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Environmental Impact Statement

GALONG LIME KILN PROJECT

Volume 1

Main Environmental Impact Statement

Proposed by
Barnu Pty Limited
A subsidiary of
Boral Limited

Olsen Environmental Consulting
June 2003

oec

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Form 2

Submission of
Environmental Impact Statement (EIS)
prepared under the Environmental Planning and
Assessment Act,
1979, Section 78A

EIS prepared by:

name: David Philip Olsen
qualifications: B. Agri Sci (Hons)
address: PO Box 101
Figtree NSW 2525

in respect of: The construction and operation of a coal-fired Lime Kiln adjacent to the existing Galong Limestone Mine. Coal and operating supplies delivered to the site by truck. Lime products dispatched by truck. Kiln operation 24 hours per day and 7 days per week. The Lime Kiln will convert 300,00 tonnes per annum of crushed limestone into 150,000 tpa of quicklime.
Operation fully described in the EIS.

development application:

applicant name: Barnu Pty Limited
applicant address: C/- Boral Limited
Clunies Ross Street
PROSPECT NSW 2148

land to be developed: Within ML 1496

lot no., DP/MPS, vol/fol etc. proposed development: Lot 1, DP 747544, Portion 139 and enclosed Crown Road Reserves – Parish of Bobbora, County of Harden

Environmental Impact Statement: An Environmental Impact Statement (EIS) is attached

certificate I, David Philip Olsen of Cordeaux Heights NSW hereby certify that I have prepared the contents of this Statement and to the best of my knowledge

- it is in accordance with clauses 72 and 73 of the Environmental Planning and Assessment Regulation, 2000; and
- it is true in all material particulars and does not, by its presentation or omission of information, materially mislead.

signature:

name: David Philip Olsen

date: 30th June 2003

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TABLES

Chapter 1

Executive Summary

1. Executive Summary

Barnu Pty Limited, a subsidiary of Boral Limited, are proposing to construct and operate a Lime Kiln near Galong in Southeastern NSW. The recent acquisition of the Mine and the proposed installation of a new Lime Kiln is a key component of Boral's long term strategic plans for lime manufacture in NSW.

The approval process for the proposal is being managed by Blue Circle Southern Cement Pty Limited, which is also a wholly owned subsidiary of Boral Limited.

Figure 1.1 shows the location of the Project within the Southeastern Region of NSW. Figure 1.2 shows the proposal with respect to the Galong Region. The Project is located within Harden Shire Council.

An artist's impression of the development is included at the end of Chapter 6 and assists the reader to obtain a general understanding of the proposal.

The Lime Kiln will be built adjacent to the existing Galong Limestone Mine. Barnu are currently seeking to increase the output of the Limestone Mine to 500,000tpa and have consequently lodged a separate Development Application and Environmental Impact Statement for the Mine Expansion Project. This Development Application is currently being assessed by Harden Shire Council.

The Lime Kiln will process up to 300,000tpa of the Mine's annual output and convert it to approximately 150,000tpa of quicklime.

The need for a Lime Kiln is based on market predictions for quicklime consumption. Demand and production capacity for quicklime in Southeastern Australia are currently at about the same level. Even with the proposed Galong Kiln, demand is predicted to exceed production by 2008.

The Galong Mine is currently the largest supplier of agricultural lime in the region. The expansion of the Mine will ensure that it remains so. The Lime Kiln proposal provides an opportunity to value add to this important resource and is seen as a logical development of the Galong resource.

Alternative proposals to meet the increased demand for quicklime are discussed in Chapter 5. Galong was selected primarily because of long term financial viability, limestone resource quality and quantity, its location with respect to major road and rail transport modes and its ability to provide a diversity of lime and limestone supply for Blue Circle Southern, all in conjunction with financial return.

The Project is classified as State Significant Development. Consequently, the Lime Kiln proposal will be reviewed and determined by the Minister for Planning rather than Harden Shire Council. The proposal is also classified as Designated Development and Integrated Development. This means that it requires an Environmental Impact Statement (EIS) and detailed review by a number of Government Agencies in addition to the Department of Planning.

The EIS, together with a Development Application (DA), will be lodged with the Department of Planning. The Department will place the EIS and DA on public display and seek comment from the community and Government Agencies. The period of public display and information on how the community may provide input to the planning process will be temperature inversion conditions when the Mine (at the thirtieth year of operation) is combined with the Kiln operation.

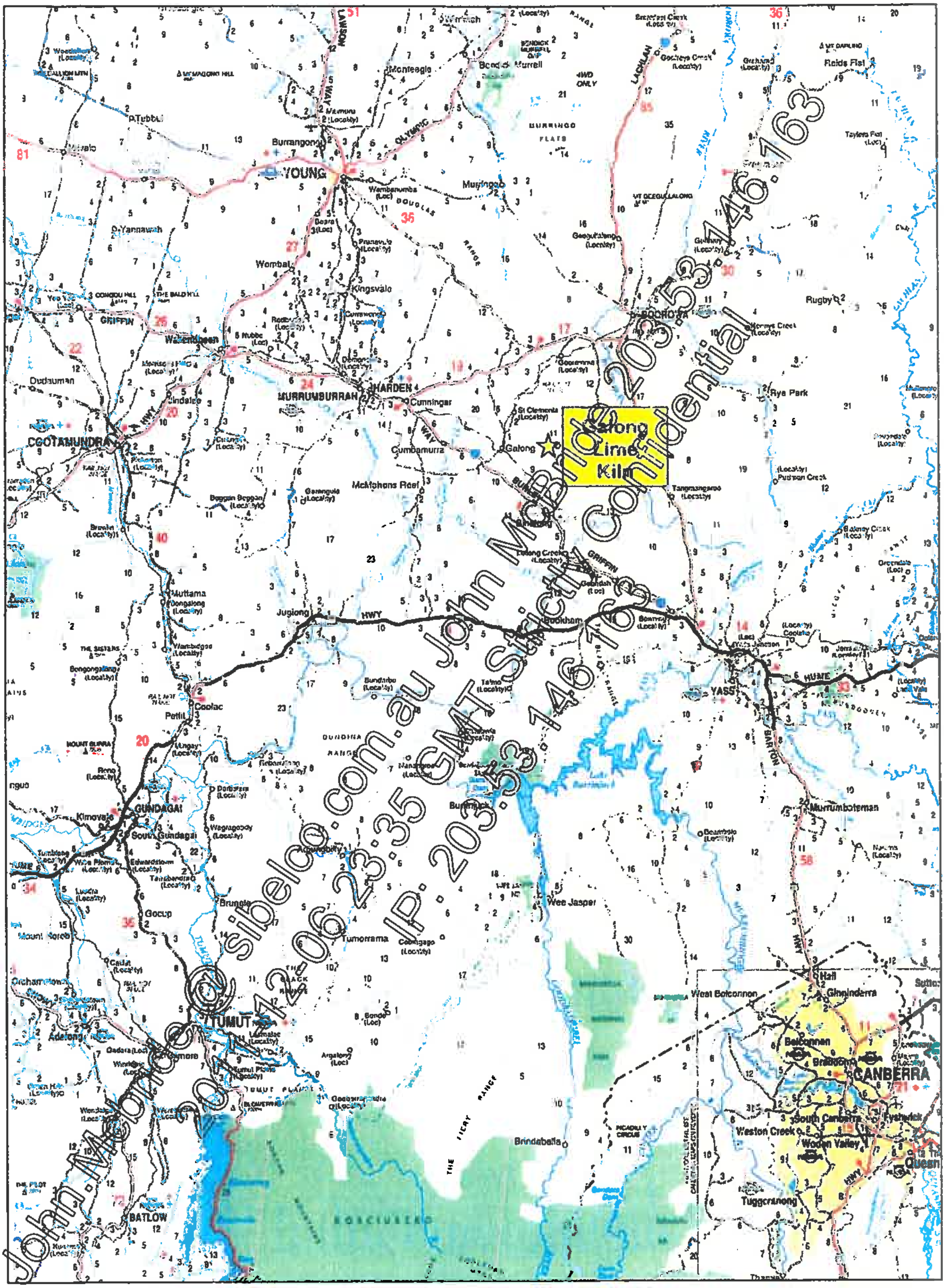
The Lime Kiln will be subject to an EPA Licence and will be managed in accordance with that Licence.

The Lime Kiln Project does not add traffic numbers that are significantly greater than those associated with the Mine Expansion Project. Traffic impacts are not expected for either the construction or operation of the Lime Kiln Project.

There are no archaeological sites affected by the Lime Kiln.

Barnu propose an Environmental Management programme that will ensure the correct management of the impacts identified in this EIS.

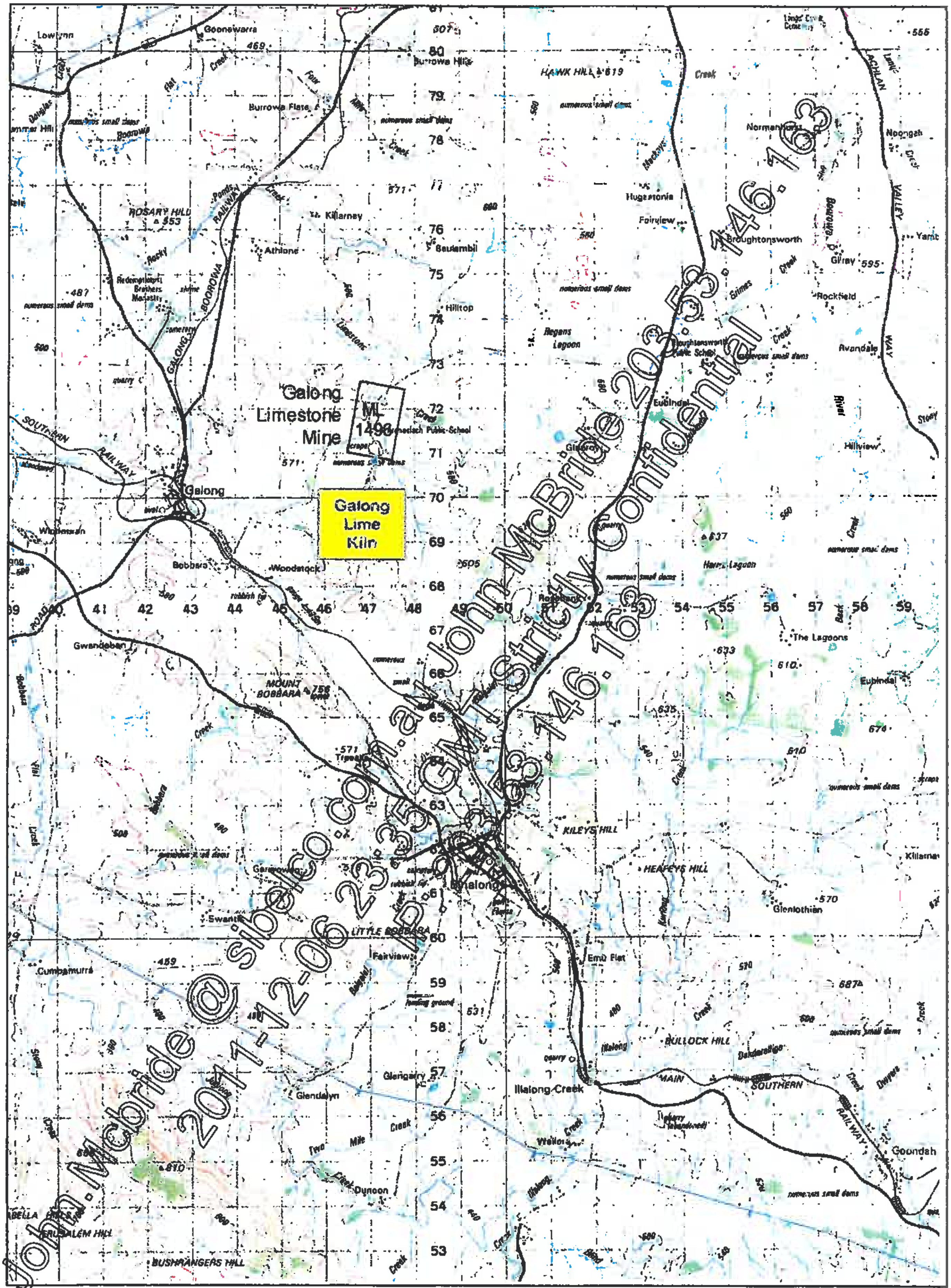
Barnu believe their Lime Kiln Project is a modern, state of the art facility that will provide benefits to the company, the community and the State of NSW. Detailed environmental assessment has shown that the Project can be implemented without major environmental impact. Appropriate management will ensure the amelioration, minimisation or control of predicted impacts. Monitoring will enable Barnu to certify compliance with predictions made in this EIS. Existing legislation ensures that environmental management of the proposed Lime Kiln will ensure a transparent and well regulated operation.



GALONG LIME KILN PROJECT

Figure 1.1

Project Location



GALONG LIME KILN PROJECT

Figure 1.2

Galong Area

Chapter 2

Introduction

2. Introduction

The Blue Circle Southern Cement (BCSC) acquisition of Barnu Pty Limited includes the purchase of the Galong limestone deposit and an existing associated crushed limestone business. BCSC proposes to continue to operate the limestone business and at the same time, install a new vertical shaft quicklime kiln capable of producing 150ktpa.

This proposal will be underpinned by increased demand for quicklime and development of the limestone and agricultural lime business potential.

2.1 Planning Background

This Environmental Impact Statement for the Galong Lime Kiln Project has been prepared to accompany a Development Application by Barnu Pty Limited (Barnu) who seek consent to construct and operate a lime kiln at the Galong Limestone Mine. Barnu is a wholly owned subsidiary of Boral Ltd.

Barnu have recently submitted another Development Application and Environmental Impact Statement relating to the Galong Limestone Mine Expansion. Should approval be granted, implementation of the Mine Expansion Project will occur before the construction and operation of the lime kiln is initiated.

The Development Applications and associated EIS's represent two separate proposals. Although the proposals are related, care has been taken to ensure that the environmental impacts of the two proposals are considered appropriately.

There are a number of impacts that are exclusive to the Mine Expansion and others that are exclusive to the Lime Kiln. In addition there are impacts that are cumulative to both Projects. This EIS considers those impacts from the Lime Kiln Project that are exclusive to that Project and also addresses those impacts that are cumulative with impacts from the Mine Expansion Project.

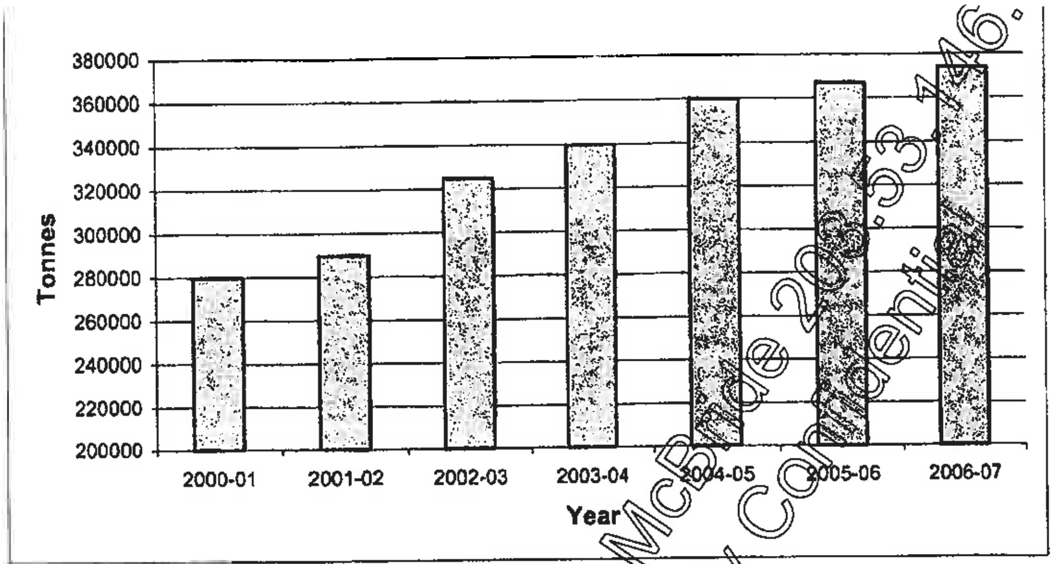
2.2 Need

The primary uses for quicklime and the percentage utilised in the Southeastern Australian market are identified in the following list:

Steel making	37%
Construction materials stabilisation	20%
Water Treatment	10%
Mining	10%
Road surfacing	7%
Industrial	7%
Building	5%
Sewage and Waste	4%

BCSC predict a significant rise in the demand for quicklime as indicated by the graph included in Figure 2.1.

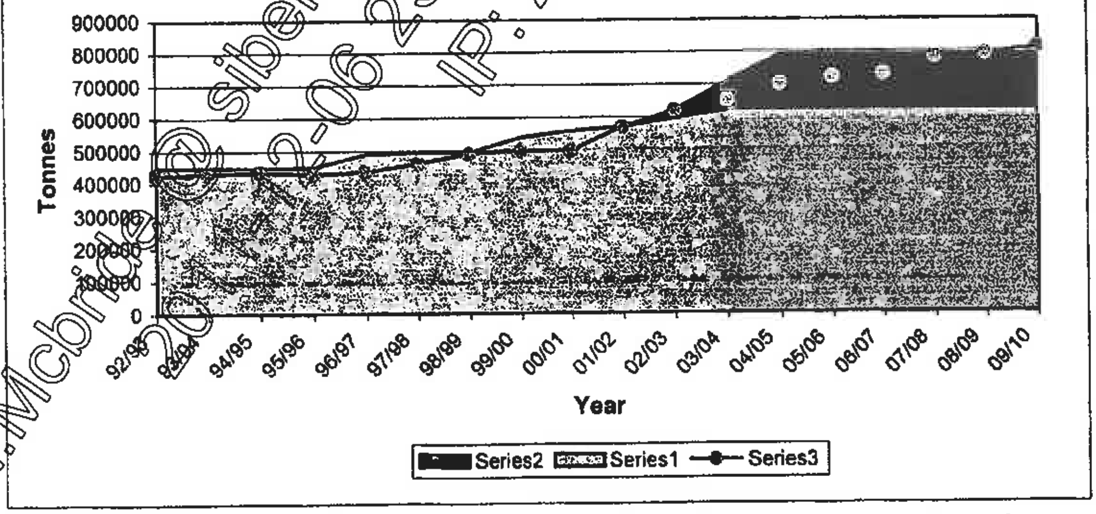
Figure 2.1 Projected Growth in Quicklime Demand SE Australia (Tonnes)



BCSC sees the Galong Lime Kiln Project as the preferred way for the company to position itself to take benefit of this potential demand growth.

Figure 2.2 presents a comparison of the existing capacity for quicklime production in Southeastern Australia and the demand. The graph demonstrates that demand and production capacity are currently at about the same level. Even with the proposed Galong production of 150ktpa, demand is predicted to exceed production by 2008.

Figure 2.2 Southeastern Australia Quicklime Demand and Production Capacity



Series 1: Production from all other producers, Series 2: Galong Production, Series 3: Demand.

The Galong Limestone Mine currently supplies agricultural lime as an acidic soil ameliorant in cropping areas in the Southwest Slopes grain belt. It is the largest supplier of agricultural lime in the Southwest Slopes region because of its proximity to the major areas of demand [illegible] freight advantages over other producers of agricultural lime. Barnu estimates that the Galong Limestone Mine supplies approximately 35% of the agricultural lime requirements of the Southwest Slopes region and 25% of the State's total requirements.

The Galong Limestone Mine currently competes with agricultural lime suppliers in Moss Vale, Marulan, Lithgow, Mudgee, Bathurst, Molong and Cudal, with two further competitors soon to enter the market in the Parkes area. Minor quantities of poorer quality limestone are also transported to the southern parts of NSW from Victorian producers.

The largest producer of agricultural lime in NSW is Omya Southern Pty Ltd at Moss Vale. Although Omya is capable of supplying around 250 000tpa to the Southwest Slopes region, customers pay a premium for freight due to the distance from Moss Vale. A similar situation applies when agricultural lime requirements are sourced from the other producers outside the Southwest Slopes region.

2.3 Objectives

BCSC plans to establish a lime production operation at Galong in order to meet the increasing demand for quicklime in Southeastern Australia. In addition, increasing crushed limestone activity at Galong enables BCSC to enter into an expanded range of minerals production.

The Marulan Limestone deposit would continue to be a core asset for BCSC. However, the Galong proposal would reduce BCSC's reliance on that deposit and provide a degree of diversification which would strengthen the resource base of the company.

Galong is seen as a strategic investment which underpins the future of BCSC operations in Southeastern Australia.

The objectives of the Environmental Impact Statement (EIS) will be to :

- Describe the operation of a proposal to produce lime from quarried limestone at Galong. This will involve the calcining of limestone in a coal-fired kiln;
- Comply with statutory environmental impact assessment requirements;
- Outline the alternatives to the proposed development option;
- Describe the Project environment;
- Identify environmental effects of the proposal and describe suitable means of mitigating and managing these effects, and;
- Obtaining Development Consent for the Project, which will permit the proposal to proceed.

2.4 Document Format

This EIS is presented in three volumes. Volume 1 is the main Environmental Impact Statement. Volume 2 is a collection of all the specialist consultant studies that were undertaken to assess the environmental impact of the Lime Kiln Project. Volume 3 is a collection of those specialist consultant studies that were initially undertaken for the Mine Expansion Project and have been referenced in Volume 1 when assessing the impact of the Lime Kiln Project. Volume 3 also contains an Archaeological Report, which was prepared for the Mine Expansion Project subsequent to the EIS going on display.

Volume 1 of the Lime Kiln EIS is presented in seven Chapters and contains a number of Appendices.

Chapter 1 is an Executive Summary of the Project.

Chapter 2 introduces the reader to the background of the Lime Kiln Project. This Chapter addresses the need for the Project and outlines the objectives aimed to be achieved by the EIS and the Project. The Chapter provides some information about the proponent and the Project Site, describes the existing operation and its development history, existing approvals and licences, existing transport arrangements and generally provides a foundational understanding of the Project.

Chapter 3 describes the Planning Background to the Project. It outlines the various planning instruments that apply, and details the role of Harden Shire Council and PlanningNSW in the Project Approval process. The Project is subject to SEPP34 Major Employment Generating Industrial Development and the Minister for Planning is the Consent Authority.

Chapter 4 provides details about the Lime Kiln Project. It includes a general description of the operation of a lime kiln and includes a detailed description of the Galong Lime Kiln Project.

Chapter 5 consists of descriptions of the various alternatives considered.

Chapter 6 provides a description of the existing environment, the environmental impact assessment and the measures that are proposed to manage the predicted impacts. It is the largest Chapter of the EIS.

Chapter 7 details the proposals for managing the environmental aspects of the Galong Lime Kiln Project.

Unless they are included in the text, all Figures appear at the end of the Chapters to which they relate.

Appendix A includes the Director General's and other Government Agency's requirements for issues to be addressed in the EIS. Appendix B assists the reader to find the various EIS sectors which address those issues identified as requiring attention.

2.5 The Proponent and the Project Site

2.5.1 The Proponent

Barnu Pty Ltd is a wholly owned subsidiary of Boral Limited. The Company is managed within the Cement and Minerals Group headed by Blue Circle Southern Cement (BCSC), the leading Australian cement producer with manufacturing operations in New South Wales, Victoria and South Australia. BCSC is also a major producer of lime and limestone for internal and external markets, fly ash for the power station and concrete industries and supplies the construction industry and retail hardware market with bagged cement, packaged concrete mixes, mortars and grouts. Boral Limited employees in excess of 3,400 people at its various operational sites across New South Wales and 11,800 people worldwide.

BCSC has entered the new millennium with the objective of increasing its exposure in the Australian cement market, whilst continuing to provide an unsurpassed level of customer support and service. The Company is committed to upholding its reputation as an environmentally aware and responsible market leader, through continued employment of best-practice operational, environmental and safety work practices.

2.5.2 The Project Site

The development application for the Galong Lime Kiln Project relates to an area referred to as the "Project Site" as shown on Figure 2.3. The Project Site is located predominantly within the boundary of Mining Lease (ML) 1496 that covers the existing Galong Limestone Mine and the area of its planned expansion. There is a small section of the Project Site located immediately south and outside ML 1496. Approaches have been made to the Department of Mineral Resources to extend ML 1496 to include this small area.

ML 1496 currently covers an area of 160ha and incorporates the following parcels of land or part thereof.

- Lots 3, DP 747544.
- Portion 139, and,
- Lot 1, DP 747544.

The Lime Kiln Project will be located on Lot 3 and part of Portion 139.

The Project Site lies within the Parish of Bobbara and County of Harden. The land within the Project Site is owned by the Bobbara Pastoral Company Pty Ltd and the Crown.

2.6 Background to the Proposal

2.6.1 Project Site History

The existing open-cut mine represents an extension of a smaller open-cut mine which was developed during the early 1900's to produce burnt lime. During this time, a State Lime Works was reportedly proposed for construction on the northern end of the limestone deposit although this proposal was abandoned following unsuccessful test work. During the 1960's, limestone was again mined from Galong to produce road construction materials. Burnt lime was also produced on the mine site during the 1960's.

In June 1993, Barnu received Development Consent (T.7/133) from Harden Shire Council for the establishment of a limestone mine and associated crushing and grinding facility at the current site. Construction activities commenced in mid-1993 under a joint venture agreement with Placer Pacific Ltd and involved the establishment of a mill capable of producing around 60 000tpa of agricultural lime. Mining commenced in mid-1994.

In mid-1995, Barnu acquired Placer's interest in the mine and obtained approval from Harden Council to install a second mill. Construction commenced in December 1995 and was completed in mid-1996. In September 1999, consent was granted to install a third grinding mill and circuit with construction commencing in late 1999 and mill commissioning occurring in March 2000. The installation of additional equipment to enable Barnu to produce finer grade crushed limestone product (as approved under the September 1999 consent) is yet to take place.

In February 2001, the Department of Mineral Resources granted Mining Lease 1496 (ML1496) to Barnu. This, coupled with Development Consent (T.00/066) from Harden Shire Council, allowed Barnu to secure its mining activities and extend mining operations to the north in an area of shallower overburden.

The Galong Limestone Mine currently has approval to produce up to 200 000tpa of milled limestone products. On 28 January 2003, Harden Shire Council granted the Proponent an amendment to the existing Development Consent (T.00/066) to cover the installation and operation of a fourth mill. Installation and operation of the fourth mill in conjunction with the three existing mills, will ultimately enable the Proponent to almost double the approved production limit of 200 000tpa of milled limestone product.

The Galong Mine Expansion Project is fully described in the EIS prepared by Rob Corkery and Co Pty Limited. The remainder of this Section summarises the main features of the Mine Expansion Project to enable the Lime Kiln Project to be placed in context with the Mine Expansion and to enable cumulative impacts to be understood.

The Mine Expansion EIS describes Barnu's principal objectives for the expansion of the Galong Limestone Mine as follows:

- Increase the production level to meet the growing demand from Southwest Slopes farmers for agricultural lime,
- Increase production to meet increased demand for other limestone products,
- Provide for the opportunity to accumulate stocks of crushed and milled limestone products to achieve greater efficiencies during high demand periods, and,
- Undertake all activities in a manner that is environmentally responsible and consistent with sustainable development principles.

These objectives are proposed to be met by Barnu undertaking the following actions as part of the Galong Limestone Mine Expansion Project:

- Expand mining operations deeper and to the north of the existing open cut to enable the recovery of 20Mt of high grade limestone,
- Increase limestone mining to 500,000tpa,
- Concurrently operate three grinding mills,
- Transport up to 350,000tpa of crushed and milled limestone products from the Mine, and,
- Convert an existing grinding mill (No3) to a coal mill to feed the new Kiln.

Annual limestone production from the current open-cut mine has steadily increased since Barnu first commenced production. In the 1994-1995 production year, 30,000t of limestone was produced from Galong. By the 2001-2002 production year, annual production had increased to 144,000t.

The expansion programme would be undertaken in a series of five stages programmed over a 40 year period. Barnu is seeking to mine more limestone that it would process by the existing three mills and the approved fourth mill. Additional limestone is required for use in either the proposed Lime Kiln Project or for increased agricultural lime sales.

The Lime Kiln Project proposes the construction and operation of a lime kiln capable of producing 150,000tpa of quicklime. Approximately 300,000t of limestone is required to be processed through a kiln in order to produce 150,000t of quicklime.

Should the Lime Kiln Project proceed, the total quantity of products produced on site would remain at 350,000tpa, consisting of 200,000tpa of agricultural lime and 150,000tpa of quicklime. If the Lime Kiln Project does not proceed, maximum agricultural lime sales would be increased to the 350,000tpa limit.

2.6.2 Existing Approvals, Leases and Licences

Barnu operates the Galong Limestone Mine in accordance with the following consents and licences.

- Development Consent T.7/133 (dated 7/6/93) and three subsequent amendments. Development Consent T.7/133 is the original Development Consent for the mine, whereas the subsequent amendments relate to increased hours of operations (22/2/94 and 6/10/94) and the installation of a second grinding mill (13/11/95).

- Development Consent T.7/169 (dated 22/8/95) for the installation of a barrel washer and vibrating screen.

- Development Consent T.99/041 (dated 20/9/99) for the installation of a third mill, fine grinding circuit and air classifier, and to increase annual production to approximately 180,000t of agricultural products and 20,000t of fine grained material for industrial uses.

- Development Consent No. T.00/066 (dated 21/2/01). This consent:

  (i) Secures operational activities in Portion 139 and enables use of the mine access road, overburden stockpile area, lay-down areas and mine access ramp,

  (ii) Approves mining of limestone to a depth no deeper than 471m AHD and within an area defined as the Extension Area, and,

  (iii) Approves mining of no more than 200,000tpa of limestone and dispatch of 200,000tpa of processed limestone from the site.

- Amendment to Development Consent No. T.00/066 (dated 28/1/03) allowing construction and operation of a fourth mill.

- On 16 November 2001, Barnu was granted Mining Lease 1496 (ML1496) by the Department of Mineral Resources for a period of 20 years. ML1496 covers an area of approximately 160ha. Subject to satisfactory performance, the term of ML 1496 could be extended well beyond 20 years.

- Environment Protection Licence No. 4660 issued by the Environment Protection Authority under the Protection of the Environment Operations Act 1997. This licence, with an anniversary date of 17 May, covers the mining and processing of limestone at a rate of up to 500,000tpa under the fee-based activities "crushing, grinding and separating works" and "mining (other than coal)".

- Bore Licence 40BL189001 issued for a five-year period by the Department of Land and Water Conservation on the 11 March 2003. The licence allows Barnu to discharge groundwater inflows from the open-cut mine onto Lot 3, DP 747544, Parish of Bobbara, Country of Harden (including into Limestone Creek) up to a maximum of 0.43ML per day, or 157 ML per annum.

2.6.3 Previous Environmental Performance

There have been no serious environmental incidents at the Galong Limestone Mine since operations re-commenced in 1994. The relevant Government Agencies have indicated their satisfaction with Barnu's performance with respect to Government and industry codes of practice. Any minor issues identified during site inspections have been promptly rectified.

2.7 Existing Mining Operations

2.7.1 Site Layout

Figure 2.4 illustrates the existing mine site layout and associated infrastructure. The major features are:

- An open-cut mine covering an area of approximately 2.8ha extending approximately 40m below the natural surface. The open-cut mine is accessed by two ramps which enter from the northeastern corner of Portion 139.

- An active overburden emplacement to the south of the open-cut mine (Southern Overburden Emplacement).

- An overburden emplacement to the west of the open-cut mine (Western Overburden Emplacement).

- Three overburden stockpiles located on the northern side of the open-cut mine. Two of these stockpiles were present in their current form at the commencement of Barnu's activities in 1994 and one, the larger and more easterly, lies in the area of a former stockpile but has been elevated by Barnu. None of the stockpiles have been rehabilitated, although all have varying degrees of vegetation cover. Other stockpile areas present at the time operations re-commenced have been reshaped and are currently either used by the Proponent for lay-down areas, or have been rehabilitated.

- A topsoil stockpile located adjacent to the western margin of the open-cut mine.

- A processing plant area comprising a crushing circuit, a mill building that presently houses three mills and associated conveyors, product storage hoppers and tanks, a weighbridge, five transportable office and storage buildings, bunded LPG and fuel tanks and an equipment laydown area.

- A bunded blended product stockpile area located to the southeast of the open-cut pit, and south of the processing plant

- Two sediment basins and a main water storage dam to collect surface water from the vicinity of the plant and any water pumped from the open-cut mine.

The Mine Expansion Project will extend in the open cut to the north and to a greater depth, down to 70m.

2.7.2 Processing Operations

Processing activities involve the primary and secondary crushing of limestone prior to milling. The approved fourth mill facility will operate in a similar fashion to existing mill circuits. It is envisaged the fourth mill will be constructed and commissioned by March 2004.

Figure 2.5 illustrates the approximate position of the approved fourth mill facility with respect to existing processing plant infrastructure. The principal processing components of the facility will be enclosed within a steel-framed and clad shed located adjacent to the western side of the existing processing plant. The steel shed will have dimensions of approximately 16.5m (length), 14m (width) and 15.75m (height). The exact location of the new components will be determined as part of the final design for the mill upgrade.

Following installation of the approved fourth mill facility, the integrated processing plant would be capable of achieving production of 400,000tpa of crushed limestone and milled product. However, planned maintenance of the processing plant would result in maximum annual production of approximately 350,000tpa when all four mills are operating concurrently.

An upgraded power supply is essential to operate the already-approved fourth mill. This upgrade will require installation of a new 66kV power line into the Mine. The need for this new line has been discussed with Country Energy in Wagga Wagga and they will organise necessary approvals.

It is not envisaged that any additional plant or changes to processing operations would be required to achieve the planned annual production of 350,000tpa of milled limestone once the approved fourth mill is operational.

The details of the Lime Kiln and associated additional facilities and infrastructure are described in Sections 4.1 and 4.2.

2.7.3 Equipment

Table 1.1 presents a list of equipment that Barnu envisage will be required for the continued operation and expansion of the Galong Limestone Mine. The Table identifies that equipment currently on site and that equipment required as apart of the Mine Expansion Project.

Equipment required for the Galong Lime Kiln Project is additional to this and is fully described in Sections 4.1 and 4.2. Both sets of equipment are necessary to assess cumulative impact.

Table 2.1 Proposed Mobile Equipment for the Expanded Galong Mine

Item	Number	Function
Volvo L 160 Front End Loader (FEL)	1	Transport of raw materials from the open cut mine to run of mine (ROM) stockpile or primary crusher; feeding primary crusher.
Volvo 4500 FEL	1	Stockpile management, yard clean up, back up to L 160.
Caterpillar 980 or 988 FEL	1*	Loading of haulage and of product trucks; loading of raw materials into primary crusher.
Komatsu PC200 Excavator	1	Breaking oversize limestone with hydraulic hammer.
Volvo A25 (25t) Dump Truck	1	Haulage of raw materials; transport of overburden to main overburden emplacement.
50-65t capacity Dump Trucks	2*	Haulage of raw materials; transport of overburden to main overburden emplacement.
Bob Cat	1*	Site maintenance work.
Water Truck	1	Dust suppression on roads and hardstand areas.
Hydraulic Drill Rig	1	Campaign drilling of blast holes.

* New equipment to be progressively delivered to site.

2.7.4 Employment

Barnu currently employs a total of 10 full-time personnel involved in mining and processing activities, the majority of whom reside within 50km of the Mine. Additional personnel (up to 5 individuals) are employed during the peak production period which coincides with the agricultural liming season.

Drilling and blasting is undertaken by experienced contractors. Product haulage activities are undertaken by contractors employed either by Barnu or directly by its clients, i.e. agricultural lime distributors throughout the Southwest Slopes.

The expanded production at the Mine and the consequent improved economic viability would provide for increased employment levels and a greater level of security to Barnu's existing workforce and associated contractors.

It is envisaged that the Mine Expansion Project would employ an additional 1 full time employee and 1 part time/casual employee. A further 1 to 2 contract positions are likely to be created as a result of the Mine Expansion Project.

Consequently, it is envisaged the Mine Expansion Project would employ up to 18 individuals in varying capacities.

The distribution of crushed and milled limestone products from the Galong Limestone Mine is likely to also require the employment of several additional full time truck drivers.

Apart from the direct employment at the Mine or for product transportation, there would also be an increase in indirect employment.

2.7.5 Operating Hours

The operating hours of the Galong Mine Expansion Project will remain within the existing approved times. The existing approved hours of operation at the Mine are presented in Table 2.2.

Table 2.2 Existing Approved Operating Hours

Activity	Hours	Days
Mining	24 hours / day	7 days
Blasting	9.00 am to 3.00 pm	Monday to Saturday
Processing	24 hours / day	7 days
Product Dispatch / Transport	7.00 am to 7.00 pm	Monday to Saturday

The Galong Lime Kiln will operate continuously for 24 hours per day and 7 days per week.

2.7.6 Infrastructure and Services

The existing infrastructure on the Galong Mine Site comprises:

- The private mine access road from Eubindal Road and internal mine roads,
- The processing plant and associated structures and hardstand areas,
- Various water management/pollution control structures, and,
- An overhead power line which extends from near Eubindal Road – Galong Road intersection to a transformer yard located adjacent to the site office building.

As part of the Mine Expansion Project, Barnu proposes to rationalise the existing internal road and track network in the vicinity of the processing plant and create a loop road for product trucks that would optimise loading times. The proposed location of new site infrastructure for the Mine Expansion Project is detailed in Figure 2.5.

The proposed new infrastructure associated with the Lime Kiln Project is discussed in Section 4.2.

Services currently provided to the Galong Limestone Mine are:

- An 11kV overhead power line which extends from Boorowa to the Mine transformer/substation. Power is reticulated to the various facilities at the Mine at 415/240V,
- Town water is supplied via polyethylene pipe from Eubindal Road, and,
- Four underground telephone lines.

The town water supply fulfils the water requirements for potable and ablutions purposes. Water for dust suppression purposes is sourced from the Main Water Storage Dam adjacent to the processing plant or directly from the sump within the open cut mine. The Main Water Storage Dam collects clarified runoff from the vicinity of the plant that has previously passed through the two adjacent sediment basins, along with water pumped from the sump within the open cut.

Barnu has to have installed a 66kV power supply to ensure adequate power for the fourth mill facility. The approvals for installation of this power line will be obtained separately by Country Energy.

No additional services are required for the Lime Kiln Project.

2.7.7 Product Transportation

Milled limestone products are currently dispatched from the Mine using trucks of varying capacities and configurations that include rigid-bodied tippers, semi-tippers, trucks with dog trailers and B-doubles. The main transportation routes used by product trucks traveling from the mine and the current tonnage and percentage of product trucks using these routes is illustrated on Figure 2.6.

All product trucks traveling from the mine do so via the private mine access road to Eubindal Road, from where they turn left and travel to the intersection with Galong Road. Unless delivering mine products to nearby landholders, product trucks turn left onto Galong Road, from where they head in a southerly direction towards Galong.

The vast majority of product trucks (~95%) travel via the 'southern transport routes' through Galong. These vehicles travel along Galong Road (known as Ryan Street and Bobbara Road within the town limits) and via the heavy vehicle bypass that includes Bobbara Road and Crescent Street. After crossing the main railway line, product trucks travel approximately 3km further along Galong Road to its intersection with Burley Griffin Way (Main Road 84) from where they can either travel east towards Yass, or west to Harden. Company information indicates that the majority of product trucks that travel through Galong turn right onto Burley Griffin Way and travel towards Harden.

Approximately 5% of product trucks travel to Harden or Boorowa via Kalangan and

Cunningar Roads or to Boorowa via Galong Road (referred to as the 'northern transport routes'). Product trucks travelling to Harden or Boorowa via the northern transport route turn right off Galong Road onto Kalangan Road, from where they travel approximately 9km in a northwesterly direction to the intersection with Cunningar Road (Main Road 380). Product trucks travelling to Harden turn left onto Cunningar Road and travel for approximately 12km in a southwesterly direction to the intersection with Burley Griffin Way, located approximately 5km east of Harden. Product trucks travelling to Boorowa turn right onto Cunningar Road at its intersection with Kalangan Road, before travelling approximately 25km in a northeasterly direction to Boorowa.

Product trucks are discouraged from traveling to Boorowa via Galong Road as the road has a nominated 8t load limit. On occasions, product trucks use other local roads for the transportation of mine products (e.g. Fairview Road, Boorowa Road east of Galong). Although Barnu discourages the use of these roads for product transportation, it is unable to dictate which transportation routes are used by product trucks that are owned and/or operated by other organisations.

In 2001-2002, Barnu paid Harden Shire Council approximately $48,000 towards the upgrading of the roads used by the trucks traveling to and from the mine in accordance with the prevailing Section 94 Contributions Plan.

After implementation of the Mine Expansion Project, crushed and milled limestone products would continue to be despatched from the Mine using trucks of varying capacities and configurations that include rigid-bodied tippers, semi-tippers, trucks with dog trailers and B-doubles.

Barnu's proposal to stage the increase in production of crushed and milled limestone products would result in a progressive increase in vehicle movements through time that reflects this staged approach.

Initially, it is proposed that products would be transported on the same routes currently used by product vehicles. Barnu proposes to gradually increase the volume of mine products transported through Galong via the southern transportation routes from the current approved volume of 200,000tpa up to approximately 340,000tpa. It is envisaged that a further 10,000tpa to 30,000tpa would be distributed via the northern transportation routes towards Harden and Boorowa, specifically along Kalangan and Cunningar Roads.

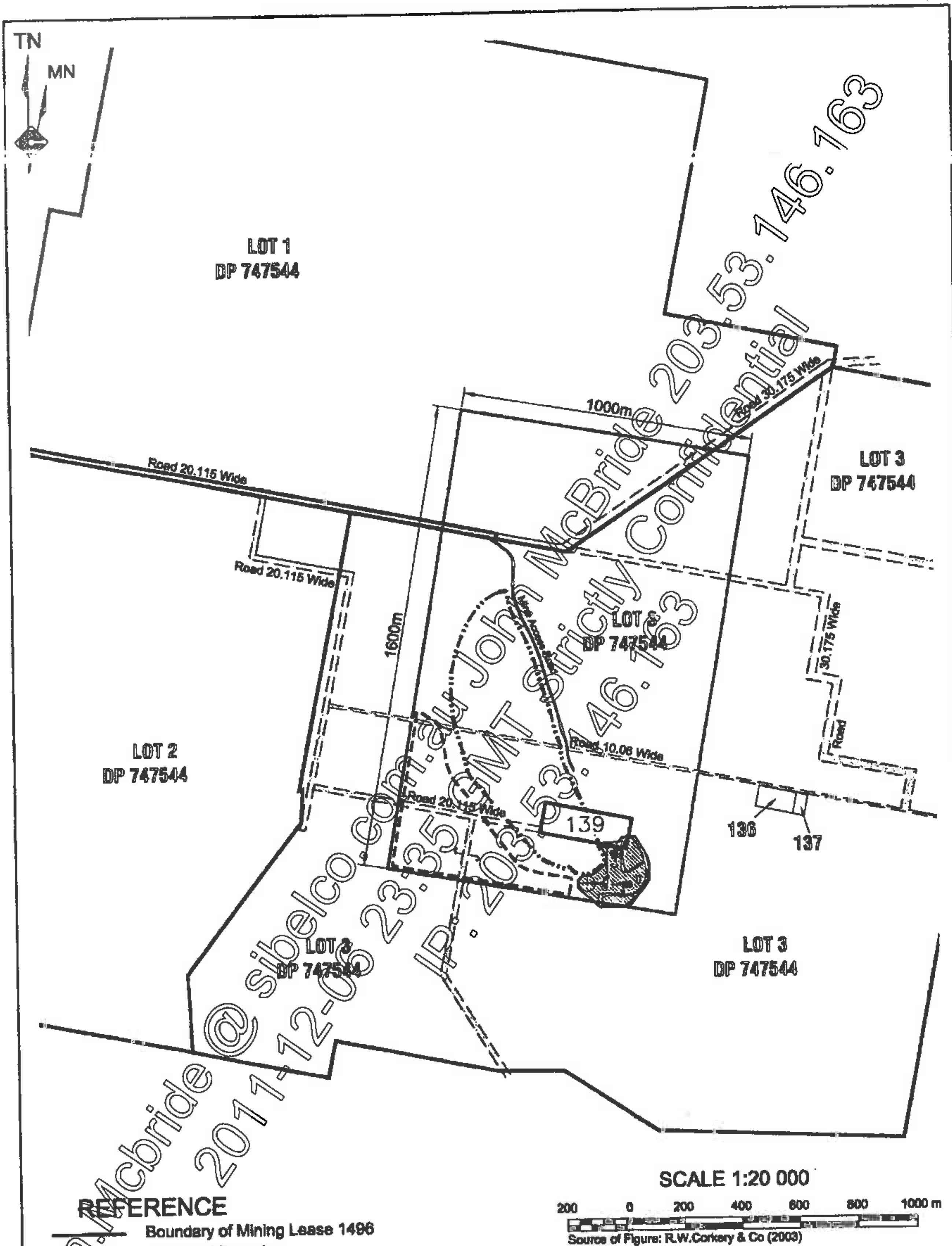
In response to Barnu's staged approach to transportation of increased product volumes from the Mine, it is envisaged that heavy vehicle movements through Galong would gradually increase over a five year period to reflect the progressive increase in transport of Mine products up to the maximum volume of 340,000tpa. This would equate to a maximum average of 78 vehicle movements per day i.e. 39 laden and 39 unladen trucks. Heavy vehicle movements along Kalangan and Cunningar Roads are unlikely to change significantly, with expected average daily vehicle movements likely to remain at approximately 2 per day but varying up to 8 per day.

The rate of product despatch would continue to vary during the year to reflect seasonal demands for agricultural lime products. However, Barnu believes that the large fluctuations in daily vehicle movements presently experienced would decrease with increased production, such that the 85th percentile of vehicle movements on all transportation routes would more closely approach the average daily vehicle movements for those routes. This would be even more likely if 150,000tpa of the product were quicklime from the proposed Lime Kiln Project.

Barnu would continue to pay contributions for road maintenance to Harden Shire Council under Section 94 of the Environmental Planning and Assessment Act 1979 and in accordance with Council's Section 94 Contributions Plan.

The Lime Kiln Project is not predicted to have much effect on the transportation impacts determined for the Mine Expansion Project. They are discussed in detail in Section 6.11.

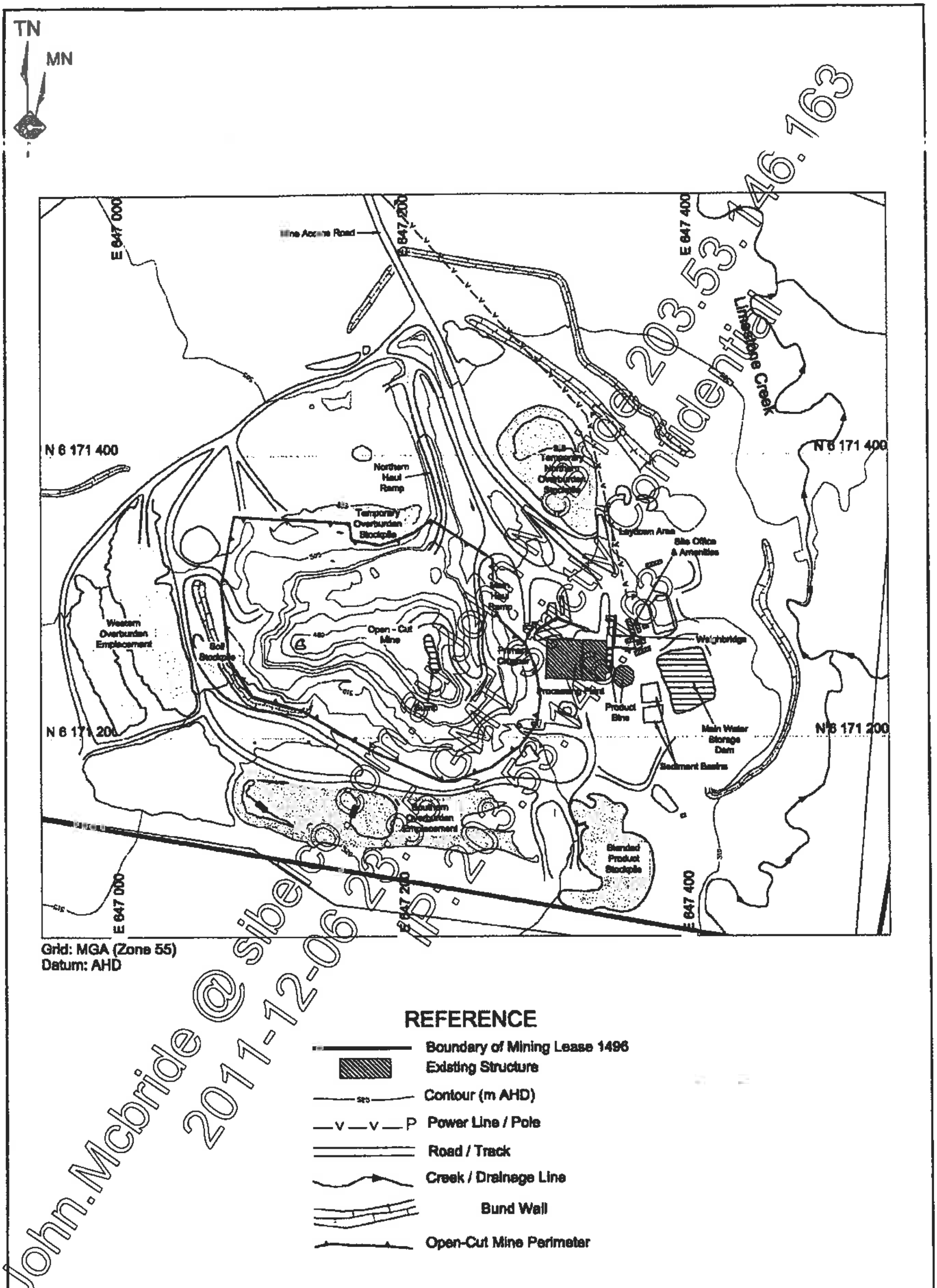
It is anticipated that the supply arrangements for quicklime will provide greater consistency of dispatch from the site, hence reducing the variability of peak traffic flows and volumes.



REFERENCE

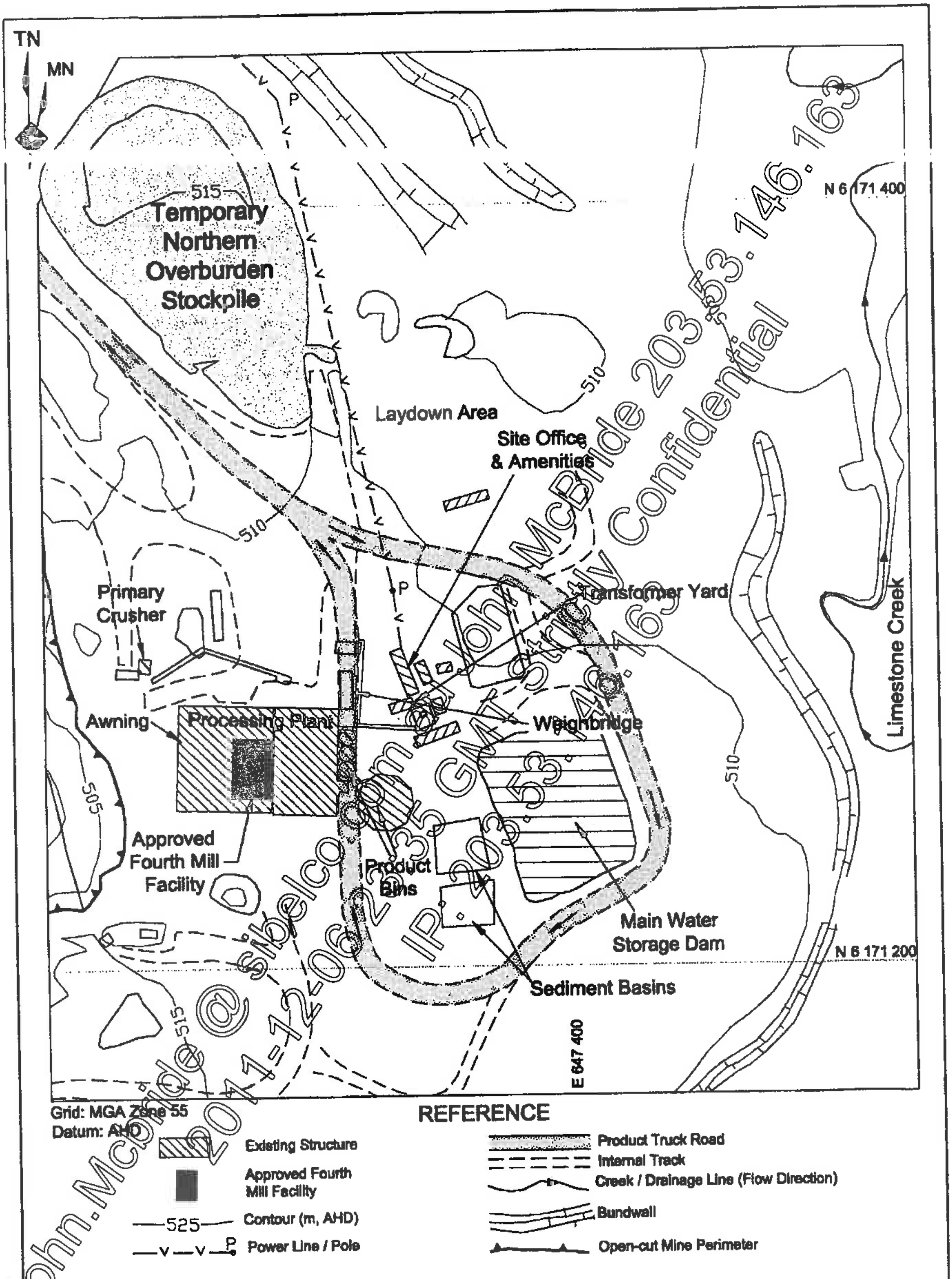
- Boundary of Mining Lease 1496
- Cadastral Boundary
- Crown Road Reserve
- Proposed Limit of Mining
- Proposed Main Overburden Emplacement
- Lime Kiln Location (The Project Site)

GALONG LIME KILN PROJECT
Figure 2.3
THE PROJECT SITE



Base Map Source: Geo-Spectrum (Australia) Pty Ltd
Source of Figure: R.W.Corkery & Co (2003)

GALONG LIME KILN PROJECT
Figure 2.4
EXISTING MINE SITE LAYOUT

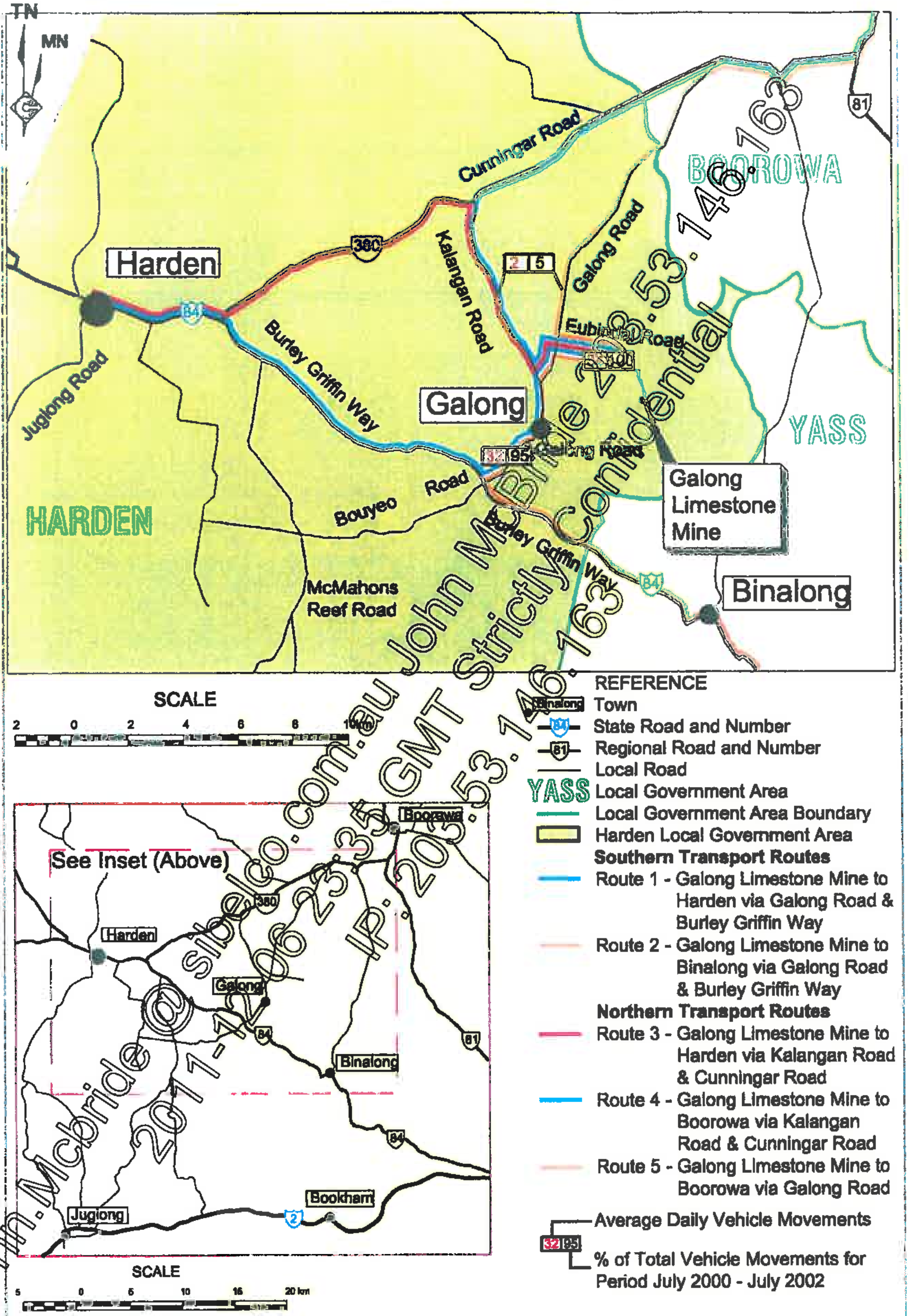


SCALE 1:1 500

25 0 25 50 75 m

Base Map Source: Geo-Spectrum (Australia) Pty Ltd
Source of Figure: R.W.Corkery & Co (2003)

GALONG LIME KILN PROJECT
Figure 2.5
Mine Processing Plant and Infrastructure Layout



Source of Figure: R.W.Corkery & Co (2003)

GALONG LIME KILN PROJECT
Figure 2.6
Existing Product Transfer Routes

Chapter 3

Planning Background

3. Planning Background

3.1 Harden Local Government Area

The Galong Lime Kiln Project is located within the Harden Local Government Area (LGA). Development within this LGA is controlled primarily by the provisions of Interim Development Order Number 1 (IDO No.1).

Harden Shire Council have prepared a Draft Local Environmental Plan (LEP) which will eventually replace IDO No.1. Even though the LEP is still in draft form, its contents give a good indication of Council's desires for development control in the Shire.

The land is zoned 1A Non-urban (a) Under IDO No. 1. Within this zoning the development of the proposed Galong Lime Kiln may be carried out only with the consent of Harden Shire Council. Because the proposed activity is State Significant Development (Refer Section 3.2), the Minister for Planning replaces Harden Shire Council as the determining authority.

Under the draft LEP, the area is zoned 1(a) Rural Zone. If the LEP was to apply to this development, rather than be in draft form, the proposed development could proceed only with development consent.

Harden Shire has a Section 94 Plan which also affects development within the LGA. The purpose of the Section 94 Plan is:

- To identify the extent to which road works provided and/or maintained in whole or in part by Council, or which need to be provided and/or maintained in whole or in part by Council, will be subjected to increased demands and/or excessive wear and tear by unpredictable developments which generate additional heavy vehicle traffic movements, and,

- To establish a basis for the payment of Section 94 contributions towards all costs of the provision of those road works established either before or after the development, and/or the upgrading and/or maintenance of those road works to meet the increased demands made as a result of unpredictable development.

The Plan defines heavy traffic generating development as any development (requiring the consent of Council) that generates (or requires) heavy vehicle movements as a significant component of its operations.

Unpredictable development is defined as development which will, or, is likely to result in the generation of additional heavy vehicular traffic upon roads in the Councils' LGA, the nature of which cannot readily or precisely be predicted and which may occur on an intense, repetitive, sporadic or disbursed basis, and without limiting the generality of the foregoing, may include development for the purposes of extractive industries, quarries and mines, intensive agriculture, major tourist developments and any other heavy vehicular traffic generating activity whether commercial, industrial, business or otherwise.

In order to discuss capital and ongoing contributions for maintaining the road network, Harden Shire Council has been approached by Barnu as part of the application for Mine Expansion. Discussions have been held with Mr G Coffey, Director Technical Services and Mr P Johnston, Director of Environmental Services, to ascertain the requirements to meet applicable statutory standards.

The volume of traffic being considered accounts for output from both the Mine Expansion Project and the Lime Kiln Project. This output is a maximum of approximately 350,000tpa.

Harden Shire Council representatives were also present at the Planning Focus Meeting held in the Harden Council Chambers on 7 May, 2003.

Ongoing discussions with Harden Shire Council members regarding Section 94 contributions have resulted in an in principal agreement for both the scope of work and responsibilities of both Council and Barnu to meet the statutory road requirements. Barnu has committed to capital contributions to upgrade the necessary roads with Council, as well as ongoing Section 94 contributions to maintain the roads as part of Council's ongoing responsibilities.

3.2 SEPP No 34 Major Employment Generating Industrial Development

State Environmental Planning Policy No 34 Major Employment Generating Industrial Development (SEPP 34) applies to major employment generating industrial development which is listed in the Schedule of the SEPP and which, in the opinion of the Minister for Planning as the consent authority:

- Would employ 100 or more people on a full time basis, or,
- Have a capital investment value of $20 Million or more.

The Galong Lime Kiln Project will require capital expenditure estimated to be in excess of $30 Million and consequently, the Project meets the second of the two qualification criteria for SEPP 34.

The Minister for Planning has determined that the Lime Kiln Project qualifies for assessment under SEPP 34.

After the Minister determined that SEPP 34 was applicable, PlanningNSW helped co-ordinate a Planning Focus Meeting (PFM) for the Project. The PFM functions to familiarise all concerned with the proposal and enable early advice to be provided to BCSC on issues which may need to be addressed prior to the Development Application being lodged.

The PFM was held in Harden Shire Council Chambers on 7 May, 2003. The PFM involved BCSC and its representatives, Harden Shire Council and relevant Government Agencies, including the Department of Mineral Resources, Department of Sustainable Natural Resources, National Parks and Wildlife Service and the Department of Agriculture. The Environment Protection Authority were unable to attend the meeting on 7 May, however, their representatives attended a presentation and site inspection on 6 May, 2003.

The Minister for Planning has also determined that development which is subject to SEPP 34 is also classified as State Significant Development. The Minister is the determining authority for such development.

3.3 SEPP No 11 Traffic Generating Developments

State Environmental Planning Policy No 11 Traffic Generating Developments (SEPP 11), aims to ensure that the Traffic Authority of NSW is made aware of, and is given an opportunity to make presentations in respect of, developments described in two Schedules included in the SEPP.

The two schedules do not include any developments of the type proposed for the Lime Kiln Project. In addition only 25 parking places will be provided for the entire workforce of both the Mine Expansion and the Lime Kiln. This number is well below the level of 50 car parking spaces that would trigger the requirements of SEPP 11. Consequently, SEPP 11 does not apply.

3.4 SEPP No 33 Hazardous and Offensive Development

PlanningNSW have published a set of Guidelines to be used for Projects that may be affected by State Environmental Planning Policy No 33, Hazardous and Offensive Development (SEPP 33).

These Guidelines were reviewed to determine whether SEPP 33 applied to the Galong Lime Kiln Project.

Figure 1 in the Guidelines enables the proponent of a Project to determine whether SEPP 33 applies. There are two basic questions that need to be addressed. These are whether the Project is potentially hazardous and whether it has pollution potential.

Addressing the potentially hazardous issue first. The Lime Kiln Project will be coal-fired. There will be diesel and liquid petroleum gas (LPG) stored on the site. The diesel will primarily be for mine operational vehicles and the LPG will be required as a start up fuel for the kiln and for drying coal prior.

Diesel is classified Class 3, C1 material in the Summary of Dangerous Goods Code of Classification reproduced at Appendix 6 in the Guidelines.

Class 3 means that it is a flammable liquid which is capable of being ignited and of burning. The C1 classification derives from it having a flashpoint above 61 °C but not exceeding 150 °C. Table 1 in the Guidelines, which outlines the screening method to be used includes the following comment. "If Class C1 and/or C2 are present on site and are stored in a separate bund or within a storage area where they are the only flammable liquid present they are not considered to be potentially hazardous".

The diesel at Galong will be stored in a separate bunded area and no other flammable liquid is present. Consequently, the Lime Kiln Project is not potentially hazardous with respect to diesel storage and SEPP 33 is not triggered for this material.

LPG is classified as Class 2.1 material in the Summary of Dangerous Goods Code of Classification reproduced at Appendix 6 in the Guidelines. However, in Table 1 of the Screening Method to be Used to determine if SEPP 33 applies , the Guidelines state that, "... though classified as a flammable gas (2.1), it (LPG) is treated separately for screening purposes and should not be grouped with other class 2.1 flammable gases".

The Guideline's Table 3, Screening Threshold Quantities, identifies the amounts of LPG stored on site that would trigger SEPP 33 provisions. These are identified as $16m^3$ if stored above ground and $64m^3$ if stored underground or mounded.

If these threshold quantities are exceeded, the proposed development would be considered potentially hazardous and SEPP 33 would apply. In such a case, a preliminary hazard analysis (PHA) is required to be submitted with the development application.

Between 15 to $40m^3$ of LPG will be kept on site and will be stored either above ground, underground or mounded as appropriate. Consequently, the Galong Lime Kiln Project is not potentially hazardous and SEPP 33 does not apply in relation to hazardous potential.

Now turning to the issue of whether the Project is potentially polluting. Operation of the Lime Kiln will be subject to a Pollution Control Licence issued by the EPA. The EPA have commented on their requirements to be addressed in this Environmental Impact Statement. It is likely that, providing certain issues are addressed, they will issue a licence to enable the Kiln to operate. The EPA Comments are included in Appendix A. Consequently, in accordance with the Guidelines, it is likely that a Pollution Control Licence can be obtained and that the development is permissible and can proceed to detailed assessment.

It is not proposed to change the existing supply route for this Project. Goods will be delivered as required along the existing route which is via Eubindal Road.

Typically, the amount of distillate delivered will not alter from that required for the Mine Expansion Project. Consequently, the delivery route does not require further assessment in accordance with the RTA's Draft Route Selection Guidelines. One truck of LPG will be delivered to site every 4 to 6 weeks.

The use of non-dangerous goods in lime production can lead to potential hazardous situations. These will be managed and avoided through appropriate occupation health and hygiene strategies.

Planning of the Lime Kiln Project incorporated a Risk Assessment (RA) of the new facility when in operation. The RA identified a number of issues across the Project that will require appropriate risk management. The RA identified the potential for explosions to occur in the coal mill. This risk will be managed by designing the new milling circuit with appropriate explosion vents to avoid the build up of an explosive mix. Further management will be obtained through training, procedures, parameters and interlocks via the plant control system.

3.5 SEPP No 44 Koala Habitat Protection

State Environmental Planning Policy No 44 Koala Habitat Protection (SEPP 44) aims to protect the habitat of the Koala. Harden Shire Council is not listed as a Local Government Area in which this SEPP applies and consequently SEPP 44 is not relevant to the Galong Lime Kiln Project. There is no Koala habitat at or near the Lime Kiln site.

3.6 SEPP No 55 Remediation of Land

State Environmental Planning Policy No 55 Remediation of Land (SEPP 55) aims to provide a Statewide planning approach to the remediation of contaminated land.

A preliminary investigation of the Lime Kiln site was undertaken to assess potential contamination that may affect the proposal. Historically the land has been used for the storage of mine overburden soil and crushed limestone. These materials are natural products and do not contain materials that could result in contamination.

The only possible contamination that could be present would have arisen from hydrocarbon spills. There is some evidence of small hydrocarbon spills associated with vehicle maintenance and operation on the site. There is no preliminary evidence of fuel and oil loss from on site storage.

It was concluded that the site is not contaminated and is considered suitable for the continued use of mining and the new use of limestone calcining.

3.7 Development Control Plans

A Development Control Plan (DCP) is a planning instrument that provides more planning and development detail than is contained in a Local Environmental Plan (LEP) or an Interim Development Order. The DCPs are consistent with, and supplementary to, an LEP.

Harden Shire Council have advised that there are no DCPs applicable to the Galong area and consequently, this Project is not affected by a Harden DCP.

3.8 Designated Development

Schedule 3 of the Environmental Planning and Assessment Regulation 2000 defines development that can be classified as Designated Development. Any Development Application for Designated Development must be accompanied by an Environmental Impact Statement (EIS).

Item 20 of Part 1 of Schedule 3 of the Regulations identifies Limestone Mines and Works as Designated Development. Accordingly, the Development Application for the Lime Kiln will need to be accompanied by an EIS.

Because the development is also classified as State Significant, the Minister for Planning is the Consent Authority.

3.9 Integrated Development

Integrated Development provisions aim to ensure that if a development consent is granted, other necessary approvals will also be given with conditions that are consistent with any conditions attached to the development consent.

Integrated Development is any development that requires development consent and another land use approval as described in the Environmental and Planning Assessment Act 1979. The other approvals include specific ones required under the Fisheries Management Act, 1994, the Heritage Act, 1977, the Mine Subsidence Compensation Act, 1961, the National Parks and Wildlife Act 1974, the Protection of the Environment Operations Act, 1997, the Rivers and Foreshores Act, 1948, the Roads Act, 1993, and the Soil Conservation Act, 1938.

The Lime Kiln Project will require modification of an EPA Licence under the Protection of the Environment Operations Act, 1997. It may also require consideration under the Roads Act, 1993, and the Rivers and Foreshores Act, 1948. Consequently, this Project is Integrated Development.

3.10 Environment Protection and Biodiversity Conservation Act, 1999

The Environment Protection and Biodiversity Conservation Act, 1999 is a Commonwealth Act that provides for the protection of the environment.

Under this legislation, it is illegal to undertake a defined action without Commonwealth Government approval. The Act defines a series of activities that trigger the application of the Act. These are defined as:

- A Commonwealth action which is likely to have a significant impact on the environment, or,

- An action which is likely to have a significant impact on a listed matter of national environmental significance. These listed matters are Ramsar wetlands, listed threatened species and ecological communities, World Heritage properties, listed migratory species, the Commonwealth marine environment and nuclear actions (including uranium mining).

Because there are no defined actions proposed, the Environment Protection and Biodiversity Conservation Act, 1999 does not apply to the Lime Kiln Project.

3.11 Planning Focus Meeting

Because it is subject to SEPP 34 (Refer Section 3.2), the Lime Kiln Project is classified as State Significant Development. In addition, in Sections 3.8 and 3.9, it is shown that the Project is classified as Designated Development, and Integrated Development. These classifications determine the assessment process for the Project.

The Minister for Planning has determined that any Project to which SEPP 34 applies is classified as State Significant Development for the purposes of Section 76A of the Environmental Planning and Assessment Act, 1979. Accordingly, the Minister will be the Consent Authority for the Lime Kiln Project.

The Development Application and accompanying Environmental Impact Statement will be assessed and processed by the Major Development Assessments Branch of PlanningNSW. PlanningNSW has published detailed guidelines for applicants to follow when making an application for State Significant Development.

Initial meetings and correspondence between the PlanningNSW and Project Management confirmed the broad Project Description and the various development classifications for the Project. A planning and approval process was discussed and agreed.

PlanningNSW requested that Blue Circle Southern Cement (BCSC) prepare for a Planning Focus Meeting (PFM). The purpose of the PFM was to familiarise all concerned with the proposal, so that early advice could be provided to the applicant on issues that may need to be addressed before the Development Application is lodged.

PlanningNSW considers the Project PFM to be an important part of the environmental assessment of major development proposals. The Lime Kiln Project PFM was held on 7 May, 2003. It brought together the major participants in the assessment process including the applicant, local Council, approval bodies and other relevant Government Agencies. In addition to PlanningNSW, these included the Department of Mineral Resources, Department of Sustainable Natural Resources, National Parks and Wildlife Service, Department of Agriculture and Harden Shire Council. Representatives from BCSC and their engineering and environmental consultants also attended. The Environment Protection Authority attended a presentation and site meeting the previous day.

The issues raised by the Government Agencies are contained in their subsequent submissions to PlanningNSW. These submissions are in Appendix A of this EIS.

A Request for Consideration under SEPP 34 was lodged with PlanningNSW. Harden Shire Council was informed of the intended Development Application and its relationship with SEPP 34.

The Development Application and Environmental Impact Statement will be lodged directly with PlanningNSW.

The initial phase of consideration will involve public exhibition of the Development Application, the Environmental Impact Statement and any associated documents.

Councils, Government Agencies and the public will be invited to make submissions on the proposal. Any submissions received by PlanningNSW will be forwarded to all relevant agencies.

PlanningNSW will co-ordinate the environmental assessment of the proposal by relevant authorities. To help with the assessment of the proposal, PlanningNSW may request additional information from BCSC.

PlanningNSW considers that the views of the Harden Shire Council are integral in the assessment of the Project. Council representatives were present at the PFM and have provided comments on the matters to be addressed in this Environmental Impact Statement. The Council will also be invited to make a submission on the Development Application.

3.12 Community Consultation

Throughout previous planning and approval processes of the various activities at Galong, company representatives have contacted members of the community in Galong and along access roads. BCSC will participate in effective community liaison to identify potential concerns early so that they can be best addressed throughout the process.

A public meeting has been held in the Galong Community Hall to outline the proposal to develop both the Mine Expansion Project and the Lime Kiln Project. During the planning process for the Mine Expansion, Barnu employees and consultants have had regular contact with members of the Galong Community and their elected representatives. This has continued through the planning process for the Lime Kiln Project.

The main issue raised by the community has been the effect of trucking on Galong. This issue has been addressed in detail in the Mine Expansion EIS and associated ongoing discussions with Harden Shire Council.

When the EIS is on display in Galong and Harden, representatives from Barnu and their environmental consultants will be available on specific occasions to help explain the Project and to advise the Community on the ways that they can participate in the planning process. The times for these specific occasions will be determined before the EIS and Development Application are placed on public display.

Chapter 4

The Lime Kiln Project

4. The Lime Kiln Project

4.1 Kiln Operating Principles

4.1.1 Introduction

Quicklime is produced by calcining, or burning, limestone. Limestone is predominantly calcium carbonate and the production of quicklime can be represented by the following equation:

$$CaCO_3 + \text{Heat Energy} \rightarrow CaO + CO_2$$

Two types of kiln are primarily used to calcine limestone in today's lime industry:

- Rotary kilns, and,
- Vertical shaft kilns.

Vertical shaft kiln technology is more energy efficient than that for rotary kilns. The heat balance of a rotary kiln is characterised by a high energy losses through the exhaust gases and through the kiln shell.

There are two main types of vertical shaft kilns:

- The single shaft counter flow heating kiln, and,
- The multiple shaft parallel flow (PFR) kiln.

A parallel flow regenerative (PFR) lime shaft kiln will be constructed at Galong.

4.1.2 The Multiple (Twin) Shaft Parallel Flow (PFR) Kiln

The proposed Galong Kiln will have twin shafts and is comparatively modern. It is internationally common and is considered best practice technology. The first parallel flow regenerative lime kilns came into operation in 1960s. It has now become the standard technology for modern shaft kilns. By 2000, there were about 320 lime shaft kilns operating on the parallel flow regenerative principle in about 50 countries world wide.

4.1.3 Operation of a Parallel Flow Regenerative Kiln

There are two key characteristics of the PFR kiln:

- The parallel flow of hot gases and limestone in the burning zone, and
- The regenerative preheating of all combustion air in the process.

The parallel flow of the limestone and combustion gases in the burning shaft provides better temperature characteristics in the kiln. The regenerative process provides the lowest heat consumption of all modern kilns.

The regenerative process requires two connected shafts. Each shaft is subject to two distinct

4.5 Strategic Planning

Section 2.2 of this EIS provides detail of the need for the Lime Kiln Project. It also details the strategic implications to Blue Circle Southern Cement (BCSC).

Galong is seen as a strategic investment, which underpins the future of BCSC operations in Southeastern Australia.

BCSC has entered the new millennium with the objective of increasing its exposure to the Australian cement market, whilst continuing to provide an unsurpassed level of customer support and service.

In summary, BCSC sees the Galong Lime Kiln Project as the preferred way for the company to position itself to take benefit of the potential growth in demand for quicklime in Southeastern Australia.

