Appendix 7

Noise and Blasting Impact Assessment
prepared by
Spectrum Acoustics Pty Limited

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Noise and Blasting Impact Assessment

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EXECUTIVE SUMMARY

A noise impact assessment has been conducted for the proposed continued operation and extension of Dowe's Quarry 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 Project Site") is approximately 1.1km west of the Mount 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 Industrial Noise Policy (INP), OEH, 2000, and
NSW Road Noise Policy (RNP), OEH, 2011
"Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration – September 1990" (ANZECC)

The INP default minimum background noise level of 30 dB(A) was adopted to establish a noise emission criterion of 35 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 criterion 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 project would be able to operate in compliance with the appropriate noise criteria for operational and road traffic noise emissions.

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1. INTRODUCTION

1.1 OBJECTIVES OF THE PROPOSAL

Darryl McCarthy Construction Pty Ltd ("the Applicant") proposes to extend the operation of a quarry producing quartzose rock at Dowe's Quarry and transportation to the Sunnyside Crushing and Screening Plant for production of a range of ivory coloured stone products. The site of the existing Dowe's Quarry and proposed quarry extension ("the Project Site") is approximately 1.1km west of the Mount Lindesay Road approximately 8km northeast of Tenterfield, within the Tenterfield Local Government Area (see **Figure 1**).

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

- the ongoing extraction of quartzose rock within the existing extraction area and a 1.4ha extension of the extraction area, including a maximum annual extraction level of 100 000tpa;
- transportation of extracted rock using the State road network, i.e. the New England Highway, for delivery principally to the Sunnyside Crushing and Screening Plant, 10km northwest of Tenterfield;
- backloading of clay fines and crusher fines from the Sunnyside Plant to Dowe's Quarry;
- progressive emplacement of overburden and returned clay fines within and adjacent to the extraction area;
- storage of surplus crusher fines from the Sunnyside Plant awaiting sale and dispatch; and
- transportation of clay fines and crusher fines to customers in the New England region when required.

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

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

- Area of existing disturbance including sediment dams (3.9ha)
- Area of proposed extension to extraction area (1.4ha)
- Area of additional internal roads (0.1ha)
- Additional area for clay fines storage (1.6ha)
- Area of remnant vegetation remaining within the Project Site (6.5ha)

The total area of the Project Site would be approximately 13.5ha of which the total disturbance area would be 7ha.

This noise impact assessment has been undertaken in accordance with the Secretary's requirements (EAR 831) for the proposal, issued by the NSW Department of Planning and Environment (DP&E) on 13 May 2014, and will accompany the *Environmental Impact Statement* (EIS) for the proposal.

