THE AUSTRAL BRICK COMPANY PTY LIMITED

ABN: 52 000 005 550

New Berrima Clay/Shale Quarry

Noise Impact Assessment

Prepared by

Spectrum Acoustics Pty Limited

August 2010

Specialist Consultant Studies Compendium:
Part 3

THE AUSTRAL BRICK COMPANY PTY LIMITED

ABN: 52 000 005 550

New Berrima Clay/Shale Quarry

Noise Impact Assessment

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EXECUTIVE SUMMARY

An assessment of potential noise impacts from the proposed New Berrima Clay/Shale quarry at New Berrima in the southern highlands of New South Wales has been conducted.

The assessment has found that exceedances of the noise criterion are likely to occur at the nearest receiver to the site under adverse conditions during construction of the proposed environmental bunds. In order to minimise the exceedances, the following recommendations have been made:

- Construction of the southern bund and the southern portion of the western bund should only occur under neutral or westerly wind conditions.
- Activities on these sections of the bunds should not occur during product haulage campaigns.

No exceedances of noise criteria for off-site road traffic noise have been predicted.

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1 INTRODUCTION

Spectrum Acoustics Pty Limited has been engaged by R.W. Corkery & Co. Pty Limited, who is in turn acting for The Austral Brick Company Pty Limited (Austral), to prepare a noise impact assessment (NIA) of a proposed clay/shale quarry. The purpose of the study is to assess the likely noise impacts of the proposed development of a clay/shale quarry (hereafter referred to as "the Project") near New Berrima in the southern highlands of New South Wales. The proposed development includes a six stage extraction operation, a surplus overburden stockpile area and internal roads. Extracted raw materials will not be processed on site but will be transported to the Bowral Brick Plant for use in the manufacture of bricks and pavers.

In summary, this report provides information on the following:

- Relevant noise goals;
- Meteorological and climatic conditions in the area;
- A discussion of the existing noise environment in the area;
- The methods used to estimate noise emissions from the proposed quarry;
- The expected noise emissions from the quarry; and
- The expected noise emissions from the transportation operations.

Descriptions of acoustical terms used in this report are contained in **Appendix A**.

2 LOCAL AREA AND PROJECT DESCRIPTION

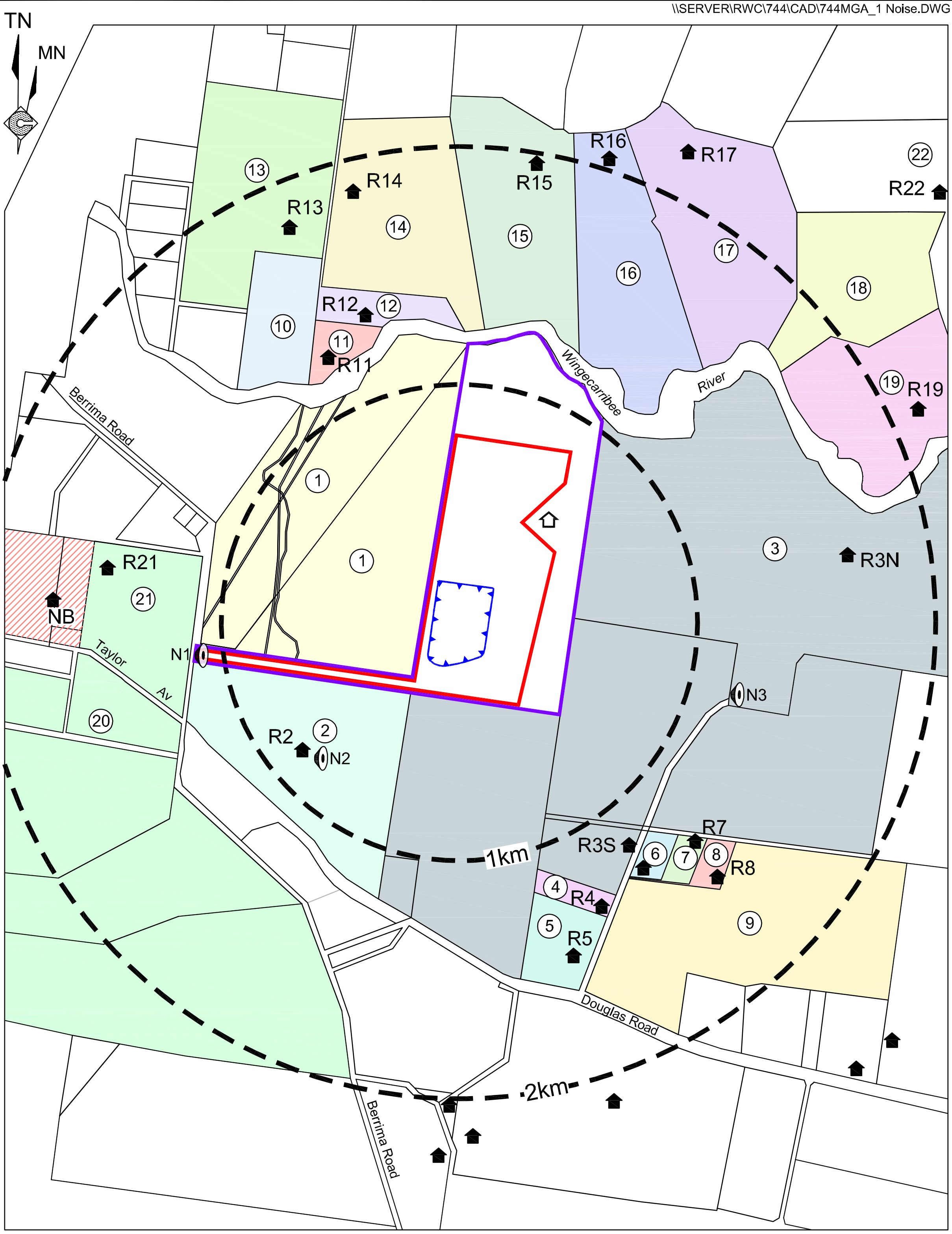
The area which is the subject of an application for project approval ("the Project Site") is approximately 51ha in area and located within the "Mandurama" property, namely Lot 1 DP 414246, 1 Berrima Road, New Berrima which is 100.2ha in area. The land is owned by The Austral Brick Company Pty Limited. The Project Site effectively incorporates the optimum clay/shale resource area on the "Mandurama" property and the access road between the property entrance and the extraction area.

The entrance to the "Mandurama" property is located on Berrima Road approximately 300m north of the intersection of Taylor Avenue and Berrima Road, New Berrima.

Figure 1 shows the local terrain of the study area, noise logging locations and residential receivers within the overall EA study area. Residential receivers considered in this NIA are described in **Table 1**. The impact of noise at these locations will be specifically addressed.

Austral is proposing to extract and transport an average of approximately 120 000tpa shale, weathered shale, brick clay and some friable sandstone, with an upper limit of 150 000tpa, for a period of 30 years. The upper limit of 150 000tpa is being sought to allow for fluctuations in the demand for the products as determined by the production levels at the Bowral Brick Plant.

\\SERVER\RWC\744\CAD\744MGA_1 Noise.DWG



REFERENCE

- Property Boundary
- Project Site Boundary
- Cadastral Boundary
- Residence (Project-related)
- R5 Residence (non Project-related) and Reference
- 1km/2km Radius from Centre of Extraction Area
- Extraction Area
- N1 Noise Logger

SCALE 1:25 000

250 0 250 500 750 1000 1250 m

Figure 1
LOCATION OF RESIDENTIAL RECEIVERS AND NOISE LOGGERS

The Project would commence with the construction of amenity bunds on the western, northern and southern sides of the extraction area. The northern bund would be constructed first to allow establishment of the bund and tree vegetation to screen residents on the northern side of the river as early as possible. Bund construction would use the overburden from Stage 1 and would be completed in six months.

Extraction operations would involve two or three campaigns each year, with approximately 40 000 to 60 000 tonnes of clay/shale extracted throughout each campaign.

Table 1. Residential Receivers Included in Noise Model

Owner Reference	Land Owner
R2	Wyndlorn Pastoral Company Pty Ltd
R3	Cowley Hills Pty Ltd
R4	P.N. Radnedge
R5	P.A. & R.F. Rusconi
R6	A.V. Dickson
R7	M. & R.K. Senior
R8	P.R. Rosen
R11	C. & K. Vella Enterprises Pty Ltd
R12	Pingama Pty Ltd
R13	P.J. & D.J. Daly
R14	G.W. Holdings Pty Ltd
R15	Flocolo Pty Ltd
R16	R.L. Lavender
R17	P. Holicek
R21	Perth St, New Berrima nearest residence

The approach to the extraction of the clay/shale would generally be consistent with that adopted in the extraction area adjacent to the Bowral Brick Plant. Following removal of topsoil and unwanted clay, the weathered shale would be pushed up with a bulldozer and used in bund construction, stockpiled in the surplus overburden stockpile area or stockpiled for despatch as required.

Once exposed, the shale would be ripped and then cross ripped preferably across a vertical interval of at least 5m to achieve a level of blending. The ripped shale would then be pushed up into one or more stockpiles on the floor of the active extraction area, typically to a height of approximately 4.5m.

The mobile equipment involved in the extraction operations would typically include the following:

- A scraper (eg Cat 637) for initial topsoil removal and subsoil/clay removal and construction of the amenity bund walls.
- A bulldozer (eg Cat D10) for topsoil removal beneath amenity bund walls and ongoing topsoil stripping campaigns, ripping and pushing up weathered shale and unweathered shale; ripping and pushing sandstone.

- An articulated haul truck (eg Cat 740) for relocation of ripped/broken sandstone within the extraction area.
- A front-end loader (eg Cat 966) for loading product clay/shale into highway trucks and ripped/broken sandstone into the articulated haul truck.

The extraction campaigns would typically produce approximately 2000t per day or an average of 10 000t per week. Based on this weekly yield, each campaign would typically occur over a period of 4 to 6 weeks, depending on limiting weather conditions.

Transportation will be predominantly conducted Monday to Friday on a full-time basis, although transport may occasionally occur on weekends under special circumstances. Assuming full-time transportation on weekdays, up to approximately 2 500t product clay/shale may be transported to the brick plant each week. With each load being approximately 30t, there would be approximately 17 loads per day, or 34 truck movements per day, for 5 days per week. This represents approximately eight or nine return trips for two trucks each day. Alternatively, if a two week per month campaign basis is engaged, there would be 34 loads per day, or 68 truck movements per day for 10 days every four weeks, This represents approximately eight or nine return trips for four trucks each day.

It is predicted that following periods of wet weather, traffic volumes may need to be as high as 68 loads per day or 136 truck movements per day. This would allow the Bowral Brick Plant to quickly accumulate product clay/shale which it had not been able to access during the wet weather, thus enabling the plant to remain operational.

3 THE EXISTING ENVIRONMENT AND NOISE CRITERIA

The existing meteorological and acoustical environments of the Project Site and its surrounds 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 and gentle winds (indicative of possible wind shear). Temperature inversions are only required under the INP to be considered for night time operations. As the proposal is for daytime operation only, inversions have not been considered.

Historical wind data for Bowral and Moss Vale on the Bureau of Meteorology (BoM) website indicate a predominance of westerly winds in autumn, winter and spring with NE winds occurring in summer. Percentage occurrences of these winds have not been analysed although both have been adopted for modelling of prevailing conditions.

The following meteorological scenarios were considered in the noise modelling:

- 3m/s winds from the West and NE.
- Neutral conditions of 20^0C, 70% relative humidity and a 1^0C/100m lapse have been modelled to represent typical calm conditions.

