Noise Impact Assessment

Ralston Quarry
Mount Tenandra, NSW.

Prepared for: OzArk Environment & Heritage Management Pty Ltd
November 2019
MAC190964RP1

Muller Acoustic Consulting

Document Information

Noise Impact Assessment

Ralston Quarry

Mount Tenandra, NSW.

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Document ID	Status	Date	Prepared By	Signed	Reviewed By	Signed
MAC190964RP1	Draft	29 November 2019	Dale Redwood		Oliver Muller	

CONTENTS

1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by OzArk Environment & Heritage Management Pty Ltd (OzArk) on behalf of Groundwork Plus Pty Ltd (Groundwork Plus) to complete a Noise Impact Assessment (NIA) to quantify potential noise emissions associated with the proposed Ralston Quarry (the "Project"), located at Mount Tenandra in Central West, NSW.

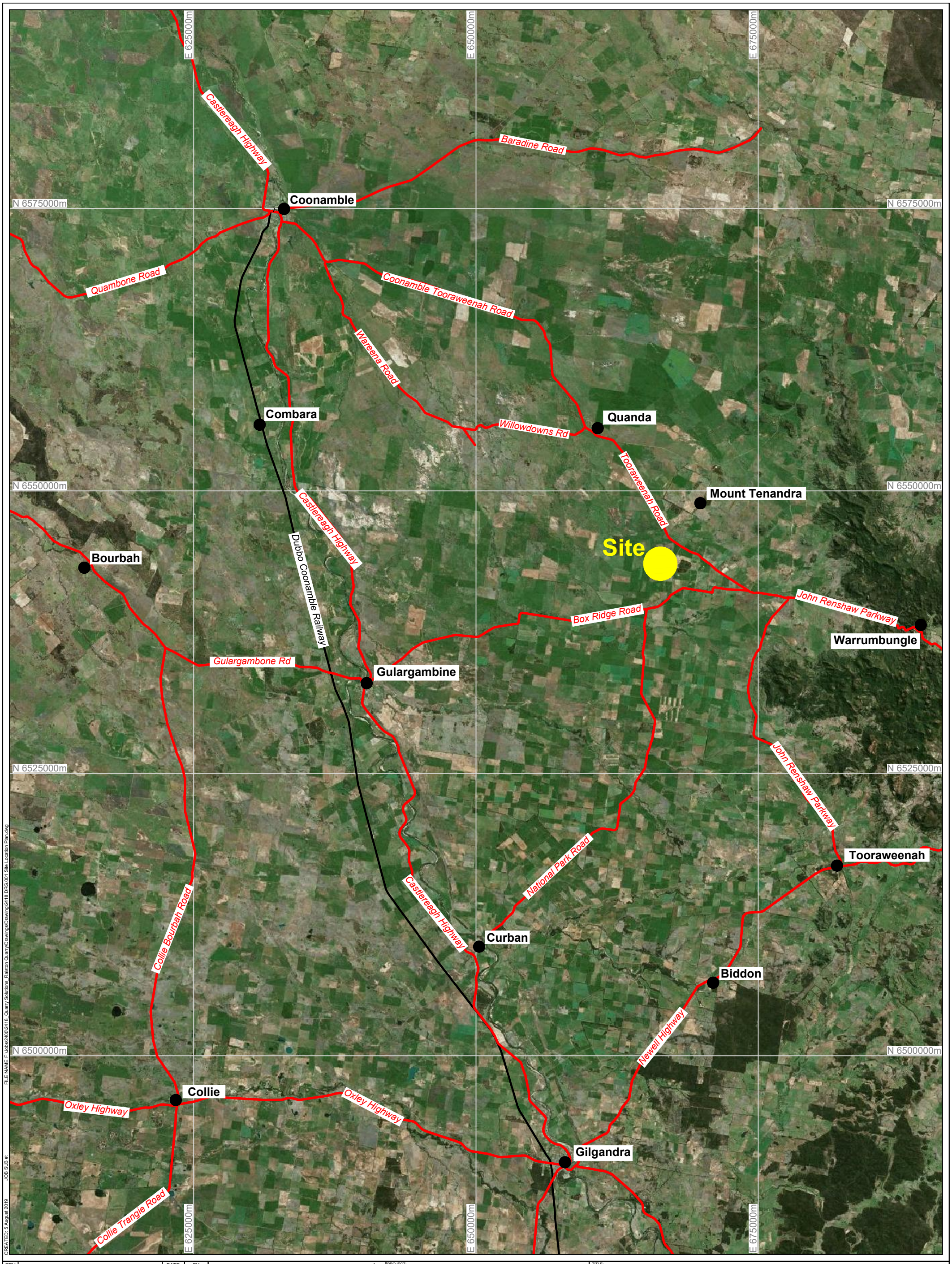
The Project is located at 4948 Tooraweenah Road, Mount Tenandra, formally identified as Lot 82 of DP820705, within the Coonamble Shire Council (CSC) local government area (LGA) of NSW. **Figure 1** (Groundwork Plus, 2019) provides a Locality Plan and **Figure 2** provides the Project Site.

The Project involves the development and operation of a new quarry on previously disturbed agricultural land to support the Inland Rail Project.

The NIA was completed to quantify potential acoustic impacts associated with the construction and operation of the Project on the surrounding community and will accompany the Statement of Environmental Effects (SoEE) that is being prepared to assess the proposed development. The NIA has been prepared in accordance with the following policies and guidelines:

- Environment Protection Authority's (EPA's), Noise Policy for Industry (NPI), 2017;
- NSW Department of Environment and Climate Change (DECC), Interim Construction Noise Guideline (ICNG), 2009;
- NSW Department of Environment, Climate Change and Water (DECCW), NSW Road Noise Policy (RNP), 2011;
- Australian Standard AS2187.2-2006 (AS2187.2) – Explosives-Storage and Use Part 2: Use of Explosives; and
- Australian and New Zealand Environment Conservation Council (ANZECC), 1990, Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A.**



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JOB SUB #:
CREATED: 5 August 2019

REV	DESCRIPTION	DATE	BY

Data Sources:
Photography: Digital Globe
Topography:
Cadastre:
Ecosystem:
Other: NSW Spatial Services

Legend:
- Project Site
- Population Centre
- State Existing Railway
- Roads

PROJECT: Ralston Quarry

CLIENT: Quarry Solutions Pty Ltd

TITLE: Figure 1 - Site Location Plan

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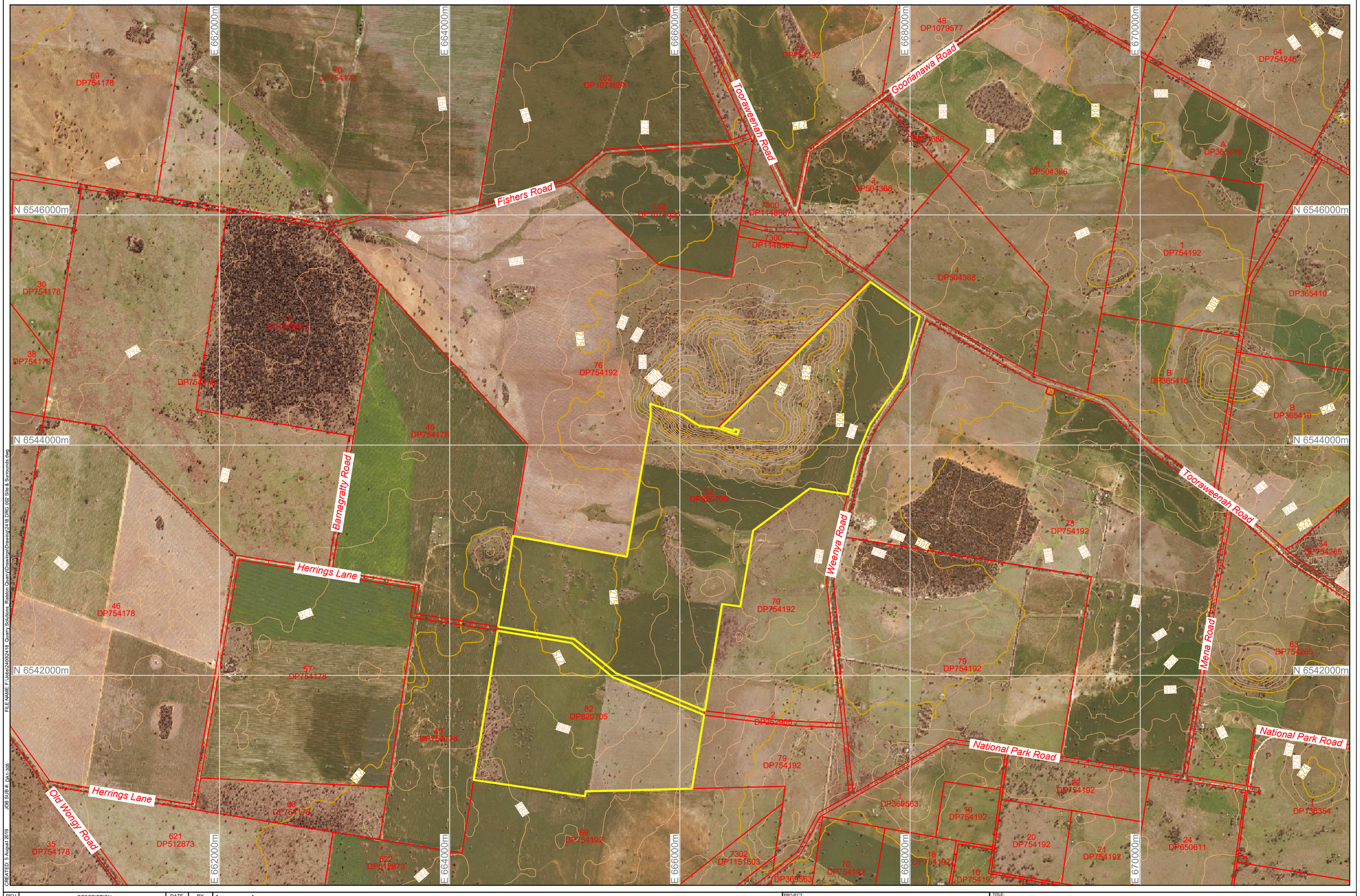
REVISION:
DATE: 5 August 2019 DRAWN: MRescar
PRINTED: 5 August 2019 CHECKED: JLawler
DATUM: HORIZONTAL / VERTICAL / ZONE MGA / / 55