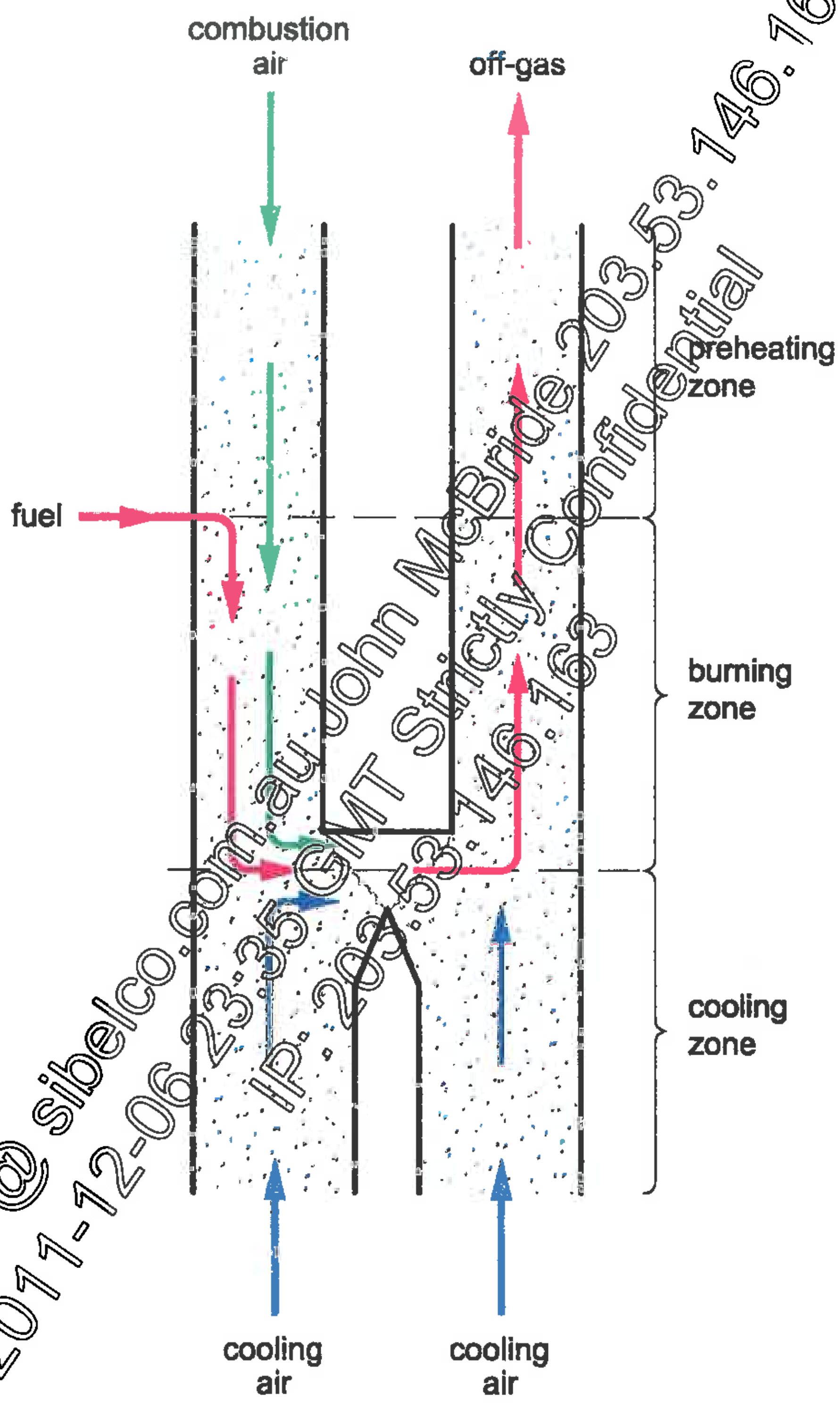
In addition, increasing crushed limestone activity at Galong enables BCSC to enter into an expanded range of minerals production.

4.6 Workforce

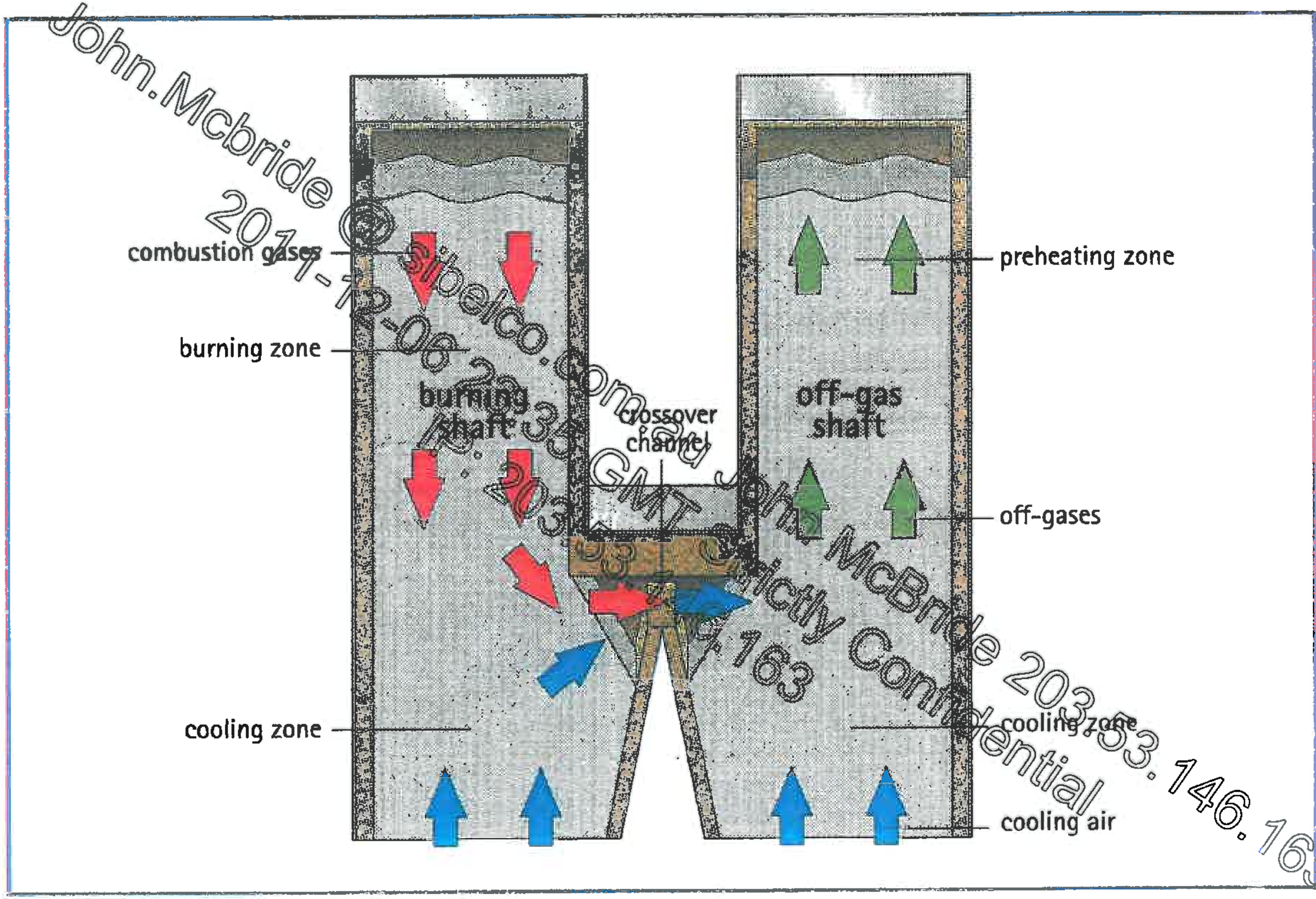
The average construction workforce will average approximately 40 per employees per 12 hour shift with a peak of approximately 60 or 70 per shift during the third quarter of construction. It is planned to work only one shift per day, from 6am to 6pm, for 6 days per week, Monday to Saturday. Some Sunday work may be required.

The construction workforce will consist of a typical range of skilled and semi-skilled employees with qualifications in boilermaking, fitting, electrical work, concreting and steel fixing. There will be earthworks specialists including piling rig operators, labourers, carpenters, landscape contractors and asphalt layers.

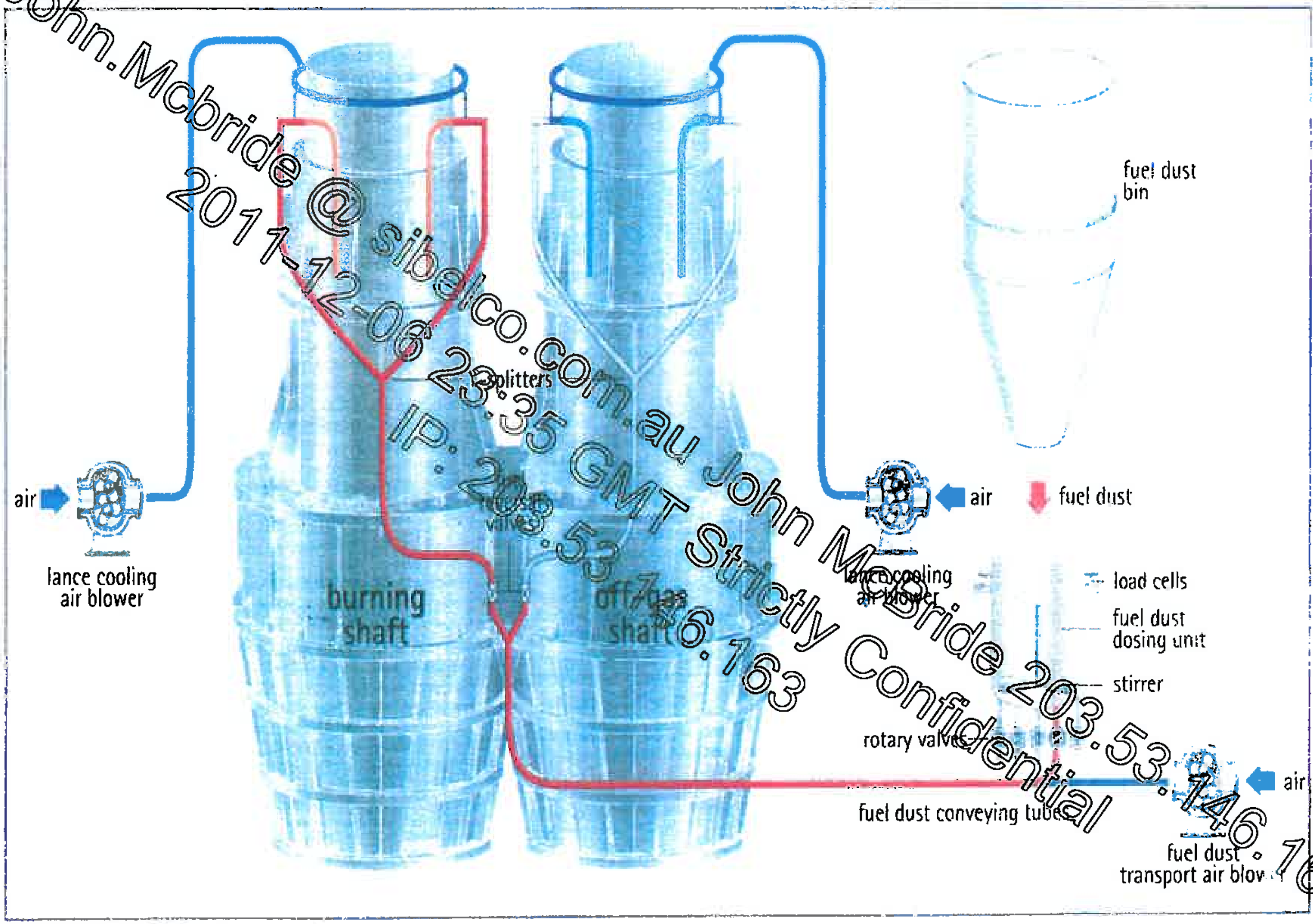
The operating workforce for the Lime Kiln will consist of an average of 4 people per day working over three shifts during a 24 hour day.



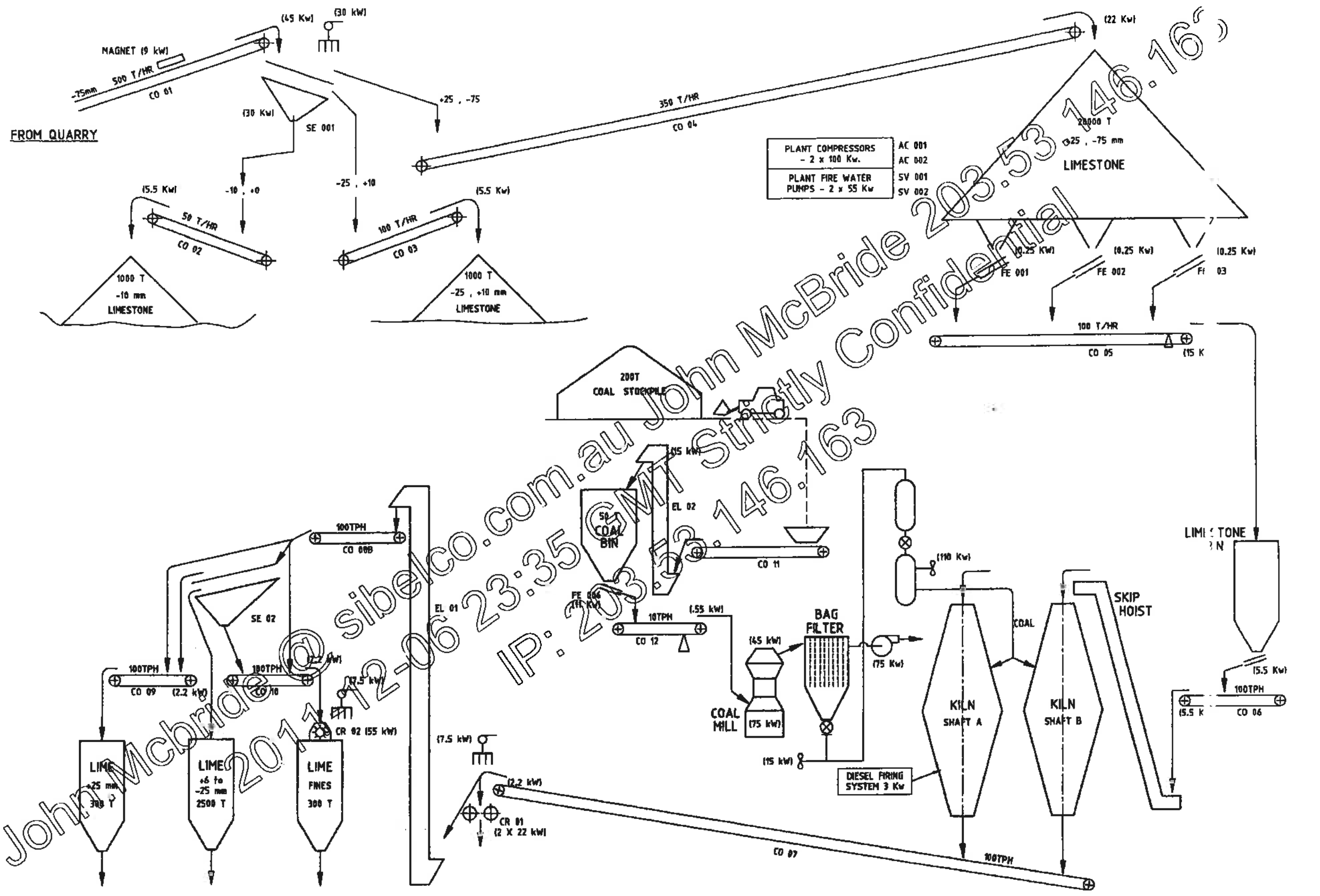
GALONG LIME KILN PROJECT
Figure 4.1
Flow Pattern in the Kiln Shaft



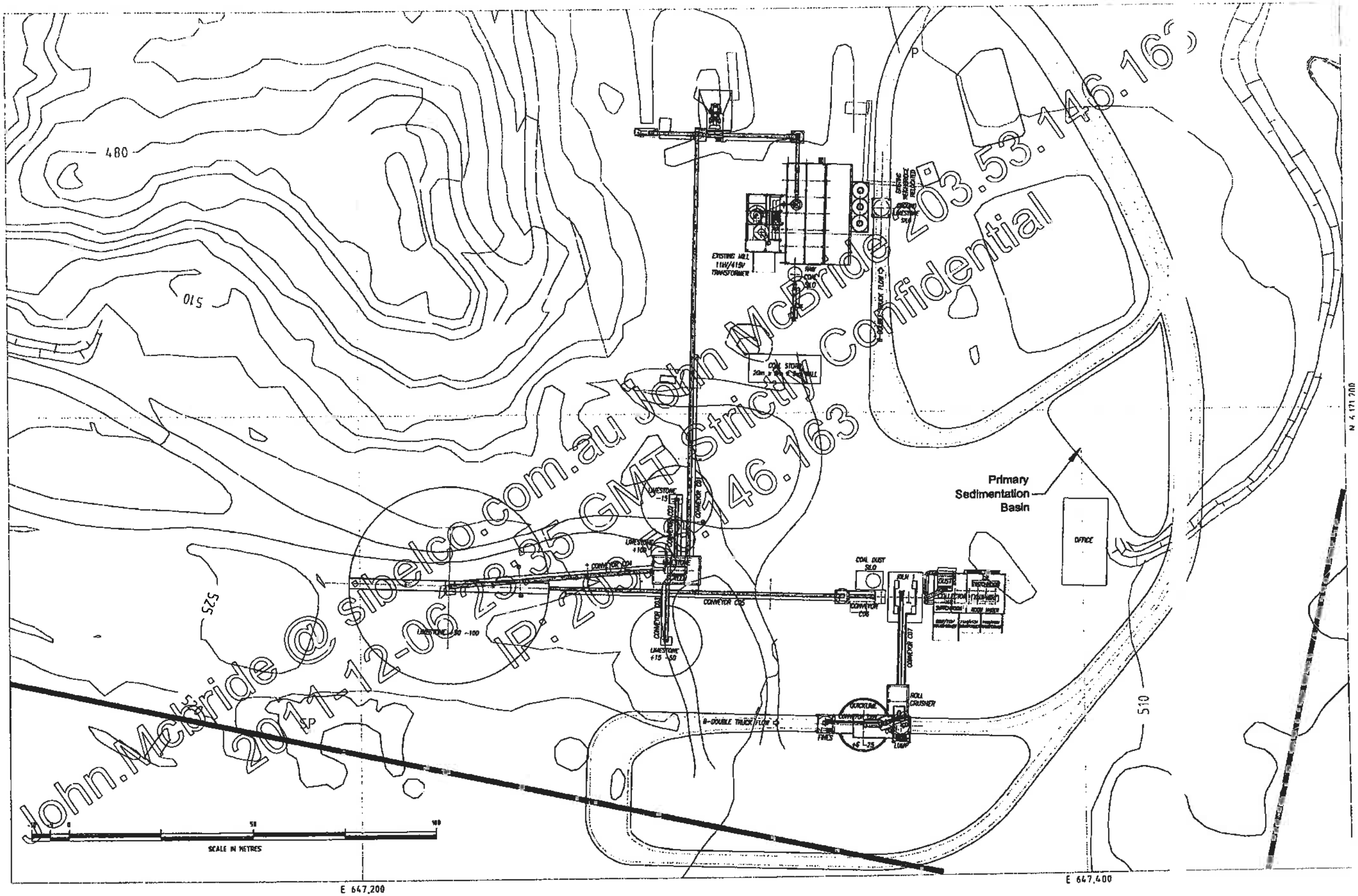
GALONG LIME KILN PROJECT
Fig 4.2
Gas Flow in the PFR Kiln



GALONG LIME KILN PROJECT
Fig 4.3
Pulverised Coal Fuel Firing System



GALONG LIME KILN PROJECT
Figure 1.4
Production Process Schematic



GALONG LIME KILN PROJECT
Figure 4.5
Plan Layout of Kiln & Infrastructure

Chapter 5

Project Alternatives

5. Project Alternatives

There were a number of alternatives considered by Blue Circle Southern Cement (BCSC) to satisfy the projected increased demand for quicklime in Southeastern Australia (Refer Section 2.2). The consideration included investigating a number of known limestone reserves, different kiln types, and transport issues. The alternatives are listed as follows:

- Develop the existing Marulan Operations,
- Reinstate the Marulan Calcimatic Kiln,
- Purchase existing operations external to BCSC,
- Develop a totally new greenfields site, and,
- Develop the existing Galong operation.

Each of these alternatives is discussed in the following sections.

5.1 Develop the Existing Marulan Operations

It would be possible to undertake development at the Marulan Site to meet the increased demands for quicklime and crushed limestone.

There are, however, a number of issues associated with Marulan development. The Marulan limestone deposit has limited reserves suitable for conversion to quicklime. A new Greenfield site, or an existing operation would provide longer term resource security.

Further development of the Marulan resource does not achieve resource diversity that is obtained by developing other alternatives such as Galong.

There is an existing lime kiln at Marulan. It is a rotary type kiln with a Low Pressure Drop Preheater and is capable of producing 550tpd of quicklime. The existing Marulan Kiln has a much higher fuel consumption compared to a new kiln. The kiln proposed for Galong is predicted to require 3.6GJ of energy per tonne of quicklime produced. The energy rating of the existing Marulan Kiln is 5.4GJ/t.

Any development at Marulan would require significant capital investment to overcome quality and limestone storage issues.

A number of alternative kiln types were considered. A Suspension Preheater Kiln similar to the one installed at Cockburn Cement in WA was considered for use at Marulan. This type of kiln would enable more of the lower quality stone in the Marulan Limestone deposit to be used than can be used in the vertical style of kiln proposed for Galong. However, the fuel consumption in a Suspension Preheater Kiln is typically 6.3GJ/t.

The Suspension Preheater kiln was not preferred because of initial high capital cost and ongoing operating costs when compared to a vertical kiln. The possibility of installing a new vertical kiln at Marulan was also considered and it does have favourable capital and operating costs.

The quantity of suitable quality limestone at Marulan did not compare favorably with the new or other existing sites investigated.

5.2 Reinstate the Calcimatic Kiln

There is an existing Calcimatic Lime Kiln at Marulan. This is an old circular kiln that has not been operated for at least ten years. It is possible to reinstate this kiln, however, this is a costly option and has more significant Occupational, Health, Safety and Environmental issues when compared to other options.

5.3 Purchase Existing Operations External to BCSC

There are a number of alternative lime kilns located in Southeastern Australia that could be purchased and upgraded to meet the projected increased demand for quicklime and crushed limestone. There are significant capital costs in such a purchase and the ongoing operating costs were greater than or equal to other alternatives. Purchasing existing operations, other than Galong, did not provide any benefits associated with diversification of resource utilisation.

5.4 Develop a Totally New Greenfields Site

The cost of installing and operating a new vertical kiln at a totally new Greenfield site would be approximately the same as that for an existing operation. However, significant additional capital expenditure would be needed to establish access and provide services and other facilities.

The new Greenfield sites that were investigated had poor access to major transport facilities. New Greenfield options were less preferred than the development of an existing operation.

5.5 Develop the Existing Galong Operation

This is the preferred option. The capital expenditure for a new vertical kiln at Galong is viable.

The site has good access to Victoria, New South Wales and South Australian markets by both highway and rail.

There are sizeable reserves of suitable quality limestone. The existing Galong Limestone Mine has identified reserves in excess of 150Mt and BCSC have developed plans to extract 20Mt of this detailed in a 40 Year Mine Plan.

The site is relatively isolated and provides an ideal site to manage environmental impacts.

Future expansion beyond the 150ktpa proposed in this Development Application, would be able to be accommodated at the Galong Site.

Development of Galong enables resource diversification for BCSC.

Chapter 6

The Existing Environment and Impact Assessment

6. The Existing Environment and Impact Assessment

6.1 Topography and Geology

6.1.1 Regional Topography

The Galong Lime Kiln Project is located within the northeastern part of the Murrumbidgee River Basin in an area of undulating to hilly topography where relief varies from 450m AHD to 750m AHD.

6.1.2 Local Topography

The Project is located in the upper part of Limestone Creek catchment in a broad open valley that faces in a northwesterly direction. The Lime Kiln and associated infrastructure will be built in a small area of land, less than 4 hectares in total area, immediately south of the existing Mine Processing Facilities. Currently, the area is covered by crushed agricultural lime stockpiles and mine overburden. These will be relocated or rationalised prior to construction of the Kiln. Land that will be disturbed for the Lime Kiln Project slopes gently to the east and towards Limestone Creek.

The topography of the Lease Area is illustrated on Figure 6.1. A series of low rises, separated by shallow drainage lines characterise much of the Lease Area. Figure 6.1 also shows the location of the Lime Kiln Project.

The topography within the Lease Area has been modified by the development of the existing open cut (approximately 40m deep), overburden stockpiles (up to 15m above natural ground level), the installation of processing facilities and water management structures. Natural elevations vary from 505-520m AHD in the southern part of the Mining Lease to 495-505m AHD in the north. Relief across the Mining Lease varies by up to 25m. Slopes generally range from less than 1:100 to 1:20 (V:H).

6.1.3 Geology and Resources

The geology of the Mining Lease is characterised by a north-south trending body of massive and locally fossiliferous limestone, which is surrounded on its eastern and western sides by poorly outcropping acid to intermediate volcanic and intrusive rocks.

Investigations of rock outcrops indicate that the limestone body extends north from the open cut for at least 1.4km. Exploration drilling undertaken by Barnu has confirmed that the limestone body is between 250m and 600m wide and occurs both east and west of Limestone Creek.

The limestone deposit strikes generally north-south and dips vertically.

The existing open cut has been worked to approximately 40m depth, allowing good exposure of the limestone body. A total of 163 bore holes have been drilled in the deposit to assess the overburden thickness, limestone quality and the presence or otherwise of water. Most holes were less than 30m deep but Barnu's recent drilling program was able to intersect 70m of limestone in many places.

Typical analyses of samples of limestone recovered from Barnu's recent drilling program generally yielded $CaCO_3$ concentrations of greater than 95%. Overall, the limestone deposit is of high quality and most suited for the production of agricultural lime and quicklime. The extensive geological investigations undertaken have enabled a resource of 20Mt of limestone to be defined within the proposed limit of mining.

6.2 Meteorology

6.2.1 Data Sources

RW Corkery and Co Pty Limited sourced the bulk of the meteorological data presented in this section from the Bureau of Meteorology Station No. 070091 at Yass (Linton Hostel), approximately 40km southwest of the Galong Mine. Meteorological data have been collected at this station over various durations (31 years to 104 years) since 1898 and consequently is believed to provide an accurate reflection of the long-term meteorological conditions experienced at the Project Site. Meteorological data collected from the Yass station are summarised in Table 6.1.

Data on wind strength and direction have been sourced from the Bureau of Meteorology Station No. 073138 at Young Airport (approximately 46km northwest of the Galong Mine). The wind data was selected from the Young station to assist with the acoustic assessment of the proposal as recordings are based on hourly measurements compared to the Yass station data where recordings are only measured at 9.00am and 3.00pm daily.

Barnu has established a comprehensive meteorological station on site in January 2003 and will be compiling site specific data for evaluation of a range of environmental components in the future.

6.2.2 Temperature

January is the hottest month with a mean daily maximum of 29.3°C and a mean daily minimum of 13.9°C. July is the coldest month with a mean daily maximum of 11.6°C and a mean daily minimum of 1.0°C.

Table 6.1 Climatic Summary (Yass - 1898 to 2002)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Temperature (°C) (51 years of records)													
Mean Daily Maximum	29.3	28.9	25.6	21.1	16.3	12.6	11.6	13.4	16.6	20.4	24.1	27.7	
Mean Daily Minimum	13.9	13.9	11.0	6.9	4.0	2.1	1.0	1.8	4.0	6.3	9.1	11.9	
Rainfall (mm) (104 years of records (mean monthly) and 94 years of records (mean rain days)													
Mean Monthly	51.1	44.2	47.5	50.2	51.9	56.9	58.9	59.4	56.7	66.5	54.6	52.1	650.1
Mean Rain days	6.0	4.8	5.4	6.2	7.4	10.0	11.2	10.7	9.3	8.7	7.1	6.2	93.0
Relative Humidity (%) (47 years of records (9.00am) and 31 years of records (3.00pm))													
9.00am	60	66	68	75	83	87	86	81	75	66	61	·57	
3.00pm	38	41	44	50	62	69	67	61	57	51	46	37	
Frost Frequency (days/month) (34 years of records)													
Mean Monthly	0	0.1	0.2	2.1	6.6	10.6	12.8	10.1	7.1	2.4	0.4	0	52.3
Fog Frequency (days/month) (34 years of records)													
Mean Monthly	0.4	0.5	1.2	2.8	5.9	7.5	6.9	4.3	1.8	0.7	0.4	0.2	32.6

Source: Bureau of Meteorology Station No. 070091 at Yass (Linton Hostel)

6.2.3 Rainfall

The annual rainfall distribution recorded at Yass shows October is generally the wettest month of the year (66.5mm) with February having the least rainfall (44.2mm). On average, Yass experiences 93 rain days per year, with a mean annual rainfall of 650mm.

In the Yass area there are generally two main causes of precipitation:

- The eastward movement of low pressure cells and associated frontal systems along the southern margins of the continent gives rise to widespread rains of long.duration in the winter months.
- During the summer months convectional lifting of moist air during the hottest part of the day, results in the formation of cumulus or cumulonimbus clouds which produce showers and thunderstorms. These usually occur towards evening and are of short duration and intensity and do not occur over large areas.

6.2.4 Temperature Inversions

Temperature inversions are significant noise enhancing phenomena and are often expressed as fogs and/or frosts. They invariably occur during an evening with clear skies and when wind speeds are low or calm conditions prevail. The inversions normally disappear the following morning.

Frosts generally occur between April and October, with July having the greatest mean number of frosts at 12.8 per month. The annual mean number of frosts is 52.3.

Records kept over 34 years show an average of 32.6 fog days per year. Table 6.P shows that while fogs may potentially occur at any time of year, they are far more likely to do so during the colder months, from April to September. June and July have the highest mean number of fogs per month with 7.5 and 6.9 respectively.

6.2.5 Wind

Wind has the potential to transport airborne dust, disperse kiln emissions and increase noise at a receiver, particularly when it is light and stable and blows from the direction of the source of noise.

Seasonal wind speed and wind direction data recorded at Young is based on average monthly observations at 9.00am and 3.00pm collected over a 13 year period.

During the summer months, northerly and easterly winds dominate in the morning with westerly winds becoming more prevalent in the afternoons. Easterly and southeasterly winds dominate during Autumn in the morning, with westerly and southwesterly winds dominating in the afternoon. In winter, the dominant winds blow from the south in the mornings and swing further to the west later in the day. Spring winds are generally from the north in the morning, but with variable occurrences of northerly and easterly winds towards the end of spring. Wind strength increases during the day with strong westerly winds dominating in the afternoons during spring.

6.3 Land Ownership

The land ownership status and nearest neighbouring residences to the Project are illustrated on Figure 6.2. With the exception of Portion 139 and Crown Road Reserves, all land within and surrounding the Galong Limestone Mine is freehold land owned by Bobbara Pastoral Company Pty Ltd.

Portion 139 comprises Crown Land under the care and control of the Department of Mineral Resources. The Crown Road Reserves within the Mining Lease are administered by the Department of Land and Rural Affairs, are unfenced and are grazed by Bobbara Pastoral Company. Prior to the creation of the internal mine access roads, the Crown Road Reserves provided the main access to Portion 139 and other parcels of land within and beyond the Galong Mine.

The two nearest residences to the existing mine are informally known as the Brown and Englert residences. Both these residences are located on land owned by Bobbara Pastoral Company and are project-related.

Table 6.2 lists the distances between the residences on surrounding properties and the existing processing facilities on the mine.

Table 6.2 Nearest Residential Locations

Location	Distance from Kiln
Brown Residence*	2.7 km
"Hilltop"*	3.4 km
"Athlone"	5.3 km
"Beulambil"	4.8 km
"Highview"	4.7 km
"Cherryvale"	4.1 km
"Glenroy"	4.6 km
"Woodstock"	3.8 km
Township of Galong	4.4 km

* Note: The Brown residence and "Hilltop" are mine-related residences, as they, and the existing Galong Limestone Mine are situated on land owned by the Bobbara Pastoral Company Pty Ltd.

6.4 Land Use

With the exception of mining and processing operations, all land within and surrounding the Lime Kiln Project is used for sheep and cattle grazing and/or cropping.

6.5 Flora

6.5.1 Introduction

The flora of the Galong Mine Expansion Project Site was studied by Geoff Cunningham Natural Resource Consultants during the preparation of the EIS for that Project. This section utilises that study to describe the flora characteristics of the Galong Lime Kiln Site. The impact of the Lime Kiln Project is assessed.

A complete copy of the flora assessment is included in Volume 3 of this EIS.

The area directly affected by the Galong Lime Kiln Project is less than 4 hectares and lies within and to the southern edge of the area affected by the Galong Mine Expansion Project. The Mine Expansion Site covers 160 hectares.

The flora study involved initial examination of colour aerial photographs of the Galong Mine Expansion Site in order to locate and map vegetation community features and boundaries. A total of twenty-four 50m x 50m quadrats were examined to record the occurrence of all tree, shrub and ground species present.

Figure 6.3 presents the boundaries of the vegetation communities identified across the Galong Site and the location of the quadrats examined.

6.5.2 Vegetation Communities

The flora study identified the following three vegetation communities within the Galong Site.

- Community 1 - Cleared Lands - Used for grazing and/or cultivation

- Community 2 - River Red Gum (*Eucalyptus camaldulensis*) Community
- Community 3 - White Box (*Eucalyptus albens*), Yellow Box (*Eucalyptus melliodora*), Blakely's Red Gum (*Eucalyptus blakelyi*), Apple Box (*Eucalyptus bridgesiana*) Community

Community 1 - Cleared Lands

This community has essentially been cropped or sown with improved pasture species. A high proportion of introduced species are presented in the ground cover layer.

The community is basically treeless although some shade trees remain as single trees or small clumps of White Box (*Eucalyptus albens)*, Blakely's Red Gum (*Eucalyptus blakelyi*), Yellow Box (*Eucalyptus melliodora)* and Apple Box (*Eucalyptus bridgesiana)*.

The main ground cover species include Wild Oats *(Avena sp.*)*, Mustardweed (Brassicaceae - unidentifiable*), Great Brome (*Bromus diandrus**), Paterson's Curse (*Echium plantagineum**), Annual Ryegrass (*Lolium sp.*),* Skeleton Weed (*Chondrilla juncea**), Lucerne (*Medicago sativa**), Scotch Thistle (*Onopordum acanthium**), Phalaris (*Phalaris aquatica**), Wireweed (*Polygonum* sp.*) and Wheat (*Triticum aestivum**). *Note: * denotes an introduced species.*

Community 2 - River Red Gum Community

This community essentially follows Limestone Creek and comprises a high proportion of the remnant native timber stands on the Galong Site. The main species present are River Red Gum (*Eucalyptus camaldulensis*) with scattered individuals of Blakely's Red Gum (*Eucalyptus blakelyi*) and Apple Box (*Eucalyptus bridgesiana*).

A large clump of the introduced Tree of Heaven (*Ailanthus altissima**) occurs to the east of the existing open cut near Limestone Creek and there are scattered occurrence of the noxious Briar Rose (Rosa rubiginosa*) throughout the community. *Note: * denotes an introduced species.*

The main ground cover species are Wild Oats (*Avena* sp.*), Spear Thistle (*Cirsium vulgare**), Couch Grass (*Cynodon dactylon**), Paterson's Curse (*Echium plantagineum**), Paspalum (*Paspalum dilatatum**), Scotch Thistle (*Onopordum acanthium**), Phalaris (*Phalaris aquatica**), Wireweed (*Polygonum* sp.*), Slender Dock (*Rumex brownii*) and Cumbungi (*Typha* sp).

Community 3 - White Box - Yellow Box - Blakely's Red Gum - Apple Box Community

This community comprises scattered clumps and some larger remnants of woodland. White Box and Blakely's Red Gum tend to be most common on the upper slopes and crests with Yellow Box and Apple Box more common on the lower slopes.

The main ground cover species include Wild Oats (*Avena* sp.*), Great Brome (*Bromus diandrus**), Paterson's Curse (*Echium plantagineum**), Annual Ryegrass (*Lolium* sp.*), Scotch Thistle (*Onopordum acanthium**) and Silver Grass (*Vulpia* spp.*).

Figure 6.3 shows the distribution of these three communities over the larger Mine Expansion Site and shows the location of the Lime Kiln Project with respect to these communities.

6.5.3 Threatened and Endangered Flora Communities

6.5.3.1 NSW Threatened Species Conservation Act 1995

A review of the Schedules 1 and 2 of the Threatened Species Conservation Act 1995 confirmed that there are no threatened species or endangered plant or flora populations recorded on the Galong Site. However, the endangered White Box, Yellow Box, Blakely's Red Gum Woodland Community (Community 3) is listed under the Schedules as likely to occur in the Galong region.

The field survey, undertaken by Geoff Cunningham Natural Resource Consultants, confirmed that there are no threatened plant species on the Mine Expansion Project Site as listed under Schedules 1 and 2 of the Act. As a result of this finding, it has been concluded that there would not be any threatened species on the Galong Lime Kiln Project Site.

Geoff Cunningham Natural Resource Consultants noted that the Galong Mine Expansion Project Site contains remnant vegetation that can be described as representative of the endangered White Box, Yellow Box, Blakely's Red Gum Woodland Community (Community 3). However, they concluded that given the degree of clearing that has taken place over the majority of the Mine Expansion Project Site and the heavily invaded nature of the ground flora over the area proposed for future extraction, the majority of vegetation present cannot be classed as a remnant of these communities.

However, the National Parks and Wildlife Service recognise that some remnant communities may be degraded. They include, in the definition of the community, "vegetation, either understorey or overstorey or both, would, under appropriate management, respond to assisted natural regeneration, such as where natural soil and associated seed bank are still at least partially intact".

It is planned that the Lime Kiln and access road will be constructed to avoid removing trees that are characteristic of Endangered Community 3. One or two trees may require removal of low branches to avoid interference with trucks on the new access road.

6.5.3.2 Commonwealth Environment Protection and Biodiversity Conservation Act 2000

The Schedule of Threatened Ecological Communities of the Environment Protection and Biodiversity Conservation Act 2000 (EPBC Act) lists Grassy White Box Woodlands as likely to occur in the region surrounding the Galong Site. This community has endangered status under the EPBC Act. Elements of the White Box, Yellow Box, Blakely's Red Gum, Apple Box Community (Community 3) are characteristic of the Grassy White Box Woodland Community and consequently, Environment Australia were contacted to determine whether the proposed Galong Mine Expansion Project constituted a "controlled action" under the Act.

Environment Australia have advised that the proposed Mine Expansion Project is not a controlled action under the Act.

The Lime Kiln Project affects a much smaller area and is located within the Mine Expansion Project Site and is not a controlled action.

6.5.4 Flora Impact Assessment

The area around the Galong Lime Kiln Project contains remnant native vegetation that could be described as representative of the Endangered White Box-Yellow Box-Blakely's Gum Woodland Community (NSW) and the Grassy White Box Woodlands (EPBC Act).

The proposed construction and operation of the Lime Kiln, associated structures and access roads would be undertaken in a way that avoids removal of any trees that are elements of these endangered communities.

Storm water diversions and erosion control systems and methodologies will ensure that there will be no surface water impacts on this remnant native vegetation.

Barnu Pty Limited are committed to develop a mine rehabilitation and general area revegetation programme based on planting trees from this endangered community. This programme will result in an increase in the number of species representative of this community in the Galong area.

Geoff Cunningham Natural Resource Consultants determined that no Threatened plant species or Endangered plant populations listed in Schedules 1 and 2 of the Threatened Species Conservation Act 1995 had previously been identified on/or within a 30km radius of, the Galong Mine Expansion Project Site. They noted however, that the Endangered White Box-Yellow Box-Blakely's Red Gum Woodland Ecological Community is listed in the Schedules of the Act as likely to occur in the Galong Region. Additionally, the Endangered Grassy White Box Woodlands, which is listed under the Environmental Protection and Biodiversity Conservation Act 2000, is also likely to occur in the Galong Region.

Remnants of both these communities occur on the Galong Mine Expansion Project Site and the much smaller Galong Lime Kiln Project Site. Consequently, an 8 Part Test of Significance was undertaken in accordance with Section 5(a) of the Environmental Planning and Assessment Act 1979 to determine whether the Lime Kiln Proposal is likely to have a significant effect on the overall survival of these communities.

Table 6.3 details the 8 Part Test results.

Table 6.3 8-Part Test of Significance for Flora Species

(a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction	No threatened flora species were recorded during the field survey and there are no records of collections of Threatened flora species from the Galong Mine Expansion Project Site. It is concluded that similarly, there are no Threatened flora species on the Galong Lime Kiln Project Site. Consequently there would be no disruption to the life cycle of a Threatened flora species caused by the proposed development.
(b) in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised	No Threatened plant populations have been listed in the Schedules of the NSW Threatened Species Conservation Act or the Commonwealth Environment Protection and Biodiversity Conservation Act for the larger Galong Mine Expansion Project Site. As a consequence, the proposed Lime Kiln development would not disrupt / compromise any local populations of Threatened plant species.

(c) in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed	The Lime Kiln Project Site is not considered to constitute a significant habitat for any Threatened plant species or flora population. No Threatened populations of flora are listed for the larger Mine Expansion Project Site, and none were recorded during field survey, and so there would not be any significant modification or removal of habitat of Threatened flora species or flora populations.
(d) whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community	The Lime Kiln Project Site does not constitute a known habitat for any Threatened plant species or population. The Lime Kiln Site is surrounded by remnants of the original White Box - Yellow Box - Blakely's Red Gum Woodland [NSW] and Grassy White Box Woodlands [EPBC Act] Endangered Ecological Community. The proposed Lime Kiln development would not cause any isolation. Consequently there would no significant impact.
(e) whether critical habitat will be affected	No critical habitat exists at the Lime Kiln Project Site. Therefore the proposed development would not affect critical habitat.
(f) whether a Threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves [or similar protected areas] in the regional environment of the species, population or community	The Lime Kiln Project Site in its present state does not support any Threatened plant species or population and so this part is not relevant to consider in the context of threatened species or flora populations. However, in relation to the White Box - Yellow Box - Blakely's Red Gum Woodland [NSW] and Grassy White Box Woodlands [EPBC Act] it is noted that this community is regarded as being poorly represented in conservation reserves although it is recorded from Border Ranges National Park, Goulburn River National Park, Mount Kaputar National Park, Oxley Wild Rivers National Park, Queanbeyan Nature Reserve, Warrumbungle National Park, and Wollemi National Park. It also occurs in Copeton, Lake Glenbawn and Lake Keepit State Recreation Areas [Scientific Committee, 2002].

(g) whether the development or activity is of a class of development or activity that is recognised as a threatening process	Clearing of Native Vegetation has been listed as a Key Threatening Process on Schedule 3 to the Threatened Species Conservation Act. Land Clearance is also listed as a Key Threatening Process under the Commonwealth Environment Protection and Biodiversity Conservation Act, 1999. The proposed construction of the Lime Kiln and associated structures and roadway would involve some clearance of native vegetation, but this would be minimal. However, as a consequence of past clearing, grazing and cropping as well as mining activity and invasion of the site by a wide range of exotic weed species, the native plant communities have been heavily modified.
(h) whether any threatened species, population or ecological community is at the limit of its known distribution	No.

Source: Modified from Geoff Cunningham Natural Resource Consultants.

The 8 Part Test of Significance confirmed that the Lime Kiln proposal would have no significant impact on any Threatened flora species or populations, Endangered ecological communities or critical habitat.

Geoff Cunningham Natural Resource Consultants also undertook an assessment of the likelihood of 14 Threatened flora species occurring on the Mine Expansion Project Site. Their assessment covered plant species listed in the Schedules of the Threatened Species Conservation Act 1995 which could potentially occur at Galong.

The fourteen plants assessed were Ammobium craspedioides, Diuris sheaffiana (tricolor), Caesis parviflora var. minor, Caladenia concolor, Calotis glandulosa, Eucalyptus arguta, Goodenia macbarroii, Hemoranthus darwinioides, Lepidium hyssopifolium, Prasophyllum petilum, Swainson recta, Thesium australe and Zieria obcordata.

Their assessment concluded that the likelihood of any species occurring on the Mine Expansion Project Site was possible, although unlikely. A similar conclusion can be reached for the smaller Lime Kiln Project Site.

6.6 Fauna

6.6.1 Introduction

The fauna of the Galong Mine Expansion Project Site was studied by Countrywide Ecological Service during the preparation of the EIS for that Project. This section utilises that study to describe the fauna characteristic of the Galong Lime Kiln Site. The impact of the Lime Kiln Project is assessed.

The area directly affected by the Galong Lime Kiln Project is less than 4 hectares and lies within and to the southern edge of the 160 hectare area affected by the Galong Mine Expansion Project.

A complete copy of the fauna assessment is included in Volume 3 of this EIS.

The fauna study was undertaken during late January and early February 2003 and involved a desktop assessment of existing literature, supported by a two-day field survey. A review was also undertaken of threatened and endangered species listed under State and Commonwealth Government legislation as likely to occur within or surrounding the Galong Site.

A search undertaken of the Atlas of NSW Wildlife (National Parks and Wildlife Service, 2003) and unpublished sources including Blakers et al (1984), Cogger (2000), Strahan (1995), NPWS (1999) and Churchill (1998) confirmed that at least 11 frog species, 111 bird species, 40 mammal species and 20 reptile species are known to occur in the region covered by the Yass 1:100 000 map sheet area, within an area known as the Southeastern Highlands Bioregion.

The field survey involved day and night time visual inspection for a range of terrestrial species, along with selective call analyses for bird and bat species.

6.6.2 Survey Results

Amphibians

Survey method:	Evening search along Limestone Creek and around small impoundments.
Species targeted:	Green and Golden Bell Frog (*Litoria aurea*).
Survey results:	No amphibians were recorded on the Mine Expansion Project Site.

Birds

Survey method:	Examination of vegetation corridors along Limestone Creek, Eubindal Road and to the west of the existing open cut. The survey involved call analysis, direct observation and opportunistic sampling. The calls of listed threatened owl species were broadcast from a callback broadcast site to determine whether these species were present in the area.
Species targeted:	Special attention was placed on the occurrence of the Turquoise Parrot (*Neophema pulchella*), Superb Parrot (*Polytelis swainsonii*,) and Swift Parrot (*Lathamus discolor*) and their habitat.
Survey results:	Seventeen protected bird species were identified on the larger Galong Mine Expansion Project Site (Refer Table 6.4).

Small Mammals

No sampling was conducted to target live small mammals as the area of the proposed Mine Expansion is a cultivated paddock. Similarly the area proposed for the Lime Kiln has been cultivated and is heavily disturbed by activity associated with storage of mine product and overburden.

Microbats

Survey method:	Recording of bat calls along a spotlight transect using ANABAT ultrasonic recorder.

Survey results: Six protected bats and two vulnerable bat species were identified on the Mine Expansion Project Site (Refer Table 6.4). The two vulnerable bat species were both identified from a single call during the two hour recording period.

Table 6.4 Project Site Fauna

Common Name	Scientific Name	Status
Bats		
Family Molossidae		
White-striped Mastiff-bat	*Nyctinomus (Tadarida) australis*	P
Little Mastiff-bat	*Mormopterus planiceps (sp 2)*	P
Undescribed Mastiff-bat @ 27KHz	*Mormopterus sp nov.*	P
Family Vespertilionidae		
Chocolate Wattled Bat	*Chalinolobus morio*	P
Gould's Wattled Bat	*Chalinolobus gouldii*	P
Large Forest Eptesicus	*Vespadelus (Eptesisus) darlingtoni*	P
Large Bent-wing Bat	*Miniopterus schreibersii*	V
Family Emballonuridae		
Yellow-bellied Sheathtail	*Saccolianus flaviventris*	V
Reptiles		
Marbled Gecko	*Christinus marmoratus*	P
Lace Monitor	*Varanus varius*	P
Marbled Gecko	*Christinus marmoratus*	P
South-eastern Morethia Skink	*Morethia boulengeri*	P
Birds		
Variegated Wren	*Malurus assimilis*	P
Australian White Ibis	*Threskiornis molucca*	P
Pacific Duck/Mallard* Cross	*Anas supercillosa/platythynchos*	P
Wedge-tailed Eagle	*Aquila audax*	P
Stubble Quail	*Coturnix pectoralis*	P
Brown-headed Honeyeater	*Melithreptus brevirostris*	P
Brown Falcon	*Falco berigora*	P
Yellow Thornbill	*Acanthiza nana*	P
Sulphur-crested Cockatoo	*Cacatua galerita*	P
Galah	*Cacatua roseicapilla*	P
Australian Magpie	*Gymnorhina tibicen*	P
Laughing Kookaburra	*Dacelo novaeguineae*	P
Rainbow Bee-eater	*Merop ornatus*	P/J
Magpie-lark	*Grallina cyanoleuca*	P
Eastern Rosella	*Platycercus eximius*	P
Crested Pigeon	*Ocyphaps lophotes*	P
Australian Wood Duck	*Chenonetta jubata*	P
* = Introduced species; P = Protected; V = Vulnerable; J = CAMBA listed species (this species was not listed in the Environment Australia database as occurring within a 10km radius of the Project Site).		
Mammals		
Eastern Grey Kangaroo	*Macropus giganteus*	
Ring-tailed Possum	*Pseudocheirus peregrinus*	
Brush-tailed Possum	*Trichosurus vulpecular*	
Swamp Wallaby	*Wallabia bicolour*	
House Mouse*	*Mus domesticus*	

Cattle*	*Bos tauris*	
European Red Fox*+	*Vulpes vulpes*	
Farm Dog*	*Lepus familairis*	
Brown Hare	*Lepus capenis*	
European Rabbit *+	*Oryctolagus cuniculus*	
Feral Cat *+	*Felis cattus*	

These are either common native species or exotic (*) species. The exotic species recorded included the European Red Fox and the Feral Cat which are listed a Key Threatening Processes (+) in NSW (TSC Act) and Federally (EPBC Act).

Source: Modified from Countrywide Ecological Service (2003) - Tables 8, 9 10 and 11.

Nocturnal Species and Arboreal Mammals

Survey method: Two 2-hr spotlight searches were conducted along Eubindal Road, the mine access road and tracks surrounding the open cut, using 50-watt spotlights mounted either side of a slow moving vehicle. Recorded calls of listed threatened species were played at a callback broadcast site while spotlighting.

Species targeted: Recorded calls targeted the Koala (*Phascolarctos cinereus*), Yellow-bellied Glider (*Petaurus australis*), Squirrel Glider (*Petaurus norfolcensis*), Bush Stone-curlew (*Burhinus grallarius*), Barking Owl (*N. connivens*), Sooty Owl (*Tyto tenebricosa*) and Masked Owl (*T. novaehollandiae*).

Survey results: The King-tailed Possum and Brush-tailed Possum were the only nocturnal species identified on the Mine Expansion Project Site.

Reptiles

Survey method: Systematic searches conducted in the leaf litter, along Limestone Creek, small creeks, under rocks and logs.

Survey results: Four protected reptile species were located on the Mine Expansion Project Site (Refer o Table 6.4). All reptiles recorded are common protected species.

Invertebrates

Survey method: Daytime searches conducted for giant dragonfly adults and larvae in all potential habitats.

Survey results: No invertebrates were recorded on the Mine Expansion Project Site.

Fish

A fish survey was not undertaken as all drainages within the Mine Expansion Project Site were dry at the time of the survey.

Five fox scats that were found on the Mine Expansion Project Site were examined macroscopically but did not yield any evidence of animal remains (hairs, feathers, bones, nails or scales).

6.6.3 Threatened and Endangered Fauna

6.6.3.1 NSW Threatened Species Conservation Act 1995

None of the species listed as threatened under the Threatened Species Conservation Act 1995 that are known to potentially occur in the Harden Local Government Area were identified on the Mine Expansion Project Site during the field survey. Consequently, none are expected on the Lime Kiln Site.

6.6.3.2 Commonwealth Environment Protection and Biodiversity Conservation Act 2000

Countrywide Ecological Service undertook a search of the Environment Australia on-line database to identify those threatened or endangered species listed under the Schedules of the Environment Protection and Biodiversity Conservation Act 2000, known to occur within a 10km radius of the Mine Expansion Project Site. None of the species listed were identified on the Project Site during the field survey. Consequently, none are expected on the Lime Kiln Project Site.

6.6.4 Fauna Impact Assessment

The Countrywide Ecological Service survey determined that the overall significance of impact on fauna due to the Mine Expansion Project would be low and associated with clearing activity.

The impact of the Kiln Project on flora is similarly considered to have a low significance. This consideration is based on the small area affected by the Lime Kiln Project, the nature of activity, steps that will be taken to avoid clearing remnant trees, and the proposal to undertake a landscaping plan utilising local native flora.

Countrywide Ecological Services undertook an 8 Part Test of Significance on the six species listed under the Threatened Species Conservation Act 1995 that could potentially be affected by the proposed implementation of the Mine Expansion Project.

This 8 Part Test of Significance is reproduced in full in Table 6.5.

Table 6.5 8 – Part Test of Significance for Fauna Species

Test Component	Superb Parrot, *Polytelis swainsonii*	Swift Parrot, *Lathamus discolor*
(a) Whether the life cycle of a threatened species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.	This species uses the region on a seasonal basis and this species is not known to nest within the Survey Area. The proposed activities would involve a small number of trees which would be further detrimentally affected by the recent construction of a contour bank upslope from them. This is within the scope of "normal agricultural practice". Thus, the proposed activity would not place upon the population any additional risk of extinction and the relatively minor scale of the proposed mining activity total disturbance confined to less than 150ha is unlikely to have a significant impact on a viable local population of this bird.	There is no resident local population of this species and the life cycle is most unlikely to be disrupted by the proposed extended activities.

Test Component	Superb Parrot, *Polytelis swainsonii*	Swift Parrot, *Lathamus discolor*
(b) Whether the life cycle of an endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.	No endangered population has been listed under the TSC Act in the region.	No endangered population has been listed in the region.
(c) Whether a significant area of known habitat of a threatened species, population or ecological community in the region is to be modified or removed.	No threatened fauna population or community has been listed under the TSC Act in this region. No significant area of the known habitat of the Superb Parrot would be modified or removed.	The Swift Parrot is nomadic in this part of its Australian mainland range. The proposed area of extension expanded activities does not represent a significant area of the known habitat of this bird.
(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.	No known habitat of Superb Parrot is likely to become isolated as a result of this proposed activity.	No known habitat of the Swift Parrot is likely to become isolated as a result of this proposed activity. Nor would the activity disrupt any interconnections between habitat areas. See reason given above.
(e) Whether critical habitat will be affected.	No critical habitat has been listed under the TSC Act for this region.	No critical habit has been listed under the TSC Act in this region.
(f) Whether a threatened species, population or ecological community, or their habitats are adequately represented in conservation reserves (or similar protected areas in the region).	The consideration of whether this species or its habitat is adequately represented in reserves here is not relevant as this threatened species would not be significantly affected by the proposed activity.	No threatened population or community has been listed under the TSC Act is the region.
(g) Whether the development or activity proposed is of a class of development or activity that is recognized as a threatening process.	The mining operation is included in the range of activities that contribute to the listed key threatening processes, namely the Clearing of Native Vegetation. The proposed mine extension expansion would be over mostly cleared land. Assuming that the recommended safeguard of replacement and compensatory planting are adopted, the few trees that would be removed would be replaced in time.	The mining operation is included in the range of activities that contribute to the listed key threatening processes, namely the Clearing of Native Vegetation. The proposed mine extension expansion would be over mostly cleared land. Assuming that the recommended safeguard of replacement and compensatory planting are adopted, the few trees that would be removed would be replaced in time.
(h) Whether any threatened species, population or ecological community is at the limit of its known distribution.	No listed threatened fauna population or ecological community occurs in this region. The Survey Area on the southwest slopes is near at the eastern limit of this species distribution and it is in a region that the species uses on a seasonal basis for breeding.	This listed endangered parrot would only use the habitat around the Survey Area on a seasonal basis during the non-breeding winter months. The Survey Area is not at the limit of this bird's distribution (see Blakers et al 1984).

Test Component	Yellow-bellied Sheathtail Bat, *Saccolaimus flaviventris*	The Large Bent-wing Bat, *Miniopterus schreibersii*
(a) Whether the life cycle of a threatened species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.	Richards (1998) suggests, ad item: "In order to assess potential impacts on the life cycle of S. flaviventris it is necessary to address the primary components of its ecology, such as breeding, foraging, roosting and movement/migration accordingly." i) Breeding Females of this species have the typical pattern of breeding in summer, with a single young being weaned by the following early autumn (Chimimba and Kitchener 1987). Proposed safeguards for this mine extension include clearing in late summer or autumn only after a pre-start inspection to ascertain that no roosting listed threatened bats are unduly affected. ii) Foraging This species can be assumed to forage primarily upon insects that are hunted by aerial intercept, which is typical of species with long tapered wings (high aspect ratio) and a high wing loading. This indicates (supported by field observations) that flight is fast, with little maneuverability, and given the loud, long-range echolocation call, insects would be captured by interception rather than being pursued. Considering that this species apparently forages over a wide range (Richards, unpublished) the net effect of a loss of a small patch or patches of habitat is most likely to be significant. iii) Roosting S. flaviventris roosts only in tree hollows, and as mentioned above, these are predicted to be large, located high in a tree, and situated such that there is enough clear space at the exit to allow an unencumbered drop until the bat attains normal flight speed. The proposed mine expansion would necessitate the removal of a number of mature trees some of which have obvious tree hollows. iv) Movement/Migration There is no information available in relation to movement or migration patterns that this species may exhibit. Richards (1983, 1995) concluded that because some S. flaviventris had been caught during the 1980's in situations where they appeared to be exhausted, and in open view of the public, that they may have been undertaking pre-winter migrations. This hypothesis has been repeated in other publications, including, for example, Ayers et al (1996). Because several individuals of this species have been recorded over the last year or so to have been infected with Lyssavirus (similar to rabies) the individuals observed may not have been exhausted but instead may have been diseased and unable to fly. The "migration" hypothesis therefore needs to be revised. This proposed mine extension expansion area represents only a small portion of the normal extensive home range of this bat and the proposed activity would not preclude it from hunting and foraging over the surrounding area.	There is no cave in the Survey Area. No roosting habitat or nursery sites would be affected by the proposed development. Thus the local population would not be placed at risk of extinction.

Test Component	Yellow-bellied Sheathtail Bat, *Saccolaimus flaviventris*	The Large Bent-wing Bat, *Miniopterus schreibersii*
(b) Whether the life cycle of an endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.	No threatened fauna population has been listed in this region under the TSC Act.	No threatened fauna population has been listed in the region under the TSC Act.
(c) Whether a significant area of known habitat of a threatened species, population or ecological community in the region is to be modified or removed.	No threatened fauna population or community has been listed for this region thus no known habitat of a threatened fauna population or ecological community in the region would be affected by the proposed mine. A few large trees would be lost along existing fences but none of the creek line gallery habitat would be affected. It is thus unlikely that the proposed activity total disturbance over less than 50ha would affect this species in this part of its distribution.	No threatened fauna population or ecological community has been listed in the region under the TSC Act. The area potentially affected by the proposed activities comprises less than 150ha of mostly cleared agricultural land and this area does not constitute a significant amount of known foraging habitat within the region for this species. Planned rehabilitation of the mine area would restore the area re-establish some of the disturbed areas to similar agricultural pastures and woodland.
(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.	The proposed activity is unlikely to isolate the local population of Sheathtail Bats from any currently interconnecting or proximate areas of habitat of this species because of its mobility and large foraging ranges.	Given its aerial mobility, the proposed mining operations would not create a barrier which would isolate any areas of habitat or disrupt interconnection between areas of habitat for this bat (also see above b and c).
(e) Whether critical habitat will be affected.	No critical fauna habitat has been listed in this region of NSW.	No critical fauna habitat has been listed under the TSC Act in this region.
(f) Whether a threatened species, population or ecological community, or their habitats are adequately represented in conservation reserves (or similar protected areas in the region).	Given the broad distribution of this species, it would be expected to occur in all the reserves this region, as well as those in coastal areas of the State.	This sub-section has been deleted from the amended Section 5A that would come into effect later this year.
(g) Whether the development or activity proposed is of a class of development or activity that is recognized as a threatening process.	The mining operation is included in the range of activities that contribute to the listed key threatening processes, namely the Clearing of Native Vegetation. The proposed mine extension expansion would be over mostly cleared land. Assuming that the recommended safeguard of replacement and compensatory planting are adopted, the few trees that would be removed would be replaced in time.	The mining operation is included in the range of activities that contribute to the listed key threatening processes, namely the Clearing of Native Vegetation. The proposed mine extension expansion would be over mostly cleared land. Assuming that the recommended safeguard of replacement and compensatory planting are adopted, the few trees that would be removed would be replaced in time.

Test Component	Yellow-bellied Sheathtail Bat, *Saccolaimus flaviventris*	The Large Bent-wing Bat, *Miniopterus schreibersii*
(h) Whether any threatened species, population or ecological community is at the limit of its known distribution.	The Survey Area is not at the limit of this listed vulnerable bat which has an extensive distribution ranging over the eastern and northern half of the Australian Continent (see Churchill 1998).	The large Bent-wing Bat has an extensive distribution along the ranges of eastern Australia extending form Cape York to southern Victoria and a sub-species inhabits the north west region of West Australia. The Survey Area is not at the limit of this species' distribution.

Given the results of this 8 Part test of Significance for Fauna Species on the Galong Mine Expansion Project Site, it can be concluded that the six species listed under the Threatened Species Conservation Act 1995 are not likely to be adversely impacted by the Lime Kiln Project.

The measures to minimise any adverse impacts from the Mine Expansion on native fauna will also minimise any impacts resulting from the Lime Kiln. It is not expected that any native vegetation will be disturbed as a result of the Lime Kiln Project. However, should it be necessary it will be restricted to operational areas to ensure retention of potential wildlife habitat. A feral pest control programme will control populations of foxes, rabbits and feral cats. The landscaping and revegetation programme will increase the native tree and shrub species around the site and will increase potential wildlife habitat for local fauna species.

6.7 Water

The water resources of the Galong area have been fully described in Section 4.2 of the Galong Limestone Mine Expansion EIS prepared by R W Corkery and Co Pty Limited.

A detailed description of the surface water was undertaken by Hughes Trueman Pty Limited. A detailed description of the ground water was undertaken by Peter Dundon and Associates Pty Limited. Full Reports from both these groups are included in Volume 3 of this EIS.

This section summarises these Reports and includes a more detailed stormwater impact assessment for the Lime Kiln Project undertaken by Ecoengineers Pty Limited.

6.7.1 Surface Water

The Galong Lime Kiln will be built in the catchment of Limestone Creek. This is an ephemeral tributary of Rocky Ponds Creek which enters Jugiong Creek. Jugiong Creek eventually enters the Murrumbidgee River approximately 30km southwest of the Lime Kiln site.

Limestone Creek has a catchment of approximately 38km^2 of which approximately 7.6km^2 is located upstream of the Galong Lime Kiln.

Drainage within the Galong Limestone Mine site has been modified by the open cut, the processing plant, soil stockpiles, an overburden emplacement, main water storage dams and on-site roads. Figure 6.1 describes the existing drainage characteristics of the Mine site and shows that the Kiln will be built in an area that drains into Limestone Creek.

Surface water flows around the Processing Plant and Site Office are directed towards the open cut or to Limestone Creek. Surface water flows in the open cut accumulate with ground water inflows in a sump. Water from this sump is used either by Barnu for process water in the Mine's operation, or by Bobbara Pastoral Company for agricultural purposes. The water requirements of the Lime Kiln Project will be met by this source.

All sediment laden surface water flows are collected and retained within two sediment basins and ultimately the Main Water Storage Dam, prior to discharge to Limestone Creek. Some percolation from the Dam to the open cut is thought to occur through the floor of the Dam.

Excess water is discharged to Limestone Creek via a grassed natural drainage line. Surface water discharges are rare and generally only occur after protracted periods of heavy rain. Most water flow to Limestone Creek results from subsurface drainage from the Main Water Storage Dam.

Hughes Trueman also assessed likely flood levels in Limestone Creek. Their modeling has examined a range of flooding scenarios and shows that even a 3 x 100 year ARI extreme flood event would not result in flood waters reaching the Galong Lime Kiln Site.

The Corkery EIS assessments conclude that the expansion of the Galong Mine would have negligible impact on the surface water environment, on flood flows in Limestone Creek, or on the catchment in general. The Lime Kiln Project will not cause a significant increase in impact.

6.7.2 Surface Water Quality

Analyses of the quality of surface water flows in Limestone Creek have been undertaken on a regular basis by Barnu as part of its ongoing environmental monitoring program.

The analyses indicate significant variability exists in salinity levels in surface water in and around the Mine site with salinity ranging from 800 to 2,400mg/L TDS.

The highest surface water salinities have been recorded from Limestone Creek upstream of the Mine. Water quality improves noticeably as Limestone Creek flows past the site.

The major ions in solution are sodium and chloride. The pH is marginally alkaline and levels range from 7.0 to 8.0.

Table 6.6 includes water quality data from one site immediately upstream and one site immediately downstream from the Galong Lime Kiln site. The upstream sample was taken at the southern boundary of the Mining Lease. The downstream sample was taken at the northern boundary. The samples were collected in July 2002.

Table 6.6 Limestone Creek Surface Water Quality.

Parameter	Upstream	Downstream
pH	8.0	7.6
Total Solids (mg/L)	2400	1300
Electrical Conductivity (uS/cm)	3500	1900
Suspended Solids (mg/L)	0.8	4.3
Alkalinity (mg/L $CaCO_3$)	478.9	236.0
Bicarbonate (mg/L)	583.9	287.0
Carbonate (mg/L)	0	0
Chloride (mg/L)	690	340
Sulphate (mg/L)	66	63
Nitrate (mg/L)	<0.02	2.8
Calcium (mg/L)	110	110
Magnesium (mg/L)	150	59
Potassium (mg/L)	5	4
Sodium (mg/L)	310	140
Dissolved Iron (mg/L)	0.01	0.02
Total Iron (mg/L)	0.04	0.09
Dissolved Copper (ug/L)	4.2	2.2
Total Copper (ug/L)	4	2
Dissolved Cadmium (ug/L)	<0.05	<0.05
Total Cadmium (ug/L)	<0.05	<0.05
Dissolved Manganese (ug/L)	29	88
Total Manganese (ug/L)	32	86
Dissolved Zinc (ug/L)	5	10
Total Zinc (ug/L)	<5	<5
Dissolved Lead (ug/L)	0.09	0.16
Total Lead (ug/L)	<0.2	<0.2

The mine is presently licensed to pump up to 430 kL/day (5 L/s) of local limestone aquifer groundwaters and surface water flows accumulating in the open cut pit sump into Limestone Creek via the mine site's small sedimentation basins and Main Water Storage Dam.

Water quality in Limestone Creek downstream of the Lime Kiln site is significantly improved by this regular (but not necessarily continuous) pumping, particularly with respect to salinity, a major constraint on the quality of freshwater ecosystems. Downstream water quality is also improved by seepage of water from the Main Water Supply Dam into Limestone Creek.

Recent water quality data included in Table 6.6 also suggest that when Limestone Creek upstream of the Lime Kiln site is flowing, the water has dissolved copper levels in excess of the default trigger value for protection of 95% of all aquatic species. Downstream of the site, the level is significantly reduced by outflows from the mine.

The biota in the Creek immediately downstream of the mine site are therefore dependent on the groundwater flow deriving from the mine although it is noted that there is no obligation on Barnu to maintain that flow.

Nevertheless, the discharge of low salinity water from the mine site to the Creek can be considered to have a beneficial impact in the Creek, both with respect to water quality and quantity. It is therefore consistent with the water quality objectives of the draft Murrumbidgee River Catchment Blueprint.

Rather than minimizing water discharges from the site, Barnu have designed a water control system that ensures that the quality of groundwater discharges meet National Criteria for the Protection of Freshwater Ecosystems (ANZECC/ARMCANZ, 2000). This helps to maintain the beneficial effect currently occurring.

During the construction phase of the Project, the risk of surface water impact would be to Limestone Creek as the potential receiving water. This risk would arise through the export of eroded sands and clays from the clayey weathered rock sub soils and shallow soil cover, particularly during the "first flush" of runoff from the disturbed catchment.

This material would potentially impact on aquatic biota downstream of the Lime Kiln site and requires removal by adequate detention for an appropriate period to achieve settlement prior to discharge.

Following Lime Kiln construction, including landscaping and re-vegetation of the construction phase active catchment, the main risk to Limestone Creek would arise from uncontrolled export of high pH alkaline water following a spill of quicklime at the loader or from trucks leaving the site or from quicklime dust fallout. There would also be lesser risks from spills of hydraulic and lubricating oils associated with existing and new conveyors and oils and fuels from the trucks transporting the quicklime.

A basic risk management assessment of the magnitude and consequences of a discrete quicklime spill and diffuse quicklime dust fallout within the site catchment is provided in Section 6.7.9.

On the basis of past regulatory practice consistent with the Clean Waters Regulations 1972, and current national default water quality trigger values for the protection of freshwater aquatic ecosystems (ANZECC/ARMCANZ, 2000), it is expected the maximum allowed pH of a discharge to Limestone Creek following completion of the proposed development would be 8.5. This would be the target for site discharge waters.

6.7.3 Groundwater

An understanding of groundwater occurrences within the Mining Lease is based upon information obtained from exploration bores drilled by Barnu during 2002 and 2003 within the known extent of the north-south trending limestone body.

Groundwater levels across the Mining Lease have been determined through measurement of standing water levels in the exploration bores. Several of these bores have since been retained as cased piezometers for ongoing monitoring purposes. Groundwater levels across the Mining Lease were recorded on 1 October 2002, 17 January 2003 and 26 February 2003.

Groundwater levels across the Mining Lease measured during October 2002 were generally in the range 493.5m AHD to 495.5m AHD. Groundwater levels measured during February 2003 were typically in the range 492m AHD to 493.5m AHD, reflecting a decline in the groundwater table in the order of 1.2m to 1.5m. This decline coincided with a period of abnormally low rainfall and is consistent with a seasonal recession between major recharge events.

The elevation of the main groundwater seepage into the open cut occurs at approximately

485m AHD, i.e. approximately 6m to 7m above the floor of the open cut. This would indicate the approximate elevation of the water table in the area immediately south of the open cut. By comparison with the groundwater levels in the bores, it suggests that the water table in the immediate vicinity of the open cut has been lowered by approximately 10m (i.e. from around 495m AHD).

Modelling undertaken by Peter Dundon & Associates as part of the groundwater assessment, indicates that the groundwater levels beneath the Mining Lease decrease in a northerly direction, with a localised draw-down effect around the existing open cut.

6.7.4 Groundwater Quality

Analysis of groundwater quality within the Mining Lease has been undertaken by Barnu through the periodic sampling of groundwater flows and seepages into the open cut. Table 6.7 presents the groundwater analyses for these samples.

Table 6.7 Water Quality Open-Cut Mine Groundwater

Parameter	July 1993 Galong 5	May 1998	20 Feb 2002 480 level	28 Feb 2002	1 April 2002	July 2002
pH	7.85	7.4	6.9	6.9	7.0	7.5
TDS (mg/L)	180		670	730	740	970
E.Conductivity (µS/cm)	270	1040	1000	1130	1140	1300
Suspended solids (mg/L)	7		<2	<2	<2	5.8
Alkalinity (mg/L $CaCO_3$)	104	250	210	240	250	294.7
Bicarbonate (mg/L)	127		260	290	310	358.9
Carbonate (mg/L)	0					0
Chloride (mg/L)	<5	180	200	180	190	170
Sulphate (mg/L)	5		33	25	26	32
Nitrate (mg/L)	15		14	73	57	7.8
Calcium (mg/L)	42		120	130	130	160
Magnesium (mg/L)	2.3		18	19	20	17
Potassium (mg/L)	3.7		1.5	2.0	1.7	2
Sodium (mg/L)	6.3		71	67	69	66
Dissolved iron (mg/L)	0.05		<0.01	<0.01	<10	<0.01
Total iron (mg/L)	0.15					<0.02
Dissolved copper (µg/L)	30		<10	<10	<10	3.8
Total copper (µg/L)	30					2
Diss cadmium (µg/L)	<2		<1	<1	<1	<0.05
Total cadmium (µg/L)	<2					<0.05
Diss manganese (µg/L)	<50		<10	<10	<10	2.4
Total manganese (µg/L)	<50					11
Dissolved zinc (µg/L)	<50		<10	<10	<10	2.9
Total zinc (µg/L)	<50					5
Dissolved lead (µg/L)	<5		<1	<1	<1	0.11
Total lead (µg/L)	<5					<0.2
Sodium cyanide			<0.1	<0.1	<0.1	
$CaCO_3$ saturation index		+ 0.5				
Adjusted SAR		2.3				

Source: Peter Dundon & Associates Pty Ltd

Groundwater that accumulates in the open cut is suitable for irrigation, stock and some domestic purposes.

The range of groundwater qualities found inflowing to the open cut pit are shown in Table 6.7 which is reproduced from the Specialist Subconsultant Studies Part 3 for the Mine Expansion

EIS (Peter Dundon and Associates Pty Ltd.) which is included in Volume 3 of this EIS.

This data shows that groundwater quality in the area is principally of the calcium bicarbonate type and ranges in pH from about 6.9 to 7.5, with a salinity ranging from about 1000μS/cm to 1300μS/cm. Higher salinities are clearly observed during prolonged dry weather conditions (e.g. July 2002). Groundwaters are saturated with calcium carbonate, which is expected for a limestone-hosted aquifer.

Volcanic rocks, which have a lower permeability than the limestone hosting the local groundwater, underlie the area to the east of the open cut. These in turn are covered by about 10m of a clayey weathered rock zone (regolith) covered by a shallow soil cover.

During the construction phase, infiltration of surface water to the underlying groundwater would be minimal but in any case could have no significant impact on groundwater quality. It is extremely unlikely that any accidental spills of oils or fuels from the trucks bringing building materials to site and earth working machinery could penetrate the clayey soils and subsoils without total absorption and attenuation near the surface.

During operation of the Lime Kiln Project, and due to the partial connectivity between Limestone Creek and local groundwater, there is some potential risk that spills of quicklime or quicklime dust fallout could result in alkaline water infiltrating to the underlying limestone aquifer and hence to Limestone Creek.

A basic risk assessment has been conducted of the maximum possible volumes of alkaline water that might be generated from either a spill of quicklime or a broader, lighter distribution of quicklime dust over the site's active catchment. The risk assessment is discussed in Section 6.7.9.

There is negligible risk to groundwater from significant spills onto hard surface areas from trucks or during the loading process being wetted in a short high intensity rainfall event. This outcome is subject to the highly alkaline runoff being collected and detained for dilution and possibly acid treatment in a basin with a low permeability liner of compacted clay or similar material.

However, the risk assessment also showed there is a potential risk from infiltration of alkaline water into the ground if a significant mass of quicklime dust were allowed to fall out over a broader, more permeable, fraction of the site's active catchment and then be wetted/dissolved by subsequent rainfall.

The assessment suggests that up to a maximum volume of about 432m^3 of alkaline water at a pH of 12.1 could infiltrate the ground over a maximum area of about 1.0ha (i.e. 4.3mm) from dissolution of a total quicklime dust burden of 100kg.

However, due to the clayey nature of the approximately 10m thick weathered zone beneath the Lime Kiln site, it's native permeability is likely to be very low, in the order of 10mm/day or less. Consequently, the alkaline water would move very slowly down through the subsoil profile and would take at least 3 years to pass through the 10m thickness of clayey subsoil to the fractured rocks beneath.

Under such conditions, there would be adequate reaction time for the alkalinity of the infiltrating water to be naturally attenuated well within that 10m depth. This attenuation would occur through alkaline dissolution (weathering) reactions with the clays and primary minerals of the volcanic rocks. These reactions also lead to production of calcium silicate hydrate and calcium aluminium silicate hydrate gel phases, further reducing permeability and retarding the downwards progress of the infiltrating alkaline water.

It is therefore considered extremely unlikely that a diffuse source of high pH water derived from quicklime dust dissolution infiltrating the local soil profile could penetrate as far as the local limestone aquifer prior to natural attenuation within the weathered zone.

6.7.5 Groundwater Recharge and Discharge

Monitoring of groundwater levels across the Mining Lease indicates that the level of the Limestone Creek bed is probably higher than the groundwater table. Furthermore, there is an indication of a groundwater gradient away from the Creek. This suggests that the groundwater table is being recharged by the Creek. This suggestion is supported by water quality analyses.

Natural discharge from the limestone aquifer system would occur by down-gradient through-flow, interpreted to occur in a northwesterly direction, which is similar to that of the surface drainage.

The presence of the open cut has caused a temporary depression in groundwater levels, and it currently acts as a local sink for groundwater flow. The effect of the mine on groundwater levels is believed to be limited to the immediate vicinity of the mine, certainly less than a distance of 500m.

6.7.6 Current Groundwater Management

Groundwater accumulates in the open cut sump, from where it is used for process water, discharged to Limestone Creek, or, used for agricultural purposes by Bobbara Pastoral Company.

The majority of groundwater that accumulates in the sump is currently pumped directly to the Main Water Storage Dam located on the eastern side of the processing plant. Water stored in this dam is used for a range of operational purposes including dust suppression. Excess dam storage capacity is currently discharged to Limestone Creek via the natural grassed overflow drainage line.

Barnu currently has approval under Bore Licence 40BL189001 issued by the Department of Land and Water Conservation on the 11 March 2003, to discharge groundwater inflows up to 0.43ML per day (157ML per annum), to Lot 3 DP747544. The planned discharge point for this water is on the western bank of Limestone Creek.

Bobbara Pastoral Company presently has a Bore Licence from the Department of Land and Water Conservation to pump up to 30ML per annum of groundwater from the open cut for irrigation purposes. It is envisaged that the Company would continue to extract its approved quota for agricultural use on Bobbara Station.

6.7.7 Surface Water / Groundwater Interaction

The salinity of surface water in Limestone Creek decreases as it flows past the Mine, suggesting interaction with lower salinity water attributed to flow and/or seepage from groundwater stored in the Main Water Storage Dam. It can be calculated from the July 2002 water quality analyses that approximately 75% of the surface water flow at the downstream sampling point in Limestone Creek would be derived from recirculated groundwater.

It is therefore likely, based on the analysis of July 2002 Limestone Creek water samples (Refer Table 6.6), that existing mining operations are causing a net discharge of groundwater from the Mining Lease, approximately equivalent to a three-fold increase in the volume of stream flow in Limestone Creek at the northern end of the Mining Lease. The net discharge of groundwater would also be causing the noticeable improvement in water quality in Limestone Creek as identified by lower salinity water downstream of the open cut. The existing mining operation is therefore considered to be having a beneficial impact on Limestone Creek, a feature compatible with the water quality objectives of the draft Murrumbidgee River Catchment Blueprint.

The Corkery EIS assessments concluded that ongoing monitoring of the groundwater is required to enable inflow rates to be established and to enable more accurate periodic reassessment of future inflow rates and volumes. This monitoring will occur.

Groundwater modeling undertaken by Peter Dundon and Associates indicated that the draw down impacts from mine dewatering associated with the staged development of the Expanded Mine would extend for only a limited distance from the open cut. The modeling predicted that by the completion of mining in 2043, dewatering imposed draw downs on the groundwater table of >1m would be limited to a radial distance of less than 1km in all directions, with draw downs of >10m confined to within a radial distance of less than 600m.