3.2 Ambient Noise Levels

Ambient noise levels at three representative locations were measured during August 2008 at 15 minute statistical intervals using Svan 949 sound and vibration analysers as environmental noise loggers. The measurements were done in accordance with relevant DECCW guidelines and AS 1055-1997 “Acoustics – Description and Measurement of Environmental Noise”. The noise loggers used comply with the requirements of AS 1259.2-1990 “Acoustics – Sound Level Meters”, and have current NATA calibration certification.

The loggers were programmed to continuously register environmental noise levels over 15 minute intervals, with internal software calculating and storing Ln percentile noise levels for each sampling period. Calibration of the loggers was performed as part of the instruments’ initialisation procedures, with calibration results being within the allowable $\pm$ 0.5 dB(A) range.

Existing ambient L_{Aeq} and Rating Background Levels (RBL,L_{A90}) are shown below in **Table 2**. Most of the noise data were found to be wind-affected, with noise from nearby trees contributing strongly to data at N1 and N2. The logger at N3 was placed in an open paddock and, in the interests of conservatism, the daytime RBL of 33 dB(A),L_{90} will be adopted for all assessed receivers. Graphs of the measured data at N3 are included in **Appendix B**.

Table 2. Ambient Noise Levels – August 2008

Location	Leq (day)	Leq (eve)	Leq (night)	L90 (day)	L90 (eve)	L90 (night)
N1 “Mandurama”	57	57	54	48	47	46
N2 (R2) “Chesley Park”	46	44	43	39	36	38
N3 (R3) “Carribee Farm”	55	46	46	33	32	34

3.3 Construction and Operational Noise Criteria

Due to the absence of significant industrial noise sources in the area, operational noise criteria will equal the INP ‘intrusive’ criteria of “Background (RBL) plus 5 dB” expressed as a 15-minute L_{Aeq}. Because the construction stage is less than twenty-six weeks, and the bunds to be formed during this period will decrease future noise emissions from the site, a construction noise criterion is applicable. This will equal the INP ‘intrusive’ criteria of “Background (RBL) plus 10 dB” expressed as a 15-minute $L_{Aeq,}$.

Based upon this background level, the operational noise criterion at all receivers is equal to 38 dB(A),$L_{eq(15min)}$ and the construction noise criterion at all receivers is equal to 43 dB(A),$L_{eq(15min)}$

3.4 Traffic Noise Criteria

The haulage route between the site and the Bowral Brick Plant comprises local, connector and arterials roads. Criteria for the generation of additional traffic noise on public roads were sourced from the DECCW *Environmental Criteria for Road Traffic Noise* (ECRTN) as follows:

	Day (7am-10pm)	Night (10pm-7am)
Land use development with potential to create additional traffic on existing **freeways/arterials**	60dB(A),$L_{eq(15hr)}$	55dB(A),$L_{eq(15hr)}$
Land use development with potential to create additional traffic on existing **collector road**	60dB(A),$L_{eq(1hr)}$	55dB(A),$L_{eq(1hr)}$
Land use development with potential to create additional traffic on existing **local road**	55dB(A),$L_{eq(1hr)}$	50dB(A),$L_{eq(1hr)}$

4 ASSESSMENT METHODOLOGY

4.1 Construction and Operational Noise

The assessment of construction and operational noise was conducted using RTA Technology's Environmental Noise Model (ENM) v3.06. All major noise producing items were modelled at most exposed positions and point calculations performed for each receiver location. Noise contours were also generated for the surrounding area, although it should be noted that differences of up to ±2 dB between point calculations and values read off the contours for the same receiver are common. This is because calculation sections in contouring mode rarely intercept the receiver locations, whereas point calculations are for the exact receiver locations.

4.1.1 Noise Sources

Noise data for significant sources associated with the Project were obtained from measurements of similar machinery previously conducted by Spectrum Acoustics. Sound power levels for noise sources used in the modelling are shown below in **Table 3**.

Table 3. Noise Source Sound Power Levels

Noise source	Sound power level dB(A),L_w
Scraper (CAT 637, construction only)	118
Bulldozer (CAT D10)	116
Front end loader (CAT 966)	111
Haul Truck (50t)	110
Product truck (road-registered)	108 (L_{max} pass-by)

4.1.2 Modelled Scenarios

As discussed in Section 3.1, modelling was conducted for the following atmospheric conditions:

- *Daytime 'neutral'* – Air temperature 20^oC, 70% relative humidity (RH), no wind, $-1^oC/100m$ vertical temperature gradient (boundary layer adiabatic lapse);
- *North-East and Westerly wind* – Air temperature 20^oC, 70% R.H., 3m/s wind speed.

Noise models were generated for each of the following construction and operational scenarios, for each of the three atmospheric conditions discussed above. These scenarios are considered to be the worst cases in terms of noise generation and potential impacts.

Scenario 1) Bund Construction:
Use of a scraper and bulldozer to form the proposed environmental bunds along (a) south-western and southern sides of extraction area and (b) north-western and northern sides of extraction area, using topsoil and overburden removed from the proposed Stage 1 area. Sources are situated at natural ground level to reflect worst case conditions with respect to the closest receivers (*R2* to the south-west and *R11* to the north-west.). Off-site haulage of material would not occur during this stage and noise modelling has been confined to the initial construction earthworks to determine the impact of these sources alone.

Scenario 2) (a) and (b):
Commencement of extraction of the clay/shale which would be approximately 7m below natural ground level at the northern extent of the proposed Stage 1 extraction area (ie. at the highest point in the proposed area of disturbance at 680m AHD).Two product transport scenarios were modelled for the on-site section of the haul route: (a) maximum of four truck movements per 15 minutes (132 movements per day) and (b) an average of two truck movements per 15 minutes (68 movements per day). Modelling was not undertaken for Stages 2 and 3 because operations during these stages would be deeper in the pit. Stage 1 operation represents the worst case scenario amongst Stages 1-3.

Scenario 3):
Commencement of topsoil and overburden removal and extraction of clay/shale at the southern extent of the proposed Stage 4 extraction area. One haul truck transporting overburden to the proposed Surplus Overburden Stockpile Area (assumed 10m above ground level at the centre) (although, in practice, this may not occur at this stage of the project because excavated materials may remain in-pit). Average product transport rate of 68 movements per day. Modelling was not undertaken for Stages 5 and 6 because operations during these stages would be deeper in the pit. Stage 4 operation represents the worst case scenario amongst Stages 4-6.

4.2 Off-site Road Traffic Noise

Off-site vehicle movements would be of an intermittent rather than constant nature. There are many methods available for calculating the noise impact arising from intermittent signals of various shapes. The methodology employed in this assessment 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 main parameters considered in the traffic noise assessment are

L_{max} = maximum vehicle noise at residence, dB(A)
T = assessment period (minutes)
τ = “10dB-down” duration per vehicle (minutes), and
n = number of vehicles during assessment period.

Calculations were performed for the maximum number of trucks movements (136 movements per day) and the average number of movements (64 movements per day) at the nearest affected residences to the haul route.

5 RESULTS AND DISCUSSION

5.1 Bund Construction Noise Levels (Scenario 1)

Predicted bund construction noise levels under all assessed meteorological conditions for the two bund construction scenarios are summarised in **Table 4**.

5.1.1 Bund Construction Recommendations

The results in **Table 4** indicate that bund construction noise levels may exceed the 43 dB(A),$L_{eq(15min)}$ criterion by 4 dB at R2 under NE wind conditions when the construction equipment is operating at the southern end of the western bund, or on the southern bund. In order for the criterion to be achieved, bund construction works should occur at the northern end of the western bund, or on the northern bund, under these adverse conditions. Formation of the southern bund or the southern end of the western bund should only occur under westerly wind conditions or under neutral conditions (when a minor 2 dB exceedance of the criterion may occur). Given the dominance of westerly winds in the area and the availability of more northerly locations for bund formation, this recommendation should be readily achievable.

Table 4. Predicted Construction Noise Levels dB(A),$_{Leq(15minute)}$

Ref	Land owner	Meteorological condition					
		South/West bund			North/West bund		
		Calm	W wind	NE wind	Calm	W wind	NE wind
R2	Wyndlorn Pastoral Company Pty Ltd	40	36	47	34	31	38
R3	Cowley Hills Pty Ltd	20	30	<20	25	35	<20
R4	P.N. Radnedge	24	35	30	30	35	32
R5	P.A. & R.F. Rusconi	25	35	30	28	32	30
R6	A.V. Dickson	25	33	25	25	34	26
R7	M. & R.K. Senior	25	32	25	27	34	28
R8	P.R. Rosen	22	30	20	25	33	26
R11	C. & K. Vella Enterprises Pty Ltd	35	35	35	35	35	35
R12	Pingama Pty Ltd	35	35	35	35	35	35
R13	P.J. & D.J. Daly	30	30	30	35	32	31
R14	G.W. Holdings Pty Ltd	30	30	30	35	32	31
R15	Flocolo Pty Ltd	29	27	24	28	28	30
R16	R.L. Lavender	29	27	24	28	28	30
R17	P. Holicek	29	27	24	28	28	30
R21	Perth St, New Berrima nearest residence	34	30	35	30	29	36

5.2 Operational Noise

5.2.1 Predicted Stage 1 Noise levels (Scenario 2)

Predicted operational noise levels for the Stage 1 scenario, for the worst case 4 truck movements per 15 minutes and the average 2 truck movements per 15 minutes are summarised in **Table 5**. Noise contours for the average number of truck movements are shown in **Appendix C**.

Table 5. Predicted Stage 1 Operational Noise Levels dB(A),$_{Leq(15minute)}$

Ref	Land owner	Meteorological condition					
		4 movements / 15 minutes			2 movements / 15 minutes		
		Calm	W wind	NE wind	Calm	W wind	NE wind
R2	Wyndlorn Pastoral Company Pty Ltd	34	34	38	31	31	35
R3	Cowley Hills Pty Ltd	20	31	<20	20	31	<20
R4	P.N. Radnedge	26	29	30	26	29	30
R5	P.A. & R.F. Rusconi	25	30	30	25	30	30
R6	A.V. Dickson	24	33	25	24	33	25
R7	M. & R.K. Senior	24	34	24	24	34	23
R8	P.R. Rosen	23	33	24	22	33	22
R11	C. & K. Vella Enterprises Pty Ltd	23	22	22	22	22	22
R12	Pingama Pty Ltd	23	22	22	22	22	22
R13	P.J. & D.J. Daly	22	22	22	22	22	22
R14	G.W. Holdings Pty Ltd	22	22	22	22	22	22
R15	Flocolo Pty Ltd	23	25	20	23	25	20
R16	R.L. Lavender	23	25	20	23	25	20
R17	P. Holicek	23	25	20	23	25	20
R21	Perth St, New Berrima nearest residence	24	20	29	23	<20	26

5.2.2 Stage 1 Recommendations

The results in **Table 5** show that noise levels may equal the 38 dB(A),$L_{eq(15min)}$ criterion at R2 during summer NE winds (ie. directly from source to receiver) when the maximum number of truck movements occurs. Predicted levels are below the criterion at all receivers for the average number of truck movements.

5.2.3 Predicted Stage 4 Noise levels

Predicted operational noise levels for the commencement of Stage 4 scenario, for the average 2 truck movements per 15 minutes are summarised in **Table 6**. Noise contours are shown in **Appendix C**. This scenario represents a typical operating condition with material extraction occurring at least one 5m bench below natural ground level and product haulage at the higher average rate for haulage campaigns lasting two weeks per month.

