Appendix 8

Noise and Vibration Impact Assessment

prepared by Spectrum Acoustics Pty Limited

(Total No. of pages including blank pages = 32)

This page has intentionally been left blank

DARRYL MCCARTHY
CONSTRUCTIONS PTY LTD

ABN: 86 001 646 028

Dowe's Quarry

Noise and Vibration Impact Assessment

Prepared by

SPECTRUM ACOUSTICS
NOISE AND VIBRATION CONSULTANTS

September 2019

Appendix 8

This page has intentionally been left blank

DARRYL MCCARTHY CONSTRUCTIONS PTY LTD

ABN: 86 001 646 028

Noise and Vibration Impact Assessment

Prepared for: R.W. Corkery & Co. Pty Limited
1st Floor, 12 Dangar Road
PO Box 239
BROOKLYN NSW 2083

Tel: (02) 9985 8511
Email: brooklyn@rwcorkery.com

On behalf of: Darryl McCarthy Constructions Pty Ltd
ABN: 86 001 646 028
PO Box 246
TENTERFIELD NSW 2372

Tel: (02) 6736 1988
Fax: (02) 6736 1385
Email: dmccarthy@nqq.com.au

Prepared by: Spectrum Acoustics Pty Limited
30 Veronica Street
CARDIFF NSW 2285

Tel: (02) 4954 2276
Email: neil@spectrumacoustics.com.au

September 2019

SPECTRUM ACOUSTICS
NOISE AND VIBRATION CONSULTANTS

CONTENTS

FIGURES

TABLES

COMMONLY USED ACRONYMS

AHD	Australian Height Datum
ANZEC	Australian and New Zealand Environment and Council
ANZECC	Australian and New Zealand Environment and Conservation Council
DEC	Department of Environment and Conservation
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
DPE	Department of Planning and Environment
DRG	Division of Resources and Geoscience
EIS	*Environmental Impact Statement*
ENM	Environmental Noise Model
EPA	Environment Protection Authority
OEH	Office of Environment and Heritage
MIC	Maximum Instantaneous Charge
MS	Morning Shoulder
NPI	*NSW Noise Policy for Industry*
OP	overpressure levels
PNTLs	project noise trigger levels
PPV	peak particle vibration
PVS	Peak Vector Sum
RBL	Rating Background Levels
RH	relative humidity
RMS	Roads and Maritime Services
RNP	*NSW Road Noise Policy*
RTA	Renzo Tonin Associates
SEARs	Secretary's Environmental Assessment Requirements
SPL	Sound Pressure Level
VLAMP	*Voluntary Land Acquisition and Mitigation Policy*

This page has intentionally been left blank

EXECUTIVE SUMMARY

A noise impact assessment has been conducted for the proposed continued operation and extension of the Dowe's Quarry ("the Proposal") including transportation of raw materials to the Sunnyside Crushing and Screening Plant. The site of the existing Dowe's Quarry and proposed quarry extension ("the Quarry Site") is approximately 1.1km west of the Mt Lindesay Road approximately 8km northeast of Tenterfield.

Operation of the quarry and road transportation of materials would only occur during daytime hours.

Documents referred to in conducting the assessment include:

- NSW Noise Policy for Industry (NPI), EPA, 2017;
- NSW Road Noise Policy (RNP), OEH, 2011; and
- "Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration – September 1990" (ANZECC).

The NSW Noise Policy for Industry (NPI) default minimum background noise level of 35 dB(A) was adopted to establish a noise emission criterion of 40 dB(A),$L_{eq(15minute)}$ for activities on site.

An assessment of available meteorological data found that winds of speeds up to 3 m/s occurred for less than 15% of the time during any season, implying that winds are not an assessable feature with regards to noise impact assessment.

Noise modelling was conducted to produce point calculations for two operational scenarios to individual residential receivers. Results are presented in tabular form.

Predicted operational noise levels were less than the noise trigger levels at all assessed receivers, for both operational scenarios.

Blast overpressure and ground vibrations levels below the criteria have been predicted at all receivers.

Road traffic noise levels below the criteria have been predicted at all receivers.

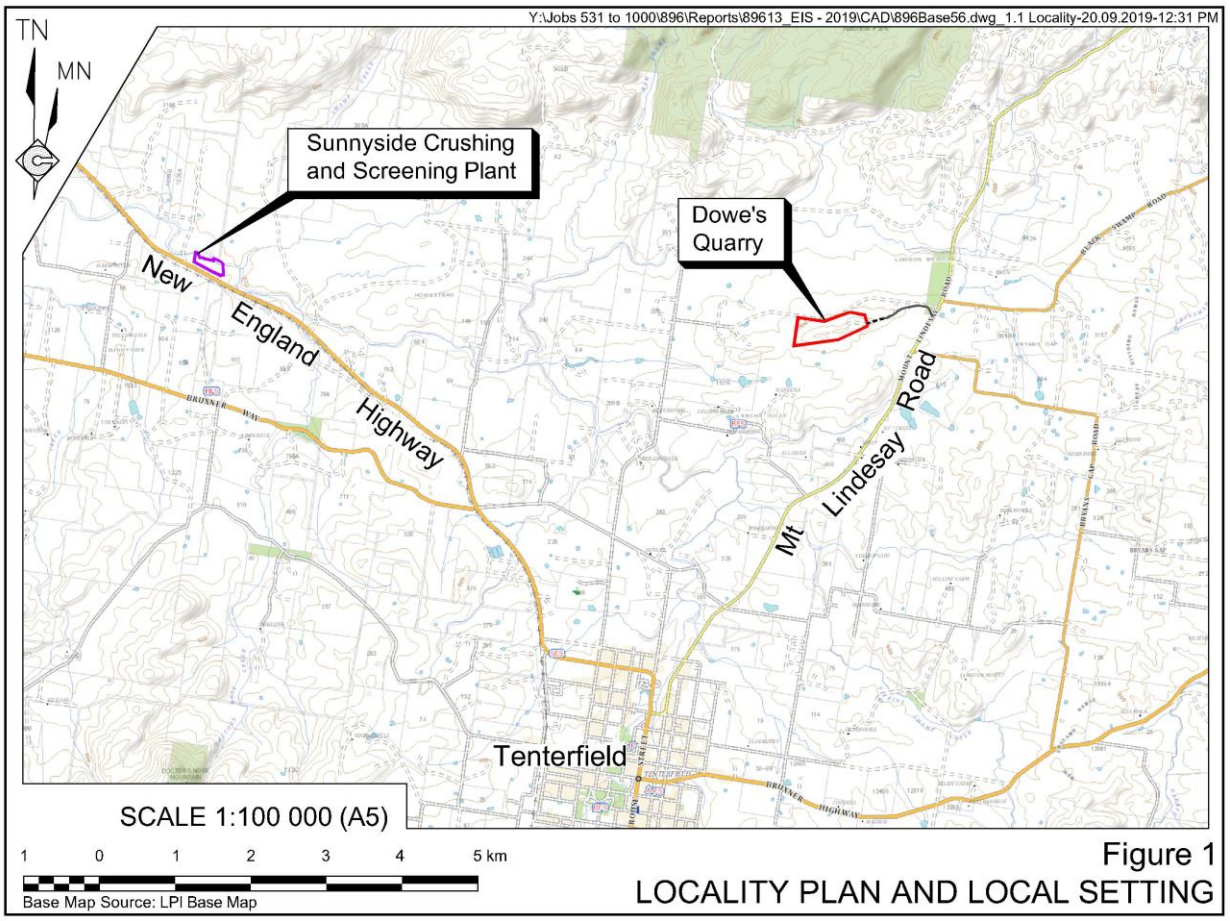
In summary, the assessment has found that the Proposal would be able to operate in compliance with the appropriate noise criteria for operational and road traffic noise emissions.

