water from the water cart. This dust management procedure has not been included in calculating the emission factor so as to remain a conservative (overestimation) assessment.

The emissions for stockpile wind erosion have been modelled as an area source located 3m above ground level. Based on this information it is estimated that the current facility emissions for wind erosion is 2,700 kg/yr and emissions for each of the proposed Stages 1-4 are 3784 kg/yr.

4.4.3 Dump Truck Loading

Loading of trucks by excavator and front-end loader generates 0.025 kg dust per tonne (SPCC et al 1988). The following have been based on 150,000 tpa for current operations and 250,000 tpa for each proposed stage operations. The emissions resulting from excavation have been modelled as an open-pit source. Based on this information we estimate that the current facility emission for excavation is 3,750 kg/yr and emissions for each of the proposed Stages 1-4 are 6,250 kg/yr.

4.4.4 Haulage

Off-highway dump trucks raise dust at the rate of 2 kg per vehicle kilometre travelled (vkt) on roads with normal dust control measures (SPCC et al 1988). For roads watered frequently the emission rate can be reduced to 1 kg/vkt (Shearer, Dougherty and Easterbrook, 1981). For modelling of haulage emissions the value of 2 kg /vkt was used. Haulage has been modelled as two distinct components.

The first is the haul road, which winds its way from the base of the pit to the top. This distance was calculated using the haul road gradient, 1 in 10, and has been modelled as an open-pit source. The second component consisted of the haul road from the top of the pit to the dumping area near the crushing and screening plant and has been modelled as an area source. It was estimated that this distance, including a return trip and manoeuvring of the vehicle to be in the correct dumping position, would be no further than 300 m.

The haulage during this operation is performed by the Caterpillar articulated dump truck D30D (30 tonne capacity). The current output of 150,000 tpa equates to 5,000 trips per year. The proposed output of 250,000 tpa equates to 8,334 trips per year. Based on this information we estimate that the current facility emission for haulage (ie including the haul road from within the pit as well as from the top of the pit to the crushing and screening plant) is 11,400 kg/yr. Total emission for Stage 1 is 19,000 kg/yr, for Stage 3 is 24,000 kg/yr and Stage 4 is 29,000 kg/yr.

4.4.5 *Dumping*

The process of dumping generates dust at the rate of 0.012 kg/t (SPCC et al 1988). The current facility has been calculated based on 150,000 tpa while the proposed Stages 1 - 4 have been based on 250,000 tpa. This emission source has been modelled as an area source with release height of 1.5m. Based on this information we estimate that the current facility emissions for dumping are 1,800 kg/yr and emissions for each of the proposed Stages 1-4 are 3,000 kg/yr.

4.4.6 *Crushing*

Dust generated from crushing depends on the extent of crushing (primary, secondary or tertiary), the moisture content and the dust mitigation measures applied to the process. The crushing and screening plant is equipped with two (2) DCE Vokes dust extraction units in addition to the Hosokawa Mikropul dust extraction unit. The plant also has misting sprays at the primary boot and product discharge points. All screens have dust covers and are sealed. As long as the mist sprays, in particular, are maintained to good working order the emissions from the crushing and screening plant are spasmodic and are typically low concentration in nature. Due to the mitigation equipment installed it is considered that the dust generated by the crushing and screening plant is insignificant under normal conditions, and therefore these emissions were incorporated into the conveyor emissions for the model.

4.4.7 *Exhaust From Vehicles*

Off-highway diesel trucks generate particulate emissions at a rate of 0.12 kg/hr (US EPA, 1995). The current operation runs for ten (10) hours a day five (5) days a week, and uses a sole Caterpillar articulated dump truck (D30D) to transport wastes. For the proposed Stages 1 -4 it is assumed two Caterpillar articulated dump trucks (D30D) will be operating and the operation hours are five (5) twelve (12) hour days a week and one (1) seven (7) hour day (Saturday 6.00 am - 1.00 pm) for fifty-two (52) weeks in a year.

These sources were modelled as both an open-pit and area source, by splitting the emissions and adding these to the haulage and haul road emissions. Based on this information the current facilities dust emissions from exhausts are 312 kg/yr, while emissions for each of the proposed Stages 1-4 are 418 kg/yr.

4.4.8 *Conveyor Transfer Points*

The emission rate for conveyor transfer points is 0.006 kg/t (NSW EPA). It has been assumed that all of the 150,000 tonnes (for the current operation), and all 250,000 tonnes (proposed operation) travels via the conveyor to transfer points. This emission has been modelled as an area source, released at a height of 1.5m. Based on this information the current facilities emissions are 900 kg/yr, while emissions for each of the proposed Stages 1-4 are 1,500 kg/yr.

4.4.9 *Product Handling*

Product handling is undertaken using front-end loaders and includes stockpiling and loading sales trucks. Dust generated from the action of front-end loaders is at a rate of 0.025 kg/hr (SPCC et al 1988). For the current operation it has been assumed that two front-end loaders are active for ten (10) hours per day, five (5) days a week. For the proposed operation it has been assumed that two front-end loaders are active for twelve (12) hours per day, five (5) days a week, with seven (7) hours of operation on a Saturday. These emissions are being modelled as an area source. Based on this information the current facilities emissions are 7,500 kg/yr, while emissions for each of the proposed Stages 1-4 are 12,500 kg/yr.

4.5 EPISODIC IMPACTS; DRILLING AND BLASTING

Drilling and blasting have the potential to cause significant impacts on the neighbouring areas. Their episodic nature allows this impact to be avoided. Drilling usually occurs over a period of two to five days, as a precursor to blasting. Three different blast designs have been proposed based on different geology (eg. solid or weathered rock) as well as for different bench heights, either 12 or 15 metres (Brodbeck, 1999). In terms of the different blast designs they differ in number of blast holes (41 - 54), blast hole depth (13 m - 16 m) and spacing between blast holes (3.7 - 4.1m). These figures are based on an approximate blast size of 20,000 tonnes and a calculated with a rock density of 2.6 g/cc. These blast designs are typical only and the particular blast design will be determined to achieve the optimum result based upon local geology and achievement of blast overpressure and ground vibration EPA criteria.

Based on 20,000 tonnes per blast, there would be an average twelve (12) drilling episodes per year (ie. monthly), each of which last for two to five days. The current blast design typically involves drilling 900 holes per year (75 per episode), while the highest number of holes that all proposed stages (1-4) will drill are, 648 per year (54 per episode).

In accordance with the proposed drilling design, blasting will occur on average monthly, however blasting occurs on one day per episode. For each blasting episode capping (stemming) is placed over blast holes to minimise dust and to maximise blast success. The capping is used to ensure that the pressure generated from the blast will be forced down the hole, opening seams for extraction.

The holes drilled for the blast are often drilled in rows of three or four, roughly the width of the desired bench. Drill rigs are fitted with dust extractors. During blasting these rows are detonated separately, but in rapid succession. The main emissions generated from these activities are emitted during this 1 - 3 second interval. Dust emanates from the entire area of the blast, averaging 400 m^2.

Due to the episodic nature of these impacts, their short, infrequent nature and the standard implementation of dust mitigation measures such as adequate stemming and not drilling and blasting in adverse weather conditions, dust generated during drilling and blasting is assumed to be insignificant for dispersion modelling which is run for a minimum period of 365 days. Therefore, drilling and blasting has not been included as a source in the model.

4.5.1 Asphalt Plant

It is proposed that a mobile asphalt plant capable of producing around 100 tonnes an hour will be located on-site on an as needed basis. An area 100 m by 50 m will be allocated south-west of the existing weighbridge and site office to accommodate this plant.

In the asphalt making process the aggregates are fed into the plant. After screening they pass through the drier to reduce moisture. Individual sized aggregates, together with filler are mixed with hot bitumen to form asphalt, which is then transported by truck to the required site.

The loading of aggregates will be undertaken by the front-end loaders used for product stockpiling and whose dust emissions are accounted for in Section 4.4.9. The asphalt plant has one stack fitted with a wet scrubber to reduce odour and dust emissions. It is expected that emissions will be minimal and stack height release high enough to reduce ground level effects.

4.5.2 Pugmill

It is proposed that a mobile pugmill be added to the facility to mix lime or cement (stored in filler silos) and aggregate together which is then loaded into trucks for delivery. Loading for this process will be undertaken using the product stockpile front-end loaders. Usage of the pugmill will be based on market demand. It is anticipated that the market volume required will be minor. As such, there are no expected additional dust or odour emissions of considerable consequence and the pugmill has not been considered in the model.

4.5.3 *Summary*

A summary of dust emissions for area and open-pit sources to be used in the ISC model is given in *Table 4.3* and *Table 4.4* respectively.

Table 4.3 SUMMARY OF INPUT EMISSIONS (AREA SOURCES)

Source /Quarry Stage	Emission (kg/yr)	Emission ($g/s/m^2$) TSP	Emission ($g/s/m^2$) PM_{10}
Dumping			
Current	1,800	0.002	0.001
Stages 1 -4	3,000	0.001	0.0005
Haul road			
Current	3,081	0.0003	0.0002
Stages 1 - 4	5,109	0.0004	0.0002
Conveyor			
Current	900	0.002	0.001
Stages 1 -4	1,500	0.002	0.001
Product handling			
Current	7,500	0.0003	0.0002
Stages 1 -4	12,500	0.0002	0.0001
Stockpiles			
Current	2,700	3.4E-5	2.4E-5
Stages 1 - 4	3784.3	2.9E-5	2.0E-5

Table 4.4 SUMMARY OF INPUT EMISSIONS (OPEN-PIT SOURCES)

Source /Quarry Stage	Emission (kg/yr)	Emission ($g/s/m^2$) TSP	Emission ($g/s/m^2$) PM_{10}
Wind erosion			
Current	15,768	9.4E-7	6.6E-7
Stage 1	26,280	2.9E-7	2.0E-7
Stage 3	26,280	1.2E-7	8.5E-8
Stage 4	26,280	1.0E-7	7.1E-7
Loading			
Current	3,750	7.5E-7	4.2E-7
Stage 1	6,250	1.7E-7	1.0E-7
Stage 3	6,250	7.3E-8	4.2E-8
Stage 4	6,250	6.0E-8	3.4E-8
Haulage			
Current	8,631	1.7E-6	1.0E-6
Stage 1	14,310	3.9E-7	2.3E-7
Stage 3	19,311	2.3E-7	1.4E-7
Stage 4	24,311	2.3E-7	1.4E-7

Chapter 5

DUST IMPACT ASSESSMENT

5.1 IMPACT ASSESSMENT

The results from the ISC model are summarised below. Stage 2 development has not been modelled separately because it is in effect an intermediate stage between 1 and 3. Stage 1 has been modelled as the westernmost point of extraction, and Stage 3 has been modelled as the eastern and northern most point of extraction, with emissions from the pit originating closer to the surface than during Stage 4. It was necessary to model Stage 4 because of the increase in haulage emissions (approximately 5,000 kg/yr more than Stage 3). The location of discrete receptors and sources modelled is shown in *Figures 5.1 to 5.3.*

All of the regular quarry activities have been included in the model. Emissions relating to blasting and drilling have not been included due to the short duration of impacts and their episodic nature.

Contours have been developed for PM_{10} 24 hour concentrations. Contours of averaging periods longer than this are not supplied due to the relatively lower impacts of the longer term (ie. annual) averaging periods. TSP 24 hour contours are not provided, as there are no applicable criteria for TSP over short-term averaging periods.

5.2 DUST DEPOSITION

Table 5.1 to *Table 5.4* summarise the highest monthly dust deposition concentrations predicted at discrete receptors from modelling. These predictions do not include drilling and blasting as an emission source due to its episodic nature being incompatible with the model inputs.

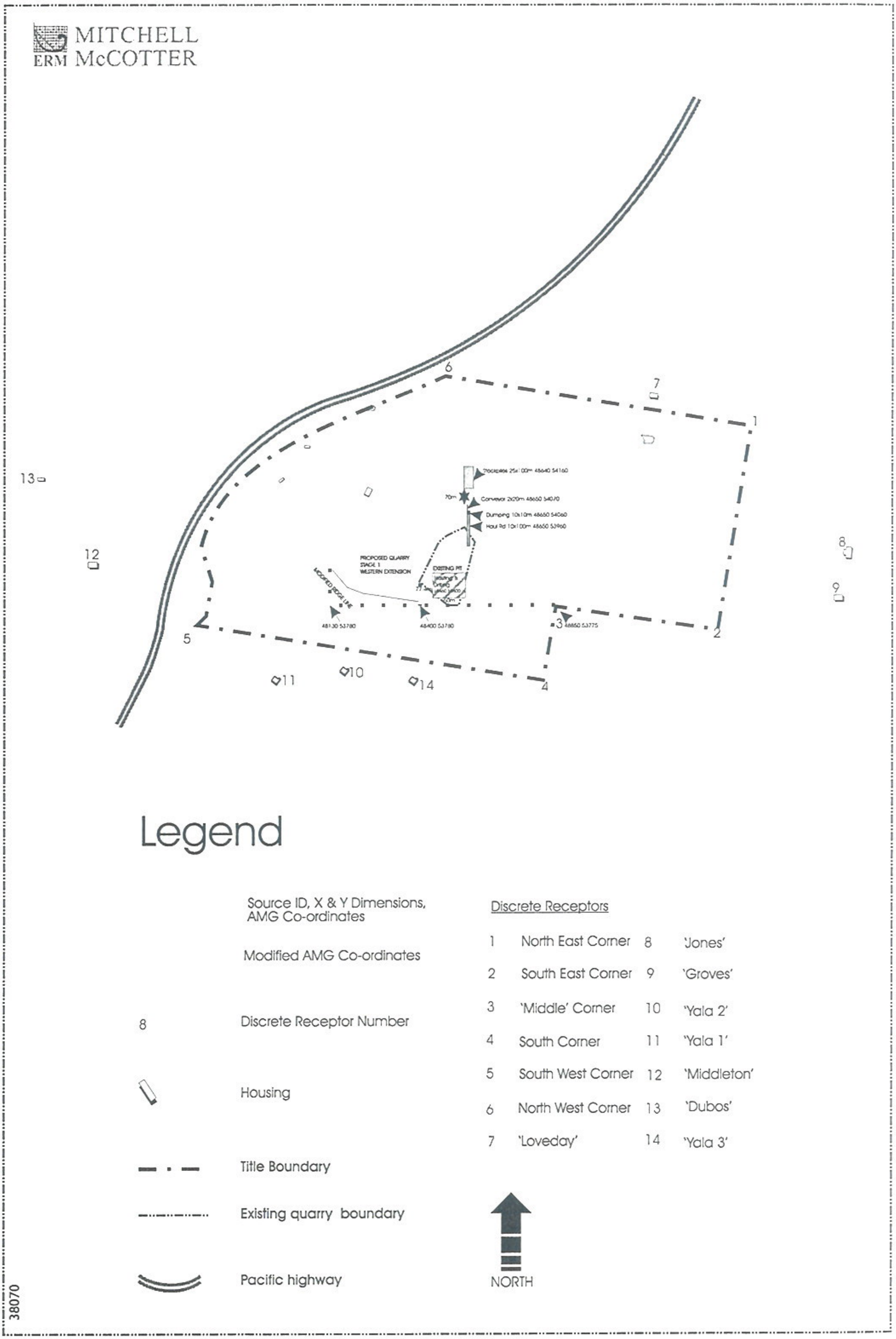
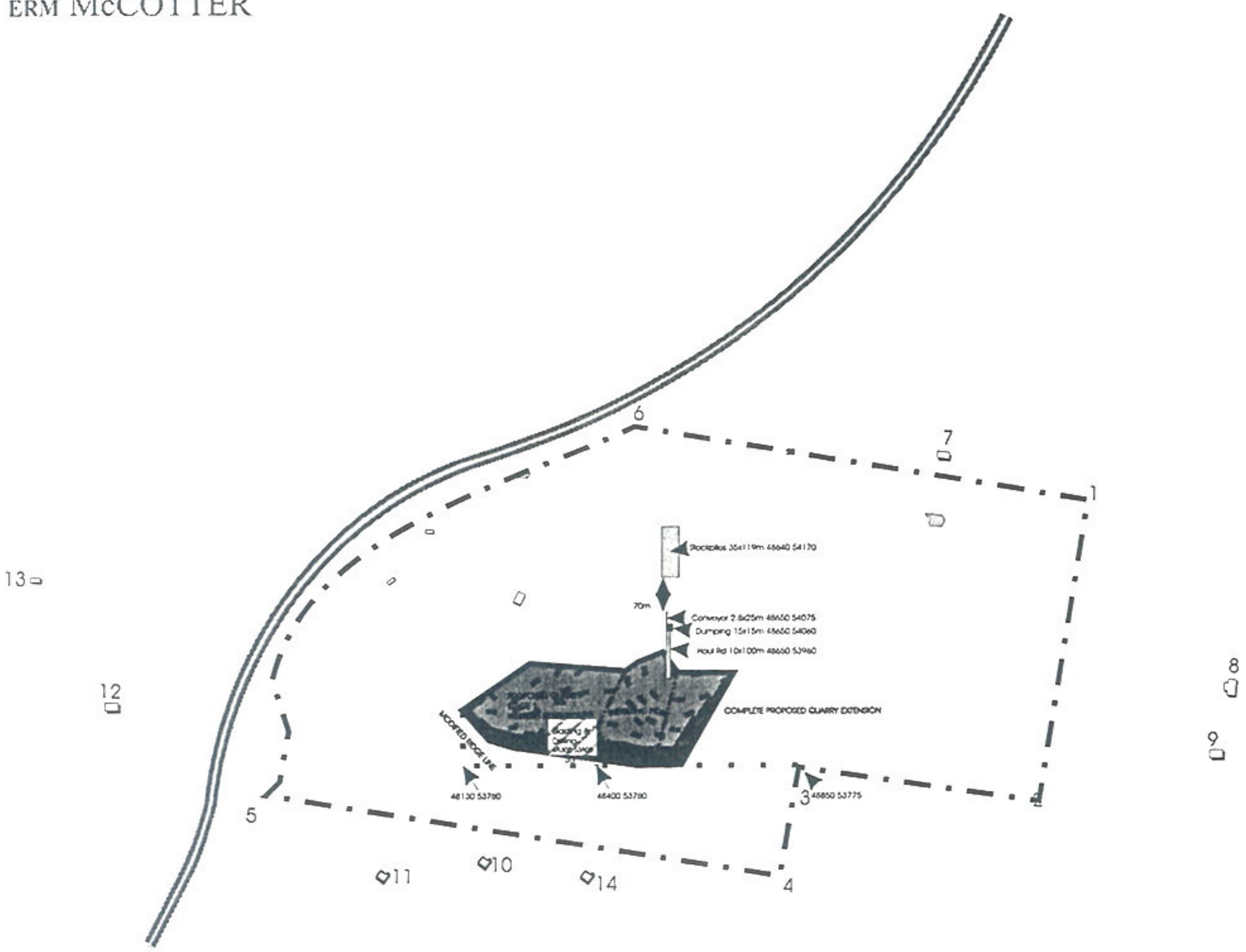


Figure 5.1 CURRENT STAGE LOCATIONS OF DISCRETE RECEPTORS AND SOURCES MODELLED

MITCHELL
ERM McCOTTER



Legend

Haul Rd 10x100m 48650 53960	Source ID, X & Y Dimensions, AMG Co-ordinates
48850 53775	Modified AMG Co-ordinates
8	Discrete Receptor Number
	Housing
	Title Boundary
	Existing quarry boundary
	Pacific highway

Discrete Receptors

1	North East Corner	8	'Jones'
2	South East Corner	9	'Groves'
3	'Middle' Corner	10	'Yala 2'
4	South Corner	11	'Yala 1'
5	South West Corner	12	'Middleton'
6	North West Corner	13	'Dubos'
7	'Loveday'	14	'Yala 3'

NORTH

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Figure 5.2 STAGE 1 LOCATIONS OF DISCRETE RECEPTORS AND SOURCES MODELLED

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ERM McCOTTER

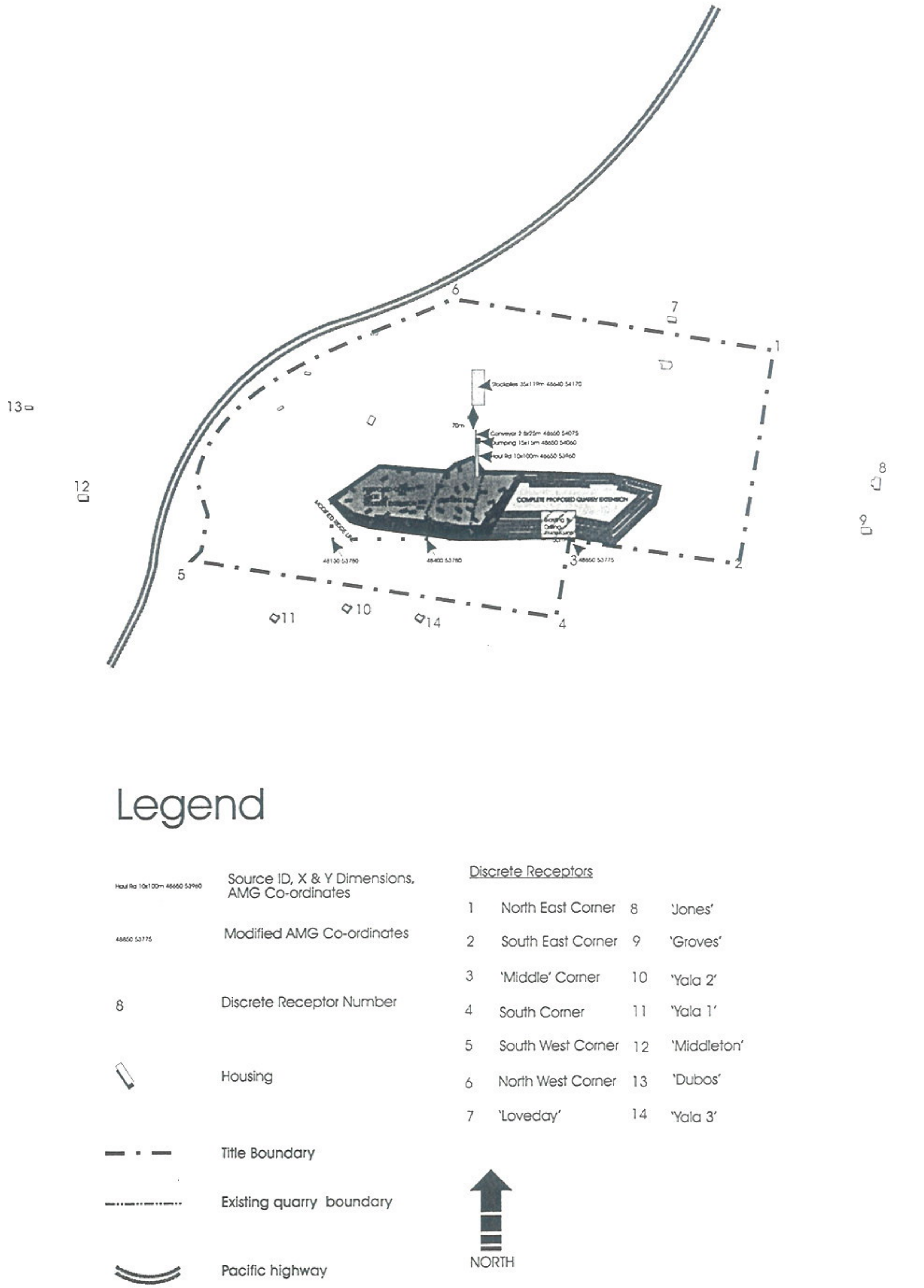

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Figure 5.3 STAGES 3 AND 4 LOCATIONS OF DISCRETE RECEPTORS AND SOURCES MODELLED

Table 5.1 DUST DEPOSITION RATES FOR THE EXISTING DEVELOPMENT

Discrete Receptor	Deposition ($g/m^2/mth$)
1. north east corner of property	0.20
2. south east corner of property	0.94
3. 'middle' corner of property	2.85
4. south corner of property	0.29
5. south west corner of property	0.46
6. north west corner of property	2.47
7. 'Loveday' house to north	0.72
8. 'Jones' house to east	0.32
9. 'Groves' house to east	0.16
10. 'YALA 2' house to south	0.44
11. 'YALA 1' house to south	0.65
12. 'Middleton' house to west	0.15
13. 'Dubos' house to west	0.33
14. 'YALA 3' house to south	2.19

Table 5.2 DUST DEPOSITION RATES FOR STAGE 1

Discrete Receptor	Deposition ($g/m^2/mth$)
1. north east corner of property	0.30
2. south east corner of property	1.17
3. 'middle' corner of property	3.69
4. south corner of property	0.47
5. south west corner of property	0.65
6. north west corner of property	2.88
7. 'Loveday' house to north	1.01
8. 'Jones' house to east	0.45
9. 'Groves' house to east	0.22
10. 'YALA 2' house to south	0.69
11. 'YALA 1' house to south	0.94
12. 'Middleton' house to west	0.20
13. 'Dubos' house to west	0.42
14. 'YALA 3' house to south	2.64

Table 5.3 DUST DEPOSITION RATES FOR STAGE 3

Discrete Receptor	Deposition (g/m²/mth)
1. north east corner of property	0.31
2. south east corner of property	1.18
3. 'middle' corner of property	3.95
4. south corner of property	0.46
5. south west corner of property	0.65
6. north west corner of property	2.90
7. 'Loveday' house to north	1.03
8. 'Jones' house to east	0.47
9. 'Groves' house to east	0.23
10. 'YALA 2' house to south	0.60
11. 'YALA 1' house to south	0.87
12. 'Middleton' house to west	0.20
13. 'Dubos' house to west	0.42
14. 'YALA 3' house to south	2.55

Table 5.4 DUST DEPOSITION RATES FOR STAGE 4

Discrete Receptor	Deposition (g/m²/mth)
1. north east corner of property	0.31
2. south east corner of property	1.18
3. 'middle' corner of property	3.89
4. south corner of property	0.45
5. south west corner of property	0.65
6. north west corner of property	2.90
7. 'Loveday' house to north	1.02
8. 'Jones' house to east	0.46
9. 'Groves' house to east	0.23
10. 'YALA 2' house to south	0.58
11. 'YALA 1' house to south	0.87
12. 'Middleton' house to west	0.19
13. 'Dubos' house to west	0.42
14. 'YALA 3' house to south	2.53

5.3 DUST CONCENTRATION

Tables 5.5 to 5.8 give annual and 24 hour concentrations predicted for different stages of the quarry. These concentrations do not include blasting and drilling practices as part of the emissions due to their episodic nature. Contours of the highest 24 hour PM_{10} dust concentrations due to quarry operations (excluding drilling and blasting) are shown in *Figures 5.4 to 5.7.*

Table 5.5 COMPARISON OF DUST CONCENTRATIONS FOR ALL SOURCES EXCEPT DRILLING & BLASTING FOR EXISTING QUARRY

Discrete Receptor	Max 24 hour PM_{10} (μ/m^3)	Annual Average PM_{10} (μ/m^3)	Annual Average TSP (μ/m^3)
1	4.97	0.30	0.46
2	19.84	0.76	1.21
3	54.38	2.62	4.25
4	4.51	0.35	0.55
5	20.42	0.40	0.60
6	57.27	2.56	3.99
7	16.84	0.87	1.42
8	6.93	0.26	0.41
9	2.12	0.14	0.22
10	12.06	0.39	0.60
11	20.33	0.48	0.79
12	5.38	0.14	0.21
13	15.89	0.30	0.47
14	69.76	1.65	2.50

Table 5.6 COMPARISON OF DUST CONCENTRATIONS FOR ALL SOURCES EXCEPT DRILLING & BLASTING FOR STAGE 1

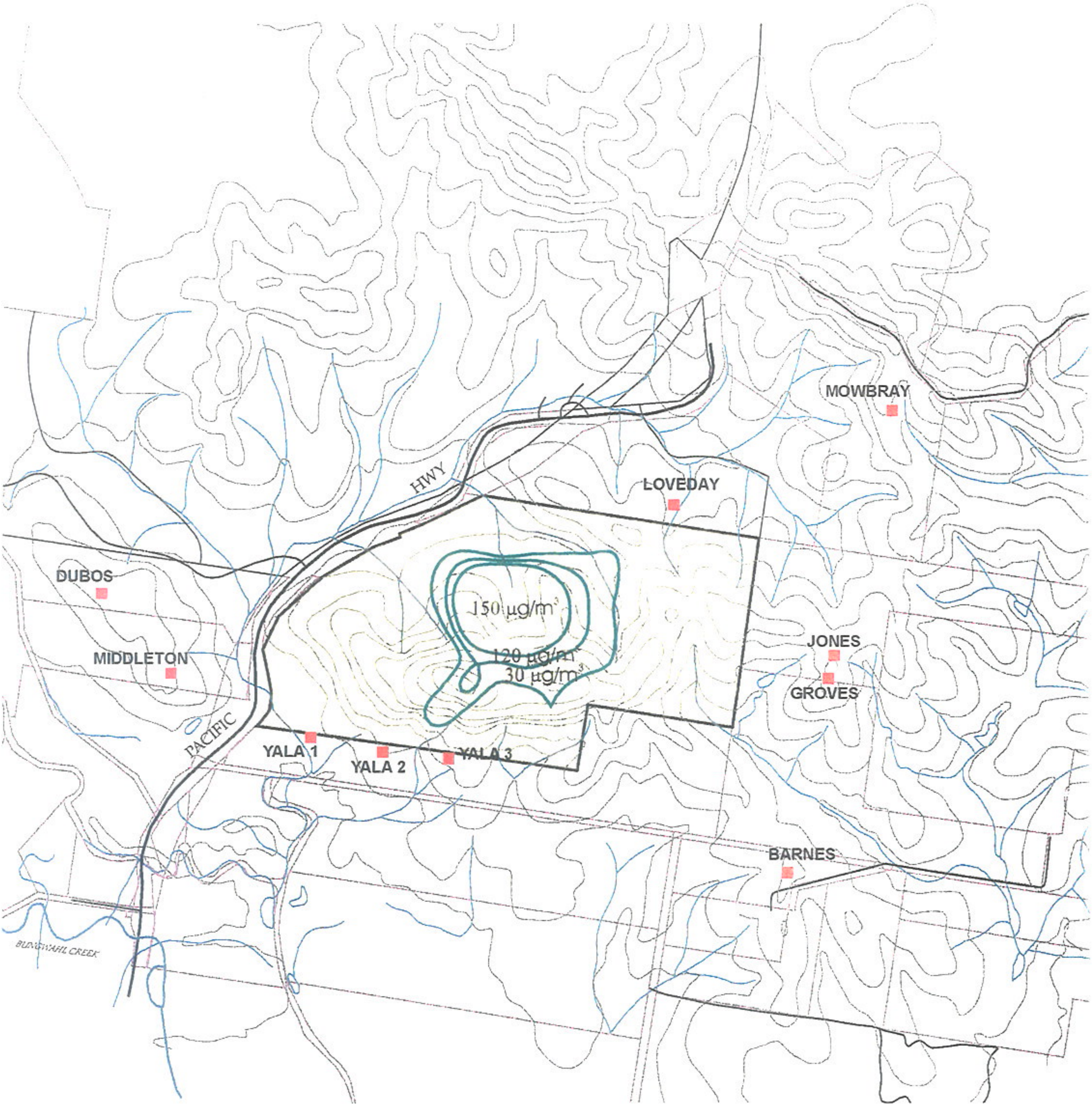
Discrete Receptor	Max 24 hour PM_{10} (µ/m³)	Annual Average PM_{10} (µ/m³)	Annual Average TSP (µ/m³)
1	3.89	0.35	0.67
2	17.72	0.79	1.52
3	54.34	2.80	5.41
4	4.41	0.48	0.87
5	23.49	0.47	0.86
6	45.32	2.40	4.56
7	21.02	1.03	1.97
8	7.20	0.30	0.58
9	1.85	0.17	0.31
10	9.49	0.56	0.97
11	24.62	0.61	1.14
12	5.69	0.16	0.30
13	14.43	0.32	0.60
14	59.94	1.77	3.16

Table 5.7 COMPARISON OF DUST CONCENTRATIONS FOR ALL SOURCES EXCEPT DRILLING & BLASTING FOR STAGE 3

Discrete Receptor	Max 24 hour PM_{10} (µ/m³)	Annual Average PM_{10} (µ/m³)	Annual Average TSP (µ/m³)
1	4.96	0.39	0.72
2	17.79	0.80	1.53
3	56.30	3.26	6.03
4	4.86	0.55	0.98
5	23.45	0.47	0.85
6	46.17	2.40	4.56
7	19.82	1.04	1.98
8	7.52	0.31	0.60
9	2.28	0.19	0.33
10	9.39	0.43	0.0
11	21.43	0.53	1.03
12	5.40	0.15	0.29
13	14.45	0.32	0.60
14	58.77	1.67	3.02

Table 5.8 COMPARISON OF DUST CONCENTRATIONS FOR ALL SOURCES EXCEPT DRILLING & BLASTING FOR STAGE 4

Discrete Receptor	Max 24 hour PM_{10} (μ/m³)	Annual Average PM_{10} (μ/m³)	Annual Average TSP (μ/m³)
1	4.82	0.38	0.71
2	17.78	0.80	1.52
3	55.94	3.14	5.79
4	4.82	0.53	0.93
5	23.45	0.47	0.85
6	46.09	2.40	4.54
7	19.75	1.03	1.96
8	7.35	0.31	0.59
9	2.06	0.18	0.31
10	9.04	0.41	0.75
11	21.21	0.52	1.02
12	5.21	0.15	0.28
13	14.45	0.32	0.82
14	58.58	1.65	2.56



RESIDENCE/NOISE RECEPTOR

150 µg/m³ PM_{10} DUST CONTOUR

CSR PROPERTY BOUNDARY

CADASTRAL BOUNDARIES

EXISTING QUARRY

57106/38070/g5.4nce.CDR

SOURCE: CMA 1:25,000 TOPO NABIAC SHEET

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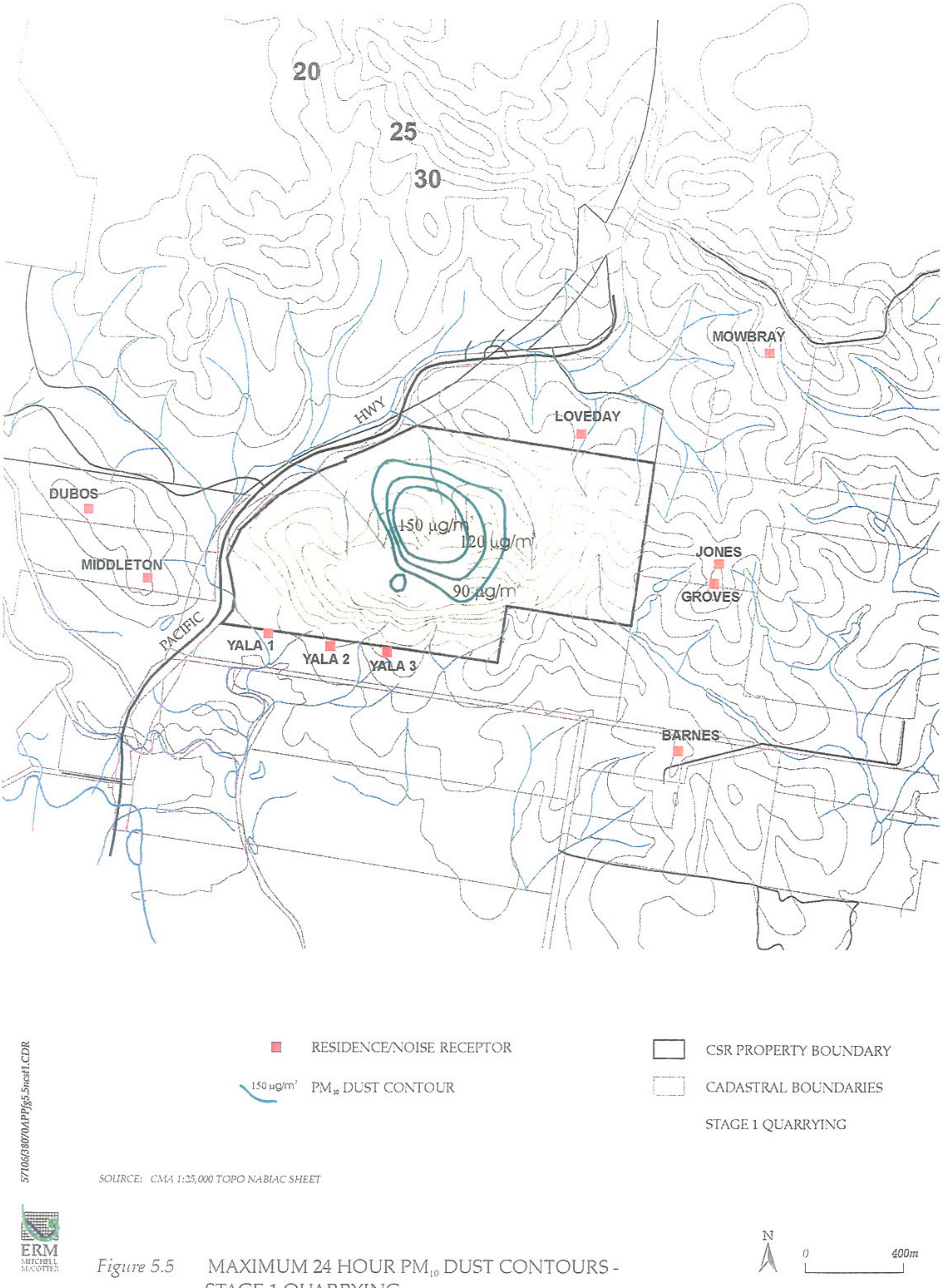
N

0 400m

Figure 5.4 MAXIMUM 24 HOUR PM_{10} DUST CONTOURS - EXISTING QUARRY

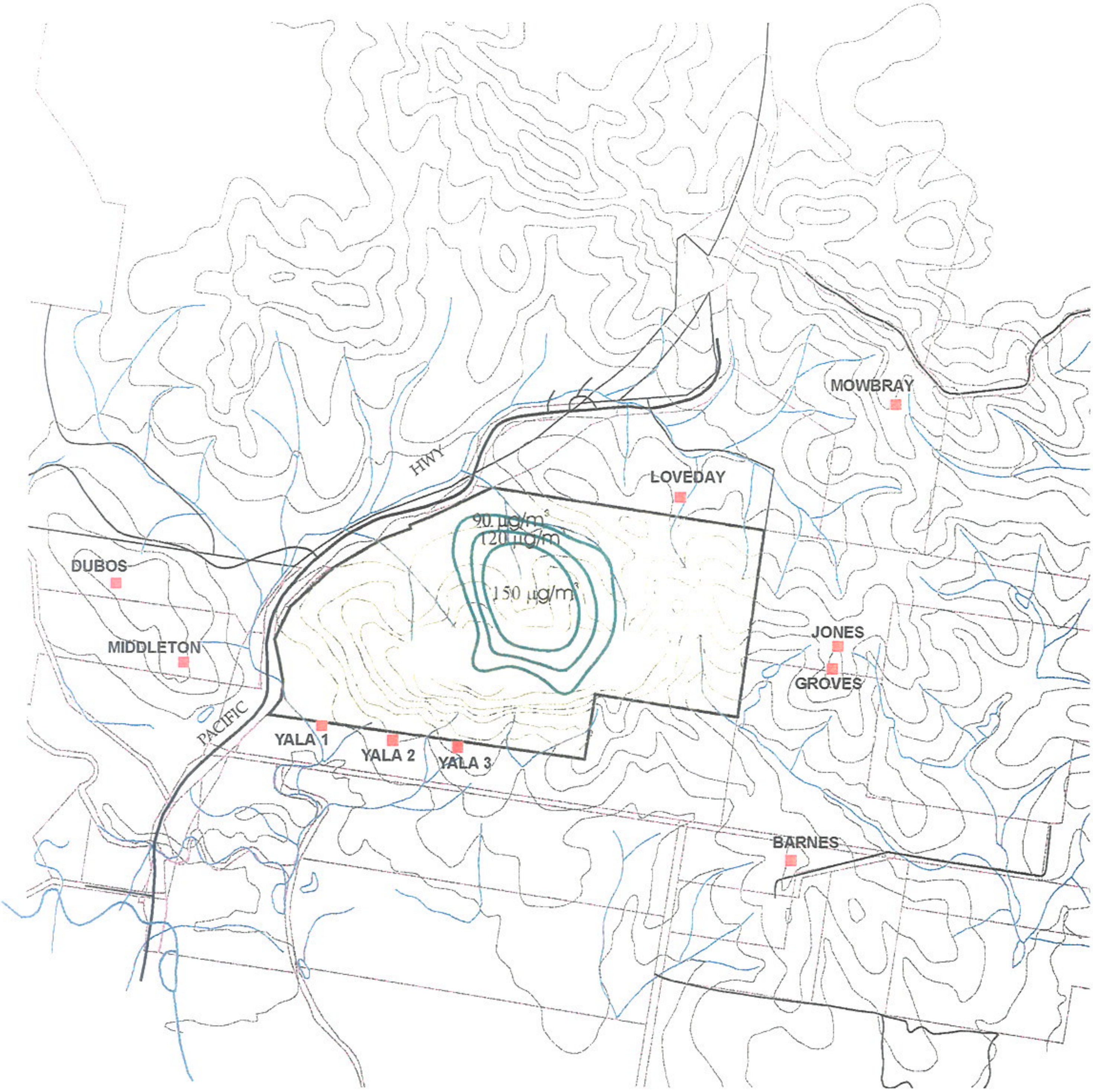


5710б/38070APP/fg5.5ncst1.CDR

SOURCE: CMA 1:25,000 TOPO NABIAC SHEET

ERM MITCHELL McCOTTER

Figure 5.5 MAXIMUM 24 HOUR PM_{10} DUST CONTOURS - STAGE 1 QUARRYING



RESIDENCE/NOISE RECEPTOR

150 µg/m³ PM_{10} DUST CONTOUR

CSR PROPERTY BOUNDARY

CADASTRAL BOUNDARIES

STAGE 3 QUARRYING

57106/38070APP/fg5.6dcst3.CDR

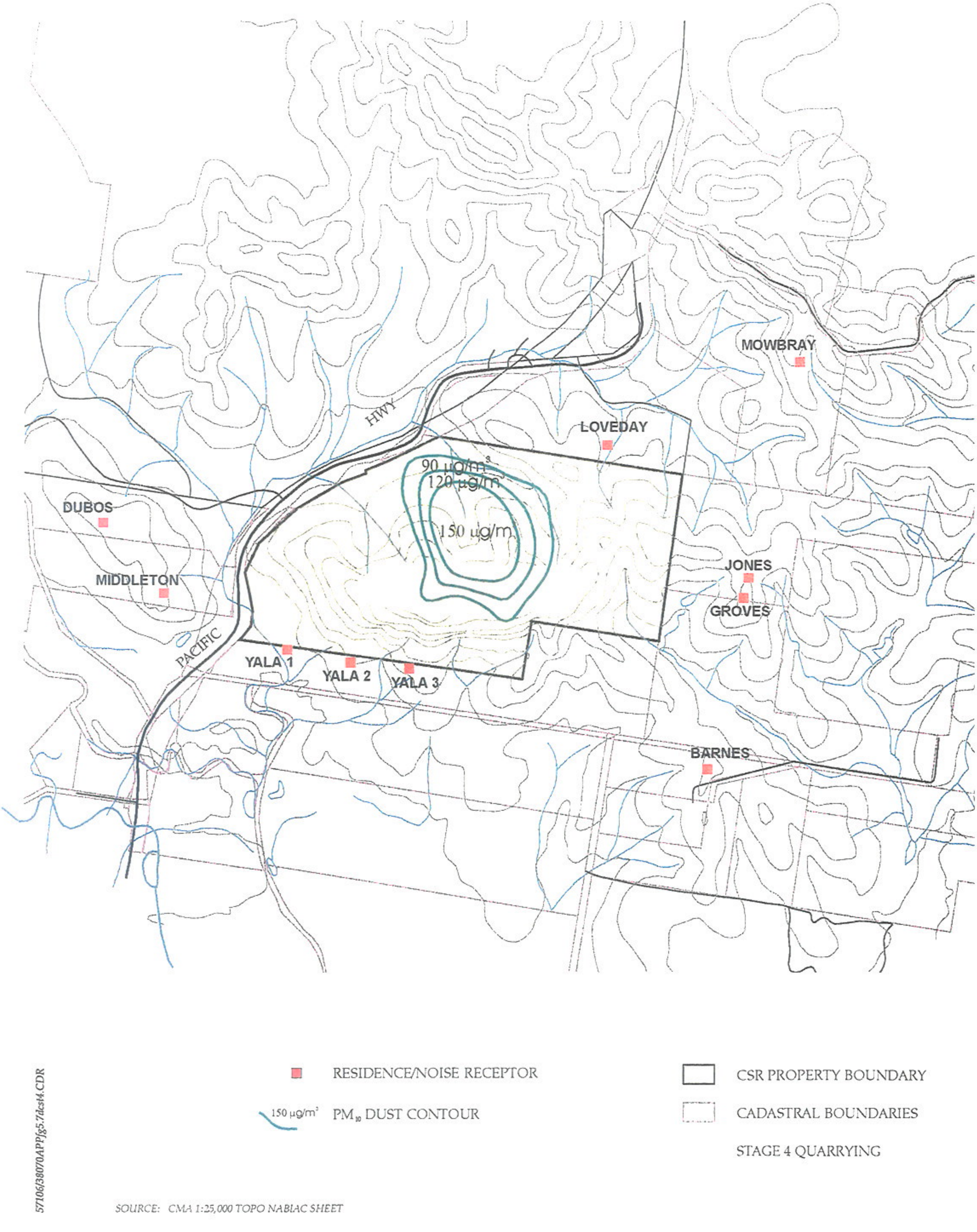
SOURCE: CMA 1:25,000 TOPO NABIAC SHEET

ERM MITCHELL McCOTTER

N

0 400m

Figure 5.6 MAXIMUM 24 HOUR PM_{10} DUST CONTOURS - STAGE 3 QUARRYING



57106/38070APPfg5.7dcst4.CDR

SOURCE: CMA 1:25,000 TOPO NABIAC SHEET

ERM MITCHELL McCOTTER

Figure 5.7 MAXIMUM 24 HOUR PM_{10} DUST CONTOURS - STAGE 4 QUARRYING

Chapter 6

DISCUSSION

6.1 DUST DEPOSITION

The current dust deposition values have been correlated against existing measurements. They show that predicted concentrations are within the range of the measured concentrations. The concentrations of dust deposition predicted by the model for Stages 1,3 and 4 show that concentrations will not significantly change.

Dust deposition will not exceed EPA criteria under the conditions modelled. All discrete receptors will have a maximum increase of less than 1.1 kg/m^2/month, well below guideline criteria for air quality amenity, 2 g/m^2/month.

6.2 DUST CONCENTRATION DUE TO NORMAL QUARRY OPERATIONS

6.2.1 *PM_{10}*

i. 24 hour Average

Modelled PM_{10} concentrations are highest at YALA 3 residence (69.76 µg/m^3), still well below the NSW EPA adopted USEPA guideline level of 150 µg/m^3 for a 24 hour concentration.

The emissions originating from quarry operations (including various open-pit sources) have a negligible effect on the surrounding discrete receptors as concentrations predicted at these locations differ only slightly between Stages 1-4. This is primarily because the emission which dramatically increase between Stages 1-4, are open-pit sources (see *Table 4.4*). Lower values have been predicted at receptors from these sources as the pit walls act as wakes (thus minimising PM_{10} emission from the cavity), as opposed to area sources, where there are no wakes (and more dispersion occurs).

The concentrations predicted at discrete receptors for all stages are primarily due to area emissions which do not emanate from the actual quarry pit.

ii. Annual Average

Modelled PM_{10} concentrations taken as an annual average are also well below the NSW EPA adopted USEPA criteria of 50 $\mu g/m^3$. The highest concentrations calculated at the YALA 3 residence and at the southern and north-western quarry property boundary were below 3 $\mu g/m^3$. It is not expected that impacts from the proposed increase in quarry area will have a significant effect on amenity or health relating to PM_{10} dust concentrations.

6.2.2 *Total Suspended Particulate*

For total suspended particulate (TSP) the NSW EPA adopt only an annual criteria being the National Health and Medical Research Council's recommended maximum annual concentration of 90 $\mu g/m^3$. The predicted concentrations for TSP between each of the proposed quarry stages also do not vary significantly and are well below this criteria. As for PM_{10} the highest concentrations calculated were at the YALA 3 residence and at the southern and north-western quarry property boundaries (less than 6.03 $\mu g/m^3$). It is not expected that impacts from the proposed increase in quarry area will have a significant effect on amenity or health relating to TSP dust concentrations.

6.3 EPISODIC IMPACTS

Episodic impacts relate to drilling and blasting as emission sources. Due to their nature it is difficult to accurately assess their impact with the ISC model. These impacts relate only to emissions which will typically occur around once or twice a month.

Impacts from drilling and blasting can be reduced through standard blasting and drilling mitigation measures as outlined in Chapter 7 - *Mitigation Measures* and CSR's guidelines *'Drilling and Blasting Procedures for Jandra Quarry'*. Primarily, it is important to consider the meteorological conditions, in particular wind speed and direction and any inversion layer before conducting drilling and blasting. Consideration must be made with all available meteorological information before each session occurs. Particular attention is required when blasting near the southern and eastern extent of the quarry where blast locations are close the property boundary and some nearby residences.

Depending on the meteorological conditions at the time of the blast, the volume of dust emanated may settle in the surrounding area in a very short period of time, travel via 'plug flow' downwind or in high wind conditions may be dispersed rapidly. As the duration of the blast is extremely short, these factors can be assessed on-site and significant impacts off-site can be avoided.

As a precursor to minimising the impact of the dust generated, blast holes can be capped with stemming, which restricts the upward emission of dust. In addition, shot rock is moistened with water sprays prior to loading into dump trucks.

Therefore, as long as standard drilling and blasting practices are followed it is anticipated that blasting and drilling will not have a significant impact on dust levels at nearby residences.

Chapter 7

ODOUR ASSESSMENT

7.1 ODOUR SOURCES

It is anticipated that most activities at the quarry will not produce odours that may have off-site effects. This is because of the relatively low concentrations of odour produced combined with the large area for dispersion to occur. The exclusion of this is the asphalt plant, which has the potential to cause off-site effects.

7.2 ASPHALT PLANT

A mobile asphalt plant is to be located on-site on an as needs basis, based on market demand. The plant will be capable of producing approximately 100 to 200 tonnes an hour. Air emissions from the asphalt plant will be directed though a wet scrubber to remove both particulate and odour emissions. The plant will be fitted with a wet scrubber flow meter with an audible and visual alarm. Lime or flyash will be contained in a filler silo reducing the potential for fugitive air emissions from these process inputs.

The process of producing hot mix asphalt involves drying and heating the aggregate before addition of the bitumen. The drying process involves the aggregate moving through a rotating, slightly inclined, direct fired drum drier. After drying the aggregate is generally heated to temperatures ranging from 150°C - 200°C and then coated with bitumen. Odour emissions from this process are associated with volatile organic compounds (VOC's) from the bitumen.

A number of process modifications such as drum rearrangement, adjustment of the asphalt injection point and optimising the combustion process will reduce the VOC's and therefore odour.

Fugitive VOC emissions from the asphalt tanks will be routed back to the combustion unit which will serve as an afterburner reducing the concentration of fugitive VOC's to atmosphere.

In addition to these mitigation measures, the exhaust stack will ensure that adequate dispersion of the emission plume takes place. It is expected that with the distance to the nearest receptor from the proposed asphalt plant site being approximately 600 metres, adequate dispersion will occur. Plume dispersion will be enhanced by the heavily vegetated nature of the area.