A more precise understanding of the impacts of the proposed Mine Expansion on groundwater inflow rates and the regional water table, would be established from the long term groundwater monitoring programme which would commence prior to the Mine Expansion.

The Lime Kiln Project will not affect the regional water table.

6.7.8 Soil and Water Management during the Project Construction Phase

The rainfall Intensity-Frequency-Duration (IFD) table for the site is included in Table 6.8 This indicates the expected rainfall intensity (mm/hour) expected for any Average Recurrence Interval (ARI).

Table 6.8 Rainfall Intensity-Frequency-Duration for Galong

Rainfall Intensity (mm/h) for Galong

1 hour, 2 years	22.10
12 hour, 2 years	4.00
72 hour, 2 years	1.12
1 hour, 50 years	43.70
12 hour, 50 years	7.00
72 hour, 50 years	1.89
Skewness	0.25
Geographical factor F2	4.31
Geographical factor F50	15.45

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\DUR ARI	5m	6m	10m	20m	30m	1h	2h	3h	6h	12h	24h	48h	72h	User
1	56	[illegible]	42.4	30.6	24.7	16.7	10.5	7.97	4.95	3.09	1.95	1.19	0.87	0.00
2	73	69	56	40.1	32.4	21.7	13.6	10.3	6.36	3.95	2.48	1.52	1.11	0.00
5	99	93	75	53	42.7	28.4	17.5	13.1	8.00	4.89	3.06	1.86	1.35	0.00
10	116	108	87	62	49.4	32.6	20.0	14.9	9.00	5.46	3.40	2.06	1.49	0.00
20	138	129	103	73	58	38.2	23.3	17.3	10.4	6.25	3.88	2.35	1.70	0.00
50	169	158	126	89	70	46.0	27.8	20.6	12.2	7.31	4.53	2.73	1.97	0.00
100	195	181	145	101	80	52	31.4	23.1	13.7	8.14	5.03	3.03	2.18	0.00
User	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Years

min	1	2	5	10	20	50	100
7	49.1	65	87	102	121	148	170
8	46.5	61	82	96	114	140	160
9	44.3	58	78	91	108	132	152
10	42.4	56	75	87	103	126	145
11	40.6	53	72	83	99	121	138
12	39.1	51	69	80	95	116	132
13	37.7	49.5	66	77	91	111	127
14	36.4	47.8	64	74	88	107	123
15	35.2	46.3	62	72	85	103	118
16	34.2	44.9	60	69	82	100	114
17	33.2	43.5	58	67	80	97	111
18	32.3	42.3	56	65	77	94	107
19	31.4	41.2	55	63	75	91	104
20	30.6	40.1	53	62	73	89	101
21	29.8	39.1	52	60	71	86	99
22	29.1	38.2	51	59	69	84	96
23	28.5	37.3	49.5	57	68	82	94
24	27.9	36.5	48.3	56	66	80	91
25	27.3	35.7	47.3	55	65	78	89
26	26.7	35.0	46.3	54	63	77	87
27	26.2	34.3	45.3	52	62	75	85
min	1	2	5	10	20	50	100
28	25.7	33.6	44.4	51	61	73	84
29	25.2	33.0	43.5	50	59	72	82
30	24.7	32.4	42.7	49.4	58	70	80
31	24.3	31.8	41.9	48.4	57	69	79
32	23.9	31.2	41.2	47.6	56	68	77
33	23.5	30.7	40.5	46.7	55	67	76
34	23.1	30.2	39.8	45.9	54	65	75
35	22.7	29.7	39.1	45.2	53	64	73
36	22.4	29.2	38.5	44.4	52	63	72
37	22.0	28.8	37.9	43.7	51	62	71
38	21.7	28.4	37.3	43.0	51	61	70
39	21.4	28.0	36.7	42.4	49.9	60	69
40	21.1	27.6	36.2	41.7	49.1	59	67
41	20.8	27.2	35.7	41.1	48.4	58	66
42	20.5	26.8	35.2	40.5	47.7	58	65
43	20.2	26.4	34.7	40.0	47.0	57	65
44	20.0	26.1	34.2	39.4	46.3	56	64
45	19.7	25.7	33.8	38.9	45.7	55	63
46	19.5	25.4	33.3	38.4	45.1	54	62
47	19.2	25.1	32.9	37.9	44.5	54	61
48	19.0	24.8	32.5	37.4	43.9	53	60
49	18.8	24.5	32.1	36.9	43.4	52	59

50	18.6	24.2	31.7	36.5	42.8	52	59
51	18.4	23.9	31.3	36.0	42.3	51	58
52	18.1	23.7	31.0	35.6	41.8	50	57
53	17.9	23.4	30.6	35.2	41.3	49.8	57
54	17.8	23.1	30.3	34.8	40.8	49.2	56
55	17.6	22.9	29.9	34.4	40.4	48.6	55
56	17.4	22.7	29.6	34.0	39.9	48.1	55
57	17.2	22.4	29.3	33.7	39.5	47.5	54
58	17.0	22.2	29.0	33.3	39.1	47.0	53
59	16.9	22.0	28.7	32.9	38.6	46.5	53

At present, surface water flows across the proposed Project site towards Limestone Creek via natural or adventitious drainage routes and shallow gullies. These routes are poorly defined due to the low relief and gradients.

Surface water flows around the limestone crushing and screening plant and office are presently directed either west towards the open-cut or east towards Limestone Creek.

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Surface water flows towards Limestone Creek are presently intercepted by two small on site sediment basins of 0.38ML and 0.19ML capacity. The flow of surface water and groundwater pumped from the open cut pit is directed into the southwest corner of the larger of these two basins. It then overflows from this basin into the smaller, and from there overflows into the northwest corner of a Main Water Storage Dam of 4.75ML maximum capacity before discharging to the Creek via a grassed spillway through a natural drainage line.

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The Main Dam is operated with a maximum freeboard of about 600mm and hence generally has a minimum volume of (pumped) groundwater in it of about 3.61ML.

For the Lime Kiln Project, it is proposed to first remove stockpiled machinery, timber, waste rock and some vegetation and to then shape and form new drainage routes for runoff from the areas where new roads and structures will be located. This will include landscaping of low bund walls to a maximum height of 2.0m where appropriate to prevent run-on into the catchment and contain runoff within the catchment.

The landscaping and new drainage network construction will more clearly define the active site catchment, within which all Lime Kiln and quicklime loader-related establishment works are being undertaken. The drainage will direct all runoff from rainfall falling within that area to a single new Primary Sedimentation Basin for management and treatment.

It is proposed at this stage to retain all 3 existing site water storages, including the two small basins just west of the Main Water Storage Dam, although these may be combined in the future.

These works will be completed at the first stage of the Project in accord with a Soil and Water Management Plan to be prepared for the construction phase works.

The Plan will detail the measures that will be used to control and manage erosion on, and potential impacts from dirty water runoff from site cutting, filling, road forming and structure base slab construction activities. The Plan will be prepared in accord with NSW State guidelines for soil and water management of construction sites as described in the Blue Book published by the NSW Department of Housing, 1998. The Blue Book is the currently applicable NSW State guideline document that applies to runoff quality management for construction sites.

The Plan will rely strongly on the stripping and handling recommendations for site soils contained in the Soil and Land Capability assessment of site soils contained in the Specialist Consultant Studies Part 1 for the Mine Expansion EIS (Geoff Cunningham Natural Resources Consultants Pty Ltd, 2003). A full copy of this report is reproduced in Volume 3 of this EIS.

The active area for construction phase earthworks is divided into two small subcatchments being:

- A southern subcatchment of about 0.78ha enclosing the proposed truck road loop, roll crusher, conveyor, quicklime loader, Lime Kiln, switch rooms and transformer substations, and,
- A northern subcatchment of about 0.36ha containing the remainder of the new entry road, the road bend up to the loop and the new office block.

Hence the total active area comprises some 1.14ha.

Engineering an appropriate and achievable gradient to the new entry road and construction of various drains will ensure that all runoff from within this catchment will be directed to a single new Primary Sedimentation Basin to service these two subcatchments. This Basin will be constructed at Project commencement once all new drainage is completed. It will be sited just south of the Main Water Storage Dam and be sized to provide adequate detention to settle out suspended solids before decantation into the Main Water Storage Dam.

Normally the Primary Sedimentation Basin would be temporary and sized in accordance with the NSW Department of Housing guidelines included in their Blue Book.

The studies of site soils contained in Volume 3 of this EIS and prepared by Geoff Cunningham Natural Resources Consultants Pty Ltd, indicate that topsoils and subsoils bared during construction would exhibit only slight dispersibility and do not contain >50% of fines less than 20µm (i.e. clay and silt sized).

Hence the 0.25-year ARI intensity for the time of concentration of a site is the appropriate design criterion for the (default) sedimentation basin surface area Type C as defined by the Blue Book. It is estimated on the basis of the proposed maximum length (approximately 150m) and slope (1%) of the site (Hannan, 1995) that the time of concentration (the time for a peak flow to exit the catchment after a rainfall peak occurs) of this 1.14ha (total) active catchment area would be about 6 minutes.

The 0.25 year ARI intensity was estimated by taking one quarter of the 1 year ARI intensity as recommended in Chapter 6 of the Blue Book. This storm can be expected to provide about 1.3mm of rainfall.

For a total site bared area (roads, loader slabs etc) of the order of 1.14ha i.e. 11,400m^2 during the Project construction phase, this would produce a peak flow rate of 0.041m^3/s. Assuming a minimum settling rate of soil fines for a 20µm particle (0.00029m/s; Dept. of Housing, 1998), the required surface area of the pond would be 142m^2. For a typical 1.3m total depth, the volume would then be only about 185m^3 (0.185ML).

However, it is proposed to construct a somewhat larger detention Basin suitable for retention of the amount of water that will run off from the site after the construction phase is completed.

The Primary Sedimentation Basin would be sited just south of the existing Main Water

Storage Dam and, in accordance with NSW EPA guidelines for mine sites, would be designed to detain the entire runoff from a 72-hour, 10 year ARI storm. Such a storm produces a total rainfall of 107.3mm (1.5mm/hour)

Experience with developed mine sites indicates that, in practice, the maximum runoff coefficient for this storm for a 50% vegetative cover (following landscaping) is not likely to exceed 0.40, producing a maximum runoff volume of about 0.49ML.

It is therefore proposed to construct a Sedimentation Basin of total capacity 0.49ML. The Basin would have a depth of about 2.0m, and hence have a surface area of about 245m^2, occupying about 2% of the catchment area.

In line with best practice, and to ensure no loss to groundwater of detained pollutants the Basin would be lined with compacted clay to achieve an acceptably low permeability of approximately 10^{-9}m/s to ensure that the Primary Sedimentation Basin could not subsequently contribute any alkaline seepage into Limestone Creek following Lime Kiln construction.

The Mine Expansion soils study indicates that there would be no difficulty in winning suitable clays for this purpose from the construction phase soil stripping operations.

6.7.9 Risk Assessment for Quicklime Spill and Dust Management

The maximum possible spill of quicklime on a hard surfaced area (e.g. roadway, concrete slab) from, for example, a truck accident within the active catchment is estimated to be about 1 – 10t over a 100m^2 area. Similarly the maximum conceivable quicklime dust fallout within the active catchment is estimated at about 100kg spread over a maximum area of approximately 1ha.

When wetted, quicklime absorbs 36% moisture in an exothermic reaction, expanding to form calcium hydroxide, which has a maximum water solubility of about 1.2kg/m^3, dissolving to produce an alkaline solution of maximum pH 12.5.

For a maximum quicklime spill over (say) a 100m^2 hard surfaced area, wash off would have to occur, unhindered, for 24 hours at a rate of up to 2mm/hr (or for 2 hours at 24mm/hr – these being the typical maximum rates of precipitation at the site (refer IFD Table 6.8)) to produce up to about 48m^3 of alkaline water at pH 12.5. Due to solubility characteristics, only a maximum of about 44kg of the quicklime would have dissolved.

Covering a quicklime spill (e.g. with plastic sheeting or tarpaulins) as soon as it occurs, regardless of weather conditions, should be a primary emergency response to such an occurrence.

A distribution of 100kg of quicklime dust distributed over 1.0ha (i.e. about 90% of the active catchment) would in the same period produce about 480m^3 of alkaline water at a pH of about 12.1 and all 100kg of the dust would have quickly dissolved due to the higher water/solid ratio. However, in this case at least 90% of the produced alkaline dust solution would not run off but would infiltrate the ground within the catchment.

Consequently, in both cases only a maximum of approximately 48m^3 of alkaline runoff at the maximum pH of 12.5 would be produced. This volume would then be captured in the Primary Sedimentation Basin.

Subsequently, allowing the Basin to fill completely with normal runoff after cleanup or coverage of the spill, or by filling with groundwater from the open cut pit would, if necessary, provide a dilution of 10 times, reducing the maximum pH of a completely filled Basin to the 11.1 to 11.5 range.

A minimum volume of about 3.61ML of groundwater pumped from the open cut is normally retained in the Main Water Storage Dam for use in stockpile and roadway dust suppression.

Therefore transfer of up to 0.49ML of water from the Primary Sedimentation Basin into the Main Water Storage Dam would further dilute that water by a factor of at least 8.4, reducing the pH by at least 0.9 pH units. In practice, the buffering capacity of the calcium carbonate-saturated open cut groundwater, would produce a slightly greater pH decrease (typically about an additional 1.0 pH unit) as some calcium carbonate precipitates in the Main Water Storage Dam.

Therefore, even a transfer of un-neutralized water from a full Primary Sedimentation Basin (of maximum pH 11.1 to 11.5) would only result in a maximum pH in the Main Water Storage Dam of 10.1 to 10.5 without any surface discharge to Limestone Creek. This water could be safely recycled back to the open cut for further dilution if required.

Inspection of the IFD Table 6.8 and a consideration of typical runoff coefficients for short duration high intensity storms suggest the Primary Sedimentation Basin would not surcharge to the Main Water Storage Dam unless a very large storm of duration less than about 30 minutes and frequency less than about 1 in 10 years occurred. It is extremely unlikely that under such conditions the active catchment would contain any significant uncovered spills of quicklime.

Stormwater control will be based on a system of maintaining a generally dry, moderately large, impermeable Primary Sedimentation Basin sized in accord with NSW EPA guidelines. There will be controlled decantation via a floating off take of clean water into the Main Water Storage Dam. This system will provide a considerable factor of safety against the potential for alkaline water discharge into Limestone Creek from the active catchment containing the proposed Lime Kiln and quicklime loading/transport operation.

6.7.10 Surface Water Management after Kiln Construction.

The Primary Sedimentation Basin will be retained to service the active area of the site after the Kiln is constructed and site landscaping and re-vegetation have been implemented. This is because all of the construction phase active catchment would continue to be considered active during Lime Kiln operation because:

- Spills of quicklime could potentially occur anywhere in the vicinity of the loader and along the truck loop and entry road,
- Fallout of quicklime dust could potentially occur in the vicinity of the Kiln and dust collector,
- Transformer oils could potentially escape from the (bunded) switchyard (e.g. a transformer explosion,
- Oils and fuel could potentially be spilled at many hard surface locations from conveyors, trucks etc, and,
- There would be general washoff of dust, rubber powder especially from the roadways and parking areas.

Following completion of construction, a landscaped and revegetated site will exhibit an average annual runoff coefficient significantly less than 0.40. As noted above, the sizing of the Primary Sedimentation Basin has been based on such a high coefficient applying during the construction phase and hence is very conservatively sized for the post-construction phase.

It is estimated from experience on small, paved and partly re-vegetated mine site catchments with groundcover of about 70% that the runoff coefficient would range from about 0.03 (3%) for light, long duration rainfall periods up to a maximum of about 0.90 (90%) for high intensity, short duration events.

It can be seen from the IFD Table 6.8 that a short high intensity storm of 5 minute duration and 1 year ARI would generate up to about 4.2mm of runoff, equivalent to a total storm volume of up to 48m^3 (48kL). Such a storm would of course be easily captured in the Primary Sedimentation Basin which will have a capacity of 0.49ML.

The Primary Sedimentation Basin would be constructed to allow an overflow through a grassed channel to the Main Water Storage Dam when surcharged but, normally, it would be emptied via a floating off take and pump decant arrangement so that it could be completely drained dry whenever the quality of water in it was suitable for filling of water trucks or transfer to the Main Water Storage Dam.

It is proposed that the pH of the water in the Primary Sedimentation Basin would be monitored immediately following all rainfall events that put a significant volume into it and if pH was less than (say) 9.0 (noting that pH is a logarithmic scale), would be decanted into the Main Water Storage Dam. Water of somewhat higher pH up to about 9.5 to 10.0 would also be suitable for use in stockpile dust suppression due to the natural attenuation of alkalinity that would apply.

It is also proposed that the Primary Sedimentation Basin would be fitted with a level gauge to enable periodic recording of its volume prior to decanting to the Main Water Storage Dam. In the unlikely rare event that a slug of high pH water accumulated in the Basin (due to a quicklime wash off) then an appropriate level of acid dosing would be calculated and applied before water was decanted into the Main Water Storage Dam for dilution and reuse or controlled discharge to Limestone Creek.

Water may enter Limestone Creek from the Main Water Storage Dam by direct discharge through a licensed discharge point or by groundwater seepage from the base of the Dam. It is anticipated that NSW EPA would require pH monitoring of discharges from the Main Water Storage Dam to Limestone Creek.

The above information is based on current estimates and information about surface area and absorption properties. The figures will be reviewed upon completion of design to ensure compliance with relevant standards.

6.7.11 Kiln Water Consumption

The Lime Kiln Project will not be a major user of water. Water will be recycled from the Main Water Storage Dam located east of the Processing Plant.

Water will be required to minimise dust generation from the stockpiles, road surfaces and hardstand areas. Dust suppression will be achieved by water sprays on the stockpiles and by distribution through a water truck as required on the road and hardstand areas.

Water consumption for these purposes is expected to be up to a maximum of 0.1MLpd on a hot windy day with an annual consumption of approximately 10ML for dust control purposes.

Bobbara Pastoral Company currently use 30ML per annum of water from the Mine for agricultural purposes.

The current annual rate of mine dewatering is 160MLpa. This is expected to rise to 390MLpa by 2033.

Consequently, there would be an excess water supply for the Lime Kiln Project and the Mine Expansion Project. After allowing for a certain level of evaporation, this excess is likely to be of the order of 250Mlpa to 300MLpa by 2033. The excess water will be discharged into Limestone Creek and continue its beneficial impact. It may also be used by Bobbara Pastoral Company for increased agricultural production.

6.8 Acoustics

6.8.1 Introduction

Richard Heggie and Associates undertook a Noise Impact Assessment of the Lime Kiln Project. A full copy of their Report is included in Volume 2 of this EIS.

The noise assessment was prepared in accordance with Australian Standard 1055, 1997 Description and Measurement of Environmental Noise Parts 1, 2 and 3 and with reference to the EPA's Industrial Noise Policy (INP). Where issues relating to noise are not addressed in the INP, such as sleep disturbance, reference was made to the Environmental Noise Control Manual (ENCM). The road traffic noise assessment was undertaken with reference to the EPA's Environmental Criteria for Road Traffic Noise (ECRTN).

Heggie's Assessment addressed the acoustic issues associated with:

- Construction of the Lime Kiln,
- Operation of the Lime Kiln, and,
- The cumulative impact of operation of the Lime Kiln in conjunction with operation of the Limestone Mine.

6.8.2 Nearest Residential Locations

The nearest residential locations to the Mine, along with approximate distances from the existing mill enclosure are contained within Table 6.9.

Table 6.9 Nearest Residential Locations

Location	Distance from Mine
Brown Residence*	2.7 km
"Hilltop"*	3.4 km
"Athlone"	5.3 km
"Beulambil"	4.8 km
"Highview"	4.7 km
"Cherryvale"	4.1 km
"Glenroy"	4.6 km
"Woodstock"	3.8 km
Township of Galong	4.4 km

* Note: The Brown residence and "Hilltop" are mine-related residences, as they, and the existing Galong Limestone Mine are situated on land owned by the Bobbara Pastoral Company Pty Ltd.

6.8.3 Construction Activity

Blue Circle Southern plan to undertake construction from 6.00 am to 6.00 pm Monday to Saturday over a construction period that will consist of 8 weeks of foundation work, 16 weeks of kiln construction and a further 8 weeks of commissioning.

No construction work is scheduled to take place on Sundays or Public Holidays, though this may occur in sporadic circumstances.

The sound power levels and octave band levels of the acoustically significant construction plant and equipment was determined from various sources.

6.8.4 Operational Activity

Barnu propose to operate the Lime Kiln 24 hours per day and seven days per week. Product dispatch and transport will occur between 7.00am to 7.00pm Monday to Saturday.

The sound power levels and octave band levels of the acoustically significant operational plant and equipment was determined from various sources.

6.8.5 Impact Assessment Criteria

Construction Noise

The EPA NSW "Environmental Noise Control Manual (ENCM)", Chapter 171, sets out noise criteria applicable to construction site noise for the purpose of defining intrusive noise impacts. Based upon this document the project specific noise limits outlined in Table 6.10 will apply to the proposed development.

Table 6.10 Construction Site Noise Control Guidelines

Total Construction Period	Acceptable LA_{10} Noise Level[1]
4 weeks and under	Background LA_{90} plus 20 dBA
4 weeks to 26 weeks	Background LA_{90} plus 10 dBA
Greater Than 26 Weeks	Background LA_{90} 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 audible construction work is to take place on Sundays or Public Holidays.

Operational Noise

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 an 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.

Assessing Intrusiveness
For assessing intrusiveness, the background noise needs to be measured. The intrusiveness criterion essentially means that the equivalent continuous noise level (LAeq) of the noise sources should not be more than 5 decibels above the measured background level (LA90) when measured at the appropriate receiver location.

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.

An extract from the EPA Industrial Noise Policy that relates to the amenity criteria is given in Table 6.11.

Table 6.11 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 (dBA)	
			Acceptable	Recommended Maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45

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

Where the existing noise level from industry approaches or exceeds these levels, the amenity criteria need to be amended to reduce the likelihood of background creep.

Assessing Sleep Disturbance
Sleep arousal was assessed using the guidelines set out in the EPA's Environmental Noise Control Manual Section 19-3.

To avoid the likelihood sleep disturbance the ENCM recommends that the LA1(1 minute) of the noise source under consideration should not exceed the background noise level (LA90) by more than 15 dBA when measured outside the bedroom window of the receiver during the night-time hours (10.00 pm to 7.00 am).

For the purpose of their assessment Heggies adopted a conservative approach, where LAmax noise levels have been used to represent LA1(1 minute) noise levels. This is due to the lack of accurate information regarding LA1(1 minute) noise levels, and the assumption that LA1(1 minute) noise levels would be similar to, and possibly slightly lower than, the LAmax noise levels.

6.8.6 Road Traffic Noise Design Goals

The EPA Policy, Environmental Criteria for Road Traffic Noise sets out noise criteria applicable to different road classifications for the purpose of defining traffic noise impacts.

Two transport routes will continue to be used for the distribution of limestone products, each of which will involve vehicles exiting the Mine via Eubindal Road. Approximately 5% of the traffic will travel north via Kalangan Road onto Cunningar Road, with the remaining 95% of the traffic travelling south along Galong Road, through the township of Galong to Burley Griffin Way.

The properties adjacent to the northern route are rural allotments with the residences significantly distanced from the road. The highest impact will continue to occur when the vehicles travel along Galong Road through Galong.

Residences adjacent to Galong Road (which becomes Ryan Street, then Bobbara Road as it passes southeast through Galong) are the most potentially affected receivers.

The ECRTN defines a sub-arterial road as roads, which connect the arterial roads to areas of development and carry traffic from one part of a region to another. From this perspective, and based upon the fact that this road connects the township of Galong to the Burley Griffin Way, which is clearly an arterial road, Galong Road would be defined as a sub-arterial road.

Notwithstanding this fact, and based upon recent traffic studies indicating low and intermittent traffic flow along Galong Road, a conservative approach was taken and Galong Road was considered to be a primary haulage route for the purpose of Heggie's Assessment.

Some industries, such as mines, are in locations that are not served by arterial roads. As such, heavy vehicles must travel along local roads to access the site. Such roads have been acknowledged by PlanningNSW in Section 2.2 of the ECRTN and, in order to manage any associated adverse impacts, the noise criteria for the route should match those for collector roads. Such roads are referred to as 'primary haulage routes". For this reason, the noise criteria outlined in Table 6.12 were adopted.

Table 6.12 EPA Environmental Criteria for Road Traffic Noise

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

While no well defined sleep disturbance criteria applicable to road traffic exists in NSW, the NSW RTA recognises that events likely to cause sleep arousal can occur, and are dependent upon both the maximum noise level of the source and the ambient background noise level at the residence. Where the L_{Amax} noise level is greater than 65 dBA and the L_{Amax} minus the L_{Aeq} noise level is greater than or equal to 15 dBA the event is recognised as a "significant" event, or an event likely to cause sleep disturbance at a residence.

6.8.7 Existing Acoustic Environment

In order to determine existing ambient noise levels at residential locations surrounding the Lime Kiln, the results of the recent background noise monitoring program undertaken for the Galong Limestone Mine Expansion, at residential locations around Galong were used. The location and identity of these residential locations is detailed in the full copy of Heggire's Report in Volume 2 of the EIS.

Background noise levels were monitored at five of the nearest residential locations to the Galong Limestone Mine from 28 January 2003 until 6 February 2003 inclusive A summary of the results of the background surveys are given in Table 6.13.

Table 6.13 Summary of Existing Ambient background Noise Levels

Location	Description	Background Noise Level (LA90 dBA) / Rating Background Level	Measured Existing LAeq Noise Level (dBA)	Estimated Contribution from Existing Industrial Noise Sources (dBA)
1 "Athlone"	**Daytime** 7am to 6pm	32	49	<30 dBA
	Evening 6 pm to 10 pm	34	55	<30 dBA
	Night 10 pm to 7 am	32	44	<30 dBA
2 "Beulambil"	**Daytime** 7am to 6pm	31	55	<30 dBA
	Evening 6 pm to 10 pm	35	57	<30 dBA
	Night 10 pm to 7 am	30*(29)	46	<30 dBA
3 Brown Residence	**Daytime** 7am to 6pm	34	56	<30 dBA
	Evening 6 pm to 10 pm	36	56	<30 dBA
	Night 10 pm to 7 am	33	46	<30 dBA
4 Township of Galong	**Daytime** 7am to 6pm	36	57	<30 dBA
	Evening 6 pm to 10 pm	37	58	<30 dBA
	Night 10 pm to 7 am	33	49	<30 dBA
5 "Woodstock"	**Daytime** 7am to 6pm	30*(29)	49	<30 dBA
	Evening 6 pm to 10 pm	31	49	<30 dBA
	Night 10 pm to 7 am	30*(27)	49	<30 dBA

Note: The LA90 represents the level exceeded for 90% of the interval period and is referred to as the average minimum or background noise level

LAeq - The equivalent continuous noise level is defined as the level of noise equivalent to the energy average of noise levels occurring over a measurement period

* Where the measured RBL is below 30 the NSW EPA recommends that 30 dBA be adopted. Actual measured values are in parentheses.

6.8.8 Project Specific Design Goals

The EPA has requested that a rating background noise level of 30 dBA be assumed for all residential locations surrounding the site. Therefore, the project specific noise level goals for all residential locations for construction noise and intrusiveness criterion were set accordingly.

Construction Noise

The construction noise emission design goals were set with reference to the EPA Environmental Noise Control Manual.

Table 6.14 contains the project specific construction noise design limits.

Construction noise level goals are 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 receivers. No construction work is planned to take place on Sundays or Public Holidays but may need to occur to meet Project schedules.

Table 6.14 Project Specific Construction Noise Goals

Location	Assumed Rating Background Level L_{A90} dBA	Total Construction Period	Project Specific L_{A10} Construction Noise Level Goal[1]
All Residential Locations	30	4 weeks and under	50 dBA
		4 weeks to 26 weeks	40 dBA
		Greater Than 26 Weeks	35 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.

Operational Noise

The operational noise emission design goals were set with reference to the EPA Industrial Noise Policy. The resulting design goals are given in Table 6.15.

Table 6.15 Project Specific Noise Emission Design Goals – Rural Residential Receivers

Location	Description	Assumed Rating Background Level L_{A90} dBA	Intrusiveness Criterion $L_{Aeq(15minute)}$ dBA	Amenity Criterion $L_{Aeq(period)}$ dBA	Sleep Disturbance Criterion $L_{A1(1\ minute)}$ dBA
All Residential Locations	**Daytime** 7am to 6pm	30	35	50	N/A
	Evening 6 pm to 10 pm	30	35	45	N/A
	Night 10 pm to 7 am	30	35	40	45

Note: The LA90 represents the level exceeded for 90% of the interval period and is referred to as the average minimum or background noise level

LAeq - The equivalent continuous noise level is defined as the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

Weather conditions, including wind speed, wind direction and inversions, have the potential to affect noise impacts. These effects were taken into account in the Heggie's Assessment. A detailed description of these effects is included in Section 7 of the Heggie's Report contained in Volume 2 of this EIS.

6.8.9 Noise Impact Assessment

The Environmental Noise Model (ENM) was used to predict the noise emissions from the Lime Kiln site. Noise levels under calm atmospheric conditions and prevailing weather conditions were modelled.

Construction Noise

Noise modelling was undertaken to determine noise levels at the nearest residences for the construction phase of the development assuming all construction equipment was operating simultaneously. This represented the worst-case acoustic scenario.

The results of noise modelling for the construction phase of the development, contained in Table 6.16, show that the predicted construction noise level is well below both the construction noise level goal for all construction periods, including a construction period of greater than 26 weeks. Actual construction is planned to be less than the 26 weeks period.

The predicted construction noise level is also below the assumed RBL of 30 dBA. It is likely that construction noise will be inaudible for most of the time at all receiver locations, meaning the extended hours of 6.00 am to 6.00 pm should pose no problem to nearby residential locations. Barnu will ensure that noisy activities are scheduled to occur, where possible, between the hours of 7.00 am to 6.00 pm Monday to Friday and 7.00 am to 1.00 pm Saturday.

Table 6.16 Noise Modelling Results – Construction Phase

Location	Predicted Noise Level (LA10 dBA)
1 "Athlone"	<30
2 "Beulambil"	<30
3 Brown Residence*	<30
4 "Hilltop"*	<30
5 Galong	<30
6 "Highview"	<30
7 "Cherryvale"	<30
8 "Glenroy"	<30
9 "Woodstock"	<30

Note: The Brown residence and "Hilltop" are mine-related residences, as they, and the existing Galong Limestone Mine are situated on land owned by the Bobbara Pastoral Company Pty. Ltd.

Operational Noise

The results of noise modelling under both calm and prevailing weather conditions (temperature inversion and drainage flow where applicable) are shown in Table 6.17, Table 6.18 and Table 6.19 respectively.

Table 6.17 Noise Modelling Results - Calm Weather Conditions

Location	Period	Predicted Noise Level (LAeq dBA)		
		Mine	Kiln	Mine and Kiln
1 "Athlone"	Daytime	<30	<30	<30
	Evening	<30	<30	<30
	Night-time	<30	<30	<30
2 "Beulambil"	Daytime	<30	<30	<30
	Evening	<30	<30	<30
	Night-time	<30	<30	<30
3 Brown Residence	Daytime	<30	<30	<30
	Evening	<30	<30	<30
	Night-time	<30	<30	<30
4 "Hilltop"	Daytime	<30	<30	<30
	Evening	<30	<30	<30
	Night-time	<30	<30	<30
5 Galong	Daytime	<30	<30	<30
	Evening	<30	<30	<30
	Night-time	<30	<30	<30
6 "Highview"	Daytime	<30	<30	<30
	Evening	<30	<30	<30
	Night-time	<30	<30	<30
7 "Cherryvale"	Daytime	<30	<30	<30
	Evening	<30	<30	<30
	Night-time	<30	<30	<30
8 "Glenroy"	Daytime	<30	<30	<30
	Evening	<30	<30	<30
	Night-time	<30	<30	<30
9 "Woodstock"	Daytime	<30	<30	<30
	Evening	<30	<30	<30
	Night-time	<30	<30	<30

Note: The mining scenario used for the assessment is based upon the 40 year mine plan. This is the worst case mine plan, where the extent of mining is at the closest point to the nearest residences.

Table 6.18 Noise Modelling Results – Temperature Inversion

Location	Period	Predicted Noise Level (LAeq dBA)		
		Mine	Kiln	Mine and Kiln
1 "Athlone"	Night-time	<30	<30	<30
2 "Beulambil"	Night-time	<30	<30	<30
3 Brown Residence	Night-time	35	30	36
4 "Hilltop"	Night-time	32	30	34
5 Galong	Night-time	<30	<30	31
6 "Highview"	Night-time	<30	<30	30
7 "Cherryvale"	Night-time	<30	<30	31
8 "Glenroy"	Night-time	<30	<30	33
9 "Woodstock"	Night-time	<30	<30	<30

Note: The mining scenario used for the assessment is based upon the 40 year mine plan. This is the worst case mine plan, where the extent of mining is at the closest point to the nearest residences, and noise levels received at the residences are at their highest.

The Brown residence and "Hilltop" are mine-related residences, as they, and the existing Galong Limestone Mine are situated on land owned by the Bobbara Pastoral Company Pty. Ltd.

Table 6.19 Noise Modelling Results – Temperature Inversion and Drainage Flow

Location	Period	Predicted Noise Level (LAeq dBA)		
		Mine	Kiln	Mine and Kiln
1 "Athlone"	Night-time	<30	<30	<35

The noise modelling results demonstrate that the operation of a Lime Kiln, on the Galong Limestone Mine site, will meet the project specific LAeq noise level goals during daytime, evening and night-time at all residential locations.

The cumulative impact of the Limestone Mine and the Lime Kiln operation will meet all project specific noise level goals at all residential locations except for a 1 dBA exceedance at the Brown Residence during temperature inversion conditions when the Lime Kiln operation is combined with the 30 year mine plan.

In order to determine sleep disturbance noise levels, the operations and equipment used on the site that exhibited the highest maximum noise levels were used. The loudest L_{Amax} noise levels will be produced by limestone being loaded into an empty bin.

The highest L_{Amax} noise levels were found to emanate from empty limestone, coal and final product bins as the product first hits the base of the bin. Once the bins are partially full, noise levels will decrease significantly.

The results of this assessment are presented in Table 6.20.

Table 6.20 Predicted Maximum Operational Noise Levels

Residence	L_{Amax} noise level (dBA) Limestone being loaded into empty bin		Noise Level Goal $L_{A1(1\ minute)}$*
	Calm	Temperature Inversion	
1 "Athlone"	<30	<30	45
2 "Beulambil"	<30	<30	45
3 Brown Residence	<30	<30	45
4 "Hilltop"	<30	<30	45
5 Galong	<30	<30	45
6 "Highview"	<30	<30	45
7 "Cherryvale"	<30	<30	45
8 "Glenroy"	<30	<30	45
9 "Woodstock"	<30	<30	45

Note * Based upon an assumed RBL of 30 dBA.

The noise modelling results show the L_{Amax} noise level of the Lime Kiln to be below the project specific noise level goal under both calm and prevailing weather conditions at all residential receiver locations. As maximum noise levels are highly unlikely to occur simultaneously, and based upon the fact that the Galong Limestone Mine meets the requirements for sleep disturbance, no cumulative impact of $L_{A1(1\ minute)}$ sleep disturbance noise levels is necessary.

Construction Road Traffic Noise

Traffic generation during construction is likely to include utility and service vehicles as required. Minibuses to convey personnel to and from the site are likely to operate morning, afternoon and up to two other times per day. There will also be up to 5 delivery vehicles per day for fuel and consumables and maintenance.

There is likely to be 1 concrete truck every 20 minutes during a concrete pour. This would be an irregular event, and is likely to occur for up to 15 days of the nine month construction period.

Consistent with the Mine Expansion Project, heavy vehicle traffic will occur only during the daytime period (7.00 am to 10.00 pm). To keep the rise in road traffic noise below the 2 dB(A) increase recommended under the ECRTN, a maximum increase of 19 heavy vehicles per hour, during the daytime period (7.00 am to 10.00 pm), would be allowable. This number is far greater than the likely increase in traffic due to construction of the Lime Kiln.

Construction traffic is only temporary, with traffic noise levels likely to increase only for the construction period.

Operation

There will be no increase in road traffic numbers, and no significant difference in the ratio of heavy vehicles to light vehicles, as a result of the operation of the Lime Kiln, which simply involves further processing of product prior to despatch to market.

6.8.10 Conclusions

As a result of their assessment Richard Heggie Associates have concluded that:

- The construction and operation of a Lime Kiln at the Galong is predicted to meet all project specific noise level goals during construction, and for operation during daytime, evening and night-time at all residential locations.

- The cumulative impact of the Mine and the Kiln demonstrates that compliance will be achieved at all residential locations for all periods of operation, except for a 1 dBA exceedance of the intrusiveness noise level at the Brown Residence (a mine-related residence) under temperature inversion when the 30 year mine plan is combined with Kiln operation. This is primarily the result of Mine operation rather than Kiln operation, with the two dominant noise sources being the jaw crusher and rock drill. Such an exceedance is unlikely to be perceivable to the human ear and is only likely to occur for a short period of time.

- Road traffic noise levels for both the construction and operation of the Lime Kiln are predicted to be within the 2 dBA increase in $L_{Aeq(1hour)}$ noise level allowable under the ECRTN.

6.9 Air Quality

6.9.1 Introduction

Holmes Air Sciences undertook an air quality assessment of the proposed Lime Kiln Project, including cumulative impacts with the Mine Expansion Project.

A complete copy of their report is included in Volume 2 of this EIS.

The methodology used in the assessment follows that set out in the NSW EPA's guidelines, Approved Methods and Guidance For the Modelling and Assessment of Air Pollutants in New South Wales.

6.9.2 Air Quality Criteria

The New South Wales Environment Protection Authority (EPA) has historically noted air quality goals for nitrogen dioxide, carbon monoxide determined by the World Health Organisation (WHO), the United States Environmental Protection Agency (US EPA) and the National Health and Medical Research Council of Australia (NHMRC). Air quality goals for hydrocarbons have been used previously, but these have been discarded because they are not specific for reactive species which are the important elements in the formation of photochemical smog.

The National Environment Protection Council of Australia (NEPC) has determined a new set of air quality goals for adoption at a national level, which are part of the National Environment Protection Measures (NEPM). In its publication Action for Air, the NSW EPA has adopted new air quality goals for nitrogen dioxide. These make the NSW standards for these emissions consistent with the NEPM standards.

Ground-level concentration (glc) criteria are specified by NSW EPA for odorous and toxic air pollutants. In addition, a recently published Draft National Environment Protection Measure for Air Toxics sets investigation level concentrations for benzene, benzo[a]pyrene (BaP) (as a marker for PAHs), formaldehyde, toluene and xylenes. Investigation level means that if the set concentration is exceeded then an appropriate form of further investigation and evaluation is required.

The operation of the Lime Kiln will result in emissions of PM_{10}, nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and trace emissions of some metals and air toxics, including copper, lead, polycyclic aromatic hydrocarbons (PAHs), dioxins and furans. The common pollutants from lime kilns are detailed in the NPI Emission Estimation Technique Manual for Lime and Dolomite Manufacturing and are presented in the Holmes Air Sciences Report together with the NSW EPA assessment criteria. For pollutants which NSW EPA does not have assessment criteria, the criteria have been sourced from other bodies, including the Victoria EPA (VEPA), the World Health Organisation (WHO), the US EPA Integrated Risk Information System (IRIS) and the California Office of Environmental Health Hazard Assessment (OEHHA).

The Mine Expansion will result in emissions of dust, which includes total suspended particles (TSP) and particulate matter less than 10 microns (PM_{10}).

Comparisons were also made against the inhalation unit risks of an air pollutant which is defined as "the additional lifetime cancer risk occurring in a hypothetical population in which all individuals are exposed continuously from birth throughout their lifetimes to a concentration of 1 $\mu g/m^3$ of the agent in the air they breathe".

Appendix A of the Holmes Air Sciences Report presents details of the health impacts associated with these pollutants.

6.9.3 Dust

The nuisance goals for inert dust during the excavation period were also considered. Table 6.21 shows the maximum acceptable increase in dust deposition over the existing dust levels and the maximum total level allowable as determined by the NSW EPA in their recent publication on air quality goals and assessment procedures.

Table 6.21 NSW EPA criteria for dust fallout

Pollutant	Averaging Period	Maximum increase in deposited dust level	Maximum total deposited dust level
Deposited dust	Annual	2 g/m^2/month	4 g/m^2/month

6.9.4 Existing Air Quality and Meteorology

Section 4 of the Holmes Air Sciences report describes the dispersion meteorology, general climate and air quality in the study area. As well as information on prevailing wind patterns, historical data on temperature, humidity and rainfall are presented to give a more complete picture of the local climate. The dispersion model used in their study require further information such as atmospheric stability class and mixed layer height. These data were all generated using the TAPM model.

Air quality standards and goals refer to pollutant levels which include the Project and existing sources. To fully assess impacts against all the relevant air quality standards and goals it is necessary to have information or estimates on existing dust concentration and deposition levels in the area in which the Project is likely to contribute to these levels.

No air quality measurements have been made specifically for this Project and there are no on-site monitoring data and no NSW EPA monitoring sites located in the vicinity. However, as Galong is situated in a rural area with no major sources of air pollution the local air quality is likely to be good and concentrations of pollutants are unlikely to exceed any of the air quality goals.

6.9.5 Assessment Approach

The AUSPLUME dispersion model (Version 5.4) was used to predict ground-level concentrations of emissions of PM_{10}, NO_2, SO_2, organic and inorganic emissions from the operation of the proposed Lime Kiln and PM_{10} and dust emissions from the Mine Expansion. The predicted concentrations have been compared with the NSW EPA's assessment criteria as required in the EPA's modelling guidelines.

In addition a health risk assessment was carried out according to the procedure developed by the Committee of the California Air Pollution Control Officers Association. A screening risk level of 1 in a million was applied to the Lime Kiln Project. This is the incremental risk level below which the NSW EPA does not require a more detailed assessment to be carried out.

6.9.6 Emissions From Lime Kiln Stack

Emissions from the Lime Kiln stack will potentially include the criteria pollutants PM_{10}, NO_x, and SO_2, air toxics and metals. The Lime Kiln will be fitted with a baghouse filter to control emissions of particulate matter.

The model was used to predict concentrations of stack emissions at a set of receptors arranged at 200m spacing for 14km x 10km around the plant.

6.22 presents the criteria pollutant emission rates. Table 6.23 presents the emission rates of the air toxics and metals in units of kg of substance per tonne of lime produced (kg/t). The modelled emissions rates in grams per second (g/s) are also presented in Table 6.23.

Table 6.22 Lime Kiln Criteria Pollutant Emission Rates

Substance	Emission Rate (g/s)
PM_{10}	0.25
NO_x	2.58
SO_2	0.645

Table 6.23 Lime Kiln Metals and Air Toxic Emission Rates

Pollutant	Emission rate (kg/t)	Modelled emission rate (g/s)
Arsenic	6	2.86E-05
Beryllium	0.33	1.57E-06
Cadmium	1.1	5.25E-06
Chromium	3.9	1.86E-05
Chromium VI[a]	-	5.55E-06
Copper	70	3.33E-04
Hydrochloric Acid	25000	1.19E-01
Mercury	110	5.25E-04
Ammonia	460	2.19E-03
Lead	38	1.81E-04
Sulphuric acid	3600	1.71E-02
Selenium	100	4.76E-04
Zinc	170	8.10E-04
Benzene	8000	3.81E-02
Formaldehyde	230	1.10E-03
Total PAHs[b] (expressed as BaP equivalent)		6.35E-07
Total Dioxins/Furans[b] (expressed as 2,3,78 TCDD equivalent)	-	7.05E-15

Note:
[a] Chromium VI emissions assumed to 30% of total Cr as per information from Greg Storrier (NPI, 2003)
[b] Calculated as detailed in Error! Reference source not found.

6.9.7 Kiln Operation Impacts

Dispersion modelling, using the AUSPLUME model (Version 5.4), was carried out to assess the impacts of the emissions from operation of the kiln.

Predictions for the criteria pollutants were made for 24-hour and annual average concentrations of PM_{10}, 1-hour and annual average concentrations of NO_2, and 1-hour, 24-hour and annual average concentrations of SO_2. It was assumed that the plant may operate for 24 hours per day, and no consideration was made for variations in emissions by hour of day. Table 6 24 presents a summary of the maximum predicted concentrations of PM_{10}, NO_x and SO_x across the whole area and Table 6 25 presents the concentrations at the sensitive receptors. This shows that none of the maximum predicted concentrations exceed the NSW EPA air quality criteria.

Table 6 24 Maximum Predicted Concentrations of Criteria Pollutants

Pollutant	Averaging Period	Location X (m)	Location Y (m)	Maximum concentration ($\mu g/m^3$)
PM_{10}	24-hour	649000	6170800	0.54
	Annual	646400	6170400	0.07
NO_x	1-hour	649000	6170000	64.01
	Annual	646400	6170400	0.73
SO_x	1-hour	649000	6170000	16.00
	24-hour	649000	6170800	1.40
	Annual	646400	6170400	0.18

Table 6 25 Maximum Predicted Concentrations of Criteria Pollutants at Sensitive Receptors

Receptor ID **	PM_{10} ($\mu g/m^3$)		NO_x ($\mu g/m^3$)		SO_x ($\mu g/m^3$)		
	24-hr	Annual	1-hr	Annual	1-hr	24-hr	Annual
1	1.04E-01	1.62E-02	4.63	1.67E-01	1.16E+00	2.69E-01	4.17E-02
2	1.42E-01	1.30E-02	3.28	1.34E-01	8.21E-01	3.67E-01	3.34E-02
3	1.12E-01	4.87E-03	4.95	5.03E-02	1.24E+00	2.90E-01	1.26E-02
4	7.25E-02	4.82E-03	6.01	4.98E-02	1.50E+00	1.87E-01	1.24E-02
5	9.08E-02	8.43E-03	6.22	8.70E-02	1.56E+00	2.34E-01	2.17E-02
6	1.38E-01	1.26E-02	9.68	1.30E-01	2.42E+00	3.57E-01	3.26E-02
7	5.39E-02	5.46E-03	4.39	5.63E-02	1.10E+00	1.39E-01	1.41E-02
8	7.06E-02	6.28E-03	4.80	6.49E-02	1.20E+00	1.82E-01	1.62E-02

** The location of the Receptors is shown on Figure 6 in the Holmes Air Sciences Report.

PM_{10}

Contour plots of predicted 24-hour and annual average PM_{10} concentrations are shown in Figure 6 of the Holmes Air Sciences report included in Volume 2. The EPA's assessment criterion of 50 $\mu g/m^3$ (24-hour average) and 30 $\mu g/m^3$ (annual average) are met everywhere. This would be true even after allowing for a reasonable background level.

NO_2

Predicted 1-hour and annual average NO_2 concentrations (assuming that all NO_x has been converted to NO_2) are shown in Figure 7 of the Holmes Air Sciences Report. The EPA's assessment criterion of 246 $\mu g/m^3$ (1-hour average) and 62 $\mu g/m^3$ (annual average) are met everywhere. This would be true even after allowing for a reasonable background level.

It was assumed that the kiln operated continuously and that all NO_x emissions are in the form of NO_2. Typically only 20% will have been converted to NO_2 by the time the plume has dispersed to the areas where the higher concentrations are found.

SO_2

Predicted maximum 1-hour, 24-hour and annual average SO_2 concentrations (assuming that all SO_x has been converted to SO_2) are shown in Figure 8 of the Holmes Air Sciences Report.

The EPA's assessment criterion of 570 μg/m^3 (1-hour average), 228 μg/m^3 (24-hour average) and 60 μg/m^3 (annual average) are met everywhere. This would be true even after allowing for a reasonable background level.

Metals and air toxics

For the metals and air toxics for which NSW EPA gives ground-level concentration (glc) criteria, 3-minute average predictions were made and the 99.9th percentile reported. For those pollutants which have an annual average or risk factor is available, annual average predictions were made and the maximum concentration is reported. For dioxins 1-hour average predictions were also made.

The Holmes Air Sciences Report presents a summary of the maximum predicted concentrations across the grid. Their Report presents a summary of the maximum predicted concentrations at the discrete receptors.

All the concentrations are below the glc and/or unit risk factors.

The results presented in Tables 6 and 7 of the Holmes Air Sciences Report are also presented as contours on a regional map. These contour maps are included as Figures 9 to 25 in the Holmes Air Sciences Report.

Health Risk Assessment

In addition to dispersion modelling to predict the ground-level concentrations of the individual pollutants, a cumulative health risk assessment was carried out according to the procedure developed by the Committee of the California Air Pollution Control Officers Association.

An assessment was made based on carcinogenic properties of total dioxins (as 2,3,7,8 TCDD), total PAHs (as BaP), arsenic, benzene, beryllium, cadmium, chromium VI, formaldehyde, and lead.

The individual predicted impacts for each of the compounds are below the NSW guideline of 1 in a million. The cumulative impact of all the compounds assessed are also shown to be below the 1 in a million screening guideline.

6.9.8 Mining Operations Impacts

The AUSPLUME model (Version 5.4) was used to assess the impacts of the emissions from operation of the Mine Expansion Project.

Table 6.26 presents a summary of the maximum predicted concentrations at the discrete receptors of PM_{10}, TSP and dust deposition concentrations. Figures 23 to 25 of the Holmes Air Sciences Report in Volume 2 of this EIS show contour plots of the predicted concentrations.

All the predictions are substantially below the NSW EPA air quality guidelines.

Table 6.26 Maximum Predicted PM_{10}, TSP and Dust Deposition Concentrations

Receptor ID **	PM_{10}	TSP	PM_{10}	TSP	Dust deposition
	Annual average ($\mu g/m^3$)		24-hour average ($\mu g/m^3$)		(g/m^2/month
1	0.24	0.45	1.88	3.78	0.087
2	0.26	0.52	2.11	4.61	0.117
3	0.16	0.26	3.02	6.65	0.024
4	0.07	0.09	1.28	1.82	0.006
5	0.08	0.11	0.87	1.28	0.012
6	0.08	0.12	0.75	1.19	0.017
7	0.04	0.05	0.66	0.96	0.005
8	0.05	0.07	0.88	1.16	0.006

**The location of the Receptors is shown on Figures 23 to 25 in the Holmes Air Sciences Report

6.9.9 Cumulative Impact of Kiln and Mine Operation

It was not necessary to model the cumulative impact of PM_{10} emissions from operation of both the Lime Kiln and Mine Expansion. This was because the maximum predicted 24-hour average concentrations of PM_{10} at any of the discrete receptors is 0.14 $\mu g/m^3$ from the Kiln operation and 3.02 $\mu g/m^3$ from operation of the Mine. Simple summation of these emissions gives 3.16 $\mu g/m^3$ which is substantially lower than the EPA guideline of 50 $\mu g/m^3$.

The maximum predicted annual average concentrations of PM_{10} at any of the discrete receptors is 0.016 $\mu g/m^3$ from the Lime Kiln operation and 0.26 $\mu g/m^3$ from operation of the Mine. Simple summation of these emissions gives 0.28 $\mu g/m^3$ which is substantially lower than the EPA guideline of 30 $\mu g/m^3$.

It is therefore unlikely that any of the EPA guidelines will be exceeded.

6.9.10 Construction Impacts

The Construction Workforce will be typically 40 increasing to 70 at the peak of construction activity.

Construction is planned to occur from November 2003 to March/April 2004. General Construction will occur from 6 am to 6 pm Monday to Saturday, with some work occurring on Sundays to meet Project schedules.

The workforce will be transported to work in a combination of mini-buses and owner vehicles.

No major earthworks will be required for the development and emissions to the air will comprise minor quantities of dust due to use of the rock breaker and excavators and from vehicle movements. Given the distance to nearby residences it is very unlikely that any air quality impacts will arise as a result of construction.

6.9.11 Greenhouse Emissions

The major greenhouse emissions from the Project will be the carbon dioxide emissions from the calcining process. These emissions would be equivalent to approximately 44% of the total limestone processed. Assuming an annual processing rate of 300,000t, carbon dioxide emissions would be 132,000t.

In addition, greenhouse emissions would arise from consumption of electricity, diesel and fuel consumption within the Kiln.

Consumption of electricity is estimated to be 45 kWh per tonne of lime produced (150,000 tonnes). On an annual basis this is equivalent to 6.75×10^6 kWh. The Australian Greenhouse Office (2003) has published a workbook which provides emission factors for a range of electricity sources. Typical emission factors for electricity sent out in NSW/ACT are 1.012 kg CO_2– e/kWh. Therefore the total CO_2 equivalent emissions from electricity consumption are 6,831 tonnes (1.012 x 45 x 150,000/1,000).

It is also estimated that 10,000 litres of diesel fuel would be consumed on site. The emission factor for diesel, taking account of the full fuel cycle analysis, is 3 kg CO_2–e/kL of fuel. Therefore total emissions would be 0.03 tonnes (3.0 x 10,000/1,000).

It is proposed to use black coal as a combustion source in the kiln. The emission factor from the fuel cycle analysis for black coal is 98.1 kg CO_2–e/GJ. This corresponds to an annual emission rate, assuming that the coal would be consumed at the rate of 504,000 GJ per annum, of 49,442t (98.1 x 504,000/1,000). Blue Circle Cement are actively pursuing alternative fuel sources for their Kiln.

Table 6.26 summarises the total estimated greenhouse emissions from activities at the site based on the above information.

The total estimated annual emissions of 178,544.03 t/year then be compared with 458.2 Mt CO_2 equivalent estimated by Environment Australia to have been produced by Australia in reference year 1999 (excluding land clearing). The total greenhouse gas emissions for the Project are therefore estimated to be 0.04% of Australia's 1999 emissions.

Table 6.27 Total greenhouse emissions (CO_2 equivalent) from on-site activities

Activity	Tpa
Calcining of limestone	132,000
Electricity consumption	6,831
Diesel fuel usage	0.03
Coal burning	49,442
Total	188,273.03

6.9.12 Air Impact Assessment Conclusions

As a result of their assessment, Holmes Air Sciences concluded that:

- Emissions due to operation of the Lime Kiln will meet all ambient air quality standards set by the EPA,
- The individual and cumulative health risk impacts of air toxics from operation of the Lime Kiln are substantially lower than the EPA 1 in a million screening guideline, and,
- Emissions due to mining activities should cause no air quality impact on nearby residential areas.

6.10 Aesthetics

Maurice Hayler and Associates, Architects, undertook a visual and aesthetic assessment of the Galong Lime Kiln Project. A copy of their report is included in Volume 2 of this EIS.

The aesthetic assessment was undertaken to:

- Assess the visual impact of the Project on the surrounding countryside,
- Provide an artist's impression of the Project to help the general public better understand its nature and appearance, and,
- Make recommendations as necessary regarding visual impact.

A copy of the artist's impression is included at the end of this Chapter.

The proposed Lime Kiln plant is made up of a number of components which include the Lime Kiln structure, storage bins, conveyors, screenhouses, crushers and limestone stockpiles. The dominant feature of the plant is the Lime Kiln structure, which is approximately 47m in height and has an industrial appearance.

The Lime Kiln structure, because of its height and appearance, has the greatest potential visual and aesthetic impact of the proposed plant structure on the surrounding rural countryside. The Kiln is essentially a static structure with few moving parts enclosed at the top and at the bottom outlet. An elevator on the side of the Kiln is the only visible moving part.

The visual and aesthetic assessment of the Lime Kiln was based on a number of considerations:

- The scale of the proposal within the landscape as seen by the general public,
- Whether the Kiln is cast against a backdrop of sky, or hills, or vegetation,
- The color or reflectiveness of the Kiln within its context,
- If there are any emissions such as steam or smoke which might draw additional attention, and,

- Any existing structures in the locality with which it can be compared.

The landscape is generally cleared farmland with rolling hills dotted with clusters of trees. The Kiln will be located within a valley and be mostly screened from public view by a ridge. It will be set against a backdrop of hills rising approximately 100m above the level of the Kiln and extending from the northeast, along the east and around the south of the site.

The Lime Kiln structure will be painted in neutral colours to blend with the backdrop. There will be exceptions on a small scale as required by safety standards. Handrails and some equipment will be brightly coloured for safety purposes.

As a guide, Maurice Hayler and Associates recommended the following paint colours for the Kiln structure:

- The Heater vessels; Equal to Dulux Hi Temp 600 Aluminium Silver,
- Steel structure: Equal to Dulux Ferridor Micaceous Iron Oxide, and
- Galvanised steelwork to be left as is.

The Lime Kiln has no visible emissions to draw additional or adverse attention.

There are two other noteworthy tall man-made structures in the locality of the Kiln. The Mt Bobbara aviation navigation tower is situated on top of Bobbara Mountain 250m above Burley Griffin Way and the surrounding countryside. The tower which is approximately 35m high, is prominently silhouetted against the sky and is seen from most points around the Mountain. The second structure is the grain silo adjacent to Galong Rail Station. It has a central tower approximately 27m high and is very prominent in the landscape and close to buildings in Galong.

Maurice Hayler and Associates recommended that a Landscape Architect be engaged to provide professional advice and layout plans for:

- Screen planting around the Mine,
- Avenue planting of endemic trees along Eubindal Road after the proposed road widening works associated with the Mine Expansion have been installed, and,
- Internal landscaping, where practical, to car parks and around office buildings.

These recommendations will be implemented.

Maurice Hayler and Associates concluded that, because of the height and industrial nature of the Lime Kiln, it would normally be an intrusive element in the rural landscape. However, because of its valley location, remote from public viewing, the proposal will have little visual or aesthetic impact on the surrounding countryside, especially if the colour treatment guidelines and landscaping recommendations are implemented.

6.11 Transport

Transport and Urban Planning undertook a traffic and transport assessment to address the traffic issues associated with the construction and operation of the Lime Kiln Project. Their Assessment Report for the Lime Kiln Project is included in full in Volume 2 of this EIS. Figure 1 of that Assessment Report shows the Lime Kiln Project Transport Routes.

Transport and Urban Planning had previously completed a similar, but more detailed, assessment for the Mine Expansion Project. Their Assessment for the Mine Expansion Project is included in Volume 3.

Transport and Urban Planning used Mine Expansion Project Assessment data in their Assessment of the Lime Kiln Project.

6.11.1 Introduction

The Lime Kiln Project will not affect the total volume of product transported from the site described for the Mine Expansion Project.

The Limestone Kiln Project proposes the construction and operation of a Lime Kiln capable of producing 150,000tpa of quicklime. Approximately 300,000t of limestone is required to be processed through the Kiln in order to produce 150,000t of quicklime. The total quantity of products produced on site would remain at 350,000tpa, consisting of 200,000tpa of agricultural lime and 150,000tpa of quicklime. If the Lime Kiln Project does not proceed, maximum agricultural lime sales would be increased to the 350,000tpa limit.

The bulk of the hydrated lime would be transported to the Illawarra Region and would pass through Galong and along Burley Griffin Way.

The Kiln will use between 60-70t of coal per day. The coal will be delivered by truck, resulting in up to two (2) B Doubles or three (3) semi trailer deliveries per day. These vehicles will arrive and depart the Mine via Burley Griffin Way through the town of Galong.

Transportation hours will be the same as for the expanded, mine which is 7am to 7pm Monday to Saturday.

Vehicle access to the proposed Lime Kiln will be via the Mine's access road which is located in Eubindal Road at the end of the formed section of that road.

All product and delivery vehicles associated with the Kiln will use the route from Burley Griffin Way (MR84) via the town of Galong. This route includes Galong Road (Crescent Street, Bobbara Road, Ryan Street through Galong town) and Eubindal Road. These vehicles will arrive from and depart to the east along Burley Griffin Way (MR84).

Should coal be sourced from the Western Coalfield access to the site would occur along the northern transport route utilising Cunningar Road and Kalangan Road. These routes are not approved for B Double use and smaller semi trailers would be used for coal deliveries in these circumstances.

Burley Griffin Way is a State road and is constructed to a high standard. The section of Burley Griffin Way between Harden Shire boundary and the Hume Highway is currently not a B Double route, however advice from the Roads and Traffic Authority indicates that upgrading works are imminent and when completed, this section of Burley Griffin Way will become a B Double route.

6.11.2 Proposed Road Upgrades

The EIS for the Galong Mine Expansion has identified the need for the progressive upgrading of the main transportation route through Galong town through the provision of an improved and wider road surface and, subject to the agreement of Harden Shire Council and the Roads and Traffic Authority, lower speed limits through Galong town and in Eubindal Road. Barnu has given an undertaking to Harden Shire Council to work with the Council to address the concerns of the residents of Galong town.

Barnu has also agreed to the upgrading of the Burley Griffin Way and Galong Road intersection to provide for increased turning vehicles to and from Burley Griffin Way, when sales and transportation of the lime products exceed 200,000 tpa.

The other transport elements of the Mine Expansion Project, namely the Code of Conduct for truck drivers and the Complaints Hotline will apply for all product and supply vehicles to the Mine including vehicles associated with the Lime Kiln.

6.11.3 Operational Phase Traffic Impacts

If the Lime Kiln Project is approved and proceeds, there will be no substantial change to the traffic generation and traffic impacts as assessed for the Mine Expansion Project.

The number of product vehicles generated by the Mine with the Kiln in place will be the same as assessed for the Mine Expansion.

In 2008, when the Mine is in full production with the Kiln operating, product truck movements using the main transportation route through Galong town will be:

- Between 74-78 truck movements on the average day with 7-8 truck movements per hour; and,
- Between 88-92 truck movements on the 85th percentile day with 9-10 truck movements per hour.

The only additional trips associated with the proposed Lime Kiln will be 14-16 trips per day consisting of:

- 4 employee trips (i.e. 4 in / 4 out) spread over the day;
- 2-3 coal truck load deliveries per day (i.e. 2-3 in / 2-3 out), and,
- Vehicle trips associated with maintenance of the Kiln which will be 1-2 visits per week.

These additional trips will be spread over the full day resulting in a maximum of 1-2 vehicle trips per hour. Other than coal load deliveries (4-6 trips per day), the remainder of the vehicle trips will consist of cars and vans.

The impacts of the additional traffic (14-16 vehicle trips) associated with the Lime Kiln on the road network will be minimal.

All of these additional trips will access the Mine via Eubindal Road. However, away from Eubindal Road, the employee trips (8 trips per day) will be spread over several routes. The coal deliveries and the maintenance vehicles will use Galong Road via Galong Town to and from Burley Griffin Way.

The additional 4-6 truck movements per day passing through Galong town between the Mine and Burley Griffin Way will not alter the traffic conditions on the road network. Traffic conditions on the road network and the principal intersections will remain satisfactory.

The proposed road upgrading works and other traffic management changes through the town of Galong associated with the Mine Expansion Project will address amenity concerns within the Galong town. In addition, the proposed upgrading of the Burley Griffin Way / Galong Road intersection will improve potential road safety at this intersection.

Transport and Urban Planning concluded that the cumulative traffic impacts of the proposed Lime Kiln will be minimal.

6.11.4 Construction Phase Impacts

The Lime Kiln Project will take approximately 7 months to construct. Subject to timely approval, construction is expected to commence in late 2003 and be completed in mid 2004. The construction workforce will typically be 40 people. During the third quarter of construction, this figure will increase to 70 people.

It is planned to work only one shift per day, from 6am to 6pm for 6 days per week, Monday to Saturday. On occasions, Sunday work will be required to meet Project schedule requirements. Construction workforce will be transported to the site in a mix of mini-buses and private vehicles. Of the 40 people typically employed during the early part of construction, 20 will be transported to and from work in 2 small mini-buses and 20 will be transported in approximately 10 private vehicles. When the workforce increases to 70, it is expected that 50 will use mini-bus transport (4 buses) and 20 will use private vehicles (10 vehicles). At any time, up to 5 additional company vehicles per day (sedans) would access the site for supervision purposes.

Construction supplies will be delivered in a range of heavy vehicles. It is proposed to have most of the fabrication undertaken off site and components delivered to the site for assembly. Typically, up to two (2) heavy vehicles (semi-trailers) per day will be required to deliver construction material to the site between the fourth and sixth months of construction. During the first three months of construction, up to six (6) concrete agitator vehicles will access the site per day. Up to three (3) smaller trucks per day will deliver small construction materials and supplies. Access will be via Galong and all restrictions on heavy vehicle movements through the town will be observed.

As noted above construction of the Kiln is scheduled to occur in 2003 and 2004. Table 6.28 shows the estimated number of vehicle trips associated with the construction of the Lime Kiln. There will be up to 52 vehicle trips (i.e. 26 in / 26 out) per day during the construction period. These trips will be spread over the day between 6am and 6pm. The majority of these vehicles will pass through Galong town.

Employee and company vehicles will make up the bulk of the construction traffic and these will be undertaken in light vehicles equivalent to Austroad Class 1 and 2 vehicles.

The number of vehicle trips associated with the construction of the Lime Kiln is numerically small and will not have any adverse traffic impacts on the road network or amenity impacts within the town of Galong. Traffic conditions on the road network including at the principal intersections and within the Galong town are expected to remain satisfactory.

Table 6. 28 Construction Phase Vehicle Trips per Day

Type of Trip	Months (1-3)	Months (4-6)	Months (7-9)
Employee trips	12 in / 12 out	12 in / 12 out	14 in / 14 out
Company staff	5 in / 5 out	5 in / 5 out	5 in / 5 out
Concrete agitator vehicles	6 in / 6 out	-	-
Deliveries – Rigid Trucks	3 in / 3 out	3 in / 3 out	3 in / 3 out
Deliveries – Prefabricated Components	-	2 in / 2 out	
Total	**26 in / 26 out**	**22 in / 22 out**	**22 in / 22 out**

6.12 Archaeology

Robert Paton Archaeological Studies Pty Limited undertook an Aboriginal Heritage Assessment of the Galong Mine Site, including the area affected by the proposed Lime Kiln Project. The Report was undertaken in June 2003 and a full copy is included in Volume 3 of this EIS.

6.12.1 Consultation with Indigenous Groups

The Aboriginal community are best able to determine actual significance and degree of significance of sacred sites and sites of significance. Additionally, the NSW National Parks and Wildlife Service have a policy that Local Aboriginal Land Councils and any relevant groups should be consulted and actively involved in the Cultural Heritage Assessment process.

The proposed development falls within the boundary of the Onerwal Local Aboriginal Land Council. Representatives of that organisation were involved in the field assessment process and in the formulation of significance assessments and management recommendations developed for any Aboriginal sites identified in the Mine area.

6.12.2 Methodology

The initial stage of the Assessment involved discussions with the Onerwal Local Aboriginal Land Council and the National Parks and Wildlife Service to obtain an understanding of any issues that each group may have had. At the same time a review of the National Parks and Wildlife Service heritage site register was completed to determine if any previously identified Aboriginal sites were located near the Mine.

The second stage of the Assessment involved field work to locate and record sits that may occur near the Mine.

The third stage of the Assessment involved the analysis of data obtained form the field survey.

6.12.3 Ethnohistory

The areas around the Mine site have been occupied by people from two language or tribal groups, known as the Wiradjuri and the Onerwal. Utilisation of the area was concentrated on the major water courses with some venturing away from them during wetter times.

The period of Aboriginal occupation has left a legacy of archaeological sites in the region including open camp sites, rock shelters, caves with living floors, axe grinding grooves, art sites, bora rings, burial grounds, scarred trees and ceremonial grounds.

6.12.4 Archaeological Background

No archaeological surveys have been undertaken around the Mine site, and the National Parks and Wildlife Service register shows that there are no recorded sites or surveys within a 10km radius of the Mine.

There have been a number of archaeological surveys carried out in the wider region surrounding the site and these can provide useful information regarding site patterning in the landscape. The results, when assessed at a general level, show a distinct patterning in site location with most sites being recorded on creek banks or high ground adjacent to permanent or semi-permanent water.

The most frequently occurring site type in the broader region is the open scatter. Most of these are small sites containing less than 50 artifacts, with medium sized sites of up to 300 artifacts occurring intermittently.

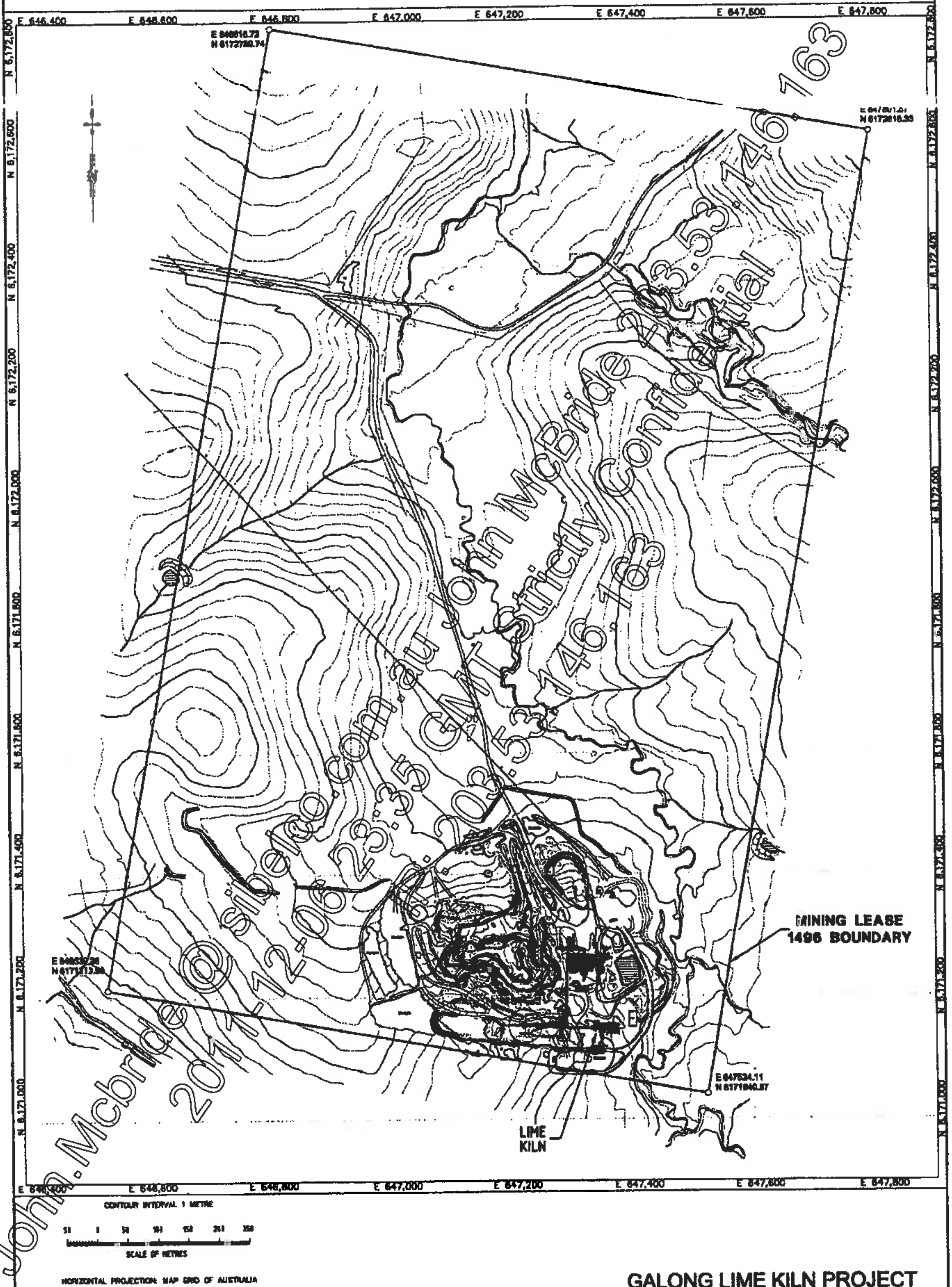
6.12.5 Outcomes and Discussion

Rob Paton noted the disturbed nature in the immediate surrounds of the Mine and that none of the original ground surface remains in this area. This included the Lime Kiln site. Paton notes that the present mine site comprises about 20% of the 160 hectares investigated and that it was very highly disturbed and had no archaeological potential.

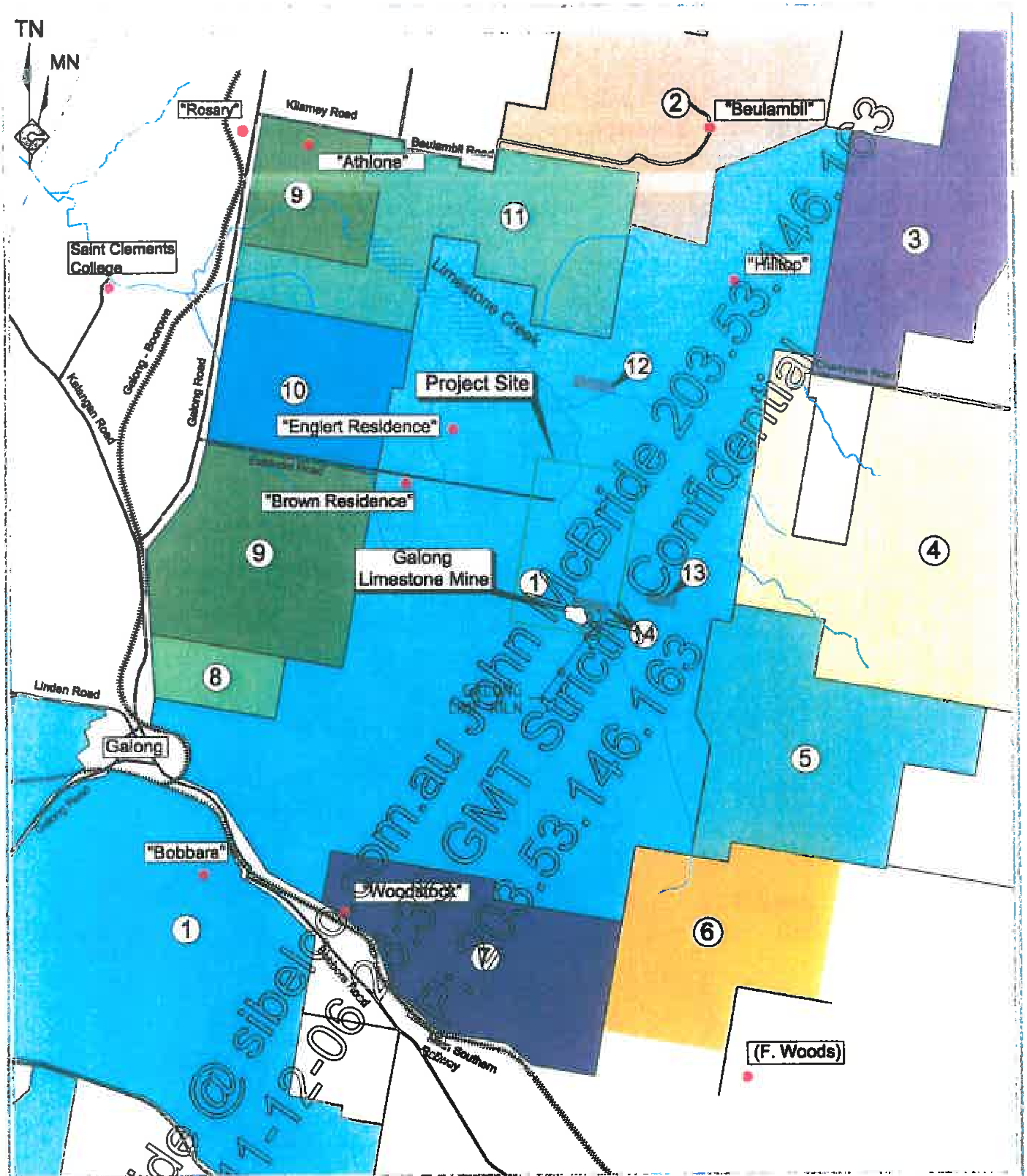
Two Aboriginal archaeological sites were identified during the surface archaeological survey. Both sites are located on the northern portion of the ridge in the proposed Mine Expansion. They will not be directly affected by the Lime Kiln Project. The Aboriginal sites comprise 1 artifact scatter and 1 isolated find. A full description of their details and location is included in Patons Report in Volume 3 of this EIS.

Prior to Paton's survey, parts of the Mine site were inspected by a member of the Onerwal Local Aboriginal Land Council. Several scarred trees were noted in the proposed overburden area to the south west. These trees were relocated and inspection showed that all of the apparent scarring was in fact the result of natural events such as limb breakage.

Management of the sites will be developed in conjunction with the Mine Expansion Project.



