REPORT 30-1079-R1
Revision 0

Noise and Blasting Impact Assessment Cleary Bros Albion Park Quarry

Prepared for

Perram and Partners
12 Clanwilliam Street
EASTWOOD NSW 2122

13 December 2002

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Noise and Blasting Impact Assessment
Cleary Bros Albion Park Quarry

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1 INTRODUCTION

Richard Heggie Associates Pty Ltd (RHA) has been commissioned by Perram and Partners (on behalf of Cleary Bros (Bombo) Pty Ltd) to conduct a noise and blasting impact assessment for expansion of the subject Albion Park Quarry. The quarry is owned by Cleary Bros (Bombo) Pty Ltd and is located near Albion Park in the Illawarra region of NSW.

Broadly, the objectives of the noise and blasting assessment are to identify the potential impacts of noise from construction activities, overburden removal, resource extraction, processing and transporting of finished product at the Albion Park Quarry site. The effect of ground vibration and airblast from blasting at the quarry was also addressed.

The noise assessment has been prepared in accordance with Australian Standard AS 1055-1997 "*Description and Measurement of Environmental Noise*" Parts 1, 2 and 3 and with reference to the EPA's "*Industrial Noise Policy*" (INP) and "*Environmental Noise Control Manual*" (ENCM). The assessment has been guided by the NSW Department of Urban Affairs (DUAP) Director General's requirements.

2 DESCRIPTION OF PROPOSED PROJECT

2.1 Proposed Development

The proposed development is to be a continuation of the existing Albion Park quarrying operation. The area of operation for extraction is to be extended, whilst existing infrastructure is utilised for crushing, screening and stockpiling of extracted rock. Finished products will be transferred to the market by road style haul trucks at existing production rates using the East-West Link Road.

The proposed expansion to the operations may be broken down into 8 stages of development:

- Construction of visual/acoustic screens
- Land clearing
- Topsoil removal and stockpiling
- Overburden removal
- Resource extraction

- Haulage of extracted rock to the processing plant
- Crushing, screening and stockpiling of extracted rock
- Transportation of finished product to the market

2.2 Plant and Equipment

Plant and equipment to be used on the site are listed under two distinct categories:

Processing Plant

- Primary crusher
- Secondary crushers and screens
- Pug mill

Mobile Equipment

- CAT 773 or CAT 769 dump truck (or similar)
- CAT 245 face shovel (or similar)
- CAT 992 loader (or similar)
- Rock drill
- Water cart
- CAT D8L dozer (or similar) used intermittently
- 235C hammer excavator (or similar) used intermittently
- CAT 980C loader
- Cat 627 Scraper (or similar) used intermittently

2.3 Plant and Equipment Noise Levels

Acoustically significant items of plant and equipment were measured at Albion Park Quarry during February 2001. The sound power levels determined from these measurements are given in **Table 2.3.1**. The details of the octave band levels recorded are given in **Appendix A**.

Table 2.3.1 Equipment Sound Power Levels

Equipment	Sound Power Levels
Processing Plant	
Primary crusher	112 dBA
Secondary crushers and screens	116 dBA
Pug mill	115 dBA
Mobile Equipment	
CAT 773 dump truck	114 dBA
CAT 627 scraper*	111 dBA
CAT 245 face shovel	117 dBA
CAT 992 loader	118 dBA
Rock drill	118 dBA
Water cart	109 dBA
CAT D8L dozer*	116 dBA
235C hammer excavator*	112 dBA
CAT 980C loader	114 dBA

* Intermittent use only

3 SITE DETAILS

The Albion Park Quarry site is located within the Illawarra region near Albion Park, NSW. Existing extraction, processing and transportation occurs on Lot 3 DP 858245 and Lot 1 DP 35908.

It is proposed that existing the infrastructure be maintained and that future extraction will take place on a 18 hectare portion of Lot 1 DP 858245. For this to be viable, haulage of raw material must occur across Lot 2 DP 858245, an adjoining parcel of land owned by CSR Readymix.

The nearest potentially affected residence to the boundary of the proposed development, which is not owned by Cleary Bros, is the "The Hill" Residence, situated approximately 430 m to the northeast (see Location Map **Appendix B**). The "Belmont" Residence, directly to the east of the proposed development, is owned by Cleary Bros.

4 HOURS OF OPERATION

Continued operations of the quarry would be undertaken within the existing daytime hours of operation for the Albion Park Quarry as specified within the current Conditions of Consent. A summary of the hours of operation is contained within **Table 4.1**.

Table 4.1 Hours of Operation

Activity	Hours	Day
Drilling	7.00 am to 5.30 pm 7.00 am to 1.00 pm	Monday to Friday Saturday
Blasting	8.30 am to 5.00 pm	Monday to Friday
Loading and haulage of blasted rock, topsoil and overburden stripping, bund wall construction, routine maintenance	7.00 am to 5.30 pm 7.00 am to 1.00 pm	Monday to Friday Saturday
Crushing, screening and stockpiling operations	7.00 am to 5.00 pm 7.00 am to 1.00 pm	Monday to Friday Saturday
Other activities [1]	7.00 am to 5.00 pm	Monday to Friday

[1] "Other activities" include those activities associated with the extraction operation but exclude other site activities which are the subject to their own approvals and/or licences eg workshop activities.

5 EXISTING ACOUSTICAL ENVIRONMENT

5.1 Background Noise Survey

The objective of the background monitoring survey was to measure $L_{A90(15minute)}$ and $L_{Aeq(15minute)}$ noise levels at the nearest potentially affected receptors during daytime, evening and night-time periods to enable the determination of the intrusiveness and amenity criteria for the development.

Background noise levels were monitored at three locations adjacent to the Albion Park Quarry site during February 2001. ARL Type EL215 environmental noise loggers were used to monitor the ambient noise levels located at the residential locations given in **Table 5.1.1**. A Location Map showing each noise monitoring location is contained in **Appendix B**. Attended noise measurements were also taken in order to determine the variety of noise sources likely to affect and contribute to the unattended noise surveys.

Table 5.1.1 Ambient Noise Monitoring Locations

Noise Monitoring Location	Date of Monitoring	Description
1	February 2001	"The Hill" Residence, Dunster Lane
2	February 2001	94 Jarrah Way, Greenmeadows Estate
3	February 2001	12 Madden Street, Oak Flats

Continuous Unattended Monitoring

Weather data for the unattended noise survey period was obtained from the weather station located at Albion Park Airport. Noise survey data during periods of any rainfall and/or wind speeds in excess of 5 m/s (approximately 9 knots) were discarded. A summary of the results of the daytime background noise surveys is given in **Table 5.1.2**. The ambient noise levels from each monitoring location are presented in graphical format in **Appendix C**.

Table 5.1.2 Summary of Existing Daytime and Ambient Background Noise Levels

Location	Description	Background Noise Level L_{A90} Rating Background Level (RBL)	Measured Existing Ambient L_{Aeq} Noise Level	Estimated L_{Aeq} Contribution from Industrial Noise Sources
Location 1 "The Hill" Residence, Dunster Lane	**Daytime** 7am to 6pm	34 dBA	52 dBA	<49 dBA
Location 2 94 Jarrah Way, Greenmeadows Estate	**Daytime** 7am to 6pm including Cleary Bros Quarrying activities	38 dBA	63 dBA	<49 dBA
	Daytime 7am to 6pm excluding Cleary Bros Quarrying activities	38 dBA	50 dBA	<39 dBA
Location 3 12 Madden Street, Oak Flats	**Daytime** 7am to 6pm	42 dBA	60 dBA	<49 dBA

Note: The L_{A90} represents the level exceeded for 90% of the interval period and is referred to as the average minimum or background noise level.
The L_{Aeq} is the equivalent continuous noise level defined as the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

Location 1 is the nearest potentially affected residence to the proposed quarry extension. Location 2 is likely to represent the general character of noise in the area but has the potential to include the influence of existing quarrying activities on the background noise levels.

Location 3 was chosen as a noise monitoring location which is likely to be representative of the local environment in the absence of noise from existing quarrying activities, being in the same general vicinity, and with a similar setback to the Princes Highway.

Ambient Noise Environment for Assessment Purposes

Monitoring results indicate that Location 3 displayed higher RBLs and ambient L_{Aeq} levels than Location 2, indicating that, although there was no contribution from existing quarrying activities, the background level was raised by other noise sources including residential activities and both local traffic and traffic on the Princes Highway. Therefore, this data has not been used in the determination of RBL values and project specific noise levels. In order to estimate background noise levels at Location 2 in the absence of the Cleary Bros Albion Park Quarry operations, ambient noise levels were examined with and without the quarry in operation.

For the purpose of assessing potential noise impacts from the Albion Park Quarry expansion, ambient noise level data has been divided into two distinct localities, namely:

- "The Hill" Residence - including background monitoring at Location 1.
- Greenmeadows Estate Residential - including background monitoring at Location 2.

On the basis if these two localities, the RBLs used to determine the project specific noise levels are presented in **Table 5.1.3**.

Table 5.1.3 Daytime L_{A90} RBL Values for Assessment Purposes

Location	L_{A90} Rating Background Level Values (dBA)
"The Hill" Residence	34
Greenmeadows Estate Residential	38

6 IMPACT ASSESSMENT PROCEDURES

6.1 General Objectives

Residential Receiver

Responsibility for the control of noise emission in New South Wales is vested in Local Government and the EPA. The EPA released a NSW Industrial Noise Policy in December 1999 that provides a framework and process for deriving noise criteria for consents and licences that will enable the EPA to regulate premises that are scheduled under the Protection of the Environment Operations Act, 1997.

The specific policy objectives are:

- To establish noise criteria that would protect the community from excessive intrusive noise and preserve amenity for specific land uses.
- To use the criteria as the basis for deriving project specific noise levels.
- To promote uniform methods to estimate and measure noise impacts, including a procedure for evaluating meteorological effects.
- To outline a range of mitigation measures that could be used to minimise noise impacts.
- To provide a formal process to guide the determination of feasible and reasonable noise limits for consents or licences that reconcile noise impacts with the economic, social and environmental considerations of industrial development.
- To carry out functions relating to the prevention, minimisation and control of noise from premises scheduled under the Act.

Assessing Intrusiveness

For assessing intrusiveness, the background noise needs to be measured. The intrusiveness criterion essentially means that the equivalent continuous noise level (L_{Aeq}) of the source should not be more than 5 decibels above the measured background level (L_{A90}).

Assessing Amenity

The amenity assessment is based on noise criteria specific to land use and associated activities. The criteria relate only to industrial-type noise and do not include road, rail or community noise. The existing noise level from industry is measured. If it approaches the criterion value, then noise levels from new industries need to be designed so that the cumulative effect does not produce noise levels that would significantly exceed the criterion. For high-traffic areas there is a separate amenity criterion. The cumulative effect of noise from industrial sources needs to be considered in assessing impact.

Extracts from the NSW Industrial Noise Policy that relate to the amenity criteria is given in **Table 6.1.1** and **Table 6.1.2**.

Table 6.1.1 Amenity Criteria - Recommended L_{Aeq} Noise Levels from Industrial Noise Sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level	
			Acceptable	Recommended Maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
	Urban	Day	60	65
		Evening	50	55
		Night	45	50
	Urban/Industrial Interface (for existing situations only)	Day	65	70
		Evening	55	60
		Night	50	55
School classrooms – internal	All	Noisiest 1-hour period when in use	35	40
Hospital ward - internal	All	Noisiest 1-hour period	35	40
- external	All	Noisiest 1-hour period	50	55
Place of worship – internal	All	When in use	40	45
Area specifically reserved for passive recreation (eg National Park)	All	When in use	50	55
Active recreation area (eg school playground, golf course)	All	When in use	55	60
Commercial premises	All	When in use	65	70
Industrial premises	All	When in use	70	75

Notes For Monday to Saturday, Daytime 7.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 7.00 am
On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am
The L_{Aeq} index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period

Table 6.1.2 Modification to Acceptable Noise Level (ANL)* to Account for Existing Levels of Industrial Noise

Total Existing LAeq noise level from Industrial Noise Sources	Maximum LAeq Noise Level for Noise from New Sources Alone, dBA
≥ Acceptable noise level plus 2 dBA	If existing noise level is *likely to decrease* in future acceptable noise level minus 10 dBA If existing noise level is *unlikely to decrease* in future existing noise level minus 10 dBA
Acceptable noise level plus 1 dBA	Acceptable noise level minus 8 dBA
Acceptable noise level	Acceptable noise level minus 8 dBA
Acceptable noise level minus 1 dBA	Acceptable noise level minus 6 dBA
Acceptable noise level minus 2 dBA	Acceptable noise level minus 4 dBA
Acceptable noise level minus 3 dBA	Acceptable noise level minus 3 dBA
Acceptable noise level minus 4 dBA	Acceptable noise level minus 2 dBA
Acceptable noise level minus 5 dBA	Acceptable noise level minus 2 dBA
Acceptable noise level minus 6 dBA	Acceptable noise level minus 1 dBA
< Acceptable noise level minus 6 dBA	Acceptable noise level

* ANL = recommended acceptable LAeq noise level for the specific receiver, area and time of day from **Table 6.1.1**.

6.2 Quarry Noise Emission Design Goals

The noise emission design goals for the proposed expansion of Albion Park Quarry have been established with reference to the NSW Industrial Noise Policy outlined in **Section 6.1**.

The existing background noise levels exhibited a trend typical of a suburban area that is, rising significantly during the day as a result of increased traffic activity. The intrusiveness criteria have been based on noise measurements taken without the quarry in operation.

The existing $L_{Aeq(period)}$ noise levels include natural sources, some passing traffic noise and noise from the existing quarrying operations. The amenity criteria were based from measurements of only industrial noise sources in the area (ie, excluding noise from transportation and natural sources). As the existing industrial noise level contributions are more than 6 dBA below the respective daytime, evening and night-time criteria, the amenity criteria were set via reference to **Table 6.1.1**. The residences in the general area (although some being in a rural setting) are influenced by extractive industry in the general area as well as noise from traffic on the Princes Highway and are therefore best described by the "suburban receiver" type.

The resulting intrusiveness and amenity design goals are given in **Table 6.2.1**.

Table 6.2.1 Albion Park Quarry Intrusiveness and Amenity Noise Design Goals

Location	Description	Intrusiveness Criterion $L_{Aeq(15minute)}$	Amenity Criterion L_{Aeq}
Location 1 "The Hill" Residence	**Daytime** 7am to 6pm	39 dBA	55 dBA
Location 2 Greenmeadows Estate Residential	**Daytime** 7am to 6pm	43 dBA	55 dBA

For assessment purposes the intrusive and amenity criterion levels at "The Hill" residence have been adopted at the Company owned "Belmont" residence.

6.3 Construction Noise Criteria

The EPA NSW "*Environmental Noise Control Manual*", Chapter 171, sets out noise criteria applicable to construction site noise for the purpose of defining intrusive noise impacts. The EPA's construction site noise control guidelines are presented in **Table 6.3.1**. Based upon the EPA's guidelines, the project specific construction noise limits outlined in **Table 6.3.2** will apply to the project.

Table 6.3.1 Construction Site Noise Control Guidelines

Total Construction Period	Acceptable L_{A10} Noise Level[1]
4 weeks and under	Background L_{A90} plus 20 dBA
4 weeks to 26 weeks	Background L_{A90} plus 10 dBA
Greater Than 26 Weeks	Background L_{A90} plus 5 dBA

1. Applicable between the hours of 7.00 am and 6.00 pm Monday to Friday, and 8.00 am to 1.00 pm Saturdays. For all other times construction noise must be inaudible at the receiver. No construction work is to take place on Sundays or Public Holidays.

Table 6.3.2 Project Specific Construction Noise Limits

Total Construction Period	LA90 Background Level		Project Specific LA10 Noise Level[1]
4 weeks and under	"The Hill" Residence	34 dBA	54 dBA
4 weeks to 26 weeks		34 dBA	44 dBA
Greater Than 26 Weeks		34 dBA	39 dBA
4 weeks and under	"Belmont" Residence	34 dBA	54 dBA
4 weeks to 26 weeks		34 dBA	44 dBA
Greater Than 26 Weeks		34 dBA	39 dBA

1. Applicable between the hours of 7.00 am and 6.00 pm Monday to Friday, and 8.00 am to 1.00 pm Saturdays. For all other times construction noise must be inaudible at the receiver. No construction work is to take place on Sundays or Public Holidays.

6.4 Traffic Noise Design Goals

All vehicles travelling to and from the quarry will now use the East-West Link Road. Traffic noise assessments in this report are based on vehicles using the East-West Link Road.

The Environment Protection Authority released the "*Environmental Criteria for Road Traffic Noise*" in May 1999.

The policy sets out noise criteria applicable to different road classifications for the purpose of defining traffic noise impacts.

The East-West Link Road clearly falls into the category of "collector road" and it is for this reason the noise criteria outlined in **Table 6.4.1** have been adopted.

Table 6.4.1 EPA Environmental Criteria for Road Traffic Noise

Category	Descriptor	Traffic Noise Goal
8. Land use developments with the potential to create additional traffic on a collector road	$L_{Aeq(1hour)}$ daytime	60 dBA*
	$L_{Aeq(1hour)}$ night-time	55 dBA*

* In all cases (where criteria are already exceeded), traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dBA.

7 ASSESSMENT OF NOISE IMPACTS

7.1 Operational Noise Modelling

A computer model was used to predict the noise emissions from the current operations and future development of the Albion Park Quarry. The Environmental Noise Model (ENM) used for the noise emission predictions has been produced in conjunction with the EPA. A map giving all relevant topographic information was digitised into the computer. The model subsequently used this map, together with the noise source data, ground cover, shielding by barriers and/or adjacent buildings and atmospheric information to predict noise levels at the various receiver locations. Atmospheric conditions, which did not enhance noise (ie 20°C air temperature, 65% Relative Humidity, 0 m/s wind speed and 0°C/100 m temperature inversion), were assumed for the initial phase of the modelling exercise. Noise contours for the Year 10, 20 and 40 quarry plans are contained within **Appendix D**. These noise contours are given for the situation without the extension to the noise control bund intended to screen the "Belmont" residence.

Noise Mitigation and Management

A visual/noise bund is to be constructed on the eastern boundary of the proposed extraction area. The location of the bund is given in the Location Map in **Appendix B**. The bund will be constructed of earth to a height of 3 m above the existing ground level and will be planted and treed with appropriate species for the area.

Table 7.1.1 Daytime Noise Impact Assessment - Calm Weather Conditions

Receiver Location	Predicted LAeq(15minute) Noise Level dBA)				Design Goals		
	Existing Situation	Year 10	Year 20	Year 30	Description	Intrusiveness Criterion LAeq(15minute)	Amenity Criterion LAeq(period)
"The Hill" Residence	27	33	38	34	**Daytime** 7.00 am to 6.00 pm	39 dBA	55 dBA
Greenmeadows Residential Estate	42	41	41	41	**Daytime** 7.00 am to 6.00 pm	43 dBA	55 dBA
"Belmont" Residence (owned by Cleary Bros)	22	47	52	67	**Daytime** 7.00 am to 6.00 pm	39 dBA	55 dBA

Noise Impact Assessment for Calm Weather Conditions

The noise level predicted for the existing situation and the future expansion (refer to **Table 7.1.1**) indicate that noise from the site will be between 1 dBA and 12 dBA below the project specific noise goal at the "The Hill" Residence and between 1 dBA and 2 dBA below the project specific noise goal at Greenmeadows Estate for daytime operation.

The "Belmont" Residence is owned by Cleary Bros but is currently occupied by the previous owner. It is likely that the previous owner will vacate the residence within approximately 5 years of the commencement of the proposed development.

It is predicted that the noise levels during the initial 10 year period of the proposed operations will exceed the project specific intrusive criterion at the "Belmont" Residence. The major impact will occur during operation of the rock drill. In order to reduce the impact of noise to an acceptable level, and subject to agreement of the previous owner, the visual/noise bund will be extended to shield the residence from the proposed operation. This will reduce noise from the proposed operation to 35 dBA which is below the project specific intrusive criterion. During the construction of the section of the bund wall closest to the "Belmont" Residence the Company will offer temporary accommodation to the resident if required.

7.2 Effects of Meteorology on Noise Levels

Wind

Wind has the potential to increase noise at a receiver when it is light and stable and blows from the direction of the source of the noise. As the strength of the wind increases the noise produced by the wind will obscure noise from most industrial and transport sources.

Wind effects need to be considered when wind is a feature of the area under consideration. Where wind blows from the source to the receiver at speeds up to 3 m/s for more than 30% of the time in any season, then wind is considered to be a feature of the area and noise level predictions must be made under these conditions.

Weather data was obtained from the Bureau of Meteorology for the past 12 months from a weather station at the Albion Park Airport. This data was analysed to determine the frequency of occurrence of winds up to speeds of 3 m/s for daytime in each season. The results of this analysis are contained within **Table 7.2.1**.

Table 7.2.1 Seasonal Frequency of Occurrence Wind Speed Intervals - Daytime

Period	Calm	Wind Direction	0.5 to 1.5 m/s	1.5 to 3 m/s	0.5 to 3 m/s
Summer	2.4%	WSW±34°	0.3%	4.2%	4.5%
Autumn	3.8%	W±34°	2.0%	5.6%	7.7%
Winter	4.2%	W±34°	1.9%	5.3%	7.2%
Spring	1.6%	ENE±34°	0.5%	4.1%	4.6%

Seasonal wind records indicate that daytime winds of up to 3 m/s predominate in autumn from the western sector (ie west ±34°) for up to approximately 8% of the time. The percentage of occurrence of daytime winds blowing from the subject mining operations towards the closest residences is therefore significantly less than 8%.

As the frequency of occurrence of daytime winds in all seasons is below 30%, then wind is not considered to be feature of the area.

Temperature Inversion

Temperature inversions, when they occur, have the ability to increase noise levels by focusing sound waves. Temperature inversions occur predominantly at night during the winter months. For a temperature inversion to be a significant characteristic of the area it needs to occur for approximately 30% of the total time during winter, or about 2 nights per week.

The EPA Industrial Noise Policy states that temperature inversions need only be considered for the night noise assessment period (ie after 10.00 pm). As the proponent does not intend to operate at night, the effect of temperature inversions has not been considered as part of this assessment.

7.3 Construction Noise Modelling

A visual/noise bund is to be constructed on the eastern boundary of the proposed extraction area. Noise modelling was undertaken to determine the likely noise level received at the nearest, most potentially affected residences during the construction period. These residences are the "The Hill" and "Belmont" Residences. Greenmeadows Estate is unlikely to be affected by this construction as it is sufficiently distanced, and topographically shielded from the construction area.

Construction Noise Calculation Inputs

The computer noise model was used to predict the noise emissions during noise bund construction. Atmospheric conditions which did not enhance noise were assumed for the modelling exercise.

The L_{10} sound power levels of acoustically significant plant and equipment to be used in the construction of the noise bund are given in **Table 7.3.1**. The sound power levels were determined from on-site measurements, and measurements obtained from a Richard Heggie Associates database.

Table 7.3.1 Equipment Sound Power Levels

Equipment	Sound Power Level
Bulldozer - CAT D9 (or similar)	116 dBA
Dump Truck or Scraper	118 dBA

Construction Noise Calculation Results

Construction noise calculations were based upon the "worst case" scenario, with equipment working at the likely closest point to the respective receivers. The results, contained in **Table 7.3.2**, indicate that acoustic bund construction noise levels will be met at the "The Hill" Residence provided that the construction period at the closest point to this residence is restricted to four weeks. Due to the proximity of the "Belmont" Residence to the bund construction, noise levels are predicted to be exceeded by up to 10 dBA at this location.

To alleviate the impact of noise during the construction of the section of the bund wall closest to the "Belmont" Residence the Company will offer temporary accommodation to the resident if required.

Table 7.3.2 Construction Noise Calculation Results

Total Construction Period	L_{A10} Construction Noise Level		Project Specific L_{A10} Noise Level[1]
4 weeks and under	"The Hill" Residence	51 dBA	54 dBA
	"Belmont" Residence	68 dBA	54 dBA
4 weeks to 26 weeks	"The Hill" Residence	51 dBA	44 dBA
	"Belmont" Residence	68 dBA	44 dBA
Greater Than 26 Weeks	"The Hill" Residence	51 dBA	39 dBA
	"Belmont" Residence	68 dBA	39 dBA

1. Applicable between the hours of 7.00 am and 6.00 pm Monday to Friday, and 8.00 am to 1.00 pm Saturdays. For all other times construction noise must be inaudible at the receiver. No construction work is to take place on Sundays or Public Holidays.

7.4 Traffic Noise Predictions

Traffic generated from product sales at the quarry will not alter from existing levels as a result of the proposed extension. All vehicles entering or leaving the quarry site now use the East-West Link Road. Opening of the East-West Link Road has effectively reduced the noise levels generated by quarry traffic at Greenmeadows Estate residences as the quarry traffic will pass some 145 m from the closest dwelling.

A traffic survey conducted in March 2000 suggested that the peak hourly traffic flow would be up to 130 vehicles per hour with approximately 60% being heavy vehicle movements.

A prediction of traffic noise levels at the closest Greenmeadows Estate residence generated from quarry traffic is given in **Table 7.4.1**.

Table 7.4.1 Predicted Quarry Traffic Noise Contribution

Receiver Location	Predicted Traffic Noise Level $L_{Aeq(1hour)}$	Design Goals	
		Period	Traffic Noise Goal $L_{Aeq(1hour)}$
Greenmeadows Estate Residence	42 dBA	**Daytime** 7 am to 10pm	60 dBA
		Night 10 pm to 7 am	55 dBA

The predicted contribution to the noise at the closest residence at Greenmeadows Estate for the peak hourly flow from quarry generated traffic is clearly below the daytime traffic noise goal. Consequently, continuation of the Cleary Bros Quarry traffic flow will not cause the noise from the total traffic flow on the East-West Link Road to exceed the daytime traffic noise goals.

There may be a requirement, at some time in the future, to import fill material into the quarry for landform rehabilitation purposes. The exact amount of fill required, or number of trucks needed, is not known at this time. It may be possible to backload aggregate delivery trucks with fill material to fulfil some of this requirement. The contribution to noise at residential receivers of current quarry traffic flow is such that some potential for traffic growth is possible without breaching the EPA criterion.

8 CUMULATIVE NOISE IMPACT

The NSW INP prescribes detailed calculation routines for establishing "project specific" $L_{Aeq(15minute)}$ intrusive criteria and $L_{Aeq(period)}$ amenity criteria at potentially affected receivers for a development (in isolation).

Potential cumulative noise impacts from existing and successive resource developments are embraced by the INP procedures by ensuring that the appropriate noise emission criteria (and consent limits) are established with a view to maintaining acceptable noise *amenity* levels for residences.

In order to assess potential cumulative noise impacts it is important to appreciate and distinguish between the INP's first and second environmental noise control objectives as follows:

Intrusive Noise Criteria $L_{Aeq(15minute)}$

The INP's first objective, that the intrusive noise emission from any single source does not exceed the background level by more than 5 dBA, relates to each individual development and the intrusive noise limit is generally specified in the Development Consent and/or Licences and Approvals.

There is not an established procedure (or regulatory requirement) to determine the cumulative intrusive $L_{Aeq(15minute)}$ noise criterion in relation to the simultaneous operation of the existing CSR and Cleary Bros quarrying operations.

Cumulative Noise Amenity Criteria $L_{Aeq(period)}$

The INP's second objective is that the $L_{Aeq(period)}$ amenity level does not exceed the specified "acceptable" level appropriate for the particular locality and land use and is aimed at restricting the potential cumulative increase in noise *amenity* levels (otherwise known as "background creep").

Based on the INP, the acceptable $L_{Aeq(period)}$ noise *amenity* level in relation to the simultaneous operation of the CSR and Cleary Bros quarries are daytime 55 dBA $L_{Aeq(11hour)}$, evening 45 dBA $L_{Aeq(4hour)}$ and night-time 40 dBA $L_{Aeq(9hour)}$.

Indicative Cumulative Noise Impact Assessment

An indicative cumulative noise impact assessment has been based upon an evaluation of the predicted worst case noise emission levels produced by the existing and future operations of the CSR and Cleary Bros quarrying operations. The noise predictions used for the CSR quarry have been obtained from a recent report submitted to Council.

In order to prepare the indicative assessment the following assumptions have been made:

- The individual $L_{Aeq(15minute)}$ emission limits from each development are simultaneously additive to give a total $L_{Aeq(15minute)}$ intrusive level.
- The cumulative $L_{Aeq(period)}$ amenity level is approximately 3 dBA less than the total $L_{Aeq(15minute)}$ intrusive level.

A summary of the indicative cumulative assessment is contained within **Table 8.1.1**.

Table 8.1.1 Indicative Maximum Cumulative Noise Impact Assessment Summary

Mine	"The Hill" Residence $L_{Aeq(15minute)}$ Daytime	Greenmeadows Estate Residential $L_{Aeq(15minute)}$ Daytime	"Belmont" Residence $L_{Aeq(15minute)}$ Daytime
Cleary Bros Quarry	38 dBA	42 dBA	47 dBA*
CSR Quarry	30 dBA	44 dBA	40 dBA
Total Intrusive Level	39 dBA	46 dBA	48 dBA
Cumulative Amenity level	**36 dBA**	**43 dBA**	**45 dBA**
Acceptable Amenity Level	**55 dBA**		

* Note: It is assumed that the "Belmont" Residence will be vacated by the end of Year 10 of the quarry extension.

Based on the foregoing, the estimated maximum cumulative $L_{Aeq(period)}$ amenity levels are well below the INP's acceptable amenity criteria during the daytime period.

9 USE OF EXPLOSIVES

An extensive study into the impact of blasting at the existing Cleary Bros Albion Park Quarry has been conducted by Richard Heggie Associates and is the subject of a detailed report entitled "*Blast Emissions Impact and Control Proposed Albion Park Quarry Extension*" Report 10-1594R1. A summary of the findings of this report, and subsequent blast emission predictions for the proposed future operation, are as follows.

9.1 Ground Vibration and Airblast Limits

Future blast design and monitoring procedures will be implemented with the primary objective of maintaining the levels of Peak Vector Sum (PVS) ground vibration velocity and peak airblast at the closest residences below 5 mm/s and 115 dB Linear respectively, the existing EPA criteria. The EPA also states that the blast emissions criteria may be exceeded for up to 5% of the total number of blasts over a period of 12 months.

These blast emission limits have been imposed on Cleary Bros Albion Park Quarry by the EPA via a Licence Number 299 for blasting between the hours of 8.30 am and 5.00 pm Monday to Friday.

Airblast Emission Levels

At the existing Cleary Bros Albion Park Quarry the limiting parameter for blast design is airblast, rather than ground vibration.

In over 3 years of accurate blast monitoring (ie since January 1999) there have been no exceedances of the EPA's vibration criteria at the nearby "The Hill" Residence and there has been only one measured airblast level (of the 113 blasts) greater than 110 dB Linear (at 112 dB Linear).

9.2 Blast Emission Monitoring Results

Presented in **Appendix E** is a summary of the Blast Emissions Monitoring Results recorded for the blasts conducted between January 1999 and February 2002. The Blast Emissions Monitoring Results sheet includes the following information:

Blast Details

- Blast identification number
- Type of blast (production or overburden)
- Date of blast event
- Time of blast initiation
- Overall and front row Maximum Instantaneous Charge (MIC) in any 8 ms interval (kg)
- Plan distance from blast to monitoring location
- Peak Vector Sum (PVS) resultant ground vibration level (mm/s)
- Peak linear airblast level (dB Linear)

9.3 Influence of Blast Initiation Direction and Face Orientation on Airblast

Results of research conducted both overseas and in Australia indicate that the level of airblast in the direction of initiation of the detonators is about 4 dB Linear higher than in the opposite direction.

Correspondingly, this research indicated that the increase in airblast in front of the blast face relative to behind the face is 5 dB Linear to 10 dB Linear.

Site specific monitoring conducted at Cleary Bros Albion Park Quarry has yielded airblast levels up to 13 dB Linear lower behind the blast face (relative to in front) and up to 11.5 dB Linear lower in the opposite direction to the direction of initiation of the detonators (relative to in the direction of initiation), at offset distances of between 300 m and 900 m.

It is on the basis of this phenomenon that the blast faces in the existing Cleary Bros Albion Park Quarry were progressively reorientated (between the beginning of 1998 and mid 1998) in order to initiate the blast in the opposite direction to the nearby residence and thereby minimise the airblast emission impacts at the "The Hill" Residence.

9.4 Future Blast Designs and Offset Distances

In order to optimise bench heights and MICs, whilst maintaining a 5% likelihood of exceeding the 115 dB Linear airblast criterion, the feasibility of using "deck charges" was investigated. Deck charges are those that are separated within a blasthole by inert material.

The initial decked blasthole design assumed the following:

- Direction of detonator initiation is away from near residences
- Use of 1.5 m solid decking per blasthole
- Two columns of explosives of equal length per blasthole
- Two detonators per blasthole
- Explosive columns initiated from the bottom
- Use of 76 mm diameter blastholes
- Stemming depth 2.2 m
- Subdrill of 1.2 m for both production and overburden blasts (where subdrill is the portion of the blasthole drilled beyond the excavation limit).

9.5 Verification of Future "Deck Charge" Blast Designs

In order to confirm the practicality and to quantify the blast emissions from decked blastholes, a series of thirteen trial blasts were conducted at Albion Park Quarry between 25 June 2001 and 15 February 2002. To demonstrate the principle of decked blastholes, the blasthole loading parameters for Blast No 22/01 are shown diagrammatically in **Appendix F**.

A summary of the most pertinent blast design parameters, the offset distances and the resulting levels of airblast and ground vibration for these deck charge trial blasts are presented in **Table 9.5.1**. Here, the front row MIC has been nominated as this is the critical row for containing and controlling airblast.

A critical design parameter for these trial blasts, apart from using deck charges, was the initiation of the blast in the direction away from the monitoring location.

Table 9.5.1 Trial Blast Design Parameters and Blast Emission Levels

Blast No	Front Row MIC	Nominal Bench Height	Monitoring Offset Distance	Airblast (dB Linear)	Ground Vibration (PVS-mm/s)
22/01	7 kg	10.5 m	500 m	110.4	2.6
28/01	21 kg	10 m	500 m	113.3 (with face blowout) 108.0 (without blowout)	3.0
30/01	21 kg	10 m	500 m	107.5	2.1
32/01	29 kg	11 m	500 m	110.6	2.5
33/01	28 kg	9.5 m	500 m	106.8	2.9
35/01	25 kg	10 m	500 m	106.5	2.7
36/01	33 kg	14 m	633 m	107.5	2.4
37/01	36 kg	11 m	500 m	109.3	2.2
38/01	35 kg	11 m	500 m	103.6	3.2
39/01	39 kg	12.2 m	250 m	117.6	6.81
40/01	34 kg	11.8 m	500 m	106.1	2.19
43/01	36 kg	12.0 m	500 m	103.8	2.00
3/02	11 kg	11.0 m	500 m	110.0	1.77

The blasts shown in **Table 9.5.1** were monitored (for airblast and ground vibration) at a nominal distance of 500 m at the same orientation from the blast that the "Belmont" Residence will be from initial blasting in the proposed quarry extension.

9.6 Blast Emissions Prediction - Decked Blastholes

In order to predict future blast emission levels for decked blastholes, the measured airblast and ground vibration data for the deck charge blasts listed in **Table 9.5.1** (together with the data for those deck charge blasts presented in **Appendix E)** were used to develop airblast and ground vibration "site laws" (as defined below).

The site specific relationships between the level of blast emissions for decked blastholes and Scaled Distance (site laws), which form **Appendices G** (airblast) and **H** (ground vibration), are presented in **Figure 9.6.1** for peak airblast and **Figure 9.6.2** for PVS (peak vector sum) ground vibration velocity.

Figure 9.6.1 Peak Linear Airblast - Site Law for Decked Blastholes - 44 Data Points

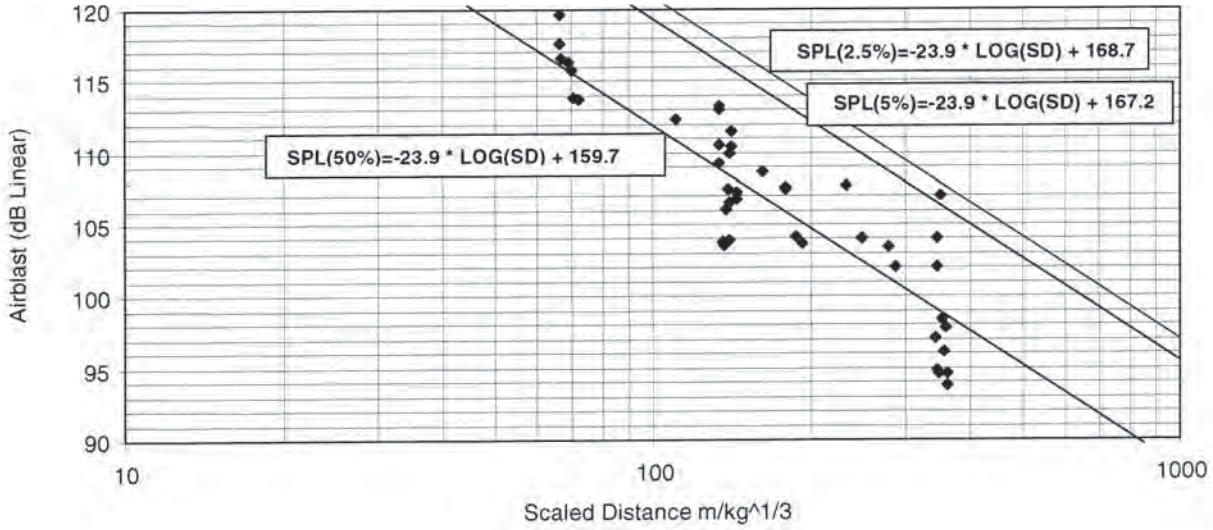
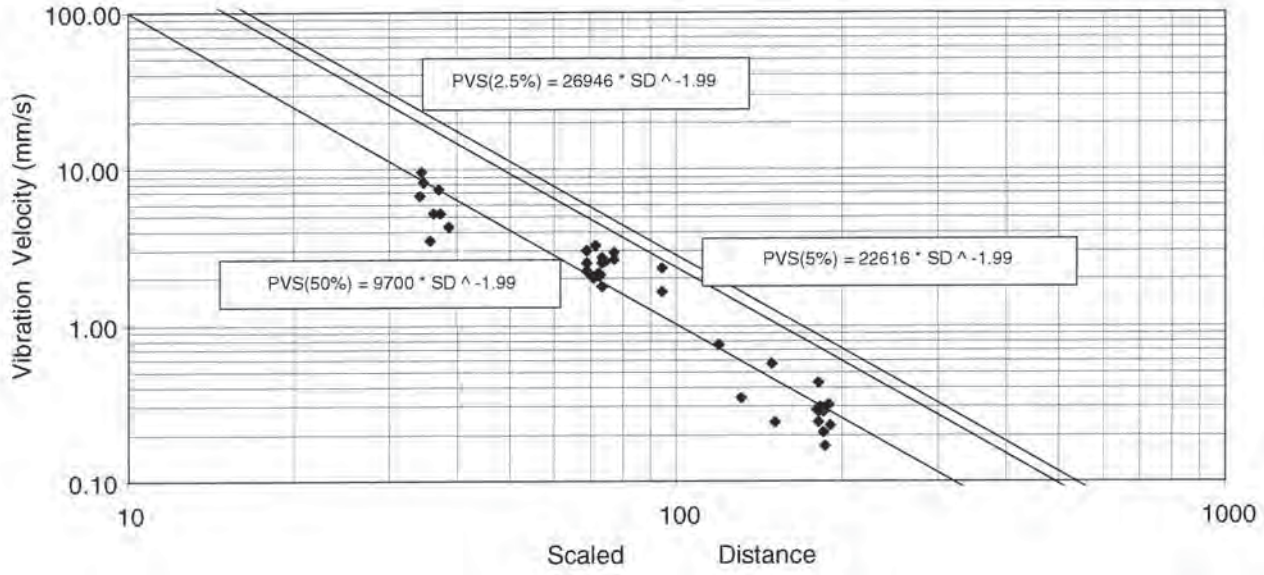


Figure 9.6.2 PVS Ground Vibration Velocity for Decked Blastholes - 37 Data Points



Based on these site laws, calculations were conducted to indicate the allowable MICs for compliance with the general EPA human comfort criteria of 115 dB Linear (airblast) and 5 mm/s (ground vibration) for a range of offset distances. The results of these calculations are presented in **Appendix I** (airblast) and **Appendix J** (ground vibration) for both a 50% and 5% likelihood of exceedance.

Review of the data presented in **Appendix I** indicates that for a 5% likelihood of exceeding 115 dB Linear airblast at 500 m the allowable MIC is 36 kg. The corresponding allowable MIC for a 5% likelihood of exceeding 5 mm/s ground vibration is 53 kg.

9.7 Blast Impact Assessment

By incorporating deck charges of the front row of blastholes in each blast and initiating the blast in the direction away from the closest receiver location, it is predicted that emissions from blasting in the proposed extension, using an MIC of up to 36 kg, would result in compliance with the EPA's general Licence Conditions of 115 dBA airblast and 5 mm/s ground vibration.