Plume dispersion in conjunction with the appropriate control technologies will ensure that odour emissions from the asphalt batching plant will not have a significant impact on nearby discrete receptors.

Chapter 8

MITIGATION MEASURES

As part of standard CSR's quarrying practices mitigation measures are conducted during daily activities. These have been developed through CSRs long association with quarrying. Mitigation measures to control air quality at the quarry include:

- regular watering of haul roads and stockpiles;
- limiting speeds of vehicles on unsealed surfaces to 40 kph;
- minimising vehicle kilometres travelled on unpaved roads;
- rehabilitating disturbed areas;
- where practical/possible conduct drilling and blasting during suitable meteorological conditions (ie. not during high winds or temperature inversions);
- adequate stemming of drill holes;
- dust extraction units on drill rigs and crushing and screening plants to be well maintained;
- seals and mist sprays on quarry equipment to be well maintained;
- dust displaced during silo filling to be controlled by an appropriate filter (ie a reverse pulse silo filling filter or equivalent);
- wet scrubber on asphalt bathing plant to be maintained regularly including the regular servicing of the recycling interceptor trap; and
- stack emissions from the asphalt batching plant to be monitored for:
  - VOCs;
  - semi VOCs;
  - CH_4, H_2, N_2, CO, CO_2 and O_2;
  - particulate;
  - Stack gas moisture, velocity and temperature; and
  - mass flow rate of exhaust gases, water, particulates, N_2, CO, CO_2 & O_2.

Chapter 9

CONCLUSION

The proposed extension of Jandra quarry from 150,000 tpa to 250,000 tpa should not significantly impact on the air quality of the surrounding area. The proposed impacts have been predicted using the ISC model.

The predictions show that a minimal increase in PM_{10} concentrations may occur over 24 hour averaging periods. Predicted annual concentrations of PM_{10} and TSP are also expected to raise slightly however all are expected to be well below the criteria nominated by the NSW EPA. It is anticipated that dust deposition criteria nominated by the NSW EPA will be complied with.

Potential short-term dust impacts due to drilling and blasting, whilst only predicted to occur once or twice a month, can be mitigated through the use of standard mitigation measures which are detailed in this assessment. CSR needs to be especially prudent when drilling and blasting practices occur near their southern property boundary during Stage 3.

Odour impacts emanating from the asphalt plant are proposed to be mitigated through the use of appropriate control technologies and an exhaust stack to produce sufficient dispersion.

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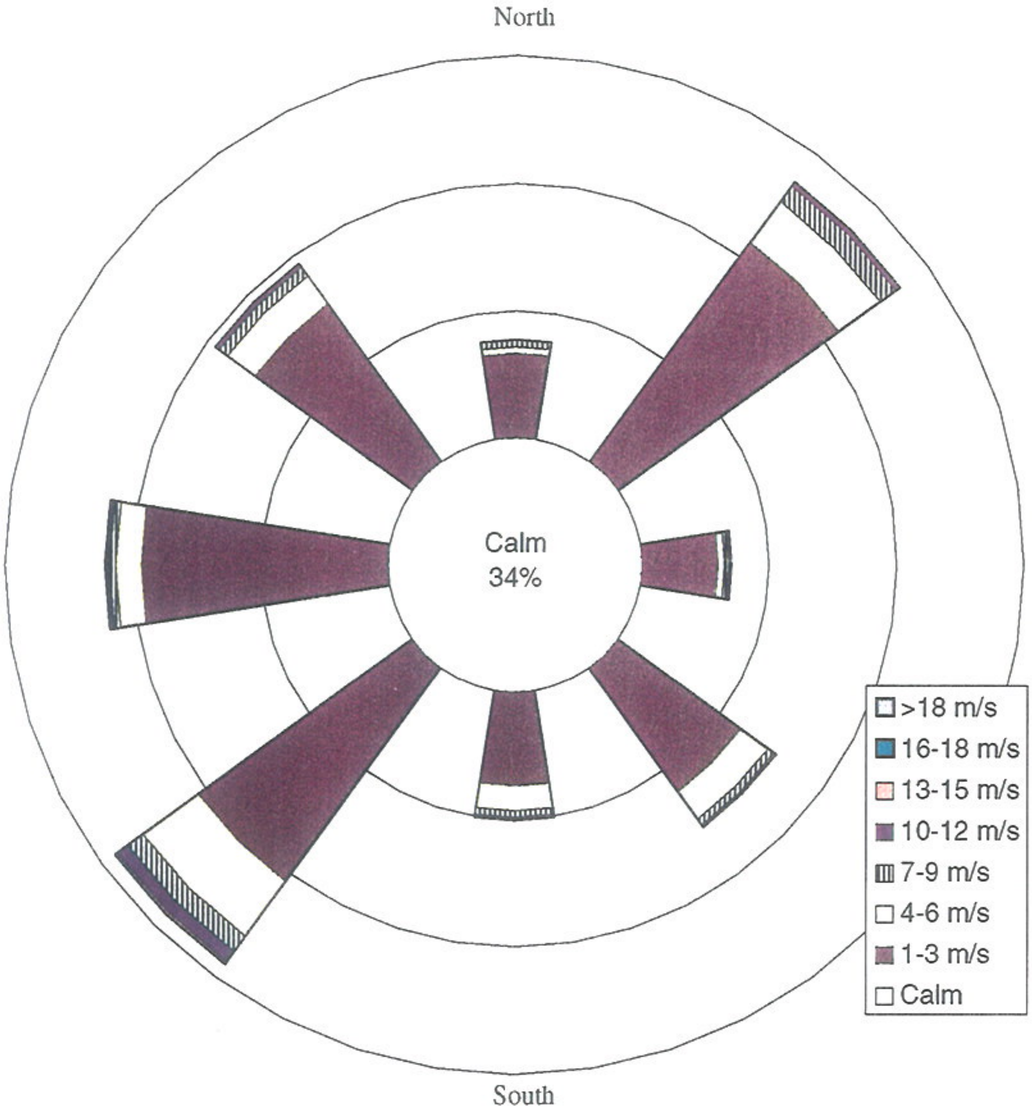
APPENDICES

Appendix A

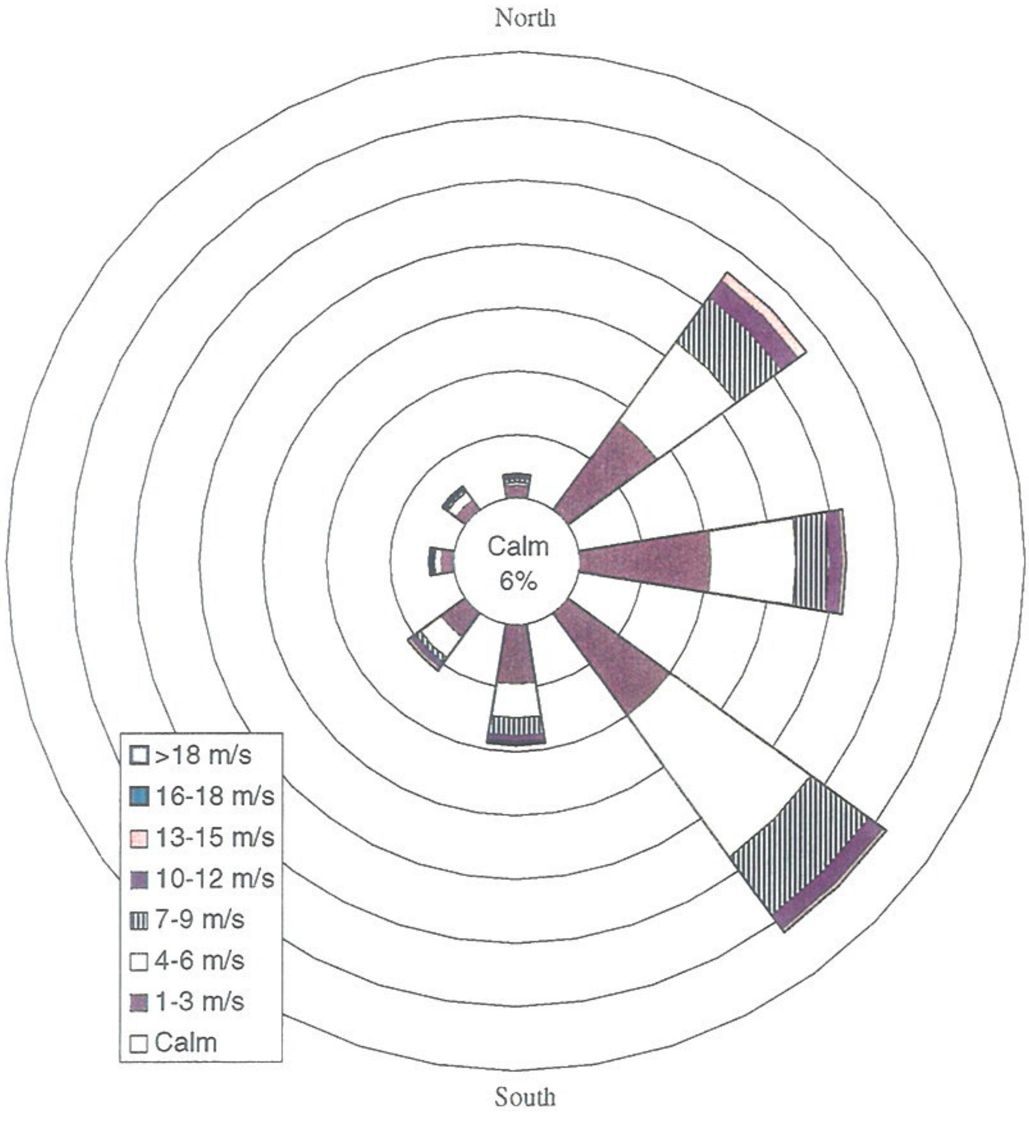
WINDROSES

Windrose for Summer
9am



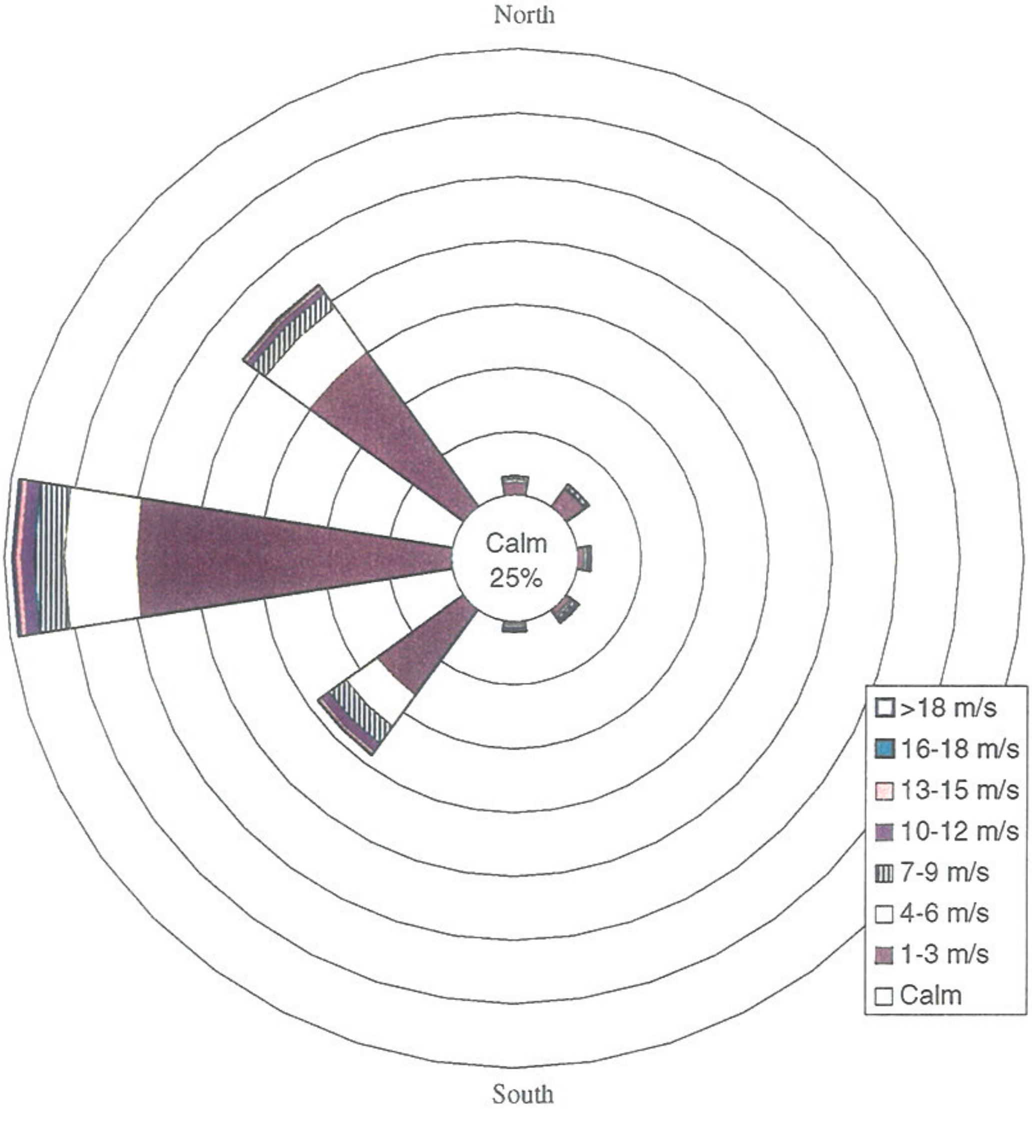
The segments of each arm represent the seven wind speed classes, with increasing windspeed from the centre outwards.The length of each arm represents the proportion of the total wind that blew from that direction. The value in the central circle represents the proportion of calm conditions. The circlular grid represents a contour interval of five percent.

Windrose for Summer
3pm



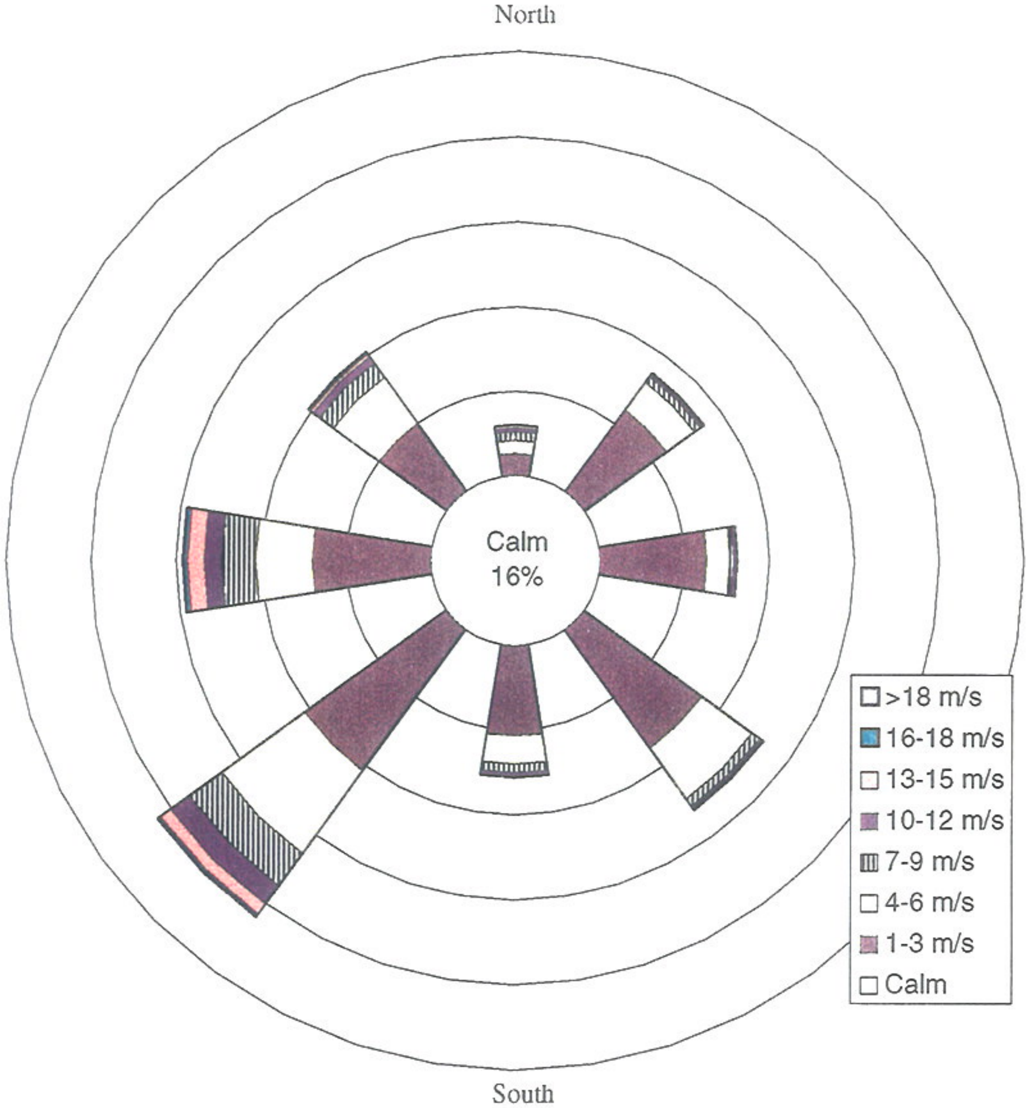
The segments of each arm represent the seven wind speed classes, with increasing windspeed from the centre outwards.The length of each arm represents the proportion of the total wind that blew from that direction. The value in the central circle represents the proportion of calm conditions. The circular grid represents a contour interval of five percent.

Windrose for Winter
9am



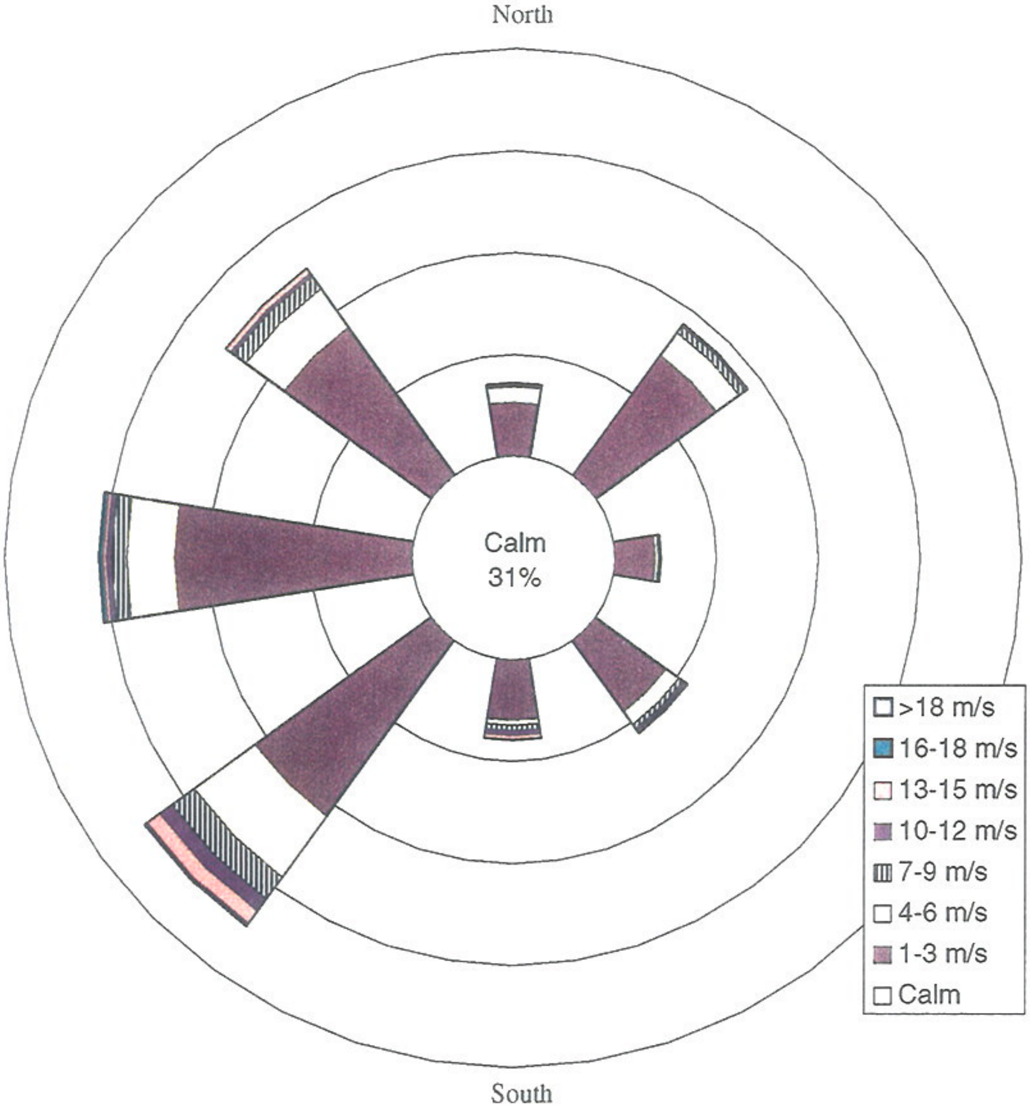
The segments of each arm represent the seven wind speed classes, with increasing windspeed from the centre outwards.The length of each arm represents the proportion of the total wind that blew from that direction. The value in the central circle represents the proportion of calm conditions. The circular grid represents a contour interval of five percent.

Windrose for Winter
3pm



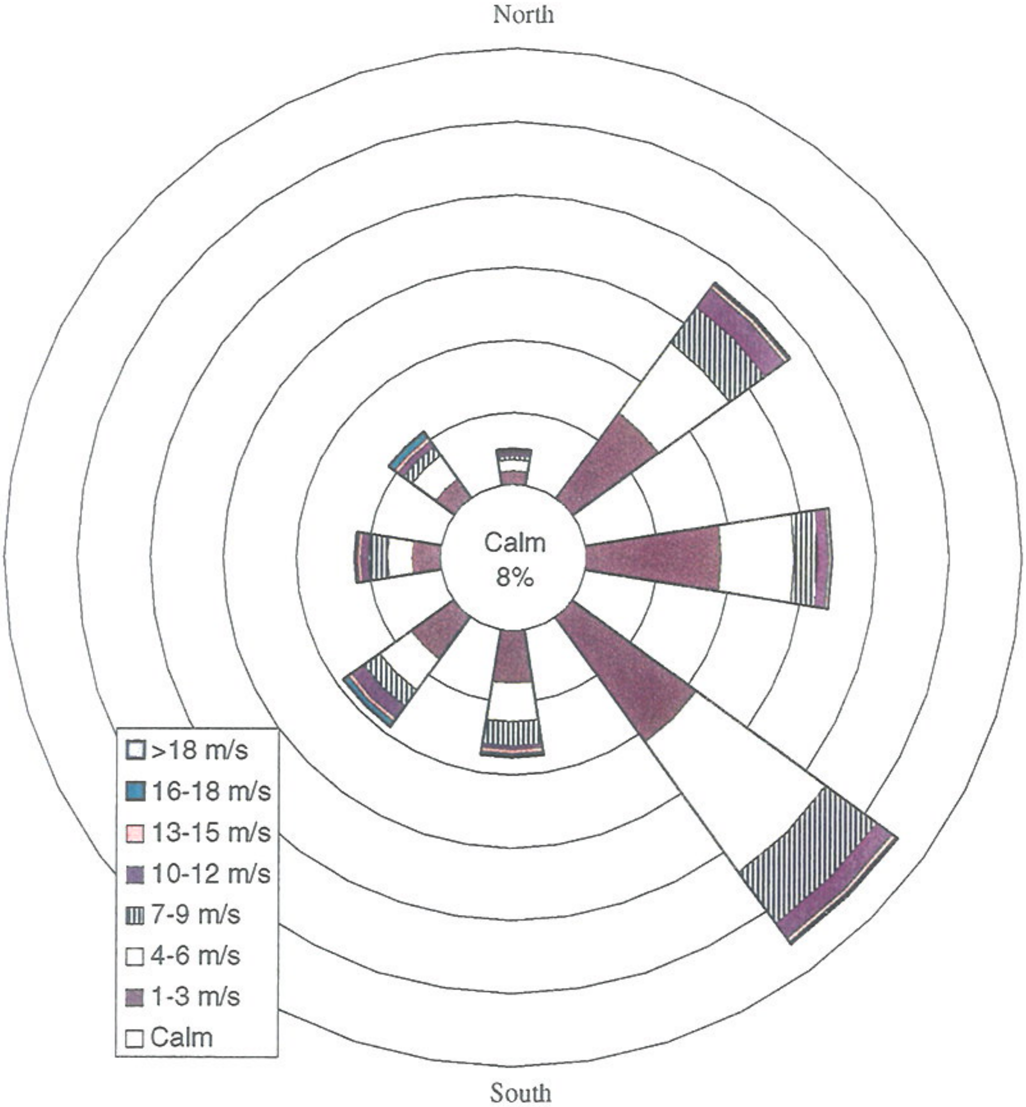
The segments of each arm represent the seven wind speed classes, with increasing windspeed from the centre outwards.The length of each arm represents the proportion of the total wind that blew from that direction. The value in the central circle represents the proportion of calm conditions. The circular grid represents a contour interval of five percent.

Windrose for Spring
9am



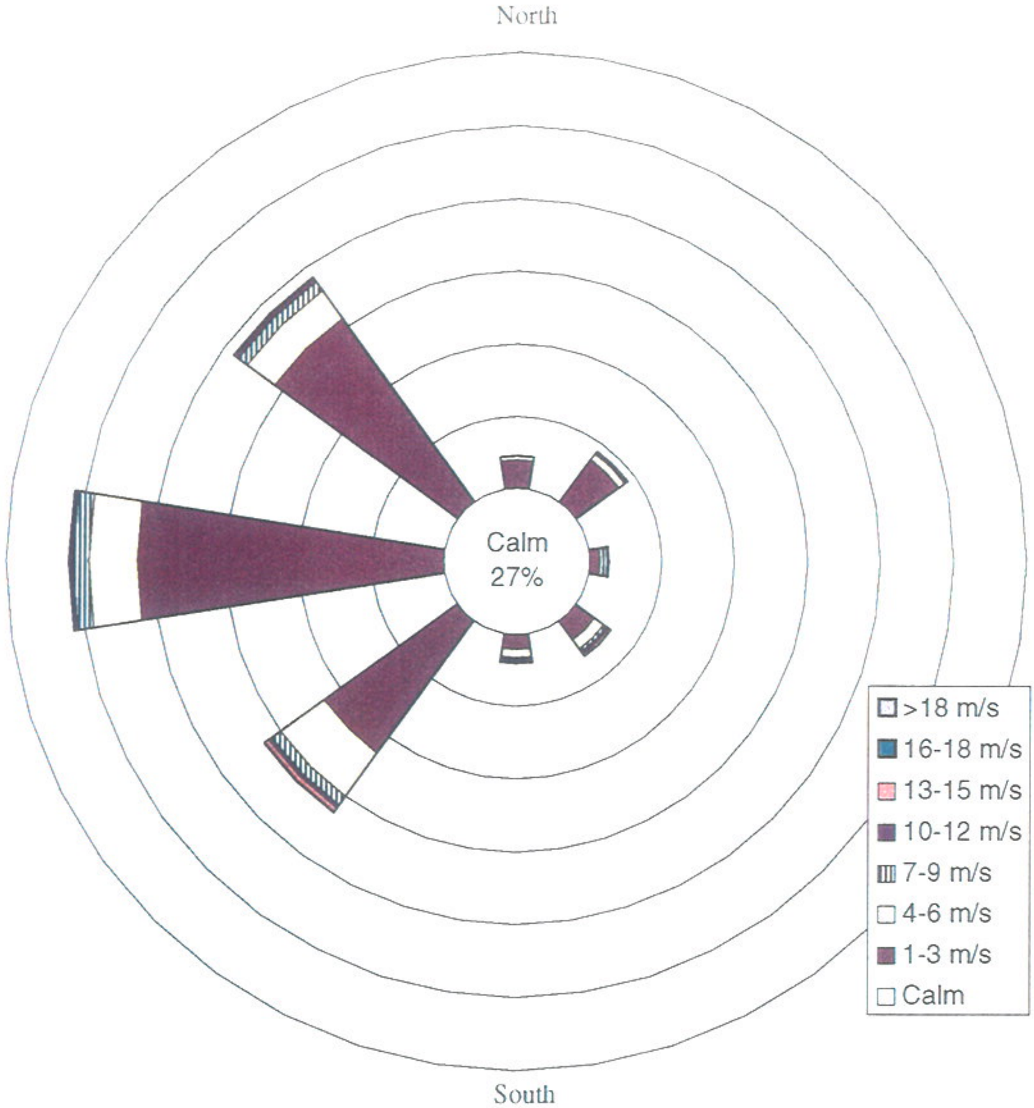
The segments of each arm represent the seven wind speed classes, with increasing windspeed from the centre outwards.The length of each arm represents the proportion of the total wind that blew from that direction. The value in the central circle represents the proportion of calm conditions. The circlular grid represents a contour interval of five percent.

Windrose for Spring
3pm



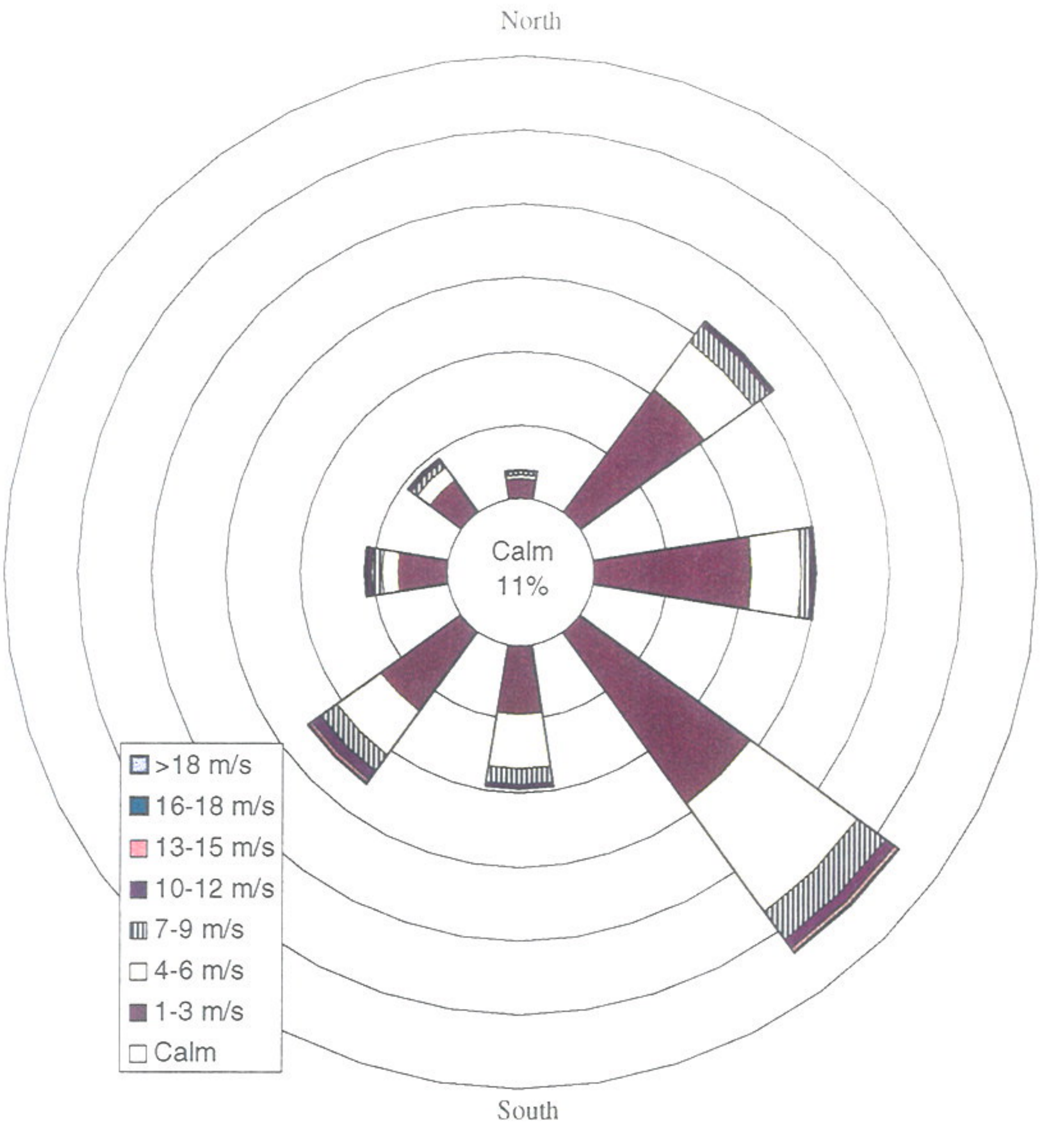
The segments of each arm represent the seven wind speed classes, with increasing windspeed from the centre outwards. The length of each arm represents the proportion of the total wind that blew from that direction. The value in the central circle represents the proportion of calm conditions. The circular grid represents a contour interval of five percent.

Windrose for Autumn
9am



The segments of each arm represent the seven wind speed classes, with increasing windspeed from the centre outwards.The length of each arm represents the proportion of the total wind that blew from that direction. The value in the central circle represents the proportion of calm conditions. The circular grid represents a contour interval of five percent.

Windrose for Autumn
3pm



The segments of each arm represent the seven wind speed classes, with increasing windspeed from the centre outwards.The length of each arm represents the proportion of the total wind that blew from that direction. The value in the central circle represents the proportion of calm conditions. The circular grid represents a contour interval of five percent.

JANDRA QUARRY
EXTENSION

CSR

L. ECOLOGICAL ASSESSMENT

JANDRA QUARRY EXTENSION

Ecological Investigations

For:
CSR CONSTRUCTION MATERIALS

October 1999

38070ECORP2

Report No. 38070ECORP2

This report was prepared in accordance with the scope of services set out in the contract between ERM Mitchell McCotter Pty Ltd ACN 002 773 248 (ERMMM) and CSR. To the best of our knowledge, the proposal presented herein accurately reflects the CSR's intentions when the report was printed. However, the application of conditions of approval or impacts of unanticipated future events could modify the outcomes described in this document. In preparing the report, ERMMM used data, surveys, analyses, designs, plans and other information provided by the individuals and organisations referenced herein. While checks were undertaken to ensure that such materials were the correct and current versions of the materials provided, except as otherwise stated, ERMMM did not independently verify the accuracy or completeness of these information sources.

Approved by:	*Tony McNamara*
Position:	Project Director
Signed:	
Date:	

ERM Mitchell McCotter Quality System

Prepared by:	*Murray Curtis*
Position:	Project Manager
Signed:	
Date:	14/10/99

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Chapter 1

INTRODUCTION

1.1 THE PROPOSED DEVELOPMENT

CSR Construction Materials Limited (referred to below as CSR) purchased Jandra Blue Metal Quarries Pty Ltd in late 1996 and commenced full scale production at the site in early 1997. The site was originally established following development consent granted by Greater Taree City Council in December 1984. A further development consent in July 1991 increased the production limit of the quarry to 150,000 tonnes per annum (tpa). The existing site is described as Lots 2, 11 ,12 ,13 ,14 and 15 in DP 790056.

The quarry is located on the eastern side of the Pacific Highway at Possum Brush, approximately 18 kilometres south of Taree. The present operation crushes and screens material and provides a pre-coating facility for sealing aggregates. The location of the quarry is shown in *Figure 1.1*.

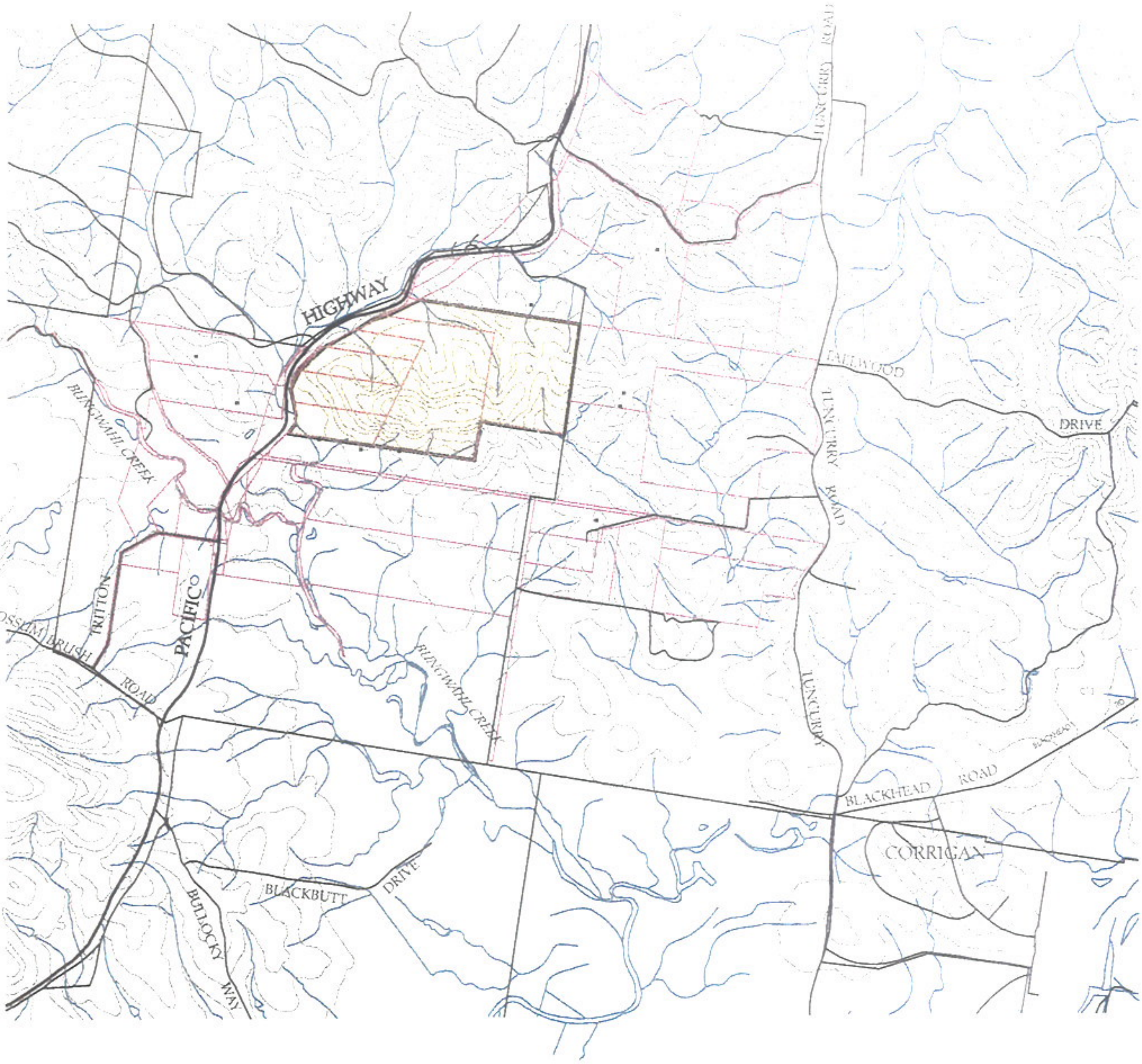
At the time of acquisition CSR calculated that reserves of legally extractable rock contained within the 5 ha approved area totalled 960,000 tonnes. Since then the company has extracted some 400,000 tonnes of material. At the current extraction rate the remaining 560,000 tonnes will last just over four years.

Geological investigations have shown a substantial available resource of at least 19 hectares (ha) on the site that is underlain by greywacke. This resource is contained with a CSR owned area of 118 ha. The company is seeking approval to increase the quarry area to allow extraction of sufficient rock that would secure the economic viability of its investment.

Approval to increase the existing quarry area would significantly expand reserves. A four staged process is proposed involving extraction down to RL 20 and providing 16 million tonnes of fresh rock.

In this application CSR also seeks to gain approval to alter its current operating conditions (1984 and 1991 approvals), as follows:

- expand operating hours from 6.00 am to 6.00 pm Monday to Friday and 6.00 am to 3.00 pm Saturdays. Ancillary operations such as refuelling, servicing and maintaining plant will be undertaken between 6.00 am and 9.00 pm Monday to Saturday;



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SOURCE: CMA 1:25,000 TOPO NABIAC SHEET

ERM MITCHELL McCOTTER

Figure 1.1 SITE LOCALITY

- expand the existing site facilities area;
- lift approved production levels from 150,000 tpa to 250,000 tpa;
- significantly expand reserves to allow planning for the companies future. This includes extraction down to RL 20 and will provide 16 million tonnes of fresh rock;
- remove the restrictions on blasting to enable the adoption of normal commercial blasting practices;
- locate on site, from time to time on an as needed basis, a mobile pugmill and or a mobile asphalt batching plant; and
- construct a new weighbridge and office complex west of the current weighbridge.

There will be no change to the processing operations at the quarry. This report on Ecological Investigations forms *Appendix J* to the Environmental Impact Statement for the proposed development. It describes existing threatened flora and fauna species and fauna habitat known or likely to occur in the study area, assesses likely impacts and provides mitigation measures. Eight Part Tests of Significance are provided for terrestrial and aquatic species in accordance with the requirements of Section 5A of the *Environmental Planning and Assessment Act* (1979) and the *Fisheries Management Amendment Act* (1997).

1.2 DEFINITIONS

The following definitions are applicable to these ecological investigations.

- ***activity*** has the same meaning as in the *Environmental Planning and Assessment Act 1979;*
- ***affected species*** means those species likely to be affected by the proposal;
- ***conservation status*** is regarded as the degree of representation of a species or community in formal conservation reserves;
- ***development*** has the same meaning as the *Environmental Planning and Assessment Act 1979;*
- ***Director-General*** means the Director General of National Parks and Wildlife;
- ***locality*** means the area within a ten kilometre radius of the study area;

- *region* means, for the purposes of the provision in which it is used, a bioregion defined in a national system of bioregionalisation that is determined (by the Director General by order published in the Gazette) to be appropriate for those purposes. The study area lies within the North Coast bio-region as documented by Thackway and Cresswell (1996).

- *significant species* means species not listed in the Threatened Species Conservation Act 1995 (TSC Act) but considered to be of regional or local significance;

- *study area* is the subject site and any additional areas which are likely to be affected by the proposal, either directly or indirectly;

- *subject site* means the area which is proposed for development/activity; and

- *subject species* means those threatened and significant species which are considered known or likely to occur in the study area.

All other definitions are the same as those contained in the TSC Act.

1.3 THE STUDY AREA

1.3.1 Climate

Meteorological data has been compiled from the nearest official meteorological station at Taree, approximately 20 kilometres from the study area. The Taree district is located in the sub-humid temperature zone where the climate is influenced by topography, latitude, the local differences in altitude, the proximity of the ocean and the effect the ocean has on temperature and precipitation patterns.

The following climatic characteristics have been determined:

- Mean annual rainfall of the area is 1,183.9 millimetres. Rainfall is seasonally distributed with a late summer/early autumn peak. March is the wettest month, with a mean monthly rainfall of 149.3 millimetres. August has the lowest mean monthly rainfall of 36.5 millimetres. In winter the westerly influences bring most of the rain.

- Mean daily pan evaporation rates range from 1.8 to 2.8 millimetres per day during the winter months, increasing to between 5.3 and 6.2 millimetres in summer.

- The highest temperatures are reached in January, when the mean temperature range is 17°C to 28.8°C. The lowest temperatures are recorded during July, with the range being 5.8°C to 18.3°C.

1.3.2 Geology and Soils

The area is underlain by an undifferentiated sequence of Devonian sediments that is approximately 345 to 395 million years old. The sequence consists of interbedded mudstone, sandstone, conglomerate, tuff and chert, with local greywacke beds.

A major greywacke bed is present in the quarry area. It is up to 190 metres thick and has a strike length of at least 1,000 metres. Diamond drilling has confirmed that there is at least 30 metres of greywacke below the current floor of the quarry. Physically the greywacke bed is a very hard durable dark grey rock with little apparent differentiation across the bed. Scattered throughout the bed are relict brachiopod shells and clasts of granitic material up to 10 cm in diameter.

No structural analysis has been carried out, but wedge type failures are evident in the upper weathered benches.

The soil overlying the study area was found to have low erosion and good rehabilitation potential. Generally, the topsoil layers were found to be suitable for rehabilitation depending on the depth of stripping and extent of stockpiling (ie. minimise stripping of inferior rocky subsoil and minimise the time frame soils are stockpiled thus reducing nutrient leaching).

1.3.3 Regional Biogeography

A biogeographic region is a complex land area composed of a cluster of interacting ecosystems that are repeated in similar form throughout (Thackway & Cresswell 1995). Region descriptions seek to describe the dominant landscape scale attributes of climate, lithology, geology, landforms and vegetation (Thackway & Cresswell 1995).

The study area falls within the NSW North Coast (NNC) biogeographic region, which covers 60,794 square kilometres (Thackway & Cresswell 1995). The Queensland component accounts for 2,604 square kilometres of this area, while the NSW component amounts to 58,189 square kilometres. In the NNC region, reserved areas account for 5-10% of the total area.

In the NNC region, the dominant ecosystem condition of the Queensland component is characterised by 'modified ecosystems with very few indigenous ecosystems remaining'. The NSW component is documented as 'having indigenous ecosystems present but co-existing with pastoral/timber industries'. Dominant limiting factors to conservation management in the Queensland component are documented as being urbanisation and horticulture. In the NSW component, the major limiting factors to conservation management are documented as being agriculture, clearing, cropping, feral animals, wildfire, forest timber production/harvesting, grazing and pastoral use, horticulture, mining, tourism, urbanisation and weeds. Thackway and Cresswell's assessment indicates that there is an inadequate representation of reserves in the NNC region.

Chapter 2

ECOLOGICAL INVESTIGATIONS

2.1 METHODOLOGY

2.1.1 Literature Review and Database Search

Investigations involved a review of relevant literature including reports, topographic maps and interpretation of 1:25,000 aerial photographs. A National Parks and Wildlife Service data search was conducted for the Bulahdelah and Wingham 1:100,000 map sheets.

2.1.2 Flora Survey

The primary objectives of the flora survey were:

- to map and describe the vegetation communities and to subsequently determine habitats on-site; and
- to identify the likelihood of any threatened plant species occurring on the site, and consequently to assess the potential impacts of the proposed activities on identified species.

Vegetation analysis consisted of a general description of the plant communities using qualitative field observations and interpretation from aerial photographs. The random meander technique was used to identify plant species, vegetation communities and habitats. This technique involves walking in a random manner through the study area, identifying the full range of potential habitats and plant communities (Cropper 1993).

Significant flora species potentially occurring within the study area were targeted by visiting the community type in which they may occur.

Terrestrial vegetation communities were classified according to the scheme proposed by Walker and Hopkins (1990). Texts used for plant identification included Harden (1990, 1991, 1992, 1993), Brooker *et al.* (1997), Auld and Medd (1996), Tame (1992), Robinson (1994) and Leonard (1996).

The conservation status of the communities occurring within the study area was determined using a variety of texts including Forestry Commission (1989), Hager and Benson (1994) and Specht *et al*. (1995).

2.1.3 *Fauna Habitat Assessment*

Vegetation communities reflect differences in community structure and plant species composition. The majority of fauna species select habitat based primarily in structural characteristics of vegetation communities rather than their composition of plant species. One notable exception is the koala, which selects habitat based on the presence of particular species suitable for feeding. Structural characteristics of vegetation communities include the height of the dominant layer, the number of distinctive layers and the density of vegetation.

Many specialised faunal groups may also rely upon the availability of water, the presence of particular tree or shrub species, or specific micro-climatic characteristics in order to survive. Human activities, particularly those that alter the structure or cover of vegetation, have the potential to change faunal habitat characteristics, which, in turn, may result in modifications to the composition of fauna within an area.

Investigations sought to identify and assess the type and quality of fauna habitats occurring within the study area. Assessment of fauna habitat types and quality was derived from a qualitative assessment of:

- dominant vegetation type;
- structural vegetation characteristics;
- presence/abundance of hollow-bearing trees;
- level of disturbance;
- density of ground litter (ie logs, leaf litter); and
- presence/absence of standing or flowing water (modified from SWC 1994).

2.1.4 *Fauna Survey*

i. Spotlighting

Spotlighting surveys were undertaken in an effort to determine the assemblage of arboreal mammals occupying the study area. They were conducted primarily to detect the squirrel glider (*Petaurus norfolcensis*) and brush-tailed phascogale (*Phascogale tapoatafa*). A total of two hours of spotlighting on foot was conducted by two ecologists walking at approximately one kilometre per hour over three nights (total 12 person hours of spotlighitng). A further half hour of spotlighting from a slow moving vehicle (moving at approximately five kilometres per hour) was undertaken over three nights (an additional one and a half hours of spotlighting).

A total transect distance of 4.5 kilometres was covered during the spotlighting surveys, as illustrated in *Figure 2.1*. Spotlighting was only undertaken during suitable weather conditions, characterised by mild to warm temperatures, low wind and no rainfall.

ii. Avifaunal Surveys

Diurnal bird surveys were conducted in an effort to detect the black bittern (*Ixobrychus flavicollis*) and the square-tailed kite (*Lophoictinia isura*). Surveys were conducted in habitats deemed suitable for these species, primarily at dam sites with emergent vegetation for the black bittern and within the dry open forest communities for the square-tailed kite.

Surveys were conducted for a minimum of 30 minutes at dusk over three nights as well as opportunistically for the duration of the field investigation. All species of avifauna incidentally observed were recorded.