This page has intentionally been left blank

1. INTRODUCTION

1.1 OBJECTIVES OF THE PROPOSAL

Darry McCarthy Construction Pty. Ltd. ("the Applicant") proposes to extend operations at Dowe's Quarry which produces a range of ivory coloured stone products. The site of the existing Dowe's Quarry and proposed quarry extension ("the Quarry Site") is approximately 1.1km west of the Mt Lindesay Road approximately 8km northeast of Tenterfield, within the Tenterfield Local Government Area (see **Figure 1**).



The Quarry has been operating in this location since 1987. The existing operations are approved under Development Consent 2014.078 (DA 2014.078), granted in March 2015. A modification to DA 2014.078 was approved in January 2016.

The proposed continued operation (and extension) of Dowe's Quarry ("the Proposal") would involve:

- Ongoing extraction of quartzose rock within the existing extraction area and a 4.4ha extension of the extraction area, producing up to 230 000tpa.
- Campaign crushing and screening on site using mobile processing equipment. On-site processing would be undertaken in response to client requirements.

- Ongoing transportation of fragmented and crushed rock to the State road network, (i.e. the New England Highway), for delivery to the Sunnyside Crushing and Screening Plant, and other destinations. Material would also continue to be delivered locally within Tenterfield for Council-managed road and infrastructure activities and directly to the local community.
- Ongoing transportation of material directly to end points of use, where further processing at the Sunnyside Crushing and Screening Plant is not required.
- Ongoing backloading of clay fines and crusher fines from the Sunnyside Plant to the Quarry;
- Progressive emplacement of overburden and fines within and adjacent to the extraction area.
- Progressive and final rehabilitation of the Quarry to develop a landform suitable for native vegetation conservation.

The Quarry Site layout displayed in **Figure 2** incorporates the existing and proposed Quarry components.

The main components and the respective approximate area of disturbance within the Quarry Site are as follows.

- Extraction area (Stage 1 – 6.9ha, Stage 2 – 10.1ha, Stage 3 – 11.4ha)
- Processing area (1.8ha)
- Bund (0.62ha)
- Overburden and fines stockpile (Stage 1 – 3.2ha, Stage 2 – 2.6ha, Stage 3 – 1.6ha)
- Overburden and fines emplacement (Stage 2 – 1.9ha, Stage 3 – 2.9ha)
- Quarry access road (1.7km)
- Sediment dams (0.2ha)

1.2 SECRETARY'S REQUIREMENTS

This noise impact assessment has been undertaken in accordance with the Secretary's requirements (EAR 1341) for the Proposal, issued by the NSW Department of Planning and Environment (DP&E) on 28 May 2019. Coverage of the SEARs within this report is summarized in **Table 1**.