Further, as the initial blasting in the proposed quarry extension will be conducted at the farthest point from both the "The Hill" and "Belmont" Residences, the opportunity exists to monitor the blasting as extraction gradually advances towards the residences and to adjust future blast designs, if necessary.

Based on initiating the blast in the direction away from the closest residence (as is the current practice) and the use of deck charges in the front row of blastholes, trials have clearly demonstrated that blasting can be conducted to within about 500 m of the "The Hill" and "Belmont" Residences whilst maintaining compliance with the current EPA Licence Conditions. However, the inevitable future introduction of improved blasting products (eg electronic detonators) will likely enable this offset distance to be reduced.

10 SUMMARY OF FINDINGS AND RECOMMENDATIONS

10.1 Operational Noise Impact

The continued operation of the Cleary Bros Albion Park Quarry will result in noise impacts at the closest most affected non Company owned residences being maintained within the EPA project specific criteria developed for the site. Noise levels at Greenmeadows Estate residential area will be 1 dBA below the project specific criteria and 1 dBA below the project specific criteria at the "The Hill" Residence.

In order to reduce the impact of noise to an acceptable level, and subject to agreement of the previous owner, the visual/noise bund will be extended to shield the "Belmont" Residence from the proposed operation. This will reduce noise from the proposed operation to 35 dBA which is below the project specific intrusive criterion.

10.2 Construction Noise Impact

Noise from construction of the visual/noise bunds will meet the EPA construction noise criteria at the "The Hill" Residence provided that the construction time, at the closest point to the residence, is limited to less than 4 weeks. Further stripping or haul road construction activities following the construction of the visual/noise bund will be maintained at or below the operational noise levels of the proposed quarrying activity.

During the construction of the section of the bund wall closest to the "Belmont" Residence the Company will offer temporary accommodation to the resident if required.

10.3 Cumulative Noise Impact

An indicative cumulative impact assessment revealed that noise from the existing and future operation of the Cleary Bros and CSR quarries would result in levels below the acceptable amenity noise level at surrounding residential areas.

10.4 Blasting Impact

Blasting impacts in the proposed quarry extension will be maintained within the EPA's Licence Conditions (for the existing operation) of 115 dBA airblast and 5 mm/s ground vibration (with an allowance 5% exceedance in a 12 month period) at the closest most affected residences surrounding the site.

10.5 Noise Mitigation and Management

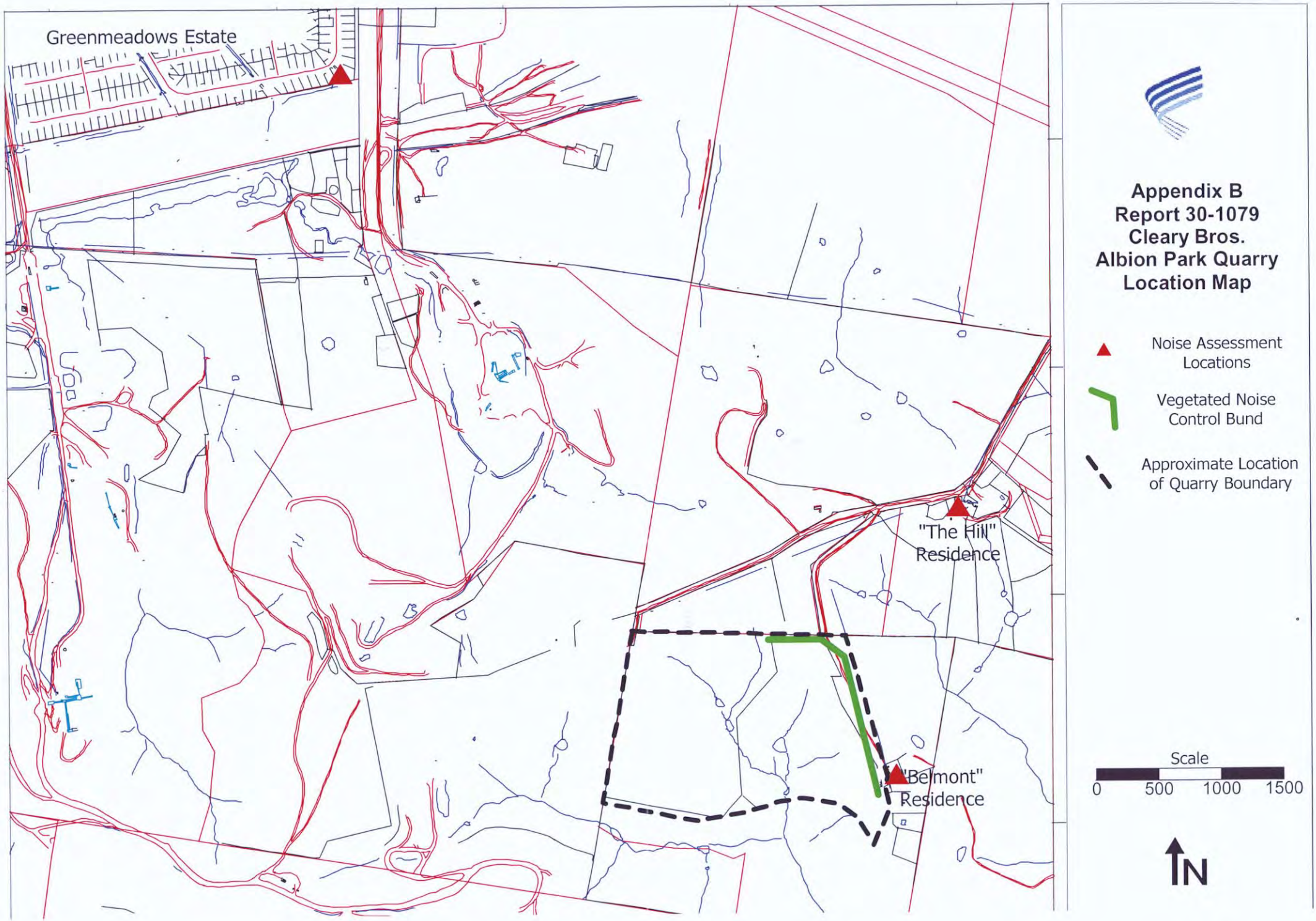
It is recommended that a visual/noise bund be constructed on the northern and eastern boundaries of the proposed extraction area to mitigate noise from the future quarrying operations. The location of the bund is given in the Location Map in **Appendix B**. The bund will be constructed of earth to a height of 3 m above the existing ground level and be planted and treed with appropriate species for the area.

It is proposed that the bund will be extended, with agreement of the previous owner, to shield "Belmont" Residence.

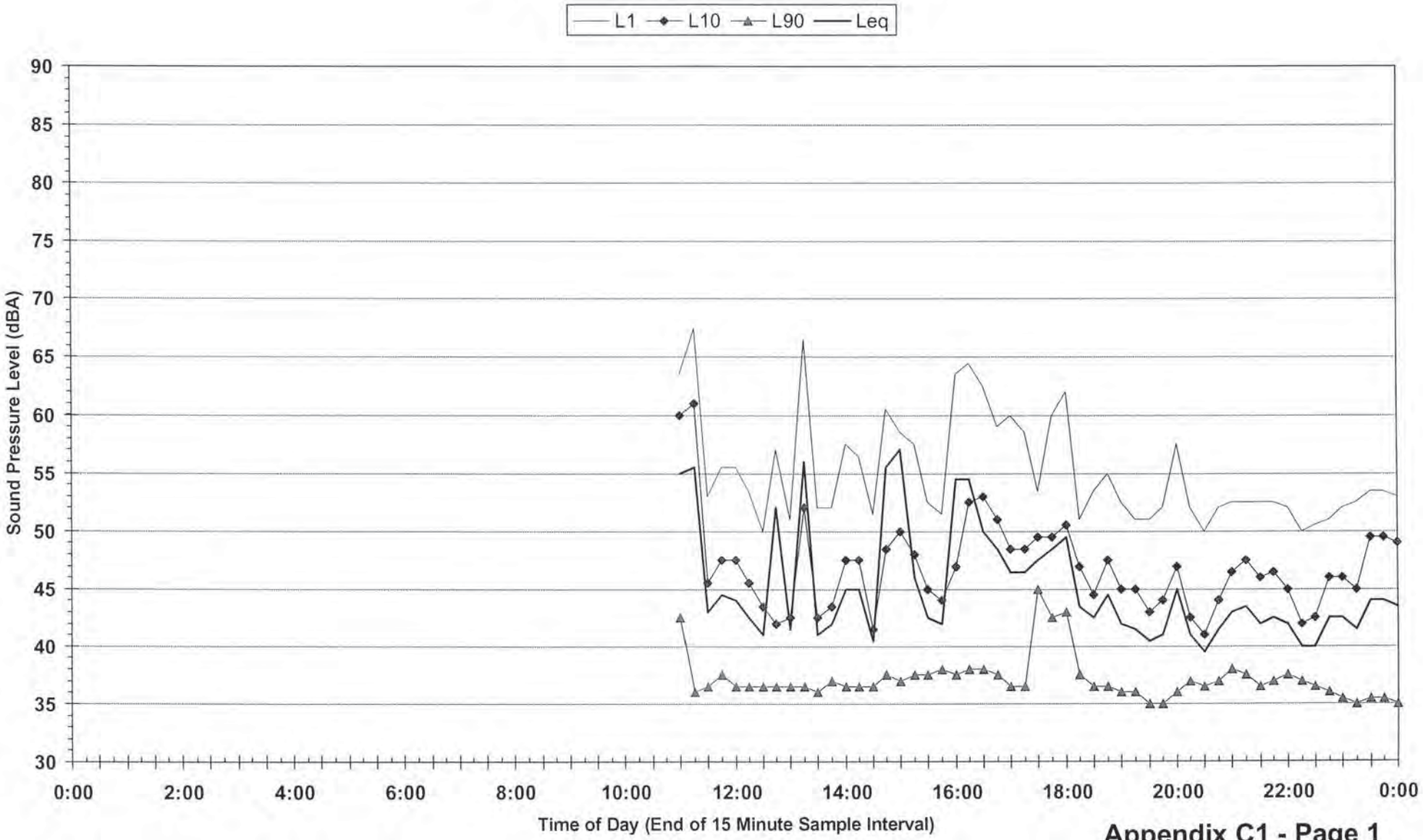
Equipment Sound Power Levels

Job Number	30-1079
Job Description	Cleary Bros. Albion Park Quarry
Project Manager	JC

Source No.	Equipment Description	Octave Band Centre Frequency (Hz) - dBL re 1pW										dB	ISG (m)		ENM (m)		Ground	Elevation
		31.5	63	125	250	500	1k	2k	4k	8k	16K	Overall	East	North	East	North	RL(m)	RL(m)
1	Cat 773 Dump Truck pass by loaded	53	93	101	92	91	90	88	81	74	74	103 dB			1820	2538	100	102
2	Cat 773 Dump Truck pass by unloaded	91	89	91	85	84	85	82	74	66	66	96 dB			1820	2538	100	102
3	Cat 245 Face Shovel loading 773	78	120	122	113	115	112	110	104	97	97	125 dB			1659	2199	102	104
4	Cat 992 Loader Loading mack trailer	100	106	106	102	104	104	102	96	87	87	112 dB			1659	2199	102	104
5	Mack Truck pass by	44	88	85	78	78	78	75	72	67	67	91 dB			1880	3187	40	42
6	Rock Drill continuous drilling	107	117	106	101	107	109	111	113	110	110	121 dB			1618	2622	117	119
7	Water Cart pass by	50	88	86	83	80	80	77	72	66	66	92 dB			1820	2538	100	102
8	CAT 980C Loader pick up and pass by	112	113	106	105	104	103	103	96	90	90	117 dB			1929	3034	40	42
9	Pug Mill	113	119	117	107	111	112	108	103	98	98	123 dB			1970	2980	46	49
10	Primary Plant	109	113	109	105	105	102	100	101	95	95	117 dB			2030	3035	55	61
11	Secondary	70	107	109	106	107	106	105	103	97	97	115 dB			1990	2990	47	50
101	Greenmwadows Estate														1645	3640	22	23.5
102	Dunster Residence														3059	2697	130	131.5
103	Cody Residence														2850	2122	110	111.5


Greenmeadows Estate
"The Hill" Residence
"Belmont" Residence
Appendix B
Report 30-1079
Cleary Bros.
Albion Park Quarry
Location Map
Noise Assessment Locations
Vegetated Noise Control Bund
Approximate Location of Quarry Boundary
Scale
0
500
1000
1500
N

Statistical Ambient Noise Levels
"The Hill" Residence - Friday 9 February 2001



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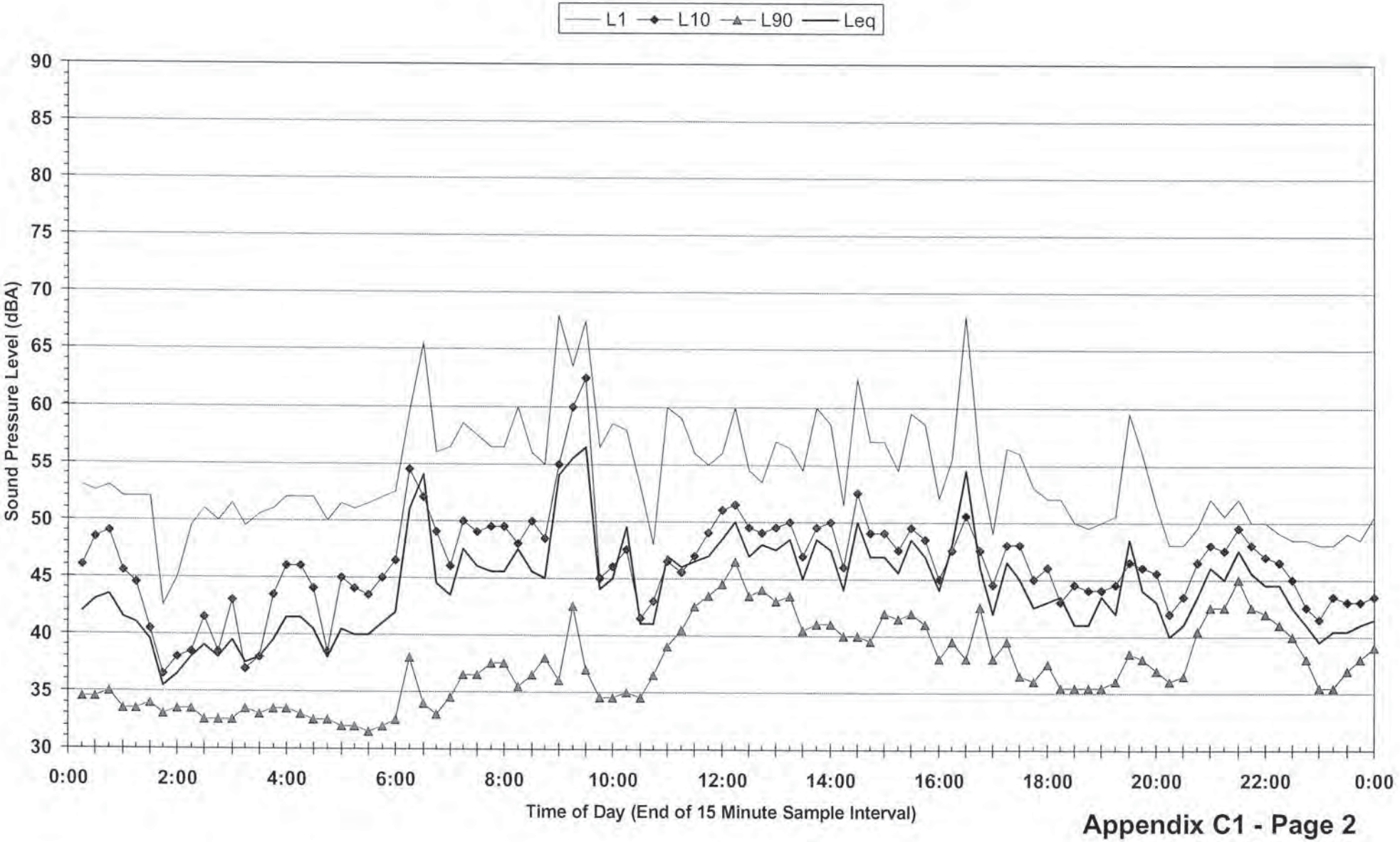
Statistical Noise Levels
RHA Report 30-1079

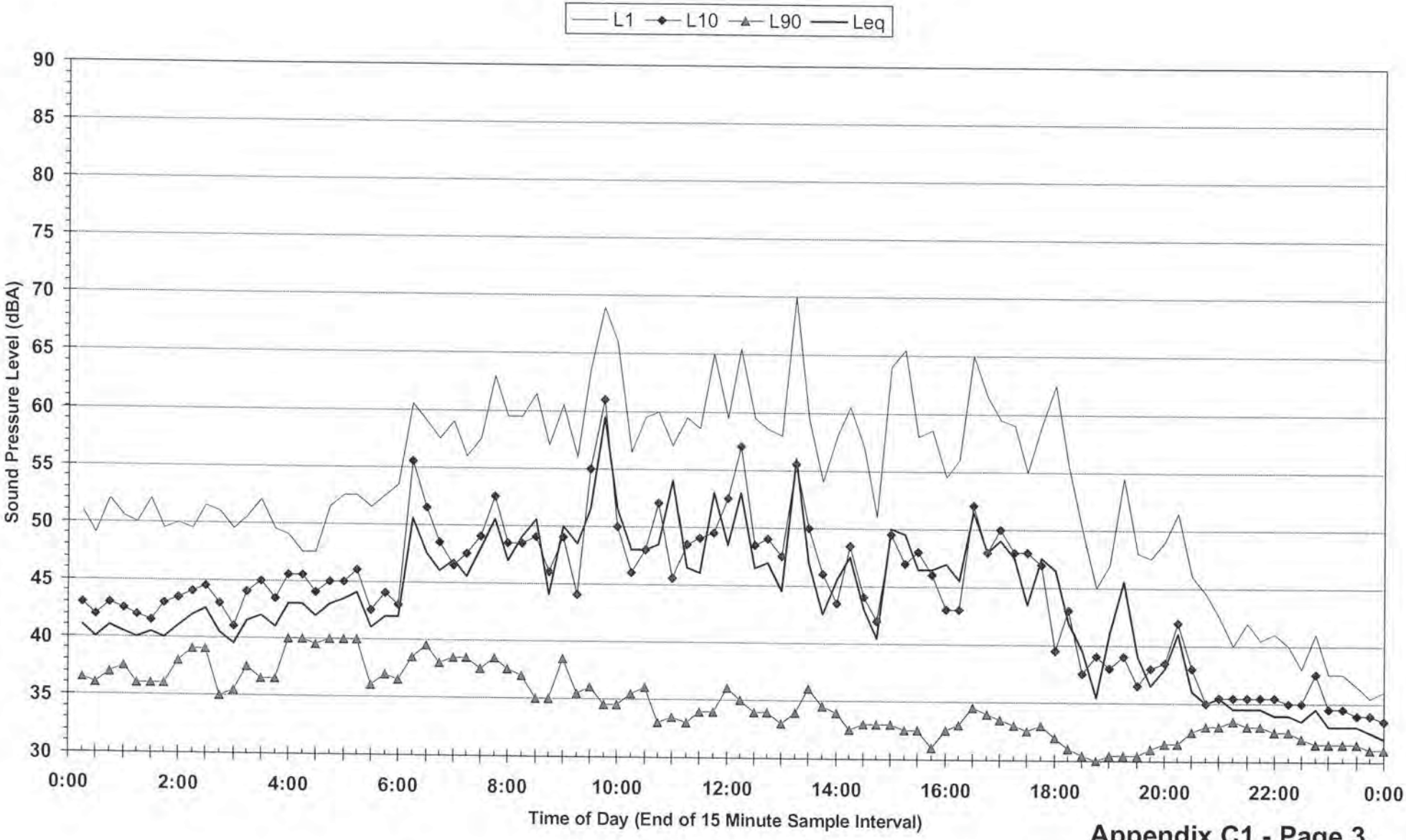
Statistical Ambient Noise Levels
"The Hill" Residence - Saturday 10 February 2001



Appendix C1 - Page 2

Statistical Noise Levels
RHA Report 30-1079

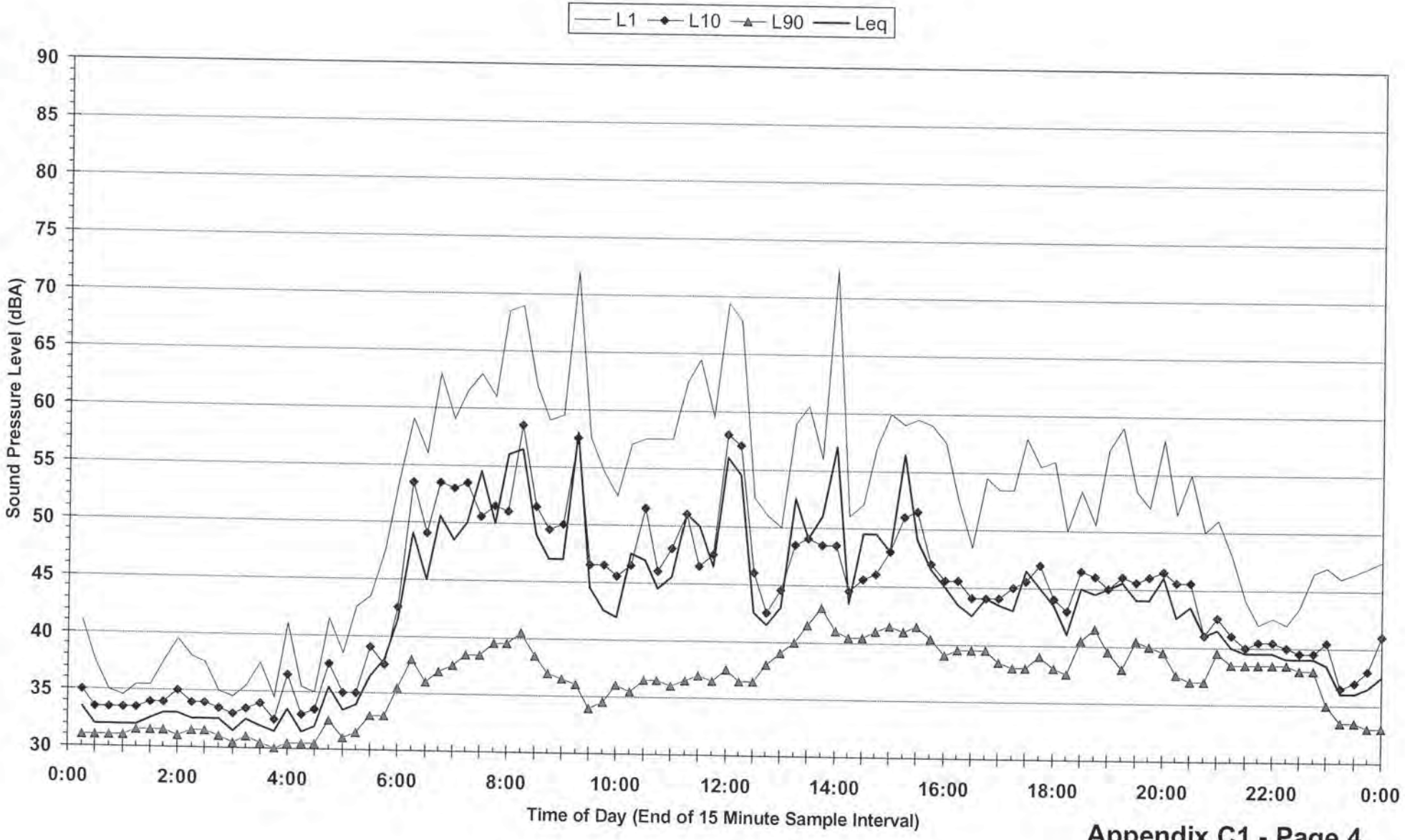
Statistical Ambient Noise Levels
"The Hill" Residence - Sunday 11 February 2001



Appendix C1 - Page 3

Statistical Noise Levels
RHA Report 30-1079

Statistical Ambient Noise Levels
"The Hill" Residence - Monday 12 February 2001



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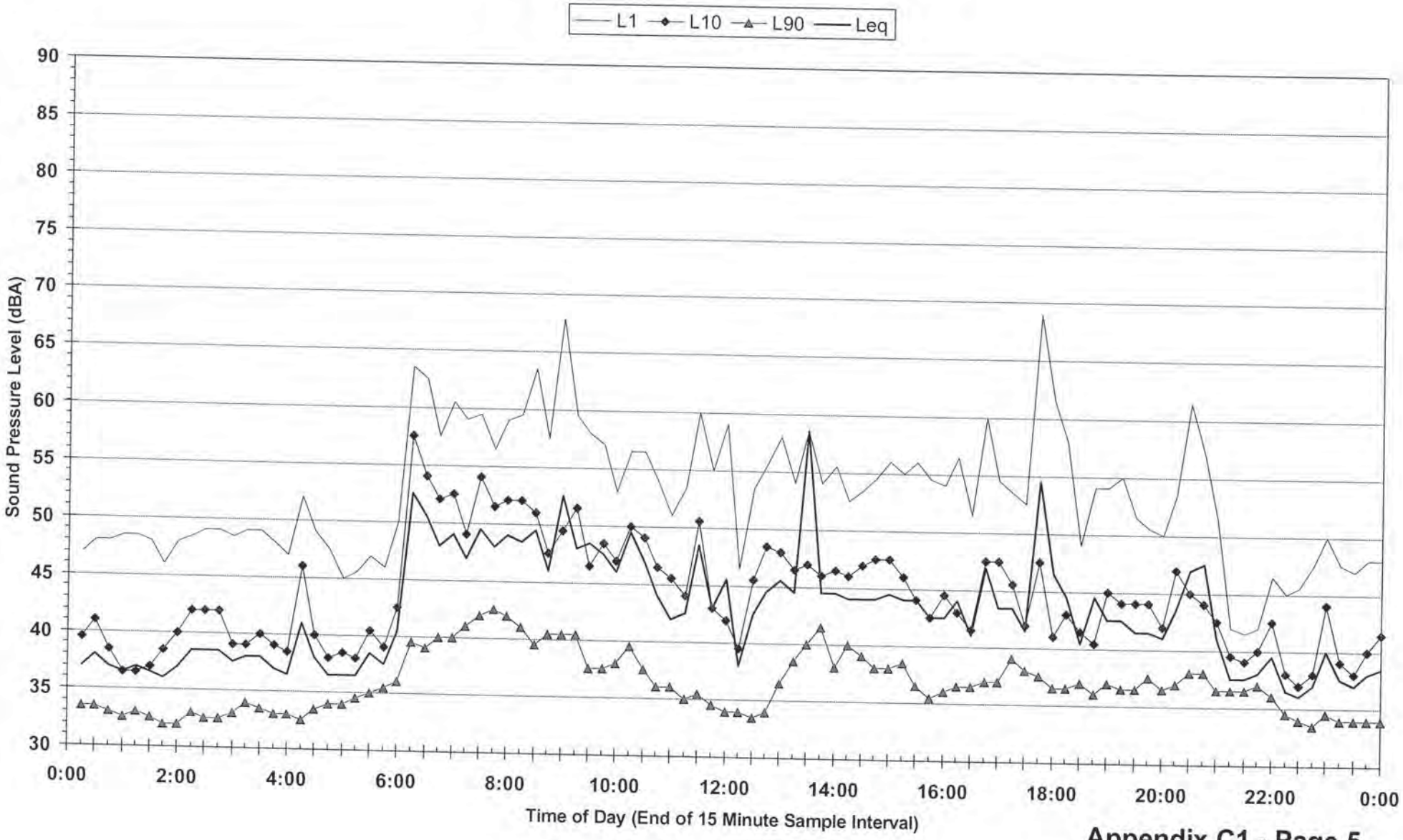
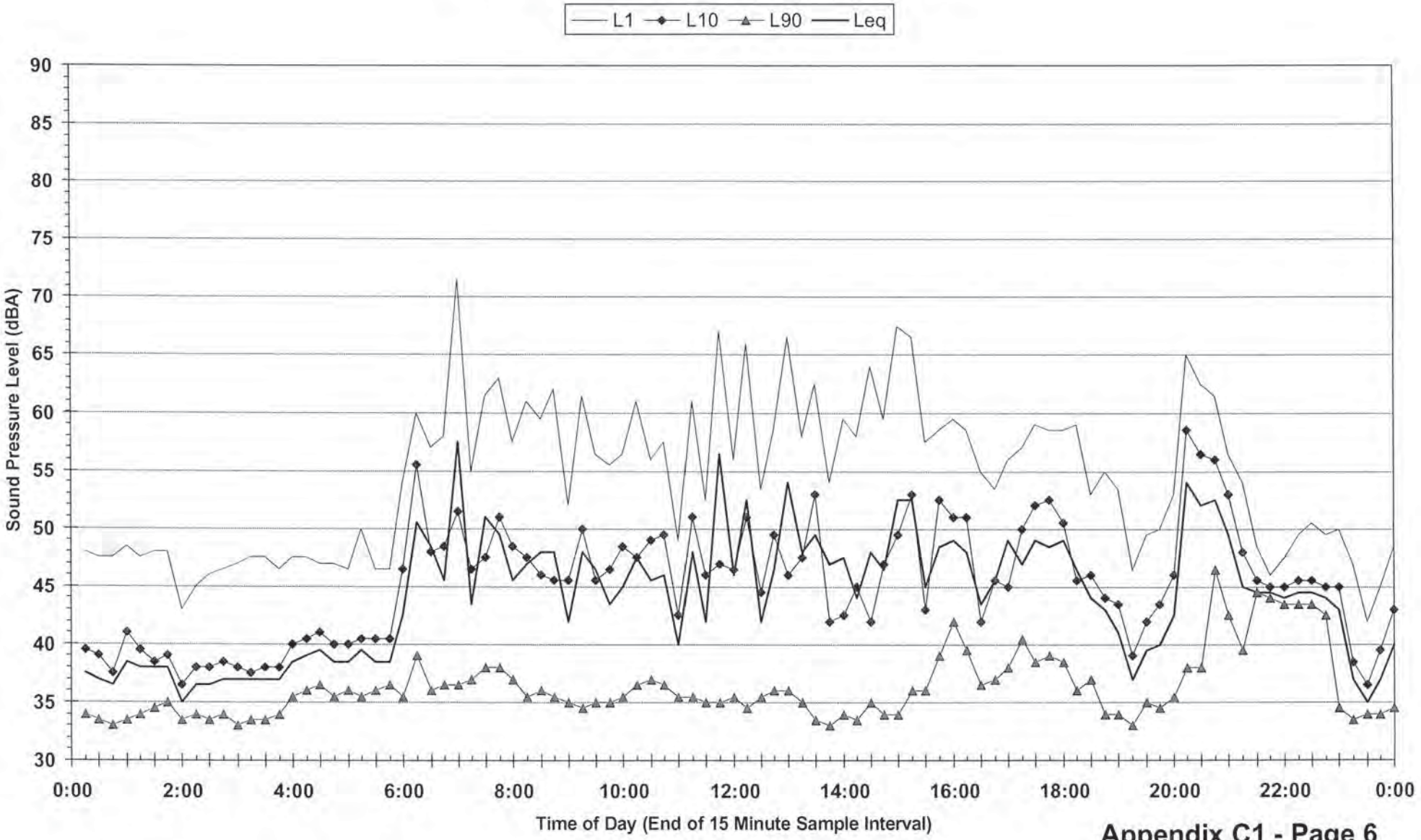
Statistical Noise Levels
RHA Report 30-1079

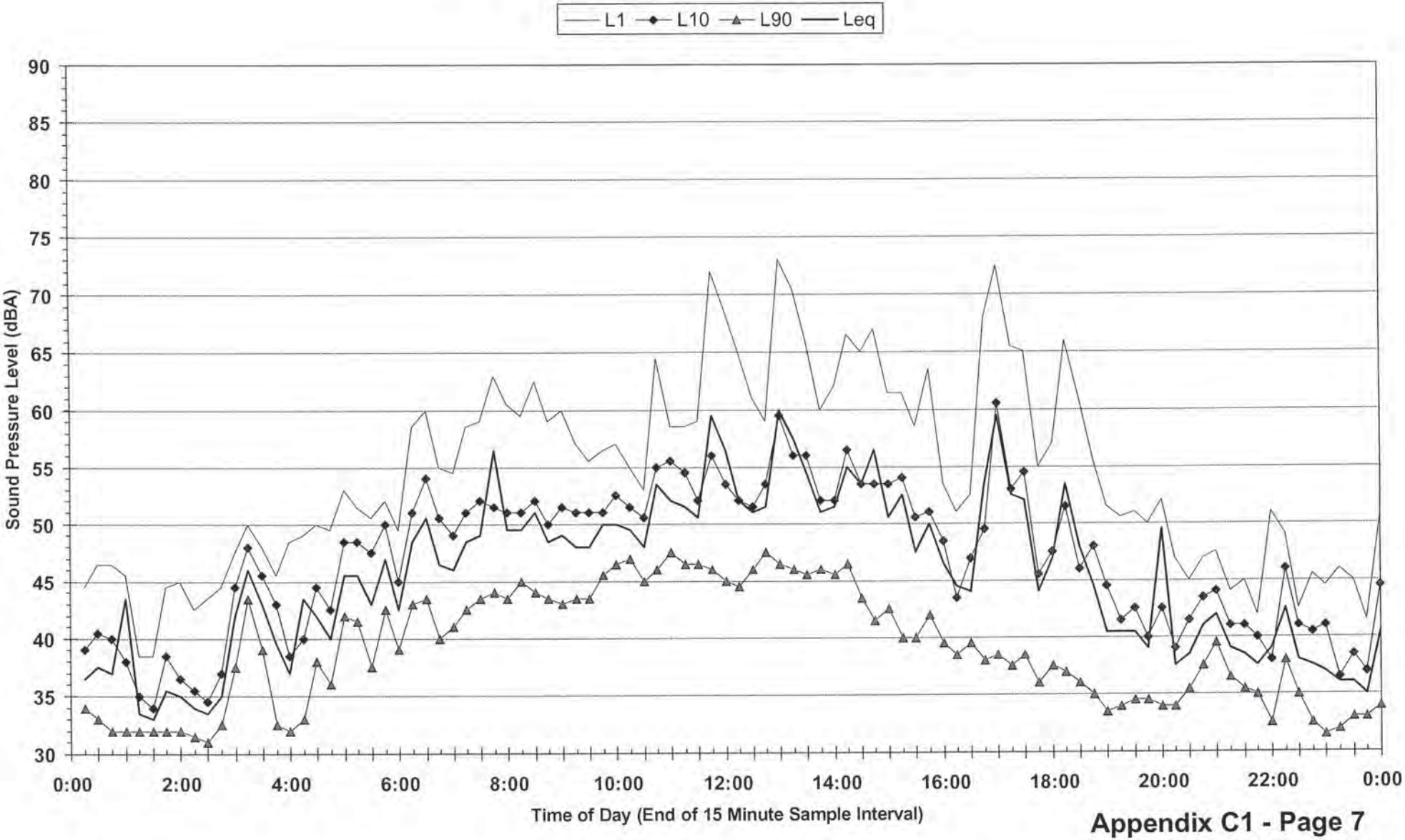
Statistical Ambient Noise Levels
"The Hill" Residence - Tuesday 13 February 2001



Statistical Ambient Noise Levels
"The Hill" Residence - Wednesday 14 February 2001



Statistical Ambient Noise Levels
"The Hill" Residence - Thursday 15 February 2001



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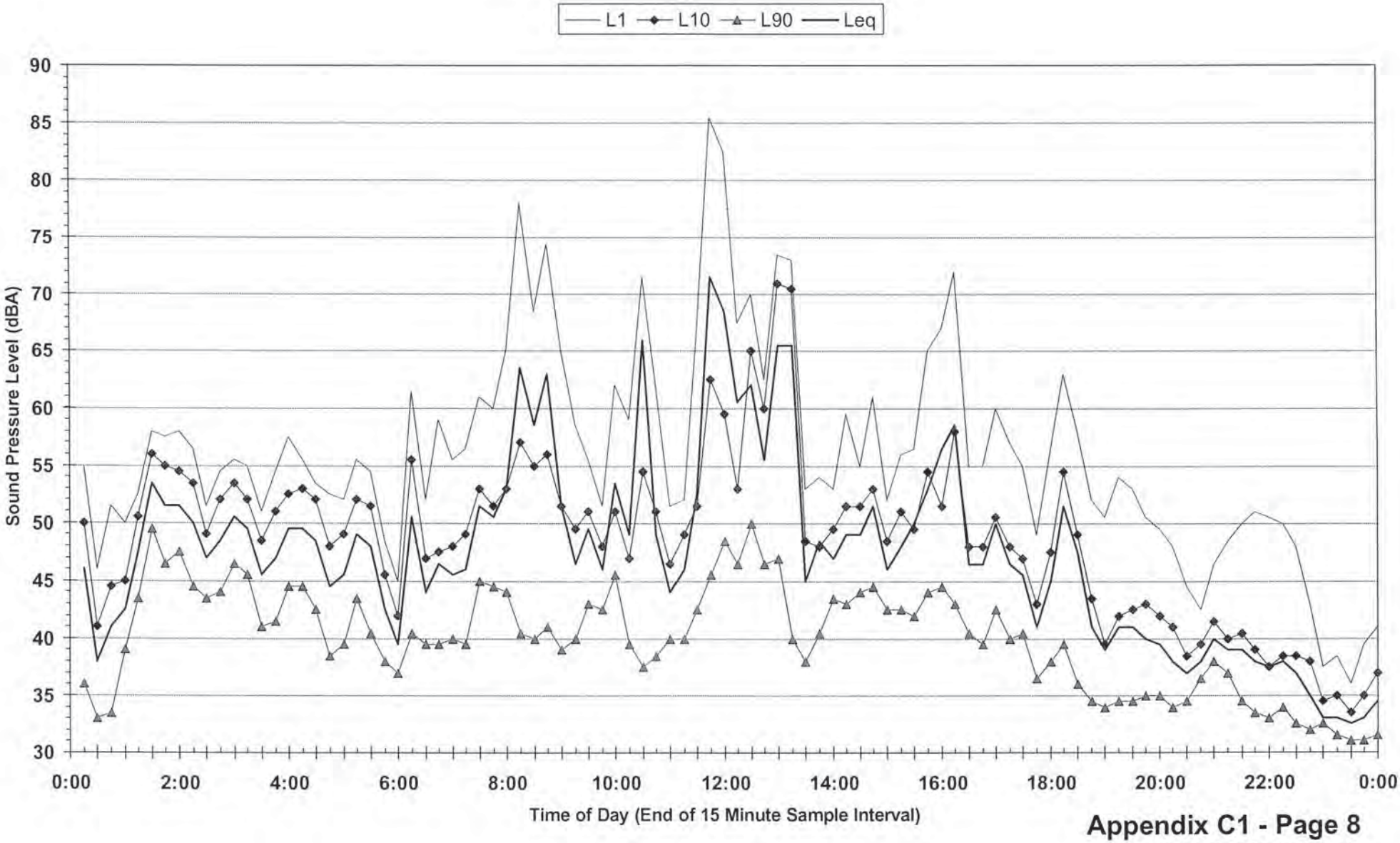
"The Hill" Residence - Friday 16 February 2001