Table 6. Predicted Stage 4 Operational Noise Levels dB(A),$_{Leq(15minute)}$

		Meteorological condition		
Ref	Land owner	Calm	W wind	NE wind
R2	Wyndlorn Pastoral Company Pty Ltd	30	30	34
R3	Cowley Hills Pty Ltd	<20	29	<20
R4	P.N. Radnedge	21	24	24
R5	P.A. & R.F. Rusconi	20	25	24
R6	A.V. Dickson	20	25	20
R7	M. & R.K. Senior	20	24	<20
R8	P.R. Rosen	<20	25	<20
R11	C. & K. Vella Enterprises Pty Ltd	20	20	<20
R12	Pingama Pty Ltd	20	20	<20
R13	P.J. & D.J. Daly	20	<20	<20
R14	G.W. Holdings Pty Ltd	20	<20	<20
R15	Flocolo Pty Ltd	20	20	20
R16	R.L. Lavender	20	20	20
R17	P. Holicek	20	20	20
R21	Perth St, New Berrima nearest residence	20	<20	22

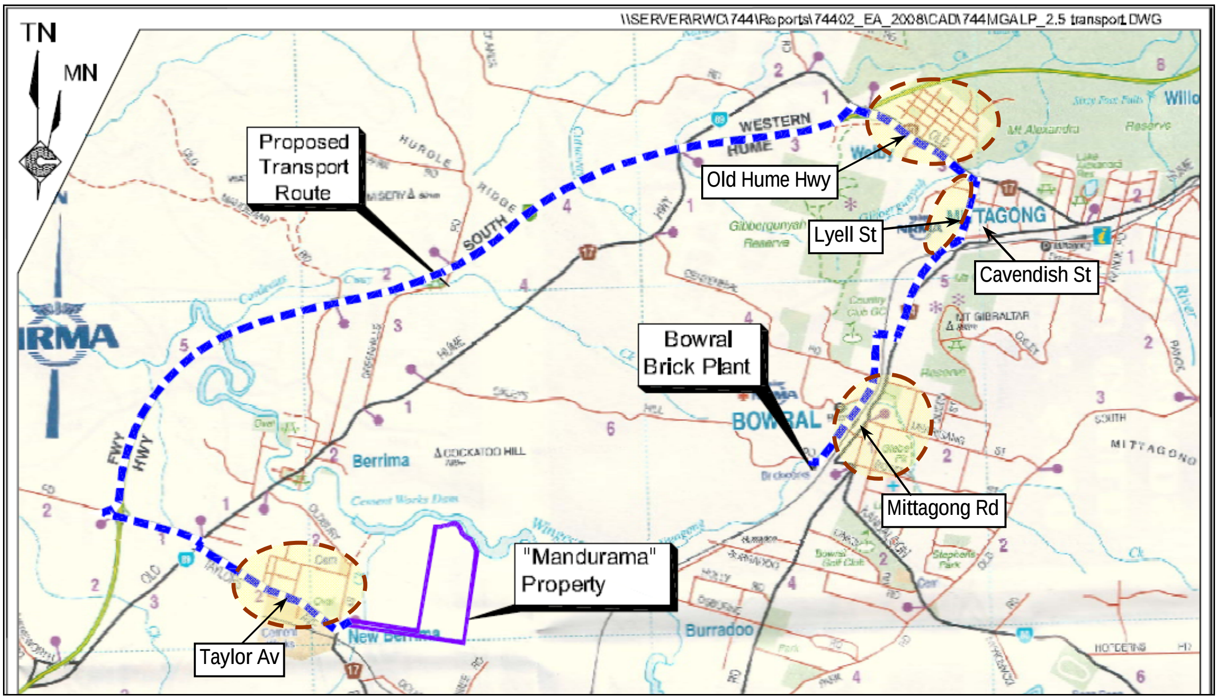
5.2.4 Stage 4 Recommendations

The results in **Table 6** show compliance with the criterion of 38 dB(A) at all receivers.

5.3 Off-site Traffic Noise

Figure 2 shows the proposed haul route (blue dotted path). The entire length of the haul route is approved by the RTA for B-double traffic. **Figure 2** also indicates areas where residences are adjacent to the haul route. At all locations except Lyell Street and Taylor Avenue, the proposed number of vehicles associated with the proposal will be less than 5% of the existing traffic volume and no quantitative assessment of traffic noise impacts is necessary. The heavy vehicle route assessment (Traffic Solutions, 2010) indicates that vehicles would travel down Cavendish Street rather than Lyall Street, Mittagong, thereby avoiding a school zone and Lyall Street residences. Only traffic noise impacts at Taylor Avenue residences require assessment.

Figure 2: Proposed Transport Route



Taylor Avenue is defined as a ‘regional, rather than ‘local’, road in the heavy vehicle route assessment and would best be described as a ‘collector’ road in the ECRTN. Accordingly, a criterion of 60 dB(A),$L_{eq(1\ hour)}$ applies.

Noise levels from such vehicles have been assessed to a point 1m from the facade of the nearest residence in Taylor Avenue at a distance of 18m from the centre of the road. Results are shown below in **Table 7**.

Table 7. Predicted Off-site Traffic Noise Levels dB(A),$L_{eq(1\ hour)}$

Element	dB(A)
No. of Vehicle movements (peak hourly period)	15 (ie. 136 / 9 hrs)
Lw per vehicle @ 50 kph	103
Distance Loss (17m)	33
Received Noise (Leq 1 hour) from eqn. 1	51
Criterion – Day (Leq 1 hour)	60
Exceedance	0

The results shown in **Table 7** indicate that noise from traffic generated by the proposal will not exceed the criterion at the most affected receiver.

6 SUMMARY

An assessment of potential noise impacts from the proposed New Berrima Clay/Shale quarry at New Berrima in the southern highlands of New South Wales has been conducted.

The assessment has found that exceedances of the noise criterion are likely to occur at the nearest receiver to the site under adverse conditions during construction of the proposed environmental bunds. In order to minimise the exceedances, the following recommendations have been made:

- Construction of the southern bund and the southern portion of the western bund should only occur under neutral or westerly wind conditions.
- Activities on these sections of the bunds should not occur during product haulage campaigns.

No exceedances of noise criteria for off-site road traffic noise have been predicted.

7 REFERENCES

DECC *NSW Industrial Noise Policy* (2000).

DECC *Environmental Criteria for Road Traffic Noise* (1999).

APPENDICES

(No. of pages excluding this page = 25)

Appendix A: Description of Acoustical terms

Appendix B: Ambient Noise Level Charts

Appendix C: Noise Level Contours

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Appendix A

Description of Acoustical Terms

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This section of the report aims to convey an understanding of several commonly used acoustical terms. Various terms are explained in plain language and the effects of certain atmospheric conditions on noise propagation are discussed. Noise level percentiles are explained with the aid of a diagram of a hypothetical noise signal.

The descriptions in this section are not formal definitions of the terms. Formal definitions may be found in AS1633-1985 "Acoustics – Glossary of terms and related symbols".

General Terms

Sound Power Level

The amount of acoustic energy (per second) emitted by a noise source. Usually written as "L_w" or "SWL", the Sound Power Level is expressed in decibels (dB) and cannot be directly measured. L_w is usually calculated from a measured sound pressure level.

Sound Pressure Level

The "noise level", in decibels (dB), heard by our ears and/or measured with a sound level meter. Written as "SPL", the sound pressure level generally decreases with increasing distance from a source. Noise levels are often written as dB(A) rather than dB. The "A-weighting" is a correction applied to the measured noise signal to account for the ear's ability to hear sound differently at different frequencies. The A-weighted sound pressure level therefore represents the measured (or predicted) noise level as it would be heard by the typical human ear.

Temperature Inversion

An atmospheric state in which the air temperature increases with altitude. Sound travels faster in warmer air than in cold air, so that during an inversion the top of a "sound wave" will move faster than the bottom. This bends (refracts) sound back towards the ground. The result is a "trapping" of sound energy near the ground and an increase in noise levels. Similarly, daytime air temperatures typically reduce with altitude (approximately 1-2 ^{0}C/100m called the adiabatic lapse rate) and sound refracts upward slightly. The result is slightly reduced noise levels compared with a uniform or 'neutral' atmosphere.

Wind Shear

A moving air mass will experience a "friction drag" at the ground in much the same way as a lava flow will flow quickly on top and "roll over" the lava beneath which must drag along the ground. This increasing wind speed with altitude is called "wind shear".

For a sound wave travelling down wind, the top of the wave moves faster than the bottom and the wave bends towards the ground. However, for a wave travelling into the wind the top of the wave is slowed down more than the bottom is and the wave bends upwards. **Figure A1** shows several examples of how atmospheric effects can bend sound waves.

FIGURE A1
Sound refraction under temperature inversions and wind gradients.

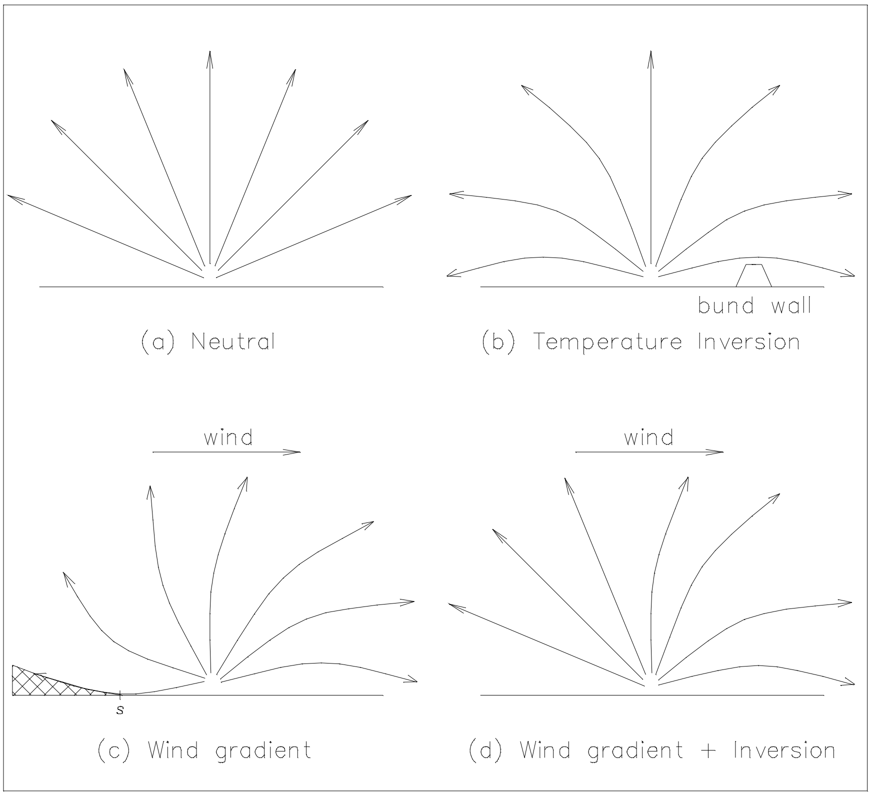


Figure A1 shows that sound rays can be refracted over a barrier (usually a bund wall or small hill) during a temperature inversion, increasing noise levels in the 'shadow zone'.

Neutral Atmospheric Conditions

An atmosphere that is at a temperature of approximately 23^0C from ground level to an altitude of 200m or more. There are no fluctuations in density or humidity and no wind. Such conditions rarely occur, as temperature will usually vary with altitude and there is always movement in various directions in different layers of the atmosphere.

