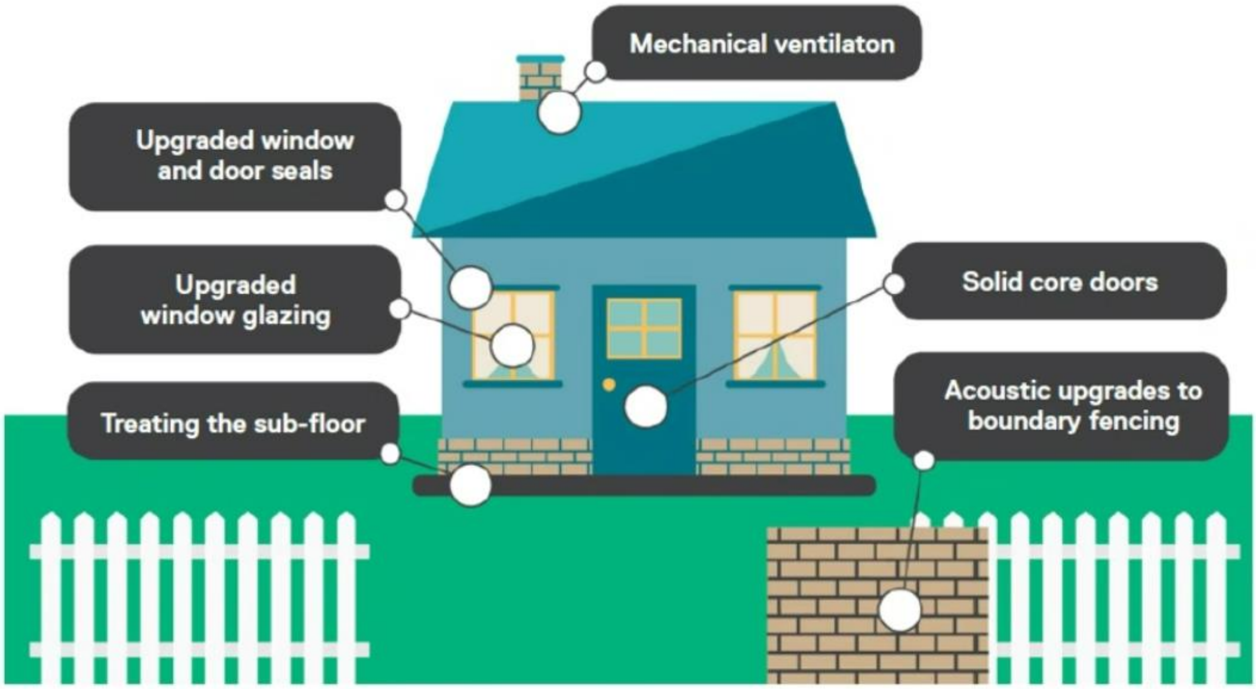


Figure 6.4 Examples of at-property treatments (Source: ARTC)

At-property acoustic treatment is most effective for rolling noise and less effective for low-frequency noise such as locomotive noise. The controlling noise sources for the receivers under investigation in this report are wagon generated noise and horns. It is expected architectural treatments will be effective for wagon generated noise (L_{Aeq}), but less effective for horns (L_{Amax}).

6.3.1 Noise treatment assessment

6.3.1.1 Condition Reports

Where at-property treatments are determined to be the most feasible and reasonable treatment for a directly impacted receiver, a building condition report will be prepared for the dwelling by a suitably qualified person. The building condition report will include:

- The type, configuration and construction materials of all openings (windows, doors, wall vents and similar penetrations) on facades identified for acoustic treatment.
- Presence of existing defects in facades exposed to railway noise .
- Existing glass gauge of any identified windows and the condition of any existing seals.
- Accessibility of confined spaces such as roof space and under floor space
- All data needed to develop a plan of the dwelling and any key surrounding features that may affect the works (e.g., direction of rail alignment); and
- The electrical supply and load details, sufficient to determine supply capability and any potential upgrade requirements.
- Presence of any hazardous materials such as asbestos.

6.3.1.2 Scope of work

Once the building condition report is complete, a scope of work detailing the at-property treatments will be prepared. The scope of work will be tailored to the property and is subject to all relevant design standards, including Australian standards and building codes, work health and safety requirements and planning constraints (e.g. bushfire, heritage). Inland Rail has developed treatment packages to guide the development of the scope of work and ensure consistency across the Inland Rail Program.

Treatment packages

The at-property treatment packages for N2NS SP2 are based on ARTC's experience delivering treatments across the ARTC network (including Inland Rail), current industry best-practice, and approaches from other major infrastructure projects. Additionally, they have been refined through consultation with industry partners involved in delivering the Transport for NSW road and rail noise abatement programs. These packages are currently being implemented on other Inland Rail projects to ensure a consistent mitigation approach for impacted receivers.

At-property packages will be tailored to properties exceeding the RING trigger levels, based on the degree of exceedance, the condition of the property and the homeowner’s preferences.

Treatments are only applied to the eligible façades of ‘habitable’ rooms. Rooms that are not considered habitable include garages, storage areas, bathrooms, laundries, toilets, verandahs, balconies or pantries will not be subject to treatment.

All proposed noise treatment selections and the final scope of work will be agreed with individual property owners. In cases where there are disagreements with impacted property owners that Inland Rail is unable to resolve, the matter will be escalated to the Department of Planning and Environment for advice.
Table 6.10 summarises the example at-property treatment packages. The treatment packages also apply where at-property treatments are provided to manage residual impacts.

Table 6.10 At-property treatment packages - Description

Predicted noise levels [3]	Example treatment package [1]
Exceed criterion by less than 3 dBA	Package A1: — A ventilation system (air con, evaporative or mechanical) that meet building code of Australia requirements with the windows and doors shut [5] — Ceiling fans — Fill minor gaps[6] in external facade OR Package A2: — Upgrading windows with 10.38 mm laminate glazing and acoustic rated seals — Upgrading external doors with acoustic rated seals — Fill minor gaps in external facade — Ceiling fans Other treatments may include: — Upgrades to existing property boundary fencing [2] — Vegetation [4]
Exceed criterion by 3 dBA but less than 10 dBA	Package B: — A ventilation system (air con, evaporative or mechanical) that meet building code of Australia requirements with the windows and doors shut [5] — Upgrading windows with 10.38 mm laminate glazing and acoustic rated seals — External solid core doors with surface mounted moulds minimum 40 mm and provide acoustic rated seals — Fill minor gaps in external façade — Ceiling fans Other treatments may include: — Upgrades to existing property boundary fencing [2] — Vegetation [4]
Exceed criterion by 10 dBA or more	Package C: — A ventilation system (air con, evaporative or mechanical) that meets building code of Australia requirements with the windows and doors shut [5] — Upgrading windows with 10.38 mm laminate glazing and acoustic rated seals — External solid core doors with surface mounted moulds minimum 40 mm and provide acoustic rated seals — Fill minor gaps in external façade — Appropriately treating the sub-floor — Sealing of wall vents, underfloor below the bearers and eaves

Predicted noise levels [3]	Example treatment package [1]
	— Upgrade façade constructions where applicable (i.e. only light weight constructions). This may include wall insulation (e.g., R2.7 90 mm thick) and re-sheeting of lightweight wall construction — Ceiling insulation (e.g., R4.0 215 mm thick) — Celling fans Other treatments may include: — Upgrades to existing property boundary fencing [2] — Vegetation [4]

1. For habitable rooms (i.e., not garages, laundries, bathrooms) where the external façade is exposed to noise levels above the criteria.
2. This may be the only treatment applied to buildings that are unsafe or in a state of disrepair
3. Based on 'design year' predictions (absolute noise levels) – 2040 either L_{Aeq} or L_{Amax}
4. Seedlings or plants to provide a visual barrier. Sparse vegetation provides no acoustic benefit
5. Where any existing systems are more than 5 years old.
6. Minor gaps are those that are a result of normal wear and tear or building movement or redundant vents.

To achieve the full acoustic benefit of the façade treatments, doors and windows facing the rail corridor need to be closed and therefore, to ensure compliance with the Building Code of Australia, a ventilation system (e.g. air conditioning, evaporative cooling, or other mechanical system) may need to be installed. Properties opting for evaporative cooling systems may have acoustic vents installed to maintain the necessary airflow, allowing doors and windows to remain closed while the cooling system operates.

If property owners accept ventilation as part of their treatment package, they would be responsible for ongoing costs such as electricity and maintenance.

Upgrades to property boundary fencing are also an option to mitigate railway noise at the receiver where only a small noise reduction in noise is required or where the dwelling is unsuitable for facade treatment due to being unsafe or in a state of disrepair (see Section 6.3.1.3 for limitations of at-property treatments). Typically, boundary fences have height limitations and can only be used for single-storey residences in line with relevant local or state regulations.

A synthesis of the most appropriate at-property treatment packages (Table 6.10) for the receivers predicted to exceed the relevant noise triggers ($L_{Aeq,9h}$ or L_{Amax}, whichever exceedance is the greatest) following the implementation of the level crossing bell suppression (as per Section 6.1.1) is detailed in Table 6.11. These property treatments are considered an alternative to the noise barriers detailed in Section 6.2.1. At-property treatment packages for the directly impacted receivers are listed in Table 6.11; these will be subject to limitations discussed in Section 6.3.1.3).

Table 6.11 Suitable at-property treatment packages for impacted dwellings

Receiver	Construction description	Predicted night time exceedance, dBA	Package (see Table 6.10)
NNS_Rx1953	Mix of cement block (ground floor), fibre cement sheet façade (both floors), steel sheet roofing, timber doors, aluminium window frames.	2	A
NNS_Rx1954	Timber weatherboard façade, steel sheet roofing, unknown doors, timber window frames, substantial number of louvers present, elevated floor	1	A
NNS_Rx1958	Timber weatherboard façade, steel sheet roofing, timber door, mix of timber and aluminium window frames.	8	B
NNS_Rx1960	Mix of cement block (ground floor) fibre cement (first floor) and metal sheeting façade (both floors), steel sheet roofing, timber doors and aluminium window frames	2	A
NNS_Rx1962	Mix of timber weatherboard and fibre cement sheet facade, steel sheet roofing, timber/glazed door, aluminium window frames, substantial number of louvers present, elevated floor	2	A
NNS_Rx1965	Building no longer present (refer Section 3.1)	2	A
NNS_Rx1967	Timber weatherboard façade, steel sheet roofing, mix of glazed and timber doors, aluminium window frames	8	B
NNS_Rx1968	Timber weatherboard façade, steel sheet roofing, timber doors, aluminium window frames	3	B
NNS_Rx1969	Brick façade, sheet steel roofing, unknown doors, window frames, floor at ground level	1	A
NNS_Rx1972	Timber weatherboard façade, steel sheet roofing, timber doors, mix of aluminium and timber window frames, louvers also present	6	B
NNS_Rx1973	Weatherboard façade, sheet steel roof, undetermined doors and window frames, elevated floor.	1	A
NNS_Rx1979	Mix of timber weatherboard, timber panel and plywood façade, steel sheet roofing, timber doors, unknown window frames, louvers also present.	5	B
NNS_Rx1983	Timber weatherboard façade, steel sheet roofing, timber doors, aluminium window frames, louvers also present.	7	B
NNS_Rx1989	Mix of timber weatherboard and fibre cement façade, steel sheet roofing, undetermined door and window frames.	10	C
NNS_Rx1998	Timber weatherboard façade, steel sheet roofing, timber doors, aluminium window frames	4	B

Receiver	Construction description	Predicted night time exceedance, dBA	Package (see Table 6.10)
NNS_Rx1999	Timber and timber look weatherboard façade, steel sheet roofing, timber doors, mix of aluminium and timber window frames	1	A
NNS_Rx3000	Mix of timber weatherboard and fibre cement façade, steel sheet roofing, timber/glazed doors and a mix of timber and aluminium window frames.	8	B
NNS_Rx3001	Rendered blockwork/brick façade, ceramic tile roofing, timber doors, aluminium window frames, floor at ground level.	1	A

6.3.1.3 At-property treatment limitations

At-property treatments are the least preferred mitigation option as they only address internal noise. Some properties may not be eligible for at-property treatments where:

- Treatment cannot be installed due to the existing construction or condition of the property.
- Treatment cannot be installed in compliance with current building standards and guidelines including the Building Code of Australia.
- Building is under construction, or external facades are not yet completed to meet minimum regulations.
- Limitations due to local planning controls.
- Internal or external access to the building is restricted.
- Presence of hazardous materials (e.g., asbestos) that pose a risk to builders or residents.
- The property is not an approved dwelling and/or does not have an occupation certificate.
- Treatment is not cost effective for the achieved noise reduction.
- A noticeable (3dBA or more) noise reduction cannot be achieved.

These constraints will be considered by Inland Rail in identifying reasonable and feasible mitigation measures for eligible properties.

6.4 Sensitivity analysis

While noting that the noise modelling methodology used within this report has been successfully applied elsewhere on the Inland Rail project, and that the model incorporates a number of layers of conservatism, this section outlines a sensitivity analysis undertaken to consider potential variations in operational noise levels. Variations between noise levels predicted in this report and actual noise levels may result from the following:

- inability to verify the model leading to an underestimation or overestimation of noise levels
- discrepancies between inputs used in the model and actual parameters (e.g. number of trains, speed, building heights).

A sensitivity analysis of the noise modelling results was undertaken in order to ensure that the proposal adequately accounts for potential variations in modelling parameters. Potential variations and associated impacts are listed in Table 6.12.

Table 6.12 Potential variations in modelling parameters

Location	Parameter	Risk	Variation	Impact L_{Aeq}	Impact L_{Amax}
Source	Rail traffic	Negligible A total of 27 trains per 24 hours, including 12 trains at night is considered in the model for the design year. The actual rail traffic on the line for the design year is 20 trains over 24 hours.	No additional increase in traffic is considered.	-	-
	Speeds	Low Noise modelling is based on forecasted speeds, i.e. 55 km/h and 60 km/h in the study area. Trains are not permitted to exceed the posted speed of 60 km/hr.	No variation is considered.	-	-
	Source levels	Low Source levels are consistent with other Inland Rail sections where model has been validated.	No variation is considered. Source levels are robust and validated on other sections of Inland Rail.	-	-
Path	Ground absorption	Medium Local ground between the tracks and the receivers may be more reflective.	A ground absorption coefficient of 0.25 instead of 0.5 is considered.	0 dBA for wagons and locos [1] 0 dBA for horns and bells [2]	0 dBA for wagons and locos [1] 0 dBA for horns and bells [2]
Receiver	Receiver height	Medium Both floors of double storey houses have been assessed.	For single storey houses raised over the local ground level, the height of the receiver is increased by 1 m.	0.7 dBA for wagons and locos 0.3 dBA for horns and bells	0.7 dBA for wagons and locos 0.3 dBA for horns and bells
Cumulative impact				Wagons: 0.7 dBA Locos: 0.7 dBA Horns: 0.3 dBA Bells: 0.3 dBA	Wagons: 0.7 dBA Locos: 0.7 dBA Horns: 0.3 dBA Bells: 0.3 dBA

[1] The Nordic Rail Prediction Method (Kilde Report 130) as implemented in SoundPLAN 8.2 for rail sources considers ground absorption of 0.5 or lower as fully reflective hard surfaces.

[2] As per ISO9613 algorithm as implemented in SoundPLAN 8.2 for fixed tonal source.

6.4.1 Impact on the RING optimised noise barrier

Table 6.13 summarises the predicted mitigated noise levels (RING optimised barriers) for the night-time period with the additional impacts as per Table 6.12. The individual contributions of wagons, locomotives, horns and bells are also presented. Shaded cells indicate predicted residual exceedances. In this scenario, warning bells remain switched off at night as per Section 6.1.3.

Table 6.13 Sensitivity analysis – RING optimised noise barriers

RING optimised barrier	Predicted night time $L_{Aeq,9h}$, dBA					Predicted night time L_{Amax}, dBA				
	Wagons	Locos	Horns	Bells	All sources	Wagons	Locos	Horns	Bells	All sources
NNS_Rx1953	54	50	46	50	57	76	84	82	60	84
NNS_Rx1954	52	51	49	52	57	74	81	84	62	84

RING optimised barrier	Predicted night time $L_{Aeq,9h}$, dBA					Predicted night time L_{Amax}, dBA				
	Wagons	Locos	Horns	Bells	All sources	Wagons	Locos	Horns	Bells	All sources
NNS_Rx1958	57	52	48	54	60	78	86	84	64	86
NNS_Rx1960	53	50	45	50	57	75	82	80	61	82
NNS_Rx1962	53	51	48	51	57	74	81	84	61	84
NNS_Rx1965	51	50	44	50	55	73	80	80	60	80
NNS_Rx1967	56	52	49	53	59	78	85	84	63	85
NNS_Rx1968	53	51	45	52	56	75	84	80	62	84
NNS_Rx1969	53	52	48	52	57	75	82	84	61	84
NNS_Rx1972	56	52	47	51	58	77	84	83	62	84
NNS_Rx1973	52	51	47	48	56	73	82	83	59	83
NNS_Rx1979	55	52	46	50	58	77	82	82	60	82
NNS_Rx1983	55	53	46	47	58	77	84	82	57	84
NNS_Rx1989	56	53	45	48	58	78	85	81	58	85
NNS_Rx1998	55	54	43	46	57	77	86	78	56	86
NNS_Rx1999	56	53	40	45	57	77	84	76	55	84
NNS_Rx3000	60	55	50	61	64	82	88	86	71	88
NNS_Rx3001	54	52	49	56	59	76	82	84	65	84

In addition to the Moree Hotel, which includes a permanent place of residence on the first floor, two additional receivers, NNS_Rx1958 and NNS_Rx1998 are predicted to exceed by 1 dBA as a result of applying the variables considered in the sensitivity analysis (i.e. cumulative impact of a more reflective ground surface and houses raised up to 1 m above local ground).

6.4.2 Impact on at-property treatments

Table 6.14 summarises the predicted mitigated noise levels for the night-time period with control at the source only (i.e. warning bells suppressed) and with the additional impacts as per Table 6.12. The individual contributions of wagons, locomotives, horns and pedestrian bells are also presented (pedestrian bells cannot be switched off and are therefore still included as a noise source). Shaded cells show predicted exceedances of the relevant trigger levels.

Table 6.14 Sensitivity analysis – Warning bell suppression

Warning bell suppression	Predicted night time $L_{Aeq,9h}$, dBA					Predicted night time L_{Amax}, dBA				
	Wagons	Locos	Horns	Bells	All sources	Wagons	Locos	Horns	Bells	All sources
NNS_Rx1953	57	52	51	50	59	79	82	87	60	87
NNS_Rx1954	52	50	51	52	57	74	79	87	62	87
NNS_Rx1958	60	55	56	54	63	82	86	93	64	93
NNS_Rx1960	57	52	50	50	60	79	82	87	61	87
NNS_Rx1962	53	50	51	51	57	74	79	87	61	87
NNS_Rx1965	56	52	50	50	59	78	82	87	60	87
NNS_Rx1967	61	56	56	53	63	83	87	93	63	93
NNS_Rx1968	58	53	52	52	60	80	86	88	62	88

Warning bell suppression	Predicted night time $L_{Aeq,9h}$, dBA					Predicted night time L_{Amax}, dBA				
	Wagons	Locos	Horns	Bells	All sources	Wagons	Locos	Horns	Bells	All sources
NNS_Rx1969	53	51	50	52	58	75	82	87	61	87
NNS_Rx1972	61	56	54	51	63	83	89	91	62	91
NNS_Rx1973	51	50	50	48	56	73	81	86	59	86
NNS_Rx1979	63	58	52	50	65	85	91	89	60	91
NNS_Rx1980	51	49	49	48	55	72	80	86	58	86
NNS_Rx1983	64	59	51	47	66	86	92	88	57	92
NNS_Rx1987	58	54	46	46	60	80	86	83	57	86
NNS_Rx1989	66	60	50	48	67	87	96	87	58	96
NNS_Rx1993	59	54	45	46	61	82	85	82	56	85
NNS_Rx1998	62	57	46	46	63	84	90	82	56	90
NNS_Rx1999	60	55	45	45	61	82	86	81	55	86
NNS_Rx3000	61	55	56	61	65	83	87	93	71	93
NNS_Rx3001	54	51	51	56	59	76	82	87	65	87

The cumulative impact of applying a more reflective ground surface, and raising houses by up to 1 m above local ground would lead to a total of 21 properties requiring at-property treatments, in the absence of a noise barrier, i.e. 3 additional properties (Rx1980, Rx1987, and Rx1993) compared to Table 6.11. Additionally, noise levels at 6 properties would be approximately 1 dBA higher; at-property treatment packages listed in Table 6.11 remain the same for these 6 properties.

As noted in Section 6.3, these property treatments are considered an alternative to the noise barriers detailed in Section 6.2.1. The RING recommends the implementation of noise control on the transmission path, i.e. noise barriers, before considering noise mitigation at the receivers (i.e. at-property treatments).

6.4.3 Conclusion

As outlined above, the noise modelling methodology used within this report has been successfully applied on other sections of the Inland Rail project (see Section 4.5.2) and the model incorporates a number of layers of conservatism including 35% higher train movements than ARTC forecasted levels for the design year, and a very low ground absorption level (see Section 4.5.1).

Nevertheless, the sensitivity analysis demonstrates that where 0.7 dBA is added to account for potential discrepancies between modelling inputs and actual conditions during the design year, the number of directly impacted receivers (i.e. receivers within the study area who are predicted to exceed RING trigger levels) would increase by 2, to a total of 3, with the RING optimised barrier and warning bell suppression and by 3, to a total of 21, with at-property treatment and warning bell suppression, in the absence of the noise barrier.

Both mitigation options, the RING optimised noise barriers and at-property treatments, will be reviewed during the preparation of the Operational Noise and Vibration Review (ONVR) during the Detailed Design of the project. It is likely that by increasing the height of the eastern barrier by 0.5 m it will be sufficient to control the additional 2 exceedances contemplated in the sensitivity analysis, assuming the noise barrier is considered preferential following the community consultation.

The sensitivity analysis concludes that the modelling approach is robust and in the event of discrepancies between the modelling inputs and actual conditions during the design year, additional controls can easily be implemented. Based on the conservative approach of modelling 35% higher than anticipated train movements, it is likely that lower impacts than considered in this assessment will eventuate.

7 Environmental assessment of noise mitigation options

This section includes further environmental assessment, including potential heritage, visual and social impacts for the noise mitigation options assessed in Section 6.

7.1 Heritage impacts

This section considers potential heritage impacts from the implementation of noise barriers and at-property treatments. Warning bell suppression and rail dampers would not be expected to have heritage impacts and are therefore not considered further in this section.

Key tasks include:

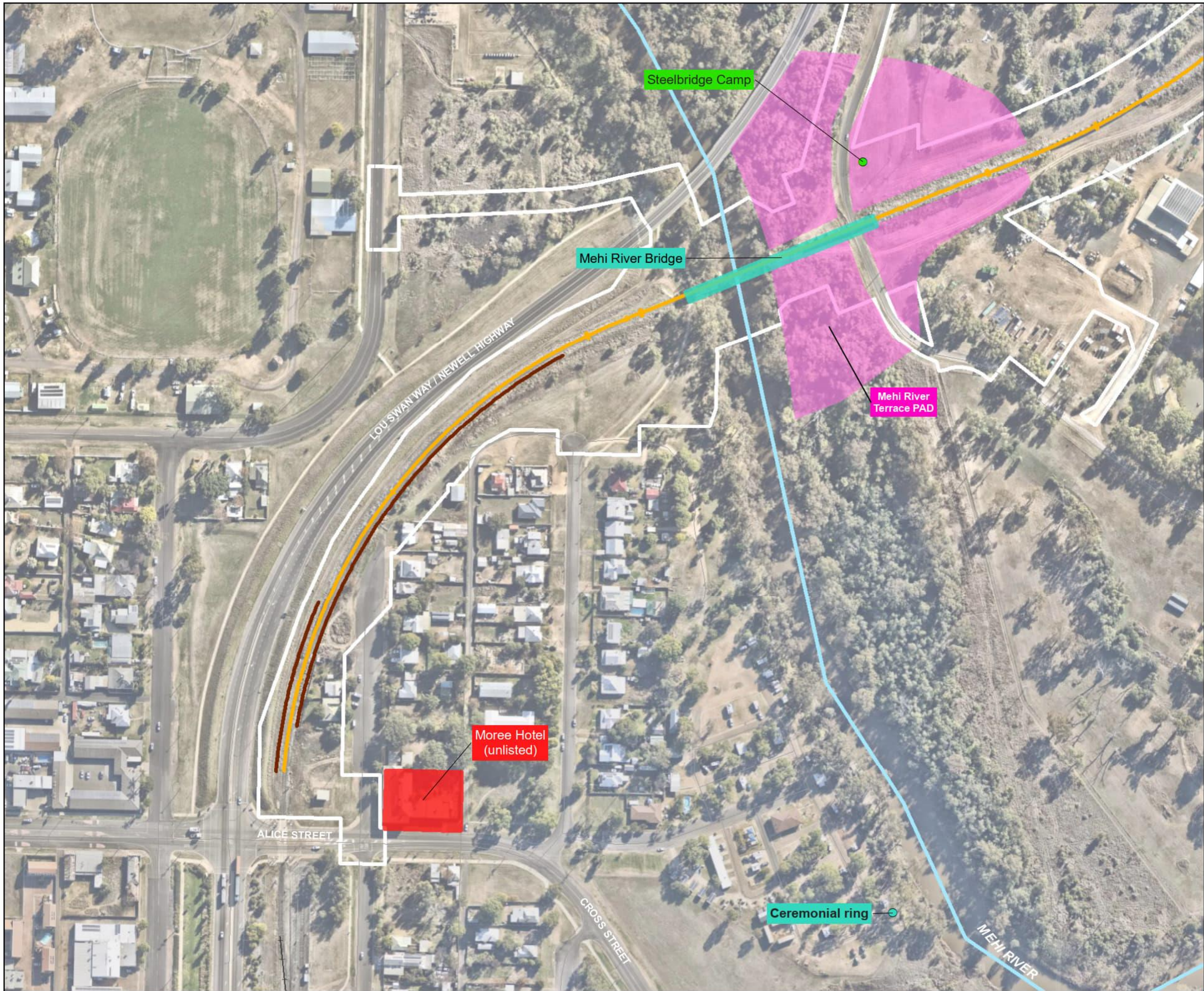
- identification of the area to be impacted by works
- review of EIS heritage impacts as considered in the Statement of Heritage Impact (SOHI) (Technical Paper 7) and Aboriginal Cultural Heritage Assessment Report (ACHAR) (Technical Paper 6) to determine if any new impacts exist that are inconsistent with the assessment and mitigation measures already included in the EIS
- developing additional mitigation measures, if required.

7.1.1 Background

An Aboriginal cultural heritage assessment for the proposal was undertaken for the EIS in accordance with the Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (NSW OEH, 2011) and the Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales (DECCW, 2010) and included a desktop assessment, RAP consultation, and field surveys. Similarly, the assessment of non-Aboriginal heritage included both a desktop assessment and site survey. The methodologies are further detailed in the EIS in Technical Paper 6, Technical Paper 7, and Section 15.2.2.

The study area for the purposes of the Aboriginal and non-Aboriginal heritage assessment undertaken for the EIS was defined as the Construction Impact Zone (CIZ), identified as the area that would be directly impacted by construction works. The CIZ boundary included, at a minimum, land up to 12 m from the centreline of the railway; this would include the footprint of the proposed noise barriers. Additional buffers were added to the CIZ for non-aboriginal heritage database searches and visual assessments.

The findings of the EIS heritage assessments are summarised below, with consideration of whether noise mitigation treatments may result in impacts consistent with those outlined in the EIS. Heritage features located in the general vicinity of proposed noise barrier works are shown in Figure 7.1.



Noise Mitigation Options Assessment Report

Figure 7.1
Surrounding heritage features

Legend

- The proposal
- Noise barriers
- River
- Construction impact zone
- PAD Extents
- Unlisted Heritage Items
- ARTC CRN s170 Heritage Register Items

AHIMS

- Artefact, Potential Archaeological Deposit (PAD)
- Ceremonial Ring (Stone or Earth)

0 50 100 Metres

Coordinate system: GDA 1994 MGA Zone 55

Scale ratio correct when printed at A3

1:2,500 Date: 15/12/2023

Data sources: - DCS, nearmap

7.1.2 Non-Aboriginal heritage

No listed heritage items were identified within the CIZ study area, including no items on the statutory World Heritage List, Commonwealth Heritage List, National Heritage List, or State Heritage Register.

No non-statutory listed items on the Register of the National Trust or the Register of the National Estate were identified within the noise mitigation study area.

The Mehi River bridge (located approximately 80 m north-east) is a listed heritage item. The bridge would be delisted and demolished as part of the railway upgrade works and is therefore not considered further in this assessment. Noise mitigation options considered in this report have no influence on the Mehi River bridge.

The Moree Hotel (NNS_Rx3000), located approximately 60 m east of the southern extent of the noise barrier, was identified as a potential heritage item. An assessment undertaken for the EIS concluded that the Hotel meets the threshold for local significance. Heritage impacts of noise mitigation measures on the Moree Hotel are considered below.

The locally listed Victoria Hotel and Moree Railway Station, located more than 250 m south of the southern extent of the proposed noise barriers, would not experience any direct or indirect impacts from implementation of noise mitigation options proposed in this assessment.

7.1.2.1 Noise barriers

The Moree Hotel would experience some short-term vibration impacts during construction. As detailed in Section 7.5 of this report, an indicative minimum working distance of 4 m is recommended for the plant item causing the most amount of vibration (excavator). The Moree Hotel, located approximately 60 m from the edge of the works, is expected to be of a sufficient distance that vibrations resulting from the proposed works would not cause structural or cosmetic damage. Mitigation measures to further protect the Moree Hotel have been included in the EIS; these include CH-8 and NV-3 which require a dilapidation study and vibration assessment prior to construction.

7.1.2.2 At-property treatment

At-property treatment may include façade treatments which have the potential to impact the heritage character of a building. As the Moree Hotel is not listed on any heritage registers there are no statutory guidelines which would apply to at-property treatments for this building. However, mitigation measure CH-19 has been added to include the need for consultation with a heritage architect should at-property treatment of Moree Hotel be proposed (refer to updated mitigation measures in PIR Appendix B).

7.1.3 Aboriginal cultural heritage

Impacts to Aboriginal cultural heritage resulting from at-property treatments are unlikely. In the event that ground disturbance occurs as a result of such treatments, unexpected finds protocols would be in place (refer to mitigation measure CH-9).

In relation to the proposed noise barriers, searches undertaken for the EIS did not identify any Aboriginal cultural heritage items or sites within or closely adjacent to the construction footprint, including:

- no Aboriginal Heritage Information Management System (AHIMS) sites
- no Aboriginal places, as declared under section 84 of the *National Parks and Wildlife Act 1974*
- no new Aboriginal sites identified during the archaeological survey
- no areas of potential archaeological deposits.

Waterways are identified as highly significant to Aboriginal people. Waterways in Moree were of importance to Aboriginal people as a place for recreation during the period in which access to Moree town places was restricted for Aboriginal people. On the eastern bank of the Mehi River the Steel Bridge Camp and landforms are considered to be of high Aboriginal cultural significance, and the adjacent Mehi River terraces are noted as areas of potential archaeological deposit (PAD) (see Figure 7.1). Impacts to the areas adjacent to the Mehi River bridge would occur as a result of bridge upgrade works and have been assessed as part of the EIS. No new impacts would occur as a result of the noise barrier construction.

As noted above, unexpected finds protocols would be in place where ground disturbance occurs (refer to mitigation measure CH-9).

7.1.4 Conclusion

The proposed noise barriers are not expected to have any cultural heritage impacts. The nearby Moree Hotel and areas adjacent to the Mehi River hold some cultural significance; however, these areas are unlikely to be impacted by the noise barrier works. A number of EIS mitigation measures would further help to manage any potential impacts, these include the need for dilapidation studies (CH-8 and NV-3), and an unexpected finds protocol (CH-9).

Where at-property treatment of Moree Hotel is considered practical and feasible, consultation with a heritage architect would be undertaken to ensure that heritage values are maintained (refer to mitigation measure CH-19).

7.2 Visual impacts

This section contains a qualitative assessment of the visual impacts from construction of the noise barriers only since it is accepted that other mitigations (bell suppression, rail dampers, and at-property treatments) will result in negligible visual impact. Key tasks included:

- selection of up to 4 public viewpoints likely to provide representation of the noise barriers
- identification of key impacted sensitive receivers
- determination of the overall significance of visual impacts by assessing the magnitude of impact in combination with the sensitivity of the receiver. Potential impacts have been rated according to their significance (severity)
- development of mitigation measures, where necessary, to minimise the potential for negative impacts and enhance the potential for positive impacts.
- preparation of a range of photomontages (provided by ARTC) to aid in the visual representation of potential impacts.

7.2.1 Visual impacts rating

In order to determine a visual impact rating, it is necessary to assess both the magnitude of the impact, and the visual sensitivity rating for the area.

The magnitude of the impact represents the level of visual contrast between the mitigation option, and the existing environment within which it is placed. This is determined by the appearance of the works, the existing landscape setting, and the capacity of the existing landscape to accommodate the changes. A severity rating of low, moderate or high is assigned for each public viewpoint and each sensitive receiver. Table 7.1 provides guidance for assigning magnitudes of change.

Table 7.1 Assigning magnitude of change

Magnitude of change	Example
High	Dominant change: major changes in view at close distances, affecting a substantial part of the view, continuously visible for a long duration, or obstructing a substantial part or important elements of view. Generally, short distances to the nearest proposal infrastructure. Considered to be foreground.
Moderate	Considerable change: clearly perceptible changes in views at intermediate distances, resulting in either a distinct new element in a significant part of the view, or a more wide-ranging, less concentrated change across a wider area. Generally, short-to-medium views to the nearest proposal infrastructure. Considered middle ground.
Low	Noticeable change: minor changes in views at long distances or visible for a short duration, and/or are expected to blend in with the existing view to a moderate extent. Generally, medium-to-long distance views to the nearest proposal infrastructure. Considered to be background.
Negligible	Barely perceptible change: change that is barely visible at a very long distance or visible for a very short duration, and/or is expected to blend with the existing view. Distant views to the nearest proposal infrastructure. Considered to be distant.

Sensitivity refers to the qualities of an area, the number and type of receivers and how sensitive the existing character of the setting is to the proposed nature of the change. Primary influences upon visual sensitivity include both distance from the proposed works and value of the existing environment. However, other considerations included the location of receivers, and the extent of existing screening. Table 7.2 provides guidance for assigning levels of visual sensitivity. As these ratings relate to the existing environment, the visual sensitivity ratings assigned to sensitive receivers in the EIS have been used, where available (refer to EIS
Table 19-10).

Table 7.2 Visual sensitivity

Sensitivity of viewpoint	Attributes of visual sensitivity
High	Large numbers of viewers or those with proprietary interest and prolonged viewing opportunities, such as residents and users of attractive and/or well-used recreational facilities. Views from a regionally important locations whose interest is specifically focused on the landscape, e.g., national parks.
Moderate	Medium numbers of residents (e.g., rural communities and townships) and moderate numbers of visitors with an interest in their environment, e.g., visitors to state forests, including bush walkers, horse riders and trail bikers. Large numbers of travellers with an interest in their surroundings, e.g., local designated scenic routes.
Low	Small numbers of visitors with a passing interest in their surroundings or transient views, e.g., those travelling along principal roads. Viewers whose interest is not specifically focused on the landscape, e.g., workers, commuters, truck drivers. Isolated or small clusters of rural residential properties.
Negligible	Small numbers of visitors with a passing interest in their surroundings or transient views, e.g., those travelling along principal roads. Viewers whose interest is not specifically focused on the landscape, e.g., workers, commuters, truck drivers. Isolated or small clusters of rural residential properties.

By combining the magnitude of impacts with the sensitivity, an overall impact significance rating is assigned, as shown in Table 7.3.

Table 7.3 Impact significance rating

		Magnitude			
		High	**Moderate**	**Low**	**Negligible**
Sensitivity	**High**	High	High-moderate	Moderate	Negligible
	Moderate	High-moderate	Moderate	Moderate-low	Negligible
	Low	Moderate	Moderate-low	Low	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

7.2.2 Key viewpoints and sensitive receivers

The experience of viewers varies according to the field of view and nature of exposure to the mitigation option. Visual receptors travelling along Alice Street/Gwydir Highway are typical public road users including local commuters and visitors. Private residences are the most sensitive to change; the visibility of the proposed noise barriers varies in relation to the height and orientation of the property, presence of screening (vegetation, existing traffic noise bund) and distance from the works.

Four key public viewpoints were selected to represent locations where the noise barriers are most likely to be visible for road users and local residents, to assist in analysis of the visual impacts of the mitigation option. Table 7.4 and Figure 7.2 identify the public viewpoints and include details of their location in relation to the proposed barriers. Photomontages for each public viewpoint are shown in Figure 7.4 to Figure 7.7. Public viewpoints to the west of the Newell Highway, along Alice street and along Gosport Street were considered; however, due to screening from the existing road traffic bunds the magnitude of the visual impact would be low negligible and the barrier may only visible for a brief period for passing road traffic. A public viewpoint from the platform at Moree Station was also considered, but rejected due to distance (located more than 200 m south) and the general urban visual landscape (built environment).

Sensitive receivers were selected on the basis of proximity to the proposal and those properties most likely to physically see the noise barriers. The level of existing visual screening was considered during this selection. Table 7.5 and Figure 7.3 identify the sensitive receivers that may be impacted by the proposed noise barriers.

Table 7.4 Key public viewpoints

Public viewpoint #	Name	Approximate distance from proposed noise barriers (m)	Receptors
1	Gwydir Highway	105	Local road users, residents
2	Morton Street (North)	40	Residents
3	Oak Street (South)	170	Residents
4	Oak Street (North)	80	Residents, pedestrians

Table 7.5 Key sensitive receiver viewpoints

Sensitive receiver ID #	Address	Approximate distance from proposed noise barriers (m)	Receptors
NNS_Rx1998	2 River Street	35	Private residence
NNS_Rx1999	3 Oak Street	50	Private residence
NNS_Rx1997	4 Oak Street	85	Private residence
NNS_Rx1994	6 Oak Street	100	Private residence
NNS_Rx1990	8 Oak Street	110	Private residence
NNS_Rx1989	284 Morton Street	10	Private residence
NNS_Rx1983	286 Morton Street	25	Private residence
NNS_Rx1979	288 Morton Street	30	Private residence
NNS_Rx1972	290 Morton Street	47	Private residence
NNS_Rx1967	292 Morton Street	52	Private residence
NNS_Rx1958	294 Morton Street	62	Private residence
NNS_Rx3000	Moree Hotel (7 Alice Street)	65	Commercial residential
NNS_Rx3001	Econo Lodge (21 Alice Street)	88	Commercial residential
NNS_Rx1980	287 Gosport Street	123	Private residence
NNS_Rx1973	289 Gosport Street	113	Private residence
NNS_Rx1969	291 Gosport Street	110	Private residence
NNS_Rx1962	293 Gosport Street	102	Private residence
NNS_Rx1954	299 Gosport Street	95	Private residence

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Noise Mitigation Options Assessment Report

Figure 7.2
Key public viewpoints

Legend

- Viewshed
- The proposal
- River
- Construction impact zone

RING optimised noise barriers - height

- 4m
- 4.5m
- 5m
- 6m

0 40 80 Metres

Coordinate system: GDA 1994 MGA Zone 55

Scale ratio correct when printed at A3

1:1,800 Date: 15/12/2023

Data sources: - DCS, nearmap

Noise Mitigation Options Assessment Report

Figure 7.3
Key visual sensitive receivers

Legend

- Sensitive receivers
- Viewshed
- The proposal
- River
- Construction impact zone

RING optimised noise barriers - height

- 4m
- 4.5m
- 5m
- 6m

0 40 80 Metres

Coordinate system: GDA 1994 MGA Zone 55

Scale ratio correct when printed at A3

1:1,800 Date: 15/12/2023

Data sources: - DCS, nearmap

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www.wsp.com

7.2.3 Noise barriers - construction impacts

Noise barrier construction may impact visual amenity in several ways including removal of vegetation, presence of construction machinery and equipment, and establishment of site laydown areas. This would result in short-term visual impacts to residents and other sensitive receivers within the vicinity of construction work, and from areas with views of the proposal site, as well as short-term impacts to the visual amenity of road users along the Gwydir Highway. Construction related visual impacts have been assessed in Section 19.4.2.2 of the EIS, and additional impacts from noise barrier works would be consistent with the EIS assessment due to works already being undertaken associated with new formation works and the Mehi bridge construction.

Construction impacts would be temporary, and management of visual impacts would occur through the Construction Environmental Management Plan (CEMP). Measures to reduce impacts would include selecting laydown areas and other ancillary sites to reduce visual impacts, directional lighting to reduced light spill in the event that night works are required, hoarding and other visual screening methods would also be considered (refer to mitigation measures LV-14, LV-16).

7.2.4 Noise barriers - operational impacts

Noise barrier construction would result in the introduction of permanent infrastructure in a rural township, primarily impacting residents, road users, and pedestrians on Morton, River, and Oak streets. Some minor impacts may also be experienced by users of the Gwydir Highway and residents on Gosport Street.

The potential impacts on each of the four key public viewpoints are presented in Table 7.6. Photomontages depicting the noise barriers from the public viewpoints are presented in Figure 7.4 to Figure 7.7. Potential impacts to sensitive receivers are presented in Table 7.7. As noted previously, barrier heights are calculated from the top of rail.

Table 7.6 Public viewpoint visual impact assessment

			1 m barriers		3 m or 4 m barriers		5 m or RING optimised (variable height) barriers	
Viewpoint	**Impact summary**	**Sensitivity**	**Magnitude**	**Overall impact rating**	**Magnitude**	**Overall impact rating**	**Magnitude**	**Overall impact rating**
1: Gwydir Highway	Barriers temporarily visible to road users and pedestrians. Existing view is a built environment. No residential viewers in this location.	Low	Negligible	Negligible	Low	Low	Low	Low
2: Morton Street	Eastern barrier in close proximity with no screening; highly visible. Western barrier not visible.	Moderate	Low	Moderate - low	High	High-moderate	High	High-moderate
3: Oak Street (S)	Some visibility for residents in this location and road users entering Oak Street. Western barrier not visible.	Moderate	Negligible	Negligible	Low	Moderate-low	Low	Moderate-low
4: Oak Street (N)	Eastern barrier in close proximity with no screening; highly visible to residents, and to pedestrians using the Mehi River walk. Western barrier not visible.	Moderate	Low	Moderate - low	High	High-moderate	High	High-moderate

Figure 7.4 Viewpoint 1: View from Gwydir Highway – before and after (RING optimised barriers)

Figure 7.5 Viewpoint 2: View from Morton Street – before and after (RING optimised barriers)

Figure 7.6 Viewpoint 3: View from Oak Street (South) – before and after (RING optimised barriers)

Figure 7.7 Viewpoint 4: View from Oak Street (North) – before and after (RING optimised barriers)

Table 7.7 Sensitive receiver visual impact assessment

			1 m barriers		3 m or 4 m barriers		5 m or RING optimised (variable height) barriers	
Sensitive receiver #	**Description***	**Sensitivity***	**Magnitude**	**Overall impact rating**	**Magnitude**	**Overall impact rating**	**Magnitude**	**Overall impact rating**
NNS_Rx1998	Views to the north, existing rail is visible through the full view from the driveway. No vegetation screening in place. Potential light spill from passing trains. Rail in relatively close proximity.	Moderate	Low	Moderate-low	High	High-moderate	High	High-moderate
NNS_Rx1999	Views to the north, existing rail is visible through the full view from the front facade. No vegetation screening in place. Rail in relatively close proximity.	Moderate	Low	Moderate-low	High	High-moderate	High	High-moderate
NNS_Rx1997	Views to the north, Vegetation screening in place; existing rail partially visible from the front facade. Northern extent of eastern barrier in peripheral view. Rail in relatively close proximity.	Moderate	Negligible	Negligible	Moderate	Moderate	Moderate	Moderate
NNS_Rx1994	Views to the west. Vegetation screening and surrounding residences block views of existing rail alignment and passing trains. Possible views of eastern barrier in periphery.	Moderate	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
NNS_Rx1990	Views to the west. Some vegetation screening and surrounding residences block views of existing alignment and passing trains. Possibility of limited views of eastern barrier in periphery.	Moderate	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
NNS_Rx1989	Views to the west, existing rail and passing trains visible through the full view. No vegetation screening in place. Potential light spill from passing trains. Rail in close proximity.	Moderate	Low	Moderate-low	High	High-moderate	High	High-moderate
NNS_Rx1983	Views to the west, existing rail and passing trains visible through the full view. No vegetation screening in place. Potential light spill from passing trains. Rail in close proximity.	Moderate	Low	Moderate-low	High	High-moderate	High	High-moderate

			1 m barriers		3 m or 4 m barriers		5 m or RING optimised (variable height) barriers	
Sensitive receiver #	**Description***	**Sensitivity***	**Magnitude**	**Overall impact rating**	**Magnitude**	**Overall impact rating**	**Magnitude**	**Overall impact rating**
NNS_Rx1979	Views to the west, existing rail and passing trains visible through the full view. No vegetation screening in place. Potential light spill from passing trains. Rail in close proximity.	Moderate	Low	Moderate-low	High	High-moderate	High	High-moderate
NNS_Rx1972	Views to the west, existing rail and passing trains visible to the south. Significant vegetation screening in place for views to the west. Limited visual impacts expected.	Moderate	Negligible	Negligible	Low	Moderate-low	Low	Moderate-low
NNS_Rx1967	Views to the west, existing rail and passing trains visible to the north-west. Significant vegetation screening in place. Limited visual impacts expected.	Moderate	Negligible	Negligible	Low	Moderate-low	Low	Moderate-low
NNS_Rx1958	Views to the west, existing rail and passing trains screened by existing vegetation. Limited visual impacts expected.	Moderate	Negligible	Negligible	Low	Moderate-low	Low	Moderate-low
NNS_Rx3000	Views to the west; existing rail line and passing trains visible. Some vegetation screening in the west and north-west. Limited peripheral views of the eastern barrier, western barrier visible within a built landscape.	Moderate	Negligible	Negligible	Low	Moderate-low	Low	Moderate-low
NNS_Rx3001	Views to the east. No vegetation screening. Existing earth bund in the foreground provides significant screening. Insignificant visual impacts expected.	Moderate	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
NNS_Rx1980	Views to the east. No vegetation screening. Existing earth bund in the foreground provides significant screening. Insignificant visual impacts expected.	Moderate	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
NNS_Rx1973	Views to the east. Some vegetation screening. Existing earth bund in the foreground provides significant screening. Insignificant visual impacts expected.	Moderate	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
NNS_Rx1969	Views to the east. Some vegetation screening. Existing earth bund in the foreground provides significant screening. Insignificant visual impacts expected.	Moderate	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible

			1 m barriers		3 m or 4 m barriers		5 m or RING optimised (variable height) barriers	
Sensitive receiver #	**Description***	**Sensitivity***	**Magnitude**	**Overall impact rating**	**Magnitude**	**Overall impact rating**	**Magnitude**	**Overall impact rating**
NNS_Rx1962	Views to the east. Existing earth bund in the foreground provides significant screening. Insignificant visual impacts expected.	Moderate	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
NNS_Rx1954	Views to the east. Existing earth bund in the foreground provides significant screening. Insignificant visual impacts expected.	Moderate	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible

*Details and ratings sourced from EIS Table 19-9, where available. It is assumed that no significant changes to vegetation have occurred.

The results of the visual assessment conclude that the 1 m barriers would have negligible visual impacts for most sensitive receivers. High-moderate impacts are predicted at five properties for the 3 m, 4 m, 5 m or RING optimised barrier options. The assessment indicates that visual impacts of the 3 m and 4 m barriers would be similar to the 5 m and RING optimised barriers. This is primarily due to the presence of dense vegetation screening receivers whose viewsheds face the 6 m portion of the eastern RING optimised barrier. Impacts are expected to be limited to receivers on the eastern side of the tracks, with the existing Newell Highway earth bunds providing significant screening for residents on Gosport Street.

7.2.5 Mitigation of visual impacts

Local community consultation would be undertaken regarding the outcome of the visual impact assessment and proposed mitigation. Primary measures under consideration include the RING optimised barriers (designed to minimise the barrier height while achieving compliance with noise trigger levels), use of sympathetic colours and screen planting. Additionally, the use of artwork or murals would be considered in detailed design. While artwork may not greatly reduce the visual impact, it would improve the overall aesthetic. Mitigations would primarily apply to the eastern barrier, the majority of the western barrier is shielded by the existing traffic bunds (when viewed from the west) and by the eastern barrier (when viewed from the east).

The strategic use of planting in the foreground (between residential receptors and the rail corridor) to filter views of the proposed barrier on the eastern side of the tracks (see measures LV-1 and LV-5) can be applied and will be further considered in the landscaping plans as part of detailed design. Planting would remain within the ARTC corridor unless specific arrangements with landowners have been established. Consultation with MPSC would be undertaken in relation to landscaping treatments proposed on public land. Low maintenance species would be prioritised, however vegetation maintenance would be the responsibility of the landowner.

Planting would take time to mature (depending at what stage of maturity they are planted, maturity may be reached in 3 – 5 years) and, therefore, would not have maximum effectiveness immediately after construction but would increase in effectiveness over time. Advanced species may be planted, where appropriate, to provide more immediate screening (see LV-1). A mixture of locally endemic trees and shrubs would be sourced, where practicable, to enhance and complement the natural patterns of the landscape and enhance biodiversity. Figure 7.8 shows an artist’s impression of screen planting in relation to the noise barrier, it should be noted that the density and height of vegetation would vary along the length of the barrier. An additional mitigation measure (LV-19) has been included to ensure retention of the trees during construction, if feasible, along Morton Road between the rail corridor and receivers NNS_Rx1958 and NNS_Rx1967.