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Cadastre: NSW Spatial Information Website
Ecosystem:
Other:

Legend:
- Cadastral Boundary
- Site Boundary
- Major Contour
- Minor Contour

PROJECT: Ralston Quarry

CLIENT: Quarry Solutions Pty Ltd

TITLE: Figure 2 - Site & Surrounds

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PRINTED: 5 August 2019 | CHECKED: JLawler
DATUM: HORIZONTAL / VERTICAL / ZONE: MGA / AHD / 55

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JOB SUB #: DA1-305
CREATED: 5 August 2019

1.1 Background

MAC understands that the Ralston Quarry is proposed to be operated in two (2) stages. Stage 1 includes the extraction of up to 490,000 tonnes of hard rock material per annum for a period of five (5) years as required to supply the Inland Rail Project. Stage 2 of the Project would reduce the operation to 100,000 tonnes of hard rock material per annum.

It is anticipated that the quarry footprint, including extraction, processing, stockpile and water management areas would be up to 28.56Ha with site access from Tooraweenah Road via Weenya Road. **Figure 3** provides the site layout identifying the Stage 1 and Stage 2 extraction areas, stockpiling and processing areas, and haulage route.

The quarry development will occur with the initial construction phase consisting of haul road improvements, establishment of erosion and sediment controls, clearing and grubbing of operational area and establishment of plant, equipment and infrastructure on site. To establish the operational area, MAC understands that drill and blast activity will be required to enable the establishment of the first bench. The duration of construction period mobilisation is three (3) to six (6) weeks.

1.2 Hours of Operation

Table 1 presents the proposed operating hours for the Project. The proposed hours and combination of activities for the Project have formed the basis of the noise modelling scenarios for this assessment.

Table 1 Hours of Operation

Operation	Monday to Friday[1]	Saturday[1]	Sunday
Extraction and Processing	6am to 6pm	6am to 1pm	N/A
Truck Dispatch	6am to 6pm	6am to 1pm	N/A
Blasting	9am to 3pm[2]	N/A	N/A

Note 1: Excludes public holidays which would operate as per the proposed hours of operation for Sunday.

Note 2: Two to three blasts per month.

Environmental Exclusion Zone Points Setout

Point #	Easting	Northing
1	666,471.953	6,543,103.795
2	666,504.749	6,543,097.835
3	666,582.912	6,542,947.759
4	666,565.575	6,542,850.669
5	666,487.611	6,542,850.669
6	666,486.690	6,542,939.957
7	666,481.488	6,542,973.765
8	666,466.752	6,543,005.839
9	666,459.817	6,543,044.848
10	666,458.950	6,543,075.188

E 666500m
E 667000m
N 6544000m
N 6543500m
N 6543000m
N 6542500m
Bench RL 320m
Bench RL 305m
Proposed Pit Floor RL 290m
274.46m
278.96m
Proposed Processing, Stockpiling and Extraction Area (Stage 2)
82 DP820705
Proposed Processing and Stockpiling (Stage 1)
40m
Proposed Pit Floor RL 281m
323.49m
421.65m
79 DP754192
Proposed Extraction Area (Stage 1)

Legend:
- Cadastral Boundary
- Site Boundary
- Access Road
- Major Contour
- Minor Contour
- Environmental Exclusion Zone
- Waterway

Site Area	- 682.35 ha
Proposed Extraction Footprint (Stage 1)	- 13.03 ha
Processing & Stockpiling Area (Stage 1)	- 5.47 ha
Proposed Processing, Stockpiling and Extraction Area (Stage 2)	- 7.65 ha

FILE NAME:F:\Jobs\2400\2418 Quarry Solutions Ralston Quarry\Drawings\Drawing\2418.DRG.004R2 Conceptual Quarry Development Plan.dwg
JOB SUB #:
CREATED: 15 November 2019

REV	DESCRIPTION	DATE	BY
1	Stage 2 added	06-Aug-19	MR
2	Stage 1 Proposed Extraction Area revised	14-Nov-19	MR

Data Sources:
Photography: Google Earth Image Capture 2018-Dec-01
Topography: DEM_LiDAR_1Sec SRTM_Extract 2019-Aug-02
Cadastre: NSW Spatial Information Website
Ecosystem:
Other:

PROJECT: Ralston Quarry
CLIENT: Quarry Solutions Pty Ltd
TITLE: Figure 3 - Conceptual Quarry Development Plan

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REVISION: 2
DATE: 15 November 2019
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PRINTED: 15 November 2019
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MGA / AHD / 55

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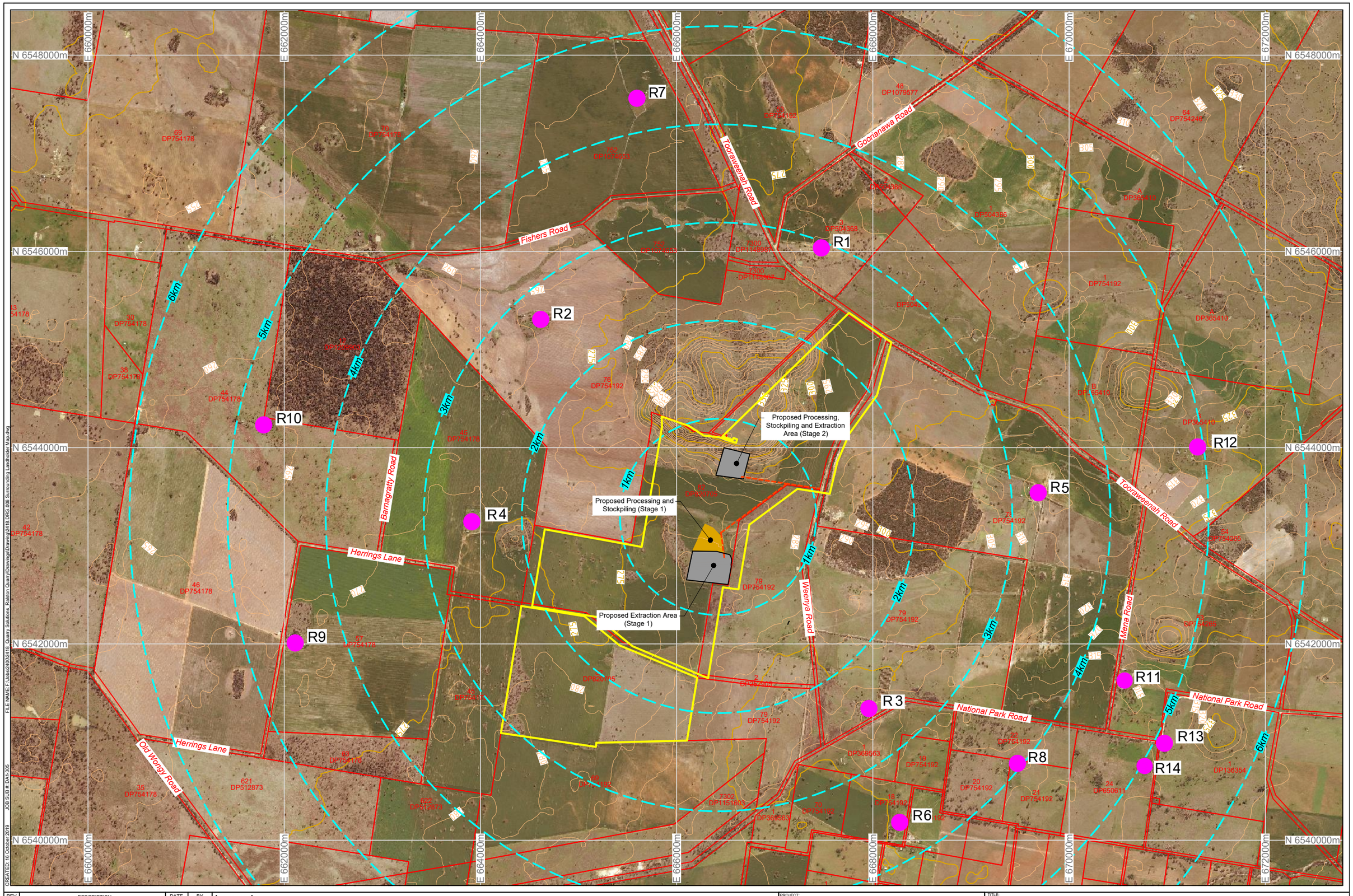
2 Receiver Review

The Project is situated at Mount Tenandra, a rural area in Central West NSW. Receivers in the locality are categorised as rural residential. The addresses and coordinates MGA(55) for the nearest potentially affected residential receivers to the Project are summarised in **Table 2** and shown on the Surrounding Land Holder Map in **Figure 4** (Groundwork Plus, 2019).