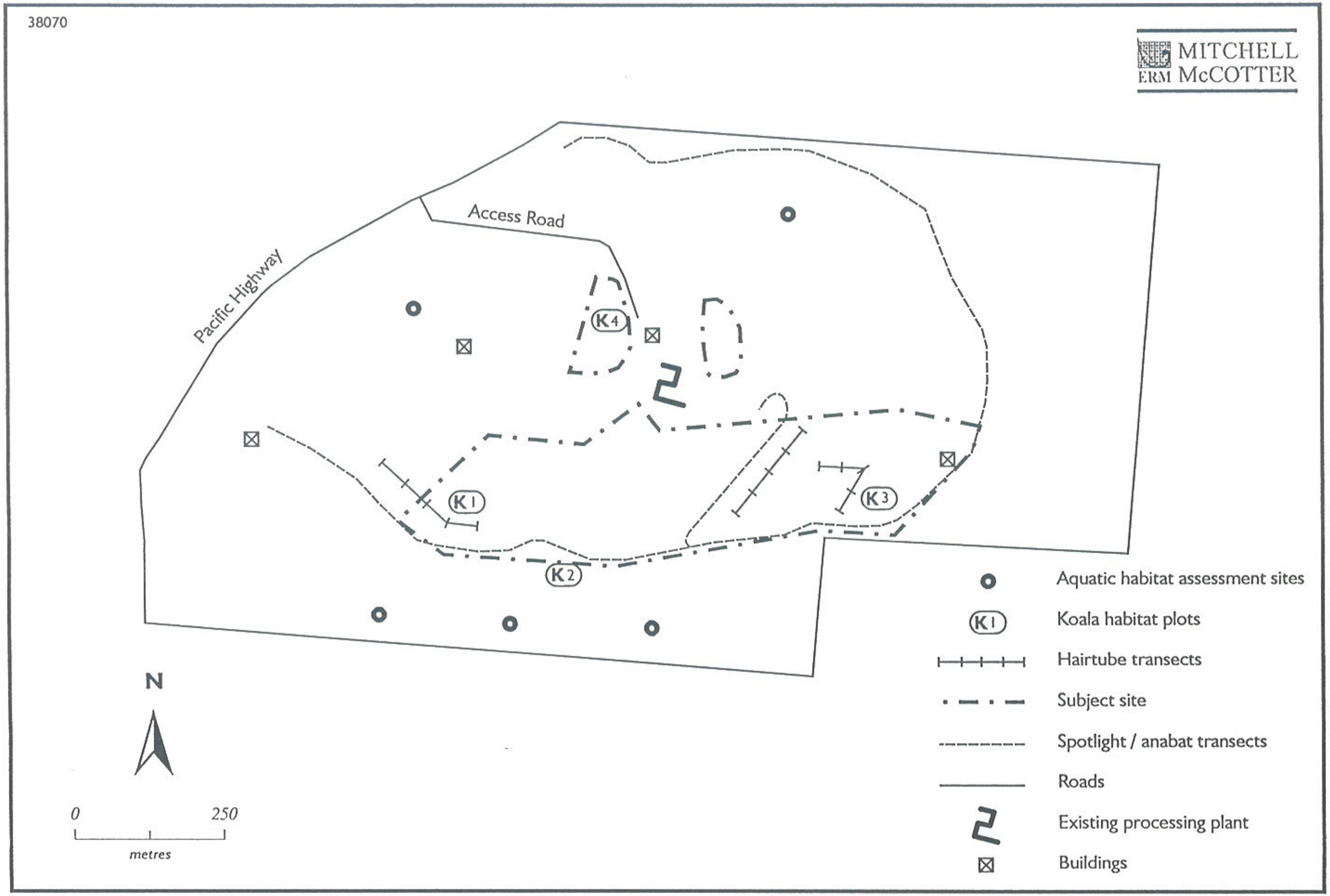
iii. Anabat Detection

Anabat surveys were conducted to detect microchiropteran bat species, particularly the common bent-wing bat (*Miniopterus schreibersii*), little bent-wing bat (*M. australis*), large footed myotis (*Myotis adversus*), eastern free-tail bat (*Mormopterus norfolkensis*), greater broad-nosed bat (*Scoteanax rueppellii*) and the yellow-bellied sheath-tailed bat (*Saccolaimus flaviventris*). Two hours of walking transects were conducted along (walked) spotlighting transects over three nights. Stationary bat detection was also conducted on the southern access road. Anabat detection was undertaken at dusk in suitable weather conditions (mild to warm, little wind and no rain). The Anabat recording path is illustrated in *Figure 2.1*.

iv. Hairtube Sampling

The hairtube sampling targeted the brush-tailed phascogale (*Phascogale tapoatafa*) and the squirrel glider (*Petaurus norfolcensis*). A total of three hairtube transects (two lines of five tubes and one line of six tubes) were set for 15 nights in habitat deemed suitable for the target species (*Figure 2.1*). The hairtubes were set 20 to 50 metres

Figure 2.1 LOCATION OF FIELDWORK ACTIVITIES WITHIN THE STUDY AREA



apart. A total of 240 hair tube nights were performed at three transect locations. Hairtubes were baited alternatively with meat (bacon pieces) and a mixture of peanut butter, honey and rolled oats.

v. Amphibian Surveys

Amphibian searches were conducted to determine the assemblage of amphibians in the study area, and specifically to detect green-thighed frog (*Litoria brevipalmata*). Searches were undertaken at three sites within the study area (*Figure 2.1*). Site selection was based on the presence of suitable habitat as determined through the ground truthing. Each site was surveyed at least twice over three consecutive nights.

Each survey consisted of a 30 minute (minimum) visual search (using a spotlight) by two team members, and call playback survey broadcasting calls of amphibian species likely to occur. Each suitable call was played for five minutes, followed by a two minute listening period. Each call playback survey was preceded and followed by a ten minute listening period.

vi. Reptile Surveys

Nocturnal reptile searches were conducted in conjunction with amphibian searches to detect the pale-headed snake (*Hoplocephalus bitorquatus*) and stephen's banded snake (*H. stephensii*). The searching technique included spotlight searching, and searching of fallen logs, decorticating bark, rock outcrops and other likely substrates. Two team members conducted each search for a minimum period of 30 minutes each evening of the field survey. Driving spotlight transects were also used in an effort to detect these species.

Diurnal searches for reptiles were also undertaken and included searches under rocks, fallen logs, decorticating bark and other crevices potentially utilised by reptiles. All reptile species opportunistically sighted were recorded. Diurnal and nocturnal reptile survey sites are illustrated in *Figure 2.1*.

vii. SEPP 44 - Koala Habitat Surveys

The field survey included a search for the presence of *'potential koala habitat'* and *'core koala habitat'* as defined in *State Environmental Planning Policy No. 44 - Koala Habitat Protection* (SEPP 44). In SEPP 44 *'potential koala habitat'* is defined as *'areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15 percent of the total number of trees in the upper or lower strata of the tree component'*. In addition to tree species listed in Schedule 2 it is also necessary to consider tree species that are recognised to be locally significant as feeding resources to koalas. For the purpose of this study the locally preferred koala food trees included the primary koala food trees identified in Evans and Fitzpatrick (1996).

The methodology used for detecting *'potential koala habitat'* was based on that used by the Australian Koala Foundation. Plots of 0.1 hectares (50 x 20 metres) in size were marked out in each vegetation type (*Figure* 2.2). The abundance of each tree species in the upper and lower canopy was recorded to enable an approximate percentage of cover for each species to be calculated. If *'potential koala habitat'* was identified then further investigations were conducted to assess the presence of *'core koala habitat'*.

In SEPP 44 *'core koala habitat'* means *'an area of land with a resident population of koalas evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population'*. Further investigations to assess the presence of *'core koala habitat'* consisted of searching each potential koala food tree for koalas, scratches (consistent with those of a koala) and scats within two metres of each tree bole. In addition, scats and scratch marks were also searched for while undertaking other fieldwork activities.

viii. Opportunistic Fauna Surveys

Field checking for evidence of fauna during the flora survey included:

- mammals: scats, diggings, burrows, footprints, roost sites, tree scratchings and feeding incisions. Habitat features such as groundcover, extent of shrub and tree layers and the presence of mature habitat trees with hollows were also considered;
- birds: incidental bird observations were recorded. Vegetation cover of the canopy, understorey and groundcover were also taken into account; and
- reptiles and amphibians: the availability of cover, basking sites and breeding sites.

2.1.5 *Aquatic Habitat Assessment*

Lincoln-Smith (1998) provides information on how to determine the appropriate level of investigation for aquatic ecosystems. Included in his description is a formula designed to assist in determining the level of detail required for aquatic ecological investigations. The application of this formula to the current proposal indicates that a level one investigation is appropriate. This conclusion is based on the predicted low level of disturbance, the high inertia, high stability and high

Figure 2.2 DISTRIBUTION AND EXTENT OF VEGETATION COMMUNITIES WITHIN THE STUDY AREA

resilience of the subject system (Lincoln-Smith 1998). A level one investigation includes the following:

- use of existing information and consultation with appropriate authorities; and
- site description including habitat inventory of the proposed development.

The impact of the proposed development on aquatic habitats is regarded as minor because it would not:

- create barriers to fish passage;
- significantly change physical properties of water;
- have chemical effects on water quality; or
- have biological effects on the aquatic environment, such as the introduction of new species.

As a consequence of the expected low impact of the proposed development, the impact assessment for fish was limited to a general assessment of the aquatic habitat and a desktop review of fish species likely to occur in the study area.

The evaluation of aquatic habitat involved a descriptive assessment of the habitats available at each potential impact site. The method used was similar to the habitat inventory method described by Lincoln-Smith (1998). The habitat components documented during the field survey include:

- type of waterbody (permanent or ephemeral);
- presence of a pool/riffle sequence;
- dominant substratum type (rock, gravel, silt, sand, organic material);
- abundance of snags;
- presence of and area of water surface covered by aquatic macrophytes;
- species of aquatic plant present;
- water depth range;
- width of waterbody;
- whether the stream was flowing or not; and

- presence of deep pools.

The ephemeral watercourses occurring in the study area were then graded using the criteria outlined in *Table 2.1* to assess the availability of fish habitat.

Table 2.1 PRELIMINARY STREAM CLASSIFICATION AND DESCRIPTION OF CLASSES

Class	Habitat Type	Description
1	Minimal Fish Habitat	Paddocks, escarpments, etc. unlikely to have defined channels or waterways, water will disperse immediately after rainfall.
2	Intermittent	Intermittent streams with no defined channel - not permanently flowing, may dry up completely, may lead to or from a farm dam.
3	Intermittent	intermittent streams with a defined channel - not permanently flowing, may dry up completely, may lead to or from a farm dam.
4	Semi-permanent	Semi-permanent waterway - defined channel, usually flowing, will generally retain pools (except in extreme drought).
5	Permanent	Permanent water.

Source:. S. Carter, pers. comm. cited in The Ecology Lab Pty Ltd (1998).

2.2 SURVEY RESULTS

2.2.1 *Threatened Species Known or Likely to Occur in the Study Area*

The eastern falsistrelle (*Falsistrellus tasmaniensis*) was the only threatened species recorded (tentatively) during the current surveys. Nevertheless, despite the results of the current survey, potential habitat exists within the study area for a variety of threatened species. *Table 2.2* outlines the threatened species that could potentially occur in the study area based on the presence of suitable habitat and, for some species, previous records in the locality.

Table 2.2 SUBJECT SPECIES POTENTIALLY OCCURRING WITHIN THE STUDY AREA

Common Name	Scientific Name	Preferred Habitat
Koala	*Phascolarctos cinereus*	Tall open forest to open woodland on high nutrient soils along river flats and drainage lines.
Tiger Quoll	*Dasyurus maculatus*	Wet and dry sclerophyll forest and rainforest.
Brush-tailed Phascogale	*Phascogale tapoatafa*	Dry sclerophyll forest and woodlands
Squirrel Glider	*Petaurus norfolcensis*	Dry sclerophyll forest and woodlands in dry upper slopes and ridges.
Long-nosed Potoroo	*Potorous tridactylus*	Coastal heath, dry and wet sclerophyll forests. Requires thick groundcover, prefers light sandy soils.
Large Bentwing Bat	*Miniopterus schreibersii*	Forested areas, including rainforest, particularly in well timbered valleys.
Little Bentwing Bat	*Miniopterus australis*	Forested areas, including rainforest, particularly in well timbered valleys.
Eastern Falsistrelle	*Falsistrellus tasmaniensis*	Sclerophyll forests from the Great Dividing Range to the coast.
Eastern Free-tail Bat	*Mormopterus norfolkensis*	A variety of forest types ranging from rainforest to dry sclerophyll forest and woodland.
Greater Broad-nosed Bat	*Scoteanax ruepellii*	Woodland, wet and dry sclerophyll forest and rainforest at altitudes less than 500 metres.
Yellow-bellied Sheath-tailed Bat	*Saccolaimus flaviventris*	Specific habitat requirements unknown.

Table 2.2 SUBJECT SPECIES POTENTIALLY OCCURRING WITHIN THE STUDY AREA

Common Name	Scientific Name	Preferred Habitat
Masked Owl	*Tyto novaehollandiae*	Roosting habitat - dense vegetative cover in gullies.
Powerful Owl	*Ninox strenua*	Wet and dry sclerophyll forests, particularly tall, dense eucalypt forest with a dense understorey, on hills and mountains.
Barking Owl	*Ninox connivens*	Wet and dry sclerophyll forests, particularly tall, dense eucalypt forest with a dense understorey, on hills and mountains.
Glossy Black-cockatoo	*Calyptorhyncus lathami*	Forests, woodlands, and timbered watercourses.
Square-tailed Kite	*Lophoictinia isura*	Coastal and sub-coastal open forests and woodlands.
Black Bittern	*Ixobrychus flavicollis*	Mangroves, streamside vegetation including small creeks in forests.
Osprey	*Pandion haliaetus*	Mangroves, rivers and estuaries, inshore islands, coastal islands and nearby forest.
Stephen's Banded Snake	*Hoplocephalus stephensii*	Dry and moist hardwood forest, coastal rainforest.
Pale Headed Snake	*Hoplocephalus bitorquatus*	Dry and moist hardwood forest, coastal rainforest.
Green-thighed Frog	*Litoria brevipalmata*	Wet and dry sclerophyll forest.
Rudder's Box	*Eucalyptus rudderi*	Wet and dry sclerophyll forest on sloping soil with medium fertility.

Table 2.2 SUBJECT SPECIES POTENTIALLY OCCURRING WITHIN THE STUDY AREA

Common Name	Scientific Name	Preferred Habitat
	Dodonaea megazyga	Dry sclerophyll forest, rainforest margins.

2.2.2 *Survey Timing and Weather Conditions*

Field investigations were conducted on 19 and 20 January and on 11 March, 1999. The weather conditions experienced were favourable for the undertaking of the survey, being mild to warm with little wind and no rain. A further flora survey was undertaken in early spring (20 September 1999) to enable identification of additional species during flowering.

2.2.3 *Vegetation Communities*

Based on structural characteristics and floristic composition, three plant communities have been identified within the study area. A full list of plant species identified in the study area is provided in *Appendix A*. No flora species of conservation significance were recorded during the ecological investigations.

The flora survey was as comprehensive as possible, however due to seasonality, some plant species could not be identified due to a lack of flowering or fruiting bodies. Therefore, the species list is unlikely to be exhaustive.

i. Corymbia maculata/ Eucalyptus acmenoides very tall open forest

This is the dominant plant community in the study area, extending from the ridgetop to the midslope on all aspects (*Figure 2.2*).

a. Description

Overstorey: The tallest stratum in this community is approximately 25 to 30 metres high, with a vegetative cover of approximately 45 to 50 per cent. The dominant canopy species are spotted gum (*Corymbia maculata*) and white mahogany (*Eucalyptus acmenoides*). Other commonly occurring species include ironbark (*Eucalyptus* sp.) and grey gum (*E. propinqua*). Tallowwood (*E. microcorys*) and broad-leaved white mahogany (*E. umbra*) occur intermittently in this vegetation community.

Midstorey: The midstorey strata is approximately 10 to 18 metres high, with a vegetative cover of approximately 15 to 20 percent. The mid-storey is dominated by forest oak (*Allocasuarina torulosa*) and juvenile overstorey species.

Understorey: The understorey stratum ranges in height from two to six metres, with a vegetative cover of approximately five to 15 percent. The dominant species in the understorey are juvenile forest oak (*Allocasuarina torulosa*), juvenile eucalypts, lantana (*Lantana camara*), sydney golden wattle (*Acacia longifolia*), spurge (*Phyllanthus gunnii*) and narrow-leaved geebung (*Persoonia linearis*). A number of vines and creepers grow amongst the understorey and include wombat berry (*Eustrephus latifolius*), blackberry (*Rubus hillii*), *Desmodium rhytidophyllum*, running postman (*Kennedia rubicunda*) and love creeper (*Glycine tabacina*).

Groundcover: Groundcover vegetation is approximately 50 to 70 centimetres high, with a foliage cover of 40 to 65 percent. The groundcover is dominated by a variety of herbaceous plants and includes wallaby grass (*Danthonia* sp.), kangaroo grass (*Themeda australis*), whisky grass (*Andropogon virginicus*), blue flax lily (*Dianella caerulea*) and purple flag (*Patersonia* sp.).

b. Condition

This community is dissected by a number of tracks and roads, and it appears to have been extensively logged in the past. There is limited evidence to suggest recent fires within this community. Weed species are relatively common, and include lantana (*Lantana camara*), prickly pear (*Opuntia vulgaris*), wild tobacco bush (*Solanum mauritianum*), blackberry (*Rubus hillii*) and scotch thistle (*Cirsium vulgare*). A number of garden varieties of trees have been planted on the periphery of this community including jacaranda, frangipani and pine trees.

c. Conservation Significance

This forest type is considered to be widespread throughout the coastal districts of NSW (Forestry Commission of NSW 1989). Benson and Hager (1994) identified this plant community to be poorly conserved in the north coast region, and suggested that the community would require several additional samples to be conserved before its conservation status could be considered adequate. However, extensive forest areas have recently (since 1994) been added to the NPWS estate, hence an accurate assessment of the plant community's conservation status cannot be determined until the representativeness of this plant community in new reserve areas has been determined.

Furthermore, the area of this plant community within the study area is in relatively poor condition, and is unlikely to be worthy of conservation due to previous disturbances.

ii. Eucalyptus acmenoides/ E. umbra/ E. microcorys very tall open forest;

This open forest type occurs predominantly on the sheltered lower slopes and valley in the study area (*Figure* 2.2).

a. Description

Overstorey: The tallest stratum in this community is approximately 30 to 35 metres high with a vegetative cover of approximately 60 percent. The dominant canopy species are white mahogany (*Eucalyptus acmenoides*), broad-leaved white mahogany (*E. umbra*) and tallowwood (*E. microcorys*). Other species that occur intermittently include grey gum (*E. propinqua*), Sydney blue gum (*E. saligna*) brush box (*Lophostemon confertus*), turpentine (*Syncarpia glomulifera*) and bloodwood (*Corymbia* spp.).

Midstorey: The height of the midstorey stratum varies from eight to 20 metres, with a vegetative cover of approximately 25 percent. It is dominated by forest oak

(*Allocasuarina torulosa*) and juvenile canopy species, particularly brush box and bloodwood species.

Understorey: The understorey stratum is approximately four metres high, with a foliage cover of less than ten percent. The dominant species in the understorey include juvenile forest oak (*Allocasuarina torulosa*), sydney golden wattle (*Acacia longifolia*), narrow-leaved geebung (*Persoonia linearis*), forest nightshade (*Solanum prinophyllum*), *Daviesia genistifolia* and breynia (*Breynia oblongifolia*). Apple dumplings (*Billardiera scandens*), climbing sarsparilla (*Smilax glycophylla*), twining guinea flower (*Hibbertia scandens*) and hardenbergia (*Hardenbergia violaceae*) are common vines or creepers in this community.

Groundcover: Within this community, the groundcover is approximately one metre high, with a foliage cover of 60 percent. The dominant species include mat rush (*Lomandra longifolia*) and bracken fern (*Pteridium esculentum*).

b. Condition

This community is dissected by a number of tracks and roads. Limited evidence exists of recent low intensity burning within this community. Weeds species are common and include bracken fern (*Pteridium esculentum*), purple top (*Verbena bonariensis*), fireweed (*Senecio* spp.) and balloon cotton plant (*Gomphocarpus* sp.).

c. Conservation Significance

This forest type resembles State Forest Type No. 60, which is found to above 300m in the North Coast and Central Coast regions (Forestry Commission of NSW 1989). Benson and Hager (1994) identified this plant community to be inadequately conserved throughout its range. However, extensive forest areas have recently (since 1994) been added to the NPWS estate, hence an accurate assessment of the plant community's conservation status cannot be determined until the representativeness of this plant community in new reserve areas has been determined.

iii. Grassland

The extent of this vegetation community is limited to the powerline easement, the edges of access roads and the area in the south-east portion of the site. The community is dominated by a variety of native and introduced grasses, including wallaby grass (*Danthonia* sp.), kangaroo grass (*Themeda australis*) and whisky grass (*Andropogon virginicus*). This community is in a state of disclimax due to previous clearing activities and regular maintenance slashing. Therefore, it is considered to have low conservation value.

2.2.4 *Habitat Assessment*

i. Terrestrial Habitats

There are four main habitat types within the study area. These consist of dry open forest, moist open forest, aquatic habitats (dams), and grassland. Each of these habitat types are described below according to their habitat elements and degree of naturalness.

a. Dry Open Forest

Vegetation Communities: *Corymbia maculata/Eucalyptus acmenoides* very tall open forest

Habitat Elements: The *Eucalyptus* and *Corymbia* species in the canopy of this habitat type, as well as the *Acacia* species in the understorey would provide a seasonal resource of flowers for nectivorous fauna. The results of the SEPP 44 investigation (Section 2.2.7) indicate that there are few suitable foraging resources for koalas (*Phascolarctos cinereus*) in this habitat type. The presence of *Allocasuarina* species may provide a suitable food resource for glossy black-cockatoos (*Calyptorhynchus lathami*), although no signs of feeding by this species were observed (ie. no chewed cones present).

The study area contains a moderate abundance of leaf litter that may provide suitable shelter for reptiles, as well as suitable foraging habitat for ground-dwelling birds. Rocks and fallen logs are sparse in this habitat type, hence there are minimal sheltering resources for small ground-dwelling mammals and reptiles. The sparse understorey strata would provide limited suitable habitat for small passerine birds. Mature trees with hollows are generally absent, hence there is limited roosting habitat for large hollow-roosting avifauna and arboreal mammals. Nevertheless, the presence of small hollows and decorticating bark may provide suitable roosting resources for microchiropteran bats, small hollow-roosting avifauna and arboreal mammals able to utilise small hollows (eg. squirrel gliders, sugar gliders and eastern pygmy-possums). There is unlikely to be any suitable foraging or breeding resources in this habitat type for amphibians due to a lack of permanent or ephemeral waterbodies in the vicinity.

This habitat type has been disturbed by previous logging and quarrying practices. Access tracks associated with the powerline and residential dwellings along the ridgeline are common within this habitat type. Furthermore, weeds are common throughout.

b. Moist Open Forest

Vegetation Communities: *Eucalyptus acmenoides/E. umbra/E. microcorys* very tall open forest.

Habitat Elements: The *Eucalyptus, Syncarpia, Lophostemon, Melaleuca* and *Callistemon* species in the canopy and midstorey of this habitat type would provide a seasonal resource of flowers for nectivorous fauna. The SEPP 44 investigation revealed some areas of potential koala habitat within this habitat type. However, despite a thorough search for scats and scratches, there was no evidence of this species' presence in the study area.

This habitat type contains a moderate abundance of leaf litter that may provide suitable shelter for amphibians and reptiles, as well as suitable foraging habitat for ground-dwelling birds. Furthermore, there is a moderate abundance of small to medium sized fallen logs that may provide suitable shelter for small ground-dwelling mammals and reptiles. The sparse understorey vegetation would provide limited suitable habitat for small passerine birds. Mature trees with hollows are generally absent, hence there is limited roosting habitat for large hollow-roosting avifauna and arboreal mammals. Nevertheless, the presence of small hollows and decorticating bark may provide suitable roosting resources for microchiropteran bats, small hollow-roosting avifauna and arboreal mammals able to utilise small hollows (eg. squirrel gliders, sugar gliders and eastern pygmy-possums). There are two ephemeral drainage lines that run through this habitat type that would provide suitable foraging and breeding habitat for several amphibian species.

This habitat has been impacted on previously by logging practices and road construction activities. One of the ephemeral creeks has been dammed. Past logging has resulted in canopy thinning and reduction in the density and abundance of hollow logs. Weeds are common on the forest fringe.

ii. Aquatic Habitats

a. Wetlands

There are five main dams within the study area. Two of the dams contain abundant emergent and floating vegetation that provide suitable habitat for a variety of amphibian species. These dams may also provide suitable foraging habitat for a variety of waterbird species.

b. Ephemeral Drainage Lines

When subjected to the preliminary fish habitat classification scheme devised by NSW Fisheries, all of the ephemeral drainage lines on the southern side of the ridgeline represent only minimal fish habitat. The two ephemeral drainage lines in the northern section of the study area could potentially represent intermittent fish habitat. However, only the drainage line in the north-eastern section of the study area appears to retain pools along the watercourse for any sustained time period. These pools could also provide suitable breeding and foraging habitat for amphibian species. The rocky substrate within the ephemeral drainage lines may also provide suitable shelter for a variety of reptile and amphibian species. The drainage lines assessed are shown on *Figure 2.1* with the results of the aquatic habitat assessment provided in *Appendix B*.

2.2.5 *Fauna Survey*

i. Spotlighting

A total of two native arboreal and one flying mammal species were recorded during the spotlighting surveys undertaken. These were the common brush-tailed possum (*Trichosurus vulpecula*), common ringtail possum (*Pseudocheirus peregrinus*) and the grey headed flying fox (*Pteropus poliocephalus*). Two feral species were observed, these being the fox (*Vulpes vulpes*) and the cat (*Felis cattus*). The only native terrestrial mammal recorded was the red necked wallaby (*Macropus rufogriseus*). One nocturnal bird species was observed, this species was the white-throated nightjar (*Eurostopodus mystacalis*). All of these species are considered to be common and are not listed on the Schedules of the TSC Act (1995).

ii. Avifaunal Surveys

Although the avifaunal surveys were only undertaken at dusk each day (and not sunrise), a total of 31 bird species were recorded during the ecological investigations. *Table 2.3* below lists these species. No species of conservation significance were recorded during the surveys.

Table 2.3 AVIFAUNAL SURVEY RESULTS

Common Name	Scientific Name
Common Koel	*Eudynamys scolopacea*
Pheasant Coucal	*Centropus phasianinus*
Australian Raven	*Corvus coronoides*
Australian Magpie	*Gymnorhina tibicen*
Magpie-lark	*Grallina cyanoleuca*
Laughing Kookaburra	*Dacelo novaeguineae*
White-throated Honeyeater	*Melithreptus albogularis*
Black-faced Cuckoo Shrike	*Coracina novaehollandiae*
Red Browed Finch	*Neochmia temporalis*
Grey Fantail	*Rhipidura fuliginosa*
Eastern Yellow Robin	*Eopsaltria australis*
Noisy Friarbird	*Philemon corniculatus*
Grey Butcherbird	*Cracticus torquatus*
Red Wattlebird	*Anthochaera carunculata*
Masked Lapwing	*Vanellus miles*
Superb Fairy Wren	*Malurus cyaneus*
Sacred Kingfisher	*Todiramphus sanctus*
Yellow-faced Honeyeater	*Lichenostomus chrysops*
Southern Boobook	*Ninox novaeseelandiae*
White-throated Nightjar	*Eurostopodus mystacalis*
King Parrot	*Alisterus scapularis*
Scarlet Honeyeater	*Myzomela sanguinolenta*
Green Catbird	*Ailuroedus crassirostris*
Brown Treecreeper	*Climacteris picumnus*
Noisy Miner	*Manorina melanocephala*
Grey Shrike-thrush	*Colluricincla harmonica*
Willie Wagtail	*Rhipidura leucophrys*
White-browed Scrub Wren	*Sericornis frontalis*
White-throated Needletail	*Hirundapus caudacutus*
Maned Duck	*Chenonetta jubata*
Channel Billed Cuckoo	*Scythrops novaehollandiae*

Table 2.3 AVIFAUNAL SURVEY RESULTS

Common Name	Scientific Name
Pied Currawong	*Strepera graculina*

iii. Bat Detection

The bat call analysis was conducted by Glenn Hoye of Fly-By-Night Bat Surveys Pty. Ltd. None of the calls could be confidently identified, however, four probable identifications and one possible identification were made. The four probable species include gould's wattled bat (*Chalinolobus gouldii*), chocolate wattled bat (*Chalinolobus morio*), eastern broadnosed bat (*Scotorepens orion*) and *Vespadelus* sp.. The possible species was identified as the eastern falsistrelle (*Falsistrellus tasmaniensis*). The eastern falsistrelle is currently listed as vulnerable on Schedule 2 of the TSC Act (1995).

iv. Hairtube Sampling

The hair analysis revealed multiple records of one species, this being the common brushtail possum (*Trichosurus vulpecula*). This species is considered to be common throughout a variety of habitats within the region.

v. Amphibian Survey

Amphibian surveys resulted in the detection of nine species of amphibians. These results are listed in *Table 2.4* below. All species recorded are considered to be common throughout the region.

Table 2.4 AMPHIBIAN SURVEY RESULTS

Common Name	Scientific Name	Method of Detection
Family Myobatrachidae		
Common Eastern Froglet	*Crinia signifera*	Call
Smooth Toadlet	*Uperoleia laevigata*	Call
Brown-striped Frog	*Limnodynastes peronii*	Call
Spotted Grass Frog	*Limnodynastes tasmaniensis*	Call
Family Hylidae		
Bleating Tree Frog	*Litoria dentata*	Call

Table 2.4 AMPHIBIAN SURVEY RESULTS

Common Name	Scientific Name	Method of Detection
Dwarf Tree Frog	*Litoria fallax*	Call; Capture
Broad-palmed Frog	*Litoria latopalmata*	Call
Peron's Tree Frog	*Litoria peronii*	Call; Capture
Tyler's Tree Frog	*Litoria tyleri*	Call

vi. Reptile Surveys

Reptile species recorded during the current survey include the lace monitor (*Varanus varius*) and skinks (*Lampropholis* spp.). Anecdotal evidence (discussions with quarry site manager) suggests that eastern brown snakes (*Pseudonaja textilis*) and red-bellied black snakes (*Pseudechis porphyriacus*) also occur within the study area.

vii. SEPP 44 - Koala Habitat Surveys

The koala habitat assessment results indicate that the moist open forest habitat in the study area contains *'potential koala habitat'* as outlined by Clause 7 of SEPP 44 (refer to *Table* 2.5). The abundance and diversity of tree species recorded during the SEPP 44 investigation is provided in *Appendix C.*

Table 2.5 ASSESSMENT OF POTENTIAL KOALA HABITAT

Plot Number	Koala Food Trees Upper Canopy	% Trees in Upper Canopy	Koala Food Trees Lower Canopy	% Trees in Lower Canopy	Potential Koala Habitat
1	11	55	4	50	yes
2	2	6	3	12	no
3	0	0	0	0	no
4	2	7	2	8	no

Note: Only locally preferred primary *koala food tree species were considered in this assessment (Evans & Fitzpatrick 1996).*
Location of plots shown in Figure 2.1.

Although the study area contains areas of *'potential koala habitat'* under the provisions of SEPP 44, no koala scats were found during fieldwork exercises. No scratches resembling those of koalas were identified. Evidence from the fieldwork undertaken for the core koala habitat assessment indicates that the study area does not contain *'core koala habitat'*. Nevertheless, koalas have been recorded within five kilometres of the study area in Kiwarrak State Forest.

2.3 IMPACT ASSESSMENT

The proposed development may have a variety of direct impacts upon threatened flora and fauna that potentially occur in the habitats of study area. These impacts are documented below and include consideration of the cumulative/indirect impact and likely contribution of the proposal to the threatening processes acting on populations of the subject species in the locality. The impact assessment also takes into account existing impacts on the study area, particularly those arising from the existing quarry operations and other activities which have altered the composition of vegetation communities and fauna habitats and ultimately, the composition of flora and fauna within the study area.

2.3.1 *Habitat Loss or Modification*

The direct effect of the quarry extension is the destruction and modification of wildlife habitats. Approximately 14 hectares of dry open forest and 2 hectares of moist open forest would be removed from the study area. The potential impacts of habitat modification and fragmentation on each terrestrial vertebrate class are discussed below.

i. Amphibians and Reptiles

Areas of suitable habitat for amphibians within the study area are likely to be in close vicinity of the ephemeral watercourses and dams. The proposed quarry expansion would not encroach upon the ephemeral drainage lines south of the ridge. However, it would remove approximately eight hectares from the catchment area of Bungwahl Creek (ie. four hectares removed from the two northern ephemeral creeks). One small artificial dam within the existing quarry area would also be removed.

The proposed quarry extension is expected to cause rapid displacement of a variety of common reptile species within the 1.7 hectares of forest to be cleared for the asphalt batching plant and expanded stockpile area. Reptile species would also be progressively displaced from the remainder of the quarry expansion area over a 66 year period (expected life span of the quarry).

The proposed revegetation program would ensure that suitable aquatic vegetation and sheltering resources would be provided in and around existing dam sites to provide some compensatory habitat for these species.

ii. Avifauna

The proposed quarry extension would result in the relatively small loss of habitat for most of the bird species known to occur in the study area. A small proportion of hollow resources would be lost for those bird species capable of utilising small hollows. The proposed development would result in a relatively small extension of edge effect influences into previously unaffected forest areas. The extension of edge effects may lead to changes in bird species composition by creating habitats that favour species with excellent dispersal abilities capable of invading and colonising disturbed habitats (Goosem & Marsh 1997; Laurance 1997; Andrews 1990).

Studies have shown that increased forest edges can potentially increase the rates of nesting failure for some species due to nests being more accessible to predators (eg. currawongs) or nest competitors (eg. cuckoos) (Andrews 1990). Conversely, a study by Taylor and Ford (1998) found that there was no significant increase in the rate of predation between artificial nests placed near the edges of woodland and artificial nests placed in the centre of fragment habitat. Nevertheless, further research of this issue is required in Australia, hence increases in nesting failure due to edge effects may still be a significant impact depending on the bird species, habitat type and size of remnant vegetation.

iii. Non-flying Mammals

The proposed quarry extension would remove nectar resources for arboreal species, and hollow resources for those species capable of utilising small hollows. Very few large hollows would be removed. The proposal would also remove ground hollow resources for small terrestrial mammals, as well as a small proportion of larger ground hollows used by medium to large terrestrial mammals.

The proposed quarry extension is likely to displace some small terrestrial mammal species with relatively small home ranges. However, the proposed revegetation east of the study area would most likely provide some compensatory habitat for these species. It is recommended that suitable sheltering resources be placed within the proposed revegetated corridor to encourage recolonisation by displaced individuals.

The encroachment of edge effects into previously undisturbed forest areas may cause permanent displacement of some forest species by more competitive edge specialist species. A study by Goosem and Marsh (1997) found that edge effects associated with fragmentation caused by a powerline through tropical rainforest enabled grassland specialist species (*Melomys burtoni* and *Rattus sordidus*) to replace rainforest specialist species (*Uromys caudimaculatus* and *Melomys cervinipes*) within the easement and adjacent forest areas. However, due to the current level of disturbance and open nature of the vegetation communities in the study area such effects are not expected to be significant.

iv. Megachiropteran and Microchiropteran Bats

All habitats within the study area are likely to represent foraging habitat for bats, particularly microchiropteran species. The proposed quarry extension has the potential to cause a very slight reduction in foraging resources for open forest/woodland foragers.

The open forest types in the study area contain a moderate abundance of small tree hollows and bark shedding tree species. The proposed quarry extension would result in the loss of sheltering habitat for those species that utilise tree hollows and shedding bark for roosting purposes.

2.3.2 *Interference with Fauna Movement*

A potential wildlife corridor currently extends in a north to south direction between the existing quarry area and the semi-cleared farmland in the east of the study area. The proposed development would progressively remove a proportion of this potential wildlife corridor over a minimum 66 year period. Fauna movement between these areas would then be restricted to either semi-cleared vegetation east of the study area, or to a relatively long narrow strip of remnant vegetation between the quarry and the Pacific Highway.

Therefore, in order to minimise the loss of wildlife corridor function in this area, the strip of semi-cleared vegetation retained in the east of the study area would be revegetated (minimum width 220 metres). The first stage of the quarry expansion would be in the western portion of the subject site, hence the revegetation program would be at an advanced stage prior to the existing potential habitat corridor being reduced in size.

2.3.3 *Road Strike*

The roads within the existing quarry site are unlikely to have a significant level of impact on the major fauna groups due to the low speed of traffic utilising the roads, and limited operating hours of the quarry, which are proposed to be from 6.00 am to 6.00 pm. No new roads would be constructed within the study area.

Bats and most bird species are highly mobile and can usually cross roads with minimal chance of injury from moving vehicles. A very small number of bird mortalities could potentially result from individuals being attracted to additional food sources associated with the roads (eg. seeding grasses) (Bennett 1991). However, the incidence of road strike is unlikely to significantly increase due to the proposal.

Arboreal mammal species that do not travel on the ground would still be capable of crossing roads (in forest areas) within the study area due to relatively narrow road widths, retention of mature trees and limited hours of quarry operation (no night traffic). Some species of small terrestrial mammals may already be incapable of crossing existing quarry roads due most likely to fear of predation (Hunt *et al*. 1987). However, no additional roads are proposed to be built, hence there is unlikely to be an increased risk of road strike.

High rates of amphibian mortality have been recorded when local populations are isolated from breeding sites by roads (Gibbs 1998). The proposed quarry expansion would not result in further isolation of potential breeding sites within the study area.

Due to the low speed of quarry traffic and limited hours of operation very few medium to large terrestrial mammals are likely to be struck on the quarry roads.

2.3.4 Noise

There is little relevant information relating to the effects of noise on Australian wildlife. The majority of published data refers to American or domestic fauna, and are frequently inconclusive and even contradictory (Shaw, 1978). Few, if any of the suggested effects of noise benefit animals or increase the chances of species' survival (Shaw, 1978).

Lee and Griffith (1978) report that the main effects of noise on American wildlife are behavioural changes leading to modifications in mating, loss of food supply for predators, changes in inter-specific relationships (predator/prey) and competition for shelter. The main reasons these impacts occur are due to impacts on hearing, communication, non-auditory physiological effects and behavioural changes.

A large number of fauna species seem to adapt well to human presence and associated noise (Busnel 1978). In fact, some species of rats, mice, crows, pigeons, starlings and seagulls have been known to take advantage of human activities by tolerating extremely loud human noise (Busnel, 1978). Nevertheless, threatened fauna species could potentially be sensitive to such human disturbances. Very little research has been carried out on the impacts of noise on Australian fauna species, which is an issue worthy of further investigation.

Noise associated with the existing quarry operation (eg. machinery, blasting) may have already caused a significant reduction in the utilisation of habitats in the immediate vicinity of the quarry by shy individuals or species. Noise could potentially disrupt species while feeding, thus reducing their foraging times within noise-affected areas.

The effects of noise on habitats further away from the quarry are unknown. It is possible that they are more of a temporary nature due to species becoming habituated to background noises.

The proposed quarry expansion would result in slightly increased noise levels due mainly to the proposed increase in utilisation of existing machinery on-site. However, such increases are unlikely to cause a significant disruption to the lifecycle of any species utilising habitats within the study area.

2.3.5 *Direct Blasting Effects*

Blasting may have the potential to cause an impact upon fauna through injury or death caused by flyrock. However, if the charge is set correctly and properly managed there should be no, or very minimal, flyrock resulting. This impact is therefore expected to be negligible on species survival. Direct blasting effects will be minimised due to all blasting occurring during daylight hours, as the majority of fauna species are nocturnal, sheltering under rocks or in hollows during the day.

2.3.6 *Water Quality*

Increases in sediment loads can affect a stream ecosystem far downstream from the actual site of erosion (Bennett 1991). Aquatic communities are sensitive to sedimentation as it blankets rocky crevices and stream beds and alters microhabitats of invertebrates and the spawning sites of fish (Bennett 1991). However, the quarry operations will meet the current EPA requirements for creek sediment loads.

The network of drainage lines within the study area ultimately lead to the Wallamba River. Five main dams exist in the study area, two of which currently act as sediment control dams. One of these is located just south of the primary crusher, and the other just north of the weighbridge. The latter one is the main sediment control dam for all runoff from the stockpile area. Stormwater from this dam overflows in a controlled fashion into the creek. From the dam, water flows through the creek for approximately 300 metres before it leaves the site. Water discharge off company owned land currently complies with EPA requirements.

As part of the proposed quarry expansion, additional measures would be implemented to maintain required water quality standards. Proposed measures would include the construction of a sump in the floor of the quarry pit to catch all water from the disturbed areas, and an increase in the size (retention time) of the main sediment control dam.

The water quality of water discharged off company owned land would continue to comply with current EPA requirements.

2.4 MITIGATION MEASURES

Mitigation measures have been formulated to minimise or prevent the potential impacts of the proposed development on the subject species and their habitats.

i. Revegetation of Disturbed Areas

Ongoing revegetation of benches visible to travellers on the Pacific Highway will be conducted after each stage is complete. Although this is being undertaken primarily to reduce the visual impact of the quarry, it will also contribute to replacing some of the fauna habitat removed during quarry expansion. Furthermore, after the life of the quarry has expired all site facility areas, stockpile areas and overburden areas will be revegetated.

ii. Sediment Control

A series of mitigation measures to address pollution control would be implemented to ensure that any disruption to viable local fish populations would be minimised. These mitigation measures are detailed in section 3.10.3 of the EIS and include:

- installation of erosion and sediment controls prior to any soil disturbance, including clean water diversion drains and sediment dams downstream of disturbed areas;
- installation of erosion and sediment controls around the overburden stockpile area; and
- the stockpiling of vegetation removed during construction activities for later use in erosion control and stabilisation of disturbed areas.

iii. Enhancement of Potential Wildlife Corridors (ie. revegetation program)

Semi-cleared land east of the eastern quarry boundary will be revegetated in order to enhance a potential movement corridor for fauna between forested communities north and south of the study area (refer to EIS *Figure 3.10*). The area to be revegetated will consist of a 220 metre (minimum width) wide strip of vegetation running north to south. The plant species used for revegetation will be based on those occurring naturally within surrounding undisturbed areas of vegetation. The plant species used will vary within the rehabilitation site depending on elevation and aspect to simulate any natural changes evident in surrounding areas of natural vegetation.

A dam site located within the proposed wildlife corridor, approximately 100 metres south-east of the eastern quarry boundary, will be incorporated into the rehabilitation site. Emergent aquatic vegetation will be planted in suitable areas of the dam, and terrestrial shelter (ie. rocks and logs) will be placed around the dam edges to provide suitable habitat resources for amphibians, reptiles and small terrestrial mammals.

A strip of cleared land (approximately 200m x 20m) along the southern edge of the access road would also be revegeted at the beginning of the proposed quarry expansion to enhance the potential wildlife corridor function of remnant vegetation between the Pacific Highway and the study area.

iv. Limited hours of operation

The operating hours of the Jandra quarry would be 6.00 am to 6.00 pm Monday to Friday, and 6.00 am to 3.00 pm on Saturday. The limited operating hours would significantly reduce the likelihood of roadstrike on nocturnally active species within the study area due to their low activity levels during the operating periods.

Chapter 3

EIGHT PART TESTS OF SIGNIFICANCE

3.1 TERRESTRIAL EIGHT PART TEST OF SIGNIFICANCE

The TSC Act commenced on 1 January 1996, and replaced the legislative scheme introduced by the *Endangered Fauna (Interim Protection Act)* (1991). The TSC Act made substantial amendments to the *National Parks and Wildlife Act* (1974) (NPW Act) and the *Environmental Planning and Assessment Act (1979)* (EP&A Act). Section 5A of the EP&A Act sets out eight factors to be considered in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats.

When undertaking the eight part test, a number of flora and fauna species have been considered. *Table 3.1* lists these species and their likelihood of occurrence based on habitat preference, known occurrence in the locality and NPWS Atlas of Wildlife recordings for the Bulahdelah and Wingham 1:100,000 topographic map sheets.

Table 3.1 THREATENED TERRESTRIAL FLORA AND FAUNA SPECIES POTENTIALLY OCCURRING IN THE STUDY AREA

Common Name	Scientific Name	Likelihood of Occurrence in the Subject Site	Likely Sensitivity to Disturbance from Proposal
Koala	*Phascolarctos cinereus*	Moderate to high. Has been recorded within the locality (3 km from site) and limited suitable habitat exists in the subject site.	Low - no levels of activity recorded during surveys. Better quality habitat in surrounding areas.
Tiger Quoll	*Dasyurus maculatus*	High. Has been recorded in the locality and suitable foraging habitat exists within the subject site.	Low - den sites unlikely to occur on site, extensive suitable habitat to be retained in locality.
Brush-tailed Phascogale	*Phascogale tapoatafa*	High. Has been recorded within the locality and suitable habitat for the species exists within the subject site.	Low to Moderate - potential foraging habitat would be removed.
Squirrel Glider	*Petaurus norfolcensis*	High. Has been recorded within the locality and suitable habitat for the species exists within the subject site.	Low to Moderate - potential foraging and roosting habitat would be removed.
Long-nosed Potoroo	*Potorous tridactylus*	Moderate. Has not been recorded in the locality and only sub-optimal habitat exists within the subject site.	Low - potential foraging habitat would be removed.
Common Bent-wing Bat	*Miniopterus schreibersii*	Moderate to high. Has not been recorded in the locality, but suitable habitat exists within	Low - small portion of potential foraging

Table 3.1 THREATENED TERRESTRIAL FLORA AND FAUNA SPECIES POTENTIALLY OCCURRING IN THE STUDY AREA

Common Name	Scientific Name	Likelihood of Occurrence in the Subject Site	Likely Sensitivity to Disturbance from Proposal
		the subject site.	and roosting habitat would be removed.
Little Bent-wing Bat	*Miniopterus australis*	High. Has been recorded within the locality and suitable habitat for the species exists within the subject site.	Low - small portion of potential foraging and roosting habitat would be removed.
Eastern Freetail-Bat	*Mormopterus norfolkensis*	Moderate to high. Has not been recorded in the locality, but suitable habitat exists within the subject site.	Low - small portion of potential foraging and roosting habitat would be removed.
Greater Broad-nosed Bat	*Scoteanax rueppellii*	Moderate to high. Has not been recorded in the locality, but suitable habitat exists within the subject site.	Low - small portion of potential foraging and roosting habitat would be removed.
Yellow-bellied Sheathtail Bat	*Saccolaimus flaviventris*	Moderate. Has not been recorded in the locality, however suitable habitat for the species potentially exists within the subject site.	Low - small portion of potential foraging and roosting habitat would be removed.
Large-footed Myotis	*Myotis adversus*	High - has been recorded in the locality, suitable foraging habitat in study area.	Low - small loss of potential roosting habitat.
Masked Owl	*Tyto novaehollandiae*	High. Has been recorded within the locality and the subject site contains suitable	Low - minor loss of potential foraging

Table 3.1 THREATENED TERRESTRIAL FLORA AND FAUNA SPECIES POTENTIALLY OCCURRING IN THE STUDY AREA

Common Name	Scientific Name	Likelihood of Occurrence in the Subject Site	Likely Sensitivity to Disturbance from Proposal
		foraging habitat.	habitat.
Powerful Owl	*Ninox strenua*	High. Has been recorded within the locality and the subject site contains suitable foraging habitat.	Low - minor loss of potential foraging habitat.
Barking Owl	*Ninox connivens*	Moderate to high. Suitable foraging habitat exists within the subject site.	Low - minor loss of potential foraging habitat.
Glossy Black-cockatoo	*Calyptorhynchus lathami*	High. The species has been recorded in the locality and suitable foraging habitat exists within the subject site.	Low - minor loss of potential foraging habitat
Square-tailed Kite	*Lophoictinia isura*	High - previously recorded in the locality suitable foraging habitat exists on site.	Low - minor loss of potential foraging habitat.
Black Bittern	*Ixobrychus flavicollis*	Moderate. The species has been recorded within the locality, however only sub-optimal habitat exists within the subject site.	Low - no loss of breeding habitat, minimal loss of potential foraging habitat.
Stephen's Banded Snake	*Hoplocephalus stephensii*	Low to moderate - sub-optimal habitat on site, not previously recorded in the locality.	Low - small area of potential habitat to be removed.

Table 3.1 THREATENED TERRESTRIAL FLORA AND FAUNA SPECIES POTENTIALLY OCCURRING IN THE STUDY AREA

Common Name	Scientific Name	Likelihood of Occurrence in the Subject Site	Likely Sensitivity to Disturbance from Proposal
Pale-headed Snake	*Hoplocephalus bitorquatus*	Low to moderate - sub-optimal habitat on site, not previously recorded in the locality.	Low - small area of potential habitat to be removed.
Green-thighed Frog	*Litoria brevipalmata*	Low to moderate. No records in the sub-region, suitable habitat on site.	Low - minimal impact on potential habitat for this species.
Rudder's Box	*Eucalyptus rudderi*	Moderate - suitable habitat on site, previously recorded in the locality, however, not recorded during current survey.	Low - the species was not recorded during the current survey, hence if it does occur, very few individuals would be removed. The species would be used during revegetation programs.

a *in the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction;*

No threatened plant species were recorded during the ecological investigations, however suitable habitat does exist in the study area for the RoTAP species rudder's box (*Eucalyptus rudderi*). The subject site has been thoroughly surveyed in order to detect this plant species, however, none have been observed. If this species does occur on the subject site, it is unlikely that the activity would cause the extinction of a viable local population due to the extent of similar vegetation communities and habitats in the locality, particularly within Kiwarrak State Forest.

The ecological investigations revealed that limited areas of potential koala habitat exist in the study area. Furthermore, despite the level of survey effort (ie. spotlighting and scat searches) no koalas (*Phascolarctos cinereus*) were observed, and no other evidence of the species (ie. scratches or scats) was located during the current survey. Furthermore, the proposed development would remove only a relatively small proportion of the potential feeding resources for this species from the locality. Therefore, the proposed development is unlikely to disrupt the lifecycle of this species such that a viable local population would be placed at risk of extinction.

The tiger quoll (*Dasyurus maculatus*) could potentially utilise the habitats in the subject site as a foraging resource within an extensive home range. Potential den sites are unlikely to occur within the subject site due to a paucity of hollow logs or caves that the species requires for breeding (State Forests of NSW 1995). It is unlikely that the proposed quarry expansion would remove or isolate significant areas of foraging habitat for the species. Furthermore, *D. maculata* has been recorded within Kiwarrak State Forest, which is likely to contain extensive areas of suitable habitat for the species. Therefore, the proposed development is unlikely to contribute to the extinction of a viable local population of the species.

The proposed quarry expansion would remove approximately 10.5 hectares of potential foraging habitat from the study area for the brush-tailed phascogale (*Phascogale tapoatafa*). Research by Rhind (1996) in Western Australia indicates that the preferred nesting trees of the species are usually dead, or have a diameter of more than 85 centimetres. Nesting females also require hollows with spacious internal cavities (nest is over 30 times larger than the female) (Rhind 1996; Soderquist 1995). Very few dead or large trees (more than 85 centimetres diameter) are located in the subject site. Therefore, the proposed quarry expansion would be unlikely remove a significant proportion of suitable roosting or breeding hollows for the species. Furthermore, large tracts of relatively undisturbed forest containing known habitat for the species would be retained within Kiwarrak State Forest, where the species has been recorded at several locations including Cow Hill, Turragurry Gully and Dennes Creek. Therefore, the proposed quarry expansion is unlikely to have a significant impact on viable local populations of this species.

The squirrel glider (*Petaurus norfolcensis*) prefers mature forests or mixed aged stands of eucalypts with an abundant supply of nectar, pollen, eucalypt sap, *Acacia* gum, honeydew and arthropods (State Forests of NSW 1995). The forest types within the subject site are unlikely to represent a significant foraging resource for the species due to the presence of relatively immature forest (resulting from previous logging practices), and a lack of dense stands of acacias or banksias within the subject site to provide additional food resources.

There is very little data available regarding preferred den characteristics of squirrel gliders (Gibbons & Lindenmayer 1997). However, the species has been recorded using living trees, dead trees and hollow stumps as den sites (Gibbons & Lindenmayer 1997). Very few large living trees, dead trees or hollow stumps occur in the subject site, hence there appears to be a paucity of suitable sheltering resources for the species. Therefore, habitats within the subject site are unlikely to represent significant habitat for the species, hence the proposed development would be unlikely to cause the extinction of a viable local population of the squirrel glider.

In NSW the long-nosed potoroo (*Potorous tridactylus*) has been recorded in rainforest, moist hardwood forest, woodland with dry heath understorey, wet heaths, dense coastal scrubs and mixed species open-forest (Seebeck *et al.* 1989). The denser vegetation types are utilised as a sheltering resource, while the surrounding wet sclerophyll forests and open vegetation types are utilised as foraging resources (Seebeck *et al.* 1989). The species appears to avoid virgin rainforest in preference for the ecotone between rainforest and moist open forest (Seebeck *et al.* 1989). The species may utilise the subject site as part of its floristically diverse foraging habitat. Although suitable sheltering habitat exists within the southern portions of the study area, only limited sheltering habitat exists within the subject site. The proposed development is therefore likely to result in the removal of a small portion of potential roosting and foraging habitat for the species. However, the long-nosed potoroo is a highly mobile species, and extensive areas of suitable habitat exist within the locality. Therefore, it is unlikely that the impacts associated with the proposed development would disrupt the lifecycle of the species to the extent that a viable local population of the species would be placed at risk of extinction.