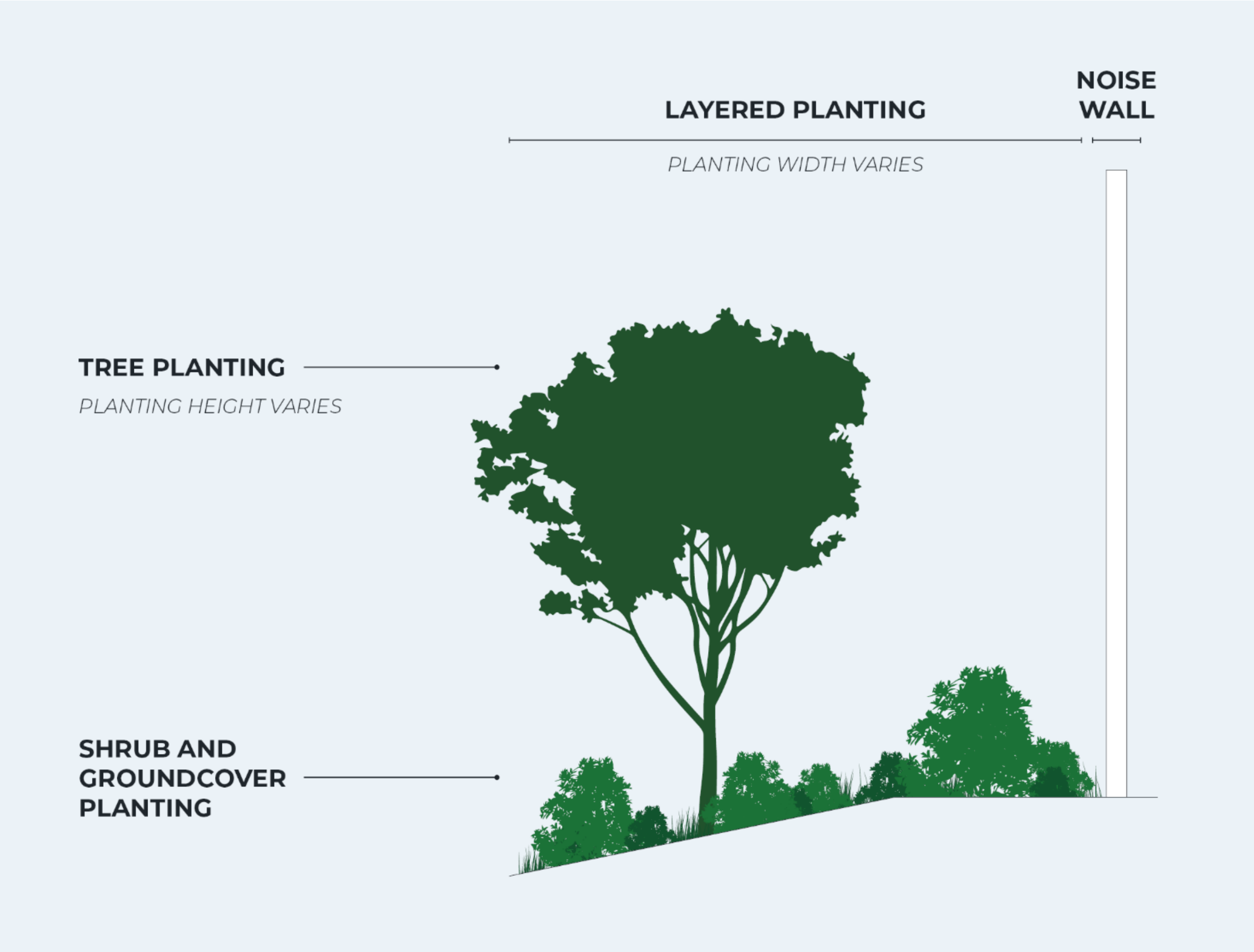


Figure 7.8. Artist's impression of landscaping treatments adjacent to the eastern noise barrier

The use of colours sympathetic to the surrounds would further reduce the impact of the barriers. Figure 7.9 reflects an artist's impression of noise barrier visual mitigation through the effective use of sympathetic colours and landscape planting. Photomontages prepared for Figure 7.4 to Figure 7.7 of this report include use of sympathetic colour palates. The proposed mitigations would be most beneficial for receivers viewing the barrier from a distance, for example from public viewpoints 1 and 3, and those residences whose views of the barrier would be peripheral, for example NNS_Rx1990, NNS_Rx1994 and NNS_Rx1997.

Residences in close proximity to the noise barriers, with little to no existing vegetation screening are predicted to experience the highest visual impacts, these include NNS_Rx1979, NNS_RX1983, NNS_Rx1998, NNS_Rx1999 and NNS_Rx1989. However, these impacts should be considered alongside the potential visual benefits including light spill reduction and shielding the passing trains from view (benefits would vary according to the height of the barriers).

The 3 m, 4 m and 5 m barriers all have very similar visual impacts, so selection of the lowest of these barriers and/or use screen planting would not significantly reduce the visual impacts. The 1 m barriers (wheel walls) result in considerably less visual impact, but the lack of noise mitigation benefits should be considered (see Section 8.2). At-property treatments would cause minimal visual impact, but they would also provide limited improvement to outdoor noise levels (and only where property fences are considered appropriate). Lower barriers and at-property treatments also reduce/remove potential visual benefits associated with noise barriers (shielding passing trains, light spill reduction).

Consultation with residents is essential to understand their views on the benefits of barriers given the significant visual change some will experience.

Figure 7.9 Artist's impression of RING optimised noise barrier before and after visual mitigation

Conclusion

Construction related visual impacts would be managed under the Construction Environmental Management Plan (CEMP), which would include consideration of site screening (hoarding) methods and directional lighting to reduced light spill, for example. Construction impacts would be temporary and limited to the construction period.

After completion of works the noise barriers would result in a residual visual impact for a limited number of private receivers. Barrier visibility would vary due to proximity and to screening provided by existing vegetation and other surrounding structures. Residual visual impacts are most significant for receivers on the northern end of Morton Street, with all noise barrier options resulting in a high level of visual impact. Negligible impacts are expected for receivers on Gosport Street due to shielding provided by the existing Newell Highway traffic noise bunds. While the visual impact of the 1 m barriers is significantly less than other options, it provides negligible acoustic mitigation. In terms of potential benefits, the higher noise barriers provide the added benefit of shielding passing trains and reducing light spill.

The detailed design of the noise barriers would consider the visual impact, and mitigation measures to minimise impacts include consideration of sympathetic colours, strategic planting to filter views of the proposed barriers, and a design or artwork to increase the visual aesthetic (mitigation measure LV-4, LV-13). The need for community consultation is recognised to ensure community issues are reflected and to demonstrate that impacts have been considered and addressed as far as practicable (LV-4).

Sensitive receiver NNS_Lx1989 is considered the most significantly impacted visual receiver due to proximity to the eastern noise barrier. These impacts are considered residual, and application of usual mitigation measures would be less successful at this location.

7.3 Social impacts

This section includes a qualitative assessment of potential social impacts from the proposed noise barriers and at-property mitigation options. Since negligible social impacts are expected to result from warning bell suppression or the installation of rail dampers. Key tasks included:

- identification of potentially relevant social matters
- review of the EIS social impact assessment to identify any relevant information specific to the residential cluster along Morton and Oak Street
- review of stakeholder engagement undertaken to-date to identify community sentiment in relation to the works
- evaluation of likely social impacts with reference to the baseline conditions established as part of the EIS social impact assessment
- identification and explanation of any residual social impacts as a result of implementing the preferred noise mitigation option/s
- where necessary, developing appropriate responses i.e., additional mitigation and management measures.

7.3.1 Introduction

As outlined in the Social Impact Assessment Guideline (the Guideline) (DPE, 2023) ‘social impacts’ generally refer to the consequences that people experience when a new project brings change. ‘People’ include individuals, households, groups, communities, or organisations. The aim of this section is to identify, predict and evaluate likely social impacts arising from the noise mitigation options, and propose responses to any predicted impacts.

For the purposes of this assessment, the study area includes the footprint of the noise barriers and the cluster of properties along Morton, River, Oak and Gosport Street north of Alice Street/Gwydir highway and more specifically, those properties which may qualify for at-property treatments.

The Guideline was reviewed to assist in identification of potentially relevant social matters. The following, as classified in the Guideline, were identified for consideration:

- way of life, including how people live, how they get around, how they work, how they play, and how they interact each day
- community, specifically cohesion and people's sense of place
- accessibility, specifically including how people access and use infrastructure, services and facilities
- health and wellbeing, including physical and mental health especially for people vulnerable to social exclusion or substantial change, psychological stress resulting from financial or other pressures, access to open space and effects on public health
- surroundings, including ecosystem services such as shade, public safety and security, access to and use of the natural and built environment, and aesthetic value and amenity.

Predicted social impacts from noise mitigation options are discussed below, with consideration of whether these impacts are consistent with those identified in the EIS Social Impact Assessment (refer to Chapter 17 and Technical Paper 8).

7.3.2 Community engagement to-date

Extensive community engagement has been undertaken in relation to the proposal. However, targeted consultation has focused on receivers east of the tracks, as the EIS predicted this area to experience the greatest noise impacts. Door-knocks were undertaken to the west of the tracks, including along Gosport Street, prior to EIS exhibition. The majority of residents residing in close proximity to the alignment expressed concerns relating to operational noise and the predicted frequency of trains. Feedback has also been received regarding the proposed noise barriers;as noted in Section 17.4.3.5 of the EIS, community views on noise barriers differ depending on location, with those closest to the rail line reporting to prefer at-property treatment, and those further away being generally more supportive.

Community consultation is ongoing, and will include presentation of this options report, as outlined in Section 10.

7.3.3 Construction

Review of the social impact assessment undertaken for the EIS concluded that factors relevant to the construction or installation of the proposed noise mitigation options would be consistent with impacts identified in the EIS. These include:

7.3.3.1 Community

As outlined in Section 17.2.1 of the EIS, an influx of non-resident workers to the Moree community could raise concerns about community safety and workforce behaviour, affecting community cohesion. Not all workers would be non-residents, and overall workforce requirements would fluctuate. It is therefore considered unlikely that the workforce would cause significant changes to the current demographic profile in nearby communities. The EIS also recognises that the area is regularly host to seasonal agricultural workers, and Community members would likely be resilient to such changes in the local community. Construction of the proposed noise barriers and/or installation of at-property treatments are not expected to require significantly more labour beyond what is required for construction of the proposal.

7.3.3.2 Way of life

Employment and training: Section 17.4.2.2 of the EIS includes an assessment of employment and training, workforce availability, and economic development for the N2NS Phase 2 proposal. The EIS recognised a range of benefits including work opportunities for the local workforce, the opportunity for training and upskilling of workers, and increased economic activity resulting from this. Construction of the proposed noise barriers and installation of at-property treatments would not result in a change to these impacts and is consistent with the findings in the EIS.

Local Movement: At-property treatments would not be expected to impact movement. Construction of noise barriers would result in temporary impacts to traffic and a small increase in both heavy and light vehicle movements on the local road network with the delivery of posts, concrete and panels. The adverse impacts to local movement are predicted to be minor delays, and inconvenience for private vehicles and pedestrians as a result of traffic control measures. It is expected that traffic control measures would be short-term and limited to the intersection upgrade works at the southern end of Morton Street and during key material delivery periods. In order to minimise construction vehicle movements along residential streets it is proposed to use the railway formation for vehicles entering the noise barrier construction zone. Vehicles would enter the construction zone at Morton Street and exit via Oak Street.

Section 8.10.3 of the EIS includes use of Morton Street for access and egress; impacts resulting from noise barrier construction are expected to be consistent with this assessment. A range of mitigation measures are proposed to manage these impacts including T-1, T-2, T-13, SI-5, SI-6, LU-3, LU-3 (consultation and communication regarding works, including potential access impacts), LU-5 (access to individual residences to be maintained during construction), and T-6 (preparation of a traffic, transport and access management plan).

7.3.3.3 Accessibility

An influx of workers has the potential to increase demand for local housing, and result in additional users of schools, leisure facilities, emergency services etc. An existing workforce camp is anticipated to accommodate the majority of the workforce required for the proposal, with further management controls included in a workforce housing and accommodation plan (mitigation measure SI-12). Given the short-term nature of the works, it is unlikely that workers would move their families, and therefore impacts to services would be minimal. As outlined above, construction of the proposed noise barriers and/or installation of at-property treatments are not expected to require significantly more labour beyond what is required for construction of the proposal. Impacts to housing availability and access to infrastructure and services would be minimal, and consistent with those considered in the EIS.

7.3.3.4 Surroundings

Residents in east Moree will experience a reduction in local amenity as a result of temporary occupation of the area south of the Mehi River bridge. This area was included as a site establishment zone in the EIS, and would be further utilised during noise barrier works. Depending on the timing of works, the space may be required for an extended period to facilitate noise barrier construction, however this would not represent an additional impact since the time required to build the bridge is significantly greater than that required for the construction of a noise barrier.

7.3.3.5 Health and wellbeing

Increases in dust, noise and vibration are predicted to occur during construction of the noise barriers, with a range of potential impacts to dwellings and local residents. The severity of impacts would increase with proximity to the works site, with residents located on Oak, River and Morton streets most likely to be impacted. A range of mitigation measures are proposed to minimise these impacts.

Noise and vibration impacts can include discomfort, stress, anxiety and sleep disturbances. Vibration impacts can also cause damage to buildings and structures. These impacts can affect the way people value and use spaces, such as their home. These amenity issues can also impact on mental health, with Indigenous people and directly affected landowners and residents identified as potentially more at risk of mental health issues during the proposal’s construction. The EIS notes that residents in east Moree already experience relatively high levels of social and economic disadvantage and may lack the resources and capacity to manage such impacts.

Appendix E of EIS Technical Paper 10 identifies several construction stages or scenarios which are predicted to impact residents in East Moree during construction of the proposal. The Sound Power Levels (SWL) calculated for these scenarios have been compared to SWLs for noise barrier construction. Noise impacts from construction of the noise barriers would not exceed impacts already assessed under the EIS.

Vibration impacts from use of excavators (the most vibration intensive plant expected to be utilised for noise barrier works) are less than the predicted impacts from vibration intensive plant required for the proposal in general. As a result, the vibration impacts from noise barrier construction would be consistent with the assessment undertaken in the EIS.

Refer to Section 7.5 of this report for more detail in relation to construction noise and vibration impacts, and proposed mitigation measures.

Impacts from an increase in dust as a result of the works have been considered in Chapter 24 of the EIS. Noise barrier construction works would generate dust, but the impacts would be significantly less from those assessed in relation to the construction of the proposal. Additionally, a range of mitigation measures are proposed to manage the potential for air quality changes, these include SI-1 (relevant stakeholders to be informed of measures to assist in overcoming potential impacts from dust), AQ-1 (air quality and dust management plan to include dust suppression measures and dust monitoring), AQ-2 (dust control measures to be implemented), AQ-3 (notification of stakeholders when dust generating activities are planned), and B-12 (works to cease in high winds), WQ-1 (soil and water management plan would include dust suppression measures).

As stated in the EIS, no night time works are planned, thereby limiting the potential for social impacts resulting from sleep disturbance.

7.3.4 Operation

7.3.4.1 Way of life

Maintenance of noise barriers, including any artwork, may create additional employment opportunities, although this positive benefit is not expected to be substantial.

7.3.4.2 Community

East Moree has limited connectivity to the rest of the town, with through access via the Gwydir Highway level crossing and Bullus Drive further to the south. While the provision of noise barriers would not have a tangible impact on this connectivity, the potential arises for a perceived social separation between residents on the east of the tracks from the rest of Moree. Considering the presence of the dual Newell Highway bunds and the exiting rail line, the lack of connectivity will be no greater than prior to any construction of noise barriers.

Provision of at-property treatment for a limited number of properties (only those that qualify) has the potential to create tension within the affected Moree communities, impacting overall community cohesion in the area.

Consultation will assist in providing further insight in relation to these issues.

7.3.4.3 Culture

Mitigation of the visual impacts of the noise barriers includes consideration of the use of naturally coloured panels, artwork or murals being applied to the barriers. This may create an opportunity to add cultural value to the area but will be subject to the outcomes of the future community consultation process.

7.3.4.4 Health and wellbeing

Community feedback has included concerns that a noise barrier, façade treatments and other mitigation measures do not address the issue of vibration from train passbys. As noted in Section 16.5.3.3 of the EIS, vibration levels are predicted to comply with the most stringent VBV and cosmetic building damage criteria.

There is a potential for an increase in minor crime; for example, the wall may attract graffiti. This would be managed by regular maintenance, with anti-graffiti treatments also proposed.

One resident’s submission following exhibition of the EIS included a concern that a noise wall would not adequately mitigate the noise impacts. The RING optimised noise barriers would provide noise reduction benefits in accordance with the relevant criteria. Lower barriers, however, are less effective from a noise mitigation perspective, which may have increased health and wellbeing implications for receivers due to noise disturbance. The RING optimised barriers, even when combined with other treatments, would not render train noise inaudible.

Another resident's submission notes that outdoor areas will be impacted by noise from the trains, and that this would not be improved by at-property treatments. It is accepted that at-property treatments are primarily designed to mitigate noise impacts in habitable spaces, though boundary fencing may provide some outdoor benefits. Similarly, lower barriers are less effective from a noise mitigation perspective; the lower the barrier, the higher the residual noise. As a result, receivers may experience reduced enjoyment of outdoor spaces. The RING optimised noise barriers would provide outdoor noise reduction benefits in accordance with the relevant criteria.

Noise barriers may also provide some positive health and wellbeing benefits, with higher barriers shielding passing trains and reducing light spill.

7.3.4.5 Surroundings: aesthetic value and amenity

The visual impacts of the proposed barriers are considered within section 7.2 of this report. Residences closely adjacent to the proposed noise barriers may also experience late afternoon shading, which could alter the thermal performance of a building and impact the general sense of wellbeing at home. The properties most susceptible to these visual and amenity impacts are the properties at the northern end of Morton Street.

7.3.5 Conclusion

Residents in east Moree experience relatively high levels of social and economic disadvantage and may be more susceptible to social impacts resulting from noise mitigation. A range of social impacts may be experienced as a result of the implementation of the noise mitigation options. However, most of these impacts would be consistent with impacts identified, assessed, and managed as part of the EIS and the measures proposed in the Social Impact Management Plan.

Some uncertainties remain in relation to perceived east/west separation which may result from the construction of noise barriers, and the potential for community tension resulting from application of at-property treatments to selected residences. Community consultation will assist in the understanding of these impacts and inform further mitigation options for implementation, if such concerns arise.

7.4 Hydrology impacts

This section considers potential impacts to hydrology resulting from the implementation of noise mitigation options. Impacts have been assessed based on the latest modelling results undertaken to update EIS Technical Paper 4, resulting from refinements implemented during the hydrology PIR assessments.

Hydrology would be totally unaffected by proposed mitigations such as bell suppression, inclusion of rail dampers and at-property treatments. While the introduction of noise barriers may be considered a potential barrier to flood waters, the assessment below suggests that the noise barriers will have a negligible to no effect on flooding.

The proposed rail noise barriers are located immediately east of an existing highway noise mound alongside the Newell Highway that extends for approximately 475 m from just north of the Alice Street and Newell Highway intersection to the southern abutment of the highway bridge over the Mehi River. This highway noise mound is approximately 2.5 to 3 m higher than the upgraded rail level and acts as a local hydraulic control on flooding in the Mehi River southern floodplain in extreme events, as the crest of the highway noise mound is higher than the water level of the Probable Maximum Flood.

The proposed rail noise barriers on each side of the rail would form thin barriers in the floodplain that will exclude to some extent the floodwaters from entering the corridor in very rare events. However, as this effect is within the influence of the existing hydraulic control posed by the highway noise mound, it would have a negligible effect on flood levels in the adjacent floodplain. Local flood levels within the urban area adjacent to the proposed rail noise barriers would continue to be governed by other features in the floodplain including the highway noise mound, bridges and rail embankment. This is the case regardless of the height or length of the proposed rail noise barriers. No impacts beyond those assessed in the PIR are anticipated and no QDL exceedances are associated with any noise mitigations.

7.5 Construction noise and vibration

This section considers potential construction noise and vibration impacts resulting from the implementation of noise barriers. Bell suppression, rail dampers and at-property treatments would result in little to no construction noise and vibration.

Potential construction noise impacts from the proposal have been considered in Chapter 16 and Technical Paper 10 of the EIS. Scenarios were developed, based on various construction stages for the purpose of assessing the worst-case noise impacts generated by the construction works within each stage.

Construction noise mapping in Appendix E of EIS Technical Paper 10 indicates that a range of noise scenarios are predicted to impact residents in the Morton/Oak Street area. Table 7.8 lists these scenarios with the associated sound power levels (SWLs). The sound power level is the inherent noise of the source and is the total power radiated by the source, in dB. Sound power level does not vary with distance from the noise source or within a different acoustic environment.

Table 7.8 EIS construction noise scenarios

Scenario ID	Scenario description	Scenario SWL, dBA
SC01	Site establishment	119
SC02	Track upgrade – reconstruction	121
SC03	Drainage	120
SC07*	Bridge demolition	122
SC08*	Bridge construction	122
SC09	Preparation works	114

* impacts primarily to the northernmost properties in Morton/Oak Street

An additional scenario “SC11” has been developed to assess potential impacts from noise barrier construction, with SWLs applied to the nominated equipment, and a scenario SWL generated. This scenario is presented in Table 7.9.

Table 7.9 SC11: noise barrier construction scenario

Equipment	Equipment SWL, dBA	Scenario SWL, dBA
Crane (60 t)	110	120
Excavator (with an auger attachment)	110	
Compactor	106	
Hand tools	102	
Road truck	108	
Dump truck	117	
Concrete truck	112	
Bobcat	95	
Water truck	107	

A comparison of the scenarios indicates that the predicted noise impacts from noise barrier construction would not exceed those assessed in the EIS. It should be noted that in comparison to other work scenarios, the noise barrier construction impacts would be relatively short-term. For constructability purposes, the noise barrier works would be undertaken soon after the main embankment works in the area, subject to the contractor's construction staging program. Due to space constraints and worker safety, it is unlikely that the noise barriers would be built at the same time as the track. This will, by default, prevent the risk of cumulative impacts being realised. However, a slightly longer construction duration will result before the contractors move to the next stage. Construction noise impacts are therefore considered to be consistent with those assessed in the EIS, albeit for a slightly longer duration.

A range of measures are in place to mitigate potential impacts including preparation and implementation of a construction noise and vibration management plan (NV-1), screening and substitution of plant, where possible (NV-2), avoidance of construction noise-generating activities in areas south of the Gwydirfield Road level crossing between 6.00 am and 7.00 am (NV-5). A complaints hotline and management procedures would also be implemented (NV-7).

Certain construction activities would require the use of vibration-intensive equipment that may affect the nearest sensitive receivers. Vibration impacts assessed under the EIS are consistent with those expected from noise barrier construction. The noise barrier works would require use of an excavator, which would be the most vibration-intensive plant nominated for these works. Recommended minimum working distances are included in Table 7.10. Vibration impacts from use of excavators are less than the predicted impacts from the most vibration intensive plant required for other work associated with the proposal as described in the EIS and is therefore consistent with the impacts described in the EIS.

Table 7.10 Recommended minimum distances from vibration intensive plant

Plant item	Minimum distance Cosmetic damage (BS 7385)	Minimum distance Human response
Excavator	4 m	15 m

7.6 Ongoing costs and maintenance considerations

7.6.1 Noise barrier

Maintenance of the noise barriers would include regular inspections to ensure the wall is in good repair, removal of any graffiti and potentially updating art work. The design life for a noise barrier is approximately 50 years, after which the likelihood of more significant repairs or replacement increases. Vegetation used to screen the barrier would require some upkeep, particularly in the early stages of establishment.

Inland Rail would be responsible for barrier maintenance and upkeep of vegetation within the rail corridor. Should vegetation screening be required outside of the rail corridor e.g. on private or public property, the relevant landowner would be responsible for any upkeep. Vegetation would be selected to suit local conditions, with priority given to low maintenance species where possible.

7.6.2 At-property treatment

At-property treatment would incur a range of ongoing costs, to be borne by the property owner, including:

- window repair - from $200 per square metre for double-glazed glass, or $300 per square metre for laminated glass, plus labour
- replacement of door and window seals on a 5 yearly cycle
- annual servicing of air conditioning unit - approximately $200/year per unit
- air conditioning unit running costs - an indication of approximate cooling costs for split system air conditioning units is provided in Table 7.11.

Table 7.11 Guidelines for approximate air conditioner capacity (size) based on room size, and estimated cooling costs (per hour)

Room size	Approx. capacity* (min max)	Cost per hour based on min usage charge (31.11c/kWh)**	Cost per hour based on max usage charge (42.71 c/kWh)**
Small (up to 20m^2) e.g. Bedroom, study	2 kW 2.5 kW	\$0.62 \$0.78	\$0.85 \$1.07
Medium (20–40m^2) e.g. Bedroom with ensuite, small lounge	2.5 kW 5 kW	\$0.78 \$1.56	\$1.07 \$2.14
Large (40–60m^2) e.g. Large bedroom, mid-sized lounge	5 kW 9 kW	\$1.56 \$2.80	\$2.14 \$3.84
Extra large (60+m^2) e.g. Open-plan areas, large lounges	6 kW 10 kW	\$1.87 \$3.11	\$2.56 \$4.27

*Source: choice.com.au as recommended in DCCEEW 'Air conditioning is cool' guide.
** Source: energymadeeasy.gov.au, single rate plans, 2-3 person house in Moree (December 2023).

Repair and maintenance prices and the costs listed in Table 7.11 should be considered a guide only. Actual costs depend on a range of factors including:

- availability of labour and materials
- choice of the most appropriate air conditioner for any given space include the total surface area of the space,
- connection to other rooms or areas that are not air conditioned,
- property construction materials,
- state of repair,
- level of insulation,
- number and type of glazed windows and doors,
- orientation of windows and level of shading e.g. from vegetation, awnings, curtains,
- the number of occupants using a room.

Based on the assumption that an average household living in a mid sized lounge for 6 hours per day, for 6 months of the year, the annual air-conditioning cost could vary from \$1,666 per annum to >\$4,204 per annum before maintenance costs.

7.7 Other impacts

A review of other potential impacts identified the following:

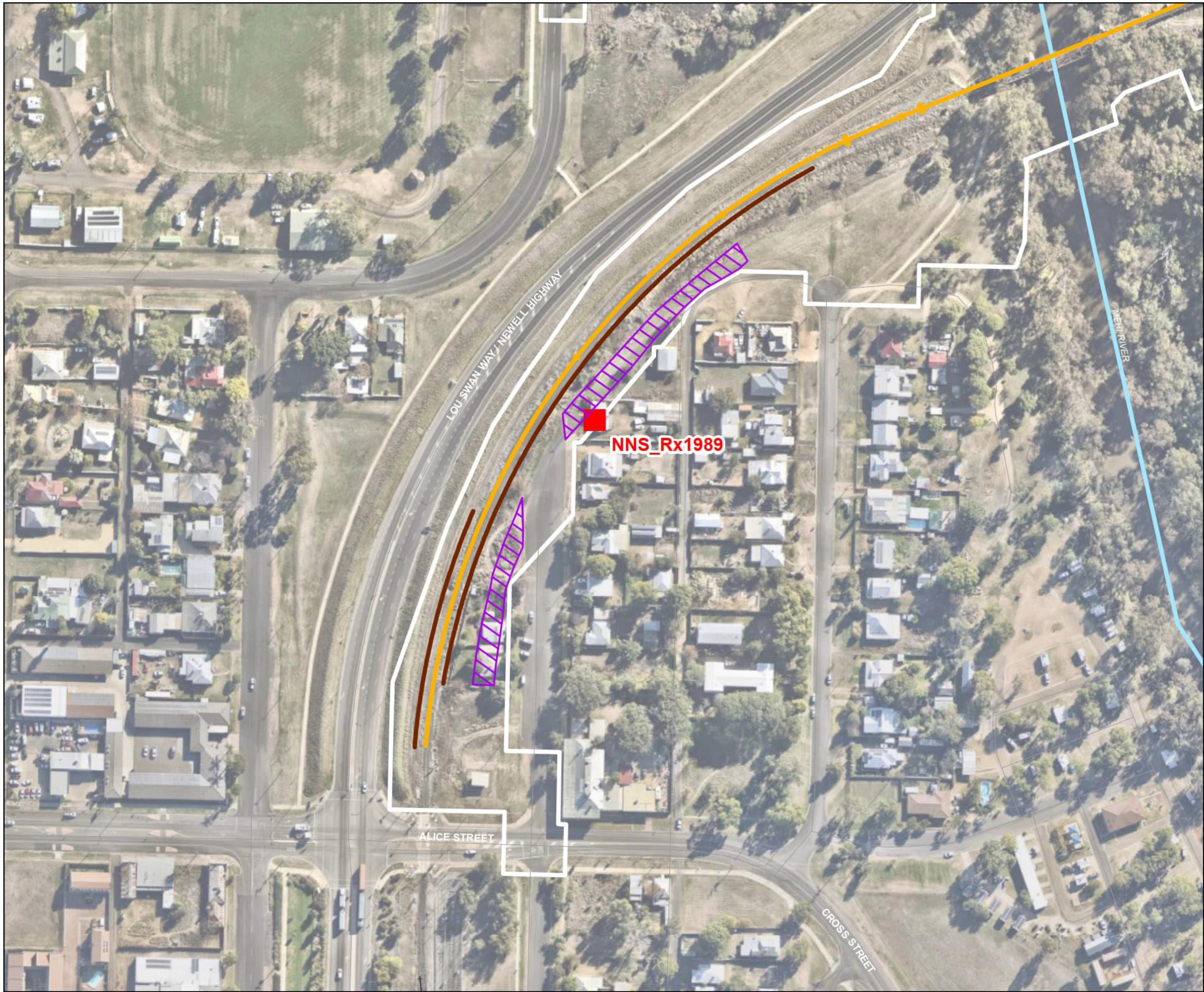
- Desktop searches undertaken for the EIS identified potential contaminated land adjacent to the noise barrier construction footprint (see EIS Figure 20-2). Further investigation would be completed during detailed design in accordance with mitigation measure SC-5.
- Footings for the proposed noise barriers may extend to approximately 7 m below the rail formation. Groundwater impacts are not anticipated as footings are proposed to be installed using continuous flight auger piles which do not require dewatering.
- It is noted that "wheel walls", are located closer to the tracks than taller noise barrier options, which can cause problems for track maintenance as they severely restrict access for track machines to undertake works such as re-sleepering, resurfacing, ballast cleaning, and undercutting. In areas where wheel walls are present, maintenance is undertaken via a rail bound track machine or a road rail capable vehicle. In order to use these vehicles, maintenance crews would be required take full track access from a

designed on-tracking location which shuts down the network availability. Reduced network availability results in reduce efficiency and takes more time to complete maintenance works.

- Constructability assessments for the proposal have identified a significant conflict with one private property, identified as NNS_Rx1989. In general, insufficient space is available to safely provide construction access between this property boundary and the proposed formation works. In addition, if noise barriers are to be constructed, panels would be installed by crane, with the land in question required for a crane access platform as shown in Figure 7.10. Currently, there is insufficient construction space to safely construct the new rail formation and for installation of noise barriers. The impact to this private residence is considered a residual impact with no reasonable mitigation available.
- Road traffic noise reflected on the rail noise barriers, potentially impacting receivers along Gosport Street, was considered. All proposed barrier options are positioned on the eastern side of the Newell Highway. Existing earthen bunds on either side of the Newell Highway provide sufficient shielding to prevent road traffic noise being reflected by the rail noise barriers to the western receivers. Calculations indicate road traffic noise increase will be less than 0.1 dB, which is not perceptible by the receivers to the west.

Noise Mitigation Options Assessment Report

Figure 7.10
Constructability impacts



Legend

- The proposal
- Nosie barriers
- River
- Construction impact zone
- Crane access platform
- Impacted property

0 40 80 Metres

Coordinate system: GDA 1994 MGA Zone 55

Scale ratio correct when printed at A3

1:1,800 Date: 15/12/2023

Data sources: - DCS, nearmap

8 Summary

This section aims to summarise the outcomes of the noise and environmental assessments considered above, as well as other potential impacts, for each of the noise mitigation options considered in Section 6.

Impact ratings have been assigned under a range of categories for each mitigation:

- The term 'residual noise' is designed to indicate whether RING noise criteria have been met for directly impacted sensitive receivers in the study area; a 'high' residual noise rating would equate to little or no improvement in design year (2040) noise levels; a 'low' rating would equate to RING criteria being met for the majority of receivers.
- A 'low' visual impact rating indicates little or no change for receivers in the study area, a 'high' rating is assigned where some receivers would experience significant visual change.
- Social ratings are based on a number of factors outlined in Section 7.3 including way of life, health and wellbeing, and community. A 'low' rating indicates little or no change would be experienced by residents in the study area, a high rating indicates that some significant social impacts may be experienced.
- The 'other' category is designed to consider other relevant factors which have not been included in the environmental and noise assessments. These include maintenance requirements, constructability, and safety.

It is acknowledged that while impact ratings contain an element of subjectivity they are scored based on industry standards using previous experience within this assessment field.

8.1 Controlling noise at the source

The two potentially feasible and reasonable options which were considered to control noise at the source are:

- suppression of warning bells; and
- rail dampers.

Table 8.1 summarises the level of impacts predicted from the implementation of these mitigations.

The noise assessment for these options concludes that rail dampers would provide a very limited benefit, the residual noise impact is therefore classified as 'high'. Switching off the warning bells at night is predicted to reduce overall noise levels by up to 6 dBA at the southern end of the study area which indicates that warning bell suppression serves at least a moderate benefit. The ability to suppress warning bells is significant as noise barriers, which provide the highest levels of noise mitigation (see Section 6) are not able to be extended to the south due to safety requirements. Noise barriers would therefore only have limited impact in the southern end of the study area with the primary noise source being pedestrian warning bells (which cannot be silenced), once the warning bells are suppressed. As a result, noise impacts for implementation of warning bell suppression is classified as 'moderate' in Table 8.1.

No heritage, visual, social or hydrology impacts are likely for either of these options, therefore the impact rating is 'low'. Dampers attach to the rails and would not be visible, however the process of installation as well as ongoing maintenance considerations should be considered – a 'moderate' rating has therefore been assigned in the 'other impacts' category in Table 8.1. Nighttime warning bell suppression would not require construction effort, and bell suppression is already implemented at the Alice Street level crossing, therefore 'other impacts' are considered 'low'.

Table 8.1 Level of impacts for at source mitigations

Mitigation	Residual noise	Heritage	Visual	Social	Hydrology	Other
Warning bell suppression	Moderate	Low	Low	Low	Low	Low

Mitigation	Residual noise	Heritage	Visual	Social	Hydrology	Other
Rail dampers	High	Low	Low	Low	Low	Moderate

The overall environmental impact of the at source treatments is low, however neither option can mitigate noise for most receivers. It recommended that warning bell suppression is implemented in conjunction with other mitigation.

8.2 Controlling noise on the transmission path

Noise barriers are considered a potentially feasible and reasonable option to control noise on the transmission path. It was anticipated that higher barriers would perform best from a noise mitigation perspective, but would not perform as well in other assessments (e.g. visual impacts). As a result, five options were assessed to provide the community with an understanding of the environmental and noise mitigation impacts for a range of barrier heights. Table 8.2 summarises the level of impacts predicted from the implementation of different barrier options and is a subjective representation to assist in visually comparing the options.

Table 8.2 Level of impacts for transmission path noise mitigation

Mitigation noise barriers*	Residual noise	Heritage	Visual	Social	Hydrology	Other
5 m	Moderate	Low	High	Moderate	Low	High
4 m	High	Low	High	Moderate	Low	High
3 m	High	Low	Moderate	Moderate	Low	Moderate
1 m (wheel walls)	High	Low	Low	Moderate	Low	Low
RING optimised	Low	Low	High	Moderate	Low	High

*includes warning bell suppression

Social impacts from the implementation of the higher (3 m, 4 m, 5 m or RING optimised) barriers include potential impacts to health and wellbeing (shading), increased graffiti risk, and increased potential for perceived east/west social separation. These potential risks increase as the barrier height increases, however higher barriers also provide benefits, including shielding of train passbys and reduction of light spill. The 1 m barriers are the least effective from an acoustic perspective, and the resulting residual noise may lead to health and wellbeing impacts. As a result, a ‘moderate’ social impact rating has been assigned for all barriers. Relevant ‘other’ impacts for noise barriers primarily include cost and constructability, with higher barriers generally being more difficult and expensive to build and maintain.

The wheel walls, 3 m and 4 m barriers provide limited noise mitigation (noise impacts following implementation of these barriers remains ‘high’) and are therefore not recommended as a feasible solution. The remaining options are expected to have a similar visual and social impacts, and therefore the recommendation is to implement the best performing option from a noise mitigation perspective – the RING optimised barriers. The RING optimised noise barriers would achieve compliance at all residential receivers with the exception of the Moree Hotel. It is recommended, in accordance with the RING hierarchy, that a noise barrier be implemented to control the transmission of noise; however, at-property treatment should be considered for the Moree Hotel.

8.3 Controlling noise at the receiver

A summary of the level of impacts predicted from the implementation of at-property treatments is provided in Table 8.3. No heritage, visual or hydrology impacts are expected, resulting in a ‘low’ impact rating. As noted above, the ‘residual noise’ rating is applied in the context of this report to indicate compliance with RING noise criteria for directly impacted receivers. However, RING trigger levels apply to noise measured at a building’s façade, whereas at-property treatment packages are designed to reduce internal noise levels only.

Therefore, compliance with RING trigger levels cannot be accurately assessed for at-property treatments. Treatment packages are designed to reduce internal noise to levels at or below the RING trigger levels, but are generally not designed to reduce outdoor noise levels, hence the 'moderate' rating.

Social impacts are considered to be 'high', this is primarily due to the potential for health and wellbeing impacts resulting from lack of outdoor noise mitigation impacting the broader community, combined with the potential for concerns that application of at-property treatment to select residences may cause community tension.

In accordance with the hierarchical approach to mitigation strategies recommended in the RING (see Section 4.5), at property treatment should be considered only after at source and transmission path mitigation options are assessed as not being feasible. As outlined in the above sections, a combination of bell suppression and noise barriers achieve compliance at all residential receivers with the exception of the Moree Hotel. At-property treatment is therefore recommended for the Moree Hotel.

Table 8.3 Level of impacts for mitigation of noise at the receiver

Mitigation	Residual noise	Heritage	Visual	Social	Hydrology
At-property treatment	Moderate	Low	Low	High	Low

9 Residual noise impact

The local noise environment is characterised by relatively low noise levels and can be described as a peaceful environment. During train pass-by events there can be a short-lived increase in noise that, depending on the receiver location, could be well above the local ambient noise level. During the night-time there is the potential that events of this nature could cause sleep disturbance impacts, such as awakening reactions, disrupted sleep or a loss of sleep quality over time.

The L_{Amax} noise assessment criteria adopted from the RING are being implemented on the proposal and manage the emergence of the highest noise level events and potential for noise related impacts. In this regard, the predicted noise levels for railway operations meet the L_{Amax} noise assessment criteria at all sensitive receivers except for the Moree Hotel. Furthermore, the recommended noise mitigation (bell suppression plus RING optimised barriers), primarily designed to control L_{Aeq} noise levels, would also assist in controlling the highest (L_{Amax}) noise events.

RING does not require that all railway generated noise is blocked from sensitive receivers. It is permissible under the RING, even where mitigation measures have been implemented, that railway noise, including train passbys, are able to be heard in the community and inside residences. Based on the assessment it is expected that additional rail noise will be audible in the area and within residences from the opening year of the proposal. This noise is anticipated to increase until full operation is achieved in 2040.

For some receivers, feasible and reasonable mitigation could be at-property treatments, which acts to improve internal noise amenity within habitable rooms. The implementation of conventional at-property treatments can reduce internal railway noise by a perceptible margin, for example at least 5 dBA. Consideration would need to be given to controlling specific noise characteristics, such as low frequency noise, as at-property treatment is generally less effective for low-frequency noise (such as locomotive noise). Noise barriers are designed to achieve compliance with RING trigger levels outside of a property, at a location 1 m in front of the most affected building façade. By contrast, at-property treatment does not control outdoor noise. As a result, the railway noise levels may remain above the rail noise assessment criteria for these receivers in outdoor spaces.

10 Community consultation process and reporting

To ensure all residents of the Phase 2 community whom have been predicted to be impacted are treated fairly, equitably and have the opportunity to provide informed input into the preferred noise mitigation method, Inland Rail proposes to complete a comprehensive engagement piece which includes, but is not limited to, the list below. . All meetings and sessions would include a subject matter expert (SME) in acoustics and will be supported with visualisations, and a suggestion/feedback box/email address to help gather feedback.

- Round 1 – primary purpose to provide detailed information on noise impacts and the effect of potential mitigation options.
  - There will then be a period of consideration for residents before the engagement team returns to them and seeks their feedback.
  - Each resident will then be asked to complete a survey.
- Round 2 – Inland Rail will identify the preferred mitigation option(s) which will be based on consideration of community views, combined with technical expertise. The preferred mitigation option(s) will then be outlined in the PIR reporting, noting that the post-approval *Operational Noise and Vibration Report* will be required to confirm mitigations once detailed design is finalised. Further information on how the 'preferred mitigation option(s)' will be identified is provided below.

Following Round 2 of the consultation, ARTC will produce a *Mitigation Options Justification Report*, justifying the selected noise mitigation measure(s) and demonstrating how community preferences for noise mitigation have influenced the selected measure(s).

The two primary consultation rounds above will be further supported through a range of engagement and communication activities including door knocks, phone calls, e-news updates, website updates, community BBQs and briefing sessions.

All interactive workshops would be independently facilitated, and community advocates will be made available to assist residents where requested.

The *Community Engagement and Outcomes Report* and the *Mitigation Options Justification Report* shall form part of the *Preferred Infrastructure Report* to be submitted to DPE in support of the assessment of the proposal.

11 Conclusion

Additional noise modelling was undertaken to further assess the effectiveness and feasibility of potential noise mitigation measures including at-source treatments, transmission path treatments (barriers), and at-property noise mitigation options for residences within the study area in Moree (as described in Section 3). Noise predictions were undertaken for sensitive receivers identified adjacent to the alignment.

The assessment methodology and rail noise model inputs (with the exception of the rail alignment, where the updated vertical alignment was used) are consistent with EIS Technical Paper 11 *Operational Noise and Vibration Impact Assessment*.

The relevant noise triggers took into account two criteria: the increase in noise levels compared to the existing noise levels (predicted to be exceeded at all receivers), and an absolute trigger level levels (60 dBA ($L_{Aeq, 9h}$) and 85 dBA (L_{Amax}).

Modelling initially considered potential exceedances with no mitigation measures in place. A total of 18 residential receivers are predicted to exceed the L_{Amax} noise trigger level of 85 dBA, 14 of them also exceeding the L_{Aeq} noise trigger level of 60 dBA. Results show that wagons and bells are the main contributors to the L_{Aeq} descriptor, and locomotives and horns are the main contributors to the L_{Amax} descriptor.

The following feasible and reasonable mitigation strategies were considered in a hierarchical approach as follows:

- At source: warning crossing bell suppression and use of rail dampers
- On the transmission path: noise barriers
- At receiver: at-property treatments.

The noise assessment of the 2 reasonable and feasible at source mitigation measures concludes that rail dampers would have a very limited impact and should not be considered further. However, switching off the warning crossing bells at night is predicted to reduce overall noise levels by up to 6 dBA at the southern end of the study area, and is already implemented at this level crossing, and is therefore recommended.

Implementation of warning bell suppression and either wheel walls, 3 m, 4 m or 5 m high noise barriers would not be sufficient to control exceedances of both descriptors. Exceedances of the L_{Amax} descriptor, controlled by the horns, are predicted even with 5 m high noise barriers. Warning bell suppression plus the RING optimised noise barriers (barriers of variable height) would achieve compliance at all residential receivers with the exception of the Moree Hotel, which includes a permanent place of residence on the first floor facing west.

Extending the eastern barrier further south, at the risk of potentially blocking line of sight between the tracks and Gwydir Highway, or increasing the height of the eastern barrier above 6 m would still not achieve compliance for the resident at the Moree Hotel. The residual noise source for the hotel is the pedestrian crossing bells, which exceeds the noise trigger level of 60 dBA $L_{Aeq,9h}$ regardless of the length or height of the barrier (refer Table 4.6). Noise impacts at Moree Hotel are unable to be mitigated by the noise barriers considered in this report. At-property treatment may achieve a level of indoor noise reduction at the Moree Hotel, but a direct comparison to the noise attenuation is not possible as barrier noise reduction levels apply to outdoor sound levels.

The noise modelling methodology used within this report has been successfully applied on other sections of the Inland Rail project, and the model incorporates a number of layers of conservatism. Nevertheless, a sensitivity sensitivity analysis was undertaken, which concluded that the modelling approach is robust and in the event of discrepancies between the modelling inputs and actual conditions during the design year, additional controls can be implemented.

The noise mitigation options present no hydrology concerns, and no heritage concerns other than in relation to at-property treatments of the Moree Hotel. Construction noise and vibration impacts are considered consistent with the EIS assessment.

Social impacts are broadly similar to those assessed in the EIS. Some questions remain in relation to the potential for perceived east/west community separation which may result from the construction of noise barriers, and the potential for community tension resulting from application of at-property treatments to selected residences. Social impacts of at-property treatments are considered ‘high’ due to potential health and wellbeing concerns, at-property treatments are primarily designed to mitigate noise impacts in habitable indoor spaces (though boundary fencing may provide some outdoor benefits). As a result, outdoor areas impacted by train noise would experience little-to-no improvement in noise levels. Additional costs associated with the maintenance of at property treatments may also become burdensome to some recipients.

Visual impacts of the noise barriers are considered a departure from impacts assessed in the EIS. The barriers with the lowest visual impacts are the wheel walls; however this option performs least well from a noise mitigation perspective. The 3 m, 4 m, 5 m and RING optimised barriers have similar visual impacts, increasing slightly with each increase in height. The RING optimised barriers, which are the best performing option from a noise mitigation perspective, do not have a significantly greater visual impact than the 3 m – 5 m options.

Visual impacts for the residents in close proximity to the eastern barrier (NNS_Rx1979, NNS_RX1983, NNS_Rx1998, and NNS_Rx1989) remain ‘high-moderate’. Barriers would provide noise reduction and potential light spill reduction benefits for these residents, and use of sympathetic colours and screen planting may further reduce the visual impact however the visual change experienced at these properties would be significant. At-property treatments would remove the visual impacts associated with noise barriers, however passing trains would be visible, with the potential for light spill impacting some residences. It is also important to consider that these treatments would provide indoor benefits only.

NNS_Rx1989, one of the properties predicted to experience ‘high-moderate’ visual impacts, is also predicted to be impacted by construction works. Insufficient construction space is currently available to safely construct the new rail formation works nor install the noise barriers; this impact is considered residual.

Recommended noise mitigation is provided in Table 11.1. The recommendation i.e. bell suppression and optimised noise barriers, plus at-property treatment for the Moree Hotel, is provided in accordance with the RING hierarchy, and the outcomes of the noise and environmental assessments within this report. This combination of treatments is considered the most acoustically effective, and aims to achieve RING compliance for the majority of directly impacted receivers.

Table 11.1 Combination of mitigation measures required to achieve compliance with noise criteria

Receiver	Recommendation to achieve compliance with noise criteria (based on RING hierarchy)		
	Bell suppression	RING optimised barriers	At property
NNS_Rx1953	✓	✓	(Not required – complies)
NNS_Rx1954	✓	✓	(Not required – complies)
NNS_Rx1958	✓	✓	(Not required – complies)
NNS_Rx1960	✓	✓	(Not required – complies)
NNS_Rx1962	✓	✓	(Not required – complies)
NNS_Rx1965	✓	✓	(Not required – complies)
NNS_Rx1967	✓	✓	(Not required – complies)
NNS_Rx1968	✓	✓	(Not required – complies)
NNS_Rx1969	✓	✓	(Not required – complies)
NNS_Rx1972	✓	✓	(Not required – complies)
NNS_Rx1973	✓	✓	(Not required – complies)
NNS_Rx1979	✓	✓	(Not required – complies)

Receiver	Recommendation to achieve compliance with noise criteria (based on RING hierarchy)		
	Bell suppression	RING optimised barriers	At property
NNS_Rx1983	✓	✓	(Not required – complies)
NNS_Rx1989	✓	✓	(Not required – complies)
NNS_Rx1998	✓	✓	(Not required – complies)
NNS_Rx1999	✓	✓	(Not required – complies)
NNS_Rx3000	✓	✓	✓
NNS_Rx3001	✓	✓	(Not required – complies)

Consultation with residents is essential to understand their views on the recommended options given the impacts, in particular the visual changes, they may experience if a barrier were to be constructed, and to ensure receivers understand that even with a combination of noise mitigation options implemented, train noise would still be audible.