GALONG LIME KILN PROJECT
Figure 6.1
Topography



REFERENCE

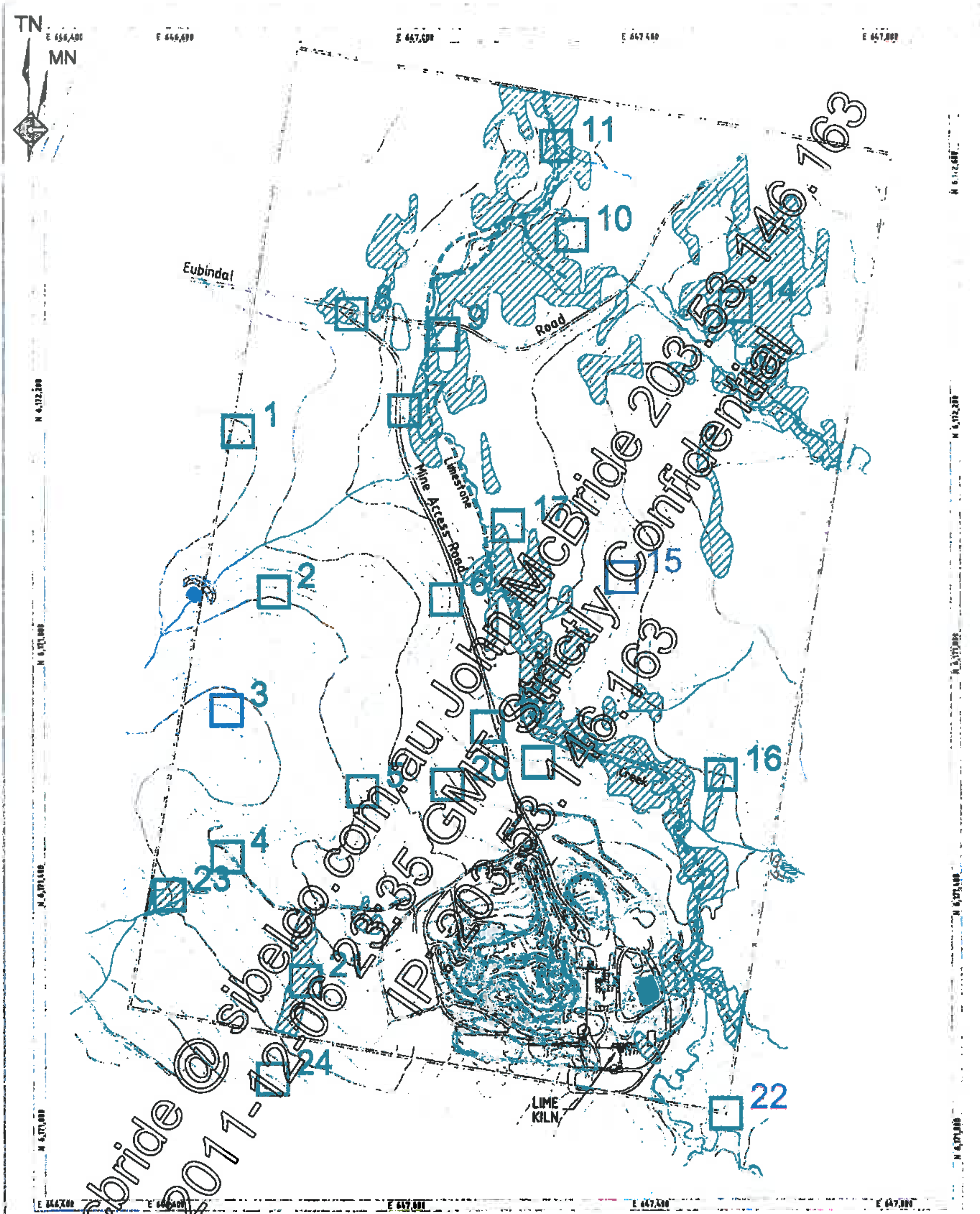
- ① Bobbara Pastoral Company Pty Ltd
- ② CONSTABLE Donald Joseph
- ③ SARGENT David Mathew
- ④ Old Bundemar Pty Limited
- ⑤ SCHULZE Janice Marie
- ⑥ WOODS Cecil & Aileen
- ⑦ SHEA Leslie & Diane
- ⑧ The Trustees of the Roman Catholic Church of the Archdiocese of Canberra & Goulburn
- ⑨ FLANERY Sean & Daniel
- ⑩ WOODHEAD Stephen & Phillip
- ⑪ Trustees of the Redemptorist Fathers
- ⑫ Crown Land (R412)
- ⑬ Crown Land (R27202 Former Public School Site 1898)
- ⑭ Crown Land (R2928) - Mining
- Boundary of Mining Lease 1496
- Road
- Railway
- Residence
- "Woodstock"

SCALE 1:60 000

0.5 0 0.5 1.0 1.5 2.0 2.5 km

Source of Figure: R.W.Corkery & Co (2003)

GALONG LIME KILN PROJECT
Figure 6.2
Surrounding Residences And Land Tenure



Grid: MGA (Zone 55)
Datum: AHD

SCALE 1:10 000

100 0 100 200 300 400 500 m

Source: Geo-Spectrum (Australia) Pty Ltd - Date of Photography: 10/07/2002
Source of Figure: R.W.Corkery & Co (2003)

REFERENCE

Boundary of Mining Lease 1496 (the "Project Site")

24 50m x 50m Survey Quadrats / Identifier

Vegetation Communities

Community 1 - Cleared Lands (all Areas within Project Site not Designated as Community 1 or 2)

Community 2 - River Red Gum Community

Community 3 - White Box, Yellow Box, Blakely's Red Gum, Apple Box Community.

GALONG LIME KILN PROJECT
Figure 6.3
Project Site Flora

Maurice Naylor & Associates
ARCHITECTS

Artists Impression

June 2003

BLUE CIRCLE SOUTHERN

PROPOSED LIME KILN
Galong NSW

Chapter 7

Environmental Management

7. Environmental Management

7.1 Ecologically Sustainable Development Principles

7.1.1 The Precautionary Principle

This principle states that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

When Blue Circle Southern Cement purchased the Barnu Pty Limited they implemented a comprehensive documented Management System at the Galong Mine Operation. This Management System will be expanded to include Environmental Management Systems (EMS) to be used for the construction and operation of the Galong Lime Kiln Project.

The eMS already contains provision for Environmental management directed at contractors activities on site. Contractors are not permitted to remove or modify any trees and/or fauna unless prior approval has been granted by Barnu. Contractors must carry out vehicle maintenance in an area that is bunded suitably for the purpose. They must remove all waste materials from the site daily and have to make good the site at the completion of work.

The Management System incorporates a workforce induction and training component. The Management System will ensure that all people entering the site are aware of operating issues and their responsibilities.

The EMS should alert Barnu to any potential or actual environmental damage and allow remedial action to be taken.

All Galong employees will receive training in Environmental Awareness.

Compliance with the EMS and its components will be confirmed by a series of inspections and audits. The inspections will be carried out at appropriate time intervals ranging from weekly through to monthly and annually.

Internal environmental audits will be undertaken. Audit results will be used to develop action plans to rectify identified environmental issues.

Barnu will continue to hold an EPA Licence for the Galong Mine and Lime Kiln. As a consequence of this EPA Licence, Barnu is liable to unannounced audits by the EPA. Barnu believe they would rate well in such audits and would respond expeditiously to any findings.

Blue Circle Southern Cement have a Manager with Environmental responsibilities who will be responsible for developing and driving implementation of the environmental component of the Management System. In addition, Blue Circle Southern Cement and Barnu have access to external environmental consultants to assist in the development and implementation of best practice environmental management techniques.

All site water and dust monitoring will be undertaken using standard procedures. Analyses will be undertaken by laboratories that are NATA registered. Systems will be in place for the laboratories to advise the Manager responsible for Environmental matters of non complying results on an urgent basis.

There are a number of Government Agencies that have environmental responsibility for the Galong operations.

The EPA Licence requires compliance with environmental operating procedures and the annual reporting of monitoring results. Barnu is also required to report to the EPA if anything happens on the premises that has caused, is causing or is likely to cause, harm to the environment.

The Mining Lease which covers the Galong operations include environmental conditions. Barnu is required to have a Mine Operations Plan (MOP) covering a nominal 7 years proposed mining activity. The current MOP will be upgraded to reflect changes proposed in the current Development Application for the Galong Mine Expansion Project. In accordance with the Mining Lease, Barnu is required to submit an Annual Environmental Management Report (AEMR) to the Department of Mineral Resources. Each AEMR is followed up by a site inspection and meeting.

Galong holds a Water Licence from the Department of Sustainable Natural Resources. This Licence controls the extraction of groundwater and discharge of excess water to Limestone Creek.

It is most likely that should a Development Consent be granted for the Galong Lime Kiln Project, it will be conditional upon an annual environmental report being submitted to PlanningNSW and other relevant Government Agencies.

7.1.2 Inter and Intra Generation Equity

Blue Circle Southern Cement has adopted best practice environmental management for their operations. These will be implemented at the Galong Site.

Monitoring and auditing systems enable pollution and waste to be identified and rectification plans to be developed and implemented.

These systems and their active support by Blue Circle Southern Cement should ensure attainment of the principles of inter and intra generational equity. These principles are that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

7.1.3 Conservation of Biodiversity and Ecological Integrity

The existing fauna, flora and natural habitats are described in Sections 6.5 and 6.6 of this EIS and they also describe the impact and amelioration measures to be adopted to minimise any impacts.

The Galong Lime Kiln Project does not have major potential to impact fauna and flora. Barnu propose a voluntary tree planting programme across the Mining Lease based on planting nursery raised plants grown from locally collected seed provenances.

7.1.4 Valuation and Pricing of Resources

The need for the Galong Lime Kiln Project is discussed in Section 2.2 of this EIS. Various alternative options are discussed in Chapter 5.

Costs of the Project will be the use of energy and various environmental impacts such as the effects on the water quality, noise, air quality and the visual environment. These impacts and their management are discussed in Sections 6.7 to 6.10 respectively.

7.2 Ongoing Environmental Management

Environmental Management of the Galong Lime Kiln Project will be addressed by the Environmental Management System (EMS) in place for Blue Circle Southern Cement operations and which will be adapted to specific Galong requirements.

The existing EMS is comprehensive and includes documentation of systems and procedures supported by an appropriate Management Structure.

In-house expertise is supported by external consultants where necessary.

External Government and Community Groups have formal and informal roles in encouraging Blue Circle Southern Cement to manage its operations with due consideration of environmental issues and to meet the various Government Approval conditions for the operation of the Galong Lime Kiln Project.

7.3 Proposed Environmental Monitoring

Barnu believe that a monitoring programme will be an integral and essential part of environmental management for the Galong Lime Kiln Project.

Monitoring will enable Barnu to confirm predicted impacts and the effects of amelioration measures. It will also enable evolving environmental issues to be identified as they develop and provide an alerting mechanism for Project Management

The overall responsibility for environmental monitoring will be with the Project Manager. That Manager will be supported by any necessary external expertise as required. The individual currently appointed to this position has been integrally involved in the planning and environmental assessment of the Galong Lime Kiln Project.

Barnu proposes to undertake a comprehensive gas monitoring programme to meet EPA, National Pollution Inventory (NPI) and process control requirements. The suite of pollutants monitored and the location and methodology of monitoring will need to be developed with the EPA as part of the Licensing procedure.

Dust deposition gauges will be located around the Lime Kiln to determine dust deposition rates. The exact location of the dust gauges will be developed in conjunction with the EPA and taking into account the requirements of the Mine operation.

It is proposed to undertake annual sampling for all NPI compounds.

Water quality will be monitored to meet EPA Licence requirements and to monitor water quality for process requirements and to determine suitability for discharge.

Noise monitoring will confirm performance of the facility in accordance with the predictions made in the Acoustic Assessment and to ensure compliance with EPA Criteria.

All sampling and analysis will be undertaken in accordance with the appropriate standards.

7.4 Waste Management

The majority of waste from the Galong Lime Kiln Project will be in the form of gaseous emissions. These are discussed in Section 6.9.

Mined limestone that does not meet specification is re-combined with the mining overburden and used as part of the mine rehabilitation programme.

Refractory linings from the Kiln are replaced in accord with the following:

- Crossover channel area 4-5 years,
- Burning Zone 6-8 years, and,
- Preheating and cooling zones 9-12 years.

The replaced refractory material would be recycled through the Berrima Cement Works or some other suitable facility. They will not be buried on site.

Site waste metals are separated and collected by a recycler. Waste oils and greases are similarly collected by a waste oil recycler for off-site processing and re-use.

Sewage is treated in a septic system. The septic system is pumped out by a licensed waste disposal contractor on an as-needed basis.

Domestic type wastes and maintenance consumables are placed in rubbish bins and transported to the Galong landfill site. These wastes will not be disposed on site.

During construction there will be waste generated from building materials and equipment packaging. Exact quantities will not be known until orders are placed for the equipment. The ordering process will address recycling of packaging materials.

As equipment is delivered to site it will be unpacked prior to installation. Packaging waste will consist of a mix of metals, timber and protective packing. The metals will be recycled in the current system. Potential for timber to be recycled will be investigated, otherwise this material, which is classified as builders waste, will be sent to the Galong landfill. The protective packing materials will be recycled.

Form work will be either recycled or deposited in an appropriate regional builders waste landfill. Scaffolding used during construction will be reclaimed and returned to the group from whom it was hired.

7.5 Land and Soil Management

Soil contamination is unlikely to occur as a result of polluted waters or deposition of air pollutants (Refer Sections 6.7 and 6.9 respectively).

Fuel supplies will need to be managed to ensure that containers are secure and do not leak causing soil and groundwater contamination.

Fuel stock control will be achieved by input and output recording and auditing. This process would identify any occasions when contents are lost from the system. Any losses should be contained in bunded areas. Material trapped in the bunds would be directed to the oil recycling contractor.

It is not likely that fuel spills from the storage vessels would result in soil contamination, however, should it occur it will be remediated. The type of remediation used would depend on the extent of contamination. Small spills would be collected in water proof containers and disposed appropriately. Larger spills may require some form of land farming to enable the spilt hydrocarbons to break down insitu.

Appendix A

Director Generals Requirements

planningnsw

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20 Lee Street Sydney NSW 2000
GPO Box 3927 Sydney NSW 2001
T 02 9762 8000
www.planning.nsw.gov.au

Our ref: S03/01187

23 May 2003

Mr Dominic Saffioti
Barnu Pty Ltd
PBS No. 4
MOSS VALE NSW 2577

Dear Mr Saffioti

Proposed Lime Kiln, Galong, Harden Local Government Area

I refer to your request for Director-General's requirements for the preparation of an Environmental Impact Statement (EIS) for the above development proposal. Attachment No. 1 outlines the statutory matters that must be included in any EIS under clauses 71 and 72 of *Environmental Planning and Assessment Regulation 2000* (the Regulation). You should note however, that if the Development Application (DA) to which these requirements relate is not made within two years of the date of this letter, Clause 73(6) of the Regulation requires you to re-consult with the Director-General prior to lodging the application.

Specific requirements

Through discussions at the Planning Focus Meeting (PFM) for this proposal, held on 7 May 2003, and subsequent consultation with relevant agencies, a number of key issues have been identified as being of particular relevance for the EIS to focus upon. Pursuant to clause 73(1) of the Regulation, the Director-General requires that the issues summarised below, and provided in detail as Attachment No. 2, be addressed in the EIS for the proposed development. The issues summarised below have been ranked to generally indicate those matters the Department considers should form major components of the EIS. Ranking is aimed at assisting in the focussed preparation of the EIS and is not necessarily indicative of the actual magnitude of any of the impacts listed.

Issues of Key Environmental Planning Importance for EIS Preparation:

- Air quality impacts, particularly dust, particulates and potential impacts on local air quality;
- Water quality and water cycle management, including water consumption, recycling and impact of any water released from the site, including stormwater impacts, associated with the Lime Kiln must be considered; and
- Cumulative impacts associated with the proposed development, in particular the cumulative impacts with regards to the current and increased mining operations must be assessed.

Issues of Environmental Planning Importance for EIS Preparation:

- Fauna and flora impacts must be addressed, particularly impacts on any endangered populations or communities, including the Box-Gum Woodland;
- Noise impacts, especially the potential noise impacts on any residences and including impacts generated by heavy vehicle movements; and
- Visual Impacts, particularly on nearby properties and residential areas.

Planning for a sustainable environment, jobs and livable communities.

Other Important Issues:

- Soil quality and groundwater issues, including salinity;
- Impacts associated with increased traffic movements, in particular heavy vehicles and including cumulative impacts with the proposed upgrade of the mine;
- Waste management issues;
- Potential hazards and risks associated with operations;
- Socio-economic impacts on the locality and the region;
- The EIS must indicate how the environmental performance of the proposal would be monitored and managed during construction and operations; and
- Effective consultation with Government bodies and the public must be undertaken, and the results included in the EIS.

The Director-General also requires the following for all State Significant Development Applications:

- The applicant shall nominate a contact person (and telephone number) who will be made available to answer public enquiries about the proposal;
- The applicant shall consult with the community that is likely to be affected by the proposal. A report on who was consulted must be submitted with the DA, describing how the affected community was identified, consultation methods, and key issues raised by the community;
- The applicant shall provide a disk containing an electronic copy of the Executive Summary to the EIS, in pdf format or another format that can be easily converted to pdf format; and
- Electronic copies of the EIS shall be provided on CD in an appropriate format.

Requirements of Integrated Approval Bodies

Under Section 91 of the *Environmental Planning and Assessment Act 1979,* development is "integrated development" if it requires certain approvals from other bodies in addition to the consent authority before it may be carried out.

In your Form A and through discussion at the PFM, it was indicated that your proposal would require additional approvals from the Environment Protection Authority (EPA) under the *Protection of the Environment Operations Act 1997* and the Department of Sustainable Natural Resources (DSNR) under the *Rivers and Foreshores Improvement Act 1948.* The National Parks and Wildlife Service (NPWS) would also become an integrated approval body under the *National Parks and Wildlife Act 1974* should any Aboriginal relics be identified onsite, prior to the lodgement of the DA, which would be destroyed by the proposal.

The EPA and DSNR have provided their requirements (provided in Attachment No.3), and you must address these requirements in your EIS. The requirements of the NPWS are also provided in Attachment No. 3, and you must address these requirements in your EIS.

If further integrated approvals are identified before the Development Application is lodged, you must conduct your own consultation with the relevant agencies and address their requirements in your EIS.

When lodging your Development Application, you must include:

- At least one copy of the Development Application and supporting documentation for each of the integrated approval bodies; and
- Cheques for $250, made payable to <u>each</u> of the integrated approval bodies.

Consultation

You should consult with the Harden Shire Council, Roads and Traffic Authority, Energy Australia (or relevant electricity supplier), Environment Australia, and any other relevant local, State and Commonwealth government authorities, service providers and community groups, and take into account any comments these agencies may have in the preparation of the EIS.

It is noted that consultation requirements may vary significantly between the parties listed. It is the Applicant's responsibility to justify the extent and scope of all consultations.

The Department of Minerals Resources and NSW Agriculture have provided requirements (provided in Attached 4), and you must address these requirements in the preparation of the EIS.

Commonwealth Approvals

If your proposal contains any actions that could have a significant impact on matters of National Environmental Significance, then it may require additional approvals under the *Commonwealth Environment Protection Biodiversity Conservation Act 1999* (EPBC Act). These approvals are in addition to any approvals required under NSW legislation. If you have any questions about the application of the *EPBC Act* to this proposal, you should contact Environment Australia in Canberra (6274 1111 or http://www.environment.gov.au).

Changes to the regulated development fees

As of July 1 2002, a one-off additional fee of $110 will be payable to the consent authority on Development Applications lodged on or after that date for:

- integrated development; and
- development that requires concurrence (other than assumed concurrence, see clause 64 of the Regulation).

Further, as of 1 November 2002, the fee schedule in the *Environmental Planning and Assessment Regulation 2000* for development applications has been amended. You must consider the revised schedule when determining the fee payable to the consent authority.

Please contact Tim Ward on (02) 9762 8161 or tim.ward@planning.nsw.gov.au if you require any further information regarding the Director-General's requirements for the EIS.

Yours sincerely

Gord Kirkby 28/5/03

Gordon Kirkby
Manager, Manufacturing and Rural Industries
Major Development Assessment
As Delegate for the Director-General

Attachment No. 1

STATUTORY REQUIREMENTS FOR THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT

In accordance with the *Environmental Planning and Assessment Act 1979* (the Act), an environmental impact statement (EIS) must meet the following requirements.

Content of EIS

Pursuant to Schedule 2 and clause 72 of the *Environmental Planning and Assessment Regulation 2000* (the Regulation), an EIS must include:

1. A summary of the environmental impact statement.
2. A statement of the objectives of the development or activity.
3. An analysis of any feasible alternatives to the carrying out of the development or activity, having regard to its objectives, including the consequences of not carrying out the development or activity.
4. An analysis of the development or activity, including:
   (a) a full description of the development or activity; and
   (b) a general description of the environment likely to be affected by the development or activity, together with a detailed description of those aspects of the environment that are likely to be significantly affected; and
   (c) the likely impact on the environment of the development or activity, and
   (d) a full description of the measures proposed to mitigate any adverse effects of the development or activity on the environment, and
   (e) a list of any approvals that must be obtained under any Act or law before the development or activity may be lawfully carried out.
5. A compilation, (in a single section of the environmental impact statement) of the measures referred to in item 4(d).
6. The reasons justifying the carrying out of the development or activity in the manner proposed, having regard to biophysical, economic and social considerations, including the following principles of ecologically sustainable development:
   (a) The precautionary principle - namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
   In the application of the precautionary principle, public and private decisions should be guided by:
      (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and
      (ii) an assessment of the risk-weighted consequences of various options,
   (b) Inter-generational equity - namely, that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations,
   (c) Conservation of biological diversity and ecological integrity, namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration,
   (d) Improved valuation, pricing and incentive mechanisms, namely, that environmental factors should be included in the valuation of assets and services, such as:
      (i) polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,
      (ii) the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,
      (iii) environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.

An environmental impact statement referred to in Section 78A(8) of the Act shall be prepared in written form. The prescribed form to accompany the environmental impact statement must comply with the requirements of clause 71 of the Regulation and be signed by the person who has prepared it.

Procedures for public exhibition of the EIS are set down in clauses 77 to 81 of the Regulation.

Attention is also drawn to clause 283 of the Regulation regarding false or misleading statements in EISs.

Note

If the development application to which the EIS relates is not made within 2 years from the date of issue of the Director-General's requirements, under clause 73(6) of the Regulation the proponent is required to reconsult with the Director-General.

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Attachment No. 2

SPECIFIC REQUIREMENTS FOR THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT

Environmental Planning Instruments

- The EIS must assess the proposal against the provisions of any relevant environmental planning instruments, particularly the following statutory instruments:
    - *State Environmental Planning Policy No. 11 – Traffic Generating Development;*
    - *State Environmental Planning Policy No. 33 – Hazardous and Offensive Development;*
    - *State Environmental Planning Policy No. 34 – Major Employment Generating Industrial Development;*
    - *State Environmental Planning Policy No. 55 – Remediation of Land;*
    - *Harden Interim Development Order Number 1*
    - *Harden Shire Council Draft Local Environmental Plan.*
- The EIS must also assess the proposal against the provisions of relevant Development Control Plans.

Land Use and Planning

- The EIS should outline the strategic planning objectives applicable to the proposed development. As part of this consideration, the EIS should provide an indication of the long-term purpose/ utilisation of the proposed development and the site and how the proposed development and site form part of any strategic direction with other developments (particularly the mine);
- Details of any new or modified utilities required by the proposed development must be outlined, including the results of any consultations with relevant utility providers in relation to the provision of those utilities; and
- The details of any existing consents which apply to the site.

Buildings and Structural Issues

- Classification of all relevant structures to be constructed on the site, in accordance with class definitions under the Building Code of Australia (BCA), should be identified in the EIS.

Air Quality

- Impacts of construction activities on air quality, particularly dust emissions, should be detailed with appropriate mitigation measures identified;
- Materials to be processed at the proposed development should be characterised, particularly in terms of composition and particle size, to provide a basis for the assessment of dust impacts from the development;
- A full air quality impact assessment must be included in the EIS, including dispersion modelling where appropriate, to meet the requirements of the EPA (detailed in *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales*). Specific consideration must be given to the impacts of oxides of sulphur and nitrogen, particulates, fluoride and hazardous substances (as defined in the *Clean Air (Plant and Equipment) Regulation 2000*);
- The EIS must include a full assessment of the impact of greenhouse gases emitted from the proposed development, and include measures to minimise the quantity of these gases released from fixed and diffuse points associated with the development;
- Measures such as building design and ventilation systems should be detailed in the context of minimisation of fugitive emissions from the proposed development;

- Details of air pollution control equipment must be provided, including how the equipment operates, how it will be managed and maintained and expected pollution control efficiencies of the proposed equipment; and
- An outline of air quality monitoring for the proposed development, including pollutants and parameters that should be monitored, monitoring locations, methods and frequencies.

Water and Stormwater Management

- Full details of stormwater management systems must be provided in the EIS with a demonstration that those systems can accommodate likely storm events (justification must be provided for the design capacity of those systems);
- Location and description of proposed stormwater infrastructure (eg major drainage, first flush systems, sedimentation devices etc) must be provided;
- Full details of the proposal's water cycle and its management must be provided, including measures to reuse water within the process and any proposal to apply water to land or discharge water to natural waterways. The EIS must clearly demonstrate a design process aimed at minimising water discharges from the site; and
- Should release of water from the site be required, the EIS should provide a clear assessment of the potential volumes and qualities of those waters, including full details of any on-site treatment required before discharge.

Flora and Fauna Impacts

- The "8 part test" (section 5A of the EP&A Act) should be applied to species, populations or ecological communities, and their habitats, that may be affected by the proposal. The EIS must justify any decision not to apply the test to all of the species, populations or ecological communities that may occur on or in the vicinity of the proposed development site. A Species Impact Statement (SIS) is required where an 8-part test identifies a significant impact. NPWS must be consulted in relation to requirements for any such SIS. Further it is recommended that the Department be consulted prior to commencing preparation of any SIS; and
- Impacts on the various communities of Box-Gum Woodland must be assessed, including any loss of vegetation and the impacts of this loss of vegetation on local fauna populations;

Noise Impacts

- The Environmental Impact Statement must clearly evaluate traffic noise impacts associated with the proposed development, with reference to existing traffic noise levels, and the likely increase in those noise levels as a result of construction and operation traffic. Assessment of traffic noise must make specific reference to the guidance provided in *Environmental Criteria for Road Traffic Noise* (EPA, 1999);
- An assessment of the noise impacts from the proposed development must be undertaken in accordance with the EPA's *Industrial Noise Policy*, with details of noise emissions from equipment and noise attenuation devices; and
- Consideration of cumulative noise impacts of the proposed development combined with those associated with other noise sources in the area (particularly the mining operation) must be provided in the EIS.

Visual Amenity Issues

- The visual and amenity impacts associated with the proposed development must be fully assessed, in particular the potential visual amenity impacts on nearby properties and residential areas within the region.

Land, Soil and Groundwater Management

- The EIS must fully detail the potential contamination issues as a result of previous land use, with appropriate management and mitigation measures outlined;
- The EIS must identify the potential for the proposed development to cause contamination, whether through direct impacts on the site, or indirectly through the movement of polluted waters or deposition of air pollutants on surrounding land uses. Measures to minimise the potential for soil contamination must be provided;
- Salinity and groundwater movement issues must be discussed and the impacts of these issues be addressed.

Transport Impacts

- A Traffic Impact Study (TIS), prepared in accordance with the RTA's publication *Guide to Traffic Generating Developments*, must be included as part of the EIS. The TIS must include details of expected traffic movements to and from the proposed development site with specific consideration of:
  - traffic generation during construction, site access points, hours of traffic movement and proposed traffic routes;
  - traffic generation during operation of the proposed development, site access points, hours of traffic movement and proposed traffic routes;
  - the types of road transport to be employed, with comment on the use of B-Doubles;
  - proposed routes for any dangerous goods transport (a Route Evaluation Study may be required, as detailed in the Department's publications *Applying SEPP 33* and draft *Route Selection*);
  - the capability of proposed routes (including road and intersection capacity) to handle predicted traffic movements associated with the proposal. Any road upgrades that may be required should be noted with a summary of consultations with the RTA and Council (where relevant) in relation to those upgrades;
  - the cumulative impacts of traffic generated by the proposed development, particularly with the traffic generated by the increased mining operations.
- Consideration of sensitive road users (school buses, cyclists etc) must be provided, where relevant. Where routes are to be shared between these sensitive users and traffic associated with the proposal, details of measures to minimise road use conflicts must be included in the EIS;

Waste Management

- Construction wastes must be considered, including quantities, qualities and treatment/ disposal methods for those materials;
- Likely annual rates of production of all waste streams from the proposed development must be provided, including domestic waste products. Proposed methods of treatment and/ or disposal of these waste streams must be clearly indicated;
- Wastes that are not to be reused or recycled must be classified in accordance with the EPA's *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes*; and
- Details of waste management at the proposed development must clearly reflect the principles of "reduce, reuse and recycle".

Risk Impacts and Hazard Management

- A preliminary risk screening must be completed in accordance with *Applying SEPP 33* (DUAP, 1994), with a clear indication of class, quantity and location of all dangerous goods to be located on the proposed development site (including hazards associated with the coal stockpiles);
- Should preliminary screening indicate that the proposed development is "potentially hazardous", a Preliminary Hazard Analysis (PHA) must be prepared for inclusion in the EIS, as required under *State Environmental Planning Policy No. 33 - Hazardous and*

Offensive Development. The PHA must be prepared in accordance with the Department's publications *Hazardous Industry Planning Advisory Paper No. 6 - Guidelines for Hazard Analysis* (DUAP, 1997) and *Multi-Level Risk Assessment* (DUAP, 1997): and

- Risk impacts associated with the transport of dangerous goods and hazardous materials must be documented with reference to the Department's draft *Route Selection* guidelines.

Socio-Economic Impacts

- Identification of relevant local indigenous communities and details of any specific measures employed to ensure these communities were consulted during the preparation of the EIS; and
- The Environmental Impact Statement must detail the results of consultations with harden Shire Council to establish the impacts of the proposed development on public infrastructure and services. An attempt should be made to establish a nexus, should one exist, between the development and impacts on services and infrastructure and to quantify appropriate contributions to any significantly affected services and infrastructure in accordance with Council's Section 94 Contributions Plan.

9 MAY 2003

Department of Sustainable Natural Resources

Contact: Darren J Wallett
Phone: (02) 6923 0571
Fax: (02) 69217 308
e-mail: dwallett@dlwc.nsw.gov.au

Our Ref: R136
[G:\RAP\CFC\RESACCES\ENVIRON\HARDEN\Galong limestone groundwater licence\DG Requirements Galong Kiln Project.doc]

8 May 2003

Mr Tim Ward
Environmental Planning Officer
Development and Infrastructure Assessment
Planning NSW
GPO Box 3927
SYDNEY NSW 2000

Dear Mr Ward

Re: Proposed Galong Lime Kiln Project

I refer to the Planning Focus Meeting at Harden Shire Council on the 7th May 2003. Planning NSW have requested the requirements of the Director General in relation to the preparation of an Environmental Impact Statement (EIS) for the above proposed development. The Department of Sustainable Resources (DSNR) requirements for an EIS for the proposed Galong Lime Kiln development are detailed below.

DSNR requests that the issues listed below are addressed in the EIS. Information relating to these issues is required to enable an adequate environmental assessment of the proposal.

1. Native vegetation

Although the Native *Vegetation Conservation Act 1997* may not apply with respect to this development, the following information should be contained in the EIS.

The EIS should detail the vegetation present on the site, and any proposed vegetation management activities. If native vegetation, including grasses and forbs is to be cleared or damaged as a result of the Galong Lime Kiln development, then any impacts need to be identified.

Consideration should also be given to the use of vegetation buffer zones adjoining the development. Buffer zones should utilise native tree and shrub species that are naturally endemic to the area.

2. Soil and water management

The EIS should contain details of erosion and sediment control measures to be put in place during construction and operation of the Galong Lime Kiln project site. This includes erosion and sediment control measures associated with access roads to the site. Soil and water management is to be done to the standards outlined in the Department of Housing document "Urban Stormwater Management – Soils and Construction", 1998. Particular attention should be given to the management of water runon to the site and runoff from the site at all stages of development and operation.

This development may require consent from DSNR under the *Rivers and Foreshores Improvement Act 1948,* as any impact within 40 metres of a drainage line (Limestone Creek) requires the approval of a 3A permit under this Act from DSNR. The EIS must detail any potential impacts on drainage lines, including works within 40 metres of such sites. Any proposal to redirect flows must also be detailed.

Information such as the management of stormwater from the development especially the lime processing area and lime/coal stockpile areas, as well as adjoining land is to be detailed. These areas should be bunded or appropriately designed to contain surface runoff from the site, and ensure runoff does not enter Limestone Creek from these areas prior to treatment and/or water analysis. Diversion banks should be constructed to ensure there is no stormwater runon to the site.

3. Effluent and waste management

The EIS must address the following points in relation to effluent management:

- Details of any proposed management system for both solid and liquid wastes.
- Details of effluent disposal systems (industrial and domestic). If detention or evaporation basins or other structural works are proposed, then full design characteristics, including soil tests are required.
- Details of stormwater management proposals in relation to effluent management.
- Recycling and reuse of water is encouraged where possible.

4. Water supply issues

The following issues need to be addressed in terms of water supply for the development:

- A water budget is required for the development. This should include details of water use requirements for all aspects of the Galong Lime Kiln project, washing, effluent treatment and any water re-use schemes. Details of peak water demand requirements are to be provided in addition to average water use data. The details of all water supply sources should be identified, including catchment yield and storage capacities of any constructed dams in relation to consumptive requirements.
- The details of current water licences, including licence conditions, volumetric allocations etc. should be provided.

5. Groundwater

The EIS must demonstrate that there is to be no contamination of groundwater resources as a result of the proposed development. The EIS must consider the groundwater conditions of the area, particularly watertable levels and linkages between local watertables and the ground surface/surface water. The following information should be provided to assist DSNR in the assessment of the proposal:

- Baseline information on groundwater aquifers on the site, or those likely to be affected by the proposal, including its quality, movement patterns, and users of the groundwater resource.
- Potential sources of pollution from designed and accidental sources as well as potential pollution pathways including contamination from seepage of contaminated surface water.

6. Crown land

The EIS must identify any issues associated with Crown land at the site. A cadastral map of the proposal that shows the relationship of lot boundaries to actual construction areas must be provided.

The location of Crown lands can be determined by contacting NSW Department of Lands, Mr John Daunt in Goulburn on (02) 48 286747.

7. Monitoring

A program of monitoring may be required for discharges of surface and groundwater to Limestone Creek.

Should the EIS identify that there are potential impacts on surface and/or ground water as a result of the development, then an appropriate monitoring program will be required. This may involve the establishment of piezometers or monitoring bores at the site. If monitoring bores or piezometers are required, these require licensing under Section 116 of the *Water Act, 1912*.

Should groundwater monitoring be required, the EIS must provide the following details for any proposed monitoring bore:

- The location of any proposed monitoring bores/piezometers.
- The depth of any proposed monitoring bores/piezometers.
- The rationale for the proposed location and depths of monitoring bores.

Monitoring guidelines should be set as per the Environment Protection Authority's (EPA) requirements.

DSNR requests that three copies of the EIS are made available to the Department for review.

Should you require further information or clarification of the points raised above, please don't hesitate to contact Darren Wallett, Environmental Review Coordinator (Resource Compliance) on phone (02) 6923 0571 or 0427 274 283.

Yours sincerely,

Darren J Wallett
Environmental Review Coordinator
For Warwick Ford
Regional Director, Murrumbidgee Region
NSW Department of Sustainable Resources

NSW Agriculture
159 Auburn Street
PO Box 389
GOULBURN NSW 2580

Phone: (02) 48286600
Facsimile: (02) 48223261
Website: www.agric.nsw.gov.au

Mr Tim Ward
Environmental Planning Officer
Major Development Assessment
GPO Box 3927
SYDNEY 2000

8th May 2003

Dear Sir,

RE: Barnu Pty Ltd Lime Kiln, Galong

I refer to your letter dated 8th May requesting the Department of Agriculture's requirements for the Environmental Impact Statement for the proposal.

NSW Agriculture provides the following comments:

- If irrigation of waste water is proposed from the kiln onto surrounding agricultural land, then details of waste water volumes and area for disposal will need to be provided.
- Details of surface and ground water impacts during construction and operation, including mitigation measures, will need to be provided, particularly the impact of salinity on the adjacent creek water.

Yours sincerely

WENDY GOODBURN
Agricultural Environment Officer
Goulburn

12 MAY 2003

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NSW NATIONAL PARKS AND WILDLIFE SERVICE

ABN 30 841 387 271

13 May 2003

Tim Ward
Environmental Planning Officer
Major Development Assessment
Planning NSW
GPO Box 3927
SYDNEY NSW 2001

Our reference: Sn03-125/LN/03-04153
Your reference: S03/01187

Dear Tim

EIS for proposed Galong Lime Kiln

I refer to correspondence of 22 April 2003 from both yourself and David Olsen, and to the planning focus meeting held on 7 May, which sought input from the National Parks and Wildlife Service (NPWS) on the material to be addressed in an environmental impact assessment for the above proposal. The comments that follow relate to the NPWS' statutory responsibilities for the care, control and management of national parks and nature reserves and state conservation areas as well as for the protection and care of Aboriginal sites and objects, and native flora and fauna throughout New South Wales.

The NPWS notes that the proposal relates to the construction of a kiln and associated coal storage and powering activities. However, the proponent has also advised that the operation of the kiln will require modification of the internal roading at the site, and that a new electric power branch line will be required. In addition to this, Harden Shire Council is formally consulting with NPWS about a significant expansion to the mine that will have both on-site and off-site impacts. It is also understood that there will be a requirement to widen the gravel public road to the site, an activity that does not appear to be mentioned in any of the documentation about developments at the mine. Therefore, as a total package, further development of the Galong mine and processing facility may have implications for the statutory responsibilities for NPWS. In this regard, NPWS is concerned that by breaking up the activities into separate applications (kiln, storage sheds, internal roading, mine expansion, new power branch line, and public road upgrades), the cumulative effects of

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43 Bridge Street
PO Box 1967
Hurstville NSW
2220 Australia
Tel: (02) 9585 6444
Fax: (02) 9585 6555

these activities on flora and fauna and potential Aboriginal cultural heritage values will be overlooked. NPWS therefore requests that all determining authorities take the big picture into account when they are assessing individual elements of developments at, and associated with, the Galong mine.

Flora and Fauna

There are no records of threatened species and endangered ecological communities on the NPWS database for the actual kiln development site. However, separate information forwarded to NPWS by Harden Shire Council in relation to the mine expansion has identified threatened bats and elements of the endangered White Box, Yellow Box, Blakely's Red Gum Woodland (Box-Gum Woodland) endangered ecological community (EEC) on the lease site. In terms of the specific request for information related to the lime kiln, NPWS notes that the potential direct impacts of construction of the kiln on flora and fauna are likely to be minimal. Nevertheless, individual trees may have values for a range of threatened species that are likely to occur in Harden Shire. Also, if the road upgrade within the site is considered part of this development application, there is potential for the works to impact on the Box-Gum Woodland and other vegetation to the east of the direct impact area. This vegetation is likely to provide habitat for threatened bird and bat species known to occur in the Harden Local Government area. These impacts may be via run-off from the site and erosion from modification of the roading at the site, which may affect vegetation health and quality. Also, as the prevailing wind is from a westerly direction, dust from a range of activities associated with the lime kiln is highly likely to contaminate vegetation and may affect the EEC and habitat for threatened fauna. Therefore the EIS should consider both direct and indirect impacts on flora and fauna in the vicinity of the site. Information sheets on Box-Gum Woodland and a pamphlet on the values of isolated native trees are enclosed for your information.

NPWS recommends that an ecologist, with expertise in the threatened species and endangered ecological communities in Harden Shire, be employed to determine whether areas impacted by the kiln provide habitat for threatened fauna known to occur in the Harden area. This information is required before any conclusions can be made about the proposal affecting native flora and fauna and their habitats. The presence of threatened species and EEC's will necessitate section 5A assessments under the *Environmental Planning and Assessment Act* 1979. If there is evidence of native fauna using the existing vegetation on the site, NPWS recommends that controls be put in place to conserve these values, and should be consulted about these strategies. In particular, if mature trees are to be removed and revegetation activities implemented on disturbed sites, NPWS recommends that as well as stabilising disturbed areas with native species known to occur in the area, effort should focus on enhancing the size of the Box-Gum Woodland remnant on the eastern side of the Limestone Creek within the mining lease area. Greening Australia and the Harden Landcare

Officer (Louise Hufton, 6386 2305 or 6386 8218) should be consulted about the appropriate species to plant and from where to obtain plants for rehabilitation work. Fencing out stock and maintaining these rehabilitation areas, including weed management, will also need to be considered. NPWS also recommends that trees retained within the works site be protected from compaction and other damage from vehicles, equipment and storage of materials by the construction of a fence that extends at least around the drip lines of the trees. If any screen planting is to occur, NPWS recommends species native to the area and a prohibition on the planting of species that are known environmental weeds in the Harden area.

Aboriginal cultural heritage

NPWS was advised at the planning focus meeting that the Local Aboriginal Land Council had visited the site. Whilst NPWS requires liaison with the LALC, NPWS has statutory responsibility for Aboriginal heritage objects and places in NSW. Although NPWS does not have any records of Aboriginal objects for this site, the absence of records is more likely to be a reflection of lack of survey rather than the non-existence of Aboriginal objects. NPWS therefore recommends that an Aboriginal cultural heritage survey be undertaken by a qualified archaeologist according to the NPWS's *Aboriginal Cultural Heritage Standards and Guidelines* kit that has been made widely available to archaeologists undertaking this type of work. Within these guidelines is the requirement for archaeologists to work with appropriate Aboriginal groups, and for three copies of reports they prepare to be forwarded direct to the NPWS Aboriginal Heritage Unit (Southern), PO Box 733, Queanbeyan NSW 2620. Please find enclosed a copy of the NPWS information on *Aboriginal Cultural Heritage and the Integrated Development Assessment Process*, which provides more background on these NPWS requirements.

If any sites are found, the Service's Southern Aboriginal Heritage Unit should be contacted immediately on 62989736. Options for managing any Aboriginal sites or objects will need to be addressed and may require a section 90 consent under the *National Parks and Wildlife Act* 1974. Under Section 90, it is an offence to damage, disturb, deface or destroy an Aboriginal object or site without first obtaining the written consent of the Director-General of the National Parks and Wildlife. Whether or not archaeological material is located during the survey, any development approval for any activity on this land should include a notification to the owners of their Section 90 requirements. These approvals also require them to notify earth moving equipment operators, and other mine staff of their responsibilities under this legislation.

During the site visit it was noted that the actual site for the kiln is highly disturbed. Nevertheless, if roading and other disturbances are to occur within the mine lease, there is the potential for any archaeological material that may be present to be impacted by these activities. Similarly, the other developments proposed for the mine, and the associated upgrades of infrastructure, may impact on archaeological material. NPWS's recommendation is for an archaeological survey to be conducted in all of the areas that are likely to be impacted either directly or indirectly by developments at the mine including: internal roading, mine expansion, overburden emplacement areas, construction of kiln and storage facilities, public road upgrades and new power branch line.

If you require further information or wish to discuss this advice, please contact Lyn Nelson, Conservation Planning Officer at Southern Directorate on telephone (02) 6298 9739.

Yours sincerely

A. Sullivan

Amanda Sullivan
A/Manager
Conservation Planning Unit
Southern Directorate

cc: David Olsen, Environmental Manager, Olsen Environmental Consulting, PO Box 101, FIGTREE NSW 2525
cc: Steve Horsley, NPWS
cc: Southern Aboriginal Heritage Unit, NPWS
cc: Peter Johnston, Harden Shire Council, PO Box 110, HARDEN NSW 2587

NSW NATIONAL PARKS AND WILDLIFE SERVICE

ABORIGINAL CULTURAL HERITAGE AND THE INTEGRATED DEVELOPMENT ASSESSMENT PROCESS

INFORMATION FOR LOCAL COUNCILS

Updated 20 February 2001

The NPWS recommends that the following information be read in conjunction with the "Guide to section 79C' prepared by the Department of Urban Affairs and Planning, which outlines Council's obligation to consider Aboriginal heritage issues in determining a development application.

The NPWS has a statutory responsibility for the identification, management and conservation of Aboriginal heritage under the *National Parks and Wildlife Act 1974*. The NPWS acknowledges that it is Aboriginal people who should determine the cultural significance of Aboriginal heritage, and the NPWS has a strong commitment to working in partnership with Aboriginal people to manage and conserve Aboriginal cultural heritage. The NPWS recognises that Aboriginal cultural heritage includes both traditional and contemporary associations of Aboriginal people with the environment as well as physical sites.

Aboriginal heritage issues should be addressed upfront as part of the planning process undertaken for developments, and prior to lodgement of a development application. The NPWS requires that options for conserving Aboriginal relics within development footprints be fully explored in discussion with the Aboriginal community as part of the development assessment process. Impacts on Aboriginal relics should only be considered where there are no viable alternatives. The NPWS will require a clear demonstration that alternatives to site destruction have been fully explored.

NSW National Parks and Wildlife Service
43 Bridge Street, Hurstville NSW PO Box 1967, Hurstville NSW 2220
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When is the NPWS an approval body in the IDA process ?

The NPWS is an approval body in the IDA process when a development will impact on an Aboriginal relic or Aboriginal place, thereby requiring a consent to destroy from the Director-General of the National Parks and Wildlife Service. Threatened species, populations and/or ecological communities do not trigger the IDA process as the *Environmental Planning & Assessment (EP&A) Act 1979* and *Threatened Species Conservation Act 1995* eliminated the need for separate licensing or approvals in relation to these issues.

The NPWS is an approval body for a development application under the IDA process when:

1) A 'relic' is known to exist on the land to which the DA applies; and/or the land to which the DA applies is an Aboriginal place, immediately before the DA is made (as per s.91 (2)(a-b), *EP&A Amendment Act 1997);* AND

2) The development proposal will destroy, deface or damage an Aboriginal 'relic' or Aboriginal place, and a consent to destroy from the Director-General of the National Parks and Wildlife Service will be required, as per section 90 of the *National Parks and Wildlife (NPW) Act 1974* (note damage to an Aboriginal relic or place may be direct damage or result from indirect impacts).

   Under the *NPW Act*, a 'relic' is defined as any deposit, object or material evidence (not being a handicraft made for sale) relating to indigenous and non-European habitation of the area that comprises NSW, being habitation both prior to and concurrent with the occupation of that area by persons of European extraction, and includes Aboriginal remains (as defined within the meaning of the NPW Act). Relics are confined to physical evidence.

   Aboriginal 'relics' are commonly referred to as Aboriginal sites.

   An "Aboriginal place" is a place which has been declared so by the Minister for the Environment because he or she believes that the place is or was of special significance to Aboriginal culture. It may or may not contain physical relics.

It should be noted that *the NPW Act* does not provide protection for spiritual areas or natural mythological areas that have no physical remains of Aboriginal occupation, unless they have been declared an 'Aboriginal place'.

For the purposes of the IDA process, the NPWS considers that an Aboriginal site ('relic') may be considered to be 'known' if:

- It is registered on the NPWS Aboriginal Sites Register; and/or
- It is an Aboriginal site known to the Aboriginal community; and/or
- It is located during surveys (eg: archaeological, anthropological) or test excavations conducted prior to lodgement of the DA.

How to obtain information about known Aboriginal sites

In order to obtain information about the location of known sites it is necessary to:

- Consult with Aboriginal community groups to identify the location of Aboriginal sites. The community groups may be aware of Aboriginal sites that have not been registered with NPWS.
- Contact the Aboriginal Sites Registrar at NPWS and request a site search to obtain a listing of registered sites. The Register only includes those Aboriginal sites which have been reported to NPWS. **Attachment 1** provides general information on the Aboriginal Sites Register, and a site search request form.
- Undertake an assessment of the known Aboriginal site/s and/or undertake survey of the subject land to locate Aboriginal sites. Test excavations may be required as part of this investigation to verify the location, extent and/or geomorphic context of Aboriginal sites. Such excavations need to be undertaken **before** the DA is submitted. A permit is required from NPWS for such investigation and if all information is attached to the application the processing time is approximately 8 weeks.

How to find out whether land contains a gazetted Aboriginal place

An Aboriginal place may be considered known if it has been declared by the Minister, and gazetted. Information on whether a proposed development site contains an Aboriginal place may be obtained by contacting the NPWS Aboriginal Sites Register (refer **Attachment 1**).

Information required by the NPWS to provide general terms of approval

In responding to requests for general terms of approval under the IDA process, the NPWS requires the <u>same</u> level of information to make an 'in-principle' decision as to whether to issue its general terms of approval as it would require to make a decision on the subsequent Section 90 consent application. In order for the NPWS to be in a position to provide its general terms of approval, all issues regarding conservation and site management need to be resolved upfront.

The NPWS does not require that a Section 90 consent application be submitted with the Integrated Development Application. The NPWS will issue its general terms of approval to the consent authority, and these terms of approval are incorporated into the development consent. Once the development consent is granted, the proponent has up to three years to apply to the NPWS for a Section 90 consent. The NPWS is then bound to issue the Section 90 consent in accordance with the development consent conditions.

In providing general terms of approval, the NPWS will require some administrative information from Council and information on the development proposal and Aboriginal heritage values of the relic and/or Aboriginal place from the applicant, as follows:

1.0 ADMINISTRATIVE INFORMATION REQUIRED FROM COUNCIL

1.1 A clear indication from Council that the development application is being assessed under the integrated development assessment (IDA) process and therefore will or is likely to require subsequent approvals from the NPWS with respect to Aboriginal heritage. Where possible, Council should include the reasons why it has reached this conclusion. If Council is unsure whether a subsequent approval from the NPWS is required, it is suggested that Council seek advice from the NPWS.

1.2 A clear statement from Council as to whether Council also wishes the NPWS to provide advice on flora, fauna and threatened species values and/or potential impacts on adjoining NPWS reserves with respect to the development proposal.

1.3 A clear statement of the time frames for comment, including:
- The date of receipt of the DA; and
- The date that general terms of approval must be back with Council (assuming that no additional information is required).

1.4 A list of other approval bodies to which the integrated development application has been referred.

1.5 A fee of $250 will be charged by the NPWS to process the application. This fee should be paid by cheque, made out to the National Parks and Wildlife Service, and <u>must</u> be attached to the application. If the cheque is not attached to the application, the NPWS will return the development application immediately upon receipt, and will not process the application until the fee is paid, in accordance with Schedule 1, Part 9, Division 1 (103)(3).

The $250 fee is solely for processing of the application. The applicant may be required to pay additional fees to the NPWS, such as a fee for obtaining a site search of the NPWS Aboriginal Sites Register, and a fee for processing an application for consent to destroy an Aboriginal site.

2.0 INFORMATION ON THE DEVELOPMENT AND ABORIGINAL CULTURAL HERITAGE

The NPWS requires two types of information from the applicant:

- <u>Aboriginal cultural heritage assessment</u> which involves consultation with the Aboriginal community groups. The NPWS is committed to working in partnership with the Aboriginal community groups in the management of Aboriginal sites and requires community assessment of any Aboriginal site management.
- <u>Archaeological assessment</u> which involves the assessment of Aboriginal sites and their management based on archaeological heritage criteria.

Council should give the applicant the NPWS's "Information for applicants' document to assist applicants in preparing their integrated development application. When Council refers a DA to the NPWS, Council should ensure the completeness of the applicant's information according to the requirements outlined below.

A flowchart is shown in **Attachment 2** that outlines the process for assessing the Aboriginal heritage values of an area to enable a decision to be made as to whether a development application will be an integrated development application for Aboriginal sites. It is essential that the outcomes of the Aboriginal cultural assessment and the technical assessment are integrated.

2.1 Aboriginal Cultural Heritage Assessment

Aboriginal sites can be the physical remains of Aboriginal occupation of an area or alternatively, an area that has particular meaning for Aboriginal people, for example, spiritual areas or natural mythological areas. It is important to consider that Aboriginal heritage is not only valuable to Aboriginal people but also to those people who are interested in learning from the early inhabitants of Australia. Proposed developments that alter landscapes can impact on these various types of Aboriginal sites.

Assessment of the cultural values of Aboriginal sites and places to the Aboriginal community is an important part of the assessment process, and the Aboriginal Cultural Heritage Assessment report (discussed below) is required by the NPWS in order for it to consider whether to issue general terms of approval.

2.1.1 Aboriginal Community Group/s Consultation

Applicants should contact (as early as possible) local Aboriginal community groups, including Local Aboriginal Land Councils, any known Tribal Elders, Corporations and Native Title Claimants to ensure that proper consultation processes are carried out. Local Aboriginal community groups will require time to consider a proposal and to discuss any issues with its members, and sufficient time must be allowed for this to occur.

The purpose of Aboriginal participation in the assessment process is:

- To notify the local Aboriginal people in sufficient detail and in a timely manner about activities or developments which may impact on Aboriginal heritage, so that their concerns and possible options for action can be identified on a fully informed basis;
- To ensure that Aboriginal people who hold cultural knowledge, including native title holders or applications, are able to contribute to the assessment process in ways that are culturally acceptable to them;
- To identify locations and cultural values of Aboriginal sites and places of significance to the Aboriginal community that may be affected by the proposal so that potential impacts can be avoided wherever possible; and
- To identify whether there are culturally acceptable mitigative measures when impacts are considered to be unavoidable by the applicant.

It is essential that applicants provide NPWS with documentation from the Aboriginal community groups regarding their views and recommendations for actions.

The Environmental Planning and Assessment Regulation 2000 (cl. 111) allows 46 days (from the date of DA lodgement with the consent authority) for the Director-General of the National Parks and Wildlife to undertake any further Aboriginal community consultation, if the Director-General of the NPW considers that such consultation is required before the Director-General can make a decision concerning the general terms of approval, and consultation commences within 25 days after the date on which the DA is forwarded to the Director-General.

- assessment of how the landsurface conditions have revealed, concealed, destroyed, impacted on or preserved archaeological evidence and how this relates to archaeological potential, the condition of Aboriginal sites and the geomorphology in these contexts

2.2.7 Methodology for Investigation

- description of input from the Aboriginal community to the method proposed for undertaking the study
- the proposed field methodology, such as type of sampling strategies and survey coverage (this should be targeted to the objectives of the study)
- description of the scope and method of recording and analysis by which the objectives of the study will be achieved
- the method whereby a clear and supportable significance assessment will be undertaken a supportable rationale for any proposed test excavations
- the program of work
- rationale for any variation in the methods adopted
- test excavation methodology, if relevant

2.2.8 Survey Coverage Data

- description of survey coverage and the effectiveness of that coverage for detecting potentially buried Aboriginal sites (this needs to be fully described and evaluated within the context of the objectives and the study plan. Specific methods are detailed in the NPWS Standards & Guidelines Kit)

2.2.9 Analysis and Reporting

- detailed Aboriginal site description/s including tabulated data summarising site content and any analysis, as per the NPWS Guidelines
- comprehensive evaluation of the study results (for potentially buried archaeological deposits this includes incorporating the information on archaeological potential and the reliability of survey coverage)
- results of test excavations, if relevant

Diagrams and photos are considered to be an essential component of archaeological reporting.

2.2.10 Archaeological Significance Assessment

- the significance criteria and attributes used for the assessment need to be fully supported by the information presented on the archaeological and landscape context of the site/s (e.g. representativeness, items and landscape elements considered to be rare, information potential, social/historical values). The criteria for assessment need to be measurable.

2.2.11 Conclusions of the Study

- evaluation of potential impacts on known Aboriginal sites and areas of
- archaeological sensitivity and potential (if relevant)
- establish clear relationship between significance assessment and impacts
- consideration of cumulative impact of development on comparable sites and landscapes at both a local and regional level

- consideration of various management options, **specifically identification of conservation options**, including on-site conservation and compensatory areas (for larger scale projects)
- description of mitigation works required for specific sites to be impact on

2.2.12 Management Options

- recommendations for conservation and other management options based on the results of the archaeological report and discussions with the land owner / manager and the Aboriginal community group/s
- incorporation of management options from Aboriginal community group/s where these relate to the management options being proposed for sites or places

The following maps are required as a minimum (more detailed specifications are set out in the NPWS Guidelines). Mapping should be at the same scale throughout the report.

- location of study area (1:25,000 map series where available, more detailed maps are useful additions)
- development layout if known, flexible components of design if applicable
- locations of previous survey undertaken and sites recorded (referred to in text)
- (for surveys) survey coverage data showing location and extent of different methods used
- land units and topographic information used
- land surface history highlighting the location and boundaries of the disturbed and intact deposits
- Aboriginal site locations

A comprehensive glossary of terms used should also be provided.

What happens if an Aboriginal site is found on the land after a development application is lodged or a development consent is granted ?

It is possible that an 'unknown' Aboriginal site could be identified on the land subsequent to the grant of development consent by Council or DUAP. The NPWS strongly advises that an adequate assessment of Aboriginal heritage values of the land be carried out prior to lodgement of the DA, so that this situation does not arise. However, in the event that this does occur, all works on or adjacent to the Aboriginal site must cease, and the applicant must seek a consent to destroy the relic from the Director-General of NPWS. A development consent granted under the *EP&A Amendment Act* does not equate to a Section 90 consent issued under the *NPW Act*. A consent to destroy an Aboriginal site must be granted pursuant to the *NPW Act* before an Aboriginal site or Aboriginal place can be destroyed. Failure to obtain this consent may result in prosecution.

Further Information

The National Parks and Wildlife Service has a Cultural Heritage Division which manages Aboriginal heritage. The Division includes 4 geographic units which deal with on- and off-park conservation planning and assessment issues. These boundaries are shown on **Attachment 4.**

For further information on these requirements, please contact the Aboriginal Heritage Unit in your area:

Manager, Central Aboriginal Heritage Unit
Cultural Heritage Division
NSW National Parks and Wildlife Service
PO Box 1967
HURSTVILLE NSW 2040

Ph: (02) 9585 6674
Fax: (02) 9595 6442

Manager, Northern Aboriginal Heritage Unit
Cultural Heritage Division
NSW National Parks and Wildlife Service
Locked Bag 914
COFFS HARBOUR NSW 2450

Ph: (02) 6659 8245
Fax: (02) 6651 6187

Manager, Southern Aboriginal Heritage Unit
Cultural Heritage Division
NSW National Parks and Wildlife Service
PO Box 2115
QUEANBEYAN NSW 2620

Ph: (02) 6298 9736
Fax: (02) 6298 4281

Manager, Western Aboriginal Heritage Unit
Cultural Heritage Division
NSW National Parks and Wildlife Service
PO Box 1007
DUBBO NSW 2830

Ph: (02) 6883 5345
Fax: (02) 6884 9382

ATTACHMENT 1

THE ABORIGINAL SITES REGISTER OF NSW

GENERAL INFORMATION

The National Parks and Wildlife Service maintains the Aboriginal Sites Register of NSW. The Register includes a computer database and site recording cards for all recorded Aboriginal sites in NSW, in addition to a database index of archaeological reports and a library of these reports. Information from the Register may be made available for a variety of uses.

What information is available?

Information relating to recorded Aboriginal sites in a particular area may be made available upon request. The information is generally available in the form of a standard report from the Register database. This report lists all recorded sites within and/or surrounding the area of interest, with each record including the site identifying number, site type, site location and Australian Map Grid co-ordinates, date of recording and the name of the recorder of the site.

If the area of interest is particularly large (e.g. a river catchment), a Data Licence Agreement may be required. This agreement is a legal contract document between the Director-General of the National Parks and Wildlife Service and a named client, and is designed to ensure that any data supplied under the agreement is used appropriately.

In some cases, written support from the relevant Local Aboriginal Land Council may be required before information can be provided from the Register.

How is the data provided?

Site information will generally be provided as a standard computer print out, however, digital computer formats on disk may be available for specific purposes.

Is there a charge for data?

The cost for supply of a standard report is $30 per search area. An urgent database search may be conducted for $60. More complex reports may incur an additional charge.

In particular circumstances there may be no charge for a report (e.g.. for Aboriginal Land Councils, research purposes etc.). The waiving of any charge requires discussion with the Aboriginal Sites Registrar.

There is no charge imposed for a Data Licence Agreement, however, any data supplied under a Licence Agreement will generally be charged at the current "cost of transfer".

Are there any limitations in the data?

It is essential to note that a report from the Register does not represent a comprehensive list of all Aboriginal sites in a specified area. A report lists recorded sites only. In any given area there may be a number of undiscovered and/or unrecorded sites. As a result of this limitation, and the fact that all Aboriginal sites are protected under NSW legislation, the NPWS may recommend that a survey for Aboriginal sites is conducted where development is proposed.

Locational details are recorded as grid references. It is important to note that there *may* be errors in these recordings. If accurate site locations are required it may be necessary to confirm the locations on the ground.

If the information provided is to be used for ongoing purposes, it is recommended that regular updates are obtained as new records are continually being added to the database.

How to obtain Aboriginal sites data

To obtain information about recorded Aboriginal sites, a written request should be forwarded to the Aboriginal Sites Registrar (a request form is available if required). All requests must include;

- Company/organisation name (if applicable)
- Contact name, phone number and address details
- Purpose for which the information is required
- Copy of a topographic map with the area of interest clearly marked
- A cheque for $30 per search area, made out to the NPWS (unless other arrangements have been made with the Registrar)

Applications should be forwarded to:

The Aboriginal Sites Registrar
Cultural Heritage Division
NPWS
PO Box 1967
Hurstville, NSW 2220. **or fax (02) 9585 6466**

Further information

For further information about the Aboriginal Sites Register, please contact the Aboriginal Sites Registrar (02 9585 6471, fax 02 9585 6466).

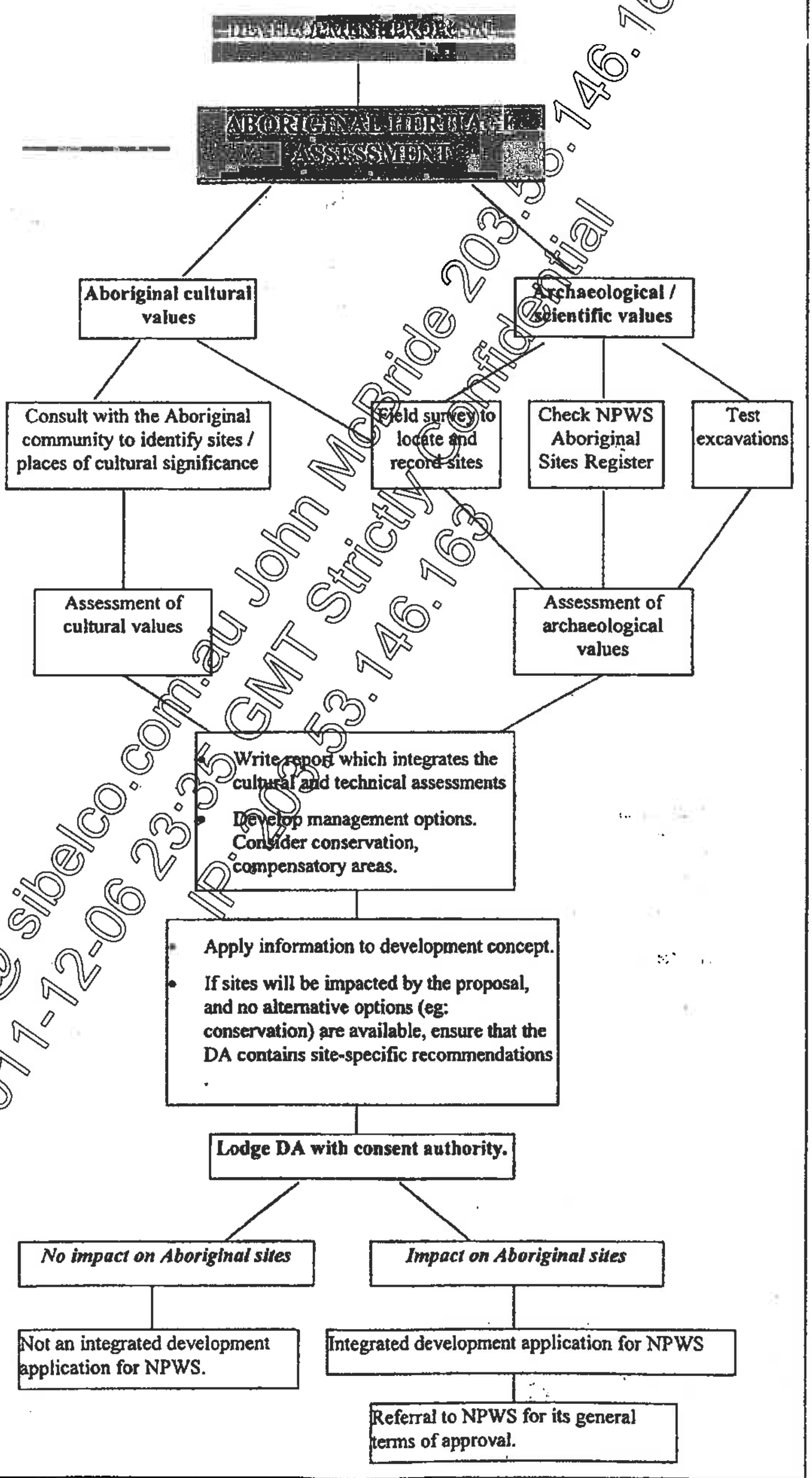
ATTACHMENT 2

PROCESS

1. Development proposal.
2. Investigative studies and assessments. This could include: Aboriginal heritage, flora and fauna, hydrology, air, noise, social / economic etc.
3. For Aboriginal heritage, information is required about:
4. Information sources:

NB: Test excavations may be required. This requires a permit from NPWS, allow 8 weeks for processing.

5. Undertake assessment
6. Prepare report and recommend management options.
7. Apply this and information from other assessments to development concept and finalise development proposal. Avoiding impact on sites is the preferred strategy.
8. Lodgement of DA with consent authority
9. DA is an IDA if development will impact on Aboriginal sites.



ATTACHMENT 3

Aboriginal Cultural Heritage Standards and Guidelines Kit

comprising

Guidelines for Aboriginal Consultants

These *Guidelines* aim to clarify for Aboriginal consultants the type of reporting required for heritage assessments. The *Guidelines* reflect the Service's commitment to partnership with Aboriginal stakeholders in protecting and managing Aboriginal cultural heritage.

Standards Manual for Archaeological Practice in Aboriginal Heritage Management

The *Standards Manual* sets out current best practices in this diverse and developing field. The *Manual* encourages archaeological methodology to be relevant to the management context. It has been developed in partnership with the professional community and will be supplemented by regular updates.

Guidelines for Archaeological Survey Reporting

These *Guidelines* set out in detail the requirements of NPWS for survey reports submitted by archaeologists. The object is to enhance the comparability of survey reports as well as to promote transparency and predictability in the industry by making clear the needs and expectations of NPWS as the reviewing agency.

Guidelines for Aboriginal Heritage Impact Assessment in the Exploration & Mining Industries

These *Guidelines* provide industry-specific advice to applicants of exploration and mining ventures. They were prepared by NPWS in co-operation with the NSW Minerals Council and the NSW Department of Mineral resources.

To obtain a copy of this valuable kit please send a cheque for $70 made out to NPWS to:
Cultural Heritage Division, NPWS, PO Box 1967, Hurstville NSW 2220
Enquires to:
Denis Byrne (02)9585 6571 *denis.byrne@npws.nsw.gov.au*
Anthony English (02)9585 6464 *anthony.english@npws.nsw.gov.au*

White Box, Yellow Box, Blakely's Red Gum Woodland (Box-Gum Woodland)

Introduction

These guidelines provide background information and assist land managers and approval authorities to identify remnants of White Box Yellow Box Blakely's Red Gum Woodland (hereafter referred to as Box-Gum Woodland) Endangered Ecological Community (EEC). The Scientific Committee published this Determination on 15/3/2002. Copies of the Determination are available on the NPWS website at

http://www.npws.nsw.gov.au/news/tscdets/f020315a.htm

Text in italics in this document is taken from the Final Determination, unless otherwise indicated.

What is Box-Gum Woodland?

Box-Gum Woodland is characterised by the presence or prior occurrence of White Box, Yellow Box or Blakely's Red Gum. The EEC occurs predominantly on the western slopes of NSW from Victoria to Queensland on soils that are moderately to highly fertile. Consequently, Box-Gum Woodland has been extensively cleared and modified by thinning, clearing, grazing, pasture improvement and cultivation. Remaining stands of Box-Gum Woodland are generally highly fragmented. Less than 5% of the pre-European extent is estimated to remain in the south and up to 10% in the north of the State. Less than 0.5% is estimated to retain pre-European levels of diversity and species composition.

The Final Determination defines Box-Gum Woodland broadly. There are five main features in the Determination that govern whether the EEC exists at a site:

1. Whether the site is within the area defined in the Determination.
2. Whether the characteristic trees of the site are (or are likely to have been) White Box, Yellow Box or Blakely's Red Gum.
3. Whether the site is mainly grassy.
4. Whether any of the listed characteristic species occur (including as part of the seedbank in the soil).
5. If the site is degraded, whether there is potential for assisted natural regeneration of the overstorey or understorey.

<u>It is important to note that the size or ages of the remnant are not determining factors as to whether it constitutes the listed EEC or not.</u>

The condition of remnants of this EEC varies. Examples of the various conditions the community may occur in include:

1. Multi-aged overstorey with a grassy, herb-rich understorey:
   - Remnants in this condition are very scarce and are generally confined to travelling stock reserves, roadside vegetation, cemeteries, some national parks and the occasional private property.
2. Partially cleared/thinned stands with a mixture of native and exotic understorey species:
   - This condition is far more common than the above, however its long-term future is often insecure due to inadequate regeneration of overstorey species. Often current management (e.g. set-stocking) is inconsistent with tree regeneration.
3. Stands where White Box, Yellow Box or Blakely's Red Gum have been killed and other species dominate the canopy:
   - This condition occurs in woodlands where the characteristic trees occur in conjunction with White Cypress Pine. The understorey is often in reasonable to very good condition.
4. Grasslands (secondary or derived grasslands), where the tree overstorey has been removed and only the Box-Gum Woodland understorey is present:
   - This condition is likely to be reasonably common in some areas and is likely to be relatively easy to rehabilitate if appropriate management strategies are implemented.

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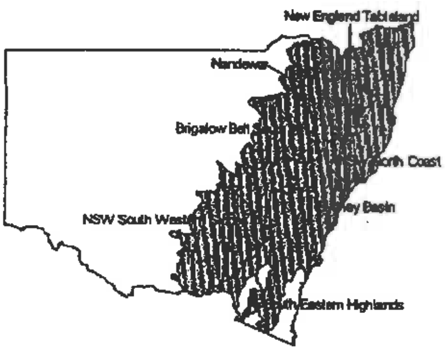
5. Degraded remnants that have few, if any, native species in the understorey:
    - This condition is typical of Box-Gum Woodland where agricultural practices have been more intensive (e.g. pasture improvement over long periods).

Where is Box-Gum Woodland found?

Box-Gum Woodland is found on relatively fertile soils on the tablelands and western slopes of NSW, extending from an altitude of approximately 170m on the lower slopes to and including the tablelands. Rainfall is between 400 and 800 mm with a slight winter dominance in the south to a slight summer dominance in the north. The listed extent the EEC is confined to the bioregions in the map below.



The overstorey

The characteristic trees are White Box, Yellow Box or Blakely's Red Gum. The density of trees is not relevant to the existence of the EEC. Where White Box, Yellow Box or Blakely's Red Gum trees have been killed, and the overstorey is now dominated by other species (e.g. White Cypress Pine), the EEC still exists (see section on Degraded Sites). The Final Determination specifically includes treeless areas in the EEC *"as a result of past clearing or thinning."*

The understorey

Box-Gum Woodland includes vegetation where *"Grass and herbaceous species generally characterise the ground layer... Shrubs are generally sparse or absent, though they may be locally common."*

The term *"locally common"* is not defined, but the intent of the statement is that shrubs may be dominant over parts of an EEC site. Shrub species are recognised as important constituents of the community as 27 of the 95 characteristic species listed in the Final Determination are shrubs.

However, shrubby woodlands, which generally occur in upper or midslope situations on shallower soils, are not part of the EEC. Such woodlands are more prevalent on hillsides of the North Western Slopes (Nandewar and Brigalow Belt South Bioregions). Where shrubby woodlands dominated by White Box, Yellow Box or Blakely's Red Gum intergrades with the Box-Gum Woodland the more shrub-free sections of the community should be regarded as Box-Gum Woodland.

In most locations the understorey will vary considerably depending on the season, management history and rainfall in preceding months. Care in identifying a site is required when a flush of annual exotic species obscures native perennial species. Another survey of the site after the annuals have died is desirable. Ideally sites should be surveyed in both spring and in autumn so that seasonal native species such as orchids, lilies and native annuals can be identified.

Characteristic species

The Final Determination of Box-Gum Woodland has a list of 95 species that are characteristic of the community.

The Final Determination for Box-Gum Woodland, in common with other Endangered Ecological Community Determinations, states, *"In any particular site not all the assemblage listed above may be present. At any one time, seeds of some species may only be present in the soil seed bank with no above-ground individuals present"*. Hence the potential of the seedbank must be considered when assessing degraded sites.

The NSW *Threatened Species Conservation Act*, 1995 defines an ecological community as *"an assemblage of species occupying a particular area."* Thus any EEC includes species occurring in association with the species listed as characteristic for the community.

For example, Box-Gum Woodland includes fauna and fungi, although these groups are not included in the lists of characteristic species.

Fauna

Many sites may be degraded and yet remain important for fauna. Fauna habitat value of individual trees is dependent on a number of features. Generally large old trees have greater value to fauna. Such trees support a diverse and abundant array of insects and the animals that feed upon them, and have numerous hollows, cracks or fissures that provide shelter and nesting sites.

Mature box and gum trees readily form hollows and thus provide important habitat for hollow-dependent fauna such as Squirrel Gliders, Barking Owls and Superb Parrots. Critically, in some areas, White Box and Yellow Box provide significant nectar flows during winter when such resources are crucial for threatened species such as the Regent Honeyeater and Swift Parrot. Large old trees on more fertile sites have been observed to produce more significant nectar flows for fauna than nearby trees on poorer sites such as hillsides.

Degraded sites

The definition of the Box-Gum Woodland explicitly recognises that some remnants are degraded. Highly disturbed sites that have few if any native species in the understorey are specifically included in the community provided *"vegetation, either understorey or overstorey or both, would, under appropriate management, respond to assisted natural regeneration, such as where the natural soil and associated seed bank are still at least partially intact."*

In some parts of NSW Box-Gum Woodlands are only represented by isolated paddocks trees with a highly modified understorey. Such remnants or vestiges of the community may still constitute valuable fauna habitat in agricultural areas and may provide a valuable source of seed for potential future regeneration.

Determining whether the vegetation will respond to assisted natural regeneration will often be highly problematic. Sites where there is unlikely to be sufficient seed remaining in the soil for the understorey or overstorey to regenerate are not part of the EEC. For example, trees under which intensive cropping of annual crop species has occurred and is ongoing, and trees within urban backyards are unlikely to be part of the community. Conversely, trees with exotic pastures underneath and those in larger urban open spaces will generally be part of the community.

Inevitably difficulties will arise when faced with decisions on whether particular sites are able to respond to assisted natural regeneration. Expert advice may need to be sought in these circumstances. One of the recovery actions for this community is the further investigation of the regeneration potential of various conditions of this EEC in a range of environmental situations. Only then will definitive advice be able to be given.

Identifying Box-Gum Woodland

Following is a key for use in determining whether Box-Gum Woodland exists on a site. Where doubt exists over an appropriate category (e.g. whether the site is mainly grassy or is shrubby), use a precautionary approach that assumes that the community is present.

At each stage there are two alternatives. Choose which is most like the site under consideration, and proceed to the alternative numbered in the right margin.

1 The site is in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands or NSW South Western Slopes Bioregions: 2

1* The site is outside the above bioregions: **the site is not Box-Gum Woodland**

2 There are no native species in the understorey, and the site is unlikely to respond to assisted natural regeneration (see section on Degraded Sites, page 3): **the site is not Box-Gum Woodland**

2* The understorey is otherwise: 3

3 The site has trees: 4

3* The site is treeless, but is likely to have supported White Box, Yellow Box or Blakely's Red Gum prior to clearing: 5

4 White Box, Yellow Box or Blakely's Red Gum, or a combination of these species, are or were present: 5

4* White Box, Yellow Box or Blakely's Red Gum have never been present: **the site is not Box-Gum Woodland**

5 The site is predominantly grassy: **the site is Box-Gum Woodland**

5* Shrubs dominate the understorey of the site. That is, shrubs are widespread and have sufficient cover to suppress grasses and herbaceous species. **the site is not Box-Gum Woodland**

Determining the conservation value of remnants

The condition of remnants of Box-Gum Woodland varies. The conservation value of a remnant, whatever its condition, will vary according to the locality. For example, whilst Box-Gum Woodland persisting as isolated paddock trees may be of limited conservation value in some areas, in highly modified agricultural landscapes they may be all that remain and thus their loss would be significant.

Additional guidelines are being prepared to assist in determining the local and regional conservation significance of Box-Gum Woodland remnants.

Useful References

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Threatened Species Conservation Act 1995, NSW Scientific Committee, (March 2002) *Final Determination: White Box Yellow Box Blakely's Red Gum Woodland.*

NSW NPWS, (2001) *Paddock Tree Brochure.* NSW NPWS.

Walker K., Burrows G., McMahon L., (2001) *'Bidgee Bush.* Greening Australia.

Website: Community Solutions http://www.communitysolutions.com.au/gwbw_project/index.html

Website: Conservation Management Network http://www.conservation-management-networks.net/

Website: NPWS http://www.npws.nsw.gov.au

For further information contact the Threatened Species Unit in your area

Threatened Species Unit
Western Directorate
NSW National Parks and Wildlife Service
PO Box 2111
DUBBO NSW 2830
Tel: (02) 6883 5330 Fax: (02) 6884 9382

Threatened Species Unit
Central Directorate
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PO Box 1967
HURSTVILLE NSW 2220
Tel: (02) 9585 6678 Fax: (02) 9585 6442

Threatened Species Unit
Northern Directorate
NSW National Parks and Wildlife Service
PO Box 914
COFFS HARBOUR NSW 2450
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Threatened Species Unit
Southern Directorate
NSW National Parks and Wildlife Service
PO Box 2115
QUEANBEYAN NSW 2620
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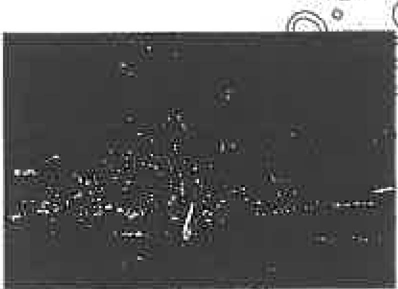
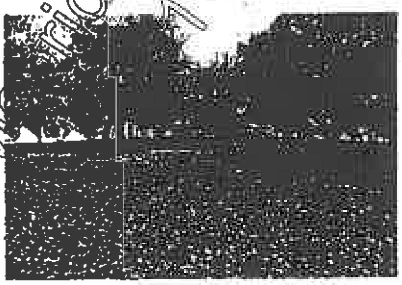
NSW NATIONAL PARKS AND WILDLIFE SERVICE

WHITE BOX-YELLOW BOX-BLAKELY'S RED GUM (BOX-GUM) WOODLAND
fact-sheet





This fact-sheet contains the following information:

1. What is an ecological community?
2. What is a Box-Gum Woodland ecological community?
3. Why is Box-Gum Woodland an endangered ecological community (EEC)?
   - The legal status of Box-Gum Woodland.
4. Identifying Box-Gum Woodland.
5. Examples of social and economic benefits of Box-Gum Woodlands.
6. Does Box-Gum Woodland have to be in a pristine state to be considered part of the EEC?
7. What happens now that Box-Gum Woodland is listed as an EEC?
   - Who issues approvals for actions that impact on EECs?
   - Examples of actions that will require approval.
8. How will the impact of proposed actions on Box-Gum Woodlands be assessed? (the 8 part test).
9. Planning for the recovery of Box-Gum Woodland.
10. NPWS Threatened Species Unit contacts.
11. Useful references.
12. Useful websites.
13. References for economic benefits section.