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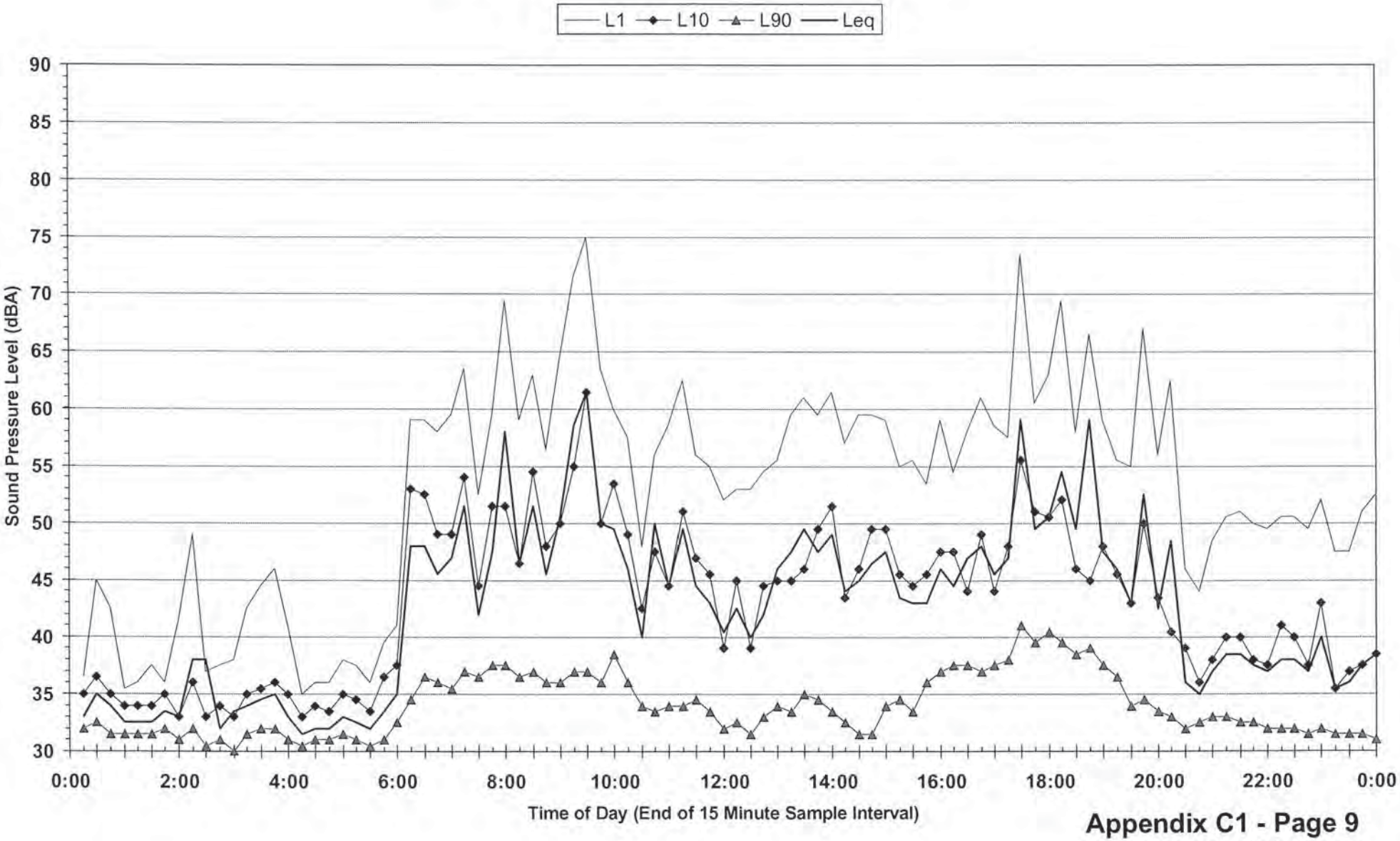
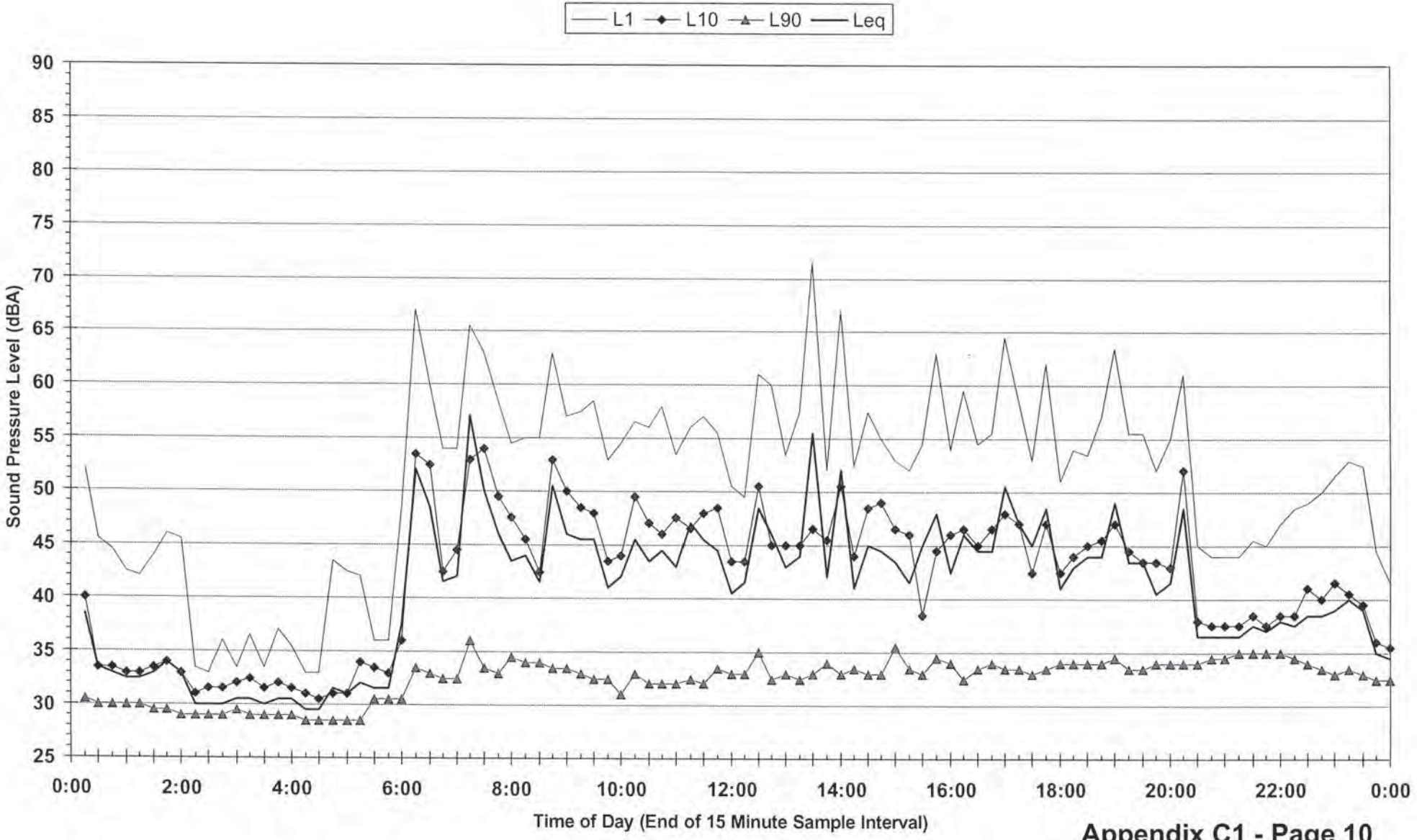


Statistical Ambient Noise Levels
"The Hill" Residence - Sunday 18 February 2001



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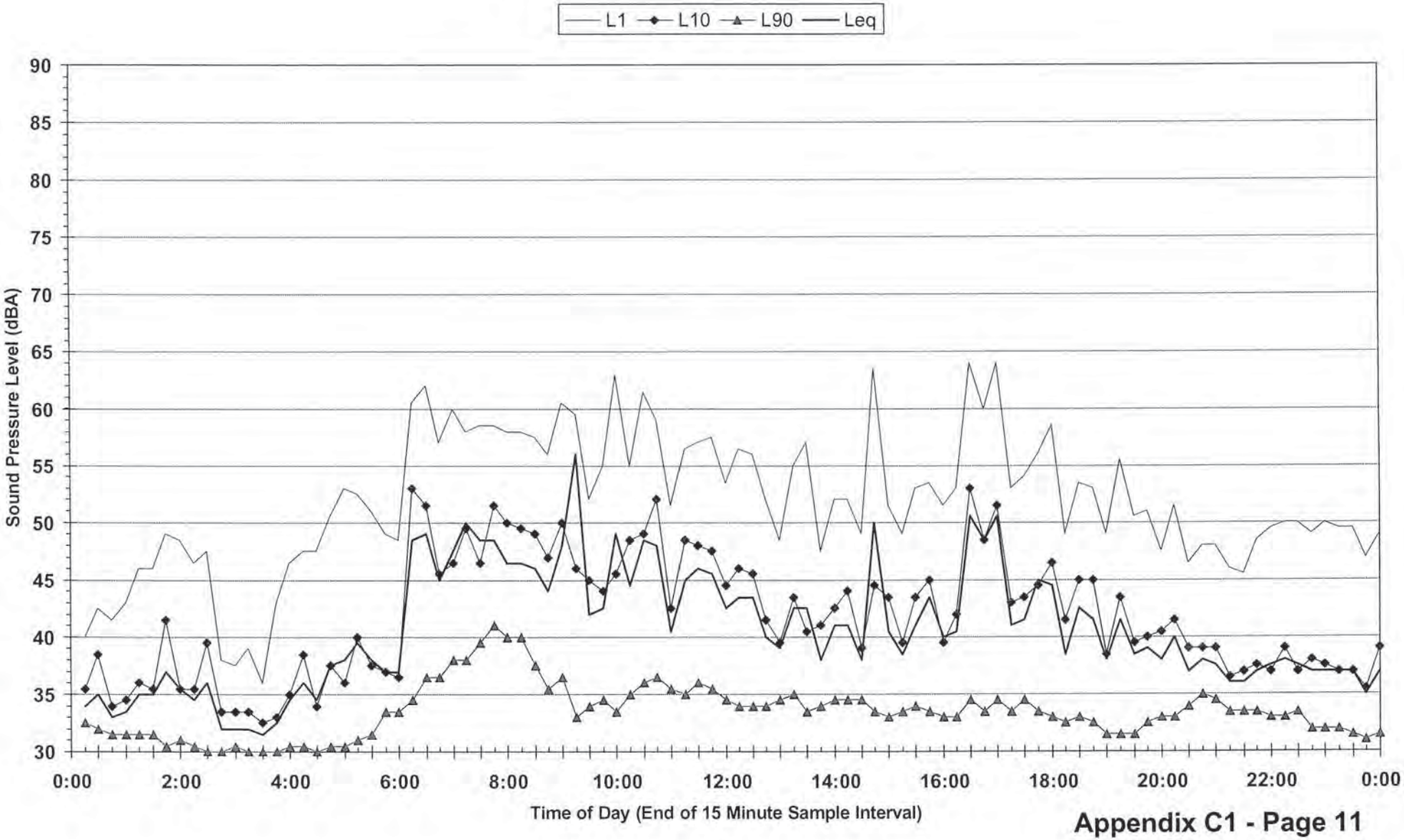
"The Hill" Residence - Monday 19 February 2001



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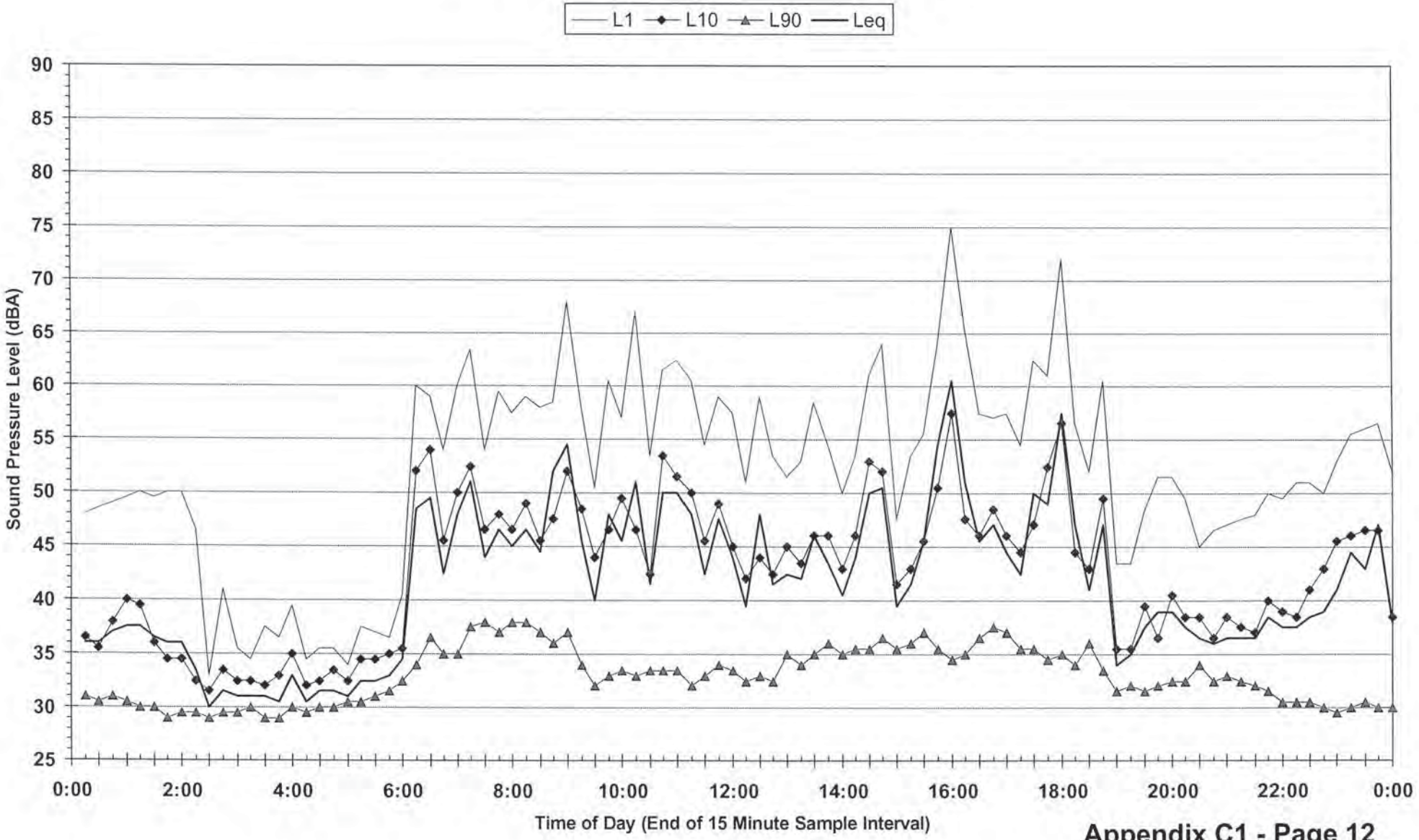
"The Hill" Residence - Tuesday 20 February 2001



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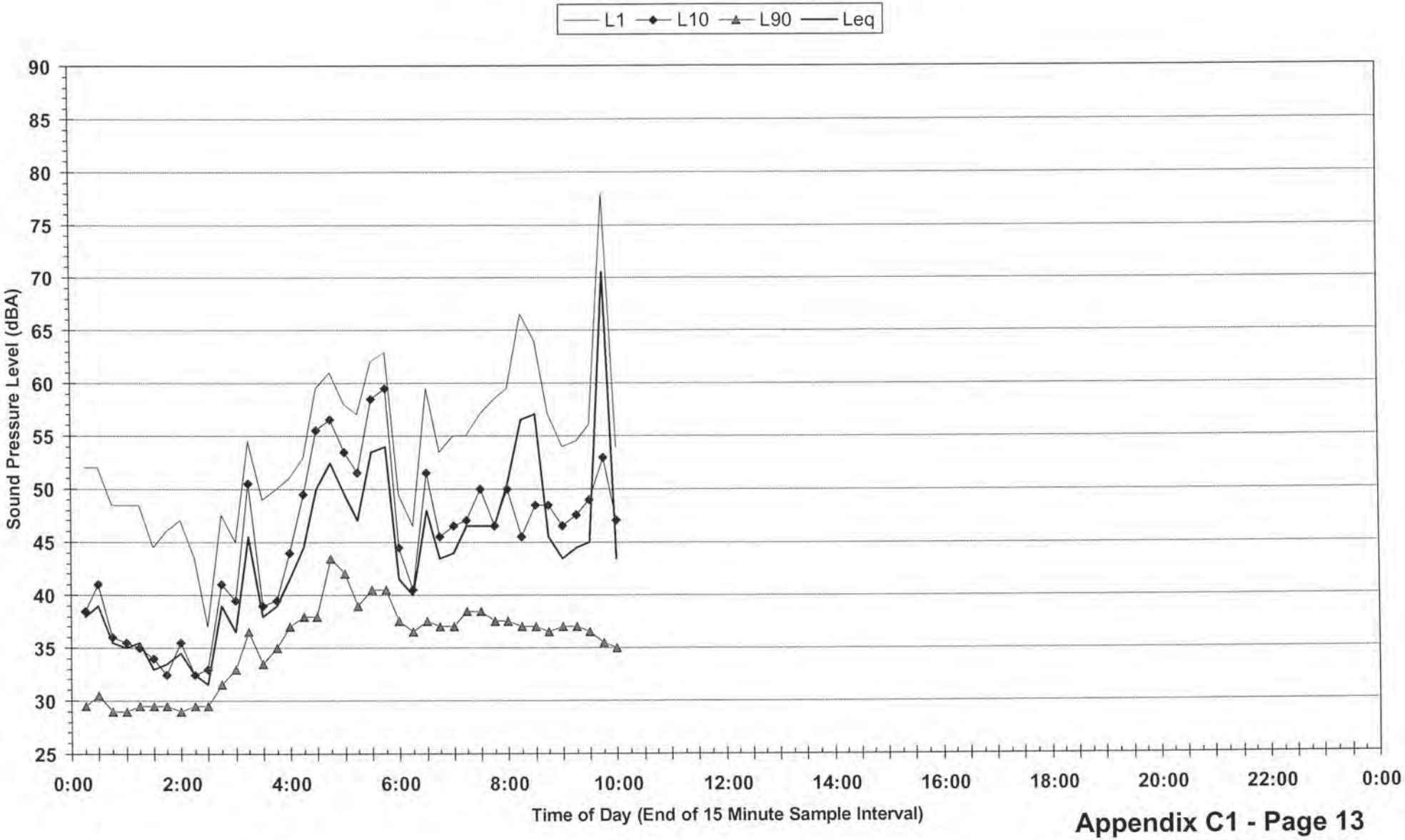
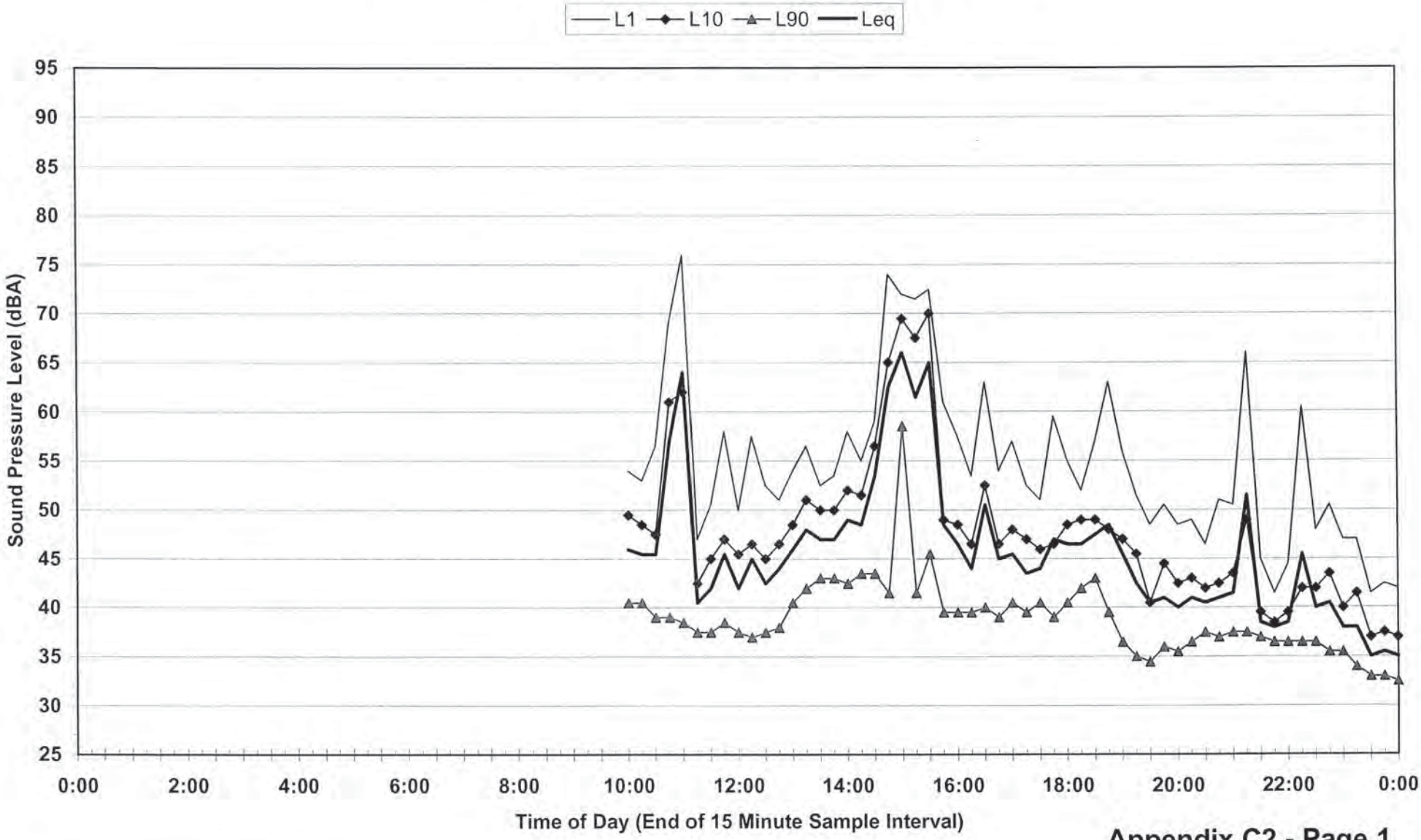
"The Hill" Residence - Wednesday 21 February 2001



Statistical Ambient Noise Levels
94 Jarrah way, Greenmeadows Estate - Friday 9 February 2001



Appendix C2 - Page 1
Statistical Noise Levels
RHA Report 30-1079

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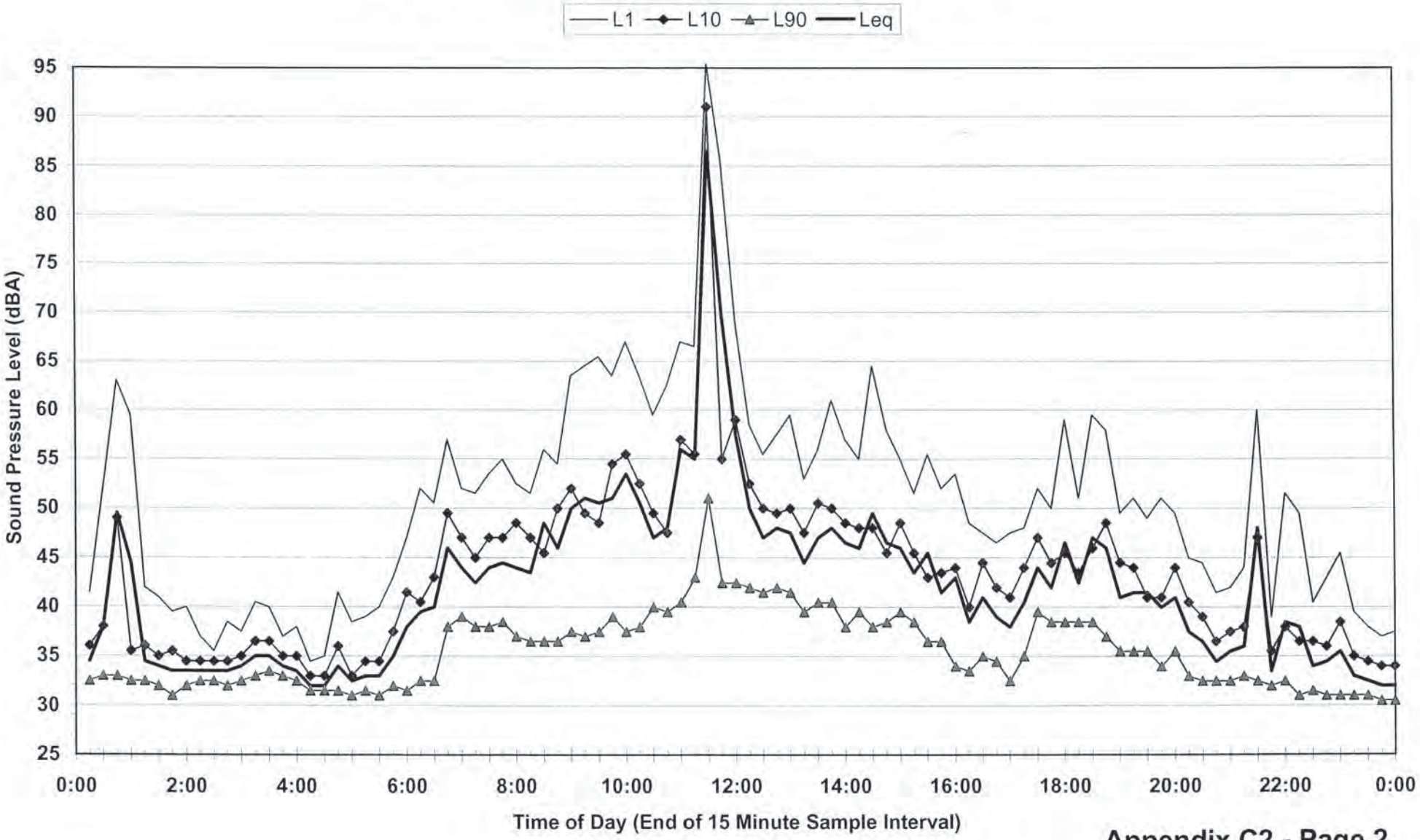
Statistical Ambient Noise Levels
94 Jarrah way, Greenmeadows Estate - Saturday 10 February 2001



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Statistical Noise Levels
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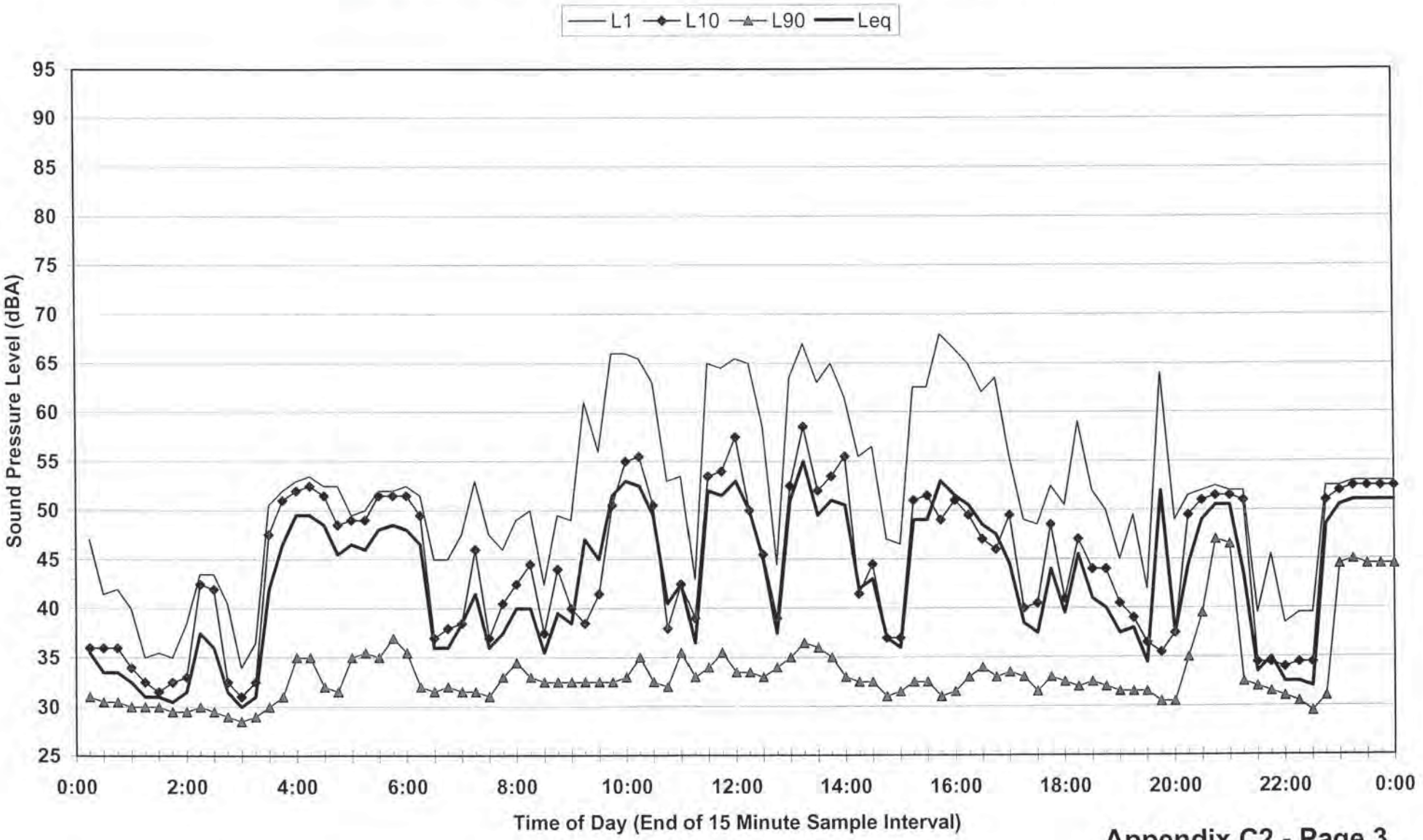

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Statistical Noise Levels
RHA Report 30-1079

Statistical Ambient Noise Levels
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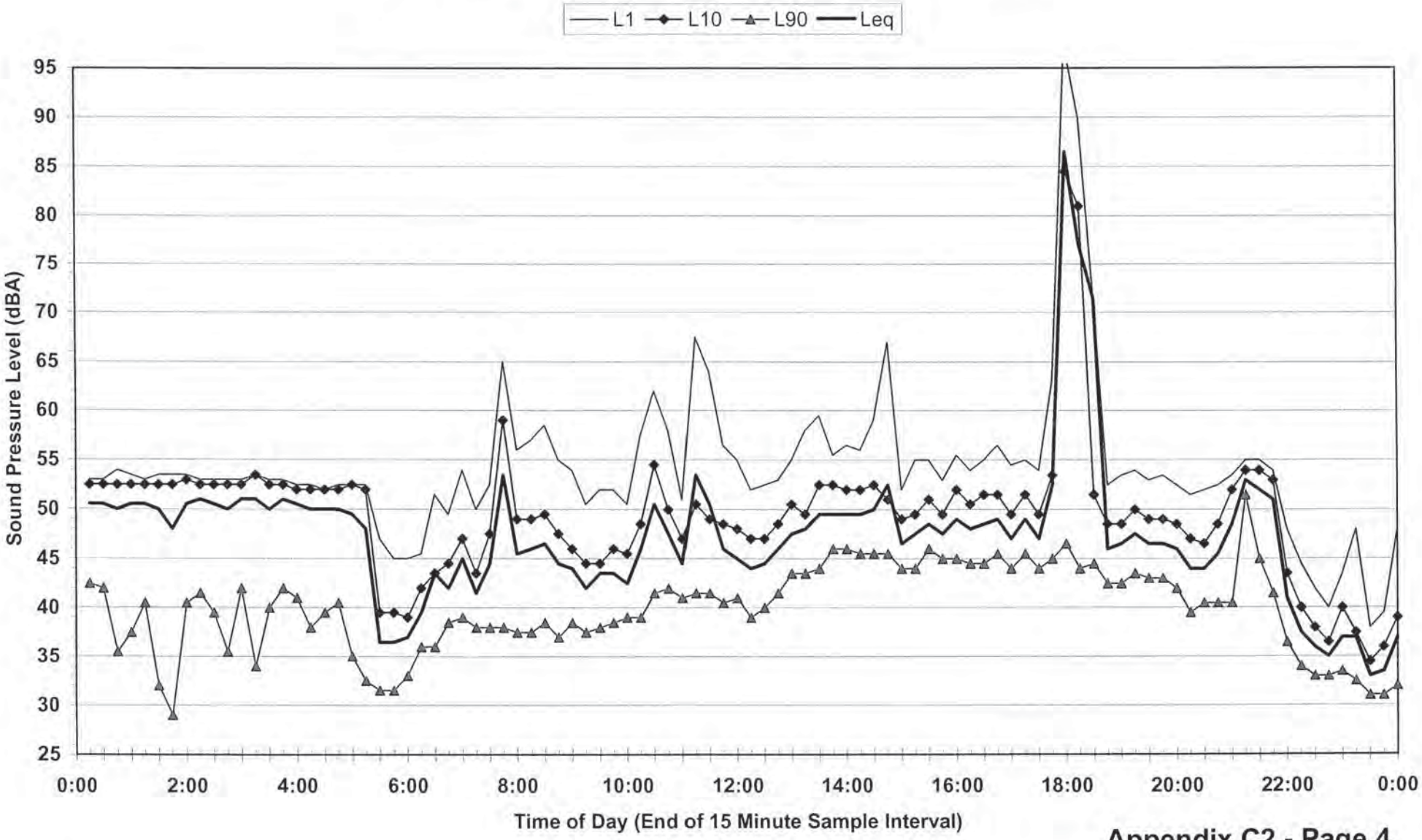

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Statistical Noise Levels
RHA Report 30-1079

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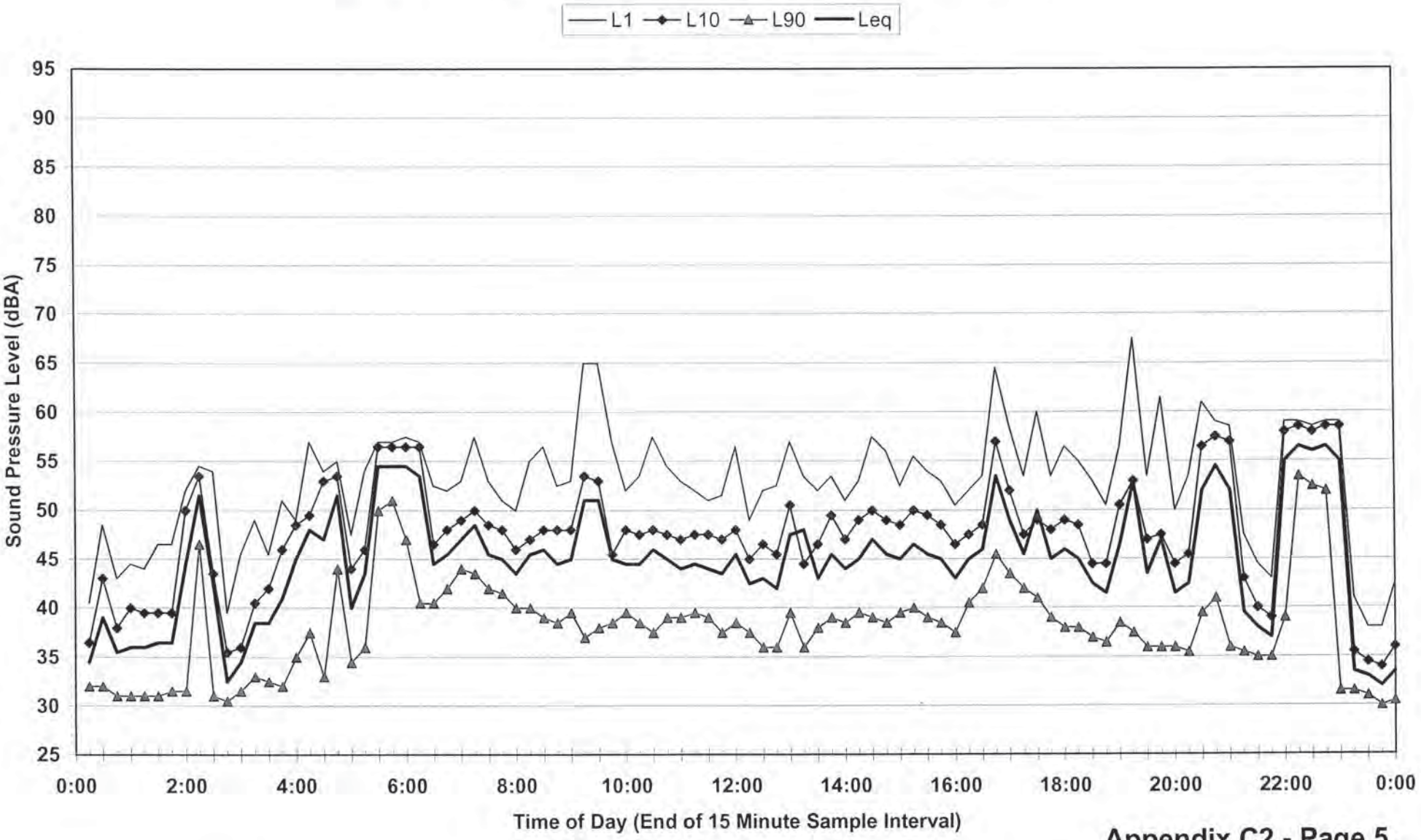
Statistical Ambient Noise Levels
94 Jarrah way, Greenmeadows Estate - Tuesday 13 February 2001



Appendix C2 - Page 5
Statistical Noise Levels
RHA Report 30-1079

Statistical Ambient Noise Levels
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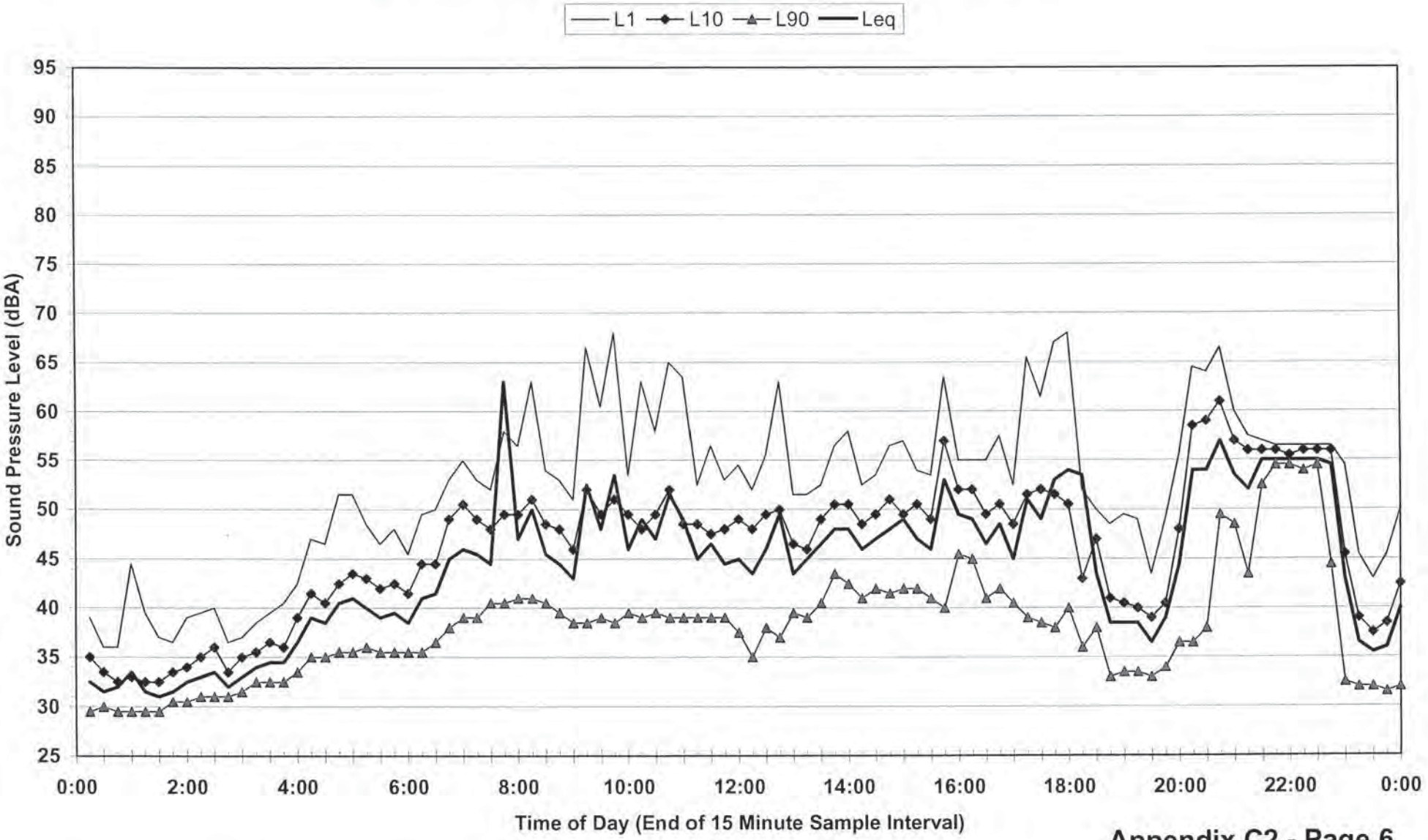