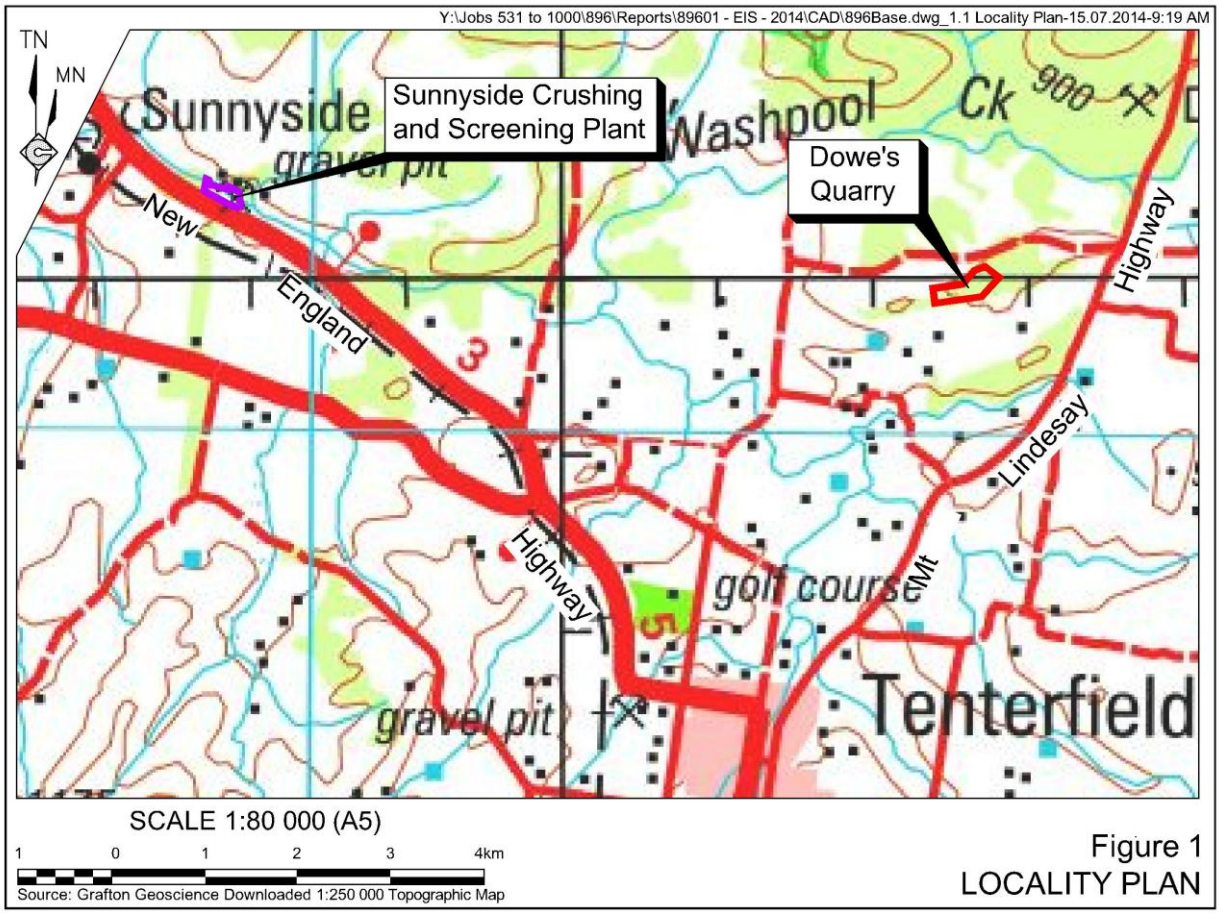


Figure 1
LOCALITY PLAN

1.2 ASSESSED RECEIVERS

Privately owned residential properties considered in this assessment are shown in **Figure 3** and described in **Table 1**.