12 References

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Appendix A

Predicted noise levels

Tabulated results

	2020		2040										Increase		Increase triggered		Level triggered		Eligible for mitigation	
	All		Wagons		Locos		Horns		Bells		All									
	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}
NNS_Rx1945	41	80	53	75	49	76	45	80	54	65	58	80	17	0.0	Y	-	-	-	-	-
NNS_Rx1946	40	81	52	74	48	77	46	81	54	65	57	81	16.8	0.0	Y	-	-	-	-	-
NNS_Rx1951	40	80	52	74	48	76	45	80	52	62	56	80	16.3	-0.1	Y	-	-	-	-	-
NNS_Rx1953	44	87	56	78	51	82	50	87	58	68	60	87	16.6	0.0	Y	-	-	Y	-	Y
NNS_Rx1954	43	86	52	73	49	78	50	86	60	70	61	86	17.7	0.0	Y	-	Y	Y	Y	Y
NNS_Rx1956	39	79	52	74	48	77	44	79	52	62	56	79	16.8	-0.1	Y	-	-	-	-	-
NNS_Rx1958	49	93	60	81	54	85	56	93	61	71	65	93	16	-0.1	Y	-	Y	Y	Y	Y
NNS_Rx1960	44	87	57	78	52	82	50	87	58	68	61	87	16.9	-0.2	Y	-	Y	Y	Y	Y
NNS_Rx1961	39	79	53	75	49	77	43	78	50	60	55	78	16	-0.8	Y	-	-	-	-	-
NNS_Rx1962	43	87	52	74	50	79	50	87	59	69	60	87	17	0.0	Y	-	-	Y	-	Y
NNS_Rx1965	44	87	55	77	52	82	50	87	57	67	60	87	16.7	-0.1	Y	-	-	Y	-	Y
NNS_Rx1966	40	81	53	75	49	77	44	80	50	61	56	80	16.2	-0.8	Y	-	-	-	-	-
NNS_Rx1967	49	93	60	82	55	86	56	93	60	70	64	93	15.8	-0.1	Y	-	Y	Y	Y	Y
NNS_Rx1968	44	88	57	79	52	85	51	88	59	68	61	88	16.5	-0.1	Y	-	Y	Y	Y	Y
NNS_Rx1969	44	86	53	74	51	81	50	86	60	70	61	86	17	0.0	Y	-	Y	Y	Y	Y
NNS_Rx1970	42	83	56	77	52	83	45	82	52	63	58	83	16.1	0.0	Y	-	-	-	-	-
NNS_Rx1971	41	81	55	77	50	78	45	81	53	64	58	81	17	0.0	Y	-	-	-	-	-
NNS_Rx1972	48	91	61	82	55	88	53	91	59	69	64	91	16.2	-0.1	Y	-	Y	Y	Y	Y
NNS_Rx1973	42	86	51	72	49	80	49	86	57	67	59	86	16.6	0.0	Y	-	-	Y	-	Y
NNS_Rx1974	39	83	49	71	46	78	46	82	52	62	55	82	15.7	-0.6	Y	-	-	-	-	-
NNS_Rx1975	43	83	56	78	51	81	45	82	56	66	60	82	17.2	-0.1	Y	-	-	-	-	-
NNS_Rx1977	41	81	56	77	51	80	44	80	51	62	58	80	16.8	-0.1	Y	-	-	-	-	-
NNS_Rx1978	43	81	57	78	52	82	46	82	55	65	60	82	17.2	1.5	Y	-	-	-	-	-
NNS_Rx1979	48	89	62	84	57	90	52	89	57	67	65	90	16.6	0.8	Y	-	Y	Y	Y	Y
NNS_Rx1980	42	85	50	72	49	80	48	85	56	66	58	85	16.5	0.0	Y	-	-	-	-	-
NNS_Rx1982	43	83	57	79	53	84	46	83	55	64	60	84	16.7	1.1	Y	-	-	-	-	-
NNS_Rx1983	49	89	64	85	58	92	51	88	54	64	65	92	16.4	2.4	Y	-	Y	Y	Y	Y
NNS_Rx1984	41	80	55	78	51	80	44	80	52	62	58	80	16.7	-0.1	Y	-	-	-	-	-
NNS_Rx1985	40	84	49	71	48	78	47	84	51	62	55	84	15.5	0.0	Y	-	-	-	-	-
NNS_Rx1986	42	80	57	79	52	81	43	80	52	62	59	81	16.8	1.4	Y	-	-	-	-	-
NNS_Rx1987	43	82	58	79	53	85	46	83	54	65	60	85	16.8	2.4	Y	-	-	-	-	-
NNS_Rx1989	50	93	65	87	60	95	49	86	55	65	66	95	16.3	2.3	Y	-	Y	Y	Y	Y
NNS_Rx1990	42	80	56	78	51	81	44	80	53	62	59	81	16.9	0.9	Y	-	-	-	-	-
NNS_Rx1991	41	83	50	72	49	79	47	83	54	64	57	83	16.3	0.0	Y	-	-	-	-	-
NNS_Rx1993	44	83	59	81	54	85	45	82	53	63	60	85	16.6	1.7	Y	-	-	-	-	-
NNS_Rx1994	42	80	57	79	51	81	44	80	52	62	59	81	16.9	1.3	Y	-	-	-	-	-
NNS_Rx1995	40	83	50	72	48	78	46	83	54	64	57	83	16.5	0.0	Y	-	-	-	-	-
NNS_Rx1997	43	80	58	80	53	83	43	80	52	62	60	83	16.8	2.8	Y	-	-	-	-	-
NNS_Rx1998	46	86	61	83	56	89	45	82	53	63	63	89	16.9	2.5	Y	-	Y	Y	Y	Y

	2020		2040										Increase		Increase triggered		Level triggered		Eligible for mitigation	
	All		Wagons		Locos		Horns		Bells		All									
	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}
NNS_Rx1999	44	83	59	81	54	86	44	81	52	62	61	86	17.1	2.5	Y	-	Y	Y	Y	Y
NNS_Rx2000	40	82	50	72	49	78	46	82	53	63	56	82	16.4	0.0	Y	-	-	-	-	-
NNS_Rx2001	42	84	52	74	51	83	47	84	54	64	58	84	15.7	0.0	Y	-	-	-	-	-
NNS_Rx2002	41	84	51	72	49	82	47	84	51	61	56	84	15	0.0	Y	-	-	-	-	-
NNS_Rx3000	50	93	60	82	55	86	56	93	68	78	69	93	18.5	-0.1	Y	-	Y	Y	Y	Y
NNS_Rx3001	45	87	54	75	50	81	51	86	63	74	64	86	19.5	-0.1	Y	-	Y	Y	Y	Y

	2040 - Warning bells										2040 - Rail dampers									
	Wagons		Locos		Horns		Bells		All		Wagons		Locos		Horns		Bells		All	
	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}
NNS_Rx1945	53	75	49	76	45	80	47	57	55	80	51	73	49	76	45	80	54	65	57	80
NNS_Rx1946	52	74	48	77	46	81	46	58	55	81	50	72	48	77	46	81	54	65	57	81
NNS_Rx1951	52	74	48	76	45	80	44	55	55	80	50	72	48	76	45	80	52	62	56	80
NNS_Rx1953	56	78	51	82	50	87	50	59	58	87	54	76	51	82	50	87	58	68	60	87
NNS_Rx1954	52	73	49	78	50	86	52	61	56	86	50	71	49	78	50	86	60	70	61	86
NNS_Rx1956	52	74	48	77	44	79	43	53	55	79	50	72	48	77	44	79	52	62	56	79
NNS_Rx1958	60	81	54	85	56	93	54	64	63	93	58	79	54	85	56	93	61	71	64	93
NNS_Rx1960	57	78	52	82	50	87	50	61	59	87	55	76	52	82	50	87	58	68	61	87
NNS_Rx1961	53	75	49	77	43	78	42	53	55	78	51	73	49	77	43	78	50	60	54	78
NNS_Rx1962	52	74	50	79	50	87	51	61	57	87	50	72	50	79	50	87	59	69	60	87
NNS_Rx1965	55	77	52	82	50	87	49	60	58	87	53	75	52	82	50	87	57	67	60	87
NNS_Rx1966	53	75	49	77	44	80	41	51	55	80	51	73	49	77	44	80	50	61	55	80
NNS_Rx1967	60	82	55	86	56	93	53	63	63	93	58	80	55	86	56	93	60	70	64	93
NNS_Rx1968	57	79	52	85	51	88	52	61	59	88	55	77	52	85	51	88	59	68	61	88
NNS_Rx1969	53	74	51	81	50	86	51	61	57	86	51	72	51	81	50	86	60	70	61	86
NNS_Rx1970	56	77	52	83	45	82	45	56	57	83	54	75	52	83	45	82	52	63	57	83
NNS_Rx1971	55	77	50	78	45	81	45	54	56	81	53	75	50	78	45	81	53	64	57	81
NNS_Rx1972	61	82	55	88	53	91	51	61	63	91	59	80	55	88	53	91	59	69	63	91
NNS_Rx1973	51	72	49	80	49	86	48	58	55	86	49	70	49	80	49	86	57	67	59	86
NNS_Rx1974	49	71	46	78	46	82	44	54	53	82	47	69	46	78	46	82	52	62	55	82
NNS_Rx1975	56	78	51	81	45	82	48	58	58	82	54	76	51	81	45	82	56	66	59	82
NNS_Rx1977	56	77	51	80	44	80	44	55	57	80	54	75	51	80	44	80	51	62	57	80
NNS_Rx1978	57	78	52	82	46	82	48	58	59	82	55	76	52	82	46	82	55	65	59	82
NNS_Rx1979	62	84	57	90	52	89	50	60	64	90	60	82	57	90	52	89	57	67	64	90
NNS_Rx1980	50	72	49	80	48	85	47	58	55	85	48	70	49	80	48	85	56	66	58	85
NNS_Rx1982	57	79	53	84	46	83	47	56	59	84	55	77	53	84	46	83	55	64	59	84
NNS_Rx1983	64	85	58	92	51	88	47	57	65	92	62	83	58	92	51	88	54	64	64	92
NNS_Rx1984	55	78	51	80	44	80	44	55	57	80	53	76	51	80	44	80	52	62	57	80
NNS_Rx1985	49	71	48	78	47	84	43	53	53	84	47	69	48	78	47	84	51	62	55	84
NNS_Rx1986	57	79	52	81	43	80	44	55	58	81	55	77	52	81	43	80	52	62	58	81
NNS_Rx1987	58	79	53	85	46	83	46	56	59	85	56	77	53	85	46	83	54	65	59	85
NNS_Rx1989	65	87	60	95	49	86	48	58	66	95	63	85	60	95	49	86	55	65	65	95
NNS_Rx1990	56	78	51	81	44	80	45	55	58	81	54	76	51	81	44	80	53	62	58	81
NNS_Rx1991	50	72	49	79	47	83	46	56	54	83	48	70	49	79	47	83	54	64	57	83
NNS_Rx1993	59	81	54	85	45	82	46	56	60	85	57	79	54	85	45	82	53	63	59	85
NNS_Rx1994	57	79	51	81	44	80	45	55	58	81	55	77	51	81	44	80	52	62	58	81
NNS_Rx1995	50	72	48	78	46	83	46	56	54	83	48	70	48	78	46	83	54	64	56	83
NNS_Rx1997	58	80	53	83	43	80	45	54	59	83	56	78	53	83	43	80	52	62	59	83
NNS_Rx1998	61	83	56	89	45	82	46	56	63	89	59	81	56	89	45	82	53	63	61	89

	2040 - Warning bells										2040 - Rail dampers									
	Wagons		Locos		Horns		Bells		All		Wagons		Locos		Horns		Bells		All	
	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}
NNS_Rx1999	59	81	54	86	44	81	44	54	61	86	57	79	54	86	44	81	52	62	60	86
NNS_Rx2000	50	72	49	78	46	82	46	55	54	82	48	70	49	78	46	82	53	63	56	82
NNS_Rx2001	52	74	51	83	47	84	46	56	56	84	50	72	51	83	47	84	54	64	57	84
NNS_Rx2002	51	72	49	82	47	84	44	53	54	84	49	70	49	82	47	84	51	61	55	84
NNS_Rx3000	60	82	55	86	56	93	61	71	64	93	58	80	55	86	56	93	68	78	68	93
NNS_Rx3001	54	75	50	81	51	86	55	65	58	86	52	73	50	81	51	86	63	74	64	86

	2040 - 5m noise barrier										2040 - 4m noise barrier									
	Wagons		Locos		Horns		Bells		All		Wagons		Locos		Horns		Bells		All	
	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}
NNS_Rx1945	52	73	49	77	44	79	47	57	55	79	52	74	49	77	45	80	47	57	55	80
NNS_Rx1946	50	72	47	79	45	79	46	58	53	79	50	72	48	79	46	81	46	58	54	81
NNS_Rx1951	52	73	47	79	43	79	44	55	53	79	52	73	48	78	45	79	44	55	53	79
NNS_Rx1953	54	75	50	83	47	83	50	59	56	83	54	75	51	83	49	86	50	59	57	86
NNS_Rx1954	51	73	49	78	47	81	52	61	56	81	52	73	50	79	50	86	52	61	56	86
NNS_Rx1956	51	73	47	79	42	78	43	53	53	79	51	73	48	79	43	79	43	53	53	79
NNS_Rx1958	56	78	52	85	51	87	54	64	60	87	56	78	54	85	54	91	54	64	61	91
NNS_Rx1960	53	74	49	81	47	83	50	61	56	83	53	75	52	83	49	86	50	61	57	86
NNS_Rx1961	52	73	47	77	41	78	42	53	53	78	52	73	49	77	43	78	42	53	53	78
NNS_Rx1962	52	74	50	78	46	81	51	61	56	81	52	74	50	80	50	86	51	61	57	86
NNS_Rx1965	51	72	49	80	46	83	49	60	55	83	51	73	51	81	49	86	49	60	56	86
NNS_Rx1966	52	73	47	76	42	77	41	51	53	77	52	73	48	78	43	78	41	51	53	78
NNS_Rx1967	55	77	52	84	51	88	53	63	59	88	56	77	55	87	53	90	53	63	60	90
NNS_Rx1968	52	74	50	83	47	84	52	61	56	84	53	74	52	85	50	87	52	61	57	87
NNS_Rx1969	52	74	50	81	46	80	51	61	57	81	53	74	51	82	49	86	51	61	57	86
NNS_Rx1970	51	72	48	78	41	77	45	56	53	78	51	72	51	82	45	82	45	56	55	82
NNS_Rx1971	52	73	48	76	42	77	45	54	53	77	52	73	49	79	45	81	45	54	54	81
NNS_Rx1972	55	77	52	84	50	86	51	61	58	86	55	77	54	86	52	89	51	61	59	89
NNS_Rx1973	51	72	49	81	45	80	48	58	55	81	51	72	50	81	49	85	48	58	55	85
NNS_Rx1974	49	71	47	80	43	78	44	54	52	80	49	71	47	80	45	80	44	54	53	80
NNS_Rx1975	50	71	48	78	41	77	48	58	54	78	50	72	51	81	45	82	48	58	55	82
NNS_Rx1977	52	74	48	78	41	76	44	55	54	78	52	74	51	80	44	80	44	55	55	80
NNS_Rx1978	53	74	49	78	42	77	48	58	54	78	53	74	51	81	45	81	48	58	55	81
NNS_Rx1979	54	76	51	81	48	85	50	60	57	85	55	76	54	86	51	88	50	60	59	88
NNS_Rx1980	50	72	49	81	44	79	47	58	54	81	51	72	50	81	48	84	47	58	55	84
NNS_Rx1982	51	73	48	77	44	81	47	56	54	81	52	73	52	83	46	83	47	56	55	83
NNS_Rx1983	54	76	52	82	48	85	47	57	57	85	55	77	55	87	50	87	47	57	59	87
NNS_Rx1984	54	75	49	80	41	76	44	55	55	80	54	75	50	80	44	80	44	55	55	80
NNS_Rx1985	50	71	49	80	44	79	43	53	53	80	50	72	49	80	47	83	43	53	54	83
NNS_Rx1986	52	74	49	79	38	74	44	55	54	79	52	74	51	80	43	79	44	55	55	80
NNS_Rx1987	54	76	50	81	44	80	46	56	55	81	54	76	53	83	46	82	46	56	56	83
NNS_Rx1989	55	77	52	83	47	84	48	58	58	84	56	77	55	87	49	85	48	58	59	87
NNS_Rx1990	53	74	48	81	41	75	45	55	54	81	53	74	51	81	44	80	45	55	55	81
NNS_Rx1991	51	72	49	81	45	81	46	56	54	81	51	72	50	81	47	83	46	56	55	83
NNS_Rx1993	54	76	49	81	41	76	46	56	55	81	54	76	52	83	44	80	46	56	56	83
NNS_Rx1994	55	77	51	81	43	78	45	55	57	81	55	77	51	81	44	80	45	55	57	81
NNS_Rx1995	51	72	49	80	45	81	46	56	54	81	51	72	50	80	46	83	46	56	55	83
NNS_Rx1997	56	77	51	83	42	78	45	54	57	83	56	77	52	83	43	79	45	54	57	83
NNS_Rx1998	54	76	50	81	44	80	46	56	56	81	54	76	53	85	45	81	46	56	57	85

	2040 - 5m noise barrier										2040 - 4m noise barrier									
	Wagons		Locos		Horns		Bells		All		Wagons		Locos		Horns		Bells		All	
	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}
NNS_Rx1999	55	76	50	82	43	79	44	54	56	82	55	77	53	83	44	81	44	54	57	83
NNS_Rx2000	51	73	50	80	44	80	46	55	55	80	51	73	50	80	46	82	46	55	55	82
NNS_Rx2001	53	77	52	84	44	79	43	53	56	84	54	77	52	84	46	83	45	54	56	84
NNS_Rx2002	51	75	50	83	43	79	40	50	54	83	52	75	50	83	46	83	42	52	55	83
NNS_Rx3000	59	81	54	87	52	88	61	71	64	88	59	81	55	87	54	91	61	71	64	91
NNS_Rx3001	54	75	50	81	48	83	55	65	58	83	54	75	50	81	50	85	55	65	58	85

	2040 - 3m noise barrier										2040 - Wheel wall									
	Wagons		Locos		Horns		Bells		All		Wagons		Locos		Horns		Bells		All	
	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}
NNS_Rx1945	52	74	49	76	45	80	47	57	55	80	53	75	49	76	45	80	47	57	56	80
NNS_Rx1946	50	72	48	77	46	81	46	58	54	81	52	73	48	77	46	81	46	58	55	81
NNS_Rx1951	52	73	48	76	45	80	44	55	54	80	52	74	48	76	45	80	44	55	54	80
NNS_Rx1953	54	76	51	82	50	87	50	59	57	87	56	78	51	82	50	87	50	59	59	87
NNS_Rx1954	52	74	49	78	50	86	52	61	57	86	52	74	49	78	50	86	52	61	57	86
NNS_Rx1956	51	73	48	77	44	79	43	53	53	79	52	74	48	77	44	79	43	53	54	79
NNS_Rx1958	56	78	55	85	56	93	54	64	61	93	59	81	54	85	56	93	54	64	62	93
NNS_Rx1960	53	75	52	82	50	87	50	61	57	87	56	78	52	81	50	87	50	61	59	87
NNS_Rx1961	52	73	49	77	43	78	42	53	53	78	52	74	49	77	43	78	42	53	54	78
NNS_Rx1962	53	74	50	79	50	87	51	61	57	87	53	75	50	79	50	87	51	61	57	87
NNS_Rx1965	52	73	52	82	50	87	49	60	57	87	55	77	52	82	50	87	49	60	58	87
NNS_Rx1966	52	73	49	78	44	80	41	51	53	80	52	74	49	78	44	80	41	51	54	80
NNS_Rx1967	56	78	55	86	56	93	53	63	61	93	60	82	55	86	56	93	53	63	63	93
NNS_Rx1968	53	75	52	85	51	88	52	61	57	88	57	79	52	85	51	88	52	61	59	88
NNS_Rx1969	53	75	50	81	50	86	51	61	57	86	53	75	50	81	50	86	51	61	57	86
NNS_Rx1970	51	73	52	83	45	82	45	56	55	83	55	77	52	83	45	82	45	56	57	83
NNS_Rx1971	52	73	50	78	45	81	45	54	54	81	54	75	50	78	45	81	45	54	56	81
NNS_Rx1972	56	77	55	88	53	91	51	61	60	91	60	81	55	88	53	91	51	61	62	91
NNS_Rx1973	51	73	49	80	49	86	48	58	56	86	52	73	49	80	49	86	48	58	56	86
NNS_Rx1974	50	71	46	78	46	82	44	54	53	82	50	71	46	78	46	82	44	54	53	82
NNS_Rx1975	51	73	51	81	45	82	48	58	56	82	56	77	51	81	45	82	48	58	58	82
NNS_Rx1977	52	74	51	80	44	80	44	55	55	80	55	77	51	80	44	80	44	55	57	80
NNS_Rx1978	53	75	52	82	46	82	48	58	56	82	55	77	52	82	46	82	48	58	58	82
NNS_Rx1979	55	77	57	90	52	89	50	60	60	90	60	82	57	90	52	89	50	60	62	90
NNS_Rx1980	51	73	49	80	48	85	47	58	55	85	51	73	49	80	48	85	47	58	55	85
NNS_Rx1982	52	74	53	84	46	83	47	56	56	84	56	78	53	84	46	83	47	56	58	84
NNS_Rx1983	56	77	58	92	50	87	47	57	61	92	61	82	58	92	51	88	47	57	63	92
NNS_Rx1984	54	75	51	80	44	80	44	55	55	80	55	77	51	80	44	80	44	55	57	80
NNS_Rx1985	50	72	48	79	47	84	43	53	54	84	50	72	48	79	47	84	43	53	54	84
NNS_Rx1986	53	74	52	81	43	80	44	55	56	81	56	77	52	81	43	80	44	55	57	81
NNS_Rx1987	54	76	53	85	46	83	46	56	57	85	56	78	53	85	46	83	46	56	58	85
NNS_Rx1989	57	79	59	93	49	86	48	58	61	93	61	83	60	95	49	86	48	58	64	95
NNS_Rx1990	53	74	51	81	44	80	45	55	56	81	55	77	51	81	44	80	45	55	57	81
NNS_Rx1991	51	73	49	79	47	83	46	56	55	83	51	73	49	79	47	83	46	56	55	83
NNS_Rx1993	54	76	54	85	45	82	46	56	57	85	57	80	54	85	45	82	46	56	59	85
NNS_Rx1994	56	77	51	81	44	80	45	55	57	81	56	78	51	81	44	80	45	55	57	81
NNS_Rx1995	51	73	48	78	46	83	46	56	54	83	51	73	48	78	46	83	46	56	54	83
NNS_Rx1997	56	77	53	83	43	80	45	54	58	83	57	78	53	83	43	80	45	54	58	83
NNS_Rx1998	55	77	56	89	45	82	46	56	59	89	58	80	56	89	45	82	46	56	60	89

	2040 - 3m noise barrier										2040 - Wheel wall									
	Wagons		Locos		Horns		Bells		All		Wagons		Locos		Horns		Bells		All	
	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}
NNS_Rx1999	55	77	54	86	44	81	44	54	58	86	57	79	54	86	44	81	44	54	59	86
NNS_Rx2000	51	73	49	78	46	82	46	55	55	82	51	73	49	78	46	82	46	55	55	82
NNS_Rx2001	54	78	51	83	47	84	46	55	56	84	54	76	51	83	47	84	46	56	57	84
NNS_Rx2002	52	75	49	82	47	84	43	53	55	84	52	74	49	82	47	84	44	53	55	84
NNS_Rx3000	60	81	55	86	56	93	61	71	64	93	61	83	55	86	56	93	61	71	64	93
NNS_Rx3001	54	76	50	81	51	86	55	65	58	86	54	76	50	81	51	86	55	65	58	86

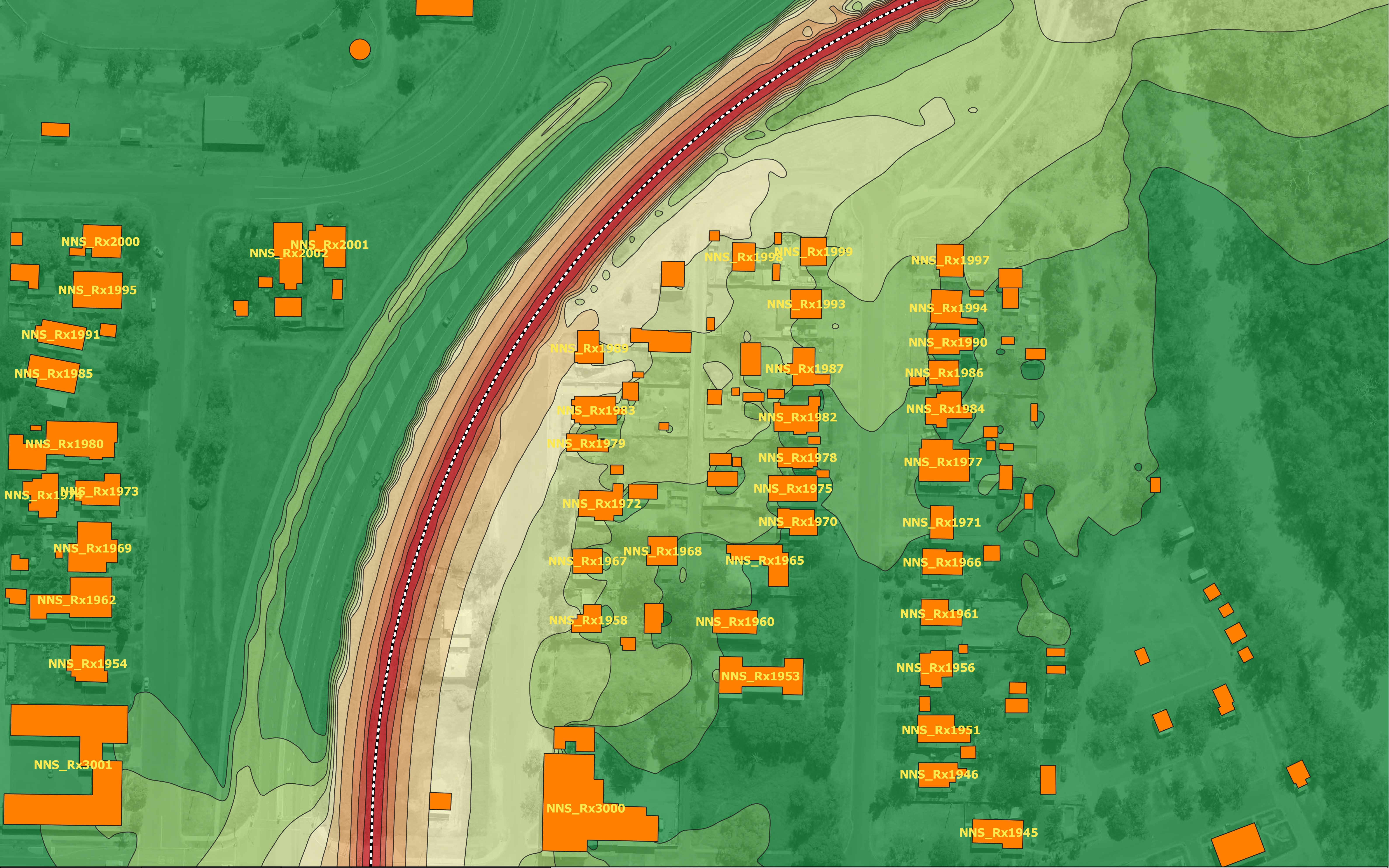
	2040 - RING optimised									
	Wagons		Locos		Horns		Bells		All	
	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}
NNS_Rx1945	52	73	49	77	43	79	47	57	55	79
NNS_Rx1946	50	72	47	79	43	79	46	58	53	79
NNS_Rx1951	52	73	48	79	42	79	44	55	53	79
NNS_Rx1953	54	75	49	83	45	81	50	59	56	83
NNS_Rx1954	52	73	50	80	48	84	52	61	56	84
NNS_Rx1956	51	73	47	79	41	78	43	53	53	79
NNS_Rx1958	56	78	51	85	48	83	54	64	59	85
NNS_Rx1960	53	74	49	81	45	79	50	61	56	81
NNS_Rx1961	52	73	48	77	41	78	42	53	53	78
NNS_Rx1962	52	74	50	80	48	84	51	61	57	84
NNS_Rx1965	51	72	49	80	43	79	49	60	55	80
NNS_Rx1966	52	73	47	76	41	77	41	51	53	77
NNS_Rx1967	55	77	51	84	48	84	53	63	59	84
NNS_Rx1968	52	74	50	83	45	80	52	61	55	83
NNS_Rx1969	53	74	51	81	48	83	51	61	57	83
NNS_Rx1970	51	72	49	80	38	73	45	56	53	80
NNS_Rx1971	52	73	48	77	42	77	45	54	53	77
NNS_Rx1972	55	77	52	84	47	83	51	61	58	84
NNS_Rx1973	51	72	50	81	47	83	48	58	55	83
NNS_Rx1974	49	71	47	80	44	78	44	54	52	80
NNS_Rx1975	50	72	50	80	38	73	48	58	54	80
NNS_Rx1977	52	74	49	80	40	76	44	55	54	80
NNS_Rx1978	53	74	50	80	40	75	48	58	54	80
NNS_Rx1979	54	76	51	81	46	82	50	60	57	82
NNS_Rx1980	51	72	50	81	46	82	47	58	55	82
NNS_Rx1982	51	73	50	83	41	77	47	56	54	83
NNS_Rx1983	54	76	52	83	45	82	47	57	57	83
NNS_Rx1984	54	75	49	80	39	76	44	55	55	80
NNS_Rx1985	50	72	49	80	45	81	43	53	54	81
NNS_Rx1986	52	74	51	80	37	73	44	55	55	80
NNS_Rx1987	54	76	51	83	42	77	46	56	55	83
NNS_Rx1989	55	77	52	85	45	81	48	58	58	85
NNS_Rx1990	53	74	50	81	40	75	45	55	55	81
NNS_Rx1991	51	72	50	81	45	81	46	56	55	81
NNS_Rx1993	54	76	51	83	39	75	46	56	56	83
NNS_Rx1994	55	77	51	81	41	75	45	55	57	81
NNS_Rx1995	51	72	49	80	45	81	46	56	54	81
NNS_Rx1997	56	77	52	83	40	75	45	54	57	83
NNS_Rx1998	54	76	53	85	42	77	46	56	57	85

	2040 - RING optimised									
	Wagons		Locos		Horns		Bells		All	
	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}	$L_{Aeq,9h}$	L_{Amax}
NNS_Rx1999	55	77	52	83	40	76	44	54	57	83
NNS_Rx2000	51	73	50	80	45	81	46	55	55	81
NNS_Rx2001	54	77	52	84	45	82	44	53	56	84
NNS_Rx2002	52	75	51	83	45	81	41	51	55	83
NNS_Rx3000	59	81	54	87	50	86	61	71	64	87
NNS_Rx3001	54	75	51	81	49	84	55	65	58	84

Appendix B

Predicted noise levels

Noise contour maps



Map: UNW1	Author: AV
Date: 31/01/2024	Approved by: BI

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

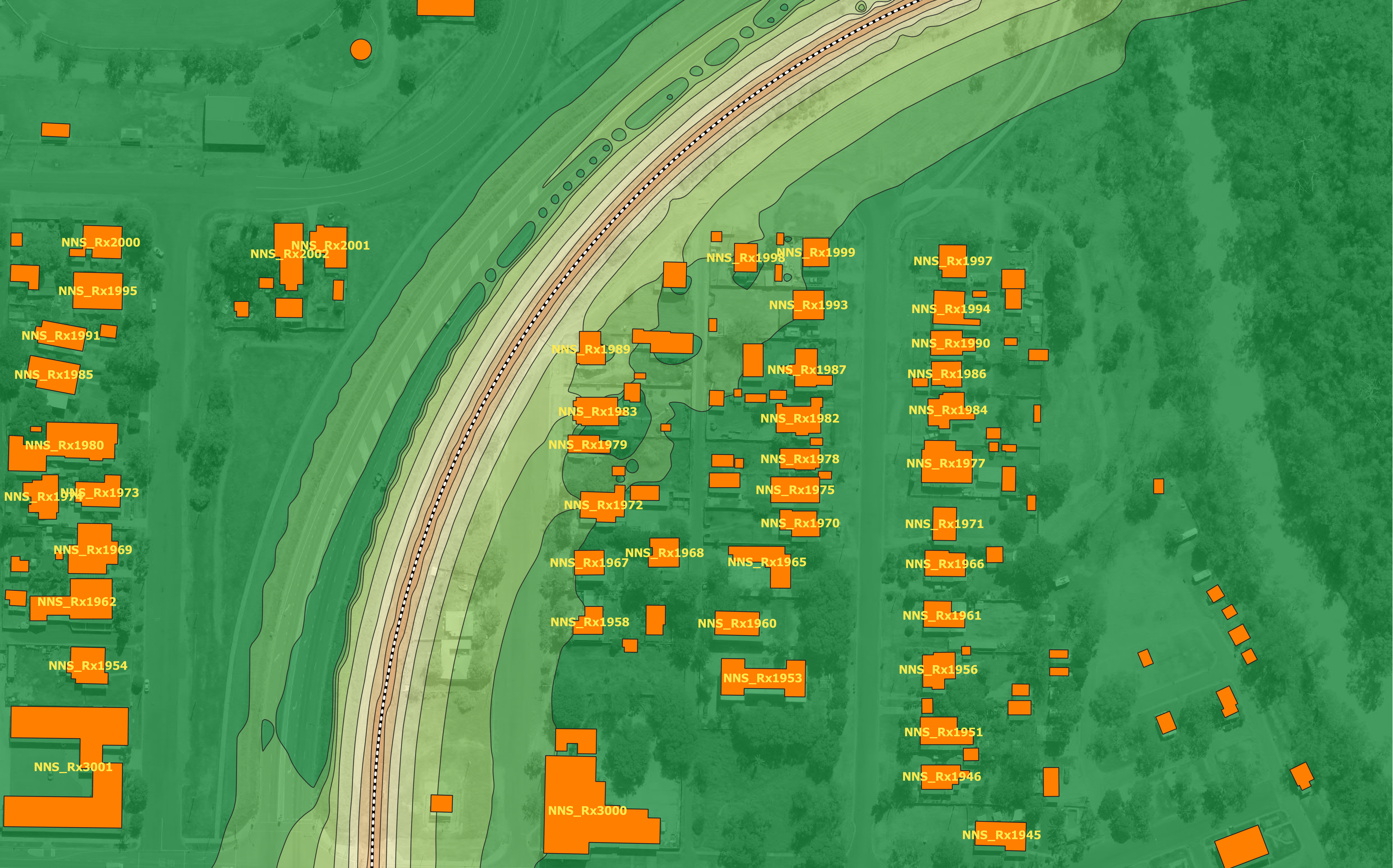
≤54	60 - 62	68 - 70
54 - 56	62 - 64	70 - 72
56 - 58	64 - 66	≥72
58 - 60	66 - 68	

Narrabri to North Star - Phase 2

Year 2040 Night - Unmitigated Wagons

MOTT MACDONALD

IRDJV



Map: UNL2	Author: AV	
Date: 31/01/2024	Approved by: BI	

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

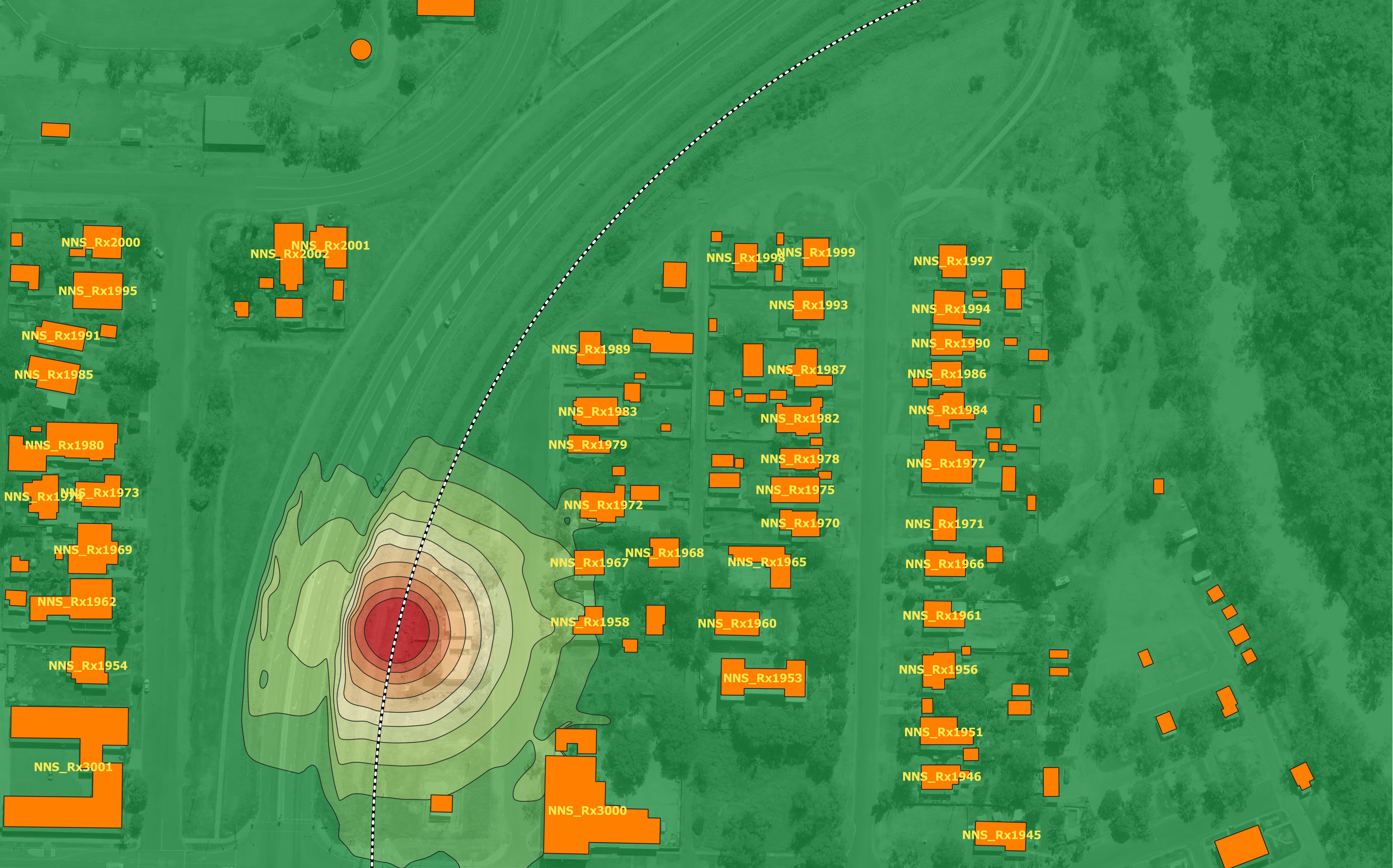
≤54	60 - 62	68 - 70
54 - 56	62 - 64	70 - 72
56 - 58	64 - 66	≥72
58 - 60	66 - 68	

Narrabri to North Star - Phase 2

Year 2040 Night - Unmitigated Locos

MOTT MACDONALD

IRDJV



Map: UNH3	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

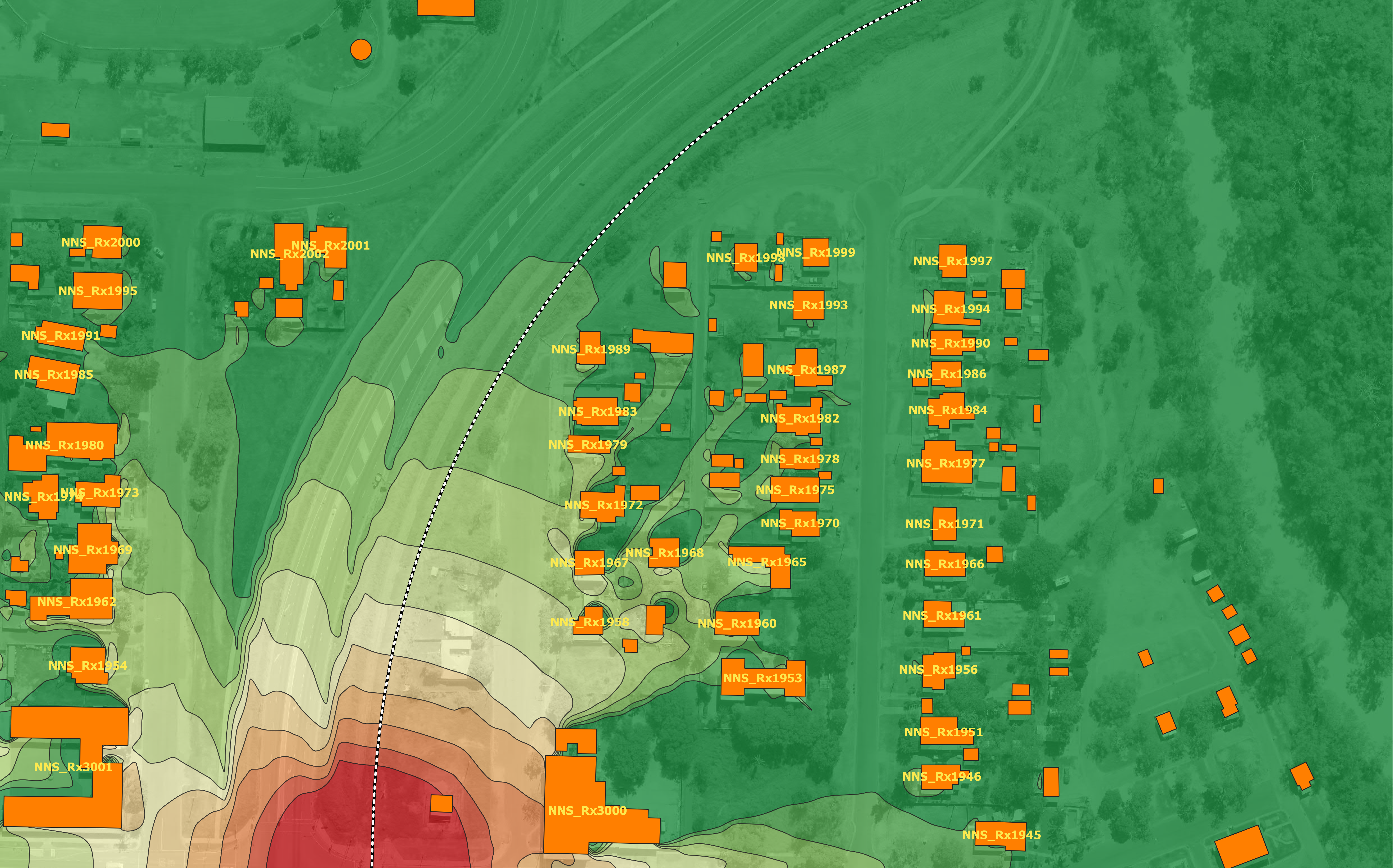
- ≤54
- 54 - 56
- 56 - 58
- 58 - 60
- 60 - 62
- 62 - 64
- 64 - 66
- 66 - 68
- 68 - 70
- 70 - 72
- ≥72

Narrabri to North Star - Phase 2

Year 2040 Night - Unmitigated Horns

MOTT MACDONALD

IRDJV



Map: UNB4	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

≤54	60 - 62	68 - 70
54 - 56	62 - 64	70 - 72
56 - 58	64 - 66	≥72
58 - 60	66 - 68	

Narrabri to North Star - Phase 2

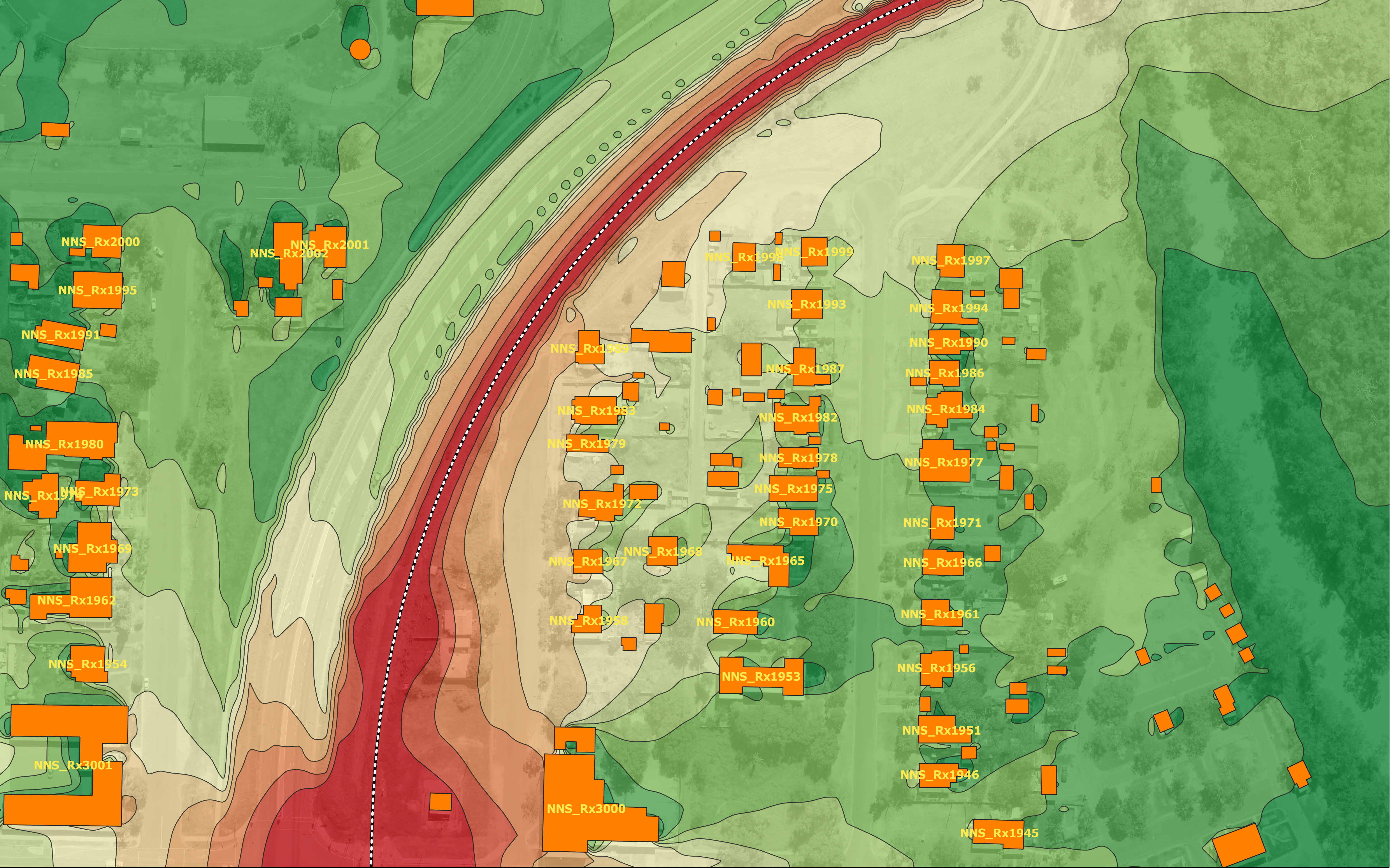
Year 2040 Night - Unmitigated

Bells

wsp

MOTT MACDONALD

IRDJV



Map: UNA5

Author: AV

Date: 31/01/2024

Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

- ≤54
- 54 - 56
- 56 - 58
- 58 - 60
- 60 - 62
- 62 - 64
- 64 - 66
- 66 - 68
- 68 - 70
- 70 - 72
- ≥72

Narrabri to North Star - Phase 2

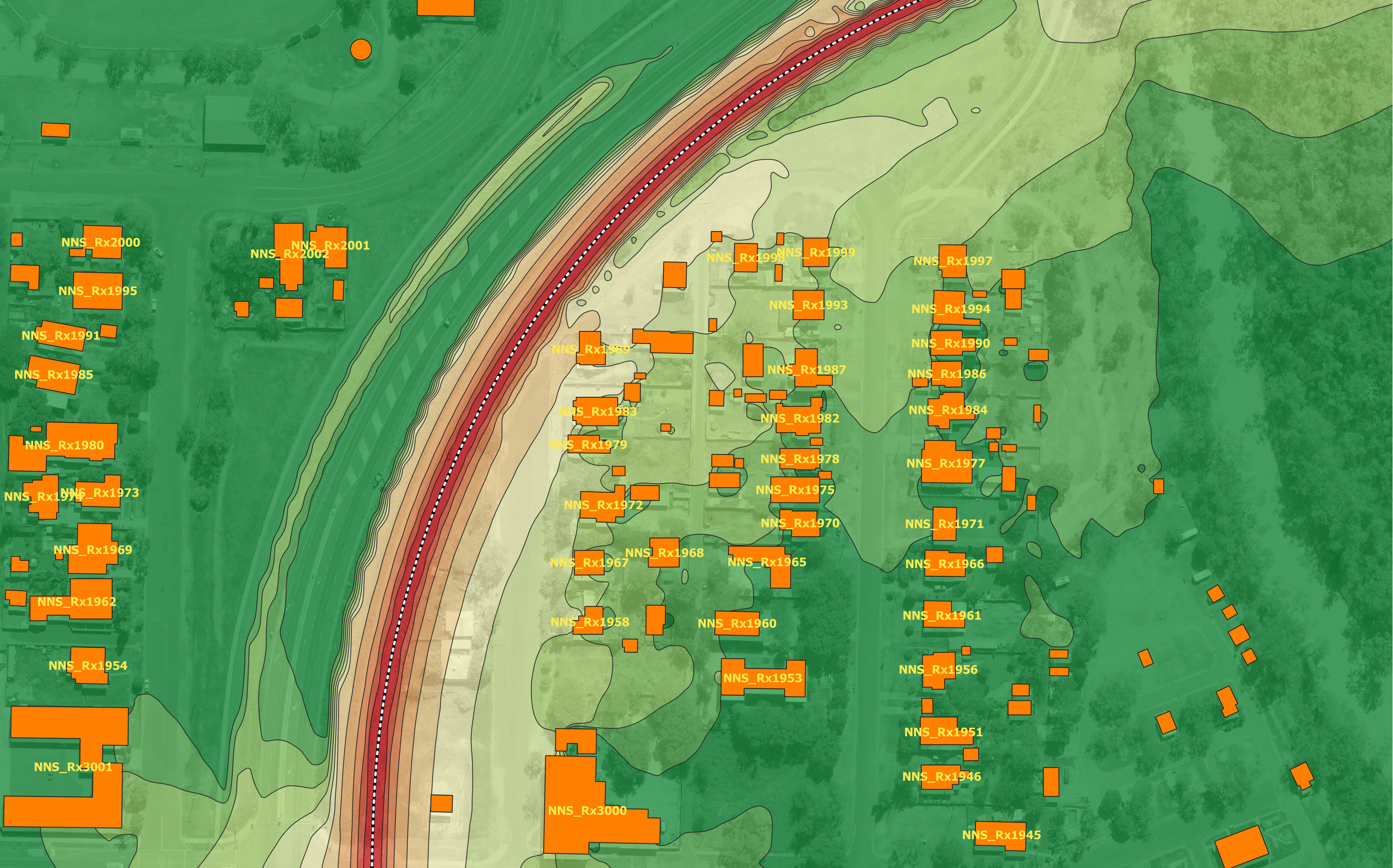
Year 2040 Night - Unmitigated

All sources

wsp

MOTT MACDONALD

IRDJV



Map: WBW1	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

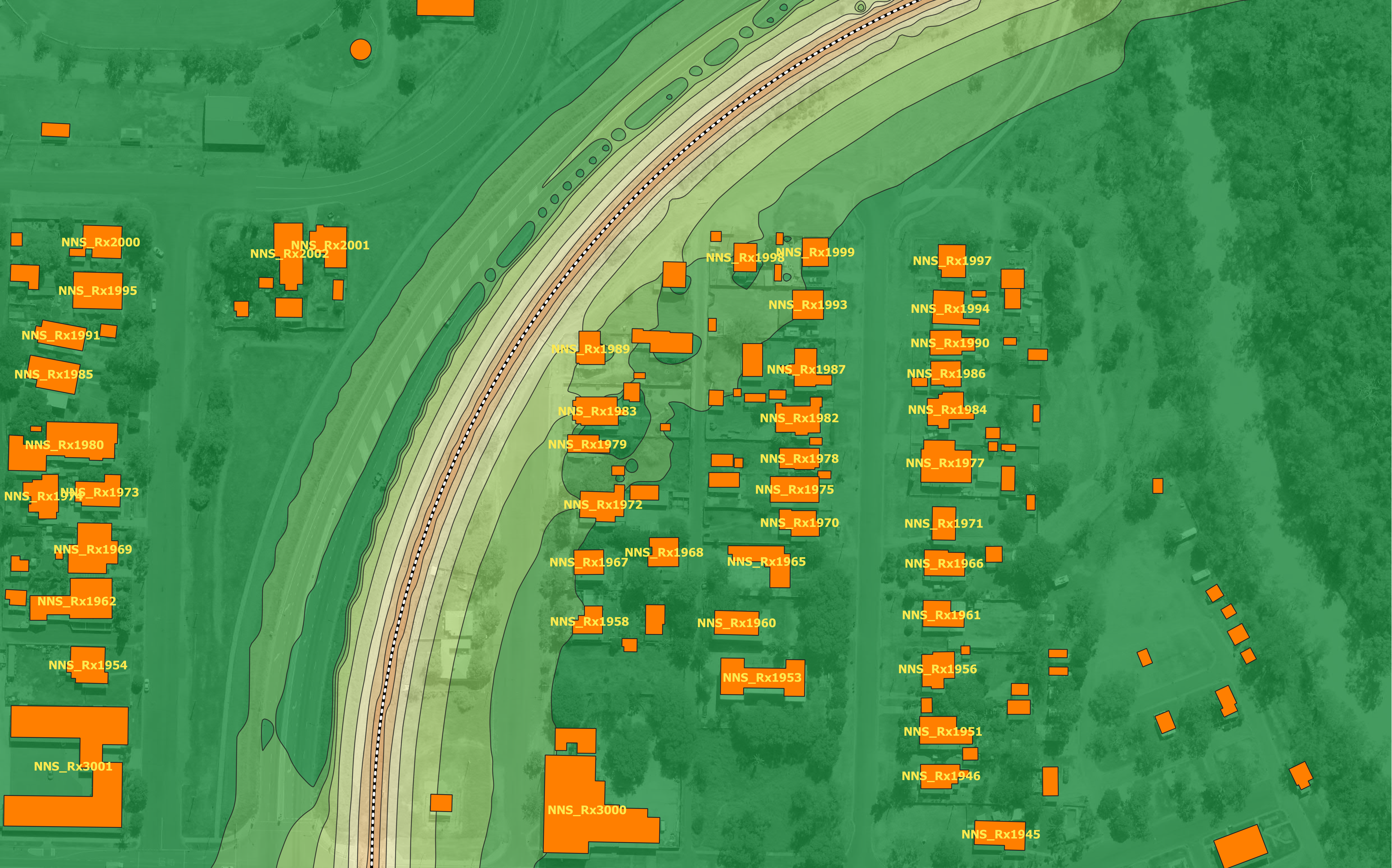
- ≤54
- 54 - 56
- 56 - 58
- 58 - 60
- 60 - 62
- 62 - 64
- 64 - 66
- 66 - 68
- 68 - 70
- 70 - 72
- ≥72