Table 2 Residential Receiver Locations

Receiver ID	MGA 55 Coordinates		Receiver Address	Approximate Distance to Project (km)
	Easting (m)	Northing (m)		
R1	667485	6546002	6 Goorianawa Road	2.2
R2	664656	6545305	4926 Tooraweenah Road	2.4
R3	667975	6541350	3063 National Park Road	2.5
R4	663867	6543145	Gulargambone Homestead	2.5
R5	669707	6543558	190 Weenya Road	3.0
R6	668258	6540168	4075 National Park Road	3.5
R7	665644	6547576	4656 Tooraweenah Road	3.8
R8	669472	6540779	4368 National Park Road	3.9
R9	662116	6542081	246 Herrings Lane	4.4
R10	661760	6544230	393 Fishers Road	4.8
R11	670544	6541555	191 Mena Road	4.5
R12	671371	6544000	5353 Tooraweenah Road	4.8
R13	670973	6540977	4524 National Park Road	5.1
R14	670814	6540764	4500 National Park Road	5.1



REV	DESCRIPTION	DATE	BY

Data Sources:
Photography: Google Earth Image Capture 2018-Dec-01
Topography: DEM_LiDAR_1Sec SRTM_Extract 2019-Aug-02
Cadastre: NSW Spatial Information Website
Ecosystem:
Other:

Legend:

- Cadastral Boundary
- Site Boundary
- Major Contour
- Minor Contour
- Receptors
- Extraction Boundary
- Proposed Processing and Stockpiling
- Access Road

PROJECT: Ralston Quarry

CLIENT: Quarry Solutions Pty Ltd

TITLE: Figure 4 - Surrounding Landholder Map

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PRINTED: 16 October 2019	CHECKED: JLawler	MGA / AHD / 55	

3 Noise and Blasting Policy and Guidelines

The following section summarises relevant policy and guidelines pertinent to undertaking a noise and blasting impact assessment for this type of project.

3.1 Interim Construction Noise Guideline

The assessment and management of noise from construction work is completed with reference to the Interim Construction Noise Guideline (ICNG). The ICNG is specifically aimed at managing noise from construction work regulated by the EPA and is used to assist in setting statutory conditions in licences or other regulatory instruments. The types of construction regulated by the EPA under the POEO Act (1997), include construction, maintenance and renewal activities carried out by a public authority, such as road upgrades as described in Schedule 1 of the POEO Act.

The ICNG provides two methodologies for the assessment of construction noise emissions:

- Quantitative, which is suited to major construction projects with typical durations of more than three weeks; or
- Qualitative, which is suited to short term infrastructure maintenance (for projects with a typical duration of less than three weeks).

Due to the nature of the proposed works, the quantitative method has been applied in this assessment. The quantitative method includes identification of potentially affected receptors, description of activities involved in the project, derivation of the construction noise management levels, quantification of potential noise impact at receptors and, provides management and mitigation recommendations.

3.1.1 Standard Hours for Construction

Table 3 summarises the ICNG recommended standard hours for construction activities where the noise from construction is audible at residential premises.

Table 3 Recommended Standard Hours for Construction

Period	Preferred Construction Hours
Day (Standard construction hours)	Monday to Friday - 7am to 6pm Saturdays - 8am to 1pm (only if required) Sundays or Public Holidays - No construction

The recommended hours do not apply in the event of direction from police, or other relevant authorities, for safety reasons or where required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm. Work conducted outside of standard hours are considered out of hours work (OOH). OOH periods are divided into two categories representing evening and night periods and cover the hours listed below:

Period 1 (evening/low risk period): Monday to Friday – 6pm to 10pm, Saturdays – 1pm to 6pm, Sundays – 8am to 6pm.

Period 2 (night/medium to high risk period): Monday to Friday – 10pm to 7am, Saturdays/Sundays – 6pm to 7am (8am on Sunday mornings).

Construction activities will generally be completed from Monday to Friday, with works on Saturday only as required. There are no out-of-hours construction work proposed for this Project.

3.1.2 Construction Noise Management Levels

Table 4 reproduces the ICNG management levels for residential receivers. The construction noise management levels are the sum of the management level and relevant rating background level (RBL) for each specific assessment period.

Table 4 Noise Management Levels

Time of Day	Management Level $LA_{eq,15min}$ [1]	How to Apply
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays.	Noise affected RBL + 10dB.	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq(15min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of work to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75dBA.	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account times identified by the community when they are less sensitive to noise (such as before and after school for work near schools, or mid-morning or mid-afternoon for work near residences; and if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours.	Noise affected RBL + 5dB.	A strong justification would typically be required for work outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dBA above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2.

Note 1: The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the construction noise management levels for noise assessment purposes and is the median of the ABL's.

3.2 Noise Policy for Industry

The EPA released the Noise Policy for Industry (NPI) in October 2017 which provides a process for establishing noise criteria for consents and licenses enabling the EPA to regulate noise emissions from scheduled premises under the Protection of the Environment Operations Act 1997.

The objectives of the NPI are to:

- provide noise criteria that is used to assess the change in both short term and long term noise levels;
- provide a clear and consistent framework for assessing environmental noise impacts from industrial premises and industrial development proposals;
- promote the use of best-practice noise mitigation measures that are feasible and reasonable where potential impacts have been identified; and
- support a process to guide the determination of achievable noise limits for planning approvals and/or licences, considering the matters that must be considered under the relevant legislation (such as the economic and social benefits and impacts of industrial development).

The policy sets out a process for industrial noise management involving the following key steps:

1. Determine the Project Noise Trigger Levels (PNTLs) (ie criteria) for a development. These are the levels (criteria), above which noise management measures are required to be considered. They are derived by considering two factors: shorter-term intrusiveness due to changes in the noise environment; and maintaining the noise amenity of an area.
2. Predict or measure the noise levels produced by the development with regard to the presence of annoying noise characteristics and meteorological effects such as temperature inversions and wind.
3. Compare the predicted or measured noise level with the PNTL, assessing impacts and the need for noise mitigation and management measures.
4. Consider residual noise impacts - that is, where noise levels exceed the PNTLs after the application of feasible and reasonable noise mitigation measures. This may involve balancing economic, social and environmental costs and benefits from the proposed development against the noise impacts, including consultation with the affected community where impacts are expected to be significant.

5. Set statutory compliance levels that reflect the best achievable and agreed noise limits for the development.

6. Monitor and report environmental noise levels from the development.

3.2.1 Project Noise Trigger Levels

The policy sets out the procedure to determine the PNTLs relevant to an industrial development. The PNTL is the lower (ie, the more stringent) of the **Project Intrusiveness Noise Level** (PINL) and **Project Amenity Noise Level** (PANL) determined in accordance with Section 2.3 and Section 2.4 of the NPI.

3.2.2 Project Intrusiveness Noise Level (PINL)

The PINL ($LA_{eq(15min)}$) is the RBL + 5dB and seeks to limit the degree of change a new noise source introduces to an existing environment. Hence, when assessing intrusiveness, background noise levels need to be measured.

For low noise environments, such as rural environments, minimum assumed RBLs apply within the NPI and can be adopted in lieu of completing background noise measurements. This is considered the most conservative method for establishing noise criteria for a project. These result in minimum intrusiveness noise levels as follows:

- Minimum Day RBL = 35dBA;
- Minimum Evening RBL = 30dBA; and
- Minimum Night RBL = 30dBA.

Due to the rural nature of the locality, the PINLs for the Project have been determined based on the minimum RBL+5dBA.

3.2.3 Project Amenity Noise Level (PANL)

The PANL is relevant to a specific land use or locality. To limit continuing increases in intrusiveness levels, the ambient noise level within an area from all combined industrial sources should remain below the recommended amenity noise levels specified in Table 2.2 (of the NPI). The NPI defines two categories of amenity noise levels:

- **Amenity Noise Levels (ANL)** – are determined considering all current and future industrial noise within a receiver area; and
- **Project Amenity Noise Level (PANL)** – is the recommended level for a receiver area, specifically focusing the project being assessed.

Additionally, Section 2.4 of the NPI states: "*to ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area, a project amenity noise level applies for each new source of industrial noise as follows*":

PANL for new industrial developments = recommended **ANL** minus 5dBA.

The following exceptions apply when deriving the PANL:

- areas with high traffic noise levels;
- proposed developments in major industrial clusters;
- existing industrial noise and cumulative industrial noise effects; and
- greenfield sites.

Furthermore, where the PANL is applicable and can be satisfied, the assessment of cumulative industrial noise is not required.

The recommended amenity noise levels as per Table 2.2 of the NPI are reproduced in **Table 5**.

Table 5 Amenity Criteria

Receiver Type	Noise Amenity Area	Time of day	Recommended amenity noise level dB $LA_{eq(period)}$
Residence	Rural	Day	50
		Evening	45
		Night	40

Notes: The recommended amenity noise levels refer only to noise from industrial noise sources. However, they refer to noise from all such sources at the receiver location, and not only noise due to a specific project under consideration. The levels represent outdoor levels except where otherwise stated.

Types of receivers are defined as rural residential; suburban residential; urban residential; industrial interface; commercial; industrial – see Table 2.3 and Section 2.7.

Time of day is defined as follows: (These periods may be varied where appropriate, for example, see A3 in Fact Sheet A.)

• day – the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays.

• evening – the period from 6pm to 10pm.

• night – the remaining periods.

3.2.4 Maximum Noise Level Assessment

The potential for sleep disturbance from maximum noise level events from a project during the night-time period needs to be considered. The NPI considers sleep disturbance to be both awakenings and disturbance to sleep stages.

Where night-time noise levels from a development/premises at a residential location exceed the following criteria, a detailed maximum noise level event assessment should be undertaken:

- $L_{Aeq(15min)}$ 40dB or the prevailing RBL plus 5dBA, whichever is the greater, and/or
- L_{Amax} 52dB or the prevailing RBL plus 15dBA, whichever is the greater,

a detailed maximum noise level event assessment should be undertaken.

A detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period.

Other factors that may be important in assessing the impacts on sleep disturbance include:

- how often the events would occur;
- the distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the development;
- whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods); and
- current understanding of effects of maximum noise level events at night.

3.3 Road Noise Policy

The road traffic noise criteria are provided in the Department of Environment, Climate Change and Water NSW (DECCW), Road Noise Policy (RNP), 2011. The policy sets out noise criteria that provide for a degree of amenity appropriate for the land use and road category.

For some industries such as mines and extractive industries, that are not served by arterial roads, a principal haulage route may be identified. The RNP indicates that where local authorities identify a 'principal haulage route', the noise criteria for the route should match those for arterial/sub-arterial roads, recognising that they carry a different level and mix of traffic to local roads.

3.4 ANZECC Blasting Guidelines

Noise and vibration levels from blasting are assessable against criteria established in the Australian and New Zealand Environment Conservation Council (ANZECC) – Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration. The blasting limits are generally consistent with the guideline levels contained within AS2187:2006 Part 2 – Explosives - Storage and Usage – Part 2. Where compliance is achieved, the risk of human annoyance is minimised.

Furthermore, for damage induced vibration, German Standard DIN 4150 - Part 3: 1999 provides the strictest guideline levels of vibration velocity for evaluating the effects of vibration in structures. Blasting and vibration induced damage criteria relevant to this assessment are presented in detail in Section 4.4.

The guidelines recommend that blasting should generally be permitted during the hours of 9am to 5pm Monday to Saturday only. Blasting should not occur on Sundays or Public Holidays. Furthermore, blasting should generally take place no more than once per day.

4 Assessment Criteria

The following sections summarise the relevant noise and blasting criteria for this type of project.

4.1 Construction Noise Management Levels

Noise Management Levels (NMLs) for construction activities for all residential receivers are 45dB $LA_{eq(15min)}$ (RBL +10dB). Construction activities are planned for standard hours, however the relevant NML standard construction hours and out of hours periods are summarised in **Table 6**.

Table 6 Construction Noise Management Levels

Location	Assessment Period	RBL dBA	NML dB $LA_{eq(15min)}$
All Residential Receivers	Day (Standard Hours)	35	45 (RBL+10dBA)
	Evening (OOH Period 1)	30	35 (RBL+5dBA)
	Night (OOH Period 2)	30	35 (RBL+5dBA)

4.2 Operational Noise Criteria

4.2.1 Project Intrusiveness Noise Levels

The PINLs for the Project are presented in **Table 7** and have been determined based on the RBL +5dBA.

Table 7 Intrusiveness Noise Levels

Receiver Type	Period[1]	Adopted RBL[2] dB LA_{90}	PINL dB $LA_{eq(15min)}$
Residential	Morning Shoulder	30	35
	Day	35	40

Note 1: Morning Shoulder – the period from 6am to 7am Monday to Saturday; Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays.

Note 2: Minimum RBLs adopted.

4.2.2 Project Amenity Noise Levels

The PANLs for residential receivers potentially affected by the Project are presented in **Table 8**.

Table 8 Project Amenity Noise Levels

Receiver Type	Noise Amenity Area	Assessment Period[1]	Recommended ANL dB $LA_{eq(period)}$[2]	PANL dB $LA_{eq(15min)}$[4]
Residential Receivers	Rural	Night/ Morning Shoulder	40	43
		Day	50	53

Note 1: Morning Shoulder – the period from 6am to 7am Monday to Saturday; Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays.

Note 2: Recommended amenity noise levels as per Table 2.2 of the NPI.

Note 3: Includes a +3dB adjustment to the amenity period level to convert to a 15-minute assessment period as per Section 2.2 of the NPI.

4.2.3 Project Noise Trigger Levels

The PNTLs are the lower of either the PINL or the PANL. **Table 9** presents the derivation of the PNTL in accordance with the methodologies outlined in the NPI.

Table 9 Project Noise Trigger Levels

Receiver Type	Period	RBL	PINL dB $LA_{eq(15min)}$	PANL dB $LA_{eq(15min)}$	PNTL dB $LA_{eq(15min)}$
Residential	Morning Shoulder	30	35	38	**35**
	Day	35	40	48	**40**

Note 1: Morning Shoulder – the period from 6am to 7am Monday to Saturday; Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays.

4.2.4 Maximum Noise Level Criteria

The maximum noise level screening criteria shown in **Table 10** is based on night-time RBLs and trigger values as per Section 2.5 of the NPI.

Table 10 Maximum Noise Level Assessment Screening Criteria

Residential Receivers			
$LA_{eq(15min)}$		LA_{max}	
40dB $LA_{eq(15min)}$ or RBL + 5dB		52dB LA_{max} or RBL + 15dB	
Trigger	40	Trigger	52
RBL 30+5dB	35	RBL 30+15dB	45
Highest	**40**	**Highest**	**52**

Note 1: As per Section 2.5 of the NPI, the highest of each metric are adopted as the screening criteria.

4.3 Road Traffic Noise Criteria

In accordance with the RNP, this assessment has adopted the 'Freeway/arterial/sub-arterial road' category for the designated inbound and outbound transport routes, consistent with the classification of the haulage route as a 'principal haulage route'. Table 11 reproduces the road traffic noise assessment criteria relevant for this road type.

Table 11 Road Traffic Noise Assessment Criteria for Residential Land Uses

Road category	Type of Project/development	Assessment Criteria - dB(A)	
		Day (7am to 10pm)	Night (10pm to 7am)
Freeway/arterial/sub-arterial road	Existing residences affected by additional traffic on existing freeways/sub-arterial/roads generated by land use developments	60dB(A) $L_{Aeq(15hr)}$	55dB(A) $L_{Aeq(9hr)}$

Note: For road noise assessments, the day period is from 7am to 10pm (ie there is no evening assessment period as there is with operational noise). Night is from 10pm to 7am.

Additionally, the RNP states where existing road traffic noise criteria are already exceeded, any additional increase in total traffic noise level should be limited to 2dB, which is generally accepted as the threshold of perceptibility to a change in noise level.

4.3.1 Relative Increase Criteria

In addition to meeting the assessment criteria, any significant increase in total traffic noise at receivers must be considered. Receivers experiencing increases in total traffic noise levels above those presented in Table 12 due to the addition of Project vehicles on Box Ridge Road and Tooraweenah Road should be considered for mitigation.

Table 12 Increase Criteria for Residential Land Uses

Road Category	Type of Project/Development	Total Traffic Noise Level Increase, dB(A)	
		Day (7am to 10pm)	Night (10pm to 7am)
Freeway/arterial/sub-arterial roads and transitways	New road corridor/redevelopment of existing road/land use development with the potential to generate additional traffic on existing road.	Existing traffic $L_{Aeq(15hr)}$ +12dB (external)	Existing traffic $L_{Aeq(9hr)}$ +12dB (external)

4.4 ANZECC Guideline Blasting Limits

The ANZECC blasting limits for air-blast overpressure and ground vibration are presented in **Table 13**

Table 13 ANZECC Guideline Blasting Limits

	Overpressure dB (Linear Peak)	Ground Vibration PPV (mm/s)
Recommended Maximum (95% of all blasts)	115	5
Level not to be exceeded	120	10
Long term goal for ground vibration	N/A	2

5 Noise Assessment Methodology

A computer model was developed to quantify Project noise emissions to neighbouring receivers for typical construction activities and operations. DGMR (iNoise, Version 2019.1) noise modelling software was used to quantify noise emissions from typical construction activities and operations. iNoise is a new intuitive and quality assured software for industrial noise calculations in the environment. 3D noise modelling is considered industry best practice for assessing noise emissions from projects.

The model incorporated a three-dimensional digital terrain map giving all relevant topographic information used in the modelling process. Additionally, the model uses relevant noise source data, ground type, attenuation from barrier or buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers.

The model calculation method used to predict noise levels was in accordance with ISO 9613-1 'Acoustics - Attenuation of sound during propagation outdoors. Part 1: Calculation of the absorption of sound by the atmosphere' and ISO 9613-2 'Acoustics - Attenuation of sound during propagation outdoors. Part 2: General method of calculation'. The ISO 9613 standard from 1996 is the most used noise prediction method worldwide. Many countries refer to ISO 9613 in their noise legislation. However, the ISO 9613 standard does not contain guidelines for quality assured software implementation, which leads to differences between applications in calculated results. In 2015 this changed with the release of ISO/TR 17534-3. This quality standard gives clear recommendations for interpreting the ISO 9613 method. iNoise fully supports these recommendations. The models and results for the 19 test cases are included in the software.

5.1 Construction Noise Modelling Parameters

Quarry development will occur with the initial construction phase consisting of haul road improvements, establishment of erosion and sediment controls, operational area cleared and grubbed, plant and equipment and infrastructure established on site. To establish the operational area of the quarry, drill and blast activity will be required on the surface to enable to establishment of the first bench. Once the first bench is established, the quarry is considered to be in operation phase.

Construction activities are typically considered to be progressive and will occur at several different locations simultaneously. Noise emissions were modelled for the following three scenarios:

- Scenario 1 - Haul road upgrade works;
- Scenario 2 - Clearing and grubbing of operational area; and
- Scenario 3 - Establishment of first quarry bench.

Noise emission data and assumptions used in this assessment are summarised in Table 14. The duration of the construction period mobilisation will be three to six weeks and will be undertaken during recommended standard construction periods. It is noted that the construction phase noise model assumed all plant operating at peak capacity for 100 per cent of the assessment period. It is therefore considered that the predicted noise levels represent worst-case operating conditions.