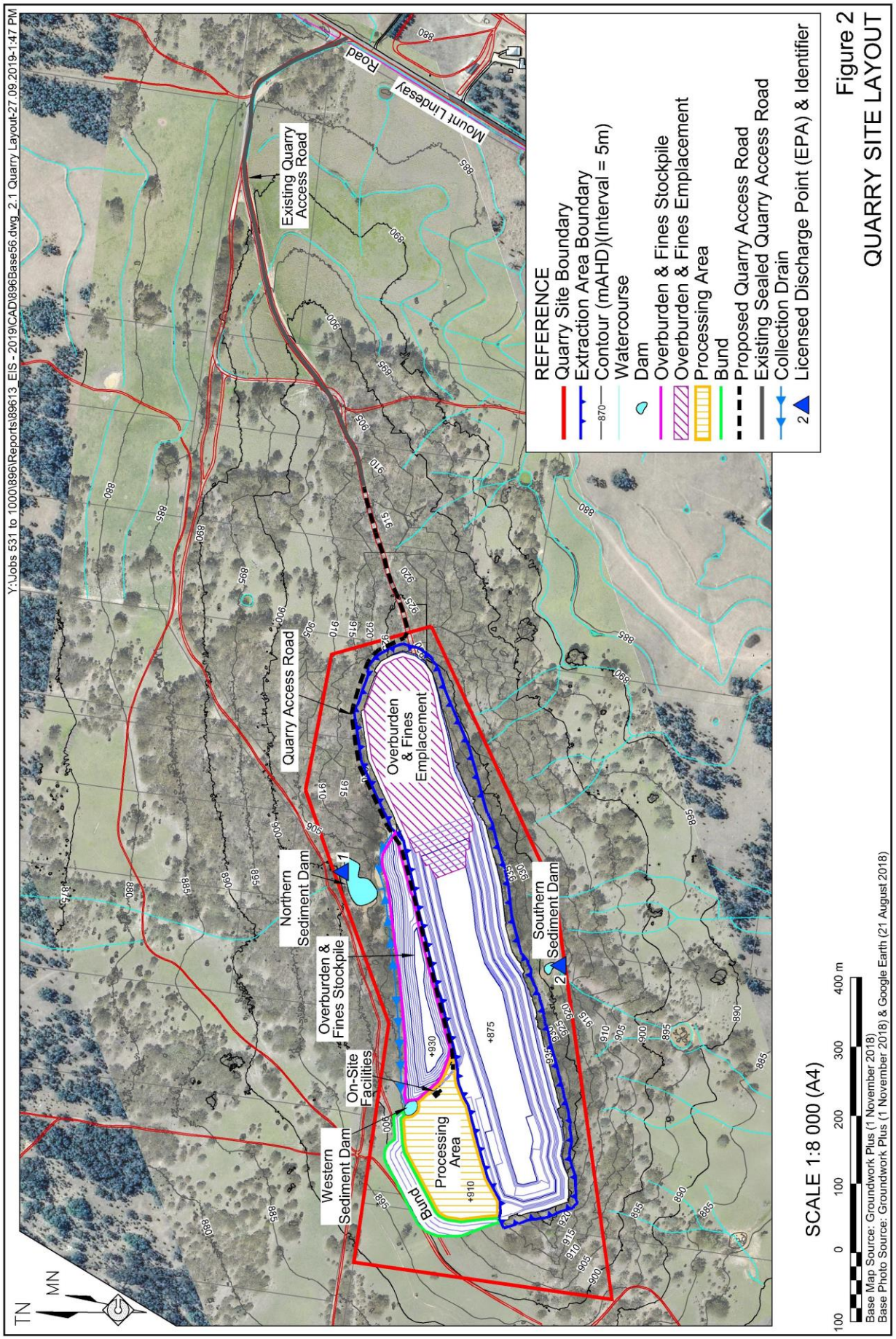

Y:\Jobs 531 to 1000\896\Reports\89613_EIS - 2019\CAD\896Base56.dwg_2.1 Quarry Layout-27.09.2019-1:47 PM
REFERENCE
Quarry Site Boundary
Extraction Area Boundary
Contour (mAHD)(Interval = 5m)
Watercourse
Dam
Overburden & Fines Stockpile
Overburden & Fines Emplacement
Processing Area
Bund
Proposed Quarry Access Road
Existing Sealed Quarry Access Road
Collection Drain
Licensed Discharge Point (EPA) & Identifier
Mount Lindesay Road
Existing Quarry Access Road
Quarry Access Road
Overburden & Fines Emplacement
Northern Sediment Dam
Overburden & Fines Stockpile
On-Site Facilities
Western Sediment Dam
Processing Area
Bund
Southern Sediment Dam
+930
+875
+910
TN
MN
SCALE 1:8 000 (A4)
100 0 100 200 300 400 m
Base Map Source: Groundwork Plus (1 November 2018)
Base Photo Source: Groundwork Plus (1 November 2018) & Google Earth (21 August 2018)
Figure 2
QUARRY SITE LAYOUT

Table 1
Coverage of Secretary's requirements

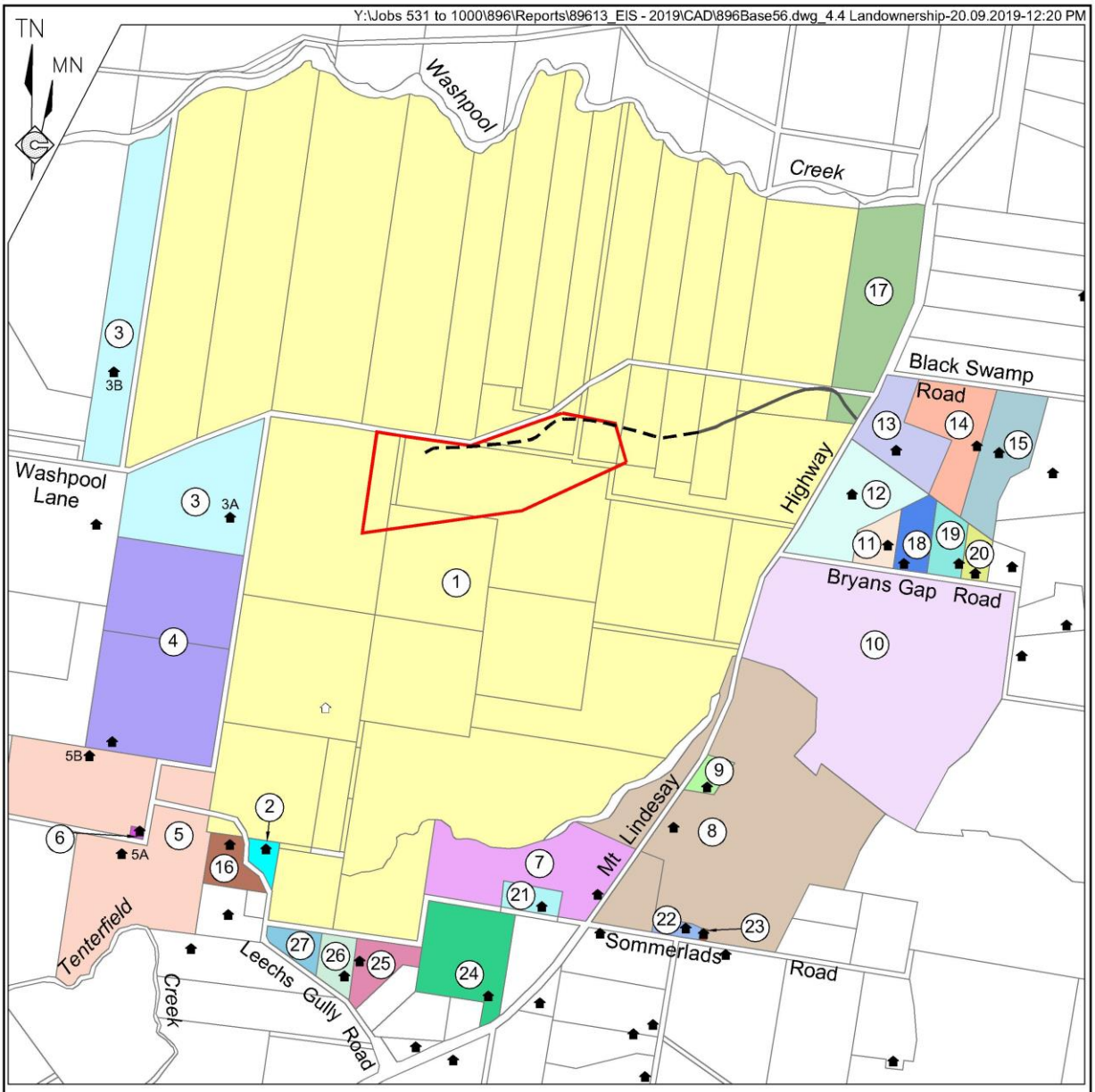
Agency	Paraphrased Relevant Requirement	Relevant Section(s)
NOISE AND BLASTING		
DPE	Include a quantitative assessment of potential: • construction and operational noise and off-site transport noise impacts of the development in accordance with the *Interim Construction Noise Guideline*, *NSW Noise Policy for Industry* and *NSW Road Noise Policy* respectively;	5.0
	• reasonable and feasible mitigation measures to minimise noise emissions; and	EIS 5.3.4
	• monitoring and management measures;	EIS 5.3.4 & 5.3.7
	• a description of the proposed blasting hours, frequency and methods; and	3.5 & 5.2
	• an assessment of the likely blasting and vibration impacts of the development, having regard to the relevant ANZEC guidelines and paying particular attention to impacts on people, buildings, livestock, infrastructure and significant natural features;	3.5 & 5.2
EPA	Assess and quantity noise and vibration Impacts associated with blasting, and operational noise particularly machinery and plant movements;	5.0
	Assess construction noise associated with the proposed development using the *Interim Construction Noise Guideline* (DECC, 2009).	N/A
	Assess vibration from all activities (including construction and operation) to be undertaken on the premises using the guidelines contained in the *Assessing Vibration: a technical guideline* (DEC, 2006).	5.0
	Demonstrate blast impacts are capable of complying with the guidelines contained in *Australian and New Zealand Environment Council- Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration* (ANZEC, 1990).	5.2
	Assess operational noise from all industrial activities (including private haul roads and private railway lines) using the guidelines contained in the *NSW Noise Policy for Industry* (EPA, 2017).	5.1
	Assess noise on public roads from increased road traffic generated by land use developments using the guidelines contained in the *NSW Road Noise Policy* and associated application notes (EPA, 2011)	5.3

1.3 ASSESSED RECEIVERS

Privately owned residential properties considered in this assessment are shown in **Figure 3** and described in **Table 2**.