Prevailing Atmospheric Conditions

Atmospheric conditions (with regards to potential effects on noise propagation) which are characteristic of the study area. These will typically include seasonal wind directions and velocities. Temperature inversions will be included as prevailing if they occur, on average, for more than 2 nights per week in winter.

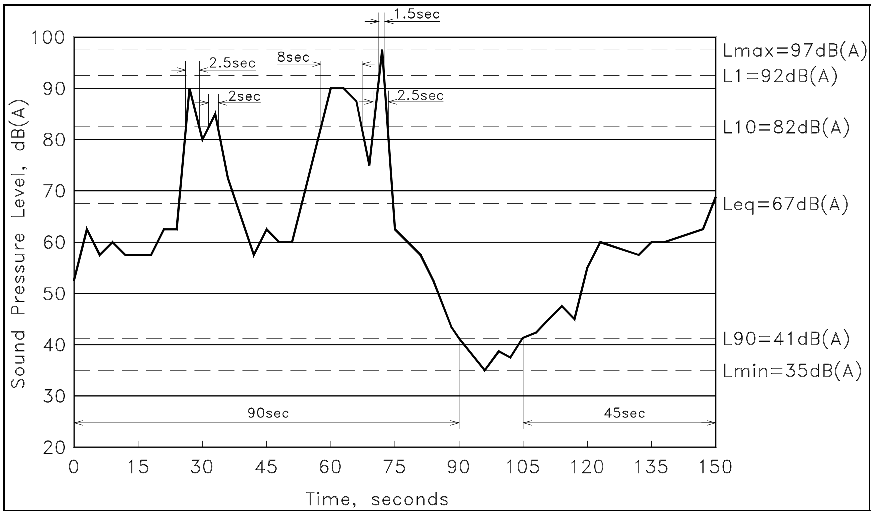
Adverse Atmospheric Conditions

Adverse conditions will include simultaneous winds and temperature inversions, even if the inversions occur for less than 2 nights per week in winter. This represents the worst case scenario for potential noise enhancement due to atmospheric effects.

Noise Level Percentiles

A noise level percentile (L_n) is the noise level (SPL) in decibels which is exceeded for "n" % of a given monitoring period. Several important L_n percentiles will be explained by considering the hypothetical time signal in **Figure A2**.

FIGURE A2
Hypothetical time signal to illustrate noise level percentiles



The signal in Figure A2 has a duration of 2.5 minutes (ie. 150 seconds) with noises occurring as follows:

- The instrument is located beside a road and records crickets in nearby grass at a level of around 60 dB (A);
- At about the 30 second mark a motorcycle passes on the road, followed by a car;
- At 60 seconds a truck passes;
- After the truck passes it sounds its air horn at the 73 second mark;
- The crickets are startled into silence as the truck fades into the distance;
- All is quiet until 105 seconds when the crickets slowly start to make noise, reaching full pitch by 120 seconds;
- The measurement stops at 150 seconds, just when an approaching car starts to become audible.

L_{A1} Noise Level

Near the top of Figure A2, there is a dashed line at 92 dB(A). A small spike of 1.5 sec duration extends above this line at around 73 seconds. Since 1.5 sec is 1% of the signal duration (150 seconds), the L_1 (or L_{A1} to signify A-weighting) noise level of this sample is 92 dB(A) and is from the truck's air horn. The L_1 percentile is often called the *average peak noise level* and is used by the NSW Department of Environment and Climate Change (DECC) as a measure of potential disturbance to sleep.

L_{A10} Noise Level

The dashed line at 82 dB(A) is exceeded for four periods of duration 2.5 sec, 2 sec, 8 sec and 2.5 sec, respectively. The total of these is 15 sec, which is 10% of the total sample period. Therefore, the L_{A10} noise level of this sample is 82 dB(A). The L_{A10} percentile is called the *average maximum noise level* and has been widely used as an indicator of annoyance caused by noise.

L_{A90} Noise Level

In similar fashion to L_{A1} and L_{A10}, Figure A2 shows that the noise level of 41 dB(A) is exceeded for 135 seconds (90 + 45 =135). As this is 90% of the total sample period, the L_{A90} noise level of this sample is 41 dB(A). The L_{A90} percentile is called the *background noise level*.

L_{Aeq} Noise Level

Equivalent continuous noise level. As the name suggests, the L_{Aeq} of a fluctuating signal is the continuous noise level which, if occurring for the duration of the signal, would deliver equivalent acoustic energy to the actual signal. L_{Aeq} can be thought of as a kind of 'average' noise level. Recent research suggests that L_{Aeq} is the best indicator of annoyance caused by industrial noise and the DEC *NSW Industrial Noise Policy* (INP) takes this into consideration.

L_{Amax} and L_{Amin} Noise Levels

These are the maximum and minimum SPL values occurring during the sample. Reference to Figure A2 shows these values to be 97 dB(A) and 35 dB(A), respectively.

Appendix B

Ambient Noise Level Charts

(No. of pages including blank pages = 9)