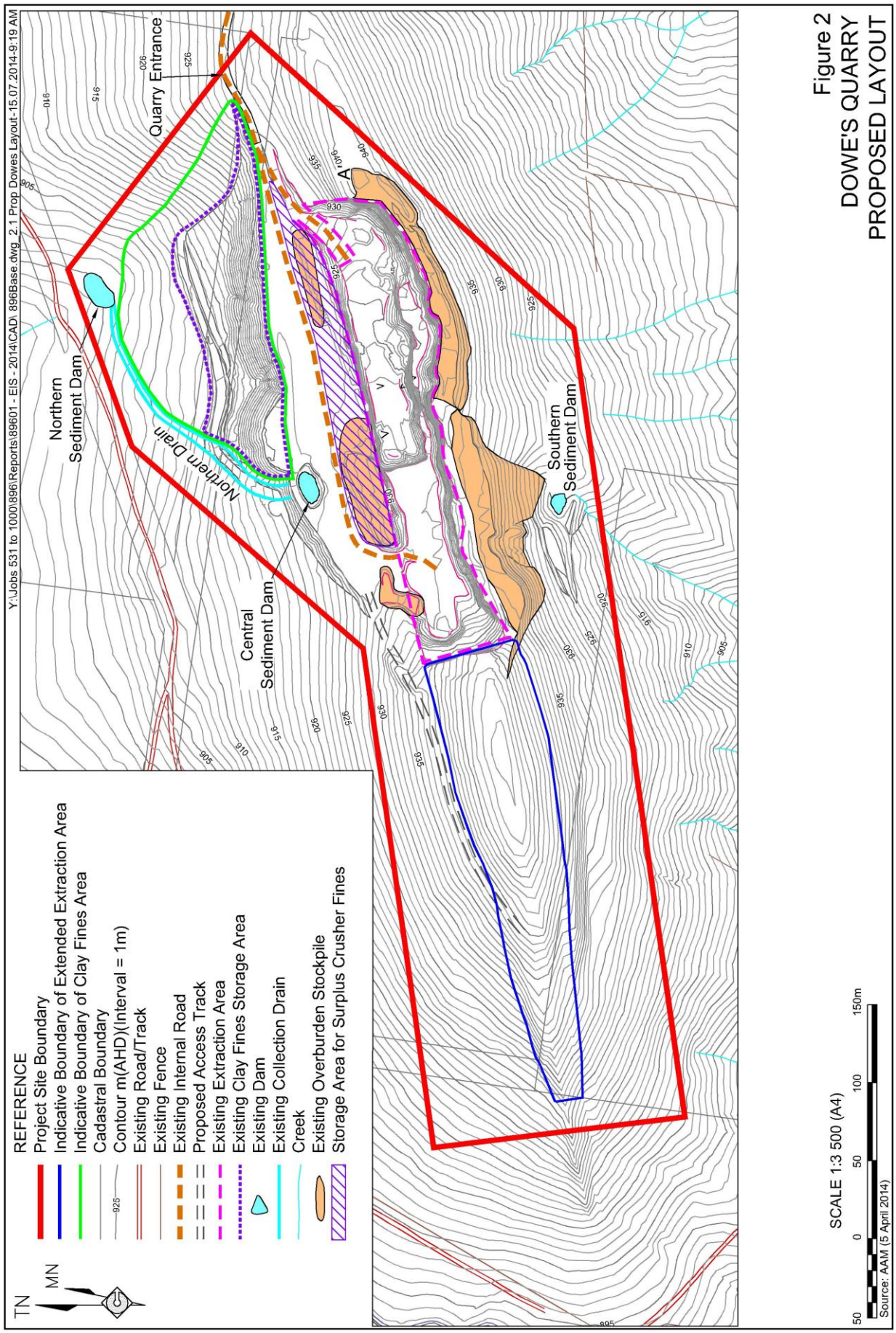
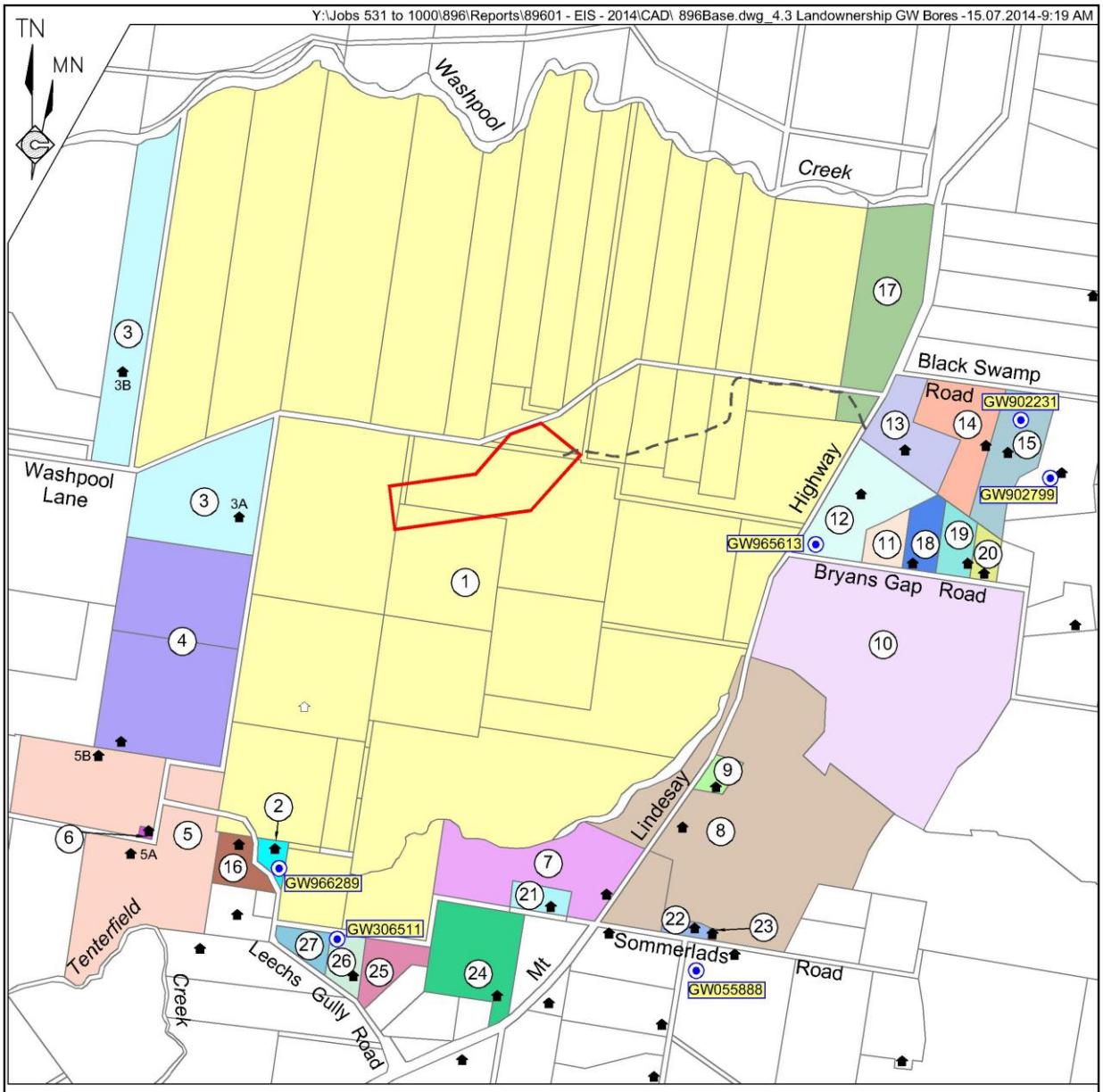