Table 14 Construction Equipment Sound Power Levels, Lw dBA re 10^{-12} W

Noise Source/Item	Utilisation %[1]	Muffler/Silencer	Lw/ Item
Scenario 1 - Haul Road Improvement Works			
Grader	10%	Yes	108
Roller (Smooth Drum)	70%	Yes	108
Water Cart	15%	Yes	101
Total – Haul Road Works			111
Scenario 2 - Clearing and Grubbing of Operational Area			
Bulldozer	70%	Yes	110
Grader	10%	Yes	108
Water Cart	15%	Yes	101
Total – Clearing and Grubbing			112
Scenario 3 - Establishment of Quarry Bench			
Drill	8%	No	114
Bulldozer	70%	Yes	110
Excavator	75%	Yes	106
Haul Truck (Moxy)	75%	Yes	108
Total – Quarry Bench			117

Note 1: Utilisation is usage over a typical working day, modelling assumed 100% utilisation of plant within a fifteen-minute period.

5.2 Operational Noise Modelling Parameters

The model incorporated three-dimensional digitised ground contours for the fixed plant and surrounding area, as derived from proposed Project plans superimposed onto the surrounding land base topography. Where relevant, modifying factors in accordance with Fact Sheet C of the NPI have been applied to calculations.

5.2.1 Meteorological Analysis

Noise emissions from industry can be significantly affected by prevailing weather conditions. Wind has the potential to increase noise at a receiver when it is at low velocities and travels from the direction of the noise source. As the strength of the wind increases, the noise produced by the wind will mask the audibility of most industrial sources.

Meteorological conditions that enhance received noise levels include source to receiver winds and the presence of temperature inversions. To account for potential enhancements, the NPI specifies that the source to the receiver wind component speeds up to 3m/s for 30% or more of the time in any seasonal period (i.e. day, evening or night), is considered to be a feature wind and predictions must incorporate these conditions.

To determine the prevailing conditions for the Project, weather data during the period November 2017 to November 2019 was obtained from the Bureau of Meteorology's (BOM) Coonamble Airport weather station located approximately 45km north west of the Project. The data was analysed using the EPA's Noise Enhancement Wind Analysis (NEWA) program in order to determine the frequency of occurrence of winds speeds up to 3m/s in each seasonal period.

Table 15 summarises the results of the wind analysis and includes the dominant wind direction and percentage occurrence during each season for each assessment period. The results of the detailed analysis of meteorological data is presented in Appendix B.

Table 15 Seasonal Frequency of Occurrence Wind Speed Intervals			
Season	Period[1]	Wind Direction ±(45°)	% Wind Speeds (m/s)
			0.5 to 3 m/s
Summer	Day	NE, ENE, E, SE	6
	Evening	NE	13
	Night	E	16
Autumn	Day	NE	11
	Evening	S	20
	Night	ESE	28
Winter	Day	SSW	12
	Evening	SSW, SW	20
	Night	ESE	24
Spring	Day	NNW – SE, S – SW	5
	Evening	S, SE	15
	Night	SSE	21

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

Based on the results of this analysis, prevailing winds are not applicable for the assessment and the relevant meteorological conditions adopted are summarised in Table 16.

Table 16 Modelled Site-Specific Meteorological Parameters				
Assessment Condition	Temperature	Wind Speed / Direction	Relative Humidity	Stability Class
Daytime[1] - Calm	20°C	n/a	60%	n/a
Morning Shoulder[2] - Inversion	10°C	n/a	90%	F

Note 1: Daytime 7am to 6pm.

Note 2: Morning Shoulder 6am to 7am.

5.2.2 Operational Noise Modelling Scenarios

The Ralston quarry is proposed to be operated in two stages. Stage 1 includes the extraction of up to 490,000 tonnes of hard rock material per annum for a period of five years. Stage 2 of the Project will reduce the operation to 100,000 tonnes per annum. The proposed extraction area for Stage 1 and Stage 2 are provided in Figure 3.

One modelling scenario was assessed for each of the two operational stages to represent typical operational noise emissions. The scenario is summarised as:

- Quarrying of hard rock material by drilling and blasting;
- Quarried rock loaded by excavator from the quarry floor/bench to haul trucks for delivery to the processing and stockpiling area;
- Quarried rock loaded by front end loader to the primary (jaw) crusher;
- Further mineral processing through secondary crusher and screen; and
- Processed aggregate will be loaded into road trucks for transportation offsite via the access road east to Weenya Road.

Mobile plant noise emission data used in modelling for this assessment were obtained from the MAC database. The noise emission levels used in modelling are summarised in **Table 17**.

Table 17 Construction Equipment Sound Power Levels, Lw dBA re 10^{-12} W

Noise Source/Item	Location on Site	Utilisation %[1]	Muffler/Silencer	Lw/ Item
Drill Rig	Extraction Area	8%	No	114
Excavator		75%	Yes	106
Mine Haul Truck	Extraction, Processing and Haul Roads	75%	Yes	112
Front End Loader	Processing Area	75%	Yes	106
Jaw Crusher		75%	Yes	114
Secondary Crusher		75%	Yes	114
Screen		75%	Yes	
Genset		75%	Yes	99
Water Cart	All Disturbed Areas	15%	Yes	101
Road Truck	Processing and Access Road	75%	Yes	102
Sleep Disturbance Assessment (L_{Amax})				
Loading Aggregate into Standard Road Truck	Processing Area	N/A	N/A	**117**

Note 1: Utilisation is usage over a typical working day, modelling assumed 100% utilisation of plant within a fifteen-minute period.

It is noted that the noise predictions assumed all plant operating at peak capacity for the entirety of the assessment period. Noise sources were modelled at the most exposed locations for each operational scenario. It is therefore considered that the noise predictions represent the worst-case operational scenarios.

5.3 Road Noise Assessment Methodology

Extracted material would typically be transported from the Project using truck and dog configuration trucks or similar. Once loaded within the Processing and Stockpile Area, trucks would exit the Project via the quarry access road onto to Weenya Road to the east before turning on to Tooraweenah Road to the north or Box Ridge Road to the south.

It is anticipated that that proportion of trucks travelling along Tooraweenah Road and Box Ridge Road would be equal. The haul route would terminate at the inland rail corridor to the west of the Project site.

The closest offset distance to receivers along Weenya Road is approximately 600m from the centreline. Minimum offset distances to residences on Box Ridge Road and Tooraweenah Road are approximately 1,200m and 350m respectively.

Project trucks would transport an average of 9,300t of material per week with approximately 43 laden trucks per day. During periods of peak demand, it is anticipated that up to 5,000t of material will be transported per day, with up to 132 laden trucks exiting the quarry per day.

The United States (US) Environment Protection Agency's road traffic calculation method was used to predict the L_{Aeq} noise levels from Project related trucks travelling past existing receivers on Weenya Road, Box Ridge Road and Tooraweenah Road. This method is an internationally accepted theoretical traffic noise prediction model and is ideal for calculating road traffic noise where relatively small traffic flows are encountered.

5.4 Blasting and Vibration Assessment Methodology

5.4.1 Air-Blast Overpressure

Calculation of overpressure has been completed using the following AS2187.2 equation:

$$\mathrm{P} = K_a \left(\frac{R}{(Q^{1/3})} \right)^a$$

Where:

P = Pressure, in kilopascals;

Q = Effective explosives charge mass, in kilograms (MIC);

R = Distance from charge, in metres;

K_a = Site constant, a conservative value of 25 was adopted; and

a = Site exponent, a value of -1.45 was adopted.

The conversion of 'P' to unweighted decibels (dBZ) is completed using the following formula:

$$\mathrm{SPL} = 10\ x \log \left(\frac{P}{P_0} \right)^2$$

5.4.2 Ground-Borne Vibration

Preliminary estimations for vibration have been completed using the following AS2187.2 equation:

$$\mathrm{V} = K_g \left(\frac{R}{(Q^{1/2})} \right)^{-B}$$

Where:

V = ground vibration as vector peak particle velocity, in mm/s;

R = distance between charge and point of measurement, in m;

Q = maximum instantaneous charge (effective charge mass per delay), in kg;

K_g = a constant related to site and rock properties for estimation purposes, a value of 1140 was adopted as per AS2187.2 to predict the 50% chance of exceedance in "average conditions"; and

B = a constant related to site and rock properties for estimation purposes, a value of 1.6 was adopted.

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6 Noise Modelling Results and Discussion

6.1 Construction Phase Noise Results

Predicted noise levels for each of the construction scenarios described in Section 5.1 are provided in Table 18. The results of the analysis show that noise emissions from each of the construction scenarios are predicted to satisfy the relevant noise management levels at all receiver locations.

Table 18 Combined Noise Predictions – Construction Scenarios

Residential Receivers						
Receiver	Predicted Noise Level dB $LA_{eq(15min)}$			NML dB $LA_{eq(15min)}$		Compliant
	Scenario 1	Scenario 2	Scenario 3	Day	OOH	
R1	<30	<30	<30	45	35	✓
R2	<30	<30	32	45	35	✓
R3	<30	<30	34	45	35	✓
R4	<30	<30	35	45	35	✓
R5	<30	<30	30	45	35	✓
R6	<30	<30	<30	45	35	✓
R7	<30	<30	<30	45	35	✓
R8	<30	<30	<30	45	35	✓
R9	<30	<30	<30	45	35	✓
R10	<30	<30	<30	45	35	✓
R11	<30	<30	<30	45	35	✓
R12	<30	<30	<30	45	35	✓
R13	<30	<30	<30	45	35	✓
R14	<30	<30	<30	45	35	✓

Note: Scenario 1 – haul road upgrade works; Scenario 2 – clearing and grubbing of operational area; Scenario 3 – establishment of first quarry bench.