Figures are included as colour on the Project CD

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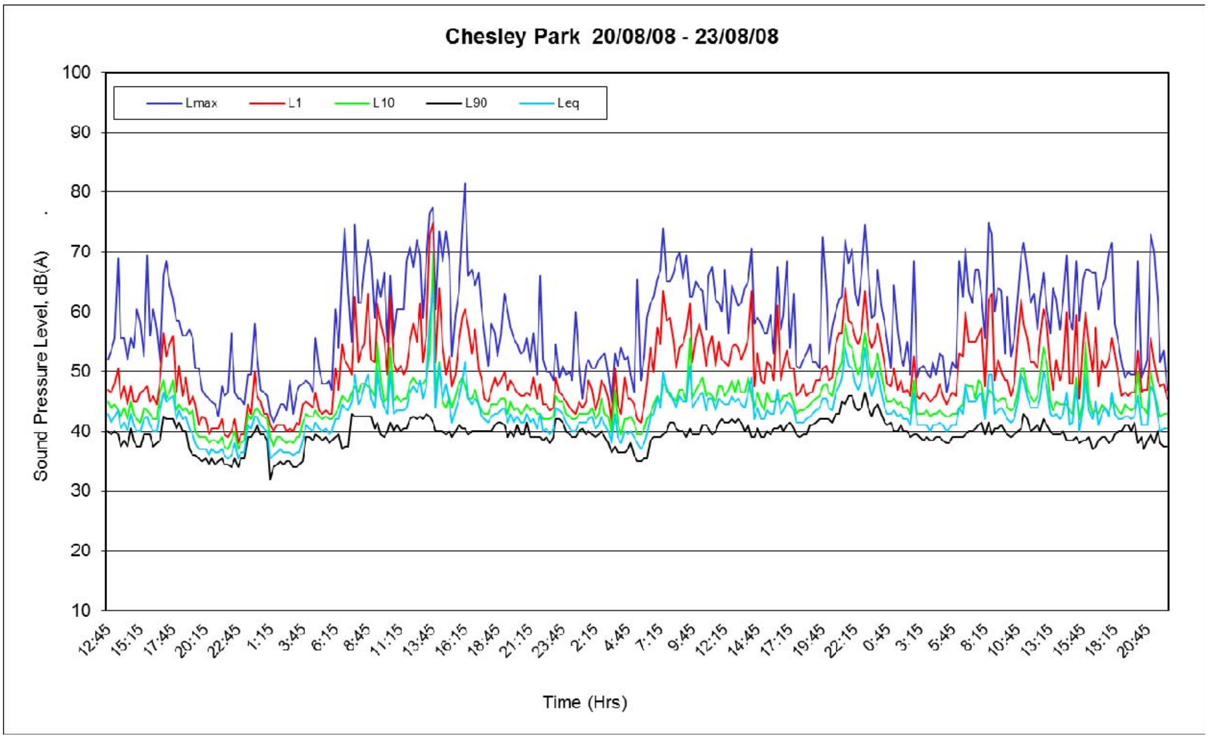
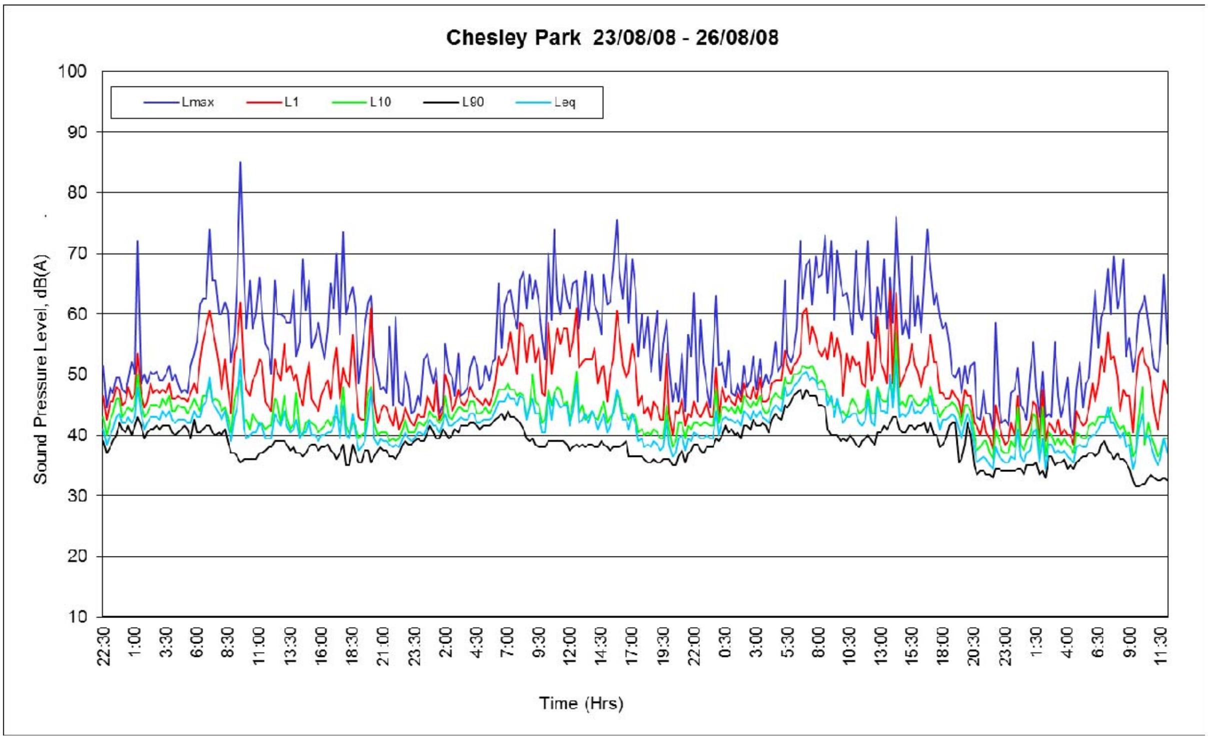
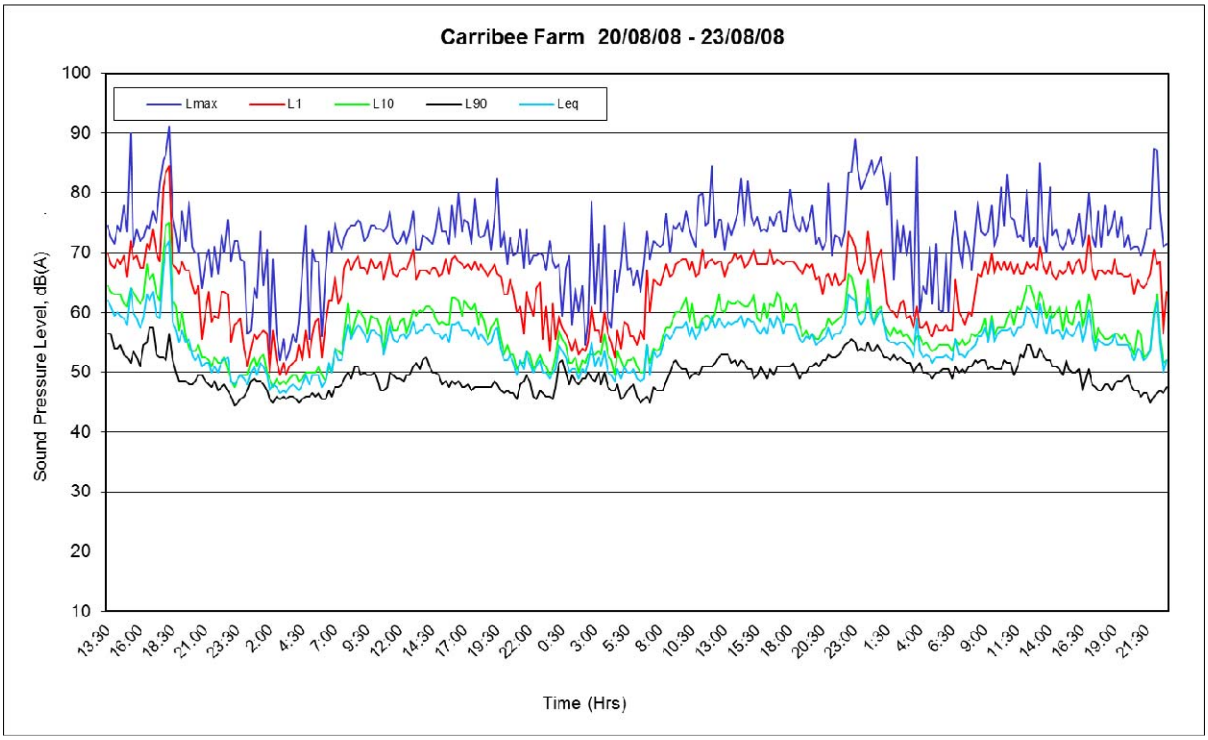
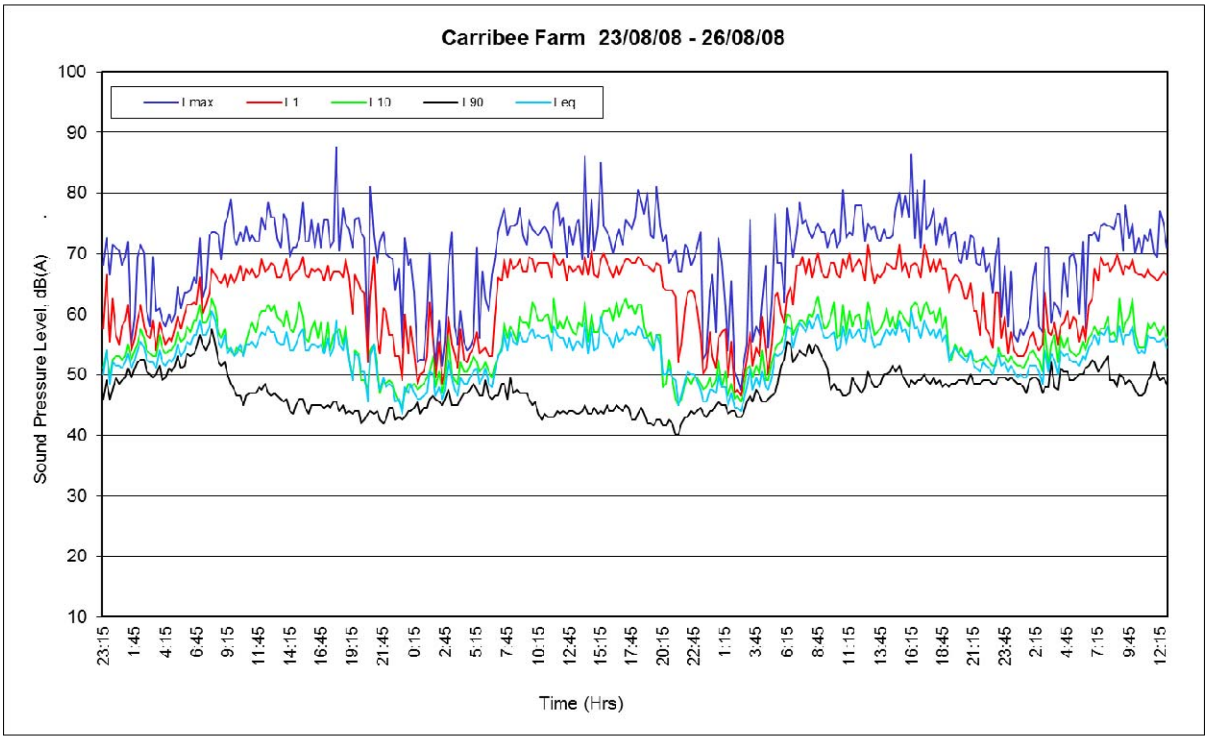
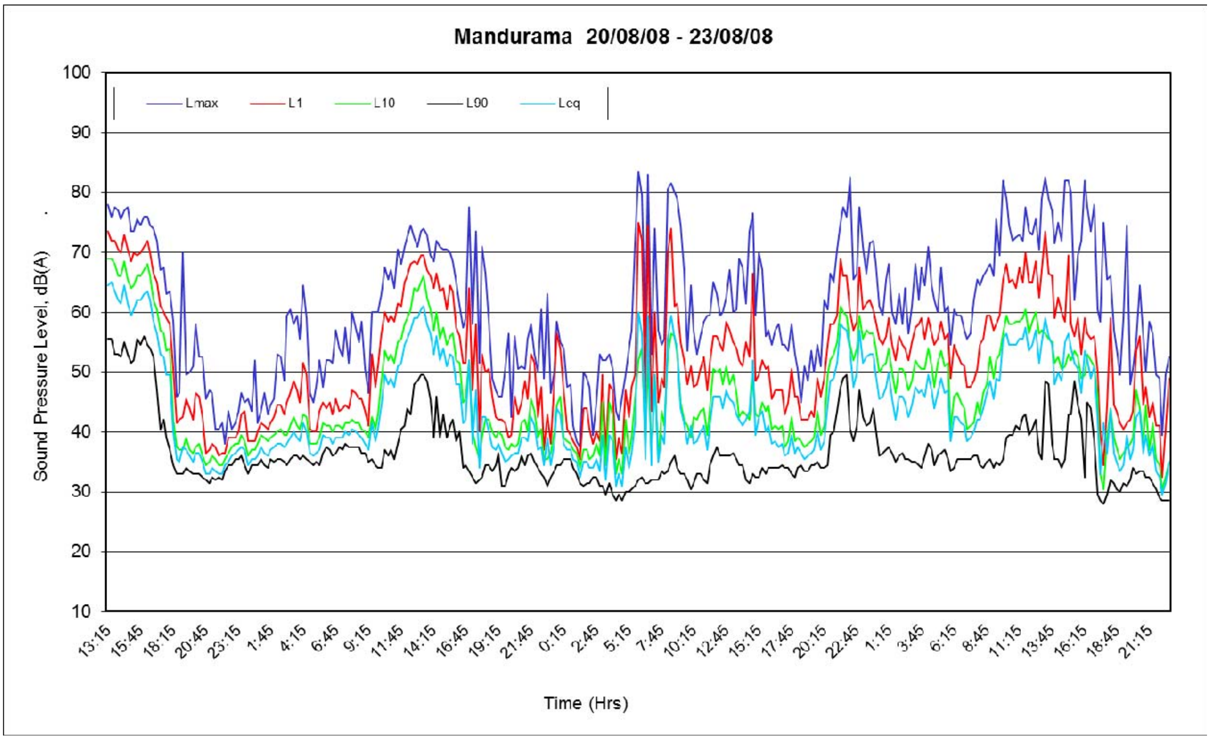
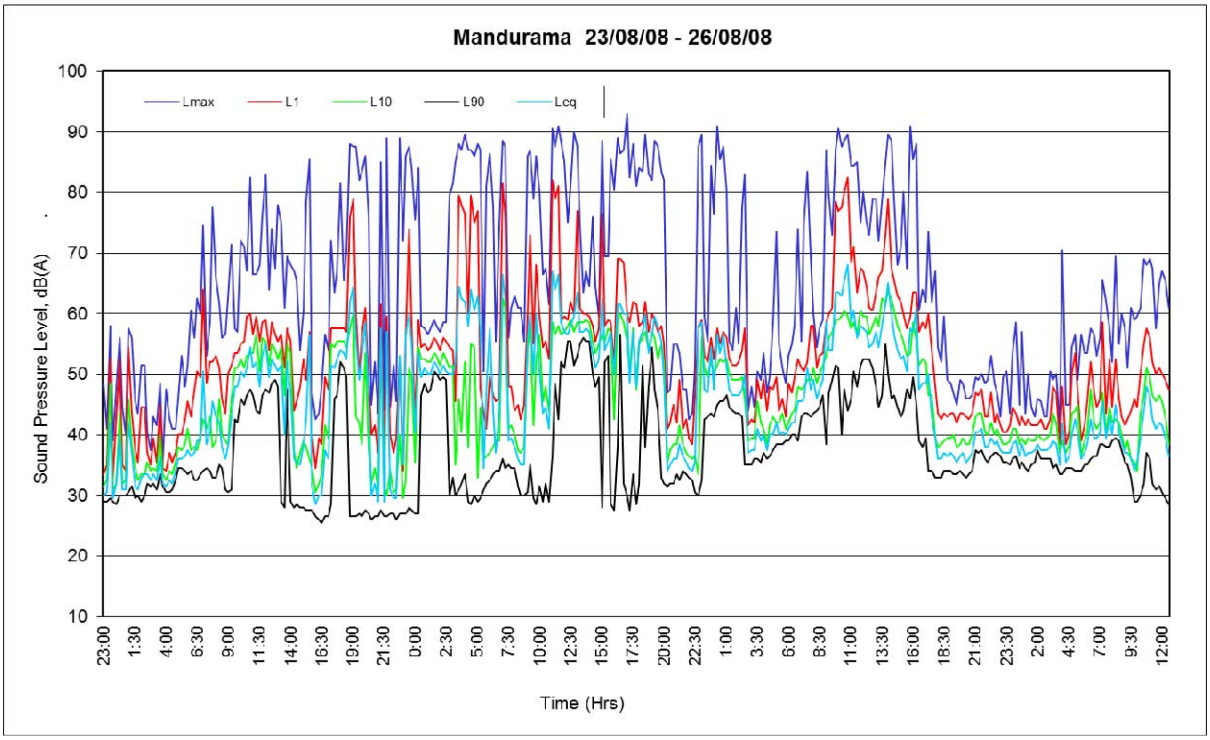

Chesley Park 20/08/08 - 23/08/08
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


Chesley Park 23/08/08 - 26/08/08
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


Carribee Farm 20/08/08 - 23/08/08
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


Carribee Farm 23/08/08 - 26/08/08
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
Time (Hrs)


Mandurama 20/08/08 - 23/08/08
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
100
90
80
70
60
50
40
30
20
10
13:15 15:45 18:15 20:45 23:15 1:45 4:15 6:45 9:15 11:45 14:15 16:45 19:15 21:45 0:15 2:45 5:15 7:45 10:15 12:45 15:15 17:45 20:15 22:45 1:15 3:45 6:15 8:45 11:15 13:45 16:15 18:45 21:15
Time (Hrs)