Figure 2
DOWE'S QUARRY
PROPOSED LAYOUT
Y:\Jobs 531 to 1000\896\Reports\89601 - EIS - 2014\CAD\ 896Base.dwg 2.1 Prop Dowes Layout-15.07.2014-9:19 AM
Quarry Entrance
Northern Sediment Dam
Northern Drain
Central Sediment Dam
Southern Sediment Dam
A
A'
REFERENCE
Project Site Boundary
Indicative Boundary of Extended Extraction Area
Indicative Boundary of Clay Fines Area
Cadastral Boundary
Contour m(AHD)(Interval = 1m)
Existing Road/Track
Existing Fence
Existing Internal Road
Proposed Access Track
Existing Extraction Area
Existing Clay Fines Storage Area
Existing Dam
Existing Collection Drain
Creek
Existing Overburden Stockpile
Storage Area for Surplus Crusher Fines
TN
MN
SCALE 1:3 500 (A4)
0
50
100
150m
Source: AAM (5 April 2014)



Ref	Landowner	Ref	Landowner
1	RSH & MO Dowe	14	GM O'Reilly, MP Watt
2	J-P Jacquet, MJ Bielski	15	WH & GM Cooper
3A,3B	Vibrato Investments Pty Limited	16	PA & KM Willis
4	RL Caldwell	17	The State of New South Wales
5A,5B	GL & JM Smith	18	MP & CA Moore
6	DB Weir, GR Smith, WF Marsden	19	GB & DK Phillips
7	SJ & JM Martin	20	CA Jackson, D Bunic
8	RB & CA Sewell	21	DM & AJ Mullins
9	MJ & NJ Lewis, RB & CA Sewell	22	JP & SL Doyle
10	KR & LA Willcocks	23	LD Merchant
11	JK & HJ Ingram	24	Harewood Investments Pty Limited
12	TE Barratt (Jnr), NL Bush	25	D Puglisi
13	IM Ibbett	26	JE Ferguson
		27	D Parsons

REFERENCE
Project Site Boundary
Cadastral Boundary
Quarry Access Road
Residence (Project Related)
Residence (Non-Project Related)
(1) Landowner Reference (See Table)
GW965613 Groundwater Bore and Identifier

SCALE 1:25 000 (A4)

250 0 250 500 750 1000 1250 m

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

Figure 3
LAND OWNERSHIP, SURROUNDING RESIDENCES AND GROUNDWATER BORES

Table 1
Residential receivers

Receiver	Land Owner
East of Project Site	
R10	KR & LA Willcocks (vacant land)
R11	KJ & HJ Ingram (vacant land)
R12	TE Barratt (Jnr), NL Bush
R13	IM Ibbett
R14	GM O'Reilly, MP Watt
R15	WH & GM Cooper
R18	MP & CA Moore
R19	GB & DK Phillips
R20	CA Jackson, D Bunic
South and Southeast of the Project Site	
R7	SJ & JM Martin
R8	RB & CA Sewell
R9	MJ & NJ Lewis, RB & CA Sewell
R21	DM & AJ Mullins
R22	JP & SL Doye
R23	LD Merchant
West and Southwest of the Project Site	
R2	J-P Jacquet, MJ Bielski
R3A	Vibrato Investments Pty Limited
R3B	Vibrato Investments Pty Limited
R4	RL Caldwell
R5A	GL & JM Smith
R5B	GL & JM Smith
R6	DB Weir, GR Smith & CA Sewell
R16	PA & KM Willis

2. DESCRIPTION OF TERMS

Table 2 contains the definitions of commonly used acoustical terms and is presented as an aid to understanding this report.

Table 2
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 Project 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 Industrial Noise Policy (INP 2000) 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.