6.2 Operational Scenario

6.2.1 Noise Modelling Results – Phase 1

Predicted noise levels for typical operations are provided in **Figure 5** to **Figure 6** and tabulated noise results are shown below in **Table 19**. The results of the model show that noise emissions from operations during Phase 1 of the Project satisfy relevant criteria during the early morning shoulder and day periods at all receiver locations.

Table 19 Combined Noise Predictions, All Receivers

Residential Receivers					
Receiver	Predicted Noise Level dB $LA_{eq(15min)}$		PNTL dB $LA_{eq(15min)}$		Compliant
	Day	Morning Shoulder	Day	Morning Shoulder	
R1	<30	<30	40	35	✓
R2	<30	<30	40	35	✓
R3	30	33	40	35	✓
R4	30	33	40	35	✓
R5	<30	<30	40	35	✓
R6	<30	<30	40	35	✓
R7	<30	<30	40	35	✓
R8	<30	<30	40	35	✓
R9	<30	<30	40	35	✓
R10	<30	<30	40	35	✓
R11	<30	<30	40	35	✓
R12	<30	<30	40	35	✓
R13	<30	<30	40	35	✓
R14	<30	<30	40	35	✓

Note: Monday to Saturday; Day 7am to 6pm; Evening 6pm to 10pm; Night 10pm to 7am. On Sundays and Public Holidays, Day 8am to 6pm; Evening 6pm to 10pm; Night 10pm to 8am.

Figure 5: Noise Modelling Results, LAeq(15min) - Phase 1 (Day)

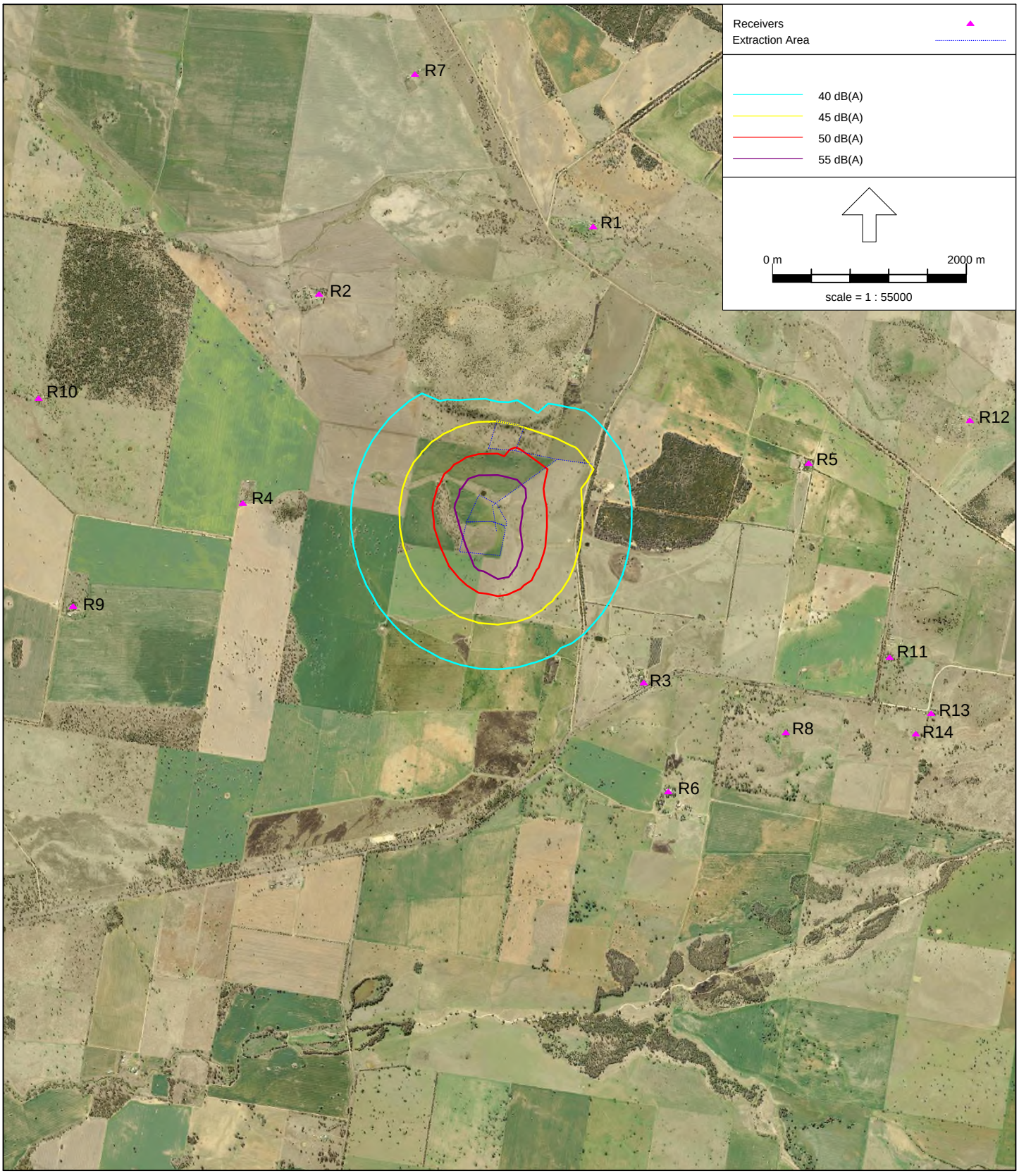

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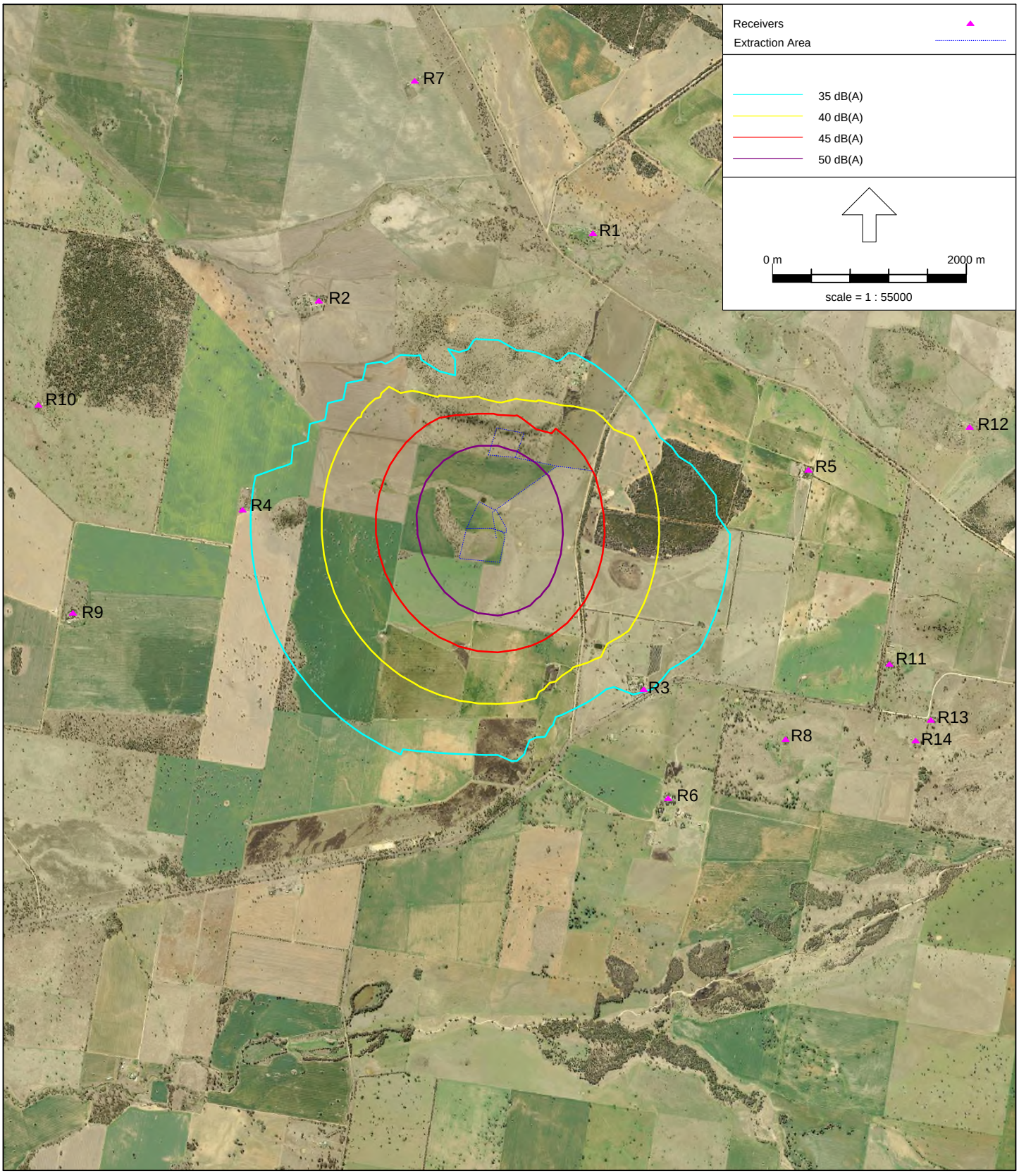
Figure 6: Noise Modelling Results, LAeq(15min) - Phase 1 (Morning Shoulder)



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6.2.2 Noise Modelling Results – Phase 2

Predicted noise levels for typical operations are provided in **Figure 7** to **Figure 8** and tabulated noise results are shown below in **Table 20**. The results of the model show that noise emissions from operations during Phase 2 of the Project satisfy relevant criteria during the early morning shoulder and day periods at all receiver locations.