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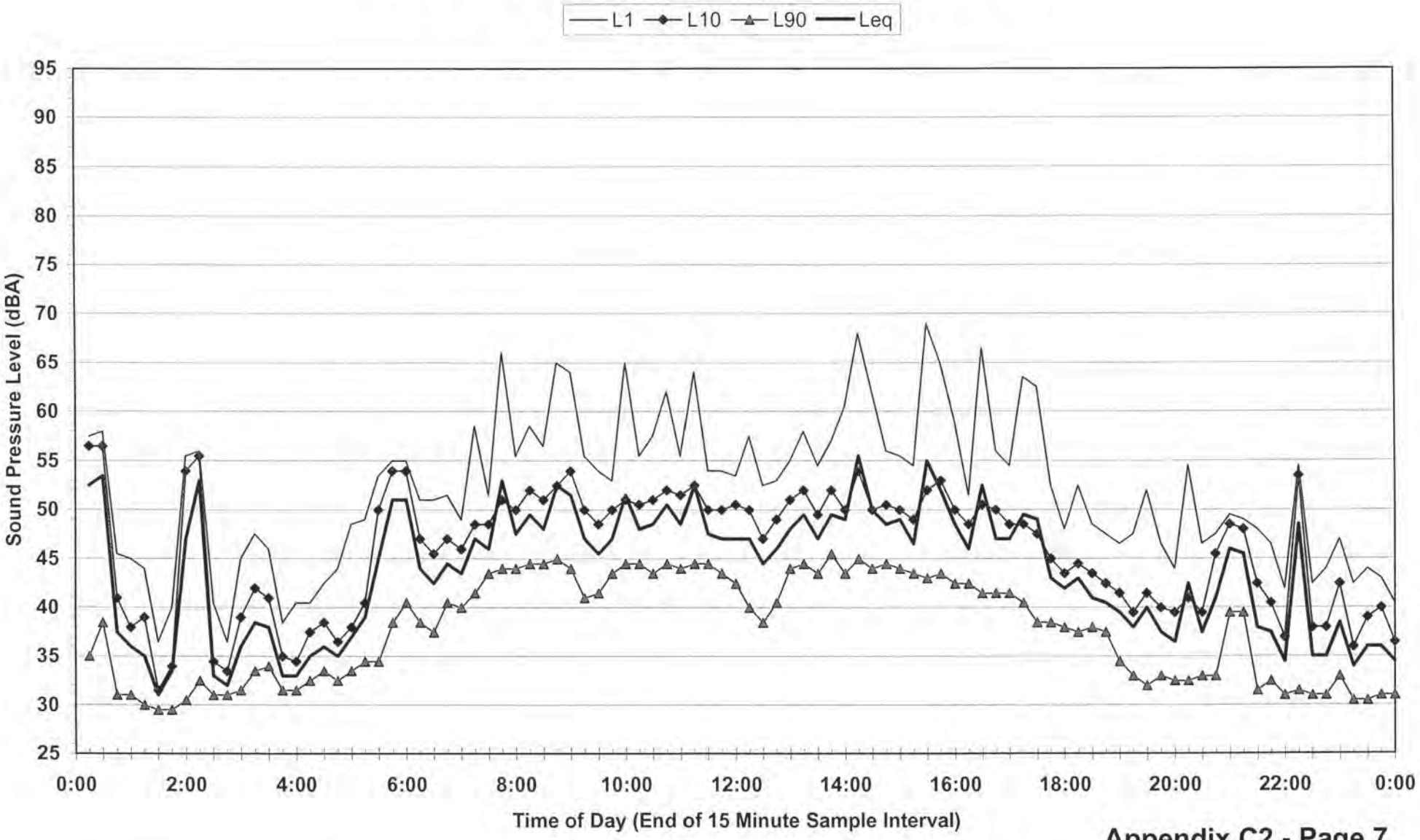
Statistical Noise Levels
RHA Report 30-1079

Statistical Ambient Noise Levels
94 Jarrah way, Greenmeadows Estate - Thursday 15 February 2001



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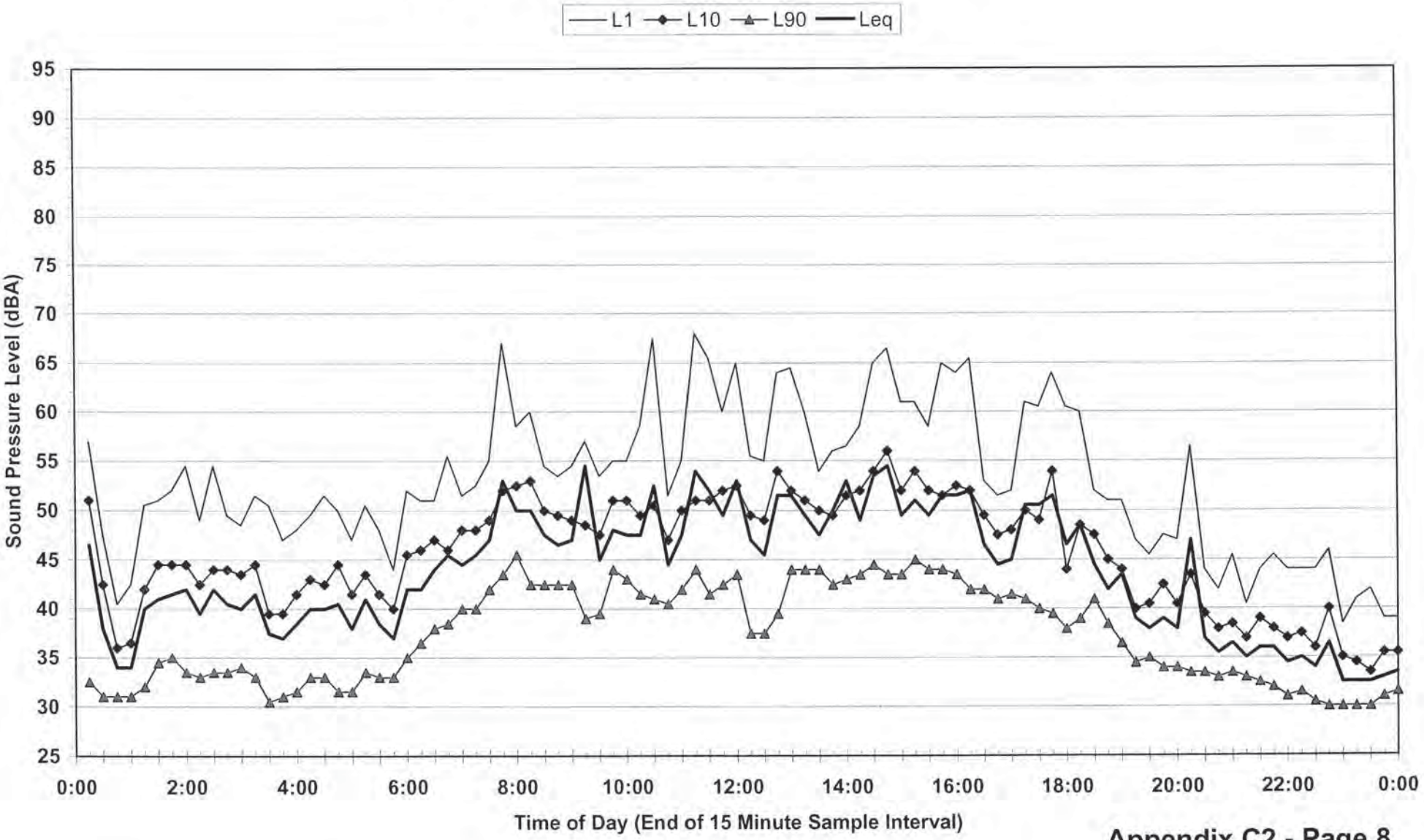
Statistical Ambient Noise Levels
94 Jarrah way, Greenmeadows Estate - Friday 16 February 2001



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Statistical Noise Levels
RHA Report 30-1079

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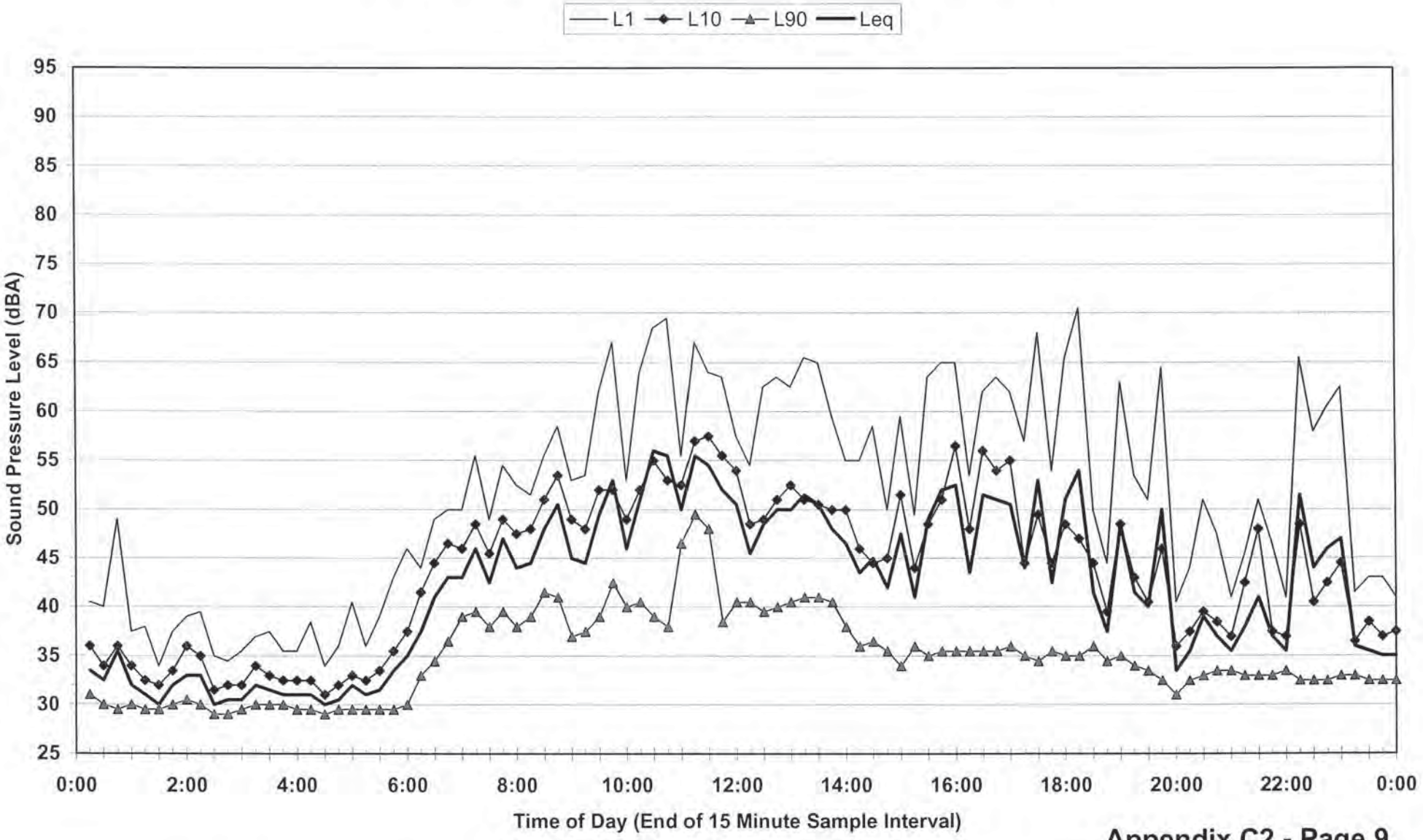
Statistical Ambient Noise Levels
94 Jarrah way, Greenmeadows Estate - Saturday 17 February 2001



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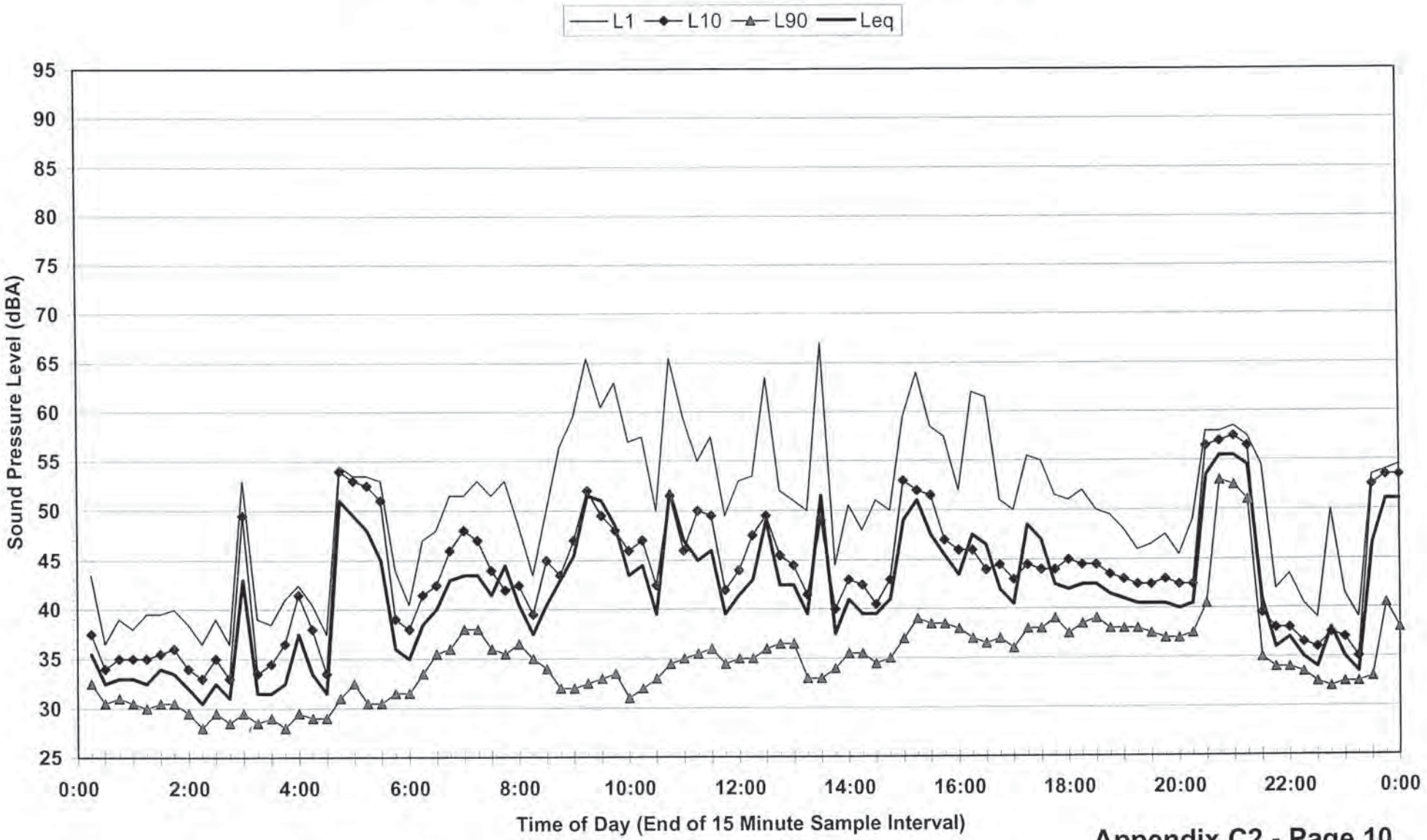
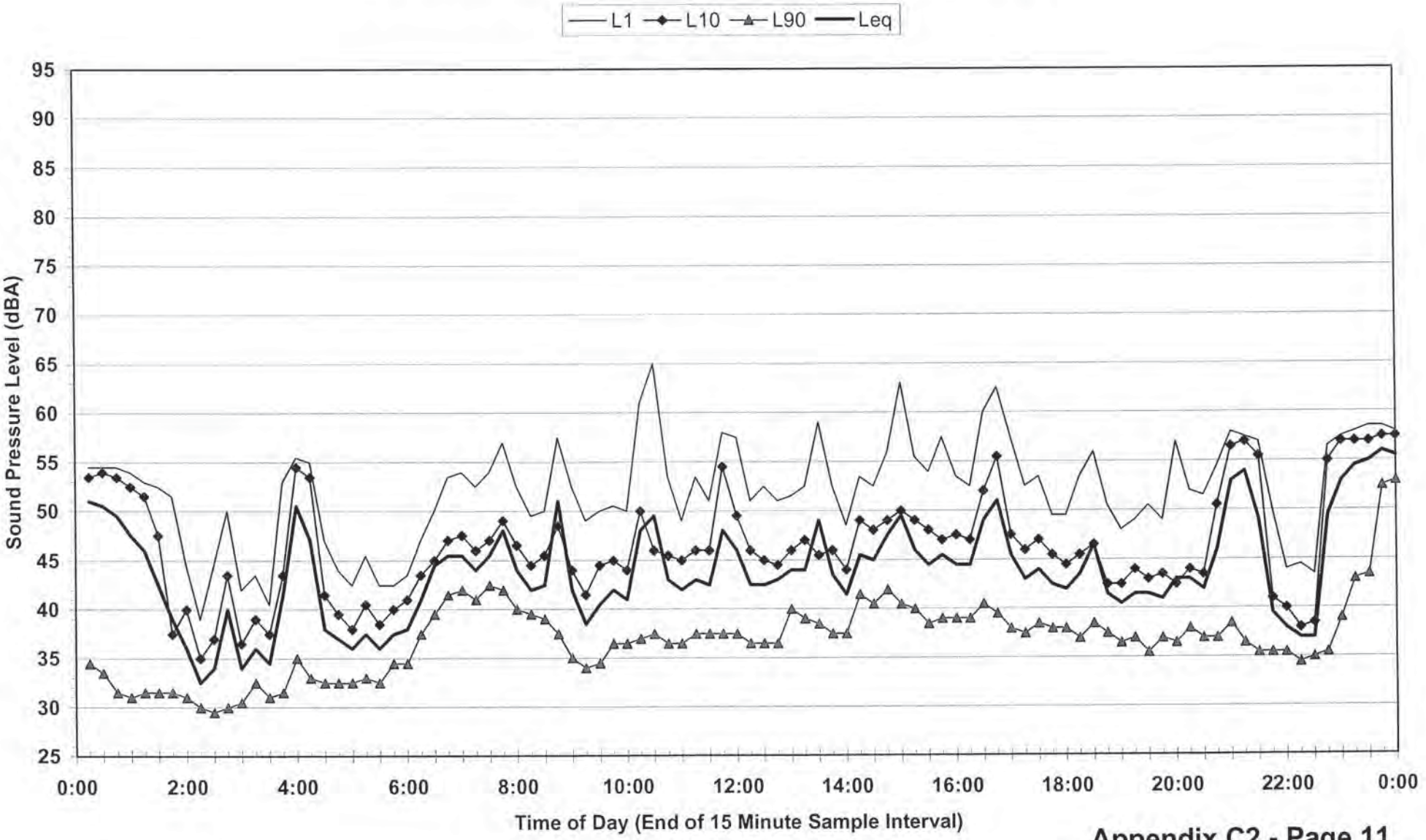
Statistical Ambient Noise Levels
94 Jarrah way, Greenmeadows Estate - Sunday 18 February 2001



Appendix C2 - Page 10
Statistical Noise Levels
RHA Report 30-1079

John Cotterill**\30-1079 Cleary Bros Albion Park\Site measurements\30-1079 BG2ed.xls
Sheet Recovered Sheet10 Printed 5/11/2002 10:46 AM

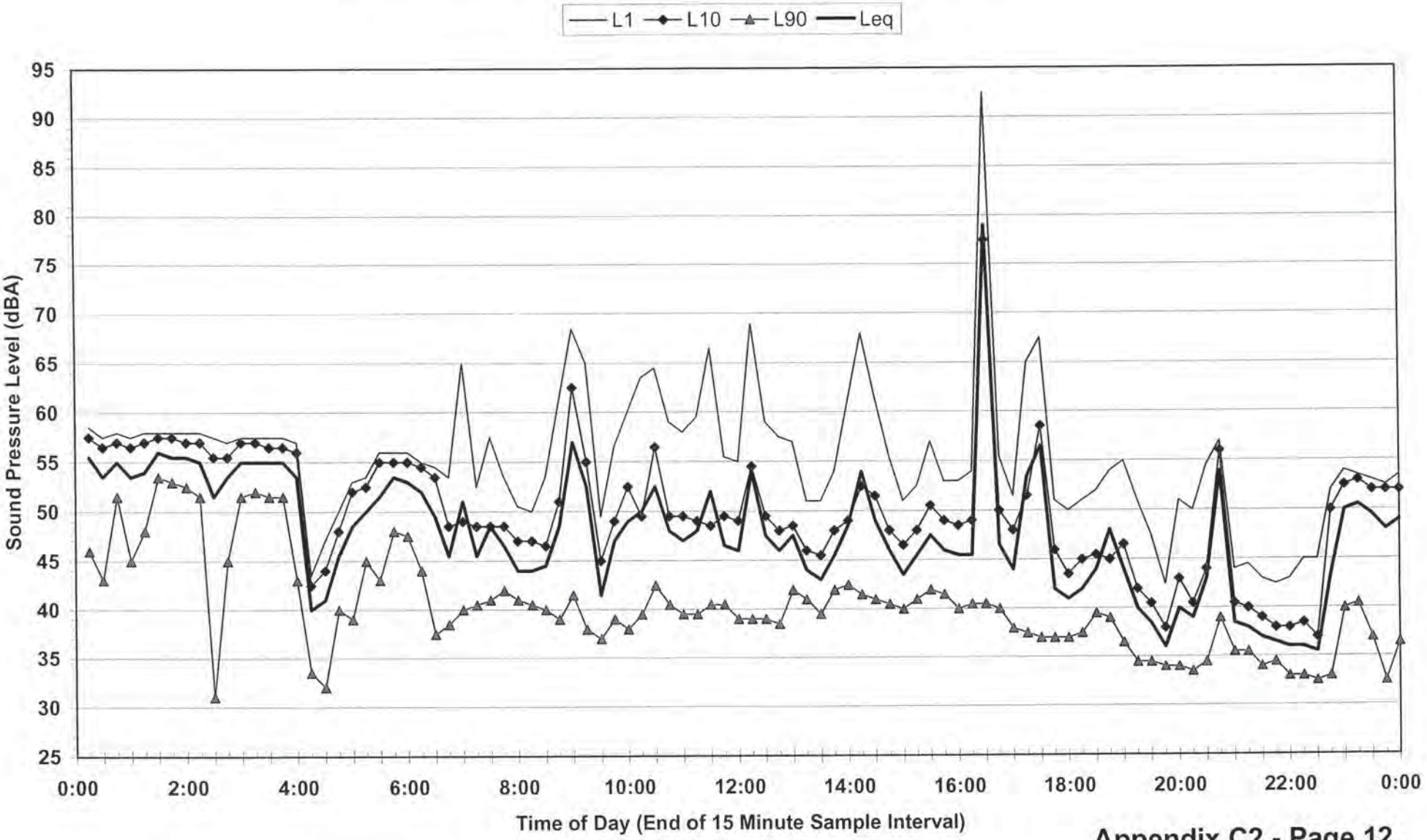
Statistical Ambient Noise Levels
94 Jarrah way, Greenmeadows Estate - Monday 19 February 2001



Appendix C2 - Page 11
Statistical Noise Levels
RHA Report 30-1079

John Cotterill**\30-1079 Cleary Bros Albion Park\Site measurements\30-1079 BG2ed.xls
Sheet Recovered_Sheet11 Printed 5/11/2002 10:46 AM

Statistical Ambient Noise Levels
94 Jarrah way, Greenmeadows Estate - Tuesday 20 February 2001



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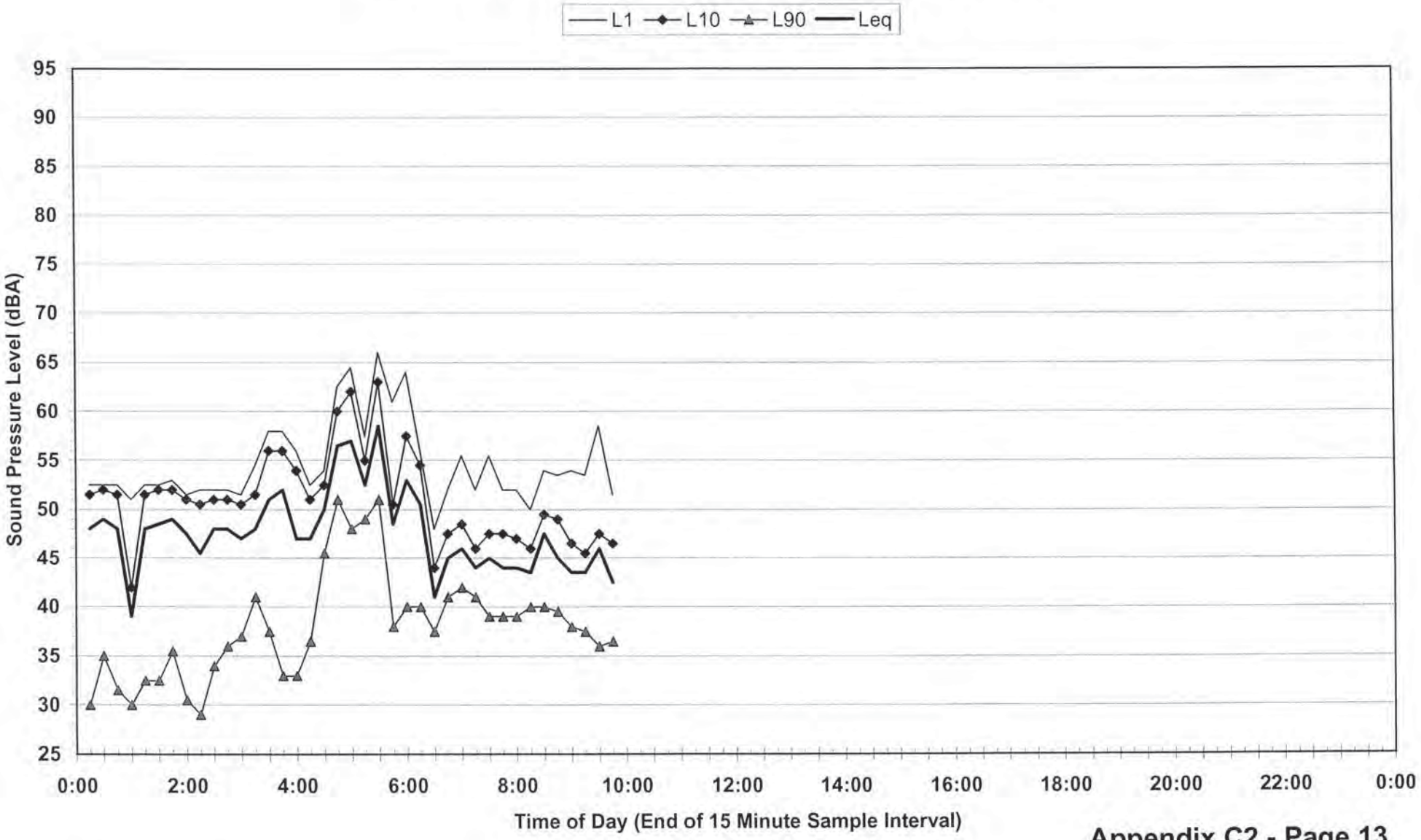
Statistical Noise Levels
RHA Report 30-1079

Statistical Ambient Noise Levels
94 Jarrah way, Greenmeadows Estate - Wednesday 21 February 2001



Appendix C2 - Page 13
Statistical Noise Levels
RHA Report 30-1079

John Cotterill**\30-1079 Cleary Bros Albion Park\Site measurements\30-1079 BG2ed.xls
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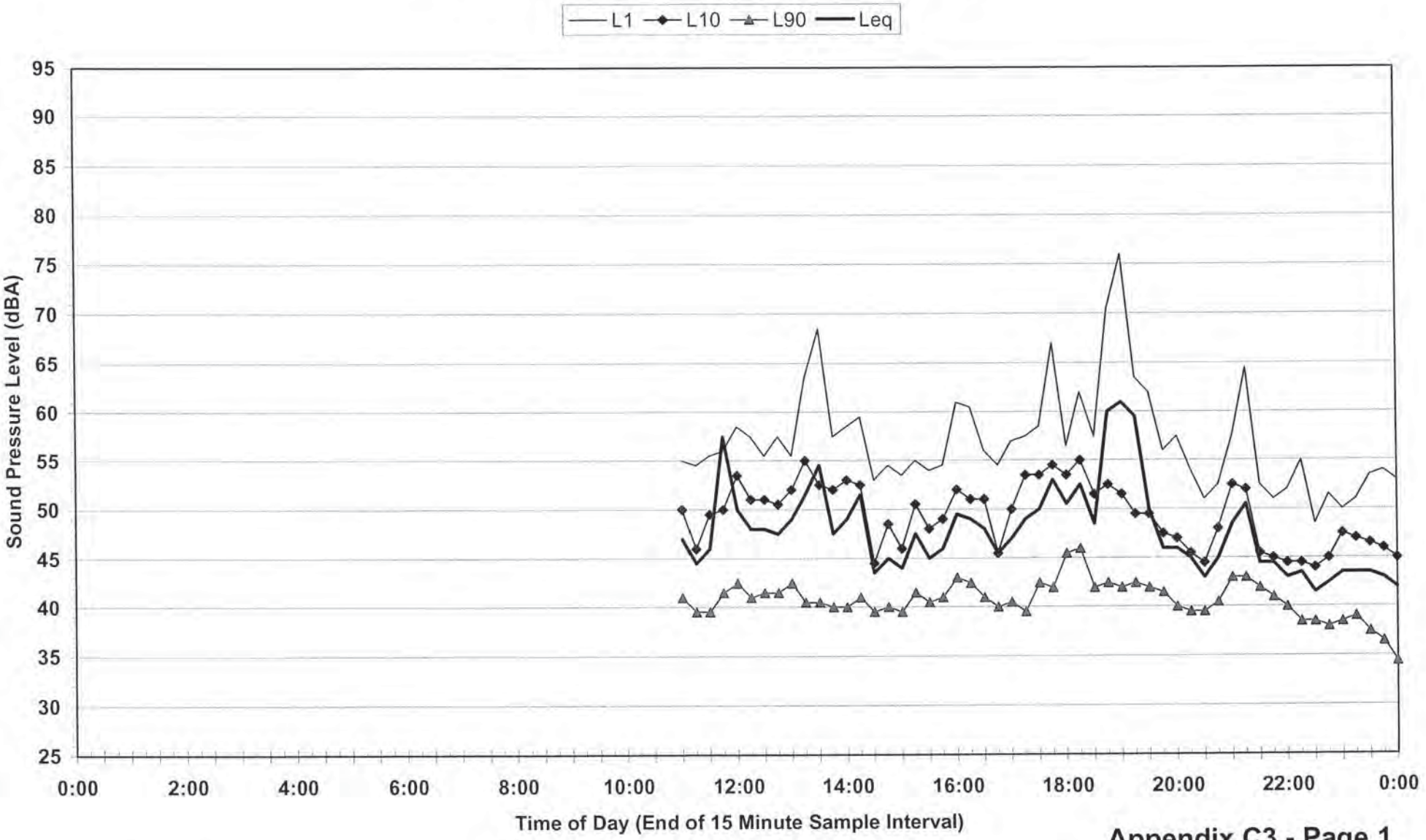
Statistical Ambient Noise Levels
12 Madden Street, Oak Flats - Friday 9 February 2001



Appendix C3 - Page 1
Statistical Noise Levels
RHA Report 30-1079

Gustaf Reuterswärd**\30-1079 Albion Park\30-1079 BG3ed.xls
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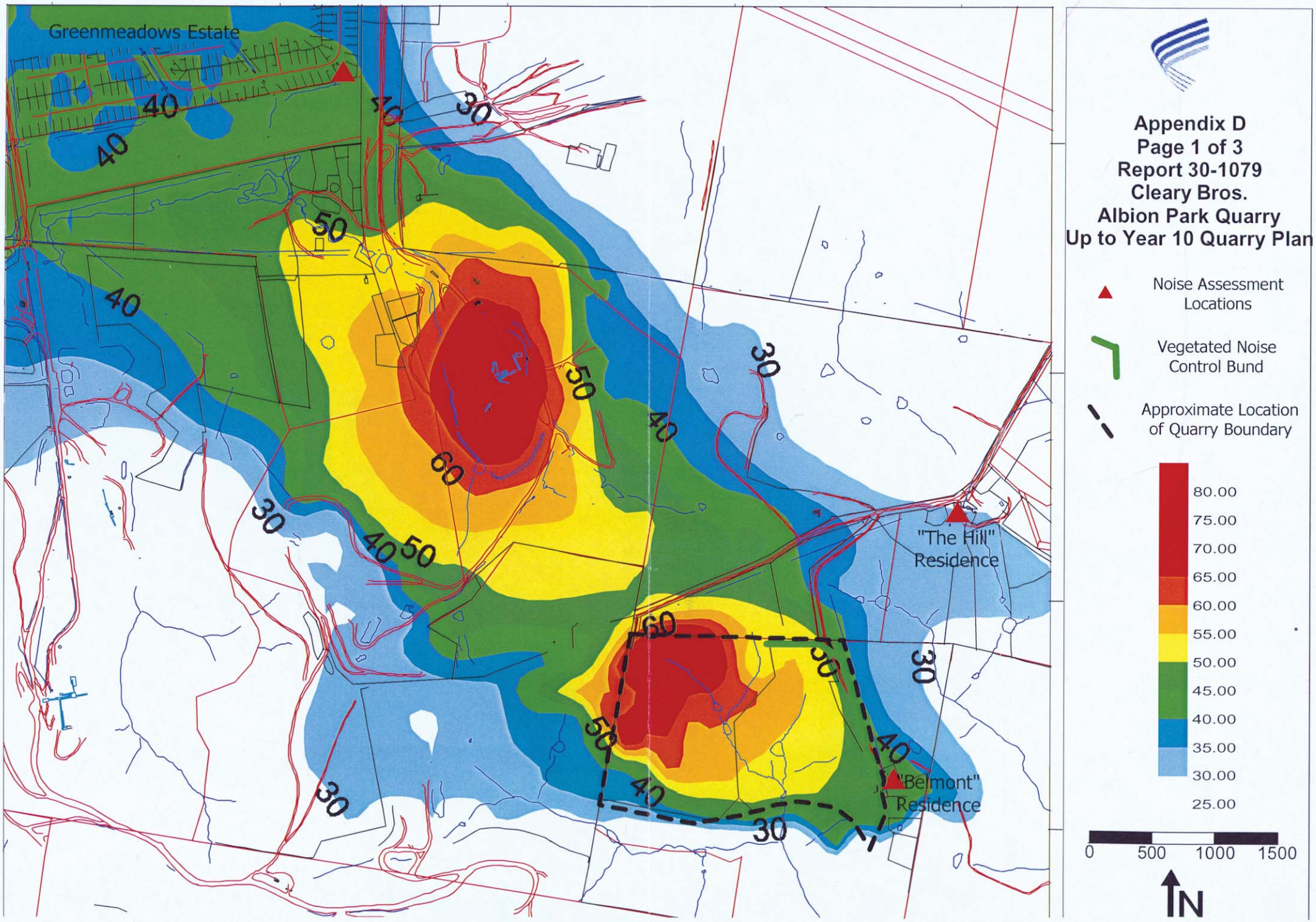
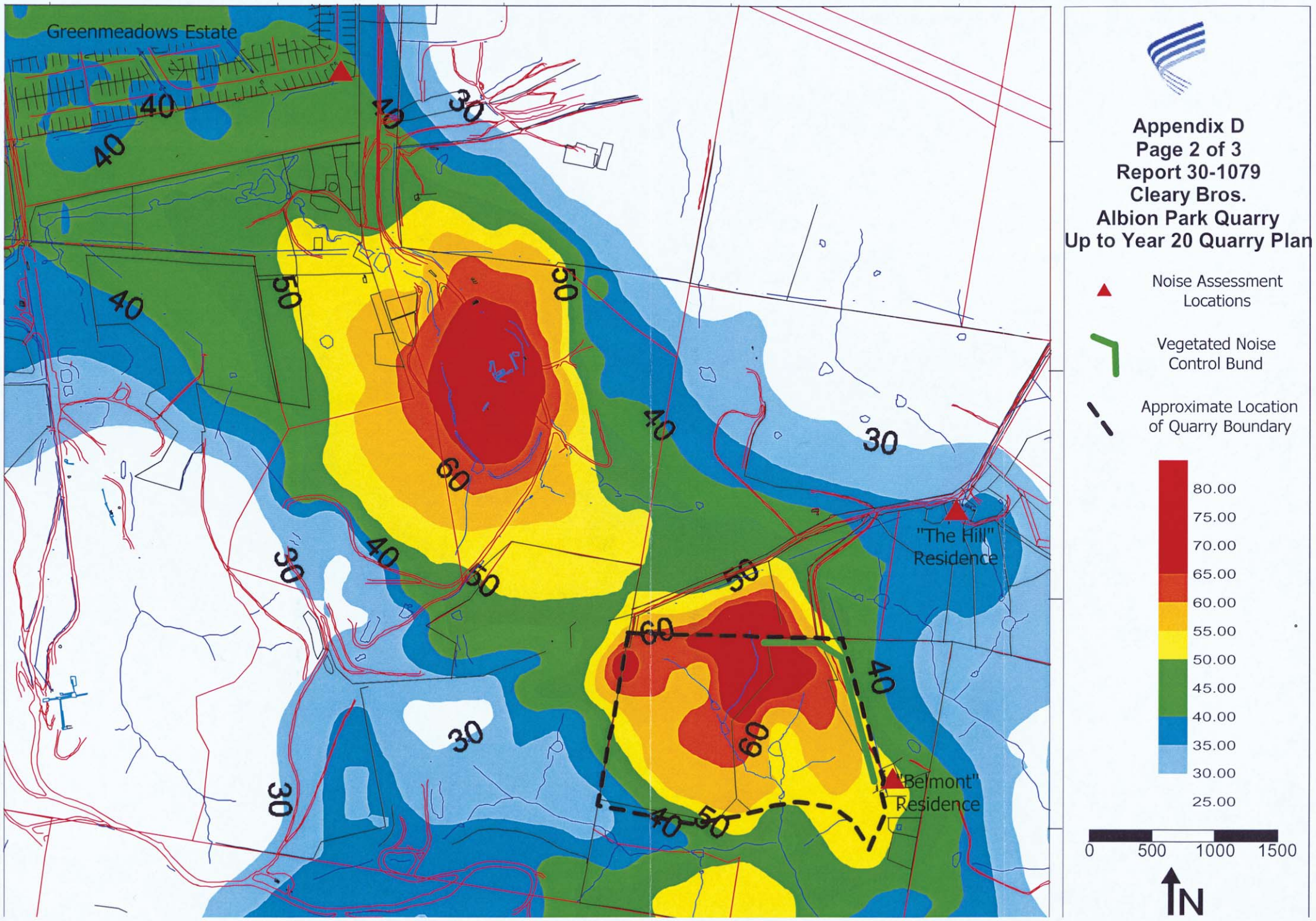
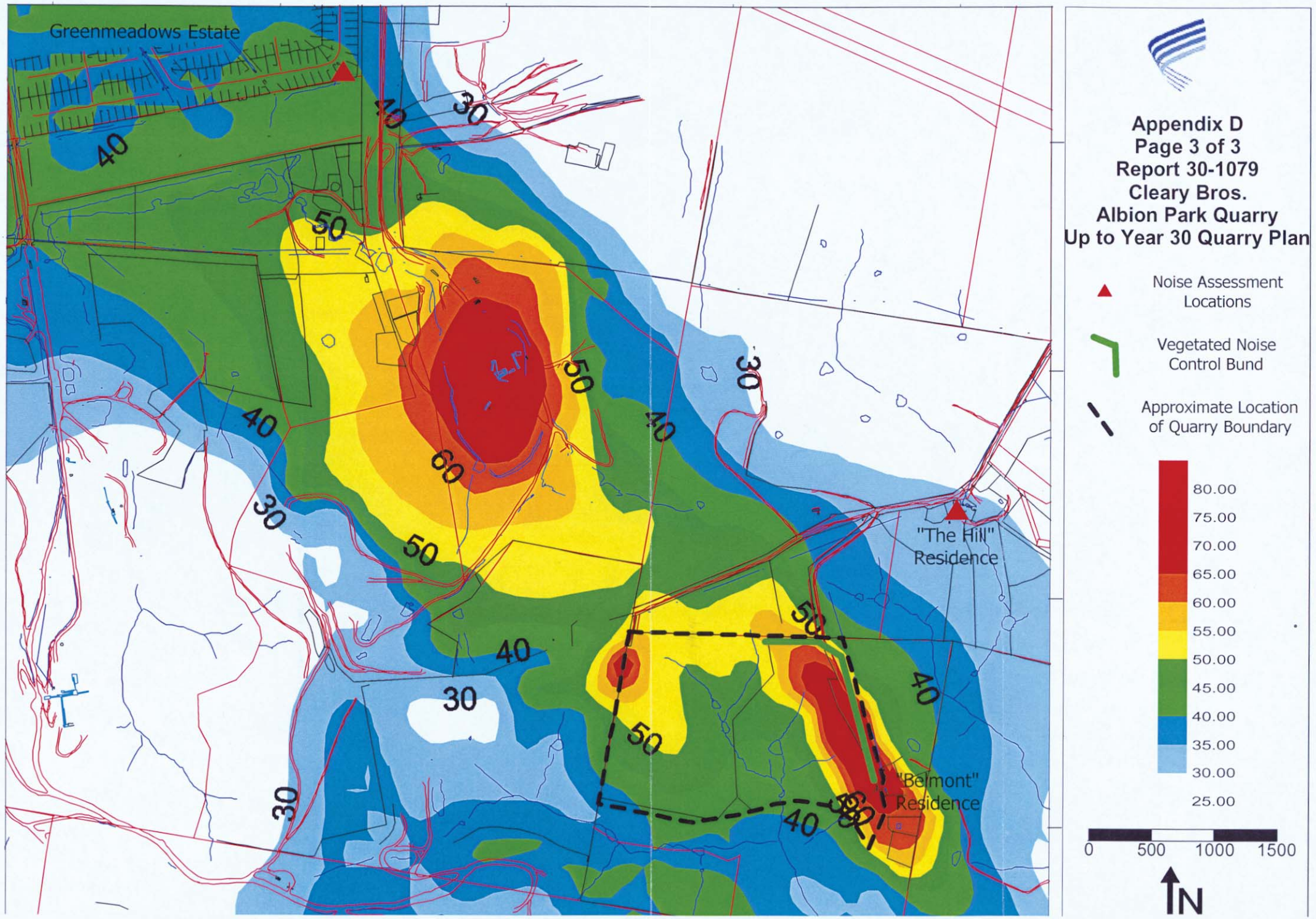