Seasonal wind roses for Tenterfield, generated by Environ using The Air Pollution Model (TAPM), 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:

- Extremes of relative humidity (RH) are rarely experienced. A value of 70% RH was adopted.
- 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 INP.

3.2 EXISTING ACOUSTIC ENVIRONMENT

It is anticipated that the background noise levels in the rural areas surrounding the Project Site would be below 30 dB(A) and, in accordance with section B1.3.3 of the INP, a default background noise level of 30 dB(A),L_{90} has been adopted as the basis for determining project-specific noise goals

3.3 PROJECT-SPECIFIC NOISE GOALS

Industrial noise is assessed against the requirements of the INP. In relation to residential receivers, the INP 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 (L90) is defined as the overall single figure background level representing each assessment period (in this case day only).

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 very little existing industrial noise in the area and the residential area that is potentially affected by noise emissions from the proposal is best described acoustically as rural.

The project specific noise level for all receivers will therefore be the intrusiveness criterion of **35 dB(A) $L_{eq(15\ min)}$.**

This criterion applies to all emissions from the site including road registered heavy vehicles moving about the Project Site and is applicable under all assessed atmospheric conditions.

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 INP 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 goals of the INP 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 Project Site and the Sunnyside Crushing and Screening Plant will do so via Mount Lindesay Road (sub-arterial road) and the New England Highway (arterial road), respectively. As shown in **Figure 4**, the proposed transport route for trucks returning to 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 3
Road traffic noise criteria

Situation	Recommended Criteria	
	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 Mount 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 (20m to 140m)