Table 20 Combined Noise Predictions, All Receivers

Residential Receivers					
Receiver	Predicted Noise Level dB $LA_{eq(15min)}$		PNTL dB $LA_{eq(15min)}$		Compliant
	Day	Morning Shoulder	Day	Morning Shoulder	
R1	<30	<30	40	35	✓
R2	<30	<30	40	35	✓
R3	30	31	40	35	✓
R4	30	32	40	35	✓
R5	<30	<30	40	35	✓
R6	<30	<30	40	35	✓
R7	<30	<30	40	35	✓
R8	<30	<30	40	35	✓
R9	<30	<30	40	35	✓
R10	<30	<30	40	35	✓
R11	<30	<30	40	35	✓
R12	<30	<30	40	35	✓
R13	<30	<30	40	35	✓
R14	<30	<30	40	35	✓

Note: Monday to Saturday; Day 7am to 6pm; Evening 6pm to 10pm; Night 10pm to 7am. On Sundays and Public Holidays, Day 8am to 6pm; Evening 6pm to 10pm; Night 10pm to 8am.

Figure 7: Noise Modelling Results, LAeq(15min) - Phase 2 (Day)

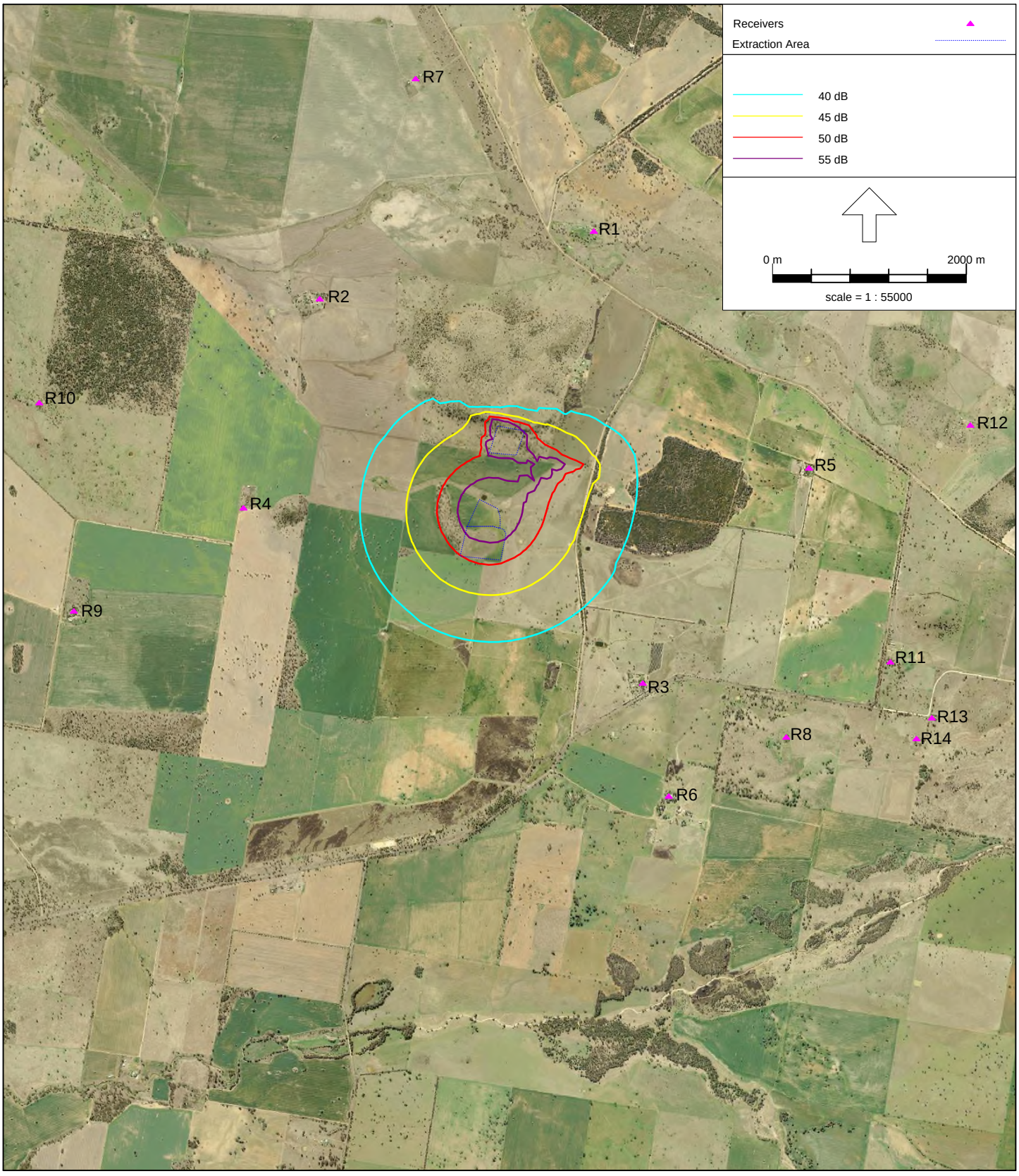

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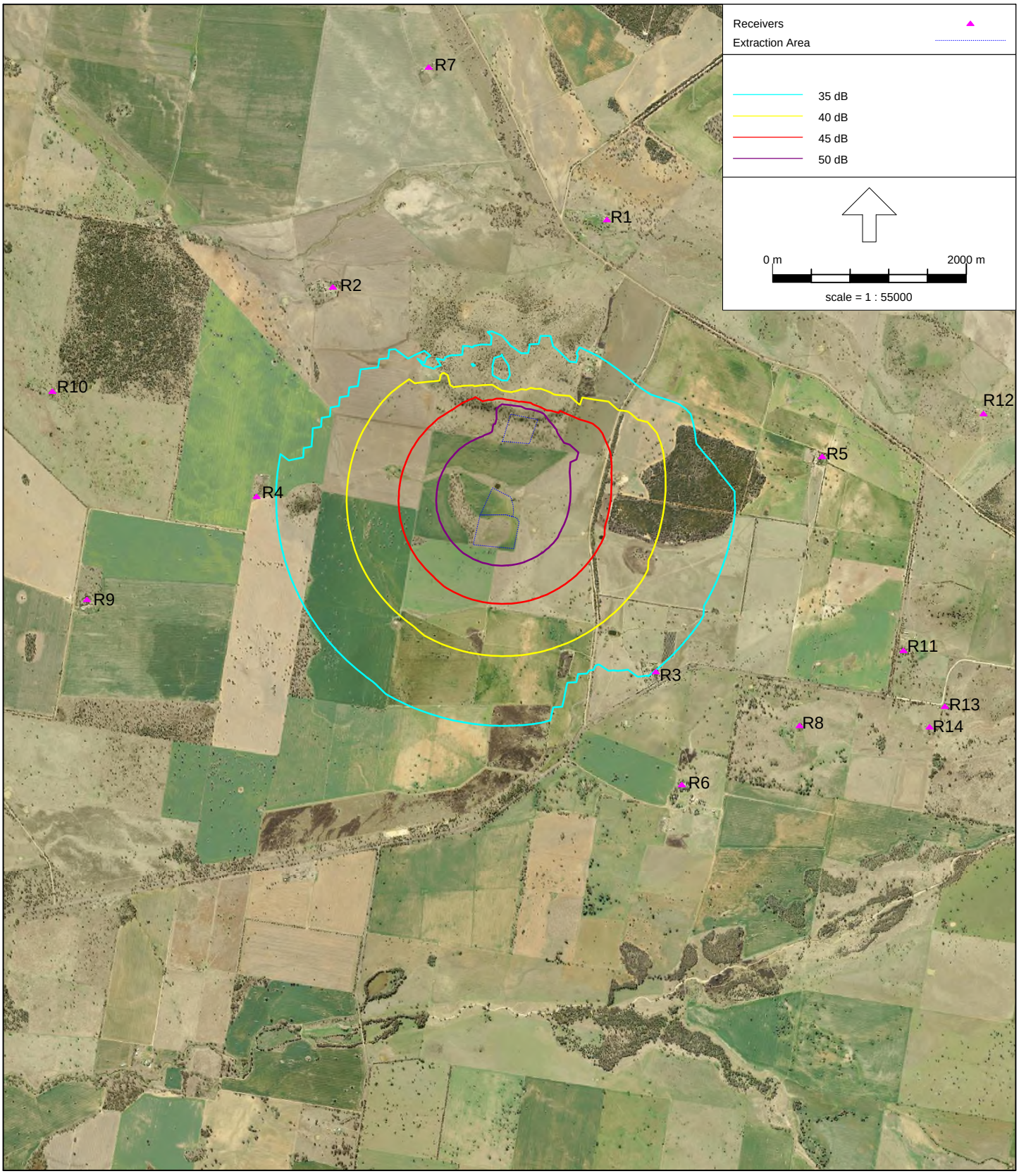
Figure 8: Noise Modelling Results, LAeq(15min) - Phase 2 (Morning Shoulder)



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6.3 Maximum Noise Level Assessment

In assessing sleep disturbance, a typical L_{Amax} noise source of 117dB was used to represent transient events such as loading trucks with aggregate, to the nearest residential receivers.

Predicted noise levels from L_{Amax} events for assessed receivers are presented in **Table 21.** Results identify that maximum level screening criterion will be satisfied for all residential receivers. It is noted that predictions are below the EPA screening criteria, hence no further assessment or detailed analysis is required.