Greenmeadows Estate
"The Hill" Residence
"Belmont" Residence
Appendix D
Page 1 of 3
Report 30-1079
Cleary Bros.
Albion Park Quarry
Up to Year 10 Quarry Plan
Noise Assessment Locations
Vegetated Noise Control Bund
Approximate Location of Quarry Boundary
80.00
75.00
70.00
65.00
60.00
55.00
50.00
45.00
40.00
35.00
30.00
25.00
0
500
1000
1500
N


Greenmeadows Estate
"The Hill" Residence
"Belmont" Residence
Appendix D
Page 2 of 3
Report 30-1079
Cleary Bros.
Albion Park Quarry
Up to Year 20 Quarry Plan
Noise Assessment Locations
Vegetated Noise Control Bund
Approximate Location of Quarry Boundary
80.00
75.00
70.00
65.00
60.00
55.00
50.00
45.00
40.00
35.00
30.00
25.00
0
500
1000
1500
N


Greenmeadows Estate
"The Hill" Residence
"Belmont" Residence
40
30
50
60
Appendix D
Page 3 of 3
Report 30-1079
Cleary Bros.
Albion Park Quarry
Up to Year 30 Quarry Plan
Noise Assessment Locations
Vegetated Noise Control Bund
Approximate Location of Quarry Boundary
80.00
75.00
70.00
65.00
60.00
55.00
50.00
45.00
40.00
35.00
30.00
25.00
0
500
1000
1500
N

CLIENT: Cleary Bros. Pty Ltd (Bombo)

LOCATION: Albion Park Quarry

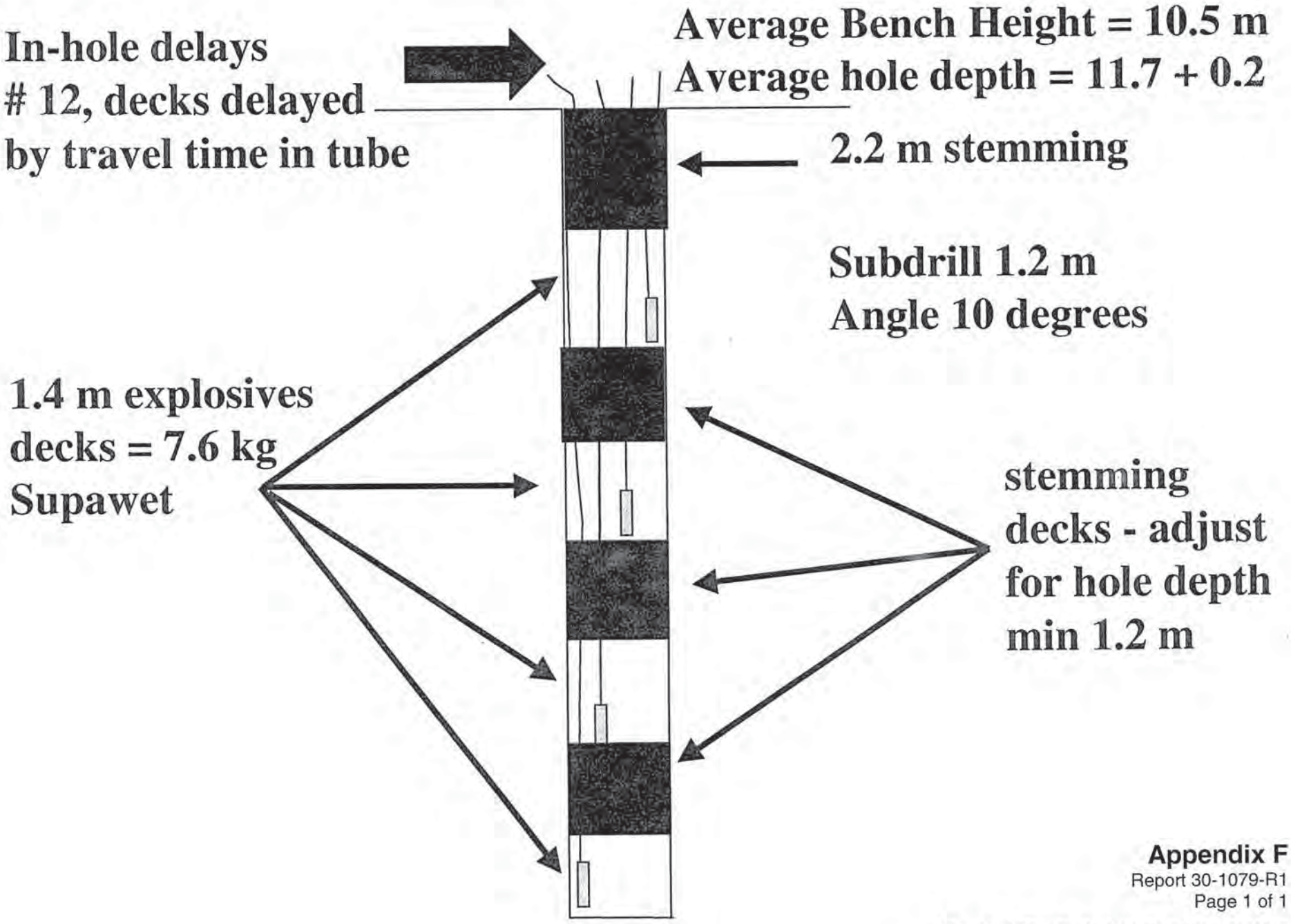
DATA: Blast Emissions Monitoring Results

No.	Shot	DATE	TIME	MIC kg	DIST m	Front Row MIC kg	PVS mm/s		Ovp dBL
1/99	Prod	29-Jan-99	11:57	45	1280	33	0.30		102.0
2/99	Prod	18-Feb-99	12:00	41	1280	44	0.49		100.0
3/99	Prod	18-Feb-99	12:06	52	1300	52	0.40		105.0
					980		0.28		111.4
4/99	Prod	25-Feb-99	12:16	42	1260	39	0.48		100.0
5/98	Burd	25-Feb-99	12:19	62	1360	61	0.18		109.0
6/99	Prod	11-Mar-99	9:58	48	1270	38	0.35		-
7/99	Prod	17-Mar-99	12:09	49	1260	44	0.46		100.0
						(CB)	1.0		100.0
					920	(M5)	-		107.6
					980	(M6)	0.22		105.0
8/99	Burd	24-Mar-99	12:18	32	1300	32	0.11		100.0
						(CB)	0.25		100.0
					970	(M5)	-		106.0
					1020	(M6)	<0.13		-
9/99	Prod	16-Apr-99	10:05	45	1270	41	1.01		100.0
11/99	Prod	6-May-99	12:37	39	1170	39	0.45		100.0
					325	M1	-		116.0
					500	M2	-		107.9
					850	ORICA	-	0.49	105.7
10/99	Burd	6-May-99	12:52	32	1360	32	0.15		106.0
					615	M1			121.0
					775	M2			114.6
					1040	ORICA	0.13		106.0
12/99	Prod	20-May-99	10:19	46	1290	36	0.36		101.3
					970		0.43		106.4
14/99	Prod	20-May-99	10:28	54	1310	54	0.19		106.2
					990		0.46		111.3
13/99	Burd	27-May-99	11:59	44	1330	38	0.53		102.4
					1010		0.60		89.2
15/99	Prod	27-May-99	12:05	44	1250	40	0.16		102.7
					930		0.42		105.3
16/99	Prod	3-Jun-99	10:10	44	1230	40	0.30		103.2
17/99	Prod	3-Jun-99	10:15	50	1280	46	0.28		105.6
18/99	Prod	1-Jul-99	12:13	40	1180	40	0.27		101.4
					860		0.25		112.5
19/99	Prod	1-Jul-99	12:26	42	1190	38	-		-
20/99	Burd	1-Jul-99	12:20	52	1320	44	0.29		105.9
					1000		0.25		111.6
21/99	Prod	8-Jul-99	10:31	47	1260	47	0.22		102.1
24/99	Burd	22-Jul-99	12:08	21	1320	21	0.11		102.7
25/99	Prod	5-Aug-99	11:59	46	1230	46	0.18		101.6
27/99	Prod	19-Aug-99	12:09	48	1250	48	0.18		108.7
28/99	Prod	19-Aug-99	12:13	48	1250	48	0.31		111.6
29/99	Burd	27-Aug-99	12:02	57	1330	57	0.13		106.8
30/99	Burd	27-Aug-99	12:08	27	1180	22	0.14		96.7
31/99	Prod	14-Sep-99	12:17	17	1220	17	0.11		87.0
32/99	Prod	14-Sep-99	12:21	53	1340	49	0.12		96.2

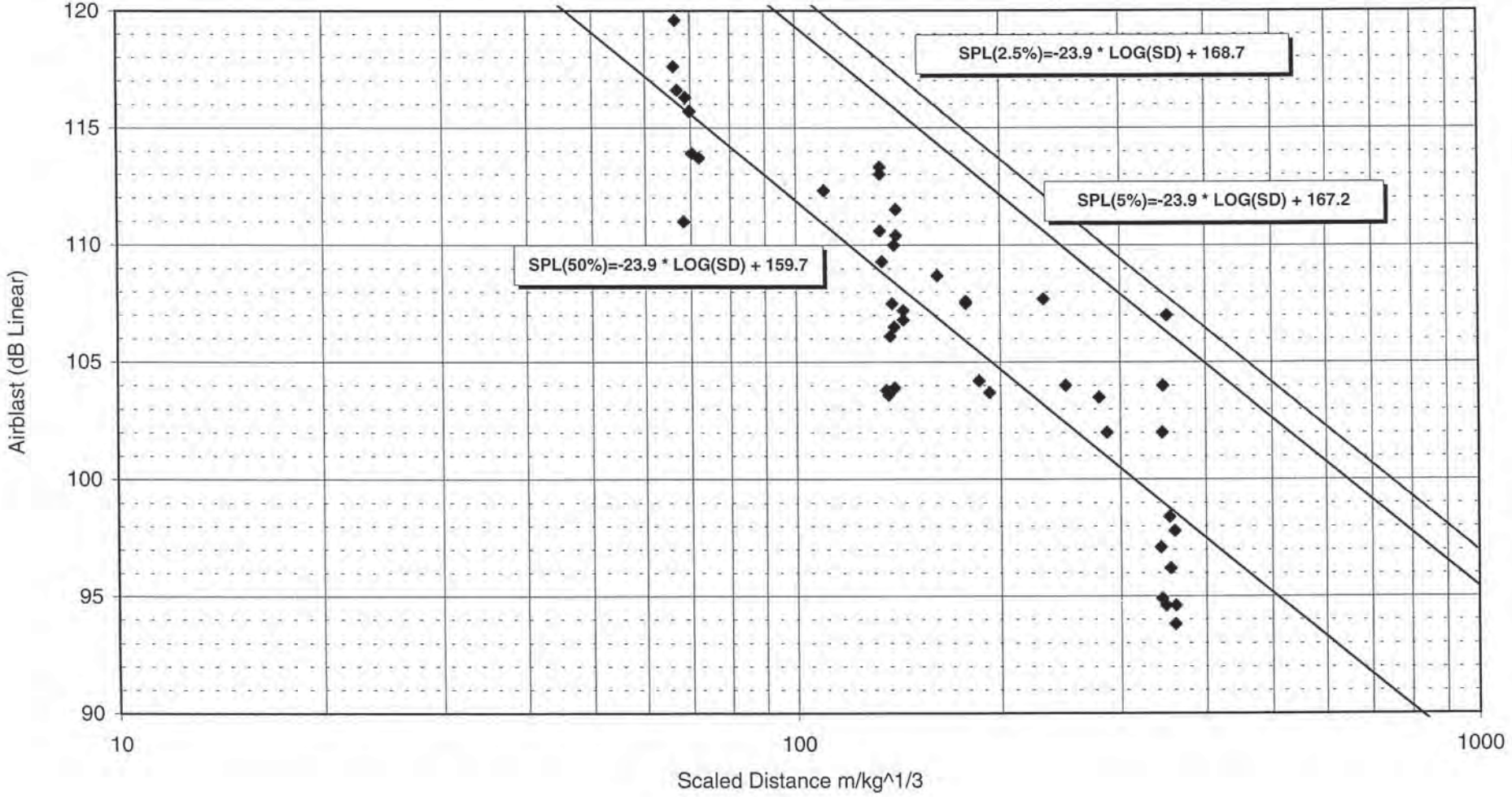
33/99	Burd	29-Sep-99	12:31	26	1310	24	0.22	93.4
34/99	Prod	-	-	51	1280	45	-	-
35/99	Prod	29-Sep-99	12:29	24	1240	24	0.16	86.6
36/99	Prod	21-Oct-99	12:00	46	1260	42	0.35	88.7
37/99	Prod	21-Oct-99	12:07	48	1320	46	0.17	95.6
38/99	Burd	-	-	44	1340	35	-	-
39/99	Prod	8-Nov-99	11:57	40	1180	40	0.19	90.2
40/99	Prod	15-Nov-99	12:00	48	1280	44	0.43	97.3
41/99	Burd	15-Nov-99	12:08	53	1290	46	0.17	96.1
42/99	Burd	24-Nov-99	12:15	71	1330	27	0.11	94.8
43/99	Prod	9-Dec-99	12:05	53	1290	49	0.19	96.3
44/99	Prod	9-Dec-99	12:09	48	1280	46	0.28	96.7
45/99	Prod	9-Dec-99	12:01	22	1220	22	0.12	93.6
46/99	Prod	21-Dec-99	9:59	46	1240	40	0.23	93.6
1/00	Prod	2-Feb-00	12:00	42	1220	21	-	-
2/00	Prod	2-Feb-00	12:00	51	1270	49	-	-
3/00	Prod	21-Feb-00	12:00	34	1210	26	0.28	90.9
4/00	Prod	21-Feb-00	12:08	53	1320	46	0.25	95.5
5/00	Prod	14-Mar-00	12:05	54	1300	53	0.14	99.0
6/00	Prod	14-Mar-00	12:12	45	1330	44	0.35	95.5
7/00	Prod	27-Mar-00	10:40	32	1200	32	0.31	93.0
8/00	Burd	14-Apr-00	10:09	50	1310	43	0.16	101.7
9/00	Burd	14-Apr-00	10:03	32	1200	32	0.16	88.4
10/00	Prod	10-May-00	10:04	54	1300	51	2.15	106.0
11/00	Prod	25-May-00	10:12	42	1330	38	0.17	108.6
12/00	Prod	2-Jun-00	10:06	51	1320	49	0.23	106.5
13/00	Prod	16-Jun-00	12:03	31	1280	21	0.28	103.1
14/00	Prod	16-Jun-00	12:12	51	1290	44	0.35	105.7
15/00	Prod	28-Jun-00	10:04	46	1260	43	0.32	105.3
16/00	Prod	19-Jul-00	12:10	26	1210	26	0.23	97.1
17/00	Prod	19-Jul-00	12:08	44	1270	20	0.27	100.8
18/00	Prod	19-Jul-00	12:12	43	1230	39	0.40	100.3
19/00	Burd	24-Jul-00	10:03	52	1330	52	0.32	105.3
20/00	Prod	24-Aug-00	10:04	50	1270	50	0.42	102.0
21/00	Prod	30-Aug-00	10:01	54	1300	49	0.30	108.6
22/00	Burd	12-Sep-00	12:02	21	1190	21	0.70	93.2
23/00	Prod	12-Sep-00	12:05	49	1260	49	0.52	103.0
24/00	Burd	12-Sep-00	12:12	56	1330	53	0.29	104.8
25/00	Burd	11-Oct-00	11:59	19	1290	19	0.29	94.9
26/00	Prod	11-Oct-00	12:01	44	1220	40	0.64	102.8
27/00	Burd	6-Dec-00	13:07	56	510	46	0.22	117.7
					685		-	105.0
28/00	Prod	6-Dec-00	13:05	56	480	50	0.36	119.0
					720		-	107.5
1/01	Prod	25-Jan-01	11:55	46	1230	41	0.45	95.5
2/01	Burd	16-Feb-01	12:02	55	1310	52	0.24	97.1
3/01	Prod	23-Feb-01	12:21	19	1280	19	0.22	100.0
					575		0.66	105.0
4/01	Burd	23-Feb-01	12:27	52	1300	47	0.38	104.0
					1300		0.32	100.1
5/01	Burd	23-Feb-01	12:34	52	1290	52	0.49	100.0
					1290		0.32	94.0
					658		1.34	107.0
6/01	Burd	28-Feb-01	11::58	57	1320	57	0.52	102.0

					696		1.20	111.0
7/01	Burd	14-Mar-01	12:07	42	1280	19	0.18	91.4
					380	Orica	1.09	-
8/01	Burd	14-Mar-01	12:10	21	1190	21	0.17	84.9
					320	Orica	1.05	-
9/01	Prod	14-Mar-01	12:17	44	1250	40	0.35	93.1
					420	Orica	3.60	-
10/01	Burd	28-Mar-01	16:34	38	1170	39	0.38	97.5
					540		0.95	108.0
11/01	Burd	10-May-01	12:34	28	1280	27	0.56	93.6
12/01	Prod	10-May-01	12:33	52	1280	46	0.27	94.9
13/01	Burd	10-May-01	12:30	49	1260	46	0.31	95.8
14/01	Burd	30-May-01	12:26	21	1200	21	0.36	91.6
15/01	Burd	13-Jun-01	13:27	23	676	23	1.08	112.0
					804	M3A	-	108.8
					923	M4A	-	110.6
					1026	M6	0.19	109.5
Misfire	Burd	13-Jun-01	14:10	23	1280	23	0.21	101.9
					676	M2	0.62	106.0
					804	M3A	-	103.9
					923	M4A	-	103.7
					1026	M6	0.10	101.9
16/01	Prod	30-May-01	12:27	50	1180	49	0.48	88.9
17/01	Burd	30-May-01	13:38	33	494	33	1.62	112.6
					623	M3A	-	109.7
					744	M4A	-	104.1
					846	M6	0.19	103.5
18/01	Prod	30-May-01	13:47	51	722	46	1.68	114.0
					836	M3A	-	110.2
					948	M4A	-	109.2
					1043	M6	0.51	107.0
19/01	Burd	30-May-01	13:53	54	1260	54	0.55	98.8
					650	M2	1.82	107.5
					761	M3A	-	106.5
					873	M4A	-	<108.1
					966	M6	0.10	101.9
20/01	Prod	25-Jun-01	12:48	24	500	24	1.04	106.0
					500			104.2
					540	M2		103.7
21/01	Burd	25-Jun-01	13:10	27	500	26	1.18	120.6
					500			122.3
22/01	Burd	25-Jun-01	13:39	45	500	7	2.61	111.5
					500			110.4
					575	M2		108.7
23/01	Burd	25-Jun-01	13:59	55	500	55	3.93	109.5
					500			108.4
					625	M2		109.7
24/01	Prod	9-Jul-01	12:08	40	1200	35	0.71	101.5
25/01	Burd	11-Jul-01	12:05	23	1290	23	0.99	109.6
26/01	Prod	23-Jul-01	1:34	36	1190	35	1.16	95.8
					500		2.98	108
27/01	Burd	23-Jul-01	12:37	46	1270	23	0.53	95.2
					500		1.96	106.5
28/01	Prod	23-Jul-01	12:42	53	1350	21	0.21	97.8
					500		3.00	113.3
29/01	Burd	9-Aug-01	13:13	46	1280	23	0.85	100.8
					500		1.78	109.2
30/01	Prod	9-Aug-01	13:16	47	1250	21	0.30	104.0
					500		2.10	107.5

31/01	Burd	21-Aug-01	12:37	16	500	16	0.47	105.7	
					870		0.20	103.9	
					500		0.57	106.5	
					250		2.70	113.3	
32/01	Prod	21-Aug-01	12:43	53	1320	29	0.28	107.0	
					500		2.49	110.6	
					870		0.75	107.7	
					500		2.25	113.0	
					250		9.54	119.6	
33/01	Prod	31-Aug-01	12:07	42	1200	28	0.28	102.0	
					970		0.57	103.5	
					500		2.93	106.8	
					500		2.68	107.2	
					250		4.31	113.7	
34/01	Prod	18-Sep-01	13:21	25	1210	25	-	-	
					544		1.36	104.2	
					930		0.24	100.0	
					544		0.98	102.1	
					250		7.30	117.6	
35/01	Prod	18-Sep-01	13:27	46	1270	25	0.17	96.2	
					500		2.70	106.5	
					893		0.34	104.0	
					500		2.52	103.9	
					250		7.54	115.7	
36/01	Burd	18-Sep-01	13:33	45	1280	33	0.23	93.8	
					633		2.36	107.5	
					1019		0.24	102.0	
					633		1.63	107.6	
					250		5.25	113.9	
37/01	Prod	3-Oct-01	15:35	52	1320	36	0.30	98.4	
					500		2.18	109.3	
					250		8.30	116.6	
38/01	Prod	22-Oct-01	15:02	49	1260	35	0.29	94.9	
					500		3.22	103.6	
					250		3.47	111.0	
39/01	Prod	31-Oct-01		54	1310	39	-	-	
					250		6.81	117.6	
40/01	Prod	16-Nov-01	14:39	48	1310	34	0.31	94.6	
					700		-	103.7	
					400		-	112.3	
					500		2.19	106.1	
					250		5.22	116.3	
41/01	????	29-Nov-01	14:25		????	???	1.30	101.8	
					500		2.58	116.4	
42/01	Prod	29-Nov-01	14:00	27	1220	27	0.51	88.9	
					500		1.81	103.1	
43/01	Prod	29-Nov-01	14:09	50	1285	36	0.43	94.6	
					500		2.00	103.8	
44/01	Prod	18-Dec-01	14:42	45	1240	25	1.06	85.0	
					500		1.73	104.8	
1/02	????	21-Jan-02	12:04	???	???	???	0.47	101.5	
					500		2.23	116.7	
2/02	Prod	15-Feb-02	14:19	42	1210	21	0.27	87.5	
					500		1.55	104.4	
3/02	Prod	15-Feb-02	14:25	46	1230	11	0.24	97.1	
					500		1.77	110.0	


In-hole delays
12, decks delayed
by travel time in tube
Average Bench Height = 10.5 m
Average hole depth = 11.7 + 0.2
2.2 m stemming
Subdrill 1.2 m
Angle 10 degrees
1.4 m explosives
decks = 7.6 kg
Supawet
stemming
decks - adjust
for hole depth
min 1.2 m

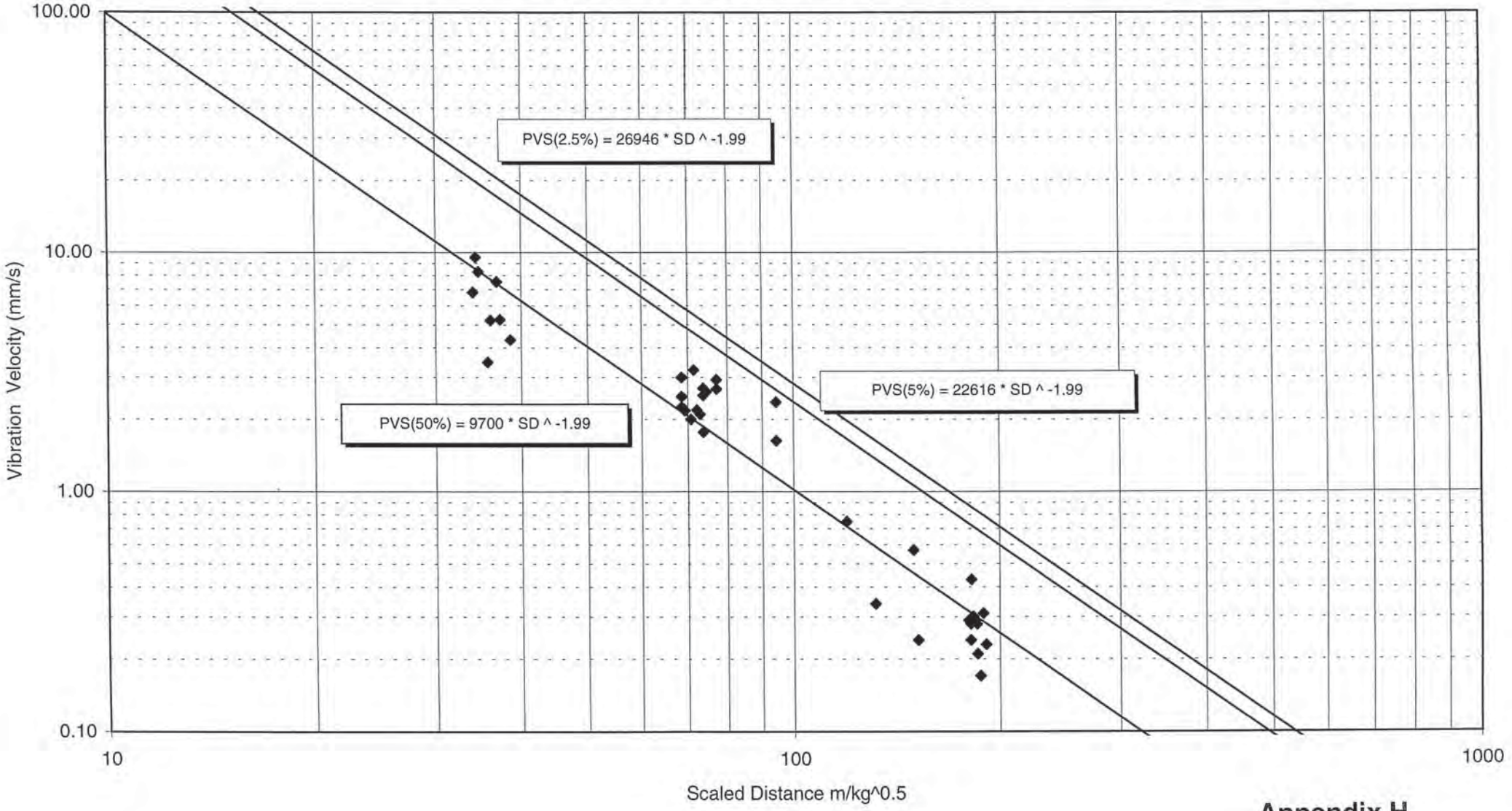
Albion Park Quarry - Cleary Bros - Decked Charge Blasts
Peak Linear Airblast Site Law - 44 Data Points



Appendix G
Report 30-1079-R1

10-1594ABSL150202.xls - 19/02/02

Albion Park Quarry - Cleary Bros - Decked Charged Blasts
PVS Ground Vibration Velocity Site Law - 37 Data Points



10-1594VSL150202.xls - 19/02/02

Appendix H
Report 30-1079-R1

PVS Ground Vibration Site Law

MIC versus Distance for Cleary Bros Albion Park Quarry Peak Airblast Site Law (2.5%, 5% and 50% Exceedance)

ALL DECKED BLASTS

Airblast Criterion: **115 dB Linear**

Site Law Constants: 2.5% 168.7
5% 167.2
50% 159.7
Site Law Slope: -23.9

DISTANCE (m)	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250	1300	1350	1400	1450	1500	1550
MIC - 2.5% Exceedance	5	8	12	17	23	31	40	50	63	78	94	113	134	158	184	213	245	280	318	359	404	452	505	561	621	685
MIC - 5% Exceedance	8	12	18	26	36	47	62	78	98	120	146	175	208	245	285	330	380	434	493	557	627	702	783	870	963	1063
MIC - 50% Exceedance	66	105	157	224	308	409	531	676	844	1038	1260	1511	1794	2109	2460	2848	3275	3742	4251	4805	5405	6053	6751	7500	8303	9162

MIC versus Distance for Albion Park PVS Ground Vibration Site Law (2.5%, 5% and 50% Exceedance)

ALL DECKED BLASTS

Vibration Criterion: 5 **mm/s**

Site Law Constants: 2.5% 26946
5% 22616
50% 9700

Site Law Slope: -1.99

DISTANCE (m)	300	320	340	360	380	400	420	440	460	480	500	520	540	560	580	600	620	640	660	680	700	720	740	760	780	800
MIC - 2.5% Exceedance	16	18	20	23	26	28	31	34	38	41	44	48	52	56	60	64	68	73	77	82	87	92	97	102	108	113
MIC - 5% Exceedance	19	22	24	27	31	34	37	41	45	49	53	57	62	66	71	76	81	87	92	98	104	110	116	122	129	135
MIC - 50% Exceedance	45	51	57	64	71	79	87	96	105	114	124	134	144	155	167	178	190	203	216	229	243	257	271	286	301	317

Appendix M

AIR QUALITY ASSESSMENT

RHA REPORT 10-1676-R1

Albion Park Quarry Extension
Air Quality Impact Assessment

Prepared for

Perram & Partners
12 Clanwilliam Street
EASTWOOD NSW 2122

23 October 2002

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Albion Park Quarry Extension
Air Quality Impact Assessment

Quality System

Quality Endorsed Company
ISO 9001 Lic 3236
Standards Australia

Richard Heggie Associates Pty Ltd operates under a Quality System which has been certified by Quality Assurance Services Pty Limited to comply with all the requirements of AS/NZS ISO 9001:2000 "Quality management systems - Requirements" (Licence No 3236).

This document has been prepared in accordance with the requirements of that System.

AAAC
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ACOUSTICAL
CONSULTANTS

Richard Heggie Associates Pty Ltd is a Member Firm of the Association of Australian Acoustical Consultants.

Reference	Status	Date	Prepared	Checked	Authorised
10-1676R1	Revision 0	23 October 2002			

TABLE OF CONTENTS

1 INTRODUCTION

Cleary Bros (Bombo) Pty Ltd is seeking to expand current operations at their Albion Park Quarry to include a new quarrying site with a projected working lifespan of approximately thirty years. Richard Heggie Associates (RHA) has been engaged by Perram and Partners to carry out an Air Quality Impact Assessment for the proposed quarry extension. This report will form part of the Environmental Impact Statement for the quarry extension.

Air quality elements of interest in this study are:

- Fugitive dust emissions from new exposed material and stockpiles
- Fugitive dust emissions from the new quarrying activities
- Wheel generated dust from site vehicles
- Combustion emissions from plant and traffic

2 INFORMATION RESOURCES FOR THE STUDY

This study is based on the most current quarry staging plans and land planning information and uses the following references:

Regarding air quality standards:

- National Environmental Protection Council, *"National Environmental Protection Measure for Ambient Air Quality"*, 1998.
- National Health and Medical Research Council
- World Health Organisation, *"Guidelines for Air Quality"*, 1999
- United States Environmental Protection Agency (USEPA), *"National Ambient Air Quality Standards"*, 1997
- NSW EPA, *"Action for Air, The NSW Government's 25-Year Air Quality Management Plan"*, 1998.
- NSW Government, *"Action for Transport 2010"*.

Regarding quarrying and motor vehicle pollutant emission rates:

- NSW SPCC (1986), "Air Pollution from Coal Mining and Related Developments", ISBN 0 7240 5936 9.
- National Energy Research Development and Demonstration Council (NERDDC), "Air Pollution from Surface Coal Mining: Volume 2 Emission Factors and Model Refinement", NERDDC Project 921, 1988.
- US EPA AP-42 "Air Pollution Emission Factors", 1985, 1995, 1998 (5th Edition).
- Environment Australia, "Emission Estimation Technique Manual for Mining", National Pollutant Inventory, March 1999.

Regarding the ISC3 Dispersion Model:

- US EPA OAQPS, "*ISC3 - A Dispersion Model for Predicting Industrial Source Air Pollution*".

Regarding ambient wind speed and direction data:

- Commonwealth Bureau of Meteorology: wind speed and wind direction data for Wollongong Airport.

Regarding ambient pollutant levels in the local area:

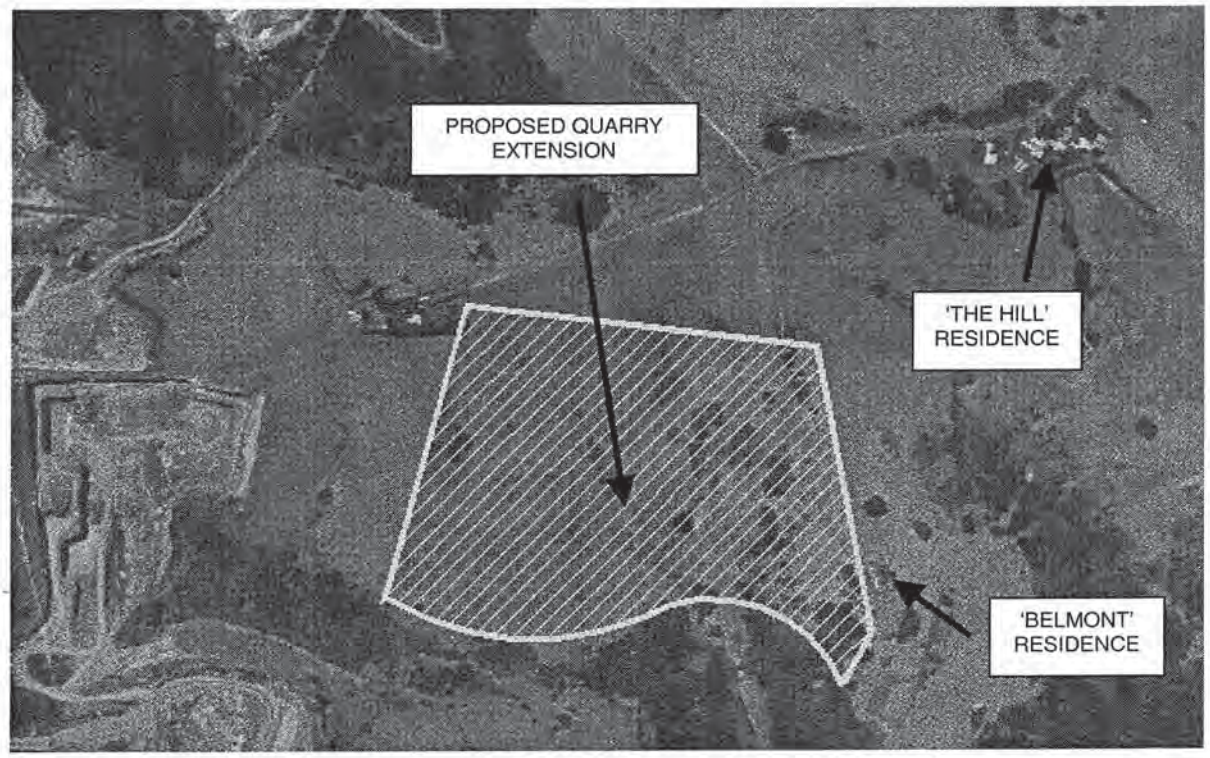
- Results of ambient monitoring undertaken at Albion Park Quarry, correspondence received from Davron Engineering, February 2001.

3 DESCRIPTION OF PROPOSAL AND NEAREST RESIDENCES

A detailed description of the proposed operation can be found in the body of the environmental impact statement.

Figure 3.1 shows an aerial view of the site and the location of the nearest residential receptors in relation to the proposed operation.

Figure 3.1 Aerial Photograph Showing Proposed Quarry Extension and Nearest Residential Receptors



4 AIR QUALITY CRITERIA

4.1 NSW Government *"Action for Air"* Guidelines

Table 4.1.1 presents the goals that form the basis for the air quality environmental management plan outlined in the NSW Government's *"Action for Air"* (1998).

Table 4.1.1 Regional Ambient Air Quality Goals

Pollutant	Averaging Time	Previous NSW Goal	*"Action for Air"* Interim Goal	Long-term Reporting Goal
Ozone (O_3)	1 Hour 4 Hour	0.10 ppm 0.08 ppm	0.10 ppm 0.08 ppm	0.08 ppm [1] 0.06 ppm [1]
Nitrogen dioxide (NO_2)	1 Hour Annual	0.16 ppm 0.05 ppm	0.125 ppm 0.03 ppm [2]	0.105 [1] -
Particulate matter <10 µm (PM_{10})	24 Hours Annual	150 µg/m^3 50 µg/m^3	50 µg/m^3 -	30 µg/m^3
Particulate matter <2.5 µm ($PM_{2.5}$)	24 Hours Annual	- -	SBD [3] SBD [3]	SBD [3] SBD [3]
Total suspended particulates (TSP)	Annual	90 µg/m^3	90 µg/m^3	

1 WHO (World Health Organisation) goal
2 Consistent with WHO goal of 0.021-0.026 ppm
3 Standard being developed. Insufficient data at this stage.

4.2 Criteria Applicable to Particulate Matter

The term *"particulate matter"* refers to a category of airborne particles typically less than 50 microns (µm) in diameter and ranging down to 0.1 µm in size. Particles less than 10 µm and 2.5 µm are referred to in this Report as "fine" particles and "super-fine" particles respectively.

Emissions of fine and super-fine particles are considered important pollutants in terms of impact due to their ability to penetrate into the respiratory system. In the case of the $PM_{2.5}$ category, recent health research has shown that this penetration can occur deep into the lungs. Potential adverse health impacts associated with exposure to fine and super-fine particles include increased mortality from cardiovascular and respiratory diseases, chronic obstructive pulmonary disease and heart disease, reduced lung capacity in asthmatic children, etc.

One of the difficulties in dealing with air quality criteria governing fine particles is that the medical community has not been able to establish a threshold value (for either PM_{10} or $PM_{2.5}$) *below which* there are *no* adverse health impacts. Historically, the goals applied in NSW regarding PM_{10} emissions were:

- A 24-hour maximum of 150 $\mu g/m^3$, and
- An annual average of 50 $\mu g/m^3$.

The 150 $\mu g/m^3$ 24-hour maximum criterion was based on a similar US EPA criterion where the 24-hour maximum level was defined as the 99% value taken over a three-year running average. The US EPA 24-hour maximum PM_{10} definition is thus equivalent (statistically) to a level which would be exceeded (on average) approximately three to four times per year.

The revised 24-hour maximum PM_{10} level proposed in the NSW Government's *"Action for Air"* parallels the PM_{10} goal established in the *"National Environmental Protection Measures for Ambient Air Quality"* (NEPC, 1998). These "NEPM" goals were developed by the National Environmental Protection Council (NEPC) to be achieved within 10 years of commencement.

The NEPM PM_{10} goal is:

- A 24-hour maximum of 50 $\mu g/m^3$, with five exceedances allowed per year.

The following additional PM_{10} criteria are noted:

- The UK (EPAQS, 1995) PM_{10} goal is a 24-hour maximum of 50 $\mu g/m^3$.
- The long-term WHO PM_{10} goal is a 24-hour maximum of 30 $\mu g/m^3$.
- The California EPA PM_{10} goal is an annual average maximum of 30 $\mu g/m^3$.

Finally, it is noted that there is currently no NEPM nor *"Action for Air"* goal covering $PM_{2.5}$ particles. The current US EPA criteria for $PM_{2.5}$ is:

- A 24-hour maximum of 65 $\mu g/ m^3$, and
- An annual average of 15 $\mu g/ m^3$.

It is noted that the US EPA criterion for $PM_{2.5}$ is currently satisfied by achievement of the NEPM goal for PM_{10}.

4.3 Nuisance Impacts of Fugitive Emissions

The preceding sections are concerned in large part with the health impacts of particulate matter. Nuisance impacts need also to be considered, mainly in relation to dust. In NSW, accepted practice regarding the nuisance impact of dust is that:

- Dust related nuisance can be expected to impact on residential areas when annual average dust deposition levels exceed 4 g/m^2/month.
- Dust related impact would be unacceptable when annual average dust deposition levels reach 10 g/m^2/month.

Table 4.3.1 presents the NSW EPA amenity based criteria for dust fallout, showing the allowable increase in dust deposition level over the ambient (background) level which would be acceptable so that dust nuisance could be avoided.

Table 4.3.1 EPA Criteria for Allowable Dust Deposition

Existing (Background) Dust Fallout Level (g/m^2/month)	Maximum Acceptable Increase over Existing Fallout Levels (g/m^2/month)	
	Residential	Other
2	2	2
3	1	2
4	0	1

4.4 Project Air Quality Goals - Fugitive Emissions

On the basis of the above, the air quality goals adopted for the assessment of the present project are:

PM_{10}: A 24-hour maximum of 50 µg/m^3,
with five exceedances allowed per year.

TSP: An average annual maximum of 90 µg/m^3.

Dust: Nuisance expected to impact on residential areas when annual average dust deposition levels exceed 2 g/m^2/month (assumes existing ambient levels of the order of 2 g/m^2/month).