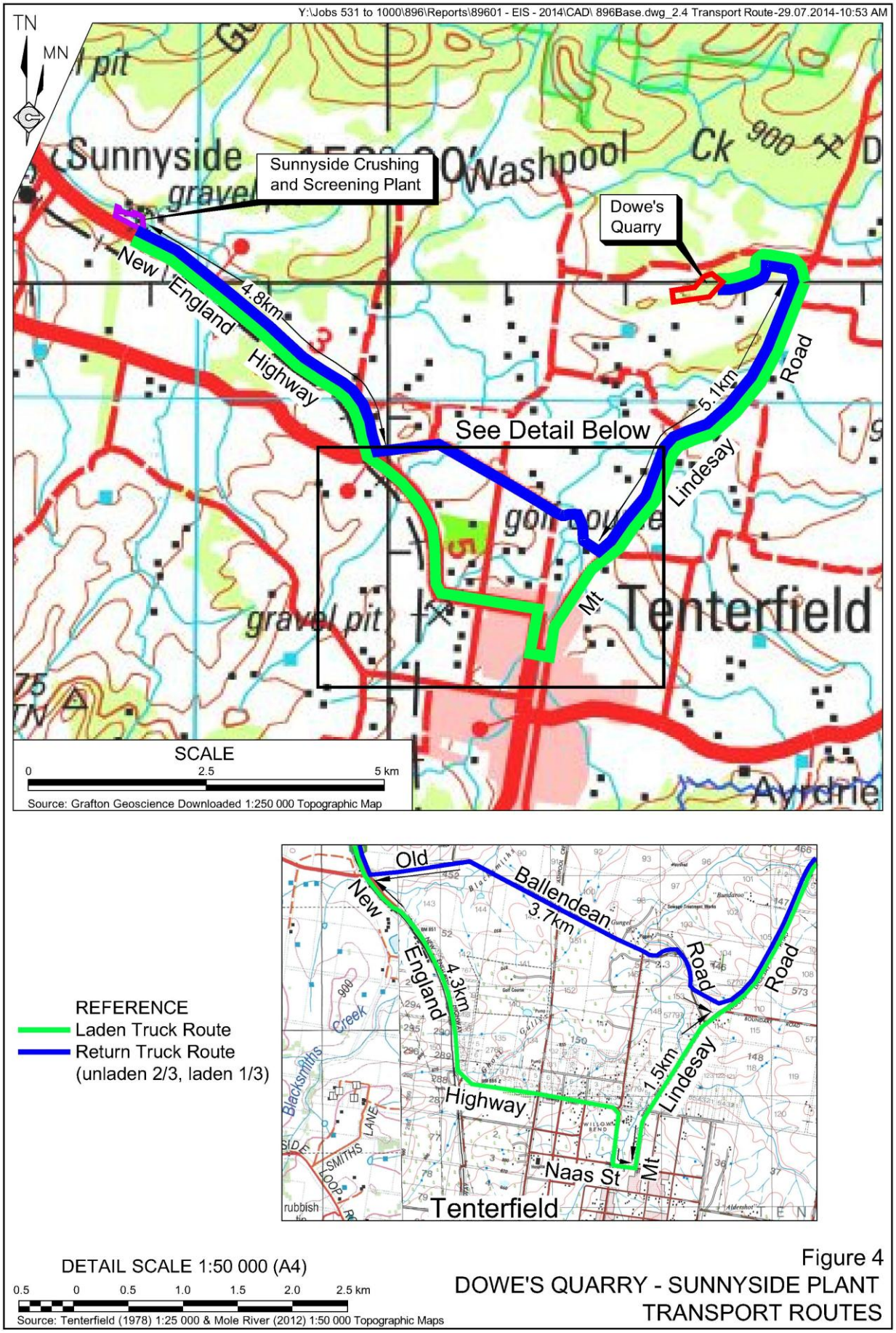


Figure 4
DOWE'S QUARRY - SUNNYSIDE PLANT
TRANSPORT ROUTES

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 100 000 tonnes

Extraction Operations, Product Loading and Despatch (based on 20 loads per day)

Drill Rig (DR) drilling blast holes in preparation for blast at 946m AHD.

Excavator (EX1) (30t) undertaking secondary breakage of oversize rock and loading blasted rock into road trucks at 928m AHD.

Excavator (EX2) (30t) undertaking re-shaping on the edge of the fines emplacement at 932m AHD.

Road truck (RT1) laden with quartzose rock travelling between active extraction face and quarry access road at 927m AHD.

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

SCENARIO 2: Annual Production – up to 100 000 tonnes

Extraction Operations, Product Loading and Despatch (based on 20 loads per day)

Drill Rig (DR) drilling blast holes in preparation for blast at 928m AHD.

Excavator (EX1) (30t) undertaking secondary breakage of oversize rock and loading blasted rock into road trucks at 918m AHD.

Excavator (EX2) (30t) preparing final landform at 940m AHD.

Road truck (RT1) laden with quartzose rock travelling between active extraction face and quarry access road at 927m AHD.