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1. What is an ecological community?

An ecological community is a grouping of species that commonly occur together in a way that is recognisably different from other groupings. A community consists of characteristic trees, shrubs, wild flowers and grasses as well as the mammals, birds, reptiles and insects that utilise the habitat.

2. What is a Box-Gum Woodland ecological community?

White Box Yellow Box Blakely's Red Gum Woodland (or Box-Gum Woodland) is found from the Queensland border in the north, to the Victorian border in the south. It occurs in the tablelands and western slopes of NSW.

In its pre-European-settlement state, Box-Gum Woodland was an extremely diverse part of the landscape. Many hundreds of plant species, including trees, shrubs, grasses, and wildflower species, such as orchids, lilies, peas, daisies and many others, traditionally make up the Box-Gum community. Many of these flora species are now threatened.

Box-Gum Woodland generally occurs on the fertile lower parts of the landscape where resources such as water and nutrients are abundant. This means that Box-Gum Woodland trees often grow very large, and hollows of all sizes develop. Hollows, including those in dead trees, are extremely important for a huge range of fauna species such as parrots, owls and bats and many of these are now also threatened species. The availability of nutrients and water also means that Box-Gum Woodland trees have relatively reliable nectar flows and foliage growth. This makes them essential resources for nectar-feeding and insectivorous birds and bats. A range of woodland birds, bats and insectivores are now also threatened.

3. Why is Box-Gum Woodland an endangered ecological community (EEC)?

Box-Gum Woodland was once widespread. However, the lower fertile footslopes and flats that support these woodlands were also the areas generally preferred for cropping, pasture and infrastructure development. As a consequence Box-Gum Woodland is now severely reduced in area, remnants tend to be highly isolated and fragmented and remnants with a full range of flora and fauna species are very rare.

For example, in the Holbrook area, woodlands have been reduced to less than 7% of the pre-European extant. In the NSW South West Slopes less than 4% remains and in the Central Lachlan Region, less than 1% remains.

Although large areas of NSW still contain the large trees that make up the backbone of the Box-Gum Woodland community, there is very little regeneration of trees. Should this situation continue vast areas now occupied by box and gum trees will be devoid of trees in 50 or 100 years. Salinity, insect induced dieback and other factors also seriously threaten large areas of Box-Gum woodlands.

Additionally, the ongoing clearing for the establishment of irrigation projects, rural sub-divisions, pine plantations and vineyards threaten Box-Gum Woodland community in some regions.

Legal status of Box-Gum Woodland.

On 15th March 2002 an independent panel of scientists, known as the NSW Scientific Committee, made a final determination to list White Box Yellow Box Blakely's Red Gum Woodland as an Endangered Ecological Community (EEC) under the *Threatened Species Conservation Act 1995* (TSC Act). You can view the Scientific Committee's Final Determination at http://www.npws.nsw.gov.au/news/tscdets/f020315a.htm.

The Commonwealth also lists Grassy White Box as endangered under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). You can view the advice for the Grassy White Box determination at http://www.ea.gov.au/biodiversity/threatened/communities/grassy-white-box.html.

Early contact with Environment Australia is recommended if the action is likely to impact on the Grassy White Box community. You can view the guidelines on making a referral to Environment Australia under the EPBC Act at http://www.ea.gov.au/epbc/assessmentsapprovals//referrals/guide.html

4. Identifying Box-Gum Woodland.

Box-Gum Woodland is characterised by the presence or prior occurrence of *Eucalyptus albens* (White Box), *E. melliodora* (Yellow Box) and/or *E. blakelyi* (Blakely's Red Gum). The trees may occur as pure stands, mixtures of the three species or in mixtures with other trees such as *E. bridgesiana* (Apple Box), *E. microcarpa* (Grey Box), *E. mannifera* (Brittle Gum), *E. rubida* (Candlebark), *E. cinerea* (Argyle Apple) and *E. macrorrhyncha* (Red Stringybark).

The understorey of Box-Gum Woodland is characterised by native grasses and wild flowers. Shrubs are generally sparse or absent from Box-Gum Woodland, though they may be locally common. Up to 1000 flora species have been identified in Box-Gum Woodland across NSW.

For more detailed information on identifying Box-Gum Woodland contact NPWS for a copy of *'Identification Guidelines for Endangered Ecological Communities: White Box-Yellow Box-Blakely's Red Gum Woodland (Box-Gum Woodland)'*.

5. Economic and social benefits of Box-Gum Woodlands.

The management and retention of remnant vegetation on farms, including Box-Gum Woodland, provides habitat for a diverse range of plant and animal species and contributes to more productive farming systems.

Box-Gum Woodland can provide shelter for stock, pasture and crops, a seed bank for further tree and native grass regeneration on the property, habitat for birds, mammals and insects that eat insect pests, and assist in the management of rising water-tables and salinity.

Stock shelter
Lack of shelter for stock can result in heat stress. Therefore, the shelter provided by remnant or regenerating Box-Gum Woodland can;

- increase milk production,
- increase liveweight gains in cattle (assists them to chew their cud),
- increase wool growth,
- increase ram fertility, ewe ovulation rate and conception,
- improve foetal development,
- decrease mortality of stock,
- assist in preventing abortion in pregnant cows and
- assist in preventing calves to be born undersized.

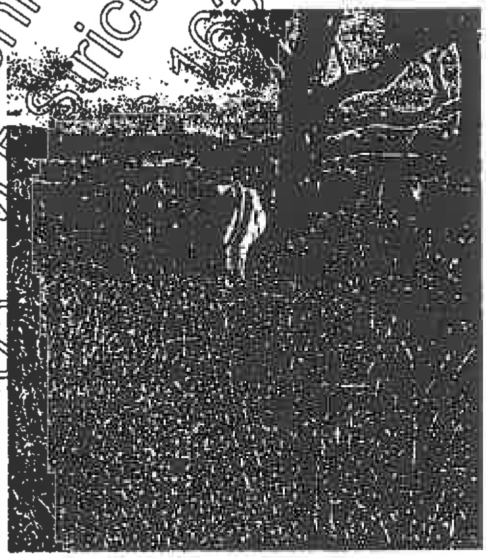
Lack of shelter can result in cold stress. Therefore, the shelter provided by remnant or regenerating Box-Gum Woodland can;

- increase wool growth,
- increase liveweight gains and
- increase milk yields.

For example, sheltered off-shears wethers require two-thirds less supplementary feed to maintain their bodyweight as unsheltered off-shears wethers.

Unsheltered newborn lambs can die at 19°C if there is rain and 18 km/hr winds.

A study in Armidale showed that sheltered sheep produced 35 % more wool and 6 kg more liveweight than exposed sheep.



Insect control
Box-Gum Woodland and its flowering native grass understorey is habitat for insectivorous insects, frogs, reptiles, birds and mammals.

For example, in healthy Eucalypt woodland birds will consume 50 % of insects present (approx. 30 kg/ha/yr). Gliders, spiders and insects consume most of what's left.

Studies near Wagga Wagga observed that about 80% of birds in Grey Box trees were insectivorous.

Woodland provides habitat for honeyeaters that consume 24-36 kg of insects per hectare per year.

At least 10 wasp species parasitise scarab beetle larvae. The adult wasps feed on nectar from trees and shrubs.

Sugar Gliders have been estimated to eat 3.25 kg of insects per glider per year. One Sugar Glider consumes the equivalent of well over 4,000 Christmas beetles or 23,000 Autumn Gum Moths per year.

Standing dead trees with hollows provide nests for insectivorous bats; one of these bats can consume up to 600 small flying insects in an hour. Bats can also consume large numbers of other farm insect pests, such as army-worms.

Reseeding after drought
Areas of remnant vegetation act as reseeding areas after drought by supplying native pasture seed to adjoining areas.

Soil benefits
Some understorey species, e.g. *Acacia* spp. and *Casuarina* spp. have bacteria-filled nodules that fix atmospheric nitrogen into the soil and convert it to nitrogen that is available to other plants.

Fallen logs, branches and litter in remnant woodland provide stores of nutrients while helping to slow runoff and reduce its erosion potential.

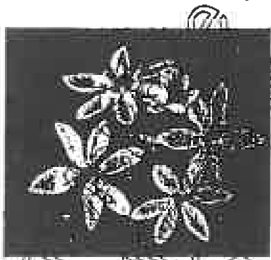
Management funding
The listing of Box-Gum Woodland as an EEC will give land managers an important point of leverage when they are applying for funding or other assistance in relation to managing their Box-Gum Woodland.

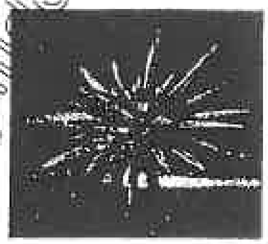
As the community is also listed under Commonwealth legislation, programs such as the Natural Heritage Trust may also be a valuable source of funds.

The Australian farming landscape
Imagine the farming landscape if trees were totally absent. This is a possibility in many areas if younger trees do not replace the old standing trees.

Box-Gum Woodland has an important aesthetic value, it represents an archetypal Australian rural landscape, and has provided inspiration for a range of landscape artists including Tom Roberts and Frederick McCubbin. It provides the vista that rural communities and their visitors expect when they are enjoying the Australian countryside.

Tourism potential
Box-Gum Woodland that retains high-quality understorey offer scenic sites that have considerable tourism potential. Some grassy Travelling Stock Reserves and cemeteries rival the alpine summer floral displays. Others provide opportunities to experience the type of woodlands that were familiar to our early explorers. Such sites will add to the portfolio of important tourist attractions that rural communities have to offer.





6. Does Box-Gum Woodland have to be in a pristine state to be considered part of the EEC?

Remnant Box-Gum Woodland can occur in a range of conditions, from almost pristine to highly modified. The importance of a particular Box-Gum Woodland remnant to the maintenance and recovery of this EEC in a local region needs to be considered in the context of the extent and condition of Box-Gum Woodland in the local region.

Intact Box-Gum Woodland remnants in which native grasses and wild flowers characterise the ground layer are extremely rare and highly significant in all regions. Remnants of this quality should be managed appropriately to ensure they remain in such good condition.

Where the Box-Gum Woodland remnant is in less than pristine condition it is still considered part of the EEC as long as the site has at least part of its natural soil and seedbank intact, so that under appropriate management it would respond to assisted natural regeneration. Therefore the Box-Gum Woodland EEC can include the following conditions,

- Trees present as a canopy with a non-native ground-layer,

- Characteristic tree species absent as a result of past clearing or thinning and only other tree species and ground-layer present and
- Overstorey absent as a result of past clearing or thinning and only a ground-layer present.

Depending on the local extent and condition of Box-Gum Woodland, isolated box or gum trees scattered across a paddock may also form part of the EEC. This is because these few remaining trees may be providing important hollow and nectar resources for fauna, they may be an important seed source for regeneration or they may be acting as 'stepping-stones' for fauna moving between larger, more complex Box-Gum Woodland remnants across an otherwise cleared landscape. However, for isolated Box-Gum Woodland trees to be considered part of the EEC, it must be considered that the site, under appropriate management, would respond to assisted natural regeneration. For additional information see the *'Identification Guidelines for Endangered Ecological Communities: White Box-Yellow Box-Blakely's Red Gum Woodland (Box-Gum Woodland)'*.

Additional guidelines are also being prepared by NPWS to assist in assessing the significance of the different conditions of Box-Gum Woodland.

7. What happens now that Box-Gum Woodland is listed as an EEC?

Listing Box-Gum Woodland as an EEC does not mean that every White Box, Yellow Box and Blakely's Red Gum tree, or every native pasture derived from clearing of these trees, is now protected and cannot be removed.

However, it does mean actions that impact on the EEC will trigger the TSC Act. This means an approval authority must consider the impact of the proposed action on the community. An approval will be issued if it is deemed the action will not have a significant impact on the local Box-Gum Woodland EEC.

Routine agricultural activities do not require approval under the TSC Act. This means that a similar agricultural activity can continue at a similar intensity on the same site. Farmers will not have to change how they currently manage their land because of the listing. However, care must be taken when applying this rule, especially if the action is likely to harm the EEC. If there is any doubt that the action is a 'routine agricultural activity' contact the appropriate Threatened Species Unit.

Actions that have already been approved under the *Environmental Planning and Assessment Act* 1979 are also exempt from further approval.

Who issues approvals for actions that impact on EECs?

The approval authority will vary according to the scale of the action and local environmental planning requirements. The following key will assist you in finding the appropriate approval authority. It is only a broad guide. For further information or if you are unsure, then contact your local council, Department of Land and Water Conservation (DLWC) or the National Parks and Wildlife Service (NPWS).

Key to approval authorities

1. Approval for an action that will impact on an isolated tree or a small patch of trees (less than 2 ha).

   If the action is clearly part of a development that is being assessed by council, council will assess it as part of the overall development application.

   If the action is not part of a broader development application and the local council has a Tree Preservation Order, the council will be the approval authority.

   If the action is not part of a broader development application and there is no Tree Preservation Order, NPWS will be the approval authority.

2. Approval for an action that will impact on a small patch of Box-Gum woodland understorey (less than 2 ha).

   NPWS will be the approval authority.

3. Approval for an action that will impact on Box-Gum woodland trees or understorey over an area greater than 2 ha.

   DLWC will be the approval authority.

NOTE: There are possible impending changes to the Native Vegetation Conservation Act 1997 regarding the 2 ha rule. This may alter the approval authority in some situations. The above key applies in July 2002.

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Examples of actions that will require approval.

The following actions have the potential to impact on the Box-Gum Woodland EEC and may require approval.

(a) Clearing Box-Gum Woodland (including native grass and wildflower species) to,
- Plant crops or exotic pastures,
- Install irrigation systems,
- Plant native or exotic tree plantations,
- Build housing, sheds, roads, etc.,
- Intensify agricultural activity,
- Undertake orchard or vineyard development and
- Undertake rural-residential development.

(b) Commercial felling of trees in Box-Gum Woodland for firewood.

(c) Clearing of remnant Box-Gum Woodland along roadsides during roadwork.

8. How will the impact of proposed actions on Box-Gum Woodland be assessed? (The '8-part test')

To determine whether the proposed actions is likely to have a significant effect on the EEC, approval authorities will use the '8-part test'.

NPWS will produce Environmental Impact Assessment Guidelines for Box-Gum Woodland and these will assist the proponent in addressing the '8-part test'. At a basic level the '8-part test' has 6 parts that need to be addressed when assessing the significance of the action on the EEC. These are;

(a) and (b)

These parts refer specifically to individual species and populations and are not applicable to Endangered Ecological Communities.

(c) In relation to the regional distribution of the habitat of a threatened ... ecological community, whether a significant area ... is to be modified or removed.

Consider the amount and quality of the Box-Gum Woodland left in the region surrounding the proposed site.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened ... ecological community.

Consider whether existing links (or corridors) between the proposed site and neighbouring Box-Gum Woodland will be impacted upon. Remember that seemingly isolated trees may actually be providing an important link across the landscape, acting like stepping stones for fauna to use.

(e) Whether critical habitat will be affected.

This part is not applicable to Box-Gum Woodland at the time of writing, as critical habitat has not been declared for this community.

(f) Whether the (...) ecological community is adequately represented in conservation reserves (or other similar protected areas) in the region.

The community is poorly represented in conservation reserves. There are only a few small occurrences of Box-Gum Woodland in national parks and nature reserves.

(g) Whether the action proposed is of a class of action that is recognised as a threatening process.

Threatening processes currently listed on Schedule 3 of the TSC Act 1995 that may impact on or occur in Box-Gum Woodland include,
- High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition,
- Clearing of native vegetation,
- Competition and grazing by the feral European Rabbit, *Oryctolagus cuniculus*,
- Predation by the European Red Fox *Vulpes vulpes* and
- Predation by the Feral Cat, *Felis catus*.

(h) Whether [the] (...) ecological community is at the limit of its known distribution.

Consider whether the Box-Gum Woodland is further east, west or at a greater or lower altitude than other examples of the community in NSW.

The 8-part test is not a pass/fail technique based on a score out of eight. Significance of effect is determined for a proposed action by the consideration on balance of all 8-part test questions. One factor alone could be sufficient to be considered a significant effect on EEC.

If, after applying the '8-part test' to the site, the approval authority considers that there will be a significant impact on the EEC and the proponent wishes to continue with the action, the proponent will need to prepare a Species Impact Statement (SIS). For further information on preparing a SIS contact NPWS.

If the approval authority considers that there will not be a significant impact on the Box-Gum Woodland they will issue an approval to carry out the work.

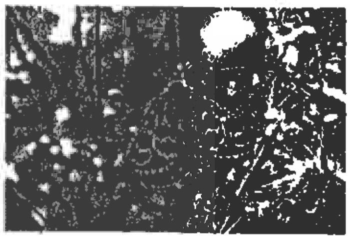
9. Planning for the recovery of Box-Gum Woodland.

When an ecological community is listed as endangered under the TSC Act, it also means that a recovery plan will be prepared to set guidelines for the long-term conservation of the EEC. A recovery team, made up of experts and community representatives prepares this plan. A draft plan is put on public exhibition for comment before it is finalised.

Actions likely to be in a recovery plan for the Box-Gum Woodland EEC include:

- identifying remnant sites that are available to be included in the NSW Reserve System as national parks or nature reserves,
- mapping and vegetation surveys in remnant sites,
- establishing long-term monitoring sites,
- preliminary studies of the impacts of burning and other management regimes,
- provision of advice to landholders managing Box-Gum Woodland on both private and public property,
- extension activities including field days, workshops, seminars and site visits and
- identifying priority areas for State and Commonwealth funding.

The recovery plan is also likely to recommend ongoing support and expansion of the Grassy Box Conservation Management Network (CMN). This network provides a focus point for the remnant grassy woodlands and their managers. The remnants in the network remain under a variety of tenures and are managed for different purposes (although always with the protection of the natural values as an important focus). For more information on CMNs visit the Conservation Management Network website listed in the 'Useful Websites' section.



NPWS Threatened Species Unit contacts

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PO Box 1967
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Phone: 02 9585 6678
Fax: 02 9585 6442

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Phone: 02 6659 8230
Fax: 02 6659 8230

Southern Directorate
PO Box 733
QUEANBEYAN 2620
Phone: 02 6297 6144
Fax: 02 6299 4281

Western Directorate
PO Box 2111
DUBBO 2830
Phone: 02 6883 5330
Fax: 02 6884 9382

10. Useful References

Eddy D., Mallinson D., Rehwinkel R., Sharp S., (1998) *Grassland Flora: a field guide for the Southern Tablelands.* E ACT, NSW NPWS, WWF. ANBG.

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NSW NPWS, (2001) *Paddock Tree Brochure.* NSW NPWS.

Walker K., Burrows G., McMahon L., (2001) *'Bidgee Bush.* Greening Australia.

11. Useful Websites

Community Solutions
http://www.communitysolutions.com.au/g wbw_project/index.html

Conservation Management Network
http://www.conservation-management-networks.net/

Environment Australia
http://www.ea.gov.au/index.html

NPWS
http://www.npws.nsw.gov.au/

12. References for Economic and Social Benefits section

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DCNR, 1995. *L for W Note No. 26*

DCNR, 1995. *L for W Note No. 30*

DCNR, 1995. *L for W Note No. 32*

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PARKS AND
WILDLIFE
SERVICE

Photography: Phil Gibbons, Stuart Cohen, Rainer Rehwinkel, Keith McDougall, Stuart McMahon and Ben Wrigley

Your reference : S03/01187
Our reference : 290539A2

NSW EPA
Southern Tablelands Region

Mr Tim Ward
Environmental Planning Officer
PlanningNSW
GPO Box 3927
SYDNEY NSW 2001

Dear Mr Ward

Re: Proposed Lime Kiln, Galong, Barnu Pty Ltd, Harden Local Government Area

I refer to your letter dated 8 May 2003, which was received by this office on Tuesday 13 May 2003, requesting the Environment Protection Authority's (EPA) requirements for the Environmental Impact Assessment for the above proposal.

The EPA emphasises the importance of ensuring that it is provided with all necessary information essential to its determination of the proposal and preparation of General Terms of Approval and appreciates the opportunity of providing its information requirements for the subject proposal.

The EPA has considered the details of the proposal as provided by PlanningNSW and by the proponent on 6 May 2003. It is expected that the EPA will require information in regard to the following aspects of the proposal as detailed in Appendix 'A':

- Air quality – specifically the nature of emissions from the coal plant and the kiln and the impact of these emissions to atmosphere, particularly on the surrounding air shed
- Noise – the kiln has the potential to emit noise that is tonal, low frequency and impulsive. The point of noise emission is elevated and has an enhanced potential to be transmitted over distance.
- Water
- Management of product and waste streams

The EPA also notes that an EIS for the expansion of the extraction operations at these premises has recently been lodged with Harden Shire Council. The EIS for the construction of the kiln should, for the purpose of this assessment, assume that the expansion has been approved and that the assessment will be predicated on the cumulative impacts of the expanded operations of the limestone mine and the operation of the kiln.

Additionally, the EPA recognises that certain aspects of the assessment of the mine expansion will be common to the EIS for the construction and operation of the kiln. The EPA anticipates that the proponent will draw upon this information. Where the construction and operation of the kiln creates an additional and/or increased impact, the cumulative impact of the new proposal must be clearly identified and assessed.

Based on the information provided to the EPA, the applicant will need to apply for a variation of the Environment Protection Licence for the premises to construct and operate both the kiln and associated infrastructure. To assist the EPA in assessing the EIS once it has been lodged with the consent authority, it is suggested that the format of the EIA follow the format of DUAP's EIS Guidelines. The EPA would like to receive 3 copies of the final EIS for assessment purposes.

Should you have any further enquires in relation to this matter, please contact Mark Robertson of this office on (02) 6122 3100.

Yours sincerely

NIGEL SARGENT
Head Regional Operations Unit
Southern Tablelands Region

Cc – David Olsen

20/5/03

APPENDIX "A"

EIS requirements for Galong Lime Kiln project

A. Executive summary

- The executive summary should include a brief discussion of the extent to which the proposal achieves identified environmental outcomes.

B. The proposal

1. Objectives of the proposal

- The objectives of the proposal should be clearly stated and refer to:
  - the size and type of the operation, the nature of the processes and the products, by-products and wastes produced;
  - a life cycle approach to the production, use or disposal of products;
  - the anticipated level of performance in meeting required environmental standards and cleaner production principles;
  - the staging and timing of the proposal and any plans for future expansion;
  - the proposal's relationship to any other industry or facility.

2. Description of the proposal

General

- Outline the production process including the environmental "mass balance" for the process – quantify in-flow and out-flow of materials, any points of discharge to the environment and their respective destinations (sewer, stormwater, atmosphere, recycling, landfill etc).
- Outline cleaner production actions, including:
  - measures to minimise waste (typically through addressing source reduction);
  - proposals for use or recycling of by-products;
  - proposed disposal methods for solid and liquid waste;
  - water management system including all potential sources of water pollution, proposals for re-use, treatment etc, emission levels of any wastewater discharged, discharge points;
  - soil contamination treatment and prevention systems.
- Outline construction works including:
  - any earthworks or site clearing; re-use and disposal of cleared material (including spoil on-site);
  - construction timetable and staging; hours of construction; proposed construction methods;
  - environment protection measures, including noise mitigation measures, dust control measures and erosion and sediment control measures.

Air

The EIS must identify and all sources of of air emissions from the development, in particular the EIS must discuss the following points relation to air quality:

- Identify all sources of air emissions (including dust and/or odour) from the development;
- Identify all pollutants of concern and their sources/discharge points. estimate emissions by quantity and identify expected receivers;
- Provide details of the project that are essential for predicting and assessing air impacts including:
    - The quantities and physico-chemical parameters (eg concentration, moisture content, bulk density, particle sizes etc) of materials to be used, transported, produced or stored;
    - An outline of procedures for handling, transport, production and storage of materials;
    - The management of solid, liquid and gaseous waste streams with potential for significant air impacts.

Note: emissions can be classed as either:
- *point (eg emissions from stack or vent) or*
- *fugitive (from wind erosion, leakages or spillages, associated with loading or unloading, conveyors, storage facilities, plant and yard operation, vehicle movements (dust from road, exhausts, loss from load), land clearing and construction works).*

- Outline and discuss any management strategies that can be implemented to minimise the impacts of the development on local air quality.

Noise and vibration

- Identify all noise sources from the development (including both construction and operation phases). Detail all potentially noisy activities including ancillary activities such as transport of goods and raw materials, and the loading of product.
- Specify the times of operation for all phases of the development and for all noise producing activities.

Water

- Provide details of the project relevant to any water impacts of the development such as drainage works and associated infrastructure; land-forming and excavations; working capacity of structures; and water resource requirements of the proposal.
- Outline site layout, including:
    - demonstrate efforts to avoid proximity to water resources;
    - show potential areas of modification of contours, drainage etc;
    - show any other pollution controls on site.
- Outline how total water cycle considerations are to be addressed showing total water balances for the development (with the objective of minimising demands and impacts on water resources). Include water requirements (quantity, quality and source(s)) and

proposed storm and wastewater disposal, including type, volumes, proposed treatment and management methods and re use options.

Waste and chemicals

Provide details of the type and quantity of any chemical substances to be used or stored and describe arrangements for their safe use and storage.

Rehabilitation

Outline considerations of site maintenance, and proposed plans for the final condition of the site (ensuring its suitability for future uses).

C. The location

General

- Provide an overview of the affected environment to place the proposal in its local and regional environmental context including:
  - meteorological data (eg rainfall, temperature and evaporation, wind speed and direction);
  - topography (landform element, slope type, gradient and length);
  - surrounding land uses (potential synergies and conflicts);
  - ecological information (water system habitat, vegetation, fauna);
  - availability of services and the accessibility of the site for transport.

Water

- Describe the catchment including proximity of the development to any waterways and provide an assessment of their sensitivity/significance from a public health, ecological and/or economic perspective.

Soil Contamination Issues

- Provide details of site history – if earthworks are proposed, this needs to be considered with regard to possible soil contamination, for example if the site was previously a landfill site or if irrigation of effluent has occurred.

D. Identification and prioritisation of issues (scoping of impact assessment)

- Provide an overview of the methodology used to identify and prioritise issues. The methodology should take into account:
  - relevant NSW government guidelines;
  - industry guidelines;
  - EISs for similar projects;
  - relevant research and reference material;
  - relevant preliminary studies or reports for the proposal;
  - consultation with stakeholders.

- Provide a summary of the outcomes of the process including:

- all issues identified including local, regional and global impacts (eg increased/ decreased greenhouse emissions);
- key issues which will require a full analysis (including comprehensive baseline assessment);
- issues not needing full analysis though they may be addressed in the mitigation strategy;
- justification for the level of analysis proposed (the capacity of the proposal to give rise to high concentrations of pollution compared with the ambient environment or environmental outcomes is an important factor in setting the level of assessment).

E. The environmental issues

The potential impacts identified in the scoping study need to be assessed to determine their significance, particularly in terms of achieving environmental outcomes, and minimising environmental pollution.

E1 Cumulative Impacts

- For any potential impacts relevant for the assessment of the proposal provide a detailed analysis of the impacts of the proposal on the environment including the cumulative impact of the proposal on the receiving environment.

- Describe the methodology used and assumptions made in undertaking this analysis (including any modelling or monitoring undertaken) and indicate the level of confidence in the predicted outcomes and the resilience of the environment to cope with the predicted impacts.

- The analysis should also make linkages between different areas of assessment where necessary to enable a full assessment of environmental impacts eg assessment of impacts on air quality will often need to draw on the analysis of traffic, health, social, soil and/or ecological systems impacts, etc.

- The assessment needs to consider impacts at all phases of the project cycle including: construction, routine operation, start-up operations, upset operations and decommissioning if relevant.

- Identify the extent that the receiving environment is already stressed by existing development and background levels of emissions to which this proposal will contribute.

- Assess the impact of the proposal against the long-term air, noise and water quality objectives for the area or region.

- Identify infrastructure requirements flowing from the proposal (eg water and sewerage services, transport infrastructure upgrades).

- Assess likely impacts from such additional infrastructure and measures reasonably available to the proponent to contain such requirements or mitigate their impacts.

E2 Air

The EIS must include a full assessment of how air emissions form the proposal will impact on the environment by providing the following information:

- provide a description of existing air quality and meteorology, using existing information and site representative ambient monitoring data.

- Identify all pollutants of concern and estimate emissions by quantity, source and discharge point.

Note: the activity of lime production is an assessable activity in accordance with the *Protection of the Environment Operations (General) Regulation, 1998.* As such the proponent would be required to assess the emission of assessable pollutants in line with the Load Calculation Protocol (EPA, May 2002). The EIS should identify the points of emission for the assessable pollutants and the proposal should make allowance for the measurement of these emissions.

- Identify expected receivers

- Provide an odour assessment/modelling of all odour sources to identify the potential impacts of odour. The EPA's *Draft Policy: Assessment and Management of Odour from Stationary Sources in NSW* (November 1999) sets out the current thinking in relation to odour assessment and management in NSW. You should be aware that the document is only a draft at this stage and does not represent formal EPA policy. However, it may assist in the preparation of the odour impact assessment if the methodologies outlined in the paper are adopted.

- Estimate the resulting ground level concentrations of all pollutants. Where necessary (eg potentially significant impacts and complex terrain effects), use an appropriate dispersion model to estimate ambient pollutant concentrations.

- Describe the effects and significance of pollutant concentration on the environment, human health, amenity and regional ambient air quality standards or goals.

- Describe the contribution that the development will make to regional and global pollution, particularly in sensitive locations.

- Outline and discuss any pollution control equipment and/or management protocols that can be implemented to minimise the impacts of the development on local air quality.

- Incorporate a full assessment of air quality impacts (including dust and/or odour) resulting from all activities at the premises and include recommendations and strategies for controlling all pollutants of concern to ensure all relevant requirements of the Protection of the Environment Operations Act, 1997 and the Clean air (Plant and Equipment) Regulation 1997 will be complied with.

Note: all technical analysis and information provided must follow guidelines and procedures outlined in the EPA's publications including "Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales" (July 2001) and "Approved Methods and guidance for the Modelling and Assessment of Air Pollutants in NSW (August 2001)

E3 Noise and vibration

i) Site and Traffic Noise and Vibration

The EIS must include a full assessment of how noise from this proposal will impact the surrounding environment and include information on the following:

- Identify of all noise sources from the development (including both construction and operation phases). Detail all potentially noisy activities including ancillary activities such as transport of product and supplies to the premises.
- Identify any noise sensitive locations likely to be affected by activities at the site, such as residential properties, and other premises.
- Typically the noise assessment should include a map of the locality showing any identified noise sensitive locations in relation to the site.
- Identify the land use zoning of the site and the immediate vicinity and the potentially affected areas.
- Determine environmental noise level criteria for each section of roads used for transport to and from the site in accordance with Tables 1 and 2 of Section 2 of the *Environmental Criteria for Road Traffic Noise (EPA, 1999) (ECRTN)*.

ii) Describe baseline conditions

- Determine the existing ambient (including background) noise levels at noise sensitive locations in the area in accordance with the NSW Government Industrial Noise Policy. (Usually requires monitoring for a continuous period of seven (7) consecutive days and nights; note that periods of unfavourable weather conditions (ie: wind speeds >5m/s and rain) which affect measured noise levels will need to be excluded. Supplementary monitoring may be needed to obtain sufficient "good" data).

Note: - *Background noise monitoring should be completed in the absence of the proposed activity (eg where an extension to an existing operation is proposed then monitoring to determine background noise level must be designed to exclude the noise produced by the existing operation).*

\- *All noise descriptors that will be used in the assessment should be monitored. For stationary sources this may include one or more of L_{Amax}, L_{A1}, L_{A10}, L_{Aeq}, L_{A90} while for traffic noise this may include $L_{eq(1hr)}$, $L_{eq(15hr)}$, $L_{eq(9hr)}$ and maximum noise levels depending on the area classification and the types of land use involved.*

The noise monitoring report should provide details of all monitoring of existing ambient noise levels including:

- Details of equipment used for the measurements,
- A brief description of where the equipment was positioned,
- A statement justifying the choice of monitoring site, including the procedure used to choose the site, having regards to definition of 'noise sensitive location(s)' and 'most affected location(s)' described in Section 3.1.2 of the INP,

- Details of the exact location of the monitoring site and a description of the land uses in the surrounding areas,

- A description of the dominant and background noise sources at the site,

- Day, evening and night background levels for each day of the monitoring period,

- The final L_{A90} values, using the RBL method set out in the NSW INP

- Graphs of the measured noise levels for each day should be provided,

- A record of periods of affected data (due to rain and/or extraneous noise), methods used to exclude invalid data and a statement indicating the need for any re-monitoring under Step 1 in Section B1.3 of the INP.

- A statement qualifying the effectiveness of the microphone windshield protection for the range of wind speeds under consideration in the noise assessment.

Conduct noise monitoring to determine whether existing traffic noise levels already exceed the environmental noise level criteria at some locations. Measurement procedures must be in accordance with Section C4 of the ECRTN. Note that all those noise descriptors that will be used in the assessment should be monitored. This may include LAeq (1hr), LAeq(15min), LAeq(9hr) and maximum noise levels, depending on the area classification and types of land use involved.

iii) **Assess environmental impacts**

Determine expected noise level and noise character (eg: tonality, impulsiveness, vibration, etc) likely to be generated from noise sources during:

- site establishment
- construction;
- operational phases;
- transport including traffic noise generated by the proposal, where appropriate; and
- Other services (such as maintenance).

Determine the noise & vibration levels to be received at the most sensitive locations (these may vary for different activities at each phase of the development). Potential impacts should be determined for the range of operating meteorological conditions.

The Rating Background Level and the Project Specific Noise Level must be determined in accordance with the NSW Industrial Noise Policy.

- Describe existing surface water quality – an assessment needs to be undertaken for any water resource likely to be affected by the proposal and for all conditions (eg a wet weather sampling program is needed if runoff events may cause impacts).

Note: *Methods of sampling and analysis need to conform with an accepted standard (eg AS 5667 "Water Quality – Sampling") or be approved, and analyses undertaken by, accredited laboratories. Table A provides a listing of suggested indicators to analyse for different water quality objectives:*

Table A: Suggested indicators by water quality objectives

Objective	Suggested Indicators
Ecosystem protection	Colour and clarity; DO; nutrients, pH; salinity; temperature; SS/turbidity; metals; halogenated aliphatic compounds; monocyclic aromatic compounds; pesticides; pthalate esters; polyaromatic hydrocarbons
Recreation and aesthetics	Bacteria; algae; aesthetics; clarity; colour; pH; temperature; oil/debris; toxic chemicals
Potable water supply	Total coliforms; faecal coliforms; algae; inorganic toxicants; organic toxicants; radiology; colour; taste & odour; turbidity; hardness; DO; pH; major ions; heavy metals and trace ions
Irrigation	Faecal coliforms; algae; major ions; heavy metals and trace ions; pesticides; and radioactivity
Livestock watering	Faecal coliforms; algae; major ions and nutrients; trace elements; pesticides; radioactivity; toxicants
Industrial water supply	Depends on industry type but usually includes pH; colour; hardness; taste; major cations; major anions; suspended solids

- Provide historic river flow data where available for the catchment.
- Provide site drainage details and surface runoff yield.
- Describe the condition of the local catchment eg erosion levels, soils, vegetation cover, etc.
- Outline baseline groundwater information, including, but not restricted to, depth to watertable, flow direction and gradient, groundwater quality, reliance on groundwater by surrounding users and by the environment.

ii) Assess environmental impacts

- Identify and estimate quantity of all pollutants that may be introduced into the water cycle by source and discharge point including residual impacts after mitigation measures are implemented.
- Describe full details of water management on the site including full details of the controlled catchments, clear water by-passes, stormwater management, discharge points, likely range of flow rates and pollutant concentrations that may be released into the environment including residual impacts after mitigation measures are implemented, for example from waste storage and treatment areas, chemical storage and transport areas.
- Provide details and assessments of the project relevant to any water impacts (both surface and groundwater) of the development such as drainage works and associated infrastructure; land forming and excavations; working capacity of structures and water resource requirements of the proposal.
- Describe the effects and significance of any pollutant loads on the receiving environment.

- Determine changes to hydrology (including drainage patterns, surface runoff yield, flow regimes, wetland hydrologic regimes and groundwater)
- Describe water quality impacts and their significance resulting from changes to hydrologic flow regimes (such as nutrient enrichment or turbidity resulting from changes in frequency and magnitude of stream flow).
- Identify any potential impacts on quality or quantity of groundwater describing their source and significance.
- Identify potential impacts associated with geomorphological activities with potential to increase surface water and sediment runoff or to reduce surface runoff and sediment transport. Also consider possible impacts such as bed lowering, bank lowering, instream siltation, floodplain erosion and floodplain siltation.

Note: The assessment of water quality impacts needs to be undertaken in a total catchment management context to provide a wide perspective on development impacts, in particular cumulative impacts.

iii) Management and mitigation of environmental impacts

- Outline pollution control measures including,
  - Stormwater management at the source to contain pollutants on site
  - Sediment and erosion control measures,
  - Waste water management appropriate to the type and volume of waste water based on hierarchy of avoiding generation, capturing contaminated water including stormwater, reuse/recycling and treating any unavoidable discharge,
  - Storage of materials, possible accidental spills, appropriate disposal methods

E5 Land Capability

- Describe the soil landscapes of the site and define the individual agronomic management units of any areas that may be used for waste utilisation.
- Assess the capability of the soils to sustainably assimilate any water irrigated from the premises

E6 Soil contamination issues

- Identify any likely impacts resulting from the construction or operation of the proposal – this should include the likelihood of:
  - disturbing any existing contaminated soil;
  - contamination of soil by operation of the activity;
  - subsidence or instability;
  - soil erosion;

E7 Waste and chemicals

The EIS must identify and discuss the following points relating to waste resulting from the development:

- The quantity and type of both liquid and non-liquid waste generated, handled, or disposed of at the premises or off site;

- The method for disposing of all wastes or recovered materials at the facility;

- The method of treating or handling all wastes from the facility prior to disposal/reuse to ensure that the system is sustainable and does not pollute surface or groundwaters;

- The emissions arising from the handling, storage, processing and reprocessing of waste

- The proposed controls for managing the environmental impacts of these activities;

- Quantifying all wastes to be removed from the premises and outlining where each will be treated or disposed of;

- Provide contingencies for waste disposal should on-site treatment facilities not be available or fail to perform to the required standards of environmental protection.

- Assess the adequacy of proposed measures to minimise natural resource consumption and minimise impacts from the handling, transporting, storage, processing and reprocessing of waste and/or chemicals.

- Outline measures to avoid the generation of waste and promote the re-use and recycling and reprocessing of any waste.
- Outline measures to support any approved regional or industry waste plans.

F. Compilation of mitigation measures

- Outline how the proposal and its environmental protection measures would be implemented and managed in an integrated manner so as to demonstrate that the proposal is capable of complying with statutory obligations under EPA licences or approvals (eg outline of an environmental management plan).

- Outline any proposed approach (such as a Management Plan) that will demonstrate how commitments made in the EIS will be implemented. Areas that should be described include:
  - operational procedures to manage environmental impacts;
  - monitoring procedures;
  - training programs;
  - community consultation;
  - complaint mechanisms including site contacts;
  - strategies to use monitoring information to improve performance;
  - strategies to achieve acceptable environmental impacts and to respond in event of exceedences.

- The mitigation strategy should include the environmental management and cleaner production principles which would be followed when planning, designing, establishing and operating the proposal. It should include two sections, one setting out the program for managing the proposal and the other outlining the monitoring program with a feedback loop to the management program.

H. Justification for the Proposal

- Reasons should be included which justify undertaking the proposal in the manner proposed, having regard to the potential environmental impacts.

J List of Approval and Licenses

The EIS must clearly identify all licensing requirements required under the *Protection of the Environment Operations Act, 1997.* (POEO).

Schedule 1 of POEO lists activities and facilities that require an Environment Protection Licence from the EPA.

MINERAL RESOURCES NEW SOUTH WALES
NSW DEPARTMENT OF MINERAL RESOURCES
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Mr. Tim Ward
Environmental Planning Officer
Major Development Assessment
Planning NSW
GPO Box 3927
SYDNEY
NSW 2001

Dear Tim

RE : Galong Kiln EIS Requirements

I refer to Planning's letter dated the 8th May 2003 requesting EIS requirements for the above project.

The project is to be located on an existing mining lease and therefore the Mining Act & mining lease conditions & amendments will cover operation & environment management. As mentioned in the minutes of the Planning Focus meeting there is a unique relationship between the Mining Act and the Environmental Planning and Assessment Act. This relationship is outlined in attachment "A".

Also under the Mining Act and mining lease conditions the project will be subject to the *Guidelines to the Mining, Rehabilitation and Environmental Management Process (MREMP)* which incorporates the Mining Operations Plan (MOP) and Annual Environmental Management Report (AEMR). A copy of the MREMP guidelines is enclosed as Attachment "B".

Department of Mineral Resources safety operations branch will also manage OH&S matters during project construction and operation. The project will be conducted in accordance with the Mines Inspection Act 1901 and General Rule 2000. Reference to all electrical & mechanical matters associated with the design and construction are required. One month prior to construction Blue Circle Southern will be required to present an outline how they intend to manage the construction phase of the project. Reference to what Safety Management Systems will be in place is essential.

Attachment "C" outlines the Department's general EIS requirements.

If you have any questions regarding the contents of this correspondence please feel free to contact me on (02-63926352) or (0408-669869).

Yours faithfully

Greg Unwin for
Director General
Monday, 19 May 2003

Division 2 of Part 2 of Schedule 1 of the Mining Act (1992) pages 207-209

Division 2 Notification of councils etc. where development consent required for mining

12 Application of Division

This division applies:

(a) in relation to a mining lease for a mineral or minerals, to land for which development consent is required before the land may be used for the purpose of obtaining minerals, and

(b) in relation to a mining lease for a mining purpose or mining purposes only, to land for which development consent is required before the land may be used for that purpose or those purposes.

13 Notification of applicant and council

(1) Before granting a mining lease (whether by tender or otherwise) over land to which this Division applies, the Minister:

(a) must cause a written notice to be served on the applicant or tenderer requiring the applicant or tenderer, on or before the date specified in the notice, to apply to the appropriate consent authority for development consent to the use of the land for the purpose of obtaining minerals, and

(b) must cause a written notice to be served on the consent authority concerned informing the authority:

(i) that the applicant or tenderer has been required to apply for development consent, and

(ii) that proposals for the inclusion in the mining lease of conditions **(including special purpose conditions)** which the authority wished to have included in the lease should be lodged with the Director-General on or before such date as is specified in the notice.

(2) This clause does not apply:

(a) in relation to a mining lease for a mineral or minerals, to the granting of the mining lease over land in respect of which a development consent to the use of the land for the purpose of obtaining minerals is in force, or

(b) in relation to a mining lease for a mining purpose or mining purposes only, to the granting of the mining lease over land in respect of which a development consent ot the use of the land for that purpose or those purposes is in force.

14 Consent of landowner not necessary in application required by this Division

Any requirement of the Environmental Planning and Assessment Act 1979 that an application for development consent be accompanied by the consent of the owner of the land concened does not apply to an application under this Division.

15 Definition

In this Division:

Special purpose condition means a condition concerning:

(a) the preparation of land for mining, or
(b) the mining methods to be employed while mining operations are being carried on, or
(c) the **rehabilitation*** of land, either while mining operations are being carried on or after they have ceased, or
(d) the safety measures to be adopted, either before mining operations are commenced, while they are being carried on or after they have ceased, or
(e) the security to be given with regard to the performance of any matter referred to in paragraph (a), (b), (c) or (d).

*The definition of "the rehabilitation of the land" covers the surface and the land to the depth of mining. This allows the Minister for Mineral Resources to impose conditions relating to environmental issued within a mining title and which has been damaged or adversely affected by prospecting or mining operations.

The Inter-Relationship Between the Mining Act (1992) and Environmental Planning & Assessment Act (1979) (EP&A Act)

by
Mr Mark Brennan
Blake Dawson Waldron – Lawyers
17th April 2003

1. The interaction of the provisions on the Mining Act (section 65 and 74 in particular) with the provisions of the EP&A Act operate to create a legislative scheme which treats mining as a special category of development. Significantly, once development consent has been obtained as a prerequisite of the grant of a mining lease, this scheme operates to remove mining activities authorised under that lease from the ambit of the EP&A Act.

2. The Mining Act (through sections 65(1) and (2) in particular) requires planning consent to be obtained prior to the grant of a mining lease. Where such consent is procured for the purpose of obtaining minerals, the Mining Act exerts paramountcy over the EP&A Act through two key provisions, namely sections 65 and 74.

3. That paramountcy is evident, first where the provisions of section 65(3) of the Act operate in respect of conditions imposed under Part 4 of the EP&A Act by a consent authority on a development consent where the conditions trespass into subject matter concerning the preparation of land for mining, mining methods, land rehabilitation, safety measures and the security to be provided with regard to the performance of any of the aforementioned matters. Conditions of a development consent invading such subject matter are characterised as "special purpose conditions" under the Mining Act (see section 65(3) and clause 15 in Schedule 1 of the Act). Such conditions are not only void, but a development consent is taken to have been given free of those conditions.

4. The second key provision in the mining legislation establishing its paramountcy is section 74. This provision operates from the time at which the mining lease is granted and for a long as it has effect.

5. Section 74 relevantly states:

74(1) While a mining lease has effect:

(a) nothing in, or done under, the Environmental Planning and Assessment Act 1979 or an environmental planning instrument operates so as to prevent the holder of the mining lease from carrying on mining operations in the mining area, and

(b) To the extent to which anything in, or done under, that Act or any such instrument would so operate, it is of no effect in relation to the holder of the mining lease

(2) .....

(3) This section does not exempt the holder of a mining lease from obtaining any consent under the Environmental Planning and Assessment Act 1979 that the person is required to obtain in connection with the erection of buildings, the opening of roads or the subdivision of land.

6. Section 74 is a clear statement of a legislative intent to ensure that mining is unaffected by the EP&A Act, save for the erection of buildings, the opening of roads or the subdivision of land, once due process has been followed under Part IV of that Act.

MINERAL RESOURCES NEW SOUTH WALES

Environmental Management Guidelines for Industry

GUIDELINES TO THE MINING, REHABILITATION AND ENVIRONMENTAL MANAGEMENT PROCESS

This guideline describes the mining, rehabilitation and environmental management process to ensure the satisfactory environmental and rehabilitation performance of mines in New South Wales. It provides an acceptable format for the preparation of Mining Operations Plans and Annual Environmental Management Reports for mines.

It replaces

Guidelines to The Mining, Rehabilitation And Environmental Management Process: DOC: 080600001.gui Issue 2 Revision 5 dated February 1998

Guidelines for the preparation of Mining Operations Plans (MOP): DOC: 080600002.gui Issue 2 Revision 4 dated February 1998)

Guidelines for the Preparation of Annual Environmental Management Reports (AEMR) DOC: 080600003.gui Issue 2 Revision 5 dated February 1998

Annual Rehabilitation Report Form Open Cut Mines DOC: 080600003.rec1 Issue 2 Revision 2 dated March 1998

Annual Rehabilitation Report Form Underground Mines DOC: 080600003.rec2 Issue 2 Revision 1 dated December 1996

Statutory Declaration DOC: 08060003 Rec2 Issue 1 Revision 2 dated May 1997

CONTENTS

AN OVERVIEW OF MINING, REHABILITATION AND ENVIRONMENTAL MANAGEMENT

1 INTRODUCTION

Under the Mining Act 1992, environmental protection and rehabilitation are regulated by conditions included in all mining leases, including requirements for the submission of a Mining Operations Plan (MOP) prior to the commencement of operations, and subsequent Annual Environmental Management Reports (AEMR).

Collectively, the MOP and AEMR constitute the Mining, Rehabilitation and Environmental Management Process (MREMP) which has been developed by the Department of Mineral Resources. The MREMP aims to facilitate the development of mining in New South Wales and to ensure that all mining operations are safe, the resources are efficiently extracted, the environment is protected and rehabilitation achieves a stable, satisfactory outcome.

2 SCOPE

This guideline introduces the Mining, Rehabilitation and Environmental Management Process of the NSW Department of Mineral Resources. It describes:

- the approval process which enables mining in NSW;
- the role of the leaseholder in preparing and lodging Mining Operations Plans and Annual Environmental Management Reports;
- the manner in which the Department responds to the documents lodged.

3 MINE APPROVAL PROCESSES

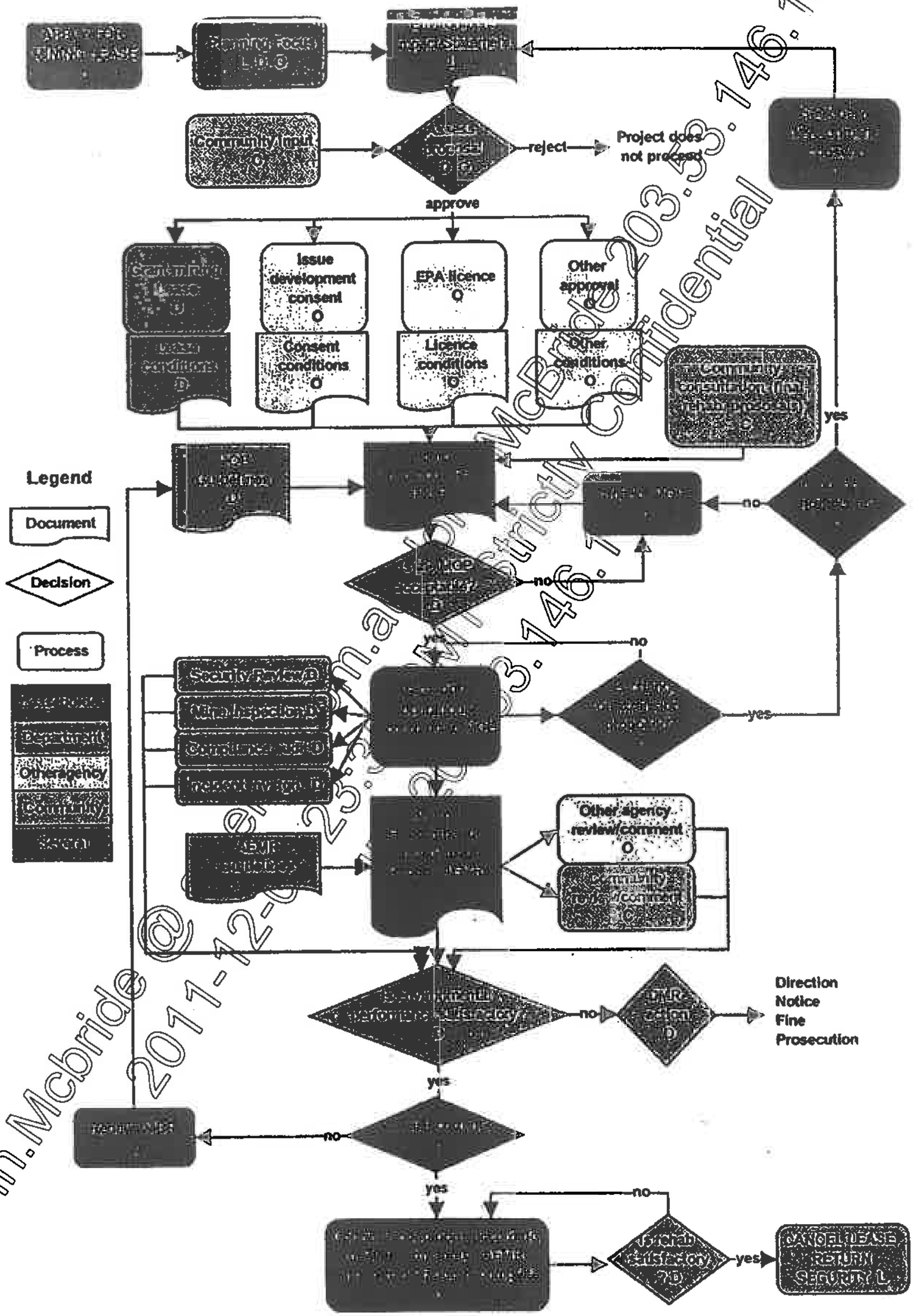
In New South Wales, a title must be obtained from the Department of Mineral Resources under the Mining Act 1992 before anyone can prospect, explore for or mine publicly owned minerals, whether on Crown or private land. Before a mining title can be granted by the Department, development consent must be obtained under the Environmental, Planning & Assessment Act and its regulations. The approval authority will generally be the local council, or for large mines and "projects of state significance", the Minister for Urban Affairs and Planning.

Development consent may be given and a mining lease granted for mines and major expansions to existing mines following consideration of an Environmental Impact Statement (EIS) written by or on behalf of the proponent. The EIS is based on a plan for the whole of the expected life of the mine. Before the commencement of any mining activity, a number of other approvals and licences may also be required. These approvals or licences and the agencies involved may include:

- an environment protection licence from the Environment Protection Authority;
- dam design and management practices acceptable to the Dams Safety Committee;
- a water licence from the Department of Land and Water Conservation;
- a threatened species management plan endorsed by the National Parks and Wildlife Service;
- for coal mining, there are also subsequent approvals issued by the Department for open cut mining, waste emplacements, and second workings (pillar extraction and long wall mining) for underground mines.

Figure 1 shows these processes as a flow sheet.

FIGURE 1. CONCEPTUAL FLOWSHEET: ENVIRONMENTAL MANAGEMENT OF OPERATING MINES



4 THE DEPARTMENT'S MINING, REHABILITATION AND ENVIRONMENTAL MANAGEMENT PROCESS (MREMP)

The Department's MREMP is based on conditions of mining leases which require the leaseholder to prepare documents *"in accordance with the Director General's guidelines current at the time of lodgement"*. Documents required are:

- a Mining Operations Plan (MOP) which describes the manner in which the leaseholder proposes to conduct mining, processing and rehabilitation consistent with development consent, and the conditions imposed by the Department and other agencies;
- an Annual Environmental Management Report (AEMR) which reports on the performance of the leaseholder and "fine tunes" the MOP.

These documents provide:

- a management tool for all operations within the mine;
- a means of identifying and managing the significant mining, rehabilitation and environmental aspects of the mining operation;
- a means of assessing environmental and rehabilitation performance
- a basis for estimating rehabilitation requirements and the amount of security required by the Department;
- an efficient and systematic framework for interaction between government agencies

If activities are proposed which are not consistent with the current MOP, activity descriptions, with revised plans and supporting documents as necessary, should be provided to the Department. The descriptions and plans should be consistent with the MOP format and guidelines and will be treated as a variation to the MOP. Changes in proposed activities may be dealt with as part of the AEMR and annual review process

The MREMP process facilitates a flexible response to changing circumstances. It can accommodate variations to schedules and processes proposed in the MOP, ongoing development and refinement of final rehabilitation plans, changes imposed by regulatory authorities and boards, and opportunities to improve environmental and operational management strategies. It cannot, however, override the scope and conditions of development consent, the mining lease, or any other statutory approvals or licences.

The Department of Mineral Resources is responsible for overseeing MOPs and AEMRs, for coordinating the involvement of other relevant government authorities, and for ensuring that mining operations and rehabilitation are carried out in accordance with the lease conditions and MOP objectives. Other management tools which may be used by the Department are:

- inspections including annual inspections coinciding with AEMR review;
- inspections and responses to complaints and incidents;
- establishment of committees, sometimes including stakeholder representations, to review environmental performance and the AEMR;
- environmental performance and compliance audits of selected mines;
- security bonds at all mines sufficient to meet the costs of outstanding rehabilitation.

5 THE MINING OPERATIONS PLAN (MOP)

Mining operations must not be undertaken other than in accordance with a MOP that has been accepted by the Department. The MOP must address the mining, processing, and rehabilitation operations necessary to comply with the Department's statutory responsibilities. These responsibilities are expressed in the Mining Act (1992), the Department's published policies, and specific conditions attached to each mining title. Proposed operations must be consistent with development consent, all other government agency approvals and licences, as well as with mine safety regulations and mine safety plans. The MOP must apply best available practice and technology to all aspects of mine operations and include strategies to control identified environmental risks.

The period of a MOP may be for a maximum of seven years or, if convenient to both the Department and the Leaseholder, an agreed lesser period.

The MOP describes all mining and mining related activities, rehabilitation plans and land use outcomes over the MOP period. The MOP must be in a format endorsed by the Department, and must contain plans and text which identify and define:

- area(s) proposed to be disturbed;
- mining and rehabilitation method(s) to be used and their sequence;
- existing and proposed surface infrastructure;
- progressive rehabilitation schedules;
- areas of particular environmental sensitivity;
- land and water management systems;
- proposed resource recovery.

Premature cessation of mining will require either a "care and maintenance plan" or a "mine rehabilitation and closure plan" prior to Ministerial approval of suspension of mining. This plan should be prepared using the MOP format with additional information where needed for consistency with the *"Strategic Framework for Mine Closure"* published by the *Australian and New Zealand Minerals and Energy Council,* and the *Minerals Council of Australia.*

The MOP is to be prepared using the format described in this guideline. Copies of the format are also available from the Department's web site, or the Department's Environmental Officers. . An abbreviated form based format may be used for small mines with low environmental risks. MOPs prepared under the previous guidelines will remain in place for the term of that MOP and will not need re-writing.

The MOP must be accompanied by a statutory declaration confirming the rights of the leaseholder to carry out the operations proposed, verifying they are consistent with all consents and conditions.

To be acceptable, a MOP must:

- meet the Department's content and format guidelines for MOP documents:

propose operations which:

- are consistent with the Environmental Impact Assessment, and any other document, on which approval and grant/renewal of the lease was based;
- are consistent with conditions imposed through approvals, mine leases and licences issued by the Department and other agencies;
- are consistent with the mine safety management plan;
- include progressive rehabilitation to the greatest practical extent;

propose rehabilitation which at least meets the Department's generic rehabilitation criteria:

- provides stable and permanent landforms;
- is suitable for an agreed subsequent land use;
- is sustainable in terms of the proposed use,
- does not have maintenance needs greater than the surrounding land;
- has no adverse environmental effects outside the lease area;

and:

- is based on plans and outcomes developed with stakeholder involvement;
- has outcomes consistent with commitments made in the EIS and any other document on which approval and grant of lease was based ;
- provides objective criteria to establish whether rehabilitation objectives have been met;
- has outcomes which are demonstrably achievable through experience in comparable situations or through site trials/research;

- is consistent with the *"Strategic Framework for Mine Closure"* published by the *Australian and New Zealand Minerals and Energy Council*, and the *Minerals Council of Australia*.

Details of operations and rehabilitation in the plan should also;

- identify risks associated with each activity;
- propose environmental control strategies to satisfactorily manage identified risks;
- include environmental monitoring to verify effectiveness of control strategies;
- follow recognised industry and government agency best practice guidelines and best available technology.

For MOPs which do not include the final rehabilitation and closure phase of a mine, rehabilitation beyond the scope of the presented MOP may be dealt with as concepts rather than in detail. It must describe the consultation and trial/research pathways through which final closure outcomes will be developed and achieved.

The Department will review the MOP as presented and respond within 2 months of lodgement. Review may involve sending parts of the MOP to other agencies for comment and advice. If not considered satisfactory, the MOP may be returned to the leaseholder for amendment.

A copy of the MOP will be made available for viewing by members of the public in the Department's offices. Commercially sensitive information should be clearly identified and will be withheld from public view.

6 THE ANNUAL ENVIRONMENTAL MANAGEMENT REPORT (AEMR)

The AEMR consolidates Government reporting requirements relating to environmental management and rehabilitation of mines by addressing:

a) The current status of:
- approvals;
- leases;
- licences;
- environmental risk management and control strategies;

b) For the previous 12 month period:
- mining, mine development, and rehabilitation in relation to the MOP;
- environmental performance in relation to the collective conditions of approvals, leases and licences;
- community relations and liaison.

c) It also looks to the next 12 months by:
- proposing improvements in environmental performance and management systems;
- specifying environmental and rehabilitation targets to be achieved.

The AEMR is to be prepared using the format described in this guideline. Copies of the format are also available from the Department's web site, or the Department's Environmental Officers. An abbreviated form based format may be used for small mines with low environmental risks.

All mines are to submit an AEMR report every year regardless of the level of activity. For a mine which has been inactive during the AEMR period, reporting requirements may, in most circumstances, be met by submission of the tables of the AEMR with a covering letter stating there have been no site activities.

The reporting period for an AEMR will have been set either as part of the Department's letter of response to a MOP or its response to the previous AEMR. Generally the AEMR must be submitted within 28 days of the end of the reporting period.

The Department's responds will depend upon the degree of other agency involvement, the environmental sensitivity of the site, the most recent site visit or inspection, and the previous performance of the mine operator. The Department may:

- organise a site inspection and integrated review of the AEMR involving other government agencies. Agencies may include the Environment Protection Authority, Department of Land and Water Conservation, local council, National Parks and Wildlife Service, and any other agencies with a statutory interest in the site;
- review the AEMR in conjunction with a site visit, from officer(s) of the Department without the involvement of other agencies;
- undertake desk review relying on a recent previous site visit for site specific information.

Following the review, the Department will provide a written response which may:

- comment on the adequacy or otherwise of the report as provided;
- address the adequacy of environmental and rehabilitation performance over the reporting period;
- comment or make recommendations on quality improvement and application of best practice;
- issue a direction to undertake specific operations, remedial actions, or supplementary studies;
- issue a direction to address non-compliances with conditions of the mining lease which have been identified in the AEMR or subsequent review and inspection.

To be acceptable, an AEMR must meet the Department's content and format guidelines for AEMR documents

Environmental performance, as documented by an AEMR will be evaluated using the following criteria:

- **For mining operations** disturbance of land as proposed in the accepted MOP, progressive rehabilitation of land according to the MOP rehabilitation schedule, conduct of operations using methods proposed in the MOP, and compliance with environmental conditions of all consents, leases and licences, including reporting requirements;
- **At final rehabilitation and mine closure:** demonstrably meeting all mine closure and rehabilitation commitments.

The AEMR may be made available for viewing by members of the public at the Department's offices.

For further information contact www.minerals.nsw.gov.au; tel. (02) 9901 8888, or Email ems@minerals.nsw.gov.au

Guidelines and Format for Preparation of a Mining Operation Plan

Documents should be completed using the headings and tables of this guide. As this guide applies regardless of the stage in the mine life cycle and the nature of operations, there may be some sections which are not relevant to a specific mine site. These should be noted as not applicable. Copies of the format are available from the Department's web site, or the Department's Environmental Officers. At the discretion of the Department, these guidelines may be adapted to suit the specific circumstances of a mine site or mine operator. An abbreviated form based format may be used for small mines with low environmental risks. Unless otherwise advised, three copies of the MOP should be lodged with the Department. One will be stamped for verification and returned to the leaseholder

1 TITLE BLOCK

Name of mine			
Mining Titles/Leases			
MOP Commencement Date	/ /	**MOP Completion date (nominal)**	/ /
Name of leaseholder			
Name of mine operator (if different)			
Reporting Officer			
Title			
Signature		....	
Date			

2 EXAMPLE CONTENTS PAGE

PLANS

1 Mine and Context
2 Pre MOP Environment
3 Land Preparation
4 Mining Activities
5 Rehabilitation
6 Final Rehabilitation
7 Vertical Sections

SUPPORTING TEXT **Page**

1 Introduction
2 Pre MOP Environment
3 Mining Activities
4 Rehabilitation
4 Final Rehabilitation
6 Environmental and Rehabilitation Risk Identification
7 Environmental Management Controls

TABLES

1 Provisional Production and Waste Schedule
2 Summary of Proposed Rehabilitation
3 Environmental Risk Identification Matrix
4 Environmental Management Controls

ATTACHMENTS

- Statutory Declaration
- Management plans required by condition of mining lease, licences or development consent (name and list individually)
- Aerial photograph of site (if available)
- Other attachments as appropriate

3 PLAN GUIDELINES

Base Plans and Scale

Plan sets may be based on survey or rectified aerial photographs or orthophoto maps. Except for *Mine Site and Context (Plan 1)* all plans must be of same scale to enable ready comparison. Plans 1 to 5 may be combined provided that information remains clear.

Mine lease holders without access to surveyed plans, and less than 10 hectares total disturbance may derive plans from a convenient base map/plan with activity areas and features drawn by hand provided there is sufficient accuracy and detail to adequately describe activities and their impact. If contours are not shown, slopes and drainage lines must be clearly marked.

All plans must show

- the name of the mine
- a graphical scale
- grid lines
- surface contours (not required for Plan 1A or for small mines)
- a title block showing the date of preparation of the plan, title and number and the name, and
- vertical sections must include the vertical exaggeration
- signature of the surveyor or person responsible for the plan

Colour Coding And *Symbols*

(hand shading is acceptable where document preparation facilities are limited)

- Mine lease boundaries ....firm black line
- *(Coal mines only)* leasehold boundary ....dash-dot(____ . ____) black line.
- *(Coal mines only)* colliery holding boundary.......firm black line.
- Sublease boundaries dash-dash-dot-dot "(____ ____) black line
- Areas disturbed by mining, (prior to this MOP)......purple shading or edging
- Areas disturbed by infrastructure ....yellow shading. including mine wastes (prior to this MOP)
- Ore/coal extraction areas (this MOP)...................Red shading or edging.
- Other areas to be disturbed (this MOP)................dark blue shading or edging.
- Areas to be rehabilitated (this MOP)....................dark green shading or edging
- Emplacement areas to be shaped..........................light brown shading.
- Emplacement area not to be shaped......................orange shading.
- Water Management Structures
  ....Clean water ....dotted light blue line/shading
  ....Dirty water (sediment) ....broken dash light blue line/shading
  ....Controlled discharge water ....dot dash light blue line/shading
  ....Contaminated water ....solid light blue line/ shading

Scale

The scale should show sufficient detail to review operations and rehabilitation. For a typical large open cut strip mine, suitable scales may be: plan 1A, 1:25,000; other plans, 1:4,000. Contour intervals for open cut coal mines may be 5 metres. In some circumstances, contour intervals of 1 metre or less may be necessary to show an appropriate level of detail. For a mine site with separated areas of activity, separate plans of each activity area may be suitable provided that the *Mine Site and Context (Plan 1A)* shows the relationship of all separate areas.

4 PLANS REQUIRED

Plan 1: Mine and Context

Show the context and surrounding features of the mine site:

- boundaries of leases, holdings and subleases;
- cadastral information (land ownership boundaries);
- natural features including swamps, rivers, creeks, streams or watercourses;
- proposed extraction areas (this MOP);
- other disturbed areas (this MOP);
- boundaries of other plans of this MOP (if of different scale);
- site access and relationship to the nearest main road and town;
- neighbouring residences, within and adjacent to the mine holding/lease area;
- areas disturbed or rehabilitated prior to this MOP.

Plan 2: Pre MOP Environment

Show the status of the site at the commencement of the MOP term:

- proposed extraction areas and other areas to be disturbed during this MOP and the mine life
- vegetation community boundaries;
- land use boundaries; e.g. cropping, pasture, forest, undisturbed flora/fauna habitat;
- rural land capability classification (RCC), obtained from maps published by the Department of Land and Water conservation or agricultural capability;
- natural features including swamps, rivers, creeks, streams or watercourses;
- flood prone land (1:100 year event);
- existing developments including roads, fences, transmission lines, derelict mines/mined land;
- buildings, dams, pipelines, water management structures and other substantial improvements;
- areas containing threatened flora and fauna habitat;
- Aboriginal, heritage and archaeological sites;
- any other areas of particular environmental sensitivity.

Plan 3: Proposed Land Preparation

For all areas to be disturbed during the MOP term show the proposed:

- outline of areas to be stripped of topsoil, including surface mining, waste emplacements, and any other infrastructure areas to be stripped;
- soil test pit sites;
- soil type boundaries and depths of areas to be stripped;
- vegetation stacking or disposal areas;
- topsoil stockpiling areas.

Plan 4: Proposed Mining Activities

As at the commencement of the MOP term, show:

- the extent of all mining, mineral processing, waste emplacement, ore/product stockpile, water management structures, other infrastructure features and rehabilitation.

For the end of the MOP term, show the proposed:

- extent of all mining;
- mineral processing plant;
- waste emplacements;
- ore/product stockpiles;
- water management structures;
- clean, dirty (sediment laden) and contaminated water containments and pathways;
- hazardous material storage areas;

- location and extent of disturbance from exploration activities;
- all feature relevant to other agency licences or approvals;
- all other infrastructure features;
- any disturbed areas not described above
- water monitoring sites.

Plan 5: Proposed Rehabilitation

For the end of the MOP term, show proposed:

- active mining areas, active waste emplacements, active tailings emplacements, infrastructure, land under rehabilitation and its status as one of "shaped and covered", "rehabilitated and under maintenance, "rehabilitation complete";
- water management containment and control structures for rehabilitated land;
- soil covered rehabilitated areas identified according to slopes; 10 degrees to 18 degrees, >18 degrees.

Plan 6: Final Rehabilitation for Lease Relinquishment

Show anticipated final

- natural features including swamps, rivers, creeks, streams or watercourses;
- areas affected by mining or mining purposes by nature of disturbance during the mine life;
- soil covered rehabilitated areas identified according to slopes; 10 degrees to 18 degrees, >18 degrees;
- remaining voids/pits;
- vegetation type, fauna habitat, land use, and rural land capability classification boundaries and status of all disturbed and undisturbed areas;
- re-created areas containing threatened species and fauna habitat;
- integrated landscape features, which show how or whether rehabilitated areas of native vegetation link with undisturbed native vegetation to provide larger areas and wildlife corridors;
- rural land capability classification (RCC), or agricultural capability;
- constructed drainage lines, water control structures, and water supply dams;
- infrastructure to remain on site after mine closure;
- features pertinent to other agency licences, approvals of other government agencies or their relinquishment;
- fences, bunds and other public, fauna/ and stock safety features.

Sections

Vertical and longitudinal sections should be selected to support and clarify plans and supporting text. They should describe the mine sections, the vertical extent of mining, emplacement shapes and sections - including:

- cover layers;
- environment control features;
- water management structures;
- features to protect rehabilitated areas and areas under rehabilitation.

For coal mines, sections at right angles to the direction of mining at intervals of 1000 m would be appropriate. Unless highly irregular in shape, two sections at right angles should be sufficient for most other mines, waste emplacements and infrastructure features.

5 HEADINGS, SUPPORTING TEXT, AND TABLES

1. INTRODUCTION

1.1 History of Operations:

Give a brief history of previous mining operations, previous MOPs submitted. Provide only sufficient information to give a context to the MOP.

1.2 Proposed and Future Operations:

Outline the objectives, scope, and benefit of operations proposed in the MOP.

Briefly outline possible operations and mine life beyond the MOP period within the mining lease according to the current development consent.

1.3 Consents Leases and Licences

List, and show the date of grant and duration of, all mining leases, sub-leases, Development Consents, and all other approvals and licences issued by Government Agencies, including for approval to operate, environmental protection, hazardous materials, water use, threatened species, and dam safety. If not previously supplied, copies of conditions should be forwarded to the Department. Where development consent is not held, a copy of the document which establishes that it is not required should be forwarded to the Department.

1.4 Mine Contacts

Supply name and contact details of the Mine Manager and Environmental Manager.

1.5 Mine Geology

Briefly describe known mine geology, proven and indicated reserves, constraints affecting mine design, and provisional ore cut off grade. This is not required for a mine in its post mining rehabilitation phase or where further mining is unlikely.

1.6 Land Ownership

Provide a schedule of land ownership, occupancy, and title over the lease area consistent with Plan 1.

1.7 Consultation

Outline the results of consultations undertaken with stakeholders in developing this MOP. Stakeholders may include other government agencies, the community, landowners, and Aboriginal groups.

2. PRE MOP ENVIRONMENT

Describe significant features shown on *Pre-Mining Environment (Plan 3).* List threatened flora, and fauna, archaeological sites.

3 PROPOSED MINING ACTIVITIES

3.1 Exploration

Describe exploration activities scheduled for the MOP period, and the extent to which they will disturb the land surface.

3.2 Land Preparation

Describe features shown on *Land Preparation (Plan 2)*. Include soil types and characteristics, soil profile and depth to be stripped, methods of disposal and/or storage of vegetation, and soil stockpile management.

3.3 Construction

Describe mine construction scheduled for the MOP period as shown on *Mining Activities (Plan 4)*. Describe layout and where relevant, design criteria. Sufficient detail need only be provided to give a context to environmental and rehabilitation management.

3.4 Mining

Describe mine features shown on *Mining Activities (Plan 4)*. Describe mine layout and where relevant, design criteria. Briefly describe the method(s) used and the sequence of working. Justify the type of mining in the context of minimising sterilisation of mineral resources. List the proposed mining equipment fleet. Sufficient detail need only be provided to give a context to environmental and rehabilitation management. Separate more detailed plans should be kept for mine record purposes and for inclusion in due course in mine lease relinquishment report, but need not form part of the MOP.

3.5 Mineral Processing

List and briefly describe mineral processing infrastructure shown on *Mining Activities (Plan 4)*. Describe minerals processing undertaken and provide a schematic flowchart of mineral processing for complex processes.

3.6 Waste Management

The location proposed for mining and processing waste emplacements should be discussed in the context of minimising or avoiding sterilisation of resource. Describe each waste facility shown on *Mining Activities (Plan 4)* including:

- dimensions and status at the commencement of the MOP period;
- proposed dimensions and status at the end of the MOP period;
- chemical and physical characteristics of waste;
- the method of waste emplacement;
- material segregation strategies within emplacements.

3.7 Ore and Product Stockpiles

Describe each ore and product stockpile area shown on *Mining Activities (Plan 4)*. List the typical, maximum, and minimum stockpile amounts. Describe the physical and chemical characteristics of each stockpile.

TABLE 1: Provisional Production And Waste Schedule

		Provisional Cumulative Production during MOP Term						
ITEM	Unit	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Stripped top soil	cum							
Waste rock	cum							
Ore	cum							
Processing waste	cum							
Product								

3.8 Water Management

Classify water containment or control/diversion structures shown on *Mining Activities (Plan 4)* as "clean", "dirty", "controlled discharge", or "contaminated" (see definitions).

Describe structures shown on *Mining Activities (Plan 4)*. Provide dimensions, storage capacity, characteristics of water to be contained. Also list annual volumes used or produced, and the extent to which volumes depend upon climate, production or other factors.

In combination, plan 4 and the supporting text should make it clear how water flows, is collected/retained, and is distributed/released for the whole of the mine site.

Descriptions of water management structures and their use which form part of a licence or approval from the EPA, DLWC or Dam Safety Committee, need not be repeated in this MOP. Such licences should be referenced and attached.

3.9 Hazardous Materials

Describe and note the capacity of hazardous material storages. Provide a reference to safety data sheets and where stored. List permits obtained for hazardous material storage.

3.10 Other Infrastructure

Describe features, shown on *Mining Activities (Plan 4)* for all other infrastructure.

4 PROPOSED REHABILITATION ACTIVITIES DURING THE MOP TERM

Rehabilitation aspects of a MOP should be progressively developed and implemented from the commencement of mine life according to the "Strategic Framework for Mine Closure" developed by the Australia and New Zealand Minerals and Energy Council. Extracts from the "Framework" outlining stakeholder involvement and closure planning are appended to this guideline. Copies are available from the Department. Key aspects are:

- Identifying and involving stakeholders in rehabilitation planning through a pro-active approach described in the MOP;
- Inclusion of a closure plan in the initial MOP, and its ongoing revision to reflect changing circumstances;
- Closure criteria for agreed land use and environmental outcomes consistent with the EIS which formed the basis for consent and grant of lease, and subsequent stakeholder consultation.

When mining is predicted to cease in the MOP term, this section must describe in detail how closure and final rehabilitation outcomes will be achieved.

4.1 Stakeholder Consultation

Identify documents, such as the EIS, and consultations with stakeholders (landowners, community, other agencies) which have led to the proposed rehabilitation outcomes.

4.2 Rehabilitation Status at MOP Commencement

Describe the nature of disturbance, state or rehabilitated outcome, area (ha), and other features of each area of disturbed land and land under rehabilitation at the commencement of the MOP, as shown on *Rehabilitation (Plan 5)*.

4.3 Proposed Rehabilitation Status at MOP Finish

Describe the nature of disturbance, status of rehabilitated land, and other features of disturbed land and land under rehabilitation at the end of the MOP, as shown on *Rehabilitation (Plan 5)*.

4.4 Buildings

Describe buildings to be renovated or removed including their:

- nature, construction, heritage status and condition;
- health and safety issues related to renovation or removal (eg asbestos);
- contamination issues during and subsequent to renovation or removal;
- future use agreements or options;

- ongoing maintenance requirements.

4.5 Rehabilitation of Disturbed Land

For each area to be rehabilitated, describe, where relevant:

- physical & chemical characteristics of mining and processing waste of emplaced material relevant to rehabilitation;
- method of land shaping;
- characteristics of all cover material including sealing/drainage layers, subsoil/topsoil;
- thicknesses of cover layers and methods of laying and compaction;
- drainage and erosion control consistent with material characteristics or erosion risk;
- final landform profile and slopes;
- soil treatment;
- vegetation species and methods of their establishment;
- the extent to which agreed rehabilitation outcomes and land use have been met;
- maintenance activities/requirements.

TABLE 2: Summary Of Proposed Rehabilitation

		Area Affected (hectares)		
		Total Area, start of MOP	**Total Area, end of MOP**	**At mine closure** *(anticipated)*
A:	**MINE LEASE AREA**			
A1	**Mine lease(s) Area**			
B:	**DISTURBED AREAS**			
B1	**Infrastructure area (other disturbed areas to be rehabilitated at closure including facilities, roads)**			
B2:	**Active Mining Area** (excluding items B3 - B5 below)			
B3	**Waste emplacements,** (active/unshaped/in or out-of-pit)			
B4	**Tailings emplacements,** (active/unshaped/uncapped)			
B5	**Shaped waste emplacement** (awaits final vegetation)			
ALL DISTURBED AREAS				
C	**REHABILITATION**			
C1	**Total Rehabilitated area** (except for maintenance)			
D:	**REHABILITATION ON SLOPES**			
D1	**10 to 18 degrees**			
D2	**Greater than 18 degrees**			
E:	**SURFACE OF REHABILITATED LAND**			
E1	**Pasture and grasses**			
E2	**Native forest/ecosystems**			
E3	**Plantations and crops**			
E4	**Other** (include nonvegetative outcomes)			

4.6 Water Management (rehabilitated land)

Describe water containment, control and distribution structures proposed for rehabilitated land.