Table 2
Residential receivers

Receiver	Land Owner
East of Quarry Site	
R10	KR & LA Willcocks (vacant land)
R11	KH Baxman & CC Hatnes
R12	BL & JA Morrow
R13	RM Ibbett & S Ibbett
R14	GM O'Reilly, MP Watt
R15	AJ & BW Lawrence
R18	MN & DN Larsen
R19	GB & DK Phillips
R20	CA Jackson, D Bunic
South and Southeast of the Quarry Site	
R7	JM Dowe
R8	RB & CA Sewell
R9	MJ & NJ Lewis, RB & CA Sewell
R21	DM & AJ Mullins
R22	JP & SL Doye
R23	LD Merchant
R24	Harewood Investments Pty Limited
R25	D Puglisi
R26	BJ & RL Tom
R27	BJ Tom & Brad Tom Investments Pty Ltd
West and Southwest of the Quarry Site	
R2	J-P Jacquet, MJ Bielski
R3A	RF & LL Tumbridge
R3B	RF & LL Tumbridge
R4	RL Caldwell
R5A	GL & JM Smith
R5B	GL & JM Smith
R6	DB Weir, GR Smith & WF Marsden
R16	PJ Della & TM Curry



REFERENCE
- Quarry Site Boundary
- Cadastral Boundary
- Proposed Realigned Quarry Access Road
- Existing Sealed Quarry Access Road
- Residence (Project Related)
- Residence (Non-Project Related)
- (1) Landowner Reference (See Table)

Ref	Landowner	Ref	Landowner
1	RSH & MO Dowe	15	AJ & BW Lawrence
2	JP Jacquet, MJ Bielski	16	PJ Della & TM Curry
3A,3B	RF & LL Tumbridge	17	The State of New South Wales
4	RL Caldwell	18	MN & DN Larsen
5A,5B	GL & JM Smith	19	GB & DK Phillips
6	DB Weir, GR Smith, WF Marsden	20	CA Jackson, D Bunic
7	JM Dowe	21	DM & AJ Mullins
8	RB & CA Sewell	22	JP & SL Doyle
9	MJ & NJ Lewis, RB & CA Sewell	23	LD Merchant
10	KR & LA Willcocks	24	Harewood Investments Pty Limited
11	KH Baxman & CC Haynes	25	D Puglisi
12	BL & JA Morrow	26	BJ & RL Tom
13	RM Ibbett, S Ibbett	27	BJ Tom & Brad Tom Investments Pty Ltd
14	GM O'Reilly, MP Watt		

SCALE 1:25 000 (A4)

250 0 250 500 750 1000 1250 m

Cadastral Source: LPI (2014)
Landowner Source: Department of Lands Online Search - April 2019

Figure 3
LAND OWNERSHIP AND NOISE RECEIVERS

2. DESCRIPTION OF TERMS

Table 3 contains the definitions of commonly used acoustical terms and is presented as an aid to understanding this report.

Table 3
Definition of acoustical terms

Term	Description
dB(A)	The quantitative measure of sound heard by the human ear, measured by the A-Scale Weighting Network of a sound level meter expressed in decibels (dB).
SPL	Sound Pressure Level. The incremental variation of sound pressure above and below atmospheric pressure and expressed in decibels. The human ear responds to pressure fluctuations, resulting in sound being heard.
STL	Sound Transmission Loss. The ability of a partition to attenuate sound, in dB.
Lw	Sound Power Level radiated by a noise source per unit time re 1pW.
Leq	Equivalent Continuous Noise Level - taking into account the fluctuations of noise over time. The time-varying level is computed to give an equivalent dB(A) level that is equal to the energy content and time period.
L1	Average Peak Noise Level - the level exceeded for 1% of the monitoring period.
L90	"Background" Noise Level - the level exceeded for 90% of the monitoring period.

3. EXISTING ENVIRONMENT AND NOISE CRITERIA

The existing meteorological and acoustical environments surrounding the Quarry Site have been studied to determine prevailing conditions and to allow noise goals to be set.

3.1 METEOROLOGY

The atmospheric conditions most relevant to noise assessments are temperature inversions, gentle winds (indicative of possible wind shear) and relative humidity. The *NSW Noise Policy for Industry* (NPI 2017) states that wind effects need to be assessed where source to receiver winds (at 10m height) of 3m/s or below occur for 30% or more of the time in any season in any assessment period.

Wind conditions predicted by Northstar Air Quality Pty Ltd using the CSIRO TAPM model at the Site for 2015, were provided by R.W. Corkery & Co. Pty Limited for assessment of prevailing winds.

The analysis found that winds up to 3 m/s occurred less than 15% of the time during all seasons, from all directions. Winds are generally aligned from the east and west, with stronger winds in excess of 3 m/s dominating.

The following points are the most significant with respect to noise propagation and were adopted as parameters for noise modelling:

- A value of 70% Relative Humidity (RH) was adopted for average daytime conditions.
- Noise modelling was carried out under the prevailing condition of neutral atmospheric conditions (20°C, no wind).

The Proposal will only operate during the day and therefore nocturnal temperature inversions are not required to be considered under the NPI.

3.2 EXISTING ACOUSTIC ENVIRONMENT

It is anticipated that the background noise levels in the rural areas surrounding the Quarry Site would be below 30 dB(A) and, in accordance with section A1.2 of the NPI, a default minimum daytime background noise level of 35 dB(A),L_{90} has been adopted as the basis for determining project-specific noise goals.

3.3 PROJECT-SPECIFIC NOISE TRIGGER LEVELS

Project-generated noise within the Quarry Site is required to be assessed against the provisions of the NPI. In relation to the residences surrounding the Quarry Site, the NPI specifies two noise criteria: *intrusiveness and amenity criteria*.

The *Intrusiveness Criterion* limits Equivalent Continuous Noise Level (Leq) from the industrial source to a value of 'background plus 5dB'. That is, the Rating Background Level (RBL) for the time period, plus 5 dB(A). The RBL (L_{A90}) is defined as the overall single figure background level representing each assessment period.

The *Amenity Criterion* aims to protect against excessive noise levels where an area is becoming increasingly developed. Amenity criteria are dependent upon the nature of the receiver area and the existing level of industrial noise. There is minimal existing industrial noise in the area, apart from the existing quarry, and the residential area that is potentially affected by noise emissions from the Project is best described acoustically as rural.

Time periods for assessment as defined in the NPI are:

- Daytime – 7:00am (8:00am on Sundays) to 6:00pm;
- Evening – 6:00pm to 10:00pm; and
- Night – 10:00pm to 7:00am (8:00am on Sundays).

The project noise trigger levels for all residential receivers are derived from the lower of the existing intrusiveness criteria and the amenity criteria and the worst case or most conservative time period. If compliance is predicted during the worst case time period assessed, then compliance is assumed for the remaining time periods.