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

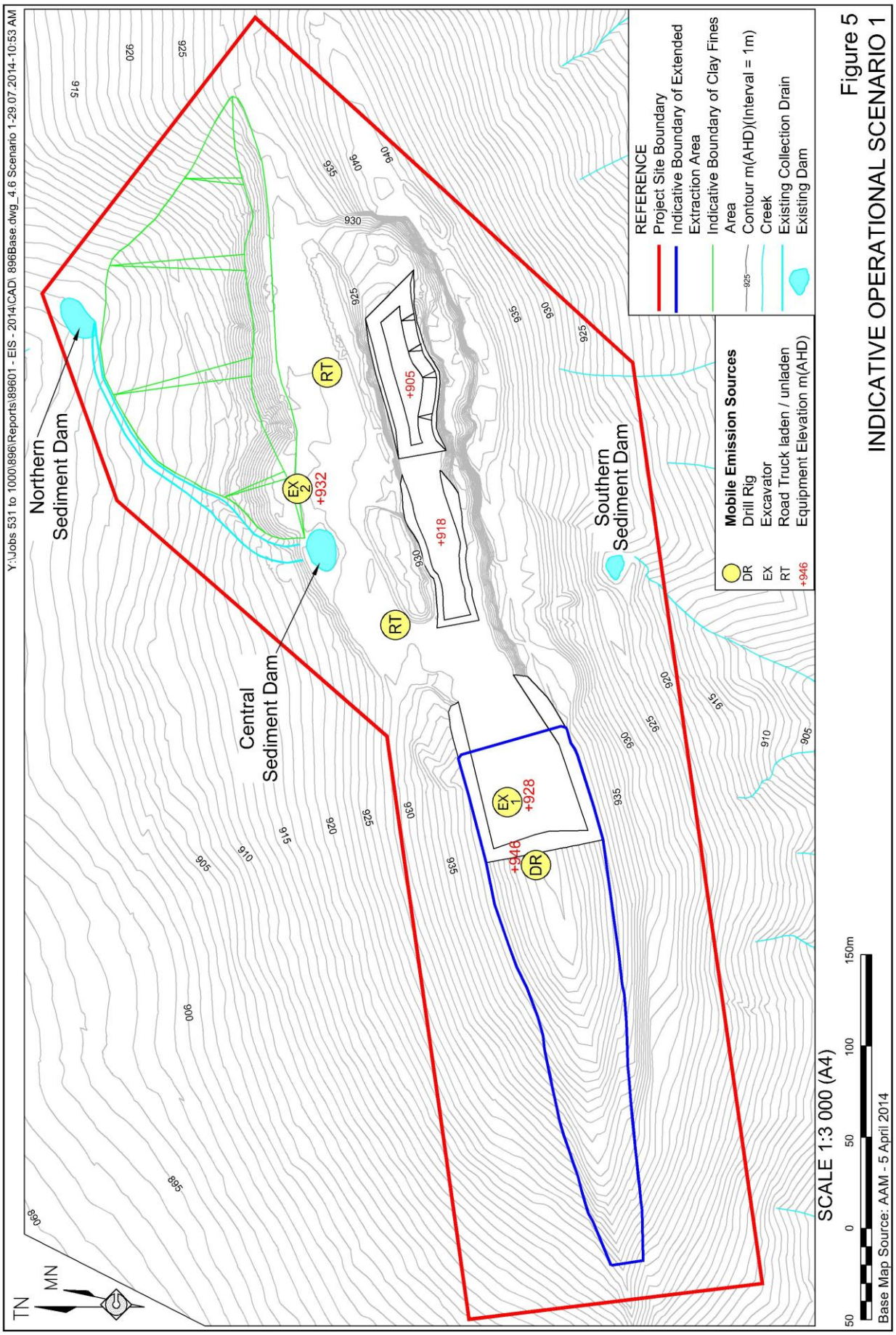


Figure 5
INDICATIVE OPERATIONAL SCENARIO 1

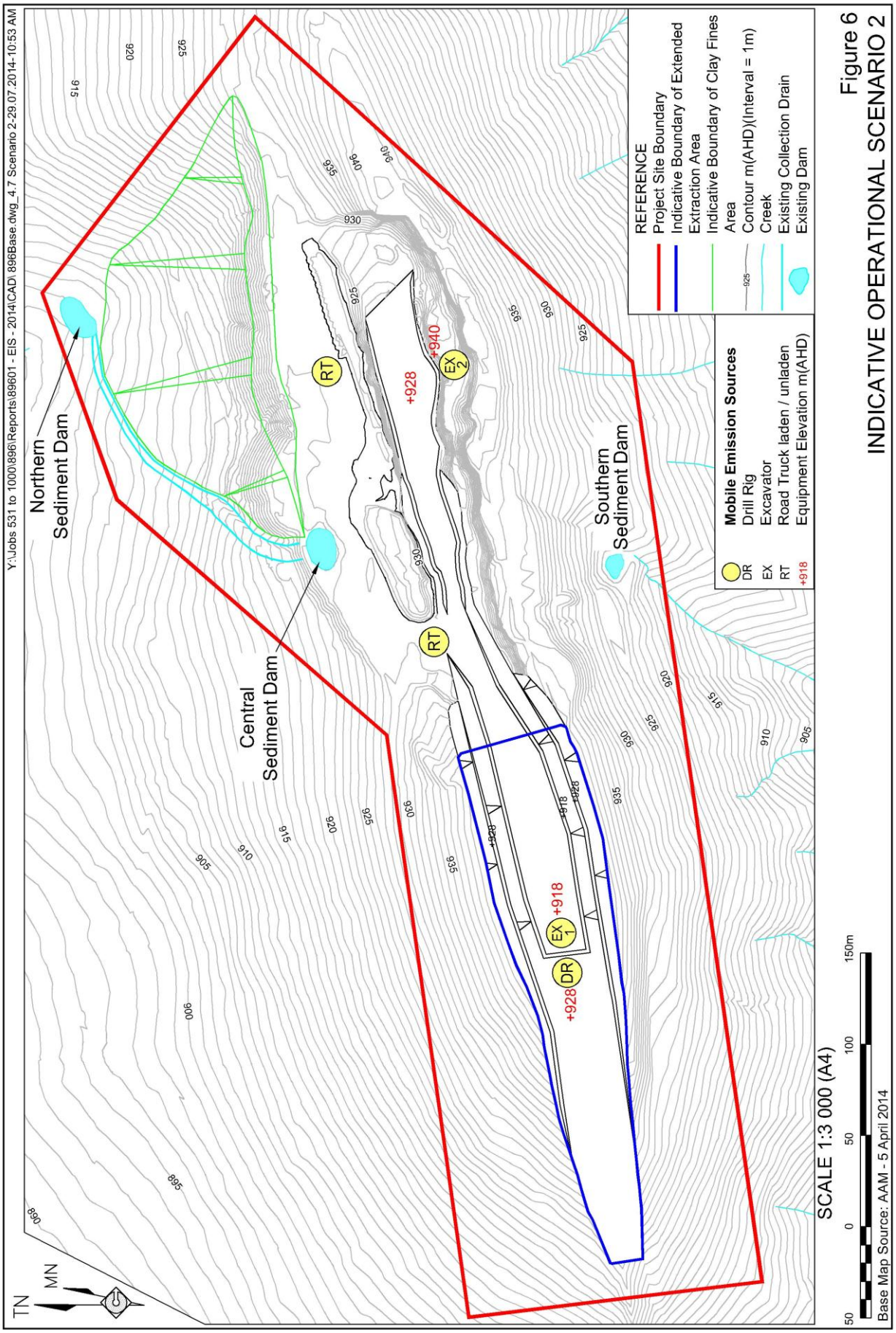


Figure 6
INDICATIVE OPERATIONAL SCENARIO 2

4.2 NOISE SOURCES

The sound power levels of the equipment used in the modelling of each scenario are listed in **Table 4**.

Table 4
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)	2-3	Transport material from extraction to Sunnyside Plant	108

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:

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

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

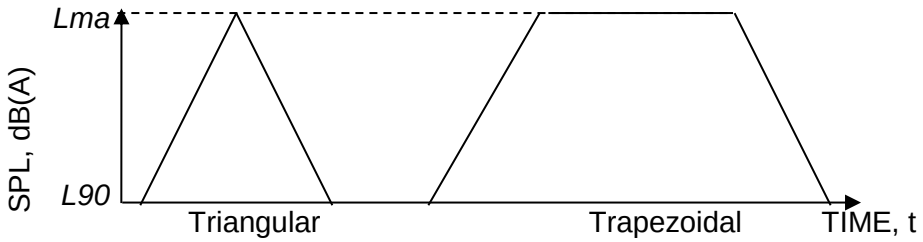
where *D* and *Q* are defined as in Equation 1. The difference between Equations 2 and 3 is the value of the coefficient 1140 or 500 and, for the sake of taking a conservative approach to the assessment, the larger value of 1140 will be adopted.

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 5** and **6**.

Table 5
Predicted noise levels, dB(A),$L_{eq(15min)}$ Scenario 1

Receiver	Meteorological condition	Criterion
	Neutral	
East of Project Site		
R10	31	35
R11	31	35
R12	32	35
R13	31	35
R14	30	35
R15	<30	35
R18	30	35
R19	<30	35
R20	<30	35
South and Southeast of the Project Site		
R7	<30	35
R8	<30	35
R9	<30	35
R21	<30	35
R22	<30	35
R23	<30	35
West and Southwest of the Project Site		
R2	<30	35
R3A	31	35
R3B	<30	35
R4	<30	35
R5A	<30	35
R5B	<30	35
R6	<30	35
R16	<30	35

Table 6
Predicted noise levels, dB(A), $L_{eq(15min)}$ Scenario 2