4.7 Other Infrastructure

Describe other rehabilitation proposed including of exploration activities, infrastructure, shafts, adits, dams, and the installation or maintenance of fences, bunds, and any other works.

4.8 Rehabilitation Trials and Research

Outline trials, research projects, and other reports which demonstrate the likely success of rehabilitation outcomes, and secure containment control and/or treatment of mining wastes. Reports must be made available on request.

5: FINAL REHABILITATION

5.1 Rehabilitated Areas and Features

Include this section whether or not final rehabilitation will be achieved in the MOP period.

Describe anticipated outcomes for mined areas, emplacement areas, dams, stockpile areas, roads and tracks, buildings, laydown areas, shafts and adits, and any other areas disturbed and to be rehabilitated during the life of the project. Agreed land use and closure criteria should be developed out of stakeholder consultation and should be demonstrably achievable. They should be consistent with the EIS which formed the basis for development consent and grant of lease, and local council land use zoning. Where they are not finalised, describe the present state of their development including options under consideration, and propose consultative strategies and/or research to do so. Issues to be considered include:

Outcomes

- agreed post rehabilitation landuse for each rehabilitated area;
- land use constraints which may have resulted from mining;
- closure criteria for land, buildings and infrastructure
- objective methods of assessing closure criteria;
- post mining rural land capability classification;
- pollution risks with strategies for managing and mitigating them;
- safety risks with strategies for managing and mitigating them;

Achievement of Outcomes

- landscape planning and landform design principles to achieve stable landforms including slopes, erosion controls, and drainage lines;
- integrated landscape features, which are compatible with surrounding landforms, and show how or whether rehabilitated areas of native vegetation link with undisturbed native vegetation to provide larger areas and wildlife corridors;
- the provisional source, thickness and compaction of cover materials to achieve the proposed rehabilitation outcomes;
- flora and vegetation to be established, including if relevant, threatened species;
- habitat for native and, if relevant, threatened fauna;
- post rehabilitation maintenance needs.

Supporting sections/plans/diagrams should be used to supplement text descriptions.

The attached extracts from the *"Strategic Framework for Mine Closure"* published by the *Australian and New Zealand Minerals and Energy Council*, and the *Minerals Council of Australia*; may be used to ensure that all relevant aspects of closure have been dealt with.

5.2 Remaining Features

Describe features shown on the *Final Rehabilitation (Plan 6)*, including infrastructure, buildings, access and roads to remain after closure.

Describe structures and methods to stabilise landforms and minimise erosion, prevent water pollution, prevent access to open pits or other hazardous locations, enhance visual amenity, preserve heritage features, and address public, stock and fauna safety.

6 ENVIRONMENTAL AND REHABILITATION RISK IDENTIFICATION

Table 3, *"Environmental Risk Identification Matrix"* is used to identify mine activities, processes and facilities which require control strategies to ensure environmental protection and compliance with conditions of lease, licence and development consent. NSW environmental legislation gives particular meanings to the terms "pollution" "threatened flora/fauna" and "contaminated land" *(see definitions p19).*

The Department's publication "Risk Management Handbook for the Mining Industry" MDG 1010 1997 provides an acceptable alternate methodology to table 3. A risk assessment which has previously been prepared as part of the EIS or the approval process may also be acceptable and referred to rather than included.

To identify risk, consideration should be given to circumstances which may trigger or exacerbate risks from: intense rain or storm events; prolonged above average rain; drought, flood and inundation, wind, earthquake, fire, equipment breakdown, human error, and accidents.

TABLE 3. Environmental Risk Identification Matrix

Available from www.minerals.gov.nsw.au as an excel file. It may be pasted as an excel object in the MOP.

	Mining Activity, Process or Facility														
Issue	Exploration	Land preparation, vegetation & topsoil stripping	All construction activities including earth moving	Mine development and mining, surface & ground	Use/maintenance of roads, tracks and equipment	Waste rock emplacement management	Mineral processing facilities and infrastructure	Ore/product stockpiling and handling	Tailings management	water management including storm event contingencies	Hazardous materials & fuel handling/spills management	Sewerage	Rubbish disposal	Rehabilitation activities	Rehabilitated land and remaining features
air pollution, dust/other															
erosion/sediment minimisation															
surface water pollution															
ground water pollution															
contaminated or polluted land															
threatened flora protection															
threatened fauna protection															
weed control & management															
operational noise															
vibration and air blast															
visual amenity, stray light															
Aboriginal heritage															
natural heritage conservation															
spontaneous combustion															
bushfire															
mine subsidence															
hydrocarbon contamination															
methane drainage/venting															
public safety															

7 ENVIRONMENTAL MANAGEMENT CONTROLS

Document environmental management and performance in terms of control strategies or Environmental Management Plans (EMP) for identified risks.

7.1 Air pollution	**7.8 Weeds**	**7.15 Bushfire**
7.2 Erosion and sediment	**7.9 Blasting**	**7.16 Mine subsidence**
7.3 Surface water pollution	**7.10 Operational noise**	**7.17 Hydrocarbon contamination**
7.4 Ground water pollution	**7.11 Visual, stray light**	**7.18 Methane drainage/ventilation**
7.5 Contaminated polluted land	**7.12 Aboriginal heritage**	**7.19 Public safety**
7.6 Threatened flora	**7.13 Natural heritage**	**7.20 Other issues and risks**
7.7 Threatened fauna	**7.14 Spontaneous combustion**	

Matters which should be taken into account in developing a control strategy include the likelihood of trigger or exacerbating circumstances, and the nature, severity and duration of the consequences. Description, either below or provided in a separate EMP, should include:

- detail of the proposed control strategy, or if it has been described in Section 4 *Proposed Mining Activities* of this MOP, a reference to that section;
- performance expectations acceptability criteria and outcomes, referenced where applicable to statute, conditions of consent or title, or commitment made in an EIS;
- a monitoring program which will establish whether or not acceptability criteria and outcomes have been met, and can evaluate performance in the context of meteorological and other circumstances;
- trigger levels for mandatory reporting to the Department or other government agencies

6 DEFINITION OF TERMS USED

Colliery Holding: A colliery holding registered under the Mining Act, 1992 for coal mining operations.

Contamination of Land is defined in the Contaminated Land Management Act (1997) as meaning "the presence in or under the land of a substance at a concentration above the concentration at which the substance is normally present in, on or under (respectively) land in the same locality, being a presence that presents a risk of harm to human health or any other aspect of the environment.

Disturbed Area: The surface area disturbed during mining or any mining purpose. It includes all infrastructure facilities, emplacement area, residue disposal area, road and rail access, soil stockpile area, product stockpile area, water diversion and storage structures.

Extraction Area: The area proposed to be mined during the MOP period, including batters and pre-strip areas.

Flood prone land: Land within 1 in 100 year flood boundaries as shown on regional maps. Where maps are not available other means may be required to assess flood potential.

Inspector of Mines: Means an officer of the Department authorised as an Inspector under the Mining Act, 1992. This includes Environmental Officers.

Landscape Planning: The sympathetic integration of the MOP's rehabilitated landforms, drainages and revegetation strategies with the environment surrounding the mine to achieve predetermined environmental outcomes and including landuse (flora and fauna habitat and visual amenity

Limits to Extraction: The boundary of an area of land from which mineral can not be extracted due to a provision, restriction or condition imposed by a government instrument:-

Mine Life: The expected extent and scope of the mine as approved in the "Development Consent". In most circumstances this will be as described in the Environmental Impact Assessment on which approval and grant of lease were based.

Mining Leases: Leases granted under the Mining Act 1992 or any previous mining legislation.

Mining Purposes: The construction, maintenance or use in or in connection with mining operations of buildings, plant, road, emplacement, stock pile and other infrastructure

Pollution: The Protection of the Environment Operations Act (1997) comprehensively defines water, air and noise pollution. In essence:

> **Water pollution** means introducing anything which makes or is likely to make the water detrimental, undrinkable, poisonous, harmful or unsuitable for use, or changing the condition of the water.
>
> **Noise pollution** means the emission of an offensive noise
>
> **Air pollution** means the emission into the air of any impurity including smoke, dust, gases, mists, odours or radioactive substances.
>
> **Land pollution** :means the degradation of land because of the disposal of waste.

Processing Wastes: Tailings from ore beneficiation and processing

Rural Land Capability Classification: A method of land classification as described in "Glossary of Terms used in Soil Conservation" published by the Soil Conservation Service of the Department of Land and Water Conservation.

Shaped Emplacement Areas: Mine and processing waste emplacements shaped to the final design contours.

Soil Stripping Depth: The depth from the surface to which soil material which is to be removed in the preparation of land for mining or mining [purposes

Sublease: An interest registered under Section 161 of the Mining Act, 1992.

Threatened flora/fauna: Species defined as threatened in the schedules of the Threatened Species Conservation Act (1995). Since 1995, threatened species will have been identified through the Development Consent process. Threatened species include fauna subject to a pre-1995 "take and kill" licence issued under section 120 of the National Parks and Wildlife Act (1974)

Unshaped Emplacement Areas: Active mine and processing waste emplacements not shaped to the final design contours.

Water - Clean water: Water from undisturbed vegetated parts of the site. Fit for diversion or direct discharge to receiving streams.

Water - Dirty water:: Water from disturbed but otherwise uncontaminated parts of the site. Fit for discharge, except for suspended solids which may require settling.

Water - Controlled Discharge: Typically water, saline but otherwise uncontaminated, collected within open cuts or underground mine workings as a result of groundwater seepage. Able to be discharged under certain conditions. For example, saline water which may be discharged under high flow conditions as part of the Hunter River Salinity Trading Scheme.

Water - Contaminated Water: Water containing potential contaminants or pollutants and not fit for discharge.

STATUTORY DECLARATION

New South Wales

STATUTORY DECLARATION

OATHS ACT, 1900

EIGHTH SCHEDULE

I,......................................, of ....
in the State of New South Wales, solemnly and sincerely declare as follows:

1. I am the duly appointed
   ....*(management position)*

   for ....*(mine name)*

2. I am authorised to make this Declaration on behalf of the Lease Holder,

   ....*(name of leaseholder)*,

   A.C.N.......................................

3. All works and activities described in the Mining Operations Plan to which this declaration is attached comply with the conditions of the title of the mining lease (or mining leases) shown in the Mining Operations Plan, and with the conditions of Development Consent and all other relevant Government Agency approvals and licences granted in respect of them.

4. I confirm that all of the works and activities referred to in the previous paragraph lie wholly within the area shown in the Mining Operations Plan and that the tenements (mining leases, colliery holdings, land ownership) details of those tenements are correct.

And I make this solemn Declaration, conscientiously believing the same to be true and by virtue of the provisions of the *Oaths Act, 1900*.

Subscribed and Declared at ....

in the State of New South Wales this .... day of..........................in

the year ....

(sgd) ....

before me (sgd) ....Justice of the Peace

Guidelines and Format for Preparation of an Annual Environmental Management Report

Documents should be completed using the headings and tables of this guide. As this guide applies regardless of the stage in the mine life cycle and the nature of operations, there may be some sections which are not relevant to a specific mine site. These should be noted as not applicable. Copies of the format are available from the Department's web site, or the Department's Environmental Officers.

At the discretion of the Department, these guidelines may be adapted to suit the specific circumstances of a mine site or mine operator. An abbreviated form based format may be used for small mines with low environmental risks.

To minimise repetition of reports required by various agencies, any matter (plans and rehabilitation detail excepted) that is required by a report to another agency may be referenced in the MOP rather than repeated. One copy of the report is to be submitted to the Department, and copies distributed directly to nominated Government agencies.

1 TITLE BLOCK

Name of mine			
Titles/Mining Leases			
MOP Commencement Date	/ /	**MOP Completion date**	/ /
AEMR Commencement Date	/ /	**AEMR End date**	/ /
Name of leaseholder			
Name of mine operator (if different)			
Reporting Officer			
Title			
Signature		....	
Date			

2 EXAMPLE CONTENTS PAGE

3 PLANS REQUIRED

Plans, current at the end date of the reporting period of the same scale and with equivalent information to ***Plan 3 Land Preparation, Plan 4 Proposed Mining Activities*** and ***Plan 5 Proposed Rehabilitation*** of the current MOP must be provided together with appropriate sections. If available, provide a recent aerial photograph and other photographs to illustrate operations and environmental performance.

Where final rehabilitation outcomes have been further developed since the MOP was submitted or since the previous AEMR, an amended version of ***Plan 6 Final Rehabilitation for Lease Relinquishment*** should be included with the AEMR.

Mine lease holders without access to surveyed plans, and less than 10 hectares total disturbance, may derive plans from a convenient base map/plan with activity areas and features drawn by hand provided there is sufficient accuracy and detail to adequately describe activities and their impact. If contours are not shown, slopes and drainage lines must be clearly marked.

4 HEADINGS, SUPPORTING TEXT, AND TABLES

1. INTRODUCTION

1.1 Consents, Lease and Licences

Provide a current list with date of grant (and if time limited duration) of leases, subleases, consents, approval or licenses. Also include the date of acceptance of the current MOP and details of any MOP amendments since the previous AEMR.

1.2 Mine Contacts

Provide contact details for the current mine manager and environmental manager.

1.3 Actions Required at Previous AEMR Review

Tabulate actions arising from the AEMR and annual inspection of the previous year or any other directions given by the Department's environmental officers.

TABLE 1. Actions Required

Action Required	Where dealt with in this AEMR

2 OPERATIONS DURING THE REPORTING PERIOD

2.1	Exploration	2.6	**Waste Management**
2.2	Land Preparation	2.7	**Ore and Product Stockpiles**
2.3	Construction	2.8	**Water Management**
2.4	Mining	2.9	**Hazardous Material Management**
2.5	Mineral Processing	2.10	**Other Infrastructure Management**

For each of section, where relevant, describe:

- activities during the reporting period, focussing on variations to the proposed MOP;
- the reasons for any variations, and whether or not the Department was notified;
- the extent of activities should be shown on plans.

TABLE 2 Production and Waste Summary

	Cumulative Production (cubic metres)		
	Start of Reporting Period	At end of Reporting Period	End of next reporting (estimated)
Topsoil stripped			
Topsoil used/spread			
Waste Rock			
Ore			
Processing Waste			
Product (units)			

TABLE 3: STORED WATER

(if more than one storage of each type, list separately)	Volumes held (cubic metres)		
	Start of Reporting Period	At end of Reporting Period	Storage Capacity
Clean water			
Dirty water			
Controlled discharge water (salinity trading schemes)			
Contaminated water			

3 ENVIRONMENTAL MANAGEMENT AND PERFORMANCE

If risks have not been previously been identified, **Table 3 Environmental Risk Identification** of the MOP format (page 17 of this guide) should be included at this point of the AEMR.

Document the implementation and effectiveness of control strategies for environmental risks identified in the MOP, previous AEMR or environmental management plan (EMP).

3.1 Air pollution	3.8 Weeds	3.15 Bushfire
3.2 Erosion and sediment	3.9 Blasting	3.16 Mine subsidence
3.3 Surface water pollution	3.10 Operational noise	3.17 Hydrocarbon contamination
3.4 Ground water pollution	3.11 Visual, stray light	3.18 Methane drainage/ventilation
3.5 Contaminated polluted land	3.12 Aboriginal heritage	3.19 Public safety
3.6 Threatened flora	3.13 Natural heritage	3.20 Other issues and risks
3.7 Threatened fauna	3.14 Spontaneous combustion	

Matters which should be described for each identified issue or risk. Include:

Environmental Management
- whether the proposed control strategy was adequate to manage risks associated with operations during the reporting period;
- variations from proposed control strategies implemented during the reporting period, the reasons for them, and whether or not the Department was notified (include initiatives to improve or further assure acceptable performance, or to deal with new risks identified during the reporting period).

Environmental Performance
- summarise monitored data, including relevant meteorological data. Data need not be included but must be available on request;
- list, monitoring and performance reports required by any other licence or agency;
- review performance outcomes;
- if useful, append photographs;

Reportable Incidents

- summarise incident reporting required by conditions of lease, licence or risk management and monitoring strategies;
- review all incidents which led to non-compliance with conditions of a mining lease, development consent or other licence;
- reference incident report documents previously provided to the Department or another agency;

Further Improvements

- describe initiatives proposed for the next reporting period to improve or further assure acceptable performance.

4 COMMUNITY RELATIONS

4.1 Environmental Complaints

List complaints, dates, and company responses to them.

4.2 Community Liaison

List and describe meetings, inspections, and other community involvement. Copies of minutes or meeting notes must by made available on request.

5 REHABILITATION

5.1 Buildings

Describe buildings renovated or removed including:

- the nature, construction, heritage status and condition;
- health and safety issues related to renovation or removal (eg asbestos);
- contamination issues during and subsequent to renovation or removal;
- future use agreements or options;
- ongoing maintenance requirements;
- variations from the MOP, the reasons for them, and whether or not the Department was notified;
- the extent of activities should be shown on plans.

5.2 Rehabilitation of Disturbed Land

For each area subject to rehabilitation during the reporting period describe:

- physical & chemical characteristics of mining and processing waste of emplaced material relevant to rehabilitation;
- method of land shaping;
- characteristics of all cover material including sealing/drainage layers, subsoil/topsoil;
- thicknesses of cover layers and methods of laying and compaction;
- drainage and erosion control consistent with material characteristics or erosion risk;
- final landform profile and slopes;
- soil treatment;
- vegetation species and methods of their establishment;
- water containment, control and distribution structures in place for rehabilitated land;
- variations from the MOP, the reasons for them, and whether or not the Department was notified;
- the extent of activities should be shown on plans.

5.3 Other Infrastructure

Describe other rehabilitation proposed including of exploration activities, infrastructure, shafts, adits, dams, and the installation or maintenance of fences, bunds, and any other works.

5.4 Rehabilitation Status At End of the Reporting Period

Describe the state of surface cover, surface erodibility, vegetation, and water management of each rehabilitated area at the end of the reporting period. Compare the current state to targets and outcomes described in the proposed and final rehabilitation plans of the MOP and progressive rehabilitation forecasts of the previous AEMR.

For each area under rehabilitation, describe further works necessary to meet completion criteria and future maintenance requirements.

Ensure each area/feature is located on the appropriate plan with rehabilitation extent, cross-sections, drainage patterns/pathways, slopes, and vegetation communities shown.

5.5 Rehabilitation Trials and Research

Outline the outcomes of trials, research projects, and other initiatives undertaken during the reporting period to enhance or assure rehabilitation outcomes. Reports must be made available on request.

5.6 Further Development of the Final Rehabilitation Plan

Where final rehabilitation outcomes and the strategies to achieve them have not yet been agreed between stakeholders, describe the steps that will be undertaken to progress agreement during the next reporting period.

Outline proposed rehabilitation trials, research projects, and other initiatives to be undertaken during the next reporting period.

Where final rehabilitation outcomes have been further developed since the MOP was submitted or since the previous AEMR, the outcomes should be described as required for ***MOP Section 5: Final Rehabilitation*** (page 16).

TABLE 4: Rehabilitation Summary

		Cumulative Area Affected (hectares)		
		To date	Last report	Next Report (estimated)
A:	**MINE LEASE AREA**			
A1	**Mine Lease(s) Area**			
B:	**DISTURBED AREAS**			
B1	**Infrastructure area** (other disturbed areas to be rehabilitated at closure including facilities, roads)			
B2:	**Active Mining Area** (excluding items B3 - B5 below)			
B3	**Waste emplacements,** (active/unshaped/in or out-of-pit)			
B4	**Tailings emplacements,** (active/unshaped/uncapped)			
B5	**Shaped waste emplacement** (awaits final vegetation)			
ALL DISTURBED AREAS				F1
C	**REHABILITATION PROGRESS**			
C1	**Total Rehabilitated area** (except for maintenance)			F2
D:	**REHABILITATION ON SLOPES**			
D1	**10 to 18 degrees**			
D2	**Greater than 18 degrees**			
E:	**SURFACE OF REHABILITATED LAND**			
E1	**Pasture and grasses**			
E2	**Native forest/ecosystems**			
E3	**Plantations and crops**			
E4	**Other** (include nonvegetative outcomes)			

TABLE 5: Maintenance Activities On Rehabilitated Land
(This period's activities and activities proposed in the next reporting period)

NATURE OF TREATMENT	Area Treated (ha) Report period	Next period	Comment/control strategies/ treatment detail
Additional erosion control works (drains re-contouring, rock protection)			
Re-covering (detail - further topsoil, subsoil sealing etc)			
Soil treatment (detail - fertiliser, lime, gypsum etc)			
Treatment/Management (detail - grazing, cropping, slashing etc)			
Re-seeding/Replanting (detail - species density, season etc)			
Adversely Affected by Weeds (detail - type and treatment)			
Feral animal control (detail - additional fencing, trapping, baiting etc)			

Extracts from "The Strategic Framework For Mine Closure"

The "Strategic Framework" is a document prepared by the Australian and New Zealand Minerals and Energy Council and the Minerals Council of Australia. The Department expects that mine closure plans incorporated in Mining Operations Plans will be consistent with the "Strategic Framework".

The extracts below may be used as a checklist to ensure that all relevant aspects of closure are dealt with in the /MOP.

Stakeholder Groups

Stakeholders fall into three broad categories, the company, the community and the State. Outlined below are some of the key sub-groups within these broad stakeholder categories, however, the list is not exhaustive and will vary with individual circumstances.

The Company

Key company stakeholders include:

- *Employees:* employees facing job loss have an obvious and immediate stake in mine closure.
- *Management:* in order to promote continuity of corporate knowledge and consistency of approach to the post-mine rehabilitation and closure process, it is important that selected managers and company environmental personnel be encouraged to continue their involvement beyond the cessation of production.
- *Shareholders:* shareholders need to be fully informed of their company's obligations for closure.

The Community

The impacts of closure on the community will vary with the degree of community dependence on, or interest in, the mining project and its environmental issues. In some cases, the community will not survive the loss of the mine. At a community level, consultation is also important to avoid building up false expectations about the outcomes of closure. Significant community stakeholders include:

- *Local business and service providers:* the economic effects of mine closure on local business and service providers may be severe, and consultation is important to assist them in their own planning for the transition.
- • *Landholders, neighbours and nearby residents:* this group may be physically affected by the closure and may have particular needs and desires that can be incorporated into rehabilitation planning.
- • *Local government:* in addition to their direct involvement with the mining operation, local government provide a vital link with the community. Early consultation and planning is essential to minimise disruption to community services.
- • NGOS *and Community Groups:* these groups often represent different points of view to those elements in the community which are physically and/or financially affected by mine closure.

The State

The requirements of government agencies must be satisfied if relinquishment is to be achieved. Consultation with these agencies is essential to ensure that rehabilitation and closure plans satisfy regulatory requirements. Important government stakeholders include:

- *The Responsible Authority (and other regulators):* a key role of the Responsible Authority is to coordinate the functions and needs of other government agencies with accountabilities in the area.

- *The land management agency:* where the land management agency (current or future) differs from the Responsible Authority, there is a need to ensure that their requirements are an integral component of the closure process.
- *Other government agencies:* the potential effects of closure on the community and individuals may necessitate consultation with government agencies, such as community welfare and employment, that have not previously impacted on the mine management.

Typical Contents of a Closure Plan

The development of a Closure Plan needs to take into account both the legal requirements and the unique environmental, economic and social properties of the operation. Outlined below are the typical contents of a Closure Plan, which will vary depending on individual circumstances. In developing the Closure Plan, the following four key objectives should be kept in mind:

⇒ to protect the environment and public health and safety by using safe and responsible closure practices;

⇒ to reduce or eliminate environmental effects once the mine ceases operations

⇒ to establish conditions which are consistent with the pre-determined end land use objectives; and

⇒ to reduce the need for long-term monitoring and maintenance by establishing effective physical and chemical stability of disturbed areas.

Closure Plan: typical contents of a Closure Plan (not a minimum requirement or template):

- Introduction & Project Description
  - ⇒ Land tenure
- Objectives of Closure
- Baseline Environmental Data
- Legal & Other Obligations
  - ⇒ Key statutes & regulations
  - ⇒ Responsible Authority
  - ⇒ Regulatory instruments
- Stakeholder Involvement
  - ⇒ Stakeholder identification
  - ⇒ Community consultation
- Risk Assessment
  - ⇒ Existing legacies
  - ⇒ Future risks
  - ⇒ Cost/benefit analysis
- Closure Criteria
- Closure Costs
  - ⇒ Provisions
  - ⇒ Securities
- Closure Action Plan
  - ⇒ Human resources/responsibilities
  - ⇒ Progressive rehabilitation
  - ⇒ Decommissioning
  - ⇒ Remediation
  - ⇒ Geotechnical assessment
  - ⇒ Landform establishment
  - ⇒ Revegetation
  - ⇒ Aesthetics
  - ⇒ Heritage
  - ⇒ Health and Safety
  - ⇒ Post-closure maintenance and monitoring
  - ⇒ Survey (remaining structures & areas of contamination
  - ⇒ Documentation/reporting/records
  - ⇒ Tenement Relinquishment

Attachment "C"

DEPARTMENT OF MINERAL RESOURCES

ENVIRONMENTAL IMPACT STATEMENT REQUIREMENT

As a general guide, the following matters would need to be covered in the EIS and any other matters relevant to the particular development in its local context.

Introduction

- summary
- history
- environmental impact assessment procedures

Background to the proposal

- the need for the development
- planning considerations
- nature and extent of the proposal
- the consequences of not proceeding
- consideration of any possible feasible alternatives and reasons for selecting the preferred alternative

The existing environment

- climate, including temperature, humidity, prevailing winds and rainfall
- terrain, soils and hydrology
- flora and fauna
- land tenure and land use patterns, including location of houses, public facilities and recreation areas
- visual amenity
- features of heritage, conservation of archaeological value

- zoning provisions and whether the proposal is permissible
- specific land use constraints
- infrastructure available (roads, water, power and so on)
- particular constraints (such as flood liability)

Detailed description of the proposal

The Resource Assessment must be sufficiently detailed and illustrated to establish:

- The characteristics of the deposit-location, geology, extent, and internal variations in grade/quality.
- The quantity of material to be extracted.
- Whether other potentially recoverable commodities occur at the site, and whether they can be stockpiled for later recovery.
- Documentation must be sufficient to justify the above claims and must include a discussion of the assessment methods and results(including reference to any relevant reports).
- quantity of materials to be produced annually and in total
- plans of operations and production techniques, including any proposed blasting and crushing.
- requirements for relocation of other development and services to permit access
- type of machinery and equipment to be used
- handling of materials, including stockpiling
- product preparation, including crushing, screening or washing
- expected life of the operation
- number of persons to be employed
- hours of operation
- energy requirements, including measures for energy conservation
- proposals for dealing with overburden or other waste materials

- water management, including water supply, drainage, sediment movement and erosion controls dealing with interception of ground waters and containment of runoff, water reuse, treatment and discharge
- disposal of coarse and fine washery reject material and proposals for mechanical dewatering
- proposals for site stabilisation and rehabilitation, vegetation establishment and landscaping; proposals should include a description of the final land form with reference to both existing and proposed works
- material haulage on site and transportation offsite, including transport routes
- environmental monitoring proposed, for example, for vegetation establishment and pollution levels
- relationship of the proposed development to the previous development
- photographs, maps, drawings and other appropriate supporting material to illustrate the proposed development, including progressive land restoration or rehabilitation following the development
- consideration of any feasible alternatives
- **Potential environmental impact/interactions**
- water pollution
- effect on flood patterns
- noise and vibration levels
- dust levels
- visual impact
- transportation
- effect on heritage values
- socio-economic effects
- land subsidence or instability
- flora and fauna affected
- waste disposal, such as washery rejects
- hazard or risk to public safety

- ɪfects on shipping if navigable waterways are involved
- soil erosion
- compatibility with other land uses

Measures to mitigate likely adverse environmental impact

- description of proposed environmental impact prevention and mitigation measures and safeguards, during and after the operation
- assessment of effectiveness of the measures proposed
- proposed on-going monitoring, including reporting procedures and identifying environmental quality standards to be achieved
- describe the Mining, Rehabilitation and Environmental Management Plan (MREMP) process

The viability and market assessment must show

- that the expected products are marketable
- that the operation will be sufficient viable to save the local community needless disruption from commencing then prematurely closing an operation
- that the operation will be sufficiently profitable to pay for rehabilitation *Alternative sources, their availability, and market acceptance
- justification for the proposal - the need for the proposed operation in a local, regional, or broader context
- justification for not utilising or stockpiling all potentially recoverable commodities (where relevant)

planningnsw

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20 Lee Street Sydney NSW 2000
T 02 9762 8000
www.planning.nsw.gov.au

Our ref: S03/01187

30 May 2003

Mr Dominic Saffioti
Barnu Pty Ltd
PBS No. 4
MOSS VALE NSW 2577

Dear Mr Saffioti

Proposed Lime Kiln, Galong, Harden Local Government Area

I refer to the Director-General's requirements forwarded to you regarding the preparation of an Environmental Impact Statement (EIS) for the above development proposal. The Department has subsequently received requirements from Harden Shire Council. I have attached Council's requirements, and you must address these requirements during the preparation of your EIS.

Please contact me at tim.ward@planning.nsw.gov.au or on (02) 9762 8161 if you have any enquiries regarding the Director-General's requirements.

Yours sincerely

T. Ward

Tim Ward
Environmental Planning Officer
Major Development Assessment

HARDEN SHIRE COUNCIL

A.B.N. 72 [illegible]

All Communications to be Addressed to the General Manager
P.O. Box 110, Harden. 2587
PHONE (02) 6386 2305
FAX (02) 6386 2083

Contact: P. Johnston
File: T.7B
Date: 29/05/2003

Mr Tim Ward
Environmental Planning Officer
Major Development Assessment
PlanningNSW
GPO Box 3927
SYDNEY NSW 2000

Dear Mr Ward,

Re: Council's Requirements for the Galong Limestone Mine [Kiln] EIS

- Council would want to know the intended road route to be used for the coal supply vehicles that would feed the major energy needs of the proposed kiln. Council is still in negotiation with the developers over section 94 contributions for the mine expansion, however the intended coal supply route may identify additional demands upon Council's road network, that may require contributions from the developer.

- Council recently adopted a new Section 94 Contributions Plan for Unpredictable Development, that requires both up-front Capital Contributions and on-going Maintenance Contributions, for all additional heavy vehicle road use of Council's road network. Please find attached a copy of Council's S94 Plan for Unpredictable Development.

- Council would like the opportunity to comment on draft conditions that could affect our S94 contributions for the mine.

- If there are any other transport related changes to the overall development that conflict with the Expansion EIS, then Council needs to be advised as soon as possible.

- Council would require:

  1. Visual and noise assessment of the impact of the vertical kiln on the surrounding landscape and neighbouring residents;

  2. Visual assessment of the 66KV transmission line;

  3. Assessment of the potential pollution emissions expected from the kiln cooking process, including details of any by-product removal and reuse.

  4. An assessment of the method of safe storage and transfer to transport vehicles for quick lime product and coal, in order to minimise dust pollution to the environment and the potential for coal dust ignition/fire;

Appendix B

Sections References to Matters Considered in the EIS

Matters to be Considered in the EIS	EIS Section Reference
Air quality impacts, particularly dust, particulates and potential impacts on local air quality.	6.9
Water quality and water cycle management , including water consumption, recycling and impact of any water released from the site, including stormwater impacts, associated with the Lime Kiln must be considered.	6.7
Cumulative impacts associated with the proposed development, in particular the cumulative impacts with regards to the current and increased mining operations must be assessed.	Chapter 6
Fauna and flora impacts must be addressed, particularly impacts on any endangered populations or communities, including the Box-Gum Woodland.	6.5 and 6.6
Noise impacts, especially the potential noise impacts on any residences and including impacts generated by heavy vehicle movements.	6.8
Visual impacts, particularly on nearby properties and residential areas.	6.10
Soil quality and groundwater issues, including salinity.	6.7 and Soils Report in Volume 3
Impacts associated with increased traffic movements, in particular heavy vehicles and including cumulative impacts with the proposed upgrade of the mine.	6.11
Waste management issues.	7.4
Potential hazards and risks associated with operations.	3.4
Socio-economic impacts on the locality and the region.	2.7.4 and 4.6
The EIS must indicate how the environmental performance of the proposal would be monitored and managed during construction and operations.	Chapter 7
Effective consultation with Government bodies and the public must be undertaken and the results included in the EIS.	3.11 and 3.12
The applicant shall nominate a contact person (and telephone number) who will be made available to answer public enquiries about the proposal.	Completed
The applicant shall consult with the community that is likely to be affected by the proposal. A report on who was consulted must be submitted with the DA, describing how the affected community was identified, consultation methods, and key issues raised by the community.	3.12

Matters to be Considered in the EIS	EIS Section Reference
Likely annual rates of production of all waste streams from the proposed development must be provided, including domestic waste products. Proposed methods of treatment and/or disposal of these waste streams must be clearly indicated.	7.4
Wastes that are not to be re-used or recycled must be classified in accordance with the EPA's Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes.	7.4
Details of waste management at the proposed development must clearly reflect the principles of reduce, reuse and recycle.	7.4
A preliminary risk screening must be completed in accordance with Applying SEPP 33 with a clear indication of class, quantity and location of all dangerous goods to be located on the proposed development site (including hazards associated with the coal stockpiles).	3.4
Should preliminary screening indicate that the proposed development is potentially hazardous, a Preliminary Hazard Analysis (PHA) must be prepared for inclusion in the EIS, as required under SEPP 33.	3.4
Risk impacts associated with the transport of dangerous goods and hazardous materials must be documented with reference to the Department's draft Route Selection.	3.4
Identification of relevant local indigenous communities and details of specific measures employed to ensure these communities were consulted during the preparation of the EIS.	6.4 and 6.5
The EIS must detail the results of consultations with Harden Shire Council to establish the impacts of the proposed development on public infrastructure and services. An attempt should be made to establish a nexus, should one exist, between the development and impacts on services and infrastructure and to quantify appropriate contributions to any significantly affected services and infrastructure in accordance with Council's Section 94 Contributions Plan.	3.1
The EIS must address the issues raised by the Environment Protection Authority, Department of Agriculture, National Parks and Wildlife Service, Department of Agriculture, Department of Sustainable Natural Resources and Harden Shire Council.	Many Sections throughout the EIS.

02.03.22.14

Environmental Impact Statement

GALONG LIME KILN PROJECT

Volume 2

Specialist Consultant Reports Prepared for Lime Kiln Project

Proposed by Barnu Pty Limited A subsidiary of Boral Limited

Olsen Environmental Consulting
June 2003

oec

Environmental Impact Statement

GALONG LIME KILN PROJECT

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**Olsen Environmental Consulting
June 2003**

oec

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RHA REPORT 30-1250-R1
Revision 0

Noise Impact Assessment
Galong Lime Kiln

Prepared for

Olsen Environmental Consulting
PO Box 101
FIGTREE NSW 2525

26 June 2003

RICHARD HEGGIE
ASSOCIATES
ABN 29 001 584 612

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Telephone 61 2 4946 3300 Facsimile 61 2 4946 3301 newcastle@heggies.com.au

Noise Impact Assessment
Galong Lime Kiln

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
MEMBER FIRM OF THE ASSOCIATION OF AUSTRALIAN ACOUSTICAL CONSULTANTS

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

Reference	Status	Date	Prepared	Checked	Authorised
30-1250R1	Revision 0	30 June 2003	JL	JC	JC

EXECUTIVE SUMMARY

INTRODUCTION

Richard Heggie Associates have been commissioned by Olsen Environmental consulting to conduct a noise impact assessment on behalf of Blue Circle Southern for the installation and operation of a limestone kiln at the existing Galong Limestone Mine site.

The noise assessment has been prepared in accordance with Australian Standard 1055: 1997 "Description and Measurement of Environmental Noise" Parts 1, 2 and 3 and with reference to the EPA's Industrial Noise Policy (INP). Where issues relating to noise are not addressed in the INP, such as sleep disturbance, reference has been made to the Environmental Noise Control Manual (ENCM). The road traffic noise assessment has been undertaken with reference to the EPA's Environmental Criteria for Road Traffic Noise (ECRTN).

The proposal is to construct and operate a lime kiln on the existing Galong Limestone Mine site, while maintaining the existing method of mining and processing. This report will address the acoustic issues associated with:

1. Construction of the lime kiln;
2. Operation of the lime kiln;
3. The cumulative impact of operation of the lime kiln in conjunction with operation of the limestone mine.

PLANT AND EQUIPMENT

Acoustically significant plant and equipment sound power levels have been supplied by the proponent where available. Where this information was not available sound power levels and octave band levels were obtained from a Richard Heggie Associates database of similar equipment.

EXISTING ACOUSTICAL ENVIRONMENT

In order to determine existing ambient noise levels at residential locations surrounding the Galong Limestone Mine, the data collected during the background monitoring survey undertaken as part of the Galong Limestone Mine expansion has been used. This survey consisted of an unattended continuous noise monitoring component and an operator-attended noise monitoring component undertaken at the residential locations given in **Table 1**.

EXECUTIVE SUMMARY

Table 1 **Noise Monitoring Locations**

Noise Monitoring Location	Description
1	"Athlone", Kilarney Road, Galong
2	"Beulambil", Beulambil Road, Galong
3	Brown Residence (mine-related), Eubindal Road, Galong
4	Hack Residence, Ryan Road, Galong
5	"Woodstock", via Bobbara Road, Galong

The EPA has requested that a Rating Background Level of 30 dBA be assumed for the assessment.

ASSESSMENT OF NOISE IMPACTS

Operational Noise

Noise modelling has been undertaken to determine noise levels at the nearest residences for the construction and operation of the lime kiln. The cumulative assessment is based upon the kiln operation combined with the projected 30 year mine plan (expected to be complete 2033), which details the lateral extents of the mine. A 40 year mine plan also exists, however, this plan only involves depth expansion of the open-cut mine, and it is expected that the 30 year mine plan will represent the worst-case scenario, from an acoustic point of view, throughout the expected life of the mine.

Noise modelling has been undertaken for calm and prevailing weather conditions. The noise modelling results indicate that predicted noise levels for operation of the lime kiln are well below the project specific noise levels, at all residential locations, for all periods of proposed operation.

The cumulative impact of the mine and the kiln demonstrates that compliance will be achieved at all residential locations for all periods of operation, except for a 1 dBA exceedance at the Brown Residence (a mine-related residence) under temperature inversion when the 30 year mine plan is combined with kiln operation. This is primarily the result of mine operation rather than kiln operation, with the two dominant noise sources being the jaw crusher and rock drill (used for drilling blast holes). Such an exceedance is unlikely to be perceivable to the human ear and is only likely to occur for a short period of time.

Construction Noise

Noise modelling for the construction of the lime kiln has been undertaken for calm weather conditions. The noise modelling results indicate that predicted noise levels for construction of the lime kiln are well below the project specific construction noise levels at all residential locations.

Road Traffic Noise

Consistent with the Galong Limestone Mine expansion we recommend that heavy vehicle movements occur only during the daytime period (7.00 am to 10.00 pm). To keep the rise in road traffic noise below the 2 dB(A) increase recommended under the ECRTN, a maximum increase of 19 heavy vehicles per hour, during the daytime period (7.00 am to 10.00 pm), would be allowable.

The maximum allowable increase in vehicle movements per hour is far greater than the likely increase in traffic due to construction of the kiln. It is also important to note that construction traffic is only temporary, with traffic noise levels likely to increase only for the construction period.

There will be no increase in road traffic numbers, and no significant difference in the ratio of heavy vehicles to light vehicles as a result of the operation of the lime kiln, which simply involves further processing of product prior to despatch to market.

CONCLUSION

Richard Heggie Associates have undertaken an acoustic assessment for the construction and operation of a lime kiln at the Galong Limestone Mine, Eubindal Road, Galong.

The construction and operation of a lime kiln at the Galong Limestone Mine site is predicted to meet all project specific noise level goals during construction, and for operation, during daytime, evening and night-time at all residential locations.

The cumulative impact of the mine and the kiln demonstrates that compliance will be achieved at all residential locations for all periods of operation, except for a 1 dBA exceedance of the intrusiveness noise level at the Brown Residence (a mine-related residence) under temperature inversion when the 30 year mine plan is combined with kiln operation. This is primarily the result of mine operation rather than kiln operation, with the two loudest noise sources being the jaw crusher and rock drill. Such an exceedance is unlikely to be perceivable to the human ear and is only likely to occur for a short period of time.

Road traffic noise levels for both the construction and operation of the lime kiln are predicted to be within the 2 dBA increase in $L_{Aeq(1hour)}$ noise level allowable under the ECRTN.

TABLE OF CONTENTS

1 INTRODUCTION

Richard Heggie Associates have been commissioned by Olsen Environmental consulting to conduct a noise impact assessment on behalf of Blue Circle Southern for the installation and operation of a limestone kiln at the existing Galong Limestone Mine site.

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). Where issues relating to noise are not addressed in the INP, such as sleep disturbance, reference has been made to the Environmental Noise Control Manual (ENCM). The road traffic noise assessment has been undertaken with reference to the EPA's Environmental Criteria for Road Traffic Noise (ECRTN).

The proposal is to construct and operate a lime kiln on the existing Galong Limestone Mine site, while maintaining the existing method of mining and processing. This report will address the acoustic issues associated with:

1. Construction of the lime kiln;
2. Operation of the lime kiln;
3. The cumulative impact of operation of the lime kiln in conjunction with operation of the limestone mine.

2 SITE DETAILS

The Galong Limestone Mine is located approximately 20 km east-southeast of Harden in the Southwest Slopes region of NSW.

The land is owned by the Bobbara Pastoral Company and the Crown, and the Project Site lies within the boundary of Mining Lease No 1496. The Project site covers an area of approximately 4 hectares and is identified as follows:

County of Harden
Parish of Bobbara
Portion 139, part Lot 3, DP 747544

The nearest residential locations to the mine, along with approximate distances from the existing mill enclosure are contained within **Table 2.1**.

Table 2.1 Nearest Residential Locations

Location	Distance from Mine
Brown Residence*	2.7 km
"Hilltop"*	3.4 km
"Athlone"	5.3 km
"Beulambil"	4.8 km
"Highview"	4.7 km
"Cherryvale"	4.1 km
"Glenroy"	4.6 km
"Woodstock"	3.8 km
Township of Galong	4.4 km

* Note: The Brown residence and "Hilltop" are mine-related residences, as they, and the existing Galong Limestone Mine are situated on land owned by the Bobbara Pastoral Company Pty Ltd.

3 DESCRIPTION OF PROJECT

The Galong Limestone Mine is the major supplier of agricultural lime for use as an acid soil ameliorant to the cropping areas of the Southwest Slopes grain belt. Blue Circle Southern is seeking approval to construct and operate a lime kiln on the property.

3.1 Description of Existing Operation

At present, blasting is used to fracture the limestone into manageable sized pieces, which are then loaded by an excavator onto a truck for transport to the jaw crusher. Alternatively, the front end loader is often used to pick up the fractured rock and transport it from the foot of the blast face to the jaw crusher. Where rock fragments are too large to manage, an excavator with a hydraulic hammer attachment is used to break the rock into manageable sized pieces.

Once broken into small (approximately 50 mm diameter) pieces by the jaw crusher, the rock is transported via conveyor to one of three mills operated on the site. These mills are housed in a metal enclosure, and reduce the rock to a powder, which is pumped into three storage silos. The final product is then loaded into semi-trailers for transport to market.

Excess product is stockpiled directly to the south of the mill building and may be loaded, via front end loader.

3.2 Description of Proposed Operation

The proposal is to utilise the existing facilities and to upgrade the operation to allow the production of quicklime.

Once the limestone has passed through the jaw crusher some will still pass through the existing mills, while some will be transported via conveyor to a screen for sizing, and storage in three stockpiles. The larger stockpile will be reclaimed via three underground vibrating feeders onto a conveyor which feeds the kiln limestone surge bin. The limestone will pass through the kiln, where it will be converted into quicklime. The quicklime will travel via conveyor to a roll crusher and a series of secondary screens for final sizing and storage in three product storage bins. These bins will be used to load trucks for transport of product to market.

Coal will initially be used to fuel the kiln. This coal will be stored in a ground storage bin to the south of the existing mill enclosure. A front-end loader will load the coal into a hopper, which will feed the coal into the existing mill three, which will be converted for coal crushing. The coal dust will then be injected into the kiln as required by a blower fan.

3.3 Hours of Operation - Construction Phase

Blue Circle Southern wish to undertake construction from 6.00 am to 6.00 pm Monday to Saturday over a construction period that will consist of 8 weeks of foundation work, 16 weeks of kiln construction and a further 8 weeks of commissioning.

No construction work is scheduled to take place on Sundays or Public Holidays, though this may occur in sporadic circumstances.

3.4 Plant and Equipment - Construction P

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Noise Impact Assessment - Galong Lime Kil
Olsen Environmental Consulting

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3.5 Plant

Table 3.4.1 Acoustically Significant Construction Plant

Plant/Equipment	
140 tonne crane	
40 to 50 tonne crane	101
Concrete pump	111
Concrete truck	111
Grader	111
Excavator (CAT 225)	104
Loader (CAT 988B)	113
Backhoe	104
Bobcat	101
Pile Auger Drilling Machine	118
Compressor (100CFM)	93
Mobile Welder (self-contained including generator)	107
Refractory Bricksaw	113

Note: Equipment noise levels have been taken from a Richard Heggie Associates database of similar equipment.

3.4 Hours of Operation - Operational Phase

The existing approved hours of operation are as follows.

Mining:	24 hours a day, 7 days per week
Blasting:	9.00 am to 3.00 pm, Monday to Sunday
Processing:	24 hours a day, 7 days per week
Product despatch/transport:	7.00 am to 7.00 pm, Monday to Saturday

The mine currently operates from 7.30 am to 6.00 pm Monday to Friday and 7.30 am to 12 noon Saturdays. There is no operation on Sundays or public holidays.

Blue Circle Southern proposes to operate the mine and the kiln 24 hours per day, 7 days per week.

and Equipment - Operational Phase

Acoustically significant plant and equipment, along with their respective noise levels are contained within **Table 3.5.1**. Sound power levels and octave band levels were obtained from the proponent where available. Where no noise levels could be supplied, sound power levels and octave band levels were obtained from a Richard Heggie Associates database of similar equipment. Details of these levels along with noise modelling inputs are given in **Appendix A**.

Table 3.5.1 Acoustically Significant Operational Plant and Equipment Noise Levels

Plant/Equipment	Sound Power Level (LAeq)
Conveyors	107
Primary Screen	101
Limestone Skip Hoist	116
Loading/feeder bins	116 (when filled from empty)
Rotary Piston Blowers	118
Roll Crusher	113
Coal/Product Elevators	97
Product Screen	111
Coal Hopper	108
Coal Blower Fan	106
Compressors	93
Transformers	85
Baghouse Fan	105

Note: Mobile equipment noise levels have been taken from a Richard Heggie Associates database of similar equipment.

Table 3.5.2 contains the LAmax sound power level used in the sleep disturbance assessment.

Table 3.5.2 Maximum Noise Levels

Plant/Equipment/Operation	Sound Power Level (LAmax)
Loading/Feeder Bins	124 when filled from empty

4 IMPACT ASSESSMENT PROCEDURES

4.1 Construction Noise

The EPA NSW "Environmental Noise Control Manual (ENCM)", Chapter 171, sets out noise criteria applicable to construction site noise for the purpose of defining intrusive noise impacts. Based upon this document the project specific noise limits outlined in **Table 4.1.1** will apply to the proposed development.

Table 4.1.1 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

Note 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 audible construction work is to take place on Sundays or Public Holidays.

4.2 Operational Noise

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 an 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 noise sources should not be more than 5 decibels above the measured background level (L_{A90}) when measured at the appropriate receiver location.

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.

An extract from the EPA Industrial Noise Policy that relates to the amenity criteria is given in Table 4.2.1.

Table 4.2.1 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 (dBA)	
			Acceptable	Recommended Maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45

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.

Where the existing noise level from industry approaches or exceeds these levels, the amenity criteria need to be amended by the values shown in Table 4.2.2 to reduce the likelihood of 'background creep'.

Table 4.2.2 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 L_{Aeq} noise level for the specific receiver, area and time of day from Table 4.1.1.

Assessing Sleep Disturbance

The EPA has acknowledged that the relationship between maximum noise levels and sleep disturbance is not currently well defined. Criteria for assessing sleep disturbance has not been defined under the INP but it is assumed that conformance with the INP would protect against the likelihood of awakening reactions. Not withstanding the preceding, sleep arousal has been assessed using the guidelines set out in the EPA's Environmental Noise Control Manual Section 19-3.

To avoid the likelihood sleep disturbance the ENCM recommends that the $L_{A1(1\ minute)}$ of the noise source under consideration should not exceed the background noise level (L_{A90}) by more than 15 dBA when measured outside the bedroom window of the receiver during the night-time hours (10.00 pm to 7.00 am).

For the purpose of this assessment a conservative approach has been undertaken, where L_{Amax} noise levels have been used to represent $L_{A1(1minute)}$ noise levels. This is due to the lack of accurate information regarding $L_{A1(1minute)}$ noise levels, and the assumption that $L_{A1(1minute)}$ noise levels would be similar to, and possibly slightly lower than, the L_{Amax} noise levels.

4.3 Road Traffic Noise Design Goals

The EPA 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.

Two transport routes will continue to be used for the distribution of limestone products, each of which will involve vehicles exiting the mine via Eubindal Road. Approximately 5% of the traffic will travel north via Kalangan Road onto Cunningar Road, with the remaining 95% of the traffic travelling south along Galong Road, through the township of Galong to Burley Griffin Way.

The properties adjacent to the northern route are rural allotments with the residences significantly distanced from the road. The highest impact will continue to occur when the vehicles travel along Galong Road through Galong.

Residences adjacent to Galong Road (which becomes Ryan Street, then Bobbara Road as it passes southeast through Galong) are the most potentially affected receivers.

The ECRTN defines a sub-arterial road as "roads, which connect the arterial roads to areas of development and carry traffic from one part of a region to another."(ERCTN, page 4, Section 2.2). From this perspective, and based upon the fact that this road connects the township of Galong to the Burley Griffin Way (which is clearly an arterial road), Galong road would be defined as a sub-arterial road.

Notwithstanding this fact, and based upon recent traffic studies indicating low and intermittent traffic flow along Galong Road, a conservative approach has been taken, whereby Galong Road has been considered to be a primary haulage route for the purpose of this assessment.

Some industries, such as mines, are in locations that are not served by arterial roads. As such, heavy vehicles must travel along local roads to access the site. Such roads have been acknowledged by Planning NSW in Section 2.2 of the ECRTN and, in order to manage any associated adverse impacts, the noise criteria for the route should match those for collector roads. Such roads are referred to as 'primary haulage routes". For this reason, the noise criteria outlined in **Table 4.3.1**, have been adopted.

Table 4.3.1 EPA Environmental Criteria for Road Traffic Noise

Policy	Descriptor	Traffic Noise Goal
8. Land use developments with the potential to create additional traffic on a collector road (or primary haulage route)	LAeq(1hour) daytime LAeq(1hour) night-time	60 dBA* 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.

While no well defined sleep disturbance criteria applicable to road traffic exists in NSW, the NSW RTA recognises that events likely to cause sleep arousal can occur, and are dependent upon both the maximum noise level of the source and the ambient background noise level at the residence. Where the L_{Amax} noise level is greater than 65 dBA and the L_{Amax} minus the L_{Aeq} noise level is greater than or equal to 15 dBA the event is recognised as a "significant" event, or an event likely to cause sleep disturbance at a residence.

5 EXISTING ACOUSTICAL ENVIRONMENT

In order to determine existing ambient noise levels at residential locations surrounding the Galong Limestone Mine, the results of a background noise monitoring program undertaken for the Galong limestone mine expansion, undertaken at the residential locations given in **Table 5.1**, has been used to determine the existing ambient noise levels. A Location Map showing each noise monitoring location is contained in **Appendix B**.

Table 5.1 Noise Monitoring Locations

Noise Monitoring Location	Description
1	"Athlone", Kilarney Road, Galong
2	"Beulambil", Beulambil Road, Galong
3	Brown Residence (mine-related), Eubindal Road, Galong
4	Hack Residence, Township of Galong
5	"Woodstock", via Galong

Background noise levels were monitored by Richard Heggie Associates at five of the nearest residential locations to the Galong Limestone Mine, from 28 January 2003 until 6 February 2003 inclusive using ARL Type EL215 environmental noise loggers. The distance of the residences to the mine ranged significantly, the nearest being the Brown residence at approximately 2.75 km from the main plant building on the mine, to "Athlone" at 5.3 km from the main plant building.

Noise data during periods of any rainfall and/or wind speeds in excess of 5 m/s (approximately 9 knots) were discarded. This included a period during Thursday 30 January 2003 from 8:30 am until 8:00 pm, when the 15 minute average wind speed at ground level was above 5 m/s (approximately 9 knots). No significant rain was recorded during the background noise monitoring period.

A summary of the results of the background surveys are given in **Table 5.1.1.**

Table 5.1.1 Summary of Existing Ambient background Noise Levels

Location	Description		Background Noise Level (LA90 dBA) / Rating Background Level	Measured Existing LAeq Noise Level (dBA)	Estimated Contribution from Existing Industrial Noise Sources (dBA)
1 "Athlone"	Daytime	7am to 6pm	32	49	<30 dBA
	Evening	6 pm to 10 pm	34	55	<30 dBA
	Night	10 pm to 7 am	32	44	<30 dBA
2 "Beulambil"	Daytime	7am to 6pm	31	55	<30 dBA
	Evening	6 pm to 10 pm	35	57	<30 dBA
	Night	10 pm to 7 am	30*(29)	46	<30 dBA
3 Brown Residence	Daytime	7am to 6pm	34	56	<30 dBA
	Evening	6 pm to 10 pm	36	56	<30 dBA
	Night	10 pm to 7 am	33	46	<30 dBA
4 Township of Galong	Daytime	7am to 6pm	36	57	<30 dBA
	Evening	6 pm to 10 pm	33	58	<30 dBA
	Night	10 pm to 7 am	33	49	<30 dBA
5 "Woodstock"	Daytime	7am to 6pm	30*(29)	49	<30 dBA
	Evening	6 pm to 10 pm	31	49	<30 dBA
	Night	10 pm to 7 am	30*(29)	49	<30 dBA

Note: The LA90 represents the level exceeded for 90% of the interval period and is referred to as the average minimum or background noise level.
LAeq - The equivalent continuous noise level is defined as the level of noise equivalent to the energy average of noise levels occurring over a measurement period.
* Where the measured RBL is below 30 the NSW EPA recommends that 30 dBA be adopted. Actual measured values are in parentheses.

6 PROJECT SPECIFIC NOISE EMISSION DESIGN GOALS

The EPA has requested that a rating background noise level of 30 dBA be assumed for all residential locations surrounding the site. Therefore, the project specific noise level goals for all residential locations for construction noise and intrusiveness criterion will be set accordingly.

Nine residential locations have been used for the assessment, including the five background noise monitoring locations, and four other residences adjacent to the mine, including "Hilltop", "Highview", "Cherryvale" and "Glenroy". For assessment purposes "Hilltop", "Highview" and "Cherryvale" are assumed to have L_{A90} rating background levels similar to "Beulambil", which is the closest monitoring location to these residences, and "Glenroy" is assumed to have a L_{A90} rating background level similar to "Woodstock".

6.1 Construction Noise

The construction noise emission design goals have been set with reference to the EPA Environmental Noise Control Manual outlined in **Section 4.1** of this report.

Table 6.1.1 contains the project specific construction noise design limits.

Construction noise level goals are 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 receivers. No construction work is planned to take place on Sundays or Public Holidays.

Table 6.1.1 Project Specific Construction Noise Goals

Location	Assumed Rating Background Level L_{A90}	Total Construction Period	Project Specific L_{A10} Construction Noise Level Goal[1]
All Residential Locations	30 dBA	4 weeks and under	50 dBA
		4 weeks to 26 weeks	40 dBA
		Greater Than 26 Weeks	35 dBA

Note 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 planned to take place on Sundays or Public Holidays.

6.2 Operational Noise

The operational noise emission design goals have been set with reference to the EPA Industrial Noise Policy outlined in **Section 4.2** of this report. The resulting design goals are given in **Table 6.2.1**.

Table 6.2.1 Project Specific Noise Emission Design Goals - Rural Residential Receivers

Location	Description	Assumed Rating Background Level LA90 dBA	Intrusiveness Criterion LAeq(15minute) dBA	Amenity Criterion LAeq(period) dBA	Sleep Disturbance Criterion LA1(1 minute) dBA
All Residential Locations	Daytime 7am to 6pm	30	35	50	N/A
	Evening 6 pm to 10 pm	30	35	45	N/A
	Night 10 pm to 7 am	30	35	40	45

Notes: The LA90 represents the level exceeded for 90% of the interval period and is referred to as the average minimum or background noise level
LAeq - The equivalent continuous noise level is defined as the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

7 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 from the closest weather station at Young over the 2002 12 month period. This data was analysed to determine the frequency of occurrence of winds up to speeds of 3m/s for daytime and night-time in each season. The results of this analysis are contained within **Tables 7.1.1, 7.1.2 and 7.1.3**.

Table 7.1.1 Seasonal Frequency of Occurrence Wind Speed Intervals - Daytime

Period	Calm	Wind Direction	0.5 to 2 m/s	2 to 3 m/s	0.5 to 3 m/s
Summer	1.5%	NNW±45°	0.6%	1.3%	1.9%
Autumn	6.2%	N±45°	5.1%	7.2%	12.2%
Winter	7.8%	N±45°	6.3%	8.1%	14.4%
Spring	2.4%	N±45°	3.5%	3%	6.5%

Table 7.1.2 Seasonal Frequency of Occurrence Wind Speed Intervals - Evening

Period	Calm	Wind Direction	0.5 to 2 m/s	2 to 3 m/s	0.5 to 3 m/s
Summer	4%	N±45°	2.1%	3.4%	5.6%
Autumn	9.4%	N±45°	6.1%	12.1%	18.2%
Winter	9.6%	N±45°	4.5%	18.3%	22.8%
Spring	6.6%	N±45°	5.[illegible]%	11.2%	16.6%

Table 7.1.3 Seasonal Frequency of Occurrence Wind Speed Intervals - Night-time

Period	Calm	Wind Direction	0.5 to 2 m/s	2 to 3 m/s	0.5 to 3 m/s
Summer	8.2%	N±45°	5.4%	5.4%	10.8%
Autumn	11.5%	N±45°	4.0%	8.0%	12.1%
Winter	12.4%	N±45°	8.5%	15.5%	24%
Spring	9.1%	N±45°	5.8%	13.4%	19.1%

Seasonal wind records indicate that northerly winds dominate in the area. The maximum percentage occurrence of winds of up to 3 m/s is 24%, from the north, during winter nights. Therefore, as per INP methodology, significant winds (of up to 3 m/s) are not a feature of the area, as the percentage occurrence of such winds does not exceed, or approach, the 30% threshold during any period. Therefore, the INP states that analysis of noise impact under significant wind does not need to be undertaken as part of this assessment.

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 night-time during winter, or about 2 nights per week.

Local weather records are not sufficient to determine whether temperature inversion is a feature of the area. Therefore, as per INP methodology, temperature inversion is assumed to occur during the night-time period, and has been taken into account as part of this assessment.

Drainage flow

The INP requires that drainage flow be taken into account where the receiver is at a lower altitude than the development, and where there is no intervening topography to prevent such flow. The receiver "Athlone" is at an altitude that is lower than the development and, although not line of sight, there is no significant intervening topography. Therefore calculations under drainage flow conditions will be undertaken for the receiver "Athlone".

8 ASSESSMENT OF NOISE IMPACTS

8.1 Noise Modelling Parameters

A computer model was used to predict the noise emissions from the project site. The Environmental Noise Model (ENM) used, has been produced in conjunction with the EPA. A map giving all relevant topographic information was digitised into the computer. The model 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 nine residences which represent the nearest, most potentially affected, residential receiver locations. Noise levels under calm atmospheric conditions and prevailing weather conditions were modelled.

Topographic data used in the ENM for the limestone kiln is the same as was used for the Galong Limestone Mine Expansion. The following information has been used:

- A map of the immediate area around the mine supplied by R W Corkery & Co Pty Ltd. This map has been produced by Geo-Spectrum (Australia) Pty. Limited, from a 1:10000 scale aerial photograph flown 10 July 2002. Contour interval is 1 m.
- To provide topography that extended from the site to the residential receiver locations, Richard Heggie Associates digitised contours from a 1:50000 scale Binalong topographic map produced by the Central Mapping Authority of NSW. The contour interval of the map is 20 m.

8.2 Construction Noise Assessment

Noise modelling has been undertaken to determine noise levels at the nearest residences for the construction phase of the development assuming all construction equipment is operating simultaneously. This will represent the worst-case scenario, from an acoustic point of view, throughout the expected construction period for the lime kiln and associated facilities.

The predicted noise emission levels for the selected construction scenario to potentially affected receivers have been calculated with the following equipment usage and meteorological parameters:

- Three pieces of every item of plant and equipment were assumed to operate on the site simultaneously. This is likely to represent a conservative estimate which allows for most eventualities.
- During calm conditions (ie 20°C air temperature, 65% relative humidity, 0 m/s wind speed and 0°C/100m temperature gradient.

The results of noise modelling for the construction phase of the development, contained in **Table 8.2.1**, show that the predicted construction noise level is well below both the construction noise level goal for all construction periods, including a construction period of greater than 26 weeks. The predicted construction noise level is also below the assumed RBL of 30 dBA. It is likely that construction noise will be inaudible for most of the time at all receiver locations, meaning the extended hours of 6.00 am to 6.00 pm should pose no problem to nearby residential locations. The proponent will ensure that noisy activities are scheduled to occur, where possible, between the hours of 7.00 am to 6.00 pm Monday to Friday and 7.00 am to 1.00 pm Saturday.

Table 8.2.1 Noise Modelling Results - Construction Phase

Location	Predicted Noise Level (LA10 dBA)
1 "Athlone"	<30
2 "Beulambil"	<30
3 Brown Residence*	<30
4 "Hilltop"*	<30
5 Galong	<30
6 "Highview"	<30
7 "Cherryvale"	<30
8 "Glenroy"	<30
9 "Woodstock"	<30

* The Brown residence and "Hilltop" are mine-related residences, as they, and the existing Galong Limestone Mine are situated on land owned by The Bobbara Pastoral Company Pty Ltd.

8.3 Operational Noise Assessment

The results of noise modelling under both calm and prevailing weather conditions (temperature inversion and drainage flow where applicable) are shown in **Table 8.3.1**, **Table 8.3.2** and **Table 8.3.3** respectively.

The predicted noise emission levels for the selected scenarios to potentially affected receivers have been calculated with the following operational and meteorological parameters:

Operational Parameters

- The screen houses are in enclosures constructed from metal sheeting with a minimum thickness of 0.8 mm.
- The top of the kiln and the skip hoist are enclosed. The enclosure is constructed from metal sheeting with a minimum thickness of 0.8 mm.
- Operation of all equipment is continuous, and all equipment operates simultaneously.
- The piston blowers are located in a concrete enclosure with acoustic vents at the foot of the kiln.

Meteorological parameters

- During calm conditions (ie 20°C air temperature, 65% relative humidity, 0 m/s wind speed and 0°C/100 m temperature gradient.
- During temperature inversion conditions and drainage flow for "Athlone" (ie 10°C air temperature, 65% relative humidity, 2m/s wind speed from source to receiver and minus 3.0°C/100 m temperature gradient.
- During temperature inversion conditions (ie 10°C air temperature, 65% relative humidity, 0 m/s wind speed and minus 3.0°C/100 m temperature gradient.

Table 8.3.1 Noise Modelling Results - Calm Weather Conditions

Location	Period	Predicted Noise Level (LAeq dBA)		
		Mine	Kiln	Mine and Kiln
1 "Athlone"	Daytime	<30	<30	<30
	Evening	<30	<30	<30
	Night-time	<30	<30	<30
2 "Beulambil"	Daytime	<30	<30	<30
	Evening	<30	<30	<30
	Night-time	<30	<30	<30
3 Brown Residence	Daytime	<30	<30	<30
	Evening	<30	<30	<30
	Night-time	<30	<30	<30
4 "Hilltop"	Daytime	<30	<30	<30
	Evening	<30	<30	<30
	Night-time	<30	<30	<30
5 Galong	Daytime	<30	<30	<30
	Evening	<30	<30	<30
	Night-time	<30	<30	<30
6 "Highview"	Daytime	<30	<30	<30
	Evening	<30	<30	<30
	Night-time	<30	<30	<30
7 "Cherryvale"	Daytime	<30	<30	<30
	Evening	<30	<30	<30
	Night-time	<30	<30	<30
8 "Glenroy"	Daytime	<30	<30	<30
	Evening	<30	<30	<30
	Night-time	<30	<30	<30
9 "Woodstock"	Daytime	<30	<30	<30
	Evening	<30	<30	<30
	Night-time	<30	<30	<30

Note: The mining scenario used for the assessment is based upon the 40 year mine plan. This is the worst case mine plan, where the extent of mining is at the closest point to the nearest residences.

Table 8.3.2 Noise Modelling Results - Temperature Inversion

Location	Period	Predicted Noise Level (LAeq dBA)		
		Mine	Kiln	Mine and Kiln
1 "Athlone"	Night-time	<30	<30	<30
2 "Beulambil"	Night-time	<30	<30	<30
3 Brown Residence	Night-time	35	30	36
4 "Hilltop"	Night-time	32	30	34
5 Galong	Night-time	<30	<30	31
6 "Highview"	Night-time	<30	<30	30
7 "Cherryvale"	Night-time	<30	<30	31
8 "Glenroy"	Night-time	<30	<30	33
9 "Woodstock"	Night-time	<30	<30	<30

Note: The mining scenario used for the assessment is based upon the 40 year mine plan. This is the worst case mine plan, where the extent of mining is at the closest point to the nearest residences, and noise levels received at the residences are at their highest.
The Brown residence and "Hilltop" are mine-related residences, as they and the existing Galong Limestone Mine are situated on land owned by the Bobbara Pastoral Company Pty Ltd.

Table 8.3.3 Noise Modelling Results - Temperature Inversion and Drainage Flow

Location	Period	Predicted Noise Level (LAeq dBA)		
		Mine	Kiln	Mine and Kiln
1 "Athlone"	Night-time	<30	<30	<35

The noise modelling results demonstrate that the operation of a lime kiln, on the Galong Limestone Mine site, will meet the project specific L_{Aeq} noise level goals during daytime, evening and night-time at all residential locations.

The cumulative impact of the limestone mine and the lime kiln operation will meet all project specific noise level goals at all residential locations except for a 1 dBA exceedance at the Brown Residence during temperature inversion conditions when the kiln operation is combined with the 30 year mine plan.

In order to determine sleep disturbance noise levels, the operations and equipment used on the site that exhibited the highest maximum noise levels were used. The loudest LAmax noise levels will be produced by limestone being loaded into an empty bin.

The highest LAmax noise levels were found to emanate from empty limestone, coal and final product bins as the product first hits the base of the bin. Once the bins are partially full noise levels will decrease significantly.

The results of this assessment are presented in **Table 8.3.3**.

Table 8.3.3 Predicted Maximum Operational Noise Levels

Residence	LAmax noise level (dBA) Limestone being Loaded into Empty Bin		Noise Level Goal LA1(1 minute)*
	Calm	Temperature Inversion	
1 "Athlone"	<30	<30	45
2 "Beulambil"	<30	<30	45
3 Brown Residence	<30	<30	45
4 "Hilltop"	<30	<30	45
5 Galong	<30	<30	45
6 "Highview"	<30	<30	45
7 "Cherryvale"	<30	<30	45
8 "Glenroy"	<30	<30	45
9 "Woodstock"	<30	<30	45

* Based upon an assumed RBL of 30 dBA.

The noise modelling results show the LAmax noise level of the kiln to be below the project specific noise level goal under both calm and prevailing weather conditions at all residential receiver locations. As maximum noise levels are highly unlikely to occur simultaneously, and based upon the fact that the Galong Limestone Mine meets the requirements for sleep disturbance, no cumulative impact of LA1(1 minute) sleep disturbance noise levels is necessary.

8.3 Road Traffic Noise

Construction

Traffic generation during construction is likely to include:

1. Utility and service vehicles as required.
2. Minibuses to convey personnel to and from the site. Likely to operate morning, afternoon and up to two other times per day.
3. Delivery vehicles for fuel and consumables and maintenance vehicles. Up to 5 per day.
4. Concrete trucks as required. Generally, there is likely to be 1 every 20 minutes during a concrete pour. This would be an irregular event, and is likely to occur for up to 15 days of the nine month construction period.

Consistent with the Galong Limestone Mine expansion we recommend that heavy vehicle traffic occur only during the daytime period (7.00 am to 10.00 pm). To keep the rise in road traffic noise below the 2dBA increase recommended under the ECRTN, a maximum increase of 19 heavy vehicles per hour, during the daytime period (7.00 am to 10.00 pm), would be allowable. This number is far greater than the likely increase in traffic due to construction of the kiln.

It is also important to note that construction traffic is only temporary, with traffic noise levels likely to increase only for the construction period.

Operation

There will be no increase in road traffic numbers, and no significant difference in the ratio of heavy vehicles to light vehicles, as a result of the operation of the lime kiln, which simply involves further processing of product prior to despatch to market.

9 CONCLUSION

Richard Heggie Associates have undertaken an acoustic assessment for the construction and operation of a lime kiln at the Galong Limestone Mine, Eubindal Road, Galong.

Noise modelling has been undertaken for calm and prevailing weather conditions where appropriate.

The noise modelling results indicate that the construction and operation of a lime kiln at the Galong Limestone Mine site is predicted to meet all project specific noise level goals during construction, and for operation during daytime, evening and night-time at all residential locations.

The cumulative impact of the mine and the kiln demonstrates that compliance will be achieved at all residential locations for all periods of operation, except for a 1 dBA exceedance of the intrusiveness noise level at the Brown Residence (a mine-related residence) under temperature inversion when the 30 year mine plan is combined with kiln operation. This is primarily the result of mine operation rather than kiln operation, with the two dominant noise sources being the jaw crusher and rock drill. Such an exceedance is unlikely to be perceivable to the human ear and is only likely to occur for a short period of time.

Road traffic noise levels for both the construction and operation of the lime kiln are predicted to be within the 2 dBA increase in $L_{Aeq(1hour)}$ noise level allowable under the ECRTN.

Job Number 30-1250 Galong Limestone Kiln

Job Description Blue Circle Southern

Equipment Description	Octave Band Centre Frequency (Hz) - dBL re 1pW									dBA
	31.5	63	125	250	500	1k	2k	4k	8k	Overall
Construction										
140 tonne crane	102	109	99	99	102	100	98	92	90	104
40-50 tonne crane - Tasman	99	106	96	96	99	97	93	89	87	101
Concrete pump	97	105	103	105	107	105	104	101	96	111
Concrete Trucks	97	105	103	105	107	105	104	101	96	111
Graders - CAT 240G	103	109	111	112	108	106	101	96	83	111
Excavators - CAT225 - at Galong	103	104	107	103	104	99	94	86	76	104
Loaders - CAT988B	111	111	119	112	111	107	106	98	90	113
Backhoes - Tasman	85	94	93	92	97	94	88	101	95	104
Bobcats - possibly	108	111	106	98	96	97	94	86	82	101
Pile Auger Drilling Machine	107	117	106	101	107	109	111	113	110	118
Compressors 100CFM	108	102	98	93	90	86	86	79	73	93
Mobile Welders (incorporating generator)	109	112	113	110	101	102	99	93	84	107
Refractory Bricksaws	73	74	82	90	100	96	103	110	106	113
Operation										
Conveyor CO1 Drive (from jaw crusher to screens)	94	102	100	98	100	103	102	93	86	107
Conveyor CO4 Drive (from screens to stockpile)	94	102	100	98	100	103	102	93	86	107
Conveyor CO5 Drive (from stockpile to limestone bin)	94	102	100	98	100	103	102	93	86	107
Limestone Screen1 - single deck Primary Screen	97	92	85	91	85	97	95	90	83	101
Limestone bin - feeder for kiln	102	113	114	108	112	112	108	107	102	116
Limestone skip hoist - to kiln feeder	111	116	113	114	115	111	109	102	93	116
Roll Crusher - product	94	113	114	112	111	108	104	100	94	113
product elevator - to screens	101	96	92	90	96	86	92	72	63	97
Quicklime Screen 1 - final product (16'x6' product)	112	114	114	106	105	104	105	105	101	111
Quicklime bin south - sales	112	113	114	108	112	112	108	107	102	116
Bulcklime bin north- sales	112	113	114	108	112	112	108	107	102	116
Coal hopper - FEL loading hopper	111	107	101	98	99	103	108	102	99	108
Coal elevator - at storage silo near existing buildings	101	96	92	90	96	86	92	72	63	97
Coal bin - storage before milling	112	113	114	108	112	112	108	107	102	116
Coal blower fan - blows coal dust into kiln	111	110	109	105	104	102	94	89	81	106
Transformer 132KVA to 11 KVA	82	81	93	91	79	71	68	63	58	85
Baghouse fan	109	109	106	101	103	101	98	95	86	105
Rotary Piston Blowers (bank of 6 @110 dBA each)	131	127	123	118	115	111	111	104	98	118
Compressors 100CFM	108	102	98	93	90	86	86	79	73	93

Appendix A
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Appendix B

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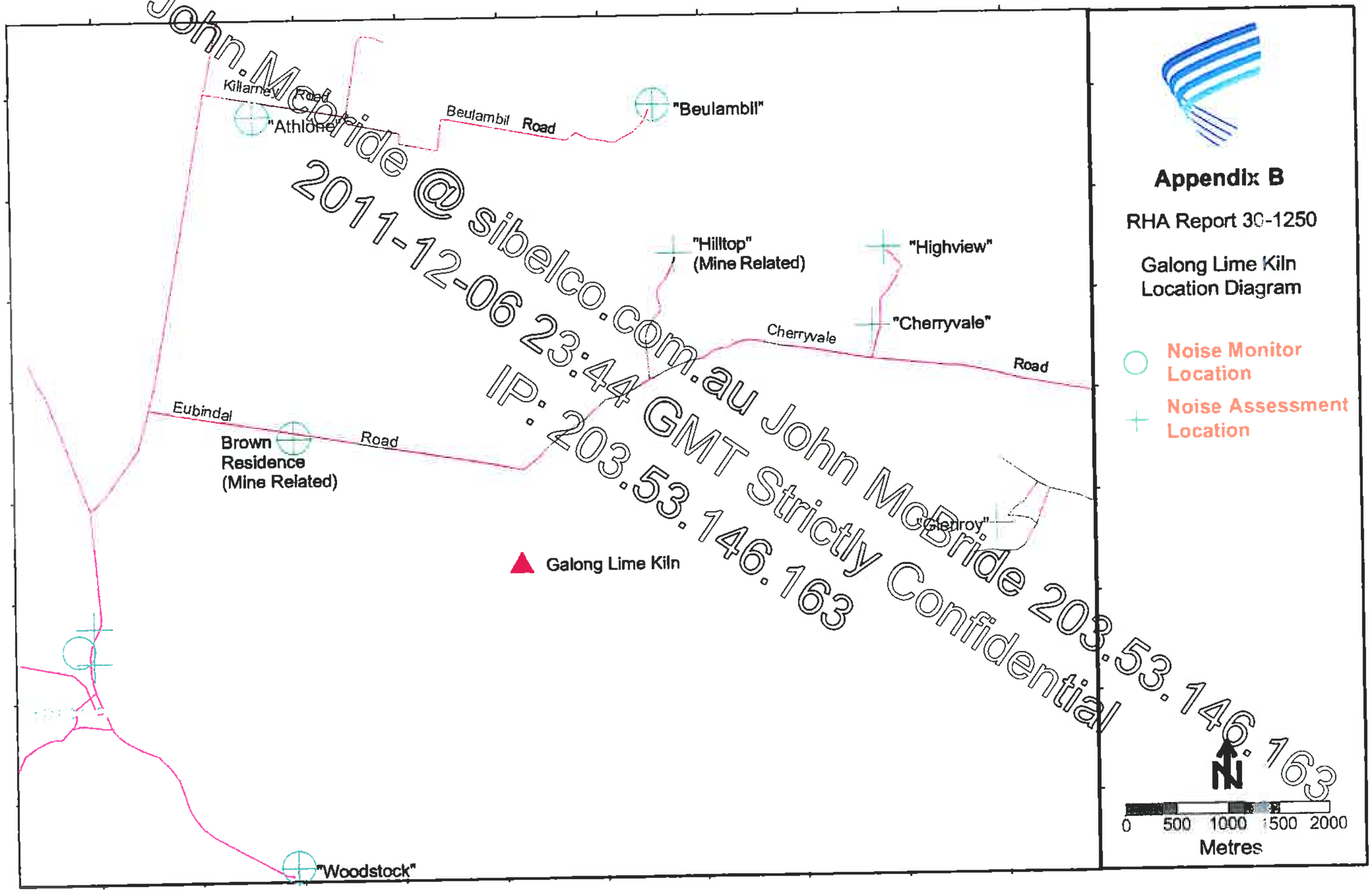
Galong Lime Kiln Location Diagram



AIR QUALITY IMPACT ASSESSMENT
GALONG LIME KILN PROJECT

FINAL June 2003

Prepared for Olsen Environmental Consulting

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FIGURES

(all figures are at the end of the report)

APPENDICES

1 INTRODUCTION

This report has been prepared by Holmes Air Sciences on behalf of Olsen Environmental Consulting, who in turn are acting for Blue Circle Southern Cement Pty Limited. Blue
Circle Southern cement recently purchased Barnu Pty Limited who are the proponents of the Galong Lime Kiln Project.