5 DISPERSION MODELLING

5.1 Methodology

The pollutant dispersion modelling carried out in the present assessment utilises the ISCST3 algorithms of the ISC3 modelling software family (source, US EPA). In particular, the *"Open Pit"* algorithm available within ISCST3 was used, which was designed specifically for surface mines and quarries.

5.2 Meteorological Data

The (Bureau of Meteorology) meteorological station used to provide data for the ISCST3 modelling was Station Number 068241: Wollongong (Albion Park). This station is situated to the northwest of the proposed quarry location. While some variations would be expected in translating the data from the met station site (at the Albion Park Aerodrome) to the quarry area, both sites are within a reasonable distance of each other.

It should be noted, however, that the proposed quarry is approximately 100 m higher in elevation and will therefore experience greater average wind speeds. As such, the dispersion model results should be regarded an over-prediction of expected emissions.

A summary of the annual wind behaviour as a wind rose is given in **Appendix E**.

5.3 Fugitive Emission Factors

A review has been carried out of dust, TSP and PM_{10} emission rates for the activities expected at the site. These include:

- Fugitive emissions associated with general excavation works within the quarry (excavator, dozer and loader).
- Fugitive emissions associated with material processing, in particular crushing.
- Fugitive emissions associated with areas of exposed material and stockpiling of material.
- Fugitive emissions associated with the general movement of heavy vehicles both within the site (using the new quarry haul road), and into and out of the site.

Sources used to select appropriate emissions factors include:

- NSW SPCC (1986), *"Air Pollution from Coal Mining and Related Developments"*, ISBN 0 7240 5936 9.
- NERDDC, *"Air Pollution from Surface Coal Mining: Volume 2 Emission Factors and Model Refinement"*, NERDDC Project 921, 1988.
- US EPA AP-42 *"Air Pollution Emission Factors"*, 1985, 1995, 1998 (5th Edition).
- Environment Australia, *"Emission Estimation Technique Manual for Mining"*, National Pollutant Inventory, March 1999.

Table 5.3.1 presents the emission factors used for the key atmospheric pollutants used in the dispersion modelling carried out in this report. These relate to emissions expected under normal operating conditions. The ratio of the PM_{10} fraction of the TSP ranges from 50% (eg wind erosion of stockpiles) down to 25% (eg dozers carrying out earthworks). The proportion of the PM_{10} fraction for each activity was derived primarily from Environment Australia (1999), *"Emission Estimation Technique Manual for Mining"*.

Table 5.3.1 Particulate Emission Factors for Air Quality Dispersion Modelling

Activity	Dust /TSP Emission Factor	PM10 Emission Factor
Bulldozer	17.00 kg/hr	4.00 kg/hr
Excavator	0.03 kg/t	0.01 kg/t
Air – Track Drill	0.59 kg/hole	0.31 kg/hole
Scrapers	2.00 kg/VKT	0.50 kg/VKT
Grader	1.08 kg/VKT	0.34 kg/VKT
Blasting	106.48 kg/blast	55.37 kg/blast
Wheel Dust (2 X Haul Trucks)	2.00 kg/VKT	0.40 kg/VKT
Open Pit Wind Erosion	0.40 kg/ha/hr	0.20 kg/ha/hr
Trucks dumping overburden (per Haul Truck)	0.01 kg/t	0.004 kg/t
Overburden Wind Erosion	0.40 kg/ha/hr	0.20 kg/ha/hr

5.4 Emission Inventory for the Proposed Operation

Appendix A provides details of the emission inventory associated with the proposed quarrying activities using the emission factors given in **Table 5.3.1**.

The proposed quarrying equipment will require one excavator, two off-road haul trucks, one air-track drill, one front-end loader, one water truck and one grader used for road maintenance. Additionally, one bulldozer, one scraper, and one excavator equipped with a rock-pick shall be used intermittently. The emission inventory used in the modelling has been derived in order to reflect the worst-case scenario for airborne emissions over a 24 hour period. As such, all equipment stated in the proposed equipment list is assumed to be engaged.

Hours of operation, typical work cycles and the life expectancy of the assumed quarry staging plan were supplied by Cleary Bros:

- The available working days per annum is based on 5.5 days per week (with 5 days for blasting) for 50 weeks a year.
- The available working day value has been multiplied by 0.8 in order to account for rain days and other events that will obstruct quarrying activities.
- The maximum usage of the bulldozer in any one day is assumed to be five hours.
- The amount of blast holes drilled per annum and the area per blast are both used in deriving the emission inventory for the respective activities. In both cases, these values have been assumed based on previous quarry activity.
- The mean vehicle speed is used to determine the grader emission factor. This has been assumed to be 10km/hr, with one grader trip per day.
- The vehicle kilometres travelled (VKT) is used to determine the scraper emission factor. As such, the grader is assumed to make 5 trips per day of use.
- Six scenarios have been examined in the present study. These correspond to activities within the 6 distinct quarrying staging areas at the site, and are for years 5, 10, 15, 20, 25 and 30 respectively. These years were chosen in order to reflect the highest possible release of particulates, as these years will yield the maximum amount of exposed surface area exposed to wind erosion.

5.5 Vehicle Exhaust Emissions

Table 5.5.1 provides combustion emission factors for the diesel vehicles used at the proposed site.

Table 5.5.1 USEPA Emission Factors for Classes of Mining Equipment (kg/1000L diesel fuel)

Equipment	CO	NO_X	SO_X (as SO_2)	VOCs (exhaust)
Bulldozer	14.73	34.29	3.74	1.58
Loader	11.79	38.5	3.74	5.17
Scrapers	10.16	30.99	3.74	2.28
Grader	6.55	30.41	3.73	1.53
Haul Truck	14.73	34.29	3.73	1.58

The equipment inventory for the proposed quarry extension requires only one of each of these pieces of equipment, apart from haul trucks, where two are anticipated.

As such, the impact of the pollutants derived from combustion, as detailed in **Table 5.5.1** are considered to be negligible. Odour impacts from such equipment may also be considered to be insignificant.

5.6 Background Concentrations

The ISCST3 modelling of dust, TSP and PM_{10} emissions only predicts the contribution of project-related emissions at each site of interest. These need to be added to the background concentrations existing at each site.

Dust deposition monitoring has been undertaken at the existing quarry, and twelve months results are summarised in **Table 5.6.1**. The approximate locations of the dust deposition monitoring are summarised in **Figure 5.6.1**.

Table 5.6.1 Dust Deposition Results From Existing Albion Park Quarry for 1999

Month	Location APD1 (g/m^2/month)	Location APD2 (g/m^2/month)	Location APD3 (g/m^2/month)
January	0.53	0.37	0.40
February	1.40	1.10	1.10
March	0.50	8.10	0.90
April	2.10	2.00	1.00
May	2.30	4.10	3.30
June	0.60	2.40	0.90
July	0.80	1.70	1.30
August	2.20	1.80	0.40
September	3.60	1.70	1.50
October	2.30	1.00	0.40
November	1.20	3.00	1.50
December	1.50	2.80	2.20
Average	1.6	2.5	1.2

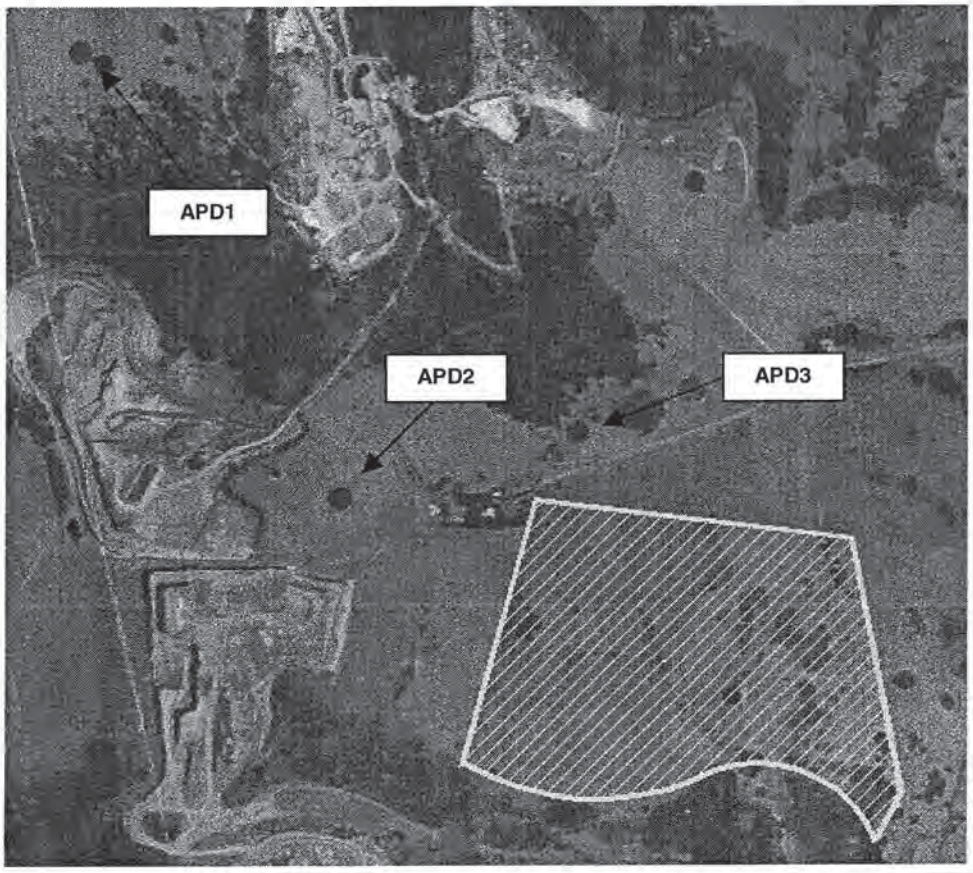
EPA guidelines relating to dust deposition were provided in **Section 4.3**:

- Dust related nuisance can be expected to impact on residential areas when annual average dust deposition levels exceed 4 g/m^2/month.
- Dust related impact would be unacceptable when annual average dust deposition levels reach 10 g/m^2/month.

Dust monitoring locations APD2 andAPD3 are the nearest to the site of the proposed quarry extension and are also close to the nearest residential receptors at the northwest corner of the site. Annual average dust deposition levels at these locations are currently averaging 2.5 and 1.2 g/m^2/month. Based on this monitoring, dust deposition levels at the residential receptor located at the northeast corner of the site ('The Hill' residence) would be expected to be at or below 1 g/m^2/month. This level of background dust deposition is considered when assessing future emissions.

It should also be noted that the current monitoring includes dust from operations in the existing Cleary Bros quarry. As the existing quarry will cease to operate when the quarry extension is commissioned, the assumed background dust deposition of 1 g/m^2/month will be a liberal estimate.

Figure 5.6.1 Approximate Locations of Dust Deposition Gauges at Albion Park Quarry



6 EMISSIONS ASSESSMENT

6.1 Fugitive Emissions

Dust

Appendix B shows the ISCST3 predictions for maximum monthly dust deposition carried out using the emission rates calculated in **Appendix A**. The results show the maximum monthly deposition experienced by receptors surrounding the site over a one-year time frame. It can be assumed that background levels of dust deposition are equal to 1 g/m^2/month for the nearest northeast receptor ('The Hill' residence) and somewhat less for the 'Belmont' residence in the southeast (refer **Section 5.6**).

At the nearest northeast residential receptor, 'The Hill' residence, maximum monthly dust deposition rates are predicted to be:

- Less than 1 g/m^2/month for the Year 5, 10, 15, 20 and 30 simulations
- Slightly over 1 g/m^2/month for the Year 25 simulation

At the nearest southeast residential receptor, 'Belmont' residence, maximum monthly dust deposition rates are predicted to be:

- Less than 1 g/m^2/month for the Year 5, 10, 15, 20 and 25 simulations
- Between 4 and 5 g/m^2/month for the Year 30 simulation

The 'Belmont' residence is located on the quarry property. The current occupant leases the house from Cleary Bros on a life tenancy basis, and has indicated an expectation that the house will be vacated after approximately five years. As such, the greater dust deposition predicted for this site after year 25 will not be an issue as Cleary Bros can arrange for the residence to be vacant during this time.

Accordingly, dust deposition would be acceptable for all applicable years of operation.

TSP

Appendix C shows the ISCST3 predictions expressed as contour plots for annual average TSP carried out using the emission rates calculated in **Appendix A**.

At the nearest northeast residential receptor, 'The Hill' residence, maximum annual average TSP levels are predicted to be:

- Less than 30 $\mu g/m^3$ for all simulations (Years 5 to 30).

At the nearest southeast residential receptor, 'Belmont' residence, maximum annual average TSP levels are predicted to be:

- Less than 30 $\mu g/m^3$ for the Year 5, 10, 15, 20 and 25 simulations
- Between 60 to 90 $\mu g/m^3$ for the Year 30 simulation

As previously stated, 'Belmont' residence will be vacant prior to the last staging area of the proposed extension. As such, TSP levels would be acceptable for all applicable years of operation.

PM_{10}

Appendix D shows the ISCST3 predictions for 24-hour PM_{10} concentrations (allowing five exceedances per year) carried out using the emission rates calculated in **Appendix A,** applying the analysis over a one-year time frame.

At the nearest northeast residential receptor, 'The Hill' residence, peak 24-hour PM_{10} concentrations are predicted to be:

- Less than 25 $\mu g/m^3$ for all simulations (Years 5 to 30)

At the nearest southeast residential receptor, 'Belmont' residence, peak 24-hour PM_{10} concentrations are predicted to be:

- Less than 25 $\mu g/m^3$ for the Year 5, 10, 15, 20 and 25 simulations
- Between 100 to 125 $\mu g/m^3$ for the Year 30 simulation

As Cleary Bros will arrange for the 'Belmont' property to be vacant during the last staging area of the proposed extension, PM_{10} emissions would be acceptable for all applicable years of operation.

6.2 Dust Minimisation Measures

Although the above assessment indicates that fugitive emissions would be acceptable for all applicable years of the operation, there should still be a dust control strategy implemented on the site, in order to minimise emissions on days when large amounts of dust are likely to be generated. Control strategies might include:

- Additional watering of exposed surfaces
- Minimisation of exposed surfaces
- Replanting over quarried areas
- Minimising the drop heights for trucks unloading overburden

- Limiting of high dust-generating activities during adverse wind conditions, ie winds from the northwest blowing directly towards the southeast receptor.

6.3 Greenhouse Gas Assessment

Greenhouse gases will be generated at the proposed quarry site due to the combustion activities of the quarry equipment. The following emissions are expected:

- Carbon Monoxide (CO) and Carbon Dioxide (CO_2)
- Methane (CH_4)
- Oxides of Nitrogen (NO_X)
- Non-Methane Volatile Organic Compounds (NMVOC's)

Carbon dioxide (CO_2) is produced as a result of the oxidation of fuel carbon content during fuel combustion. CO_2 is likely to make the largest contribution to greenhouse gas emissions as, according to the National Greenhouse Gas Inventory Committee, 99% of ADO fuel may be assumed to be oxidised during the combustion process.

The other gases will be produced from incomplete fuel combustion, reactions between air and fuel constituents during fuel combustion, and post-combustion reactions. Fugitive emissions of NMVOC's may also be expected due to fuel evaporation. However, due to the low volatility of ADO, fugitive emissions of NMVOC's due to evaporation may be regarded as negligible.

The fuel source for the quarry equipment will be exclusively Automotive Diesel Oil (ADO). At present, there is no alternative fuel source available that is economically viable for quarrying activities. The consumption of ADO by plant will be limited by economic factors, thus ensuring that machinery is only engaged when absolutely necessary. The proposed quarrying equipment inventory is summarised in **Table 6.3.1**.

Table 6.3.1 Quarrying Equipment Inventory for Proposed Extension

Item	Quantity
Bulldozer (D8 or D9)	1*
Excavator (CAT 235 or 245)	1
Off-road Haul Trucks (CAT 769 or 773)	2
Air-track drill (Ingersol Rand LC500)	1
Scrapers (CAT 627 or 637)	1*
Excavator (CAT 235) with hydraulic rock-pick	1*
Front-end Loader (CAT 992)	1
Water Truck	1
Grader (CAT 12G or 14G)	1

* Intermittent use only

Given the limited amount of equipment to be used in the quarrying process, the increase in greenhouse gas contribution from the quarrying activities may be regarded as minimal.

Finally, it should be noted that the proposed equipment inventory uses plant that is imported either as vehicles or engines from the USA or Europe. As emission control regulations are in force for these vehicles, it may be assumed that the best available emission technology shall be utilised.

7 CONCLUSION

It is proposed that the current operation at the Albion Park quarry be expanded to include an area detached from the current quarry. The extension will have a thirty-year lifespan.

Richard Heggie Associates has been engaged by Perram and Partners to assess the proposed quarry extension in terms of air quality impact.

Modelling of fugitive dust emissions and an assessment of combustion emissions was undertaken to determine the resulting air quality impacts of the proposed operation.

Computer predictions of fugitive emissions from the site were undertaken using the ISCST3 modelling software suite (open pit algorithms). These predictions indicate that particulate matter and dust levels attributable to the proposed expanded operation will be within current EPA (and NEPM) air quality goals.

At the 'Belmont' residence in the southeast corner of the proposed extension, the computer predictions of fugitive emissions indicate that particulate matter and dust levels would all exceed allowable levels (taking into account background levels) during the last staging operation of the proposed quarry, ie the Year 26 to Year 30 stage. As Cleary Bros will arrange for the residence to be vacant during the last staging area of the proposed extension, fugitive emissions would be acceptable for all applicable years of operation.

Albion Park Extension - Year 5	TSP Emission Factor	PM_{10} Emission Factor	Emission Factor Units	Quantity solid (m^3/ annum)	Number of Hectares of stockpile	Average number of kilometres per return trip	Working days available[1]	Working hours per day	TSP Emission Rate (g/s)[2]	PM_{10} Emission Rate (g/s)
Bulldozer[3]	17.00	4.00	kg/hr	N/A	N/A	N/A	N/A	5	2.249	0.529
Excavator	0.03	0.01	kg/t	23050	N/A	N/A	275	10.5	0.133	0.064
Air - Track Drill[4]	0.59	0.31	kg/hole	N/A	N/A	N/A	275	10.5	0.089	0.047
Scrapers[5]	2.00	0.50	kg/VKT	N/A	N/A	0.1	N/A	10.5	0.014	0.004
Grader[6]	1.08	0.34	kg/VKT	N/A	N/A	1	275	10.5	0.028	0.009
Blasting[7]	106.48	55.37	kg/blast	N/A	N/A	N/A	200	8.5	2.817	1.465
FROM QUARRYING ACTIVITIES									5.330	2.118

Wheel Dust (2 x Haul Trucks)	2.00	0.40	kg/VKT	23050	N/A	1	275	10.5	0.130	0.026
Open Pit Wind Erosion	0.40	0.20	kg/ha/hr	N/A	1.0025	N/A	N/A	N/A	0.111	0.056
Trucks dumping overburden (per Haul Truck)	0.01	0.004	kg/t	23050	N/A	N/A	275	10.5	0.032	0.011
Overburden Wind Erosion	0.40	0.20	kg/ha/hr	N/A	0.25	N/A	N/A	N/A	0.028	0.014

Albion Park Extension - Year 10	TSP Emission Factor	PM_{10} Emission Factor	Emission Factor Units	Quantity solid (m^3/ annum)	Number of Hectares of stockpile	Average number of kilometres per return trip	Working days available[1]	Working hours per day	TSP Emission Rate (g/s)[2]	PM_{10} Emission Rate (g/s)
Bulldozer[3]	17.00	4.00	kg/hr	N/A	N/A	N/A	N/A	5	2.249	0.529
Excavator	0.03	0.01	kg/t	29200	N/A	N/A	275	10.5	0.169	0.081
Air - Track Drill[4]	0.59	0.31	kg/hole	N/A	N/A	N/A	275	10.5	0.089	0.047
Scrapers[5]	2.00	0.50	kg/VKT	N/A	N/A	0.1	N/A	10.5	0.014	0.004
Grader[6]	1.08	0.34	kg/VKT	N/A	N/A	1.5	275	10.5	0.043	0.013
Blasting[7]	106.48	55.37	kg/blast	N/A	N/A	N/A	200	8.5	2.817	1.465
FROM QUARRYING ACTIVITIES									5.380	2.140
Wheel Dust (2 x Haul Trucks)	2.00	0.40	kg/VKT	29200	N/A	1.5	275	10.5	0.248	0.050
Open Pit Wind Erosion	0.40	0.20	kg/ha/hr	N/A	0.72	N/A	N/A	N/A	0.080	0.040
Trucks dumping overburden	0.01	0.00	kg/t	29200	N/A	N/A	275	10.5	0.040	0.014
Overburden Wind Erosion	0.40	0.20	kg/ha/hr	N/A	0.8	N/A	N/A	N/A	0.089	0.044

Albion Park Extension - Year 15	TSP Emission Factor	PM_{10} Emission Factor	Emission Factor Units	Quantity solid (m^3/ annum)	Number of Hectares of stockpile	Average number of kilometres per return trip	Working days available[1]	Working hours per day	TSP Emission Rate (g/s)[2]	PM_{10} Emission Rate (g/s)
Bulldozer[3]	17.00	4.00	kg/hr	N/A	N/A	N/A	N/A	5	2.249	0.529
Excavator	0.03	0.01	kg/t	63200	N/A	N/A	275	10.5	0.365	0.175
Air - Track Drill[4]	0.59	0.31	kg/hole	N/A	N/A	N/A	275	10.5	0.089	0.047
Scrapers[5]	2.00	0.50	kg/VKT	N/A	N/A	0.1	N/A	10.5	0.014	0.004
Grader[6]	1.08	0.34	kg/VKT	N/A	N/A		275	10.5	0.023	0.007
Blasting[7]	106.48	55.37	kg/blast	N/A	N/A	N/A	200	8.5	2.817	1.465
FROM QUARRYING ACTIVITIES									5.556	2.227

Wheel Dust (2 x Haul Trucks)	2.00	0.40	kg/VKT	63200	N/A	0.8	275	10.5	0.286	0.057
Open Pit Wind Erosion	0.40	0.20	kg/ha/hr	N/A	2.16	N/A	N/A	N/A	0.240	0.120
Trucks dumping overburden	0.01	0.00	kg/t	63200	N/A	N/A	275	10.5	0.088	0.031
Overburden Wind Erosion	0.40	0.20	kg/ha/hr	N/A	0.8	N/A	N/A	N/A	0.089	0.044

Albion Park Extension - Year 20	TSP Emission Factor	PM_{10} Emission Factor	Emission Factor Units	Quantity solid (m^3/ annum)	Number of Hectares of stockpile	Average number of kilometres per return trip	Working days available[1]	Working hours per day	TSP Emission Rate (g/s)[2]	PM_{10} Emission Rate (g/s)
Bulldozer[3]	17.00	4.00	kg/hr	N/A	N/A	N/A	N/A	5	2.249	0.529
Excavator	0.03	0.01	kg/t	67000	N/A	N/A	275	10.5	0.387	0.186
Air - Track Drill[4]	0.59	0.31	kg/hole	N/A	N/A	N/A	275	10.5	0.089	0.047
Scrapers[5]	2.00	0.50	kg/VKT	N/A	N/A	0.25	N/A	10.5	0.036	0.011
Grader[6]	1.08	0.34	kg/VKT	N/A	N/A	1.5	275	10.5	0.043	0.013
Blasting[7]	106.48	55.37	kg/blast	N/A	N/A	N/A	200	8.5	2.817	1.465
FROM QUARRYING									5.620	2.251

Wheel Dust (2 x Haul Trucks)	2.00	0.40	kg/VKT	67000	N/A	1.5	275	10.5	0.569	0.114
Open Pit Wind Erosion	0.40	0.20	kg/ha/hr	N/A	2.35	N/A	N/A	N/A	0.261	0.131
Trucks dumping overburden	0.01	0.00	kg/t	67000	N/A	N/A	275	10.5	0.093	0.033
Overburden Wind Erosion	0.40	0.20	kg/ha/hr	N/A	0.8	N/A	N/A	N/A	0.089	0.044

Albion Park Extension - Year 25	TSP Emission Factor	PM_{10} Emission Factor	Emission Factor Units	Quantity solid (m^3/ annum)	Number of Hectares of stockpile	Average number of kilometres per return trip	Working days available[1]	Working hours per day	TSP Emission Rate (g/s)[2]	PM_{10} Emission Rate (g/s)
Bulldozer[3]	17.00	4.00	kg/hr	N/A	N/A	N/A	N/A	5	2.249	0.529
Excavator	0.03	0.01	kg/t	41000	N/A	N/A	275	10.5	0.237	0.114
Air - Track Drill[4]	0.59	0.31	kg/hole	N/A	N/A	N/A	275	10.5	0.089	0.047
Scrapers[5]	2.00	0.50	kg/VKT	N/A	N/A	0.1	N/A	10.5	0.014	0.004
Grader[6]	1.08	0.34	kg/VKT	N/A	N/A	1.8	275	10.5	0.051	0.016
Blasting[7]	106.48	55.37	kg/blast	N/A	N/A	N/A	200	8.5	2.817	1.465
FROM QUARRYING									5.457	2.175

Wheel Dust (2 x Haul Trucks)	2.00	0.40	kg/VKT	41000	N/A	1.8	275	10.5	0.418	0.084
Open Pit Wind Erosion	0.40	0.20	kg/ha/hr	N/A	1.3	N/A	N/A	N/A	0.144	0.072
Trucks dumping overburden	0.01	0.00	kg/t	41000	N/A	N/A	275	10.5	0.057	0.020
Overburden Wind Erosion	0.40	0.20	kg/ha/hr	N/A	0.8	N/A	N/A	N/A	0.089	0.044

Albion Park Extension - Year 30	TSP Emission Factor	PM_{10} Emission Factor	Emission Factor Units	Quantity solid (m^3/ annum)	Number of Hectares of stockpile	Average number of kilometres per return trip	Working days available[1]	Working hours per day	TSP Emission Rate (g/s)[2]	PM_{10} Emission Rate (g/s)
Bulldozer[3]	17.00	4.00	kg/hr	N/A	N/A	N/A	N/A	5	2.249	0.529
Excavator	0.03	0.01	kg/t	51600	N/A	N/A	275	10.5	0.298	0.143
Air - Track Drill[4]	0.59	0.31	kg/hole	N/A	N/A	N/A	275	10.5	0.089	0.047
Scrapers[5]	2.00	0.50	kg/VKT	N/A	N/A	0.1	N/A	10.5	0.014	0.004
Grader[6]	1.08	0.34	kg/VKT	N/A	N/A	1.4	275	10.5	0.040	0.013
Blasting[7]	106.48	55.37	kg/blast	N/A	N/A	N/A	200	8.5	2.817	1.465
FROM QUARRYING									5.507	2.201
Wheel Dust (2 x Haul Trucks)	2.00	0.40	kg/VKT	51600	N/A	1.4	275	10.5	0.409	0.082
Open Pit Wind Erosion	0.40	0.20	kg/ha/hr	N/A	2.58	N/A	N/A	N/A	0.287	0.143
Trucks dumping overburden	0.01	0.00	kg/t	51600	N/A	N/A	275	10.5	0.071	0.026
Overburden Wind Erosion	0.40	0.20	kg/ha/hr	N/A	0.8	N/A	N/A	N/A	0.089	0.044

[1] The working days available is based on 5.5 days a week (5 days for blasting), for 50 weeks a year. This has been multiplied by 0.8 in order to account for rain days and other events that will obstruct quarrying activities.

[2] The Emission Rates represent the worst case scenario emission over a 24 hour period.

[3] The maximum useage of the bulldozer in any one day is assumed to be 5 hours.

[4] The Amount of blast holes drilled per annum is used to determine the Air-Track drill Emission Factor. This has been assumed to be 1570 holes / annum, as based on previous quarry activity

[5] The vehicle kilometers travelled is used to determine the Scrapers Emission Factor. This has been assumed to be 5 trips per day of use.

[6] The Mean Vehicle Speed is used to determine the Grader Emission Factor. This has been assumed to be 10km/hr. One grader trip per day has been assumed.

[7] The area per blast is used to determine the blasting Emission Factor. This has been assumed to be 270 m^2 as based on previous quarry activity. The scenario assumes that a maximum of three blasts may be undertaken in a 24 hour period.

Appendix B

Report 10-1676-R1
Pages : 6

Predicted Dust Deposition Contours from Proposed Development

RevNo	Revision note	Date	Initials	Checked

	Worked Area
	Exposed Areas
	Spoil Route

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Quality Endorsed Company

Designed by	Checked by	Approved by - date	Filename	Date	Scale
DR	PNG		10-1676	1/11/01	

Title
Albion Park Quarry Extension
Max. Monthly Dust Deposition Contours - Year 5

DWG.No. 10-1676 Year 05 Dust
Sheet | Rev

All dimensions in millimetres unless otherwise stated
Do not scale from drawing

RevNo	Revision note	Date	Initials	Checked

	Worked Area
	Exposed Areas
	Spoil Route

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Title
Albion Park Quarry Extension
Max. Monthly Dust Deposition Contours - Year 10

DWG.No. 10-1676 Year 10 Dust

Sheet | Rev

RevNo	Revision note	Date	Initials	Checked

	Worked Area
	Exposed Areas
	Spoil Route

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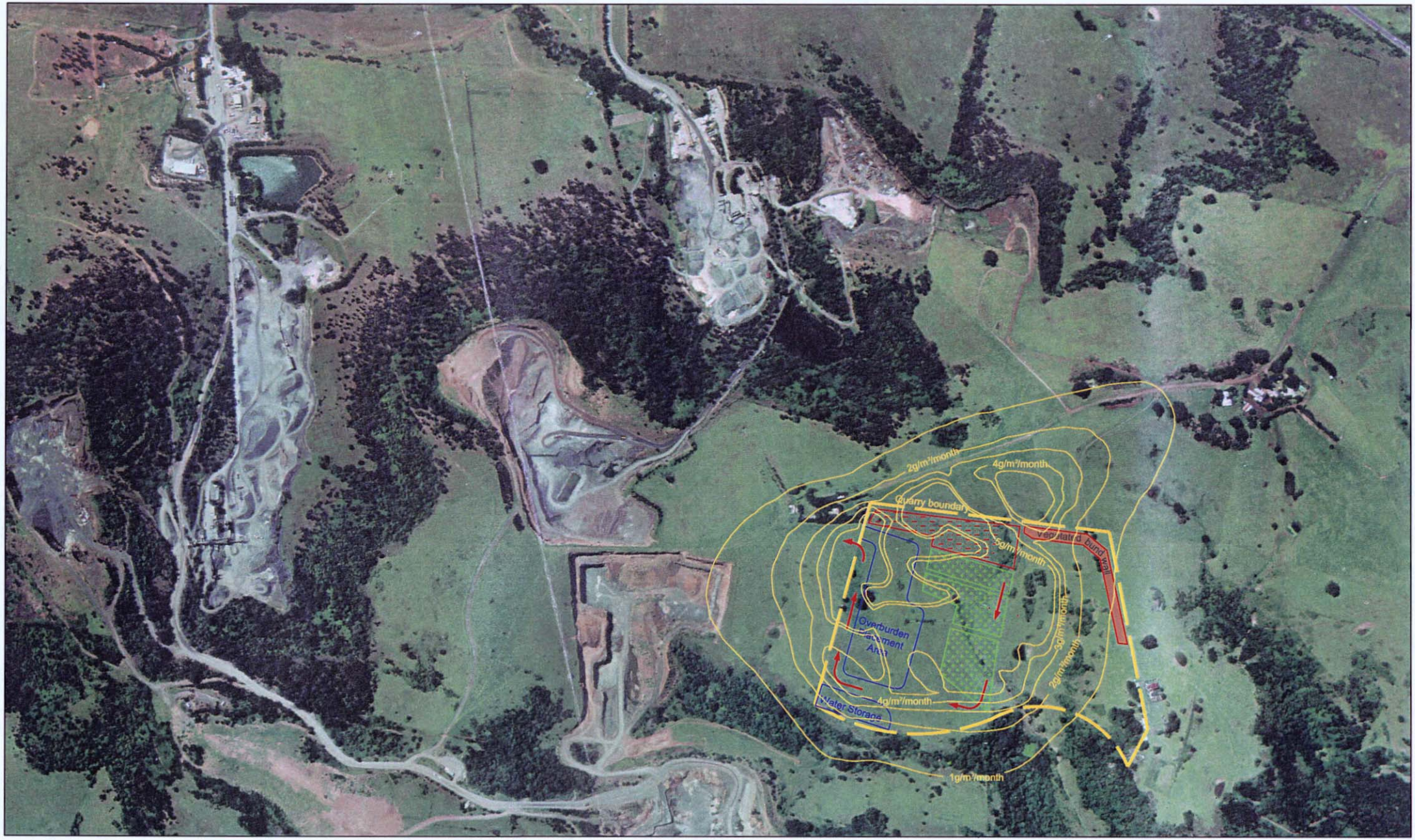
Title
Albion Park Quarry Extension
Max. Monthly Dust Deposition Contours - Year 15

DWG.No. 10-1676 Year 15 Dust

Sheet | Rev

RevNo	Revision note	Date	Initials	Checked



	Worked Area
	Exposed Areas
	Spoil Route

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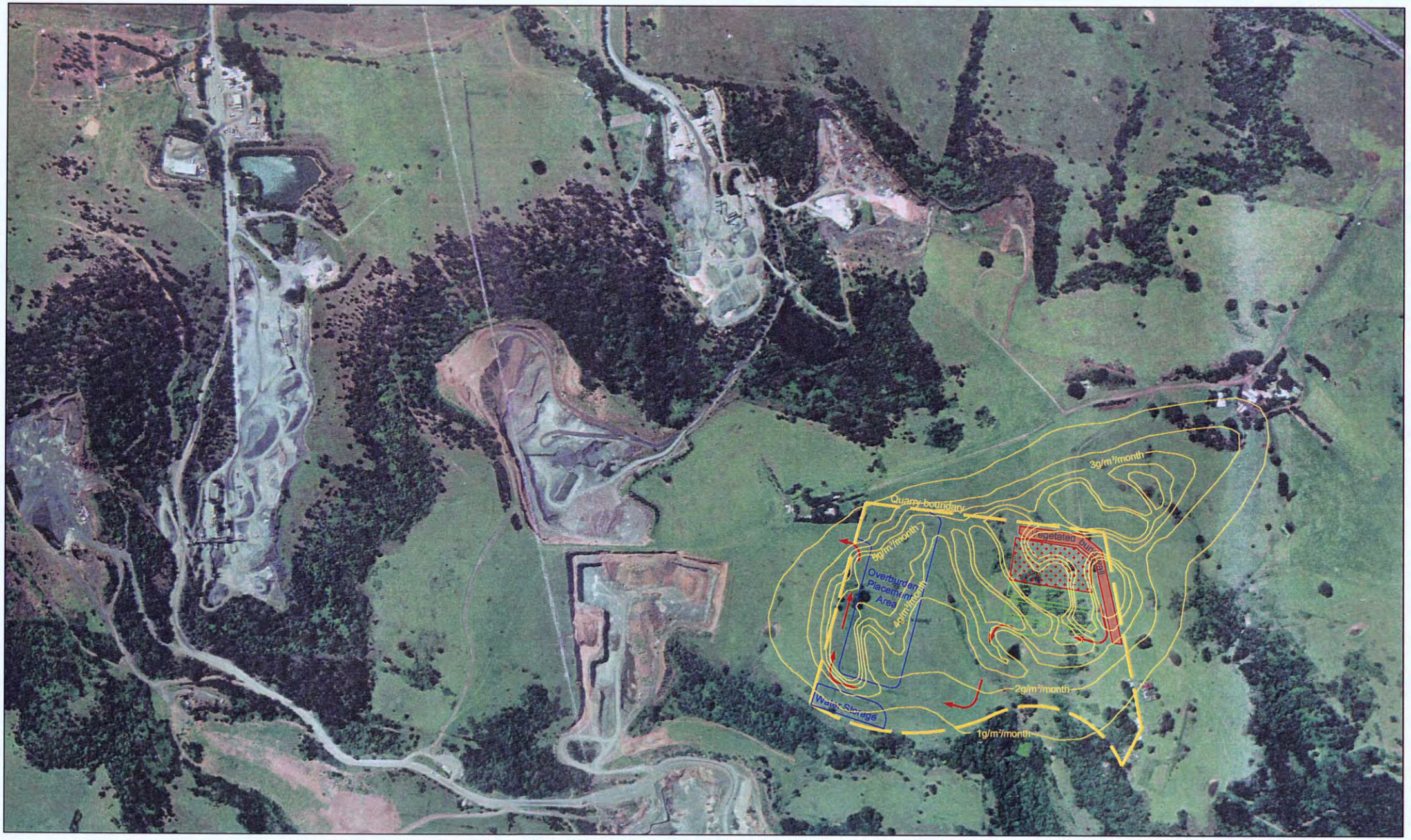
DR	PNG		10-1676	1/11/01	

Title
Albion Park Quarry Extension
Max Monthly Dust Deposition Contours - Year 20

DWG.No. 10-1676 Year 20 Dust.dw

Sheet | Rev

RevNo	Revision note	Date	Initials	Checked



	Worked Area
	Exposed Areas
	Spoil Route

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DR	PNG		10-1676	1/11/01	

Title
Albion Park Quarry Extension
Max. Monthly Dust Deposition Contours - Year 25

DWG.No. 10-1676 Year 25 Dust.dw

Sheet | Rev

RevNo	Revision note	Date	Initials	Checked

	Worked Area
	Exposed Areas
	Spoil Route

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Title
Albion Park Quarry Extension
Max. Monthly Dust Deposition Contours - Year 30

DWG.No. 10-1676 Year 30 Dust.dw

Sheet | Rev

Appendix C

Report 10-1676-R1
Pages : 6

Predicted TSP Concentration Contours from Proposed Development

RevNo	Revision note	Date	Initials	Checked

	Worked Area
	Exposed Areas
	Spoil Route

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DR	PNG		10-1676	1/10/01	

Title
Albion Park Quarry Extension
Annual TSP Contours - Year 5

DWG.No. 10-1676 Year 05 TSP

Sheet | Rev

RevNo	Revision note	Date	Initials	Checked

	Worked Area
	Exposed Areas
	Spoil Route

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Title
Albion Park Quarry Extension
Annual TSP Contours - Year 10

DWG.No. 10-1676 Year 10 TSP

Sheet | Rev

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Do not scale from drawing

RevNo	Revision note	Date	Initials	Checked

	Worked Area
	Exposed Areas
	Spoil Route

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Designed by	Checked by	Approved by - date	Filename	Date	Scale
DR	PNG		10-1676	1/11/01	

Title
Albion Park Quarry Extension
Annual TSP Contours - Year 15

DWG.No. 10-1676 Year 15 TSP

Sheet | Rev

RevNo	Revision note	Date	Initials	Checked

	Worked Area
	Exposed Areas
	Spoil Route

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DR	PNG		10-1676	1/11/01	

Title
Albion Park Quarry Extension
Annual TSP Contours - Year 20

DWG.No. 10-1676 Year 20 TSP

Sheet | Rev

RevNo	Revision note	Date	Initials	Checked

	Worked Area
	Exposed Areas
	Spoil Route

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Title
Albion Park Quarry Extension
Annual TSP Contours - Year 25

