Appendix 7

Noise and Blasting Impact Assessment

prepared by
Muller Acoustic Consulting Pty Ltd

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Noise and Blasting Impact Assessment

Austen Quarry Stage 2 Extension Project, Hartley, NSW.

Prepared for: R.W. Corkery & Co Pty Limited
January 2018

MAC
Muller Acoustic Consulting

Document Information

Noise and Blasting Impact Assessment

Austen Quarry Stage 2 Extension Project, Hartley, NSW.

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1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by R.W. Corkery & Co Pty Limited (RWC) on behalf of Hy-Tec Industries Pty Limited (Hy-Tec) to complete a Noise and Blasting Impact Assessment (NBIA) to quantify potential noise emissions associated with the proposed modifications to the Austen Quarry Stage 2 Extension Project. The quarry is located 3.5km south-southwest of the village of Hartley NSW and 10km south of Lithgow, NSW.

The Stage 2 Extension Project was approved on 15 July 2015 under Development Consent SSD 6084 (SSD 6084) and operations under SSD 6084 commenced on 15 September 2016. Operations under SSD 6084 have been occurring for over 12 months and Hy-Tec is now seeking a modification to approved operations, requiring a Statement of Environmental Effects (SEE) to be prepared.

This NBIA has been undertaken to quantify potential acoustic impacts associated with the operation of the Quarry on the surrounding community and will accompany the SEE. The NBIA has been prepared taking into consideration, the requirements outlined in the Environmental Assessment Requirements for Austen Quarry Extension Project (SSD 6084) Modification 1 issued by the NSW Department of Planning and Environment (16 November 2017), requiring a detailed noise (operational and road) and blast impact assessment in accordance with the following policies and guidelines:

- Environment Protection Authority's (EPA's), Noise Policy for Industry (NPI), 2017; and
- Department of Environment, Climate Change and Water NSW (DECCW), Road Noise Policy (RNP), 2011.

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

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2 Project Description

The Austen Quarry Extension Project was approved on 15 July 2015 under SSD 6084 and operations commenced under this consent on 15 September 2016. This NBIA has been prepared to support the SEE for proposed modifications to SSD 6084 for the Austen Quarry.

2.1 Current Operations

Extraction is undertaken using conventional drill and blast, load and haul methods to the primary crushing station adjacent to extraction area. Vegetation is first cleared by bulldozer and/or hydraulic excavator and stockpiled for rehabilitation areas or transported to the overburden emplacement.

The extraction area and primary crushing station are connected to the secondary processing area by a primary conveyor which carries feed from an elevation of 750m AHD to the primary stockpile at approximately 685m AHD. The secondary processing area is located on the northern side of the hills that form the extraction area, and is shielded to the south by the hills and the retained ridge of the extraction area.

A wide range of aggregates and blended products are stockpiled within the secondary processing area from where road trucks are loaded by front-end loader and despatched. All products are loaded into road registered trucks within either the secondary processing area or the Yorkeys Creek stockpile area. Trucks exit the Quarry via the departure weighbridge and Quarry Access Road, with virtually all trucks turning right onto Jenolan Caves Road and continuing northwards to the intersection with the Great Western Highway.

Blasting occurs at a maximum frequency of once per week. Current blast sizes may vary according to the location within the extraction area but generally vary from 10 000t through to approximately 100 000t (with an average of approximately 60 000t).

2.1.1 Design and Operational Controls

The Quarry currently operates in accordance with an approved Noise Management Plan (NMP) which is an operational tool to assist in the management of noise related issues during the operation of the quarry. The NMP includes a schedule of unattended and operator attended noise monitoring and requires the results and performance of the site operations to be discussed with local residents and landholders.

The Quarry has been designed with an objective to minimise the noise generated by extraction, processing and transport activities. The design features and operational noise controls to meet this objective are as follows.

Design Features

- No additional processing equipment is proposed with all fixed plant to remain in current locations, i.e. noise from processing operations would remain the same as that currently generated.
- The continued operation of the primary conveyor between the primary crushing station and secondary processing area reduces noise emissions significantly by avoiding the requirement for truck movements between the extraction and processing areas.
- Sequencing of the proposed Stage 2 extraction area to reduce the visual exposure of the extraction operations, also provides noise attenuation.
- Stockpiles and ancillary equipment will be positioned to limit potential noise impacts.
- Ancillary equipment will be enclosed, where feasible.

Operational Safeguards

- All approved hours of operation would be strictly adhered to.
- Compliance with the maximum number of truck movements per day nominated in Condition 8 of Schedule 2 of SSD-6084.
- All drivers would be required to sign the Chain of Responsibility, and, the Driver's Code of Conduct documentation requiring a high standard of driver performance, avoidance of using exhaust brakes in built-up areas and travel at the required speeds.
- The internal road network would be maintained to their current standard and if any new roads are proposed these will be constructed to limit body noise from empty trucks.
- All equipment on site would be serviced in accordance with Original Equipment Manufacturer (OEM) requirements to ensure sound power levels remain at or below that nominated for noise modelling purposes (see Table 16). This would include ensuring that all product delivery trucks under Hy-Tec responsibility are maintained to meet RMS noise limit requirements.
- Operations at exposed locations and under unfavourable weather conditions will be modified, where necessary, to reduce potential noise-related impacts.

- Maintenance work on all plant and equipment would be confined to approved maintenance hours.

2.2 Proposed Operations

The proposed modifications include the following changes to current operations relevant to this assessment.

- An increase to the limit on Quarry product despatch from 1.1Mtpa to 1.6Mtpa and associated increase to the limits on maximum and average daily traffic levels.
- A modification to permitted hours of operations to permit truck loading and transport activities to commence from 4am from the existing approved start time of 5am for weekdays only.

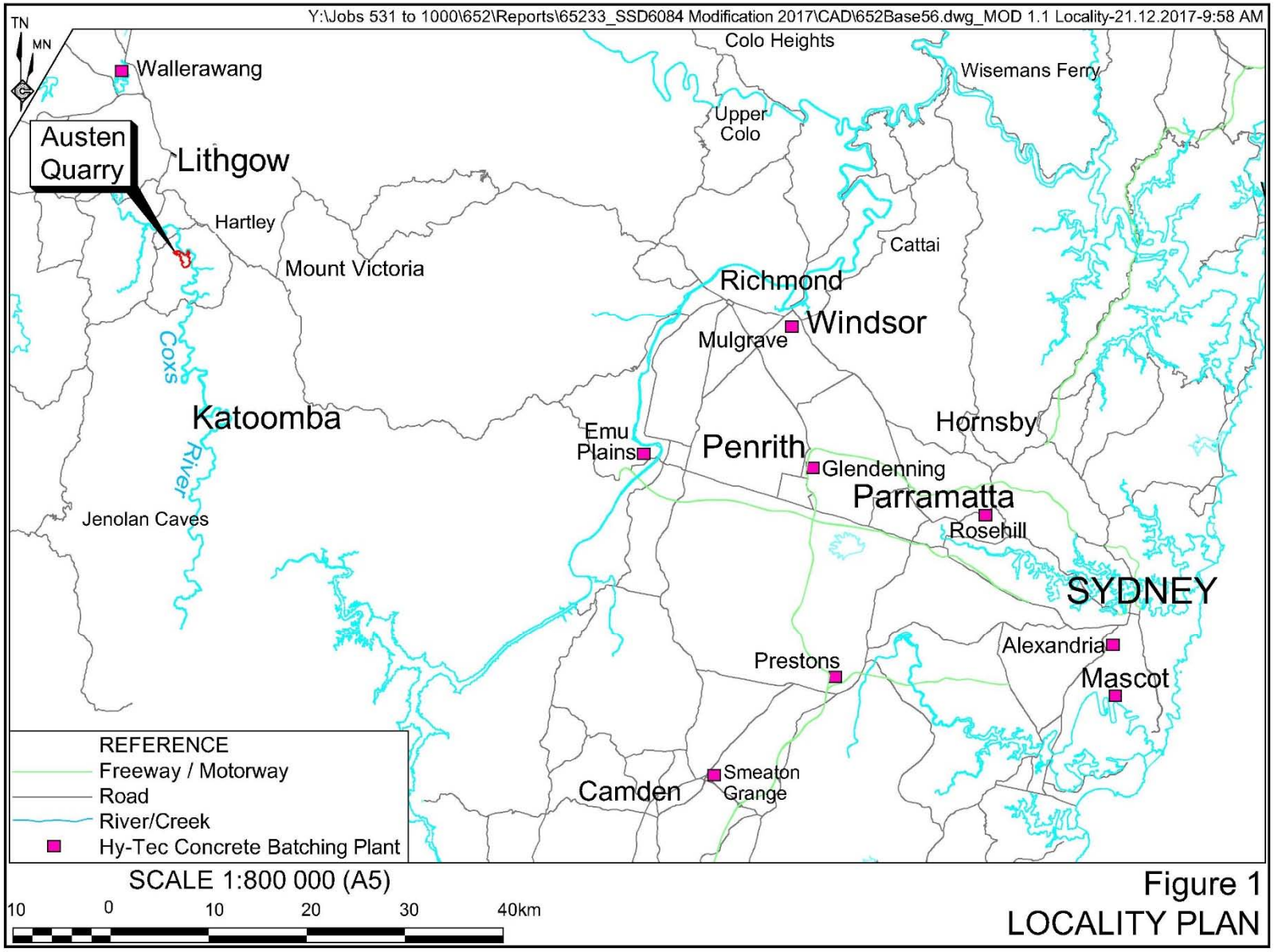
It is noted that Hy-Tec is proposing to reduce the extent of the overburden placement and re-align the approved extraction area as well as modifying the biodiversity obligations associated with the Stage 2 Extension Project. These matters are not assessed in this report.

A Noise Assessment Report was undertaken by Benbow Environmental for the Austen Quarry Stage 2 Extension Project EIS (Ref No: 131043_Noise and Vibration Impact Assessment_Report_Rev2) in October 2014, herein referred to as the "EIS Noise 2014"; and is referenced in relation to the existing acoustic and meteorological environment, plant noise source levels and road traffic movements associated with the project.

Figure 1 displays the location of the Quarry in relation to Sydney, Lithgow and the Hy-Tec concrete batching plant. **Figure 2** presents the local setting including the village of Hartley, The Great Western Highway and Jenolan Caves Road.

2.2.1 Potential Impacts

Potential noise impacts associated with the modification relate to operational noise associated with operation of equipment and processing facilities, blasting emissions (airblast overpressure and ground vibration), and road traffic noise associated with the transportation of product to customers.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TN
MN
Wallerawang
Colo Heights
Wisemans Ferry
Upper Colo
Austen Quarry
Lithgow
Hartley
Mount Victoria
Cattai
Richmond
Windsor
Mulgrave
Coxs
Katoomba
River
Emu Plains
Penrith
Hornsby
Glendenning
Parramatta
Rosehill
Jenolan Caves
SYDNEY
Alexandria
Prestons
Mascot
Camden
Smeaton Grange
REFERENCE
Freeway / Motorway
Road
River/Creek
Hy-Tec Concrete Batching Plant
SCALE 1:800 000 (A5)
10 0 10 20 30 40km
Figure 1
LOCALITY PLAN

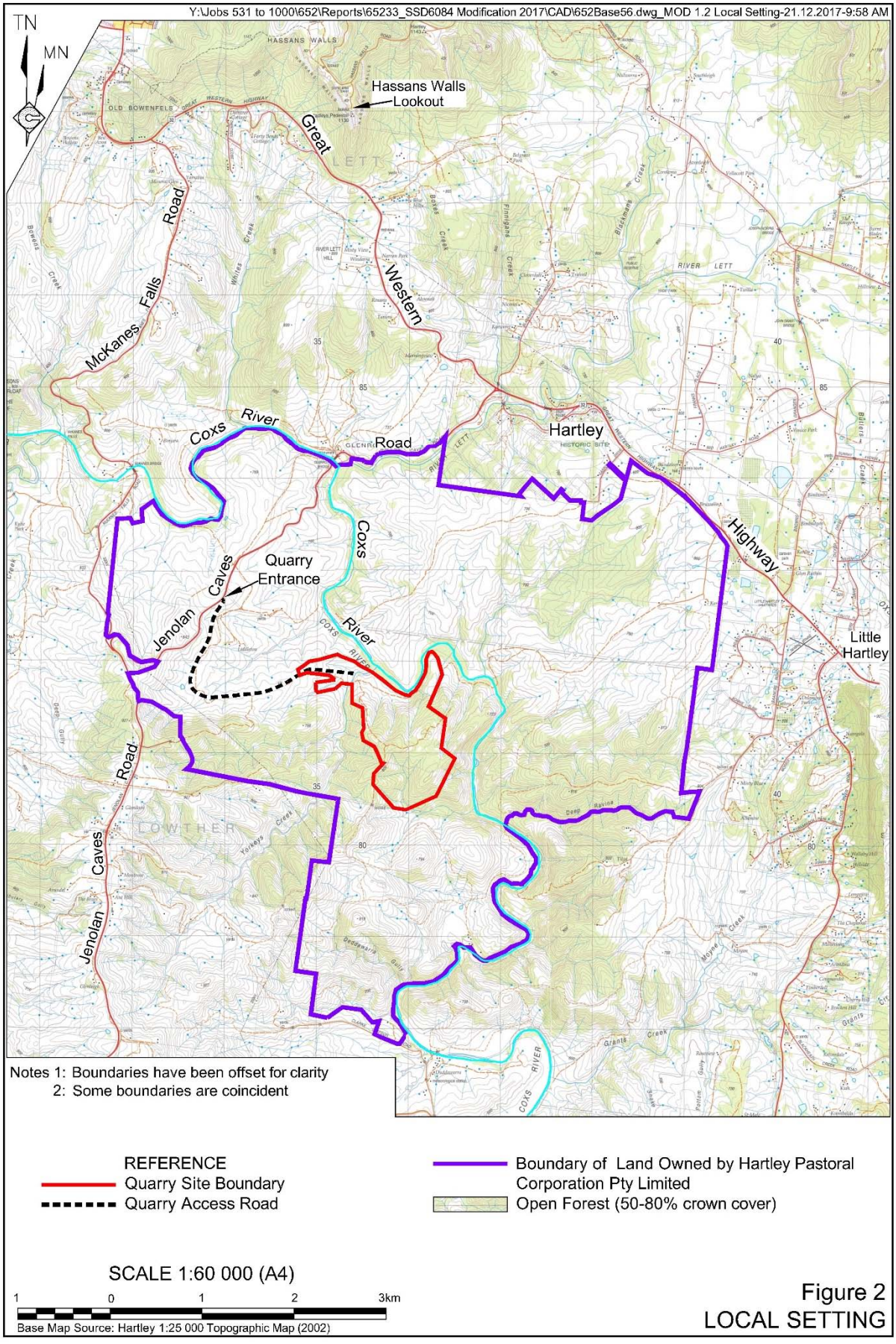

Figure 2
LOCAL SETTING

2.3 Hours of Operation

Table 1 presents the proposed changes in operating hours and activities that form the basis of the noise modelling scenarios for this assessment. The only change from the approved operating hours is to the loading and despatch activities from Monday to Friday.