The project specific noise level for all receivers will therefore be the daytime intrusiveness criterion of **40 dB(A) $L_{eq(15\ min)}$.**

This criterion applies to all emissions from the site including road registered heavy vehicles moving about the Quarry Site.

3.4 SLEEP DISTURBANCE

As the Proposal would operate between 7:00am and 5:00pm, Monday – Saturday (i.e. during the day) the sleep disturbance criterion does not apply.

3.5 BLASTING

Overpressure and vibration levels from blasting are assessable against criteria proposed by the Australian and New Zealand Environment and Conservation Council (ANZECC) in their publication *"Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration – September 1990"*. These criteria are summarised as follows.

- The recommended maximum overpressure level for blasting is 115dB.
- The level of 115dB may be exceeded for up to 5% of the total number of blasts over a 12-month period, but should not exceed 120dB at any time.
- The recommended maximum vibration velocity for blasting is 5mm/s Peak Vector Sum (PVS).
- The PVS level of 5mm/s may be exceeded for up to 5% of the total number of blasts over a 12-month period, but should not exceed 10mm/s at any time.
- Blasting should generally only be permitted during the hours of 9am to 5pm Monday to Saturday, and should not take place on Sundays and Public Holidays.

Blasting should generally take place no more than once per day.

3.6 TRAFFIC NOISE

In NSW, noise from vehicle movements associated with an industrial source is assessed in terms of the NPI if the vehicles are not on a public road. If the vehicles are on a public road, the *NSW Road Noise Policy* (RNP) applies. Noise from the Proposal must, therefore, be assessed against the Project-specific noise trigger levels of the NPI and also the criteria in the RNP.

The RNP recommends various criteria based on the functional categories of roads applied by the NSW Roads and Maritime Services (RMS). The RMS differentiates roads based on a number of factors including traffic volume, heavy vehicle use, through or local traffic, vehicle speeds and applicable traffic management options.

Vehicles accessing the Quarry Site and the Sunnyside Crushing and Screening Plant will do so via Mount Lindesay Road (sub-arterial road), Naas Street[1] (local road) and the New England Highway (arterial road), respectively. As shown in **Figure 4**, the proposed transport route for trucks returning to the Dowe's Quarry includes Old Ballandean Road which is a local road.

Table 4 below shows the noise criteria relevant to traffic on various road types extracted from *Table 3* of the RNP. For the assessment of traffic noise, the day time period is from 7am to 10pm, whilst night is from 10pm to 7am. Only the daytime criteria are applicable to this Proposal.

Table 4
Road traffic noise criteria

	Recommended Criteria	
Situation	**Day (7am to 10pm)**	**Night* (10pm to 7am)**
Existing residences affected by additional traffic on existing freeway/arterial/sub-arterial roads generated by land use developments	Leq (15-hour) 60	Leq (9-hour) 55
Existing residences affected by additional traffic on local roads generated by land use developments	Leq (15-hour) 55	Leq (9-hour) 50

Source: NSW Road Noise Policy, Table 3.

* It is not proposed to haul product at night, so only the daytime criteria are applicable.

The setback distances to the residences adjacent to Mt Lindesay Road, New England Highway and Old Ballandean Road, are as follows.

Mount Lindesay Road

- 100kph Section (28m to 46m)
- 70kph Section (18m to 35m)
- 50kph Section (15m to 30m)

New England Highway.

- 100kph Section (18m to 190m)
- 80kph Section (32m to 60m)
- 50kph Section (10m to 30m)

Old Ballandean Road.

- 100kph Section (25m to 140m)

[1] There are no residences fronting the 200m section of Naas Street between Mount Lindesay Road (Logan Street) and the New England Highway.

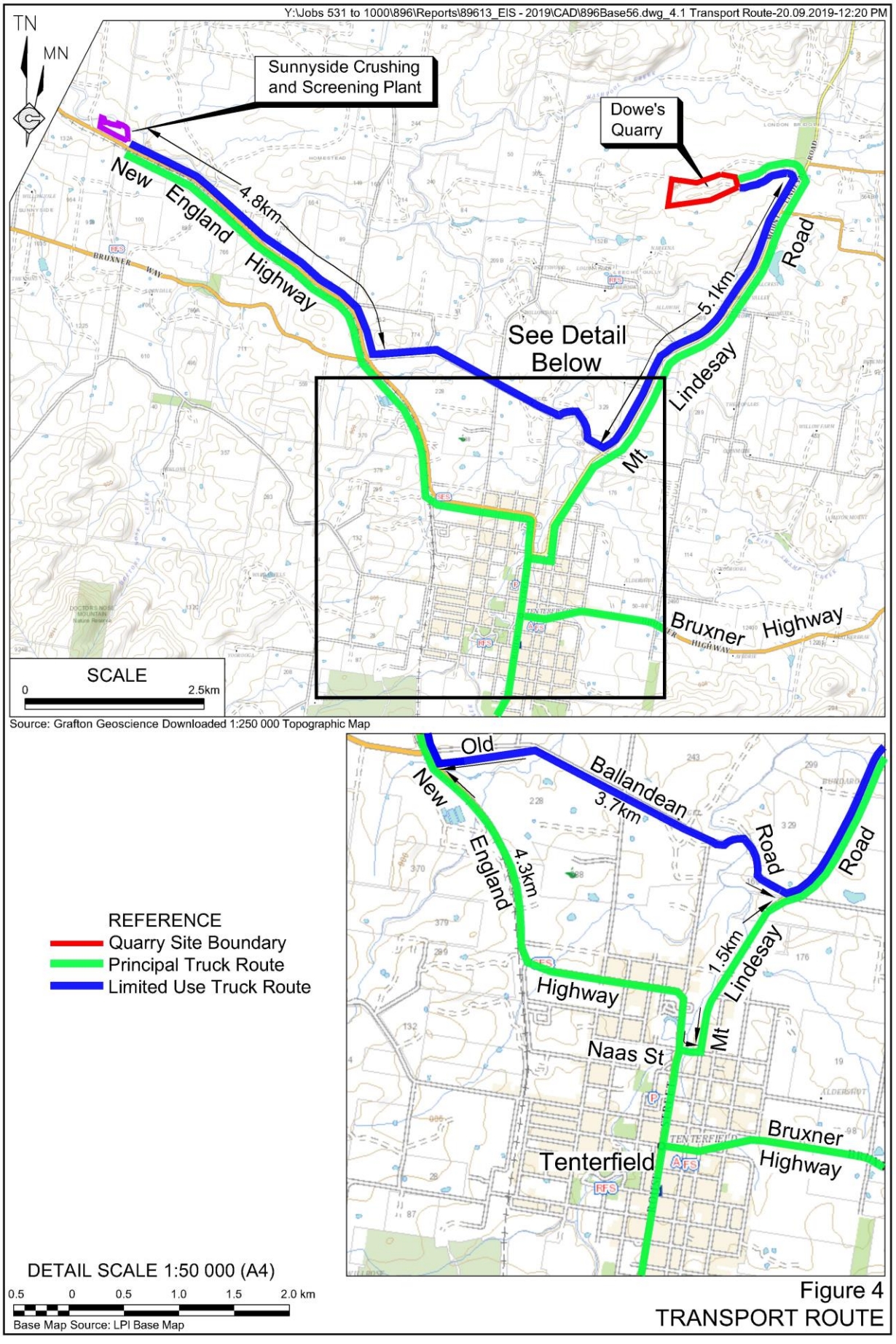


Figure 4
TRANSPORT ROUTE

4. ASSESSMENT METHODOLOGY

4.1 MODELLED SCENARIOS

A full description of the Proposal is given in Section 2 of the EIS. In discussion with the client, it was determined that the following two operational noise scenarios represent worst case potential for noise impacts at residential receivers.