Narrabri to North Star - Phase 2

Year 2040 Night - Warning Bells Wagons

MOTT MACDONALD

IRDJV



Map: WBL2

Author: AV

Date: 31/01/2024

Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

≤54	60 - 62	68 - 70
54 - 56	62 - 64	70 - 72
56 - 58	64 - 66	≥72
58 - 60	66 - 68	

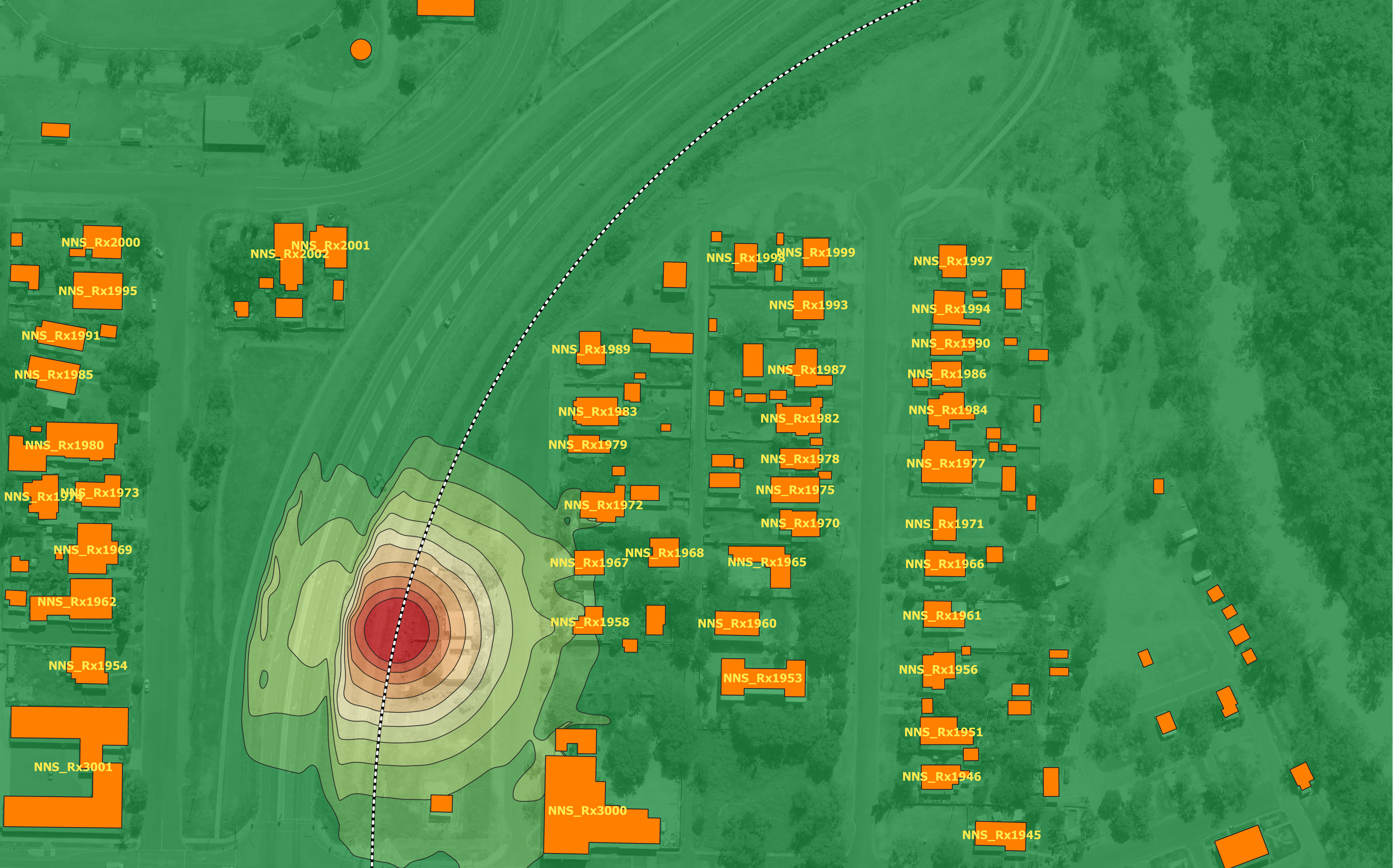
Narrabri to North Star - Phase 2

Year 2040 Night - Warning Bells Locos

wsp

MOTT MACDONALD

IRDJV



Map: WBH3	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

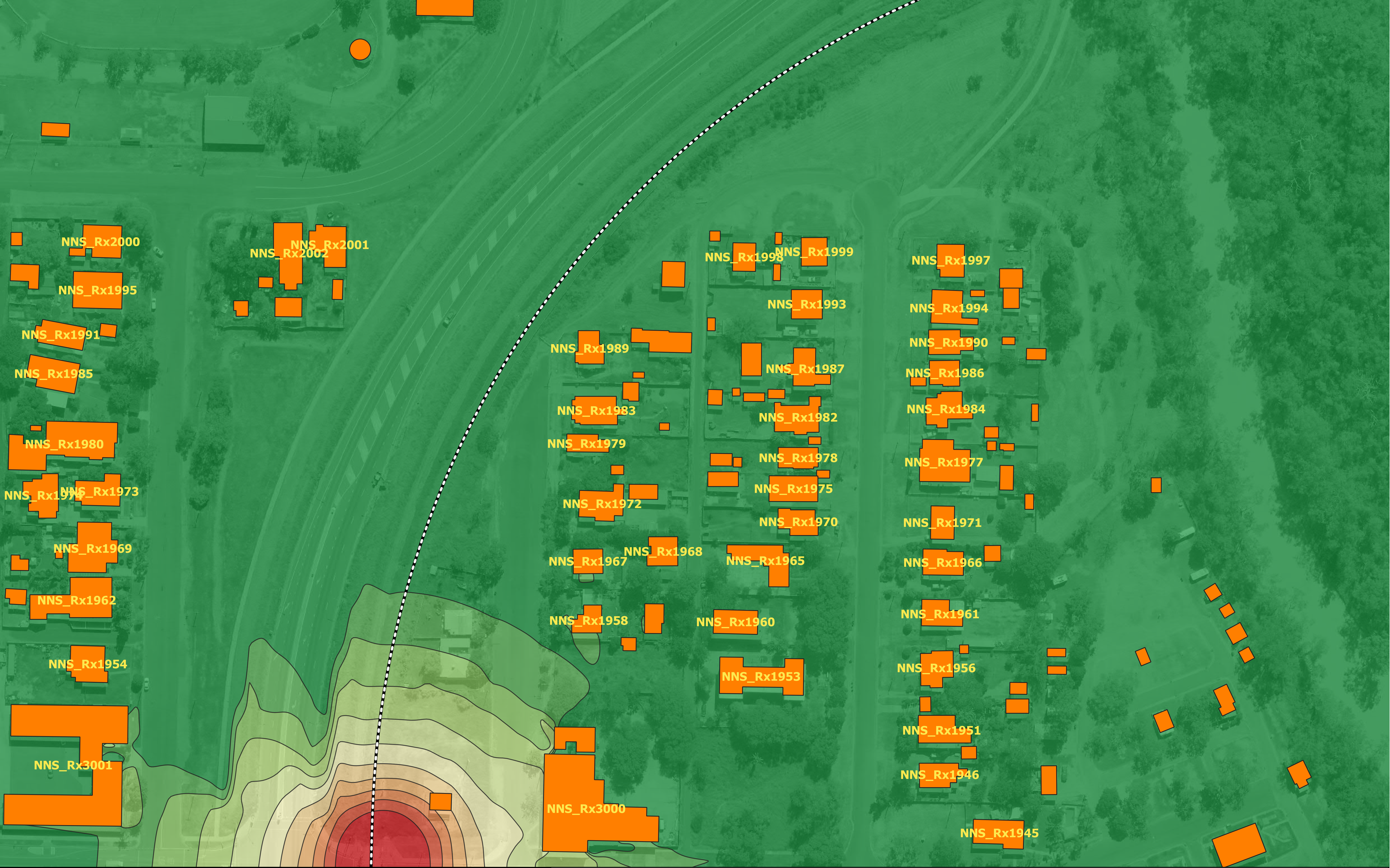
- ≤54
- 54 - 56
- 56 - 58
- 58 - 60
- 60 - 62
- 62 - 64
- 64 - 66
- 66 - 68
- 68 - 70
- 70 - 72
- ≥72

Narrabri to North Star - Phase 2

Year 2040 Night - Warning Bells Horns

MOTT MACDONALD

IRDJV



Map: WBB4	Author: AV
Date: 31/01/2024	Approved by: BI

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

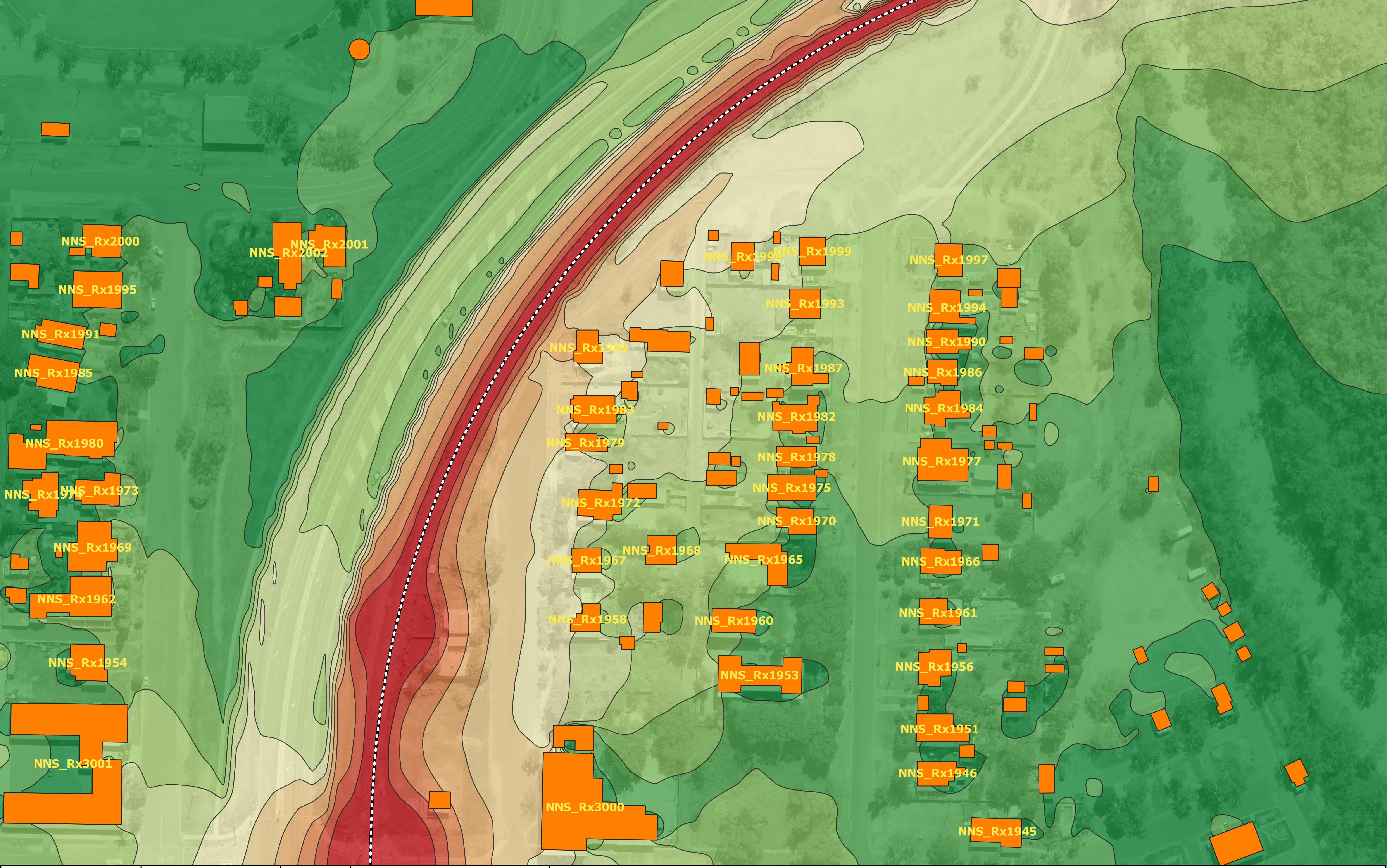
- ≤54
- 54 - 56
- 56 - 58
- 58 - 60
- 60 - 62
- 62 - 64
- 64 - 66
- 66 - 68
- 68 - 70
- 70 - 72
- ≥72

Narrabri to North Star - Phase 2

Year 2040 Night - Warning Bells Bells

MOTT MACDONALD

IRDJV



Map: WBA5	Author: AV
Date: 31/01/2024	Approved by: BI

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

- ≤54
- 54 - 56
- 56 - 58
- 58 - 60
- 60 - 62
- 62 - 64
- 64 - 66
- 66 - 68
- 68 - 70
- 70 - 72
- ≥72

Narrabri to North Star - Phase 2

Year 2040 Night - Warning Bells

All sources

MOTT MACDONALD

IRDJV

Map: RDW1

Author: AV

Date: 31/01/2024

Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

≤54	60 - 62	68 - 70
54 - 56	62 - 64	70 - 72
56 - 58	64 - 66	≥72
58 - 60	66 - 68	

Narrabri to North Star - Phase 2

Year 2040 Night - Rail Dampers Wagons

wsp

MOTT MACDONALD

IRDJV

Map: RDL2
Author: AV
Date: 31/01/2024
Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

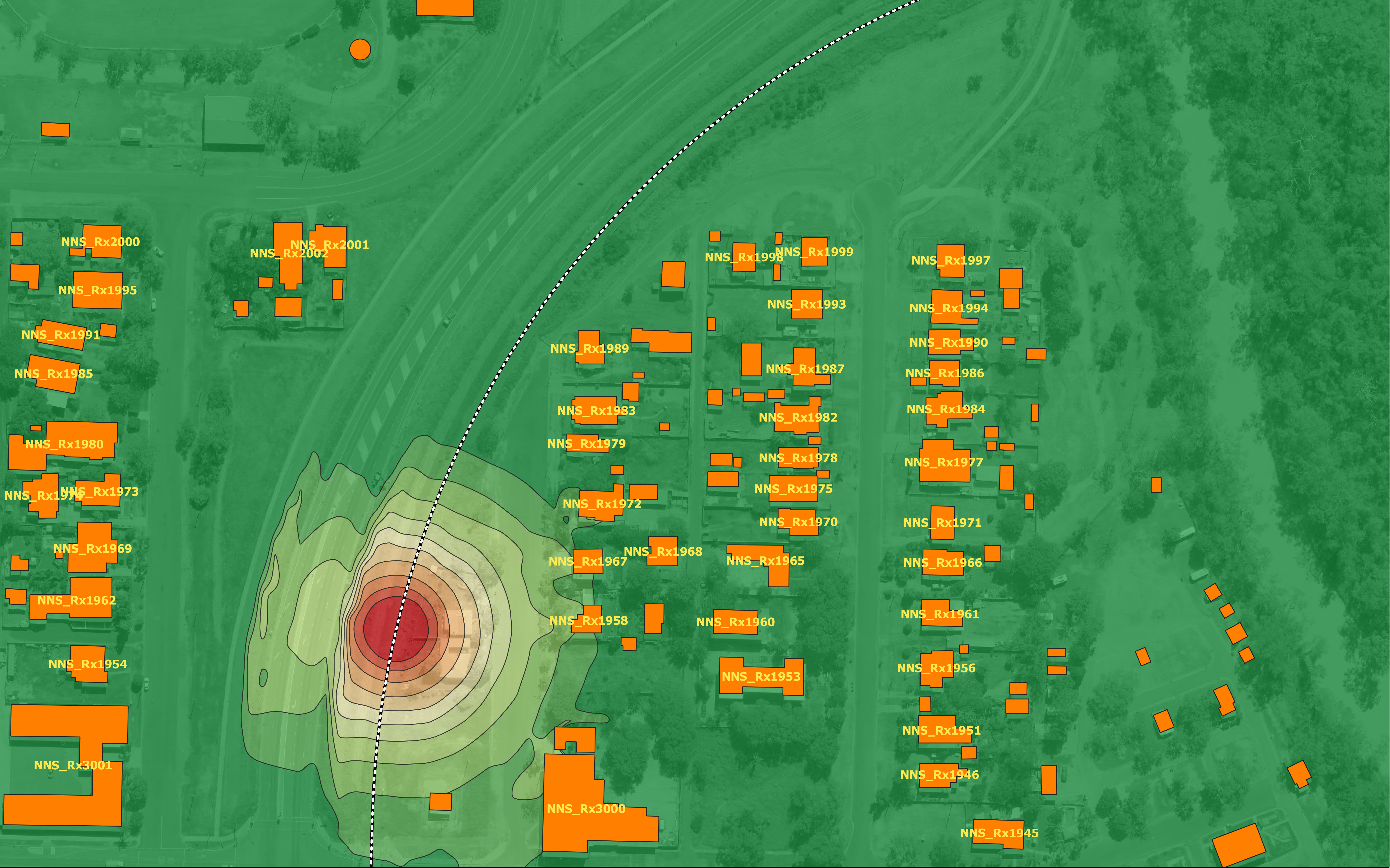
- ≤54
- 54 - 56
- 56 - 58
- 58 - 60
- 60 - 62
- 62 - 64
- 64 - 66
- 66 - 68
- 68 - 70
- 70 - 72
- ≥72

Narrabri to North Star - Phase 2

Year 2040 Night - Rail Dampers Locos

MOTT MACDONALD

IRDJV



Map: RDH3	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

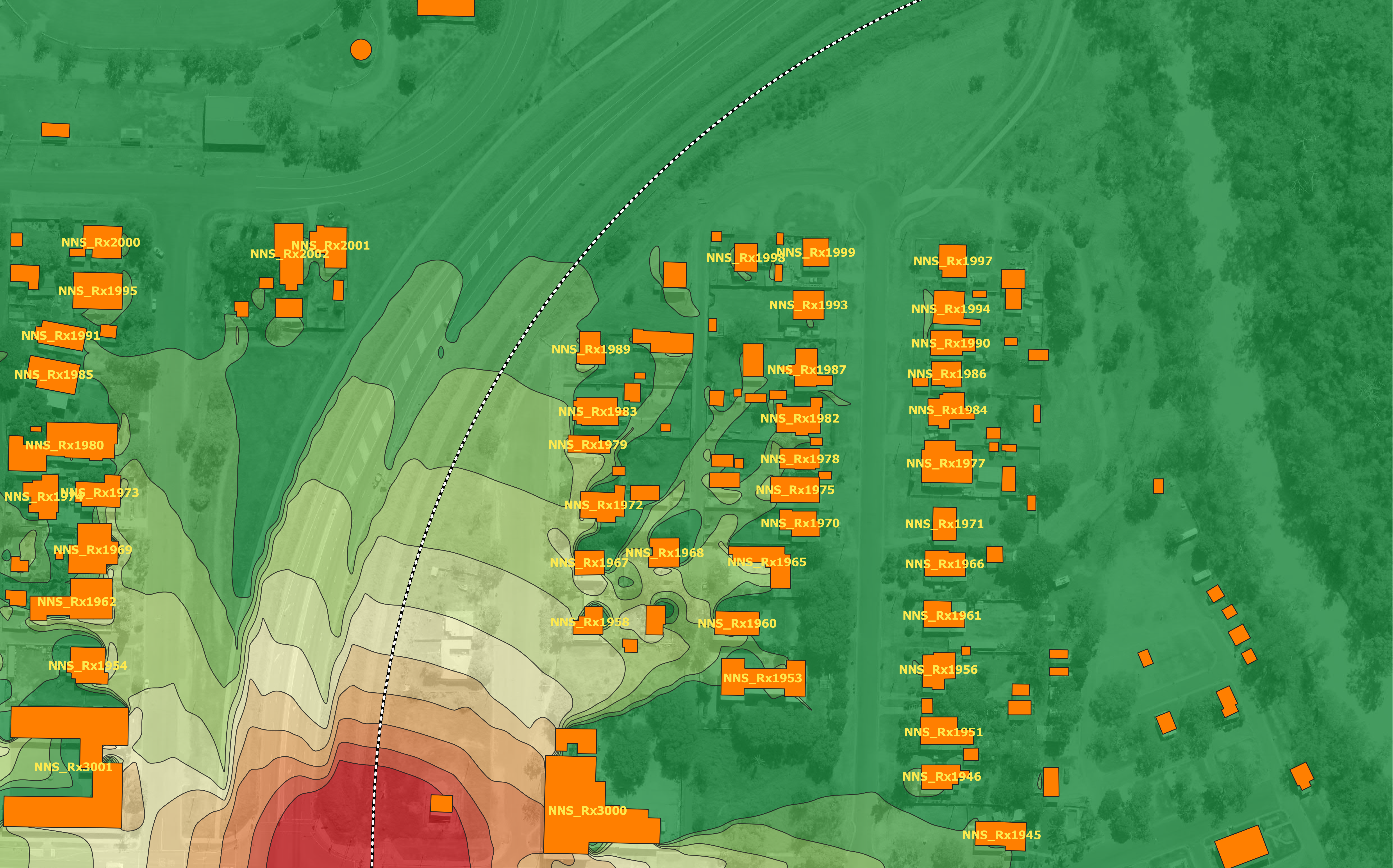
- ≤54
- 54 - 56
- 56 - 58
- 58 - 60
- 60 - 62
- 62 - 64
- 64 - 66
- 66 - 68
- 68 - 70
- 70 - 72
- ≥72

Narrabri to North Star - Phase 2

Year 2040 Night - Rail Dampers Horns

MOTT MACDONALD

IRDJV



Map: RDB4	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

- ≤54
- 54 - 56
- 56 - 58
- 58 - 60
- 60 - 62
- 62 - 64
- 64 - 66
- 66 - 68
- 68 - 70
- 70 - 72
- ≥72

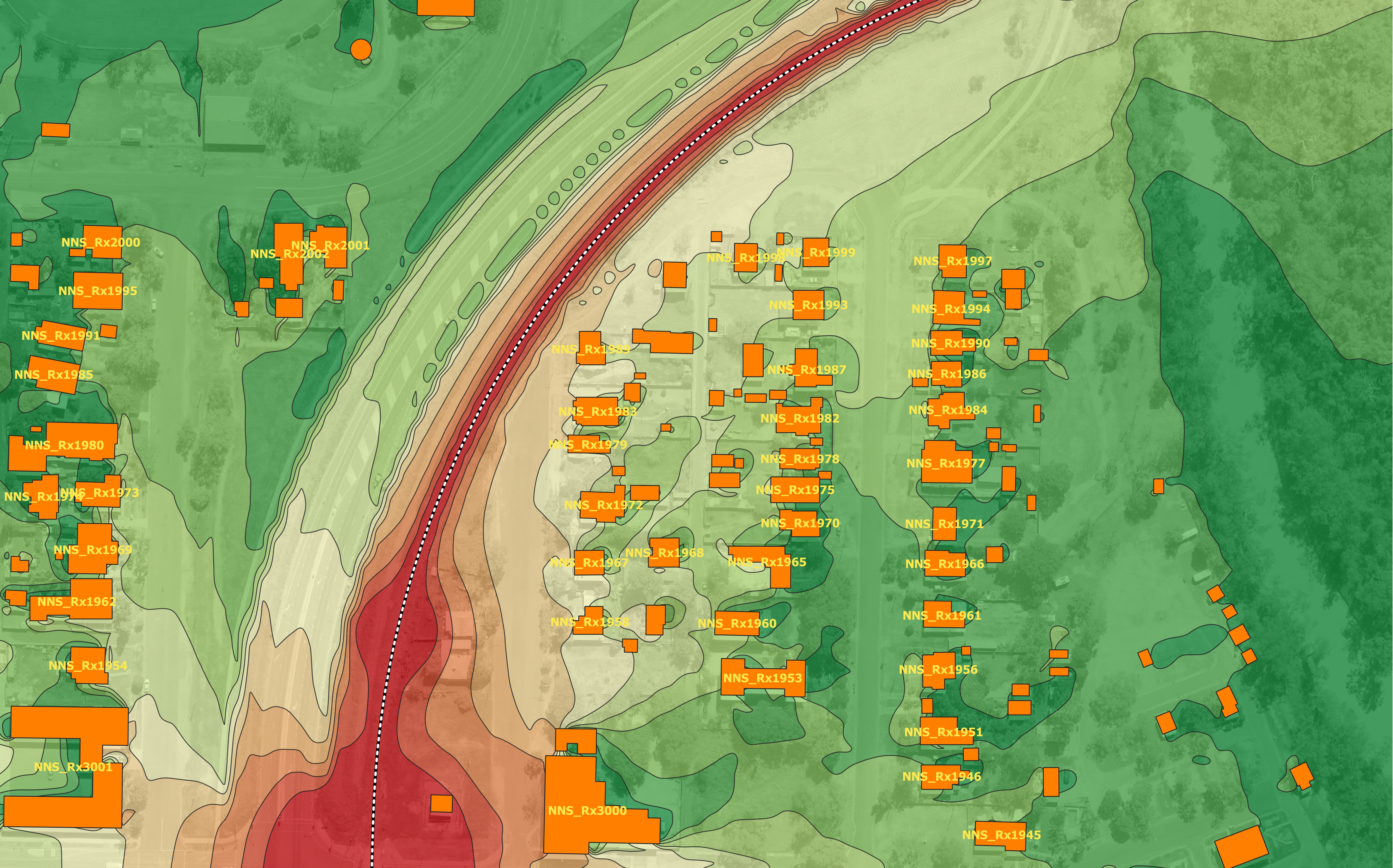
Narrabri to North Star - Phase 2

Year 2040 Night - Rail Dampers

Bells

MOTT MACDONALD

IRDJV



Map: RDA5	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

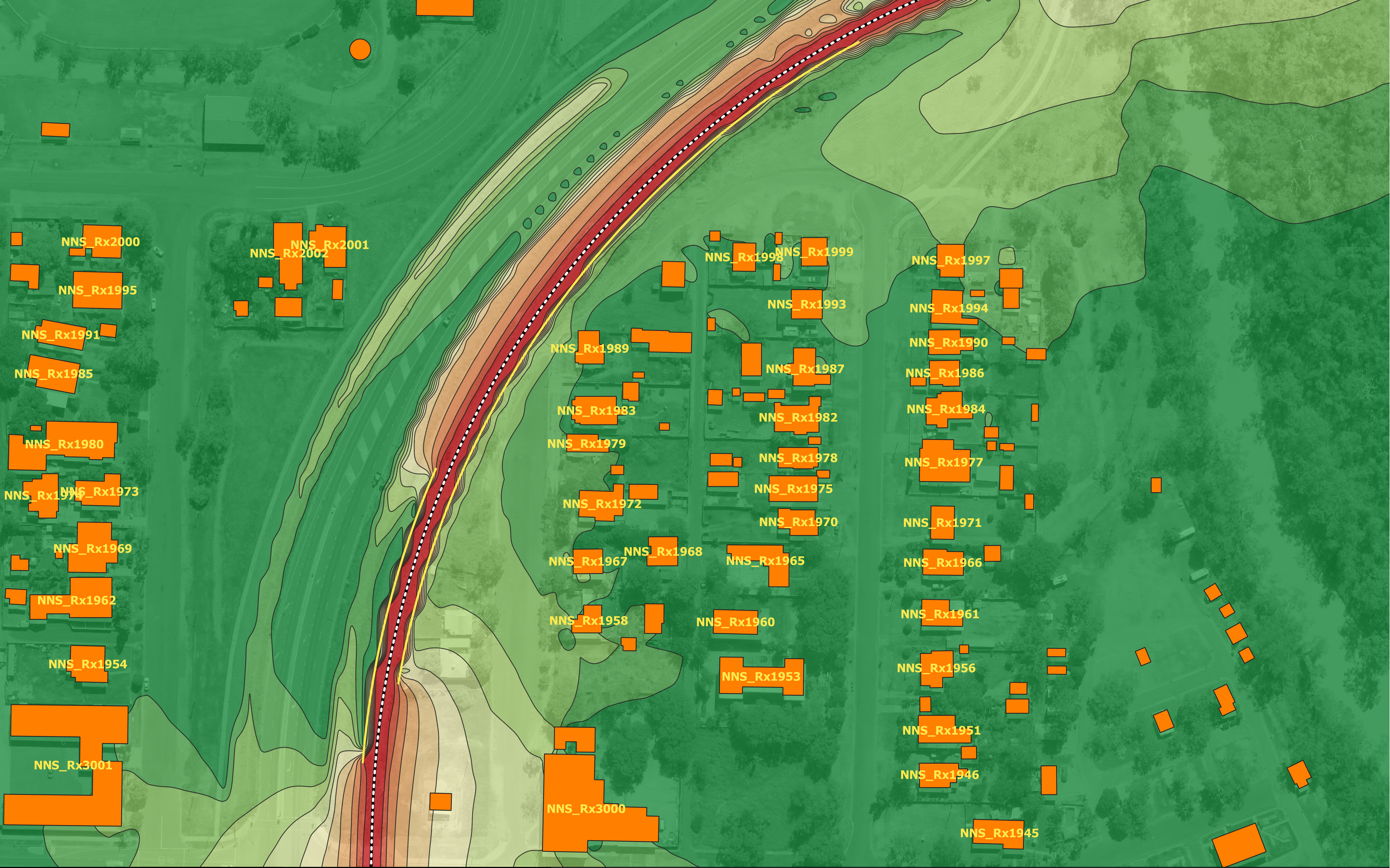
- ≤54
- 54 - 56
- 56 - 58
- 58 - 60
- 60 - 62
- 62 - 64
- 64 - 66
- 66 - 68
- 68 - 70
- 70 - 72
- ≥72

Narrabri to North Star - Phase 2

Year 2040 Night - Rail Dampers
All sources

MOTT MACDONALD

IRDJV



Map: 5MW1	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

- ≤54
- 54 - 56
- 56 - 58
- 58 - 60
- 60 - 62
- 62 - 64
- 64 - 66
- 66 - 68
- 68 - 70
- 70 - 72
- ≥72

Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 5m

Wagons

wsp

MOTT MACDONALD

IRDJV

Map: 5ML2
Author: AV
Date: 31/01/2024
Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

≤54	60 - 62	68 - 70
54 - 56	62 - 64	70 - 72
56 - 58	64 - 66	≥72
58 - 60	66 - 68	

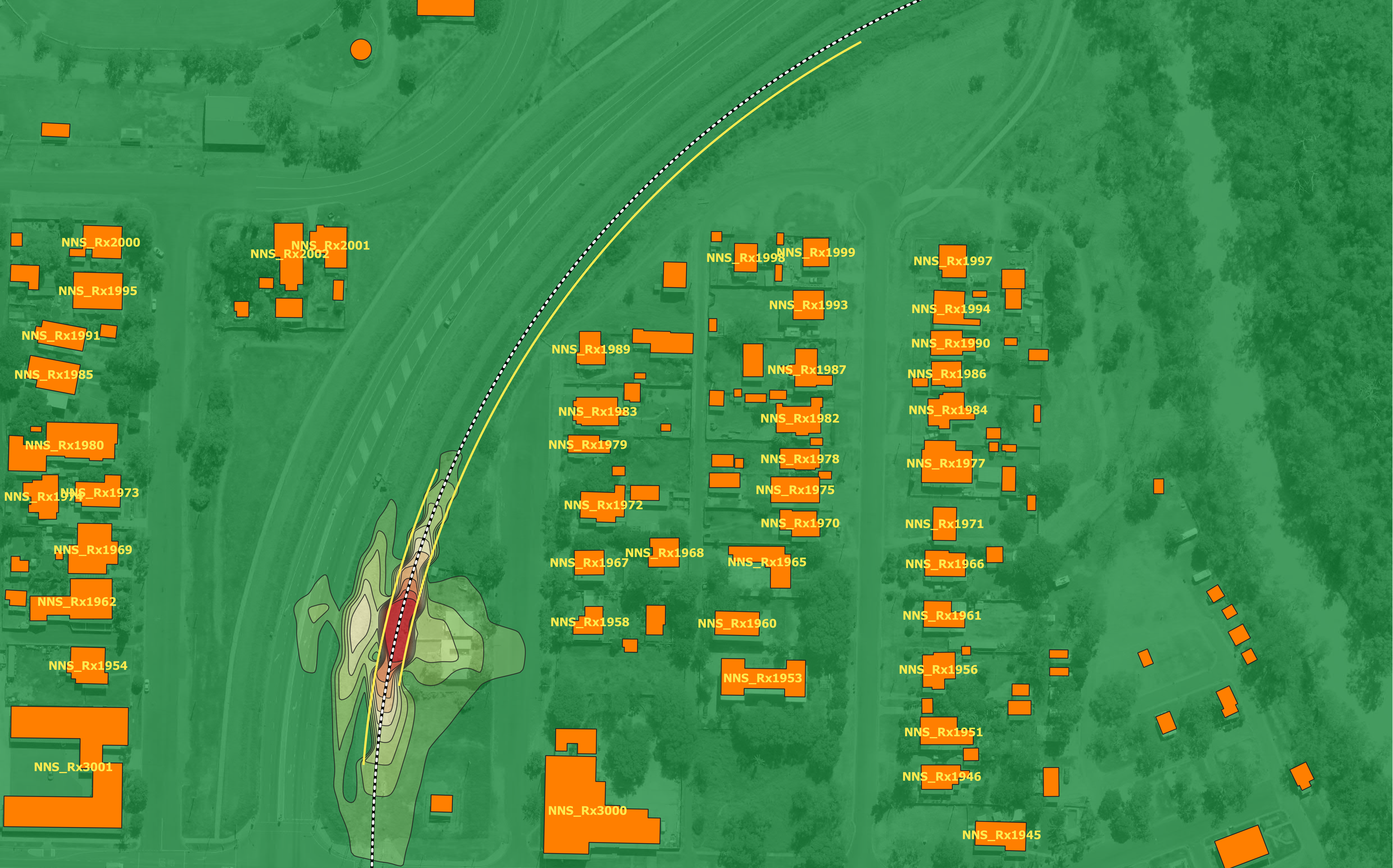
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 5m

Locos

MOTT MACDONALD

IRDJV



Map: 5MH3	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

- ≤54
- 54 - 56
- 56 - 58
- 58 - 60
- 60 - 62
- 62 - 64
- 64 - 66
- 66 - 68
- 68 - 70
- 70 - 72
- ≥72

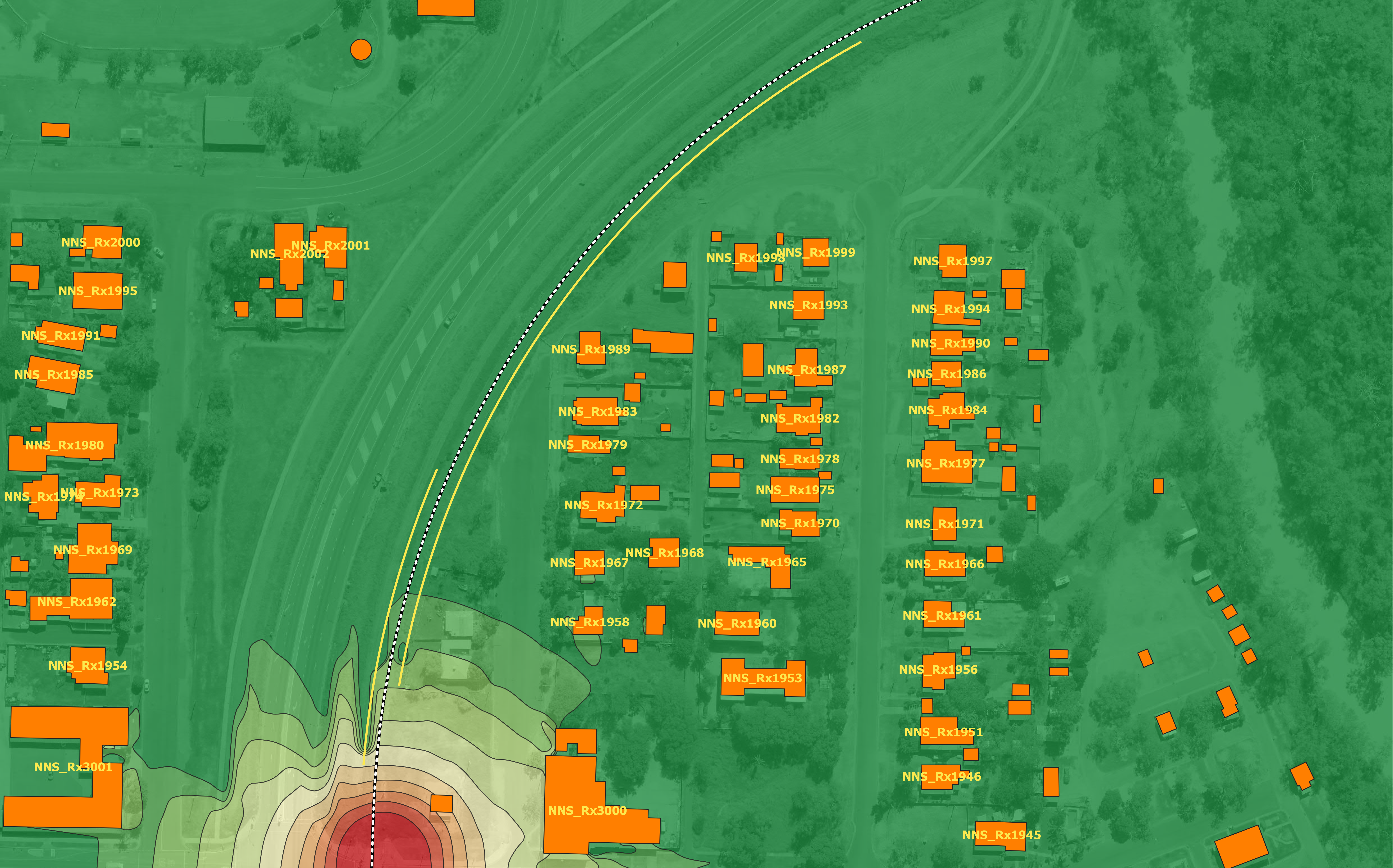
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 5m

Horns

MOTT MACDONALD

IRDJV



Map: 5MB4	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

- ≤54
- 54 - 56
- 56 - 58
- 58 - 60
- 60 - 62
- 62 - 64
- 64 - 66
- 66 - 68
- 68 - 70
- 70 - 72
- ≥72

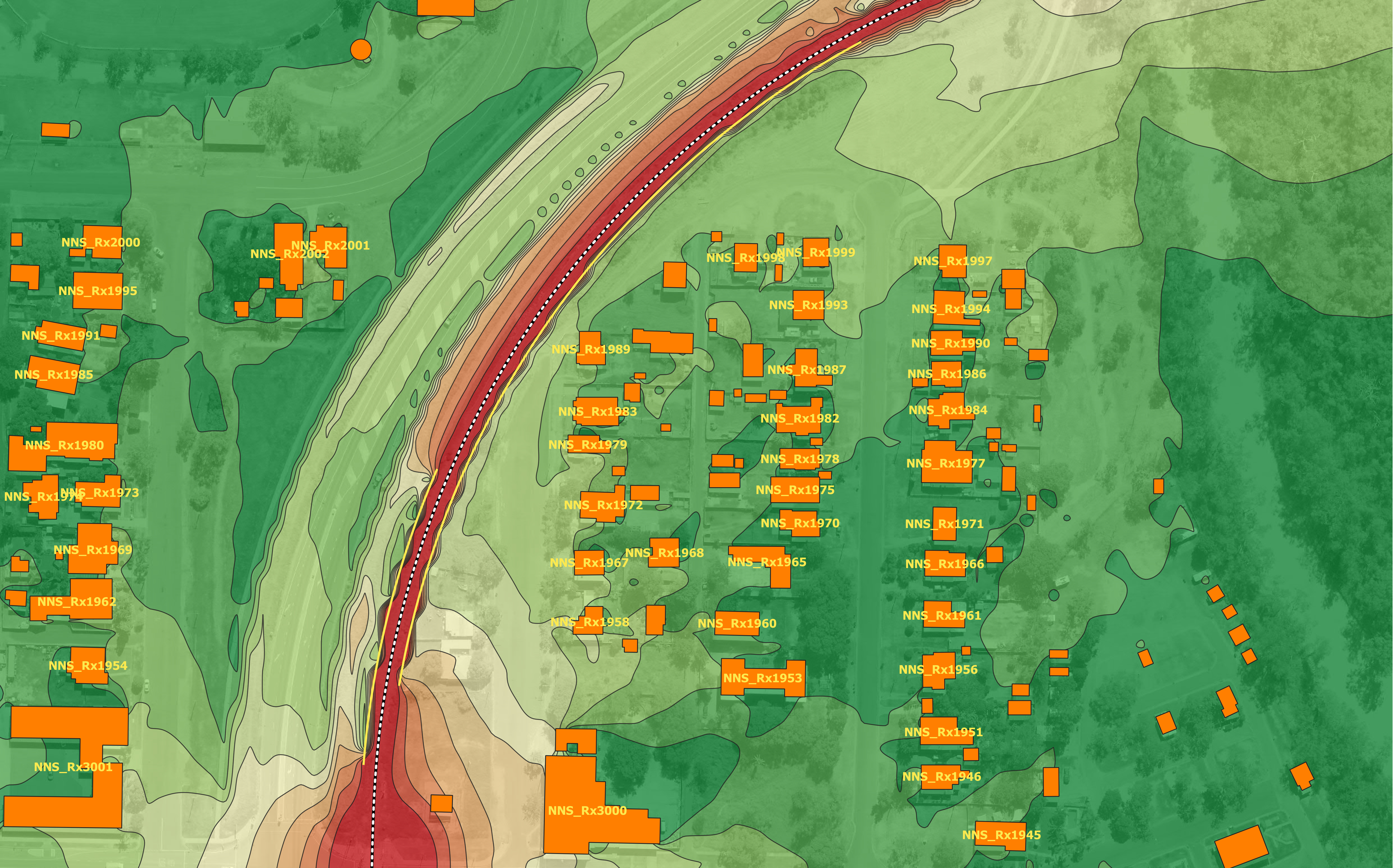
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 5m

Bells

MOTT MACDONALD

IRDJV



Map: 5MA5	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

- ≤54
- 54 - 56
- 56 - 58
- 58 - 60
- 60 - 62
- 62 - 64
- 64 - 66
- 66 - 68
- 68 - 70
- 70 - 72
- ≥72

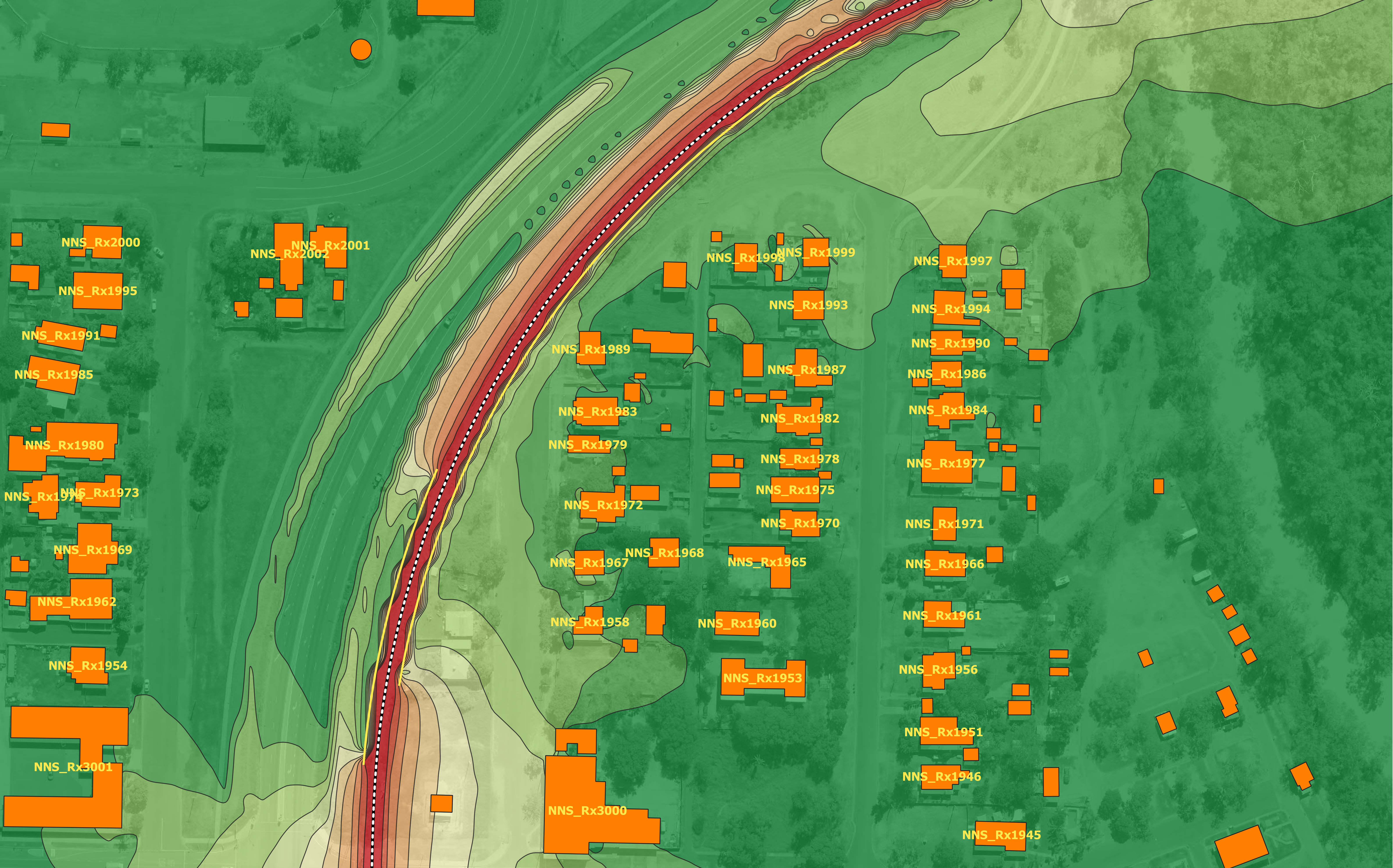
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 5m

All sources

MOTT MACDONALD

IRDJV



Map: 4MW1

Author: AV

Date: 31/01/2024

Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

- ≤54
- 54 - 56
- 56 - 58
- 58 - 60
- 60 - 62
- 62 - 64
- 64 - 66
- 66 - 68
- 68 - 70
- 70 - 72
- ≥72

Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 4m Wagons

MOTT MACDONALD

IRDJV

Map: 4ML2	Author: AV
Date: 31/01/2024	Approved by: BI

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

- ≤54
- 54 - 56
- 56 - 58
- 58 - 60
- 60 - 62
- 62 - 64
- 64 - 66
- 66 - 68
- 68 - 70
- 70 - 72
- ≥72

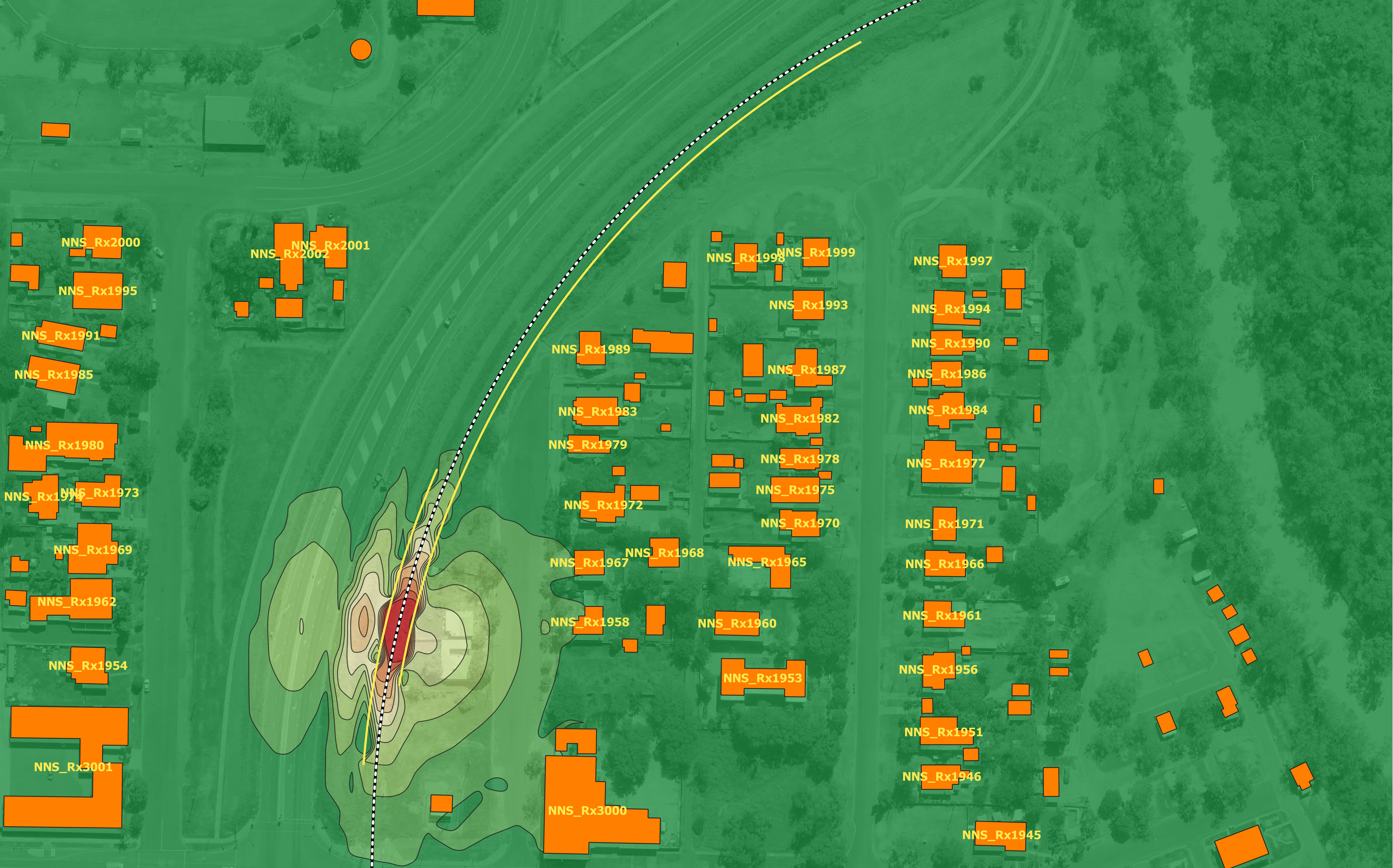
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 4m