Table 1 Existing and Proposed Hours of Operation

Operation	Monday to Friday[1]	Saturday[1]	Sunday
Extraction Processing and Screening Overburden Management Stockpile Management	6am to 10pm	6am to 3pm	N/A
Loading and Dispatch	4am to 10pm	5am to 3pm	N/A
Blasting	10am to 3pm	N/A	N/A

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

2.4 Receivers

The Quarry is situated near Hartley, 15km south of Lithgow, NSW. Receivers in the locality surrounding the site are primarily rural residential. The receiver addresses and MGA56 coordinates for the nearest key representative receivers to the Quarry are summarised in **Table 2.**

Table 2 Residential Receiver Locations (ref: MGA56)

Receiver ID	Description	Easting, m	Northing, m	Height m AHD
R9	Residential	239260	6281564	800
R16	Residential	238396	6280210	798
R22	Residential	231681	6282071	769
R23	Residential	232701	6283352	796
R24	Residential	235229	6284328	690
R27	Residential	236142	6277621	580
R31	Residential	234503	6280563	830
R48	Residential	237951	6283668	798
R49	Residential	239564	6283116	816
R54	Residential	233294	6281159	894

3 Assessment Methodology

The methodology and assumptions adopted in the Noise and Blasting Impact Assessment are outlined below.

3.1 Guidelines and Standards

This Noise and Blasting Impact Assessment has been conducted with due regard to and in accordance with the following key policy and guidelines:

- Environment Protection Authority's (EPA's), Noise Policy for Industry (NPI), 2017;
- NSW Department of Environment, Climate Change and Water – NSW Road Noise Policy (RNP), March 2011;
- Australia and New Zealand Environment Council (ANZEC) Guideline – Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration (ANZEC Guideline), September 1990; and
- NSW Government, Voluntary Land Acquisition and Mitigation Policy (VLAMP), 2014.

The assessment has also considered and applied the following additional policy, guidelines and standards where relevant:

- Standards Australia AS1055–1997 (AS1055) – Description and Measurement of Environmental Noise;
- Standards Australia AS IEC 61672.1–2004 (AS61672) – Electro Acoustics - Sound Level Meters Specifications Monitoring or Standards Australia AS1259.2-1990™ (AS1259) – Acoustics – Sound Level Meters – Integrating/Averaging as appropriate to the device;
- Standards Australia AS/IEC 60942:2004/IEC 60942:2003 (IEC60942) – Australian Standard – Electroacoustics – Sound Calibrators; and
- Standards Australia AS2187.2 –2006 (AS2187) - Explosives-Storage and Use - Use of Explosives.

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 the noise levels that are used to assess both change in noise level 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, taking into account 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 and require the measurement of existing background levels.

2. Predict or measure the noise levels produced by the development regarding 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 project noise trigger level, and assessing impacts and the need for noise mitigation and management measures.

4. Consider residual noise impacts - that is, where noise levels exceed the project noise trigger levels 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 (that is, the more stringent) value of the **Project Intrusiveness Noise Level** and **Project Amenity Noise Level** determined in accordance with Section 2.3 and Section 2.4 of the NPI.

3.2.2 Intrusiveness Noise Level

The Project Intrusiveness Noise Level ($LA_{eq,15min}$) 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 needs to be measured.

A notable change in the NPI, in comparison to the INP, is that the minimum RBL for the daytime has changed from 30dBA to 35dBA. This results in a minimum intrusiveness daytime criterion of 40dB $LA_{eq,15min}$, compared to the previous INP minimum intrusive criteria of 35dB $LA_{eq,15min}$. There is no change to the minimum RBLs applicable to the evening and night time periods.

3.2.3 Assessing Amenity

Amenity noise levels are 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** – are determined considering all current and future industrial noise within a receiver area.

- **Project Amenity Noise Levels (PANL)** – is the recommended levels for a receiver area, specifically focusing the project under investigation.

As per Section 2.4 of the NPI, amenity noise levels and PANLs consider:

- areas with high traffic noise levels;

- proposed developments in major industrial clusters;

- existing industrial noise; and
- greenfield sites.

The recommended amenity noise levels as per Table 2.2 of the NPI are reproduced in **Table 3**.

Table 3 Amenity Criteria

Receiver Type	Noise Amenity Area	Time of day	Recommended amenity noise level L_{Aeq}, dBA
Residential	Rural	Day	50
		Evening	45
		Night	40
	Suburban	Day	55
		Evening	45
		Night	40
	Urban	Day	60
		Evening	50
		Night	45
Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks	See column 4	See column 4	5dBA above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day
School classroom – internal	All	Noisiest 1-hour period when in use	35
Hospital ward - internal - external	All	Noisiest 1 hour Noisiest 1 hour	35 50
Place of worship – internal	All	When in use	40
Area specifically reserved for passive recreation (e.g. national park)	All	When in use	50
Active recreation area (e.g. school playground, golf course)	All	When in use	55
Commercial premises	All	When in use	65
Industrial premises	All	When in use	70
Industrial interface (applicable only to residential noise amenity areas)	All	All	Add 5dBA to recommended noise amenity area

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 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays

• evening – the period from 6 pm to 10 pm

• night – the remaining periods.

In the case where existing schools are affected by noise from existing industrial noise sources, the acceptable LAeq noise level may be increased to 40 dB LAeq(1hr).

3.2.4 Maximum Noise Level Assessment

The potential for sleep disturbance from maximum noise level events from premises 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:

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

3.2.5 Voluntary Land Acquisition and Mitigation Policy

The Voluntary Land Acquisition and Mitigation Policy (VLAMP November 2014) seeks to balance acquisition and mitigation obligations for mining and quarry operators that provide appropriate protections for landholders, where impacts are identified.

In accordance with the Voluntary Land Acquisition and Mitigation Policy (NSW Government, 2014) for state significant extraction projects, an assessment has been undertaken of potential impacts on vacant land surrounding the project including the most affected 25% of any privately-owned land parcels, where existing planning controls would permit development on this land. The relevant criteria are outlined in **Section 5.1.6** and the assessment is presented in **Section 5.1.6**.

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 applicable to different road classifications for the purpose of quantifying traffic noise impacts. Road noise criteria relevant to this assessment are presented in **Section 5.2** for residential receivers.

3.4 Blasting Guideline

The limits adopted by EPA for blasting are provided in the Australian and New Zealand Environment Conservation Council (ANZECC) - Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration. Blasting criteria relevant to this assessment are presented in detail in **Section 5.3** and the assessment is presented in **Section 7.6**.

4 Existing Environment

4.1 Background Noise Environment

The EIS Noise 2014 contains historic project information with respect to background noise levels and prevailing meteorological conditions for the area surrounding the Quarry Site. For consistency and where relevant the historic information has been adopted in this assessment.

4.1.1 Unattended Noise Monitoring

Review of the EIS Noise 2014 reveals that existing noise levels at receivers in the vicinity of the Quarry are influenced by a range of sources including traffic on Jenolan Caves Road and local roads, agricultural equipment, flow of the Coxs River, livestock, wind in trees, wildlife, as well as noise associated with existing Austen Quarry operations.

To quantify the existing background noise environment of the area, noise levels recorded during unattended noise monitoring from the EIS Noise 2014 are reproduced in **Table 4**.

Table 4 Background Noise Monitoring Summary

Monitoring Location	Period[1]	Measured Background Noise Level (LA_{90}) RBL dBA	Measured $LA_{eq,period}$ dBA
Location A 220 Jenolan Caves Road	Day	39	63
	Evening	39	58
	Night	38	56
Location B 770 Jenolan Caves Road	Day	27	59
	Evening	22	54
	Night	21	51
Location C 66 Dicker Drive, Little Hartley	Day	35	47
	Evening	34	46
	Night	30	41

Note 1: Monday – 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.

4.1.2 Supplementary Unattended Noise Measurements

Additional noise monitoring was conducted by MAC in September 2017 to quantify the morning shoulder period (4am to 7am) RBLs. The measurements were completed to determine if surrounding major transport routes elevate noise levels during this period compared to the more stringent night time period.

The following supplementary unattended noise measurements have been conducted:

- Location R31 – 781 Jenolan Caves Road, Good Forest: 19 September 2017 to 5 October 2017;
- Location R48 – 64 Carroll Drive, Hartley: 19 September 2017 to 20 September 2017 and 4 October 2017 to 5 October 2017.
- Location R24A – 200 Jenolan Caves Road, Hartley:19 September 2017 to 20 September 2017 and 4 October 2017 to 5 October 2017.

The analysis of the noise monitoring results for the morning shoulder period at all locations resulted in RBLs of 30dBA or less. Hence, no additional assessment of morning shoulder criterion has been undertaken as this demonstrates that the night time criterion will be applicable for proposed operations during the morning shoulder period.

4.1.3 Supplementary Operator Attended Noise Measurements

As part of the regular noise compliance survey, operator attended noise measurements were conducted by MAC on Wednesday 4 October 2017 to Thursday 5 October 2017; and 6 December 2017 to 7 December 2017 at Location R54, Location R24A and Location R48.

Results of the measurements determined that current quarry noise contributions were less than 35dB $LA_{eq,15min}$ at all receiver locations for all measurements undertaken during the morning shoulder period (6am to 7am), daytime period (7am to 6pm) and evening period (6pm to 10pm) and are compliant with the current EPL limits. Additional analysis of the measurements has been undertaken to inform the low frequency noise assessment in **Section 0**.

5 Assessment Criteria

5.1 Operational Noise Criteria

5.1.1 Intrusiveness Noise Levels

The intrusiveness criteria for the project are presented in **Table 5** and have been determined based on the (EIS Noise 2014) RBLs +5dBA.

Table 5 Intrusiveness Noise Levels

Measurement Location	Receiver	Period[1]	Measured RBL dB LA_{90}	Adopted RBL[2] dB LA_{90}	Intrusiveness Noise Level dB $LA_{eq,15min}$
Location A	R24	Day	39	39	44
		Evening	39	39	44
		Night	38	38	43
Location B	R9 R16 R22 R23 R27 R31 R54	Day	27	35	40
		Evening	22	30	35
		Night	21	30	35
Location C	R48 R49	Day	35	35	40
		Evening	34	34	39
		Night	30	30	35

Note 1: Monday – 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.

Note 2: Where this level is less than 35dBA for the day period, the rating background noise level is set to 35dBA; where the noise level is less than 30dBA for the evening and night periods, the rating background noise level is set to 30dBA.

5.1.2 Amenity Noise Levels and Project Amenity Noise Levels

The amenity noise levels and project amenity noise levels for residential receivers potentially affected by operational noise from modified operations are presented in **Table 6.**

Table 6 Amenity Noise Levels and Project Amenity Levels

Receiver Type	Noise Amenity Area	Assessment Period[1]	Recommended Amenity Noise Level dB $LA_{eq,period}$	Amenity Noise Level dB $LA_{eq,period}$[2]	Project Amenity Noise Level dB $LA_{eq,15min}$[3]
Residential	Rural	Day	50	50	53
		Evening	45	45	48
		Night	40	40	43

Note 1: Monday – 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.

Note 2: Project Amenity Noise Level equals the amenity noise level as there is no other industry in the area.

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

5.1.3 Project Noise Trigger Levels

The Project Noise Trigger Levels (PNTLs) is the lower of either the intrusiveness noise level and the Project Amenity Noise Level. **Table 7** presents the derivation of the PNTL's in accordance with the methodologies outlined in the NPI.

Table 7 Project Noise Trigger Levels

Catchment	Receivers	Assessment Period[1]	Intrusiveness Noise Level dB $LA_{eq,15min}$	Project Amenity Noise Level dB $LA_{eq,15min}$	PNTL, dB $LA_{eq,15min}$
Location A	R24	Day	44	53	44
		Evening	44	48	44
		Night	43	43	43
Location B	R9 R16 R22 R23 R27 R31 R54	Day	40	53	40
		Evening	35	48	35
		Night	35	43	35
Location C	R48 R49	Day	40	53	40
		Evening	39	48	39
		Night	35	43	35

Note 1: Monday – 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.