Receiver	Meteorological condition	Criterion
	Neutral	
East of Project Site		
R10	30	35
R11	30	35
R12	30	35
R13	30	35
R14	<30	35
R15	<30	35
R18	<30	35
R19	<30	35
R20	<30	35
South and Southeast of the Project Site		
R7	<30	35
R8	<30	35
R9	<30	35
R21	<30	35
R22	<30	35
R23	<30	35
West and Southwest of the Project Site		
R2	<30	35
R3A	33	35
R3B	30	35
R4	<30	35
R5A	<30	35
R5B	<30	35
R6	<30	35
R16	<30	35

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 be required approximately once per month. Blast design is as follows:

- Drill holes are 89mm diameter and have a maximum depth of 15m.
- Drill holes typically have a 3.3m x 3.3m 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 7**.

Table 7
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 100,000t and including back-loading of material from the Sunnyside Crushing and Screening Plant to the quarry, the proposal would generate up to 40 heavy vehicle movements per day, Monday to Saturday.

These values enabled calculation of traffic noise levels using Equation 4. As summarised in Table 8.

Table 8
Predicted traffic noise levels

Road	Speed, km/h	Distance, m	Traffic noise, dB(A),Leq(15hour)	Criterion, dB(A),Leq(15hour)
Mount Lindesay Road	100*	28	46.9	55
	70	18	47.9	55
	50	15	47.4	55
New England Highway	100	18	48.9	55
	80	32	45.1	55
	50	10	49.2	55
Old Ballandean Road	80*	20	49.3	50

* Signposted 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 have 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.