SCENARIO 1: Annual Production – up to 230 000 tonnes

Extraction Operations, Product Loading and Despatch (worst case 28 loads per day)

Drill Rig (DR) drilling blast holes in preparation for blast at 925m AHD in the eastern end of extraction area.

Excavator (EX1) (30t) undertaking secondary breakage of oversize rock and loading blasted rock into road trucks at 905m AHD in the eastern end of extraction area.

Haul truck (HT) on overburden and fines stockpile at 945m AHD.

Excavator (EX2) (30t) operating in the processing area at 910m AHD.

Road truck (RT1) in processing area at 910m AHD.

Mobile crushing and screening plant (MC) in processing area at 910m AHD.

Road truck (RT2) (40t) unladen truck arriving at the quarry 927m AHD.

SCENARIO 2: Annual Production – up to 230 000 tonnes

Extraction Operations, Product Loading and Despatch (worst case 28 loads per day)

Drill Rig (DR) drilling blast holes in preparation for blast at 910m AHD in the eastern end of extraction area.

Excavator (EX1) (30t) undertaking secondary breakage of oversize rock and loading blasted rock into road trucks at 875m AHD in the eastern end of extraction area.

Haul truck (HT) on overburden and fines stockpile at 945m AHD.

Excavator (EX2) (30t) operating in the processing area at 910m AHD.

Road truck (RT1) in processing area at 910m AHD.

Mobile crushing and screening plant (MC) in processing area at 910m AHD.

Road truck (RT2) (40t) unladen truck arriving at the quarry 920m AHD.

Figures 5 and **6** show source locations for the above scenarios. The modelling was undertaken for the atmospheric conditions described in Section 3.1.

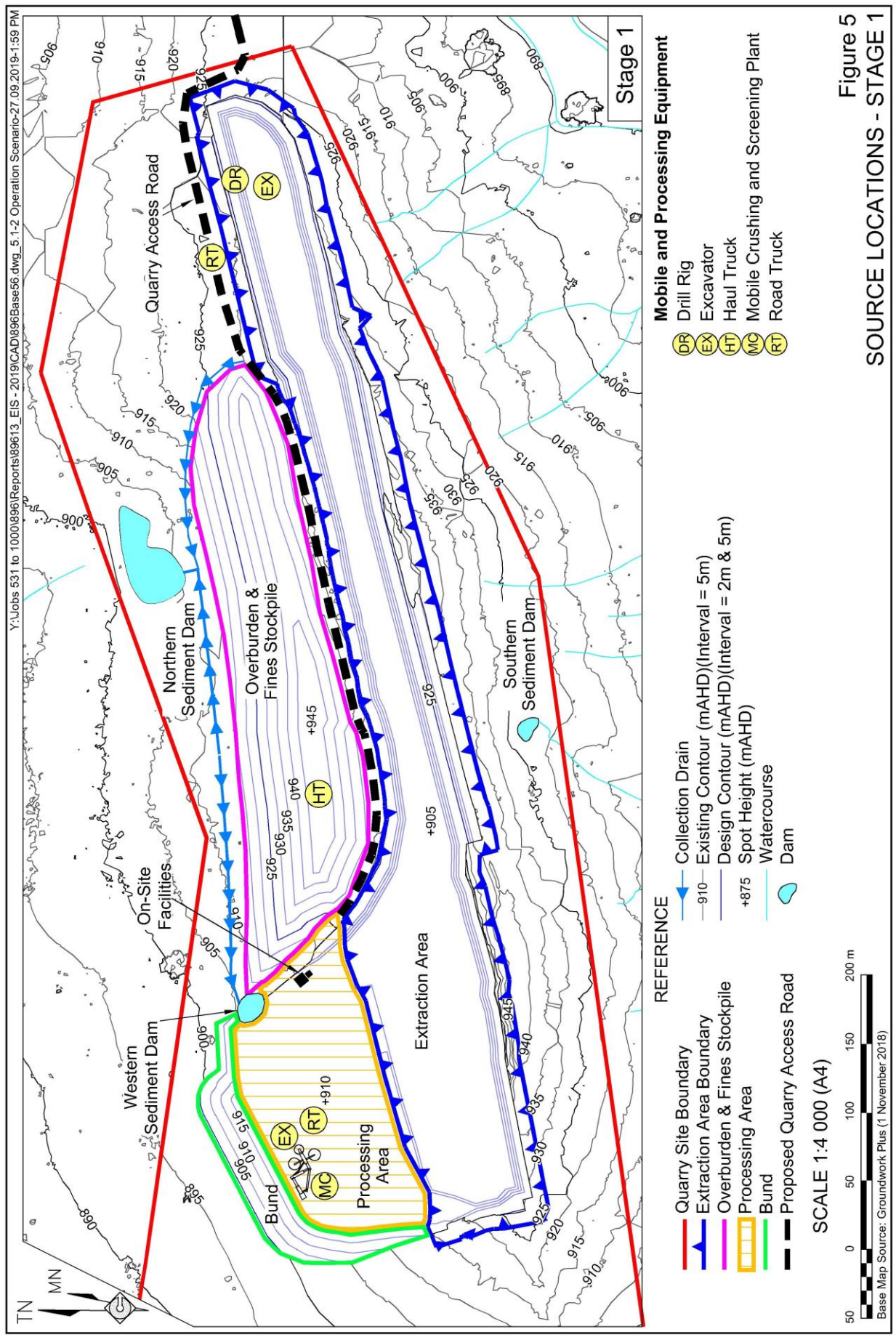
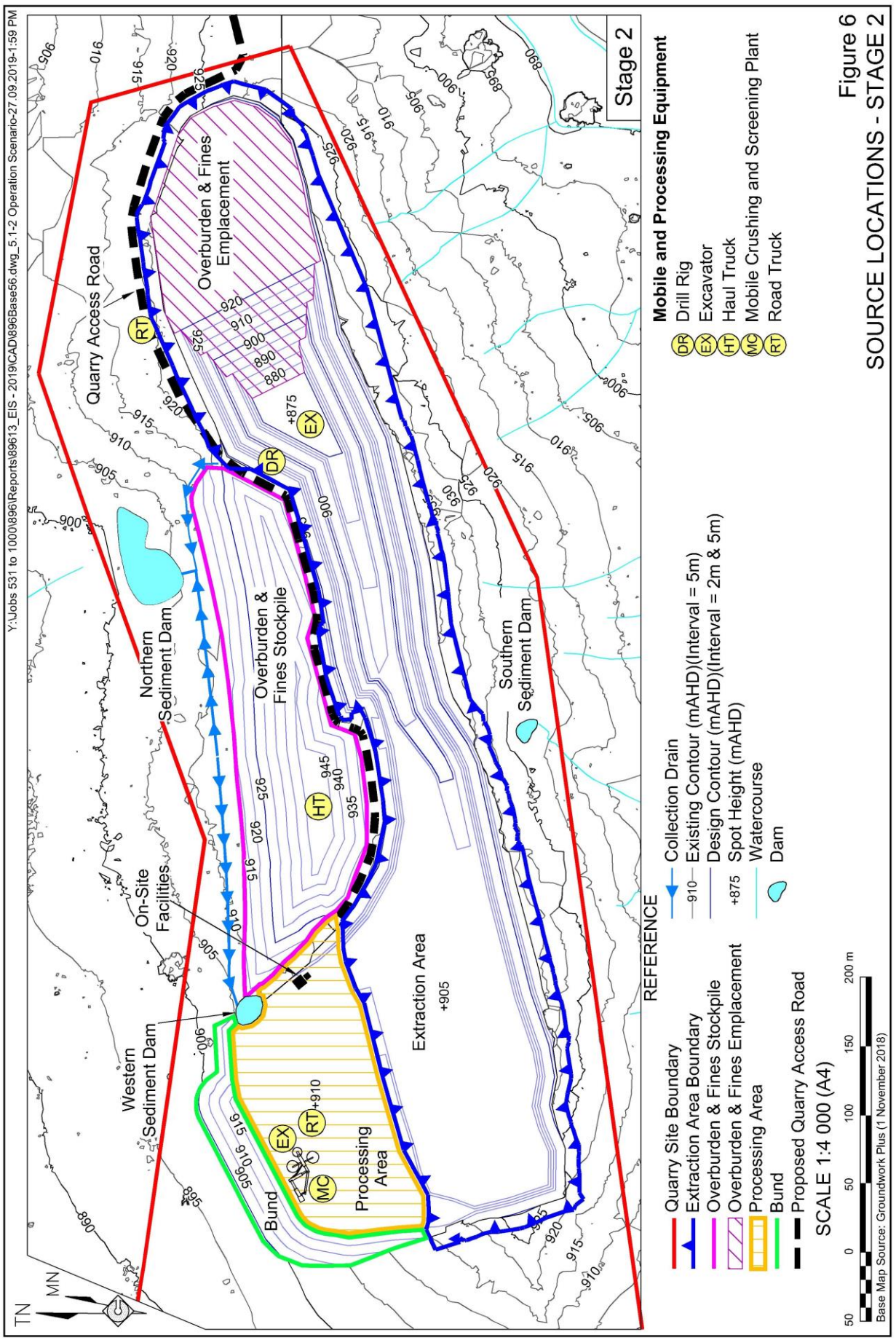