Habitat within the study area may provide a foraging resource for a variety of threatened bat species including the yellow-bellied sheathtail bat (*Saccolaimus flaviventris*), large bent-wing bat (*Miniopterus schreibersii*), little bent-wing bat (*Miniopterus australis*), greater broad-nosed bat (*Scoteanax rueppellii*), large-footed myotis (*Myotis adversus*) and the eastern freetail-bat (*Mormopterus norfolkensis*). The bent-wing bats and the large-footed myotis are primarily cave-dwelling species that require caves or similar structures for breeding (Churchill 1998), hence the study area does not contain suitable breeding habitat for these species. However, suitable roosting habitat for all species does exist on site in the form of small tree hollows and trees with decorticating bark (Churchill 1998). All of these species appear to utilise a wide variety of habitat types ranging from rainforest to dry sclerophyll forest and open woodland (Churchill 1998). All of these species are highly mobile, and extensive suitable roosting and foraging resources are likely to exist in surrounding areas. Therefore, the proposed development has the potential to modify a relatively small area of suitable foraging habitat and remove some roosting resources for these species, however, not the extent that viable local populations would be placed at risk of extinction.

There are very few hollow bearing trees within the study area that represent suitable roosting or nesting resources for the masked owl (*Tyto novaehollandiae*), barking owl (*Ninox connivens*) or the powerful owl (*Ninox strenua*). These threatened owl species may however utilise the habitats of the subject site as a foraging resource within an extensive home range. Furthermore, large areas of suitable foraging habitat are likely to exist within adjacent forests and woodlands. Therefore, the proposed quarry expansion is likely to remove only a small portion of foraging habitat hence it is unlikely to contribute to the extinction of a viable local population of these species.

Although potential foraging resources for the glossy black-cockatoo (*Calyptorhyncus lathami*) exist within the study area, these resources represent only a small fraction of the potential foraging resources available for this species in the locality. Due to there being a lack of medium to large hollows over the study area, the site is unlikely to be utilised for breeding purposes by the species. Nevertheless, the proposed development could potentially degrade the quality of foraging habitat for this species within the study area, but not to the extent that a viable local population of the species would be placed at risk of extinction.

The square-tailed kite (*Lophoictinia isura*) appears to utilise a wide variety of structurally diverse habitat types including eucalypt forest and woodland, mallee, heath and scrubby habitats (Garnett 1993; State Forests of NSW 1995). The species does not seem to have any specific nesting requirements, other than living trees within tall eucalypt forest. Therefore, extensive areas of potential foraging and nesting habitat in the form of dry open forest and woodland exist within the locality for the species. The subject site represents only a very small fraction of potential foraging and roosting habitat for this species in the locality. The proposed development could potentially degrade the quality of foraging and roosting habitat for the species within the subject site, however, not to the extent that a viable local population of the species would be placed at risk of extinction.

The black bittern (*Ixobrychus flavicollis*) occurs in thick vegetation at margins of watercourses, swamps, billabongs, mudflats and mangroves in tidal creeks and rivers. Denser vegetation along the margins of the ephemeral watercourses in the north of the study area may provide suitable foraging habitat for the species. The proposed quarry expansion would not encroach on these denser vegetated areas. Critical breeding habitat for the black bittern usually consists of mangrove belts along coastal waterways and densely vegetated wetlands (State Forests of NSW 1995). Habitats within the study area are unlikely to represent suitable breeding habitat for the species, nevertheless, areas of dense riparian vegetation would not be subject to direct disturbance by the proposed quarry expansion.

The stephen's banded and pale-headed snakes (*Hoplocephalus*) inhabit a variety of habitat types including dry rainforest, sub-tropical rainforest, wet sclerophyll forest, dry sclerophyll forest and rock outcrops (Gilmore and Parnaby 1994). In terms of sheltering resources, these species utilise gaps underneath decorticating bark on trees, hollow trunks and limbs of dead trees, or gaps within exfoliating rock outcrops (Gilmore and Parnaby 1994; State Forests of NSW 1995). The subject site does not contain significant areas of exfoliating rock or trees (living or dead) with hollow trunks and limbs. There are some trees with decorticating bark within the subject site that may provide sheltering resources for these species. However, other areas containing suitable sheltering and foraging resources exist within the study area and surrounding areas. Therefore, although the proposed quarry expansion would remove a relatively small portion of potential sheltering habitat from the study area, the impacts of this removal would be unlikely to have a significant impact on viable local populations of these species.

In terms of foraging resources, the *Hoplocephalus* species are nocturnally active, and hunt for tree frogs, lizards, birds and small mammals usually within the dense shrub understorey and groundcover layers. Potential foraging habitat for these species is likely to occur within the relatively dense riparian vegetation along the ephemeral watercourses in the north of the study area. These areas of dense riparian vegetation would not be disturbed by the proposed quarry expansion, hence no significant impact on local populations of these species is expected.

The green-thighed frog (*Litoria brevipalmata*) is known to inhabit primarily rainforest and wet sclerophyll forest (Cogger 1996). However, it has also been recorded in dry open forest and coastal swamp forest. Studies by Lemckert *et al.* (1997) suggest that the species prefers to live in areas of moist forest with both a deep and moist leaf litter and a complex and dense understorey. Potential habitat for this species in the study area is likely to be associated with dense vegetation around the two large permanent dams. It is proposed to use these two dams for emergency water supplies primarily for dust suppression on quarry roads. Access to these dams by water trucks and pumps would be restricted to existing tracks, hence there would be minimal disturbance to the vegetation around the dams. Furthermore, water would be retained in these dams at all times. Therefore, the proposed quarry expansion would be unlikely to disturb the lifecycle of the green-thighed frog to the extent that a viable local population would be placed at risk of extinction.

b *in the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised;*

No relevant endangered populations of native fauna and flora (as listed on Part 2 of Schedule 1 of the TSC Act) occur within the study area.

c *in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed;*

Other than the possible recording of the eastern falsistrelle (*Falsistrellus tasmaniensis*), the study area does not currently represent known habitat for any threatened species. Nevertheless, formal conservation reserves and State Forests make up approximately 39 percent (2.4 million hectares) of land contained within the NSW North Coast region (6 million hectares). A large proportion of this 39 percent consists of habitat types dominated by eucalypt species such as those within the study area. Hence, in a regional context the habitats within the subject site are relatively common and widespread. Within the locality there is approximately 9400 hectares of forest contained in Kiwarrak State Forest alone. Extensive areas of forest also occur on private land within the locality. The proposed quarry expansion would remove approximately 8.8 hectares (16.3 percent) of dry open forest and 1.7 hectares (five percent) of moist open forest from the study area. The study area contains approximately 54 hectares of dry open forest and 34.5 hectares of moist open forest. The proposed clearing would amount to a cumulative loss of forest habitat of less than 0.1 percent within the locality. The area of habitat to be removed is unlikely to represent a significant area of habitat for threatened flora or fauna species.

d *whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community;*

A potential wildlife corridor currently extends in a north to south direction between the existing quarry area and the semi-cleared farmland in the east of the study area. Although the potential corridor has been completely cut by a light vehicle access track and powerline easements, it is likely to still function as a corridor for a variety of more mobile species such as birds, flying mammals and medium to large terrestrial fauna.

The proposed development would progressively remove a large proportion of this potential wildlife corridor over a period of 60 years. The main impact on the potential corridor would during Stage 3 of the quarry expansion, which would take place in at least 40 years time. If the proposed mitigation measures were not implemented then fauna movement between these areas may then be restricted to either semi-cleared vegetation east of the study area, or to a relatively long narrow strip of remnant vegetation between the quarry and the Pacific Highway.

In order to minimise the potential loss of wildlife corridor function in this area a strip of semi-cleared vegetation retained on the farmland in the east of the study area (minimum width 220 metres) would be revegetated. The revegetation program for this area would commence at the beginning of the proposed quarry expansion. Stage 1 of the proposed expansion would take at least 20 years to complete, and would not encroach upon the potential wildlife corridor. Stage 2 would take at least an additional 20 years to complete, and would remove approximately half of the potential wildlife corridor. Therefore, the proposed revegetation corridor would have at least 40 years to establish prior to the potential habitat corridor being cut, hence the revegetated area would be at an advanced (mature) stage prior to the potential loss of corridor function.

Furthermore, a strip of cleared land (approximately 200m x 20m) along the southern edge of the access road would also be revegeted at the beginning of the proposed quarry expansion to enhance the potential wildlife corridor function of remnant vegetation between the Pacific Highway and the study area.

e *whether critical habitat will be affected;*

At the time of report production no relevant "critical habitat" had been declared by the Director General of NSW NPWS. Therefore, the impact associated with the proposed activities on critical habitat could not be assessed.

f *whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region;*

In 1997, conservation reserves covered an area of approximately 5,752,738 hectares within the NSW North Coast region (EPA 1997). Extensive areas have since been dedicated as conservation reserves in the region, however, the total size of these new areas was not available during the preparation of this report. All of the potentially occurring threatened species within the study area would be represented within existing conservation reserves (and other similar protected areas). However, due to particular habitat requirements, large home ranges and/or sparse distributions a significant proportion of these species cannot be considered to be adequately represented within existing conservation reserves (and other similar protected areas).

g *whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process;*

The proposed activity is not specifically recognised as a key threatening process on Schedule 3 of the TSC Act. However, the removal of habitat is an activity that is likely to be recognised by the scientific community as potentially detrimental to certain species or their habitats. Nevertheless, given the disturbed nature of habitats within the subject site, the extent of proposed habitat removal and the types of mitigation measures proposed, the impact of the proposed quarry expansion is unlikely to have a significant impact on threatened species or their habitats.

h *whether any species, population or ecological community is at the limit of its known distribution.*

None of the threatened species potentially occurring within the study area would be at the limit of their known distribution.

3.1.1 *Conclusion*

The study area does provide suitable habitat for a number of threatened species. However, the vegetation communities within the study area have been degraded through previous disturbances from quarry activities, timber harvesting, rural residential development and road and powerline easement construction. The extent of proposed habitat removal on site is unlikely to significantly impact on threatened species likely to occur. Part of the study area could potentially represent a fauna movement corridor between forest areas to the north and south of the study area. However, the proposed revegetation program and staged expansion of the quarry from the western side of the subject site should ensure the maintenance of the potential corridor function between these forest areas.

Based on the eight factors considered above, it is highly unlikely that the proposed development would cause a significant impact on threatened species potentially occurring within the study area.

3.2 AQUATIC EIGHT PART TEST OF SIGNIFICANCE

3.2.1 *Background*

NSW Fisheries legislation has recently been strengthened with the inclusion of Threatened Species Conservation provisions to declare and list threatened species of fish and marine vegetation, endangered populations and ecological communities and key threatening processes. These provisions mirror those in the *Threatened Species Conservation Act* (1995) (administered by NSW NPWS), and must be considered when referring to Section 5A of the *Environmental Planning and Assessment Act* (1979) (EPA Act).

The Fisheries Management Act 1994, as amended by the Fisheries Management Amendment 1997, has the following objectives in terms of the protection of threatened species and their habitats:

a. to conserve biological diversity of fish and marine vegetation and promote ecologically sustainable development;

b. to prevent the extinction and promote the recovery of threatened species, populations and ecological communities of fish and marine vegetation;

c. to protect the critical habitat of those threatened species, populations and ecological communities that are endangered;

d. to eliminate or manage certain processes that threaten the survival or evolutionary development of threatened species, populations and ecological communities of fish and marine vegetation;

e. to ensure that the impact of any action affecting threatened species, populations and ecological communities of fish and marine vegetation is properly assessed; and

f. to encourage the conservation of threatened species, populations and ecological communities of fish and marine vegetation by the adoption of measures involving cooperative management.

ERM has undertaken an Eight Part Test of Significance as defined in Section 5A of the *Environmental Planning and Assessment Act,* 1979 (EP&A Act). The Eight Part Test was undertaken to specifically assess whether the proposed extensions to the Jandra Quarry is likely to have a significant effect on threatened fish species, populations or ecological communities, or their habitats that may occur within the study area.

3.2.2 *Factors for Consideration*

a *in the case of a threatened species whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction;*

None of the species currently listed as Endangered or Vulnerable in the *Fisheries Management Amendment Act* (1997) are likely to occur in the ephemeral drainage lines surveyed. Therefore, the lifecycle of any threatened fish species is highly unlikely to be disrupted by the proposed development such that a viable local population of the species would be placed at risk of extinction.

A series of mitigation measures to address pollution control would be implemented to ensure that any disruption to viable local fish populations would be minimised. These mitigation measures include:

- installation of erosion and sediment controls prior to any soil disturbance, including clean water diversion drains, sediment basins in gully systems and catch drains to divert runoff from disturbed areas to the basins;
- construction of diversion drains along the ridge lines around and beside the excavation site to ensure that clean rainfall runoff drains around the zone of disturbance;
- the provision of sedimentation basins and controls on all diversion drains;
- the establishment of sedimentation drains down slope of the excavation area to retain all runoff from disturbed areas;
- installation of erosion and sediment controls around the site of the stockpiled excavation material; and
- the mulching and stockpiling of vegetation removed during construction activities for later use in erosion control and stabilisation of disturbed areas.

b ***in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised;***

There are currently no endangered fish populations listed on the *Fisheries Management Amendment Act* (1997).

c ***in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed;***

No known habitat for species currently listed as Endangered or Vulnerable on the *Fisheries Management Amendment Act* (1997) exists within the watercourses located in the study area.

d ***whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community;***

The ephemeral watercourses within the study area are not recognised as known habitat for any species currently listed as Endangered or Vulnerable on the *Fisheries Management Amendment Act* (1997). Furthermore, the proposed development would remove a small section of the initial headwaters of Bungwahl Creek, hence, in effect, shortening the waterway rather than cutting it.

e ***whether critical habitat will be affected;***

There are currently no areas of critical habitat listed on the *Fisheries Management Amendment Act* (1997).

f ***whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region;***

At present, NSW Fisheries have declared eight Aquatic Reserves, and one marine protected area within NSW (NSW Fisheries 1998). However, these reserves cover predominantly marine and estuarine habitats and are unlikely to adequately represent threatened species, populations or ecological communities, or their habitats in the region.

However, there are extensive numbers of waterways similar to that within the study area existing within State Forests in the region. For the purposes of this report waterways within State Forests are considered to be *other similar protected areas* due to the level of protection offered to these forested areas and associated waterways under current State Forests of NSW management practices. Therefore, aquatic habitat to be removed by the proposed development is likely to be adequately reserved in the region.

g ***whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process;***

The proposed activity is not specifically recognised as a threatening process on the *Fisheries Management Amendment Act* (1997). However, if the proposed activity is not conducted in accordance with adequate mitigation measures it is likely to be recognised by the scientific community as potentially detrimental to certain species and their habitats.

h ***whether any threatened species, population or ecological community is at the limit of its known distribution.***

The study area is not within the known distribution of any of the species currently listed as Endangered or Vulnerable on the *Fisheries Management Amendment Act* (1997).

3.3 CONCLUSIONS

Based on the eight factors considered above, it is highly unlikely that the proposed development would cause any adverse effect on threatened fish species, fish populations or their habitats.

The best practice methods available would be used to mitigate the potential water quality impacts of the proposed quarry extension. The adoption of best practice methods effectively promotes ecologically sustainable development and minimises processes that threaten the survival or evolutionary development of threatened species, populations and ecological communities of fish and marine vegetation.

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APPENDICES

Appendix A

FLORA SPECIES LIST

APPENDIX A: FLORA SPECIES RECORDED

Family	Scientific Name	Common Name
Asclepiadaceae	*Gomphocarpus fruticosa*	Balloon Cotton Plant
Asteliaceae	*Cordyline stricta*	Palm Lily
Asteraceae	*Ageratina adenophora*	Crofton Weed
	Bidens pilosa	Farmer's Friends
	Cirsium vulgare	Scotch Thistle
	Olearia viscidula	Wallaby Weed
	Senecio madagascariensis	Fireweed
	Tagetes minuta	Stinking Roger
Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine
Cactaceae	*Opuntia stricta*	Prickly Pear
Caesalpinioidaceae	*Senna coluteoides*	Cassia
Casuarinaceae	*Allocasuarina littoralis*	Black She Oak
	Allocasuarina torulosa	Forest Oak
Commelinaceae	*Commelina cyanea*	Wandering Jew
Dennstaedtiaceae	*Pteridium esculentum*	Bracken Fern
Dicksoniaceae	*Calochlaena dubia*	False Bracken Fern
Dilleniaceae	*Hibbertia dentata*	Twining Guinea Flower
	Hibbertia diffusa	

APPENDIX A: FLORA SPECIES RECORDED

Family	Scientific Name	Common Name
Epacridaceae	*Leucopogon juniperinus*	
Euphorbiaceae	*Breynia oblongifolia*	Breynia
	Phyllanthus gunnii	Spurge
Fabaceae	*Daviesia genistifolia*	
	Glycine tabacina	Love Creeper
	Glycine sp.	
	Hardenbergia violaceae	
	Indogofera australis	
	Jacksonia scoparia	Dog Wood
	Kennedia rubicunda	Running Postman
	Oxylobium cordifolium	Native Holly
	Oxylobium ilicifoliim	Native Holly
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort
Iridaceae	*Patersonia glabrata*	Purple Flag
Lamiaceae	*Plectranthus parviflorus*	Cockspur Flower
Lobeliaceae	*Pratia purpurascens*	White Root
Lomandraceae	*Lomandra longifolia*	Mat Rush
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry

APPENDIX A: FLORA SPECIES RECORDED

Family	Scientific Name	Common Name
	Geitenoplesium cymosum	
Menispermaceae	*Sarcopetalum harveyanum*	
Mimosaceae	*Acacia binervata*	Two-veined Hickory
	Acacia longifolia	Sydney Golden Wattle
	Acacia sp.	Wattle
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush
	Corymbia intermedia	Pink Bloodwood
	Corymbia maculata	Spotted Gum
	Eucalyptus acmenoides	White Mahogany
	Eucalyptus microcorys	Tallowwood
	Eucalyptus propinqua	Grey Gum
	Eucalyptus saligna	Sydney Blue Gum
	Eucalyptus placita	Grey Ironbark
	Eucalyptus umbra	Broad-leaved White Mahogany
	Lophostemon confertus	Brush-box
	Melaleuca sieberi	Sieber's Paperbark
	Syncarpia glomulifera	Turpentine
Nymphaceae	*Nymphaea sp.*	Water Lillies
Oxalidaceae	*Oxalis* sp.	

APPENDIX A: FLORA SPECIES RECORDED

Family	Scientific Name	Common Name
Passifloraceae	*Passiflora subpeltata*	Wild Passionfruit
Philydraceae	*Philydrum lanuginosum*	Woolly Frogmouth
Phormiaceae	*Dianella caerulea*	Blue Flax Lily
Pittosporaceae	*Billardiera scandens*	Apple Dumplings
	Bursaria spinosa	Blackthorn
	Pittosporum revolutum	Rough Fruited Pittosporum
	Pittosporum undulatum	Sweet Pittosporum
Platyzomataceae	*Adiantum aethiopicum*	Maiden Hair Fern
Poaceae	*Chloris truncata*	Rhodes Grass
	Danthonia sp	Wallaby Grass
	Echinopogon sp	Tufted Hedgehog Grass
	Imperata cylindrica	Blady Grass
	Themeda australis	Kangaroo Grass
	Andropogon virginicus	Whisky Grass
Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung
Rhamnaceae	*Emmenosperma alphitonioides*	Bonewood
Rosaceae	*Rubus hillii*	Blackberry
Rutaceae	*Zieria smithii*	Sandfly Zieria
Santalaceae	*Exocarpos cupressiformis*	Cherry Ballart

APPENDIX A: FLORA SPECIES RECORDED

Family	Scientific Name	Common Name
Smilaceae	*Smilax glyciphylla*	Climbing Sarsparilla
Solanaceae	*Solanum mauritianum*	Wild Tobacco Tree
	Solanum prinophyllum	Forest Nightshade
Typhaceae	*Typha orientalis*	Bull Rush
Thymelaceae	*Pimelea linifolia*	Rice Flower
Verbenaceae	*Lantana camara*	Lantana
	Verbena bonariensis	Purple Top
Violaceae	*Viola hederaceae*	Native Violet

Appendix B

AQUATIC HABITAT ASSESSMENT RESULTS

APPENDIX B: AQUATIC HABITAT ASSESSMENT RESULTS.

Criteria	Site 1	Site 2	Site 3	Site 4	Site 5
Location	E448300; N6453650	E448600; N6453650	E448800; N6453600	E448550; N6454400	E448200; N6454300
Waterbody Type	ephemeral drainage line	ephemeral drainage line	ephemeral drainage line	ephemeral creek with permanent dam	ephemeral drainage line
Pool/Riffle Sequence	no	no	no	pools, no riffles	no
Substratum Type	rock	rock	rock	clay loam	clay loam
Snag Abundance	sparse	sparse - moderate	sparse - moderate	moderate	moderate
Instream Vegetation	no aquatic species (ie. lantana, grasses)	no aquatic species (ie. lantana, bracken fern, grasses)	no aquatic species (ie. fishbone fern, grasses)	*Gahnia* sp. emergent veg.	nil
Water Depth	nil	nil	nil	0 to 60 cm	nil
Waterbody Width	nil	nil	nil	2.5m	nil
Streamflow Present	no	no	no	no	no

APPENDIX B: AQUATIC HABITAT ASSESSMENT RESULTS.

Criteria	Site 1	Site 2	Site 3	Site 4	Site 5
Deep Pools Present	nil	nil	nil	dam	no
Impediments to Fish Passage	no flow	no flow	no flow	dam structure, lack of streamflow	no flow
Riparian Zone Veg. Type	dry open forest	moist open forest		moist open forest	moist open forest
Water Clarity	n/a	n/a	n/a	<10 cm	n/a
Stream Classification	1	1	1	3	2

Note: *Stream classification is explained in Section 2.1.5.*
Stream site locations are shown on Figure 2.1.

Appendix C

SEPP 44 KOALA HABITAT ASSESSMENT RESULTS

APPENDIX C: RESULTS OF SEPP 44 INVESTIGATION

Plot Number	Lower Canopy Tree Species	No. Individuals	Upper Canopy Tree Species	No. Individuals
1	*Eucalyptus microcorys*	1	*E. microcorys*	6
	E. propinqua	1	*E. propinqua*	2
	Corymbia resinifera	2	*E. acmenoides* *	5
	C. gummifera	1	*C. resinifera*	3
	Allocasuarina torulosa	3	*Syncarpia glomulifera*	1
			A. torulosa	3
2	*E. propinqua*	3	*E. propinqua*	2
	E. acmenoides *	3	*E. acmenoides* *	6
	C. maculata *	8	*C. maculata* *	17
	E. placita *	3	*E. placita* *	9
	A. torulosa	8		
3	*C. maculata* *	5	*C. maculata* *	11
	E. placita *	4	*E. placita* *	6
	E. acmenoides *	1	*E. acmenoides* *	3
	A. torulosa	15		
4	*E. microcorys*	1	*E. microcorys*	1
	E. propinqua	1	*E. propinqua*	1

APPENDIX C: RESULTS OF SEPP 44 INVESTIGATION

Plot Number	Lower Canopy Tree Species	No. Individuals	Upper Canopy Tree Species	No. Individuals
	E. acmenoides *	7	*E. acmenoides* *	6
	C. maculata *	15	*C. maculata* *	15
	E. crebra	1	*A. torulosa*	1
	A. torulosa	5		

Note: Highlighted text indicates preferred koala feed tree species, including primary species of locally preferred koala food trees as identified by Evans and Fitzpatrick (1996).

Plot locations shown on *Figure 2.1* in main document.

* These species have been identified as secondary koala food tree species in the Manning Valley Catchment (Evans & Fitzpatrick 1996).

JANDRA QUARRY

EXTENSION

CSR

M. NOISE AND BLASTING ASSESSMENT

JANDRA QUARRY EXTENSION

Noise And Blast Assessment

For:
CSR CONSTRUCTION MATERIALS

October 1999
38070NOISERP2

Report No. 38070NOISERP2

This report was prepared in accordance with the scope of services set out in the contract between ERM Mitchell McCotter Pty Ltd ACN 002 773 248 (ERMMM) and CSR Construction Materials. To the best of our knowledge, the proposal presented herein accurately reflects the CSR intentions when the report was printed. However, the application of conditions of approval or impacts of unanticipated future events could modify the outcomes described in this document. In preparing the report, ERMMM used data, surveys, analyses, designs, plans and other information provided by the individuals and organisations referenced herein. While checks were undertaken to ensure that such materials were the correct and current versions of the materials provided, except as otherwise stated, ERMMM did not independently verify the accuracy or completeness of these information sources.

Approved by:	*Tony McNamara*
Position:	Project Director
Signed:	
Date:	

ERM Mitchell McCotter Quality System

Prepared by:	*Murray Curtis*
Position:	Project Manager
Signed:	
Date:	14/10/99

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Chapter 1

INTRODUCTION

1.1 BACKGROUND

ERM was commissioned by CSR Construction Materials to undertake a noise and blasting assessment for the proposed expansion of Jandra Quarry. The quarry is located approximately 20 kilometres south of Taree on the mid north coast of NSW. The quarry locality is shown on *Figure 1.1*.

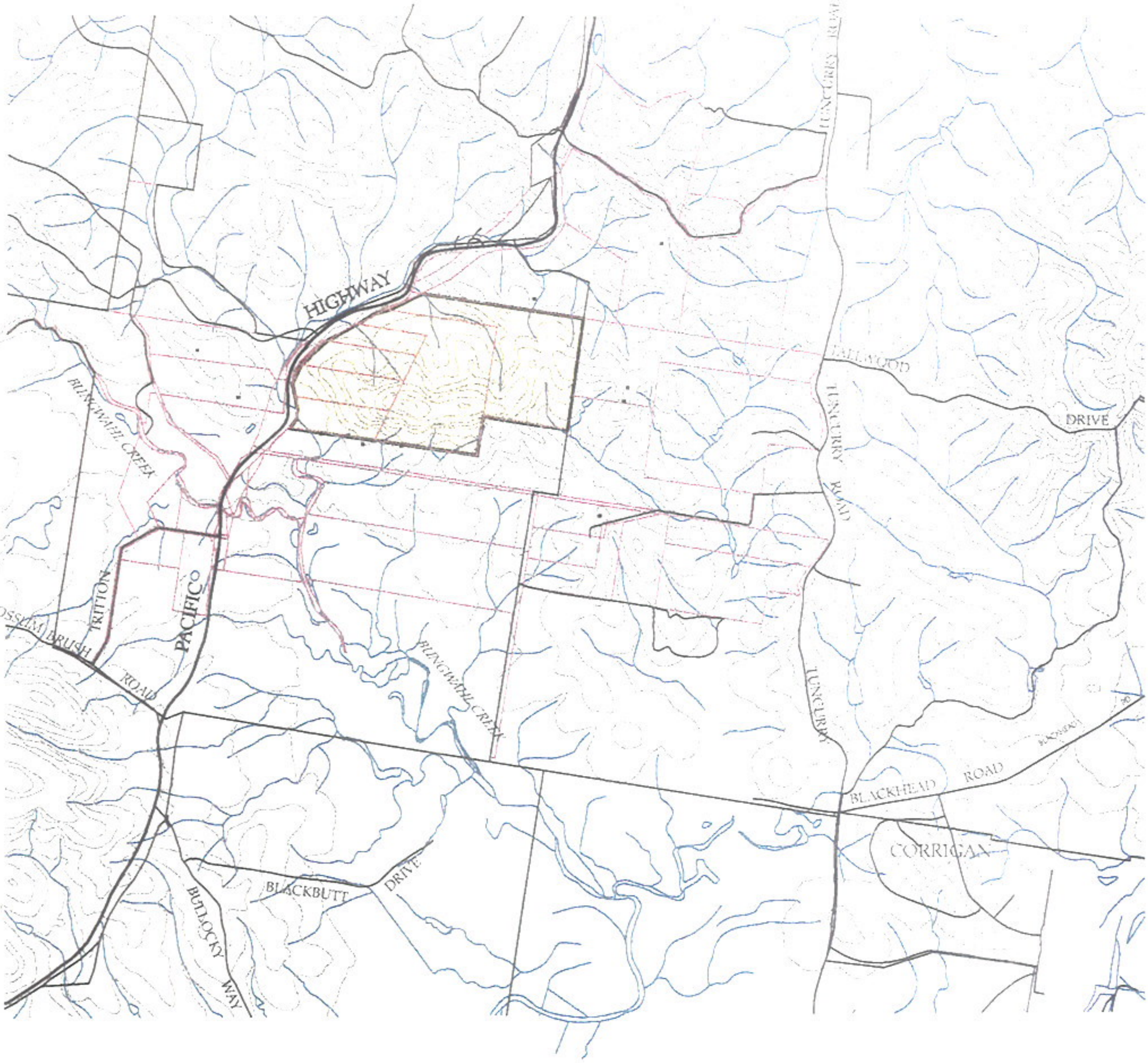
1.1.1 Quarry Development Plan

A figure showing the contour plan of the existing quarry is provided in *Appendix A*. Future quarry development is planned to take place in four stages. The following summaries of quarry development have been provided by CSR.

- Stage 1 comprises the westerly development of the quarry towards the Pacific Highway. The western limit of extraction is 400 metres from the Highway with the floor level of the quarry remaining at the existing level of RL 50m;
- Stage 2 involves the easterly development of the RL 50, 62, 74, 86 and 98 metre faces half way to the proposed eastern limit of the quarry and developing a cut to RL 35 in the latter part;
- Stage 3 sees the continued development east of the RL 35, 50, 62, 74 and 98 metre benches to their most eastern limit. At no stage will the eastern ridge be breached. Towards the end a drop cut to RL 20 will be developed; and
- Stage 4 comprises development of the final bench resulting in a floor level at RL 20, and some peripheral clean up.

Plans showing quarry development stages are also attached in *Appendix A*.

In regard to prediction of noise levels generated by the proposed expansion of the quarry, assessment of Stage 4 is not considered warranted as extraction operations would be on either previously worked benches or on benches below natural ground level and as such any worst case noise and vibration generation scenario would not create noise or vibration levels above those predicted for Stage 1 or Stage 3.



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ERM MITCHELL McCOTTER

Figure 1.1 SITE LOCALITY

Stage 2 operations have not been assessed as Stage 3 represents worst case noise exposures for residences to the east of the quarry with plant located at the eastern extremity of extraction during Stage 3.

1.2 TERMINOLOGY

Environmental noise levels vary with time, requiring statistical descriptors to characterise the noise environment. The following descriptors are commonly used to assess noise:

- L_{10}, the noise level which is exceeded for 10 per cent of the time and is approximately the average of the maximum noise levels;
- L_{90}, the level exceeded for 90 per cent of the time and is approximately the average of the minimum noise levels. The L_{90} level is often referred to as the "background" noise level and is commonly used to determine noise criteria for assessment purposes;
- L_{eq}, this level represents the average noise energy during a measurement period; and
- dB(A). Noise level measurement units are decibels (dB). The "A" weighting scale is used to describe human response to noise.

Chapter 2

METHODOLOGY

2.1 ACOUSTIC ASSESSMENT

The following methodology was followed for the acoustic assessment of the quarry:

- determine existing background noise level via continuous noise logging at three locations surrounding the quarry;
- obtain plant sound power data from measurements of existing or similar quarry plant items to be used for predictive noise modelling;
- model noise levels from the quarry for various stages of quarry operation with plant items located in worst case scenario locations; and
- compare predicted noise levels to EPA noise criteria.

2.1.1 Background Noise Measurement

Noise levels were measured at three locations using noise data loggers over the period 16 March to 23 March 1999 as shown in *Figure 2.1*. These locations were:

- Proposed residence at rear of YALA property (YALA 3);
- Loveday residence; and
- Jones residence.

The following equipment was used to measure and record environmental noise levels and weather conditions:

- ARL EL215 noise data loggers; and
- Bruel and Kjaer Type 4230 sound level calibrator.

Noise levels were measured over 15 minute intervals with statistical parameters calculated including L_{eq}, L_1, L_{10}, L_{90}, L_{99}, L_{max} and L_{min}.

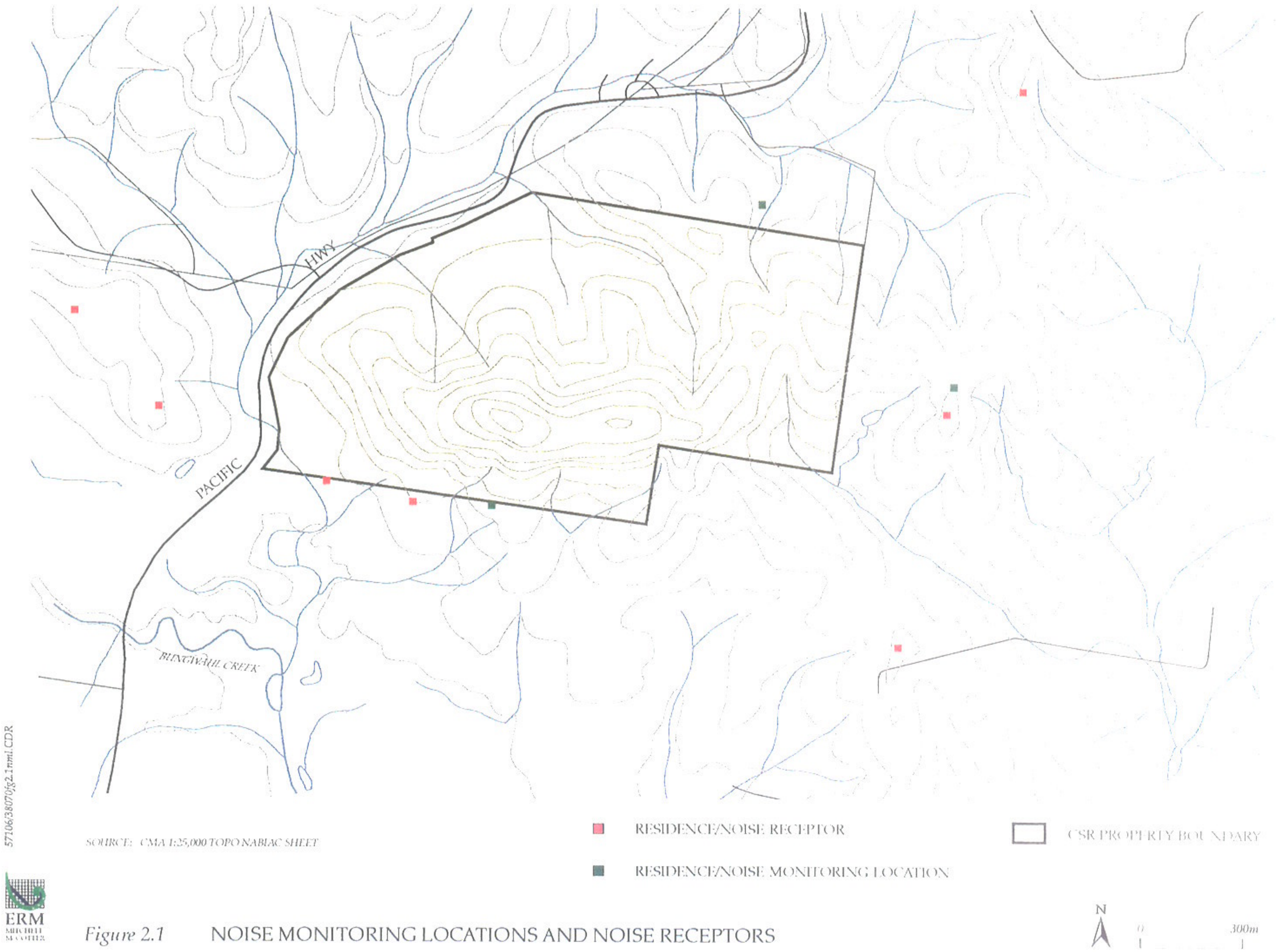


Figure 2.1 NOISE MONITORING LOCATIONS AND NOISE RECEPTORS

Weather data (hourly wind and rainfall) sourced from Taree Airport allowed correlation of atmospheric parameters and measured noise levels. The weather information was used to filter data where wind speed exceeded five metres per second and/or rainfall occurred.

The EPA recommends minimum repeatable background noise levels be used for determining noise level criteria. The "minimum repeatable" level may be estimated by calculating the 90th percentile of measured L_{90} background noise levels, for the time period of interest.

2.1.2 *Sound Power Level Determination*

Plant sound power levels are required for noise modelling. Third octave sound pressure levels were measured using a SVAN 912 sound level meter and Bruel and Kjaer Type 4230 sound level calibrator. Plant sound power levels were determined generally in accordance with AS 1217 part 7 '*Acoustics - Determination of sound power levels of noise sources - Survey method*'. Sound power of the following plant at the Jandra quarry were determined based on measurements taken on Tuesday 23rd March, 1999.

- CAT 966C Front End Loader;
- CAT 980C Front End Loader;
- Water Cart (International 18t);
- Hitachi EX300-2 Excavator; and
- Komatsu HD325 35t Dump Truck.

Sound power levels of plant items not available on-site at the time have been obtained from previous measurements of similar plant from the ERM database. Data for the Jandra drill rig has been obtained from a noise control report supplied by CSR (Dick Benbow & Associates Pty Ltd, 1998).

2.1.3 *Predictive Noise Modelling*

i. Noise Model

Noise levels from the quarry were calculated using the NSW EPA approved Environmental Noise Model (ENM). This model takes account of noise attenuation due to distance, atmospheric absorption, barriers and the 'ground effect'. It gives consistently reliable predictions of environmental noise levels. Initial calculations were performed with no wind or temperature gradient (still isothermal conditions or SI conditions), for comparison with the appropriate criteria. Assumed atmospheric conditions were 20 degrees Celsius and relative humidity of 80 percent.

Topographical information was supplied by CSR and the Central Mapping Authority (CMA). CSR provided 2 metre contour maps of Jandra Quarry for the existing site, Stage 1, Stage 2, Stage 3 and the final quarry landform. This was combined with digital contours supplied by CMA of the 1:25000 Nabiac 9333-1-N map sheet. The topographical information together with plant locations and sound power levels and receiver locations were entered into ENM to produce noise contours around the quarry and single point calculations at the nearest ten residences to the quarry. The locations of these residences are shown in *Figure 2.1*.

Output from the model not only provides the total received noise level but also a ranking of noise sources and received level from each. This allows those plant items providing the highest noise levels at the receptor to be targeted for control if required.

The noise model estimates maximum noise levels and assumes all plant and equipment operates simultaneously and at full power. In practice, such an operating scenario would be unlikely to occur. Measurements at similar quarries and mines have indicated that there is a difference of up to 7 dB(A) between the maximum noise level, as predicted by the model, and the L_{10} level generated by quarrying. To estimate the L_{10} level, a conservative value of 5 dB(A) was deducted from the calculated maximum level.

ii. Analysis of Wind Effects

Under various wind and temperature gradient conditions, noise levels may be increased or decreased compared with still-isothermal (SI) conditions, that is, zero wind and temperature gradient. The *Draft Stationary Noise Source Policy* (EPA, 1998) makes significant moves towards accounting for non-neutral atmospheric conditions which affect noise propagation. These include the effects of temperature inversions and wind velocity gradients which can both enhance or reduce noise propagation from source to receiver compared with SI conditions. This is due to refraction of sound propagating through the atmosphere, brought about by a change in sound speed with height. Sound levels are increased when the wind blows from source to receiver or under temperature inversion conditions, and decreased when the wind blows from receiver to the source or under temperature lapse conditions. Assessment of temperature inversions has not been conducted for Jandra Quarry as no night-time operations are proposed.

Bureau of Meteorology data between 1965 and 1999 from Taree Radio Station 2RE was used to determine the prevalent wind vectors for the site. Average monthly data at 9:00 am and 3:00 pm were provided by the Bureau of Meteorology.

The ENM model calculates noise levels under various combinations of wind speed and wind direction. In total, 16 specific meteorological conditions were considered and assigned percentage occurrences. These were categorised as follows:

- wind speed: two categories, zero to three metres per second and greater than three metres per second; and

- wind direction: eight categories in 45 degree increments.

Noise levels for surrounding residences were calculated for the range of possible combinations of wind speed and wind direction. Using the proportion of time when each of these combinations applied, the probable distribution of noise levels was calculated. In calculations, wind speeds greater than 3 metres per second were replaced with 3 metres per second. This is required because the ENM model does not accurately predict turbulence effects associated with higher wind speeds. The cut-off value of 3 metres per second is believed to be conservatively high. Wind speeds in the zero to three metres per second category were modelled using a wind speed of 2 metres per second and the results for still isothermal conditions were used for calm periods.

Noise models, including ENM, are less accurate in predicting noise under adverse conditions than under SI conditions. Hence, any noise level predictions presented under these conditions should be interpreted more carefully than traditional noise contours calculated under SI conditions.

2.1.4 Noise Criteria

i. Neutral Atmospheric Conditions

Noise emissions from the proposed development are compared to criteria determined using the Environment Protection Authority's *Environmental Noise Control Manual* (ENCM) (EPA, 1994). Criteria described in the Environment Protection Authority's recently-released Draft Stationary Noise Source Policy (EPA, 1998) are also considered.

The EPA lists objectives for environmental noise in its Environmental Noise Control Manual (EPA, 1994). These are that:

- noise from any single source should not intrude greatly above the prevailing background noise level, generally by more than 5 dB; and
- background noise should not exceed an appropriate level for the particular locality and land use. Similarly, the Draft Policy discusses maintaining noise level amenity in the long-term.

The "intrusiveness criterion" is designed to achieve the first objective, and is expressed as:

$$L_{A10,15minute} \leq (^{*}L_{90}) + 5$$

where $L_{A10,15minute}$ is the L_{10} noise level from the source, measured over a 15-minute period and $^{*}L_{90}$ is the minimum repeatable background level.

To satisfy the second EPA objective, background noise levels should be kept within the "maximum acceptable" noise levels suggested in the EPA's Environmental Noise Control Manual. For residences in a rural area these are a night-time background noise level of 35 dB(A) and a daytime level of 45 dB(A).

Similarly, the Draft Policy (EPA, 1998) states that total L_{eq} noise levels from stationary sources should be kept within the "amenity criteria". For residences in a rural area these are L_{eq} levels of 50, 45 and 40 dB(A) for day, evening and night periods respectively.

ii. Adverse Weather Conditions

The "intrusiveness" noise criterion has traditionally been applied under still-isothermal conditions. Experience indicates that if the criterion is met under these conditions, noise under more adverse conditions is generally (but not always) acceptable.

Experience in similar rural areas such as the Hunter Valley, people become more noise sensitive if night-time noise levels exceed about 40 dB(A) on a regular basis. This is 5 dB above the level which would be set as a noise criterion under still-isothermal atmospheric conditions. Hence, one possible formulation for additional criteria would be that noise should not exceed the SI criterion by more than 5 dB on more than ten per cent of occasions throughout a year. This goal would relate to all meteorological conditions.

For this proposal, the following procedure has been used to provide an assessment under the complete range of meteorological conditions, which supplements the assessment under SI conditions:

- an additional "intrusiveness" criterion is used, that under prevailing meteorological conditions, noise levels should not exceed the standard intrusiveness criterion by more than 5 dB(A) for more than 10 per cent of the operating period during a year; and
- additional calculations are performed to define the probability of occurrence of various noise levels accounting for the range of wind speeds and wind directions (and the interactions between these parameters) which are found at the site.

The production of "tenth percentile" noise levels involves detailed and complex noise level calculations. However, this level of detail of the likely noise environment provides regulatory bodies and residents with a more comprehensive and representative understanding of the extent and level of potential noise impacts from the development. This assessment describes the range of noise levels at each potentially affected residence under prevailing meteorological conditions, as well as graphically indicating the tenth percentile noise level.

Using the probability of occurrence of wind speed and wind direction requires more calculation than would a procedure involving a single set of meteorological parameters. This method of assessment represents best available technology and is among the most comprehensive methods to estimate actual noise levels received at a receptor as a percentage of time accounting for atmospheric effects.

Chapter 3

RESULTS

3.1 BACKGROUND NOISE AND INTRUSIVENESS CRITERIA

Minimum repeatable background noise levels were calculated from the logged data at each location. Minimum repeatable background noise levels for the area are used in deriving 'intrusiveness criteria'. Results of background noise measurements are shown in Table 3.1. Graphs of measured noise levels are provided in *Appendix B*.

Table 3.1 BACKGROUND NOISE LEVELS AND INTRUSIVENESS CRITERIA

Location	Minimum Repeatable L_{90} dB(A)	"Intrusiveness" Noise Criteria, L_{10} dB(A)
YALA 3	37.0	42.0
Loveday	36.8	41.8
Jones	35.0	40.0

Notes: 1. Data where wind speed exceeded 5 m/s or where rainfall occurred not included..
2. Minimum repeatable L_{90} over hours of operation. Mon to Fri: 6:00 am to 6:00 pm & Sat: 7:00 am to 3:00 pm.

The L_{90} criteria for the quarry as defined in the ENCM (EPA, 1994) is dependent upon the existing background noise level as described in Chapter 20 of the ENCM. As existing background noise levels are more than 6 dB(A) below the acceptable maximum level, the L_{90} criterion for the development is 5 dB(A) above background level. The intrusiveness criterion will therefore be the determining factor as the L_{10} intrusiveness criterion is also defined as background plus 5 dB(A). As the L_{10} noise level is by definition not lower than the L_{90} noise level the intrusiveness criterion is the limiting factor and will be considered in this acoustic assessment.

3.2 SOUND POWER LEVELS

Sound power levels for plant items used in noise modelling are shown in *Table 3.2*.

Table 3.2 PLANT SOUND POWER LEVELS

Item	63	125	250	500	1000	2000	4000	8000	Total dB(L)	Total dB(A)
Asphalt Plant	107	113	107	105	101.2	98.9	96.8	94.5	**116**	**108**
Crusher	121.2	122.1	112.6	111.3	110.0	111.8	112.0	105.1	**126**	**118**
Drill	94.1	94.0	93.5	100.2	101.9	106.7	108.9	103.0	**113**	**113**
D8 Dozer	85.0	91.0	101.0	109.0	109.0	107.0	101.0	88.0	**114**	**113**
WA420 FEL	107	107	103	106	104	103	97	89	**113**	**109**
Cat 966C FEL	107	107	103	106	104	103	97	89	**113**	**109**
Cat 980C FEL	105	116	109	111	111	107	100	92	**119**	**115**
Water Cart (International 18 t)	106.0	107.0	108.0	109.0	106.0	105.0	100.0	91.0	**115**	**112**
Transport Truck	93	96	100	101	103	103	98	88	**109**	**108**
Volvo 18t Haul Truck	106.0	107.0	108.0	109.0	106.0	105.0	100.0	91.0	**115**	**112**
Hitachi EX300-2	108.0	113.0	104.0	103.0	101.0	97.0	90.0	84.0	**115**	**106**
Komatsu HD325	102	106	106	107	106	106	99	91	**114**	**111**

Notes: 1. Spectrum dB(Lin).

3.3 NOISE MODELLING

3.3.1 *Neutral Atmospheric Conditions*

Noise modelling was conducted under still isothermal meteorological conditions - that is, calm conditions with no temperature gradient. Plant items were located in worst case scenario locations which included stripping topsoil and quarrying and drilling on the topmost benches of the quarry. All plant were operated simultaneously at maximum power. Plant sound power levels are detailed in *Table 3.2* and ISG co-ordinates of plant locations are included in *Appendix C*. Results of single point noise calculations for the closest 10 residences using ENM are shown in *Table 3.3*.

Table 3.3 L_{10} NOISE LEVELS

Residence	Criteria	Existing	Stage 1	Stage 3
YALA 1	42	21.2	36.2	18.4
YALA 2	42	23.9	37.9	20.1
YALA 3	42	27.2	36.4	23.5
Jones	40	25.9	25.6	38.7
Groves	40	24.8	26.4	39.1
Loveday	42	29.5	30.1	32.5
Mowbray	42	31.5	28.7	31.2
Barnes	40	16.5	23.9	35.5
Middleton	42	23.6	31	23.4
Dubos	42	26	29.6	26.3

Notes: *1. All values L_{10} dB(A).*

2. Still isothermal meteorological conditions

3. Adopted criteria for residences not subject to noise monitoring are based on location in regard to monitoring sites and the Pacific Highway

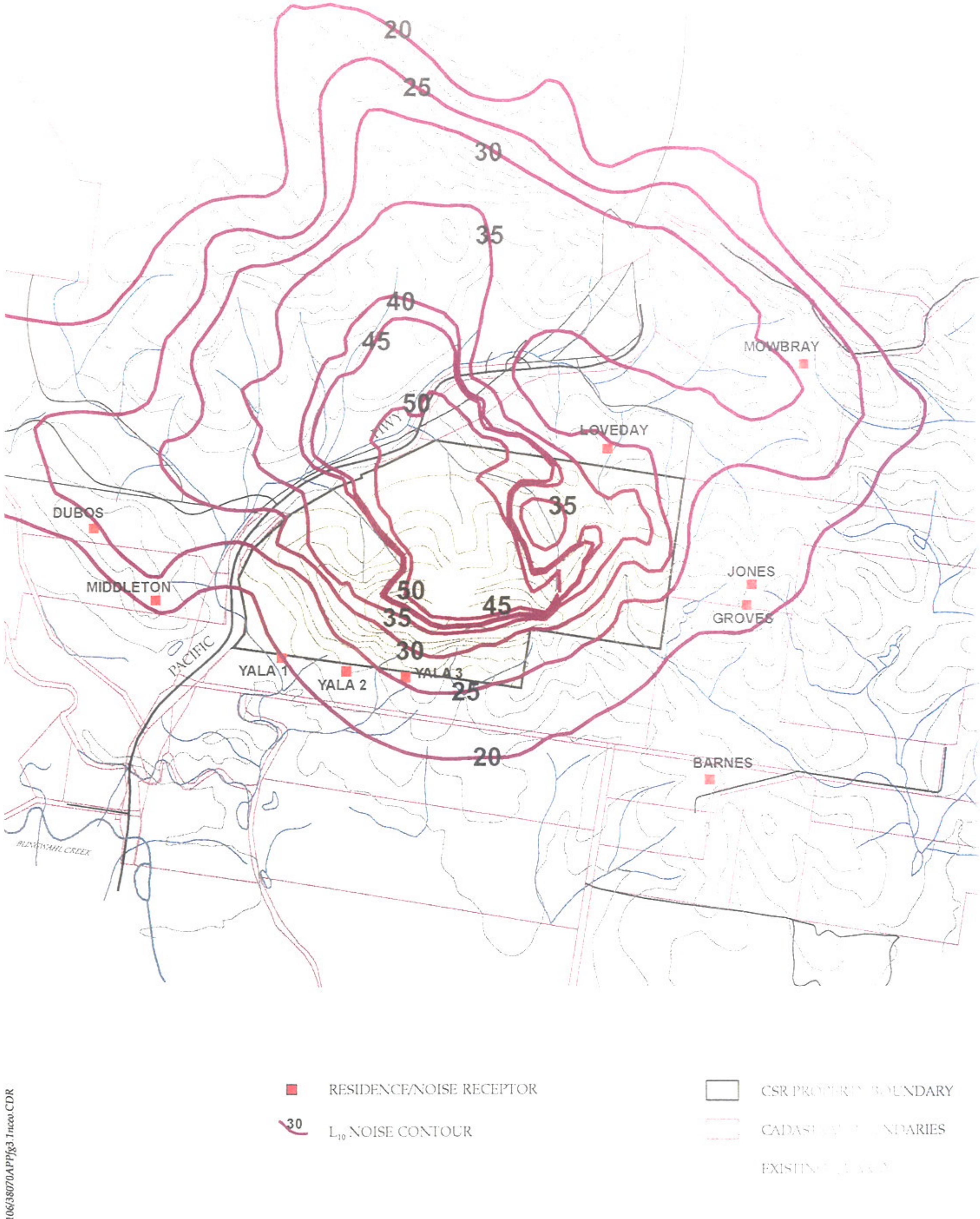
The results given in *Table* 3.3 indicate that there are no exceedences of the adopted criteria at any residence during any stage of quarry development.