Locos

MOTT MACDONALD

IRDJV



Map: 4MH3	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

≤54	60 - 62	68 - 70
54 - 56	62 - 64	70 - 72
56 - 58	64 - 66	≥72
58 - 60	66 - 68	

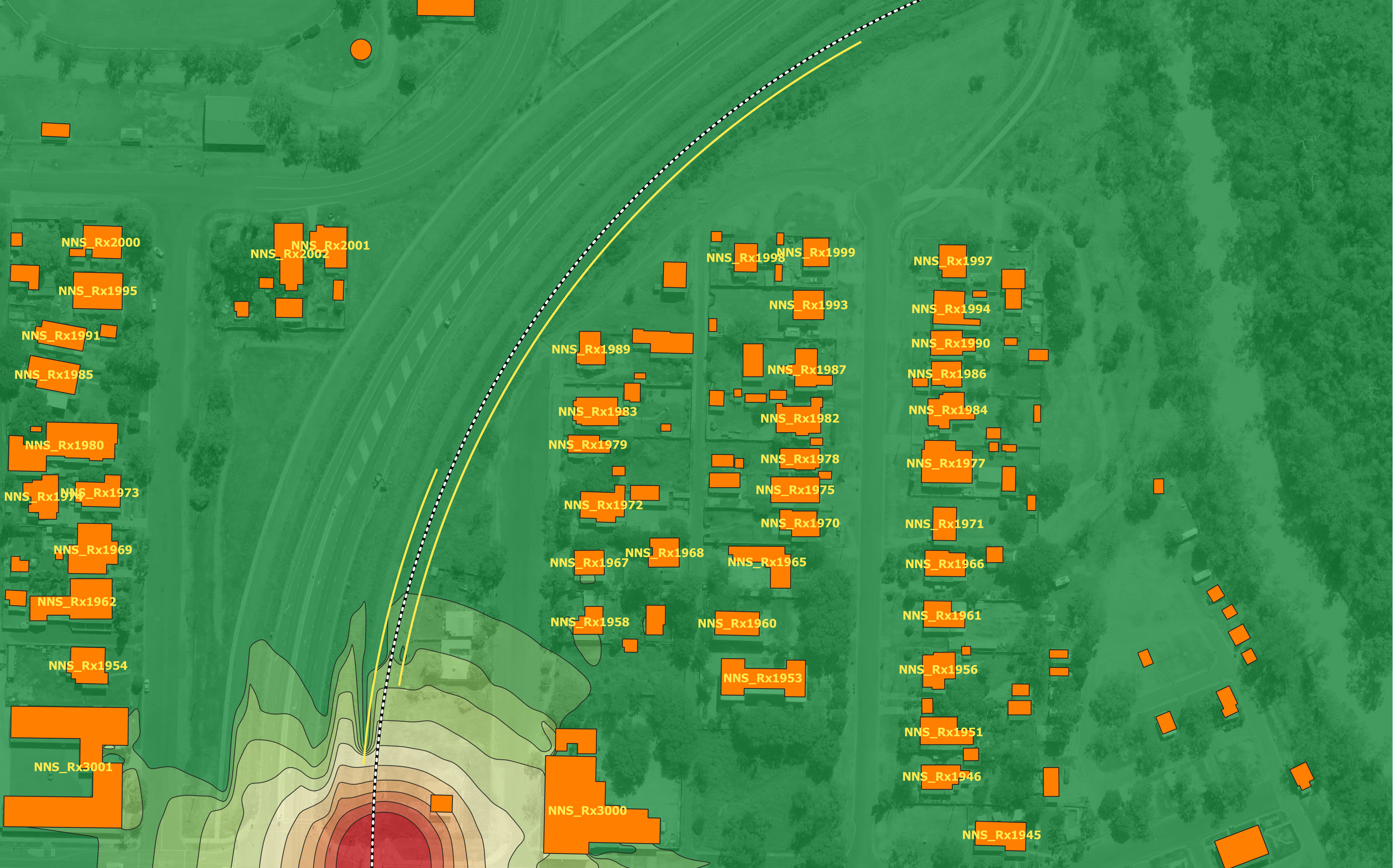
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 4m

Horns

MOTT MACDONALD

IRDJV



Map: 4MB4	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

≤54	60 - 62	68 - 70
54 - 56	62 - 64	70 - 72
56 - 58	64 - 66	≥72
58 - 60	66 - 68	

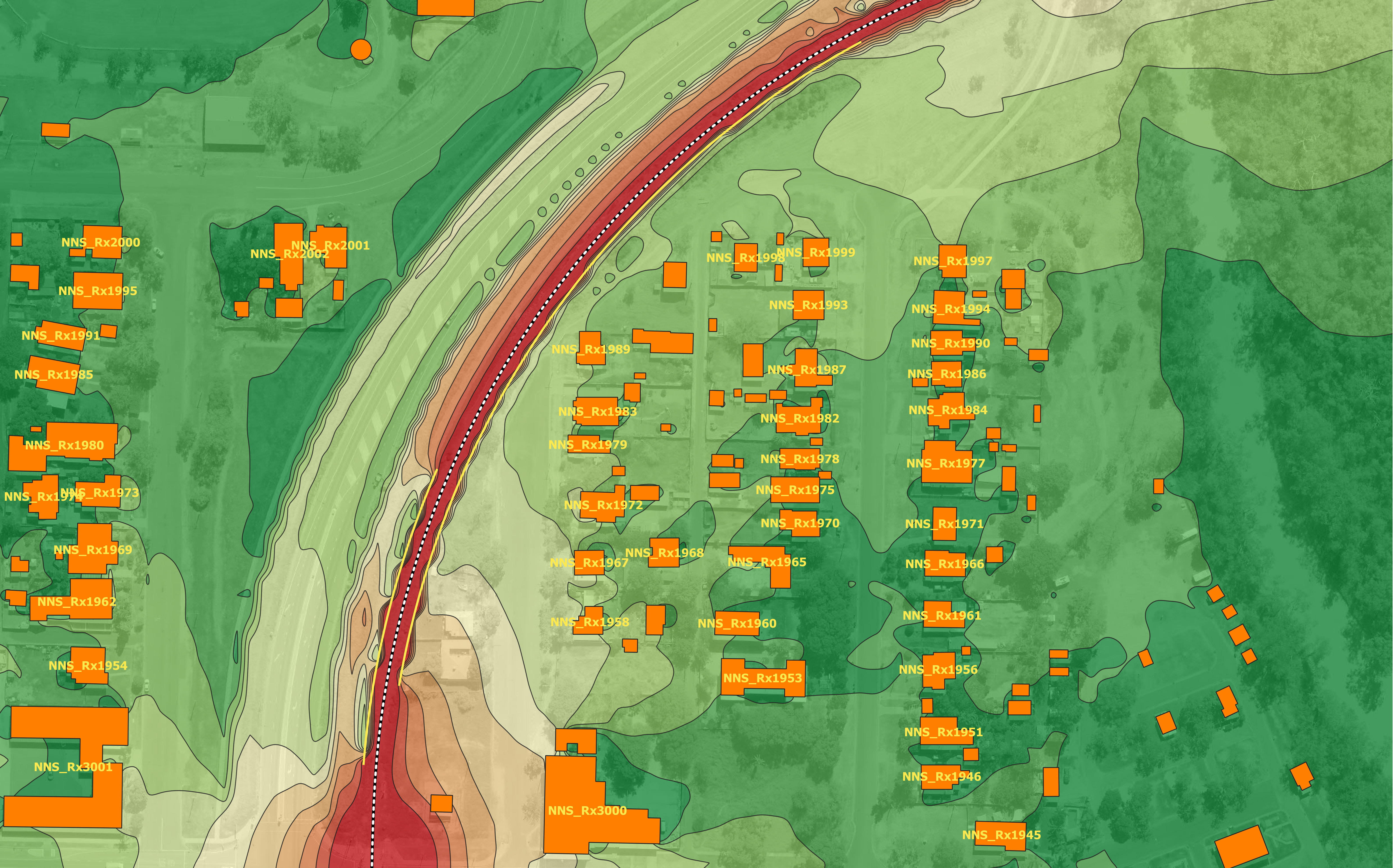
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 4m

Bells

MOTT MACDONALD

IRDJV



Map: 4MA5	Author: AV		0 10 20 30 40 50 m 1:1,300 at A3	
Date: 31/01/2024	Approved by: BI		Coordinate system: GDA94. MGA Zone 55 Aerial imagery source: MetroMaps	

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

- ≤54
- 54 - 56
- 56 - 58
- 58 - 60
- 60 - 62
- 62 - 64
- 64 - 66
- 66 - 68
- 68 - 70
- 70 - 72
- ≥72

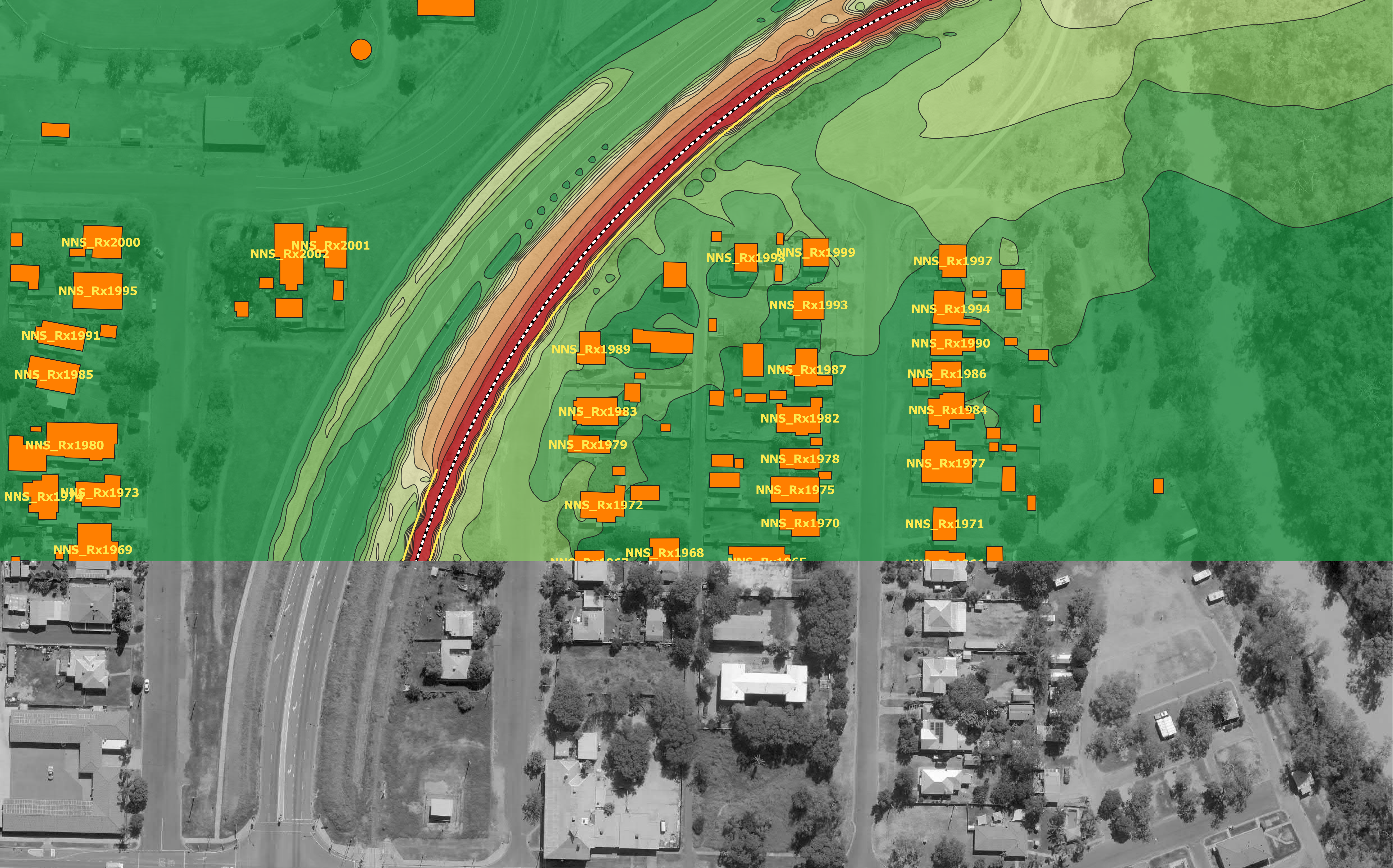
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 4m

All sources

MOTT MACDONALD

IRDJV



Map: 3MW1	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

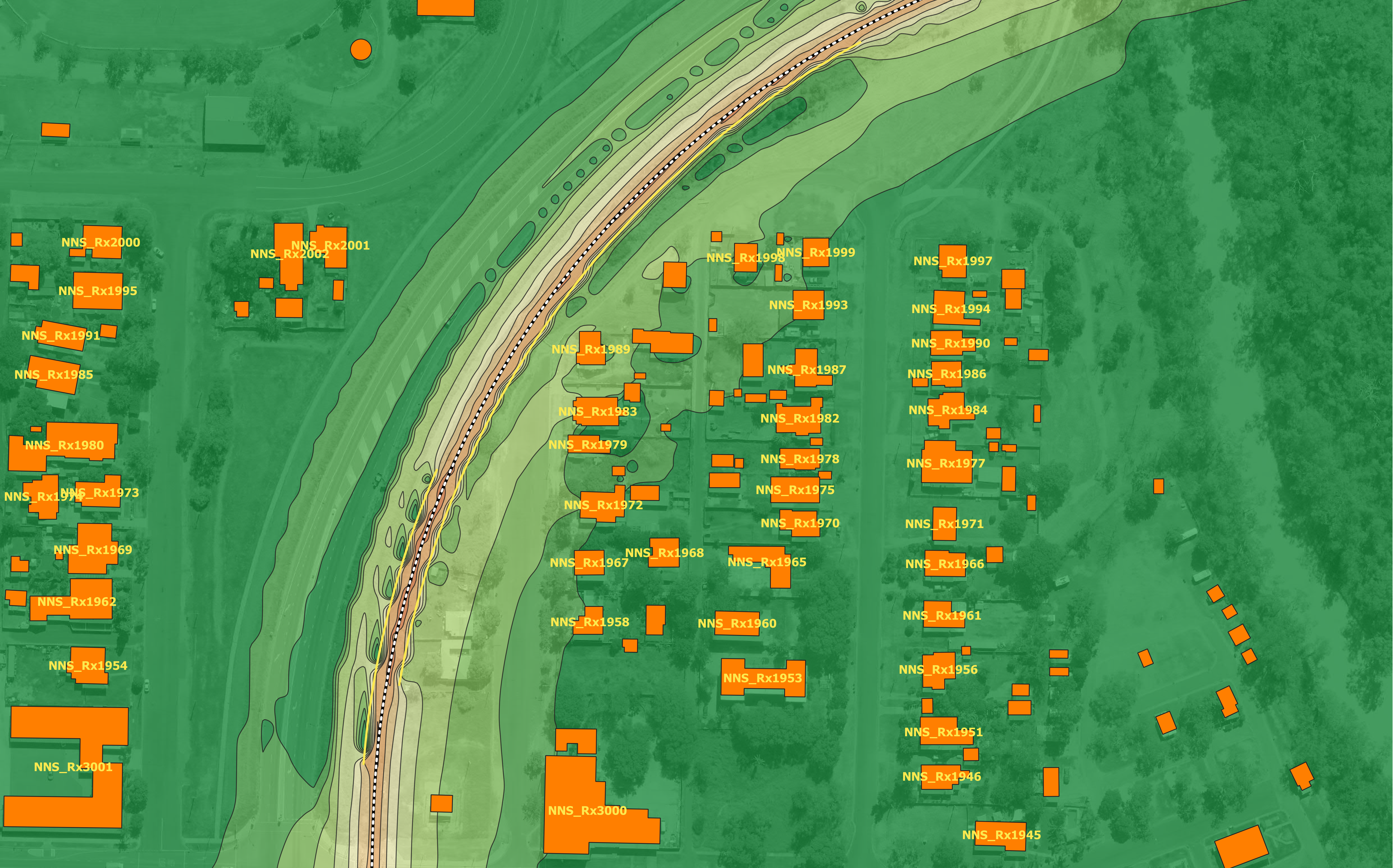
- ≤54
- 54 - 56
- 56 - 58
- 58 - 60
- 60 - 62
- 62 - 64
- 64 - 66
- 66 - 68
- 68 - 70
- 70 - 72
- ≥72

Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 3m Wagons

MOTT MACDONALD

IRDJV



Map: 3ML2	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

≤54	60 - 62	68 - 70
54 - 56	62 - 64	70 - 72
56 - 58	64 - 66	≥72
58 - 60	66 - 68	

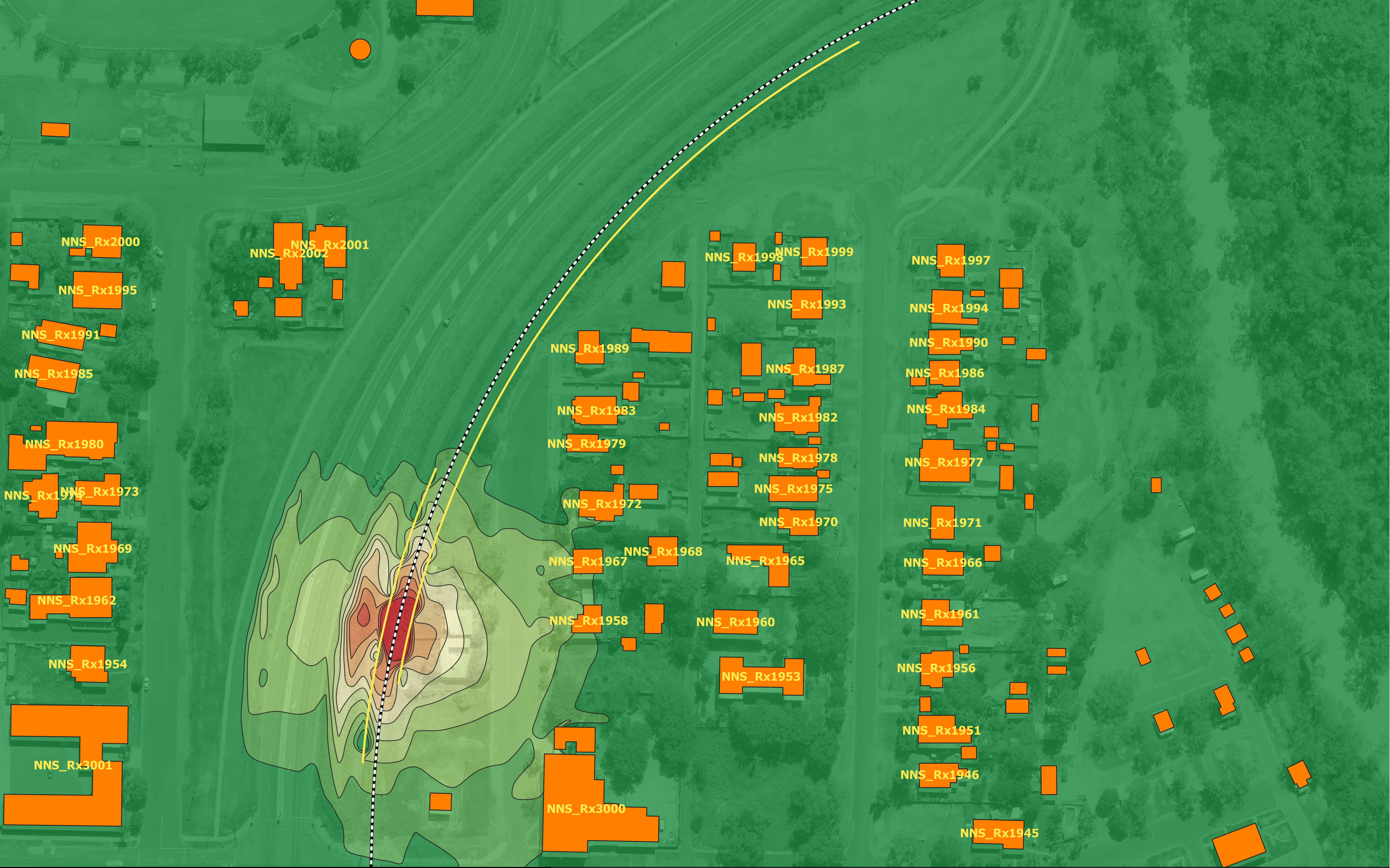
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 3m

Locos

MOTT MACDONALD

IRDJV



Map: 3MH3
Author: AV
Date: 31/01/2024
Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

≤54	60 - 62	68 - 70
54 - 56	62 - 64	70 - 72
56 - 58	64 - 66	≥72
58 - 60	66 - 68	

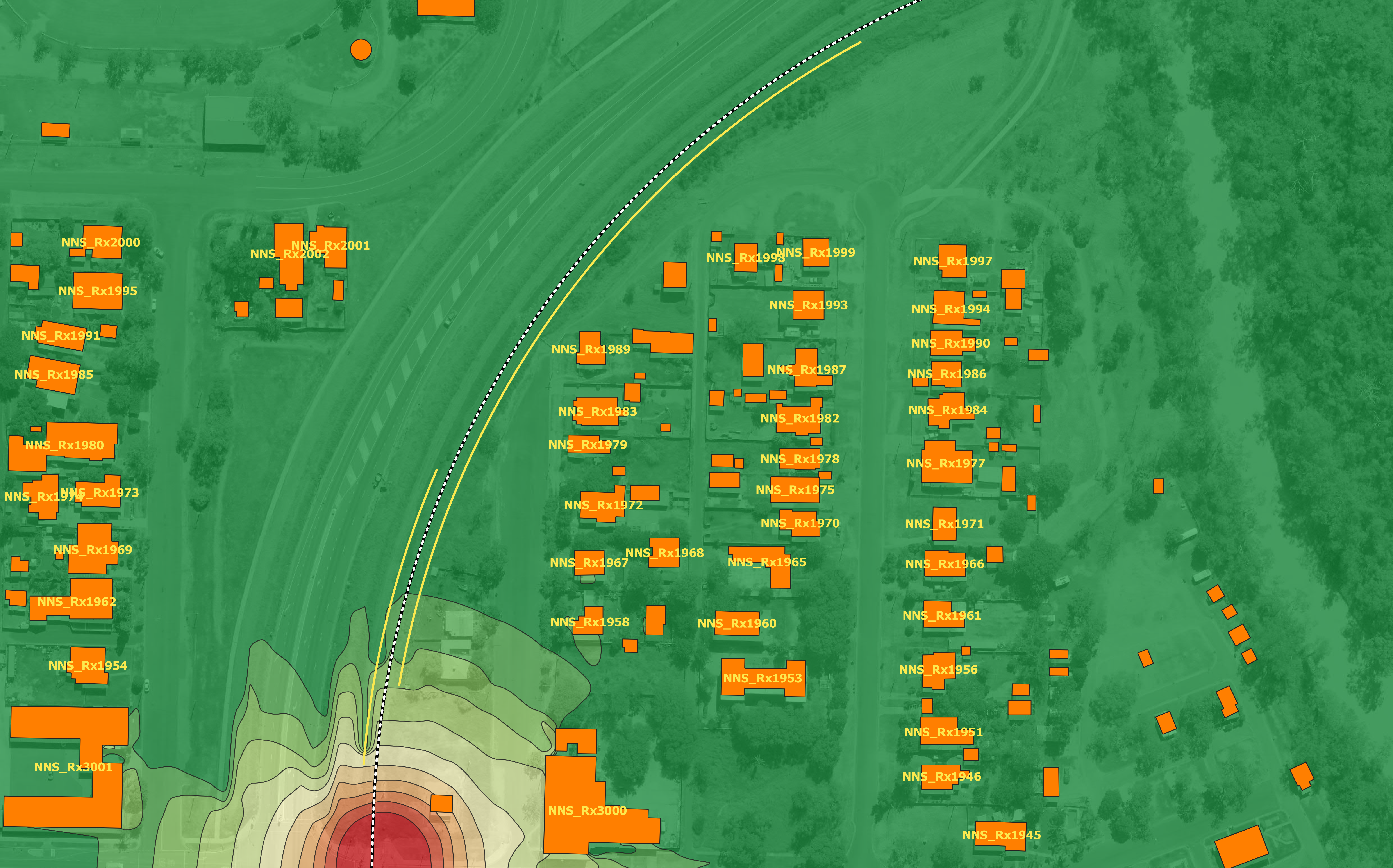
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 3m

Horns

MOTT MACDONALD

IRDJV



Map: 3MB4	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

- ≤54
- 54 - 56
- 56 - 58
- 58 - 60
- 60 - 62
- 62 - 64
- 64 - 66
- 66 - 68
- 68 - 70
- 70 - 72
- ≥72

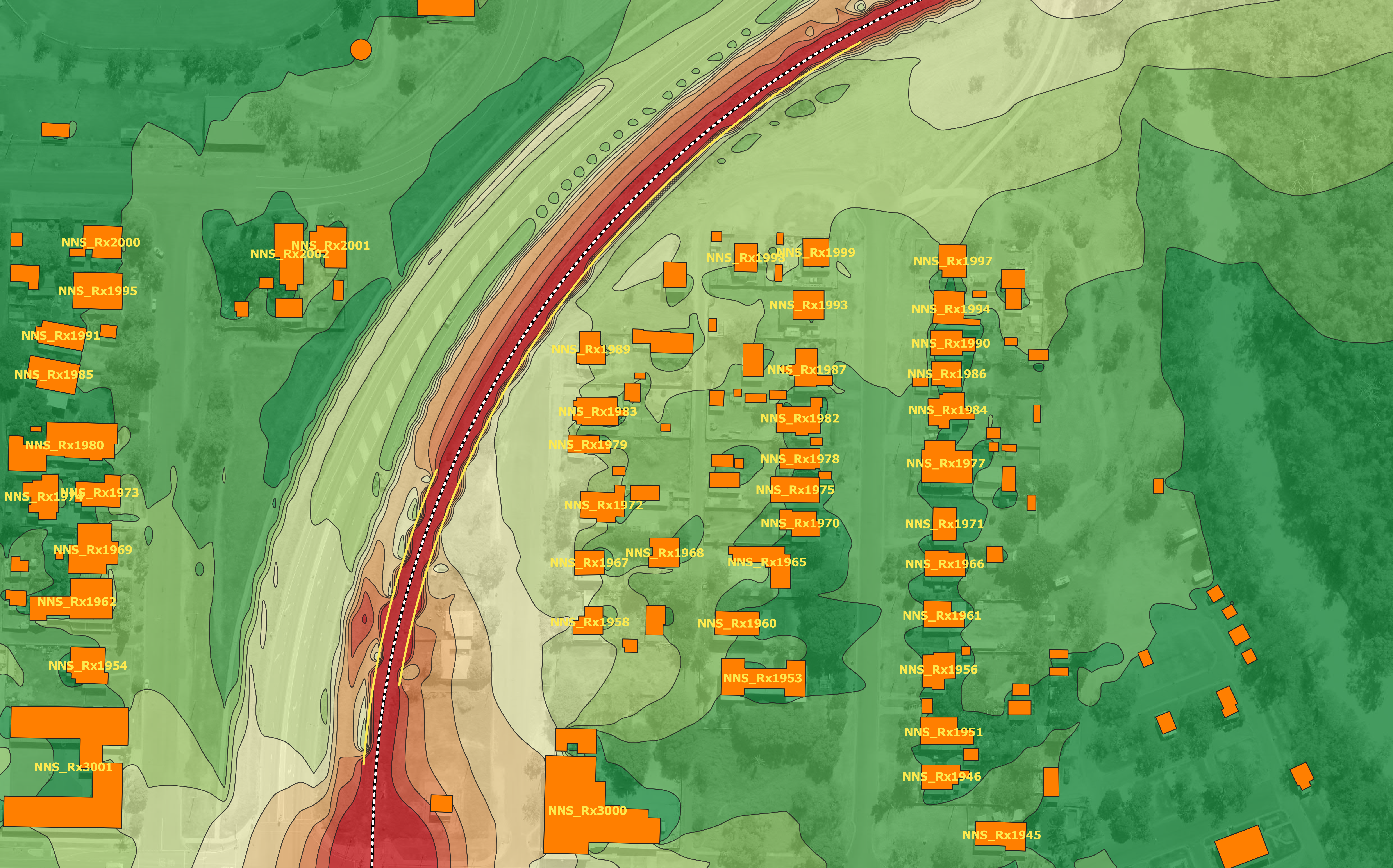
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 3m

Bells

wsp MOTT MACDONALD

IRDJV



Map: 3MA5	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

- ≤54
- 54 - 56
- 56 - 58
- 58 - 60
- 60 - 62
- 62 - 64
- 64 - 66
- 66 - 68
- 68 - 70
- 70 - 72
- ≥72

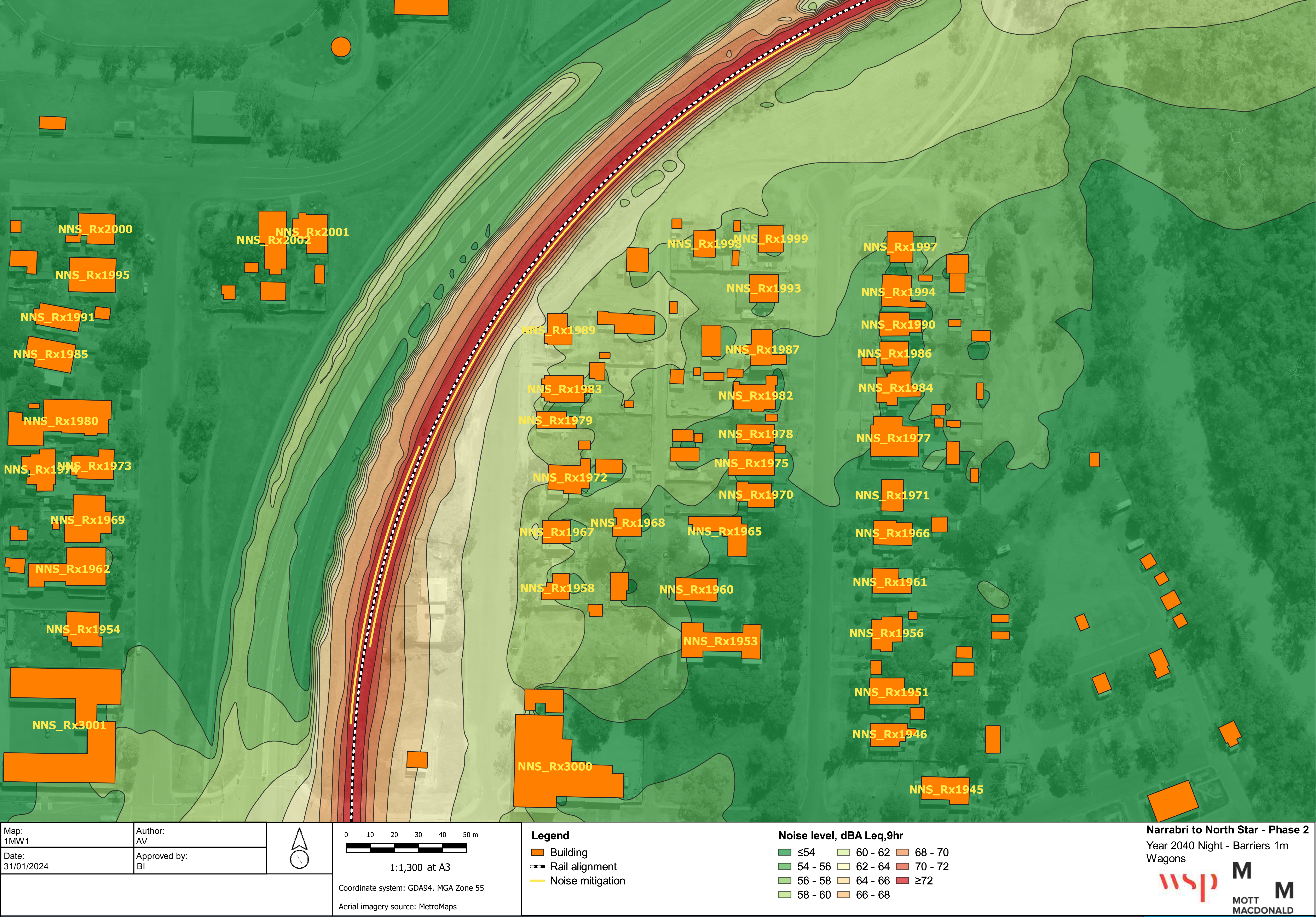
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 3m

All sources

MOTT MACDONALD

IRDJV



Map: 1MW1	Author: AV
Date: 31/01/2024	Approved by: BI

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 1m

Wagons

MOTT MACDONALD

IRDJV

Map: 1ML2	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

- ≤54
- 54 - 56
- 56 - 58
- 58 - 60
- 60 - 62
- 62 - 64
- 64 - 66
- 66 - 68
- 68 - 70
- 70 - 72
- ≥72

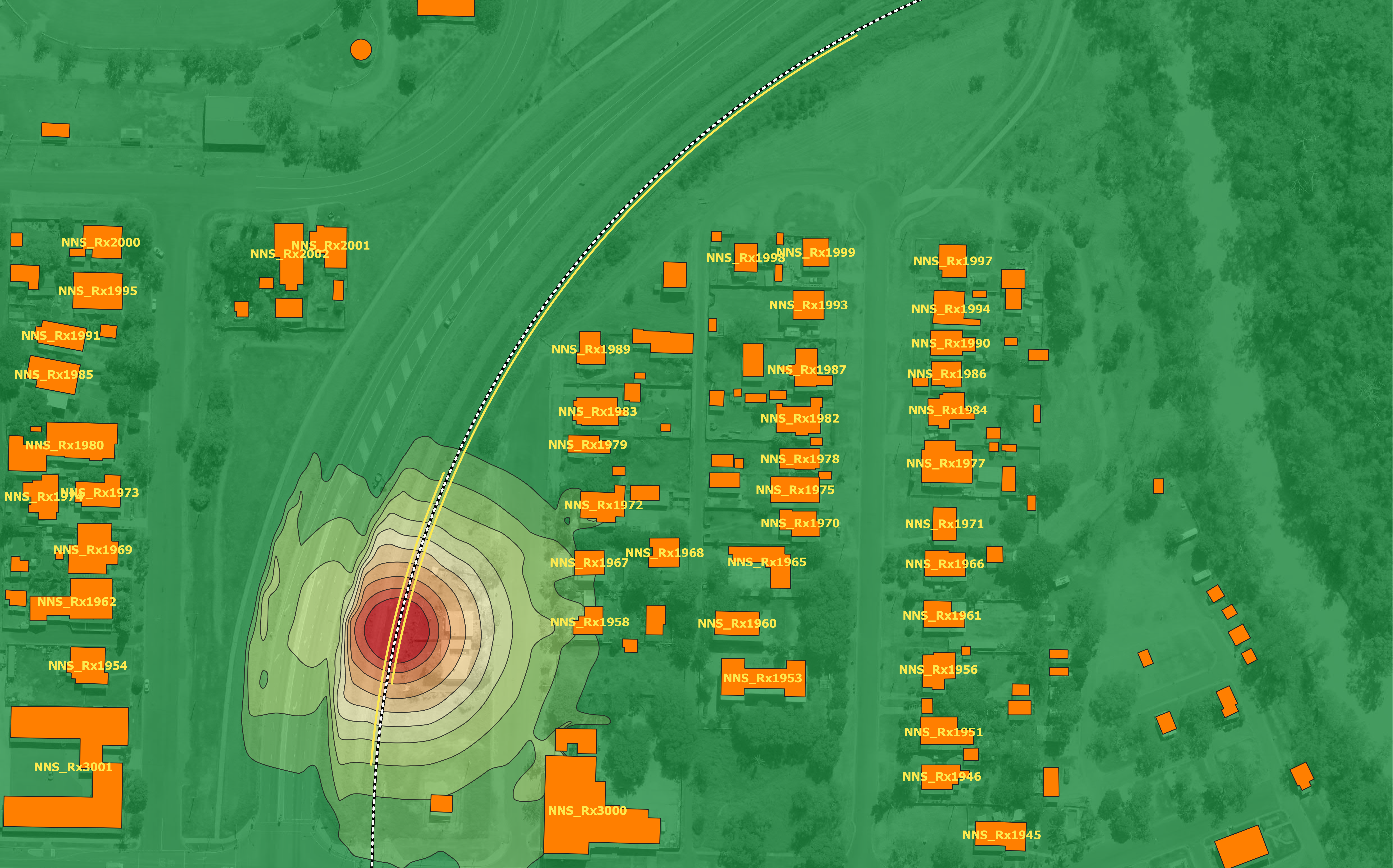
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 1m Locos

wsp

MOTT MACDONALD

IRDJV



Map: 1MH3	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

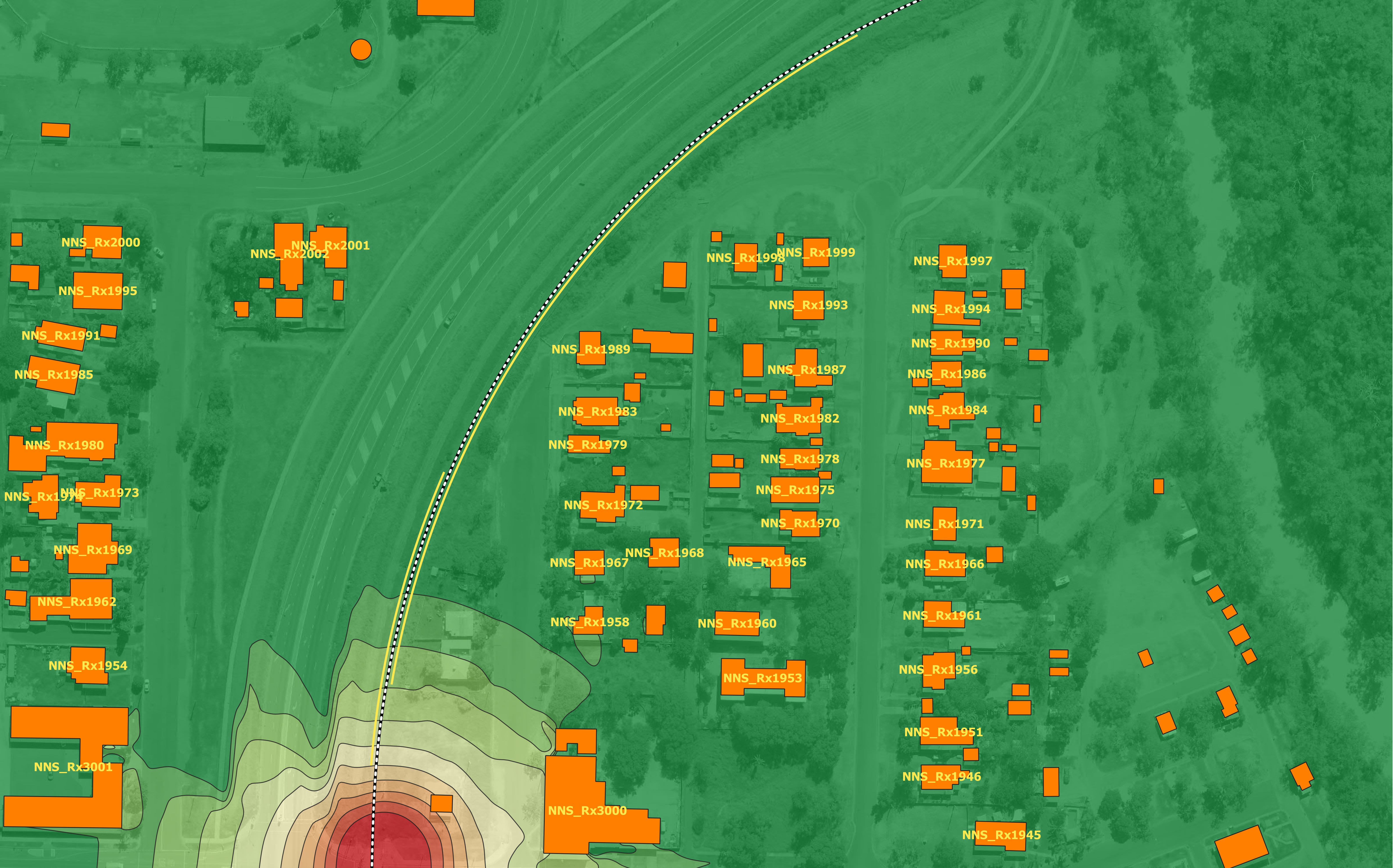
≤54	60 - 62	68 - 70
54 - 56	62 - 64	70 - 72
56 - 58	64 - 66	≥72
58 - 60	66 - 68	

Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 1m

Horns

MOTT MACDONALD



Map: 1MB4	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

- ≤54
- 54 - 56
- 56 - 58
- 58 - 60
- 60 - 62
- 62 - 64
- 64 - 66
- 66 - 68
- 68 - 70
- 70 - 72
- ≥72

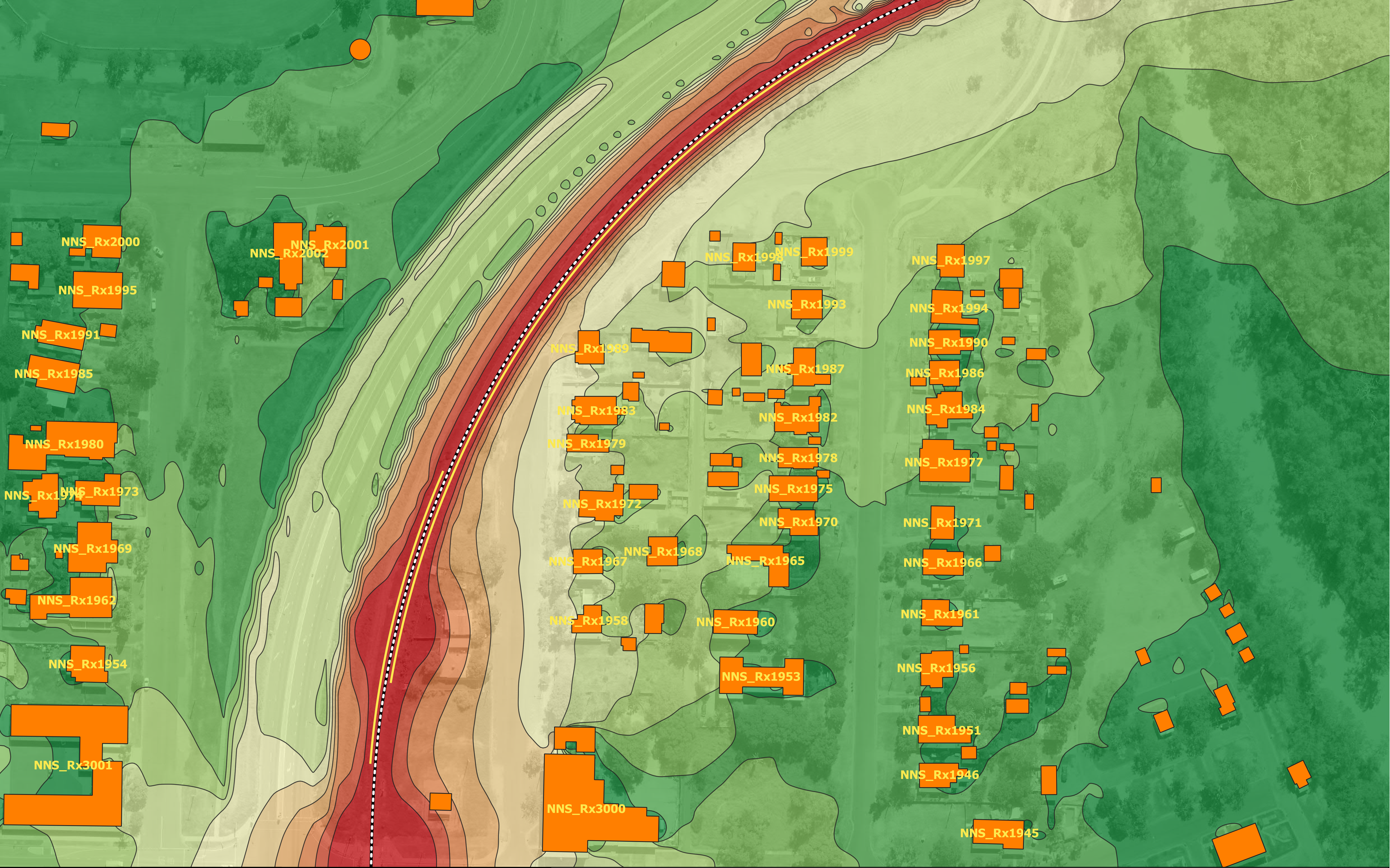
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 1m

Bells

MOTT MACDONALD

IRDJV



Map: 1MA5

Author: AV

Date: 31/01/2024

Approved by: BI

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

≤54	60 - 62	68 - 70
54 - 56	62 - 64	70 - 72
56 - 58	64 - 66	≥72
58 - 60	66 - 68	

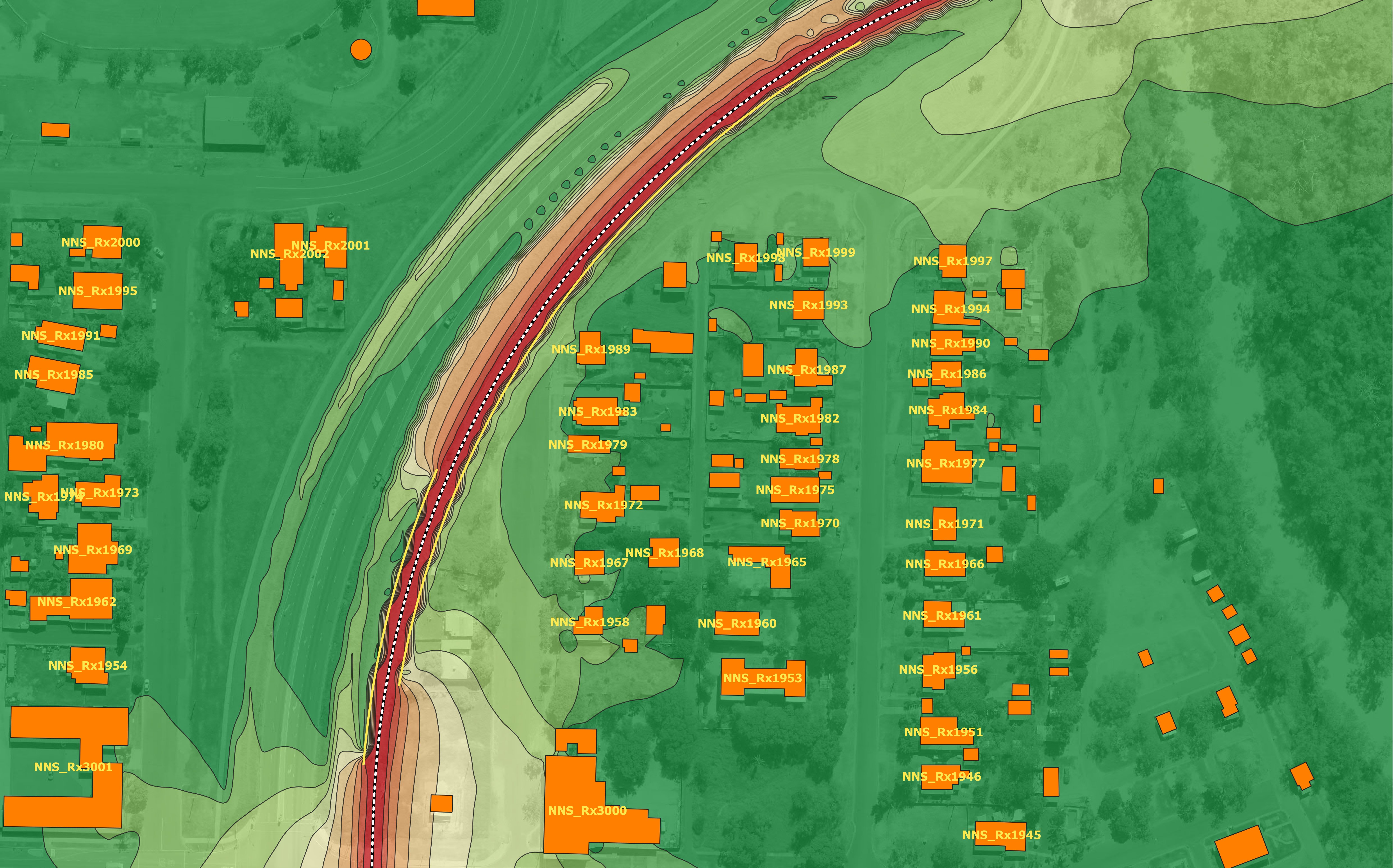
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 1m

All sources

MOTT MACDONALD

IRDJV



Map: ROW1	Author: AV
Date: 31/01/2024	Approved by: BI

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

≤54	60 - 62	68 - 70
54 - 56	62 - 64	70 - 72
56 - 58	64 - 66	≥72
58 - 60	66 - 68	

Narrabri to North Star - Phase 2

Year 2040 Night - Barriers RING Wagons

MOTT MACDONALD

Map: ROL2	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

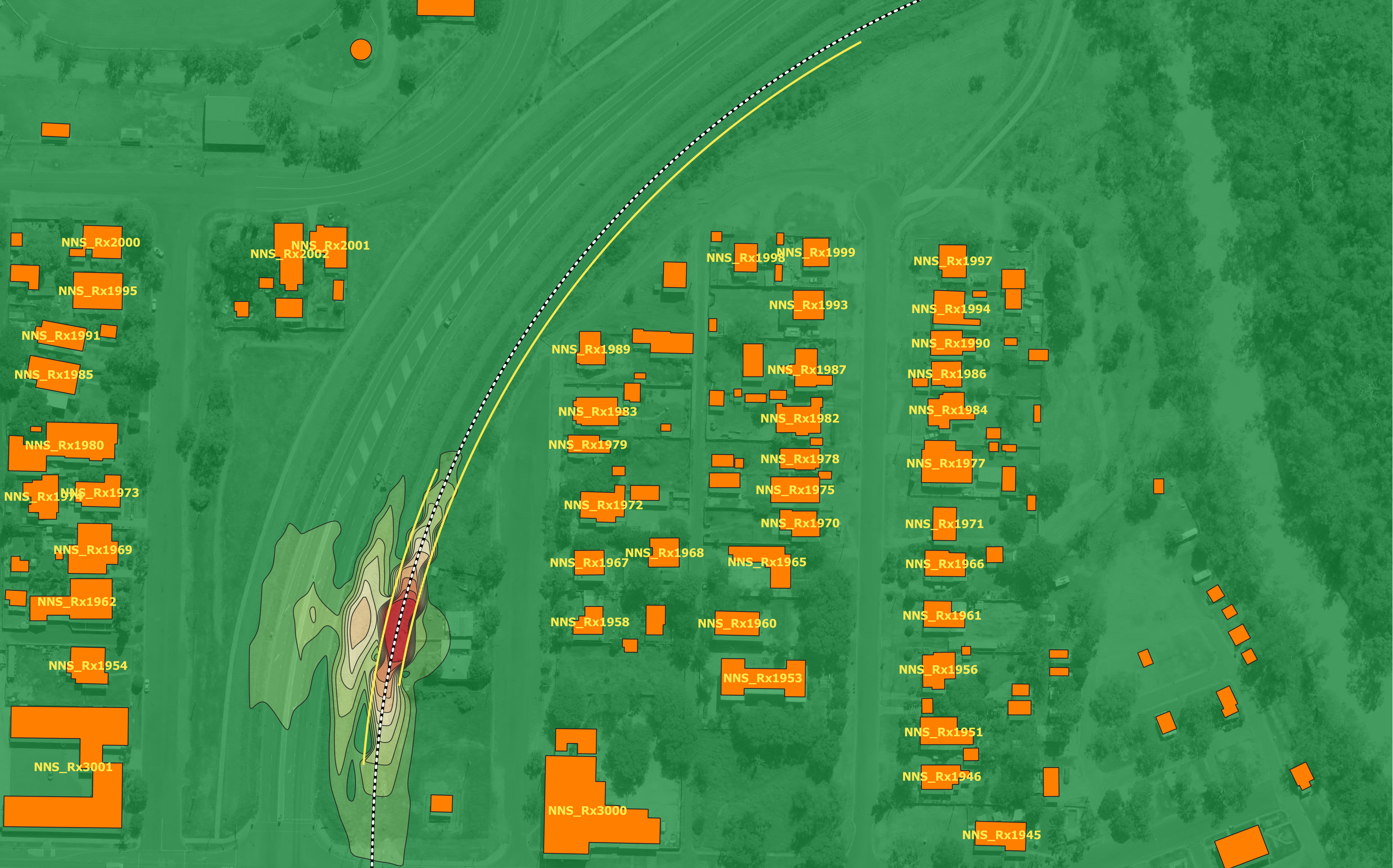
- ≤54
- 54 - 56
- 56 - 58
- 58 - 60
- 60 - 62
- 62 - 64
- 64 - 66
- 66 - 68
- 68 - 70
- 70 - 72
- ≥72