Figure 5
SOURCE LOCATIONS - STAGE 1


Y:\Jobs 531 to 1000\896\Reports\89613_EIS - 2019\CAD\896Base56.dwg, 5.1-2 Operation Scenario-27.09.2019-1:59 PM
Stage 2
Overburden & Fines Emplacement
Quarry Access Road
Northern Sediment Dam
Overburden & Fines Stockpile
On-Site Facilities
Western Sediment Dam
Southern Sediment Dam
Extraction Area
+905
Processing Area
Bund
RT
EX
DR
HT
MC
+875
+910
TN
MN
Mobile and Processing Equipment
Drill Rig
Excavator
Haul Truck
Mobile Crushing and Screening Plant
Road Truck
REFERENCE
Quarry Site Boundary
Extraction Area Boundary
Overburden & Fines Stockpile
Overburden & Fines Emplacement
Processing Area
Bund
Proposed Quarry Access Road
Collection Drain
Existing Contour (mAHD)(Interval = 5m)
Design Contour (mAHD)(Interval = 2m & 5m)
Spot Height (mAHD)
Watercourse
Dam
SCALE 1:4 000 (A4)
50 0 50 100 150 200 m
Base Map Source: Groundwork Plus (1 November 2018)
Figure 6
SOURCE LOCATIONS - STAGE 2

4.2 NOISE SOURCES

The sound power levels of the equipment used in the modelling of each scenario are listed in **Table 5**.

Table 5
Noise source sound power levels

Equipment	Indicative Number	Use	Lw dB(A),$L_{eq(15minute)}$
Excavator (Komatsu PC300)	2	Soil stripping, excavation	104
Drill (Atlas Copco T35)	1	Drilling blast holes	114
Haul truck (15 m^3)	1	Transport material from extraction to process area	108
Mobile crushing plant	1	Crushing and sizing of extracted material	113

4.3 BLASTING

The following sections provide standard equations for predicting blast overpressure and ground vibration levels, sourced from the United States Bureau of Mines.

4.3.1 Blast Overpressure

Unweighted airblast overpressure levels (OP) are predicted from **Equation 1** below.

$$OP = 165 - 24(\log_{10}(D) - 0.3 \log_{10}(Q)), \quad dB \qquad (1)$$

where *D* is distance from the blast to the assessment point (m) and
Q is the weight of explosive per delay (kg).

Equation 1 has been found through previous analysis of large quantities of blast data to underestimate overpressure levels by up to 3 dB for small blasts (MIC <400kg) and overestimate by 1 dB for larger blasts (MIC > 400kg). A +3dB correction will be applied for the relatively small blasts proposed for the project.

4.3.2 Blast Vibration

The basic equations for calculation of peak particle vibration (PPV) levels from blasting are as follows:

$$PPV = 1140\left(\frac{D}{Q^{0.5}}\right)^{-1.6}, \text{ mm/s (for average ground type)} \qquad (2)$$

$$PPV = 500\left(\frac{D}{Q^{0.5}}\right)^{-1.6}, \text{ mm/s (for hard rock)} \qquad (3)$$

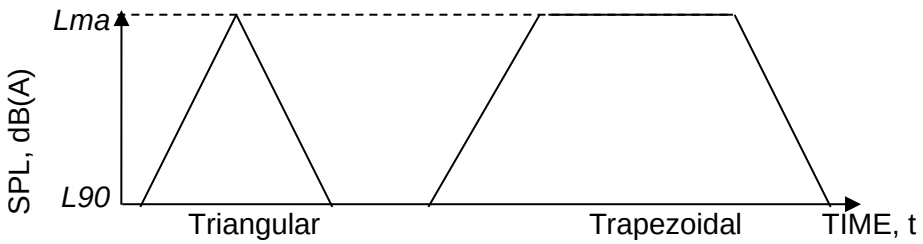
where *D* and *Q* are defined as in Equation 1. The difference between Equations 2 and 3 is the value of the coefficient 1140 or 500 and, for the sake of taking a conservative approach to the assessment, the larger value of 1140 will be adopted.