Noise calculations were not performed for Stage 4 as this stage is primarily the lowering of the pit floor resulting in increased barrier attenuation for workface equipment. Stage 2 has not been modelled as plant in Stage 3 reach the eastern limit of extraction and result in worst case noise exposures for residences to the east. Operations during existing, Stage 1 and Stage 3 represent worst case noise exposures for surrounding residences.

L_{10} noise contours for the existing quarry operations and for Stages 1 and 3 have been calculated and are shown in *Figure 3.1, Figure* 3.2 and *Figure* 3.3 respectively. Noise levels at all residences are below the adopted criteria.

3.3.2 *Adverse Weather Conditions*

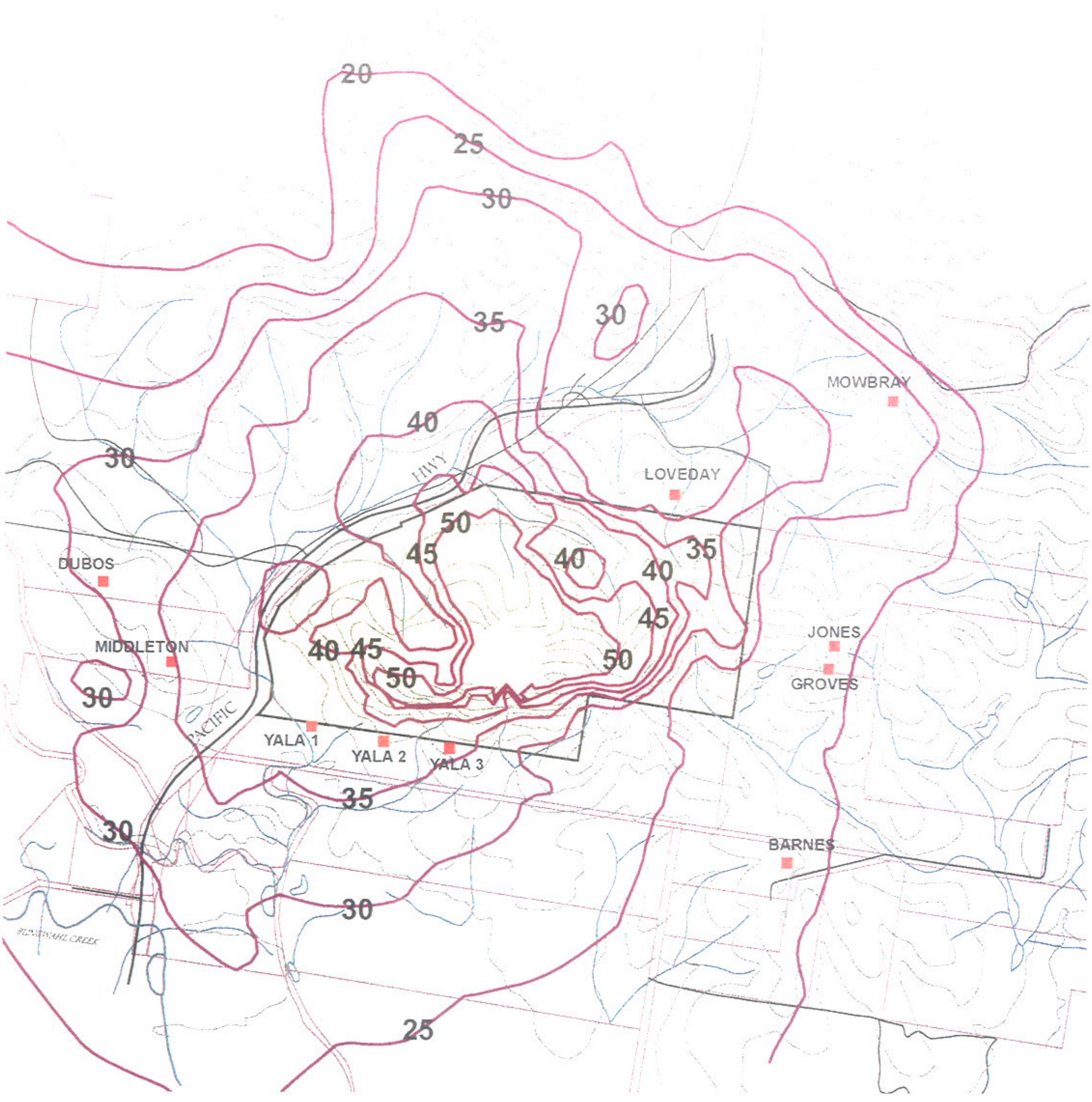
Weather data supplied by the Bureau of Meteorology for Taree Radio Station 2RE between 1965 and 1999 was used to generate seasonal wind roses representing general wind vectors for the area (*Appendix D*). Wind vector percentage occurrence



57106/38070APPfg3.1nceo.CDR

ERM

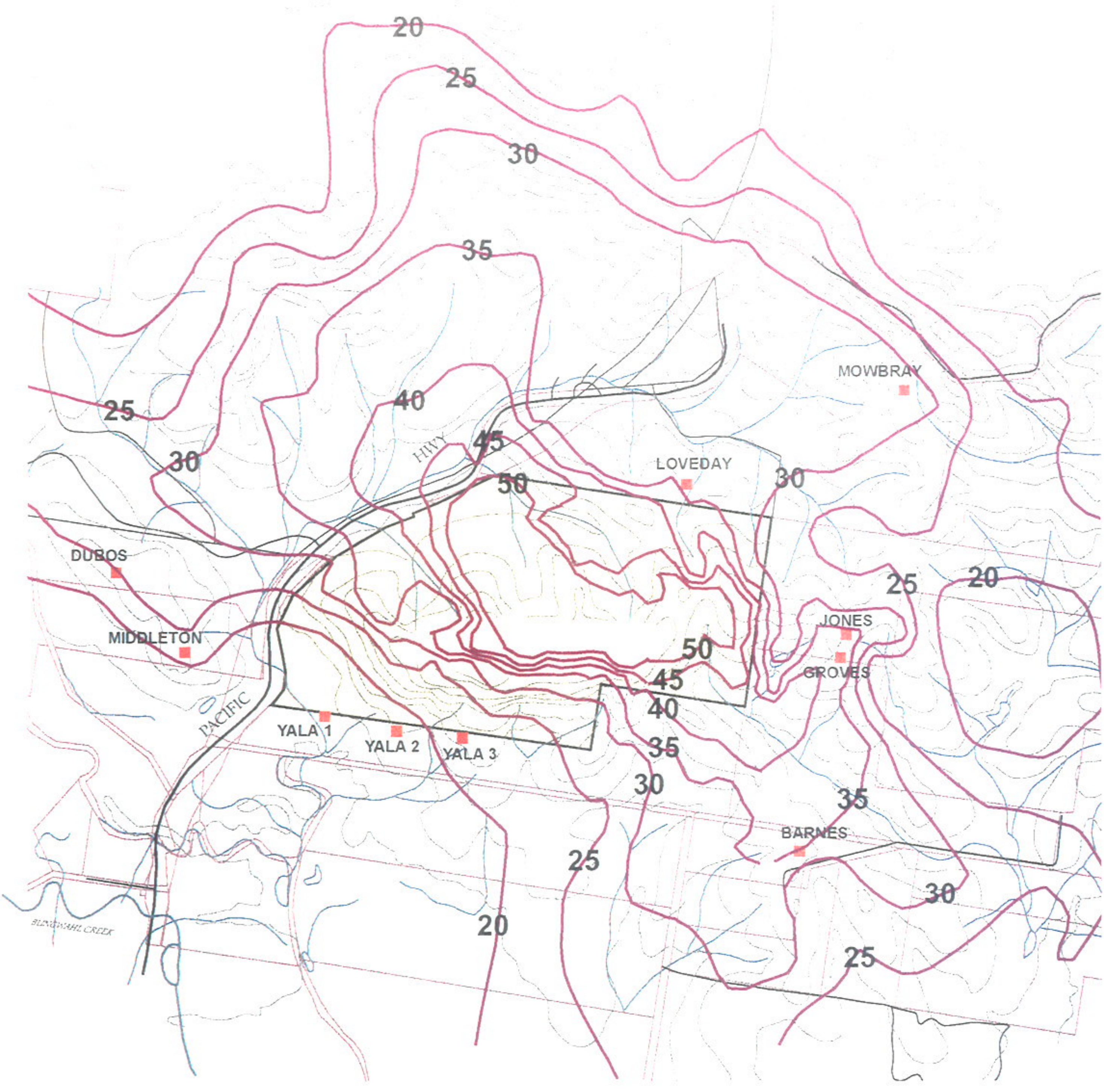
Figure 3.1 STABLE ISOTHERMAL L_{10} NOISE CONTOURS - EXISTING QUARRY



57106/38070APPfg3.2ncst1.CDR

ERM MITCHELL McCOTTER

Figure 3.2 STABLE ISOTHERMAL L_{10} NOISE CONTOURS - STAGE 1 QUARRYING



RESIDENCE/NOISE RECEPTOR

30 L_{10} NOISE CONTOUR

CSR PROPERTY BOUNDARY

CADASTRAL BOUNDARIES

STAGE 3 QUARRYING

SOURCE: CMA 1:25,000 TOPO NABIAC SHEET

57106/3807/0APPfg3.3ncst3.CDR

ERM MITCHELL McCOTTER

N

400m

Figure 3.3 STABLE ISOTHERMAL L_{10} NOISE CONTOURS - STAGE 3 QUARRYING

data was combined with corresponding noise levels for the analysis of the complete set of meteorological conditions as described in Section 2.1.3*ii*.

Calculations were performed for the closest residences to the quarry in each direction. These were:

- YALA 2;
- Groves;
- Loveday; and
- Dubos.

Results have been presented in terms of percentage of time that a given noise level is exceeded and are shown in *Figures 3.4* to *3.6*.

Modelling of noise levels for the range of atmospheric conditions has been conducted for existing, Stage 1 and Stage 3. The criterion adopted for these meteorological conditions is that noise levels should not exceed the standard intrusiveness criterion by more than 5 dB(A) for more than 10% of the specified time period during a year. That is, noise levels should not exceed 45 dB(A) or 47 dB(A) (depending on the location) for more than 10 per cent of the time, see *Table 3.3* for standard intrusiveness criteria applicable to individual residences.

i. Existing Quarry Noise Levels

Noise levels for the existing quarry are within the criteria with no exceedences of the adopted criterion at the 10 per cent level.

Loveday approaches the criterion level for the existing quarry with 45 dB(A) occurring 10 per cent of the time, which remains 2 dB(A) below the adverse weather conditions criterion of 47 dB(A).

ii. Stage 1

Noise levels for Stage 1 are within the criteria with no exceedences of the adopted criteria at the 10 per cent level at any residence.

iii. Stage 3

Noise levels for Stage 3 exceed the criteria level for Groves, which is also representative of Jones, for the worst case scenario modelled. The adopted criterion for these residences is 45 dB(A) which should not be exceeded for more than 10 percent of the time. The 45 dB(A) noise level occurs for 31 percent of the time with noise levels at 47 dB(A) occurring for approximately 8 per cent of the time. Therefore a reduction of 2 dB(A) would result in compliance.

Analysis of the relative contribution to total noise indicates that the dozer removing topsoil is dominant. The dozer is used periodically and is not a permanent plant item. Removal of the dozer results in noise levels approximately 6 dB(A) lower which will result in noise levels complying with the criteria. Use of the dozer for topsoil stripping will need to be co-ordinated not to coincide with adverse wind conditions (west or north west winds), which occur predominantly during winter and autumn mornings.

It should be noted that higher noise levels are often associated with higher wind speeds, and in these cases background noise levels will also be elevated and this may tend to mask quarry noise.

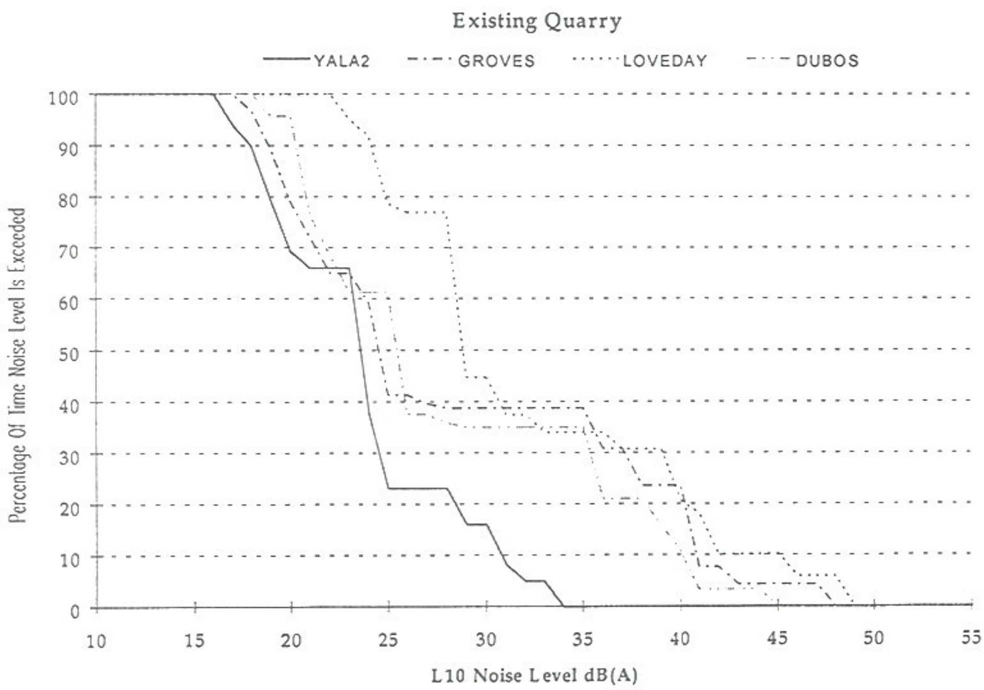


Figure 3.4 NOISE LEVEL DISTRIBUTION, EXISTING QUARRY

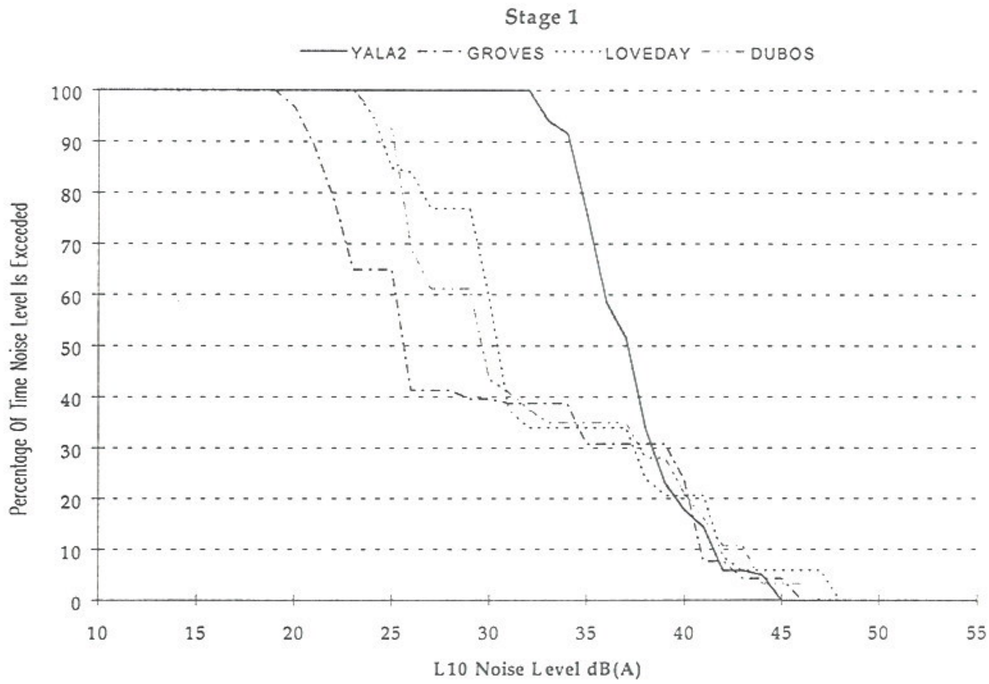


Figure 3.5 NOISE LEVEL DISTRIBUTION, STAGE 1

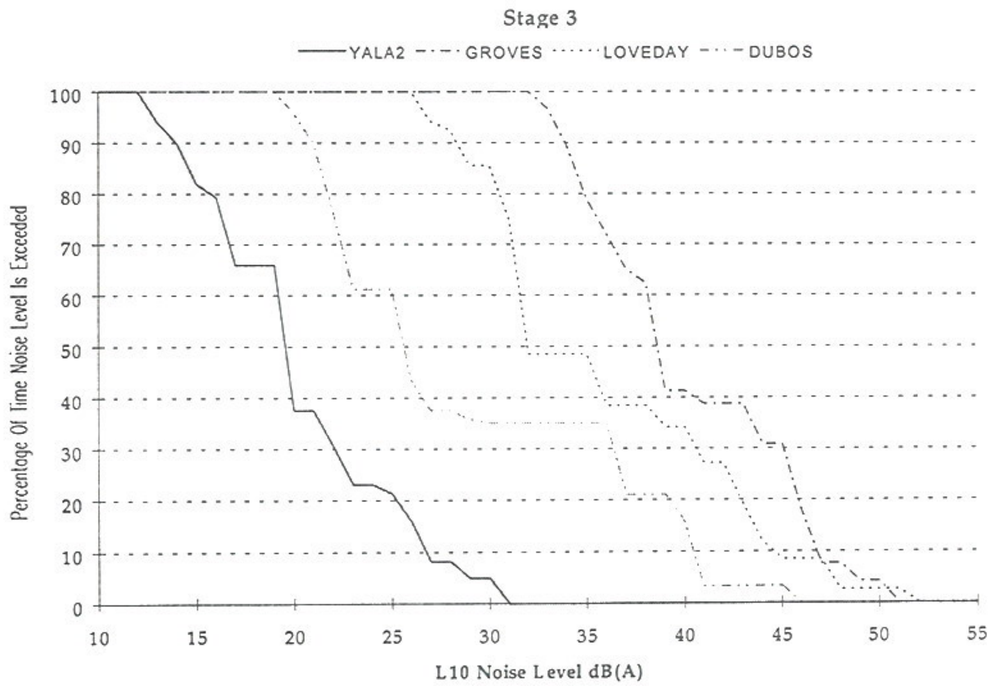


Figure 3.6 NOISE LEVEL DISTRIBUTION, STAGE 3

Chapter 4

BLASTING

4.1 ASSESSMENT CRITERIA

Noise and vibration criteria for blasting are proposed in the EPA's Environmental Noise Control Manual. However, the EPA has indicated that these have been superseded by values from the Australian and New Zealand Environment Conservation Council's (ANZECC) *"Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration"* (ANZECC, 1990). The ANZECC guidelines are the same as the Environmental Noise Control Manual except for blasting times. Blast overpressure levels should not exceed 115 dB(Lin) at any residence not associated with the quarry, and ground vibration levels should not exceed five millimetres per second (5 mm/s) peak particle velocity. However, it is accepted that some limited exceedence of the criteria may occur on infrequent occasions. This should be limited to not more than 5 per cent of the total number of blasts, and should not exceed 120 dB(Lin) overpressure and 10 mm/s peak particle velocity at any time.

The ANZECC guidelines recommend that blasting should occur only between 9 am and 5 pm, Monday to Saturday, and there should be no blasting on Sundays and public holidays. In addition, it is recommended that blasting occur not more than once a day (Note: occasionally more than one blast per day may be required, for instance, the need for a 'corrective shot').

4.2 BLASTING ASSESSMENT

Blasting impacts can be predicted using a relationship between the maximum instantaneous charge (MIC) and distance from the blast. This form of predictive modelling is of guidance value only as other blast design issues such as blast location, face surveying, length of stemming etc. have a significant influence on blast impacts. Noise and vibration levels due to blasting may be related to the "scaled distance" from the blast, which is defined as:

Scaled Distance = $D/W^{(1/3)}$ for airblast overpressure; and

Scaled Distance = $D/W^{(1/2)}$ for ground vibration.

where D is the distance from the blast to the receptor in metres, and W is the maximum instantaneous charge in kilograms. The formulae for overpressure and ground vibration are site specific.

CSR provided blast monitoring data for 32 blasts over the period 23 April 1997 to 11 November 1998 collected at the former Williams' property (now owned by CSR) located approximately 300 metres to the north-west of the existing quarry face. At this average distance the data show the average overpressure from an MIC 40 kg blast has been 110 dB(Lin). The data is provided in *Appendix E* with a summary given in *Table 4.1*.

Table 4.1 HISTORICAL BLAST DATA SUMMARY

	Approximate Distance metres	**Peak particle velocity millimetres per second**	**Overpressure dB(Lin)**
Maximum	390	5	114.5
Minimum	225	0	103.1
Average	300	3	109.8

The historical blast monitoring data at the site were analysed. However, site specific blast and overpressure equations were not developed for the following reasons:

- monitoring location to blast distances did not vary greatly;
- monitoring location to blast distance was not always recorded; and
- the total number of blasts accurately monitored was insufficient.

Instead, standard predictive formulae (those used where no blast monitoring data is available) were used to calculate likely vibration and overpressure levels. Preliminary indications from the blast monitoring data show that actual blast impacts are currently less than those predicted using the standard methods.

4.3 BLASTING IMPACTS

Five recent blasts have been monitored on both the open face side of the quarry (at the site office) and behind the face, on the other side of the southern ridge line, at the nearest residence to any potential blast site (YALA 3). The monitoring data given in *Table 4.2* shows the intervening ridge attenuates blast overpressure to YALA 3 by an average 12 dB. This attenuation is likely to increase for blasts located on the proposed benches below RL 50.

Although only five blasts have been monitored to date, the results indicate that vibration is likely to be the limiting criteria for determining a suitable design for blasts located along the southern face of the quarry near the YALA residences. The results indicate that blasts at the southern face close to YALA 3 using current blast designs do not exceed the relevant criteria.

Table 4.2 RECENT BLAST MONITORING DATA

Date	Distance metres	Peak particle velocity millimetres per second	Overpressure dB(Lin)
19/04/99	300 shielded side (YALA 3)	4.58	106.1
07/05/99	300 open side (site office)	2.02	118.0
	300 shielded side (YALA 3)	4.65	101.0
15/06/99	300 open side (site office)	4.33	116.9
	300 shielded side (YALA 3)	4.88	108.9
9/08/99	300 open side (site office)	4.9	114.5
30/08/99	300 shielded side (YALA 3)	1.5	97.8

Note: The site office is not a residence and being associated with the quarry EPA criteria is not applicable.

Predicted vibration and overpressure levels for most residences using standard formulae for the proposed typical blast MICs are below the criteria of 115 dB(Lin) and 5 mm/s respectively. These calculations are for unshielded blasts (ie. line of sight between blast and receptor) using a conservative methodology. The criteria is predicted to be exceeded at the nearest residences located on the YALA property which are actually shielded from quarry faces by the ridge line running along the southern boundary of the site. However, as shown by the monitoring data provided in *Table 4.2* above, specific blast designs can be formulated to ensure EPA criteria is not exceeded when blasting close to the YALA residences.

The proposed quarry plans indicate that potential blast locations cover an estimated area of approximately 900 m by 250 m with distances of up to 900 m from the YALA 3 residence. With significant variations in distances to receptors it is extremely inefficient to limit blasts to a specific MIC. It is CSR's intention to monitor several blasts at multiple locations to gather data sufficient for confident impact predictions. The design of blasts nearest the YALA residences can then be optimised to limit the possibility of criteria exceedences and preferred blast designs can be used for blast locations with adequate distances to residences.

CSR has developed a specific set of standard procedures to control blasting at Jandra blasting (CSR Construction Materials, 1999). These procedures are amended by CSR to reflect best management practices as they arise. It should be noted that there will be no secondary blasting.

The primary measure to ensure blast impacts are within acceptable limits is through good design and accurate monitoring. Use of specific blast MIC is only one of a number of tools used in the design process. CSR's experience indicates that current practices such as undertaking face surveys and borehole deviation measurements are an even more important component of the design process. This allows optimisation of blast loading and control of vibration and overpressure.

All blasts will be monitored for both overpressure and vibration levels to ensure statutory limits are not exceeded. If blast overpressure and vibration are found to be in exceedence the cause will be identified and blast design or control procedures modified to prevent recurrence.

4.4 MITIGATION MEASURES

The blasting impact assessment indicates that the quarry can effectively undertake blasting operations such that blasting impacts at nearby receptors will meet ANZECC guideline limits. The following mitigation measures will be implemented to control blasting activities:

- all blasting to be undertaken in accordance with Department of Mineral Resources regulations;
- whenever possible blasting to be limited between 9 am and 5 pm, Monday to Friday and 9.00 am to 3.00 pm Saturday, with no blasting on Sundays and public holidays;
- all blasts to be monitored at the closest residence to ensure that predicted overpressure and ground vibration levels are not exceeded. Blast design to be modified if criteria are exceeded;
- blasting to be avoided in adverse meteorological conditions (ie. not during high winds or temperature inversions); and
- nearby residents on Lot 10 DP 790056 (currently YALA) and Lot 4 DP790058 (currently Loveday) to be advised verbally (or by mutually agreed method) of specific blast times.

Chapter 5

CONCLUSION

Noise modelling was conducted for existing, Stage 1 and Stage 3 phases of operation at Jandra Quarry. For each stage, plant items were located in worst case scenario locations and operated simultaneously at maximum power. Results of single point noise calculations under still isothermal conditions are shown in *Table 3.3*. L_{10} noise levels are below the adopted intrusiveness criteria for all surrounding residences for each stage of quarry development. Natural topographic shielding and distance attenuation result in noise levels below the determining intrusiveness noise criteria.

Modelling for the complete range of meteorological conditions was undertaken for existing, Stage 1 and Stage 3. The analysis gives a comprehensive representation of the range of noise levels likely to occur throughout the year. Noise levels complied with the adopted criteria of still isothermal plus 5 dB for less than 10 per cent of the time under the worst case conditions modelled, except for residences to the east at Stage 3, where an exceedence of approximately 2 dB(A) was found. Analysis of the relative contribution of plant items to noise levels for the Jones and Groves residences to the east revealed that noise levels were dominated by the D8 dozer used to strip topsoil. This operation is temporary and will be planned to coincide with non-adverse weather conditions wherever possible. Removing the D8 dozer results in noise levels complying with the adopted criteria.

It should be noted that noise modelling for both still isothermal and the complete range of meteorological conditions has been conducted for worst case scenarios, which are in reality unlikely to occur with any significant frequency. This has significant implications for the annual distribution of noise levels where it is assumed that worst case plant locations occur for the entire year. This is obviously not going to occur and the assessment is therefore conservative and represents the upper envelope of likely noise levels.

Potential noise impacts at residences surrounding the proposed expansion of Jandra Quarry are within acceptable limits as defined by the EPA. It may be necessary to utilise noise control practices when using the D8 dozer for topsoil stripping. Possible control methods include limiting other plant items simultaneously operating on high or exposed benches, noise control of the dozer or operation in non adverse meteorological conditions.

The blasting impact assessment indicates that the quarry can effectively undertake blasting operations such that blasting impacts at nearby receptors are likely to meet ANZECC guideline limits. Initially, several blasts will be monitored at multiple locations to gather data sufficient for confident impact predictions. The design of blasts for the nearest residences can then be optimised to limit the possibility of criteria exceedences. All future blasts will be monitored for both overpressure and vibration levels to ensure statutory limits are not exceeded. Monitoring will allow refinement of blast design and control procedures. Monitoring along with other specific mitigation measures proposed in Section 4.4 will ensure the amenity of neighbouring residents is not significantly impacted by blasting activities.

REFERENCES

ANZECC, 1990
Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration

CSR Construction Materials, 1999
Drilling and Blasting Procedures for Jandra Quarry

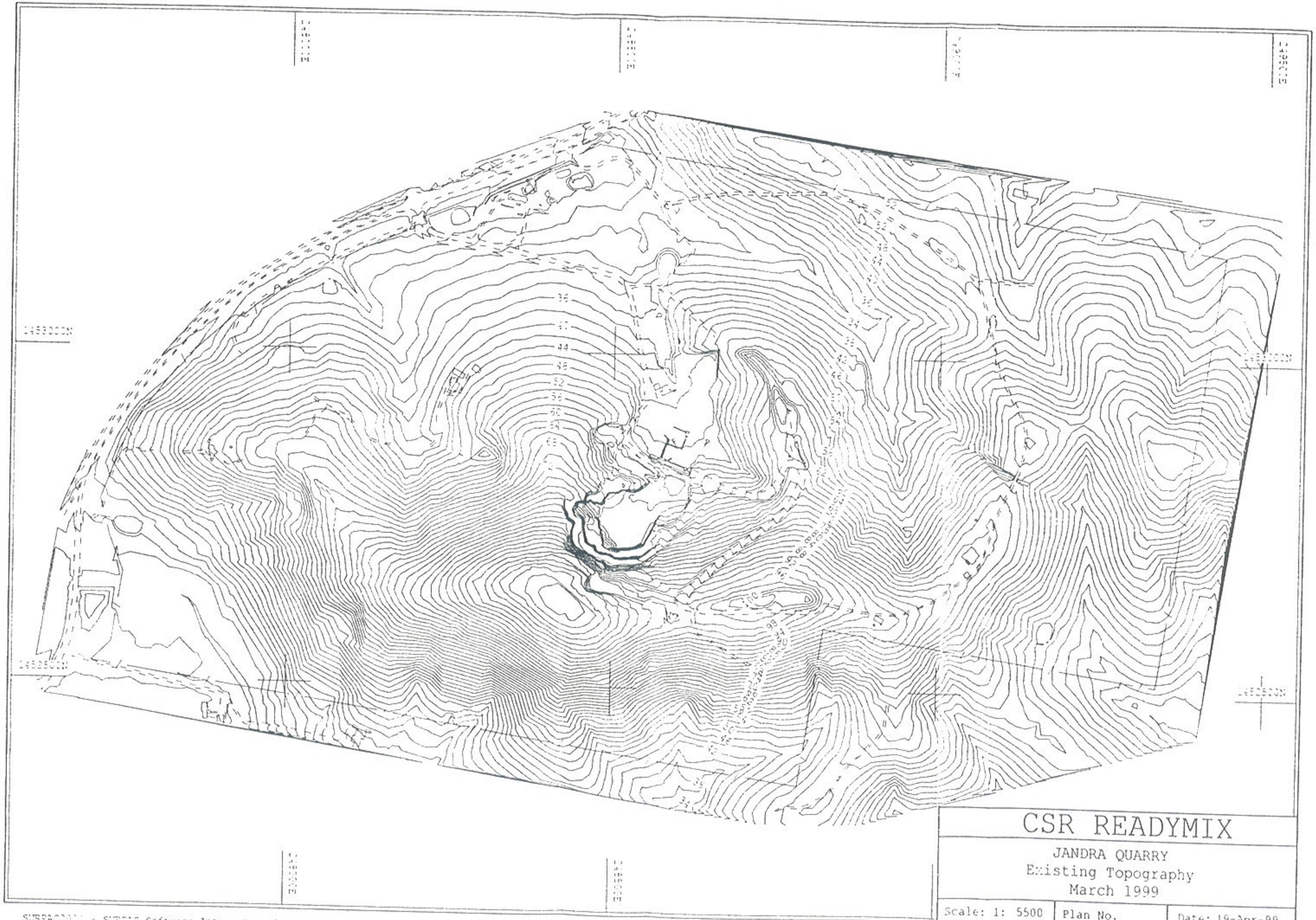
Dick Benbow & Associates Pty Ltd, 1998
EIS Scoping Report CSR Readymix Jandra Quarry

EPA, 1994
Environmental Noise Control Manual

EPA, 1998
Draft Stationary Noise Source Policy

Appendix A

QUARRY DEVELOPMENT PLANS



CSR READYMIX

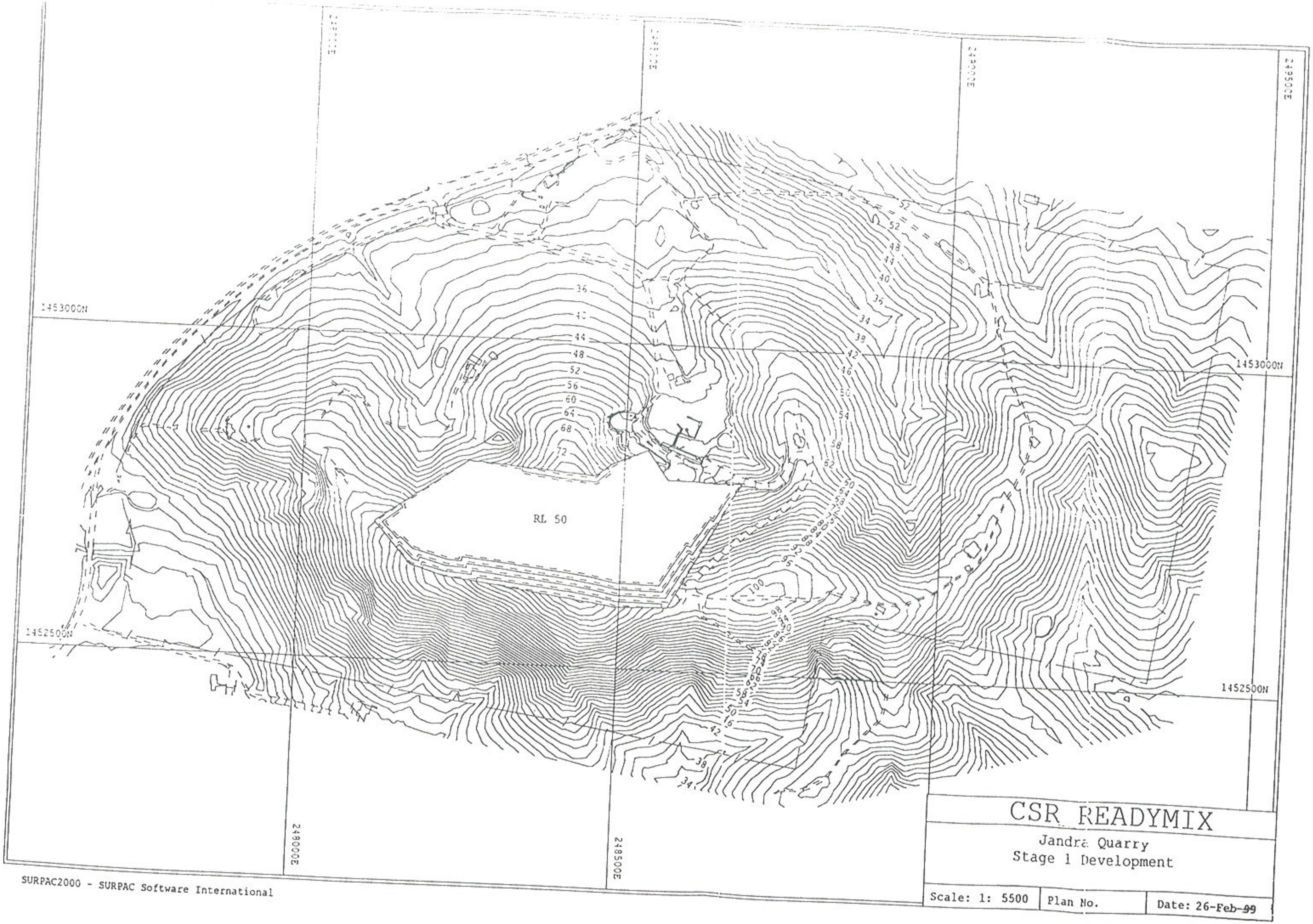
JANDRA QUARRY
Existing Topography
March 1999

Scale: 1: 5500	Plan No.	Date: 19-Apr-99

jan-etsf.pf

SURPAC2000 - SURPAC Software International

jan-eisa.pf



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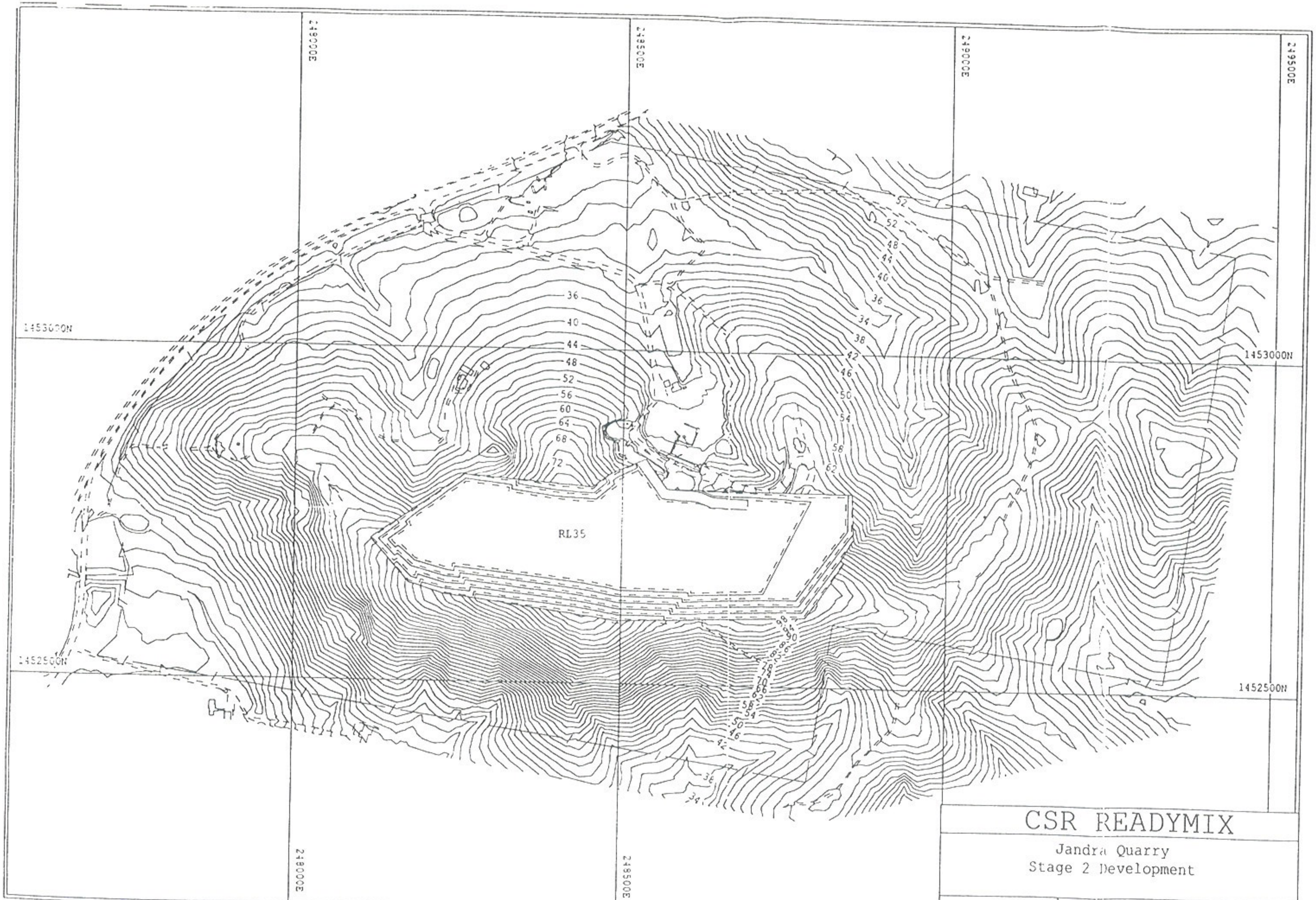


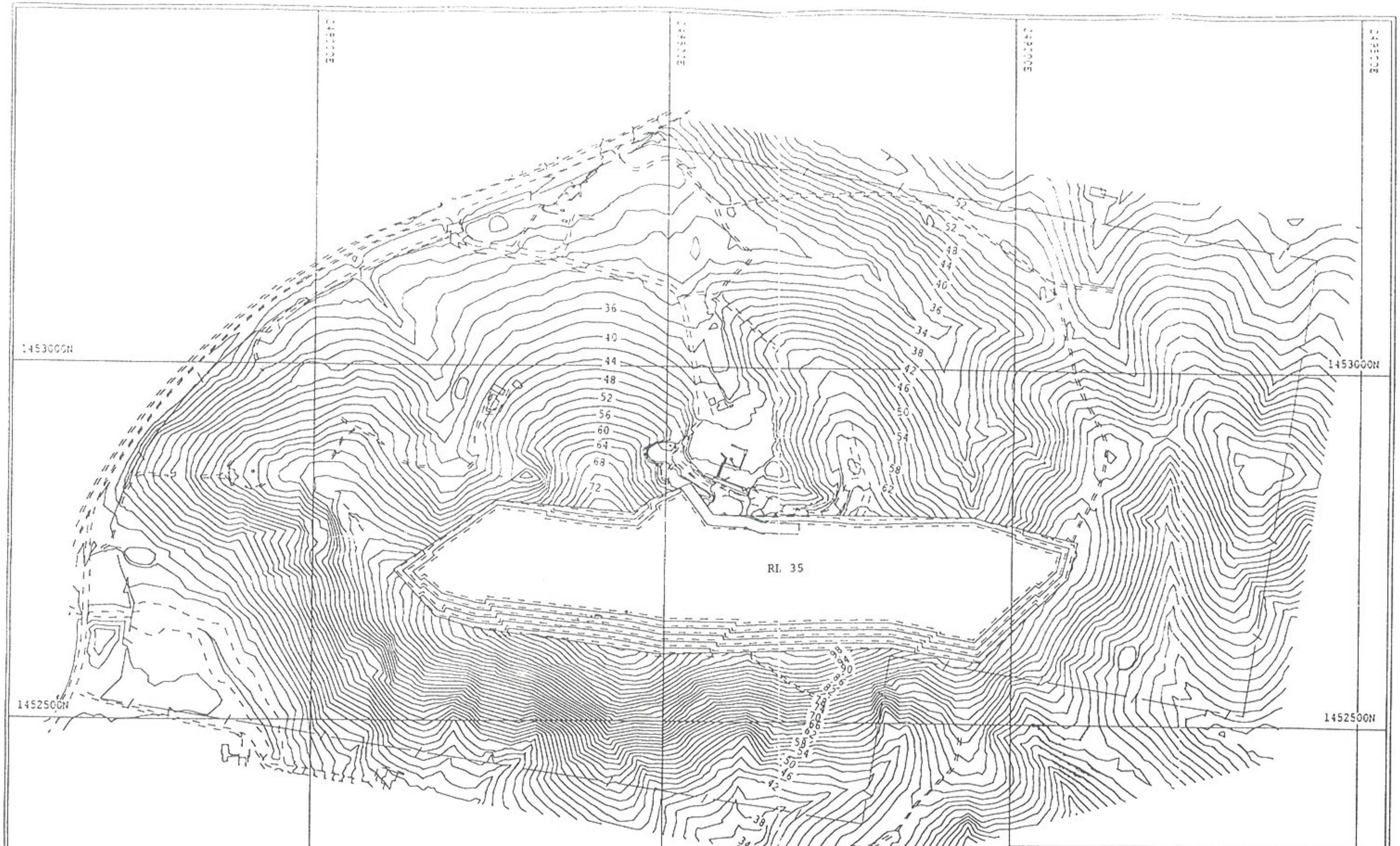
CSR READYMIX

Jandra Quarry
Stage 2 Development

Scale: 1: 5500	Plan No.	Date: 06-Apr-99

SURPAC2000 - SURPAC Software International

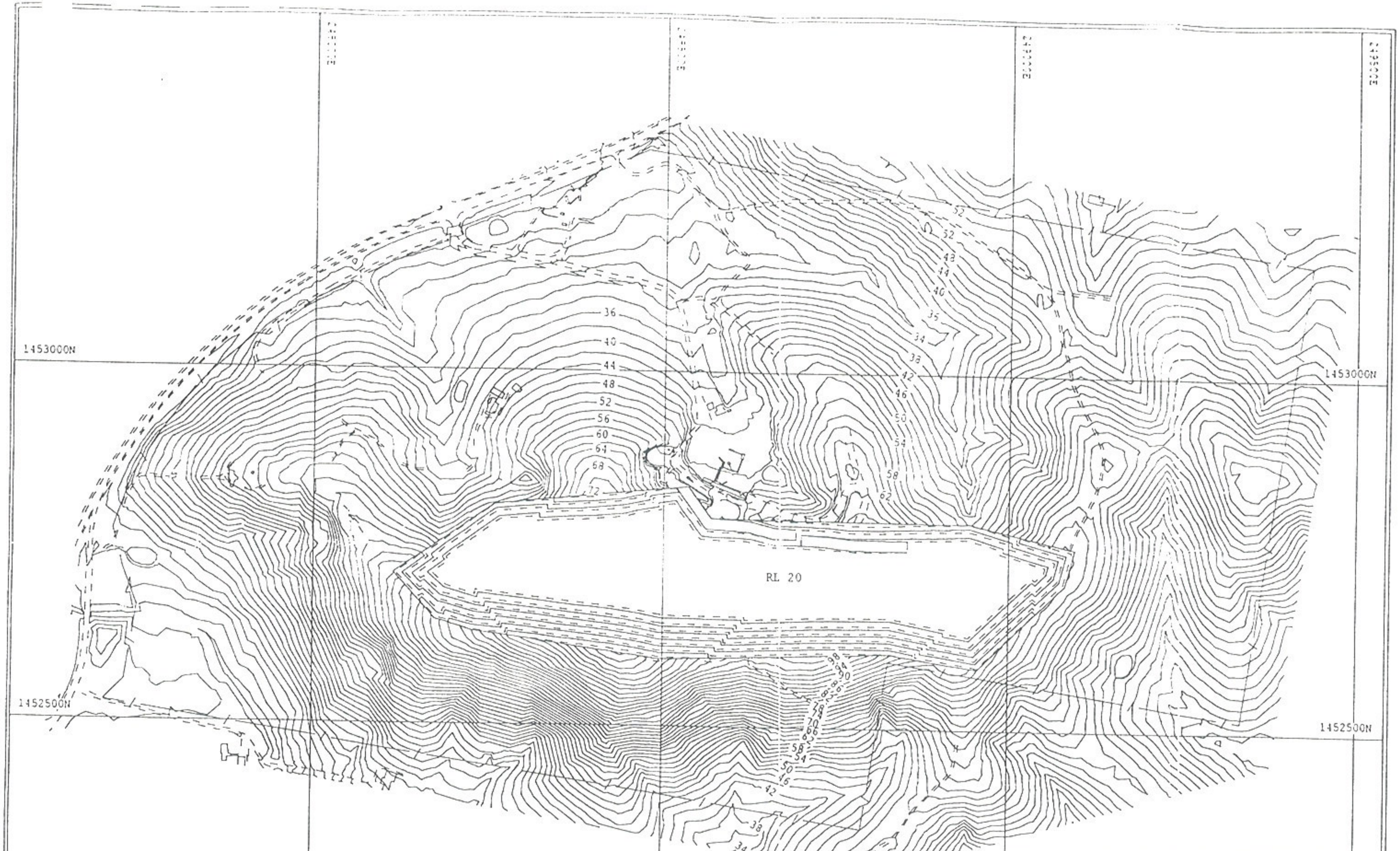
jan-else.pf



CSR READYMIX		
Jandra Quarry Stage 3 Development		
Scale: 1: 5500	Plan No.	Date: 26-Feb-99

jan-eisb.pf

SURPAC2000 - SURPAC Software International



CSR READYMIX

Jandra Quarry
Complete Development

Scale: 1: 5500	Plan No.	Date: 26-Feb-99

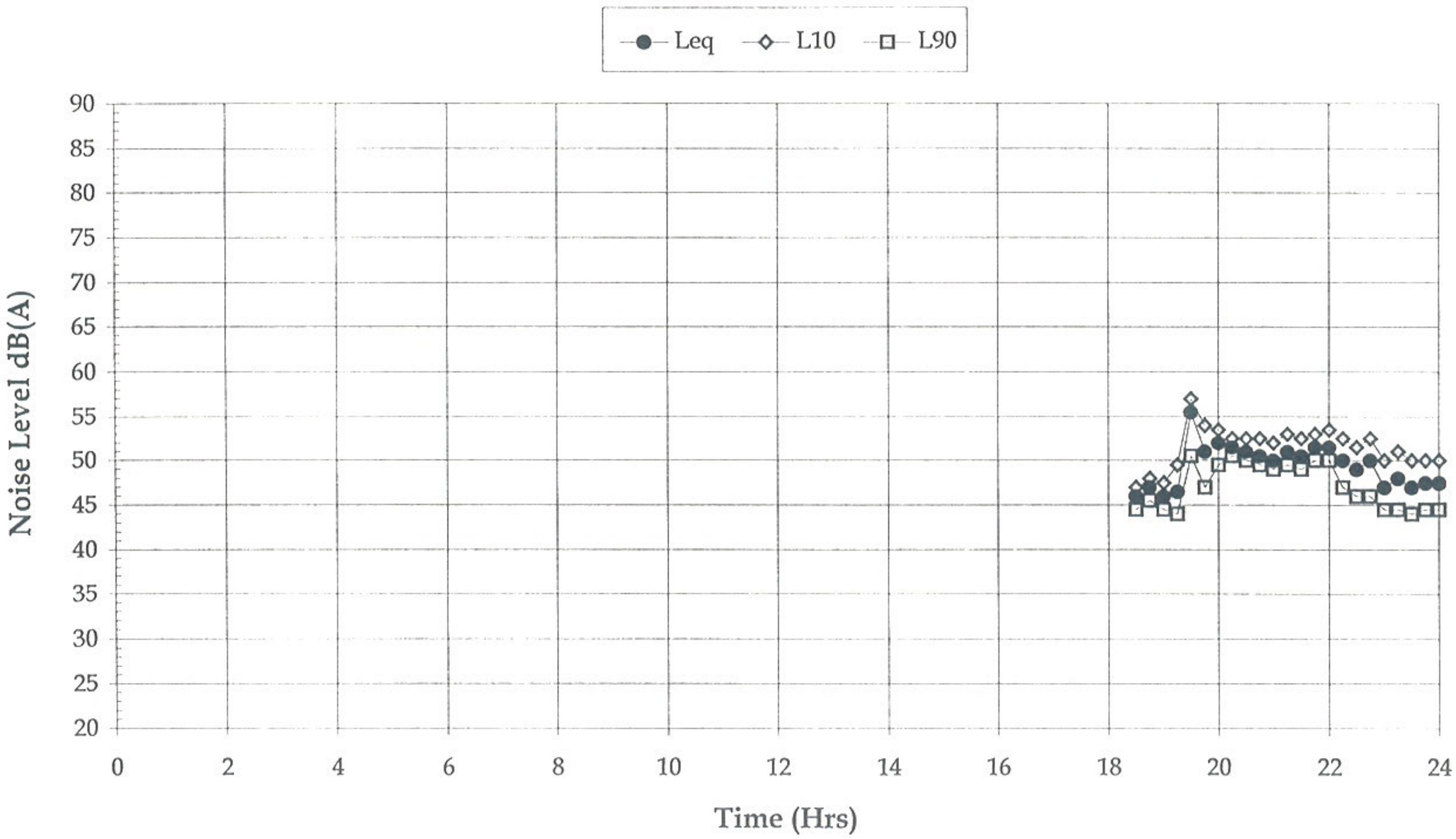
SURPAC2000 - SURPAC Software International