Technical Note

This assessment has been conducted in accordance with the recently released NPI, which supersedes the INP, A key change in the NPI compared to the INP (relating to criteria) is the minimum applicable daytime RBL. This is now 35dBA (previously 30dBA in the INP) and results in a minimum daytime PNTL of 40dBA $LA_{eq,15min}$. The method used in EIS Noise 2014 was highly conservative adopting a minimum RBL of 30dBA for all receiver locations, resulting in a 35dBA $LA_{eq,15min}$ criteria for all periods. This assessment has determined criteria, adopting a combination of measured and default RBLs in accordance with the contemporary NPI methodology.

5.1.4 Maximum Noise Level Screening Criterion

The maximum noise level screening criterion shown in **Table 8** is based on night time RBLs and trigger values as per Section 2.5 of the NPI.

Table 8 Maximum Noise Assessment Trigger Levels

Receiver	dB $LA_{eq,15min}$ 40dB or RBL + 5dB		LA_{max} 52dB or RBL + 15dB	
R24	RBL	38	RBL	38
	RBL +5dB	43	RBL +15dB	53
	Maximum	43	Maximum	53
R9 R16 R22 R23 R27 R31 R54	RBL	30	RBL	30
	RBL +5dB	35	RBL +15dB	45
	Maximum	40	Maximum	52
R48 R49	RBL	30	RBL	30
	RBL +5dB	35	RBL +15dB	45
	Maximum	40	Maximum	52

5.1.5 Low Frequency Noise Criteria

Fact Sheet C of the NPI provides guidelines for applying 'modifying factor' adjustments to account for low frequency noise emissions. The NPI states that where there is a difference of 15dB or more between the measured 'C' weighted (dBC) and measured 'A' weighted (dBA) levels, then a correction factor of +5dB is applicable. Sources that may contain relatively higher components of low frequency noise energy include pumps, screens, centrifuges and other plant typically found in a material processing facility.

The NPI method involves a two stage assessment approach:

- Compare overall site dBC and dBA noise levels. If dBC minus dBA is less than or equal to 15dB then no correction is applied. If dBC minus dBA is greater than 15dB then the following is applicable;
- Compare the one third octave band noise level to the NPI reference curve in Table C2. If the curve is exceeded by up to 5dB in any one third octave band, a +2dB adjustment applies for the evening and night period. If the curve is exceeded by greater than 5dB, a +2dB penalty applies for the day and evening, and a +5dB penalty applies for the night period.

5.1.6 Vacant Lands Assessment Criteria

The Voluntary Land Acquisition and Mitigation Policy (NSW Government, 2014) requires an assessment to determine whether project noise emissions exceed the relevant amenity criteria as per Table 2.2 of the NPI on more than 25% of any privately-owned land parcels. As per the VLAMP, a consent authority should only apply voluntary land acquisition rights where:

- Noise generated by the project are more than 5dBA above the PNTL at any residence on privately owned land; or
- Noise generated by the project would contribute to exceedances of the recommended maximum noise levels in Table 2.2 of the NPI on more than 25% of any privately owned land where there is an existing dwelling or where a dwelling could be built under existing planning controls.

Similarly, a consent authority should only apply voluntary land mitigation rights where, including the implementation of best practice management:

- The noise generated by the development would be equal to or greater than 3dBA above the NPI PNTL at any residence on privately owned land; or
- The development would increase the total industrial noise level at any residence on privately owned land by more than 1dBA and noise levels at the residence are already above the recommended amenity criteria in Table 2.2 of the NPI.

Three potentially affected vacant land parcels have been identified for the project with the resulting VLAMP criteria presented in **Table 9** are applicable to the project. It is noted that the criteria is the more stringent of the PANL and PNTL.

Table 9 VLAMP Criteria

ID	Lot DP	Distance from Quarry, m	Assessment Period	VLAMP Vacant Lands dB $L_{Aeq,15min}$[3]	VLAMP Residential Dwelling dB $L_{Aeq,15min}$
L17[1]	Lot 11 DP1113701	750 - 2000	Day	53	45
L19[1]	Lot 4 DP1113701	1300-2100	Evening	48	40
L32[1]	Lot 2 DP870895	1500-2600	Night	43	40
L50[2]	Various lot subdivisions	1700-2400	Day	53	45
			Evening	48	44
			Night	43	40

Note 1: Noise catchment area represented by Location B

Note 2: Noise catchment area represented by Location C

Note 3: Where project noise emissions exceed the relevant criteria on more than 25% for any privately-owned land parcels.

5.2 Road Traffic Noise Criteria

The road traffic noise criteria are provided in the RNP. The 'sub arterial road' category, as specified in the RNP, has been adopted for Jenolan Caves Road. **Table 10** presents the road traffic noise assessment criteria reproduced from the RNP for this road category.

Table 10 Road Traffic Noise Assessment Criteria for Residential Land Uses

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

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 2dBA, which is generally accepted as the threshold of perceptibility to a change in noise level.

5.2.1 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 11** due to the addition of quarry vehicles on Jenolan Caves Road should be considered for mitigation.

Table 11 Increase Criteria for Residential Land Uses

Road Category	Type of Project/Development	Total Traffic Noise Level Increase, dBA	
		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 $LA_{eq,15hr}$ +12dB (external)	Existing traffic $LA_{eq,9hr}$ +12dB (external)

5.3 Blasting Criteria

The quarry is required to operate within the overpressure and ground vibration limits stipulated in Condition 6 of Schedule 3 of SSD 6084 and Environment Protection Licence 12323 (EPL), reproduced in **Table 12**.

Table 12 Blasting Emissions Criteria

Receiver	Airblast Overpressure (dBZ Peak)	Ground Vibration (mm/s)	Allowable Exceedance
Any Residences on privately owned land	120	10	0%
	15	5	5% of the total number of blast over a period of 12 months

6 Assessment Methodology

6.1 Operational Noise Modelling Methodology

Brüel and Kjær Predictor Type 7810 (Version 11.10) noise modelling software was used to develop a noise model to determine the impact of project noise emissions to neighbouring receivers for a worst case operational scenario. A three-dimensional digital terrain map giving all relevant topographic information was used in the modelling process. The model uses relevant noise source data (measured on site at the Quarry), ground type, shielding such as barriers and/or adjacent buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers. Plant and equipment were modelled at various locations and heights, representative of realistic operating conditions for assessed scenarios.

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'.

6.2 Operational Noise Modelling Parameters

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

6.2.1 Meteorological Analysis

Meteorological conditions that enhance received noise levels include source to receiver winds and the presence of temperature inversions. To account for the potential for enhancements, the INP 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.

Historical data (EIS Noise 2014) indicates that temperature inversions occur for approximately 60% of winter nights and therefore must be considered in the assessment.

Table 13 summarises the results of the NEWA 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 13 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	247.5	46
	Evening	247.5	56
	Night	247.5	51
Autumn	Day	247.5	36
	Evening	247.5	50
	Night	247.5	32
Spring	Evening	225	41
	Night	247.5	30

Note 1: Day 7am to 6pm; Evening 6pm to 10pm; Night 10pm to 7am.

Based on the results of this analysis the relevant meteorological conditions adopted in the noise modelling assessment are summarised in **Table 14**.

Table 14 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
WSW Wind	10°C	3m/s WSW	60%	n/a
Temperature Inversion[2]	10°C	n/a	80%	F

Note 1: Day 7am to 6pm.

Note 2: Winter Nights 10pm to 7am,

6.2.2 Operational Noise Modelling Scenarios

Stage B operations were adopted in this assessment to represent worst case operational noise emissions from the Quarry Site with clearing, drilling and extraction operations at the highest elevation in the extraction area. This scenario is summarised in **Table 15.** Locations of mobile equipment and fixed plant for extraction and processing areas are presented in **Figure 3** and **Figure 4**.

Table 15 Stage B Operational Scenario

Task[1]	Monday to Friday	Saturday	Equipment
Clearing	6am to 10pm	6am to 3pm	Dozer[2]
Extraction	6am to 10pm	6am to 3pm	Excavator, Drill, Dozer[2] Haul Truck x 3
Processing and Screening	6am to 10pm	6am to 3pm	All Crushers and Screens
Overburden Management	6am to 10pm	6am to 3pm	Front End Loader[2] x 1 Haul Truck[2]
Stockpile Management	6am to 10pm	6am to 3pm	Front End Loader x 2
Loading and Dispatch	4am to 10pm	5am to 3pm	Front End Loader x 2/3 Product Truck
Infrastructure/ Support	6am to 10pm	5am to 3pm	Pump, Generator Water Cart, Grader

Note 1: No operation on Sundays

Note 2: Dozer, FEL, Haul Truck allocated between various operational areas as required