Narrabri to North Star - Phase 2

Year 2040 Night - Barriers RING Locos

MOTT MACDONALD

IRDJV



Map: ROH3	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

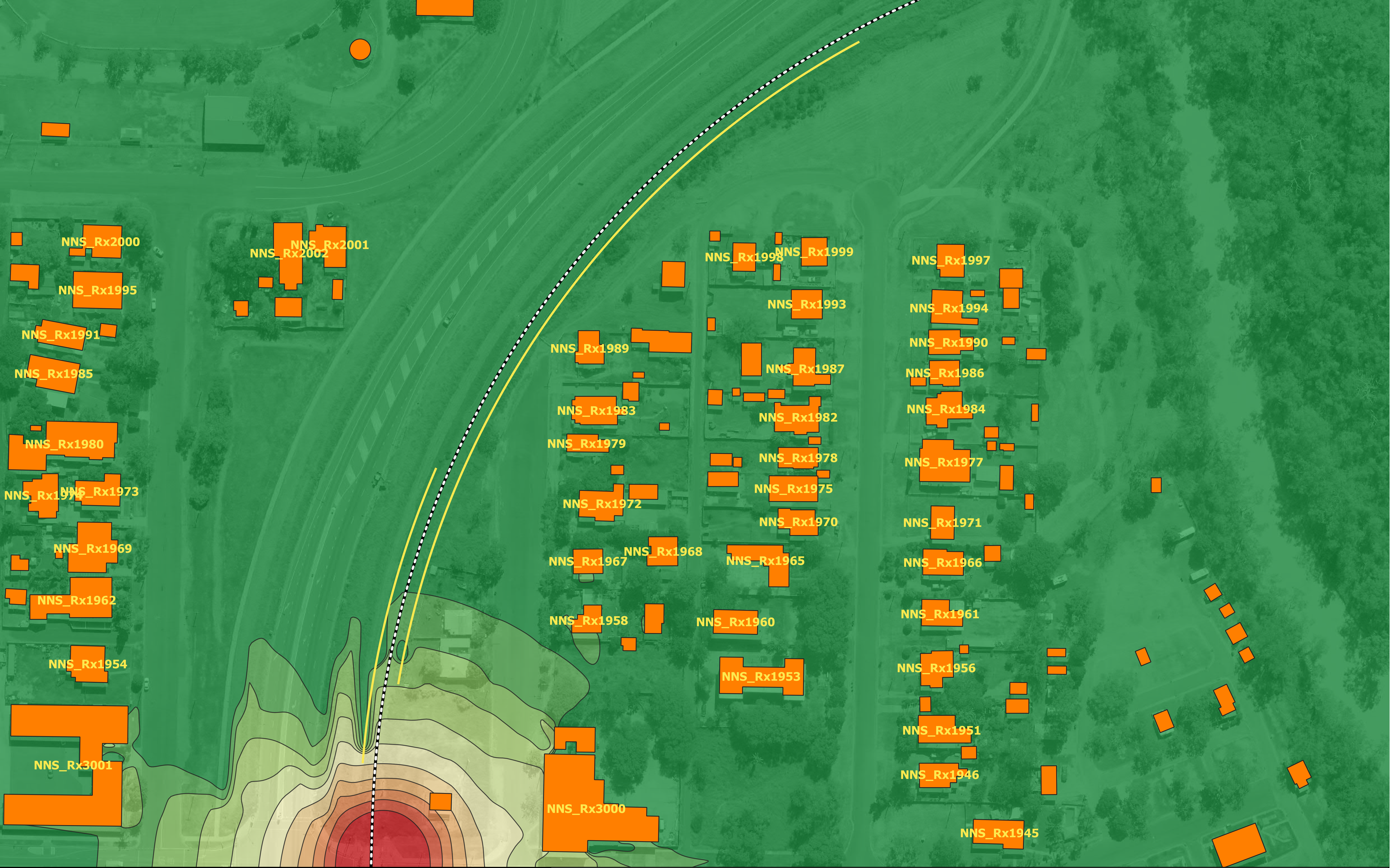
≤54	60 - 62	68 - 70
54 - 56	62 - 64	70 - 72
56 - 58	64 - 66	≥72
58 - 60	66 - 68	

Narrabri to North Star - Phase 2

Year 2040 Night - Barriers RING Horns

MOTT MACDONALD

IRDJV



Map: ROB4	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Leq,9hr

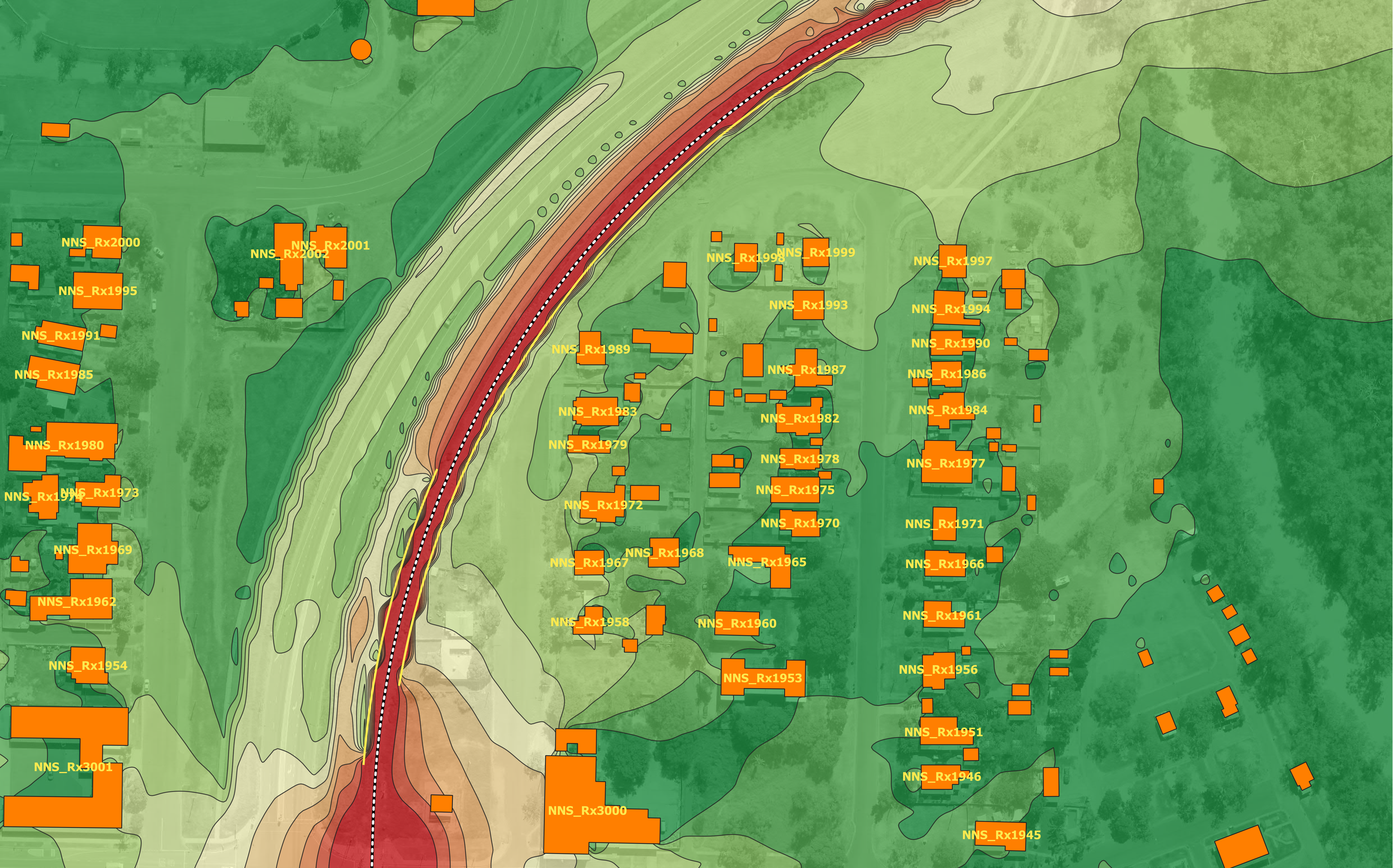
- ≤54
- 54 - 56
- 56 - 58
- 58 - 60
- 60 - 62
- 62 - 64
- 64 - 66
- 66 - 68
- 68 - 70
- 70 - 72
- ≥72

Narrabri to North Star - Phase 2

Year 2040 Night - Barriers RING Bells

MOTT MACDONALD

IRDJV



Map:
ROA5

Author:
AV

Date:
31/01/2024

Approved by:
BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

Building

Rail alignment

Noise mitigation

Noise level, dBA Leq,9hr

≤54

54 - 56

56 - 58

58 - 60

60 - 62

62 - 64

64 - 66

66 - 68

68 - 70

70 - 72

≥72

Narrabri to North Star - Phase 2

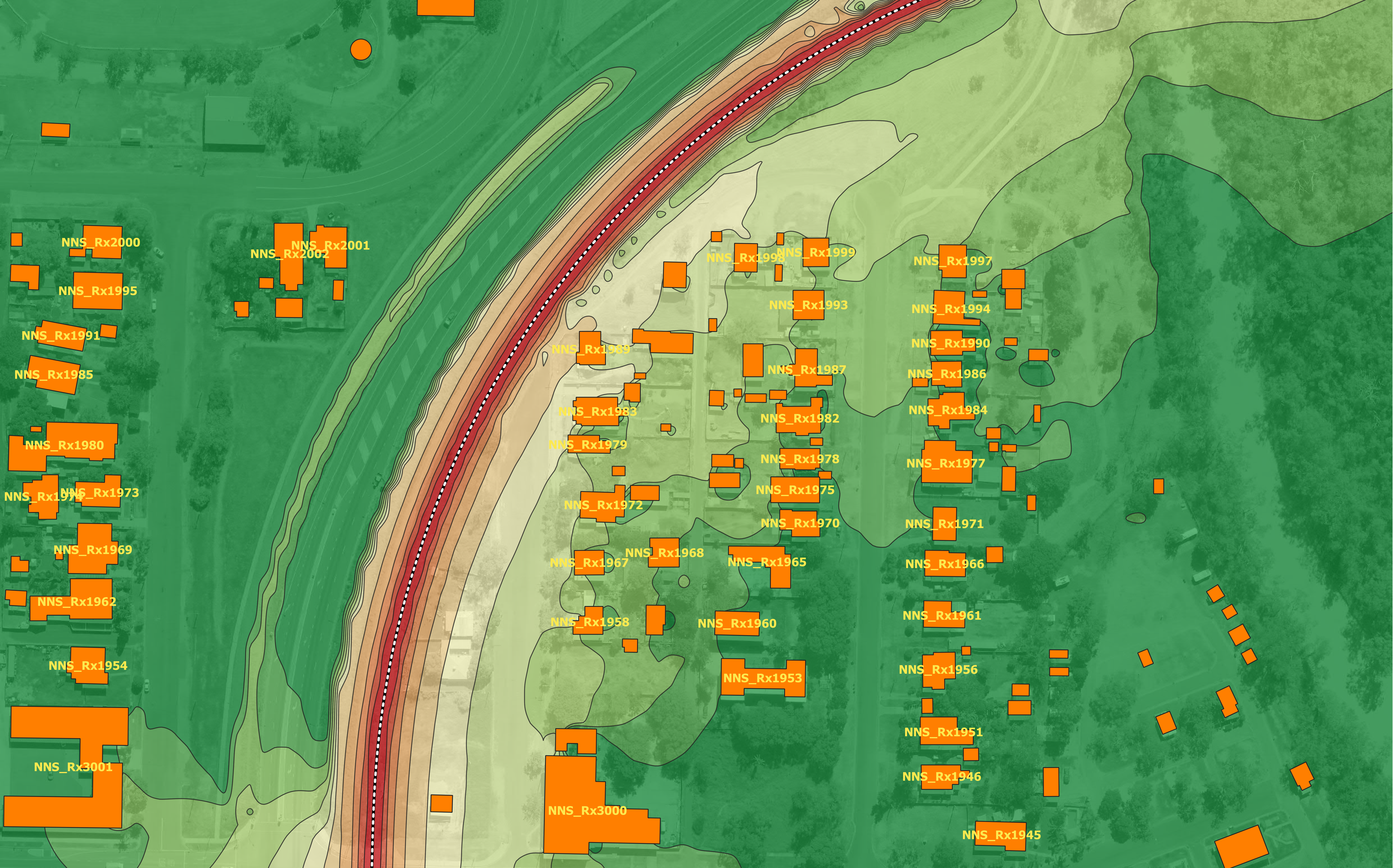
Year 2040 Night - Barriers RING

All sources

wsp

MOTT MACDONALD

IRDJV



Map: UNW6	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

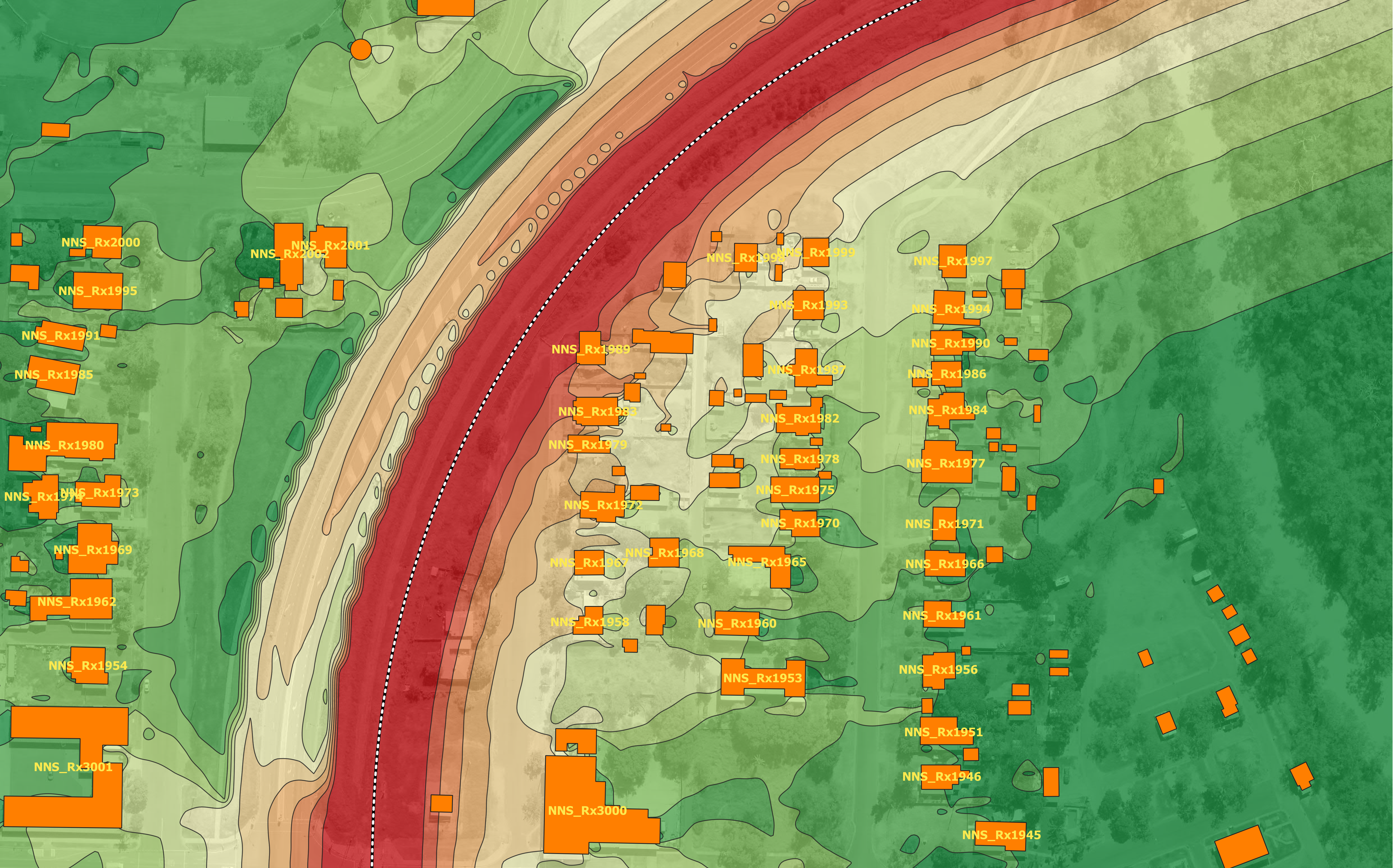
- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

Narrabri to North Star - Phase 2

Year 2040 Night - Unmitigated Wagons

MOTT MACDONALD

IRDJV



Map: UNL7	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

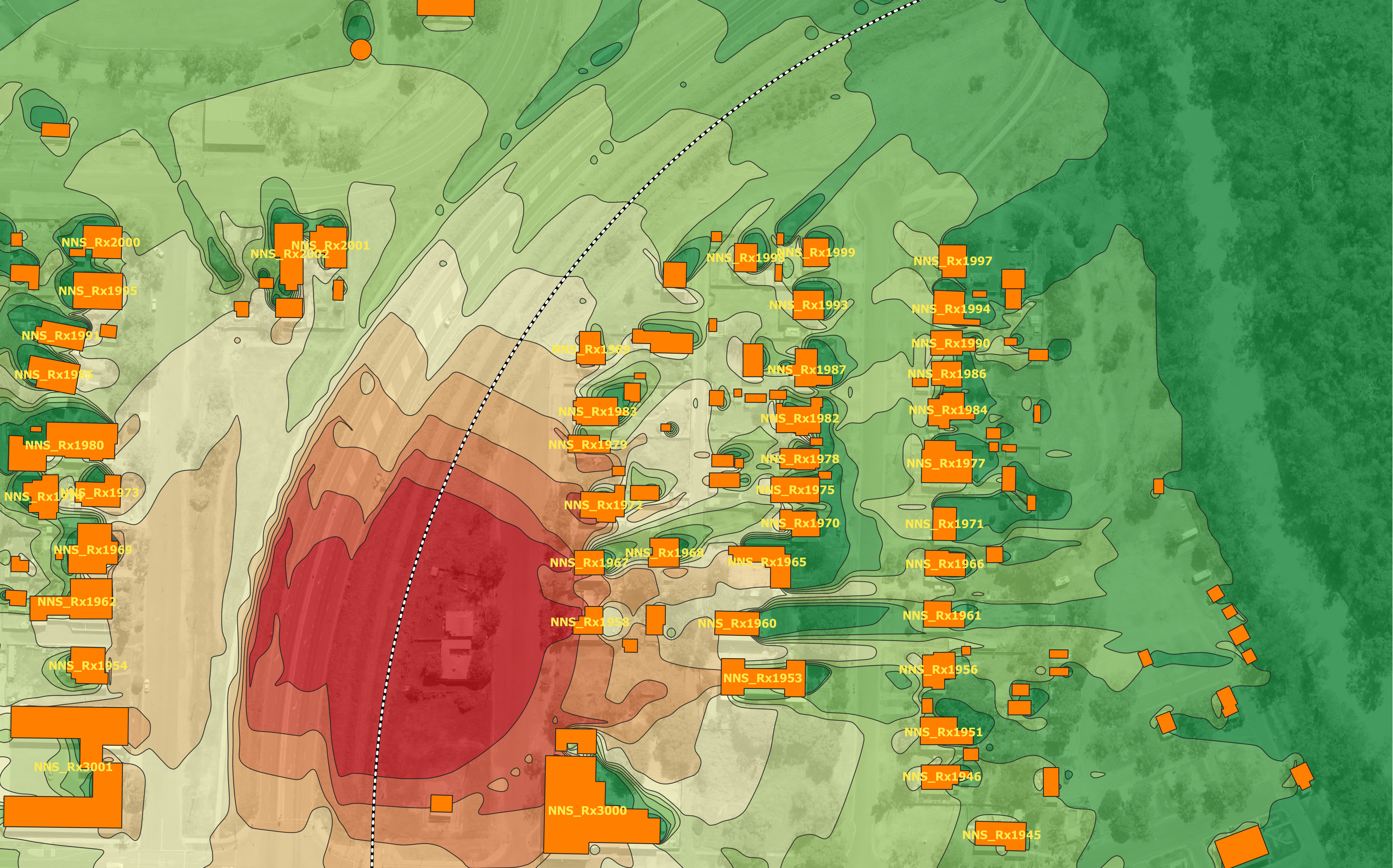
≤76	82 - 84	90 - 92
76 - 78	84 - 86	92 - 94
78 - 80	86 - 88	≥94
80 - 82	88 - 90	

Narrabri to North Star - Phase 2

Year 2040 Night - Unmitigated Locos

MOTT MACDONALD

IRDJV



Map: UNH8	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

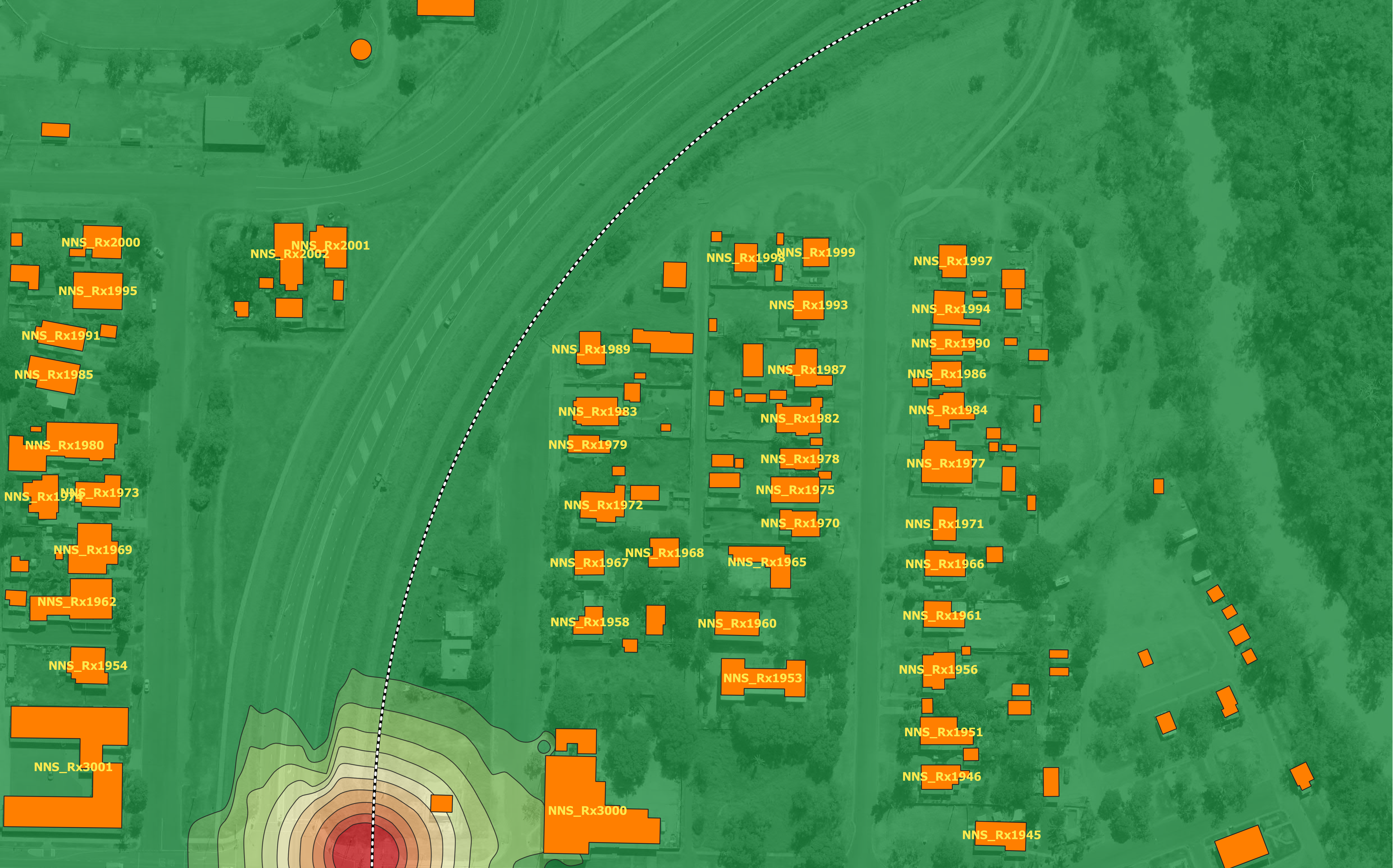
- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

Narrabri to North Star - Phase 2

Year 2040 Night - Unmitigated Horns

MOTT MACDONALD

IRDJV



Map: UNB9	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

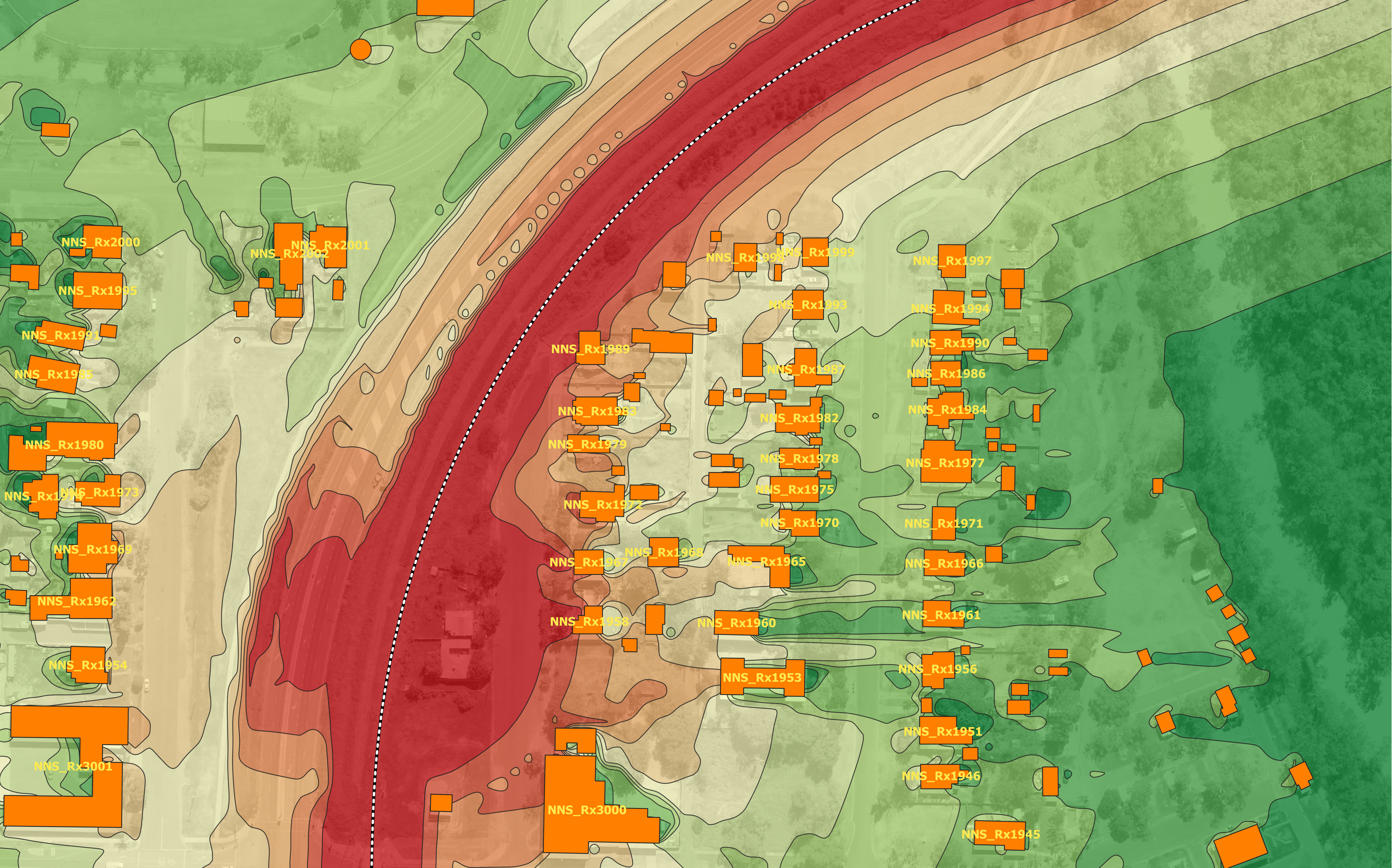
Narrabri to North Star - Phase 2

Year 2040 Night - Unmitigated

Bells

MOTT MACDONALD

IRDJV



Map: UNA10	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

≤76	82 - 84	90 - 92
76 - 78	84 - 86	92 - 94
78 - 80	86 - 88	≥94
80 - 82	88 - 90	

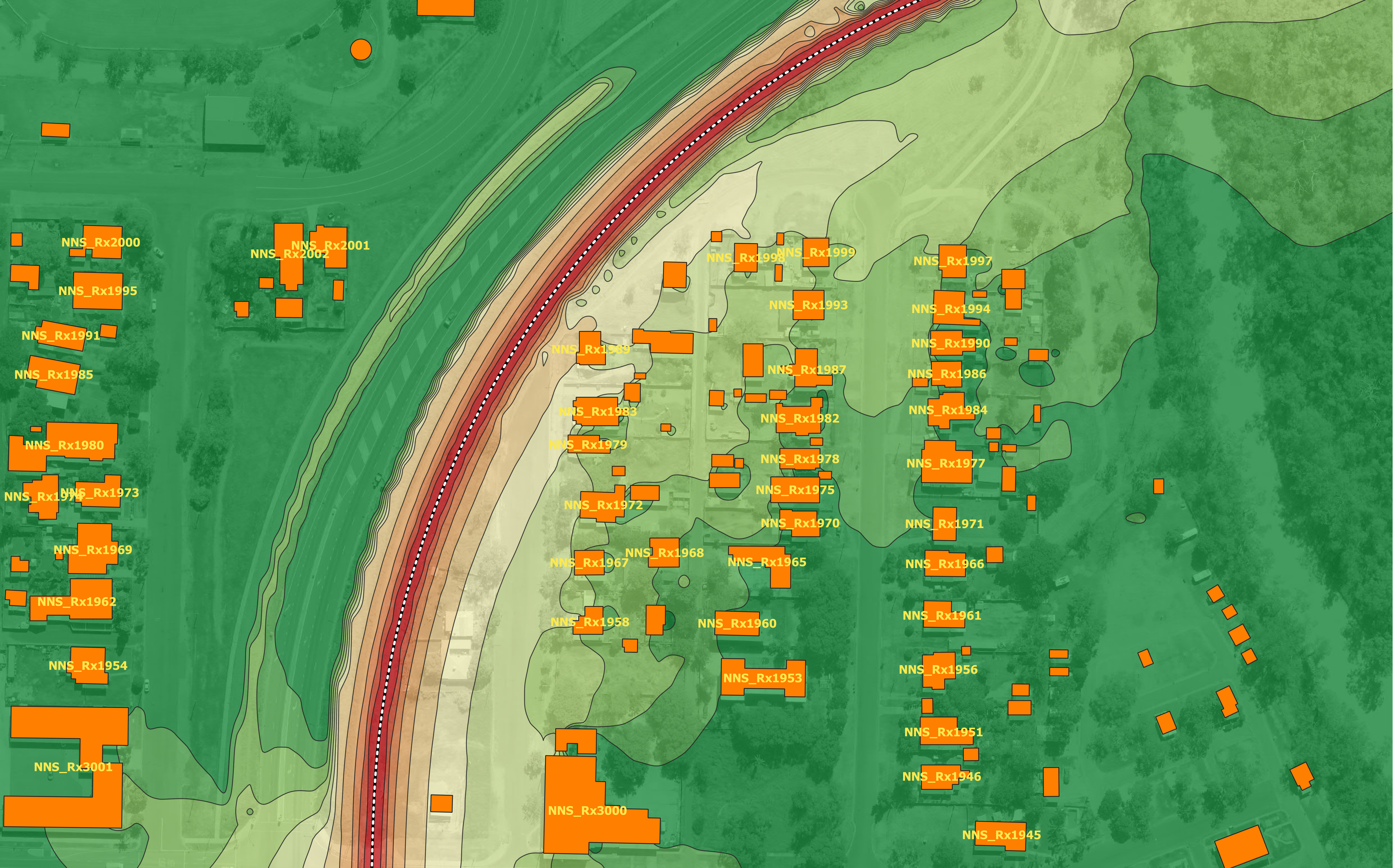
Narrabri to North Star - Phase 2

Year 2040 Night - Unmitigated

All sources

MOTT MACDONALD

IRDJV



Map: WBW6	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

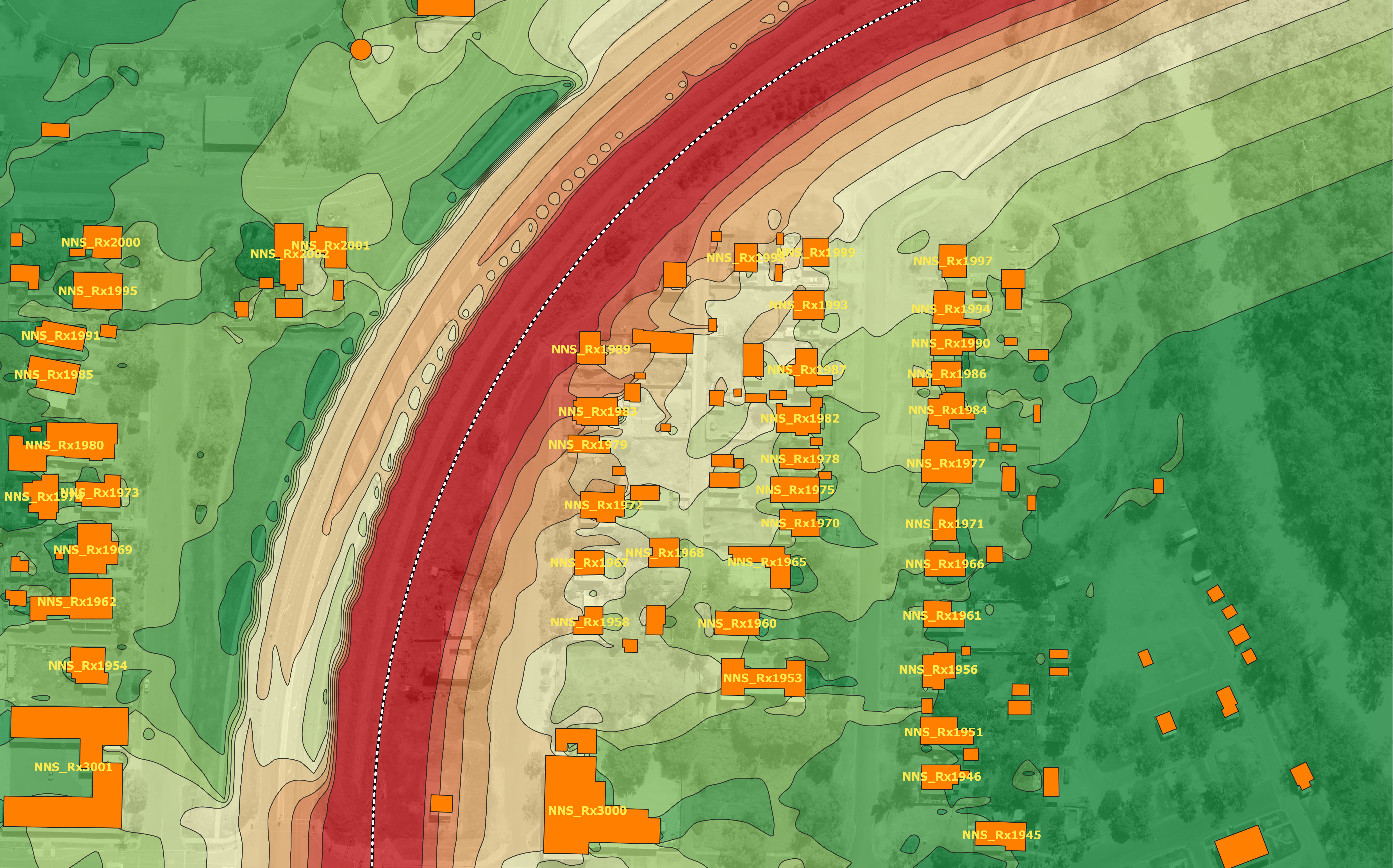
- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

Narrabri to North Star - Phase 2

Year 2040 Night - Warning Bells Wagons

MOTT MACDONALD

IRDJV



Map: WBL7	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

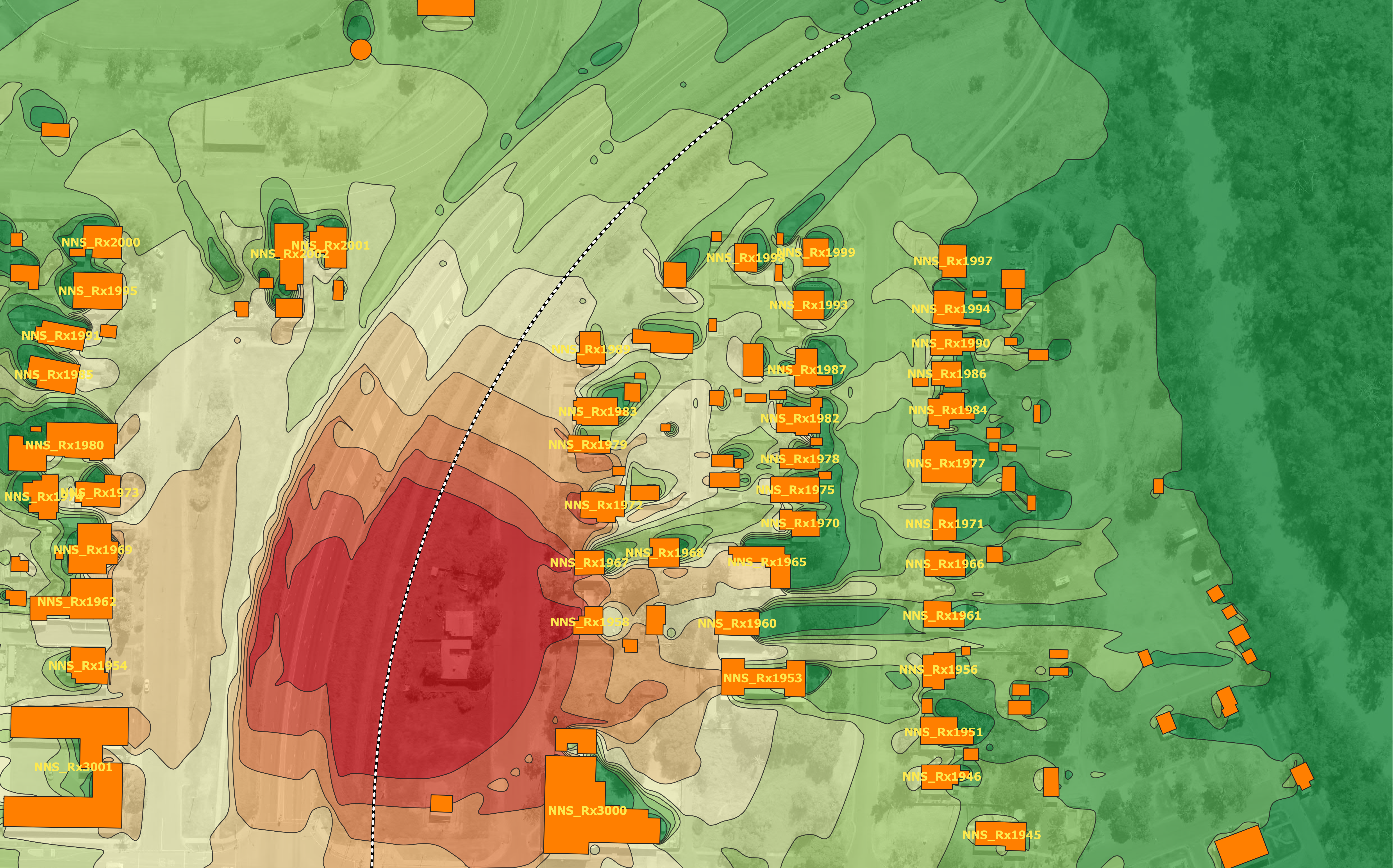
- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

Narrabri to North Star - Phase 2

Year 2040 Night - Warning Bells Locos

MOTT MACDONALD

IRDJV



Map: WBH8	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

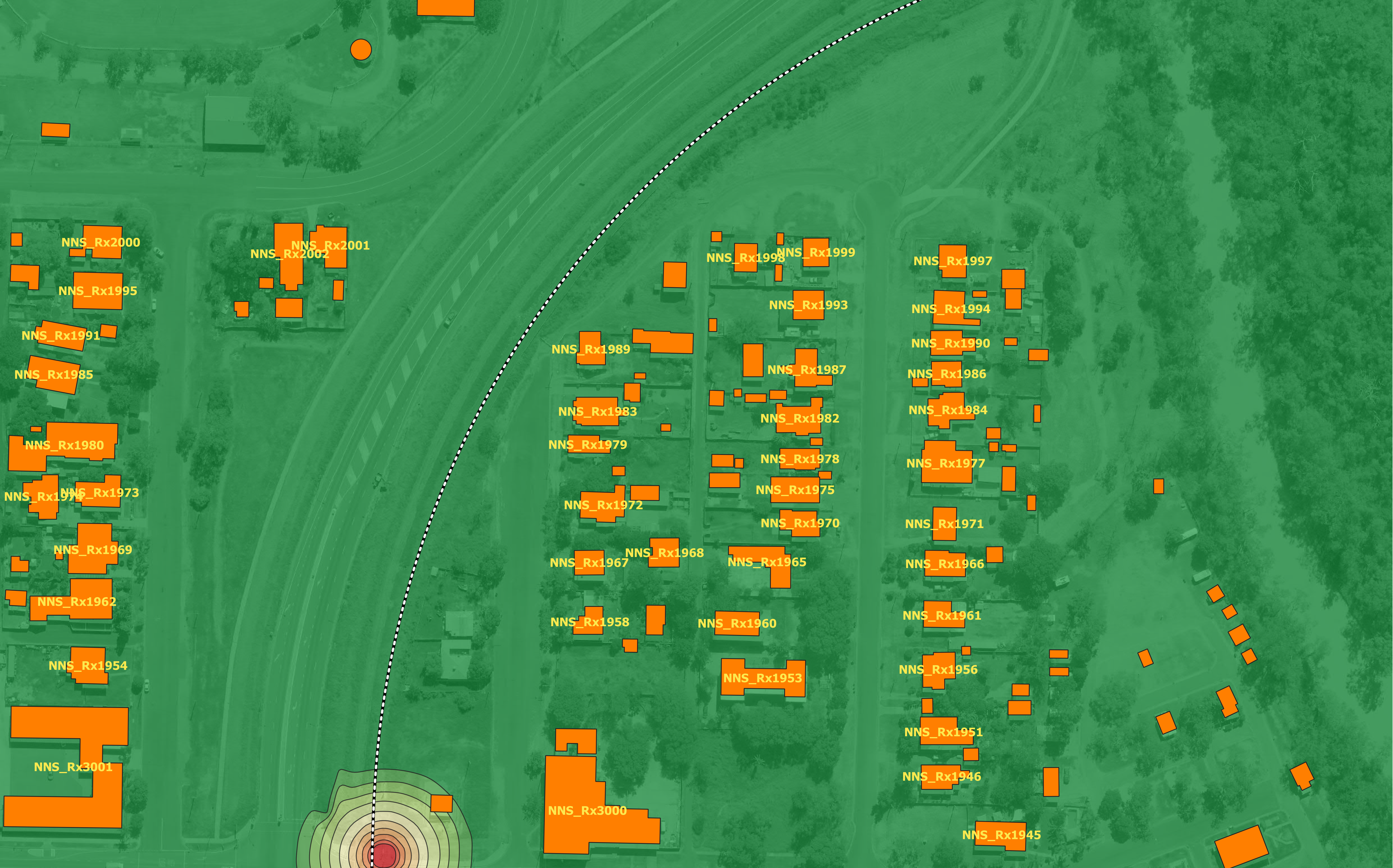
≤76	82 - 84	90 - 92
76 - 78	84 - 86	92 - 94
78 - 80	86 - 88	≥94
80 - 82	88 - 90	

Narrabri to North Star - Phase 2

Year 2040 Night - Warning Bells Horns

MOTT MACDONALD

IRDJV



Map: WBB9	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

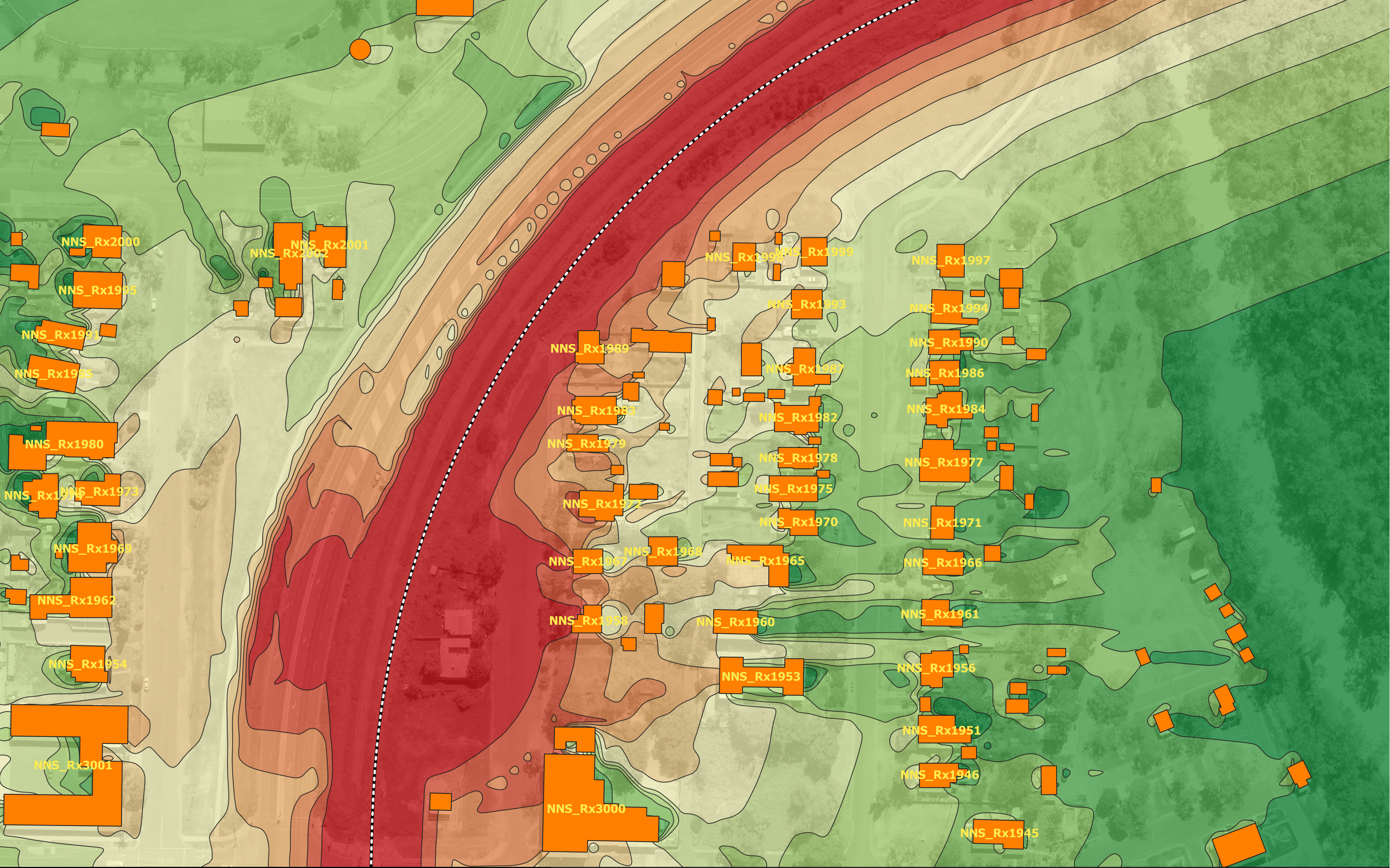
- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

Narrabri to North Star - Phase 2

Year 2040 Night - Warning Bells Bells

MOTT MACDONALD

IRDJV



Map: WBA10	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

Narrabri to North Star - Phase 2

Year 2040 Night - Warning Bells

All sources

MOTT MACDONALD

IRDJV

Map: RDW6

Author: AV

Date: 31/01/2024

Approved by: BI

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

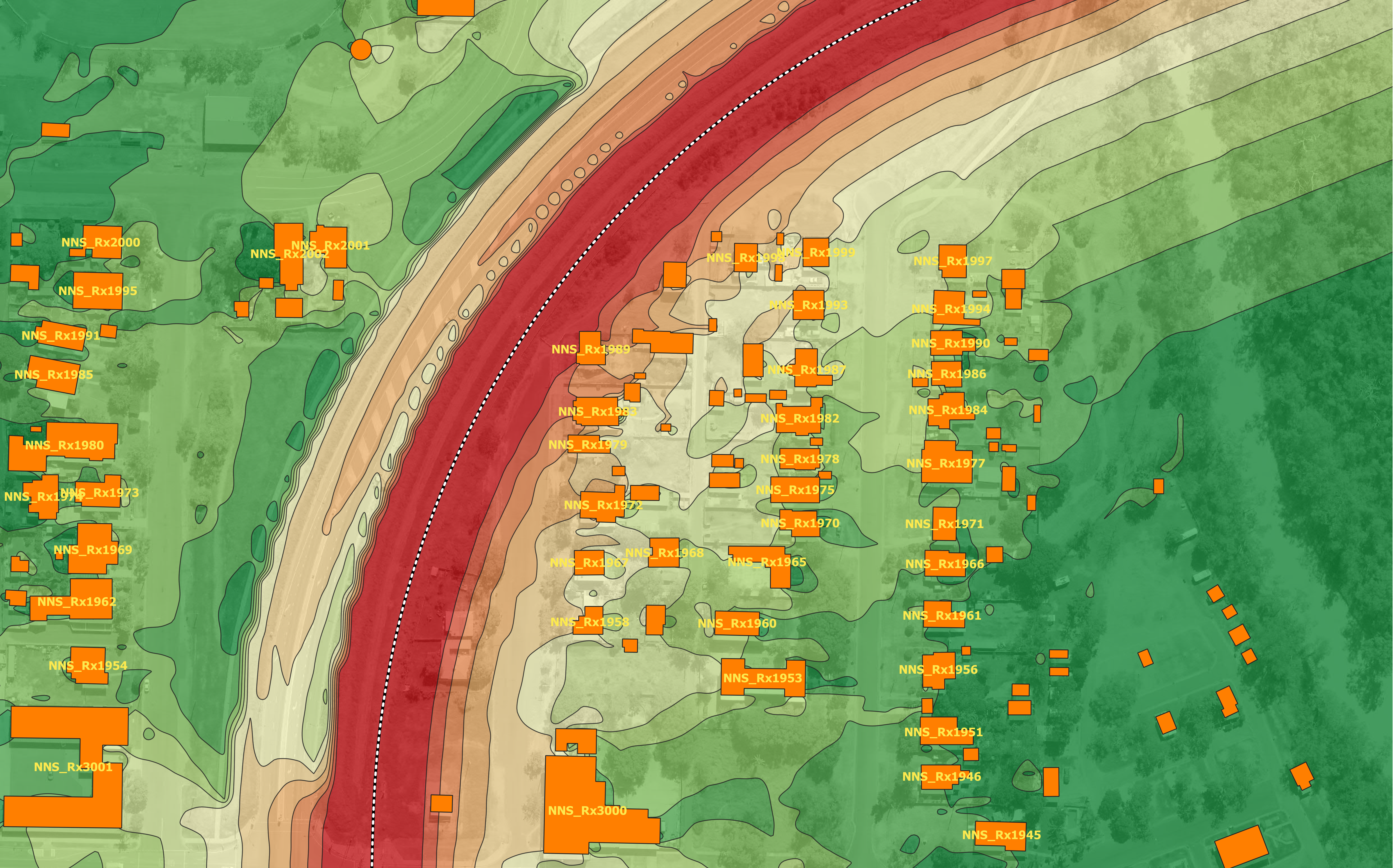
- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