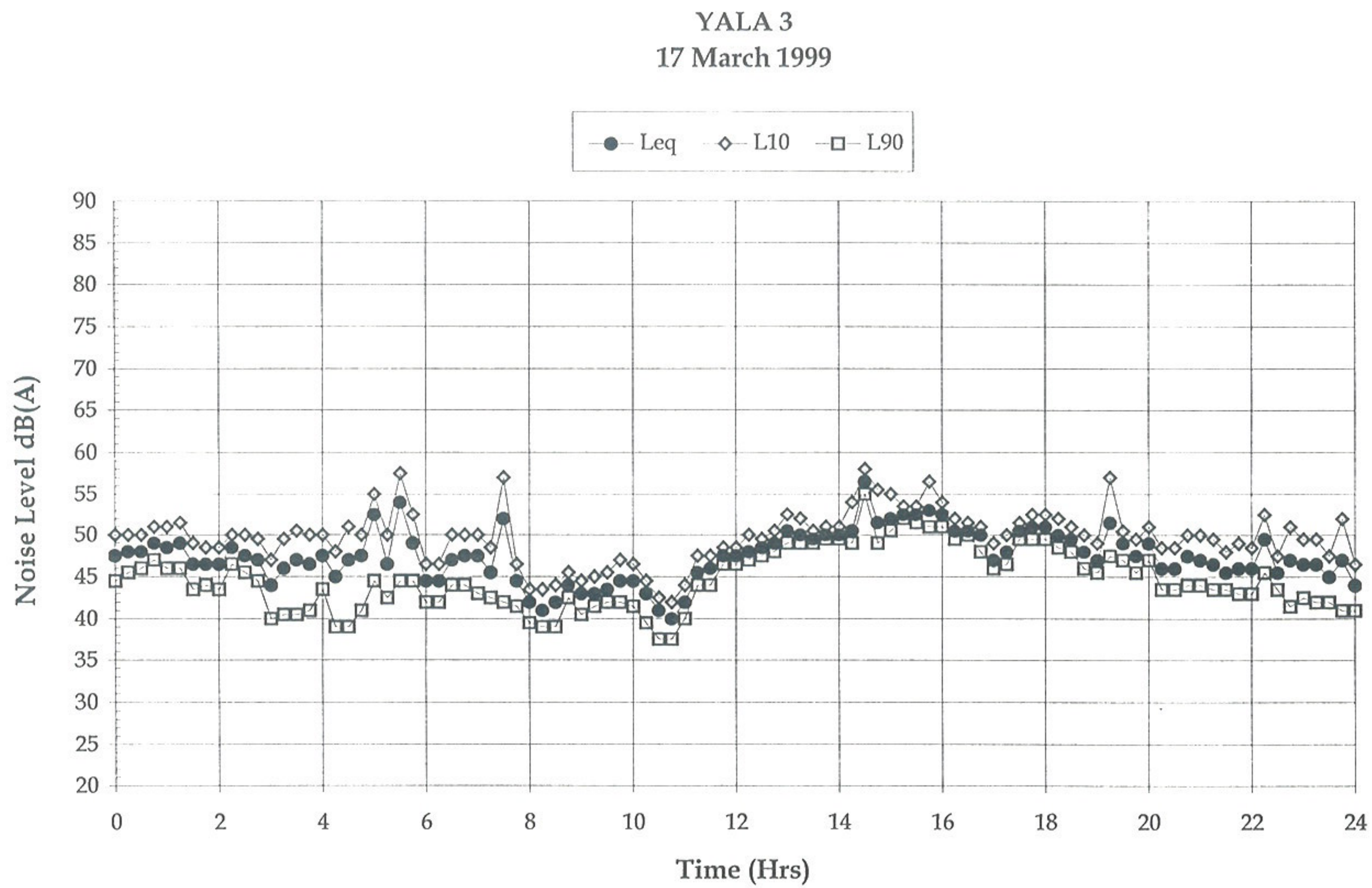
jan-eisc.pf

Appendix B

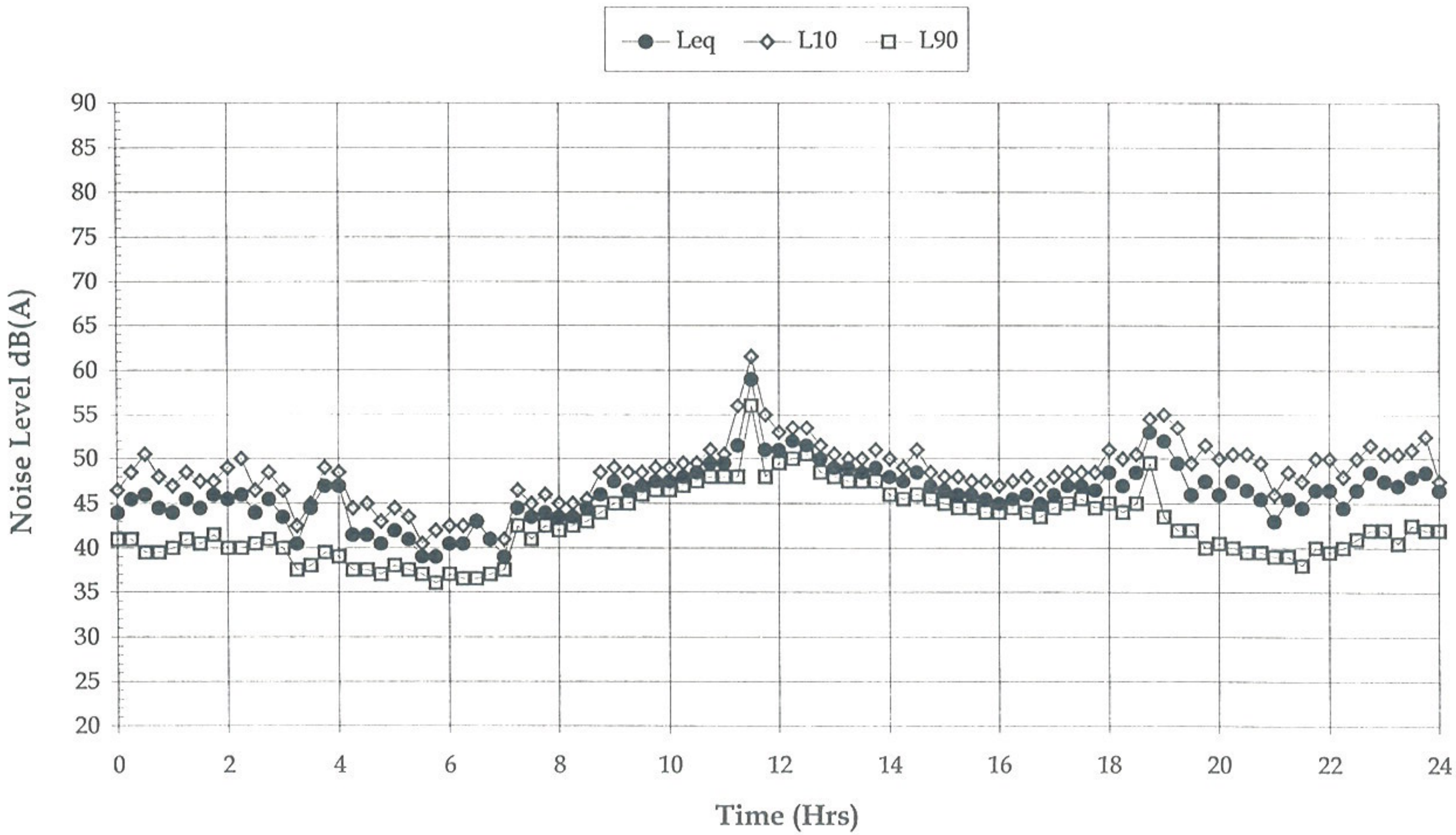
NOISE GRAPHS

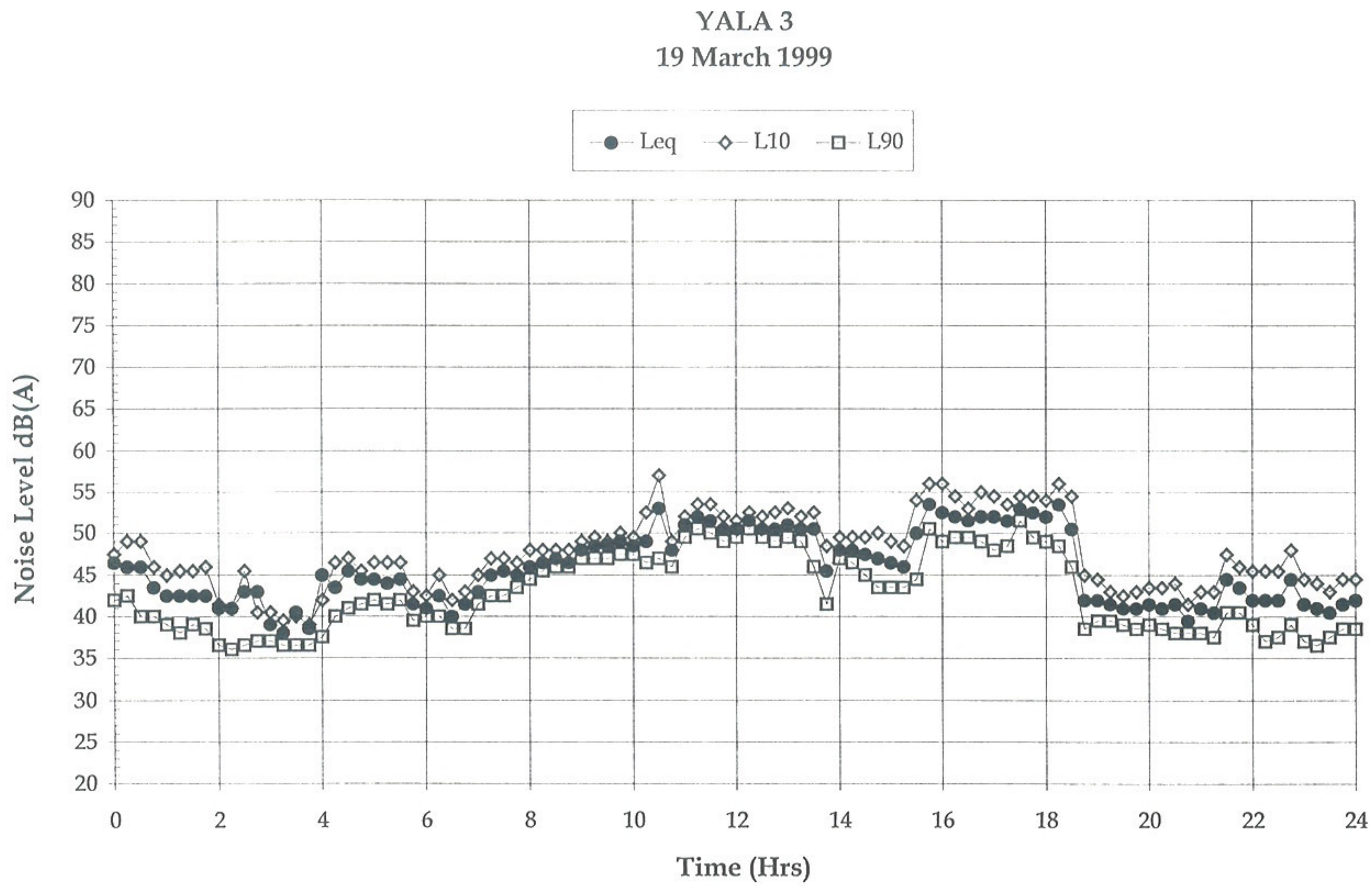
YALA 3
16 March 1999

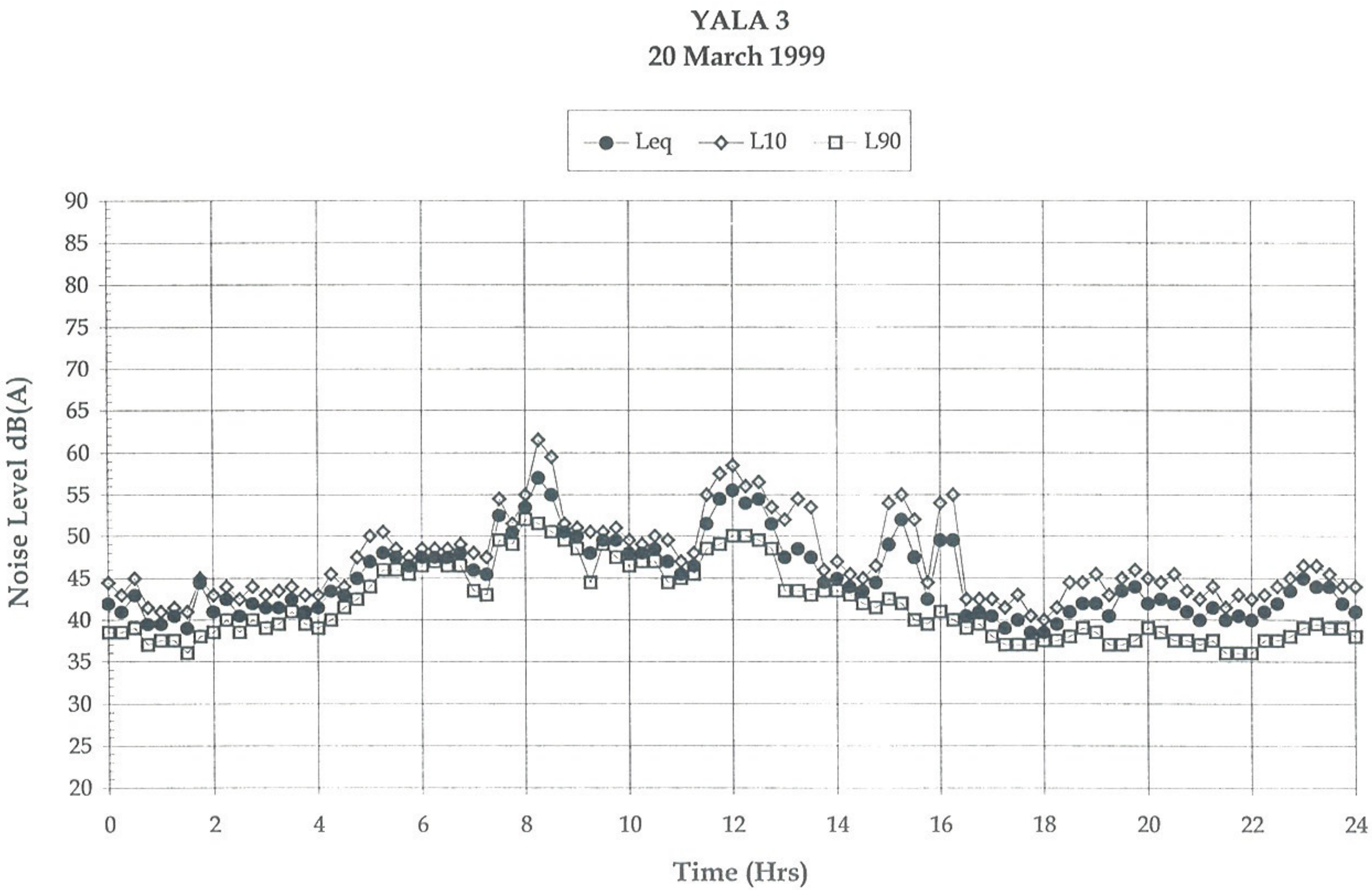



YALA 3
17 March 1999
Leq
L10
L90
Noise Level dB(A)
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (Hrs)

YALA 3
18 March 1999




YALA 3
19 March 1999
Leq
L10
L90
Noise Level dB(A)
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (Hrs)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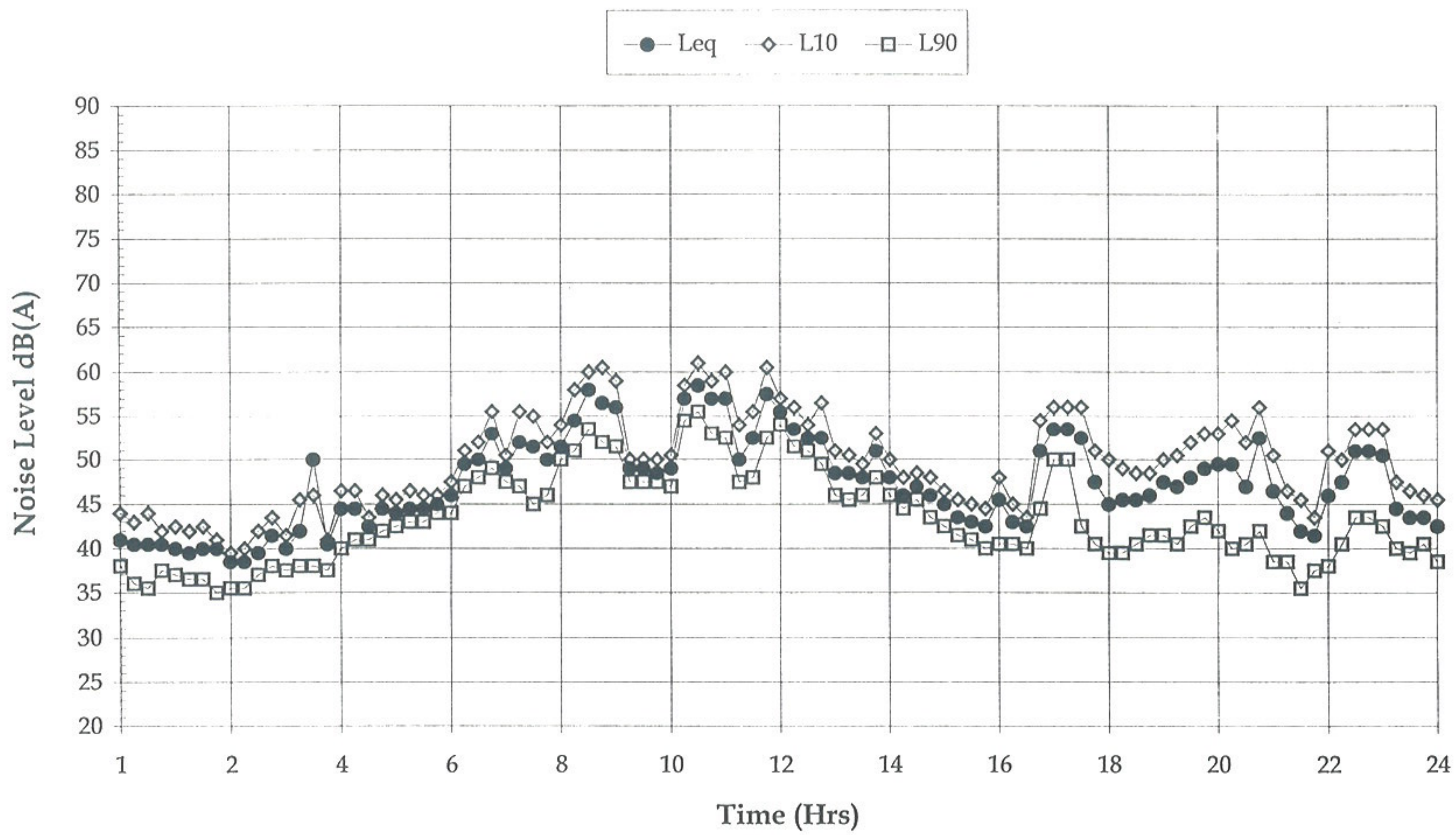

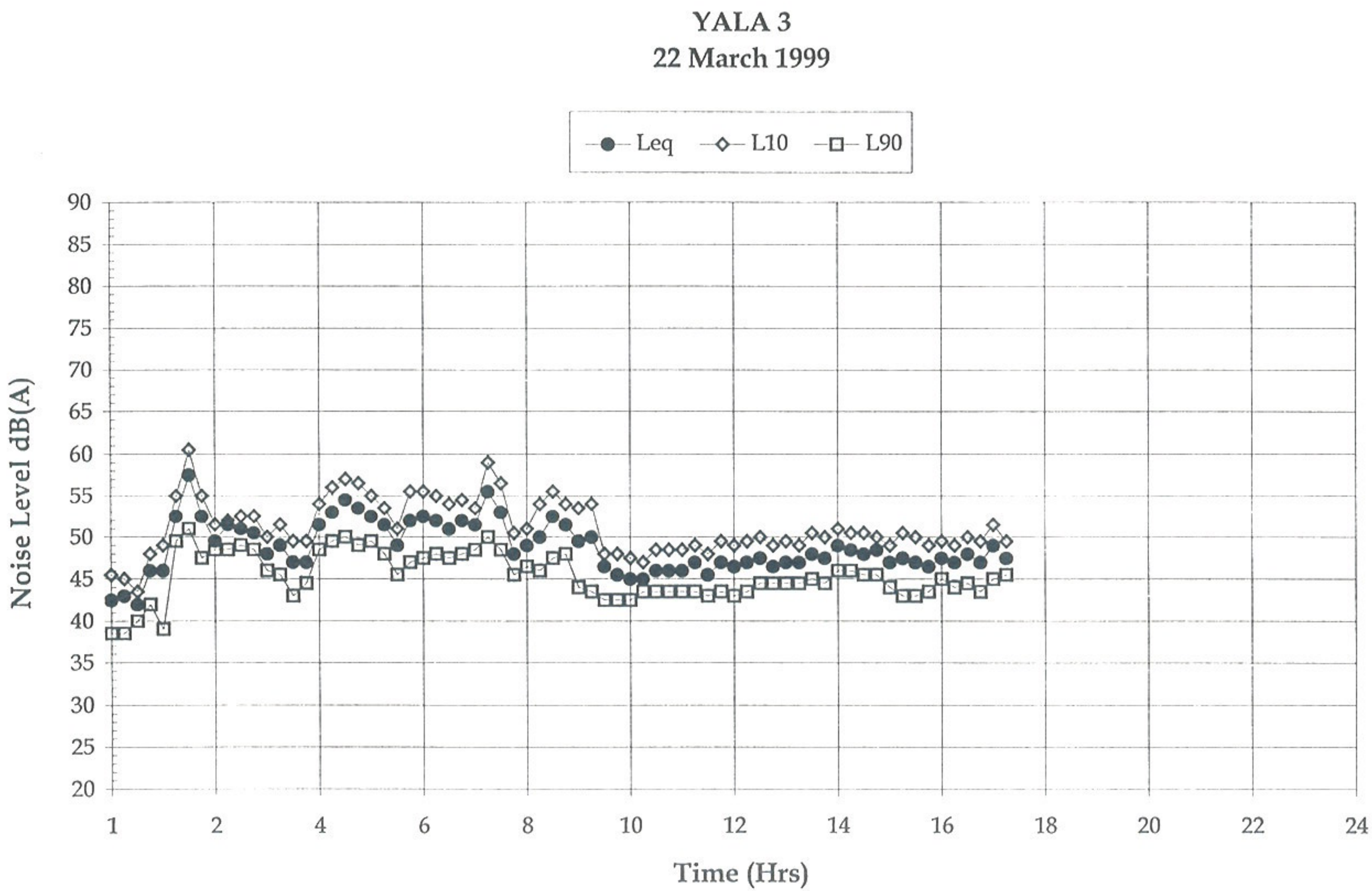
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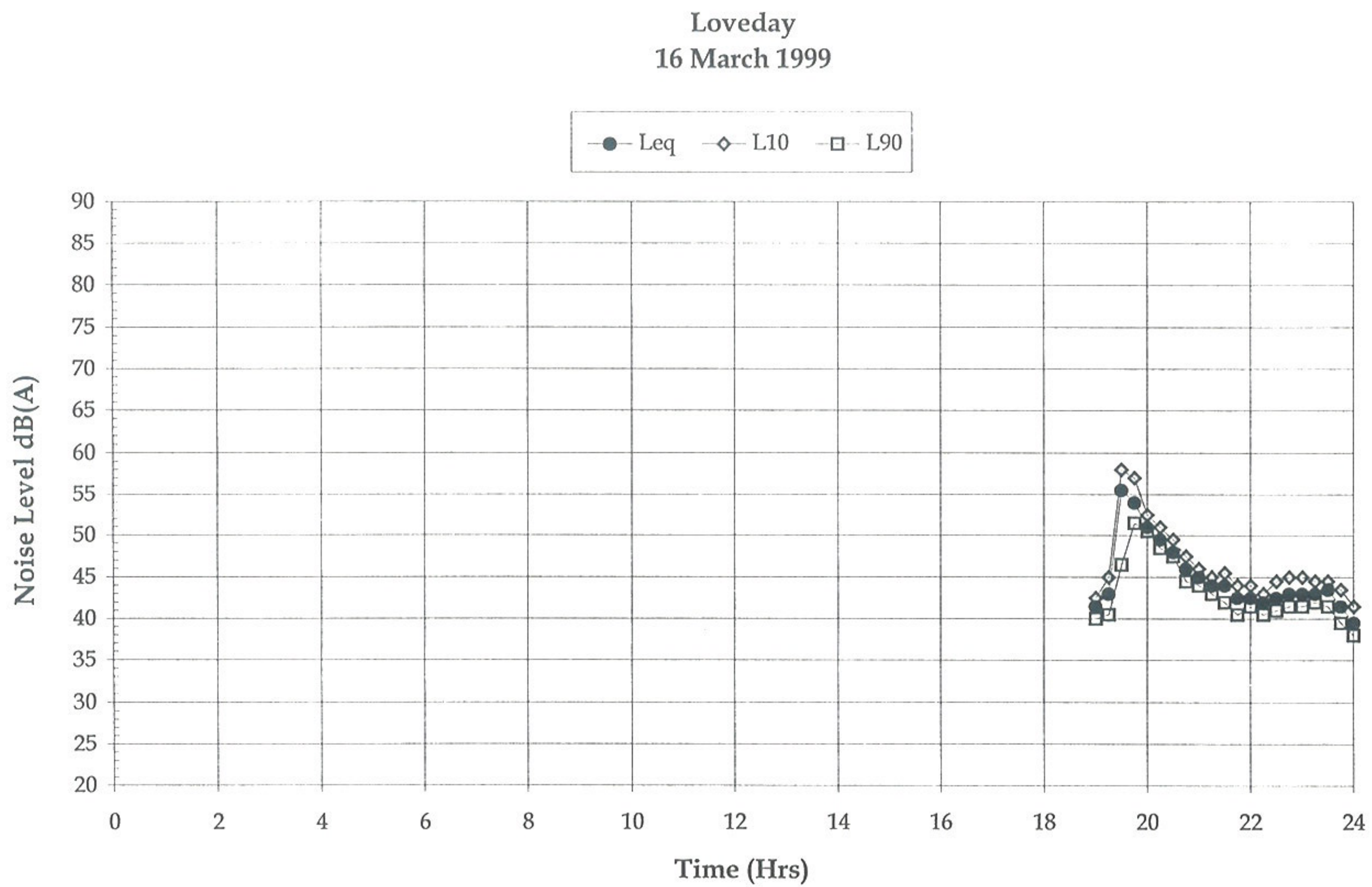
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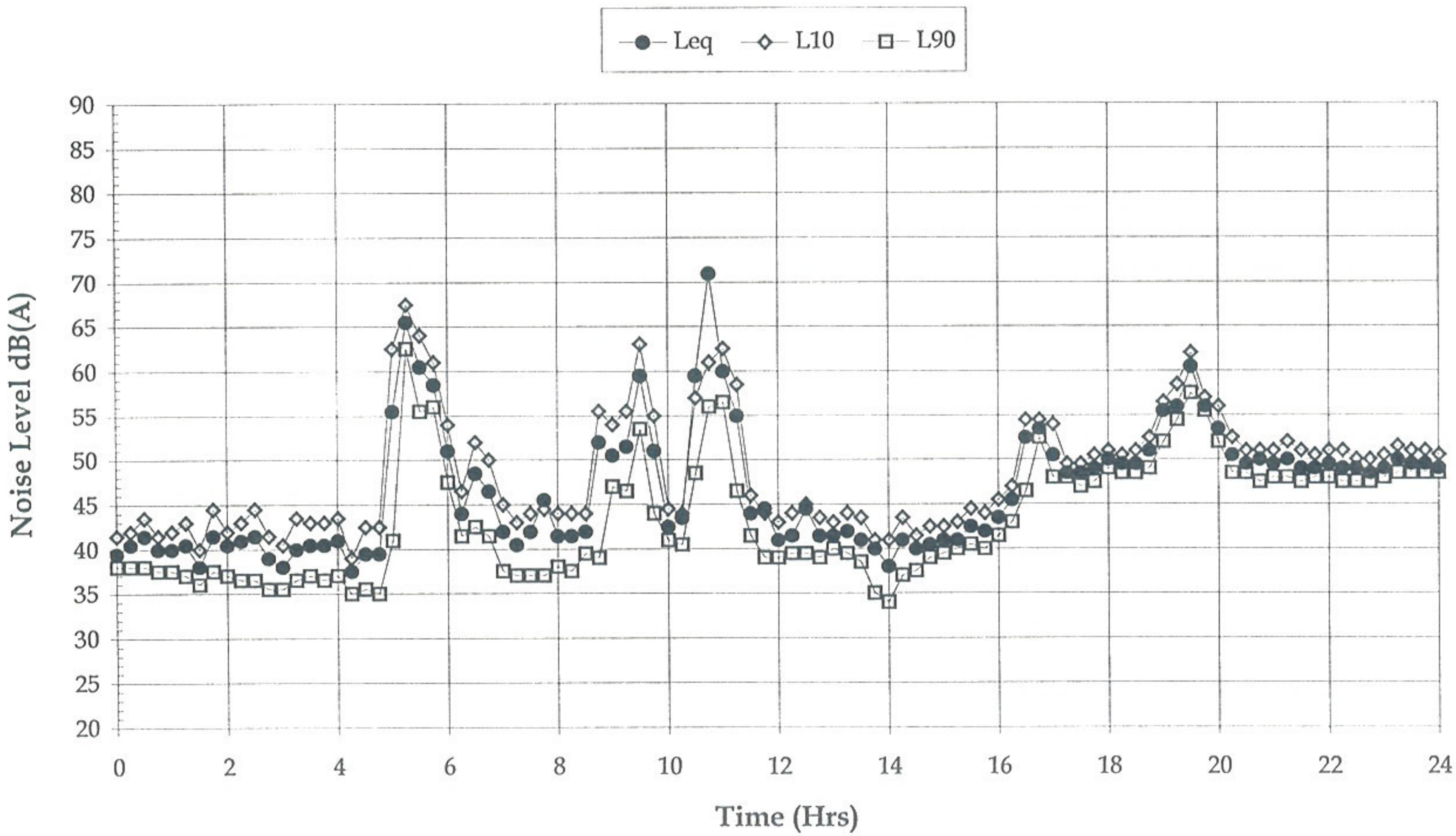

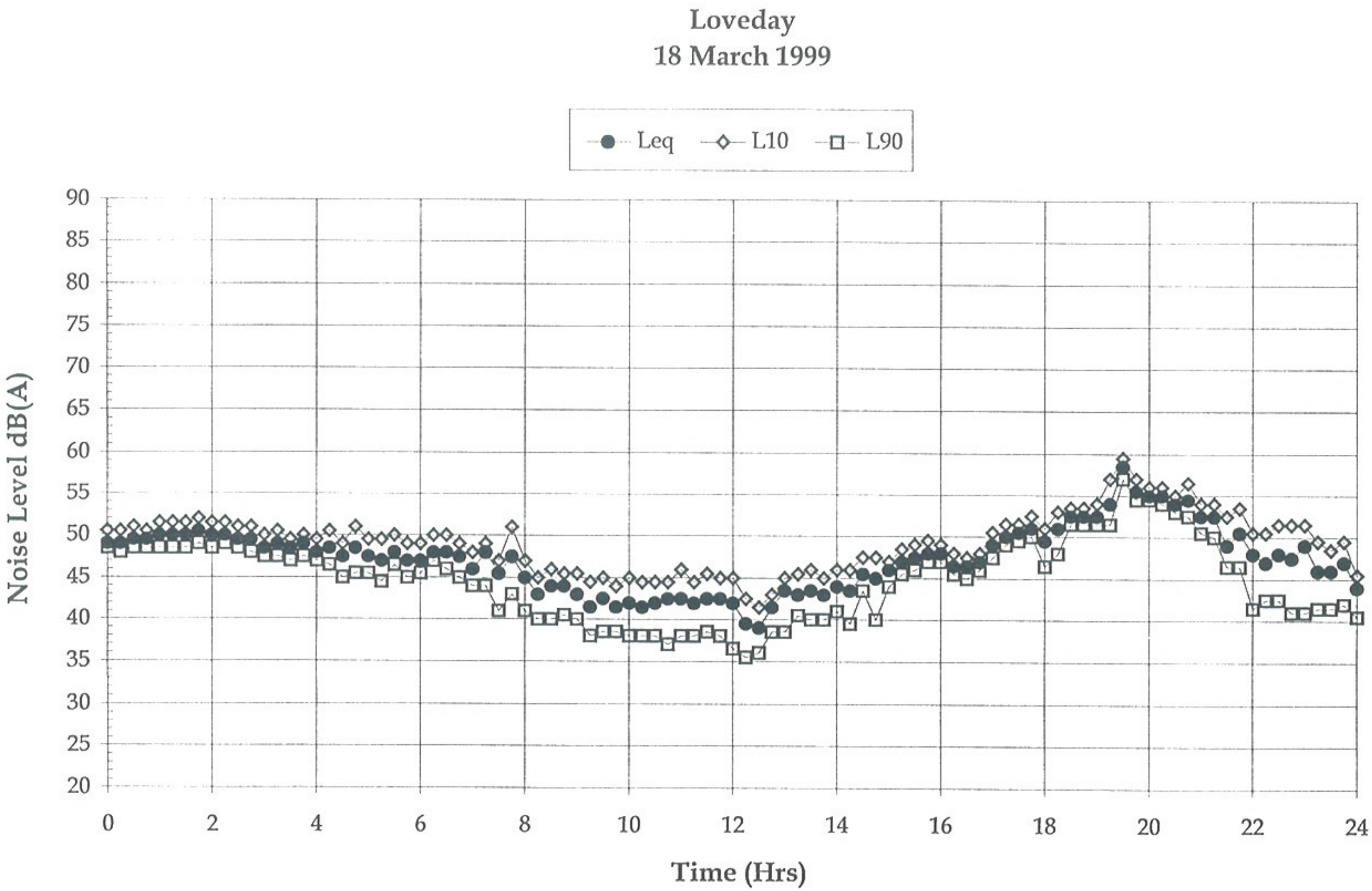
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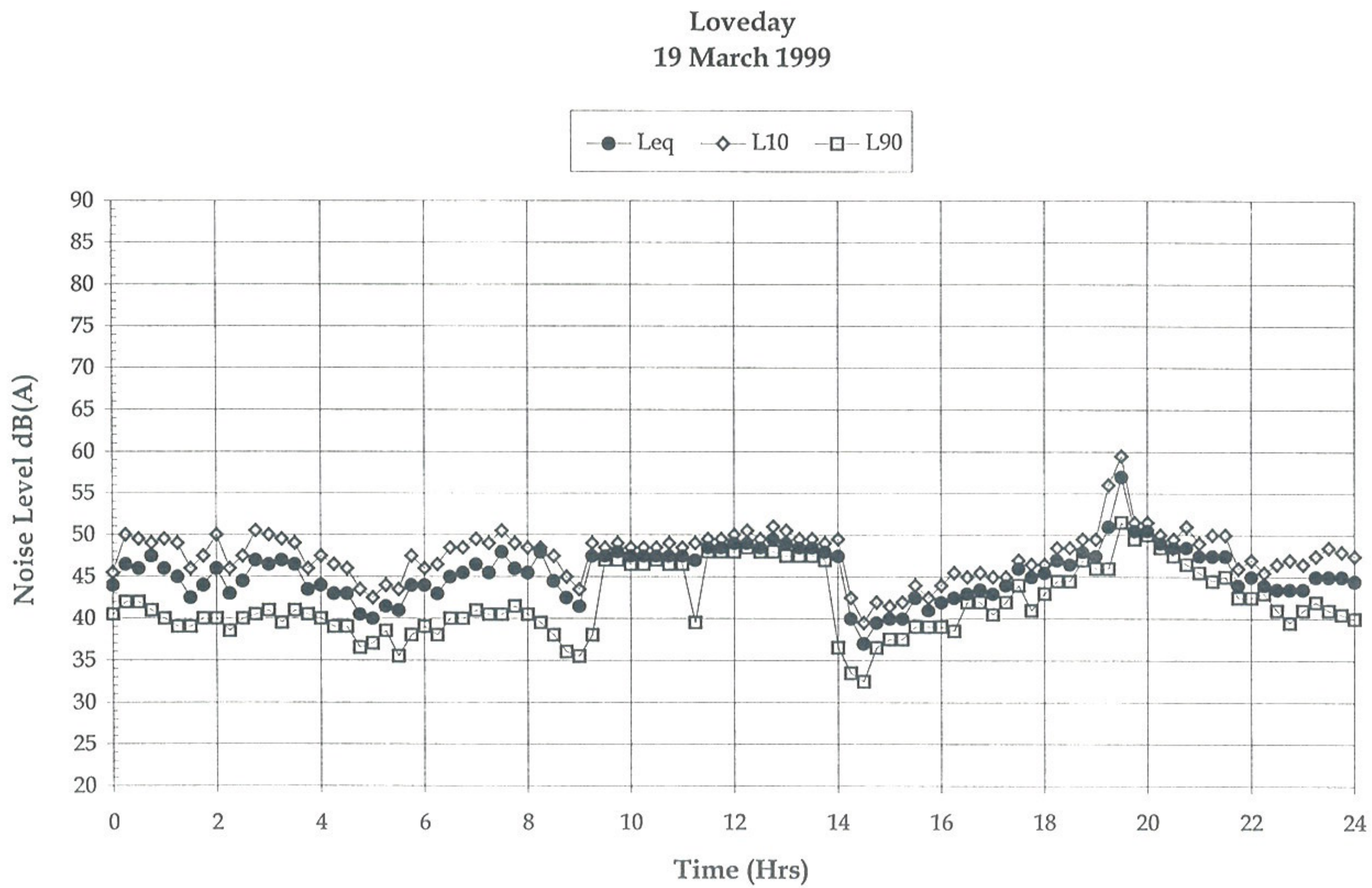

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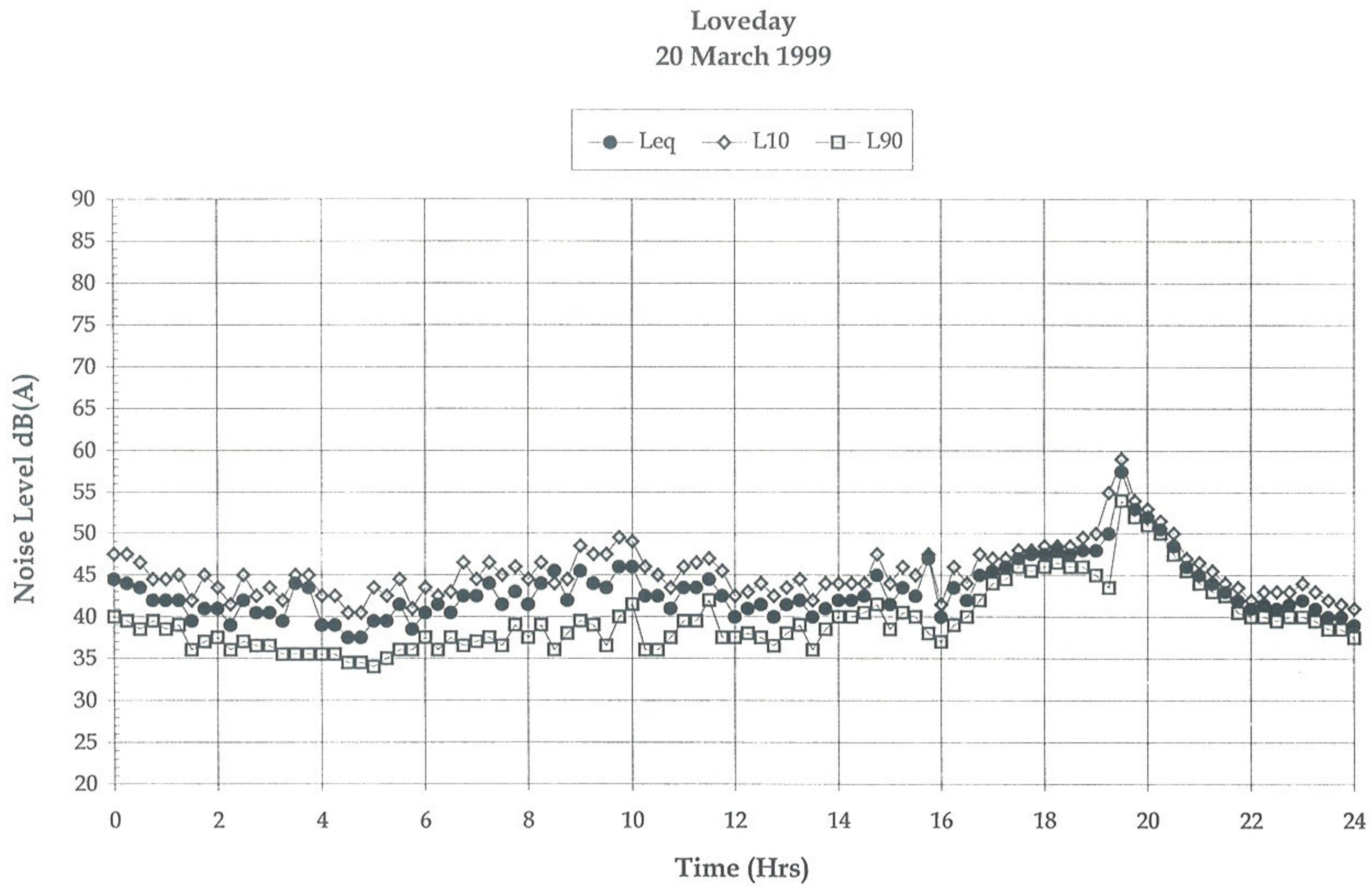
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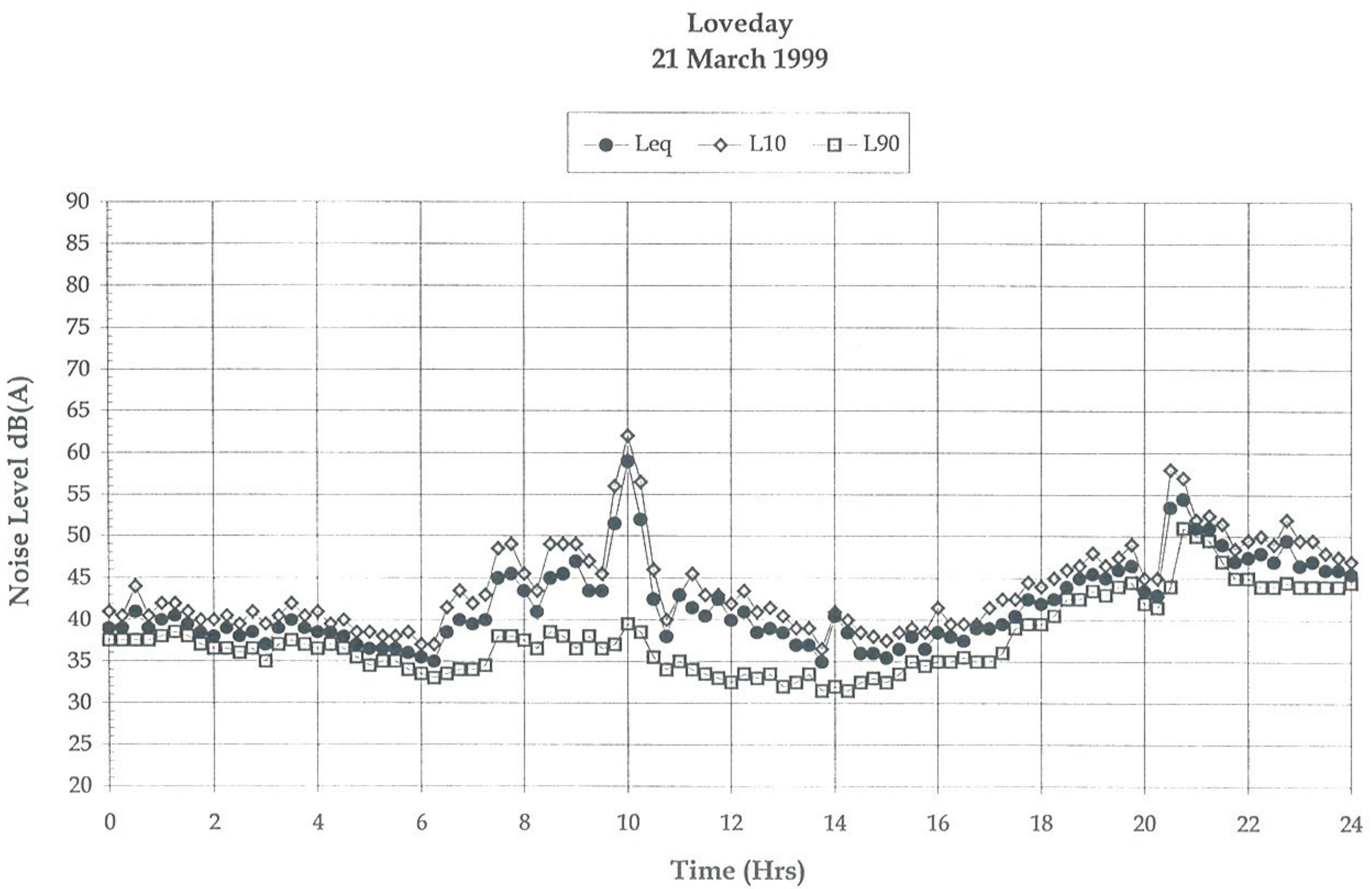
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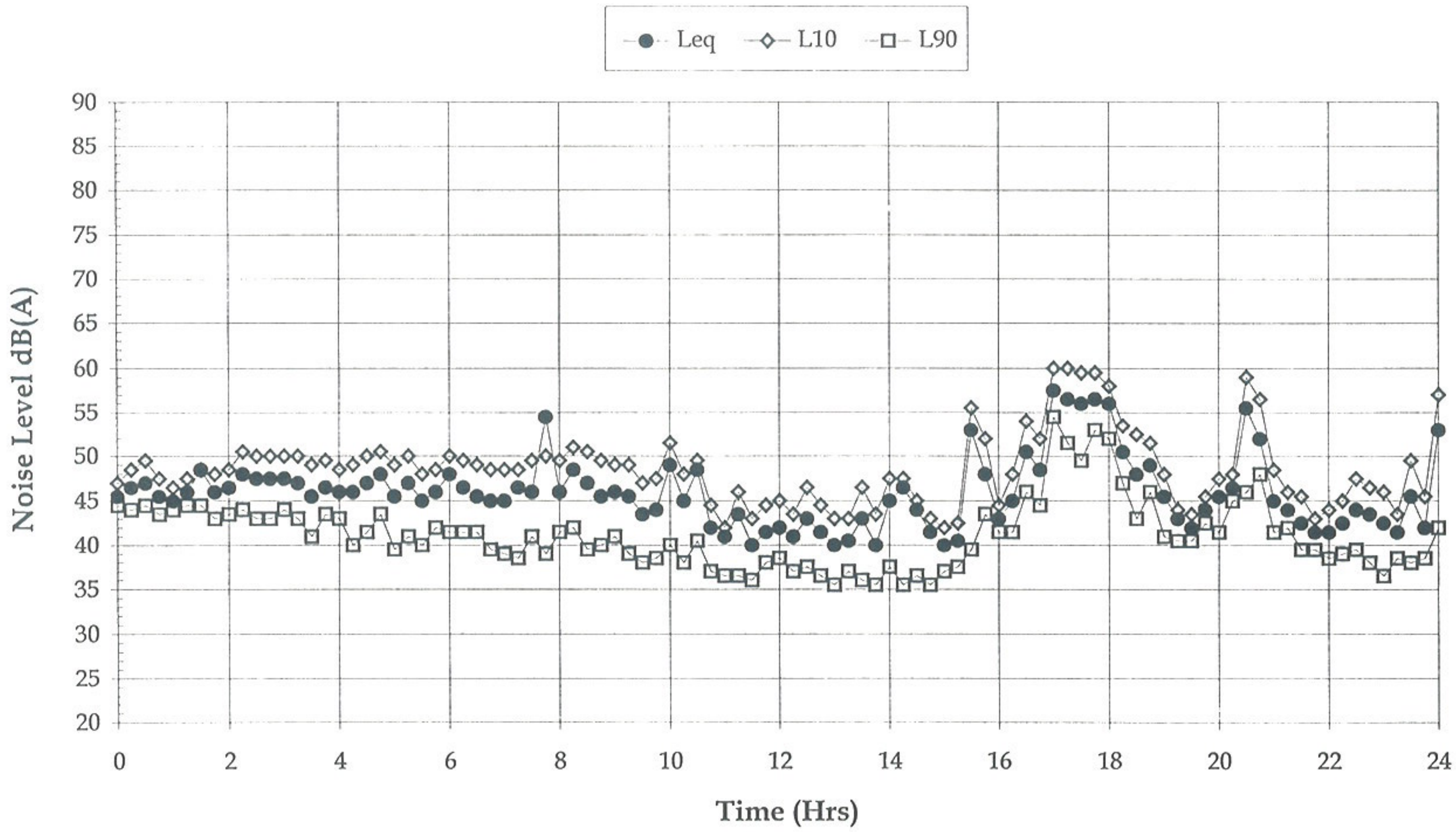

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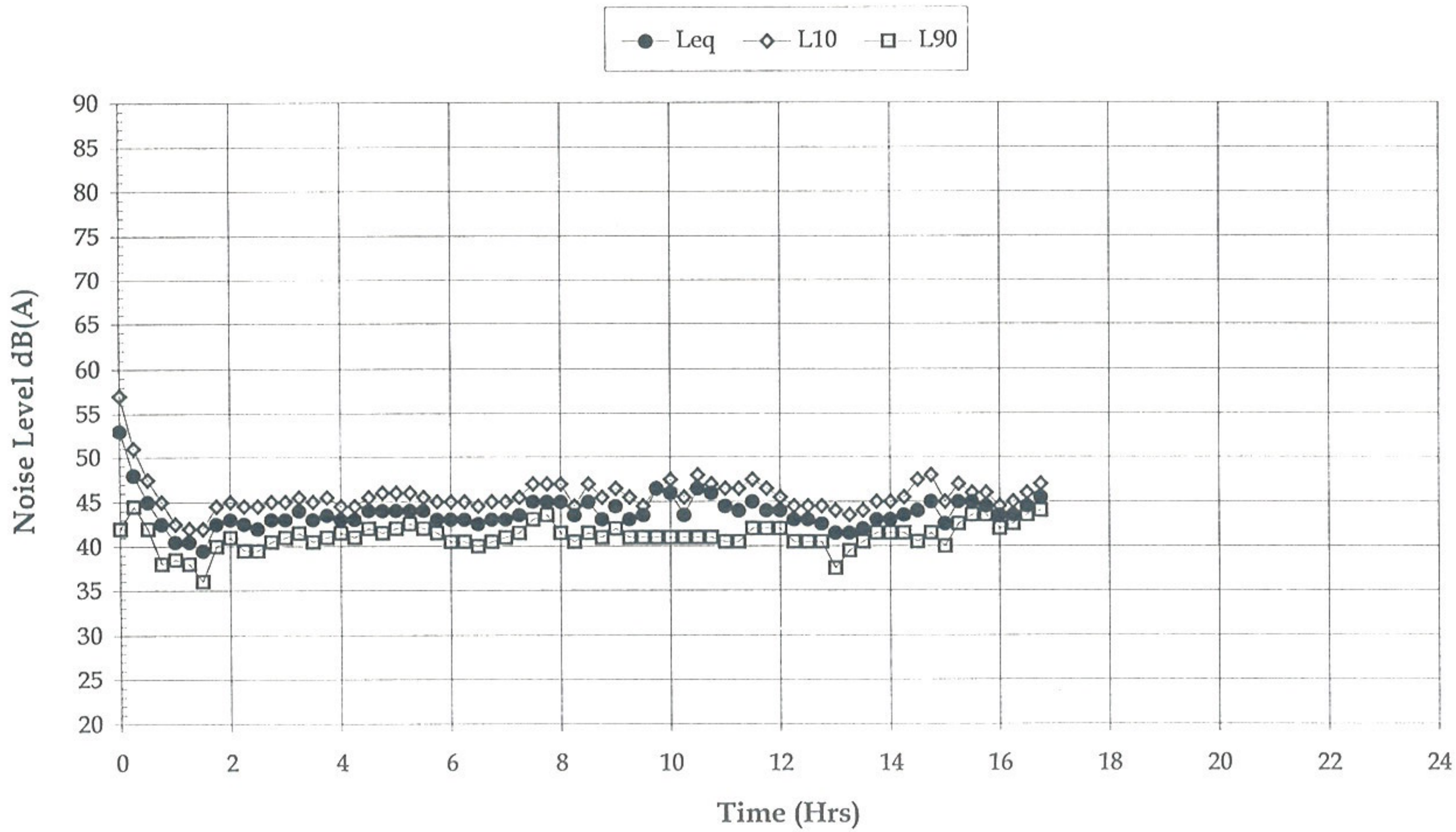