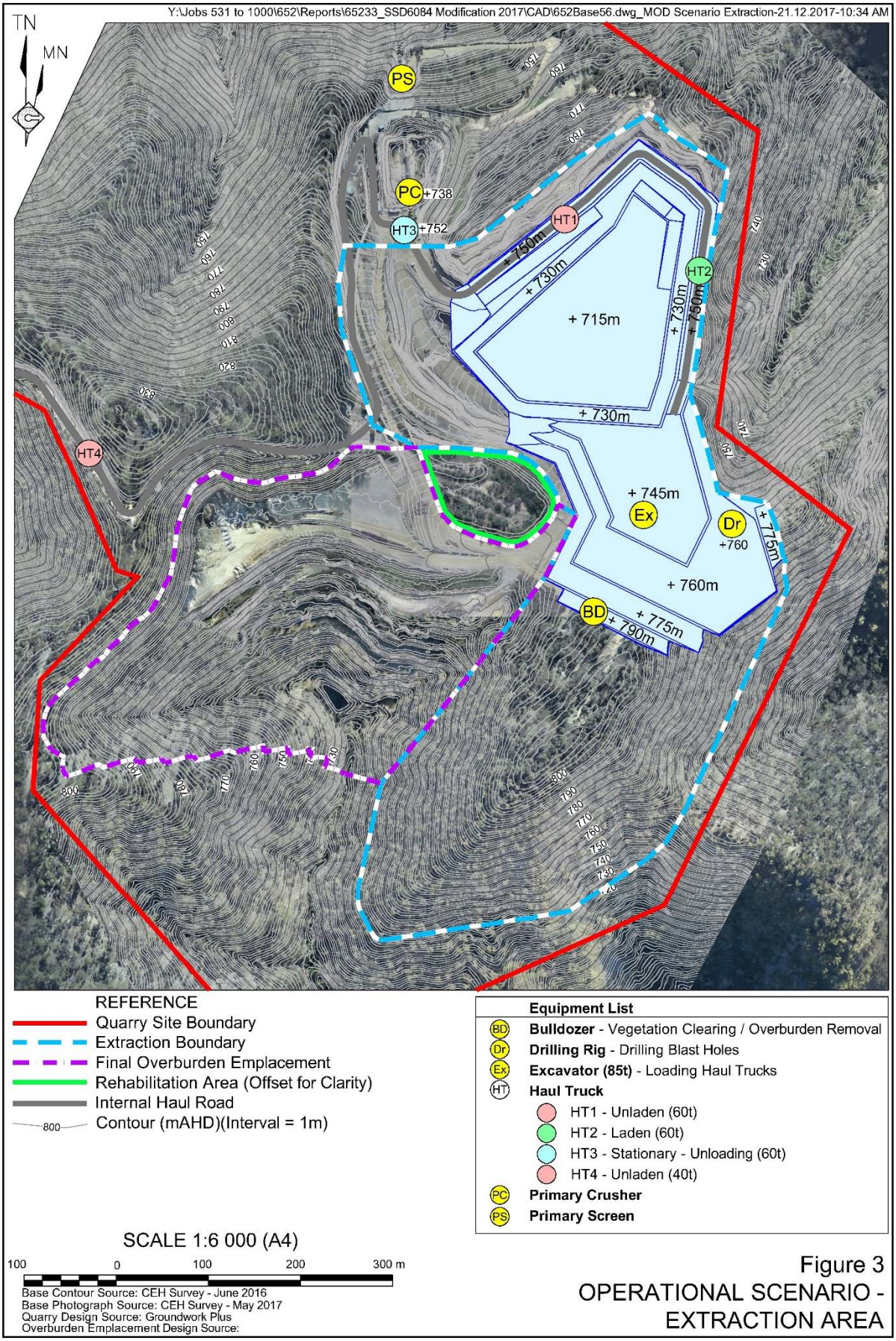

Figure 3
OPERATIONAL SCENARIO - EXTRACTION AREA

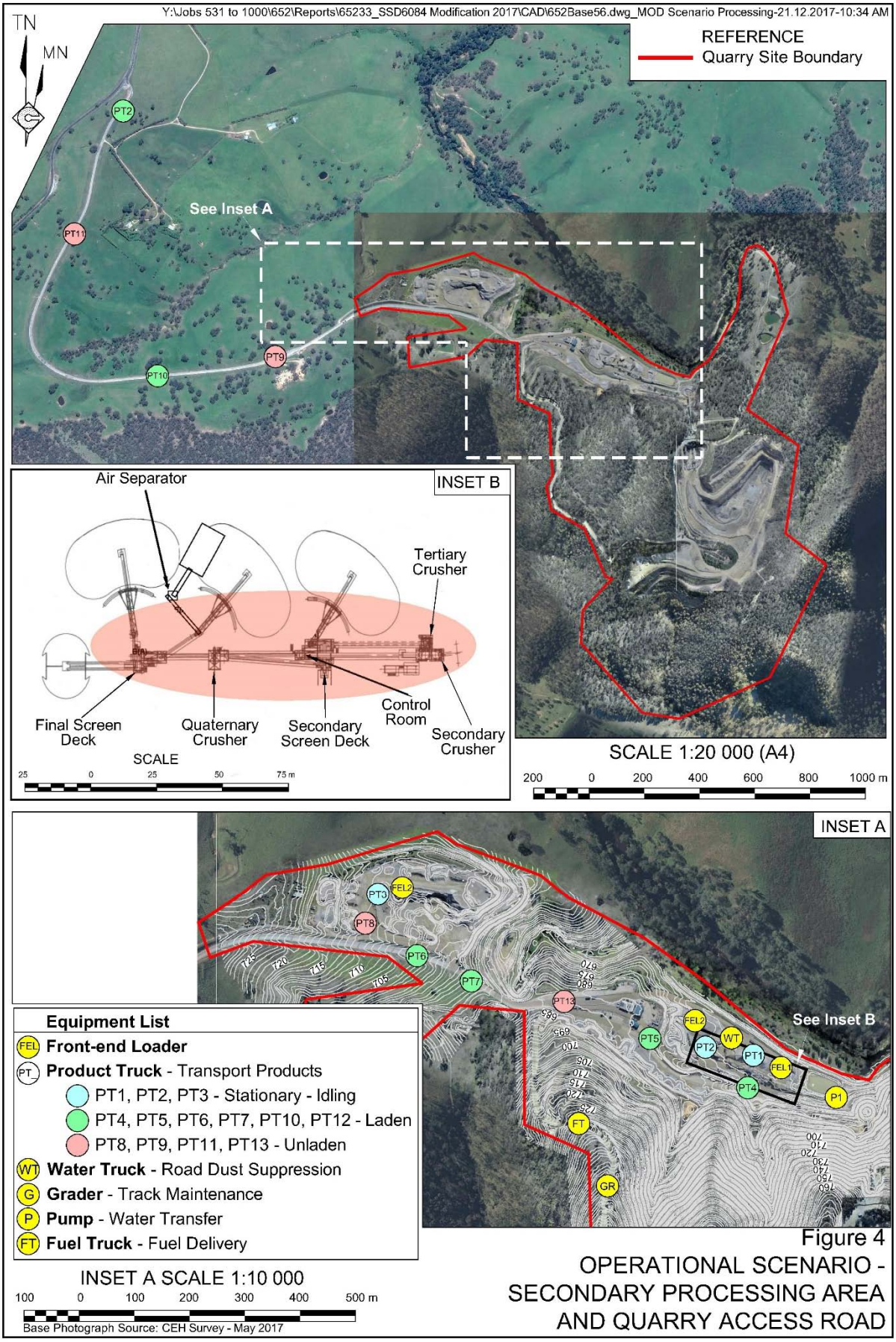

Figure 4
OPERATIONAL SCENARIO - SECONDARY PROCESSING AREA AND QUARRY ACCESS ROAD

6.2.3 Sound Power Levels

Mobile plant noise emission data used in modelling for this assessment were obtained from EIS Noise 2014 and from measurements conducted at the Quarry Site or the MAC database. The noise emission levels used in modelling are summarised in **Table 16**.

Table 16 Equipment Sound Power Levels (dBA ref 10^{-12}W)

Noise Source/Item	Octave Band Centre Frequency, Hz									Total, dBA
	31.5	63	125	250	500	1000	2000	4000	8000	
Drill[1]	63	71	86	88	104	108	113	112	109	117
Excavator	69	81	91	95	105	109	109	105	97	113
Dozer	97	94	92	97	101	107	94	91	81	109
Haul Truck	80	91	102	106	111	112	112	105	95	117
Primary Crusher[1]	83	92	99	106	109	109	107	102	91	114
Primary Screens[1]	70	89	91	98	106	109	106	99	91	112
Secondary Crusher[1]	67	86	90	99	108	111	108	101	93	114
Tertiary Crusher[1]	69	87	90	95	99	99	97	93	83	104
Secondary Screen[1]	69	83	85	96	105	106	105	100	92	111
Quaternary Crusher[1]	64	82	85	90	94	94	92	88	78	99
Final Screen[1]	73	85	90	102	102	100	98	93	88	107
Front End Loader	70	83	95	100	104	110	97	94	83	112
Product Truck	75	81	86	91	93	97	94	88	84	101
Air Separator	58	73	75	82	84	84	82	78	71	90
Conveyor (dB/m)	40	46	62	70	79	80	81	75	69	86
Grader	75	79	89	95	100	104	105	104	100	110
Water Cart	75	79	89	95	100	104	105	104	100	110
Genset	60	75	78	90	95	98	95	91	87	102
Diesel Pump	23	49	55	68	81	83	80	72	65	87

Note 1: Sound power level determined via measurement of equipment on site

6.3 Road Traffic Noise Assessment Methodology

Extracted material would be transported from the Quarry Site using a range of truck types but would typically involve truck and dog size vehicles. Once loaded within the Processing and Stockpile Area, trucks would exit the Quarry Site via Jenolan Caves Road and onto the existing intersection with The Great Western Highway.

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 the transport

route. 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.

The increase in quarry production and the additional hour of road traffic in the morning between 4am and 5am result in the following road traffic movements associated with the modified operations presented in **Table 17**.

Table 17 Road Traffic Parameters

Scenario	Annual Production	Daily Maximum Trucks dispatched	Daily Average Trucks dispatched	Maximum Trucks per hour during night period
Current Approval	1.1Mtpa	250	150	20[1]
Proposed	1.6Mtpa	300	200	20[2]

Note 1: Current approval is for 5am to 7am

Note 2: Proposed morning dispatch is for 4am to 7am

6.4 Blasting Assessment Methodology

The quarry currently operates within the overpressure and ground vibration limits stipulated in EPL. Historic blast monitoring data measured at Hartley Village are consistently below the trigger level of the blast monitor (100dBZ Peak and 0.51mm/s) with five of 72 blast events above the trigger level. A maximum level of 95.9dBZ Peak and 1.36mm/s was recorded during the period from July 2015 to November 2017. Blasting records for the previous 21 blasts show that the MIC ranges between 70kg to 170kg per delay. Typical blasts are over 100kg, with the average charge weight of 136kg.

Typically, where blast monitoring data is available, a site law can be developed for the calculation of future blasts. However, as blast levels are not available (as they are rarely triggered), an estimation of air-blast overpressure and ground-borne vibration levels has been conducted in accordance with methods in AS2187.2. The estimation adopted an MIC of 170kg with blasting locations assumed to be at the extremities of the extraction areas, which is a worst case scenario.

6.4.1 Air-Blast Overpressure

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

Where:

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

P = Pressure, in kilopascals;

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

R = Distance from charge, in metres;

Ka = 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:

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

6.4.2 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;

Kg = a constant related to site and rock properties for estimation purposes, a value of 1140 was adopted; and

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

7 Results

7.1 Stage B Operational Scenario

Predicted noise levels for Stage B of operations (see **Figure 3** and **Figure 4**) are provided in **Table 18** and as contours in **Appendix C.** The results show that noise emissions from operations satisfy relevant criteria at all assessed receivers.

Table 18 Stage B Operations Predicted Noise Levels

Calm Conditions								
Receiver	Predicted Noise Level, dB $LA_{eq,15min}$[1]				PNTL dB $LA_{eq,15min}$[1]			
	Day	Evening	Night[2] 4am-6am	Night[2] 6am-7am	Day	Evening	Night	Compliant
R9	26	25	<25	25	40	35	35	✓
R16	29	29	<25	28	40	35	35	✓
R22	<25	<25	<25	<25	40	35	35	✓
R23	25	25	<25	25	40	35	35	✓
R24A	27	27	<25	27	44	44	43	✓
R27	<25	<25	<25	<25	40	35	35	✓
R31	33	33	<25	32	40	35	35	✓
R48	30	29	<25	29	40	39	35	✓
R49	25	25	<25	25	40	39	35	✓
R54	31	31	27	30	40	35	35	✓
Prevailing WSW Wind								
Receiver	Predicted Noise Level, dB $LA_{eq,15min}$[1]				PNTL dB $LA_{eq,15min}$[1]			Compliant
	Day	Evening	Night[2] 4am-6am	Night[2] 6am-7am	Day	Evening	Night	
R9	29	29	<25	28	40	35	35	✓
R16	32	32	<25	32	40	35	35	✓
R22	<25	<25	<25	<25	40	35	35	✓
R23	<25	<25	<25	<25	40	35	35	✓
R24A	29	29	<25	29	44	44	43	✓
R27	<25	<25	<25	<25	40	35	35	✓
R31	30	29	<25	29	40	35	35	✓
R48	32	32	<25	32	40	39	35	✓
R49	27	27	<25	27	40	39	35	✓
R54	28	28	<25	27	40	35	35	✓

Table 18 Stage B Operations Predicted Noise Levels

Temperature Inversion								
Receiver	Predicted Noise Level, dB $LA_{eq,15min}$[1]				PNTL dB $LA_{eq,15min}$[1]			Compliant
	Day	Evening	Night[2] 4am-6am	Night[2] 6am-7am	Day	Evening	Night	
R9	n/a	29	<25	28	40	35	35	✓
R16	n/a	32	<25	32	40	35	35	✓
R22	n/a	25	<25	<25	40	35	35	✓
R23	n/a	27	<25	27	40	35	35	✓
R24A	n/a	30	<25	30	44	44	43	✓
R27	n/a	25	<25	<25	40	35	35	✓
R31	n/a	35	25	35	40	35	35	✓
R48	n/a	32	<25	32	40	39	35	✓
R49	n/a	27	<25	27	40	39	35	✓
R54	n/a	34	29	33	40	35	35	✓

Note 1: 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.

Note: 2: Product loading and dispatch operations only from 4am to 6am; extractive operations, processing, product loading and dispatch from 6am to 7am.

7.2 Maximum Noise Level Assessment - Operations

Predicted noise levels from $LA_{eq,15min}$ and LA_{max} events for assessed receivers are presented in **Table 19.** Results identify that the maximum noise level screening criterion is satisfied at all receivers and a detailed maximum noise level assessment is not required.

Table 19 Stage B Operations – Maximum Noise Level Assessment (Night)[1]

Calm Conditions					
Receiver	Predicted Noise Level[2], dBA		Screening Criterion, dBA		Compliant
	$LA_{eq,15min}$	LA_{max}	$LA_{eq,15min}$	LA_{max}	
R9	25	36	40	52	✓
R16	28	39	40	52	✓
R22	22	33	40	52	✓
R23	25	35	40	52	✓
R24A	27	37	43	53	✓
R27	<25	32	40	52	✓
R31	32	43	40	52	✓
R48	29	40	40	52	✓
R49	25	35	40	52	✓
R54	30	41	40	52	✓

Table 19 Stage B Operations – Maximum Noise Level Assessment (Night)[1]					
Prevailing WSW Wind					
Receiver	Predicted Noise Level[2], dBA		Screening Criterion, dBA		Compliant
	$L_{Aeq,15min}$	L_{Amax}	$L_{Aeq,15min}$	L_{Amax}	
R9	28	39	40	52	✓
R16	32	42	40	52	✓
R22	<25	31	40	52	✓
R23	<25	33	40	52	✓
R24A	29	39	43	53	✓
R27	<25	30	40	52	✓
R31	29	40	40	52	✓
R48	32	42	40	52	✓
R49	27	37	40	52	✓
R54	27	38	40	52	✓
Temperature Inversion					
Receiver	Predicted Noise Level[2], dBA		Screening Criterion, dBA		Compliant
	$L_{Aeq,15min}$	L_{Amax}	$L_{Aeq,15min}$	L_{Amax}	
R9	28	39	40	52	✓
R16	32	42	40	52	✓
R22	<25	35	40	52	✓
R23	27	38	40	52	✓
R24A	30	40	43	53	✓
R27	<25	35	40	52	✓
R31	35	46	40	52	✓
R48	32	42	40	52	✓
R49	27	37	40	52	✓
R54	33	44	40	52	✓

Note 1: Monday to Saturday; Night 10pm to 7am.

Note 2: Predicted LAeq and LAmax is the maximum level during the period 4am to 7am

7.3 Low Frequency Noise

Analysis of the dBC and dBA noise levels measured during compliance surveys has been undertaken. The measurements were 15 minutes in duration with one second samples, resulting in 900 samples per measurement. The measurements were analysed to determine representative dBC – dBA levels to evaluate ambient low frequency noise levels as well as observed audible events attributable to the quarry.

The results of the analysis are presented in **Table 20** detailing the time and date of the measurements, the overall 15-minute dBA and dBC levels and the average dBC – dBA value calculated from the one second samples. The analysis determined that the dBC – dBA values are less than the NPI screening criterion of 15dB when the quarry was operational indicating that low frequency noise is not a feature at the receiver locations. Therefore, the low frequency noise modifying factors are not applicable.

Table 20 Low Frequency Noise

Location/ Date/ Time	dB $LA_{eq,15min}$	dB $LC_{eq,15min}$	Average $LA_{eq} - LC_{eq}$	Quarry Operating	Comments & Observations
R54 6-12-2017 18:16	50	62	13.3	Not Operating	Birds, insects, livestock, light aircraft
R24A 6-12-2017 18:43	59	66	6.1	Not Operating	Creek flow noise, birds, insects, traffic
R54 7-12-2017 06:45	41	53	12.5	Operating	Analysis during observed noise event from quarry (haul truck) shows dBC-dBA <15dB
R54 7-12-2017 08:22	47	54	11.4	Operating	Birds, insects, livestock, light aircraft, distant road traffic
R24A 7-12-2017 06:21	67	77	9.2	Operating	Creek flow noise, birds, insects, traffic
R24A 7-12-2017 07:55	68	79	9.2	Operating	Creek flow noise, birds, insects, traffic

7.4 VLAMP Assessment - Operations

Table 21 presents the findings of noise predictions for the VLAMP assessment. Results demonstrate that the VLAMP criteria are satisfied for all identified vacant lands surrounding the Quarry Site.