Mandurama 23/08/08 - 26/08/08
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
100
90
80
70
60
50
40
30
20
10
23:00 1:30 4:00 6:30 9:00 11:30 14:00 16:30 19:00 21:30 0:00 2:30 5:00 7:30 10:00 12:30 15:00 17:30 20:00 22:30 1:00 3:30 6:00 8:30 11:00 13:30 16:00 18:30 21:00 23:30 2:00 4:30 7:00 9:30 12:00
Time (Hrs)

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Appendix C

Noise Level Contours

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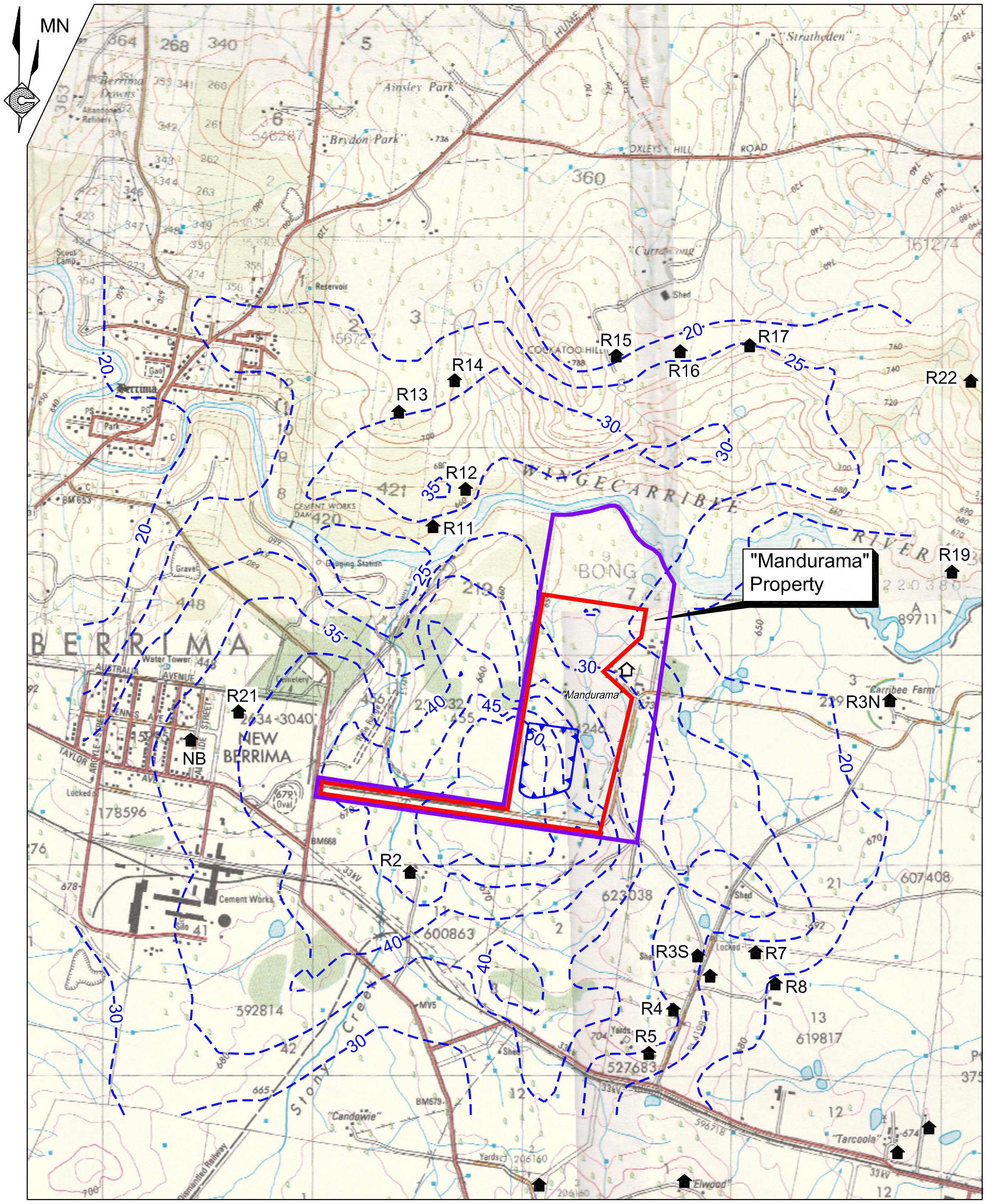
\\SERVER\RWC\744\Reports\74402_EA_2008\CAD\744MGALP_Noise C1.DWG



REFERENCE

- Property Boundary
- Project Site Boundary
- Proposed Limit of Extraction
- 30 Noise Contour (dB(A))
- Residence (Project related)
- R5 Residence (non Project-related) and Reference

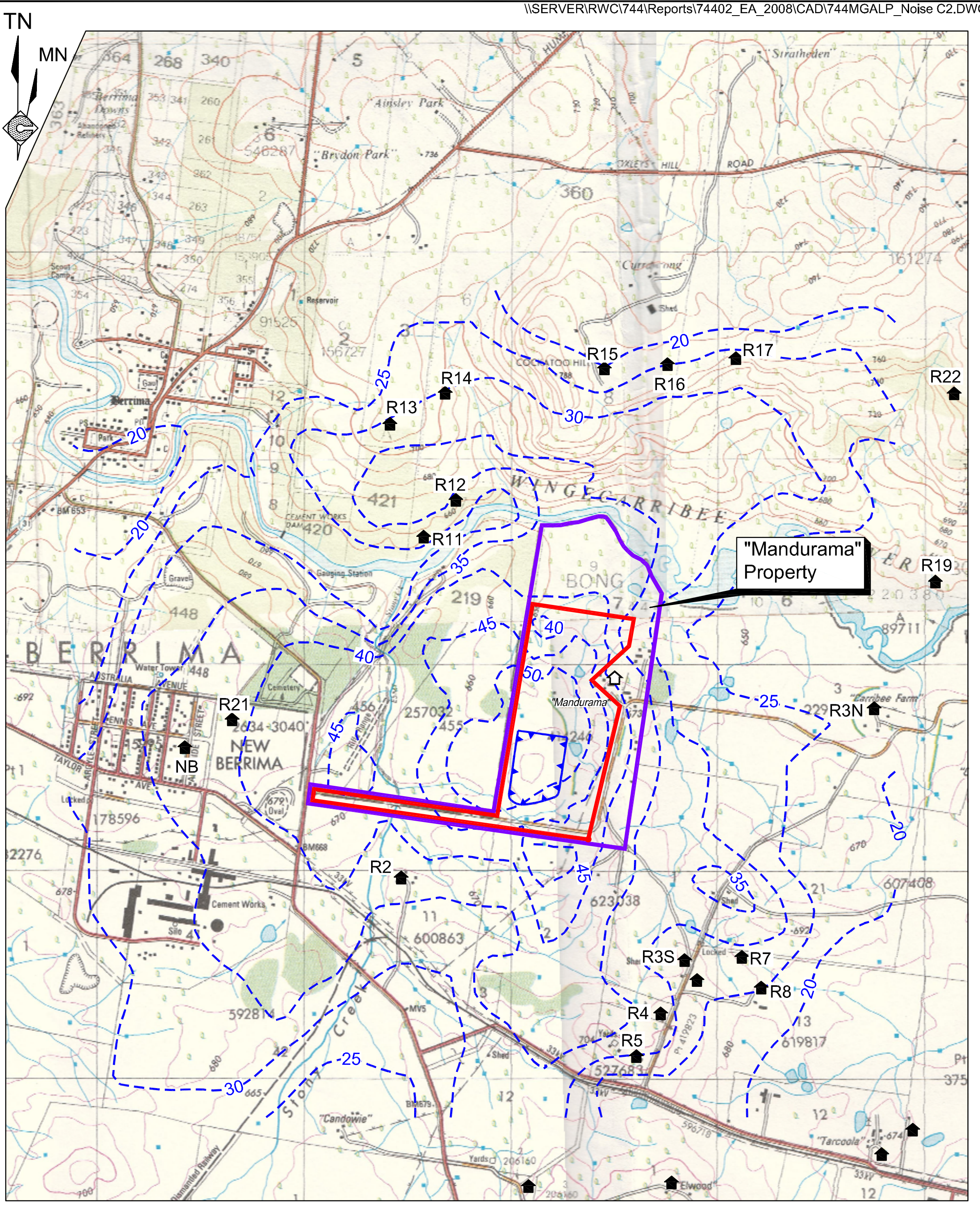
SCALE 1:30 000

500 0 500 1000 1500 m

Base Map Source: Moss Vale 1:25 000 Topographic Map (Date: 1985)

Figure C1
SOUTHERN BUND CONSTRUCTION
NORTH-EAST WIND

\\SERVER\RWC\744\Reports\74402_EA_2008\CAD\744MGALP_Noise C2.DWG



REFERENCE
Property Boundary
Project Site Boundary
Proposed Limit of Extraction
30 Noise Contour (dB(A))
Residence (Project related)
R5 Residence (non Project-related) and Reference

SCALE 1:30 000

500 0 500 1000 1500 m

Base Map Source: Moss Vale 1:25 000 Topographic Map (Date: 1985)