DWG.No. 10-1676 Year 25 TSP

Sheet | Rev

RevNo	Revision note	Date	Initials	Checked

Worked Area

Richard Heggie Associates Pty Ltd

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Appendix D

Report 10-1676-R1
Pages : 6

Predicted PM_{10} Concentration Contours from Proposed Development

RevNo	Revision note	Date	Initials	Checked

Worked Area
Exposed Areas
Spoil Route

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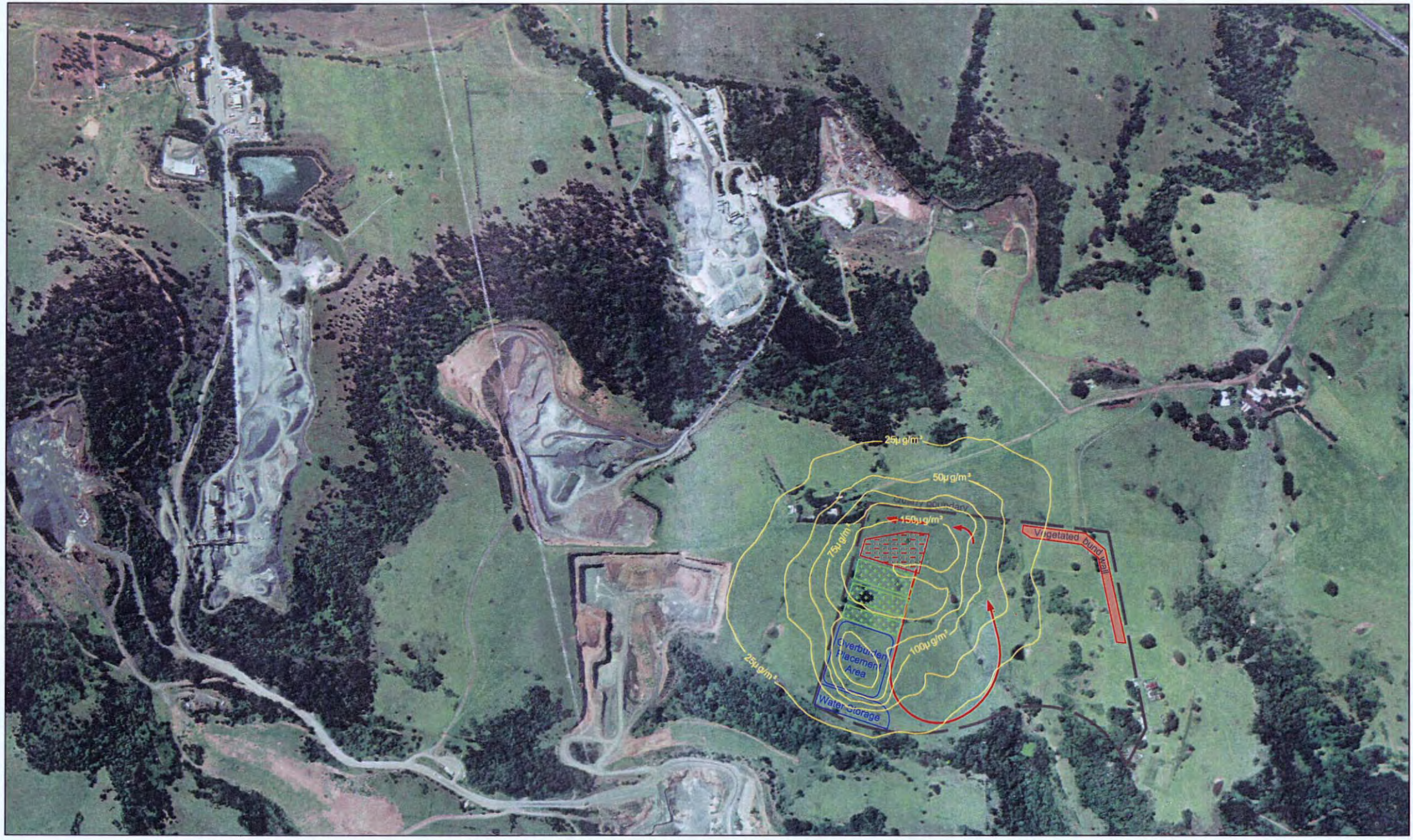
Title
Albion Park Quarry Extension
6th Highest (24-hr) PM10 Contours - Year 5

DWG.No. 10-1676 Year 05 PM10

Sheet | Rev

All dimensions in millimetres unless otherwise stated
Do not scale from drawing

RevNo	Revision note	Date	Initials	Checked



	Worked Area
	Exposed Areas
	Spoil Route

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DR	PNG		10-1676	1/11/01	

Title
Albion Park Quarry Extension
6th Highest (24-hr) PM10 Contours - Year 10

DWG.No. 10-1676 Year 10 PM10
Sheet
Rev

RevNo	Revision note	Date	Initials	Checked

	Worked Area
	Exposed Areas
	Spoil Route

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DR	PNG		10-1676	1/11/01	

Title
Albion Park Quarry Extension
6th Highest PM10 Contours - Year 15

DWG.No. 10-1676 Year 15 PM10

Sheet | Rev

All dimensions in millimetres unless otherwise stated
Do not scale from drawing

RevNo	Revision note	Date	Initials	Checked

	Worked Area
	Exposed Areas
	Spoil Route

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DR	PNG		10-1676	1/11/01	

Title
Albion Park Quarry Extension
6th Highest (24-hr) PM10 Contours - Year 20

DWG.No. 10-1676 Year 20 PM10

Sheet | Rev

RevNo	Revision note	Date	Initials	Checked

	Worked Area
	Exposed Areas
	Spoil Route

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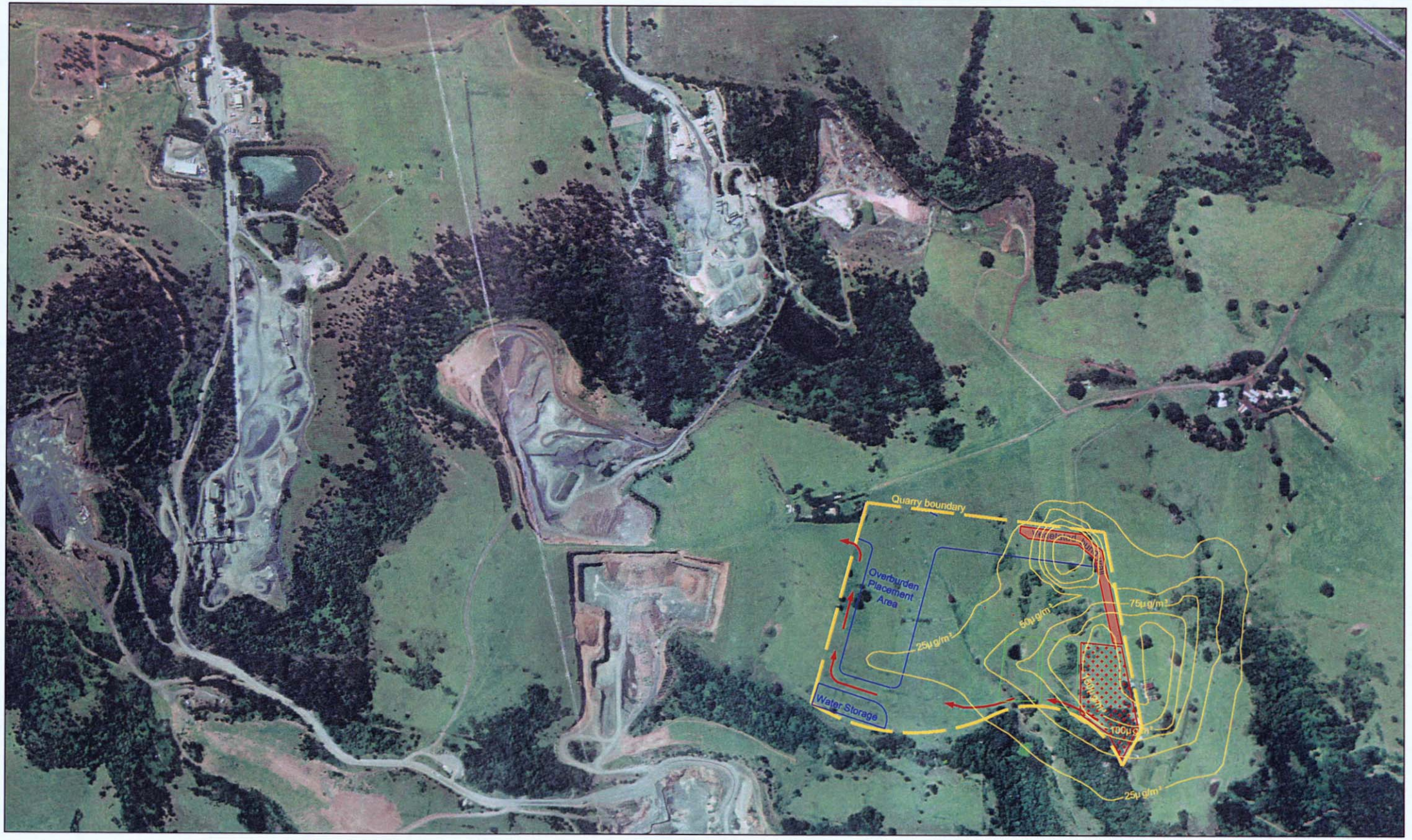
Designed by	Checked by	Approved by - date	Filename	Date	Scale
DR	PNG		10-1676	1/11/01	

Title
Albion Park Quarry Extension
6th Highest (24-hr) PM10 Contours - Year 25

DWG.No. 10-1676 Year 25 PM10.d

Sheet | Rev

RevNo	Revision note	Date	Initials	Checked



	Worked Area
	Exposed Areas
	Spoil Route

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Designed by	Checked by	Approved by - date	Filename	Date	Scale
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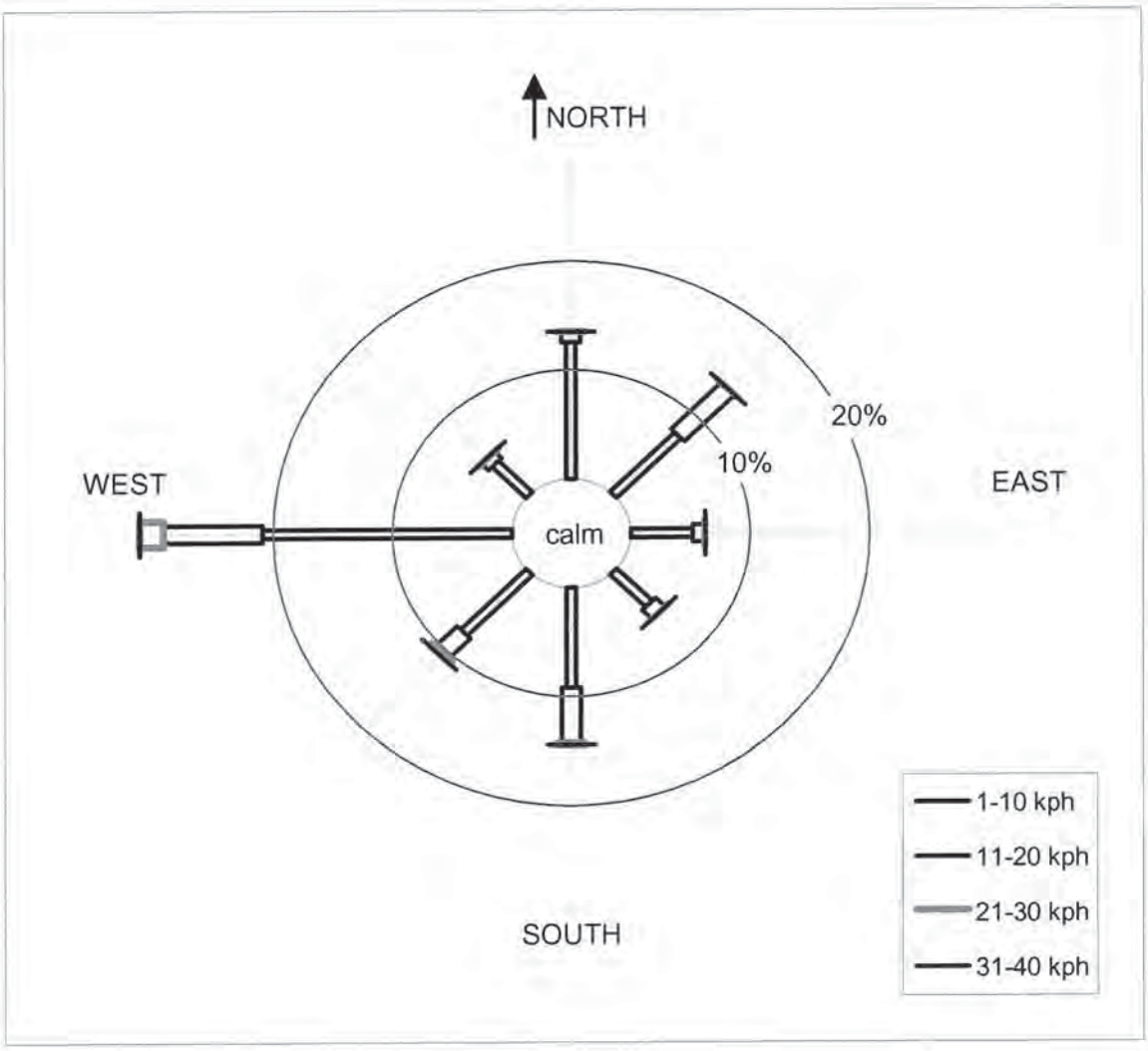
Title
Albion Park Quarry Extension
6th Highest (24-hr) PM10 Contours - Year 30

DWG.No. 10-1676 Year 30 PM10.d

Sheet | Rev


NORTH
WEST
EAST
SOUTH
20%
10%
calm
1-10 kph
11-20 kph
21-30 kph
31-40 kph

Appendix N

TRANSPORT ASSESSMENT

TRANSPORT STUDY

Albion Park Quarry
Extension to Quarry Area

April 2003

Prepared for
Cleary Bros (Bombo) Pty Ltd

MASSON | WILSON | TWINEY
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Contents

1. Introduction

Masson Wilson Twiney Pty Ltd has been commissioned to study the transport aspects of a proposed extension to the existing extractive area and continuation of associated extractive industry activities at the Cleary Bros Albion Park Quarry (Quarry).

Our study report is structured through the following chapters:-

- Chapter 2 - describes the background, existing situation and transport context
- Chapter 3 - assesses the implications of the proposal
- Chapter 4 - provides a summary of the report's findings and its conclusions.

Appended is the published RTA count information on the Princes Highway and automatic counter data of the existing traffic generation of the Quarry.

2. Existing Situation and Transport Context

Background

Quarrying has been undertaken on the Cleary Bros Albion Park site for the past thirty years. The current extraction area is becoming low in resource and it is proposed to extend the quarrying area to a parcel of land (to the south-east of the existing operation) to allow continuation of existing extraction.

Part of the proposal is that the crushing, screening, processing, stockpiling, and transportation activities associated with quarry product will remain the same as the existing operations using the existing infrastructure.

Apart from market fluctuations and natural growth there is no planned expansion and/or increased production from the existing infrastructure.

Existing Situation

The Quarry lies to the south of the Princes Highway as shown in Figure 1.

Vehicle access to the Quarry is provided from the recently constructed East-West Link Road. Stage 1 of the Link Road (opened 2002) extends between the Princes Highway and Croome Road. Ultimately the Link Road will be extended to Terry Street (Jamberoo Road) as shown in Figure 2.

The Link Road includes an overpass of the railway and a grade separated interchange with the Princes Highway. A roundabout has been installed at the intersection of the Link Road and the Quarry access road as shown in Figure 3.

The Quarry access road does not provide access to any developments other than the Cleary Bros Quarry. Thus all traffic along the Quarry access road is associated with the Quarry. The roundabout intersection has been designed to accommodate vehicle activity generated by the Quarry.

The roundabout on the Link Road provides direct access between the Quarry access road and the arterial road network with access to the Princes Highway via the Oaks Flat interchange. Thus a haulage route is provided between the Quarry and the Highway which avoids the need to travel through the residential areas of Albion Park Rail.

Prior to the opening of the Link Road, access to the Quarry was via a priority controlled intersection on the Princess Highway. As a result of increasing local and regional traffic flows, Quarry traffic was experiencing increasing delays at this intersection. The existing access arrangements via the Link Road are a significant improvement on previous access arrangements.

Investigations undertaken by the RTA indicated that the Link Road is forecast to carry around 11,000 vehicles per day by around 2018.

ALBION PARK QUARRY

SITE LOCATION

MASSON | WILSON | TWINEY

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Figure 1

Filename: 001377d01 BI

Date: 24 March 2003

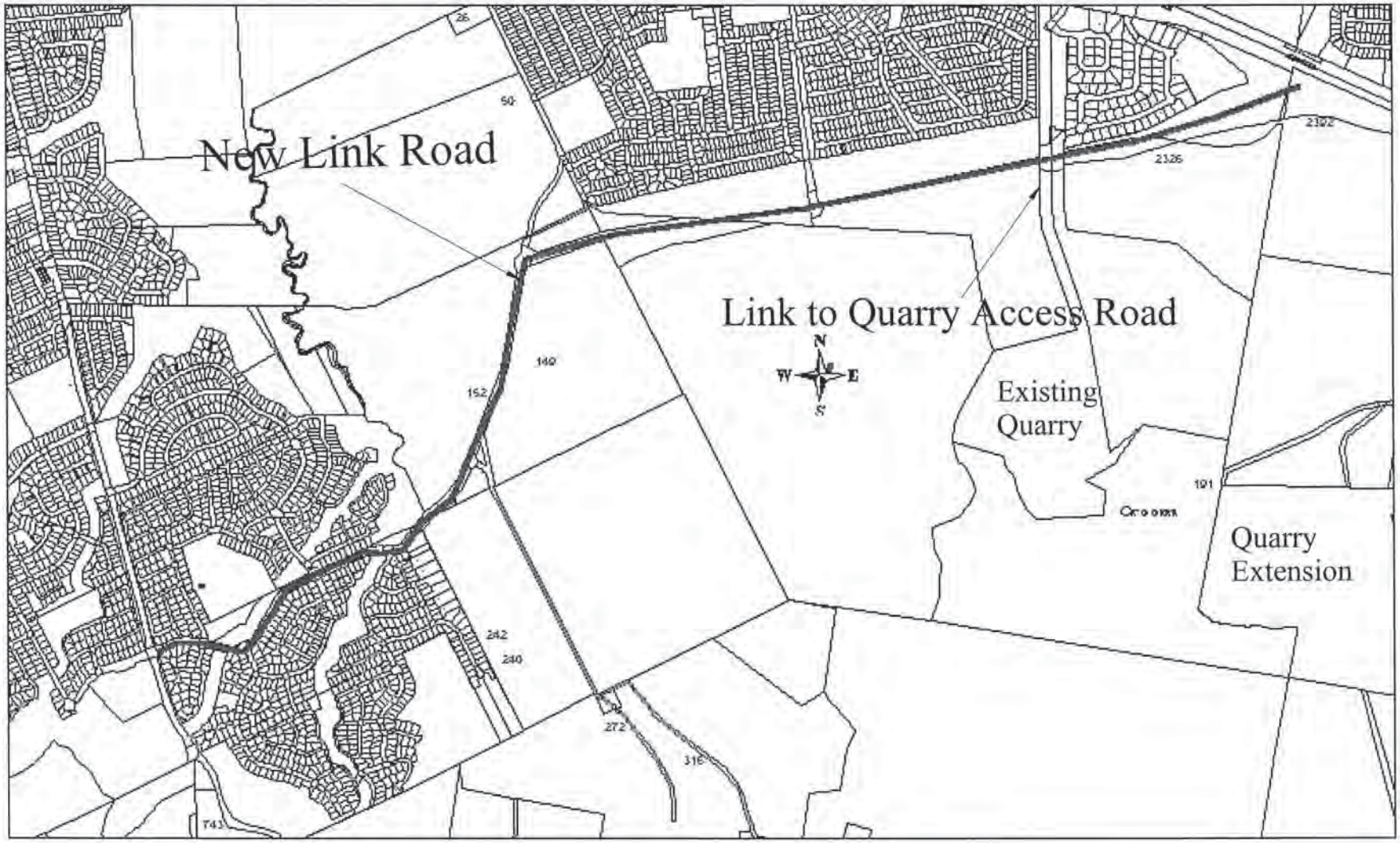

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Figure 2
New Link Road

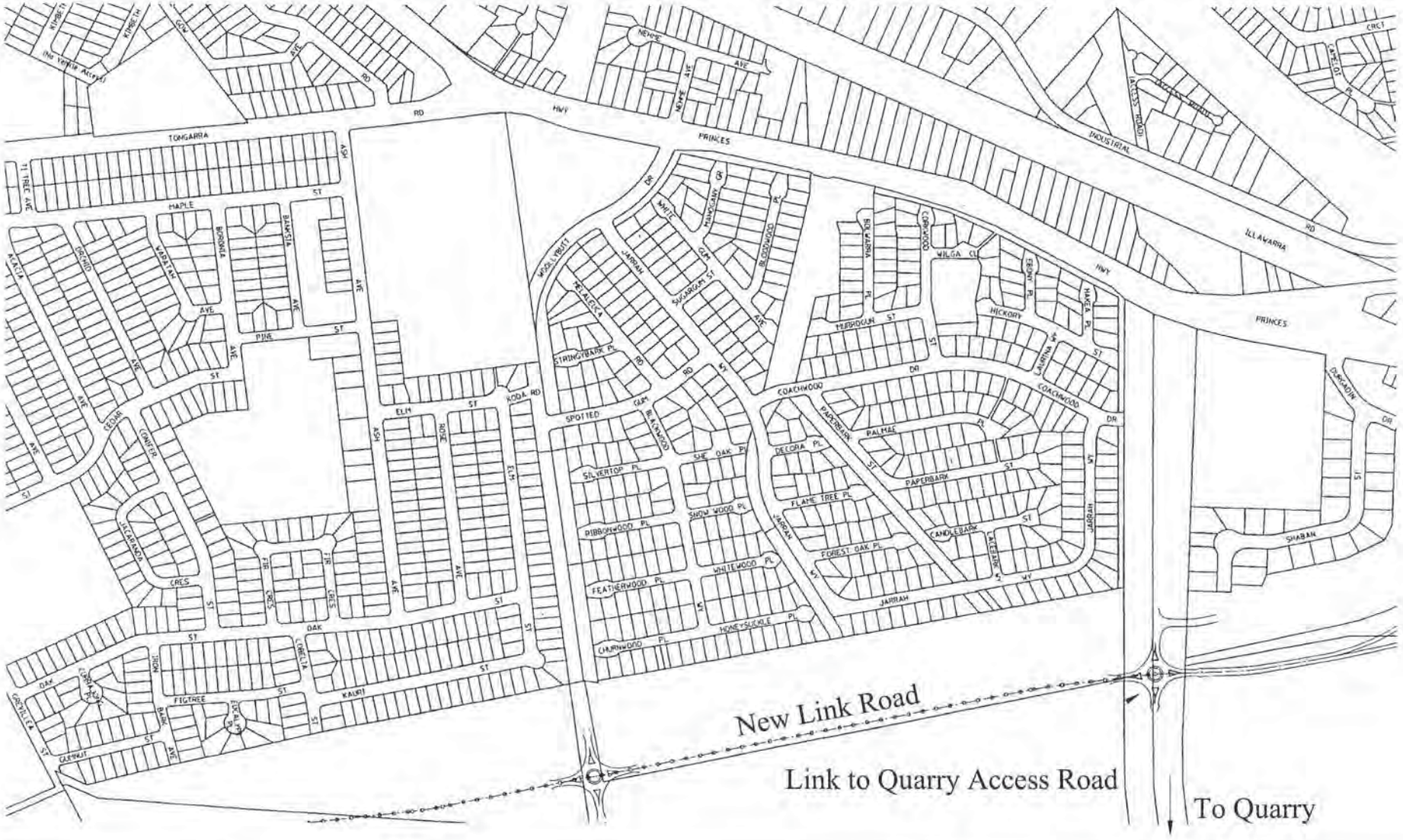

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Figure 3
New Link Road

Traffic surveys undertaken by Shellharbour City Council upon completion of Stage 1 of the link (Princes Highway to Croome Road) indicated that the Link Road carried approximately 5,500 vehicles per day in July 2002.

Traffic Flows

The Princes Highway is a major arterial road. RTA counts indicate the following average annual daily traffic flows (AADTs).

Table 1 - Princes Highway (SH1) Daily Traffic Flows

Site	Year					
	1992	1994	1997	2000	2001 [1.]	2002 [2.]
07039 Oak Flats: Nth of Tongarra Rd	28908	32806	28679	30,152	-	31,078
07040 Oak Flats: East of Tongarra Rd	33443	42204	37472	40,689	36,211	-

Notes: *1. Based on RTA survey December 2001*
2. Based on RTA survey August 2002

The traffic data for 2001 and 2002 have been provided by the RTA. These surveys are not yet published and do not take into account seasonality. As such they are treated as indicative until published survey data is produced.

It can be seen that the Princess Highway, in the immediate vicinity of the site access, currently carries in the order of 36,000 vehicles per day.

Table 1 indicates that traffic on the section of the Princes Highway between Tongarra Road and the new Link Road intersections has dropped in the order of 4,500 vehicles per day after the opening of the Link Road.

Main Road 611 which becomes the New Lake Entrance Road has the following AADTs (Table 2). Daily traffic count data post the opening of the Link Road for New Lake Entrance Road north of the Princes Highway are not yet available.

Table 2 - New Lake Entrance Road (MR611) Daily Traffic Flows

Site	Year				
	1990	1992	1994	1997	2000
07588 Oak Flats: East of Princes Highway	16,668	19,947	20,926	21,699	22,030

It can be seen that this road carried some 22,000 vehicles per day in 2000.

An idea of daily/seasonal variation in traffic flows on the Princes Highway can be gained from the permanent counter at the Macquarie Rivulet Bridge. The results at this counter are appended and indicate that:-

- there can be significant increase in southbound flows at the start of holiday periods and in northbound flows at the end of holiday periods
- Friday southbound flows have a higher AADT than other weekdays whilst Sunday northbound flows are similar to weekday average flows.

Quarry Operations

Survey in 1997

A survey of the traffic generation of the Quarry was undertaken over a two week period between 8 December and 20 December 1997.

The results of this survey may be summarised as follows:-

- Passenger vehicles[1] accounted for 60% of all quarry vehicle trips during the week. Quarry/heavy vehicles accounted for 34% of all trips. In real terms, this equates to 372 passenger trips and 189 heavy vehicle trips per week day.
- Peak vehicle movements associated with the quarry were between 6.00am-8.00am and 4.00pm-6.00pm for passenger vehicle arrivals and departures respectively.
- Peak hour heavy vehicle movements took place between 6.00am-8.00am for departures whilst arrivals were consistent for a period between 11.00am-3.00pm.

Survey in 2001

An automatic counter was located on the Quarry access road for one week (from 18 March 2001).

The detailed results are appended. Overall the survey of the access road showed:-

- an average weekday flow of 549 vehicles southbound and 513 vehicles northbound, a two-way total of 1060 vehicles
- week day flows ranged between 839 and 1368 (two-way) vehicles
- peak entry flow was either 6-7am or 7-8am with some 50 to 70 vehicles/hour
- peak exit flow was 4-5pm with 50 to 60 vehicles per hour
- some 40% of daily vehicles are 'light vehicles' such as cars and some 60% heavy vehicles. Heavy vehicles include vans and light trucks up to articulated vehicles.

Cleary Bros carried out a detailed survey of the number of vehicles generated by the Quarry, workshop, concrete, plant and 'other' as shown in Table 3 (for Thursday 22 March 2001).

[1] Differences in percentages likely to be the result of differences in vehicle definitions

Table 3 – Cleary Bros Survey 22/3/01 (weather fine)

	Quarry	Workshop	Concrete	Plant	Other	Total
6am	18	3	4	0	58	83
7am	29	1	5	1	23	59
8am	18	3	7	1	24	53
9am	20	0	3	2	20	45
10am	28	1	5	1	23	58
11am	26	0	2	1	22	51
12noon	20	2	7	0	10	39
1pm	25	3	8	1	13	50
2pm	21	2	2	1	27	53
3pm	26	2	4	1	27	60
4pm	18	2	2	1	47	70
5pm	2	1	2	0	31	36
Total	251	20	51	10	325	657

It can be seen that 'quarry' and 'other' were the two main generators of traffic of these vehicle trips 64% were reported as being to/from the east and 36% to/from the west.

The time variation of vehicle trips to/from the access directions (for the Thursday) is shown in Figure 4 and Table 4.

Table 4 – Vehicle Trip Directions (Thursday)

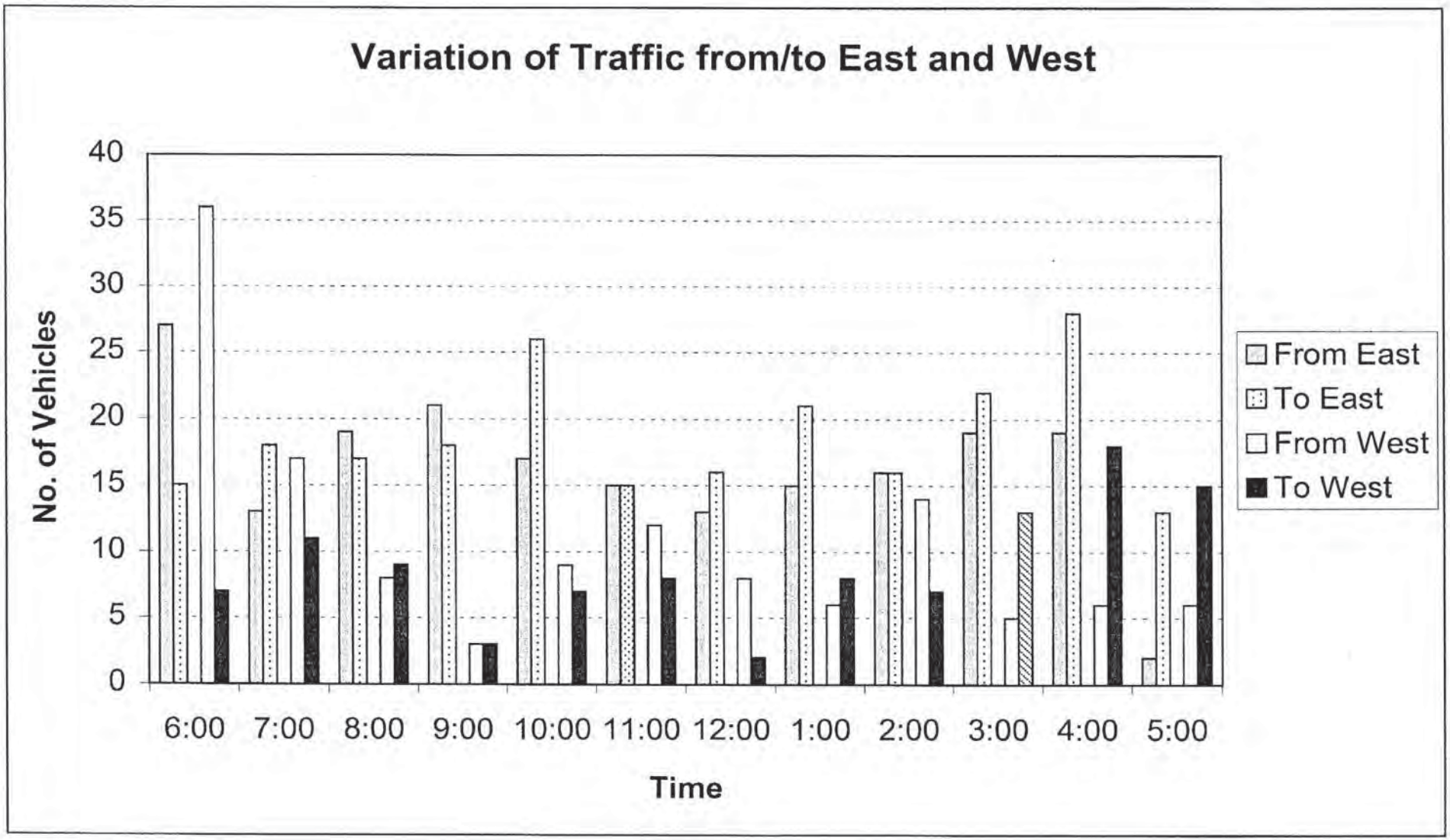
Hour Commencing	From East	To East	Total	From West	To West	Total
6	27	15	42	36	7	43
7	13	18	31	17	11	28
8	19	17	36	8	9	17
9	21	18	39	3	3	6
10	17	26	43	9	7	16
11	15	15	30	12	8	20
12	13	16	29	8	2	10
13	15	21	36	6	8	14
14	16	16	32	14	7	21
15	19	22	41	5	13	18
16	19	28	47	6	18	24
17	2	13	15	6	15	21
			421 (64%)			238 (37%)
TOTAL			659			

The current operation of the quarry with respect to quarry generated traffic has not changed significantly since the 2001 traffic surveys. Therefore the survey results are to be representative of existing quarry operations.

A traffic assessment has been undertaken by Connell Wagner (2003) which considered the peak period operation of the Link Road and Quarry Access road intersection.

The intersection analysis included existing Quarry generated traffic and predicted through traffic volumes on the Link Road. Link Road volumes assumed the completion link between Princes Highway and Terry Street (ie. 11,000 vehicles per day).

The results of the intersection analysis are presented in Table 5.



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File: 001377d03 Date: 31/7/01

Figure 4

Table 5 – Quarry Access Road Roundabout - Intersection Performance

Intersection Approach	AM Peak Hour		AM Peak Hour	
	Average Delay (sec/veh)	Level Of Service	Average Delay (sec/veh)	Level Of Service
Link Rd – Eastbound	12.0	A	12.1	A
Link Rd – Westbound	11.9	A	11.8	A
Quarry Access Rd – Northbound	19.0	B	18.5	B
Quarry Access Rd - Southbound	17.6	B	19.6	B

Source: Connell Wagner (2003)

The results of the intersection analysis indicate that with the existing Quarry traffic generation, the Quarry access road intersection will operate satisfactorily with acceptable delays and spare intersection capacity with the Link Road constructed through to Terry Street.

It is noted that the current traffic flows along the Link Road (Stage 1) are approximately 5,500 vehicles per day. This is approximately half of the through traffic flows used in the traffic analysis presented in Table 5. Therefore for Stage 1 flows, the Quarry access road intersection will operate with less delay and greater spare capacity than indicated in Table 5.

3. Implications of the Proposal

The Proposal

The proposal is to continue the existing Quarry processes on the site by making use of a new parcel of land (situated to the south east of the current operations).

The proposal is thus a continuation of the existing pattern of traffic generation associated with product removal from the site. Apart from market fluctuations and natural growth there are no planned expansion and / or increased production from the existing infrastructure.

Progressive backfilling of the quarry is proposed to occur to agreed levels. Traffic associated with backfilling would be additional to existing Quarry traffic generation as backfilling does not currently occur on the site.

Backfilling operations would be undertaken periodically as opportunities arise. Therefore, traffic generated by backfilling operations would be periodic.

As discussed in Chapter 2 of this report, the traffic currently generated on a daily basis by the Quarry varies significantly as a result of market fluctuations.

Traffic generated by backfilling operations is not expected to significantly change the current peak daily traffic generation of the Quarry as used in the Connell Wagner traffic assessment (see Table 5).

Traffic Effects

Traffic generation of the proposed Quarry extension proposal will not significantly change to the existing pattern of daily/seasonal generation of the Quarry site (as described in Chapter 2) which is satisfactorily accepted by the existing surrounding road network.

The recently improved access to and from the Quarry has increased the potential capacity of the road network to accommodate future quarry traffic and general traffic growth.

The RTA has designed the intersection of the Quarry access road with the Link Road mindful of the truck activity generated by the Quarry.

4. Summary and Conclusions

The existing Quarry operation generates some 1,000 vehicle trips (in plus out) per day.

Peak entry flow is some 50 to 70 vehicles per hour at around 7am and peak exit flow is some 50 to 60 vehicles per hour at around 4-5pm.

Some 40% of daily vehicles are 'light' (cars) and 60% 'heavy' (trucks). Some 60% of daily vehicle trips are to/from the east and some 40% to/from the west.

A new Link Road has been constructed from the Princes Highway to Croome Road (Stage 1) and includes a large roundabout controlled intersection with the Quarry access road. The Link Road will eventually be extended to Terry Street (Jamberoo Road).

Prior to the opening of the Link Road, access to the Quarry access was via a priority controlled intersection on the Princess Highway. As a result of increasing local and regional traffic flows, Quarry traffic was experiencing increasing delays at this intersection. The existing access arrangements via the Link Road are a significant improvement on previous access arrangements.

The proposal is to continue the existing processes on the site making use of a new parcel of land. Apart from market fluctuations and natural growth no expansion in production is planned.

Backfilling to agreed levels will generate additional traffic, as backfilling is currently not undertaken. However, additional backfilling traffic is not expected to change the current peak levels of Quarry related traffic generation.

The traffic analysis indicates that the recent road improvements have increased the capacity of the road network surrounding the Quarry. These improvements would be sufficient to adequately accommodate traffic generated by the proposed extension of the Quarry.

Furthermore, the recent construction of the Link Road and Quarry Road access removes the need for Quarry traffic to travel through residential areas of Albion Park Rail, thus providing residential amenity benefits.