Table 21 Stage B Operations – Vacant Lands Assessment[1]

	Predicted Noise Level, dB $LA_{eq,15min}$[1]				VLAMP Criteria dB $LA_{eq,15min}$[2]			
Land	Day	Evening	Night[2] 4am-6am	Night[2] 6am-7am	Day	Evening	Night	Compliant
L17, L19	34	34	<25	33	45	40	40	✓
L32	30	35	26	35	45	40	40	✓
L50	32	32	<25	32	45	44	40	✓

Note 1: Predicted value is the maximum LAeq for all assessment conditions – Calm, WSW wind and temperature inversion for each period.

Note 2: Most stringent VLMAP criteria (Table 9)

7.5 Road Traffic Noise Predictions

The closest and potentially most affected residential receiver from project related road traffic noise is residence R24A, 200 Jenolan Caves Road, Hartley. The dwelling façade is approximately 7m from the road (10m from the centreline). The results of the traffic noise calculations at this receiver are presented in **Table 22**, resulting in negligible increases (<0.5dB) in road traffic noise levels for both the daytime and night time assessment periods. Hence, the project related road traffic noise levels satisfy the relevant RNP criteria.

Table 22 Operational Road Traffic Noise Levels at R24A - 10m from road centreline

Assessment Criteria[1]	Predicted Existing Quarry Traffic[2]	Future Quarry Traffic Noise	Predicted Existing Non Quarry Road Traffic Noise[2]	Predicted Existing Road Traffic Noise[3]	Future Road Traffic Noise[3]	Total Change[3]
Day 60dB $LA_{eq,15hr}$	57.1	58.0	67.7	68.08	68.14	0.08
Night 55dB $LA_{eq,9hr}$	49.3	49.3	57.5	58.12	58.12	0.0

Note 1: Day 7am to 10pm. Night 10am to 7am

Note 2: EIS Noise 2014 – Table 6.1.

Note 3: Predicted noise levels shown to two decimal places to demonstrate the minor change otherwise not presented when rounded

7.6 Blasting Results

Airblast overpressure and vibration levels are predicted to meet the criteria at all assessed receivers for blasts up to 170kg MIC in the Stage 2 extraction area. Detailed airblast overpressure and vibration results are presented in **Table 23**.

Table 23 Blasting Emissions Results

Blast Location	Easting	Northing	Height, m AHD	Receiver	R9	R16	R22	R23	R24A	R27	R31	R48	R49	R54
Stage 2 East	236432	6280872	760	Distance from Blast	2912	2073	4901	4481	3661	3268	1955	3182	3853	3154
				Airblast - dBZ Peak	103	107	96	98	100	102	108	102	100	102
				Ground Vibration - PPV, mm/s	0.2	0.3	0.1	0.1	0.1	0.2	0.4	0.2	0.1	0.2
Stage 2 North	236321	6281056	764	Distance from Blast	2983	2241	4751	4288	3451	3443	1885	3079	3842	3032
				Airblast - dBZ Peak	103	106	97	98	101	101	109	102	100	103
				Ground Vibration - PPV, mm/s	0.2	0.3	0.1	0.1	0.2	0.2	0.4	0.2	0.1	0.2
Stage 2 South	236012	6280514	737	Distance from Blast	3414	2404	4603	4362	3894	2899	1513	3703	4403	2798
				Airblast - dBZ Peak	101	105	97	98	99	103	111	100	98	104
				Ground Vibration - PPV, mm/s	0.2	0.3	0.1	0.1	0.1	0.2	0.6	0.1	0.1	0.2
Stage 2 South East	236323	6280647	758	Distance from Blast	3078	2120	4856	4521	3841	3035	1823	3433	4075	3074
				Airblast - dBZ Peak	102	107	97	97	100	103	109	101	99	102
				Ground Vibration - PPV, mm/s	0.2	0.3	0.1	0.1	0.1	0.2	0.4	0.2	0.1	0.2
Stage 2 West	236127	6280862	776	Distance from Blast	3211	2361	4608	4235	3582	3246	1652	3347	4110	2850
				Airblast - dBZ Peak	102	106	97	98	100	102	110	101	99	103
				Ground Vibration - PPV, mm/s	0.2	0.3	0.1	0.1	0.1	0.2	0.5	0.2	0.1	0.2

8 Discussion and Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has conducted a Noise and Blasting Impact Assessment (NBIA) for the proposed modification to SSD 6084 of the Austen Quarry Stage 2 Extension Project at Hartley, NSW. The assessment has quantified potential noise emissions including extraction, processing, dispatch and transportation via road trucks from the Quarry Site.

The quarry currently operates within the EPL noise limits of 35dB $LA_{eq,15min}$ at all receiver locations, and the proposed operations are generally consistent with current operations. However, notwithstanding this, the results of the NBIA demonstrate that operational noise levels comply with the relevant NPI criteria for all assessment periods and prevailing meteorological conditions at all privately owned non-project related receivers.

Operational noise levels are predicted to comply with the VLAMP criteria on any identified vacant lands surrounding the project for all assessment periods and meteorological conditions.

Additionally, the NBIA demonstrates that the road noise criteria as specified in the RNP will be satisfied at receiver distances of greater than 10m and project related vehicles will not increase existing road noise levels by more than 2dB.

The quarry currently operates within the blasting emissions limits stipulated in EPL. Existing proven blasting practice at the quarry will be maintained, including the separation distances and assentation of the blast faces. Notwithstanding, calculations of airblast overpressure and ground vibration for blasts based on the maximum MIC used on site for the Stage 2 extraction area are predicted to meet the criteria at all identified receivers.

Based on the Noise and Blast Impact Assessment results, there are no noise or blast related issues which would prevent the approval of the proposed modifications. The results of the assessment show compliance with the relevant operational and road traffic noise criteria. Additionally, the results of the assessment demonstrate compliance with the relevant EPA and DECCW policies, without modification to noise mitigation and management measures, design safeguards, controls or compliance procedures being required.

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Appendix A – Glossary of Terms

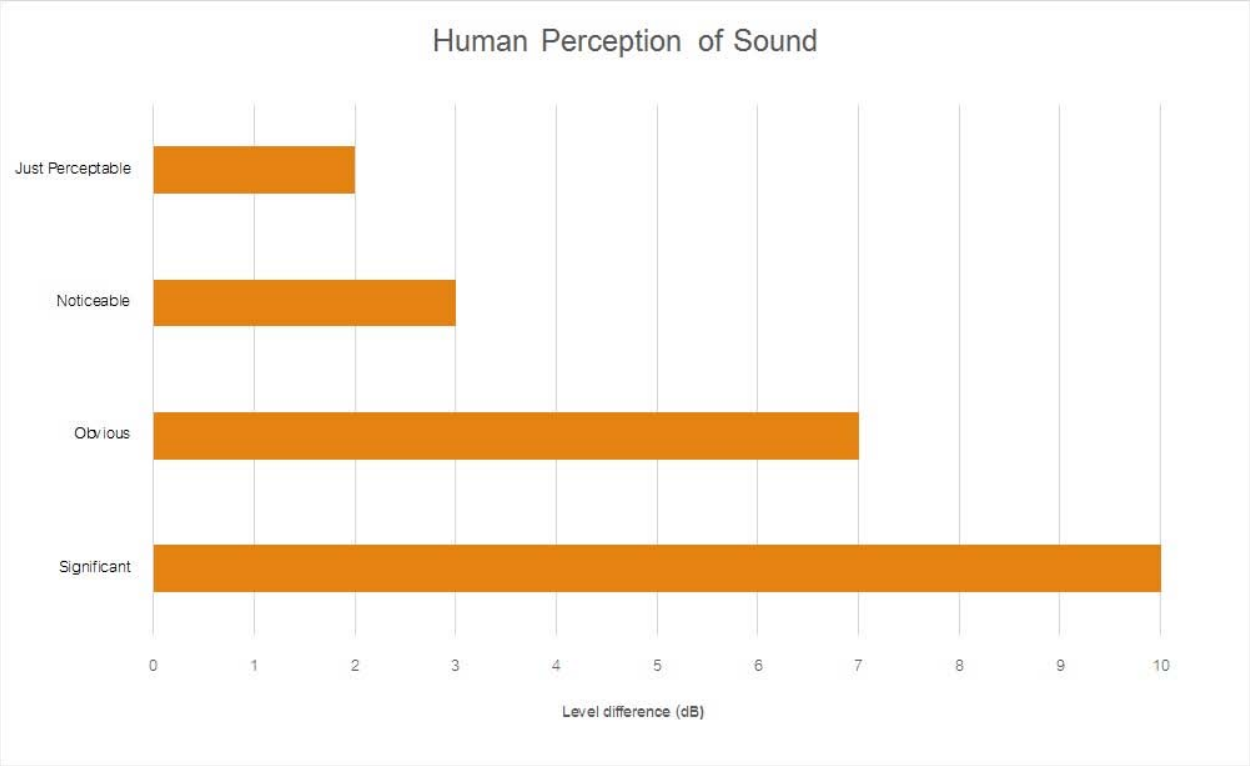
Table A1 provides a list of technical terms have been used in this report.

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 INP as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured LA90 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.
dBA	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 dBA, 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 (L_W)	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), dBA	
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 Meteorological Conditions, Mount Boyce NSW									
Direction ± 45°	Season	Day	Evening	Night	Direction	Season	Day	Evening	Night
		Percentage Occurrence %					Percentage Occurrence %		
0	Summer	2	1	3	180	Summer	6	4	10
0	Autumn	6	3	6	180	Autumn	6	5	9
0	Winter	6	3	6	180	Winter	4	6	6
0	Spring	2	1	3	180	Spring	4	4	6
22.5	Summer	3	2	4	202.5	Summer	17	14	25
22.5	Autumn	6	3	6	202.5	Autumn	12	16	17
22.5	Winter	6	3	7	202.5	Winter	9	11	8
22.5	Spring	3	3	4	202.5	Spring	11	13	15
45	Summer	9	4	10	225	Summer	45	57	50
45	Autumn	14	7	13	225	Autumn	33	48	30
45	Winter	14	11	14	225	Winter	18	24	15
45	Spring	11	10	13	225	Spring	29	41	29
67.5	Summer	11	5	12	247.5	Summer	46	56	51
67.5	Autumn	15	7	13	247.5	Autumn	36	50	32
67.5	Winter	14	10	13	247.5	Winter	19	25	15
67.5	Spring	10	10	15	247.5	Spring	29	39	30
90	Summer	10	5	13	270	Summer	43	56	49
90	Autumn	14	6	13	270	Autumn	35	50	30
90	Winter	13	10	13	270	Winter	18	23	14
90	Spring	10	11	15	270	Spring	28	38	29
112.5	Summer	11	6	14	292.5	Summer	38	57	35
112.5	Autumn	14	7	14	292.5	Autumn	30	40	23
112.5	Winter	13	12	15	292.5	Winter	15	18	12
112.5	Spring	11	12	17	292.5	Spring	24	34	20
135	Summer	9	5	12	315	Summer	12	10	13
135	Autumn	13	6	13	315	Autumn	14	12	14
135	Winter	13	11	13	315	Winter	7	7	7
135	Spring	10	8	13	315	Spring	8	6	7
157.5	Summer	4	4	8	337.5	Summer	2	2	4
157.5	Autumn	4	4	7	337.5	Autumn	5	3	6
157.5	Winter	3	5	7	337.5	Winter	4	3	4
157.5	Spring	3	4	6	337.5	Spring	2	1	3

Appendix C – Stage B Operations

Noise Contours

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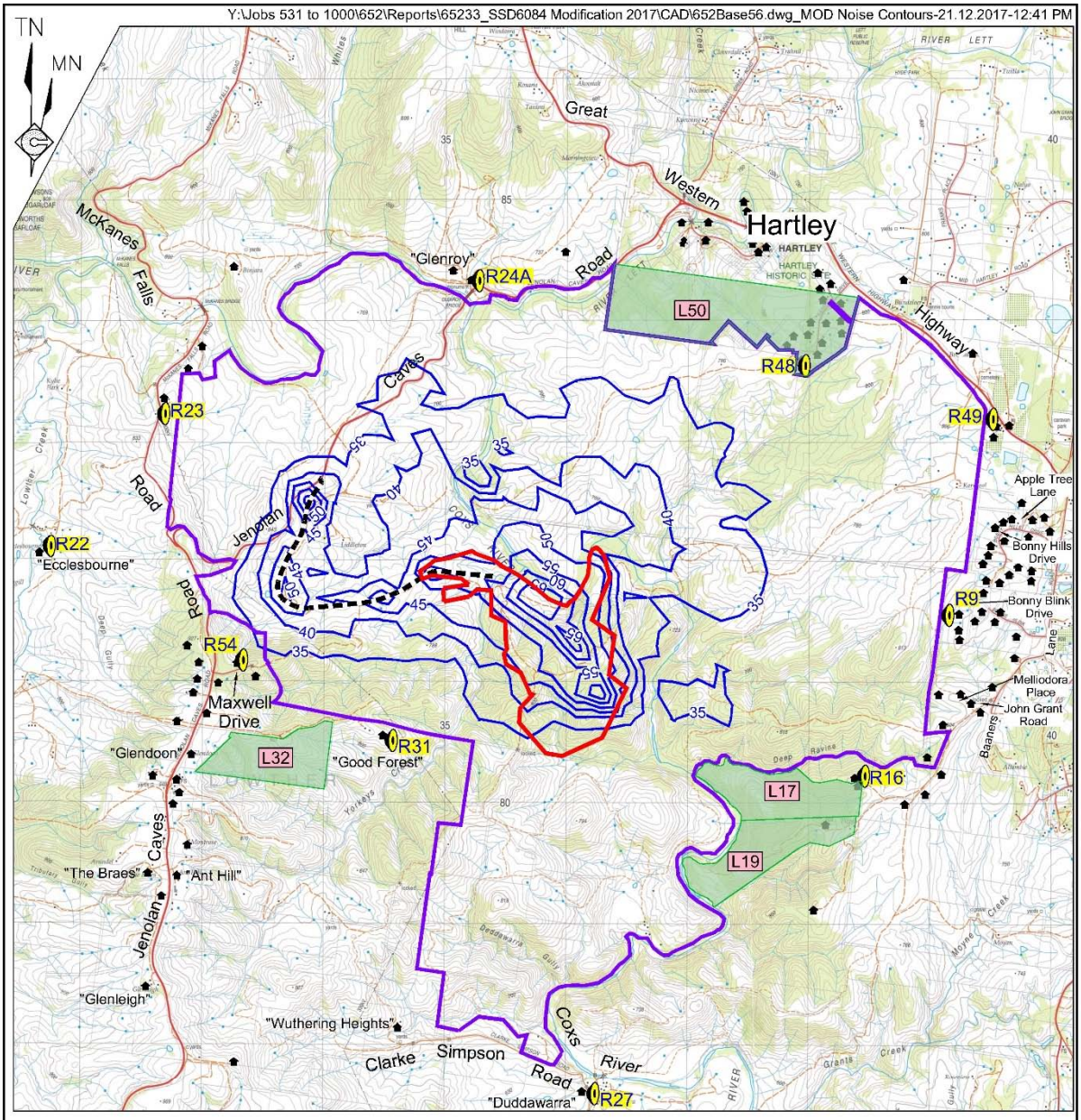