4.4 TRAFFIC NOISE

Additional traffic noise generated by the Proposal will be of a discrete rather than constant nature. There are many methods available for calculating the cumulative noise impact arising from discrete signals of various shapes. The methodology employed in this Section was sourced from the US Environmental Protection Agency document No. 550/9-74-004 *Information on Levels of Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, March 1974*.

The document refers to triangular and trapezoidal time signals, which are illustrated in **Figure 7**. A triangular time signal rises from the background level to a peak noise level and then immediately begins to subside. A triangular time signal is a good approximation of the Sound Pressure Level (SPL) signal of a truck as it passes an observation point. A trapezoidal time signal rises from the background level to a maximum level and sustains that level for a period of time before subsiding. The trapezoidal time signal is a good approximation of the SPL signal of a train as it passes an observation point.

Figure 7 Triangular and Trapezoidal Noise Signals



The value of $L_{eq,T}$ for a series of identical triangular time patterns having a maximum level of L_{max} is given by **Equation 4**.

$$L_{eq},T = L_b + 10\log\left[1 + \frac{ND}{T}\left(\frac{10^{(L\max - Lb)/10} - 1}{2.3} - \frac{\left(L_{\max} - L_b\right)}{10}\right)\right] \quad (4)$$

Where

- L_b is background noise level, dB(A)
- L_{MAX} is vehicle noise, dB(A)
- T is the time for each group of vehicles (min)
- N is number of vehicle trips
- D is duration of noise of each vehicle (min)

For calculation purposes, L_{max} is the maximum vehicle noise at the assessment point(s), and has been based on numerous measurements of quarry truck pass-by noise taken by Spectrum Acoustics at receivers near other quarries in recent years. Maximum pass-by levels from laden and unladen tracks travelling on sealed roads at speeds ranging from 50km/h to 100km/h were adjusted to match the minimum setback distances listed in Section 3.6 to enable calculation of traffic noise levels using Equation 4. The assessment period T corresponds to the stated criterion period, that is, 15 hours.

5. RESULTS AND DISCUSSION

5.1 PREDICTED OPERATIONAL NOISE LEVELS

Noise levels were modelled using RTA's *Environmental Noise Model* v3.06 (ENM) software for each of the atmospheric scenarios described in Section 4.1. Point calculations were performed for all receivers in **Table 1**.

Predicted noise levels under various neutral atmospheric conditions for the two modelled scenarios are summarised in **Tables 6** and **7**.

Table 6
Predicted noise levels, dB(A), $L_{eq(15min)}$ Scenario 1

Receiver	Meteorological condition	Criterion
	Neutral	
East of Quarry Site		
R10	<30	40
R11	<30	40
R12	<30	40
R13	<30	40
R14	<30	40
R15	<30	40
R18	<30	40
R19	<30	40
R20	<30	40
South and Southeast of the Quarry Site		
R7	<30	40
R8	<30	40
R9	<30	40
R21	<30	40
R22	<30	40
R23	<30	40
R24	<30	40
R25	<30	40
R26	<30	40
R27	<30	40
West and Southwest of the Quarry Site		
R2	<30	40
R3A	35	40
R3B	31	40
R4	30	40
R5A	<30	40
R5B	<30	40
R6	<30	40
R16	<30	40

Table 7
Predicted noise levels, dB(A), $L_{eq(15min)}$ Scenario 2

Receiver	Meteorological condition	Criterion
	Neutral	
East of Quarry Site		
R10	<30	40
R11	<30	40
R12	<30	40
R13	<30	40
R14	<30	40
R15	<30	40
R18	<30	40
R19	<30	40
R20	<30	40
South and Southeast of the Quarry Site		
R7	<30	40
R8	<30	40
R9	<30	40
R21	<30	40
R22	<30	40
R23	<30	40
R24	<30	40
R25	<30	40
R26	<30	40
R27	<30	40
West and Southwest of the Quarry Site		
R2	<30	40
R3A	34	40
R3B	31	40
R4	30	40
R5A	<30	40
R5B	30	40
R6	<30	40
R16	<30	40

The results in **Tables 5** and **6** show noise levels below the operational noise criterion at all assessed receivers.

5.2 BLASTING

The client has advised that blasting within the quarry would typically be required approximately once per month, however, in the interest of practical limits of ongoing operations, blasting of no more than once per week is proposed. Blast design is as follows:

- Drill holes are 89mm diameter and have a maximum depth of 15m, with up to 1m of subdrill.

- Drill holes typically have a 3m x 3m spacing, 3m stemming and use 5.6kg/m of ANFO.
- Typical blasts use 3 rows with 8 drill holes per row and a combination of 17ms and 45ms delays on the detonators.

Based on the above data, each hole would contain up to 67.2 kg ANFO fired at one hole per delay, therefore maximum instantaneous charge (MIC) is 67.2 kg.

Calculated blast overpressure and ground vibration levels at the nearest receivers within each receiver group, based on this worst-case MIC, are summarised in **Table 8**.

Table 8
Predicted blast overpressure and ground vibration levels

Location	Distance m	Overpressure dB	Criterion	Vibration mm/s	Criterion
R12 (east)	1160	108.5	115	0.7	5.0
R9 (south east)	1295	107.4	115	0.6	5.0
R3A (west)	740	113.2	115	1.4	5.0

The above results show worst case blast impact levels well below the overpressure and ground vibration criteria at the potentially worst impacted receivers.

5.3 ROAD TRAFFIC NOISE

As discussed in Section 4.3, data from our extensive library of noise measurements were used to determine maximum pass-by noise levels for laden and unladen trucks at a variety of distances and speeds. Based on the maximum annual production rate of 230,000t and including back-loading of material from the Sunnyside Crushing and Screening Plant to the quarry, the Proposal would generate up to 56 movements per day, Monday to Saturday. Half of these movements would be loaded trucks passing the nearest residences to Mt Lindesay Road and the New England Highway and half would pass by the nearest residences to old Ballandean Road.

These values enabled calculation of traffic noise levels using Equation 4. As summarised in **Table 9**.

Table 9
Predicted traffic noise levels

Road	Speed km/h	Distance m	Traffic noise dB(A),$L_{eq(15hour)}$	Criterion dB(A),$L_{eq(15hour)}$
Mount Lindesay Road	100	28	48.4	55
	70	18	49.5	55
	50	15	48.9	55
New England Highway	100	18	50.4	55
	80	32	46.6	55
	50	10	50.7	55
Old Ballandean Road	80*	25	46.3	50

* Sign-posted speed limit is 100 km/h but the proponent has a self-imposed limit of 80 km/h.

The results in Table 8 show compliance with the traffic noise criteria at receivers nearest to all sections of the transport route, implying compliance at other receivers further from the transport route.

6. SUMMARY OF RESULTS

A noise impact assessment of the proposed extension of Dowe's Quarry via Tenterfield NSW has been conducted. The study has found the following:

- No exceedance of operational noise criteria has been predicted at any receiver;
- No exceedance of blast overpressure and ground vibration criteria at any receiver;
- No exceedance of off-site traffic noise criteria at any receiver.

We therefore advise that the Proposal can operate within the EPA noise criteria and recommend approval of the Proposal, as far as acoustic issues are concerned.