Appendix A - RTA Counts

STATE HIGHWAY NO.1 - PRINCES HIGHWAY (Continued)

SHELLHARBOUR LGA

STATION	LOCATION	MAP	Km	1986 AADT	1988 AADT	1990 AADT	1992 AADT	1994 AADT	1997 AADT	2000 AADT
V07.035	ALBION PARK-AT MACQUARIE RIVULET BR	E	100.3	20322	--	31230*	33808*	37781V	40752V	44635V
07.037	ALBION PARK-S OF SH25,ILLAWARRA HWY	E	100.6	16424	20799	24739	32106	33644	34575	37869
07.039	OAK FLATS-N OF MR262,TONGARRA RD	G	103.2	15061	19273	22239	28908	32806	28679	30152
07.040	OAK FLATS-E OF MR262,TONGARRA RD	G	103.3	20035	25504	31384	33443	42204	37472	40689
07.041	DUNMORE-0.8KM N OF MR522,SHELLHBR RD	G	109.1	10371	14167	15739	17449	18992	19995	20928
07.042	DUNMORE-0.8KM S OF MR522,SHELLHBR RD	G	110.7	17968	16511	22188	25153	25118	27174	27956

KIAMA LGA

STATION	LOCATION	MAP	Km	1986 AADT	1988 AADT	1990 AADT	1992 AADT	1994 AADT	1997 AADT	2000 AADT
07.317	KIAMA-AT QUARRY RLY XING	TOWN	115.9	18159	--	22308	--	25641	26623	--
07.804	KIAMA-AT BOMBO RLY STN	TOWN	116.6	--	--	--	--	--	--	28768
07.769	KIAMA-AT SADDLEBACK MTN RD OVBR	TOWN	119.5	--	--	16000	--	13061	13483	15081
V07.800	OMEGA-0.4KM N OF ROSE VALLEY RD	54	125.0	--	11631*	12944*	14169*	14791*	15711V	17753V
07.649	OMEGA-N OF FERN ST	54	126.2	9069	--	--	--	--	--	--
07.045	GERRINGONG-W OF MR571,BELINDA ST	54	128.7	4890	--	7148	--	7724	8801	9363

SHOALHAVEN LGA

STATION	LOCATION	MAP	Km	1986 AADT	1988 AADT	1990 AADT	1992 AADT	1994 AADT	1997 AADT	2000 AADT
07.803	BERRY-N OF TANNERY RD	54	140.0	--	--	--	--	--	--	8883
07.046	BERRY-AT BROUGHTON MILL CK BR	54	141.8	5536	--	7718	--	9118	9657	--
07.047	BERRY-S OF KANGAROO VALLEY RD	54	143.4	5849	--	7213	--	9131	--	11023
07.048	BOMADERRY-N OF MR261,CAMBEWARRA RD	TOWN	155.9	6492	--	7416	--	8952	9593	9748
07.050	BOMADERRY-S OF MR261,CAMBEWARRA RD	TOWN	156.0	10456	--	13301	--	15454	17729	18104
V07.051	NOWRA-AT SHOALHAVEN RIVER BR	TOWN	158.4	32483	--	34862V	36760V	39116V	40184V	42320V
07.703	NOWRA-S OF NORTH ST	TOWN	159.6	4836	--	--	--	--	--	--
07.659	NOWRA-N OF JUNCTION ST	TOWN	158.8	21007	--	23313	--	25465	28878	28294
07.704	NOWRA-S OF WORRIGEE ST	TOWN	160.3	24854	--	26643	--	28483	--	--
07.707	NOWRA-AT BROWNS CK BR	TOWN	162.4	14365	--	19109	--	19339	21443	23144
07.052	NOWRA-6KM S OF P.O.	55	165.8	10886	--	--	--	--	--	--
V07.053	FALLS CREEK-N OF MR312,HUSKISSON RD	55	172.1	10163*	11467*	12868*	13629*	14481V	15721V	16664V
07.802	TOMERONG-N-BRAIDWOOD RD @TOMERONG CK	55	180.0	--	--	--	--	--	--	9799
07.058	WANDANDIAN-N OF SUSSEX INLET RD	55	192.6	4928	--	5816	--	6418	6213	7849
07.059	WANDANDIAN-S OF SUSSEX INLET RD	55	192.7	4303	--	--	--	--	--	--
07.060	CONJOLA-AT CONJOLA CK BR	55	206.8	3795	--	4784	--	--	5662	6021
07.650	MILTON-N OF WASON ST	55	221.6	5742	--	--	--	--	8915	--
07.368	ULLADULLA-AT MILLARDS CK BR	55	226.2	11023	--	11892	--	10993	13586	13472
*07.063	BURRILL LAKE-1.5KM S OF BR	55	232.6	3997	4227	4580	4812	5005	5240	5804
07.691	TERMEIL-1KM N OF BAWLEY POINT RD	58	245.6	3307	--	3744	--	4012	4178	4603
07.356	AT EUROBODALLA SHIRE BDY	58	263.3	2784	--	3380	--	3530	3246	3931

EUROBODALLA LGA

STATION	LOCATION	MAP	Km	1978 AADT	1982 AADT	1986 AADT	1990 AADT	1994 AADT	1997 AADT	2000 AADT
V08.052	BATEMANS BAY-N OF MR51,BRAIDWOOD RD	TOWN	274.0	3020	3810	4205	--	6892	5818V	6352V
08.003	BATEMANS BAY-AT CLYDE RIVER BR	TOWN	274.5	6050*	6410*	8312*	9935*	11204*	--	--
08.360	BATEMANS BAY-S OF CROWN ST	TOWN	276.1	--	2670	5527	5858	6508	6249	6880
08.056	MOGO-N OF NELLIGEN RD	58	282.7	2610	2970	3326	4566	5576	6455	6549
08.368	MOGO-S OF BUCKENBOWRA RD	58	0.0	--	--	--	--	--	4754	4946
08.059	MORUYA-3.2KM N OF P.O.	58	299.0	3300	4100	3409	4069	4645	4719	5011
08.123	MORUYA-AT MORUYA RIVER BR	TOWN	301.7	4680	5750	5669	6990	7679	8287	--
08.124	MORUYA-N OF CAMPBELL ST	TOWN	302.1	4860	6240	5934	8576	9896	9521	9662
08.125	MORUYA-E OF FORD ST	TOWN	302.3	4340	5580	5602	7313	7928	8882	8637
08.126	MORUYA-S OF ALBERT ST	TOWN	302.9	2810	4190	3988	5417	5893	6581	6504
08.127	BERGALIA-N OF P.O.	58	310.9	2450	2900	3183	3716	4391	4973	5147
08.129	TURLINJAH-S OF TUROSS HEAD RD	58	316.0	2020	2510	2487	--	3624	3746	3960
*08.062	BODALLA-1.6KM S OF P.O.	58	327.5	2340	2118*	2615*	2915*	3200*	3416*	3665*
08.130	NAROOMA-AT WAGONGA INLET BR	58	342.5	5540	4930	5700	6736	7473	8031	8160
08.065	AT VICTORIA CREEK BR	58	357.2	1530	1980	2031	2218	2542	3099	2884
08.334	TILBA TILBA-S OF MR272,BERMAGUI RD	58	364.3	1330	1360	1316	--	1713	1820	1773

MAIN ROAD NO.610 - WILTON-APPIN

WOLLONDILLY LGA

STATION	LOCATION	MAP	Km	1986 AADT	1988 AADT	1990 AADT	1992 AADT	1994 AADT	1997 AADT	2000 AADT
07.742	AT BROUGHTON PASS	48	3.0	2023	--	2035	--	1943	1870	1835
07.762	APPIN-S OF MR177,APPIN RD	49	8.0	2871	--	--	--	--	--	--

MAIN ROAD NO.611 - OAK FLATS-WARILLA

SHELLHARBOUR LGA

STATION	LOCATION	MAP	Km	1986 AADT	1988 AADT	1990 AADT	1992 AADT	1994 AADT	1997 AADT	2000 AADT
07.588	OAK FLATS-E OF SH1,PRINCES HWY	G	0.2	14110	13153	16668	19947	20926	21699	22030
07.633	OAK FLATS-S OF LANG ST	G	0.8	11105	--	--	--	--	--	--
07.634	BARRACK HEIGHTS-S OF HUNTER ST	E	2.0	14435	15162	18963	21185	20133	23864	25213
07.291	LAKE ILLAWARRA-W OF MR522,WINDANG RD	F	5.0	20238	19744	19725	24446	21531	22084	21883

MAIN ROAD NO.612 - PHEASANTS NEST-OAKDALE

WOLLONDILLY LGA

STATION	LOCATION	MAP	Km	1986 AADT	1988 AADT	1990 AADT	1992 AADT	1994 AADT	1997 AADT	2000 AADT
07.363	MALDON-AT NEPEAN RIVER BR	48	3.2	4084	--	4510	--	5645	6276	7074
07.404	PICTON-0.8KM S OF PRINCE ST	TOWN	8.6	4501	--	5125	--	6530	5058	7167
07.403	PICTON-E OF MR620,ARGYLE ST	TOWN	10.5	3972	--	--	--	--	--	--
07.475	PICTON-0.8KM N OF MR620,ARGYLE ST	TOWN	11.4	1443	--	1500	--	1624	--	--
07.476	0.2KM E OF BARKERS LODGE	48	18.2	518	--	1513	--	1915	1719	1174
07.472	BARKERS LODGE-0.1KM W OF THE OAKS RD	48	18.5	802	--	--	--	1497	--	--
07.471	OAKDALE-S OF MR259,CAMDEN RD	48	29.7	888	--	1111	--	--	968	896

MAIN ROAD NO.613 - PORT KEMBLA-KEMBLA GRANGE

WOLLONGONG LGA

STATION	LOCATION	MAP	Km	1986 AADT	1988 AADT	1990 AADT	1992 AADT	1994 AADT	1997 AADT	2000 AADT
07.616	WARRAWONG-W OF MR522,KING ST	F	2.5	12461	--	--	--	--	--	--
07.254	LAKE HEIGHTS-E OF LAKE HEIGHTS RD	F	4.7	9999	10173	11688	13332	12199	13621	14165
07.630	BERKELEY-E OF F6,SOUTHERN FWY	D	8.6	12397	14795	14144	14612	--	15312	16069
07.231	KEMBLA GRANGE-E OF SH1,PRINCES HWY	D	9.3	7451	9339	8208	8869	9812	10377	10319

MAIN ROAD NO.620 - YANDERRA-PRESTONS

WOLLONDILLY LGA

STATION	LOCATION	MAP	Km	1986 AADT	1988 AADT	1990 AADT	1992 AADT	1994 AADT	1997 AADT	2000 AADT
07.376	BARGO-0.8KM S OF BARGO P.O.	48	2.0	2132	--	4571	--	5190	--	--
07.374	TAHMOOR-0.8KM S OF TAHMOOR P.O.	48	9.2	5111	--	5872	--	6944	6710	10705
07.372	PICTON-N OF PRINCE ST	TOWN	16.1	6598	--	--	--	--	--	--
07.371	PICTON-S OF MR612,MENANGLE ST	TOWN	17.5	8129	--	9844	--	11970	12609	12019
07.370	PICTON-0.5KM N OF REGREME RD	TOWN	18.5	4235	--	5674	--	6409	6433	7704
V07.023	NORTH OF DOUGLAS PARK RD	48	30.0	5297*	6007*	6861*	7049*	7548*	8545*	8912V

MAIN ROAD NO.626 - NORTHERN SUBURBS DISTRIBUTOR

WOLLONGONG LGA

STATION	LOCATION	MAP	Km	1986 AADT	1988 AADT	1990 AADT	1992 AADT	1994 AADT	1997 AADT	2000 AADT
V07.801	TOWRADGI-S OF TOWRADGI RD	C	0.0	--	--	16403	18790	25722V	26788V	28453V
07.142	WOLLONGONG-S OF SH1,PRINCES HWY	C	0.1	24451	28099	29550	--	26219	21484	43108

DAILY TRAFFIC VOLUMES Year 2000

PRINCES HWY,SH1 ALBION PARK-AT MACQUARIE RIVULET BR Station No. 07.035.N

Week	Beginning	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Total	Percent
1	3/01/00	20982 p	21694	21532	22970	24349	20911	24298	156736	1.9473
2	10/01/00	22240	21462	21913	22617	23731	21542	25886	159391	1.9803
3	17/01/00	21955	21769	22267	22834	23967	21687	25213	159692	1.9840
4	24/01/00	23017	23620	19031 p	23766	24142	20056	22877	156509	1.9445
5	31/01/00	22066	21472	21874	22578	23491	20017	23763	155261	1.9290
6	7/02/00	22250	21806	22557	23237	23623	19141	22842	155456	1.9314
7	14/02/00	22307	22173	22436	23354	24348	20661	26004	161283	2.0038
8	21/02/00	22804	22270	22452	23819	24612	22524	24408	162889	2.0237
9	28/02/00	23277	22479	22716	23424	24538	21294	24395	162123	2.0142
10	6/03/00	23339	22418	21000	21720	23346	18795	22224	152842	1.8989
11	13/03/00	21897	22314	22579	23114	24164	20731	24308	159107	1.9767
12	20/03/00	21262	19980	20784	22320	23067	19325	23032	149770	1.8607
13	27/03/00	22259	22236	22322	23504	24204	20614	22590	157729	1.9596
14	3/04/00	22509	22256	21614	22498	23613	20505	23214	156209	1.9407
15	10/04/00	22268	22224	22617	23744	24265	21344	21682	158144	1.9648
16	17/04/00	23018	23063	23847	23461	13647 p	18323	21233	146592	1.8213
17	24/04/00	26441 p	23390 p	25514	23224	24868	22292	21469	167198	2.0773
18	1/05/00	22317	21559	21160	21548	22622	19217	21442	149865	1.8619
19	8/05/00	22065	22062	22175	22814	23839	21263	23623	157841	1.9610
20	15/05/00	21911	21955	22732	22654	23635	20486	22251	155624	1.9335
21	22/05/00	22187	21888	21772	22606	23711	20298	19530	151992	1.8884
22	29/05/00	21493	21500	21673	22504	22950	19803	21246	151169	1.8781
23	5/06/00	21431	21443	22144	22719	22770	18960	18186	147653	1.8344
24	12/06/00	22932 p	23792	22122	22731	23652	20331	20110	155670	1.9340
25	19/06/00	21231	21484	21774	22669	23388	20810	21283	152639	1.8964
26	26/06/00	21598	21531	22073	22395	21731	17975	19378	146681	1.8224
27	3/07/00	20061	19981	20995	21901	23081	19874	22839	148732	1.8478
28	10/07/00	21772	21986	22624	22987	23596	20276	21793	155034	1.9261
29	17/07/00	21312	21195	21426	22428	22906	19935	21205	150407	1.8687
30	24/07/00	21363	21696	22027	21923	23102	20493	21506	152110	1.8898
31	31/07/00	21787	21372	21475	22475	23361	19775	21624	151869	1.8868
32	7/08/00	22201	21646	21795	22353	22988	20217	20243	151443	1.8815
33	14/08/00	21577	21245	21982	22430	23478	19485	21169	151366	1.8806
34	21/08/00	21469	21793	21684	22217	23278	19470	20030	149941	1.8629
35	28/08/00	21294	21651	21853	22543	23651	19963	23097	154052	1.9139
36	4/09/00	21873	21771	21915	22451	23418	20002	22612	154042	1.9138
37	11/09/00	23864	21180	21739	22396	21967	17454	20067	148667	1.8470
38	18/09/00	20948	21150	21751	22519	23227	19557	21255	150407	1.8687
39	25/09/00	21343	21015	21554	21790	22377	18572	19670	146321	1.8179
40	2/10/00	22251 p	22814	21886	22725	23497	19579	21938	154690	1.9219
41	9/10/00	21162	21768	21913	22596	22834	19104	21971	151348	1.8804
42	16/10/00	22582	21650	21910	22016	23348	19375	23601	154482	1.9193
43	23/10/00	22237	21876	22583	22872	24511	19765	23062	156906	1.9494
44	30/10/00	22520	22161	22607	22886	23721	19748	22962	156605	1.9457
45	6/11/00	22243	20806	22399	23609	24538	20165	23502	157262	1.9538
46	13/11/00	22233	18652	20025	21769	22767	18680	19913	144039	1.7895
47	20/11/00	22132	21423	22374	23652	24595	20760	24927	159863	1.9861
48	27/11/00	23203	22887	22861	23609	24290	20964	24961	162775	2.0223
49	4/12/00	22855	23175	22986	23781	25232	21661	24187	163877	2.0360
50	11/12/00	23757	23318	23760	24485	25366	21568	22869	165123	2.0515
51	18/12/00	23634	23738	24228	24912	23778	19981	19116	159387	1.9802
52	25/12/00	20215 p	22131 p	21372	22050	23632	22999	19711	152110	1.8898
Annual Averages:		22130	21848	22145	22812	23631	20160	22237	154787	

AADT	AAWT	AAWE	AAPH
22112	22523	21199	21224

p indicates Public Holiday

DAILY TRAFFIC VOLUMES Year 2000

PRINCES HWY,SH1 ALBION PARK-AT MACQUARIE RIVULET BR Station No. 07.035.S

Week	Beginning	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Total	Percent
1	3/01/00	18952 p	21704	22086	22644	25363	21239	19107	151095	1.8430
2	10/01/00	22486	21880	22277	22454	26352	23751	20527	159727	1.9483
3	17/01/00	21505	22258	22589	23549	27644	23634	19421	160600	1.9589
4	24/01/00	22533	24223	17793 p	23434	27189	21316	17313	153801	1.8760
5	31/01/00	21749	22025	22333	23436	27886	22969	18382	158780	1.9367
6	7/02/00	22185	23008	22879	23897	28275	22136	17276	159656	1.9474
7	14/02/00	21750	22572	23030	23833	29211	23651	19708	163755	1.9974
8	21/02/00	22453	22612	22948	24148	29088	23632	18332	163213	1.9908
9	28/02/00	22559	22941	23353	24288	29345	23446	19071	165003	2.0126
10	6/03/00	23164	22985	21532	22387	27189	20862	18024	156143	1.9046
11	13/03/00	21568	22651	23233	23673	28254	23549	19159	162087	1.9771
12	20/03/00	20843	19970	20912	22691	26059	21274	19241	150990	1.8417
13	27/03/00	22056	22684	22749	23940	28112	23273	18339	161153	1.9657
14	3/04/00	22227	22726	21992	22849	27232	22645	19103	158774	1.9366
15	10/04/00	21988	22726	23154	24242	26885	24168	19902	163065	1.9890
16	17/04/00	23810	24681	26038	32635	26386 p	22798	20827	177175	2.1611
17	24/04/00	18514 p	12832 p	21464	21768	24743	21724	18452	139497	1.7015
18	1/05/00	22581	21513	21587	21847	24654	21015	18551	151748	1.8509
19	8/05/00	22002	22639	22364	23474	25971	22706	20806	159962	1.9511
20	15/05/00	22037	22626	23188	23067	27110	22668	18553	159249	1.9424
21	22/05/00	22251	22392	22411	23322	26494	22160	16397	155427	1.8958
22	29/05/00	21553	21961	22355	23040	25172	21742	18712	154535	1.8849
23	5/06/00	21283	21916	22289	23886	28683	25335	17417	160809	1.9615
24	12/06/00	14019 p	22402	22360	23004	25687	21789	18108	147369	1.7975
25	19/06/00	21339	21900	22504	23154	25770	22359	18728	155754	1.8998
26	26/06/00	21700	22020	22677	22909	23702	20085	17587	150680	1.8379
27	3/07/00	20562	20848	21882	22757	26063	22473	18966	153551	1.8729
28	10/07/00	21865	22222	23099	23239	25510	21518	19037	156490	1.9088
29	17/07/00	20970	21518	21954	22975	25363	21823	18427	153030	1.8666
30	24/07/00	21362	22178	22386	22637	25833	22175	18553	155124	1.8921
31	31/07/00	21542	21836	21959	23057	26679	22323	18062	155458	1.8962
32	7/08/00	21603	21906	22250	23127	26028	21994	16719	153627	1.8739
33	14/08/00	21401	21750	22499	22927	26181	21511	18109	154378	1.8830
34	21/08/00	21112	22205	22057	22766	26148	21457	16684	152429	1.8592
35	28/08/00	21136	21875	22159	23068	26421	21926	19721	156306	1.9065
36	4/09/00	22001	22370	22628	23176	27304	23160	19524	160163	1.9536
37	11/09/00	21360	21506	21909	22953	24039	20236	17851	149854	1.8278
38	18/09/00	21669	21374	22215	22192	25078	20768	18693	151989	1.8539
39	25/09/00	21619	21310	21735	22524	27512	22888	16853	154441	1.8838
40	2/10/00	17108 p	22006	22304	23097	26846	21935	17370	150666	1.8377
41	9/10/00	20694	22256	22609	23392	26406	21085	18129	154571	1.8854
42	16/10/00	22347	22118	21777	22705	27328	21673	19207	157155	1.9169
43	23/10/00	22026	22370	22991	23616	28273	22225	18835	160336	1.9557
44	30/10/00	22823	22975	22948	23789	27995	21770	18435	160735	1.9606
45	6/11/00	21984	21142	22989	24493	28687	22625	18385	160305	1.9553
46	13/11/00	21998	18720	19610	21349	25966	20697	16608	144948	1.7680
47	20/11/00	21947	22020	22860	24278	28555	23290	20035	162985	1.9880
48	27/11/00	22649	23057	23248	23941	27786	23781	20762	165224	2.0153
49	4/12/00	22433	23533	23726	24194	28345	24107	20627	166965	2.0366
50	11/12/00	23682	23956	24096	24764	27694	24063	20404	168659	2.0572
51	18/12/00	23884	24305	24967	25873	26739	25276	21614	172658	2.1060
52	25/12/00	24636 p	26444 p	26219	23501	24994	23315	17216	166325	2.0287
Annual Averages:		21964	22247	22615	23461	26781	22423	18690	157662	

AADT	AAWT	AAWE	AAPH
22523	23442	20557	19632

p indicates Public Holiday

Appendix B - Automatic Counter Results

Traffic Count Summary Report

Count Number	2931 Ref : MWT
Street	QUARRY ACCESS ROAD, OAK FLATS : From PRINCES HIGHWAY to QUARRY SITE : SOUTH BOUND
Location	Cleary Bros. Quarry Access Road , just south of Princes Highway, On Tree near Cyclone Fence Carriageway

TOTAL COUNT MATRIX

Start Date	18-MAR-01
Start Time	100
Duration	7 DAYS
Interval	1 HOUR

Weekly 50th Percentile Speed	32
Weekly 85th Percentile Speed	50
Five Day AADT	549
Seven Day AADT	427

	MON	TUE	WED	THU	FRI	SAT	SUN	5 Day Total	5 Day Average	7 Day Total	7 Day Average
Midnight - 1am	0	1	0	1	1	0	1	3	1	4	1
1am - 2am	0	0	0	0	0	1	0	0	0	1	0
2am - 3am	0	0	2	0	0	0	0	2	0	2	0
3am - 4am	5	1	0	0	0	9	0	6	1	15	2
4am - 5am	17	7	7	4	5	9	1	40	8	50	7
5am - 6am	17	22	18	15	29	11	0	101	20	112	16
6am - 7am	49	67	55	69	61	49	1	301	60	351	50
7am - 8am	60	72	60	35	40	16	2	267	53	285	41
8am - 9am	64	64	56	32	39	16	3	255	51	274	39
9am - 10am	43	52	45	29	27	16	5	196	39	217	31
10am - 11am	49	63	59	34	31	21	3	236	47	260	37
11am - Midday	46	62	52	32	29	14	0	221	44	235	34
Midday - 1pm	42	52	36	28	25	10	4	183	37	197	28
1pm - 2pm	43	38	41	30	28	16	0	180	36	196	28
2pm - 3pm	50	66	35	36	22	18	0	209	42	227	32
3pm - 4pm	63	54	38	30	27	3	4	212	42	219	31
4pm - 5pm	54	57	31	29	34	3	2	205	41	210	30
5pm - 6pm	9	27	11	13	15	3	1	75	15	79	11
6pm - 7pm	8	7	6	3	6	2	1	30	6	33	5
7pm - 8pm	2	2	5	4	2	0	0	15	3	15	2
8pm - 9pm	0	1	0	1	1	0	0	3	1	3	0
9pm - 10pm	0	1	0	0	0	0	0	1	0	1	0
10pm - 11pm	0	0	0	0	1	0	0	1	0	1	0
11pm - Midnight	0	1	0	0	1	0	0	2	0	2	0
Total	621	717	557	425	424	217	28	2744	548	2989	427

Data displayed has been compiled from pneumatic traffic count processes and is subject to the documented limitations

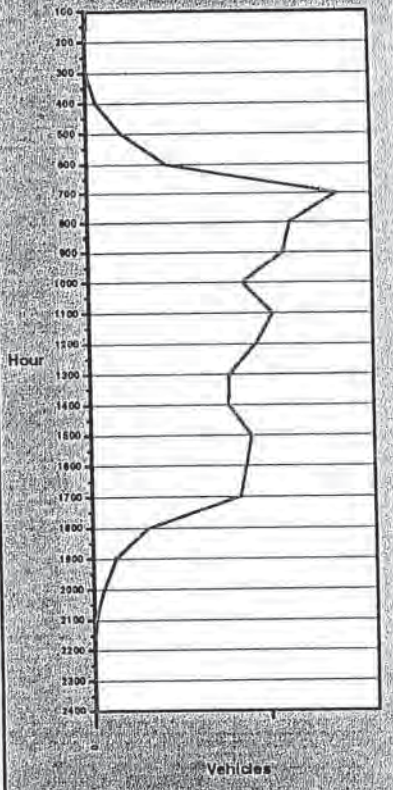
Hourly Classification Summary

Count Number	**2931** Ref : **MWT**
Street	**QUARRY ACCESS ROAD, OAK FLATS : From PRINCES HIGHWAY to QUARRY SITE : SOUTH BOUND**
Location	Cleary Bros. Quarry Access Road , just south of Princes Highway, On Tree near Cyclone Fence — Carriageway

Start Date	18-MAR-01
Start Time	100
Duration	7 DAYS
Interval	1 HOUR

Weekly 50th Percentile Speed	**32**
Weekly 85th Percentile Speed	**50**
Five Day AADT	**549**
Seven Day AADT	**427**

Time	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Midnight - 1am	4	0	0	0	0	0	0	0	0	0	0	0	0	4
1am - 2am	1	0	0	0	0	0	0	0	0	0	0	0	0	1
2am - 3am	1	0	1	0	0	0	0	0	0	0	0	0	0	2
3am - 4am	9	0	6	0	0	0	0	0	0	0	0	0	0	15
4am - 5am	43	0	6	1	0	0	0	0	0	0	0	0	0	50
5am - 6am	89	1	13	7	0	0	0	0	2	0	0	0	0	112
6am - 7am	237	2	45	26	3	1	0	4	18	4	11	0	0	351
7am - 8am	110	0	35	45	9	0	0	12	49	9	16	0	0	285
8am - 9am	87	0	38	55	7	1	1	10	46	13	16	0	0	274
9am - 10am	67	1	39	34	3	0	0	10	42	7	14	0	0	217
10am - 11am	73	0	47	47	8	1	1	10	48	13	12	0	0	260
11am - Midday	70	1	37	45	2	1	0	11	43	10	15	0	0	235
Midday - 1pm	58	3	23	43	4	0	0	11	39	7	9	0	0	197
1pm - 2pm	57	0	25	47	4	0	1	6	38	6	12	0	0	196
2pm - 3pm	61	0	35	44	4	1	0	13	46	11	12	0	0	227
3pm - 4pm	55	0	32	44	6	0	4	13	42	10	13	0	0	219
4pm - 5pm	62	2	29	46	4	1	0	13	35	11	7	0	0	210
5pm - 6pm	48	0	7	11	0	0	0	3	6	3	1	0	0	79
6pm - 7pm	21	0	5	4	2	0	0	0	1	0	0	0	0	33
7pm - 8pm	10	0	4	0	1	0	0	0	0	0	0	0	0	15
8pm - 9pm	2	0	1	0	0	0	0	0	0	0	0	0	0	3
9pm - 10pm	0	0	1	0	0	0	0	0	0	0	0	0	0	1
10pm - 11pm	1	0	0	0	0	0	0	0	0	0	0	0	0	1
11pm - Midnight	2	0	0	0	0	0	0	0	0	0	0	0	0	2
Total	1168	10	429	499	57	6	7	116	455	104	138	0	0	2989
% of Total	39		14	17	2			4	15	3	5			



Data displayed has been compiled from pneumatic traffic count processes and is subject to the documented limitations

Traffic Count Summary Report

Count Number	**2931**	Ref : **MWT**	
Street	**QUARRY ACCESS ROAD, OAK FLATS : From QUARRY SITE to PRINCES HIGHWAY : NORTH BOUND**		
Location	Cleary Bros. Quarry Access Road , just south of Princes Highway, On Tree near Cyclone Fence		Carriageway

TOTAL COUNT MATRIX

Start Date	18-MAR-01
Start Time	100
Duration	7 DAYS
Interval	1 HOUR

Weekly 50th Percentile Speed	32
Weekly 85th Percentile Speed	51
Five Day AADT	513
Seven Day AADT	401

	MON	TUE	WED	THU	FRI	SAT	SUN	5 Day Total	5 Day Average	7 Day Total	7 Day Average
Midnight - 1am	0	3	0	2	4	0	0	9	2	9	1
1am - 2am	0	0	0	2	0	1	1	2	0	4	1
2am - 3am	0	0	1	0	0	0	0	1	0	1	0
3am - 4am	1	0	0	0	0	5	0	1	0	6	1
4am - 5am	10	3	3	2	2	6	0	20	4	26	4
5am - 6am	5	12	9	8	16	7	1	50	10	58	8
6am - 7am	25	31	24	24	30	11	1	134	27	146	21
7am - 8am	43	56	47	31	31	14	1	208	42	223	32
8am - 9am	56	54	47	31	30	13	0	218	44	231	33
9am - 10am	36	48	43	26	29	18	4	182	36	204	29
10am - 11am	54	60	49	33	30	17	4	226	45	247	35
11am - Midday	40	60	47	34	36	17	3	217	43	237	34
Midday - 1pm	33	43	35	24	29	15	4	164	33	183	26
1pm - 2pm	33	42	37	32	28	22	2	172	34	196	28
2pm - 3pm	44	44	37	25	24	41	1	174	35	216	31
3pm - 4pm	58	55	43	44	34	5	2	234	47	241	34
4pm - 5pm	58	65	39	50	54	5	1	266	53	272	39
5pm - 6pm	32	46	31	28	31	4	3	168	34	175	25
6pm - 7pm	14	17	8	11	17	8	5	67	13	80	11
7pm - 8pm	4	3	9	6	10	1	0	32	6	33	5
8pm - 9pm	1	0	3	1	1	0	0	6	1	6	1
9pm - 10pm	0	2	0	0	0	0	0	2	0	2	0
10pm - 11pm	0	0	0	0	1	0	0	1	0	1	0
11pm - Midnight	1	4	0	0	4	0	0	9	2	9	1
Total	**548**	**648**	**512**	**414**	**441**	**210**	**33**	**2563**	**512**	**2806**	**400**

Data displayed has been compiled from pneumatic traffic count processes and is subject to the documented limitations

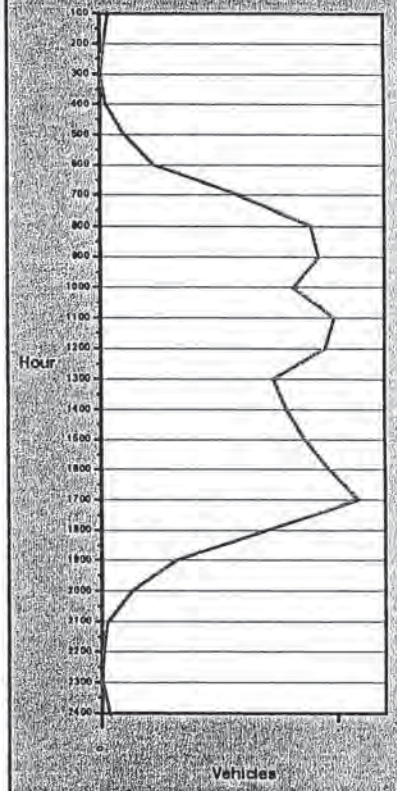
Hourly Classification Summary

Count Number	**2931** Ref : **MWT**
Street	**QUARRY ACCESS ROAD, OAK FLATS : From QUARRY SITE to PRINCES HIGHWAY : NORTH BOUND**
Location	Cleary Bros. Quarry Access Road , just south of Princes Highway, On Tree near Cyclone Fence Carriageway

Start Date	18-MAR-01
Start Time	100
Duration	7 DAYS
Interval	1 HOUR

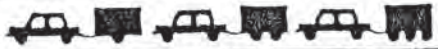
Weekly 50th Percentile Speed	**32**
Weekly 85th Percentile Speed	**51**
Five Day AADT	**513**
Seven Day AADT	**401**

Time	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Midnight - 1am	9	0	0	0	0	0	0	0	0	0	0	0	0	9
1am - 2am	4	0	0	0	0	0	0	0	0	0	0	0	0	4
2am - 3am	0	0	0	0	0	0	0	0	1	0	0	0	0	1
3am - 4am	1	0	0	0	0	0	0	0	3	1	1	0	0	6
4am - 5am	4	0	5	2	0	0	0	2	7	5	1	0	0	26
5am - 6am	10	0	4	10	4	0	0	1	18	8	3	0	0	58
6am - 7am	40	0	15	34	6	0	0	8	33	6	4	0	0	146
7am - 8am	49	0	26	55	11	0	0	10	51	4	17	0	0	223
8am - 9am	63	1	28	38	5	1	0	5	58	8	24	0	0	231
9am - 10am	64	1	30	34	4	0	1	3	40	9	18	0	0	204
10am - 11am	71	0	37	44	8	0	0	6	56	4	21	0	0	247
11am - Midday	85	3	24	32	8	0	0	6	52	8	19	0	0	237
Midday - 1pm	60	1	22	25	2	0	0	5	44	10	14	0	0	183
1pm - 2pm	68	0	23	35	5	0	0	8	38	4	15	0	0	196
2pm - 3pm	78	0	24	31	7	0	0	4	49	10	13	0	0	216
3pm - 4pm	120	1	20	27	5	0	0	7	42	5	14	0	0	241
4pm - 5pm	171	0	35	19	0	1	0	2	30	4	10	0	0	272
5pm - 6pm	146	1	18	2	0	0	0	0	4	0	4	0	0	175
6pm - 7pm	73	0	5	1	0	0	0	0	1	0	0	0	0	80
7pm - 8pm	24	0	8	1	0	0	0	0	0	0	0	0	0	33
8pm - 9pm	6	0	0	0	0	0	0	0	0	0	0	0	0	6
9pm - 10pm	1	0	1	0	0	0	0	0	0	0	0	0	0	2
10pm - 11pm	1	0	0	0	0	0	0	0	0	0	0	0	0	1
11pm - Midnight	9	0	0	0	0	0	0	0	0	0	0	0	0	9
Total	1157	8	325	390	65	2	1	67	527	86	178	0	0	**2806**
% of Total	41		12	14	2			2	19	3	6			



Data displayed has been compiled from pneumatic traffic count processes and is subject to the documented limitations

Golden River Vehicle Classification Scheme GRCS-10 (AUSTROADS 1994 Class Scheme)

LENGTH (indicative)	CLASS	VEHICLE TYPE	AXLES AND AXLE GROUPS		AUSTROADS CLASSIFICATION
			AXLES	GROUPS	PARAMETERS
		LIGHT VEHICLES			
SHORT Up to 5.5m	1	SHORT VEHICLE SEDAN WAGON, 4WD, UTILITY, LIGHT VAN, BICYCLE, MOTORCYCLE etc 	2	1 or 2	d(1) < = 3.2m and Axles = 2
MEDIUM 5.5m to 14.5m	2	SHORT VEHICLE TOWING eg TRAILER, CARAVAN, BOAT etc 	3, 4, or 5	3	Groups = 3 d(1) > = 2.1m, d(1) < = 3.2m d(2) > = 2.1 and Axles = 3, 4, or 5
		HEAVY VEHICLES			
	3	TWO AXLE TRUCK OR BUS 	2	2	d (1) > 3.2m and Axles = 2
	4	THREE AXLE TRUCK OR BUS 	3	2	Axles = 3 and Groups = 2
	5	FOUR AXLE TRUCK 	>3	2	Axles > 3 and Groups = 2
LONG 11.5m to 19.0m	6	THREE AXLE ARTICULATED VEHICLE RIGID VEHICLE AND TRAILER, OR 3 AXLE ARTICULATED VEHICLE 	3	3	d(1) > 3.2m, Axles =3 and Groups = 3
	7	FOUR AXLE ARTICULATED VEHICLE RIGID VEHICLE AND TRAILER OR 4 AXLE ARTICULATED VEHICLE 	4	>2	d(2) < 2.1m or d(1) < 2.1m or d(1) > 3.2m Axles = 4 and Groups > 2
	8	FIVE AXLE ARTICULATED VEHICLE RIGID VEHICLE AND TRAILER, OR 5 AXLE ARTICULATED VEHICLE 	5	>2	d(2) < 2.1m or d(1) < 2.1m or d(1) > 3.2m Axles = 5 and Groups > 2
	9	SIX AXLE ARTICULATED VEHICLE RIGID VEHICLE AND TRAILER, OR 6 (OR MORE) AXLE ARTICULATED VEHICLE 	6 >6	>2 3	Axles = 6 and Groups > 2, or Axles > 6 and Groups = 3
MEDIUM COMBINATION VEHICLE 17.5m to 36.5m	10	B-DOUBLE B DOUBLE OR HEAVY TRUCK AND TRAILER 	>6	4	Groups = 4 and Axles > 6
	11	DOUBLE ROAD TRAIN DOUBLE ROAD TRAIN, OR HEAVY TRUCK WITH TWO TRAILERS 	>6	5 or 6	Groups = 5 or 6 and Axles > 6
LONG COMBINATION VEHICLE Over 33.0m	12	TRIPLE ROAD TRAIN TRIPLE ROAD TRAIN, OR HEAVY TRUCK AND THREE TRAILERS 	>6	>6	Groups > 6 and Axles > 6
-	13	ALL OTHER VEHICLES	-	-	-

DEFINITIONS: Group - axle group where the axles are less than 2.1m apart
Groups - number of axle groups
Axles - number of axles on the vehicle (maximum axle spacing of 10m)
d(1) - distance between first and second axle of vehicle
d(2) - distance between second and third axle of vehicle

STRATFORD TRAFFIC PTY LTD

Appendix O

FLORA AND FAUNA ASSESSMENT

FLORA AND FAUNA ASSESSMENT
PROPOSED EXTENSION TO
CLEARY BROS (BOMBO)
ALBION PARK QUARRY
CITY OF SHELLHARBOUR

a report prepared by

KEVIN MILLS & ASSOCIATES
ECOLOGICAL AND ENVIRONMENTAL CONSULTANTS

May 2003
01/55/2

FLORA AND FAUNA ASSESSMENT
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KEVIN MILLS & ASSOCIATES
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for

CLEARY BROS (BOMBO) PTY LTD
39 FIVE ISLANDS ROAD
PORT KEMBLA NSW 2505

May 2003
01/55/2

Kevin Mills & Associates Pty Limited ACN 003 441 610
as trustee for Kevin Mills & Associates Trust

FLORA AND FAUNA ASSESSMENT
PROPOSED EXTENSION TO
CLEARY BROS (BOMBO) ALBION PARK QUARRY
CITY OF SHELLHARBOUR

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1 INTRODUCTION

1.1 BACKGROUND

This report was commissioned by Cleary Bros (Bombo) Pty Ltd who are preparing a Development Application for a new quarry adjacent to their Albion Park operations. The company intends to submit a Development Application to extract Bumbo Latite rock, commonly referred to as "basalt" or "blue metal", from the site. Full details of the proposal are provided in the Development Application, including an Environmental Impact Statement, being prepared by Perram & Partners Pty limited, Planning and Environmental Consultants.

This report was prepared by Kevin Mills & Associates Pty Limited, ecological and environmental consultants, and builds on an earlier report prepared by this company and Mr. Gary Leonard (Kevin Mills & Associates 1998).

1.2 THE SCOPE OF THIS STUDY

The scope of this report is to undertake a thorough flora and fauna study of the site to meet the requirements of the *Environmental Planning and Assessment Act 1979* as they relate to the preparation of Environmental Impact Statements.

Most particularly, this report addresses the requirements of the *Threatened Species Conservation Act 1995*, by applying the "eight part test" of significance, to assess the potential impact of the proposed quarry development on the threatened species, endangered populations and endangered ecological communities listed under the Act. The report describes the vegetation and fauna habitats on the site, provides lists of the species observed, discusses the threatened species known to occur in the local area and assesses their potential to occur on the property. The report also describes the potential impact of the proposed quarry on flora and fauna, in general.

This report contains:
i. a description of the vegetation communities and fauna habitats in the study area;
ii. lists of the flora and fauna observed;
iii. a discussion of the threatened species known to occur in the vicinity of the study area;
iv. an assessment of the potential impact of the proposed development on the ecological environment, including an "eight-part test" assessment of the potential impact on the threatened species, endangered populations and endangered ecological communities listed under the *Threatened Species Conservation Act 1995*;
v. an assessment under *State Environmental Planning Policy No.44 - Koala Habitat Protection*;
vi. an assessment under the *Native Vegetation Conservation Act 1997;*

vii. an assessment under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*; and
viii. recommendations to mitigate the potential impact of the development on flora and fauna.

1.3 THE STUDY AREA

The study area is known as Lot 1 DP 858245 and Lot 7 DP 3709 at Albion Park in the City of Shellharbour. Referred to as the Cody's and Lindsay's Lane properties, the land has a total area of 83 hectares and adjoins the southern and southeastern boundaries of Cleary Bros' existing Albion Park quarry operations. The proposed quarry does not cover the whole of this land, as shown in Figure 1. The study area includes the 400 metre long proposed access road across the neighbouring CSR land, to the west of the quarry site, Lot 2 DP 858245.

The proposed area for the quarry is mostly cleared, although large areas of native vegetation, mainly rainforest, are still present on other parts of the properties. Most of the bushland occurs on the steep slopes and along gullies, while the gentler slopes and flat land have been almost totally cleared and are used for grazing purposes.

Farming and quarrying are the main land uses in the vicinity of the study area. There has been a long history of farming at Albion Park, dating from 1817 when the first land grants were made. There are several quarries in the area, and the hard rock quarry operated by Cleary Bros. (Bombo) Pty Limited has been operating for about 35 years.

The study area is located on a ridge system composed of the Permian Gerringong Volcanics, a unit of which, the Bumbo Latite, is the objective of the proposed quarry. It receives an estimated rainfall of approximately 1,120 mm per year. The altitude of the study area ranges from about 70 metres to 130 metres.

2 FLORA

2.1 METHODOLOGY FOR THE FLORA STUDY

Parts of the study area and adjacent areas have been the subject of various studies in recent years. The western section was included in a study carried out for CSR Readymix (QEM 1994). The sections of rainforest in this western section were extensively searched in autumn 1992 and in winter and spring 1993. During the current survey these sections of vegetation were searched using a general botanical survey method, as outlined by York, Binns and Shields (1991), in order to confirm mapping and differentiation of vegetation types, as well as the continued survival of plant species of conservation significance that had been previously located. No records of previous studies of the vegetation stands in the eastern end of the study area were located, so all vegetation stands were initially surveyed using the general botanical survey method. Specific searches were then carried out for plant species of conservation significance using the "Random Meander Technique" (Cropper 1993). This method involves the selection of areas of potential habitat for particular species, then carrying out searches within such areas.

The flora surveys were carried out over a total of five days between October 1997 and February 1998. No terrestrial orchids were recorded during the surveys. It is possible that some individuals were overlooked, although it is also likely that some orchid species which occur on the site may have been dormant during this period. All stands of native vegetation were surveyed and mapped. The locations of plant species of conservation significance were noted and their locations marked onto a base map. The vegetation classification units identified are described in Section 2.2 in terms of structure, occurrence and floristics. The closed forest community was classified according to systems developed by Floyd (1990) and Mills and Jakeman (1995), in order to determine the conservation significance of the vegetation type, on a national as well as on a regional basis.

The conservation significance of individual species was established with reference to Briggs and Leigh (1996), the Schedules of the *Threatened Species Conservation Act 1995*, Mills (1988) for rainforest species, Matthes and Nash (1993) for *Cynanchum elegans* and Mills and Jakeman (1993) for *Zieria granulata*. The conservation significance of plant species was established in the regional context according to Mills (1989) and Mills and Jakeman (1995).

Ms Maria Matthes (NPWS) and Mr. Anders Bofeldt (Wollongong City Council) were consulted by Mr. Leonard in 1998 about the distribution and frequency of occurrence in the general area of several of the plant species of conservation significance.

The flora of the area was described in the report on the rezoning, prepared in 1998 by Kevin Mills & Associates (1998), with the assistance of Mr. G. Leonard.

2.2 PLANT COMMUNITIES

The closed forest (rainforest) stands in the study area constitute remnants of the once extensive "Illawarra Brush", described by Mills & Jakeman (1995) as originally occurring on the coastal Permian volcanics from Jamberoo to Gerringong. In the study area, more-or-less continuous stands of closed forest occur along a major creek-line, below the proposed quarry site; see Figure 1. Small patches of remnant or regrowth closed forest also occur on the quarry site, as do several fig trees, reminders of the original extent of rainforest on these hills.

Stands of open forest are sparse in the general area. One stand of eucalypt forest occurs on the southern edge of the proposed quarry site; see Figure 1.

The edges of most regrowth or remnant stands are generally lined with dense bands of weed species such as Blackberry *Rubus fruticosus* and Lantana *Lantana camara*, or pioneer native species such as Whalebone Tree *Streblus brunonianus*, Sweet Pittosporum *Pittosporum undulatum* and Black Wattle *Acacia mearnsii*. Two plant species of conservation importance, *Zieria granulata* and *Cynanchum elegans* appear to be more common along edges, rather than within native vegetation stands. This also appears to be the case with two plant species of regional conservation significance, *Alchornea ilicifolia* and *Dodonaea viscosa* var. *angustifolia*.

Five vegetation community types were identified in the study area, as summarised in Table 1; these are described below and their distribution is shown on Figure 1.