Figure C1
PREDICTED NOISE LEVELS - dB LAeq, 15min
DAYTIME - CALM CONDITIONS

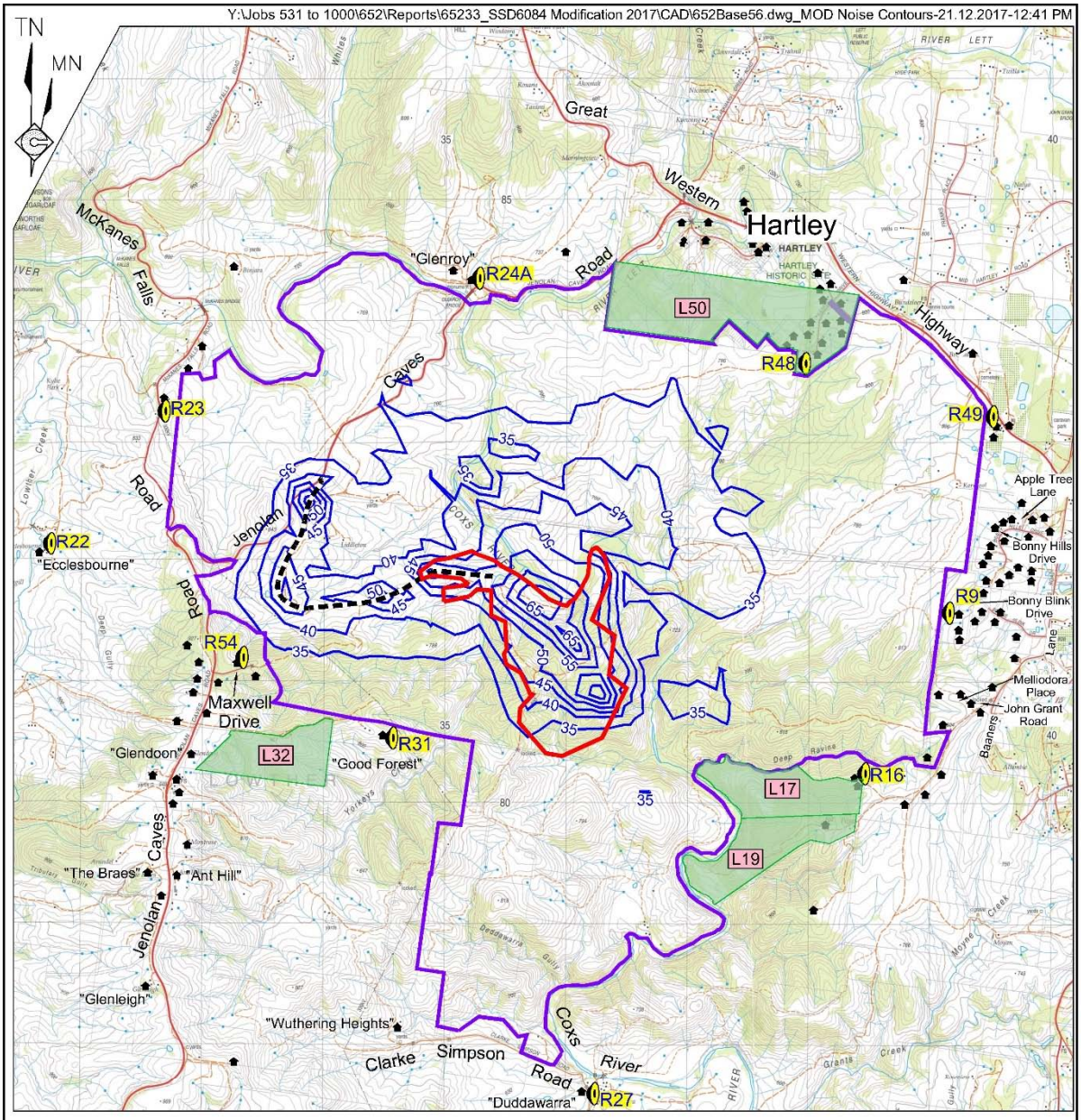

Figure C2
PREDICTED NOISE LEVELS - dB LAeq, 15min
EVENING - CALM CONDITIONS

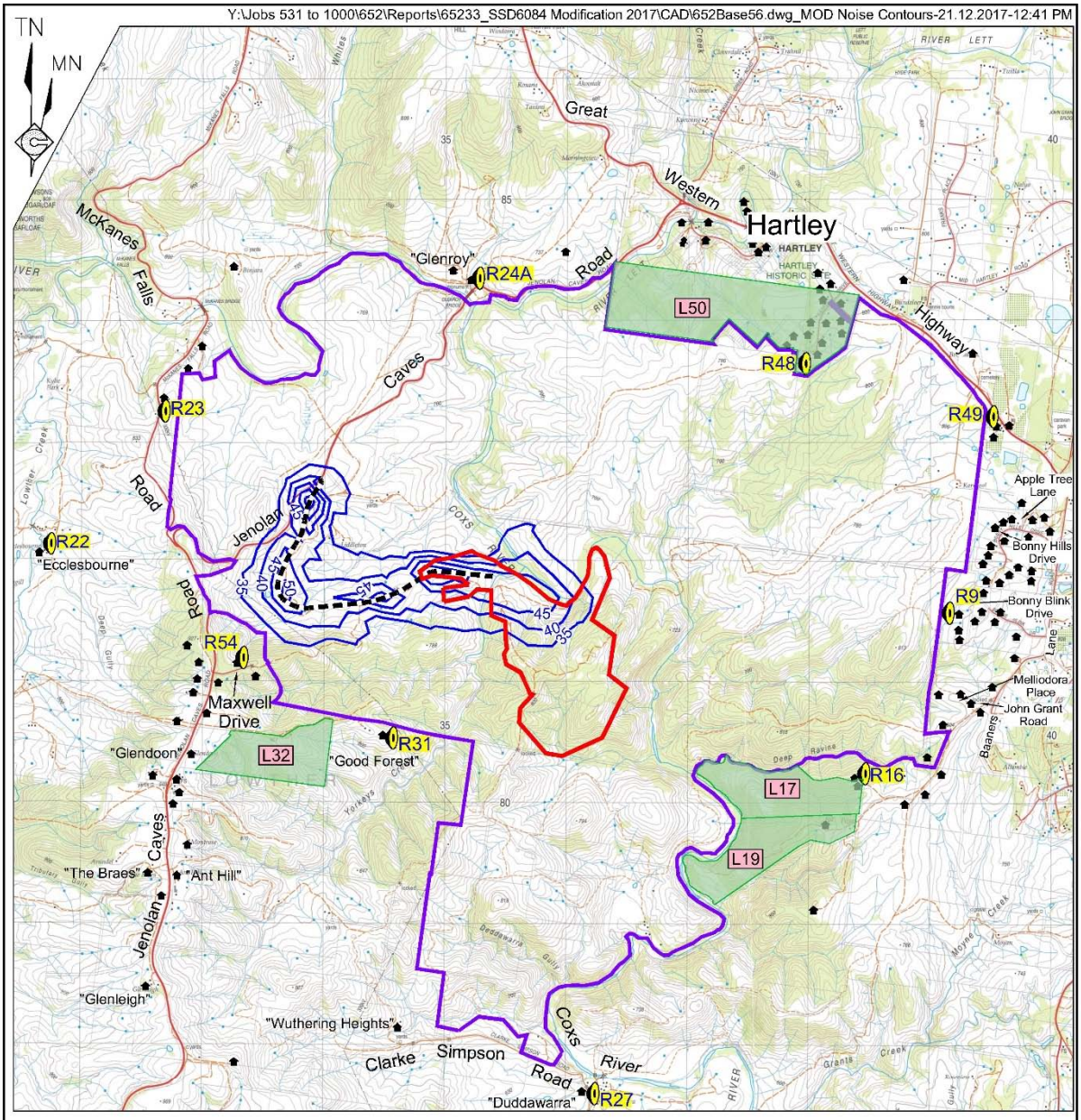

Figure C3
PREDICTED NOISE LEVELS - dB LAeq, 15min
NIGHT - CALM CONDITIONS

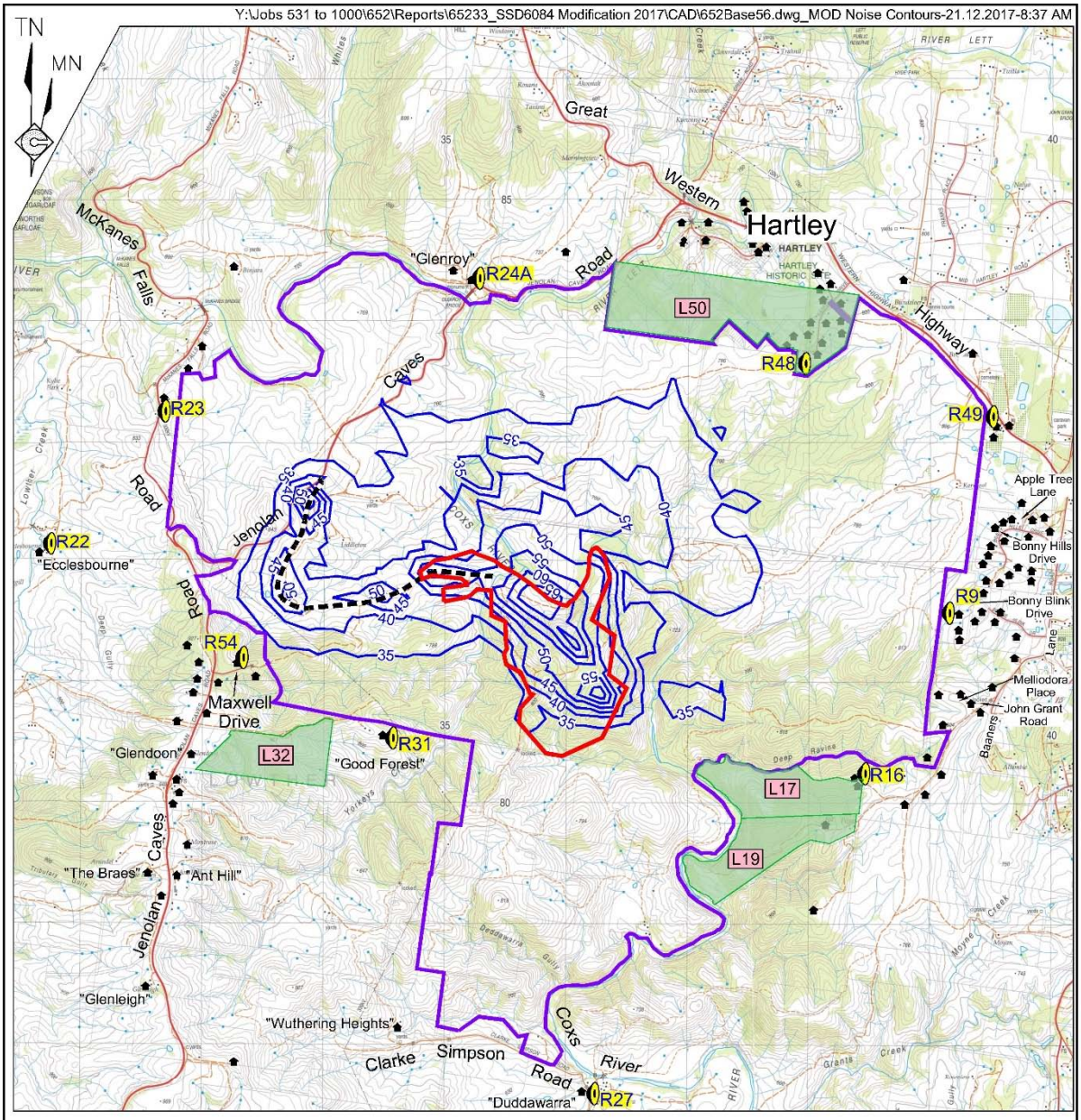

Figure C4
PREDICTED NOISE LEVELS - dB LAeq, 15min
MORNING SHOULDER - CALM CONDITIONS

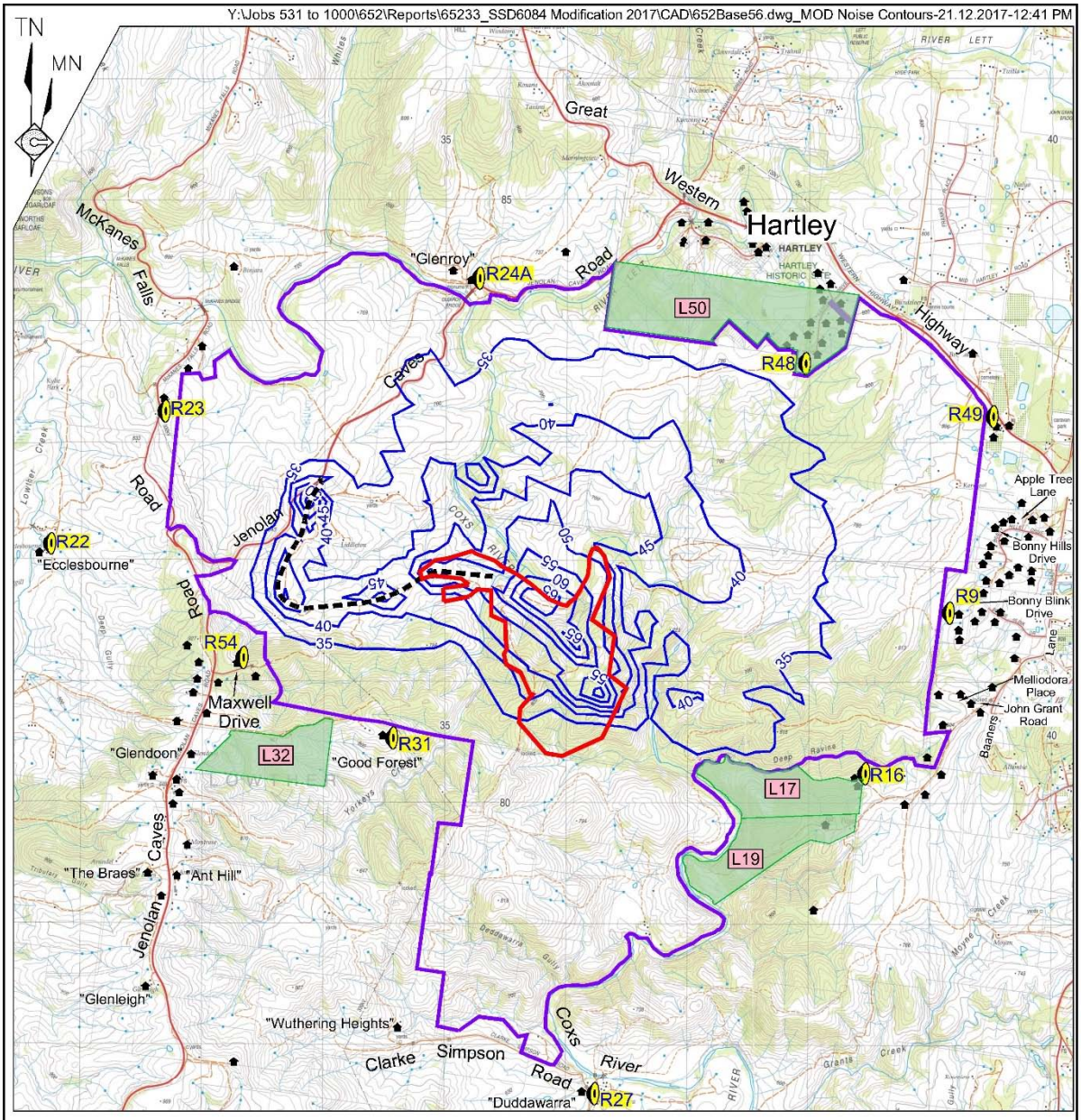