Narrabri to North Star - Phase 2

Year 2040 Night - Rail Dampers Wagons

wsp

MOTT MACDONALD



Map: RDL7	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

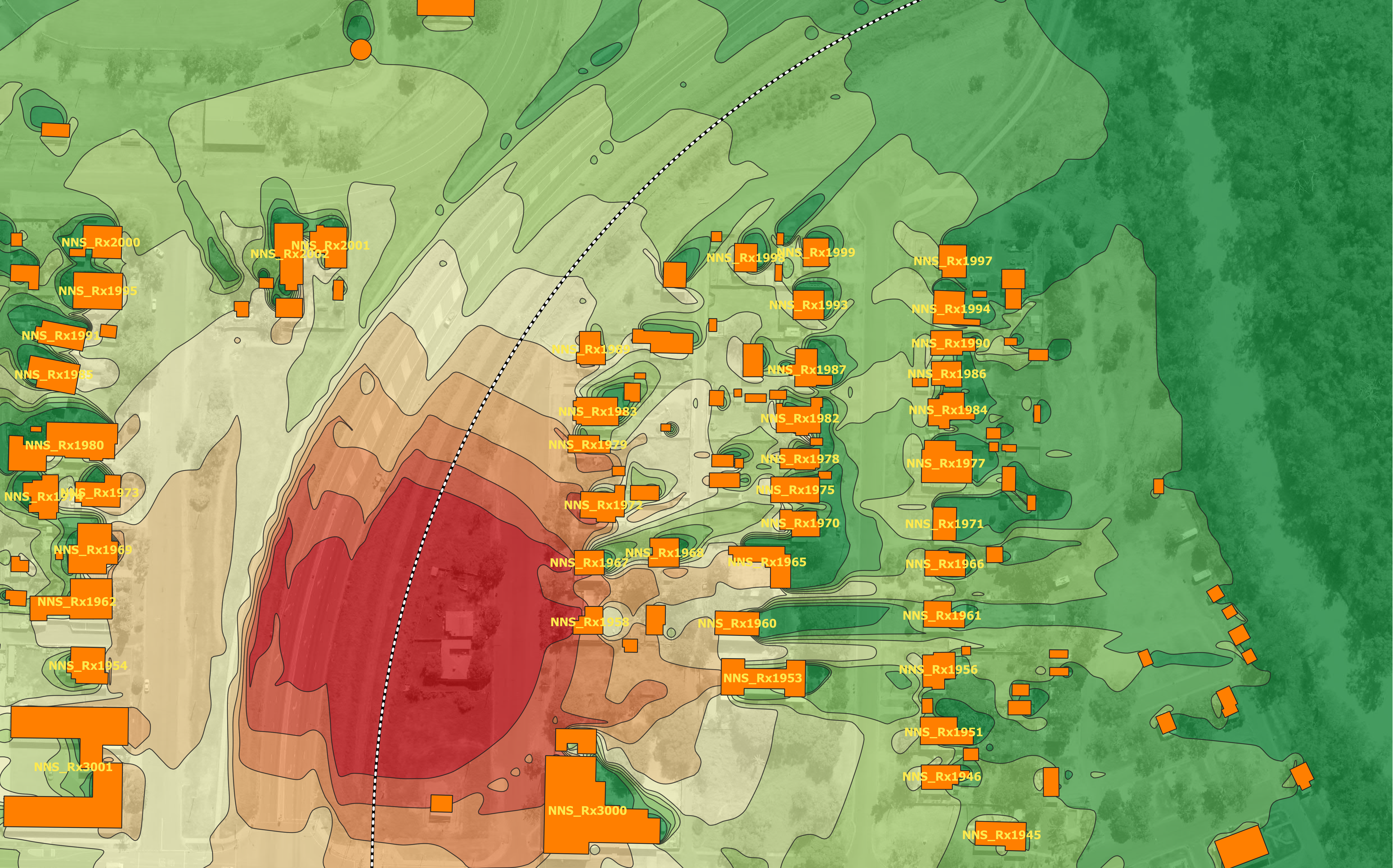
- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

Narrabri to North Star - Phase 2

Year 2040 Night - Rail Dampers Locos

MOTT MACDONALD

IRDJV



Map: RDH8
Author: AV
Date: 31/01/2024
Approved by: BI

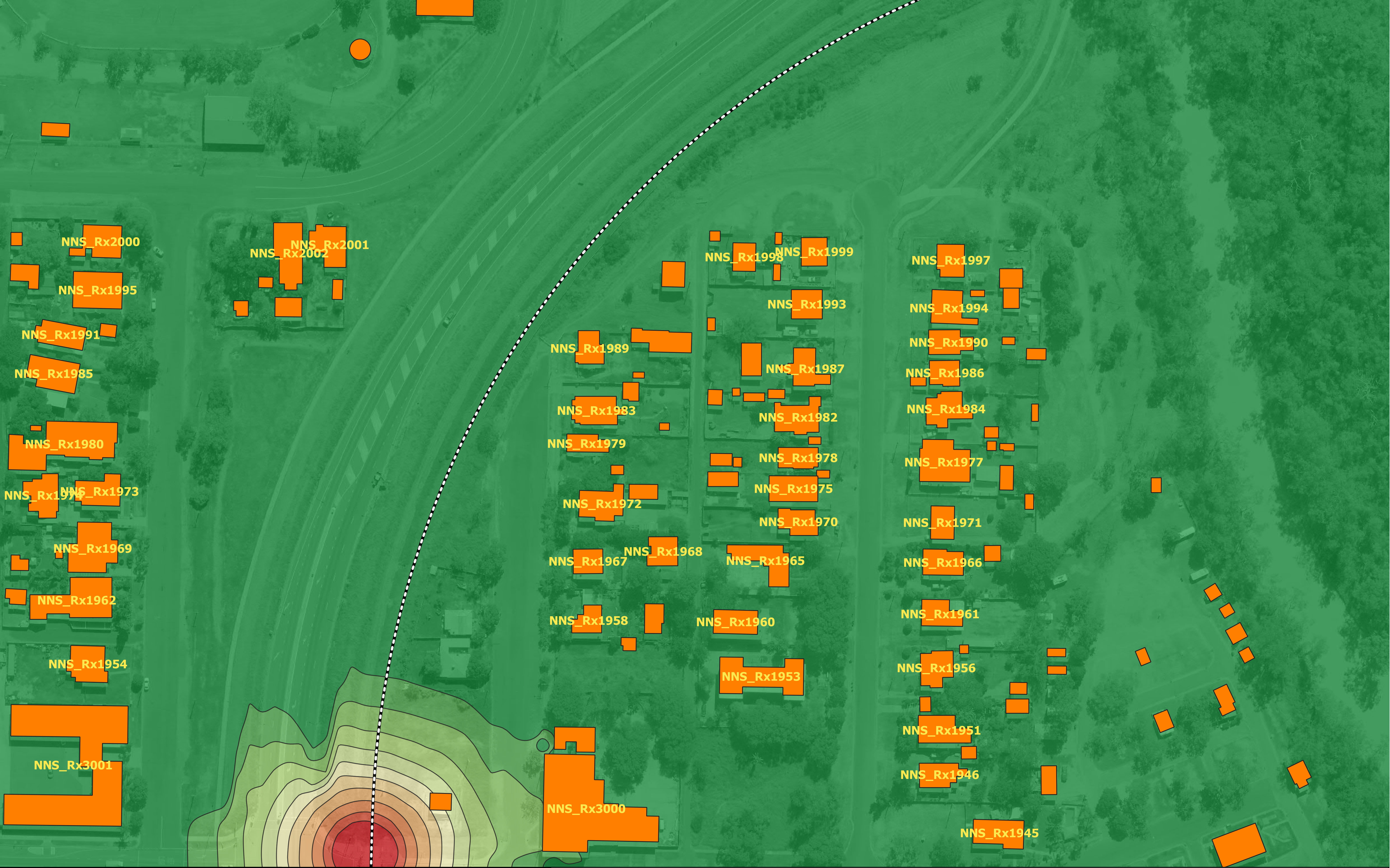
0 10 20 30 40 50 m
1:1,300 at A3
Coordinate system: GDA94. MGA Zone 55
Aerial imagery source: MetroMaps

Legend
- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

≤76	82 - 84	90 - 92
76 - 78	84 - 86	92 - 94
78 - 80	86 - 88	≥94
80 - 82	88 - 90	

Narrabri to North Star - Phase 2
Year 2040 Night - Rail Dampers Horns



Map: RDB9	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

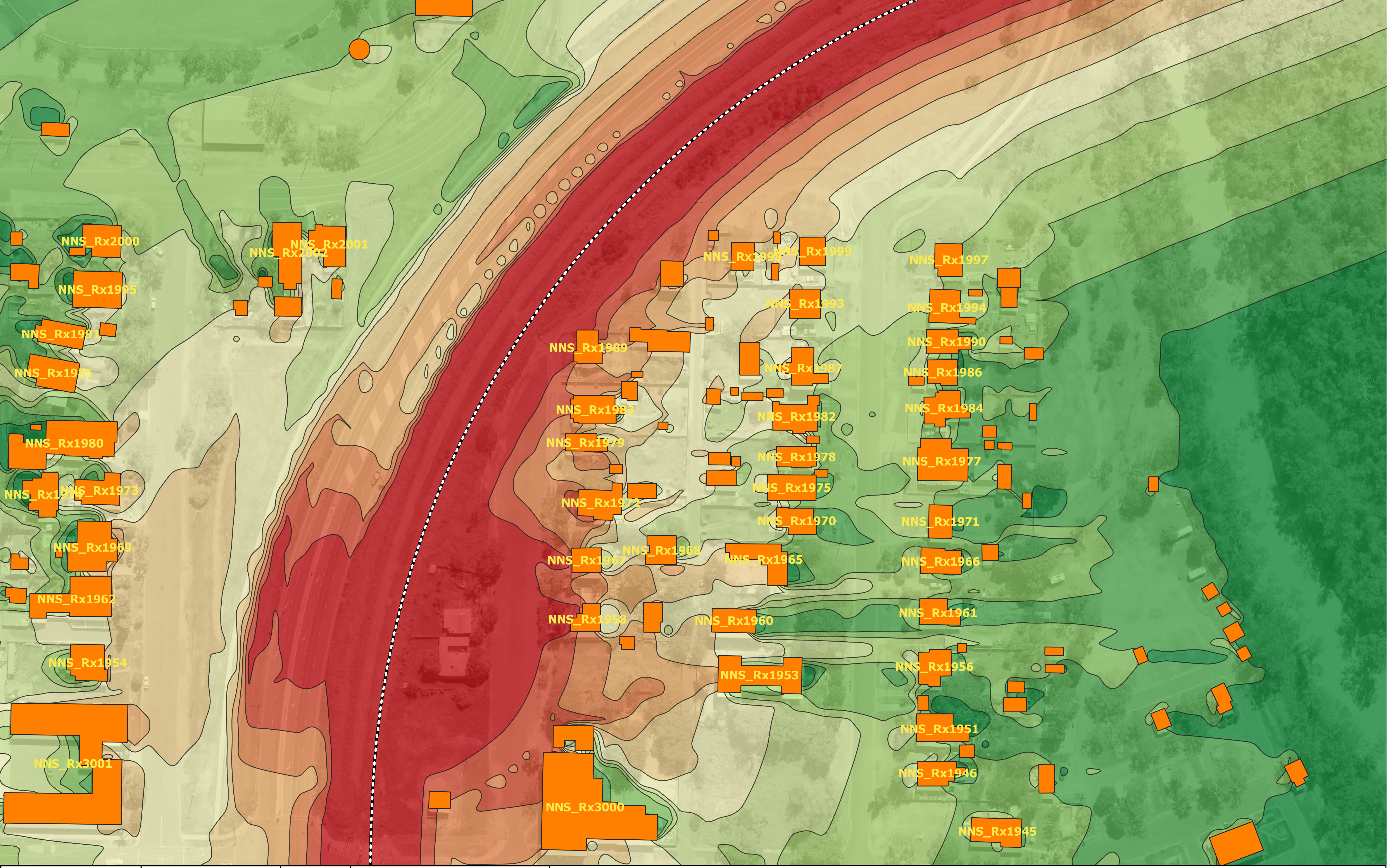
- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

Narrabri to North Star - Phase 2

Year 2040 Night - Rail Dampers
Bells

MOTT MACDONALD

IRDJV



Map: RDA10
Author: AV
Date: 31/01/2024
Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

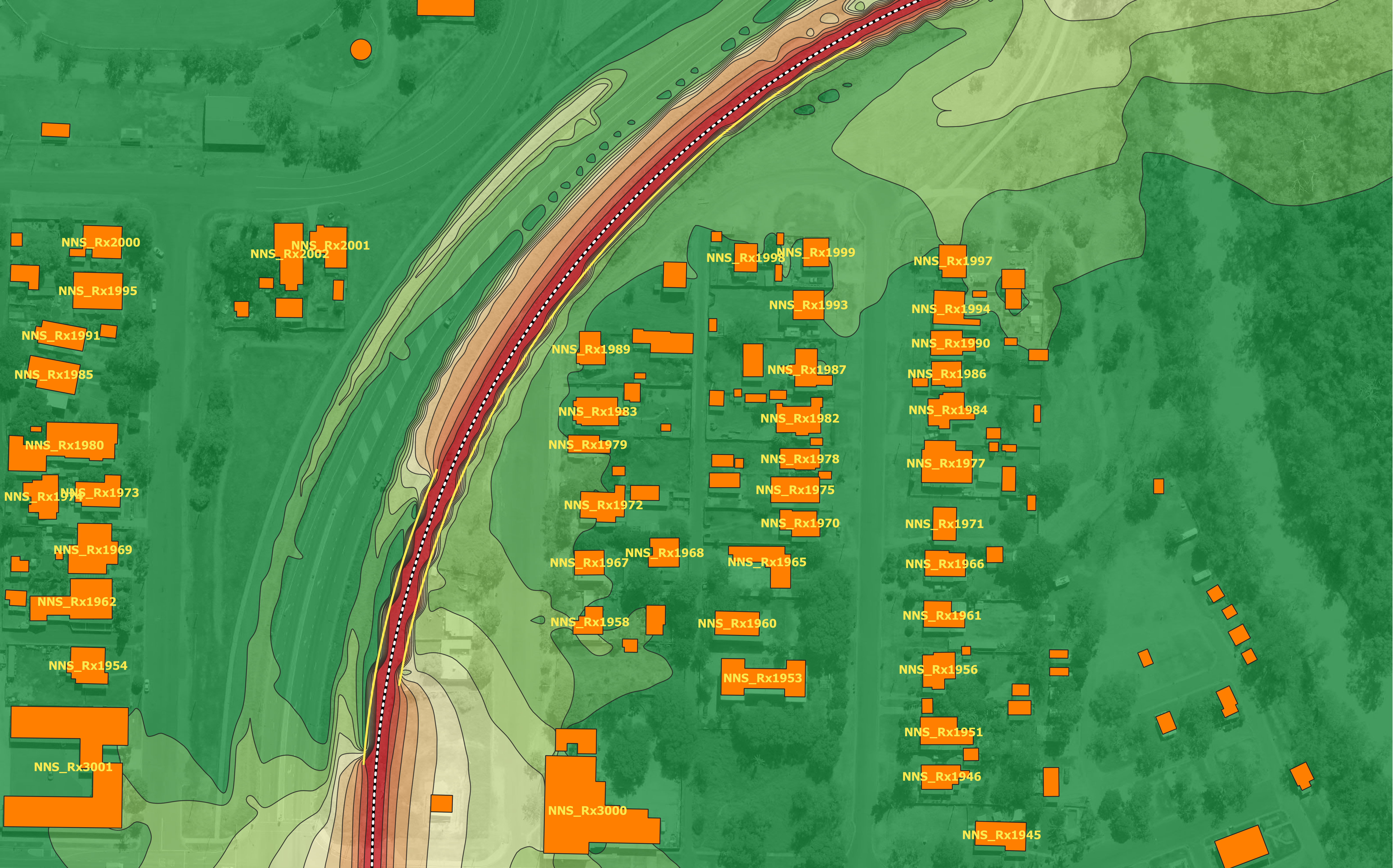
Narrabri to North Star - Phase 2

Year 2040 Night - Rail Dampers

All sources

MOTT MACDONALD

IRDJV



Map: 5MW6	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

Narrabri to North Star - Phase 2

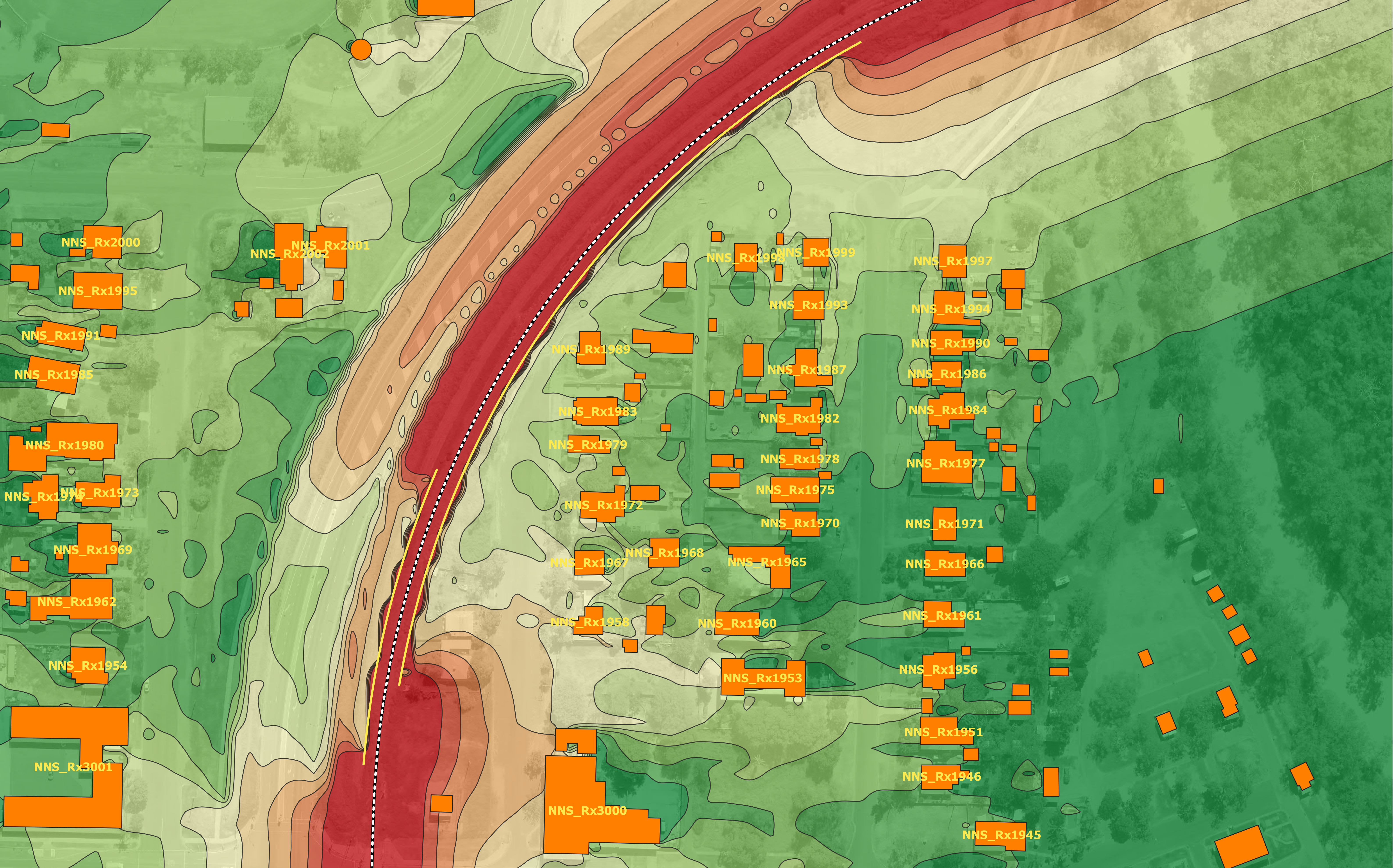
Year 2040 Night - Barriers 5m

Wagons

wsp

MOTT MACDONALD

IRDJV



Map: 5ML7	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

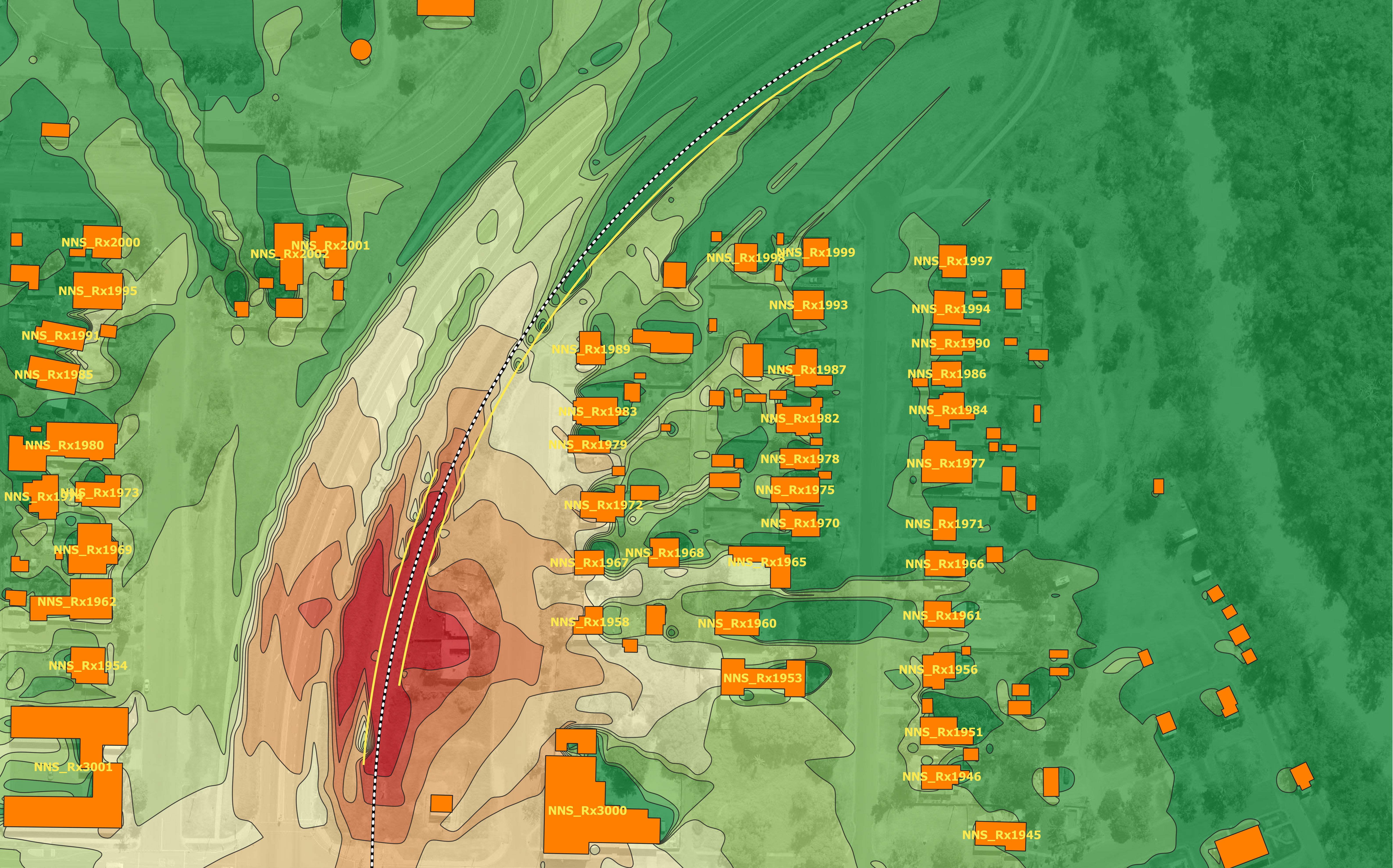
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 5m

Locos

MOTT MACDONALD

IRDJV



Map: 5MH8	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

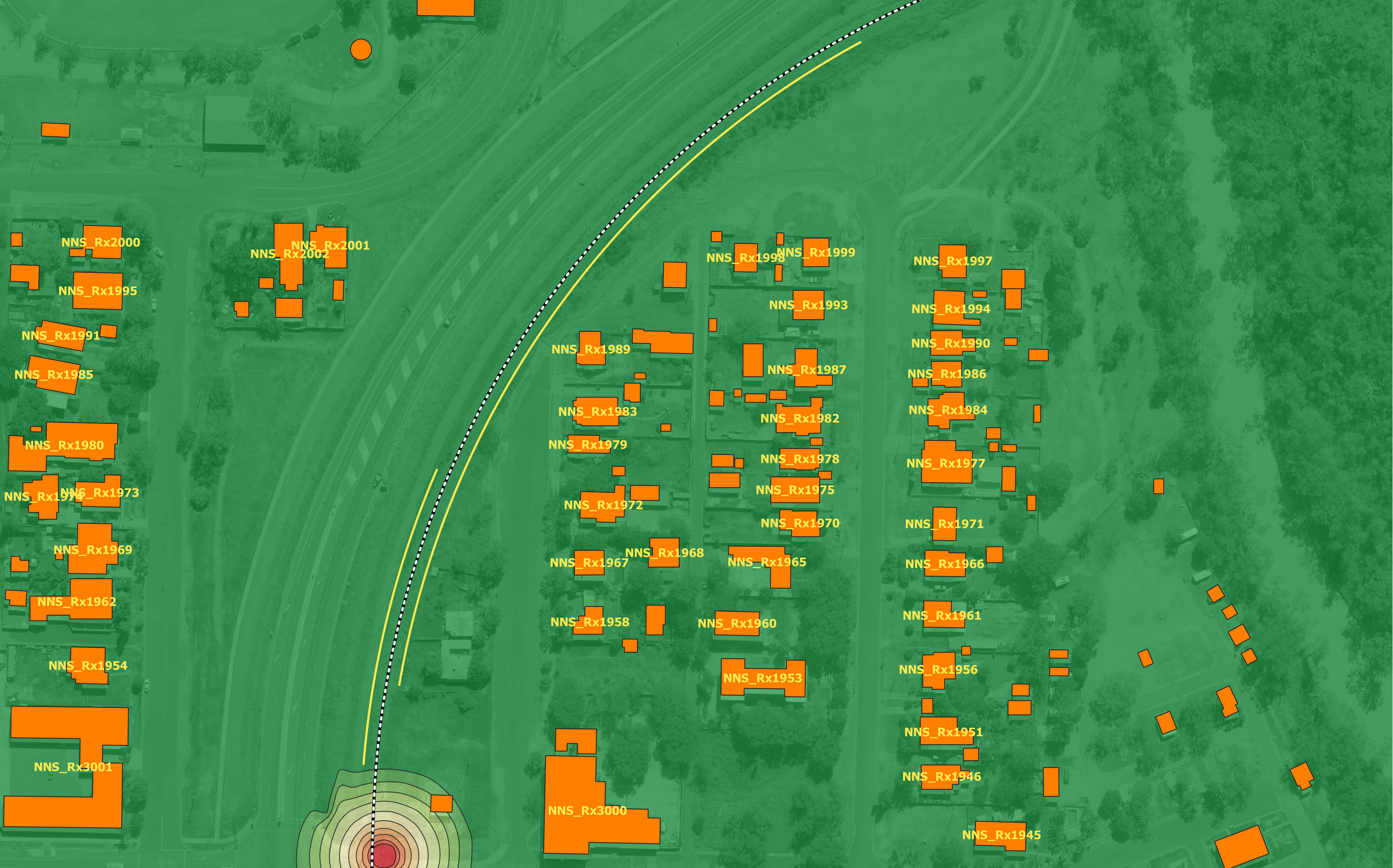
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 5m

Horns

MOTT MACDONALD

IRDJV



Map: 5MB9	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

Narrabri to North Star - Phase 2

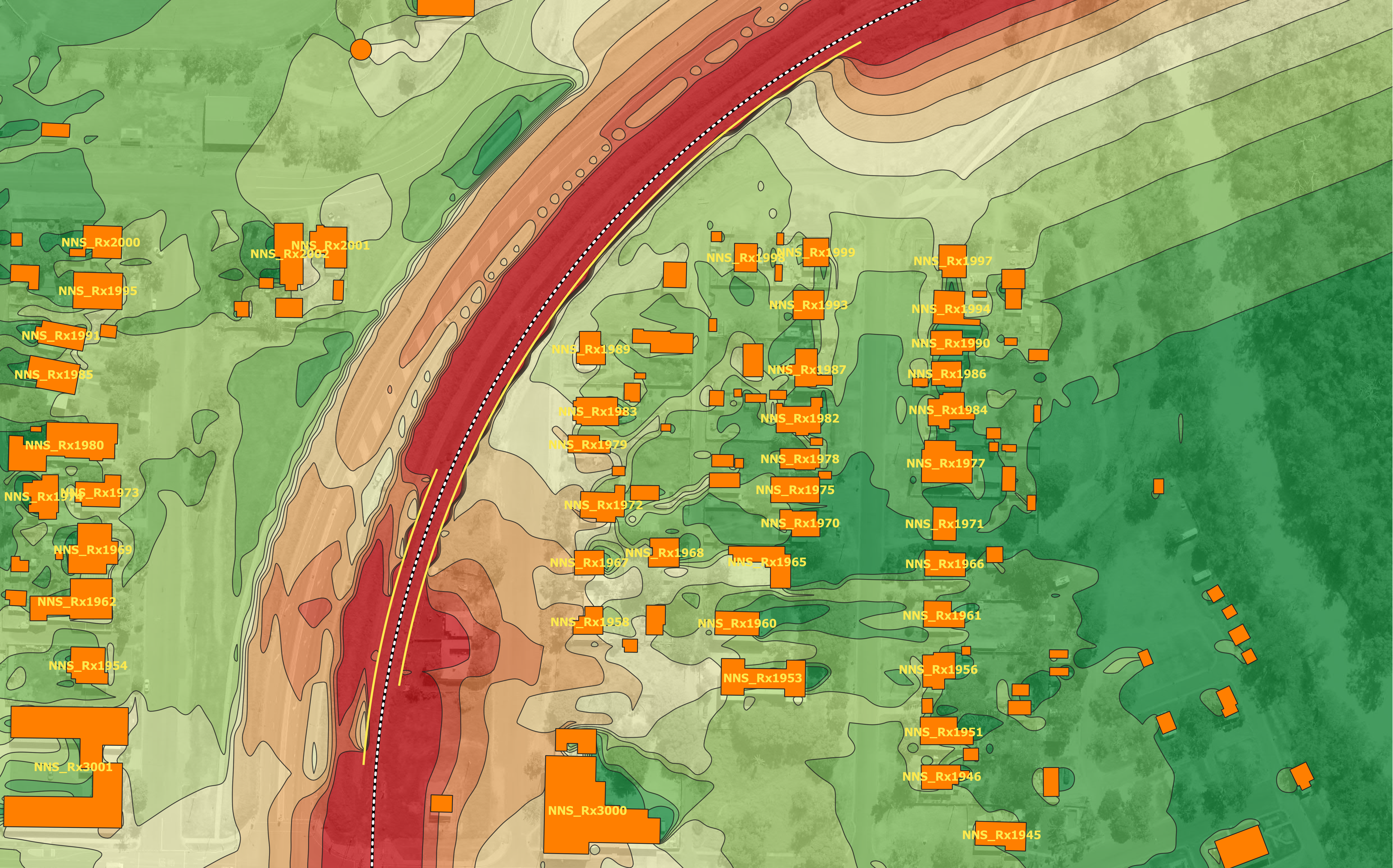
Year 2040 Night - Barriers 5m

Bells

wsp

MOTT MACDONALD

IRDJV



Map: 5MA10	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 5m

All sources

wsp

MOTT MACDONALD

IRDJV

Map: 4MW6	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

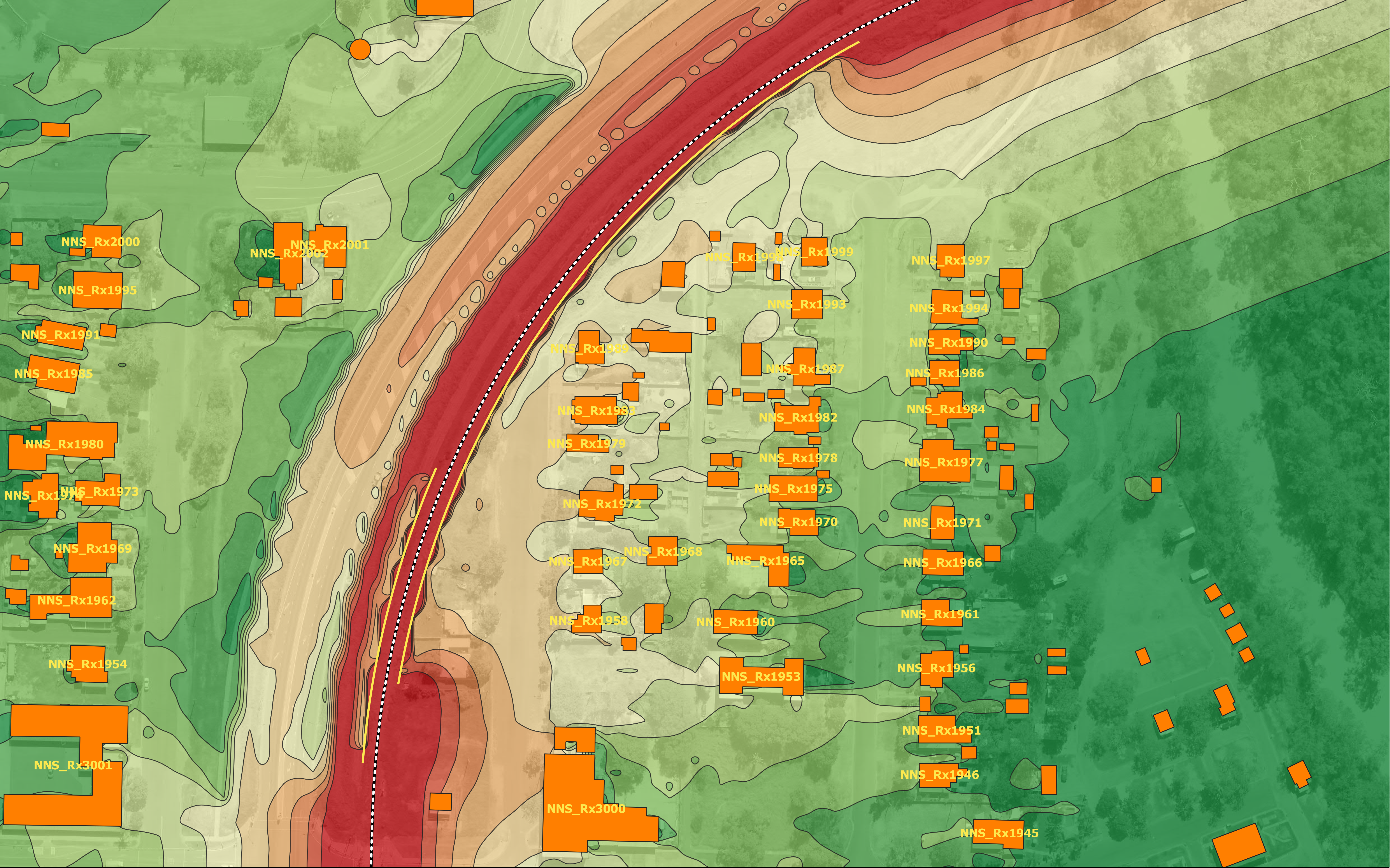
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 4m

Wagons

MOTT MACDONALD

IRDJV



Map: 4ML7	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

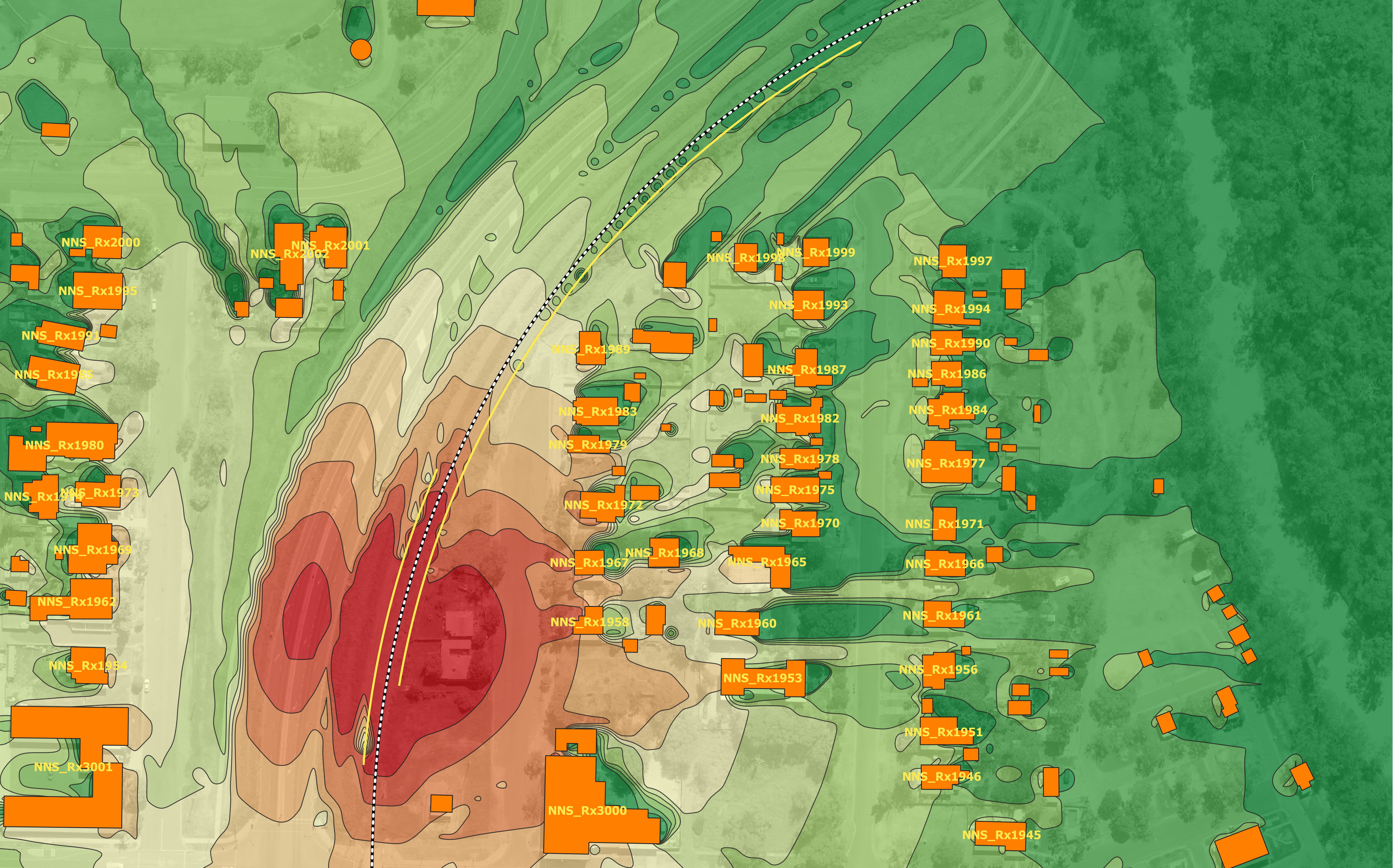
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 4m

Locos

MOTT MACDONALD

IRDJV



Map: 4MH8	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

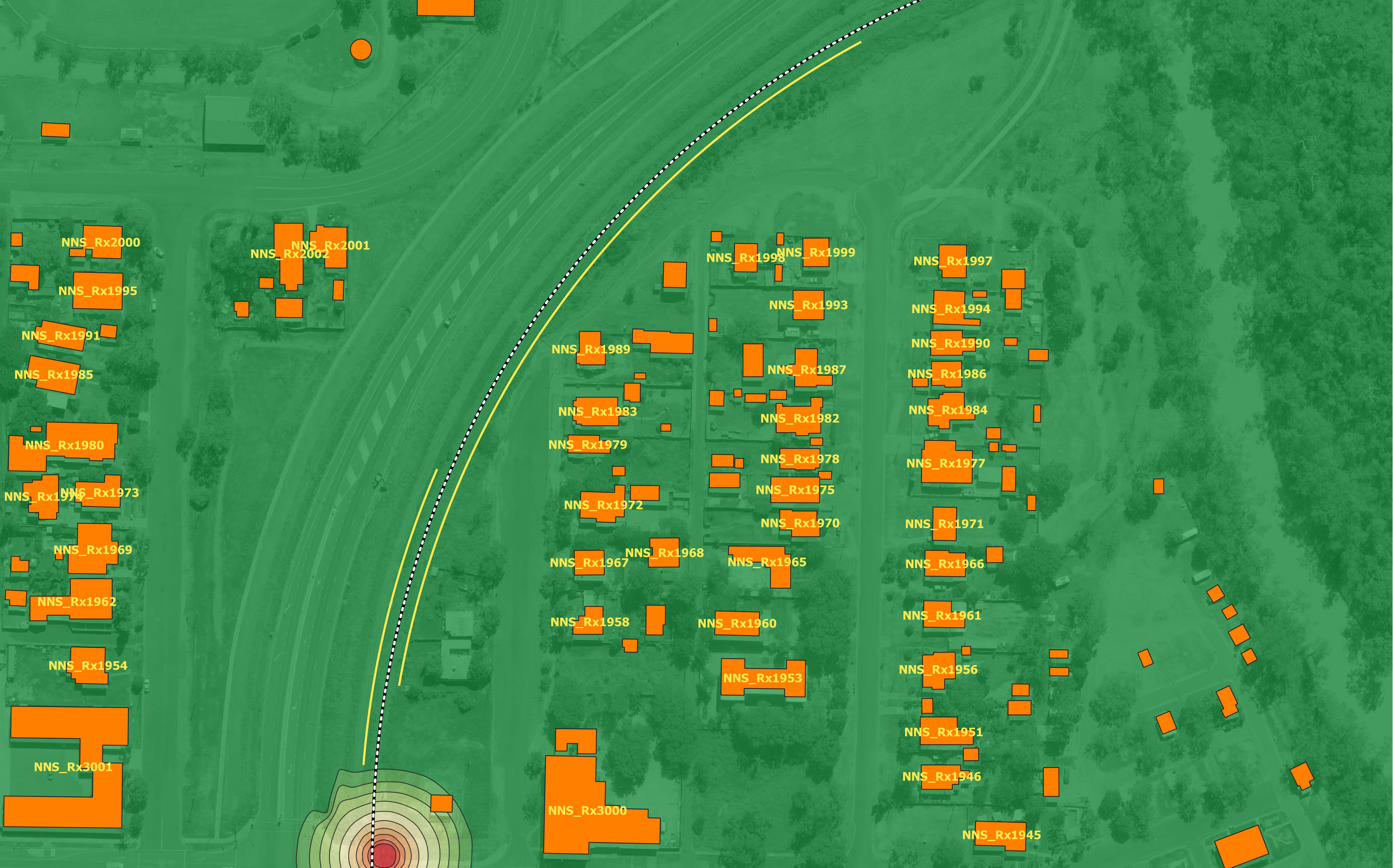
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 4m

Horns

MOTT MACDONALD

IRDJV



Map: 4MB9	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

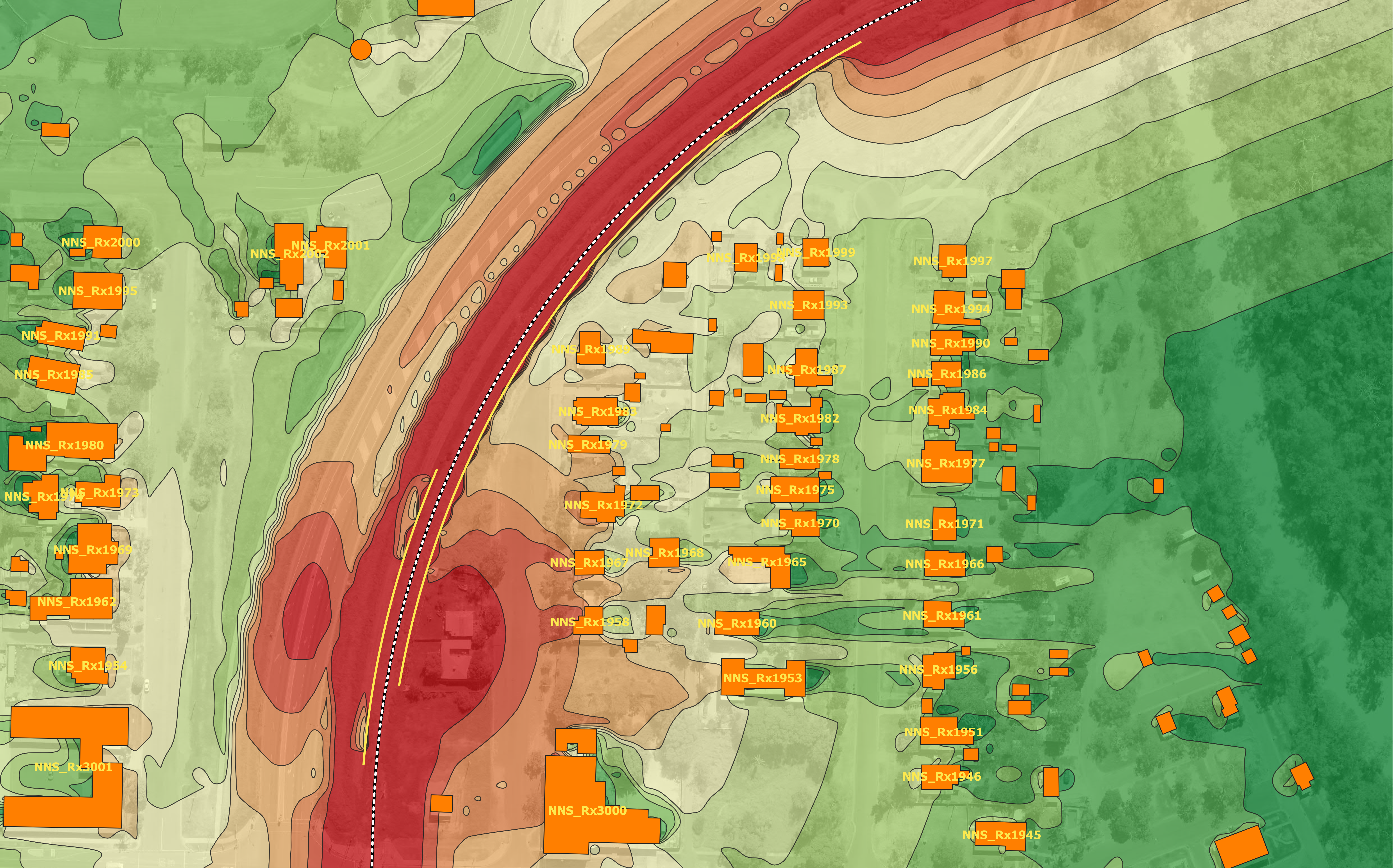
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 4m

Bells

MOTT MACDONALD

IRDJV



Map: 4MA10	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

≤76	82 - 84	90 - 92
76 - 78	84 - 86	92 - 94
78 - 80	86 - 88	≥94
80 - 82	88 - 90	

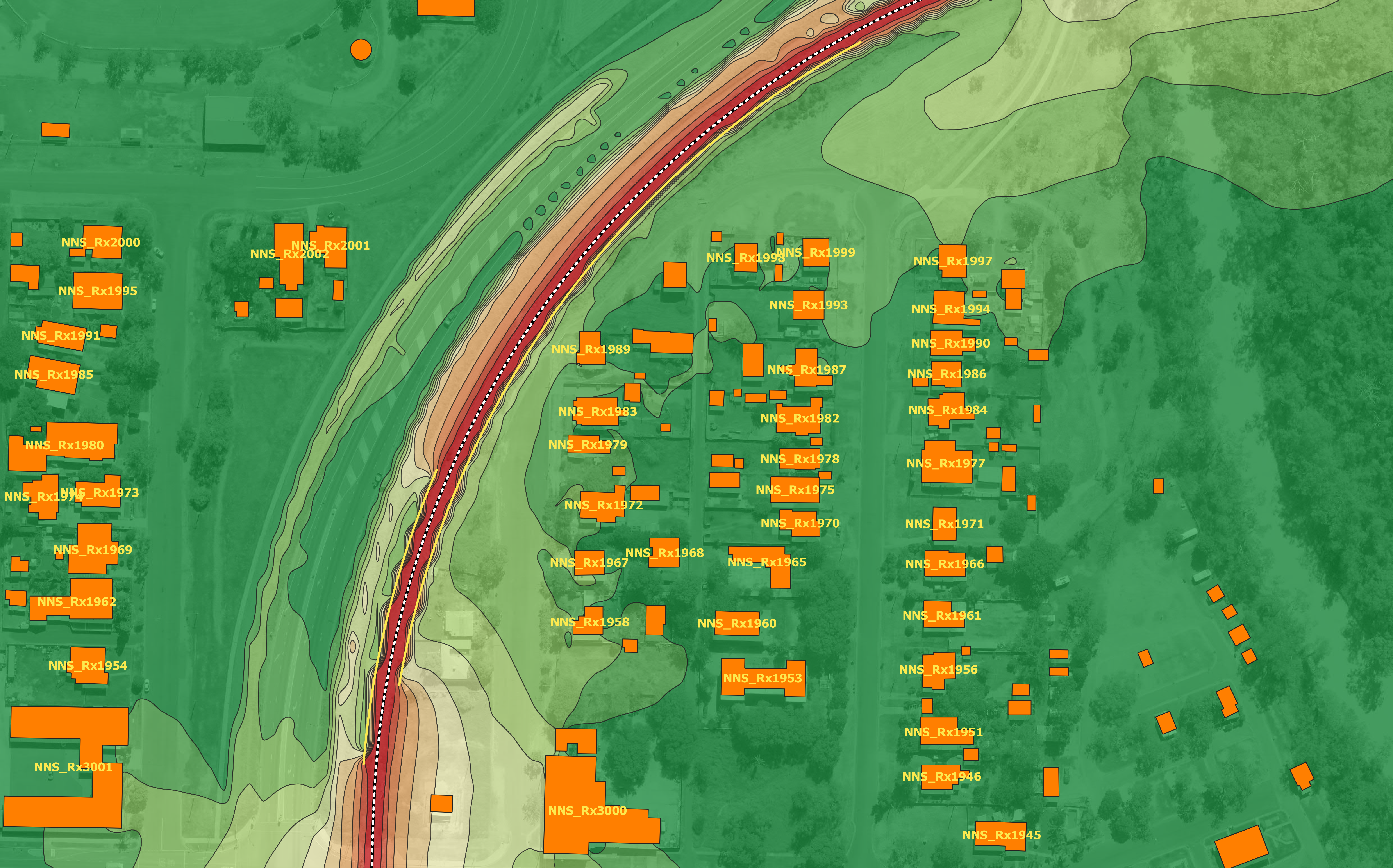
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 4m