Table 21 Maximum Noise Levels Assessment (Night)[1]

Receiver	Predicted Level		Screening Criteria		Compliant
	dB $L_{Aeq(15min)}$	dB L_{Amax}	dB $L_{Aeq(15min)}$	dB L_{Amax}	
R1	<30	<30	40	52	✓
R2	<30	31	40	52	✓
R3	33	34	40	52	✓
R4	33	35	40	52	✓
R5	<30	<30	40	52	✓
R6	<30	<30	40	52	✓
R7	<30	<30	40	52	✓
R8	<30	<30	40	52	✓
R9	<30	<30	40	52	✓
R10	<30	<30	40	52	✓
R11	<30	<30	40	52	✓
R12	<30	<30	40	52	✓
R13	<30	<30	40	52	✓
R14	<30	<30	40	52	✓

Note 1: Monday to Saturday; Night 10pm to 7am. On Sundays and Public Holidays Night 10pm to 8am.

6.4 Road Traffic Noise Results

The results of the road traffic noise calculations indicated that for the closest residential receiver to the proposed haul route, identified as receiver R1 and setback approximately 350m from Tooraweenah Road, the Project related road traffic noise levels would be less than 40dB $L_{Aeq(period)}$ for the day and night (early morning shoulder) periods. The road traffic noise criteria are therefore satisfied.

6.5 Blasting Assessment Results

Blast overpressure and vibration have been calculated to each assessed receiver for the Project adopting an MIC of up to 300kg. It is understood that the MIC of blasts at the Project site would typically be less than 100kg, therefore the calculated blast overpressure and vibration results are considered to be highly conservative.

Calculated levels for overpressure and vibration have been compared to the relevant ANZECC criteria and are presented in **Table 22**. Results identify blasts of MICs up to 300kgs would satisfy relevant ANZECC overpressure and vibration criteria.

Notwithstanding, the proposed MIC blast patterns should be designed specifically to meet the relevant ANZECC guidelines at receivers and be completed in conjunction with an appropriate blast monitoring program.

Table 22 Blasting Emissions

Receiver ID	Distance to Charge, m	Airblast Overpressure dBZ Peak	Ground Vibration mm/s
R1	2,200	109	0.50
R2	2,400	109	0.47
R3	2,500	111	0.61
R4	2,500	108	0.46
R5	3,000	105	0.31
R6	3,500	105	0.30
R7	3,800	103	0.22
R8	3,900	103	0.24
R9	4,400	101	0.19
R10	4,500	100	0.15
R11	4,800	101	0.18
R12	4,800	100	0.15
R13	5,100	99	0.13
R14	5,100	99	0.15

6.5.1 Effects of Vibration on Infrastructure from Blasting

The nearest infrastructure to blasting is Box Ridge Road, where vibration levels are calculated to be below 5mm/s. Hence there are no significant vibration effects from blasting on infrastructure which are typically less sensitive to vibration than residential receivers.

6.5.2 Effects of Blasting on Animals and Livestock

Blast effects resulting from the Mine Development are predicted to be, at worst for overpressure up to 109dBZ, and for vibration between 0.13 mm/s and 0.49 mm/s. These levels are well below the regulatory criteria and considerably lower than other sources of overpressure that horses or livestock are likely to be already subjected to such as lightning strikes which are typically between 120dBZ and 130dBZ[1].

[1] Equine Health Impact Statement – Drayton South Coal Project (2015)

7 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has conducted a Noise Impact Assessment (NIA) of potential emissions from the proposed Ralston Quarry (the "Project"), located at Mount Tenandra in Central West NSW. The assessment has quantified potential noise emissions including extraction and dispatch of product via road trucks associated with future operations from the Project.

The results of the NIA demonstrate that construction phase and operational noise levels comply with the relevant NPI criteria for all assessment periods at the most affected sensitive receiver locations.

Results of the maximum noise level assessment are identified to remain below the sleep disturbance screening criteria at all residential receivers. Therefore, sleep disturbance due to noise sources within the Project are unlikely to cause awakening reactions to adjacent receivers.

Additionally, the NIA demonstrates that the road noise criteria as specified in the RNP will be satisfied at the nearest potentially affected receivers for worst case operational road traffic.

Airblast overpressure and vibration levels are also predicted to meet the criteria at all assessed receivers for blasts up to 300kg MIC.

Based on the NIA results, there are no noise related issues which would prevent the approval of the Project. The results of the assessment show compliance with the relevant operational and road noise criteria. Additionally, the results of the assessment demonstrate compliance with the relative EPA and DECCW policies, without ameliorative measures being required.

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Appendix A – Glossary of Terms

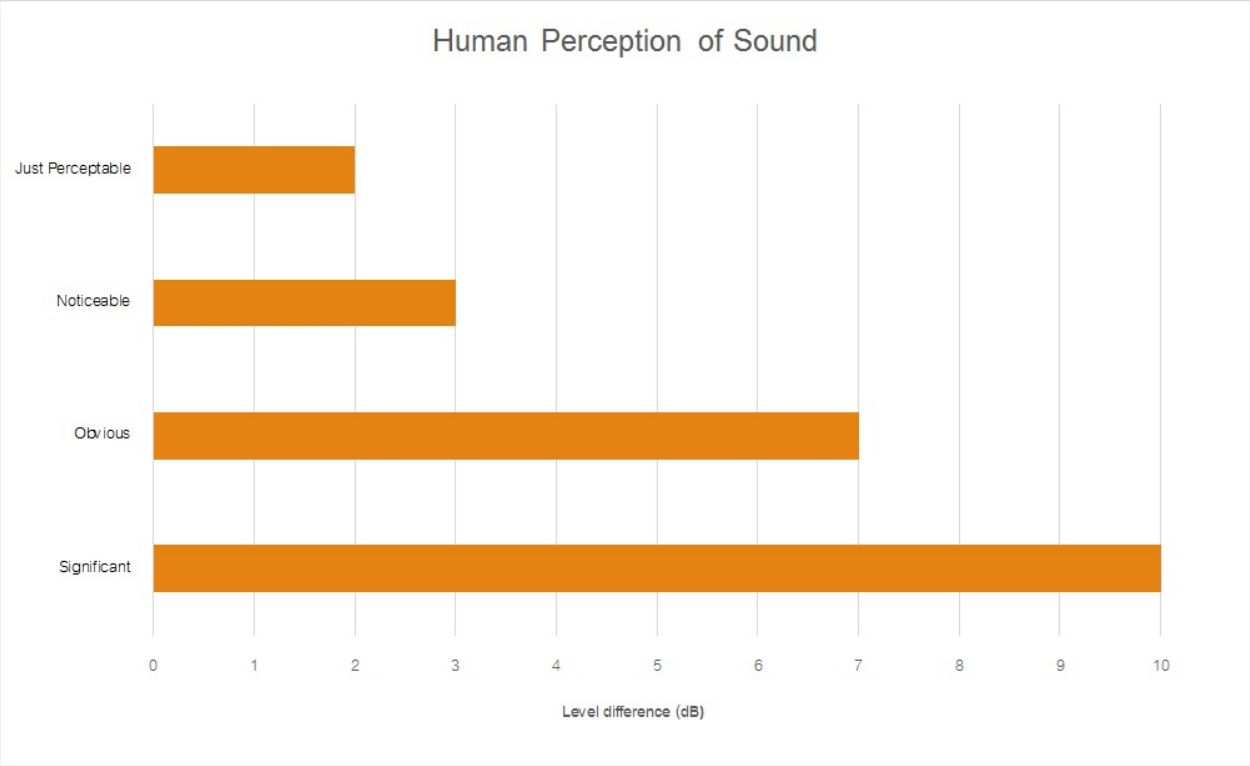
Table A1 provides a number of technical terms have been used in this report.

Table A1 Glossary of Terms	
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured LA_{90} statistical noise levels.
Adverse Weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dB(A)	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear. In some cases the overall change in noise level is described in dB rather than dB(A), or dB(Z) which relates to the weighted scale.
dB(Z)	Linear Z-weighted decibels.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA_{10}	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA_{90}	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LA_{eq}	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LA_{max}	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (LW)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment. Or a measure of the energy emitted from a source as sound and is given by : = 10.log10 (W/Wo) Where : W is the sound power in watts and Wo is the sound reference power at 10-12 watts.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dB(A)	
Source	Typical Sound Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



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Appendix B – NEWA Analysed Meteorology

Table B1 NEWA Analysed Daytime Meteorological Conditions, Coonamble NSW					
Direction ± 45°	Season	Day Percentage Occurrence %	Direction	Season	Day Percentage Occurrence %
0	Summer	5	180	Summer	4
0	Autumn	8	180	Autumn	9
0	Winter	6	180	Winter	11
0	Spring	5	180	Spring	5
22.5	Summer	6	202.5	Summer	4
22.5	Autumn	9	202.5	Autumn	9
22.5	Winter	7	202.5	Winter	12
22.5	Spring	5	202.5	Spring	5
45	Summer	6	225	Summer	3
45	Autumn	11	225	Autumn	7
45	Winter	7	225	Winter	11
45	Spring	5	225	Spring	5
67.5	Summer	6	247.5	Summer	3
67.5	Autumn	9	247.5	Autumn	6
67.5	Winter	7	247.5	Winter	11
67.5	Spring	5	247.5	Spring	4
90	Summer	6	270	Summer	3
90	Autumn	8	270	Autumn	5
90	Winter	7	270	Winter	8
90	Spring	5	270	Spring	4
112.5	Summer	5	292.5	Summer	3
112.5	Autumn	9	292.5	Autumn	4
112.5	Winter	9	292.5	Winter	7
112.5	Spring	5	292.5	Spring	3
135	Summer	6	315	Summer	4
135	Autumn	9	315	Autumn	5
135	Winter	9	315	Winter	6
135	Spring	5	315	Spring	4
157.5	Summer	3	337.5	Summer	4
157.5	Autumn	6	337.5	Autumn	7
157.5	Winter	6	337.5	Winter	6
157.5	Spring	3	337.5	Spring	5

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