Figure C5
PREDICTED NOISE LEVELS - dB LAeq, 15min
DAYTIME - PREVAILING WSW WIND

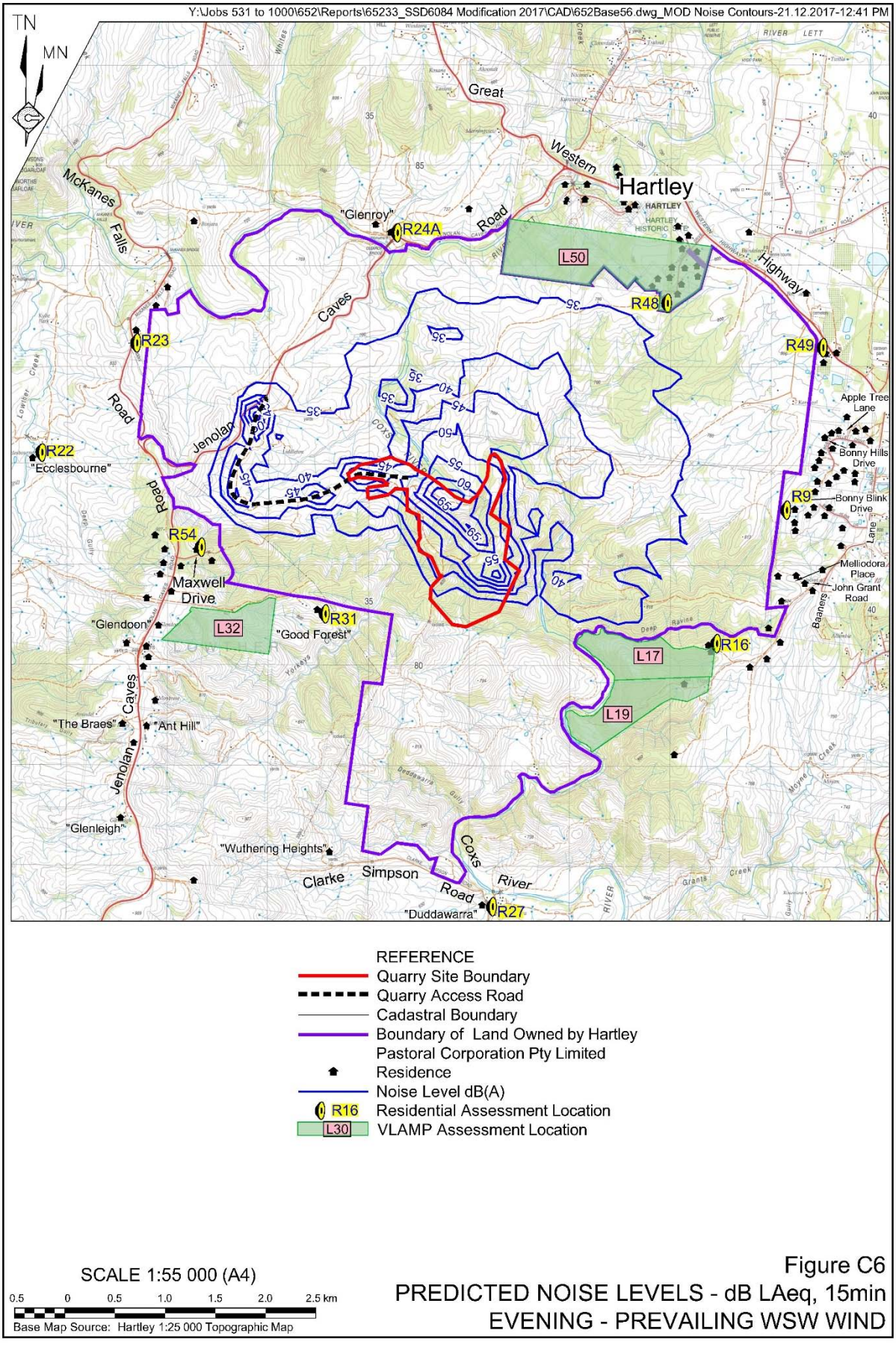

Figure C6
PREDICTED NOISE LEVELS - dB LAeq, 15min
EVENING - PREVAILING WSW WIND

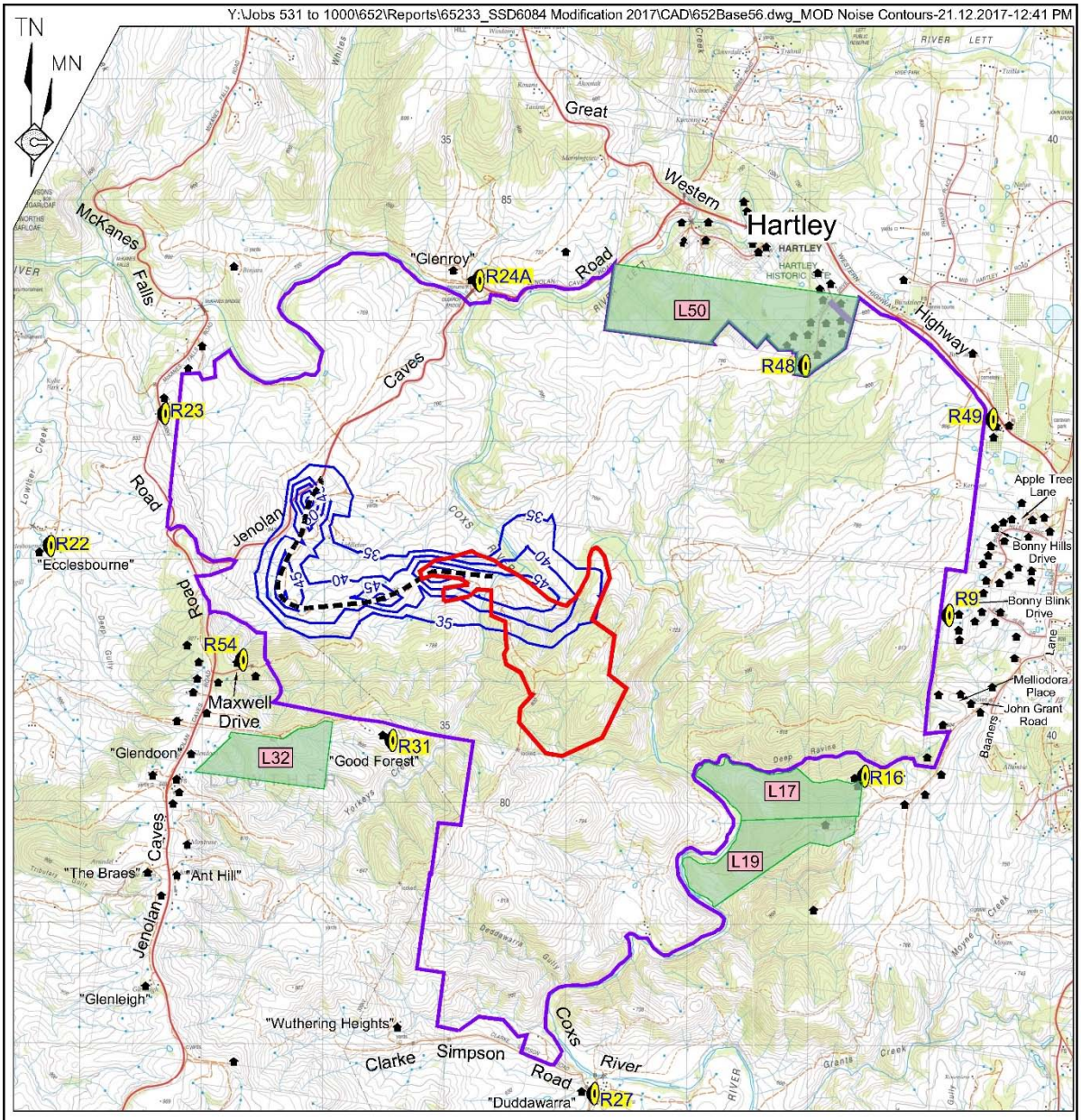

Figure C7
PREDICTED NOISE LEVELS - dB LAeq, 15min
NIGHT- PREVAILING WSW WIND

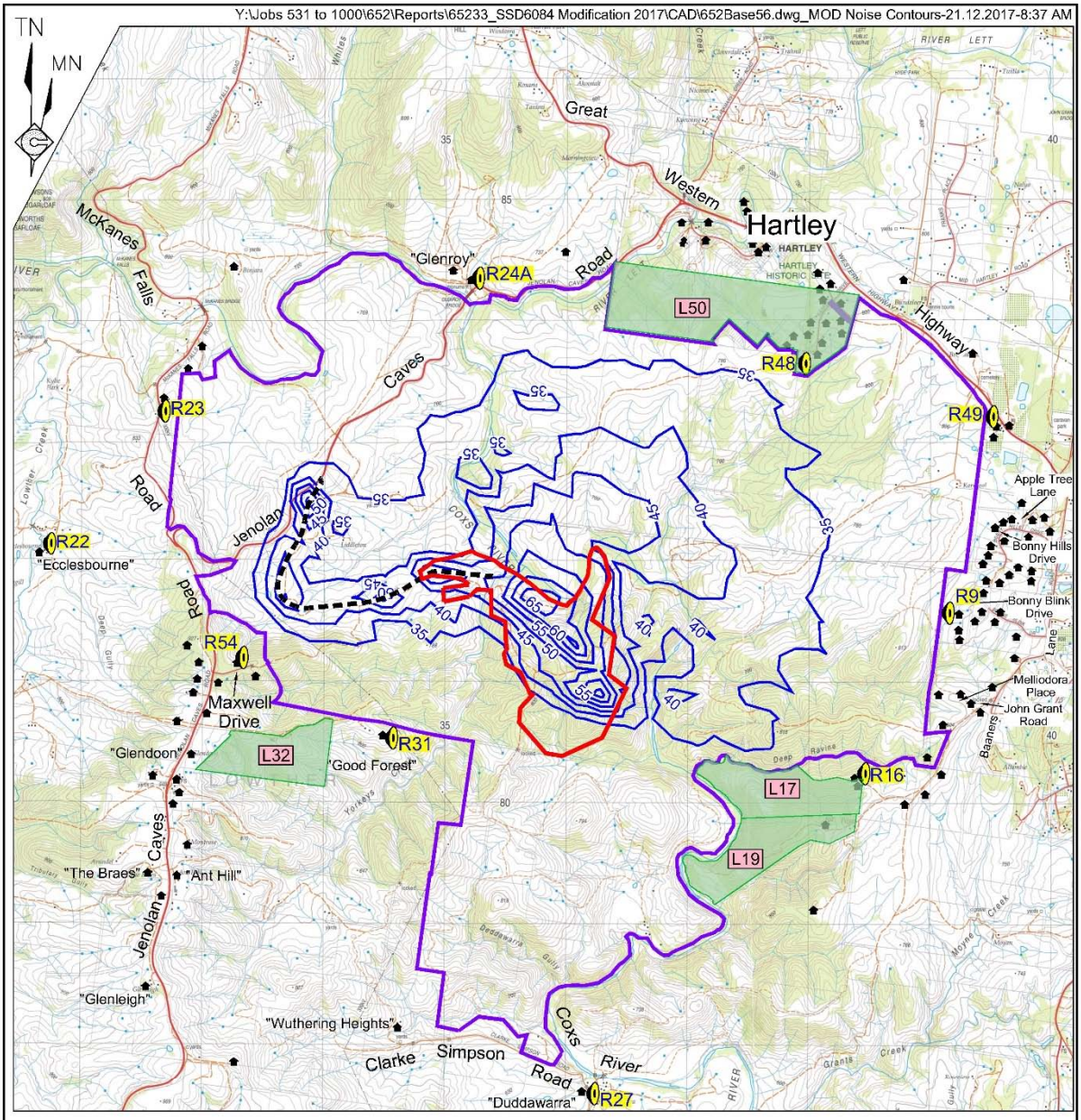

Figure C8
PREDICTED NOISE LEVELS - dB LAeq, 15min
MORNING SHOULDER- PREVAILING WSW WIND