Figure C2
NORTHERN BUND CONSTRUCTION
NORTH-EAST WIND

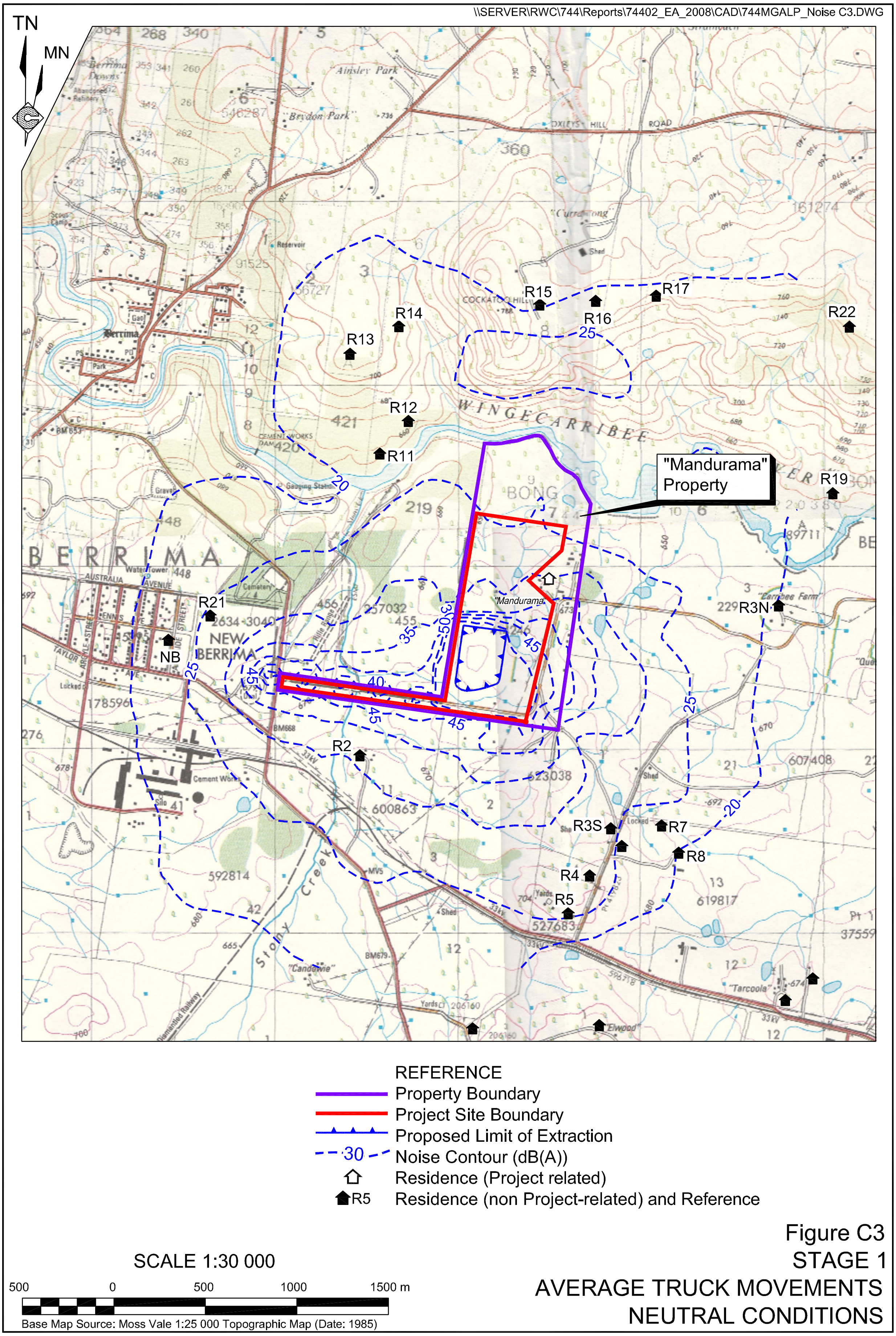
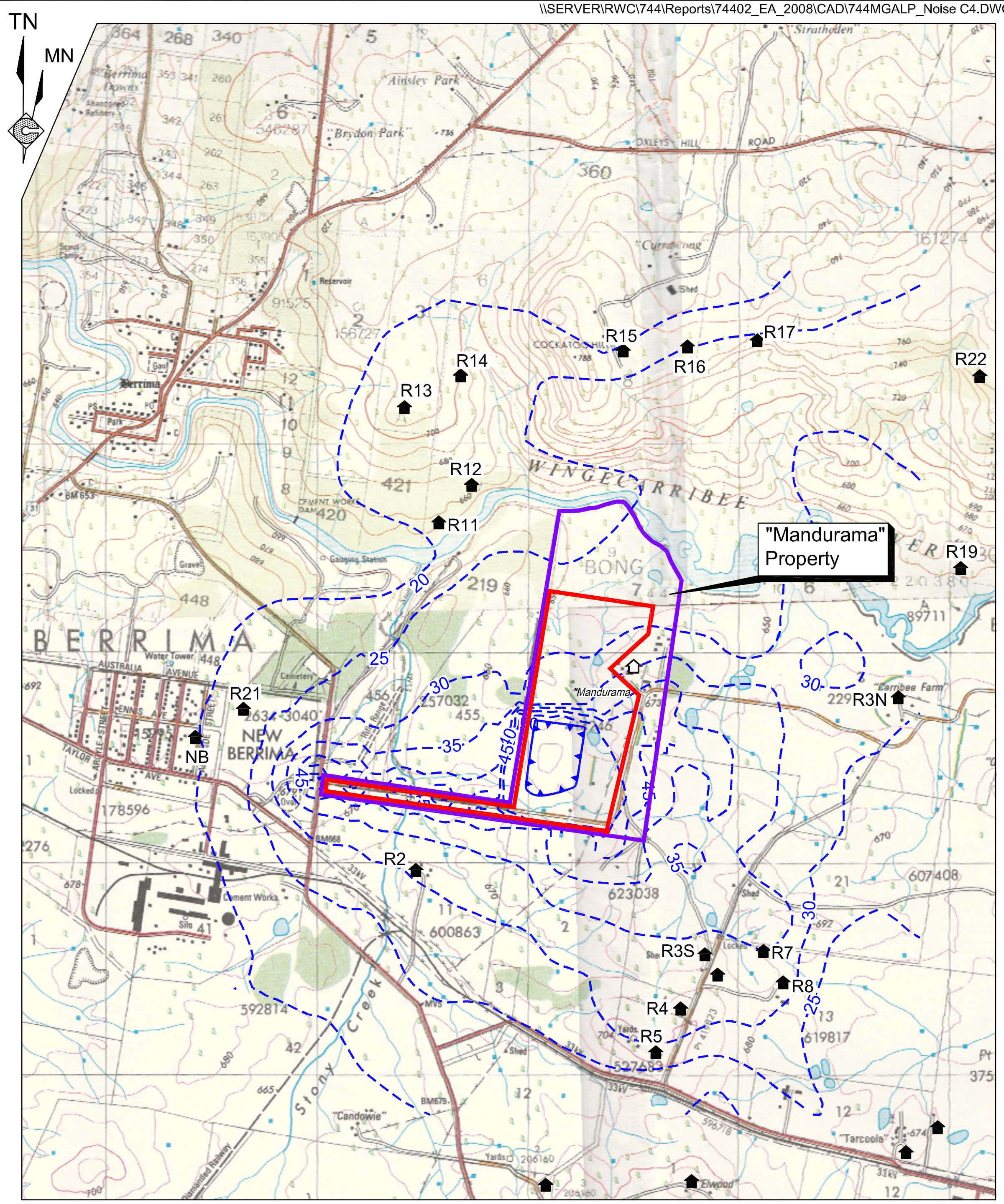


Figure C3
STAGE 1
AVERAGE TRUCK MOVEMENTS
NEUTRAL CONDITIONS

\\SERVER\RWC\744\Reports\74402_EA_2008\CAD\744MGALP_Noise C4.DWG



REFERENCE
Property Boundary
Project Site Boundary
Proposed Limit of Extraction
30 Noise Contour (dB(A))
Residence (Project related)
R5 Residence (non Project-related) and Reference

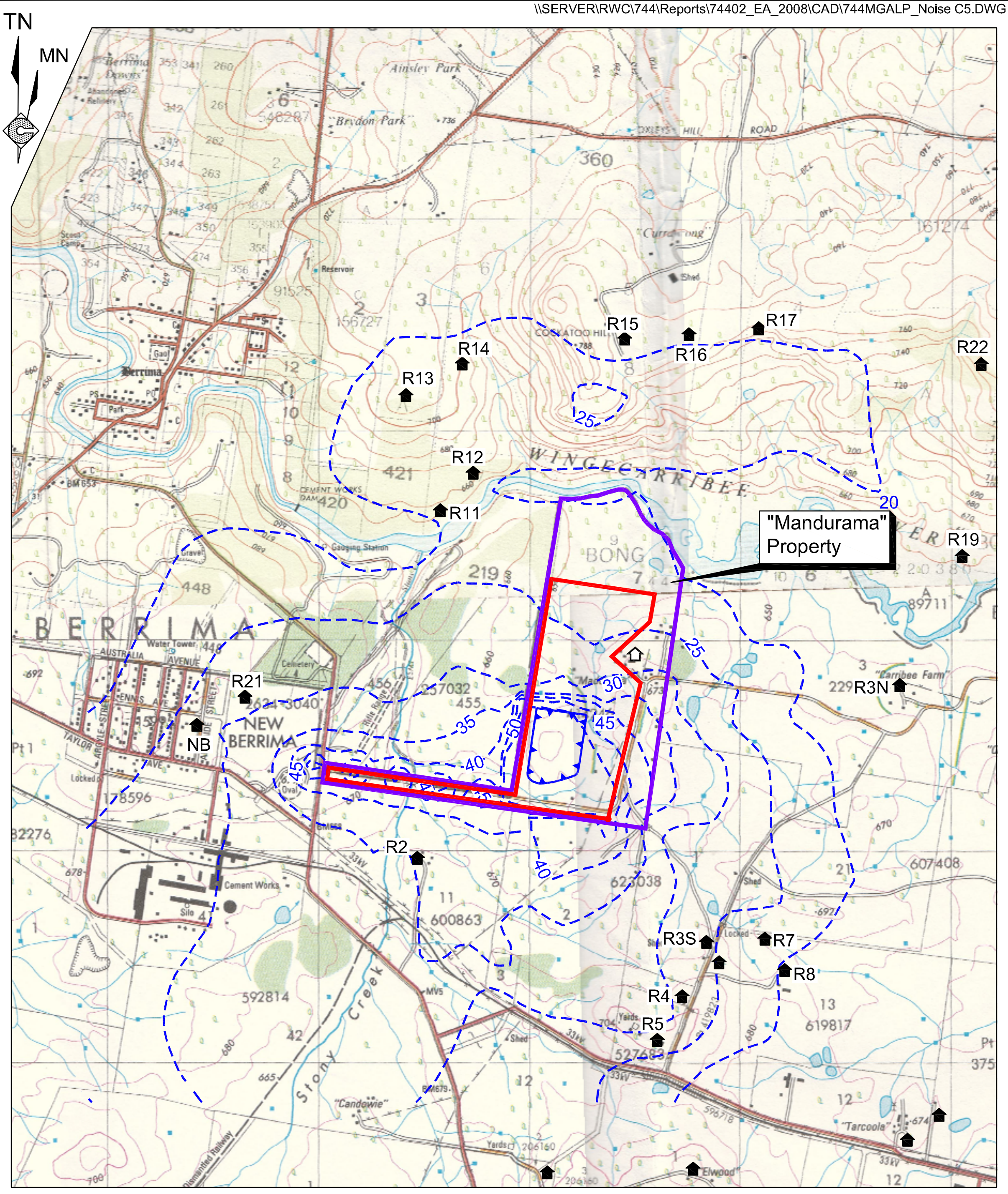
SCALE 1:30 000

500 0 500 1000 1500 m

Base Map Source: Moss Vale 1:25 000 Topographic Map (Date: 1985)

Figure C4
STAGE 1
AVERAGE TRUCK MOVEMENTS -
WEST WIND

\\SERVER\RWC\744\Reports\74402_EA_2008\CAD\744MGALP_Noise C5.DWG



REFERENCE
Property Boundary
Project Site Boundary
Proposed Limit of Extraction
30 Noise Contour (dB(A))
Residence (Project related)
R5 Residence (non Project-related) and Reference

SCALE 1:30 000

500 0 500 1000 1500 m

Base Map Source: Moss Vale 1:25 000 Topographic Map (Date: 1985)