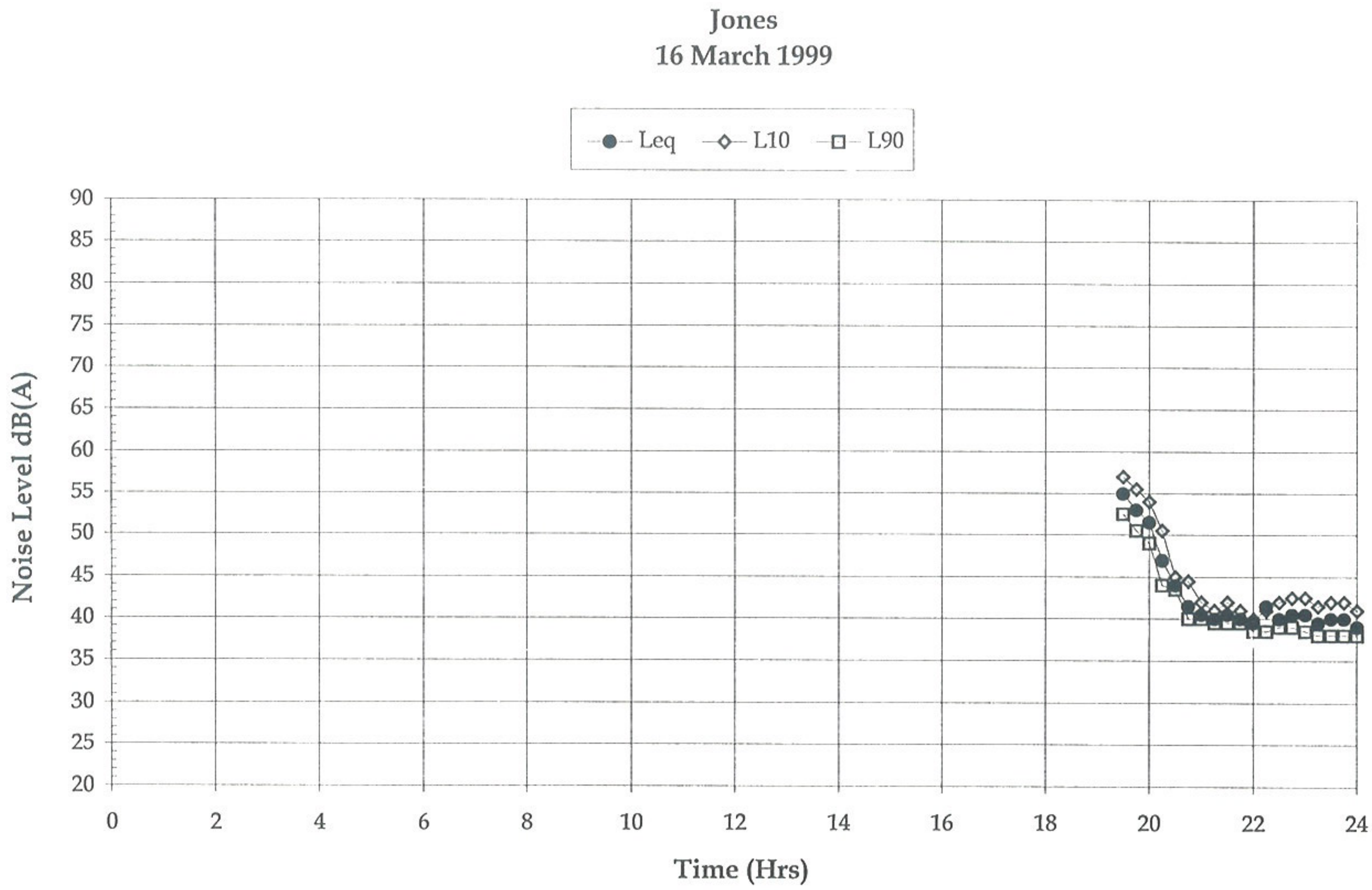
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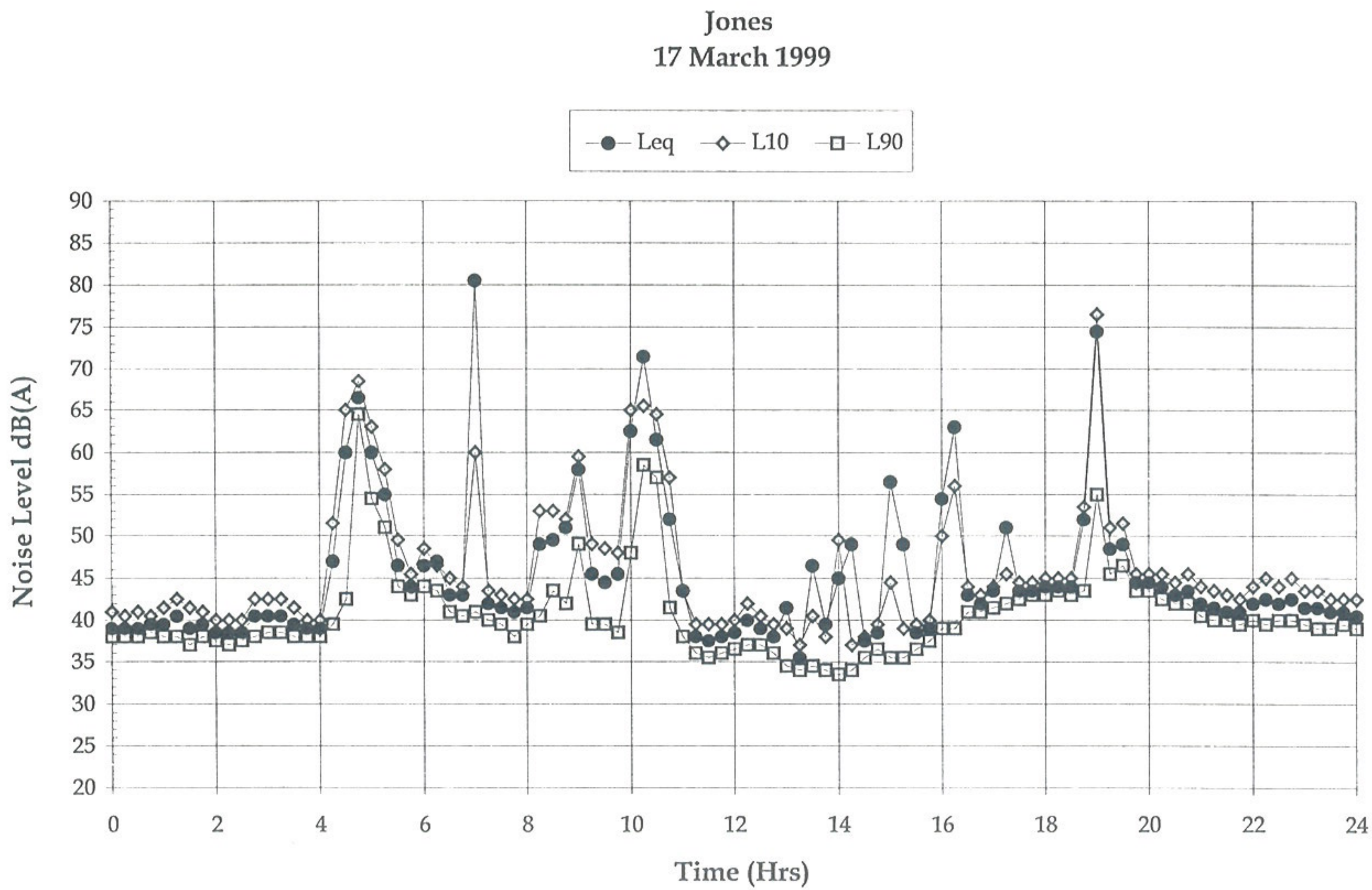

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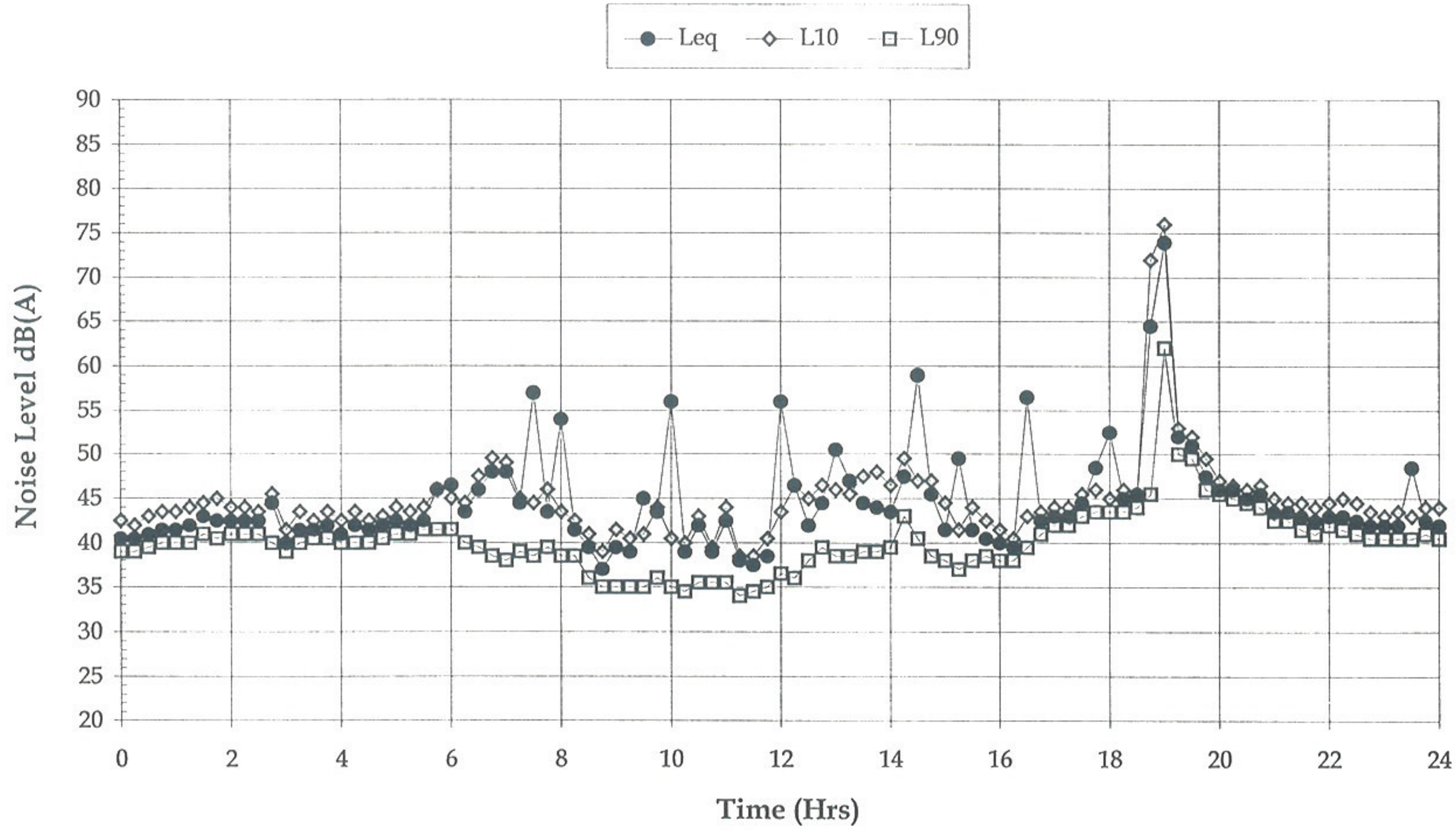

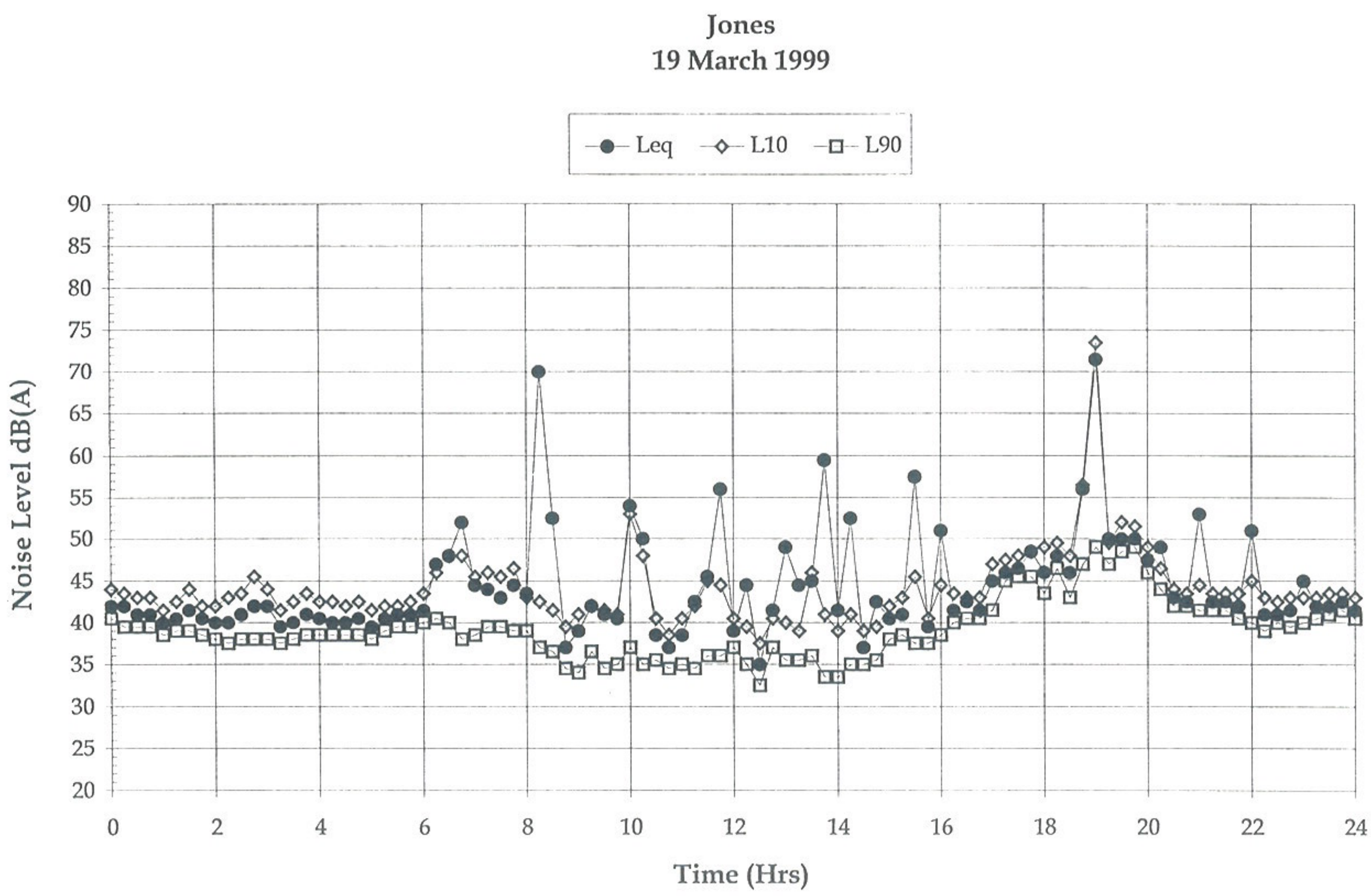

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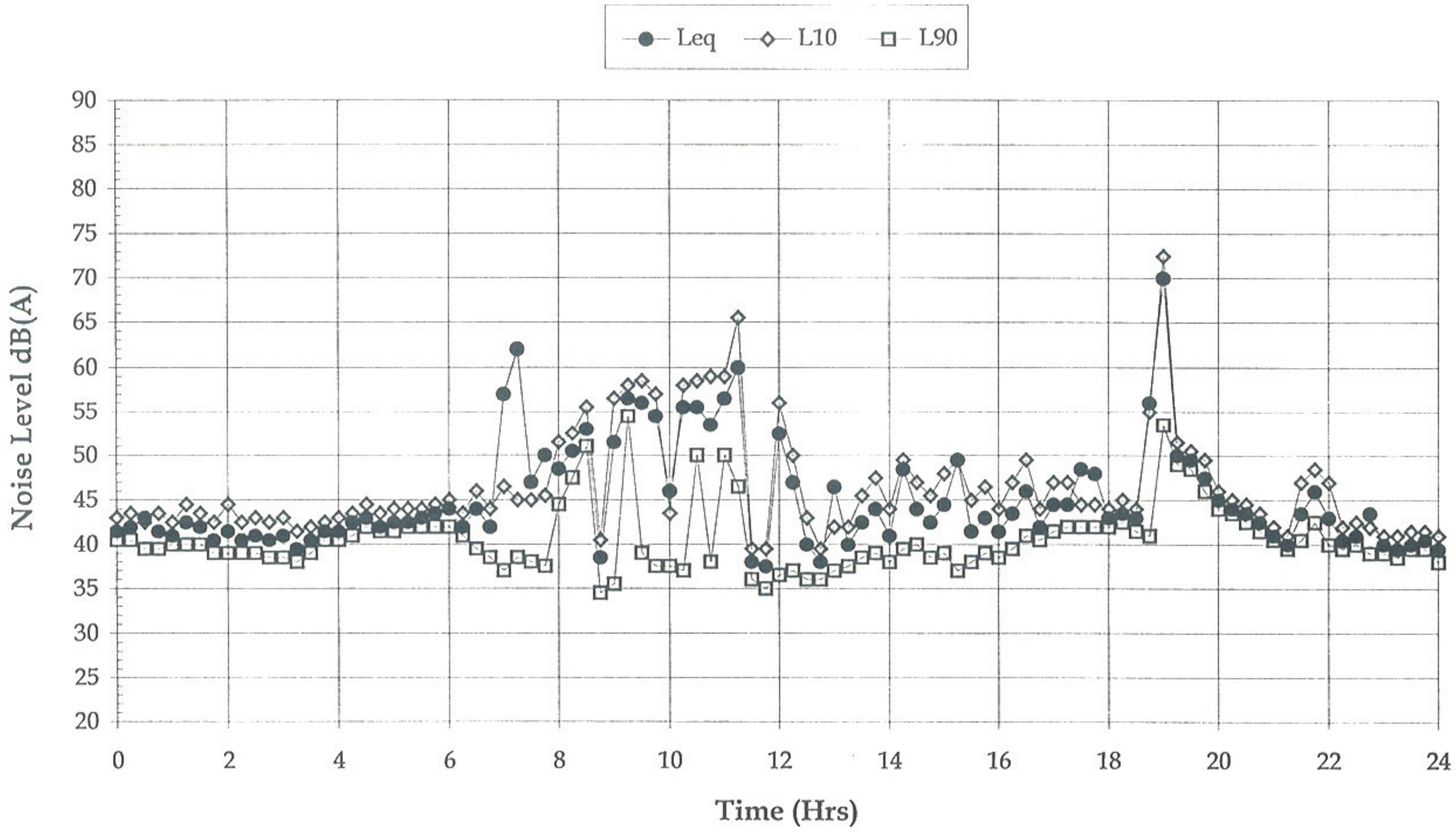

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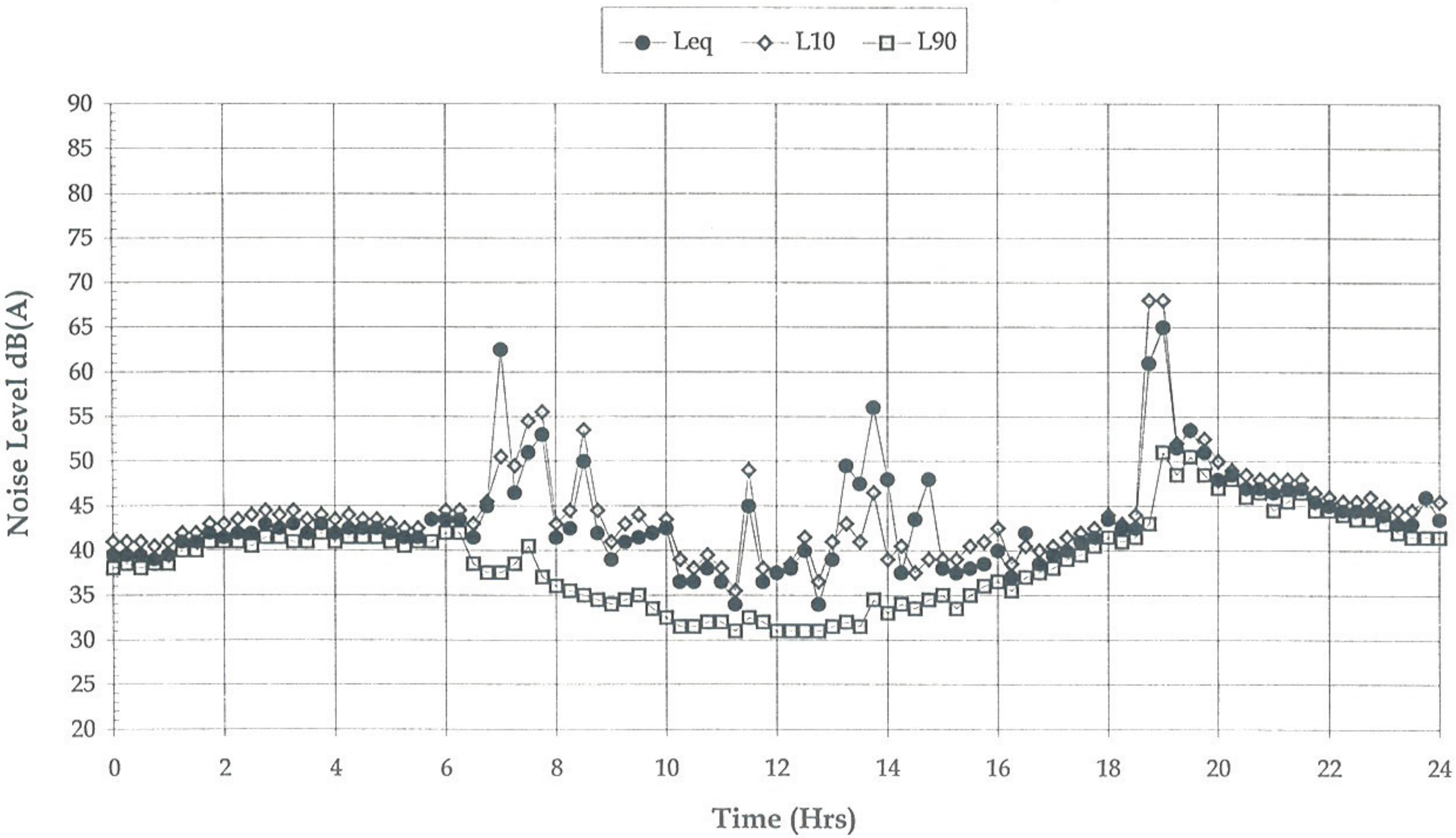

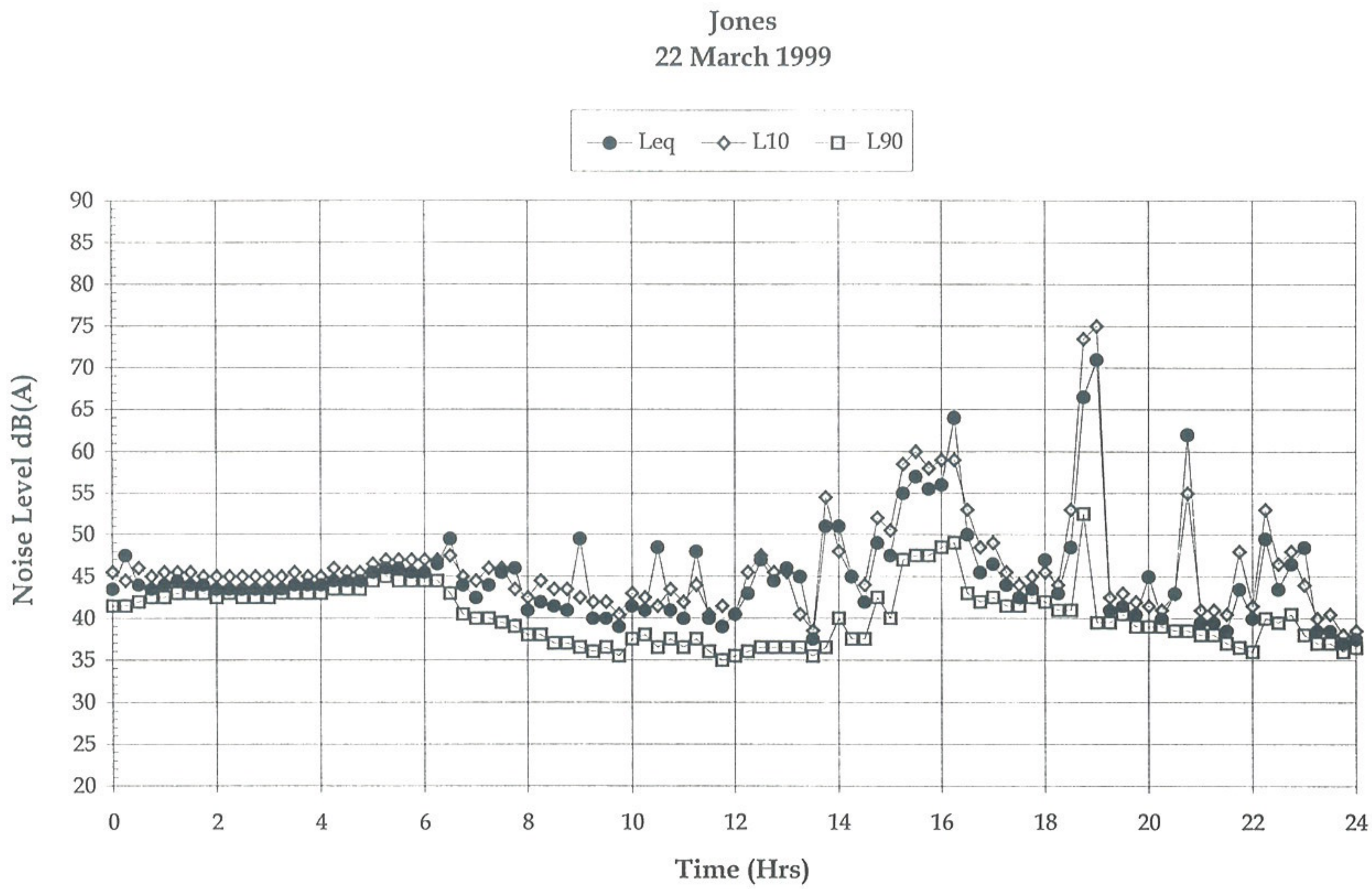
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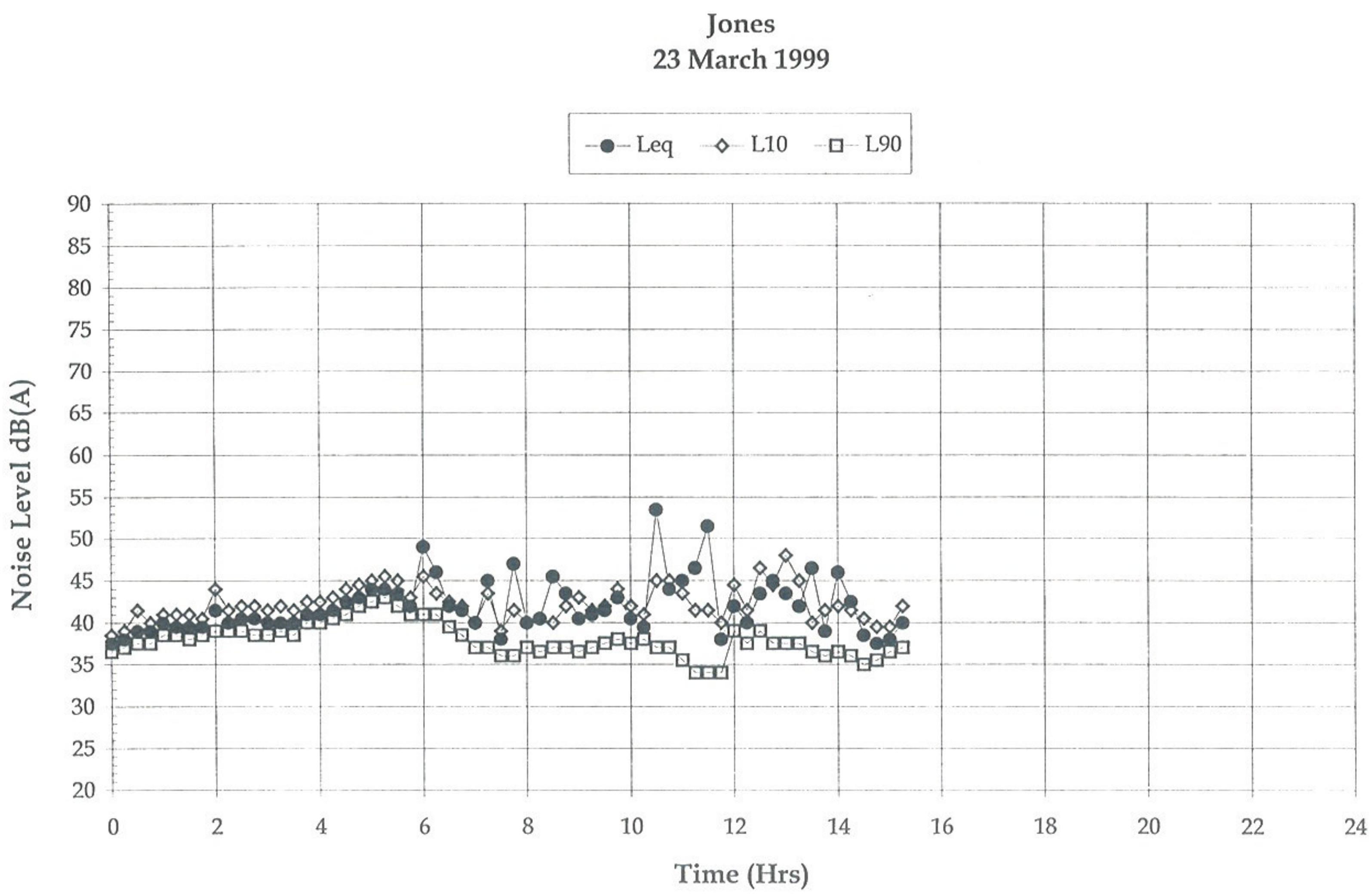
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Time (Hrs)

Appendix C

ISG PLANT CO-ORDINATES

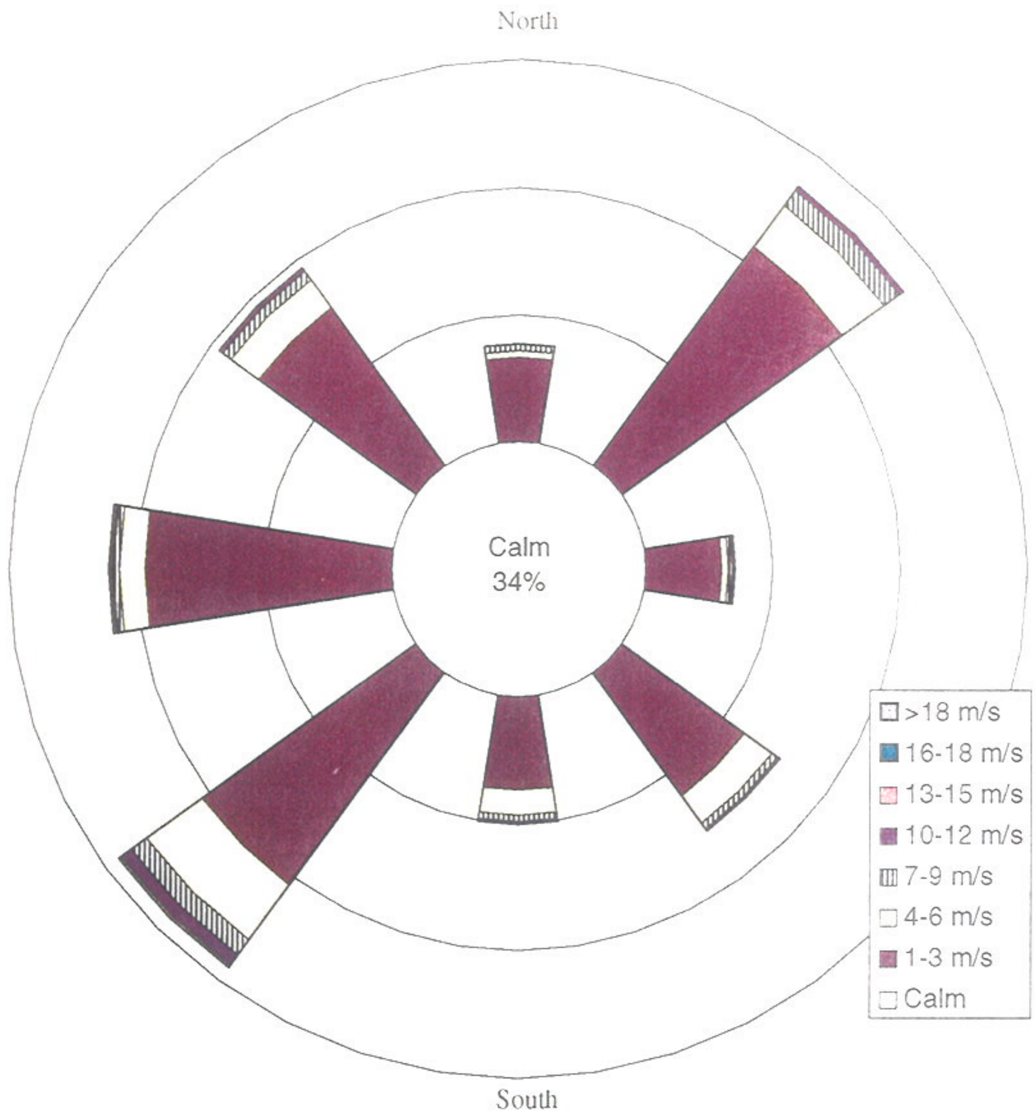
Table C.1 ISG PLANT LOCATIONS FOR NOISE MODELLING

		Stage 0			Stage 1			Stage 3		
id	Plant	x	y	z	x	y	z	x	y	z
1	D8 Dozer	248431	1452769	74	248195	1452640	84	249092	1452754	76
2	EX300	248444	1452728	74	248250	1452632	92	249089	1452734	76
3	966FEL	248453	1453109	34	248453	1453109	34	248453	1453109	34
4	Drill	248467	1452727	62	248453	1452609	98	249055	1452691	62
5	980FEL	248496	1452690	72	248320	1452625	98	249022	1452667	62
6	Komatsu HD325	248537	1452688	72	248554	1452609	98	249049	1452760	62
7	Volvo 18t	248984	1452776	56	248640	1452690	42	248984	1452776	50
8	Crusher	248594	1452852	44	248594	1452852	44	248594	1452852	44
9	WA420 FEL	248625	1452984	42	248625	1452984	42	248625	1452984	42
10	Transport Truck	248570	1452930	42	248570	1452930	42	248570	1452930	42
11	Water Cart 18t	248566	1452719	66	248789	1452836	66	248608	1452897	43
12	Asphalt Plant	248445	1453094	34	248445	1453094	34	248445	1453094	34

Appendix D

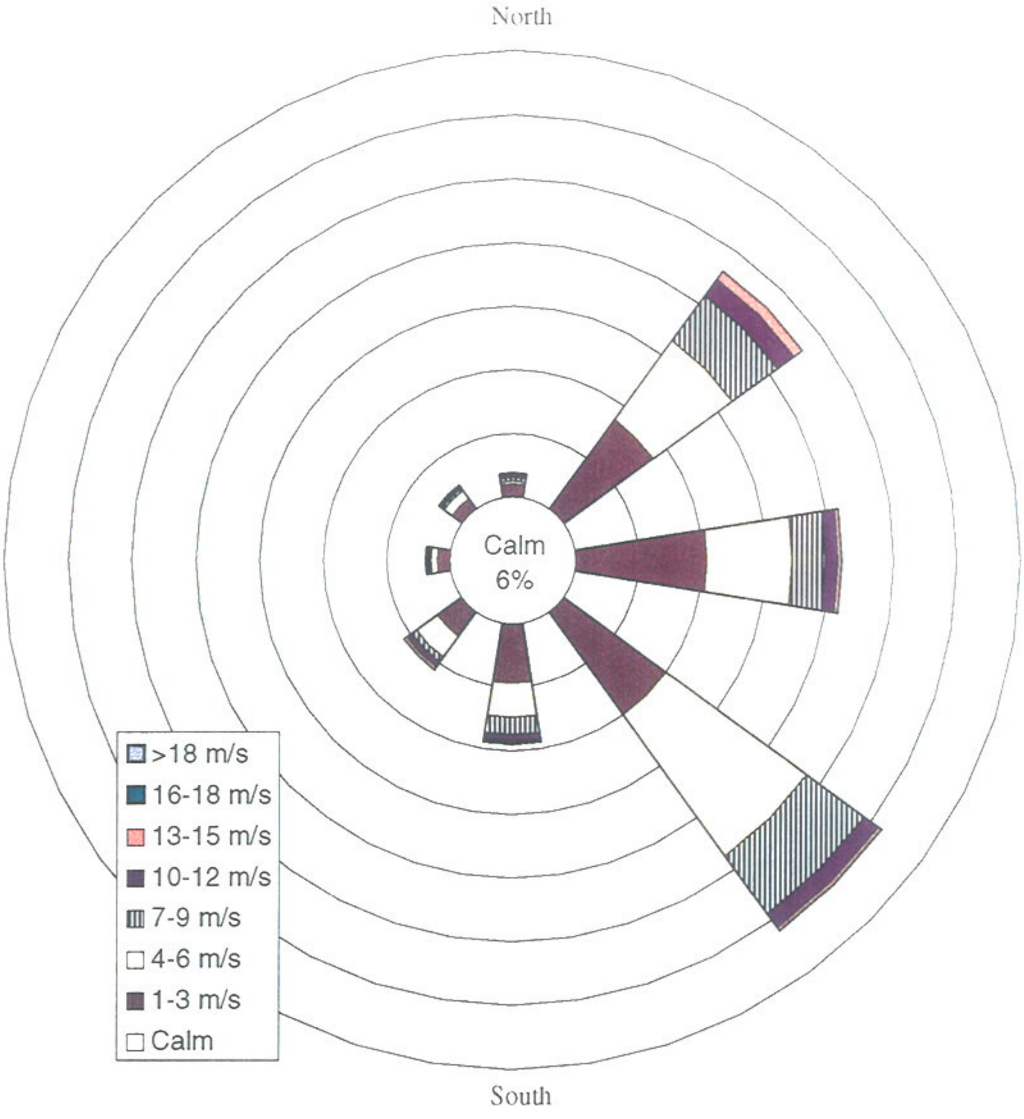
WIND ROSES FOR TAREE AIRPORT

Windrose for Summer
9am



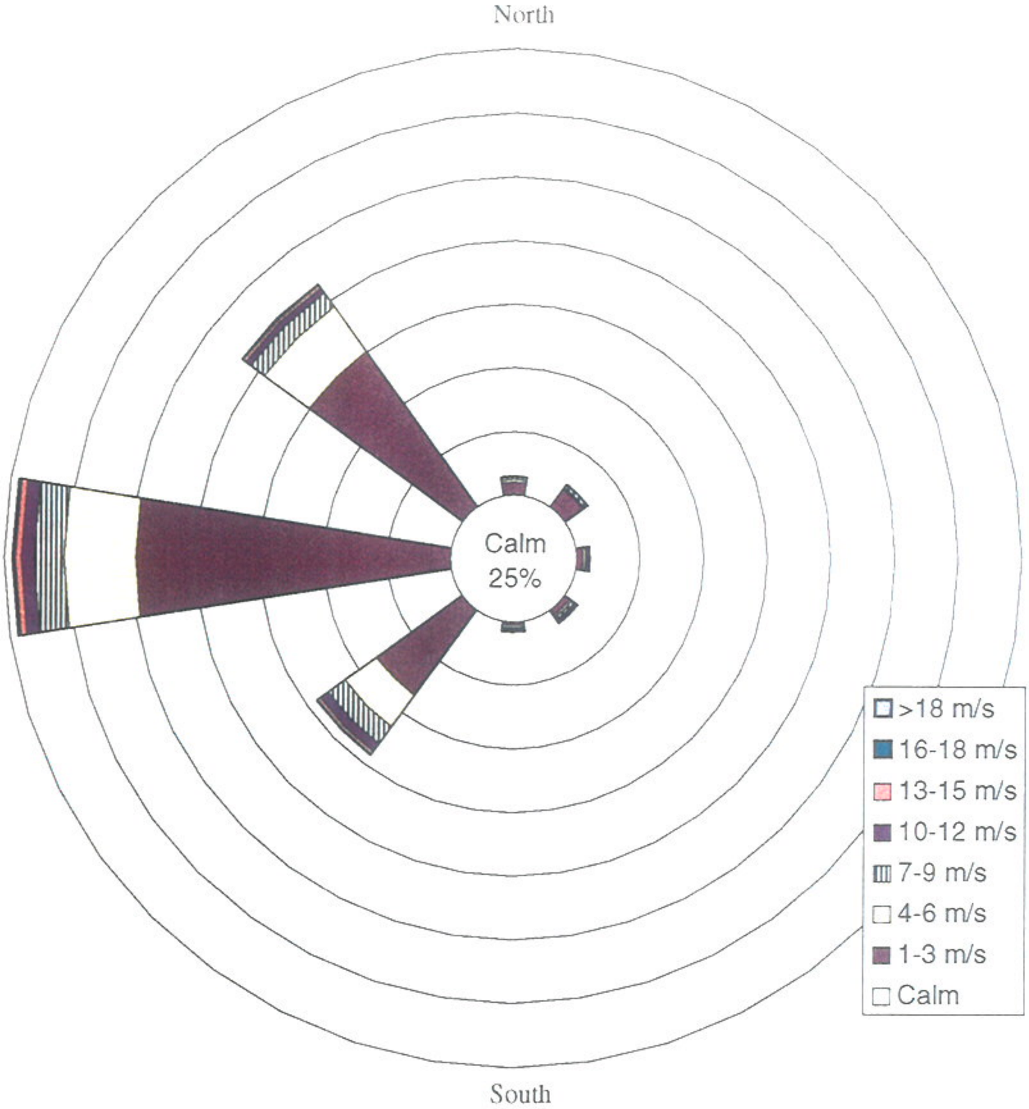
The segments of each arm represent the seven wind speed classes, with increasing windspeed from the centre outwards.The length of each arm represents the proportion of the total wind that blew from that direction. The value in the central circle represents the proportion of calm conditions. The circular grid represents a contour interval of five percent.

Windrose for Summer
3pm



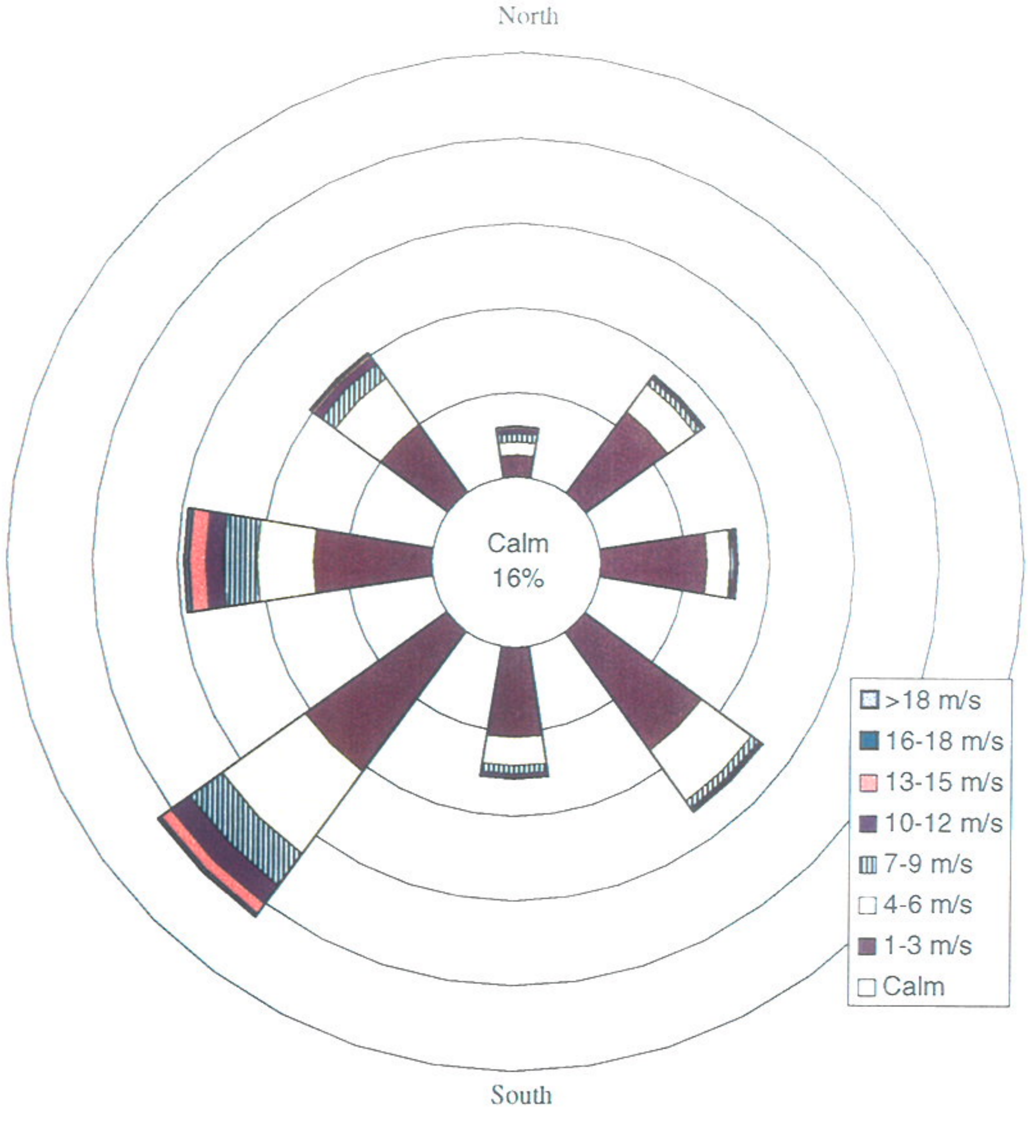
The segments of each arm represent the seven wind speed classes, with increasing windspeed from the centre outwards. The length of each arm represents the proportion of the total wind that blew from that direction. The value in the central circle represents the proportion of calm conditions. The circular grid represents a contour interval of five percent.

Windrose for Winter
9am



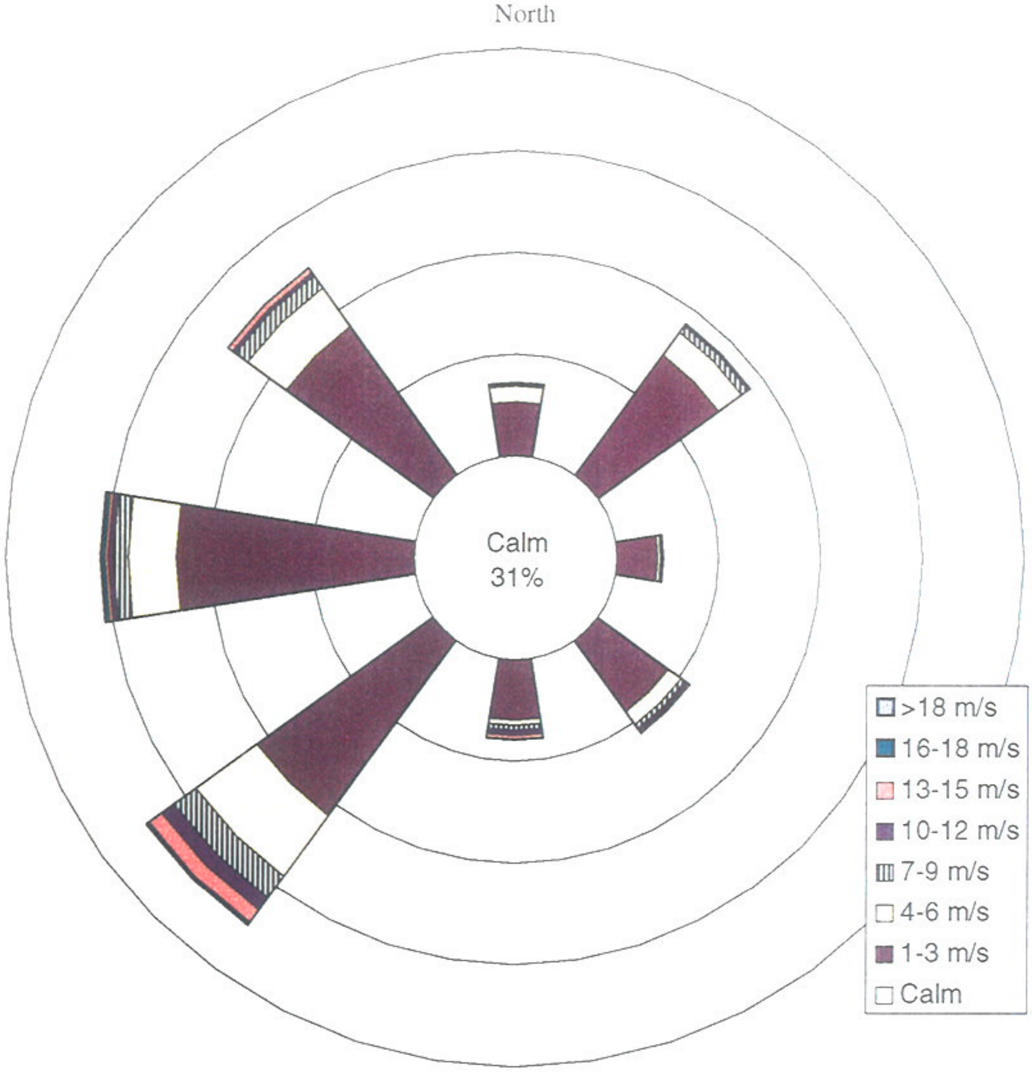
The segments of each arm represent the seven wind speed classes, with increasing windspeed from the centre outwards.The length of each arm represents the proportion of the total wind that blew from that direction. The value in the central circle represents the proportion of calm conditions. The circular grid represents a contour interval of five percent.