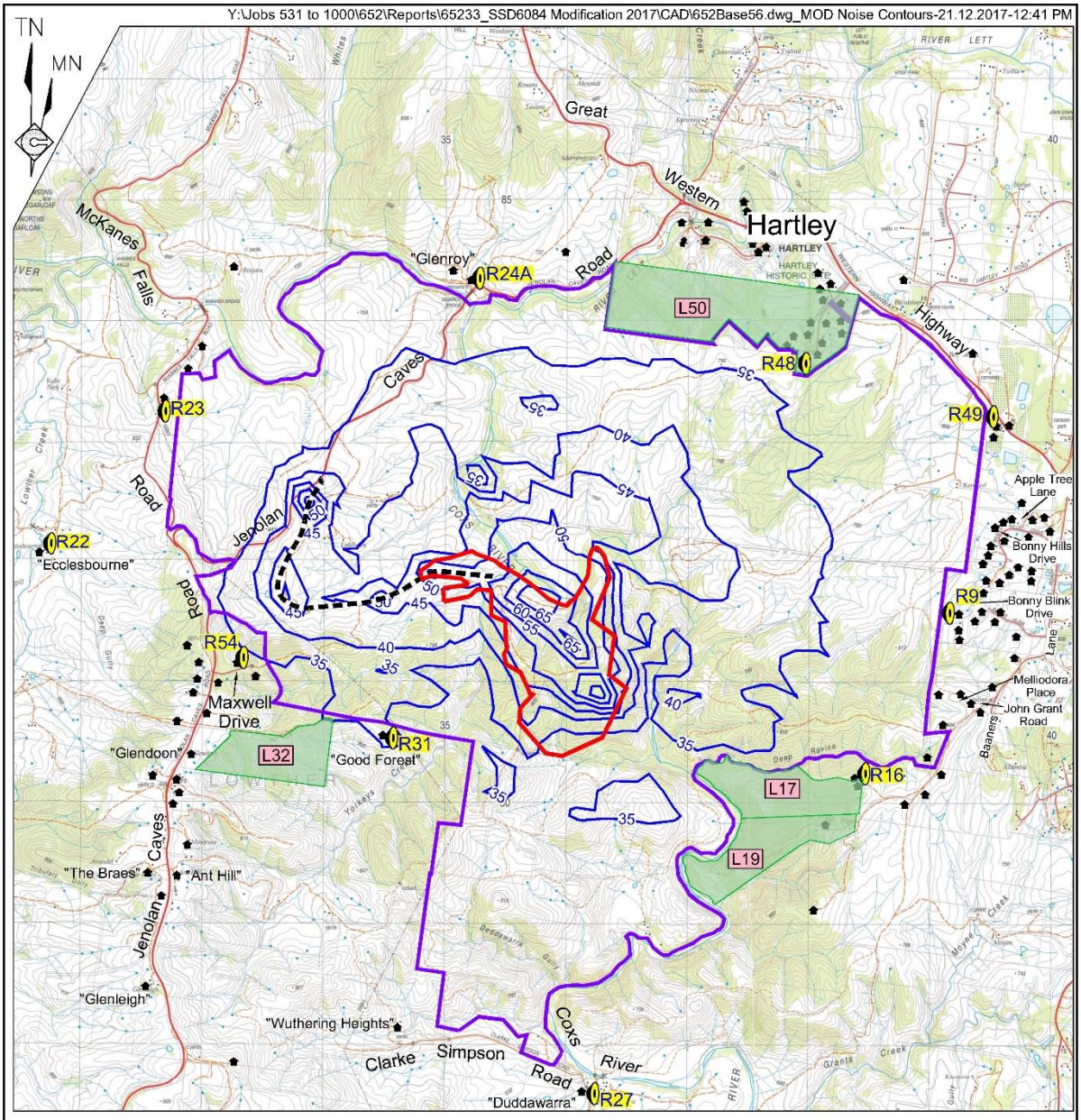

Figure C9
PREDICTED NOISE LEVELS - dB LAeq, 15min
EVENING - TEMPERATURE INVERSION

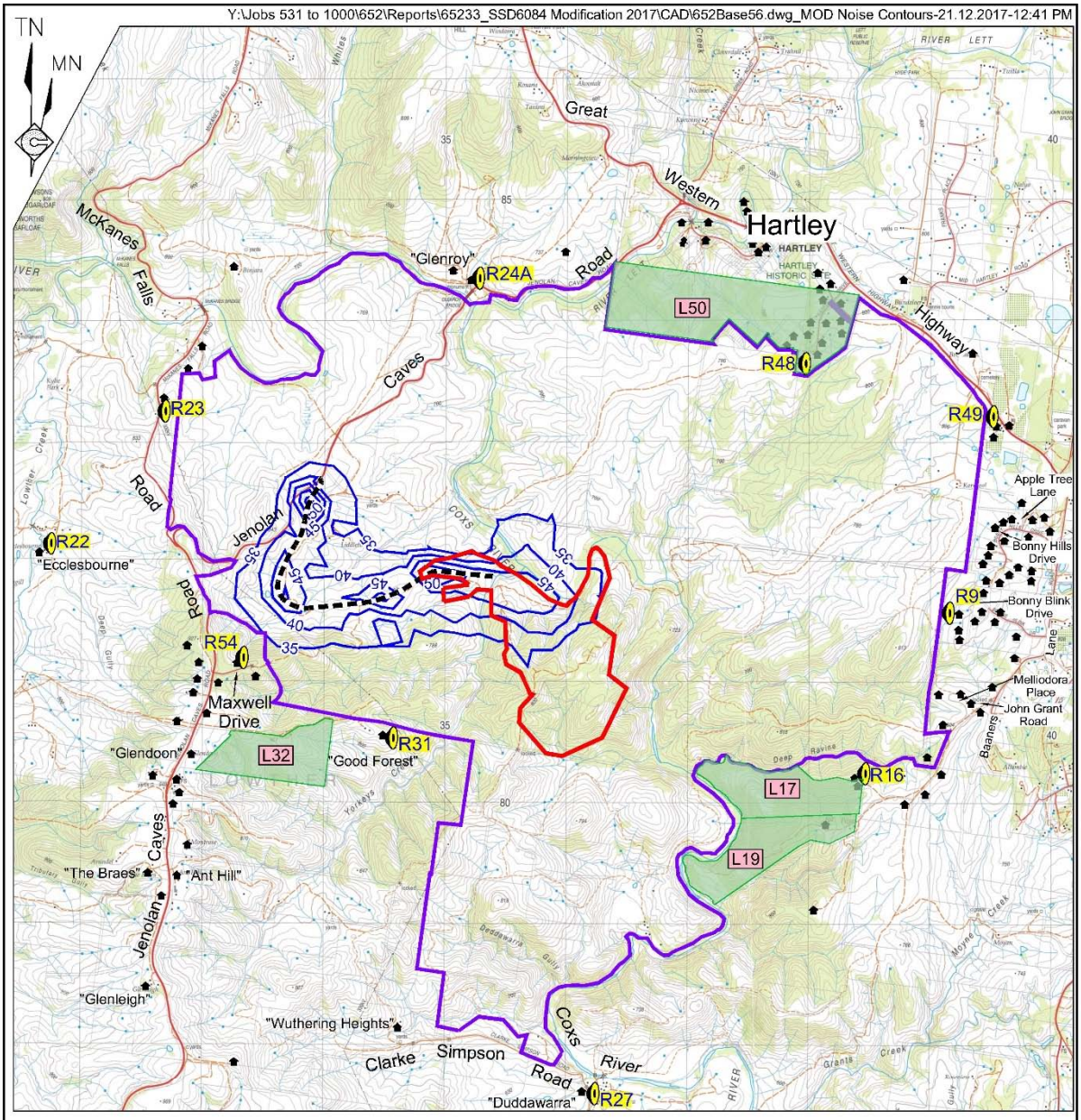

Figure C10
PREDICTED NOISE LEVELS - dB LAeq, 15min
NIGHT - TEMPERATURE INVERSION

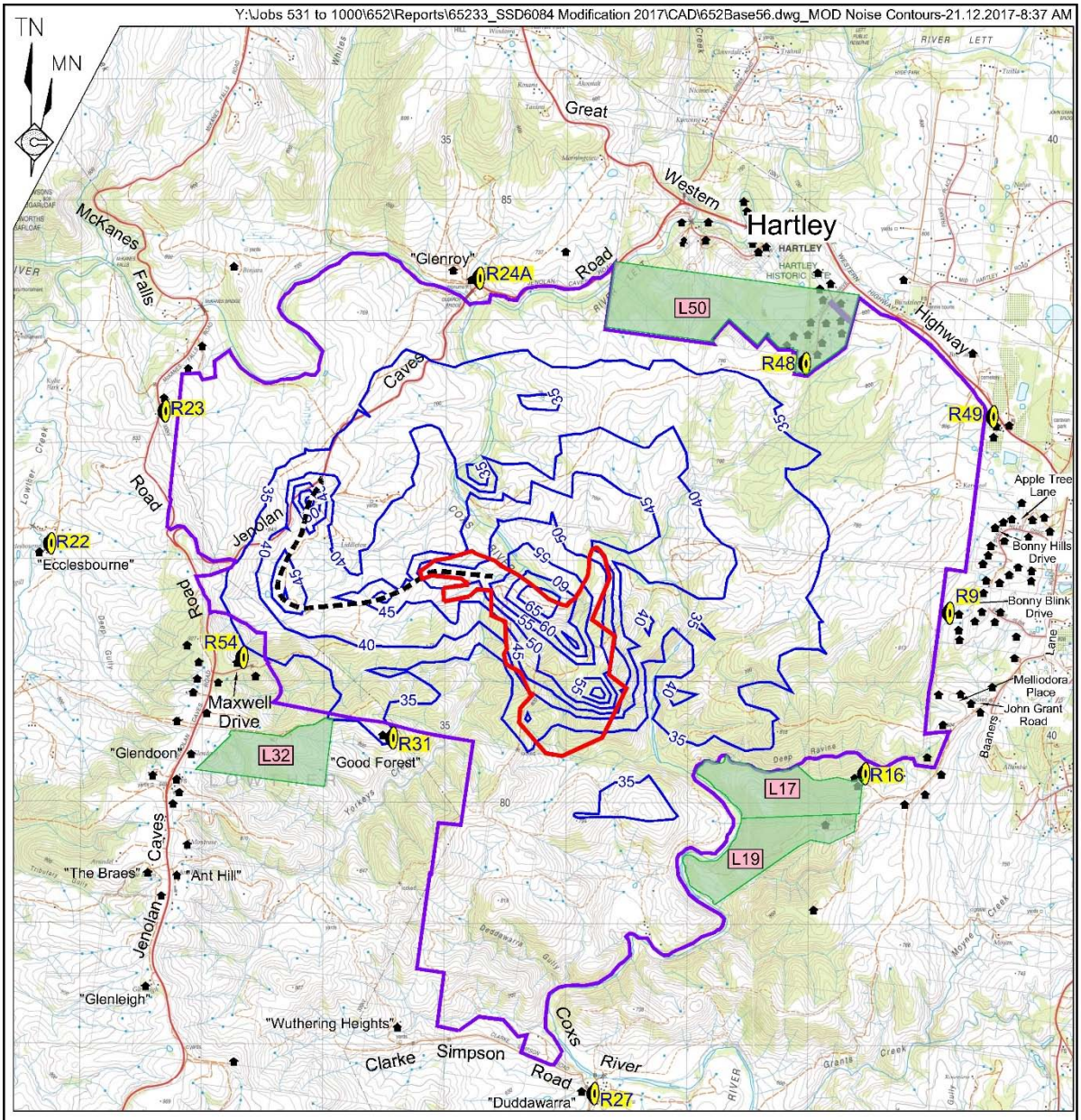

Figure C11
PREDICTED NOISE LEVELS - dB LAeq, 15min
MORNING SHOULDER - TEMPERATURE INVERSION

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MAC
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