All sources

MOTT MACDONALD

IRDJV



Map: 3MW6	Author: AV
Date: 31/01/2024	Approved by: BI

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

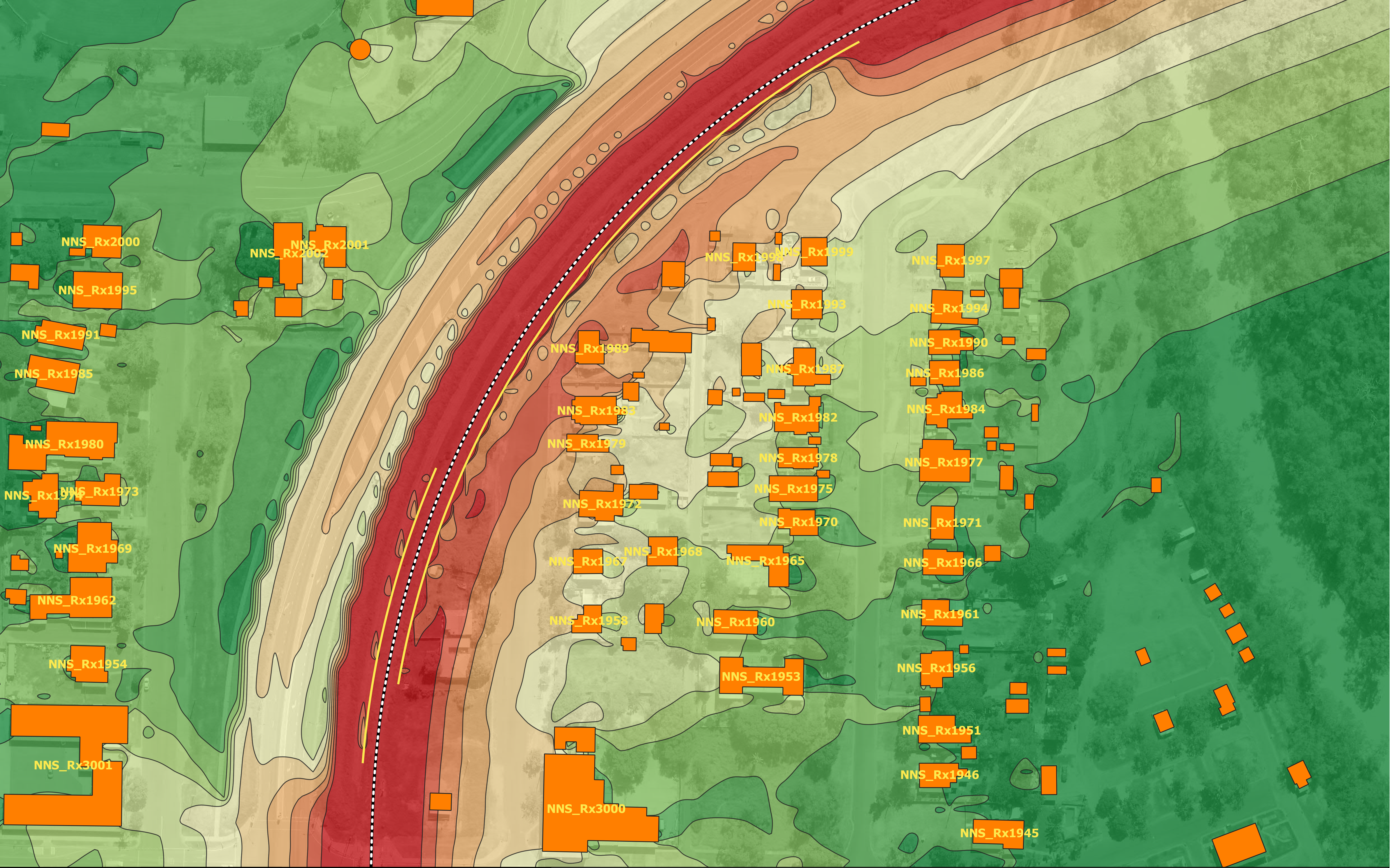
- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 3m Wagons

MOTT MACDONALD

IRDJV



Map: 3ML7	Author: AV	
Date: 31/01/2024	Approved by: BI	

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

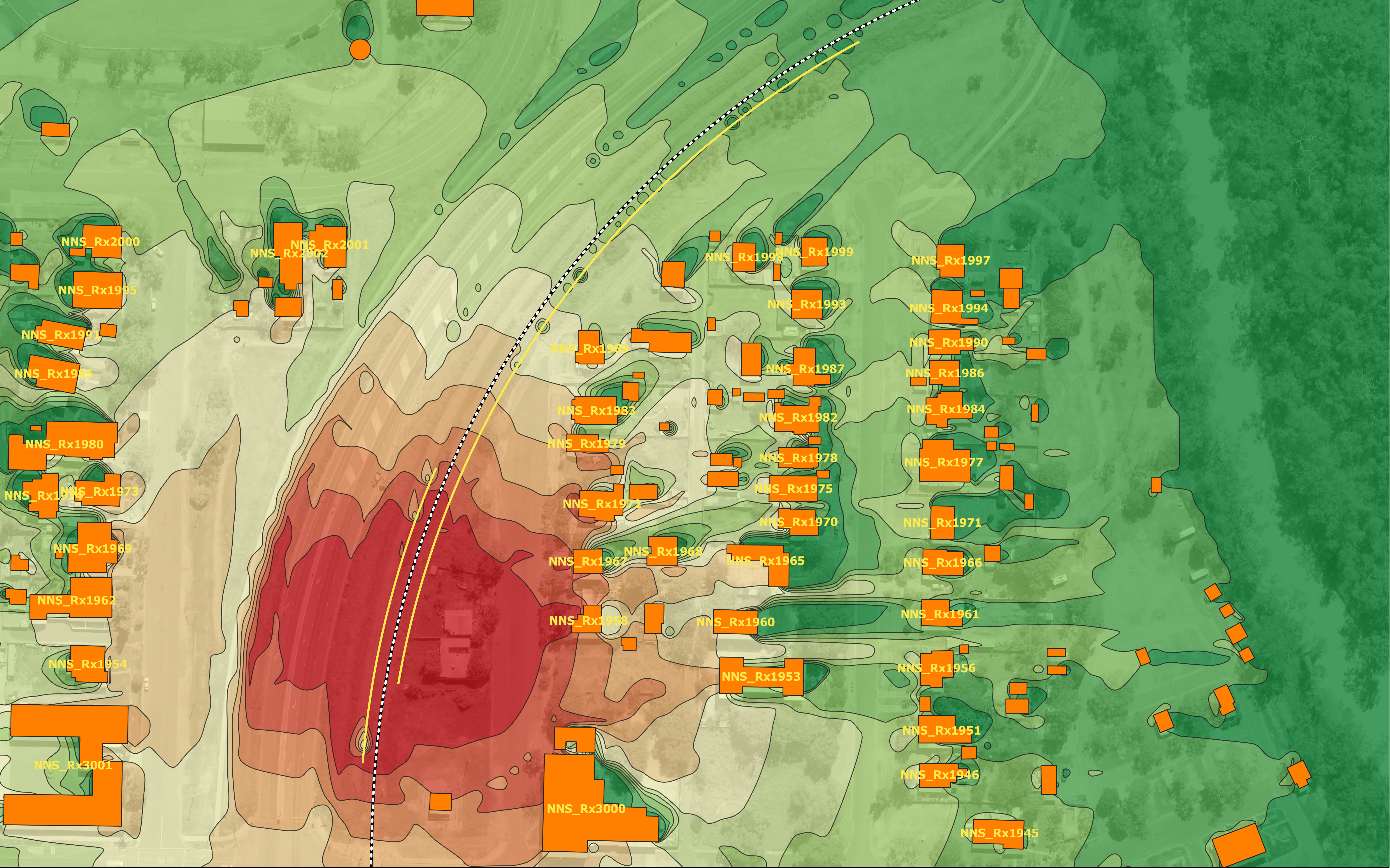
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 3m

Locos

MOTT MACDONALD

IRDJV



Map: 3MH8	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

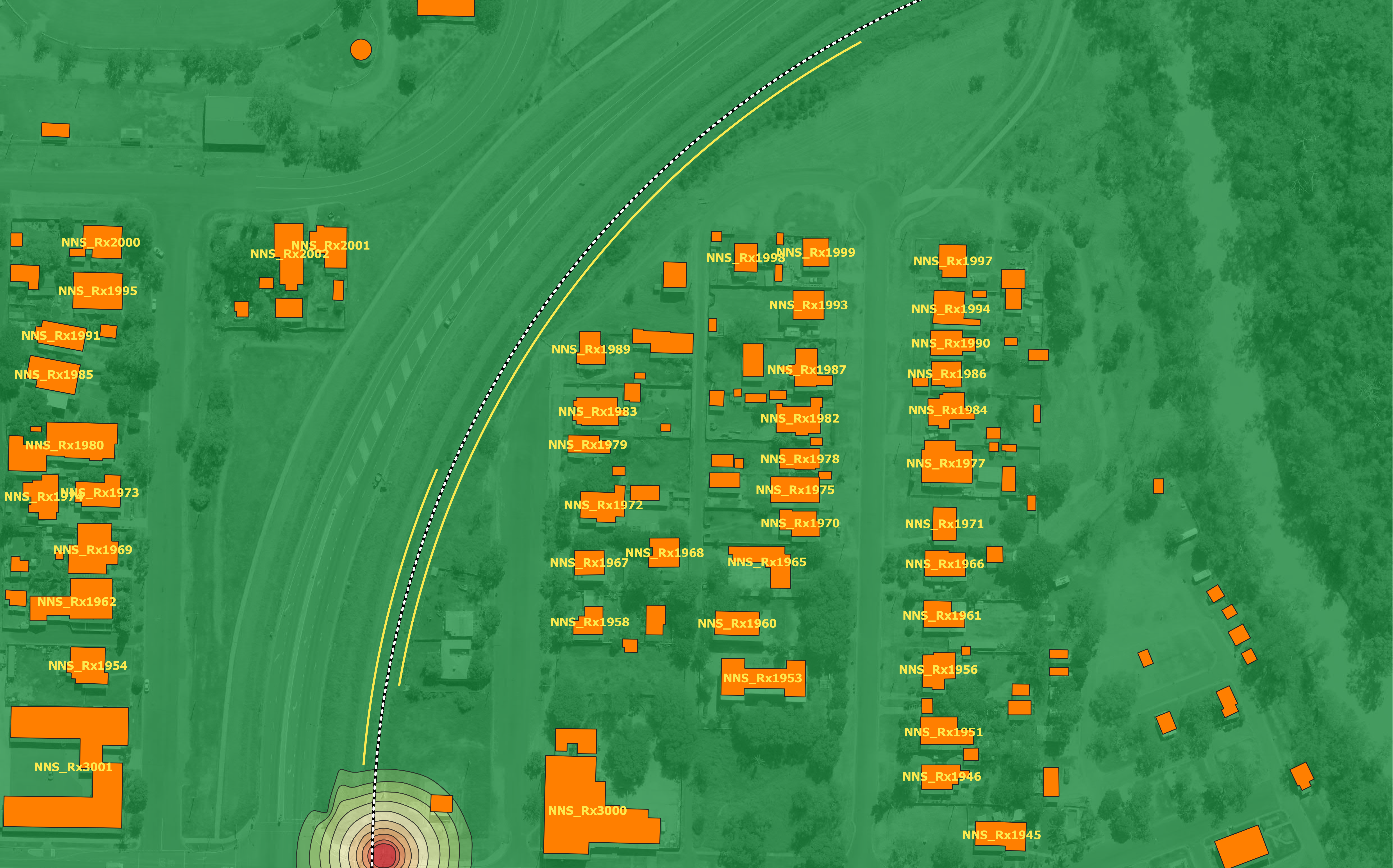
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 3m

Horns

MOTT MACDONALD

IRDJV



Map: 3MB9	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

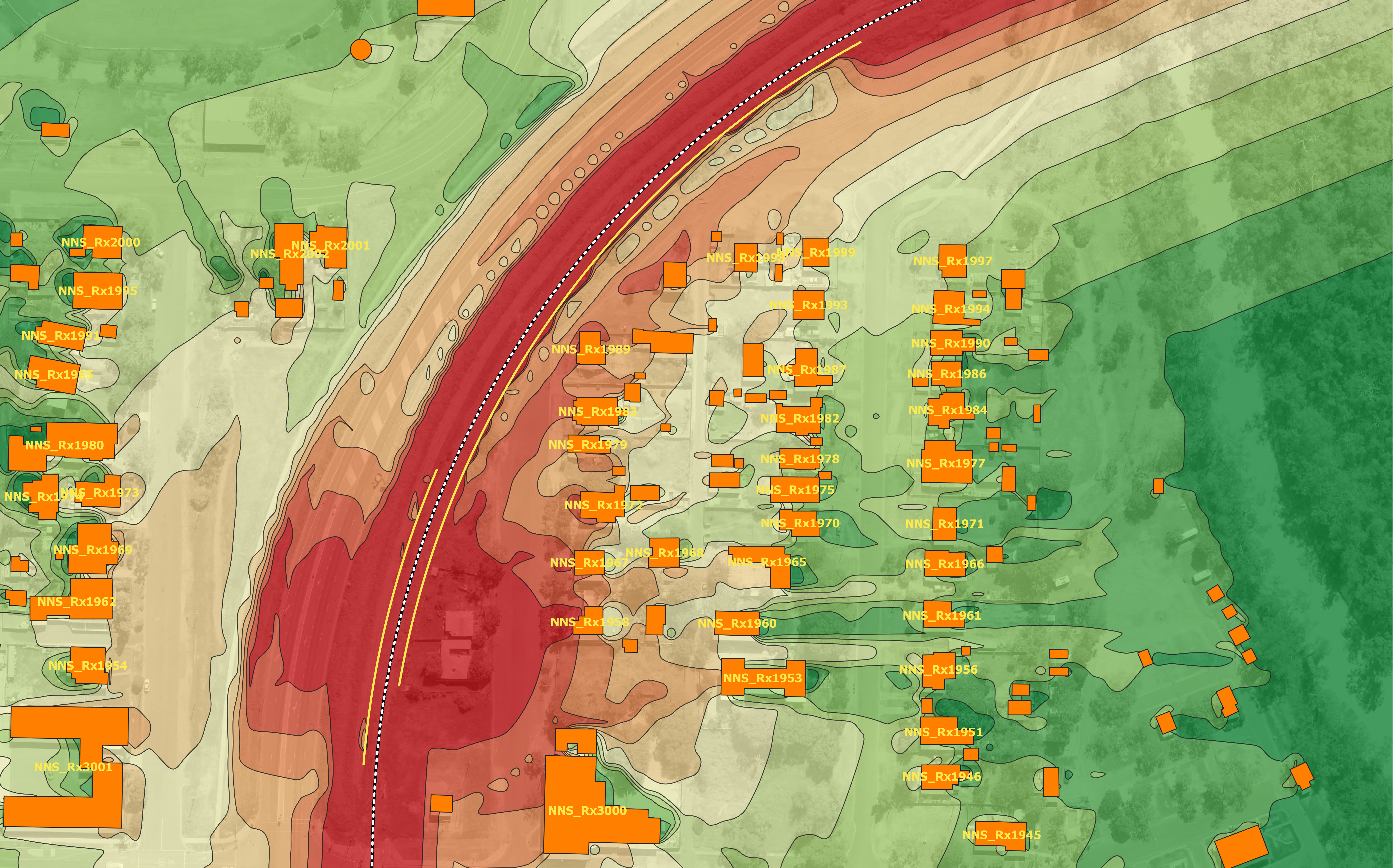
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 3m

Bells

MOTT MACDONALD

IRDJV



Map:
3MA10

Author:
AV

Date:
31/01/2024

Approved by:
BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

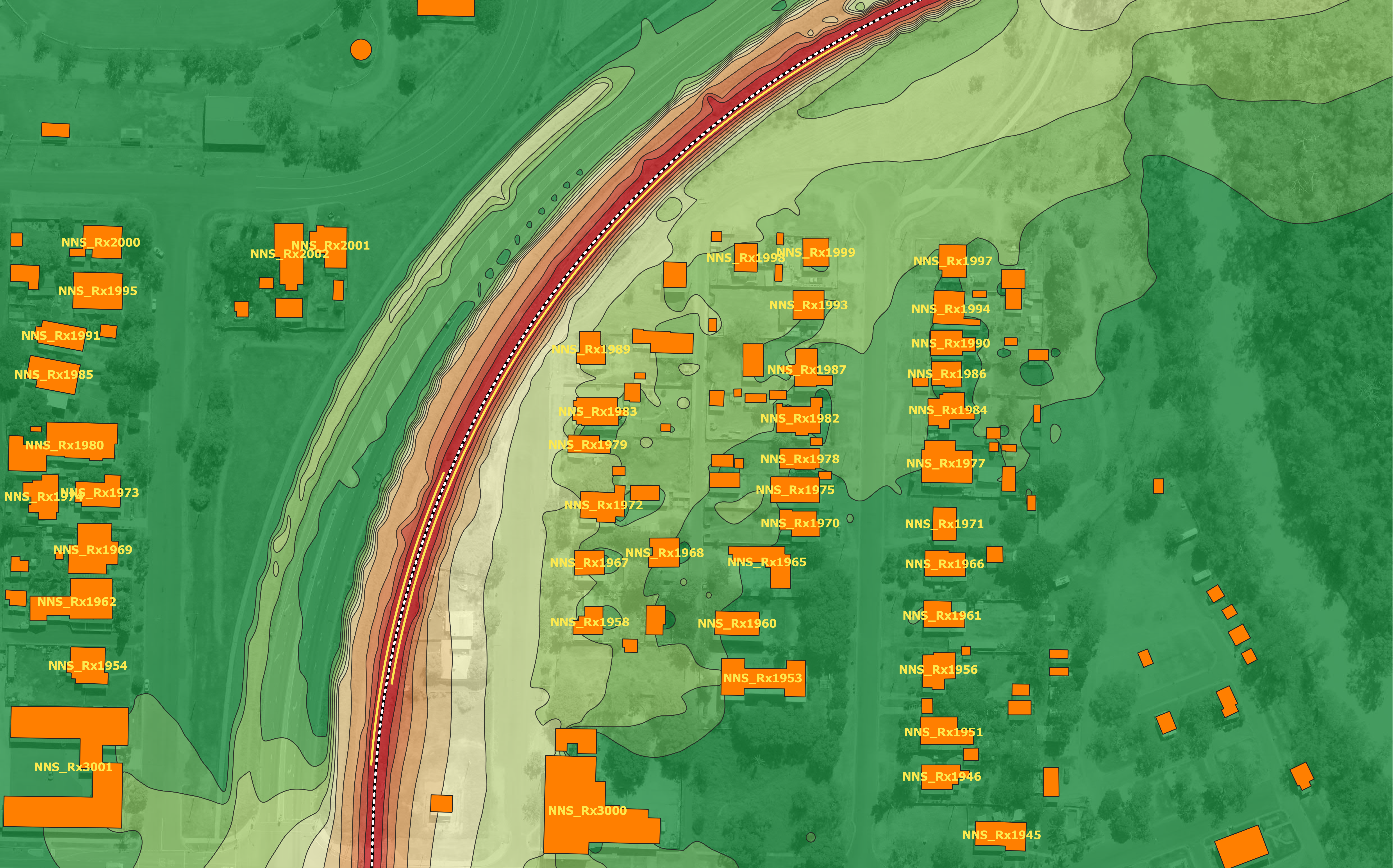
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 3m

All sources

MOTT MACDONALD

IRDJV



Map: 1MW6	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

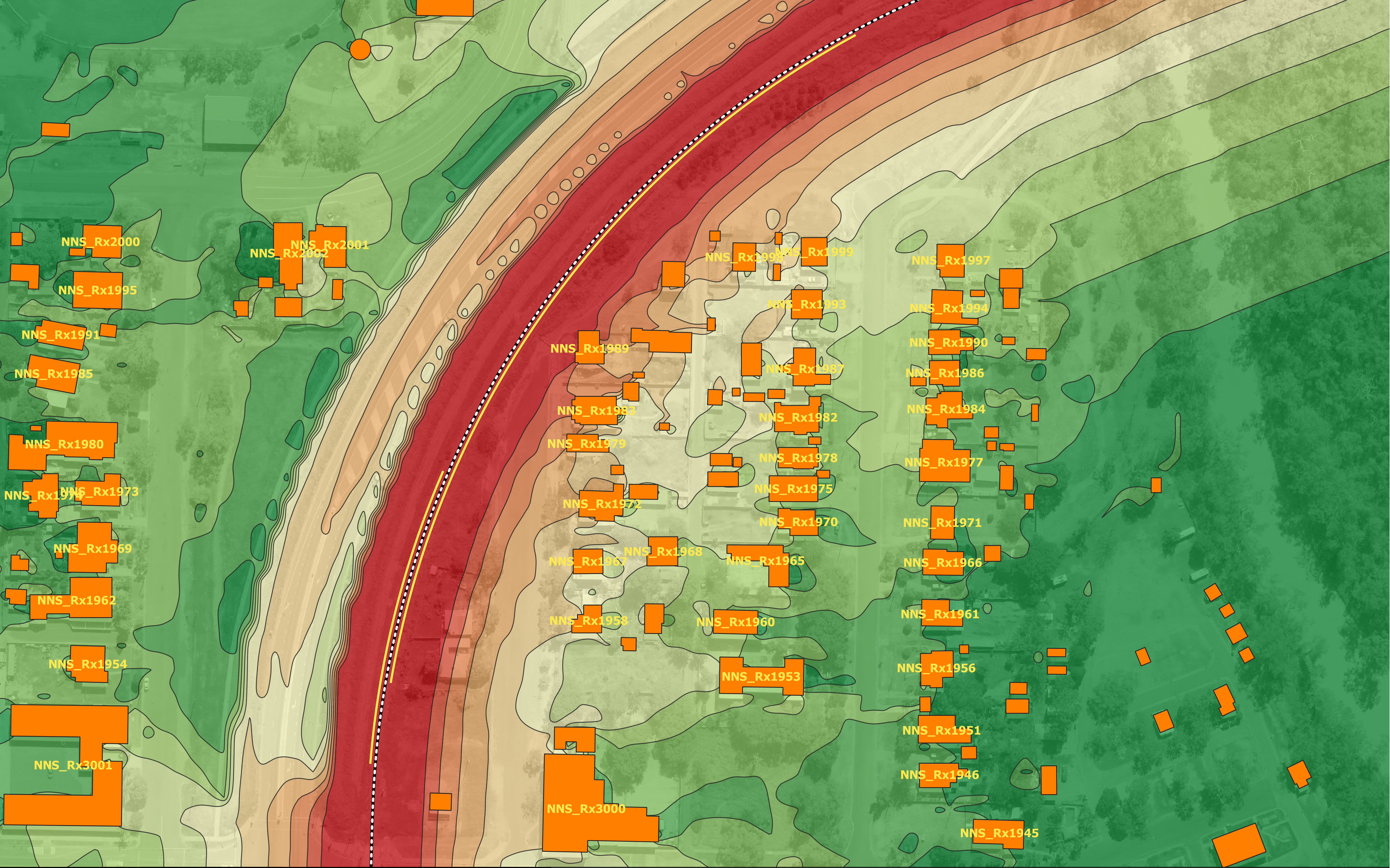
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 1m

Wagons

MOTT MACDONALD

IRDJV



Map: 1ML7	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

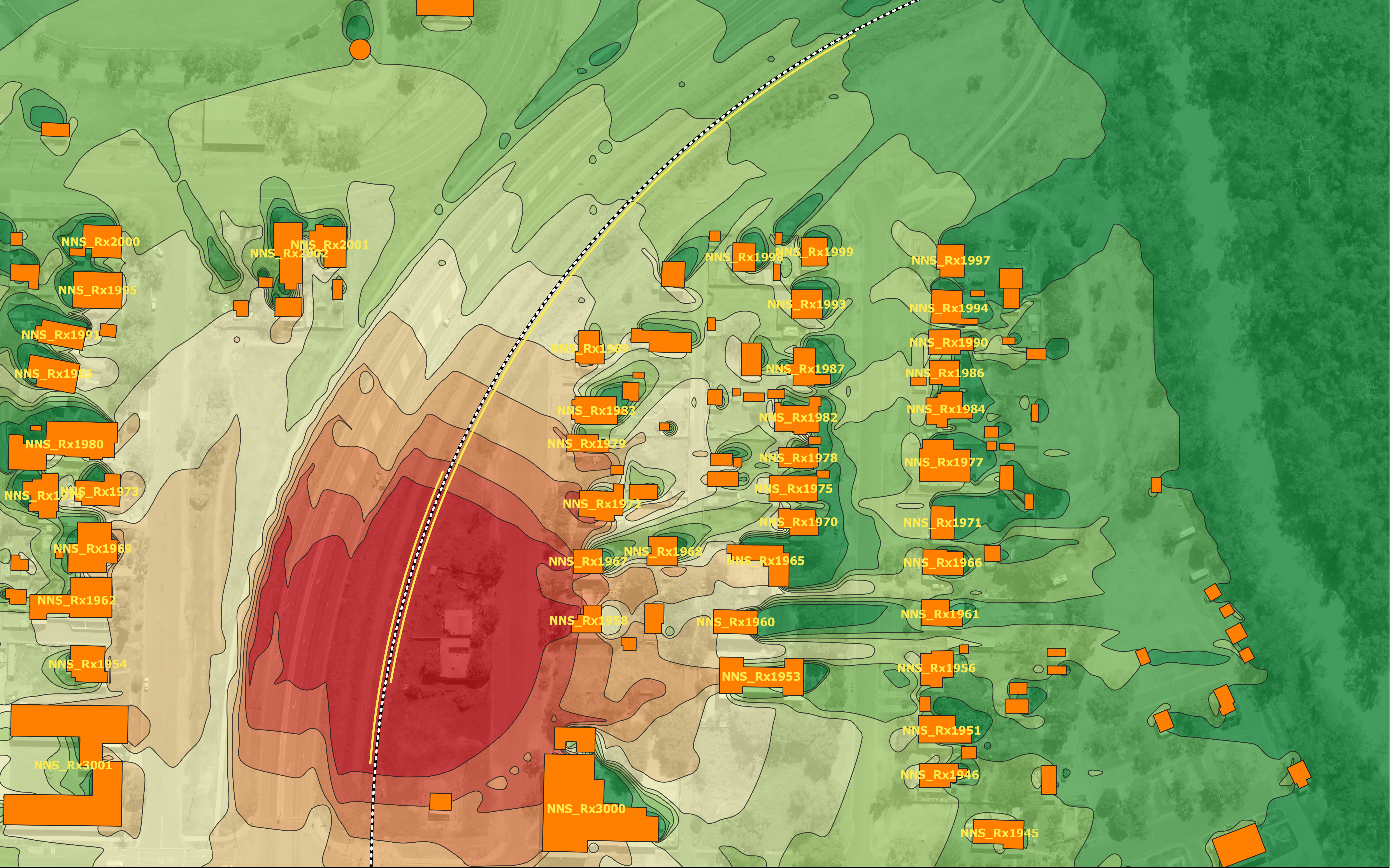
Legend
- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax
- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

Narrabri to North Star - Phase 2
Year 2040 Night - Barriers 1m
Locos

wsp MOTT MACDONALD

IRDJV



Map: 1MH8	Author: AV	
Date: 31/01/2024	Approved by: BI	

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

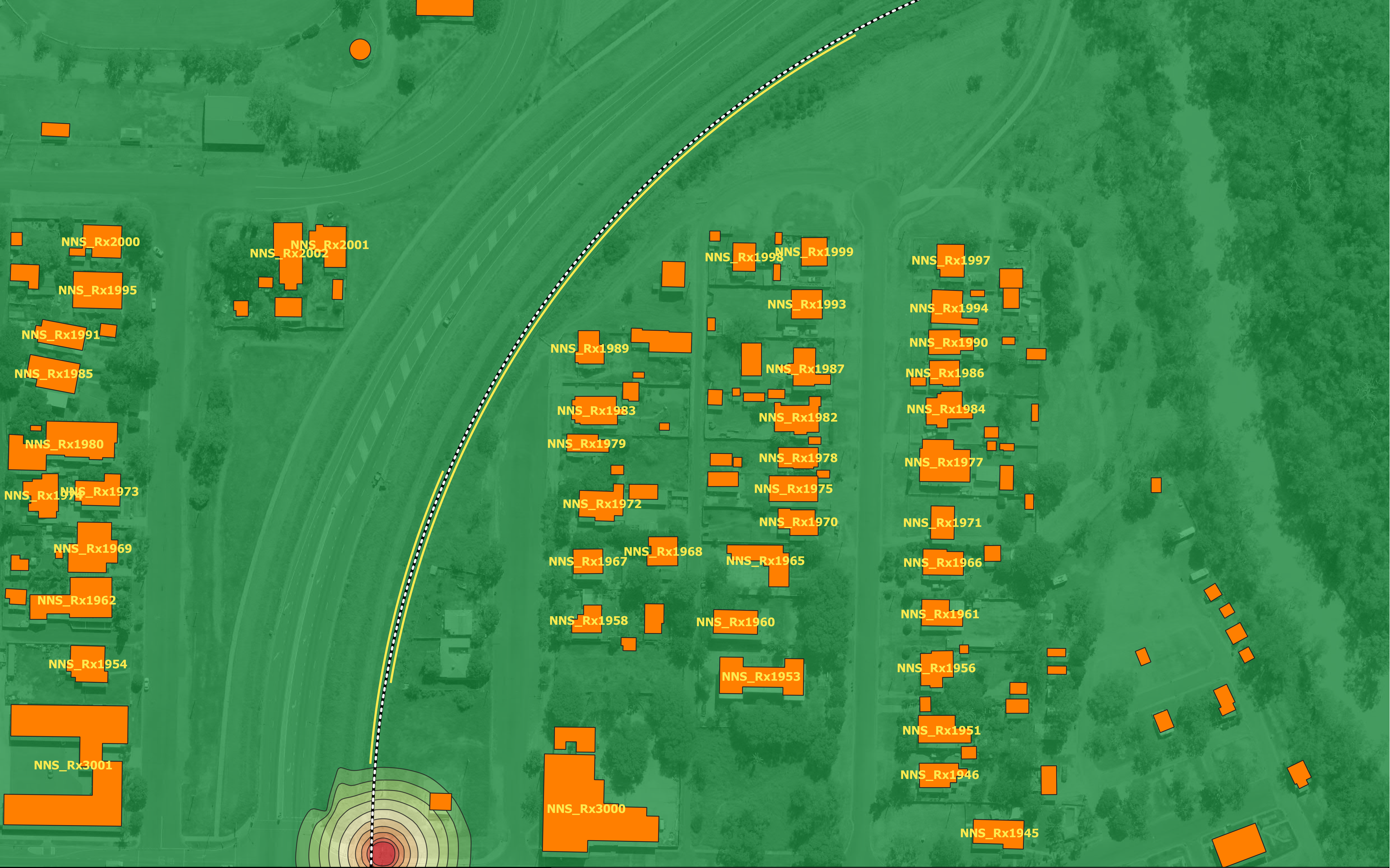
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 1m

Horns

MOTT MACDONALD

IRDJV



Map: 1MB9	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

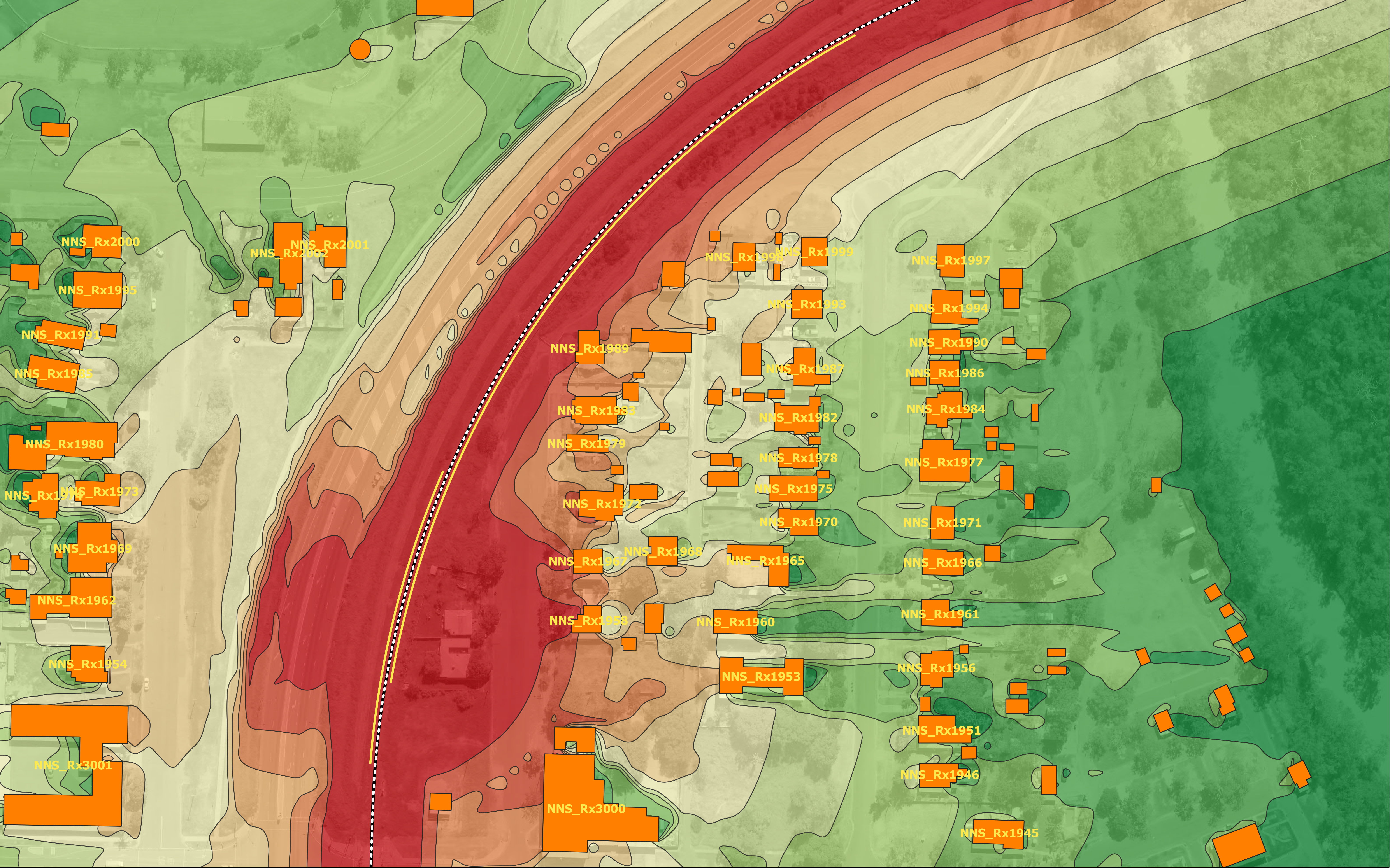
Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 1m

Bells

MOTT MACDONALD

IRDJV



Map: 1MA10	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

Narrabri to North Star - Phase 2

Year 2040 Night - Barriers 1m

All sources

MOTT MACDONALD

IRDJV

Map: ROW6	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

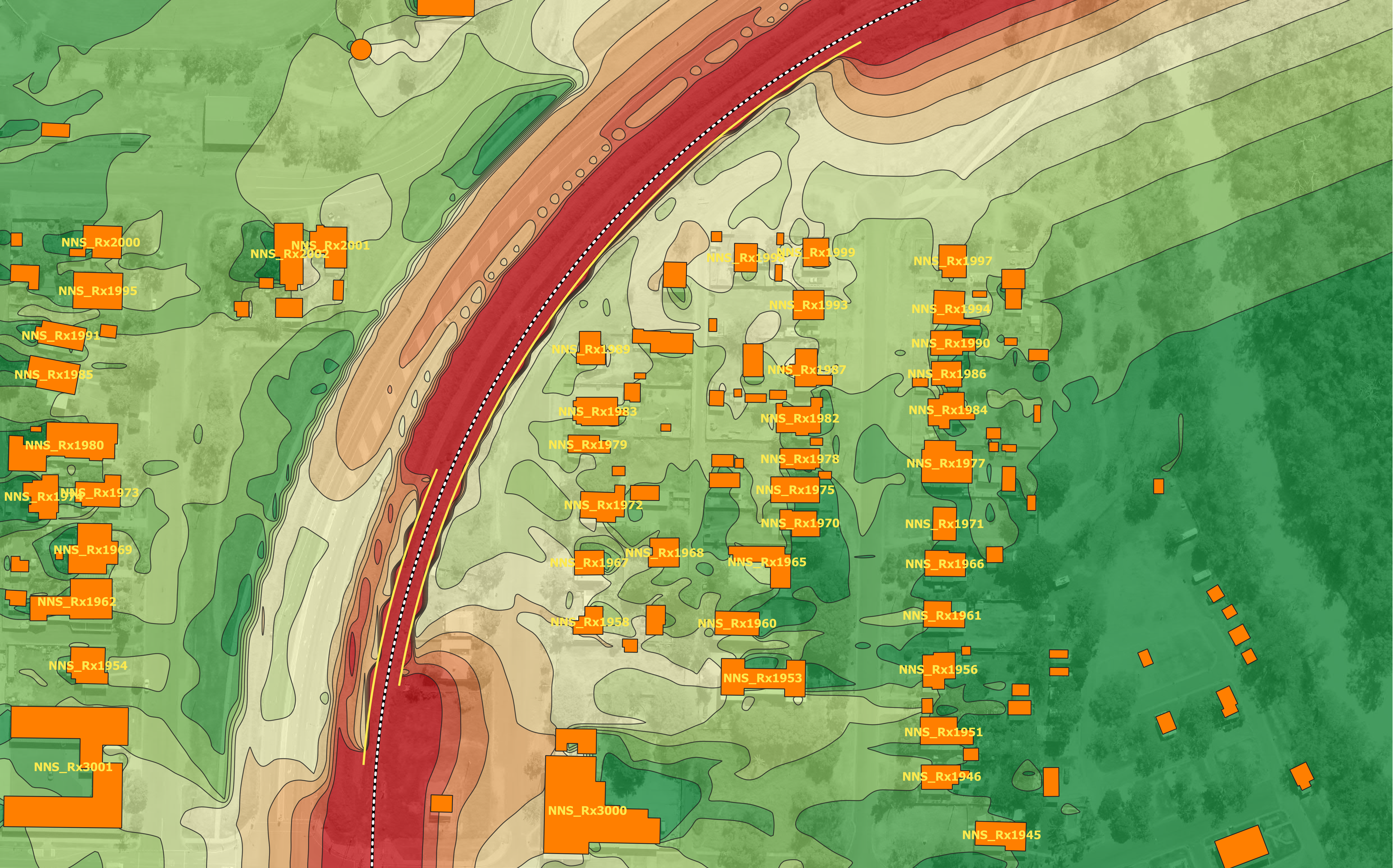
≤76	82 - 84	90 - 92
76 - 78	84 - 86	92 - 94
78 - 80	86 - 88	≥94
80 - 82	88 - 90	

Narrabri to North Star - Phase 2

Year 2040 Night - Barriers RING Wagons

MOTT MACDONALD

IRDJV



Map: ROL7	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

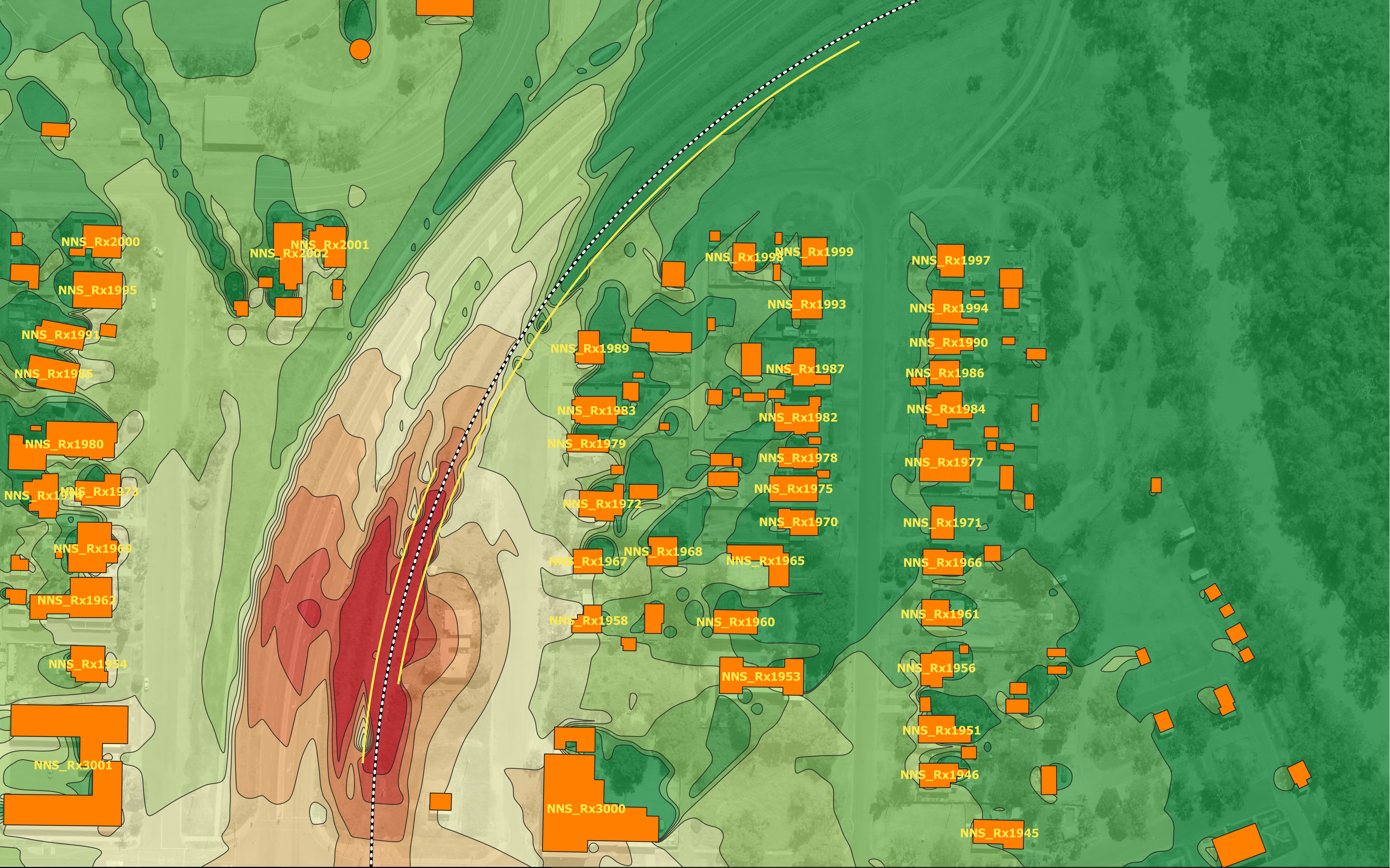
- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

Narrabri to North Star - Phase 2

Year 2040 Night - Barriers RING Locos

MOTT MACDONALD

IRDJV



Map: ROH8

Author: AV

Date: 31/01/2024

Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

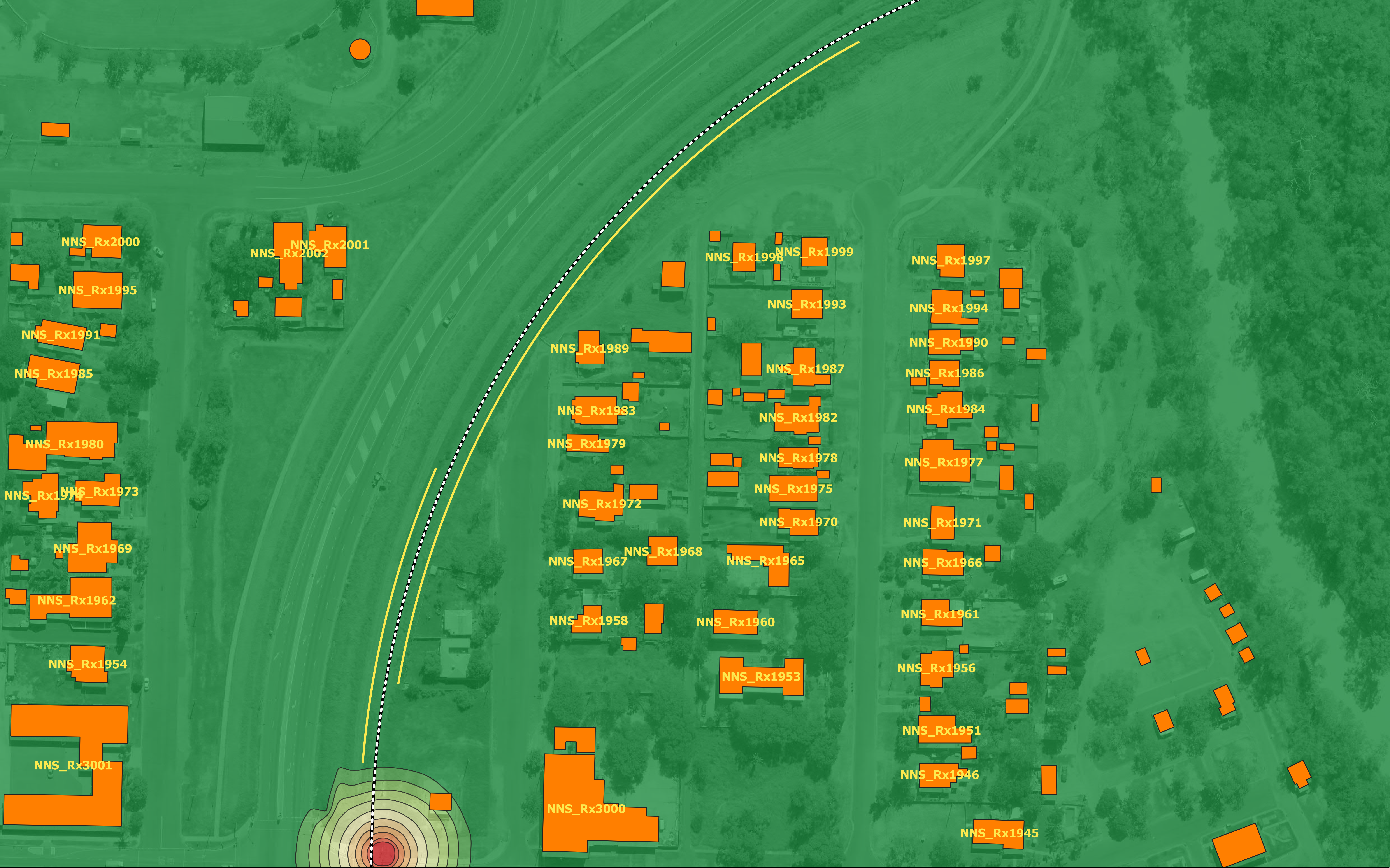
≤76	82 - 84	90 - 92
76 - 78	84 - 86	92 - 94
78 - 80	86 - 88	≥94
80 - 82	88 - 90	

Narrabri to North Star - Phase 2

Year 2040 Night - Barriers RING Horns

MOTT MACDONALD

IRDJV



Map: ROB9	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

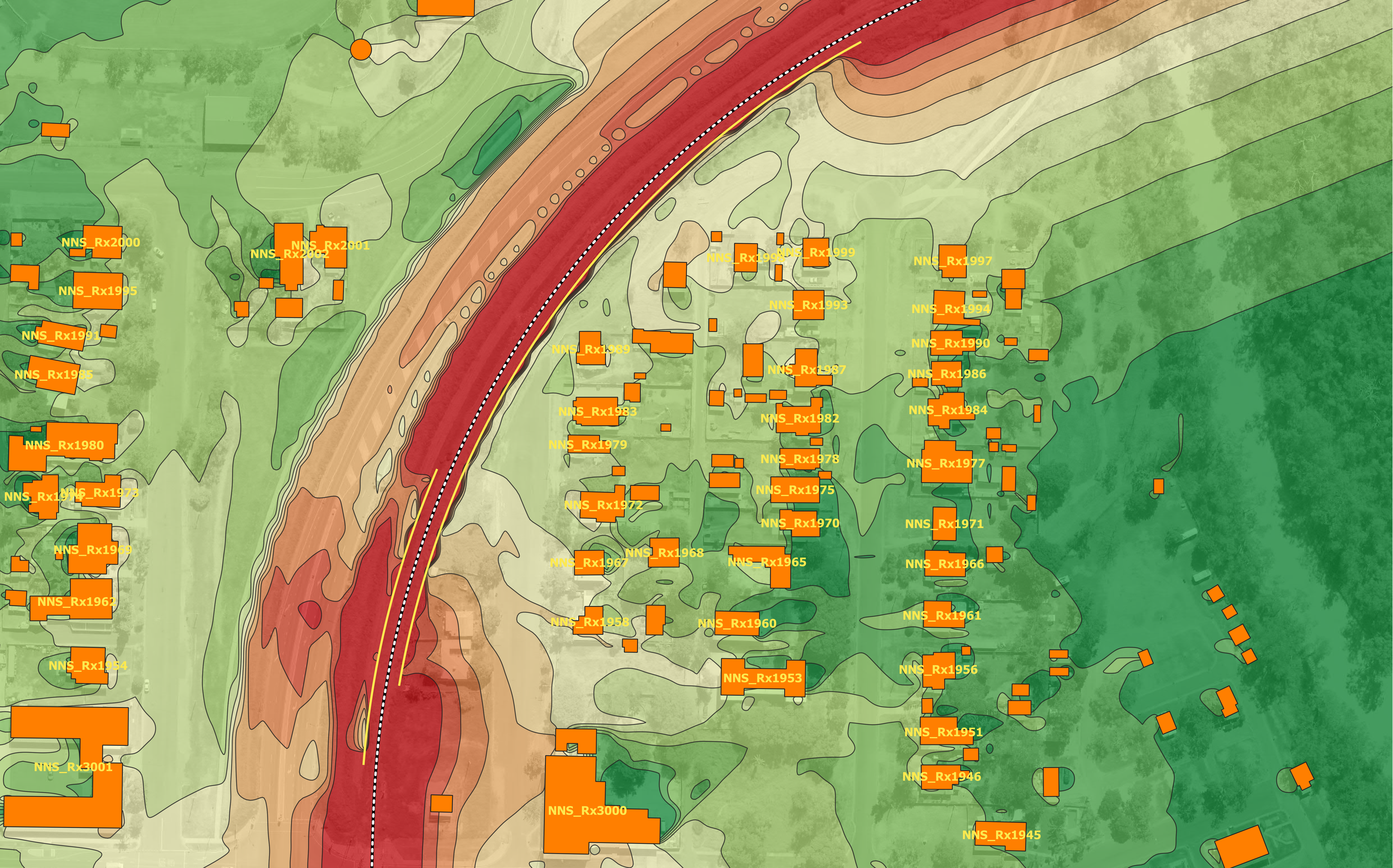
- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

Narrabri to North Star - Phase 2

Year 2040 Night - Barriers RING Bells

MOTT MACDONALD

IRDJV



Map: ROA10	Author: AV
Date: 31/01/2024	Approved by: BI

0 10 20 30 40 50 m

1:1,300 at A3

Coordinate system: GDA94. MGA Zone 55

Aerial imagery source: MetroMaps

Legend

- Building
- Rail alignment
- Noise mitigation

Noise level, dBA Lmax

- ≤76
- 76 - 78
- 78 - 80
- 80 - 82
- 82 - 84
- 84 - 86
- 86 - 88
- 88 - 90
- 90 - 92
- 92 - 94
- ≥94

Narrabri to North Star - Phase 2

Year 2040 Night - Barriers RING

All sources

MOTT MACDONALD

IRDJV