The report provides an air quality assessment of the proposed expansion of the Galong Limestone Mine and the installation of a lime kiln.

The methodology used in the assessment follows that set out in the NSW EPA's guidelines entitled "Approved Methods and Guidance For the Modelling and Assessment of Air Pollutants in New South Wales" **(NSW EPA, 2001)**.

2 LOCAL SETTING AND PROJECT DESCRIPTION

The existing plant is located approximately 4.52 km north-east of Galong, in the NSW Southern Highlands. The site is relatively flat and the surrounding area is gently undulating with a ridge to the west of the site. The local terrain has been included in the dispersion modelling. **Figure 1** shows the location of the site and **Figure 2** shows a 3-dimensional plot of the area.

Barnu are seeking to expand mine production and then install a lime kiln. A previous EIS has addressed the Mine Expansion Project. This report forms part of the EIS for the Lime Kiln Project and addresses cumulative impacts with the Mine Expansion and the Lime Kiln.

The proposed expansion of the mine would comprise:

- Expansion of the mining operations deeper and to the north of the existing open-cut mine to enable the recovery of 20 Mt of high-grade limestone.
- Increase mining of limestone to 500,000 t/y
- Operate all four grinding mills concurrently
- Transport of up to 350,000 t/y of crushed and milled limestone products from the mine.

The Proponent, Barnu, is seeking to mine more limestone than would be transported off-site, The proposed Lime Kiln will produce up to 150,000 t/y of quicklime. This would require approximately 300,000 t of limestone. The remaining 200,000 t would be milled for agricultural lime.

3 AIR QUALITY CRITERIA

3.1 Introduction

The New South Wales Environment Protection Authority (EPA) has historically noted air quality goals for nitrogen dioxide, carbon monoxide determined by the World Health Organisation (WHO), the United States Environmental Protection Agency (US EPA) and the National Health and Medical Research Council of Australia (NHMRC). Air quality goals for hydrocarbons have been used previously, but these have been discarded because they are not specific for **reactive** species which are the important elements in the formation of photochemical smog.

The National Environment Protection Council of Australia (NEPC) has determined a new set of air quality goals for adoption at a national level, which are part of the National Environment Protection Measures (NEPM). In its publication "Action for Air" (**NSW EPA, 1998**), the NSW EPA has adopted new air quality goals for nitrogen dioxide. These make the NSW standards for these emissions consistent with the NEPM standards.

Ground-level concentration (glc) criteria are specified by NSW EPA for odorous and toxic air pollutants. In addition, a recently published Draft National Environment Protection Measure for Air Toxics (**NEPM, 2003**) sets "investigation level" concentrations for benzene, benzo[a]pyrene (BaP) (as a marker for PAHs), formaldehyde, toluene and xylenes. "Investigation level" means that if the set concentration is exceeded then an appropriate form of further investigation and evaluation is required.

The expansion of the mine will result in emissions of dust, which includes total suspended particles (TSP) and particulate matter less than 10 microns (PM_{10}). The operation of the kiln will result in emissions of PM_{10}, nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and trace emissions of some metals and air toxics, including copper, lead, polycyclic aromatic hydrocarbons (PAHs), dioxins and furans. The common pollutants from lime kilns are detailed in the NPI Emission Estimation Technique Manual for Lime and Dolomite Manufacturing (**NPI, 1999**) and are presented in **Table 1** with the NSW EPA assessment criteria. For pollutants which NSW EPA does not have assessment criteria, the criteria have been sourced from other bodies, including the Victoria EPA (VEPA), the World Health Organisation (WHO), the US EPA Integrated Risk Information System (IRIS) and the California Office of Environmental Health Hazard Assessment (OEHHA).

It should be noted that the assumed emission rates (see **Section 6.2**) for pollutants other than the criteria pollutants were drawn from the NPI database.

Comparisons are also made against the inhalation unit risks of an air pollutant which is defined as "the additional lifetime cancer risk occurring in a hypothetical population in which all individuals are exposed continuously from birth throughout their lifetimes to a concentration of 1 µg/m^3 of the agent in the air they breathe".

Appendix A presents details of the health impacts associated with these pollutants.

Table 1: Impact assessment criteria for pollutants

Pollutant	Averaging period	Objective/standard ppm	Objective/standard µg/m³	
Criteria pollutants				
NO_2	1-hour 1-year	0.12 0.03	246 62	NSW EPA NSW EPA
SO_2	1-hour 24-hour	0.2 0.08	570 228	NSW EPA NSW EPA
TSP	24-hour Annual	- -	- 90	- NSW EPA
PM_{10}	24-hour Annual	- -	50 30	NSW EPA NSW EPA
Inorganics				
Ammonia	3-minute	0.83	600	NSW EPA
Arsenic	Risk factor of 3.3×10^{-3} for lifetime exposure to 1µg/m³			OEHHA
Beryllium	3-minute	-	0.0[illegible]	NSW EPA
	Risk factor of 2.4×10^{-3} for lifetime exposure to 1µg/m³			OEHHA
Cadmium	Risk factor of 4.2×10^{-3} for lifetime exposure to 1µg/m³			OEHHA
Chromium (VI)	3-minute	-	17	NSW EPA
	Risk factor of 1.5×10^{-1} for lifetime exposure to 1µg/m³			OEHHA
Copper	3-minute Annual	- -	33 100	NSW EPA WHO
Hydrochloric Acid	3-minute	-	200	NSW EPA
Lead	Annual	-	0.5	NEPM
	Risk factor of 1.2×10^{-5} for lifetime exposure to 1µg/m³			OEHHA
Mercury	Annual[b]	-	1.09	WHO
Sulphuric acid	3-minute		33	NSW EPA
Zinc	3-minute	-	33	VEPA
Organics				
Benzene	3-minute Annual	0.033 0.003	100 10	NSW EPA NSW EPA (Investigation Level)
	Risk factor of 1.2×10^{-5} for lifetime exposure to 1µg/m³			OEHHA
Formaldehyde	Annual		19	NSW EPA (Investigation Level)
	Risk factor of 6.0×10^{-6} for lifetime exposure to 1µg/m³			IRIS
Total PAHs[a]	Benzo(a)pyrene used as a indicator compound			
Benzo(a)pyrene	Annual	-	0.0003	NSW EPA (Investigation Level)
	Risk factor of 1.1×10^{-3} for lifetime exposure to 1µg/m³			OEHHA
Total Dioxins/Furans[b]	1-hour	-	0.0003	VEPA
2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)	Risk factor of 3.8×10^{1} for lifetime exposure to 1µg/m³			OEHHA

a) Individual PAH emission rates have been adjusted to the relative potency of BaP
b) Individual dioxin/furan emission rates have been adjusted to the toxic equivalence of 2,3,7,8 TCDD

3.2 *Dust*

In addition to the health goals for pollutant concentrations it is appropriate to consider nuisance goals for inert dust during the excavation period. Early work by the NSW EPA showed that residential areas begin to experience dust related nuisance impacts when annual average dust (insoluble solids) deposition levels exceed 4 g/m^2/month, and that dust impacts would be at unacceptable levels when they reached 10 g/m^2/month (**SPCC, 1986**). In the early 1990s the EPA (**Dean et al., 1990**) refined these criteria in terms of an acceptable increase in dust deposition over the existing background. For example, in residential areas with annual average deposition levels of between 0 and 2 g/m^2/month, an increase of up to 2 g/m^2/month would be permitted before it is considered that a significant degradation of air quality has occurred.

The NSW EPA has adopted this approach in setting air quality goals for deposited dust. **Table 2** shows the maximum acceptable increase in dust deposition over the existing dust levels and the maximum total level allowable as determined by the NSW EPA in their recent publication on air quality goals and assessment procedures (**NSW EPA, 2001**).

Table 2: NSW EPA criteria for dust fallout

Pollutant	Averaging Period	Maximum increase in deposited dust level	Maximum total deposited dust level
Deposited dust	Annual	2 g/m^2/month	4 g/m^2/month

4 METEOROLOGY, CLIMATE AND EXISTING AIR QUALITY

This section describes the dispersion meteorology, general climate and air quality in the study area. As well as information on prevailing wind patterns, historical data on temperature, humidity and rainfall are presented to give a more complete picture of the local climate.

4.1 *Wind data*

An on-site weather station has been in operation since February 2003, **Figure 3** shows a windrose of the data collected between February and April 2003. This shows that winds for this period are predominantly from the south-east, east-south-east and south-south-east.

The dispersion model used in this assessment requires a year of data and as this is not available from the on-site station, a set of site-specific, synthetic meteorological data for Galong were also created using The Air Pollution Model (TAPM) developed by CSIRO.

TAPM is a prognostic model which includes synoptic information determined from the six hourly Limited Area Prediction System (LAPS) (**Puri et al., 1997**). The model is discussed further in the user manual which accompanies the model (see **Hurley, 1999**).

Figure 4 shows the annual and seasonal windroses for 2001 compiled from the data generated using TAPM. This shows a predominant wind direction from the east in the [illegible] the predominant wind directions are shown to be from the west and east, in the spring westerlies are dominant together with a large percentage from the north-east.

It would be preferable to use a year of on-site data, however, in the absence of these data, the TAPM file is considered to be of sufficient quality.

4.2 *Other parameters required for modelling*

The dispersion model used in this study requires further information such as atmospheric stability[1] class and mixed-layer height[2]. These data were all generated using the TAPM model.

As shown in **Table 3**, there are a high percentage of neutral conditions (C and D-class stability). Neutral conditions are associated with relatively strong wind speeds and moderate solar radiation. Under these conditions, emissions will disperse relatively well. There are also a high percentage of E and F-Class stability conditions. Under these conditions of light winds and stable conditions, emissions will disperse slowly.

Table 3: Frequency of occurrence of stability class

Stability Class	Frequency of occurrence
A	2.9%
B	8.3%
C	13.3%
D	56.4%
E	10.1%
F	9.0%

4.3 *Meteorological data*

The closest Bureau of Meteorology station to Galong is located at Yass. The Yass meteorological station is located approximately 40 km to the southeast of the plant and both the mine site and station are at approximately the same elevation, between 510 to 520 m (AHD). The data are summarised in **Table 4**, which shows information on temperature, relative humidity, and rainfall.

---

[1] In dispersion modelling stability class is used to categorise the rate at which a plume will disperse. In the Pasquill-Gifford stability class assignment scheme (as used in this study) there are six stability classes, A through to F. Class-A relates to unstable conditions, such as might be found on a sunny day with light winds. In such conditions plumes will spread rapidly. Class F relates to stable conditions, such as occur when the sky is clear, the winds are light and an inversion is present. Plume spreading is slow in these circumstances. The intermediate classes B, C, D and E relate to intermediate dispersion conditions.

[2] The term mixed-layer height, refers to the height above the ground through which ground-based emissions will eventually be dispersed once a plume has been thoroughly mixed. An elevated plume, initially above the mixed-layer height will remain isolated from the ground until such time as the mixed-layer height reaches the height of the plume. In general the mixed-layer height will increase during the day as the sun causes convection to deepen the turbulent layer of the atmosphere close to the ground. Mixed-layer height will also increase if the wind speed increases because higher wind speeds will increase turbulence as the wind blows over the rough ground.

4.3.1 Temperature

On average January is the warmest month with a mean daily maximum temperature of 29.8 °C and July the coolest with a mean daily maximum of 11.8 °C.

4.3.2 Relative humidity

Relative humidity, dew point and wet bulb temperature data are presented in **Table 4**. This review focuses on the relative humidity data. Relative humidity observed at 9 am is lowest in December (57%) and highest in June (86%). For the 3 pm observations the lowest relative humidity occurs in January and September (37%) and the highest in June (68%).

4.3.3 Rainfall

Mean annual rainfall over 102.3 years of data has been 651.7 mm. On average, the wettest month is September (monthly average 67.3 mm) and the driest is February (monthly average 42.8 mm).

Table 4: Temperature, humidity and rainfall data for Yass (Linton Hostel)

(Station number 070091 Latitude: 34 deg 50 min; Longitude: 148 deg 55 min)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
9am Mean Temperature (oC) and Relative Humidity (%) (103 years of record)													
Dry-bulb	19.9	19.4	17.5	12.8	8.6	5.8	4.7	6.6	10.1	14.1	16.1	18.8	12.9
Humidity	59	65	67	74	83	86	85	81	75	66	61	57	72
3pm Mean Temperature (oC) and Relative Humidity (%) (103 years of record)													
Dry-bulb	27.6	27.2	24.3	19.5	15.1	11.4	10.5	12.3	15.1	18.7	21.9	25.6	19.2
Humidity	37	40	43	49	61	68	67	61	56	52	46	37	52
Daily Maximum Temperature (°C) (103 years of record)													
Mean	29.3	29	25.6	20.9	16.2	12.5	11.5	13.4	16.5	20.4	24	27.7	20.7
Daily Minimum Temperature (°C) (103 years of record)													
Mean	13.8	13.9	11	6.8	4	2.2	1	1.9	4	6.3	9	11.9	7.2
Rainfall (mm) (103 years of record)													
Mean monthly rainfall - mm	51.7	42.8	47.7	50.4	52.4	56.9	59.2	59.5	56.8	67.3	55.2	51.4	651
Raindays (Number (103 years of record)													
Mean no. of raindays	6	4.8	5.4	6.2	7.4	9.9	11	10.6	9.3	8.8	7.1	6.2	92.7

Source: Bureau of Meteorology (http://www.bom.gov.au/climate/averages/).

5 EXISTING AIR QUALITY

Air quality standards and goals refer to pollutant levels which include the project and existing sources. To fully assess impacts against all the relevant air quality standards and goals (detailed in **Section 3.1**) it is necessary to have information or estimates on existing dust concentration and deposition levels in the area in which the project is likely to contribute to these levels.

No air quality measurements have been made specifically for this project and there are no on-site monitoring data and no NSW EPA monitoring sites located in the vicinity. However, as Galong is situated in a rural area with no major sources of air pollution the local air quality is likely to be good and concentrations of pollutants are unlikely to exceed any of the air quality goals.

6 APPROACH TO ASSESSMENT

6.1 Introduction

The AUSPLUME dispersion model (Version 5.4) was used to predict ground-level concentrations of emissions of PM_{10}, NO_2, SO_2, organic and inorganic emissions from the operation of the proposed lime kiln and PM_{10} and dust emissions from the mine expansion. The predicted concentrations have been compared with the NSW EPA's assessment criteria as required in the EPA's modelling guidelines (**NSW EPA, 2001**).

In addition a health risk assessment has been carried out according to the procedure developed by the Committee of the California Air Pollution Control Officers Association. (**CAPCOA, 1993**). This is discussed in further in **Section 7.1.3**. A screening risk level of 1 in a million has been applied to the project. This is the incremental risk level below which the NSW EPA does not require a more detailed assessment to be carried out.

6.2 Emissions from lime kiln stack

For the stack emissions, the model has been used to predict concentrations of emissions at a set of receptors arranged at 200 metres spacing for 14 km x 10 km around the plant. Eight discrete receptors were also positioned in the vicinity of the closest sensitive receptors. **Figure 5** shows the location of these receptors.

As discussed in **Section 3**, emissions from the kiln stack will include the criteria pollutants PM_{10}, NO_x, and SO_2, air toxics and metals. The kiln will be fitted with a baghouse filter to control emissions of particulate matter.

Modelling of stack emissions has been undertaken with the parameters summarised in **Table 5**. **Table 6** presents the criteria pollutant emission rates. These data were supplied by Blue Circle Cement. **Table 7** presents the emission rates of the air toxics and metals in units of kg of substance per tonne of lime produced (kg/t). These data were derived from the NPI Handbook. Using the equation below, and based on the assumption that 150,000 tonnes of lime are produced in the kiln per year, and the kiln operates year round (that is, 8,760 hours per year), the modelled emissions rates in grams per second (g/s) are also presented.

$$\text{Emission rate}\left[\frac{g}{s}\right] = \frac{\text{Emission rate}\left[\frac{kg}{tonne}\right] * \text{Lime produced}\left[\frac{tonne}{yr}\right] * 1000\left[\frac{g}{kg}\right]}{3153600\left[\frac{s}{yr}\right]}$$

Appendix B presents the calculations for PAHs emissions which are expressed as BaP equivalent and dioxin/furan emissions which are expressed as 2,3,7,8 TCDD equivalent.

The output file from a modelling run is included in **Appendix C** to provide the reader with information on the parameters used. Information on local terrain has been obtained from topographic maps of the area. This has been included in the modelling using the Egan half height method.

Table 5: Lime kiln stack parameters

Stack conditions		
Stack height	(m)	47
Ground elevation	(m)	516.3
Location	(AMG)	647241 mE 6170960 mN
Stack diameter (m)	(m)	1.2
Exit Temperature	(°C)	110
Exit Velocity	(m/s)	16
Volumetric flow	(Nm^3/s)	18

Table 6: Lime kiln criteria pollutant emission rates

Substance	Emission Rate (g/s)
PM_{10}	0.25
NO_x	2.58
SO_2	0.645

Table 7: Lime kiln metals and air toxic emission rates

Pollutant	Emission rate (kg/t)	Modelled emission rate (g/s)
Arsenic	6	2.86E-05
Beryllium	0.33	1.57E-06
Cadmium	1.1	5.25E-06
Chromium	3.9	1.86E-05
Chromium VI	.	5.55E-06
Copper	70	3.33E-04
Hydrochloric Acid	25000	1.19E-01
Mercury	110	5.25E-04
Ammonia	460	2.19E-03
Lead	38	1.81E-04
Sulphuric acid	3600	1.71E-02
Selenium	100	4.76E-04
Zinc	170	8.10E-04
Benzene	8000	3.81E-02
Formaldehyde	230	1.10E-03

Total PAHs(b) (expressed as BaP equivalent)	·	6.35E-07
Total Dioxins/Furans(b) (expressed as 2,3,7,8 TCDD equivalent)		[illegible]

Note:

(a) *Chromium VI emissions assumed to 30% of total Cr as per information from Greg Storrier (NPI, 2003)*

(b) *Calculated as detailed in* ***Appendix B***

6.3 Dust modelling

The AUSPLUME dispersion model (Version 5.4) was also used for the dust modelling. The receptor grid was set closer to the source (10 km x 6 km with a spacing of 250 m) as the major impacts would be close to the site. Special receptors were also positioned in the same locations as for the kiln modelling.

The modelling has been based on the use of three particle size categories (0 to 2.5 µm - referred to as $PM_{2.5}$, 2.5 to 10 µm - referred to as CM (coarse matter) and 10 to 30 µm - referred to as the Rest). Emission rates have been developed using emission factor equations provided in the **US EPA (1985)** (and subsequent updates) publication referred to as AP-42 and from factors determined by **NERDDC (1988)** (see **Appendix D**)

The distribution of particles in each particle size range is as follows:

- $PM_{2.5}$ (FP) is 0.0468 of the TSP
- $PM_{2.5-10}$ (CM) is 0.3440 of TSP
- PM_{10-30} (Rest) is 0.6090 of TSP

Modelling was done using three source groups. Each group corresponded to a particle size category. Each source in the group was assumed to emit at the full TSP emission rate and to deposit from the plume in accordance with the deposition rate appropriate for particles with an aerodynamic diameter equal to the geometric mean of the limits of the particle size range, except for the $PM_{2.5}$ group, which was assumed to have a particle size of 1 µm. The predicted concentration in the three plot output files for each group were then combined according to the weightings above to determine the concentration of PM_{10} and TSP.

The AUSPLUME model also has the capacity to take into account dust emissions that vary in time, or with meteorological conditions. This has proved particularly useful for simulating emissions of mining or quarry operations where wind speed is an important factor in determining the rate at which dust is generated.

For the current study the operations were represented by a series of volume sources located according to the site layout. Estimates of emissions for each source were developed on an hourly time step taking into account the activities that would take place at that location. Thus, for each source, for each hour, an emission rate was determined which depended upon the wind speed and assumed 24-hour operations. It is important to do this in the AUSPLUME model to ensure that long-term average emission rates are not combined with worst-case dispersion conditions which are associated with light winds. Light winds in a quarry area correspond with periods of low dust generation (because wind erosion and other wind dependent emissions rates will be low) and also correspond with periods of poor dispersion. If these measures are not taken then the model has the potential to significantly overstate impacts.

Dust concentrations and depositions rates have been predicted in the vicinity of the [illegible] into the dust concentrations estimations however for dust deposition estimations, the AUSPLUME model assumes the terrain is flat.

Details on the activities and estimated dust emissions for the quarry operations are presented below in **Table 8**. It has been assumed that 500,000 t/y of material is mined and 200,000 t/y of material is milled (with the remaining 300,000 t/y being processed in the lime kiln). These estimates assume some control of dust emissions is achievable through the use of watering carts on unsealed areas of the active extraction site. Details of the calculations of the dust emissions are presented in **Appendix D.**

Stage 4 of the mine operation has been assessed as this corresponds to the period of maximum exposed area subject to wind erosion.

Table 8 : Estimated dust emissions due to proposed project activities

Activity	TSP emission rate (kg/y)
Excavator working/loading overburden	194
Scraper working on overburden	6,451
Excavator working/loading limestone	2,500
Blasting	141
Drilling	660
Transporting to overburden emplacement	7,430
Truck dumping to overburden emplacement	194
Transporting to limestone stockpile	48,000
Truck dumping to limestone stockpile	2,500
Loading material to feed bin of crusher	2,500
Primary crushing	750
Milling	1,840
Loading to transport truck	1,750
Transporting material offsite	56,940
Wind erosion from excavation and stockpile areas	79,190
TOTAL	***211,040***

7 ASSESSMENT OF IMPACTS

7.1 Kiln operation

Dispersion modelling was carried out to assess the impacts of the emissions from operation of the kiln. The AUSPLUME model (Version 5.4) was used, incorporating the operating parameters and emissions data outlined in **Section 6.2.**

7.1.1 *Criteria pollutants*

Predictions for the criteria pollutants were made for 24-hour and annual average concentrations of PM_{10}, 1-hour and annual average concentrations of NO_2 and 24-hour and annual average concentrations of SO_2. It has been assumed that the plant may operate for 24-hours per day, and no consideration has been made for variations in emissions by hour of day. **Table 9** presents a summary of the maximum predicted concentrations of PM_{10}, NO_x and SO_x across the whole area and **Table 10** presents the concentrations at the sensitive receptors. This shows that none of the maximum predicted concentrations exceed the NSW EPA air quality criteria discussed in **Section 3**.

Table 9: Maximum predicted concentrations of criteria pollutants				
Pollutant	**Averaging Period**	**Location**		**Maximum concentration (μg/m³)**
		X (m)	Y (m)	
PM_{10}	24-hour	649000	6170800	0.54
	Annual	646400	6170400	0.07
NO_x	1-hour	649000	6170000	64.01
	Annual	646400	6170400	0.73
SO_x	1-hour	649000	6170000	16.00
	24-hour	649000	6170800	1.40
	Annual	646400	6170400	0.18

Table 10: Maximum predicted concentrations of criteria pollutants at sensitive receptors							
Receptor ID	**PM_{10} (μg/m³)**		**NO_x (μg/m³)**		**SO_x (μg/m³)**		
	24-hr	**Annual**	**1-hr**	**Annual**	**1-hr**	**24-hr**	**Annual**
1	1.04E-01	1.62E-02	4.63	1.67E-01	1.16E+00	2.69E-01	4.17E-02
2	1.42E-01	1.30E-02	3.28	1.34E-01	8.21E-01	3.67E-01	3.34E-02
3	1.12E-01	4.87E-03	4.95	5.03E-02	1.24E+00	2.90E-01	1.26E-02
4	7.25E-02	4.82E-03	6.01	4.98E-02	1.50E+00	1.87E-01	1.24E-02
5	9.08E-02	8.43E-03	6.22	8.70E-02	1.56E+00	2.34E-01	2.17E-02
6	1.38E-01	1.26E-02	9.68	1.30E-01	2.42E+00	3.57E-01	3.26E-02
7	5.39E-02	5.46E-03	4.39	5.63E-02	1.10E+00	1.39E-01	1.41E-02
8	7.06E-02	6.28E-03	4.80	6.49E-02	1.20E+00	1.82E-01	1.62E-02

PM_{10}

Contour plots of predicted 24-hour and annual average PM_{10} concentrations are shown in **Figure 6**. The EPA's assessment criterion of 50 μg/m³ (24-hour average) and 30 μg/m³ (annual average) are met everywhere. This would be true even after allowing for a reasonable background level.

NO_2

Predicted 1-hour and annual average NO_2 concentrations (assuming that all NO_x has been converted to NO_2) are shown in **Figure 7**. The EPA's assessment criterion of 246 μg/m³ (1-hour average) and 62 μg/m³ (annual average) are met everywhere. This would be true even after allowing for a reasonable background level.

Note, it has been assumed that the kiln is operated continuously and that all NO_x emissions are in the form of NO_2. Typically only 20% will have been converted to NO_2 by the time the plume has dispersed to the areas where the higher concentrations are found.

SO_2

Predicted maximum 1-hour, 24-hour and annual average SO_2 concentrations (assuming that all SO_x has been converted to SO_2) are shown in **Figure 8**. The EPA's assessment criterion of 570 μg/m³ (1-hour average), 228 μg/m³ (24-hour average) and 60 μg/m³ (annual average) are met everywhere. This would be true even after allowing for a reasonable background level.

7.1.2 *Metals and air toxics*

For the metals and air toxics for which NSW EPA gives ground-level concentration (glc) criteria, 3-minute average predictions were made and the 99.9th percentile is reported. For those pollutants which have an annual average or risk factor is available, annual average predictions were made and the maximum concentration is reported. For dioxins 1-hour average predictions were also made.

Table 11 presents a summary of the maximum predicted concentrations across the grid.

Table 12 presents a summary of the maximum predicted concentrations at the discrete receptors. All the concentrations are below the glc and/or unit risk factors.

Table 11: Metals and air toxics maximum predicted concentrations across area

Location	3-minute average	1-hour average	Annual average
X (m)	649000	649000	646400
Y (m)	6170000	6170000	6170400
	Inorganics		
Pollutant	99.9th percentile ($\mu g/m^3$)	Maximum ($\mu g/m^3$)	Maximum ($\mu g/m^3$)
Ammonia	3.24E-02		
Arsenic			8.09E-06
Beryllium	2.33E-05		4.45E-07
Cadmium			1.48E-06
Chromium VI	8.25E-05		1.58E-06
Copper	4.94E-03		9.44E-05
HCl	1.76E+00		
Lead			5.13E-05
Mercury			1.48E-04
Sulphuric acid	2.54E-01		
Zinc	1.20E-02		
	Organics		
Benzene	5.64E-01		1.08E-02
Formaldehyde			3.11E-04
PAH (as BaP)			1.79E-07
Dioxins (as 2,3,7,8 TCDD)		1.75E-13	2.00E-15

Table 12: Metals and air toxics maximum predicted concentrations at discrete receptors

Pollutant	Averaging period	Receptor ID 1	2	3	4	5	6	7	8
Inorganics (µg/m³)									
Ammonia	3-minute	4.55E-03	3.31E-03	3.70E-03	5.00E-03	6.76E-03	7.74E-03	3.47E-03	4.01E
Arsenic	Annual	1.85E-06	1.48E-06	5.57E-07	5.51E-07	9.62E-07	1.44E-06	6.23E-07	7.18E
Beryllium	3-minute	3.27E-06	2.37E-06	2.66E-06	3.59E-06	4.85E-06	5.55E-06	2.49E-06	2.87E
	Annual	1.02E-07	8.12E-08	3.06E-08	3.03E-08	5.29E-08	7.92E-08	3.43E-08	3.95E
Cadmium	Annual	3.39E-07	2.71E-07	1.02E-07	1.01E-07	1.76E-07	2.64E-07	1.14E-07	1.32E
Chromium VI	3-minute	1.16E-05	8.41E-06	9.42E-06	1.27E-05	1.72E-05	1.97E-05	8.82E-06	1.02E
	Annual	3.60E-07	2.88E-07	1.09E-07	1.07E-07	1.88E-07	2.81E-07	1.21E-07	1.40E
Copper	3-minute	6.93E-04	5.03E-04	5.64E-04	7.61E-04	1.03E-03	1.18E-03	5.28E-04	6.10E
	Annual	2.16E-05	1.72E-05	6.50E-06	6.43E-06	1.12E-05	1.68E-05	7.27E-06	8.37E
HCl	3-minute	2.47E-01	1.80E-01	2.01E-01	2.72E-01	3.68E-01	4.21E-01	1.89E-01	2.18E
Lead	Annual	1.17E-05	9.35E-06	3.53E-06	3.49E-06	5.10E-06	9.12E-06	3.94E-06	4.54E
Mercury	Annual	3.39E-05	2.71E-05	1.02E-05	1.01E-05	1.76E-05	2.64E-05	1.14E-05	1.32E
Sulphuric acid	3-minute	3.56E-02	2.59E-02	2.90E-02	3.92E-02	5.29E-02	6.06E-02	2.72E-02	3.14E
	Annual	1.11E-03	8.86E-04	3.34E-04	3.30E-04	5.77E-04	8.64E-04	3.74E-04	4.31E
Zinc	3-minute	1.68E-03	1.22E-03	1.37E-03	1.85E-03	2.50E-03	2.86E-03	1.28E-03	1.48E
	Annual	5.24E-05	4.18E-05	1.58E-05	1.56E-05	2.73E-05	4.08E-05	1.76E-05	2.03E
Organics (µg/m³)									
Benzene	3-minute	7.92E-02	5.75E-02	6.44E-02	8.70E-02	1.18E-01	1.35E-01	6.03E-02	6.97E
	Annual	2.46E-03	1.97E-03	7.42E-04	7.34E-04	1.28E-03	1.92E-03	8.30E-04	9.57E
Formaldehyde	Annual	7.08E-05	5.66E-05	2.13E-05	2.11E-05	3.69E-05	5.52E-05	2.39E-05	2.75E
PAH	Annual	4.07E-08	3.27E-08	1.23E-08	1.22E-08	2.13E-08	3.18E-08	1.38E-08	1.59E
Dioxins	1-hr	1.27E-14	8.98E-15	1.35E-14	1.64E-14	1.70E-14	2.65E-14	1.20E-14	1.31E
	Annual	4.56E-16	3.66E-16	1.38E-16	1.36E-16	2.38E-16	3.56E-16	1.54E-16	1.77E

Ammonia

Predicted 99.9th percentile 3-minute average ammonia concentrations are shown in **Figure 9**. The EPA's assessment criterion of 600 µg/m³ is met everywhere.

Arsenic

Predicted annual average arsenic concentrations are shown in **Figure 10**. The maximum predicted concentration of arsenic is 8.09E-06 µg/m³, when multiplied by the arsenic risk factor of 3.30E-03, the predicted risk of 2.67E-08 is below the NSW guideline of 1 in a million.

Beryllium

Predicted 99.9th percentile 3-minute and annual average beryllium concentrations are shown in **Figure 11**. The EPA's 3-minute average assessment criterion of 0.07 µg/m³ is met everywhere.

The maximum predicted annual average concentration of beryllium is 4.45E-07 µg/m³, when multiplied by the beryllium risk factor of 2.40E-03, the predicted risk of 1.07E-09 is below the NSW guideline of 1 in a million.

Cadmium

Predicted annual average cadmium concentrations are shown in **Figure 12**. The maximum predicted concentration of cadmium is 1.48E-06 µg/m³, when multiplied by the cadmium risk factor of 4.20E-03, the predicted risk of 6.23E-09 is below the NSW guideline of 1 in a million.

Chromium VI
Predicted 99.9th percentile 3-minute and annual average chromium concentrations are shown in **Figure 13**. The EPA's 3-minute average assessment criterion of 17 μg/m³ is met everywhere.

The maximum predicted annual average concentration of chromium VI is 1.58E-06 μg/m³, when multiplied by the chromium risk factor of 1.50E-01, the predicted risk of 2.37E-07 is below the NSW guideline of 1 in a million.

Copper
Predicted 99.9th percentile 3-minute and annual average copper concentrations are shown in **Figure 14**. The EPA's 3-minute assessment criterion of 33 μg/m³ is met everywhere, as is the WHO annual average assessment criterion of 100 μg/m³.

Hydrochloric Acid
Predicted 99.9th percentile 3-minute average hydrochloric acid concentrations are shown in **Figure 15**. The EPA's assessment criterion of 200 μg/m³ is met everywhere.

Lead
Predicted annual average lead concentrations are shown in **Figure 16**.The EPA's assessment criteria for lead of 0.5 μg/m³ is met everywhere.

The maximum predicted annual average concentration of lead is 5.13E-05 μg/m³, when multiplied by the lead risk factor of 1.20E-05, the predicted risk of 6.15E-10 is below the NSW guideline of 1 in a million.

Mercury
Predicted annual average mercury concentrations are shown in **Figure 17**.The WHO assessment criteria for mercury of 1.00 μg/m³ is met everywhere.

Sulphuric acid
Predicted 99.9th percentile 3-minute average sulphuric acid concentrations are shown in **Figure 18**. The EPA's assessment criterion of 33 μg/m³ is met everywhere.

Zinc
Predicted 99.9th percentile 3-minute average zinc concentrations are shown in **Figure 19**. The Victorian EPA's assessment criterion of 33 μg/m³ is met everywhere.

Benzene
Predicted 99.9th percentile 3-minute and annual average benzene concentrations are shown in **Figure 20**. The EPA's 3-minute average assessment criterion of 17 μg/m³ is met everywhere.

The maximum predicted annual average concentration of benzene is 1.08E-02 μg/m³, when multiplied by the benzene risk factor of 1.20E-05, the predicted risk of 1.30E-07 is below the NSW guideline of 1 in a million.

Formaldehyde

Predicted annual average formaldehyde concentrations are shown in **Figure 21**. The EPA's assessment criteria for formaldehyde of 19 µg/m³ is met everywhere. [illegible] of formaldehyde is 3.1[illegible]E-04 µg/m³, when multiplied by the formaldehyde risk factor of 6.00E-06, the predicted risk of 1.86E-09 is below the NSW guideline of 1 in a million

PAH's (as BaP)
Predicted annual average benzo(a)pyrene concentrations are shown in **Figure 22**. The EPA's investigation level for benzo(a)pyrene of 0.0003 µg/m³ is met everywhere.

The maximum predicted annual average concentration of benzo(a)pyrene is 1.79E-07 µg/m³, when multiplied by the benzo(a)pyrene risk factor of 1.10E-03, the predicted risk of 1.97E-10 is below the NSW guideline of 1 in a million

Dioxins (as 2,3,7,8 TCDD)
Predicted annual average 2,3,7,8 TCDD concentrations are extremely low and therefore have not been plotted as contour plots.

The maximum predicted 1-hour average concentration of 2,3,7,8 TCDD is 3.50E-13 µg/m³, this is substantially lower than the VEPA standard of 0.0003 µg/m³.

The maximum predicted annual average concentration of 2,3,7,8 TCDD is 2.00E-15 µg/m³, when multiplied by the 2,3,7,8 TCDD risk factor of 3.80E+01, the predicted risk of 7.60E-14 is below the NSW guideline of 1 in a million

7.1.3 Health Risk Assessement

In addition to dispersion modelling to predict the ground-level concentrations of the individual pollutants, a cumulative health risk assessment has been carried out according to the procedure developed by the Committee of the California Air Pollution Control Officers Association (**CAPCOA, 1993**).

An assessment was made based on carcinogenic properties of total dioxins (as 2,3,7,8 TCDD), total PAHs (as BaP), arsenic, benzene, beryllium, cadmium, chromium VI, formaldehyde, and lead. Multiple exposure pathways have been assessed and it has also been assumed that 25% of produce consumed is homegrown.

The individual risks factors are presented in **Table 1** and as discussed in Section **7.1.2**, the individual predicted impacts for each of the compounds are below the NSW guideline of 1 in a million. The cumulative impact of all the compounds assessed are also shown to be below the 1 in a million screening guideline. The health risk assessment output is presented in **Appendix E**

7.2 Mining

Dispersion modelling was carried out to assess the impacts of the emissions from operation of the kiln. The AUSPLUME model (Version 5.4) was used, incorporating the operating parameters and emissions data outlined in **Section 3.2**. An output from the modelling is presented in **Appendix F**.

Table 13 presents a summary of the maximum predicted concentrations at the discrete receptors of PM_{10}, TSP and dust deposition concentrations. All the predictions are substantially below the NSW EPA air quality guidelines. **Figures 23** to **Figure 25** show contour plots of the predicted concentrations.

Table 13: Maximum predicted PM_{10}, TSP and dust deposition concentrations

Receptor ID	PM_{10} Annual average ($\mu g/m^3$)	TSP Annual average ($\mu g/m^3$)	PM_{10} 24-hour average ($\mu g/m^3$)	TSP 24-hour average ($\mu g/m^3$)	Dust deposition (g/m^2/month)
1	0.24	0.45	1.88	3.78	0.087
2	0.26	0.52	2.11	4.61	0.117
3	0.16	0.26	3.02	6.65	0.024
4	0.07	0.09	1.28	1.82	0.006
5	0.08	0.11	0.87	1.28	0.012
6	0.08	0.12	0.75	1.18	0.017
7	0.04	0.05	0.66	0.96	0.005
8	0.05	0.07	0.88	1.16	0.006

7.3 *Greenhouse emissions*

The major greenhouse emissions from the project will be the carbon dioxide emissions from the calcining process. These emissions would be equivalent to approximately 44% of the total limestone processed. Assuming an annual processing rate of 300,000 tonnes, carbon dioxide emissions would be 132,000 tonnes.

In addition, greenhouse emissions would arise from consumption of electricity, diesel and fuel consumption within the kiln.

Consumption of electricity is estimated to be 45 kWh per tonne of lime produced (150,000 tonnes). On an annual basis this is equivalent to 6.75×10^6 kWh. The **Australian Greenhouse Office (2003)** has published a workbook which provides emission factors for a range of electricity sources. Typical emission factors for electricity sent out in NSW/ACT are 1.012 kg CO_2–e/kWh. Therefore the total CO_2 equivalent emissions from electricity consumption are 6,831 tonnes (1.012 x 45 x 150,000/1,000).

It is also estimated that 10,000 litres of diesel fuel would be consumed on site. The emission factor for diesel, taking account of the full fuel cycle analysis, is 3 kg CO_2–e/kL of fuel. Therefore total emissions would be 0.03 tonnes (3.0 x 10,000/1,000).

It is proposed to use black coal as a combustion source in the kiln. The emission factor from the fuel cycle analysis for black coal is 98.1 kg CO_2–e/GJ. This corresponds to an annual emission rate, assuming that the coal would be consumed at the rate of 504,000 GJ per annum, of 49,442 tonnes (98.1 x 504,000/1,000). Blue Circle Cement are actively pursuing alternative fuel sources for their kiln.

Table 14 summarises the total estimated greenhouse emissions from activities at the site based on the above information provided by Blue Circle Cement.

The total estimated annual emissions of 178,544.03 t can then be compared with 458.2 Mt CO_2 equivalent estimated by Environment Australia to have been produced by Australia in reference year 1999 (excluding land clearing, see http://www.greenhouse/facts/pdfs/nggifs1s.pdf). The total greenhouse gas emissions for the project are therefore estimated to be 0.04% of Australia's 1999 emissions.

Table 14- Total greenhouse emissions (CO_2 equivalent) from on-site activities.

Activity	Tpa
Calcining of limestone	132,000
Electricity consumption	6,831
Diesel fuel usage	0.03
Coal burning	49,442
Total	188,273.03

7.4 Cumulative impact of kiln and mine operation

The cumulative impact of PM_{10} emissions from operation of both the kiln and mine has not been modelled. However, the maximum predicted 24-hour average concentrations of PM_{10} at any of the discrete receptors is 0.14 µg/m^3 from the kiln operation and 3.02 µg/m^3 from operation of the mine. Simple summation of these emissions gives 3.16 µg/m^3 which is substantially lower than the EPA guideline of 50 µg/m^3.

The maximum predicted annual average concentrations of PM_{10} at any of the discrete receptors is 0.016 µg/m^3 from the kiln operation and 0.26 µg/m^3 from operation of the mine. Simple summation of these emissions gives 0.28 µg/m^3 which is substantially lower than the EPA guideline of 30 µg/m^3.

It is therefore unlikely that any of the EPA guidelines will be exceeded.

8 CONCLUSIONS

The following conclusions have been drawn from the analysis contained in this report:

1. Emissions due to operation of the kiln will meet all ambient air quality standards set by the EPA.
2. The individual and cumulative health risk impacts of air toxics from operation of the kiln are substantially lower than the EPA 1 in a million screening guideline.
3. Emissions due to mining activities should cause no air quality impact on nearby residential areas.

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Appendix A - Health effects of pollutants

HEALTH EFFECTS OF POLLUTANTS

Carbon monoxide

Carbon monoxide can be harmful to humans because its affinity for haemoglobin is more than 200 times greater than that of oxygen. When it is inhaled it is taken up by the blood and therefore reduces the capacity of the blood to transport oxygen. This process is reversible and reducing the exposure will lead to the establishment of a new equilibrium with a period of three hours being the approximate time required to reach fifty percent of the equilibrium value.

Symptoms of carbon monoxide intoxication are lassitude and headaches, however these are generally not reported until the concentrations of carboxyhaemoglobin in the blood are in excess of ten percent of saturation. This is approximately the equilibrium value achieved with an ambient atmospheric concentration of 70 mg/m^3 for a person engaged in light activity. However, there is evidence that there is a risk for individuals with cardiovascular disease when the carboxyhaemoglobin concentration reaches four percent and the WHO recommends that ambient concentrations be kept to values which would protect individuals from exceeding the four percent level.

The 15-minute, 1-hour and 8-hour goals noted by the EPA provide a significant margin for safety, however this is appropriate for this type of guideline, which is designed to protect a wide range of people in the community including the very young and elderly. The 15-minute, 1-hour and 8-hour goals are 108 mg/m^3, 30 mg/m^3 and 10 mg/m^3 respectively.

Oxides of Nitrogen

Nitrogen oxides are produced in most combustion processes and are formed during the oxidation of nitrogen in the fuel and nitrogen in the air. Generally during high-temperature processes a number of nitrogen oxides are formed including nitric oxide (NO) and nitrogen dioxide (NO_2). Generally at the point of emission NO will comprise the greatest proportion of emission and typically constitute 95% by volume of the NO_x and NO_2 will comprise 5%. The presence of NO_x emissions can be of concern in urban environments where the control of photochemical smog is important. From the point of view of impacts on human health, it is NO_2 which is of greatest concern.

Ultimately however all nitric oxides emitted into the atmosphere are oxidised to NO_2 and to other higher oxides of nitrogen. The rate at which this oxidation takes place depends on prevailing atmospheric conditions including temperature, humidity and the presence of other substances in the atmosphere such as ozone. It can vary from a few minutes to many hours. The rate of conversion is quite important because from the point of emission to the point of maximum ground level concentration there will be an interval of time during which some oxidation will take place. If the dispersion is sufficient to have diluted the plume to the point where the concentration is very low it is unimportant that the oxidation has taken place. However, if the oxidation is rapid then high concentrations of NO_2 can occur.

Generally, for plumes impacting close to the source the time interval for oxidation is not sufficient to have converted a large proportion of the plume to the more harmful NO_2.

The EPA has not set any air quality goals for nitric oxide, however it has set 1-hour and annual average goals for nitrogen dioxide. It has adopted the NEPM standard of 0.12 ppm or 245 µg/m^3. It has also adopted the WHO 1-hour goal of 0.11ppm or 200 µg/m^3 as a long term reporting goal.

Particulate matter

The presence of particulate matter in the atmosphere can have an adverse effect on health and amenity. The health effects of particles are largely related to the extent to which they can penetrate the respiratory tract. Larger particles, that is those greater than 10 µm, generally adhere to the mucous in the nose, mouth, pharynx and larger bronchi and from there are removed by either swallowing or expectorating. Finer particles can enter bronchial and pulmonary regions of the respiratory tract, with increased deposition during mouth breathing which increases during exercise. The very fine particles can be deposited in the pulmonary region and it is these which are of particular concern. The health effects of particulate matter are further complicated by the chemical nature of the particles and by the possibility of synergistic effects with other air pollutants such as sulphur dioxide.

Much of the recent concern over the health effects of fine particulate matter is based on investigations carried out in the US, with the view to quantifying the health risks associated with both long-term and short-term exposure to airborne particulate matter. The study is colloquially referred to as "The Six Cities Study" from the original work by **Dockery et al. (1993)**, which determined a relationship between fine particulate matter (defined as particles smaller than 2.5 µm in diameter) in the air and mortality in six US cities.

The basic findings of the Six Cities Study is that there is an increase in mortality with increasing concentrations of fine particulate matter. The conclusions appear to be robust and have been supported by subsequent studies and as far as can be determined are not confounded by other known variables. The mechanism is still unknown.

These findings have not yet been fully evaluated by the scientific community and new Australian standards have recently been evaluated by NEPC. The US EPA has not changed its PM_{10} (particles less than 10 µm in diameter) goal but has introduced new goals for very fine particles ($PM_{2.5}$) with a 24-hour limit of 65 µg/m^3 and an annual limit of 15 µg/m^3. The NSW EPA has historically noted the US EPA 24-hour air quality standard of 150 µg/m^3 and annual average standard of 50 µg/m^3 for PM_{10}. It will now adopt the NEPM 24-hour standard of 50 µg/m^3 and reference a new annual average of 30 µg/m^3 as a long-term reporting goal.

The NSW EPA also continues to note the NHMRC's 90 µg/m^3 annual average goal for total suspended particulate matter (TSP). This level is recommended as the maximum permissible level in urban environments.

Polycyclic aromatic hydrocarbons

Polycyclic aromatic hydrocarbons (PAHs) are mainly formed from the incomplete combustion of organic materials. On inhalation they are readily absorbed by the lungs but are rapidly metabolised and show little tendency towards bioaccumulation in fatty tissues. Epidemiological studies provide sufficient evidence to suggest inhaled PAH have a significant role in the induction of lung cancer. Animal studies indicate that adverse effects from several PAHs include immunotoxicity, genotoxicity, carcinogenicity and reproductive toxicity. The most commonly studied PAH is Benzo[a]pyrene (BaP) which is taken to be an indicator for the carcinogenic PAH in [illegible] atmospheric deposition of PAHs on grains, fruits and vegetables supports suggestions that food is the major source of human PAH exposure.

The carcinogenicity of PAH mixtures may be influenced by the presence of other components emitted during the incomplete combustion. Significantly more data is necessary to understand the carcinogenic potential of PAH and to develop lung cancer risk estimates. Because several PAHs have been shown to be carcinogenic, no safe level can be recommended.

Dioxins and furans

The term dioxins represents a class of halogenated aromatic hydrocarbon compounds including polychlorinated dibenzodioxins and dibenzofurans. Animal studies have show some dioxins to be carcinogenic, toxic to the immune system, as well as causing reproductive and developmental effects.

Dioxins are extremely stable compounds and are primarily associated with particulate and organic matter in the environment. Air emissions of contaminated particulates and subsequent atmospheric deposition of dioxins on to plants are sources for human exposure by inhalation and ingestion.

Many fuels, including wood, coal, natural gas, oil, gasoline, and diesel, can release dioxins when burned depending on the fuel type and combustion process.

Dioxins are widespread in the environment, but in view of their toxicity and potential effects on human health, it is prudent to minimise exposure.

Ammonia

Ammonia is a corrosive colourless gas with a strong door. Acute ammonia exposure can irritate the skin; burn the eyes, causing temporary or permanent blindness; and cause headaches, nausea and vomiting. High levels can cause fluid in the respiratory system (pulmonary or laryngeal oedema), which may lead to death. Chronic exposure damages the lungs; repeated exposure can lead to bronchitis with coughing or shortness of breath.

Arsenic

Inorganic arsenic compounds are established human carcinogens (**WHO, 1987**) with lung cancer considered the most critical effect following exposure via inhalation. In nature, arsenic appears in the form of sulphides in association with sulphides of ores of heavy metals with trace amounts of arsenic found in soils and other environmental media. Inhaled particulate arsenic compounds are deposited in the respiratory tract and absorbed in the blood where they can be transported around the body. Epidemiological studies of workers exposed to high levels of airborne arsenic observed increased mortality from cardiovascular diseases.

Beryllium

Acute exposure to high concentrations of beryllium can cause severe bronchitis or pneumonia. This can lead to permanent lung scarring, making breathing very difficult. There is evidence that beryllium may cause cancer when an individual is regularly exposed during his/her lifetime above defined exposure limits. Chronic exposure to smaller amounts of beryllium can cause Chronic Beryllium Disease, commonly called berylliosis. This is a severe reaction caused by the body's own immune system. The disease frequently occurs 15 to 20 years after exposure begins. Symptoms include fatigue, shortness of breath, weight loss and poor appetite. These symptoms are long lasting and grow progressively worse. Berylliosis may also occur after a single exposure of more than 0.10 micrograms per cubic meter.

Cadmium

Short term exposure to cadmium fumes can cause: sore eyes, nose and throat; coughing, headache, dizziness and weakness; chill, fever, chest pains and breathlessness. Where exposure repeatedly happens over a long period of time, then all forms of cadmium cause some concern. There is the potential for harm to the kidneys and lungs. The sulphide pigments pose less of a threat than the oxide dust or fume, or the more soluble cadmium compounds.

Certain cadmium compounds, that is, chloride, sulphate and oxide have been shown to cause cancer in animals. This has not been proved to occur in humans, but employers are required to handle cadmium oxide, cadmium chloride and cadmium sulphate as if they can cause cancer. There is more uncertainty about whether or not cadmium sulphide and cadmium pigments can cause cancer.

Chromium

Chromium and its compounds form a large and varied group of chemicals, the hazards of which depend on the chemical forms encountered. These are referred to as chromium metal(0) chromium (11), chromium (111), chromium (IV) and chromium (V1). Of these,
chromium (V1) compounds have the most significant effects on health.

Chromium (V1) compounds (chromates, bichromates, chromic acid) pose the most significant health hazards. Short-term effects include irritation and inflammation of the nose and upper respiratory tract, burns to the skin possibly leading to ulcers and eye damage from splashes. Long-term effects can include damage to the nose, including ulcers and holes in the flap of tissue separating the nostrils, irritation of the lungs, kidney damage, allergic reactions in the skin and respiratory tract, and risk of cancer of the lung and nose.

Copper

Copper (powder) is a substance that can be absorbed into the body by inhalation and by ingestion. On inhalation, acute exposure to this substance causes coughing, headache, shortness of breath sore throat, and metal fever while longer term exposures may cause skin sensitisation.

Formaldehyde

Formaldehyde is a flammable, colourless gas with a pungent, suffocating door. Acute exposure irritates and burns the skin, eyes, nose, mouth, and throat. Higher levels can cause a build-up of fluid in the lungs (pulmonary oedema) or spasm in the windpipe, either of which may be fatal. Chronic exposure may cause both an asthma-like allergy and bronchitis with symptoms of coughing and shortness of breath. Formaldehyde causes cancer of the nasal passages in animals and is considered a probable human carcinogen.

Hydrochloric acid

Hydrochloric acid is a corrosive colourless to slightly yellow gas with a strong odour. Acute exposure to hydrogen chloride can cause severe burns of the skin and eyes leading to permanent damage and blindness. Breathing hydrogen chloride vapour irritates the mouth, nose, throat, and lungs, causing coughing, shortness of breath, fluid build-up in the lungs (pulmonary oedema), and possibly death. Chronic exposure damages the lungs and may erode the teeth.

Lead

Lead is a cumulative poison which exerts its toxic effects on the kidneys, blood and central nervous system. It is now generally agreed, that while the effects are not readily discernible on an individual basis, on a population basis, lead exposure in young children can lead to an IQ deficit of between 2 to 3 points for each 10 µg/dL increment in blood lead. As environmental lead has emerged as a public health issue, governments in Australia have developed strategies to reduce the levels of lead exposure.

It has been estimated that about 90% of the lead in air arises from motor vehicle emissions, apart from areas where there are significant local lead industries. However ingestion, rather than inhalation is the more significant route of lead intake for young children who absorb lead very efficiently, up to 50% of ingested lead compared to 10-15% in adults.

Most ingested lead is from contaminated soil and dust which children take in through exploratory hand to mouth activities. Some measures to reduce lead intake through ingestion include washing of children's hands and faces before meals, regular washing of outside toys and planting grass or ground cover on exposed areas of soil in the yard.

The NHMRC goal for lead is 1.5 µg/m^3 (90-day average). The NEPM draft standard is 0.5 µg/m^3 on an annual basis. Since the introduction of unleaded petrol in motor vehicles there has been a steady and unambiguous decline in lead emissions and in the low concentration of lead in the air in urban environment, clearly demonstrating the effectiveness of this strategy.

Mercury

Mercury exists in three chemical forms: mercury vapour, inorganic mercury compounds and methylmercury compounds. Mercury sources are numerous and vary significantly. It is primarily produced by the mining and smelting of cinnabor ore and its uses include paints, switching equipment and batteries, as a catalyst in chemical processes, lamps, and in the production of explosives. Other industries which are not related to mercury production contribute significant amounts to the environment; examples of these include the burning of fossil fuels, cement manufacture and waste disposal. The vapour of metallic mercury is present in the atmosphere whereby most human exposure occurs.

It is estimated that 80% of inhaled mercury vapour is absorbed via the lungs and retained in the body. The deposition and absorption of inhaled aerosols of inorganic mercury will depend on factors such as particle size and solubility. Mercury vapour is distributed via the bloodstream to all tissues in the body. The health effects of mercury and its compounds are dependent upon the chemical form of mercury with most damage confined to the nervous system (mercury vapour and methylmercury compounds). Inorganic mercury compounds are corrosive poisons which, in high single doses, can cause death by kidney failure and system shock. Damage is mainly to the nervous system and can result in deficits in short term memory. The effects on the nervous system, especially those on motor functions, are usually reversible.

Sulphuric acid

Sulphuric acid is an oily liquid that is highly corrosive. Breathing sulphuric acid mist can irritate the lungs; high levels can cause death through a dangerous build-up of fluid in the lungs (pulmonary oedema). Contact can severely burn the skin and eyes. Repeat exposure can cause erosion and pitting of the teeth, stomach upset, nose bleeds, tearing of the eyes, emphysema, and bronchitis.

Appendix B - PAH and dioxin equivalency calculations

PAH and dioxin/furan equivalency calculations

The equivalent emission rate of a mixture of PAHs is calculated by applying the relative potency compared to benzo[a]pyrene the individual PAH emission rates.

The equivalent emission rate of a mixture of dioxin/furan emissions is calculated by applying the Toxic Equivalent Factor (TEF) of 2,3,7,8 TCDD (tetrachlorodibenzo-p-dioxin) to the individual dioxin/furan emission rates.

Table B1 presents the emission rates in kg/tonne as given in the NPI Emission Estimation Manual for Lime and Dolomite Manufacturing (**NPI, 1999**). The emission rates in grams per second (g/s) were calculated using the equation below assuming 150,000 tonnes of lime are produced per year.

$$Emission\ rate\left[\frac{g}{s}\right]=\frac{Emission\ rate\left[\frac{kg}{tonne}\right]*Lime\ produced\left[\frac{tonne}{yr}\right]*1000\left[\frac{g}{kg}\right]}{31536000\left[\frac{s}{yr}\right]}$$

The equivalent emission rates were calculated using the equation below and the total equivalent emission rates were used in the AUSPLUME model.

$$Equivalent\ emission\ rate\left[\frac{g}{s}\right]=Emission\ rate\left[\frac{g}{s}\right]*Relative\ potency\ or\ TEF$$

Table B1: PAH and dioxin/furan equivalent emission rates

PAHs				
Compound	**Relative potency compared to BaP**	**Emission rate kg/tonne**	**Emission rate (µg/s)**	**Equivalent emission rates (µg/s)**
Benz[a]anthracene	0.145	2.10E-08	9.99E-02	1.45E-02
Benzo[a]pyrene	1	6.50E-08	3.09E-01	3.09E-01
Benzo[b]flouranthene	0.141	2.80E-07	1.33E+00	1.88E-01
Benzo[k]flouranthene	0.1	7.70E-08	3.66E-01	3.66E-02
Chrysene	0.1	8.10E-08	3.85E-01	3.85E-02
Indeno[1,2,3,-cd]pyrene	0.232	4.30E-08	2.05E-01	4.75E-02
			Total PAHs	**0.63**

Dioxins/Furans				
Compound	**TEF compared to 2,3,7,8 TCDD**	**Emission rate kg/tonne**	**Emission rate (µg/s)**	**Equivalent emission rates (µg/s)**
PCDD (Pentachlorodibenzo-p-dioxin)	1	1.40E-15	6.66E-09	6.66E-09
HPCDD (Heptachlorodibenzo-p-dioxin)	0.01	2.00E-16	9.51E-10	9.51E-12
OCDD (Octochlorodibenzo-p-dioxin)	0.0001	1.00E-15	4.76E-09	4.76E-13
TCDF (Tetrachlorodibenzo-p-furan)	0.1	1.40E-16	6.66E-10	6.66E-11
PCDF (Pentachlorodibenzo-p-furan)	0.5	1.40E-16	6.66E-10	3.33E-10
			Total Dioxins/Furans	**7.07E-09**

Appendix C - AUSPLUME output file - lime kiln operation

1

Concentration or deposition	Concentration
Emission rate units	grams/second
Concentration units	microgram/m3
Units conversion factor	1 00E+06
Constant background concentration	0.00E+00
Terrain effects	Egan method
Smooth stability class changes?	No
Other stability class adjustments ("urban modes")	None
Ignore building wake effects?	No
Decay coefficient (unless overridden by met. file)	0.000
Anemometer height	10 m
Roughness height at the wind vane site	0.400 m

DISPERSION CURVES

Horizontal dispersion curves for sources <100m high	Pasquill-Gifford
Vertical dispersion curves for sources <100m high	Pasquill-Gifford
Horizontal dispersion curves for sources >100m high	Briggs Rural
Vertical dispersion curves for sources >100m high	Briggs Rural
Enhance horizontal plume spreads for buoyancy?	Yes
Enhance vertical plume spreads for buoyancy?	Yes
Adjust horizontal P-G formulae for roughness height?	Yes
Adjust vertical P-G formulae for roughness height?	Yes
Roughness height	0.400m
Adjustment for wind directional shear	None

PLUME RISE OPTIONS

Gradual plume rise?	Yes
Stack-tip downwash included?	Yes
Building downwash algorithm:	PRIME method.
Entrainment coeff. for neutral & stable lapse rates	0.60,0.60
Partial penetration of elevated inversions?	No
Disregard temp. gradients in the hourly met. file?	No

and in the absence of boundary-layer potential temperature gradients given by the hourly met. file, a value from the following table (in K/m) is used:

Wind Speed Category	Stability Class A	B	C	D	E	F
1	0.000	0.000	0.000	0.000	0.020	0.035
2	0.000	0.000	0.000	0.000	0.020	0.035
3	0.000	0.000	0.000	0.000	0.020	0.035
4	0.000	0.000	0.000	0.000	0.020	0.035
5	0.000	0.000	0.000	0.000	0.020	0.035
6	0.000	0.000	0.000	0.000	0.020	0.035

WIND SPEED CATEGORIES
Boundaries between categories (in m/s) are: 1.54, 3.09, 5.14, 8.23, 10.80

WIND PROFILE EXPONENTS: "Irwin Rural" values (unless overridden by met. file)

AVERAGING TIMES
1 hour

1

Galong - NOx

SOURCE CHARACTERISTICS

STACK SOURCE: KILN

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
642241	6170960	516m	47m	1.20m	110C	16.0m/s

Effective building dimensions (in metres)

Flow direction	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width	7	0	0	0	0	0	0	0	4	5	5	6
Effective building height	45	0	0	0	0	0	0	0	27	27	27	27
Along-flow building length	9	0	0	0	0	0	0	0	4	5	5	6
Along-flow distance from stack	9	0	0	0	0	0	0	0	-11	-12	-13	-13
Across-flow distance from stack	9	0	0	0	0	0	0	0	4	2	1	-1

Flow direction	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°

Effective building width	6	6	0	0	0	0	0	0	0	0	0	0
Effective building height	27	27	0	0	0	0	0	0	0	0	0	0
Along-flow building length	6	6	0	0	0	0	0	0	0	0	0	0
Along-flow distance from stack	-13	-12	0	0	0	0	0	0	0	0	0	0

Flow direction	250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Effective building width	0	0	4	5	5	6	6	6	0	0	7	6
Effective building height	0	0	27	27	27	27	27	27	0	0	45	45
Along-flow building length	0	0	4	5	5	6	6	6	0	0	9	8
Along-flow distance from stack	0	0	7	7	7	7	7	6	0	0	9	-33
Across-flow distance from stack	0	0	-4	-2	-1	1	3	4	0	0	8	[illegible]

(Constant) emission rate = 2.58E+00 grams/second
No gravitational settling or scavenging.

1

Galong NOx

RECEPTOR LOCATIONS

The Cartesian receptor grid has the following x-values (or eastings):
640000.m 640200.m 640400.m 640600.m 640800.m 641000.m 641200.m
641400.m 641600.m 641800.m 642000.m 642200.m 642400.m 642600.m
642800.m 643000.m 643200.m 643400.m 643600.m 643800.m 644000.m
644200.m 644400.m 644600.m 644800.m 645000.m 645200.m 645400.m
645600.m 645800.m 646000.m 646200.m 646400.m 646600.m 646800.m
647000.m 647200.m 647400.m 647600.m 647800.m 648000.m 648200.m
648400.m 648600.m 648800.m 649000.m 649200.m 649400.m 649600.m
649800.m 650000.m 650200.m 650400.m 650600.m 650800.m 651000.m
651200.m 651400.m 651600.m 651800.m 652000.m 652200.m 652400.m
652600.m 652800.m 653000.m 653200.m 653400.m 653600.m 653800.m
654000.m

and these y-values (or northings):
6166000.m 6166200.m 6166400.m 6166600.m 6166800.m 6167000.m 6167200.m
6167400.m 6167600.m 6167800.m 6168000.m 6168200.m 6168400.m 6168600.m
6168800.m 6169000.m 6169200.m 6169400.m 6169600.m 6169800.m 6170000.m
6170200.m 6170400.m 6170600.m 6170800.m 6171000.m 6171200.m 6171400.m
6171600.m 6171800.m 6172000.m 6172200.m 6172400.m 6172600.m 6172800.m
6173000.m 6173200.m 6173400.m 6173600.m 6173800.m 6174000.m 6174200.m
6174400.m 6174600.m 6174800.m 6175000.m 6175200.m 6175400.m 6175600.m
6175800.m 6176000.m

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	ELEVN	HEIGHT	No.	X	Y	ELEVN	HEIGHT
1	644539	6169430	521.0	0.0	5	650637	6173488	560.0	0.0
2	643610	6171607	501.0	0.0	6	651907	6171357	580.0	0.0
3	645877	6172808	500.0	0.0	7	651249	6167118	536.0	0.0
4	648551	6174146	536.0	0.0	8	648619	6166619	539.0	0.0

METEOROLOGICAL DATA : Galong TAPM output 2001

1 Peak values for the 100 worst cases (in microgram/m3)
Averaging time = 1 hour

Rank	Value	Time Recorded hour,date	Coordinates (* denotes polar)
1	6.40E+01	04,31/12/01	(649000, 6170000, 0.0)
2	6.19E+01	03,24/06/01	(649000, 6170000, 0.0)
3	5.21E+01	24,24/10/01	(649000, 6169800, 0.0)
4	4.80E+01	20,27/06/01	(646400, 6168400, 0.0)
5	4.57E+01	20,17/09/01	(646400, 6168200, 0.0)
6	4.43E+01	01,25/10/01	(646200, 6168600, 0.0)
7	4.27E+01	04,27/03/01	(649200, 6170600, 0.0)
8	4.16E+01	01,26/10/01	(647600, 6168400, 0.0)
9	4.09E+01	20,23/02/01	(649200, 6170000, 0.0)
10	4.04E+01	20,22/01/01	(649000, 6170800, 0.0)
11	3.98E+01	04,10/12/01	(649000, 6170600, 0.0)
12	3.78E+01	05,12/11/01	(646400, 6168400, 0.0)
13	3.68E+01	01,04/10/01	(649000, 6170400, 0.0)
14	3.64E+01	05,27/03/01	(649200, 6170600, 0.0)
15	3.64E+01	21,01/12/01	(649000, 6170800, 0.0)
16	3.58E+01	22,27/10/01	(649000, 6170400, 0.0)

17	3.56E+01	19,27/06/01	(649000,	6170000,	0.0)
18	3.53E+01	24,25/04/01	(647000,	6168600,	0.0)
19	3.37E+01	05,07/08/01	(649000,	6169800,	0.0)
20	3.37E+01	20,12/05/01	(646400,	6168600,	0.0)
22	3.34E+01	06,27/03/01	(649400,	6170200,	0.0)
23	3.33E+01	24,25/10/01	(649000,	6170800,	0.0)
24	3.22E+01	01,04/12/01	(649200,	6170000,	0.0)
25	3.16E+01	02,25/12/01	(648800,	6169800,	0.0)
26	3.04E+01	23,25/10/01	(649000,	6170800,	0.0)
27	3.04E+01	04,24/06/01	(647600,	6168400,	0.0)
28	2.99E+01	19,18/04/01	(649000,	6170000,	0.0)
29	2.99E+01	03,26/03/01	(649000,	6170800,	0.0)
30	2.96E+01	02,14/09/01	(649000,	6170800,	0.0)
31	2.88E+01	20,25/05/01	(649200,	6170600,	0.0)
32	2.86E+01	22,25/05/01	(645800,	6168400,	0.0)
33	2.84E+01	18,12/05/01	(649000,	6169800,	0.0)
34	2.84E+01	04,26/03/01	(648800,	6169800,	0.0)
35	2.79E+01	23,25/02/01	(649000,	6172600,	0.0)
36	2.76E+01	03,17/09/01	(647000,	6168600,	0.0)
37	2.76E+01	20,02/06/01	(647200,	6168400,	0.0)
38	2.73E+01	24,26/03/01	(649600,	6171600,	0.0)
39	2.69E+01	03,31/12/01	(649000,	6172600,	0.0)
40	2.62E+01	23,24/10/01	(649200,	6170200,	0.0)
41	2.61E+01	19,16/04/01	(649200,	6170000,	0.0)
42	2.60E+01	03,27/03/01	(649000,	6170800,	0.0)
43	2.60E+01	20,20/01/01	(647000,	6168600,	0.0)
44	2.57E+01	04,07/08/01	(649400,	6172000,	0.0)
45	2.52E+01	20,18/04/01	(647600,	6168600,	0.0)
46	2.48E+01	02,07/07/01	(649000,	6170000,	0.0)
47	2.43E+01	04,04/09/01	(649000,	6169800,	0.0)
48	2.43E+01	04,07/07/01	(649000,	6170000,	0.0)
49	2.42E+01	04,14/10/01	(649000,	6170400,	0.0)
50	2.40E+01	23,15/09/01	(648800,	6169800,	0.0)
51	2.37E+01	21,25/05/01	(649000,	6168400,	0.0)
52	2.36E+01	02,26/03/01	(649400,	6172000,	0.0)
53	2.36E+01	21,02/06/01	(646200,	6168600,	0.0)
54	2.32E+01	02,04/12/01	(646600,	6168400,	0.0)
55	2.31E+01	19,17/09/01	(649200,	6170000,	0.0)
56	2.31E+01	04,30/10/01	(649000,	6170400,	0.0)
57	2.30E+01	03,04/09/01	(649200,	6170400,	0.0)
58	2.26E+01	01,25/12/01	(649000,	6171000,	0.0)
59	2.26E+01	18,02/06/01	(648800,	6169800,	0.0)
60	2.26E+01	20,23/03/01	(649000,	6170000,	0.0)
61	2.26E+01	24,27/10/01	(647600,	6168600,	0.0)
62	2.23E+01	01,28/10/01	(647400,	6168600,	0.0)
63	2.23E+01	19,25/05/01	(649000,	6170800,	0.0)
64	2.22E+01	23,26/03/01	(649400,	6171600,	0.0)
65	2.20E+01	24,17/10/01	(649000,	6170600,	0.0)
66	2.19E+01	05,14/10/01	(649000,	6170000,	0.0)
67	2.19E+01	23,03/10/01	(649400,	6172000,	0.0)
68	2.15E+01	05,11/11/01	(646800,	6168400,	0.0)
69	2.14E+01	03,27/10/01	(649000,	6170400,	0.0)
70	2.14E+01	22,25/02/01	(649200,	6172600,	0.0)
71	2.13E+01	01,31/12/01	(649000,	6172600,	0.0)
72	2.12E+01	02,26/11/01	(646800,	6168400,	0.0)
73	2.10E+01	01,18/10/01	(649000,	6170000,	0.0)
74	2.08E+01	02,30/10/01	(649400,	6172000,	0.0)
75	2.07E+01	02,26/05/01	(646200,	6168600,	0.0)
76	2.07E+01	20,15/04/01	(646400,	6168400,	0.0)
77	2.04E+01	24,03/10/01	(649000,	6171000,	0.0)
78	2.03E+01	22,26/03/01	(649600,	6171600,	0.0)
79	2.03E+01	22,25/10/01	(649000,	6170600,	0.0)
80	2.02E+01	23,06/08/01	(649000,	6170800,	0.0)
81	2.02E+01	03,07/07/01	(649000,	6170000,	0.0)
82	2.01E+01	23,25/11/01	(648800,	6169800,	0.0)
83	2.01E+01	19,21/09/01	(649400,	6172000,	0.0)
84	2.00E+01	03,30/10/01	(649000,	6171000,	0.0)
85	2.00E+01	03,10/12/01	(649800,	6171200,	0.0)
86	1.99E+01	18,02/07/01	(649800,	6171400,	0.0)
87	1.94E+01	19,17/04/01	(649400,	6172200,	0.0)
88	1.94E+01	24,25/11/01	(648800,	6169600,	0.0)
89	1.94E+01	20,23/01/01	(646400,	6168600,	0.0)
90	1.93E+01	02,10/12/01	(649000,	6171000,	0.0)
91	1.93E+01	03,13/11/01	(649000,	6170600,	0.0)
92	1.93E+01	21,23/03/01	(647600,	6168600,	0.0)
93	1.93E+01	18,27/06/01	(649000,	6170000,	0.0)
94	1.92E+01	23,10/08/01	(646000,	6168600,	0.0)
95	1.92E+01	01,26/05/01	(646000,	6168600,	0.0)
96	1.91E+01	02,28/10/01	(647400,	6168600,	0.0)
97	1.91E+01	01,26/02/01	(647800,	6174000,	0.0)
98	1.91E+01	24,15/09/01	(648800,	6169600,	0.0)
99	1.91E+01	23,09/12/01	(649000,	6170800,	0.0)
100	1.91E+01	02,04/09/01	(649000,	6170800,	0.0)

Appendix D - Dust emission calculations

ESTIMATED DUST EMISSIONS : GALONG LIME QUARRY

Introduction

The dust emission inventory has been formulated from the description of the quarrying operations provided by RW Corkery & Co Pty Limited in the Environmental Impact Statement fro the expansion of the quarry. Emission rates have been developed using emission factor equations provided in the US EPA (1985) (and subsequent updates) publication referred to as AP-42 and from factors determined by NERDDC (1988).

Estimated emissions are presented for all significant dust generating activities associated with the extraction operations.

It has been assumed that 500,000 t/y of material is mined and 200,000 t/y of material is milled (with the remaining 300,000 t/y being processed in the lime kiln). It has been assumed that the overburden removal (430,000 m^3 over 10 years) and exposed area (21.6 ha) would be consistent with Stage 4 of the project.

Drilling

Approximately 500,000 t/y of material would be blasted requiring the drilling of 1100 holes (10 blasts/y at approximately 110 holes/blast). It is assumed that 0.6 kg of dust will be generated in drilling each hole (US EPA, 1985). The total number of holes is 1100 and so the total annual dust emission is estimated to be 660 kg/y [1100 holes x 0.6 kg/hole]. Drilling would be controlled with the use of dust collection bags.

Blasting

TSP emissions from blasting can be estimated using the US EPA (1985) emission factor equation given in Equation 1.

Equation 1

$$E_{TSP} = 0.00022 \times A^{1.5} \quad kg/blast$$

where :

$$A = area \ \ to\ be\ blasted\ in\ m^2$$

The area required per blast is approximately 1,600 m^2. The emission factor is therefore approximately 14.1 kg/blast. There will be approximately 10 blasts/year. The total emission due to blasting is therefore approximately 141 kg/y [14.1 kg/blast x 10 blasts/year].

Excavator working/loading overburden

The excavator would load approximately 50% of the total 43,000 m^3 (assumed 77,400 tonnes) of overburden. Material would be loaded directly to an on-site dump truck for transfer to the emplacement area. Each tonne of material loaded will generate a certain amount of dust, depending on the wind speed and the moisture content. Equation 2 (US EPA, 1995B, 13.2.4-3) shows the relationship between these variables.

Equation 2

$$E_{TSP} = k \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \right) \quad \text{kg/t}$$

where,
k = 0.74
U = wind speed (m/s)
M = moisture content (%)
[where 0.25 ≤ M ≤ 4.8]

A "wind speed factor", [that is the $(U/2.2)^{1.3}$ part of Equation 2], will vary from hour to hour. This factor has been calculated for each hour in the meteorological data file and an annual average determined to be approximately 1.62. Assuming a moisture content of 2%, the total dust emission is calculated to be 0.005 kg/t.

Therefore the total emissions from the excavator loading material to trucks will be approximately 193.5 kg/y [38,700 t/y x 0.005 kg/t].

Scraper working
The appropriate emission factor for scrapers is as follows:

Equation 3

$E=9.6x10^{-6}\ (s)^{1.3}\ (W)^{2.4}$ kg/VKT

Mean gross scraper weights are approximately 30 t. Assuming 10% silt content of the haul road, the dust generation rate would therefore be approximately 0.672 kg/VKT.

Assuming the scraper works 8 hours per day and travels at 5 km/h a conservative estimate of the total distance travelled by the scraper would be 9,600 km. The total dust generated therefore is expected to be 6,451 kg/y [(9,600 km x 0.672 kg/km].

Transporting overburden to emplacement area
Approximately 77,400 t/y of material will be hauled using the on-site 25 t dump truck. The maximum distance from the excavation area to the emplacement could be 0.6 km. Assuming a return travel distance of 1,2 km on an unsealed path, dust generation rate of 4 kg/VKT and 50% control of dust by watering of the haul road, the total dust generated is expected to be 7,430 kg/y [77,400 t/y / 25 t x 1.2 km x 4 kg/km x 50/100].

Dumping to overburden stockpile
In a typical year for Stage 4 operations, approximately 77,400 t/y of overburden material will be unloaded from the on-site dump truck to the stockpile. Each tonne of material loaded will generate a certain amount of dust, depending on the wind speed and the moisture content. From Equation 2 this has been determined to be 0.005 kg/t.

Therefore the total emissions from the unloading from the dump truck to the stockpile will be approximately 193.5 kg/y [77,400 t/y x 0.005 kg/t].

Excavator working on limestone
It is assumed that the emission factor for limestone is the same for overburden. Assuming that 500,000 t/y are excavated, then the total emissions are 2500 kg.

Transporting limestone to stockpiles
Approximately 500,000 t/y of material will be hauled using the on-site 25 t dump truck. The maximum distance from the excavation area to the stockpiles could be 0.6 km. Assuming a return travel distance of 1,2 km on an unsealed path, dust generation rate of 4 kg/VKT and 50% control of dust by watering of the haul road, the total dust generated is expected to be 48,000 kg/y [500,00 t/y / 25 t x 1.2 km x 4 kg/km x 50/100].

Dumping material to stockpiles
This is assumed to be the same as fro the excavator working on the limestone, that is 2,500 kg/y.

Loading material to feed bin of crusher
Approximately 500,000 t/y of material will be loaded into the primary crusher. It has been assumed that this would be the same as dumping the material to the stockpile, that is 2,500 kg/y

Primary crushing of material
The emission rate for this has been assumed to be 0.0015 kg/t making a total of 750 kg/y (500,000 t/y x 0.0015 kg/t).

Milling of material
Approximately 200,000 t/y of material would be milled. It has been assumed that the emissions rate from this is 0.0092 kg/t. Therefore total emissions are 1840 kg/y (200,000 t/y x 0.0092 kg/t)

Loading material to trucks for off-site haulage
Approximately 350,000 t/y of material will be loaded into trucks for off-site transport. It has been assumed that this would be at the same emission rate as dumping the material to the stockpiles, that is 1,750 kg/y.

Hauling from site facilities to weighbridge
Approximately 350,000 t/y of product will be hauled from the site facilities to the weighbridge on sealed roads using a variety of trucks sizes. Approximately 78 truck movements per day would be required. Assuming a return travel distance of 2 km (a conservative assumption) , dust generation rate of 2 kg/VKT, the total dust generated is expected to be 56,940 kg/y [(39 x 365) x 2 km x 2 kg/km.

Wind erosion from the exposed working area and stockpiles
Assuming that the exposed working area is approximately 21.6 ha and the stockpiles are approximately 1 ha, the annual dust emission will be approximately 79,190 kg/y [22.6 ha x 0.4 kg/ha/h x 24 h/day x 365 day/y].