Windrose for Winter
3pm



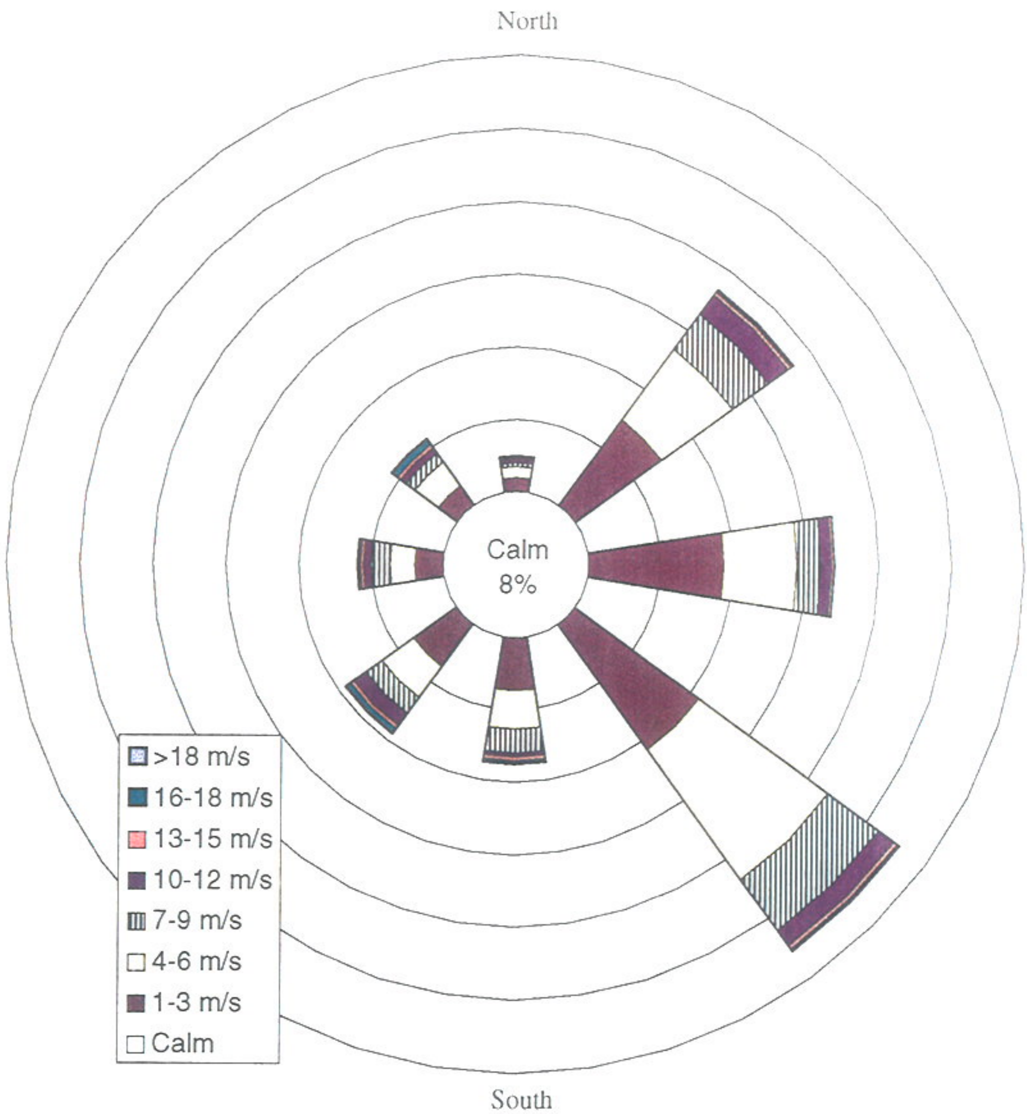
The segments of each arm represent the seven wind speed classes, with increasing windspeed from the centre outwards.The length of each arm represents the proportion of the total wind that blew from that direction. The value in the central circle represents the proportion of calm conditions. The circular grid represents a contour interval of five percent.

Windrose for Spring
9am



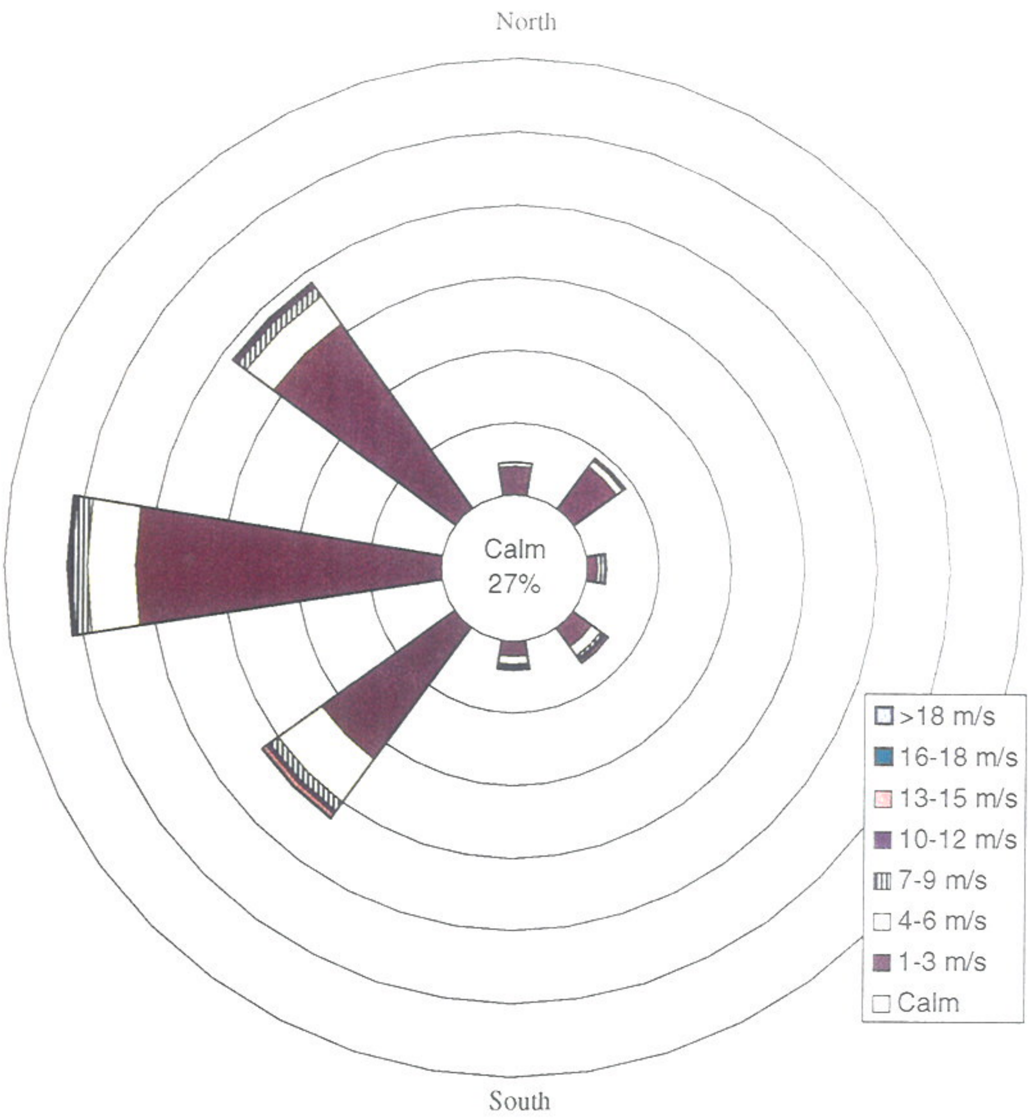
The segments of each arm represent the seven wind speed classes, with increasing windspeed from the centre outwards.The length of each arm represents the proportion of the total wind that blew from that direction. The value in the central circle represents the proportion of calm conditions. The circular grid represents a contour interval of five percent.

Windrose for Spring
3pm



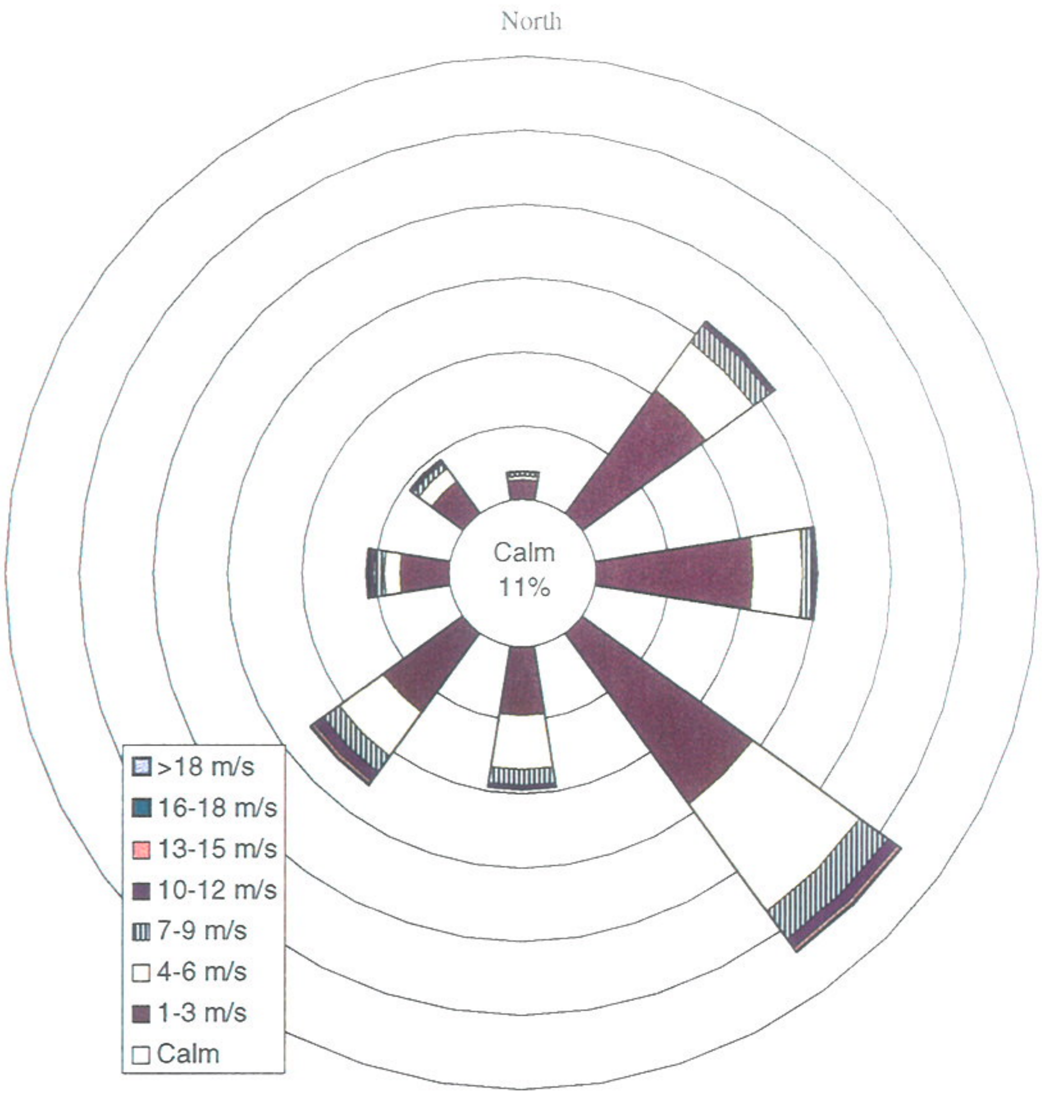
The segments of each arm represent the seven wind speed classes, with increasing windspeed from the centre outwards.The length of each arm represents the proportion of the total wind that blew from that direction. The value in the central circle represents the proportion of calm conditions. The circular grid represents a contour interval of five percent.

Windrose for Autumn
9am



The segments of each arm represent the seven wind speed classes, with increasing windspeed from the centre outwards. The length of each arm represents the proportion of the total wind that blew from that direction. The value in the central circle represents the proportion of calm conditions. The circular grid represents a contour interval of five percent.

Windrose for Autumn
3pm



The segments of each arm represent the seven wind speed classes, with increasing windspeed from the centre outwards.The length of each arm represents the proportion of the total wind that blew from that direction. The value in the central circle represents the proportion of calm conditions. The circular grid represents a contour interval of five percent.

Appendix E

BLAST MONITORING DATA

4 August, 1999
ref: gtccbm3

The General Manager
Greater Taree City Council
PO Box 482
TAREE NSW 2430

Attention: Graham Gardner
Bruce Byatt

Dear Sir

Re: Jandra Quarry - Blast Monitor Results

Please find below a summary of blast monitoring results for the Jandra Quarry for the period 23/4/97 to 11/11/98

Date	**No. of Blasts**	**Ground Vibration (max. = 5mm/sec)**	**Overpressure (max. = 115dB)**
23/4/97	1	<0.9	<111.3
19/5/97	3	0.12	102.7
		1.47	111.4
		3.27	107.6
1/7/97	2	<3.78	113.9
		<3.78	<104.5
25/7/97	3	2.24	114.3
		3.35	109.8
		<1.87	< 94.8
25/8/97	1	<1.53	<110.5
28/8/97	1	2.35	109.1

Date	No. of Blasts	Ground Vibration (max. = 5mm/sec)	Overpressure (max. = 115dB)
17/9/97	1	4.28	115.0
22/9/97	1	1.28	98.8
2/10/97	1	2.41	109.9
15/10/97	1	3.98	107.2
7/11/97	1	3.56	106.5
13/11/97	2	0.93	108.7
		3.09	109.3
27/11/97	1	1.83	108.8
7/1/98	2	3.57	114.5
		2.31	113.4
3/2/98	1	2.57	113.9
30/3/98	1	3.0	109.0
6/4/98	1	3.26	112.2
1/5/98	1	3.17	111.0
25/5/98	1	2.65	112.2
9/6/98	1	0.84	106.1
16/7/98	1	<5.0	<115.0
24/9/98	1	0.31	114.1
28/9/98	1	3.26	109.4
11/11/98	1	0.19	104.4

Please note that the "<" figures in the above table mean that the vibration &/or noise level was lower than the stated figure i.e. the level set on the blast monitor was not triggered.

JANDRA QUARRY

EXTENSION

CSR

JANDRA QUARRY

EXTENSION

Visual Assessment

For:
CSR CONSTRUCTION MATERIALS

October 1999
698253RPT2 FINAL

Report No. 698253RPT 2 FINAL

This report was prepared in accordance with the scope of services set out in the contract between ERM Mitchell McCotter Pty Ltd ACN 002 773 248 (ERMMM) and the Client. To the best of our knowledge, the proposal presented herein accurately reflects the Client's intentions when the report was printed. However, the application of conditions of approval or impacts of unanticipated future events could modify the outcomes described in this document. In preparing the report, ERMMM used data, surveys, analyses, designs, plans and other information provided by the individuals and organisations referenced herein. While checks were undertaken to ensure that such materials were the correct and current versions of the materials provided, except as otherwise stated, ERMMM did not independently verify the accuracy or completeness of these information sources.

Approved by:	*Tony McNamara*
Position:	Project Director
Signed:	
Date:	

ERM Mitchell McCotter Quality System

Prepared by:	*Murray Curtis*
Position:	Project Manager
Signed:	
Date:	14/10/99

TABLE OF CONTENTS

LIST OF FIGURES

Chapter 1

INTRODUCTION

This report has been prepared for CSR Construction Materials as part of the Environmental Impact Statement for the proposed Jandra Quarry Extension.

1.1 OBJECTIVES

The objectives of the Visual Assessment are:

- to assess the impact of the proposed quarry extension on the landscape character of the locality;
- to assess the visual impacts of the proposed quarry extension from sensitive view points outside the quarry boundary and;
- to determine a landscape strategy which would help to mitigate significant impacts and to integrate the proposed quarry extension into the existing landscape.

1.2 SCOPE OF THIS PAPER

To assess the visual impact of the proposed extension to the Jandra Quarry this report will:

- Describe the existing quarry and the surrounding landscape.
- Describe the proposed extension to the quarry and the visual catchment from which the proposed quarry would be visible.
- Identify sensitive viewpoints to the proposed quarry extension which require detailed assessment or are representative of views from the surrounding area.

- Undertake a qualitative analysis using photographs of the existing site from the sensitive viewpoints. The visual change brought about by the quarry extension will be discussed for each viewpoint.

- Present mitigation measures to minimise the visual impacts of the proposed quarry extension.

Chapter 2

PROJECT DESCRIPTION

2.1 BACKGROUND

The Jandra Quarry was originally approved in 1985 with excavation commencing soon after. The visual exposure of the quarry to passing motorists was increased as a result of the realignment of the Pacific Highway in 1991. The realignment directed motorists views to the cut faces which have since been excavated close to their maximum capacity. Under the current conditions there is minimal reserve left to continue excavation.

The imminent closure of the CSR's Manning River Gravel extraction operation will further deplete the availability of the resource and associated jobs. The availability of good quality rock in an east / west direction from the current pit has the potential to serve the local market for at least a further 50 years.

2.2 EXISTING SITE AND SURROUNDS

2.2.1 Existing Quarry

The existing quarry is cut into the northern face of the hillside and extends from the highest point of the ridgeline (elevation 115m) in a north easterly direction. The length of the quarry is approximately 440m and its width approximately 180m. The working face of the existing quarry is visible but quarry operations equipment and structures are not visible from surrounding areas.

2.2.2 Vegetation

The land immediately surrounding the quarry is extensively vegetated to the perimeter of the property. Beyond this to the south and east, areas of land have been cleared for farming purposes. Pockets of dense vegetation remain to the south-east and north of the subject site. Vegetation communities consist of indigenous species with upper and middle canopy trees and shrubs, and low level ground covers.

2.2.3 *Topography*

The surrounding topography is generally undulating with rolling hills and plains. To the north-west of the subject site is the fire lookout, which is at an elevation of 299m.

2.2.4 *Man Made Structures*

The surrounding landscape is extensively modified with cleared land associated with farming activities, the Pacific Highway and the existing quarry the main contributing factors. The extension of the quarry will encroach further on the remaining natural landscape, however this will present only a small proportion of change to the existing modified environment.

i. Roads

Immediately to the west of the site is the Pacific Highway. This road dissects the vegetation and is a significant man made element within the landscape. Motorists travelling in a south-westerly direction are exposed to the face of the existing quarry.

Other minor roads access surrounding properties and are typically of gravel construction. Some of these roads view toward the existing quarry.

ii. Transmission Easements

A number of transmission easements occur on and around the subject site. Many of these easements have required the removal of vegetation to allow connections to surrounding properties.

iii. Houses

A number of residential houses are located in close proximity to the existing quarry within a radius of approximately 2km from the mine perimeter. Properties likely to be affected by the visual changes will be assessed to determine the likely visual impacts associated with the proposed quarry extension.

Chapter 3

VISUAL ASSESSMENT METHODOLOGY

3.1 GENERAL

The visual assessment aims to explain the visual impacts of the proposed quarry extension when viewed from specific viewpoints. In undertaking this assessment, qualitative techniques of description, photographs and sections to interpret the visual impacts of the proposed extension are used.

3.2 QUALITATIVE ANALYSIS

In undertaking the qualitative analysis, consideration has been given to the following factors:

- the existing landscape character and its sensitivity to change;
- modifications to the landscape due to the proposed quarry extension;
- assessment of impacts from sensitive viewpoints; and
- mitigation measures.

These components are further discussed below.

3.2.1 Landscape Character

The background setting and surrounding natural/built environment can help to absorb changes brought about by development. Alternatively, a development which contrasts significantly with the existing environment can make its integration more difficult.

The existing quarry is a dominant visual element within the landscape. The proposed quarry extension expands the current view. Generally those viewpoints that exist in close proximity to the proposed extension are most likely to be visually affected and are further investigated in this assessment.

There are three major elements that affect the extent to which the proposed quarry extension would be viewed within the landscape. These are:

i. Vegetation

Vegetation plays an important role in visual impacts associated with development works. The height and density of vegetation can contribute to the visual quality of the landscape. It can also contribute to screening of visual impacts. Conversely the lack of vegetation may maximise views to a development from a particular viewpoint.

The land surrounding the exiting quarry is variable in character. In some areas houses are located within dense vegetation and even though they are close to the quarry views to it are screened by foreground vegetation.

ii. Topography

Developments are most visible from elevated positions. The topography can play an important role in determining the visibility of a development within the landscape, depending on elevation of viewpoints and their relationship with the proposed development, surrounding vegetation and structures. There are few vantage points which overlook large sections of the quarry.

iii. Distance

As distance increases, the impacts associated with development decrease. The changes to the landscape resulting from the proposed quarry extension would become less visible at greater distances primarily due to the reduced angle of disturbance, but also due to the screening effect of surrounding vegetation.

3.2.2 Modifications to the Landscape due to the Proposed Quarry Extension

The proposed quarry extension would extend to the east and west of the existing pit. Stage 1 development involves the western quarry extension with the limit of extraction 400m from the highway. Work would commence on the upper benches to enable rehabilitation of the most visible faces as quickly as possible. Rehabilitation would primarily occur on the benches, which are located at 12m intervals.

The second and third stages of excavations extend in an easterly direction to the eastern limit of extraction. The quarry does not breach the eastern most ridgeline.

The excavation works would require the removal of a significant amount of existing vegetation covering the hillside. The degree of change and the relative visual impact are related to the surrounding land uses and the sensitivity of nearby viewpoints.

3.2.3 Sensitive Viewpoints

The location and frequency of viewing are important considerations when assessing visual impact.

Within the context of this study, the proposed quarry extension has been assessed from a number of viewpoints that are considered sensitive. These include views to the proposed quarry from:

- nearby houses/settlements;
- nearby tourist destinations; and
- the perspective of travellers on the Pacific Highway.

i. Residences

Major construction works that occur close to houses are a concern to residents. In part, this concern is based on the economic implications on property re-sale as well as effects on the quality of the surroundings for the residents. In general, distance is the main element reducing visual impact. Screening techniques using vegetation and earthworks can reduce visual impact.

ii. Tourist Lookouts and Destinations

Recognised tourist destinations and lookouts are considered sensitive viewpoints. Changes to the landscape can potentially reduce the desirability to visit these areas. Alterations to the landscape should be integrated with the surrounding area to minimise negative visual impacts.

iii. Major Roads

Most people view changes to the landscape from major and secondary roads. Roads form part of the built environment. Generally views most valued by motorists are unique or picturesque settings. Views that are repetitive or uniform within the landscape are less valued.

3.2.4 *Mitigation Measures*

There are a number of mitigation measures that would be recommended to ameliorate visual impacts associated with the proposed quarry extension. These may include:

- Vegetation Removal and Replacement

Construction activities would be undertaken to minimise the removal of existing vegetation wherever possible. Where it is necessary for clearing to occur replanting with species to reflect the existing character of the area would be undertaken. In areas of indigenous vegetation, care would be taken to replant using native seed stock collected from the locality. This method of planting would minimise maintenance requirements and would help to maintain habitat values. Planting would primarily occur on the quarry benches, which are approximately 6m wide.

- Screening and Framing of Views

Planting and mounding, especially when located closer to the observer, is an effective tool in screening or greatly reducing the visual impact of the proposed quarry extension.

Foreground planting of grasses, ground covers and low shrubs and trees would help to reduce the immediate visual impact of the proposed quarry extension. Species should be drawn from those in the immediate area so that the landscape is integrated into the surrounding area.

- Time

A mature or established landscape would help to integrate a development within the existing landscape. The use of advanced planting in association with mounding would be an effective tool to screen unsightly views.

- Specific Measures for Mitigation

More specific mitigation measures would be recommended relating to sensitive viewpoints. These measures will be subject to the final form of the quarry and may include specific recommendations relating to vegetation retention and re-establishment, species selection, location and degree of earthworks and other techniques for amelioration of visual impacts.

Chapter 4

VISUAL ASSESSMENT

4.1 OVERVIEW

The proposed quarry extension would expand operations in an easterly and westerly direction from the existing pit. Excavation would be primarily located on the northern face of the hill below the ridgeline and would be no wider than the existing pit. In some areas however the southern face of the quarry would extend marginally over the ridgeline a small distance. Excavation works would alter the ridgeline of the hill when viewed from surrounding locations. In particular, viewing locations to the north-west and east of the ridgeline have the potential to be visually impacted. Viewing locations to the south of the ridgeline will experience only a minor change to the hill skyline. Existing vegetation will be maintained along the crest of the ridge protecting views of exposed quarry faces.

4.2 RESIDENTIAL AREAS

Major construction works in close proximity to houses are a major concern to residents. In part this concern is based upon the economic implications on property re-sale as well as effects on the quality of the surroundings for the residents. In general the main mitigating element affecting impact is distance. Screening, without detrimentally changing existing outlooks, can also mitigate visual impact.

4.2.1 *Properties to the East*

Houses to the east of the site include the Jones, Groves and Fatseas properties, which are located on a prominent hill. The existing quarry is not visible from these properties.

Figure 4.1 – Aerial photo looking west showing the relationship of the houses to the existing quarry

i. *Fatseas Property*

a. Description

The Fatseas property is located on the hillside directly east of the quarry property boundary. The residence is oriented in a southerly direction overlooking the ocean. It is positioned on the east side of a small ridge limiting views in a westerly direction toward the quarry. Surrounding the sides and rear of the residence is dense vegetation which further screens views in this direction, and focuses them on the ocean.

Of the residences situated on this hill, the Fatsias property is least affected by the proposed quarry extension.

Figure 4.2 – Aerial photo of the Fatseas residence.

b. Landscape Effect

The visual impact of the proposed quarry extension will not visually impact on this property. Local variations in topography and existing vegetation screen views from the residence and surrounding land toward the quarry.

c. Mitigation Measures

No mitigation measures are required.

ii. Jones Property

a. Description

The Jones residence is a two storey dwelling located on the hill to the east of the Jandra site. The western boundary of the Jones property abuts the subject site. Due to its elevated position, the property allows expansive views over the surrounding landscape. Vegetation surrounds the residence forming an apron around its perimeter. The house is orientated with the main entry to the east. This orientation allows views over the surrounding landscape in the distance. At the rear of the house is a garage. An adjoining activity room and pool area extend in a northerly direction and are largely enclosed by existing vegetation.

Views to the existing quarry are not apparent from the property.

Figure 4.3 – View from the Jones property (southern boundary) looking along the transmission easement toward the existing quarry

b. Landscape Effect

The alignment of the proposed quarry extension would result in modification to the existing ridgeline. These changes to the ridgeline would potentially be visible from locations within the Jones property looking west. Due to the inclined angle of view to the proposed quarry, 5m of exposed rock face would be visible above the treeline. The distance separating the exposed quarry face from the Jones residence is approximately 1,250 metres. The apparent width of exposed rock face would be approximately 50m, affording a view angle of approximately 2 degrees.

The visual impact of the quarry extension is regarded as low from this viewing location.

c. Mitigation Measures

The excavation works would be staged to minimise the exposure of the rock face when viewed from properties to the east. Stage 1 involves the excavation of the western extension of the quarry. By retaining the eastern land intact, the peak of the hill is effectively screened from view by an intervening ridgeline. The excavation of the western portion of the quarry would be undertaken over a period of approximately eighteen years. The initial extraction would be located above a bench at RL98. Benches would be approximately 12m high and approximately 6m width. Revegetation of the benches with indigenous species would effectively screen the rock face prior to extension of the quarry to the east.

Existing vegetation would be retained at the top of the cut face which would maintain the appearance of a vegetated ridgeline when viewed from properties to the south and east.

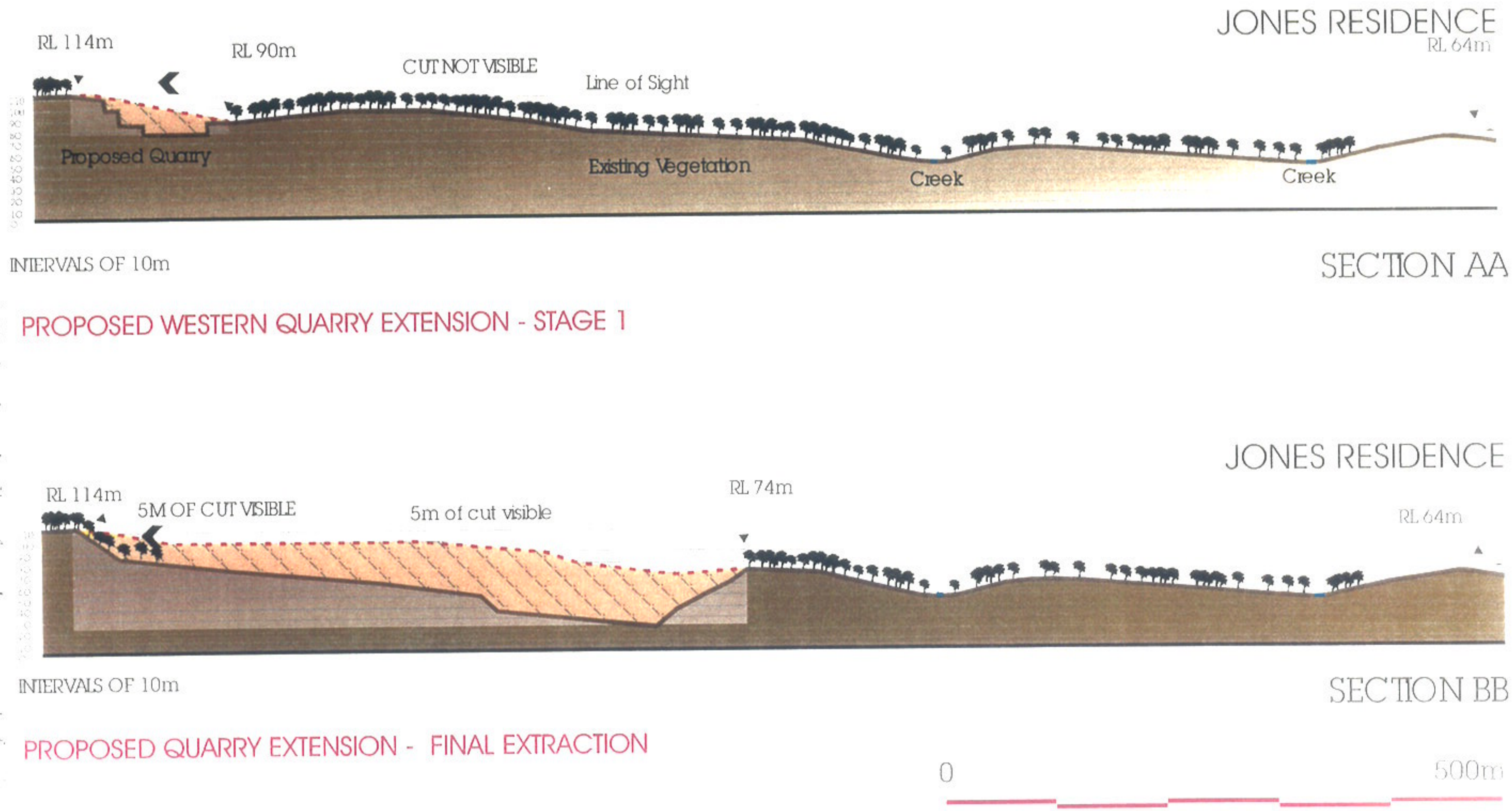


Figure 4.4 – Sections AA and BB showing viewlines from Jones property for S... 1 and final extractions respectively.

iii. Groves Property

a. Description

The Groves property is located on the hill to the east of the subject site. The residence is separated from the proposed quarry face by a distance of approximately 700m. On this land are two dwellings, one of which is under construction. Both dwellings are in close proximity, separated by only approximately 30m. The dwelling under construction is slightly more elevated and orientated in a more southerly direction. The residence occupied by the Groves is two storey and has been excavated into the hill. The front of the property is orientated to the north-east whilst the back of the house is cut into the hill with ground floor views blocked by the cut embankment. Of the houses located on this hill, the Groves residence is the most elevated at approximately 70m.

Figure 4.5 – View looking from Groves property toward Jandra Quarry.

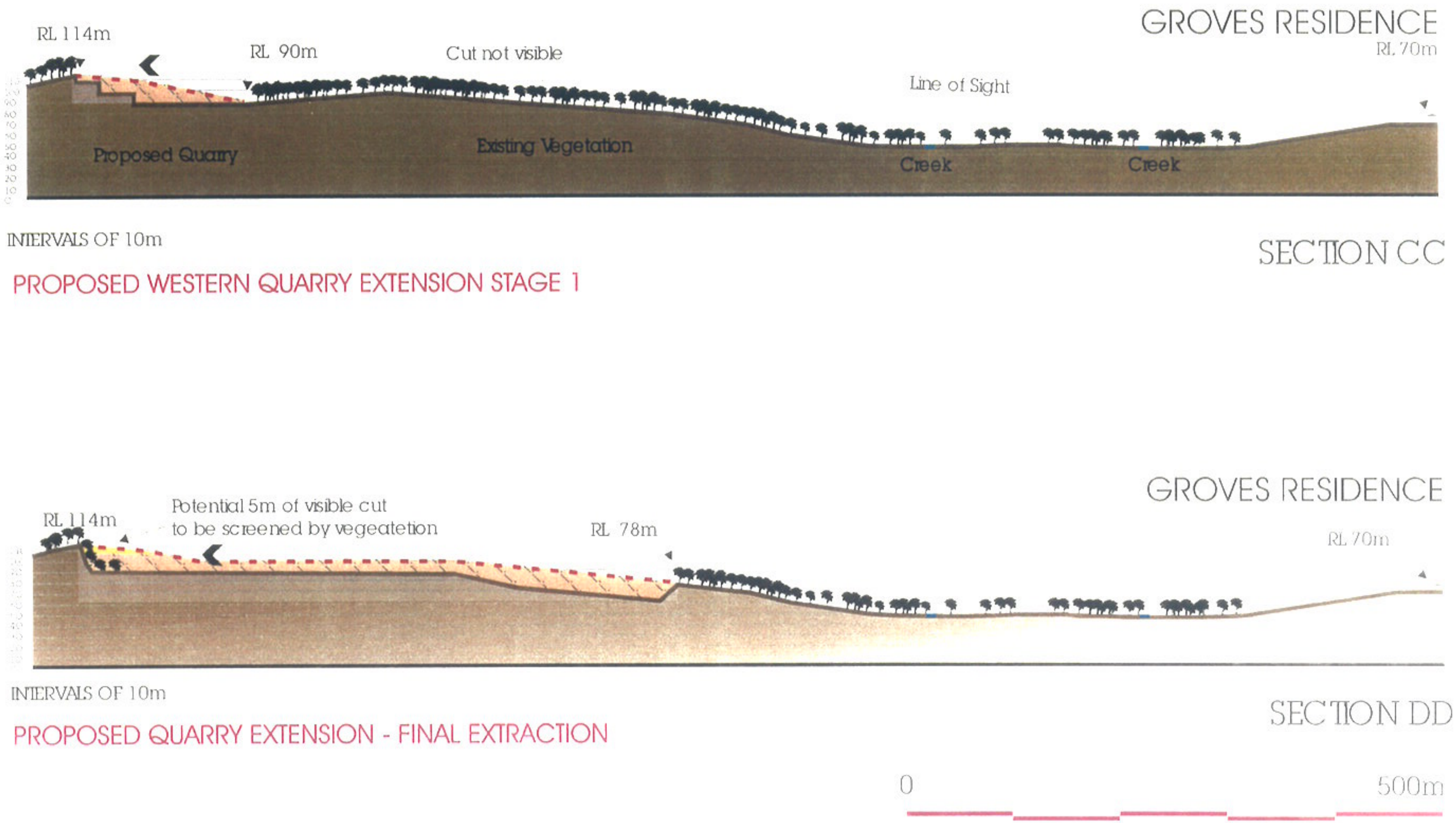
b. Landscape Effect

The proposed quarry extension will be potentially visible from the Groves residence with approximately 5m of cut face exposed at the highpoint of the ridgeline. The width of exposed cut visible from the Groves residence is approximately 50m. Over a distance of approximately 1,200m the viewing angle is less than 5 degrees. In the context of the existing man modified environment the degree of visual impact is considered minimal.

c. Mitigation Measures

Mitigation measures are those previously described for the Jones residence.

Figure 4.6 – Section CC and DD illustrating view lines from Groves propert
Stage 1 and final extractions respectively



4.2.2 *Properties to the North*

i. Loveday Property

a. Description

Immediately to the north of subject site is the Loveday property. The house is situated within dense bushland which effectively contains all views to the immediate foreground. The residence is accessed by a road which connects with the Pacific Highway. Vegetation lines the access road also screening views to the quarry

Figure 4.7 – Photo showing Loveday property surrounded by tall vegetation preventing views to the quarry

b. Development Effect

The proposed quarry extension will have no visual impact on the views currently experienced by the Lovedays.

c. Mitigation Measures

No mitigation measures are required for this property.

Figure 4.8 – Photo of surrounding vegetation which contain views to foreground

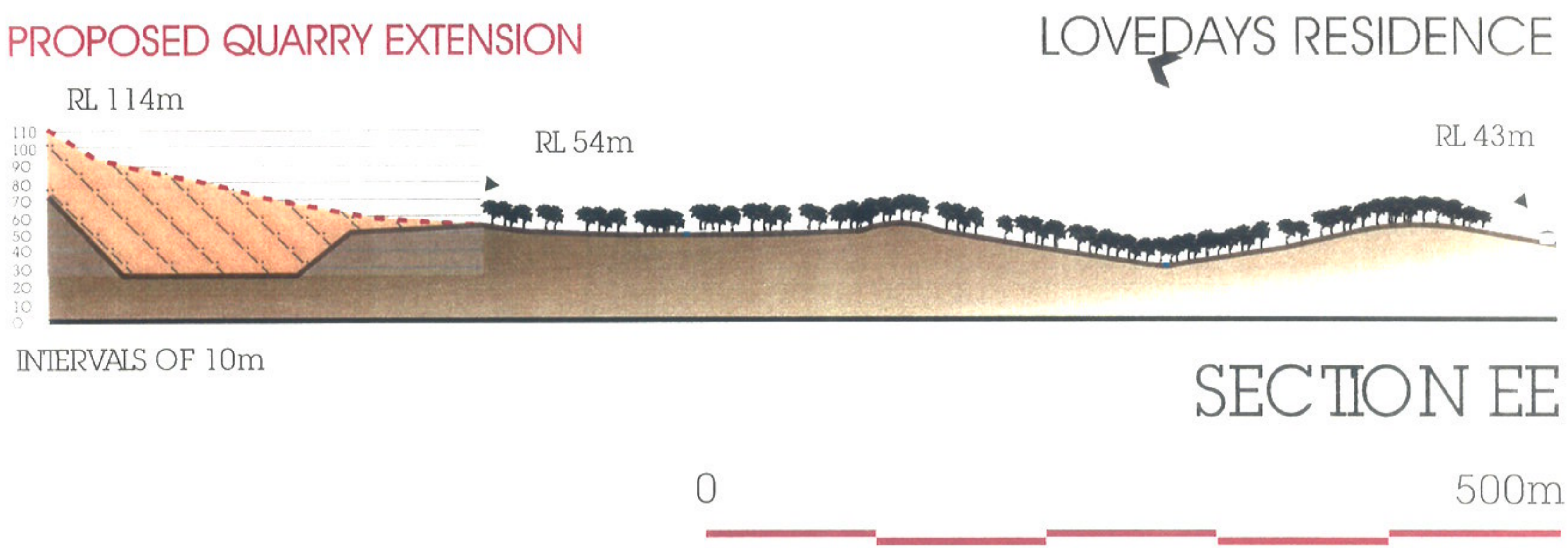


Figure 4.9 – Section EE illustrating view from Loveday property toward quarry

ii. Mowbray Property

a. Description

Further north-east of the site, lies the Mowbray property. This house is accessed via a dirt road connecting with the Pacific Highway. The dirt road runs parallel to the northern boundary of the property, and views to the existing quarry face.

Figure 4.10 – View looking to existing quarry from access road adjacent to the northern boundary of the Mowbray property

Views from the dwelling are filtered by foreground vegetation to the point where the quarry is barely visible.

Figure 4.11 – Photo from Mowbray residence looking toward the quarry

b. Development Effect

The proposed quarry extension will have a minimal visual impact when viewed from the Mowbray residence due to the existing foreground vegetation which will screen the quarry.

From other parts of the property however, the quarry will remain visible. In particular, the access track to the north of the property affords views to the existing quarry. Due to the expansion of the quarry in an east west direction, the quarry from face will become more visible. As this track services few properties and views to the quarry form passing motorists are relatively infrequent, its significance is regarded as low.

c. Mitigation Measures

Subject to consultation with the Mowbray's supplementing planting in the foreground of the residence, could screen any residual views to the quarry.

Subject to consultation with Council and track users, the road reserve for the access track could be revegetated to reflect its original wooded condition. This will help to direct views along the road, and screen views to the proposed quarry extension.

4.2.3 *Properties to the South*

a. Description

Situated immediately to the south of the existing quarry are rural properties owned by Smith, YALA and Barnes. The YALA property is located closest to the southern boundary of the subject site. Located on the YALA property are two dwellings and associated farm buildings. Development consent has also been obtained for a two further dwellings on the property (YALA 3). Views from the existing and proposed buildings to the quarry are effectively screened due to the separating ridgeline which is heavily vegetated. The existing quarry operations are not visible from any of the properties as excavation works are restricted to the northern face of the hill below the ridgeline.

Figure 4.12 – Aerial photograph looking in an easterly direction toward the southern site boundary and adjoining YALA property

b. Development Effect

The proposed quarry extension will not impact on the residences within the YALA property at the foot of the hill. The angle of view, and close proximity of vegetation on the northern property boundary will prevent views to the ridgeline. Further southwards, as the view angle to the ridgeline decreases, changes to the form of the ridgeline will become apparent as excavation works encroach onto the southern face of the hill. No cut faces will be exposed as they will be below the newly formed ridgeline.

The modification of the hill ridgeline will present a minor alteration to the existing skyline when viewed from properties and roads to the south. The new curvature of the ridgeline will require as little as two metres being cut of the top of the ridge. As the cut does dissect the contours, the skyline will reflect the natural curvature of the hill. This alteration would be almost imperceptible.

c. Mitigation Measures

No mitigation measures are required.

4.2.4 Properties to the West

a. Description

West of the Pacific Highway are three rural properties including Dubos, Middleton and Stennett. These properties view toward the vegetated western face of the Jandra Hill. The Dubos property is located approximately in line with the ridgeline. Middleton and Stennet properties are located further southward.

Figure 4.13 – View looking toward Jandra Quarry from eastern verandah of Dubos residence

Figure 4.14 – View looking toward Jandra Quarry from eastern verandah of Middleton residence

Views to the hill are often filtered/screened by clumps of trees and individual plants located in the foreground. However, uninterrupted views to Jandra hill are possible from various locations within each of the properties.

The existing quarry is not visible from any these properties as excavation works are limited to the northern face of the ridgeline.

Figure 4.15 – View looking toward Jandra Quarry from Dubos property

Figure 4.16 – View looking toward Jandra Quarry from Middleton property

b. Development Effect

The proposed quarry extension will involve modification to the ridgeline when viewed from properties to the west. This will result in a cut face being visible from specific locations within properties. The excavation of the northern face of the hill will expose the top 20m of face when viewed from the northern portion of the Dubos property. This will be the worst scenario with lesser impacts visible from Middleton and Stennet property. The width of the cut face exposed will be approximately 100m which equates to less than 4.76 degrees of the field of view. The majority of the cut face would be screened by the ridgeline located in the foreground. Excavation will not be visible from the dwellings due to dense vegetation screening these views. However views to the quarry extension from other areas within the properties will be more apparent. As these areas are not frequented as regularly, and the degree of visual change is relatively small the impact is not significant.

c. Mitigation Measures

Supplementary planting in the foreground of residences will screen views to the proposed quarry extension. In other locations where the views are more apparent due to clearing, it is proposed to supplement planting with indigenous species to filter views to the quarry. The extent of any planting would be determined following consultation with property owners.

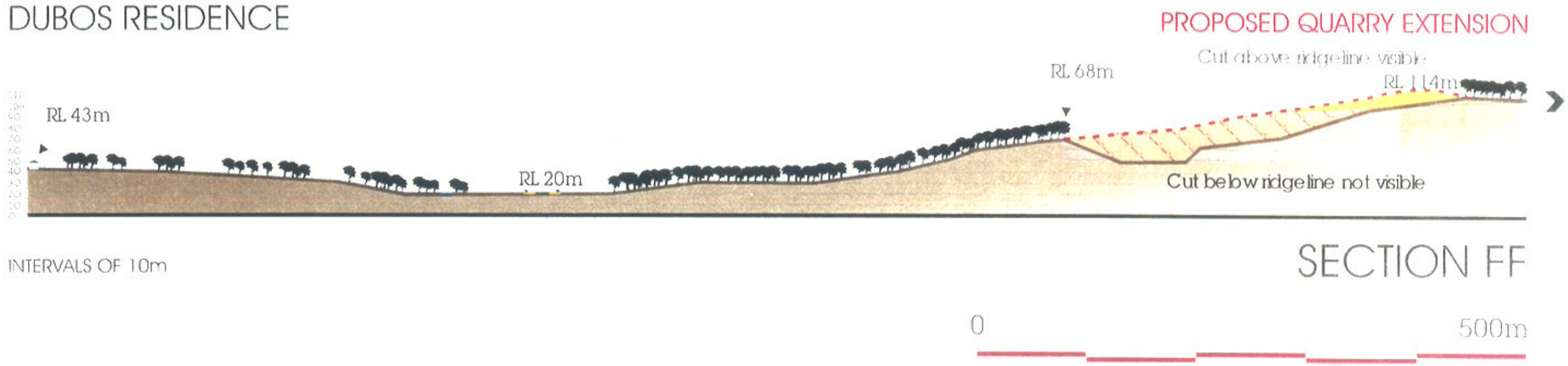


Figure 4.17 – Section illustrating view line from Dubos property cut above the ridgeline visible through vegetation at residential foreground.

4.3 MAJOR ROADS

Most people view changes to the landscape from major and secondary roads. Roads form part of the modified environment. Generally views most valued by motorists are unique or picturesque settings. Views that are repetitive or uniform within the landscape are less valued.

i. Pacific Highway

a. Description

The Pacific Highway provides the major vehicle connection between Brisbane and Sydney. The road services both local vehicles and those travelling to more distant destinations for commercial and private purposes. The existing quarry is clearly evident from the highway when travelling in a south-westerly direction from Taree. The importance of this road as part of the major road network servicing the region, makes this viewpoint worthy of investigation in this assessment to determine the extent of the visual impacts associated with the quarry extension.

Figure 4.18 – Photo looking north from the Pacific Highway toward the existing quarry.

b. Landscape Effects

The proposed extension of the quarry will increase the exposure of the quarry face when viewed from vehicles travelling along the Pacific Highway in a southerly direction. This view is apparent for a brief period as vehicles round the crest of a hill and begin to descend into the valley towards the quarry entry. At the crest of the hill the road aligns with the quarry face before curving to redirect views in a south-westerly direction. As the road descends, motorists views are directed downwards and roadside vegetation contains foreground views. When travelling along the highway (at the speed limit) the quarry is visible for a period of approximately 25 seconds. In the context of any journey this exposure time is regarded as insignificant. The proposed quarry extension would increase this exposure time marginally.

For local residents the visual change to the landscape is more apparent due to the increased frequency of viewing. However, contextually the expansion of the quarry would not alter the character of the existing view which is dominated by the existing quarry. Consequently the visual impact is not considered significant.

c. Mitigation Measures

Progressive rehabilitation of upper benches will be undertaken to limit the extent of quarry visible at any time.

Planting of additional roadside vegetation on both sides of the existing highway would also help to screen views of the quarry. This planting should be located along the elevated roadside where views to the quarry are maximised. Planting within the median between carriageways north of Blackbutt Road intersection would reduce the visibility of the quarry during travel by approximately 50%. Planting in this area would be subject to approval by the RTA.

4.4 TOURIST LOCATIONS

i. Taree Lookout

a. Description

The Taree Lookout facility and fire tower is situated approximately 5km north-west from the quarry at an elevation of 299m. The location has 360 degree views of the surrounding region and include a wide diversity of land use activities including, farming, forest, urban development, quarries, ocean, easements and roads. When viewing south-east from the lookout, Jandra Quarry is visible in the distance. The quarry blends with the surrounding environment and appears as an area of cleared land for farming. In the context of the 360 degree panoramic views experienced from

the lookout, the angle of disturbance is extremely minor and in no way dominates the views from this location. Preferred views would be in an easterly direction toward the ocean.

Figure 4.19 – View looking towards Jandra Quarry from the Taree Lookout.

b. Landscape Effect

The expansion of the quarry is expected to have a negligible visual impact from this viewpoint. The distance of the viewpoint from the quarry will allow the exposed rock faces to be absorbed within the landscape. Therefore visual impacts are regarded as low.

c. Mitigation Measures

No mitigation measures are required at this location

Chapter 5

CONCLUSION

5.1 CONCLUSION

The proposed quarry would significantly alter the existing landform due to excavation of the hillside in an easterly and westerly direction. The quarry expansion would be consistent with the existing dominant land use in this area. The visual changes associated with the proposed expansion would primarily be viewed by motorists travelling in a south-westerley direction from Taree, and a small number of nearby residents.

The visual impacts in relation to these viewpoints are minimal for the following reasons.

Motorists

- Motorists travelling along the existing highway currently experience views to the existing quarry. These views were considered acceptable when the highway was realigned in 1991 making the quarry working faces more visible. The expansion of the quarry is consistent with the existing dominant visual element in this area.

- Motorists would view the quarry for only a relatively small period within the context of a long journey.

Residential Properties

Views from nearby residential dwellings to the quarry expansion are either screened from view by existing foreground vegetation, or have the potential to be screened with additional planting. Properties that will experience visual impacts are summarised below.

- Properties to the East

The Jones and Groves properties will experience minimal changes to their existing views due to the proposed staging of the works. It is estimated that Stage 1 western excavation would continue over approximately 18 years. Rehabilitation of the uppermost areas by planting on benches would ensure that rock faces would not be exposed to view when the eastern excavation commenced. Consequently the vegetated distant views to the hillside would be maintained.

- Property to the North

The Mowbray residence

Views from the Mowbray residence toward the existing quarry are currently screened by foreground vegetation. By supplementing this vegetation the quarry extension could also be effectively screened from view.

The main views to the quarry are from the access road adjacent to the northern property boundary. These views can be largely screened by planting within the road reserve subject to consultation with council and affected land owners. From other parts of the property the quarry extension would be exposed however views from these areas to the quarry are less frequent.

- Properties to the West

Views to the existing quarry from the Dubos, Middleton and Stennett residences are screened from view as excavation works are limited to the northern face of the ridgeline. The proposed quarry will remain screened from residences by existing foreground vegetation which would be supplemented in consultation with the landowner.

The quarry extension would be visible from other areas within the properties however these views are less significant.

Overall the proposed quarry extension would visually impact on very few properties.

Strategies to reduce visual impacts through staging of works and mitigation measures would help to prevent significant visual intrusion when viewed from nearby residences.

Appendix A

JANDRA QUARRY VISUAL ASSESSMENT
SITE PLAN

MITCHELL McCOTTER

JANDRA QUARRY

VISUAL ASSESSMENT
SITE PLAN
DRAWING LS1

JANDRA QUARRY

EXTENSION

CSR™