Figure C5
STAGE 1
AVERAGE TRUCK MOVEMENTS - NORTH-EAST WIND

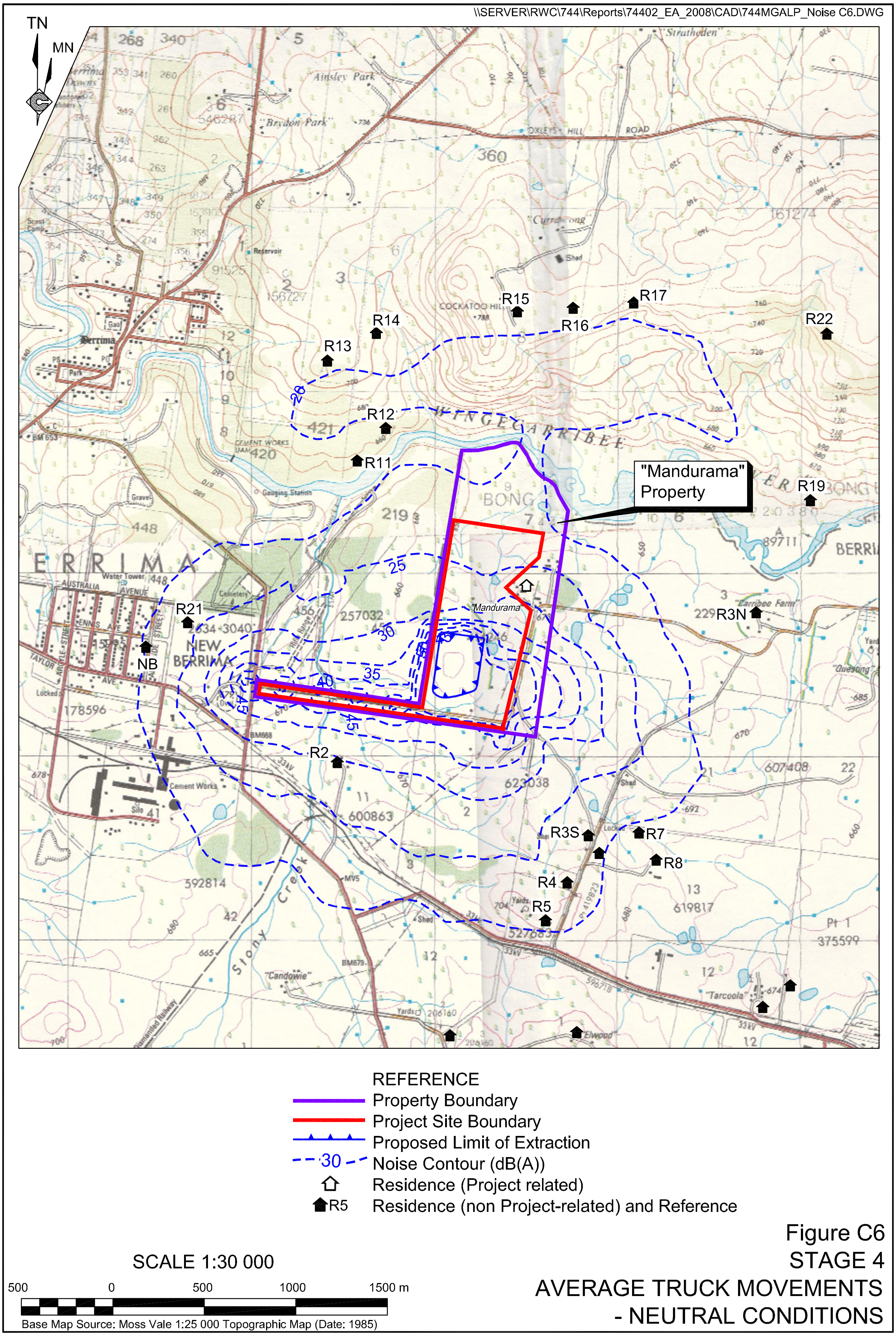
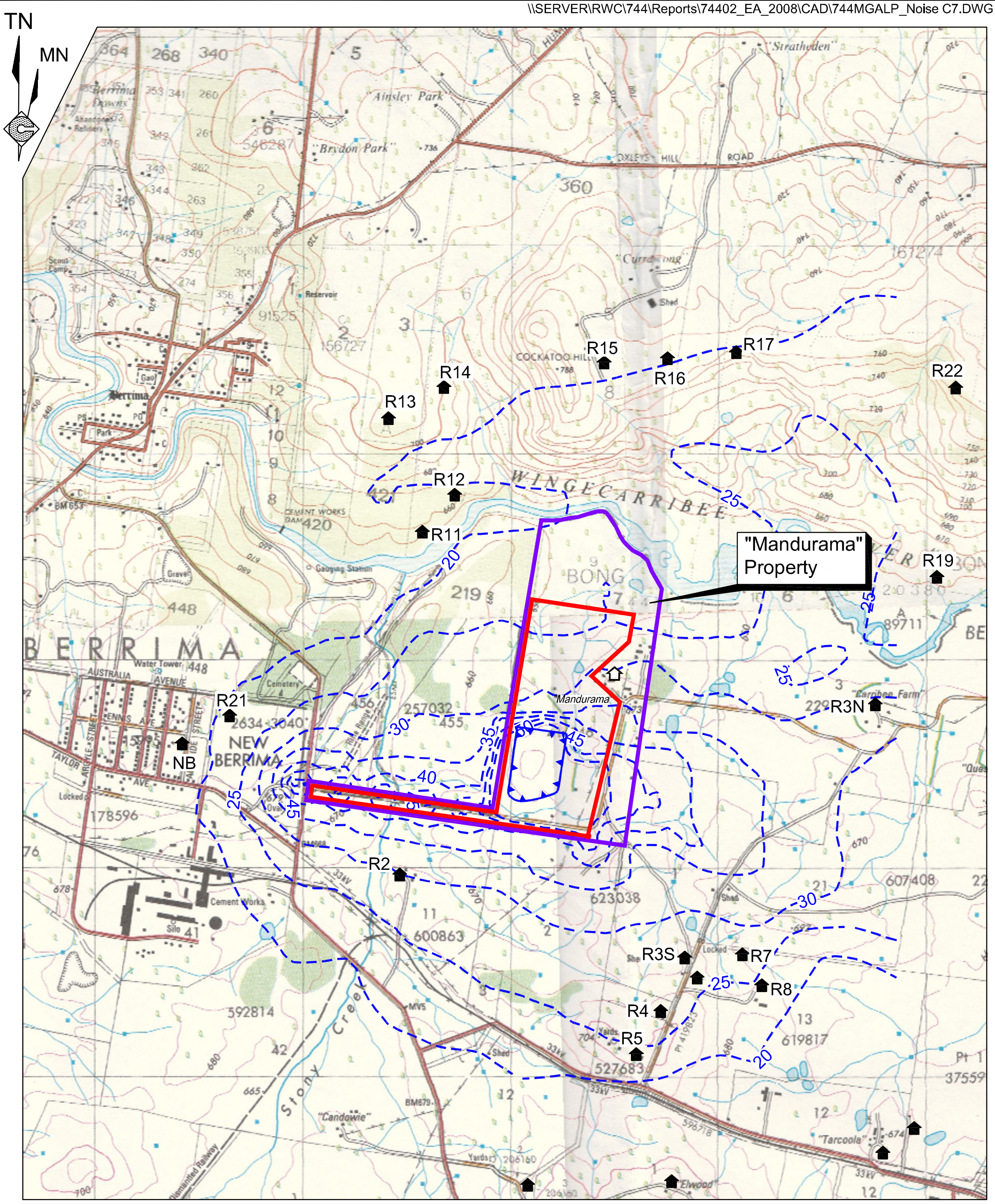


Figure C6
STAGE 4
AVERAGE TRUCK MOVEMENTS
- NEUTRAL CONDITIONS

\\SERVER\RWC\744\Reports\74402_EA_2008\CAD\744MGALP_Noise C7.DWG



REFERENCE
Property Boundary
Project Site Boundary
Proposed Limit of Extraction
30 Noise Contour (dB(A))
Residence (Project related)
R5 Residence (non Project-related) and Reference

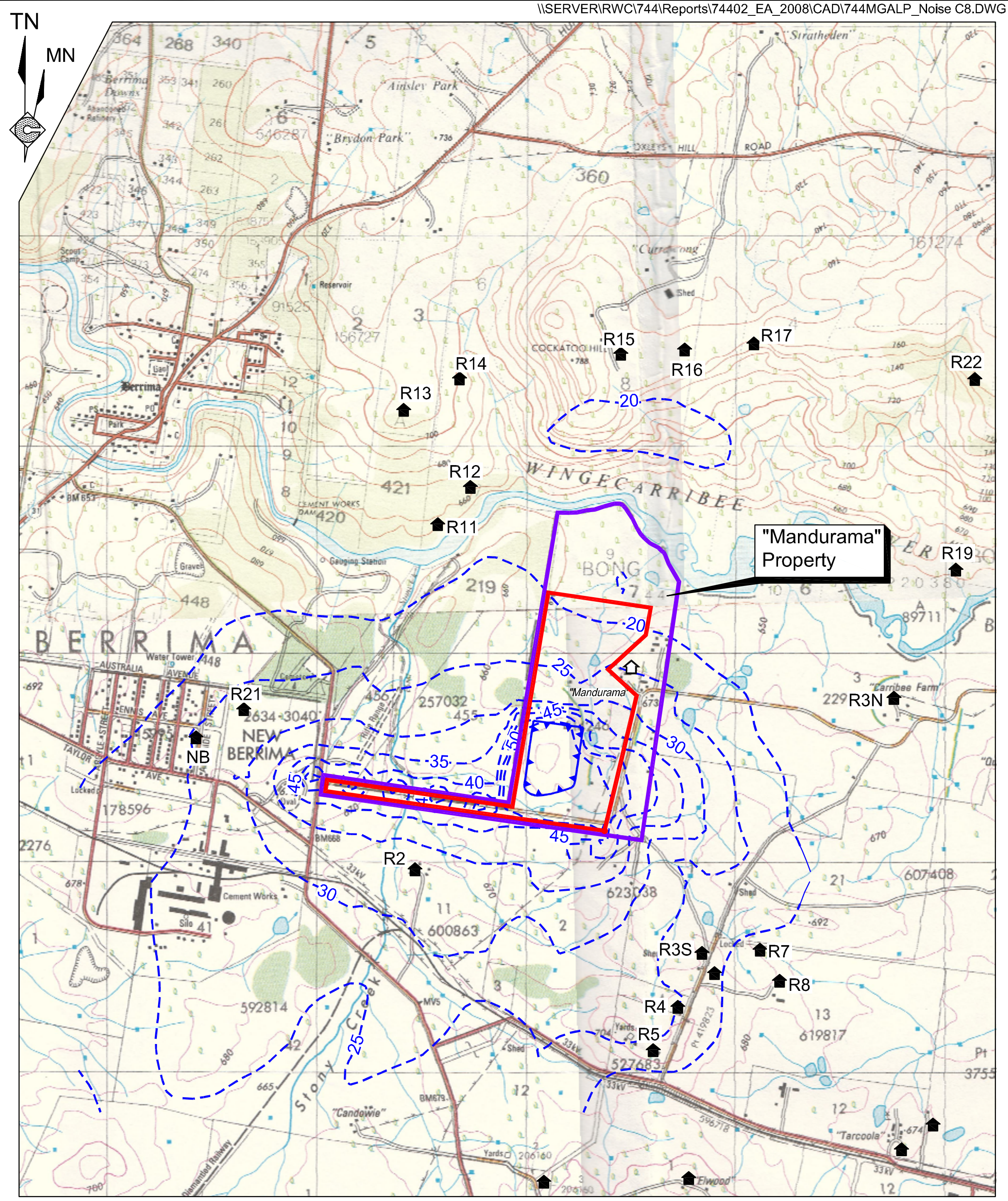
SCALE 1:30 000

500 0 500 1000 1500 m

Base Map Source: Moss Vale 1:25 000 Topographic Map (Date: 1985)

Figure C7
STAGE 4
AVERAGE TRUCK MOVEMENTS
- WEST WIND

\\SERVER\RWC\744\Reports\74402_EA_2008\CAD\744MGALP_Noise C8.DWG



REFERENCE
Property Boundary
Project Site Boundary
Proposed Limit of Extraction
30 Noise Contour (dB(A))
Residence (Project related)
R5 Residence (non Project-related) and Reference

SCALE 1:30 000

500 0 500 1000 1500 m

Base Map Source: Moss Vale 1:25 000 Topographic Map (Date: 1985)

Figure C8
STAGE 4
AVERAGE TRUCK MOVEMENTS
- NORTH-EAST WIND