Appendix E - Health Risk Assessment Output

California Air Resources Board

And

Office of Environmental Health Hazard Assessment

Health Risk Assessment Program

Version 2.0e

INDIVIDUAL CANCER RISK REPORT

Run Made By

Judith Cox

Holmes Air Sciences

Project : Galong

Jun. 2, 1996

Pollutant Database Date : Nov. 15, 2000
Database Reference..... : CAPCOA Risk Assessment Guidelines

DILUTION FACTOR FOR POINT UNDER EVALUATION

X/Q (ug/m3)/(g/s) : 2.82E-01

ANNUAL AVERAGE EMISSION RATE INFORMATION

File: CANCER.E96

Pollutant Name	Emission Rate (g/s)
ARSENIC AND COMPOUNDS (INOR	2.850E-05
BENZENE	3.810E-02
BERYLLIUM AND COMPOUNDS	1.570E-06
CADMIUM AND COMPOUNDS	5.230E-06
CHROMIUM 6+	5.570E-06
COPPER AND COMPOUNDS	3.330E-04
FORMALDEHYDE	1.090E-03
HYDROCHLORIC ACID	1.190E-01
LEAD AND COMPOUNDS	1.810E-04
MERCURY AND COMPOUNDS (INOR	5.230E-04
PAH:BENZO(A)PYRENE	6.300E-07
PCDD as 2,3,7,8-TCDD	7.070E-15
SELENIUM AND COMPOUNDS (NOT	4.760E-04
SULFURIC ACID AND OLEUM	1.710E-02
ZINC COMPOUNDS	8.090E-04

EXPOSURE ROUTE INFORMATION

File: ROUTE.I96

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Deposition Velocity (m/s) .....:  0.020

Fraction of Homegrown Produce .:  0.250

Dilution Factor for Farm/Ranch X/Q (ug/m3)/(g/s) ....:   0.0000
Fraction of Animals' Diet From Grazing ..............:   0.0000
Fraction of Animals' Diet From Impacted Feed ........:   0.0000

Fraction of Animals' Water Impacted by Deposition ...:   0.0000

  Surface Area (m2) ....:  0.000E+00
  Volume (liters) ......:  0.000E+00
  Volume Changes .......:  0.000E+00


Fraction of Meat in Diet Impacted ..: 0.0000

  Beef ................: 0.0000
  Pork ................: 0.0000
  Lamb/Goat ...........: 0.0000
  Chicken .............: 0.0000

Fraction of Milk in Diet Impacted ..: 0.0000

  Goat Milk Fraction ..: 0.0000

Fraction of Eggs in Diet Impacted ..: 0.0000


Fraction of Impacted Drinking Water ..: 0.0000

  X/Q at water source ..:      0.0000
  Surface Area (m2) ....:   0.000E+00
  Volume (liters) ......:   0.000E+00
  Volume changes .......:   0.000E+00


Fraction of Fish from Impacted Water: 0.0000

  X/Q at Fish Source ...:      0.0000
  Surface Area (m2) ....:   0.000E+00
  Volume (liters) ......:   0.000E+00
  Volume changes .......:   0.000E+00

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44 YEAR
INDIVIDUAL CANCER RISK BY POLLUTANT AND ROUTE

Pollutant	Air	Soil	Skin	Garden	MMilk	Other
ARSENIC AND COM	1.67E-08	2.70E-08	5.72E-10	1.41E-08	0.00E+00	0.00E+00
BENZENE	1.96E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BERYLLIUM AND C	6.68E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CADMIUM AND COM	3.89E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CHROMIUM 6+	1.48E-07	1.48E-09	3.13E-10	7.36E-10	0.00E+00	0.00E+00
FORMALDEHYDE	1.16E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LEAD AND COMPOU	3.85E-10	9.73E-10	2.06E-11	5.13E-10	0.00E+00	0.00E+00
PAH:BENZO(A)PYR	1.23E-10	1.89E-10	1.20E-10	2.23E-09	4.84E-10	0.00E+00
PCDD as 2,3,7,8	4.76E-14	8.29E-14	8.16E-14	1.17E-13	0.00E+00	0.00E+00
Route Total	3.67E-07	2.97E-08	1.03E-09	1.76E-08	4.84E-10	0.00E+00

TOTAL RISK: 4.16E-07

70 YEAR
INDIVIDUAL CANCER RISK BY POLLUTANT AND ROUTE

Pollutant	Air	Soil	Skin	Garden	MMilk	Other
ARSENIC AND COM	2.65E-08	3.14E-08	6.64E-10	2.18E-08	0.00E+00	0.00E+00
BENZENE	3.12E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BERYLLIUM AND C	1.06E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CADMIUM AND COM	6 19E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CHROMIUM 6+	2.36E-07	1.72E-09	3.63E-10	1.15E-09	0.00E+00	0.00E+00
FORMALDEHYDE	1.84E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LEAD AND COMPOU	6.13E-10	1.13E-09	2.39E-11	7.90E-10	0.00E+00	0.00E+00
PAH:BENZO(A)PYR	1.95E-10	2.93E-10	1.86E-10	3.55E-09	0.00E+00	0.00E+00
PCDD as 2,3,7,8	7.58E-14	1.09E-13	1.07E-13	1.85E-13	0.00E+00	0.00E+00
Route Total	5.84E-07	3.46E-08	1.24E-09	2.73E-08	0.00E+00	0.00E+00

TOTAL RISK: 6.47E-07

Appendix F - AUSPLUME output file - mining operations

1

AUSPLUME Input File : Dust concetration

Concentration or deposition	Concentration
Emission rate units	grams/second
Concentration units	microgram/m3
Units conversion factor	1.00E+06
Constant background concentration	0.00E+00
Terrain effects	Egan method
Plume depletion due to dry removal mechanisms included.	
Smooth stability class changes?	No
Other stability class adjustments ("urban modes")	None
Ignore building wake effects?	Yes
Decay coefficient (unless overridden by met. file)	0.000
Anemometer height	10 m
Roughness height at the wind vane site	0.500 m

DISPERSION CURVES

Horizontal dispersion curves for sources <100m high	Pasquill-Gifford
Vertical dispersion curves for sources <100m high	Pasquill-Gifford
Horizontal dispersion curves for sources >100m high	Briggs Rural
Vertical dispersion curves for sources >100m high	Briggs Rural
Enhance horizontal plume spreads for buoyancy?	Yes
Enhance vertical plume spreads for buoyancy?	Yes
Adjust horizontal P-G formulae for roughness height?	Yes
Adjust vertical P-G formulae for roughness height?	Yes
Roughness height	0.500m
Adjustment for wind directional shear	None

PLUME RISE OPTIONS

Gradual plume rise?	Yes
Stack-tip downwash included?	Yes
Building downwash algorithm:	Schulman-Scire method.
Entrainment coeff. for neutral & stable lapse rates	0.60,0.60
Partial penetration of elevated inversions?	No
Disregard temp. gradients in the hourly met. file?	No

and in the absence of boundary-layer potential temperature gradients given by the hourly met. file, a value from the following table (in K/m) is used:

Wind Speed Category	Stability Class A	B	C	D	E	F
1	0.000	0.000	0.000	0.000	0.020	0.035
2	0.000	0.000	0.000	0.000	0.020	0.035
3	0.000	0.000	0.000	0.000	0.020	0.035
4	0.000	0.000	0.000	0.000	0.020	0.035
5	0.000	0.000	0.000	0.000	0.020	0.035
6	0.000	0.000	0.000	0.000	0.020	0.035

WIND SPEED CATEGORIES
Boundaries between categories (in m/s) are: 1.54, 3.09, 5.14, 8.23, 10.80

WIND PROFILE EXPONENTS: "Irwin Rural" values (unless overridden by met. file)

AVERAGING TIMES
24 hours
average over all hours

AUSPLUME Input File : Dust concetration

SOURCE GROUPS

Group No.	Members						
1	1	2	3	4	5	6	7
	8	9					
2	10	11	12	13	14	15	16
	17	18					
3	19	20	21	22	23	24	25
	26	27					

1

AUSPLUME Input File : Dust concetration

SOURCE CHARACTERISTICS

VOLUME SOURCE: 1

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
646993	6171625	510m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	1.0	2.50

VOLUME SOURCE: 2

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
647077	6171628	510m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	1.0	2.50

VOLUME SOURCE: 3

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
647100	6171560	510m	2m	20m	2m

(Constant) emission rate = 1.00E-00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	1.0	2.50

VOLUME SOURCE: 4

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
647118	6171484	510m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	1.0	2.50

VOLUME SOURCE: 5

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
646901	6171610	490m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	1.0	2.50

VOLUME SOURCE: 6

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
646931	6171453	490m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	1.0	2.50

VOLUME SOURCE: 7

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
646983	6171293	490m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	1.0	2.50

VOLUME SOURCE: 8

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
647135	6171183	515m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	1.0	2.50

VOLUME SOURCE: 9

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
647121	6171071	515m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	1.0	2.50

VOLUME SOURCE: 10

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
646993	6171625	510m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	5.0	2.50

VOLUME SOURCE: 11

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
647077	6171628	510m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	5.0	2.50

VOLUME SOURCE: 12

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
647100	6171560	510m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	5.0	2.50

VOLUME SOURCE: 13

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
647118	6171484	510m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass	Particle Size	Particle Density
1.0000	5.0	2.50

VOLUME SOURCE: 14

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
646901	6171610	490m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	5.0	2.50

VOLUME SOURCE: 15

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
646931	6171453	490m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particla Density (g/cm3)
1.0000	5.0	2.50

VOLUME SOURCE: 16

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
646983	6171293	490m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	5.0	2.50

VOLUME SOURCE: 17

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
647135	6171183	515m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	5.0	2.50

VOLUME SOURCE: 18

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
647121	6171073	515m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	5.0	2.50

VOLUME SOURCE: 19

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
646993	6171625	510m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	17.3	2.50

VOLUME SOURCE: 20

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
647077	6171628	510m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	17.3	2.50

VOLUME SOURCE: 21

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
647100	6171560	510m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	17.3	2.50

VOLUME SOURCE: 22

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
647118	6171484	510m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	17.3	2.50

VOLUME SOURCE: 23

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
646901	6171610	490m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	17.3	2.50

VOLUME SOURCE: 24

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
646931	6171453	490m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with
this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	17.3	2.50

VOLUME SOURCE: 25

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
646983	6171293	490m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with this emission factor.

Particle Mass	Particle Size	Particle Density
1.0000	17.3	2.50

VOLUME SOURCE: 26

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
647135	6171183	515m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	17.3	2.50

VOLUME SOURCE: 27

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
647121	6171071	515m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	17.3	2.50

1

AUSPLUME Input File : Dust concetration

RECEPTOR LOCATIONS

The Cartesian receptor grid has the following x-values (or eastings):
642000.m

and these y-values (or northings):
6168000.m

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	ELEVN	HEIGHT	No.	X	Y	ELEVN	HEIGHT
1	644539	6169430	521.0	0.0	5	650637	6173488	569.0	0.0
2	643610	6171607	501.0	0.0	6	651902	6171357	580.0	0.0
3	645877	6172808	500.0	0.0	7	651249	6167148	536.0	0.0
4	648551	6174146	536.0	0.0	8	648619	6166619	539.0	0.0

METEOROLOGICAL DATA : AUS to AUS Extended records (Met MANAGER)

HOURLY VARIABLE EMISSION FACTOR INFORMATION

The input emission rates specified above will be multiplied by hourly varying factors entered via the input file:
C:\Galong\Met Data\S1.src
For each stack source, hourly values within this file will be added to each declared exit velocity (m/sec) and temperature (K).

Title of input hourly emission factor file is:
AUSPLUME Variable emissions file (Met MANAGER)

HOURLY EMISSION FACTOR SOURCE TYPE ALLOCATION

Prefix 1 allocated: 1
Prefix 2 allocated: 2
Prefix 3 allocated: 3
Prefix 4 allocated: 4
Prefix 5 allocated: 5
Prefix 6 allocated: 6
Prefix 7 allocated: 7
Prefix 8 allocated: 8
Prefix 9 allocated: 9
Prefix 10 allocated: 10
Prefix 11 allocated: 11
Prefix 12 allocated: 12
Prefix 13 allocated: 13

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Prefix 14      allocated: 14
Prefix 15      allocated: 15
Prefix 16      allocated: 16
Prefix 17      allocated: 17
Prefix 19      allocated: 19
Prefix 20      allocated: 20
Prefix 21      allocated: 21
Prefix 22      allocated: 22
Prefix 23      allocated: 23
Prefix 24      allocated: 24
Prefix 25      allocated: 25
Prefix 26      allocated: 26
Prefix 27      allocated: 27
```

AVERAGE OVER ALL HOURS FOR SOURCE GROUP No. 1
in microgram/m3

X (km): 642.000

Y (km)	
6168.000	6.19E-01

Concentrations at the discrete receptors (No. : Value):

1:1.28E+00 2:1.50E+00 3:6.43E-01 4:2.71E-01 5:3.45E-01 6:3.88E-01 7:3.72E-01 8:2.19E-01

AVERAGE OVER ALL HOURS FOR SOURCE GROUP No. 2
in microgram/m3

X (km): 642.000

Y (km)	
6168.000	2.01E-01

Concentrations at the discrete receptors (No. : Value):

1:5.15E-01 2:5.65E-01 3:3.85E-01 4:1.66E-01 5:1.73E-01 6:1.78E-01 7:8.26E-02 8:1.12E-01

AVERAGE OVER ALL HOURS FOR SOURCE GROUP No. 3
in microgram/m3

X (km): 642.000

Y (km)	
6168.000	1.23E-01

Concentrations at the discrete receptors (No. : Value):

1:3.45E-01 2:4.26E-01 3:2.51E-01 4:3.74E-02 5:6.11E-02 6:7.28E-02 7:2.59E-02 8:3.48E-02

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1 Peak values for the 100 worst cases (in microgram/m3)
Averaging time = 24 hours: Source group No. 1

Rank	Value	Time Recorded hour,date	Coordinates (* denotes polar)		
1	1.62E+01	24,19/11/01	(645877,	6172808,	0.0)
2	1.27E+01	24,06/02/01	(643610,	6171607,	0.0)
3	1.24E+01	24,11/01/01	(643610,	6171607,	0.0)
4	1.05E+01	24,05/03/01	(643610,	6171607,	0.0)
5	1.03E+01	24,20/11/01	(645877,	6172808,	0.0)
6	1.03E+01	24,01/02/01	(643610,	6171607,	0.0)
7	1.02E+01	24,29/04/01	(643610,	6171607,	0.0)
8	1.00E+01	24,07/05/01	(645877,	6172808,	0.0)
9	9.99E+00	24,05/06/01	(644539,	6169430,	0.0)
10	9.34E+00	24,18/01/01	(643610,	6171607,	0.0)
11	9.28E+00	24,06/05/01	(645877,	6172808,	0.0)
12	9.10E+00	24,08/03/01	(643610,	6171607,	0.0)
13	8.92E+00	24,09/01/01	(643610,	6171607,	0.0)
14	8.46E+00	24,06/03/01	(643610,	6171607,	0.0)
15	8.17E+00	24,08/01/01	(643610,	6171607,	0.0)
16	7.96E+00	24,08/05/01	(645877,	6172808,	0.0)
17	7.61E+00	24,30/04/01	(643610,	6171607,	0.0)
18	7.53E+00	24,29/05/01	(645877,	6172808,	0.0)
19	7.51E+00	24,16/02/01	(643610,	6171607,	0.0)
20	7.41E+00	24,30/01/01	(643610,	6171607,	0.0)
21	7.40E+00	24,02/04/01	(643610,	6171607,	0.0)
22	7.22E+00	24,16/03/01	(644539,	6169430,	0.0)
23	7.12E+00	24,02/08/01	(645877,	6172808,	0.0)
24	7.07E+00	24,05/03/01	(643610,	6171607,	0.0)
25	7.06E+00	24,07/03/01	(643610,	6171607,	0.0)
26	7.05E+00	24,10/10/01	(644539,	6169430,	0.0)
27	7.02E+00	24,16/01/01	(643610,	6171607,	0.0)
28	6.90E+00	24,21/04/01	(643610,	6171607,	0.0)
29	6.88E+00	24,15/03/01	(644539,	6169430,	0.0)
30	6.69E+00	24,03/07/01	(643610,	6171607,	0.0)

31	6.63E+00	24,29/07/01	(645877, 6172808,	0.0)
32	6.51E+00	24,04/06/01	(644539, 6169430,	0.0)
33	6.32E+00	24,21/07/01	(643610, 6171607,	0.0)
34	6.21E+00	24,13/01/01	(643610, 6171607,	0.0)
35	6.08E+00	24,08/11/01	(643610, 6171607,	0.0)
37	6.06E+00	24,04/11/01	(644539, 6169430,	0.0)
38	5.93E+00	24,20/04/01	(643610, 6171607,	0.0)
39	5.89E+00	24,22/10/01	(644539, 6169430,	0.0)
40	5.89E+00	24,08/02/01	(644539, 6169430,	0.0)
41	5.86E+00	24,03/02/01	(644539, 6169430,	0.0)
42	5.84E+00	24,06/06/01	(644539, 6169430,	0.0)
43	5.84E+00	24,22/05/01	(643610, 6171607,	0.0)
44	5.70E+00	24,04/03/01	(643610, 6171607,	0.0)
45	5.69E+00	24,05/12/01	(643610, 6171607,	0.0)
46	5.64E+00	24,27/09/01	(643610, 6171607,	0.0)
47	5.63E+00	24,03/06/01	(644539, 6169430,	0.0)
48	5.61E+00	24,28/09/01	(644539, 6169430,	0.0)
49	5.59E+00	24,01/03/01	(643610, 6171607,	0.0)
50	5.55E+00	24,23/11/01	(644539, 6169430,	0.0)
51	5.55E+00	24,31/05/01	(643610, 6171607,	0.0)
52	5.49E+00	24,20/02/01	(643610, 6171607,	0.0)
53	5.45E+00	24,07/04/01	(644539, 6169430,	0.0)
54	5.42E+00	24,15/12/01	(643610, 6171607,	0.0)
55	5.40E+00	24,17/10/01	(645877, 6172808,	0.0)
56	5.36E+00	24,12/02/01	(644539, 6169430,	0.0)
57	5.34E+00	24,11/09/01	(644539, 6169430,	0.0)
58	5.31E+00	24,14/03/01	(644539, 6169430,	0.0)
59	5.28E+00	24,11/02/01	(643610, 6171607,	0.0)
60	5.25E+00	24,22/07/01	(643610, 6171607,	0.0)
61	5.24E+00	24,11/07/01	(643610, 6171607,	0.0)
62	5.23E+00	24,23/02/01	(644539, 6169430,	0.0)
63	5.12E+00	24,31/03/01	(644539, 6169430,	0.0)
64	5.05E+00	24,19/01/01	(643610, 6171607,	0.0)
65	5.03E+00	24,28/01/01	(643610, 6171607,	0.0)
66	4.98E+00	24,01/01/01	(644539, 6169430,	0.0)
67	4.93E+00	24,01/05/01	(643610, 6171607,	0.0)
68	4.91E+00	24,29/03/01	(643610, 6171607,	0.0)
69	4.87E+00	24,15/02/01	(643610, 6171607,	0.0)
70	4.82E+00	24,13/05/01	(645877, 6172808,	0.0)
71	4.80E+00	24,15/10/01	(645877, 6172808,	0.0)
72	4.78E+00	24,22/11/01	(643610, 6171607,	0.0)
73	4.77E+00	24,12/04/01	(645877, 6172808,	0.0)
74	4.75E+00	24,30/07/01	(645877, 6172808,	0.0)
75	4.74E+00	24,30/06/01	(643610, 6171607,	0.0)
76	4.70E+00	24,06/09/01	(644539, 6169430,	0.0)
77	4.68E+00	24,17/12/01	(644539, 6169430,	0.0)
78	4.65E+00	24,15/05/01	(644539, 6169430,	0.0)
79	4.64E+00	24,01/09/01	(644539, 6169430,	0.0)
80	4.64E+00	24,13/08/01	(643610, 6171607,	0.0)
81	4.61E+00	24,03/03/01	(643610, 6171607,	0.0)
82	4.51E-00	24,01/11/01	(648551, 6174146,	0.0)
83	4.46E+00	24,17/02/01	(643610, 6171607,	0.0)
84	4.46E+00	24,07/03/01	(644539, 6169430,	0.0)
85	4.45E+00	24,21/05/01	(643610, 6171607,	0.0)
86	4.44E+00	24,11/01/01	(644539, 6169430,	0.0)
87	4.44E+00	24,01/07/01	(644539, 6169430,	0.0)
88	4.42E+00	24,20/01/01	(644539, 6169430,	0.0)
89	4.42E+00	24,05/02/01	(643610, 6171607,	0.0)
90	4.32E+00	24,07/02/01	(643610, 6171607,	0.0)
91	4.26E+00	24,18/09/01	(644539, 6169430,	0.0)
92	4.25E+00	24,26/07/01	(643610, 6171607,	0.0)
93	4.23E+00	24,01/06/01	(644539, 6169430,	0.0)
94	4.15E+00	24,30/03/01	(644539, 6169430,	0.0)
95	4.15E+00	24,30/07/01	(644539, 6169430,	0.0)
96	4.09E+00	24,05/07/01	(644539, 6169430,	0.0)
97	4.09E+00	24,13/04/01	(643610, 6171607,	0.0)
98	4.09E+00	24,10/04/01	(643610, 6171607,	0.0)
99	4.01E+00	24,20/06/01	(645877, 6172808,	0.0)
100	4.00E+00	24,11/03/01	(644539, 6169430,	0.0)

1 **Peak values for the 100 worst cases (in microgram/m3)**
Averaging time = 24 hours; **Source group No. 2**

Rank	Value	Time Recorded hour,date	Coordinates (* denotes polar)	
1	6.57E+00	24,19/11/01	(645877, 6172808,	0.0)
2	4.90E+00	24,02/08/01	(645877, 6172808,	0.0)
3	4.53E+00	24,20/11/01	(645877, 6172808,	0.0)
4	4.47E+00	24,07/05/01	(645877, 6172808,	0.0)
5	4.39E+00	24,06/02/01	(643610, 6171607,	0.0)
6	4.29E+00	24,15/10/01	(645877, 6172808,	0.0)
7	4.23E+00	24,06/05/01	(645877, 6172808,	0.0)
8	4.11E+00	24,03/06/01	(644539, 6169430,	0.0)
9	3.93E+00	24,31/01/01	(643610, 6171607,	0.0)
10	3.89E+00	24,17/10/01	(645877, 6172808,	0.0)
11	3.81E+00	24,13/05/01	(645877, 6172808,	0.0)
12	3.74E+00	24,05/06/01	(644539, 6169430,	0.0)
13	3.63E+00	24,08/05/01	(645877, 6172808,	0.0)
14	3.49E+00	24,29/05/01	(645877, 6172808,	0.0)
15	3.40E+00	24,29/04/01	(643610, 6171607,	0.0)
16	3.26E+00	24,09/03/01	(643610, 6171607,	0.0)
17	3.21E+00	24,01/02/01	(643610, 6171607,	0.0)
18	3.19E+00	24,04/06/01	(644539, 6169430,	0.0)
19	3.12E+00	24,01/11/01	(648551, 6174146,	0.0)
20	3.12E+00	24,18/01/01	(643610, 6171607,	0.0)
21	3.12E+00	24,12/11/01	(645877, 6172808,	0.0)
22	3.12E+00	24,08/03/01	(643610, 6171607,	0.0)

23	3.07E+00	24,20/06/01	(645877,	6172808,	0.0)
24	2.87E+00	24,09/01/01	(643610,	6171607,	0.0)
25	2.82E+00	24,27/12/01	(645877,	6172808,	0.0)
26	2.78E+00	24,29/07/01	(645877,	6172808,	0.0)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
29	2.62E+00	24,30/04/01	(643610,	6171607,	0.0)
30	2.59E+00	24,31/05/01	(643610,	6171607,	0.0)
31	2.59E+00	24,19/05/01	(645877,	6172808,	0.0)
32	2.59E+00	24,03/07/01	(643610,	6171607,	0.0)
33	2.56E+00	24,02/04/01	(643610,	6171607,	0.0)
34	2.56E+00	24,16/02/01	(643610,	6171607,	0.0)
35	2.53E+00	24,07/03/01	(643610,	6171607,	0.0)
36	2.52E+00	24,20/07/01	(645877,	6172808,	0.0)
37	2.51E+00	24,30/01/01	(643610,	6171607,	0.0)
38	2.51E+00	24,16/01/01	(643610,	6171607,	0.0)
39	2.47E+00	24,12/05/01	(644539,	6169430,	0.0)
40	2.47E+00	24,15/09/01	(645877,	6172808,	0.0)
41	2.44E+00	24,21/07/01	(643610,	6171607,	0.0)
42	2.38E+00	24,23/02/01	(644539,	6169430,	0.0)
43	2.37E+00	24,11/11/01	(645877,	6172808,	0.0)
44	2.36E+00	24,30/07/01	(644539,	6169430,	0.0)
45	2.34E+00	24,28/04/01	(643610,	6171607,	0.0)
46	2.34E+00	24,16/06/01	(648551,	6174146,	0.0)
47	2.33E+00	24,15/03/01	(644539,	6169430,	0.0)
48	2.33E+00	24,16/03/01	(644539,	6169430,	0.0)
49	2.33E+00	24,17/06/01	(645877,	6172808,	0.0)
50	2.32E+00	24,10/10/01	(644539,	6169430,	0.0)
51	2.30E+00	24,12/04/01	(645877,	6172808,	0.0)
52	2.28E+00	24,05/03/01	(643610,	6171607,	0.0)
53	2.27E+00	24,21/04/01	(643610,	6171607,	0.0)
54	2.27E+00	24,14/09/01	(648551,	6174146,	0.0)
55	2.22E+00	24,08/02/01	(644539,	6169430,	0.0)
56	2.20E+00	24,22/05/01	(643610,	6171607,	0.0)
57	2.17E+00	24,03/02/01	(644539,	6169430,	0.0)
58	2.15E+00	24,23/08/01	(648551,	6174146,	0.0)
59	2.11E+00	24,28/09/01	(644539,	6169430,	0.0)
60	2.11E+00	24,24/06/01	(648619,	6166619,	0.0)
61	2.10E+00	24,13/01/01	(643610,	6171607,	0.0)
62	2.08E+00	24,05/10/01	(645877,	6172808,	0.0)
63	2.08E+00	24,04/03/01	(643610,	6171607,	0.0)
64	2.07E+00	24,22/10/01	(644539,	6169430,	0.0)
65	2.06E+00	24,06/06/01	(644539,	6169430,	0.0)
66	2.05E+00	24,25/04/01	(648619,	6166619,	0.0)
67	2.04E+00	24,26/02/01	(645877,	6172808,	0.0)
68	2.03E+00	24,04/11/01	(644539,	6169430,	0.0)
69	2.01E+00	24,03/10/01	(650637,	6173488,	0.0)
70	2.00E+00	24,20/04/01	(643610,	6171607,	0.0)
71	2.00E+00	24,22/07/01	(643610,	6171607,	0.0)
72	1.98E+00	24,27/09/01	(643610,	6171607,	0.0)
73	1.98E+00	24,20/02/01	(643610,	6171607,	0.0)
74	1.98E+00	24,21/05/01	(645877,	6172808,	0.0)
75	1.96E+00	24,16/10/01	(645877,	6172808,	0.0)
76	1.96E+00	24,10/11/01	(644539,	6169430,	0.0)
77	1.95E+00	24,01/12/01	(645877,	6172808,	0.0)
78	1.95E+00	24,15/12/01	(643610,	6171607,	0.0)
79	1.95E+00	24,13/09/01	(648551,	6174146,	0.0)
80	1.94E+00	24,26/04/01	(644539,	6169430,	0.0)
81	1.94E+00	24,11/07/01	(643610,	6171607,	0.0)
82	1.91E+00	24,05/12/01	(643610,	6171607,	0.0)
83	1.91E+00	24,30/06/01	(643610,	6171607,	0.0)
84	1.90E+00	24,25/05/01	(645877,	6172808	0.0)
85	1.89E+00	24,08/11/01	(643610,	6171607,	0.0)
86	1.88E+00	24,01/05/01	(643610,	6171607,	0.0)
87	1.88E+00	24,28/01/01	(643610,	6171607,	0.0)
88	1.88E+00	24,01/03/01	(643610,	6171607,	0.0)
89	1.88E+00	24,11/09/01	(644539,	6169430,	0.0)
90	1.88E+00	24,20/10/01	(645877,	6172808,	0.0)
91	1.87E+00	24,07/08/01	(644539,	6169430,	0.0)
92	1.86E+00	24,18/07/01	(650637,	6173488,	0.0)
93	1.84E+00	24,12/02/01	(644539,	6169430,	0.0)
94	1.81E+00	24,17/05/01	(648551,	6174146,	0.0)
95	1.81E+00	24,28/03/01	(643610,	6171607,	0.0)
96	1.81E+00	24,22/06/01	(648551,	6174146,	0.0)
97	1.81E+00	24,31/03/01	(644539,	6169430,	0.0)
98	1.81E+00	24,23/11/01	(644539,	6169430,	0.0)
99	1.61E+00	24,20/01/01	(644539,	6169430,	0.0)
100	1.80E+00	24,01/01/01	(644539,	6169430,	0.0)

1 Peak values for the 100 worst cases (in microgram/m3)
Averaging time = 24 hours: Source group No. 3

Rank	Value	Time Recorded hour.date	Coordinates (* denotes polar)		
1	5.96E+00	24,19/11/01	(645877,	6172808,	0.0)
2	4.11E+00	24,06/02/01	(643610,	6171607,	0.0)
3	3.98E+00	24,20/11/01	(645877,	6172808,	0.0)
4	3.81E+00	24,07/05/01	(645877,	6172808,	0.0)
5	3.62E+00	24,31/01/01	(643610,	6171607,	0.0)
6	3.32E+00	24,06/05/01	(645877,	6172808,	0.0)
7	3.13E+00	24,05/06/01	(644539,	6169430,	0.0)
8	3.00E+00	24,29/04/01	(643610,	6171607,	0.0)
9	2.97E+00	24,09/03/01	(643610,	6171607,	0.0)
10	2.90E+00	24,01/02/01	(643610,	6171607,	0.0)
11	2.76E+00	24,08/05/01	(645877,	6172808,	0.0)
12	2.74E+00	24,18/01/01	(643610,	6171607,	0.0)
13	2.74E+00	24,08/03/01	(643610,	6171607,	0.0)
14	2.57E+00	24,09/01/01	(643610,	6171607,	0.0)

15	2.45E+00	24,29/05/01	(645877,	6172808,	0.0)
16	2.41E+00	24,06/03/01	(643610,	6171607,	0.0)
17	2.38E+00	24,08/01/01	(643610,	6171607,	0.0)
18	2.34E+00	24,16/01/01	(643610,	6171607,	0.0)
19	2.28E+00	24,30/01/01	(643610,	6171607,	0.0)
21	2.27E+00	24,16/02/01	(643610,	6171607,	0.0)
22	2.21E+00	24,07/03/01	(643610,	6171607,	0.0)
23	2.20E+00	24,02/04/01	(643610,	6171607,	0.0)
24	2.11E+00	24,16/03/01	(644539,	6169430,	0.0)
25	2.10E+00	24,10/10/01	(644539,	6169430,	0.0)
26	2.08E+00	24,29/07/01	(645877,	6172808,	0.0)
27	2.06E+00	24,15/03/01	(644539,	6169430,	0.0)
28	2.05E+00	24,05/03/01	(643610,	6171607,	0.0)
29	2.02E+00	24,21/04/01	(643610,	6171607,	0.0)
30	2.00E+00	24,12/04/01	(645877,	6172808,	0.0)
31	1.98E+00	24,03/07/01	(643610,	6171607,	0.0)
32	1.93E+00	24,21/07/01	(643610,	6171607,	0.0)
33	1.91E+00	24,28/04/01	(643610,	6171607,	0.0)
34	1.88E+00	24,03/02/01	(644539,	6169430,	0.0)
35	1.87E+00	24,13/01/01	(643610,	6171607,	0.0)
36	1.83E+00	24,22/05/01	(643610,	6171607,	0.0)
37	1.83E+00	24,04/11/01	(644539,	6169430,	0.0)
38	1.82E+00	24,08/02/01	(644539,	6169430,	0.0)
39	1.81E+00	24,04/03/01	(643610,	6171607,	0.0)
40	1.81E+00	24,22/10/01	(644539,	6169430,	0.0)
41	1.79E+00	24,06/06/01	(644539,	6169430,	0.0)
42	1.77E+00	24,28/09/01	(644539,	6169430,	0.0)
43	1.76E+00	24,01/03/01	(643610,	6171607,	0.0)
44	1.73E+00	24,20/02/01	(643610,	6171607,	0.0)
45	1.73E+00	24,20/04/01	(643610,	6171607,	0.0)
46	1.72E+00	24,27/09/01	(643610,	6171607,	0.0)
47	1.71E+00	24,08/11/01	(643610,	6171607,	0.0)
48	1.68E+00	24,05/12/01	(643610,	6171607,	0.0)
49	1.68E+00	24,15/12/01	(643610,	6171607,	0.0)
50	1.65E+00	24,23/11/01	(644539,	6169430,	0.0)
51	1.65E+00	24,07/04/01	(644539,	6169430,	0.0)
52	1.63E+00	24,22/07/01	(643610,	6171607,	0.0)
53	1.63E+00	24,14/03/01	(644539,	6169430,	0.0)
54	1.61E+00	24,12/02/01	(644539,	6169430,	0.0)
55	1.60E+00	24,28/01/01	(643610,	6171607,	0.0)
56	1.59E+00	24,11/07/01	(643610,	6171607,	0.0)
57	1.58E+00	24,11/09/01	(644539,	6169430,	0.0)
58	1.56E+00	24,01/01/01	(644539,	6169430,	0.0)
59	1.56E+00	24,11/02/01	(643610,	6171607,	0.0)
60	1.56E+00	24,19/01/01	(643610,	6171607,	0.0)
61	1.55E+00	24,05/02/01	(643610,	6171607,	0.0)
62	1.54E+00	24,04/06/01	(644539,	6169430,	0.0)
63	1.51E+00	24,31/03/01	(644539,	6169430,	0.0)
64	1.51E+00	24,15/02/01	(643610,	6171607,	0.0)
65	1.51E+00	24,29/03/01	(643610,	6171607,	0.0)
66	1.50E+00	24,06/09/01	(644539,	6169430,	0.0)
67	1.45E+00	24,30/06/01	(643610,	6171607,	0.0)
68	1.45E+00	24,21/11/01	(645877,	6172808,	0.0)
69	1.44E+00	24,01/05/01	(643610,	6171607,	0.0)
70	1.43E+00	24,22/11/01	(643610,	6171607,	0.0)
71	1.43E+00	24,20/10/01	(645877,	6172808,	0.0)
72	1.43E+00	24,03/03/01	(643610,	6171607,	0.0)
73	1.43E+00	24,17/02/01	(643610,	6171607,	0.0)
74	1.40E+00	24,17/12/01	(644539,	6169430,	0.0)
75	1.40E+00	24,15/05/01	(644539,	6169430,	0.0)
76	1.39E+00	24,01/06/01	(644539,	6169430,	0.0)
77	1.38E+00	24,28/05/01	(645877,	6172808,	0.0)
78	1.38E+00	24,13/08/01	(643610,	6171607,	0.0)
79	1.37E+00	24,07/01/01	(644539,	6169430,	0.0)
80	1.35E+00	24,01/09/01	(644539,	6169430,	0.0)
81	1.34E+00	24,21/05/01	(643610,	6171607,	0.0)
82	1.32E+00	24,31/05/01	(643610,	6171607,	0.0)
83	1.30E+00	24,29/08/01	(645877,	6172808,	0.0)
84	1.30E+00	24,13/04/01	(643610,	6171607,	0.0)
85	1.27E+00	24,30/05/01	(644539,	6169430,	0.0)
86	1.27E+00	24,10/04/01	(643610,	6171607,	0.0)
87	1.27E+00	24,11/03/01	(644539,	6169430,	0.0)
88	1.26E+00	24,07/02/01	(643610,	6171607,	0.0)
89	1.26E+00	24,05/07/01	(644539,	6169430,	0.0)
90	1.25E+00	24,09/10/01	(643610,	6171607,	0.0)
91	1.24E+00	24,22/09/01	(644539,	6169430,	0.0)
92	1.24E+00	24,20/01/01	(644539,	6169430,	0.0)
93	1.22E+00	24,18/09/01	(644539,	6169430,	0.0)
94	1.21E+00	24,11/01/01	(644539,	6169430,	0.0)
95	1.20E+00	24,27/02/01	(644539,	6169430,	0.0)
96	1.20E+00	24,14/04/01	(644539,	6169430,	0.0)
97	1.17E+00	24,06/01/01	(644539,	6169430,	0.0)
98	1.17E+00	24,10/03/01	(644539,	6169430,	0.0)
99	1.16E+00	24,23/02/01	(644539,	6169430,	0.0)
100	1.14E+00	24,28/11/01	(644539,	6169430,	0.0)

FIGURES

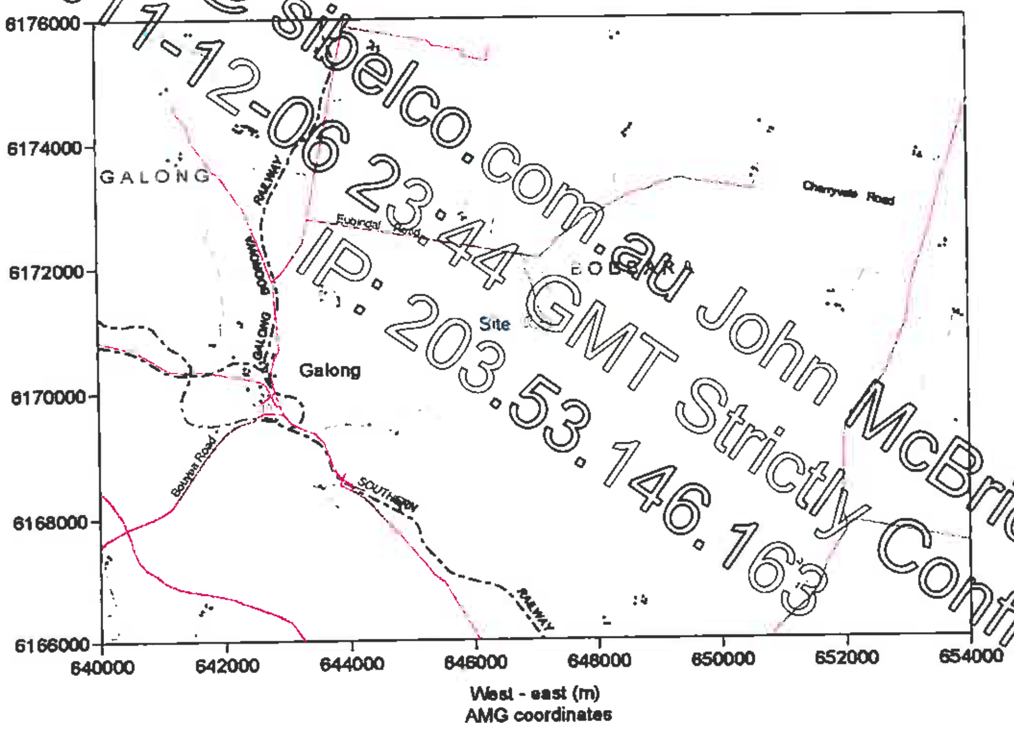


Figure 1

Location of study area

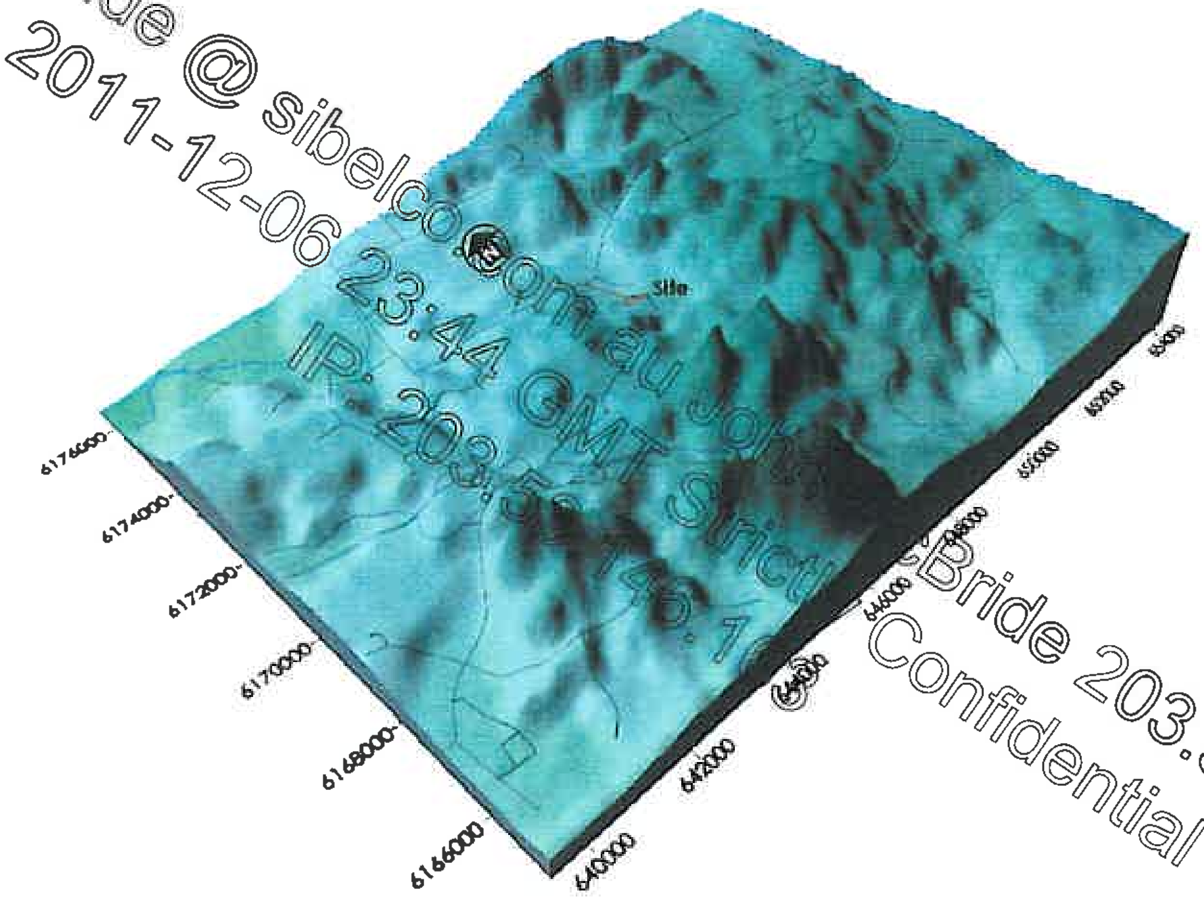
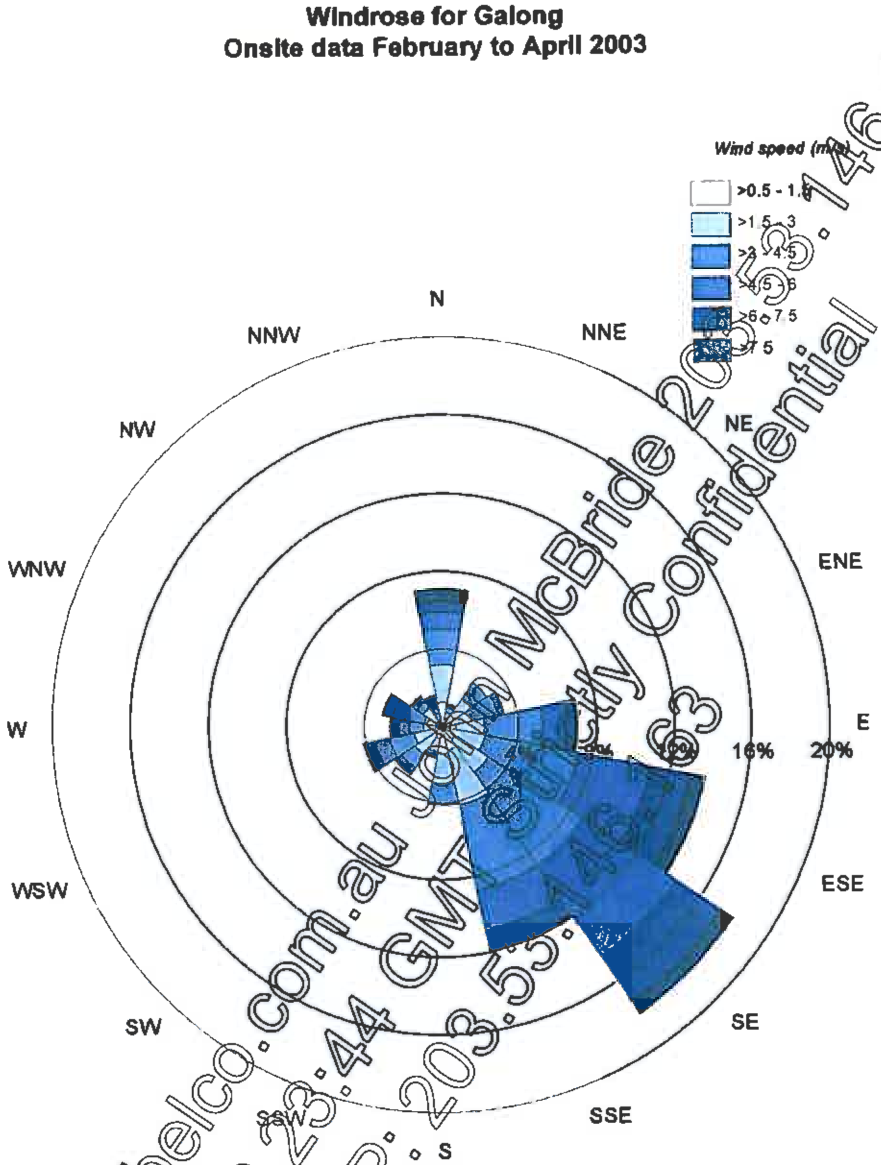


Figure 2

3D plot of Galong area



Windrose for Galong
Onsite data February to April 2003
Wind speed (m/s)
>0.5 - 1.5
>1.5 - 3
>3 - 4.5
>4.5 - 6
>6 - 7.5
>7.5
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
4%
8%
12%
16%
20%

Figure 3

Synthetic Annual and Seasonal Windroses for Galong (TAPM)

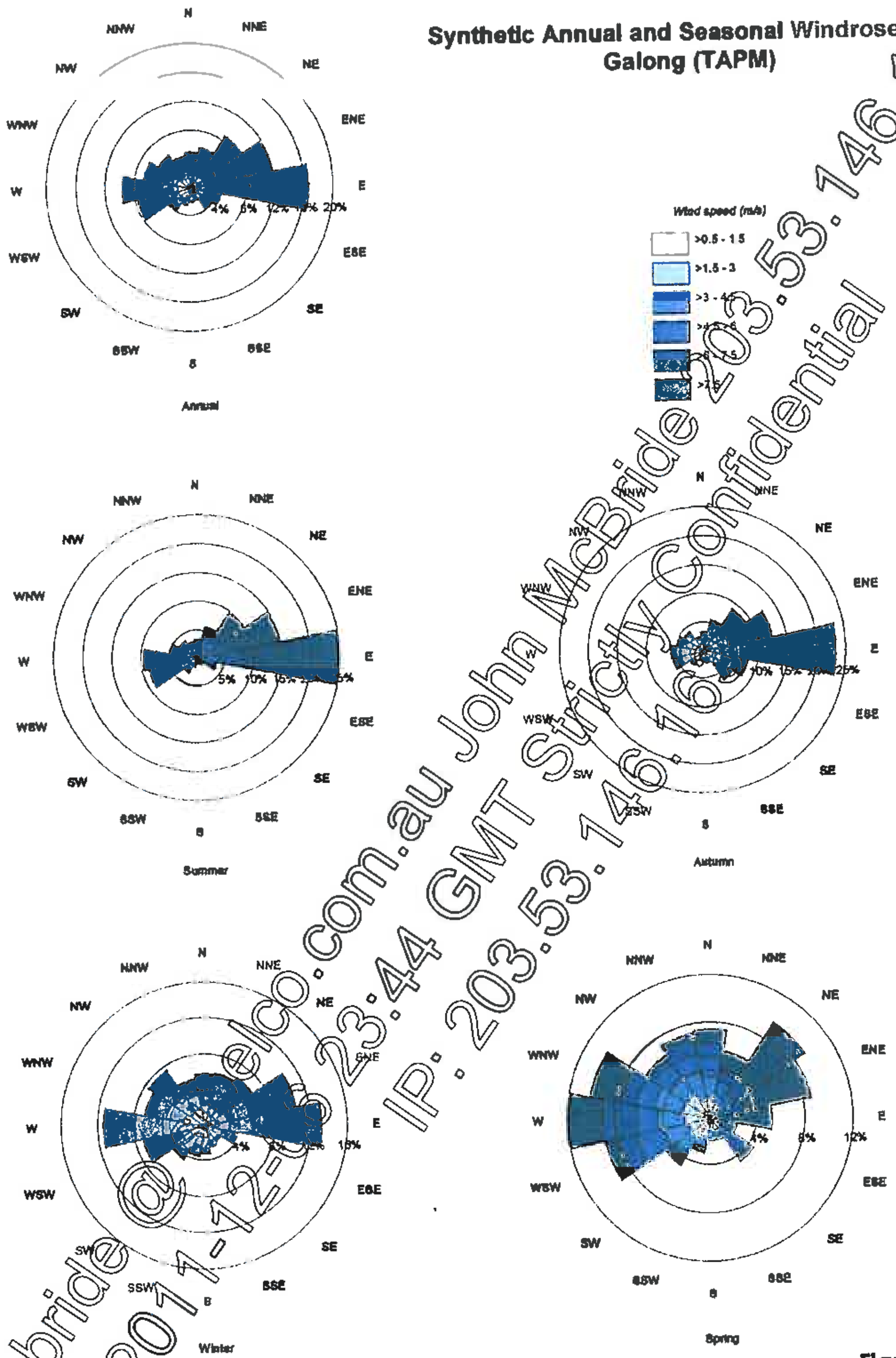
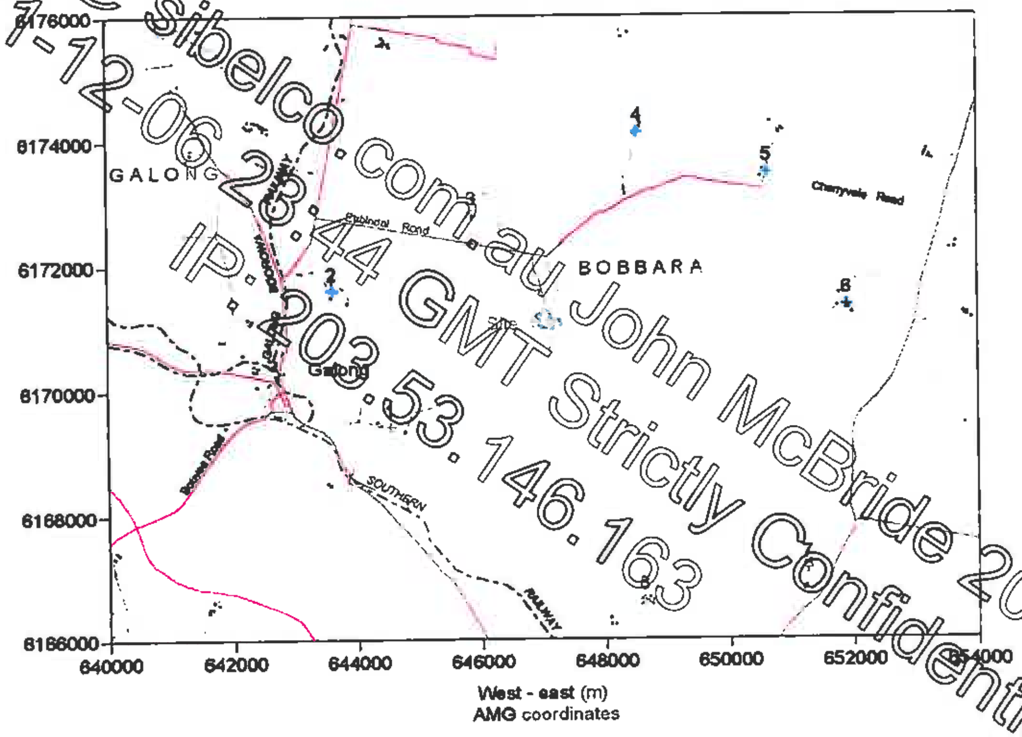


Figure 4



Location of discrete receptors

Figure 5

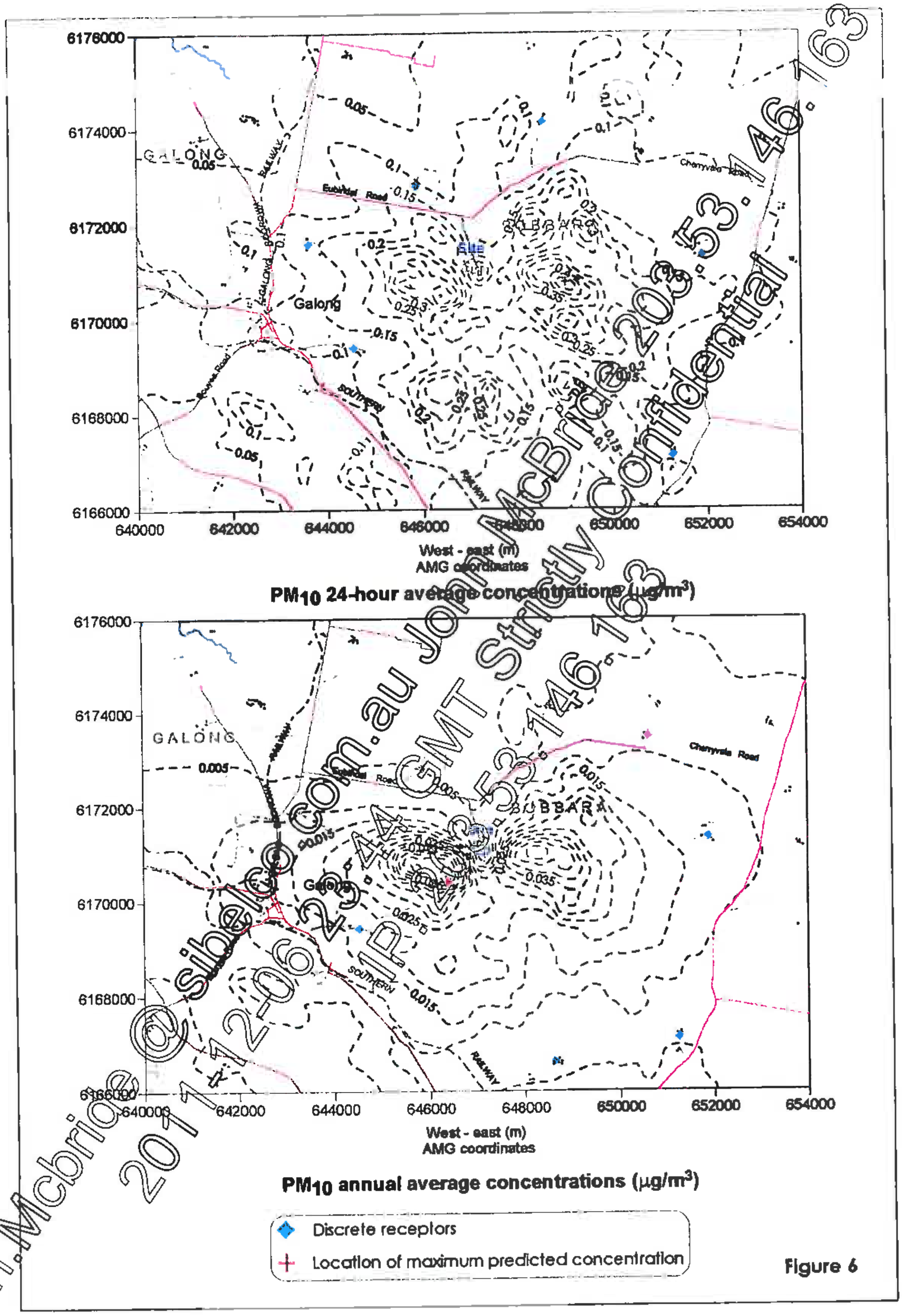

PM10 24-hour average concentrations (µg/m³)
PM10 annual average concentrations (µg/m³)
West - east (m)
AMG coordinates
GALONG
Galong
BUBBAR
Eubindal Road
Cherryvale Road
RAILWAY
SOUTHERN
Site
Discrete receptors
Location of maximum predicted concentration

Figure 6

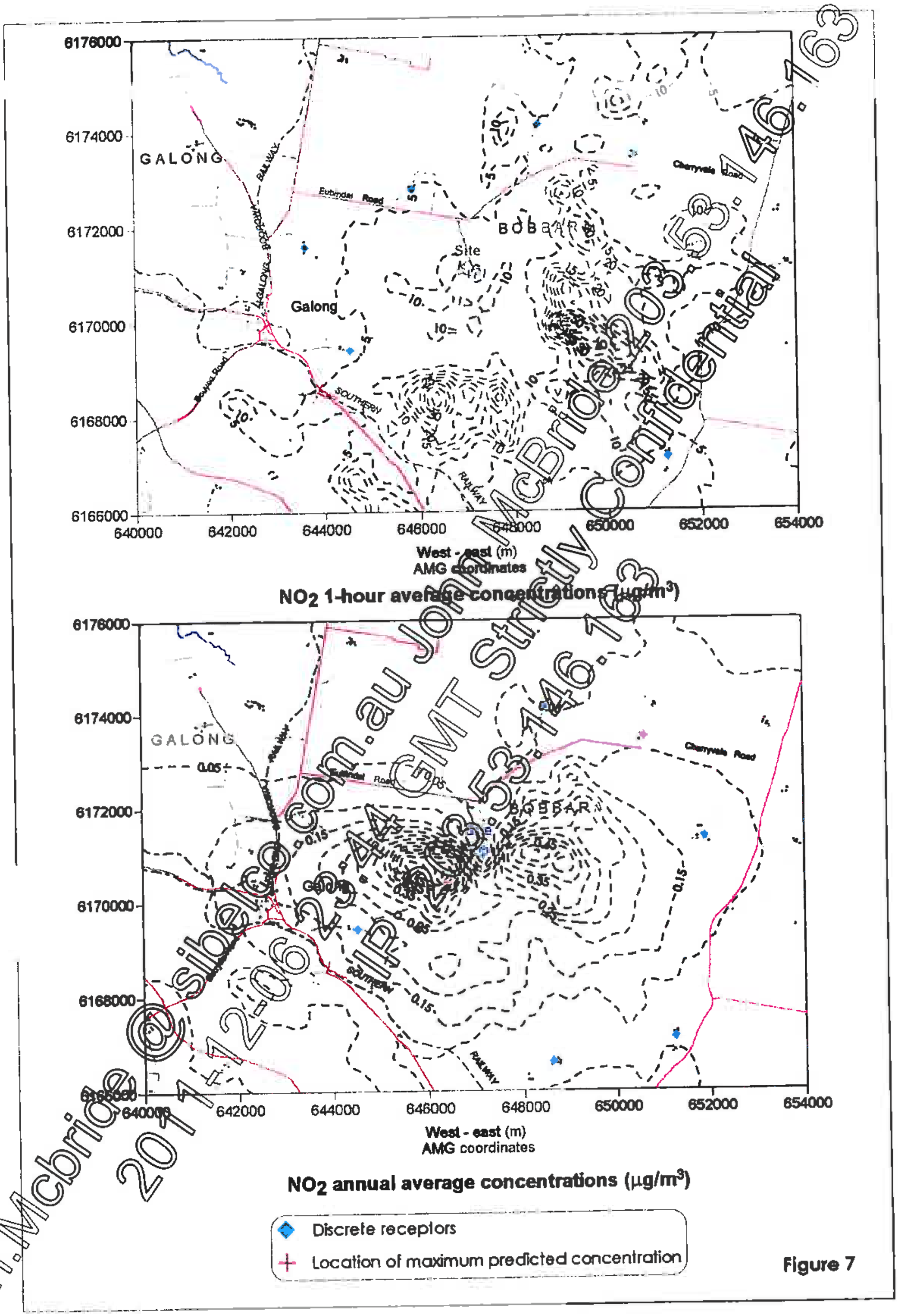
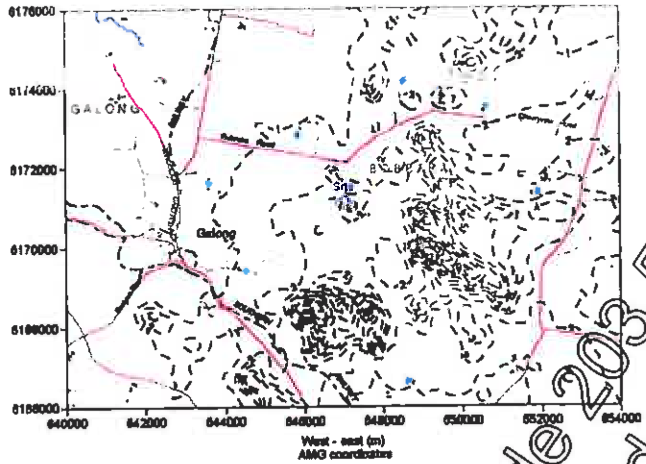
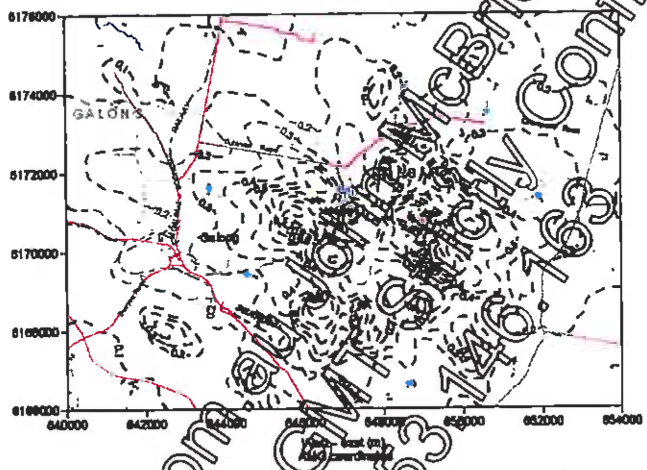

6176000
6174000
6172000
6170000
6168000
6166000
640000
642000
644000
646000
648000
650000
652000
654000
GALONG
Galong
BOBBARA
Site
Eubindal Road
Cherryvale Road
SOUTHERN
RAILWAY
West - east (m)
AMG coordinates
NO2 1-hour average concentrations (µg/m³)
0.05
0.15
0.35
NO2 annual average concentrations (µg/m³)
Discrete receptors
Location of maximum predicted concentration

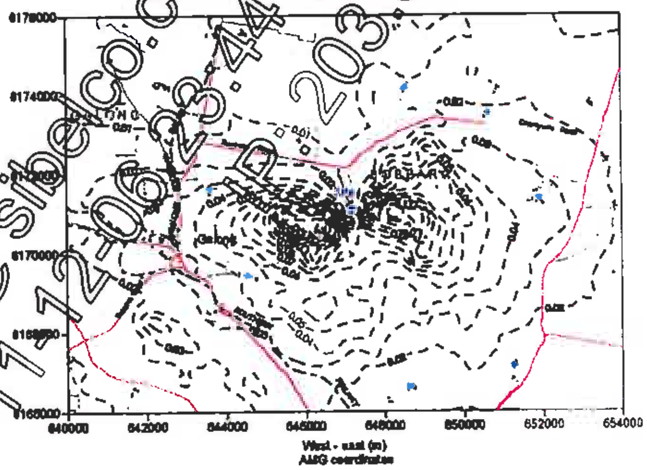
Figure 7



SO$_2$ - 1-hour average concentrations ($\mu g/m^3$)



SO$_2$ - 24-hour average concentrations ($\mu g/m^3$)

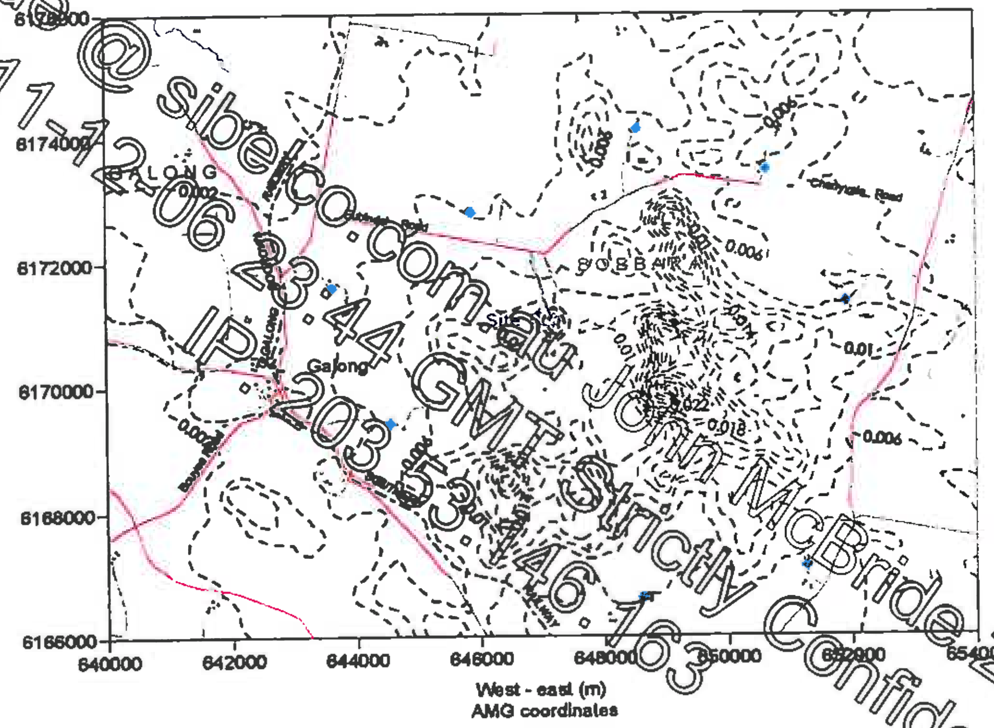


SO$_2$ - annual hour average concentrations ($\mu g/m^3$)

Discrete receptors

Location of maximum predicted concentration

Figure 8



Ammonia 99.9th percentile 3-minute average concentrations ($\mu g/m^3$)

Discrete receptors

Location of maximum predicted concentration

Figure 9

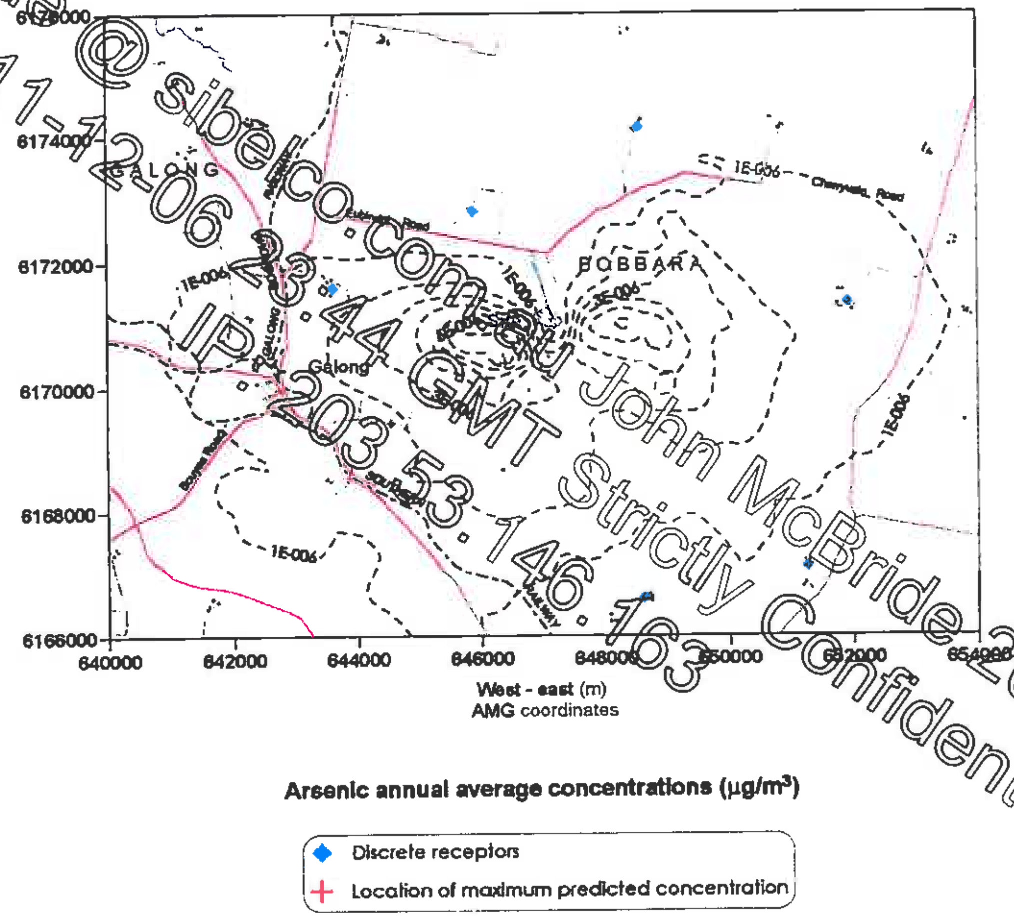
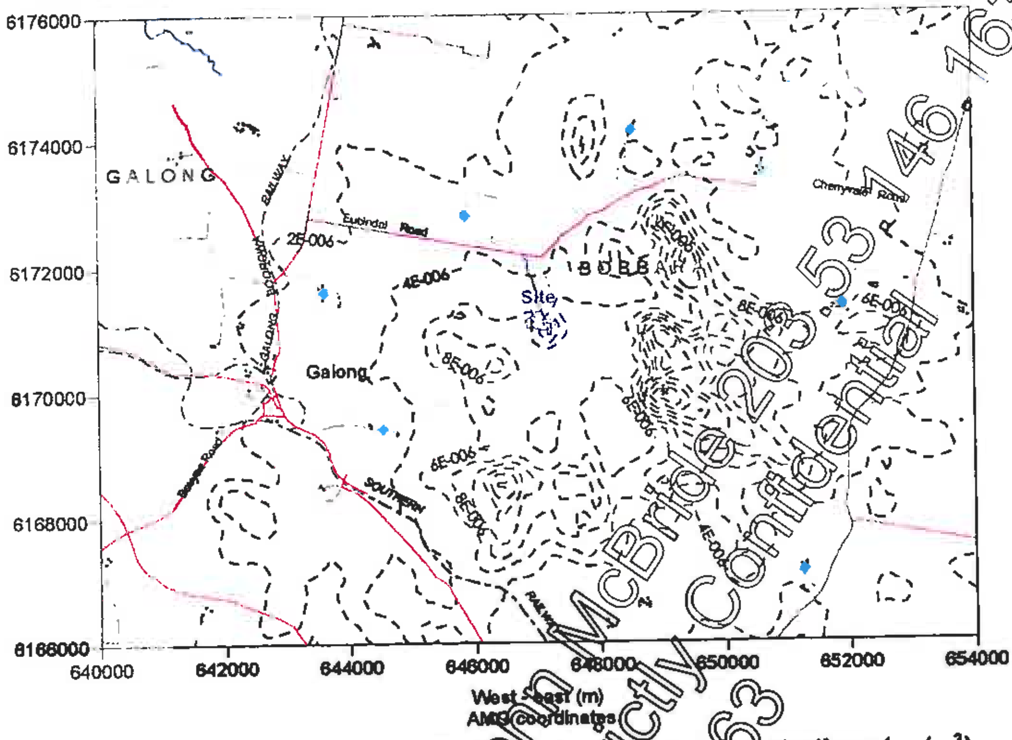
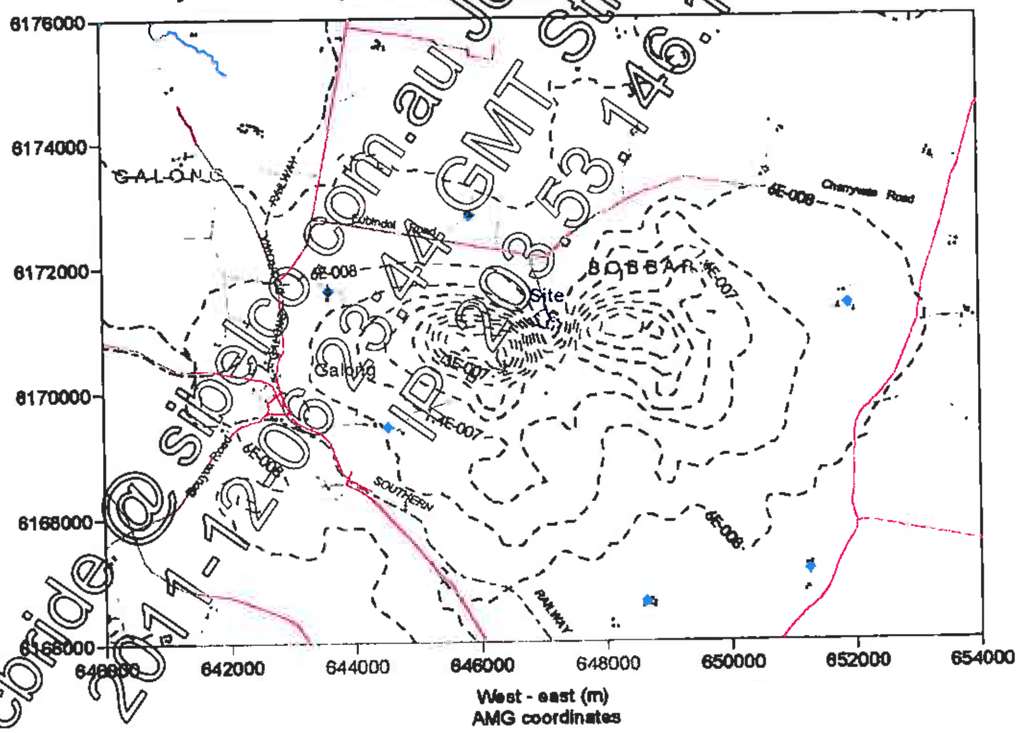

6176000
6174000
6172000
6170000
6168000
6166000
640000
642000
644000
646000
648000
650000
652000
654000
West - east (m)
AMG coordinates
GALONG
BOBBARA
Galong
1E-006
Cherrydale Road
Arsenic annual average concentrations (µg/m³)
Discrete receptors
Location of maximum predicted concentration

Figure 10



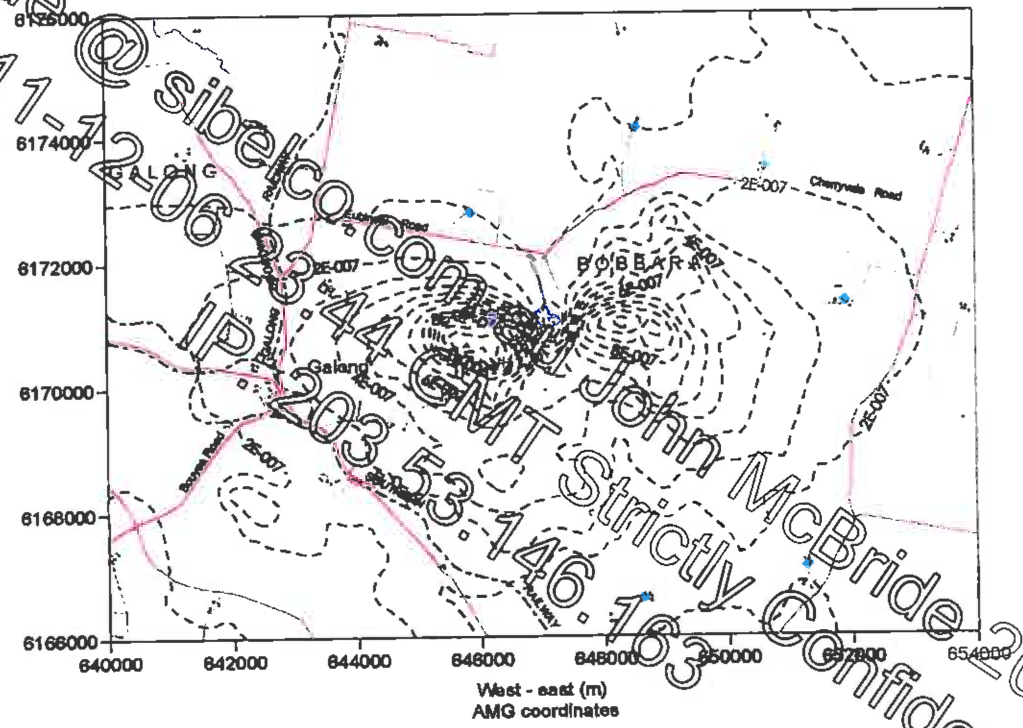
Beryllium 99.9th percentile 3-minute average concentrations (µg/m³)



Beryllium annual average concentrations (µg/m³)

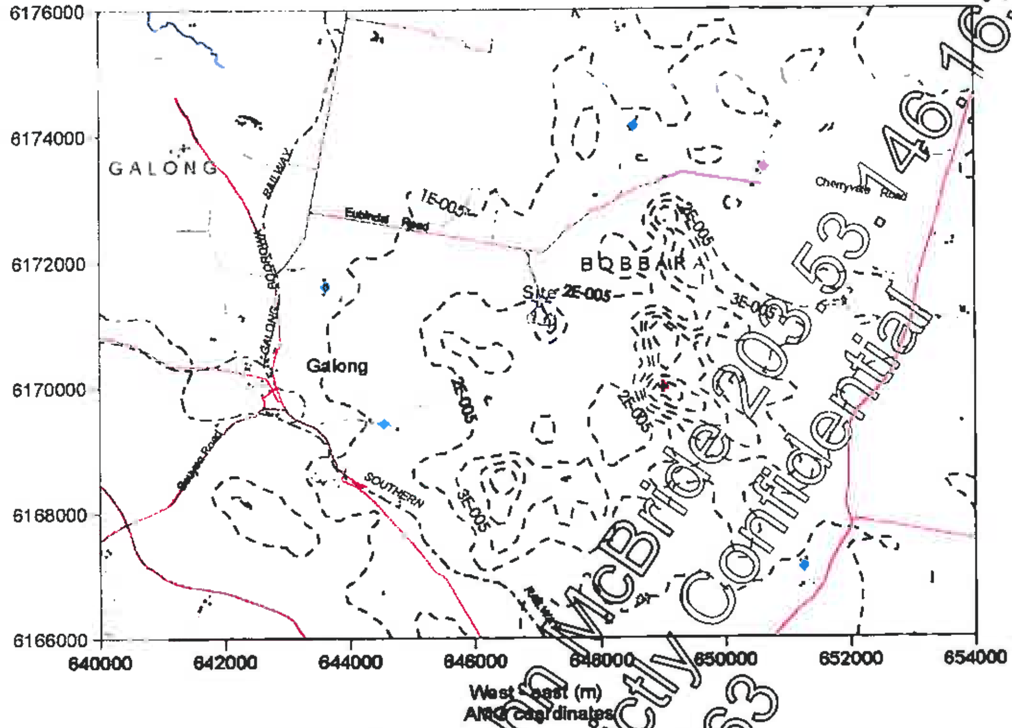
Discrete receptors
Location of maximum predicted concentration

Figure 11

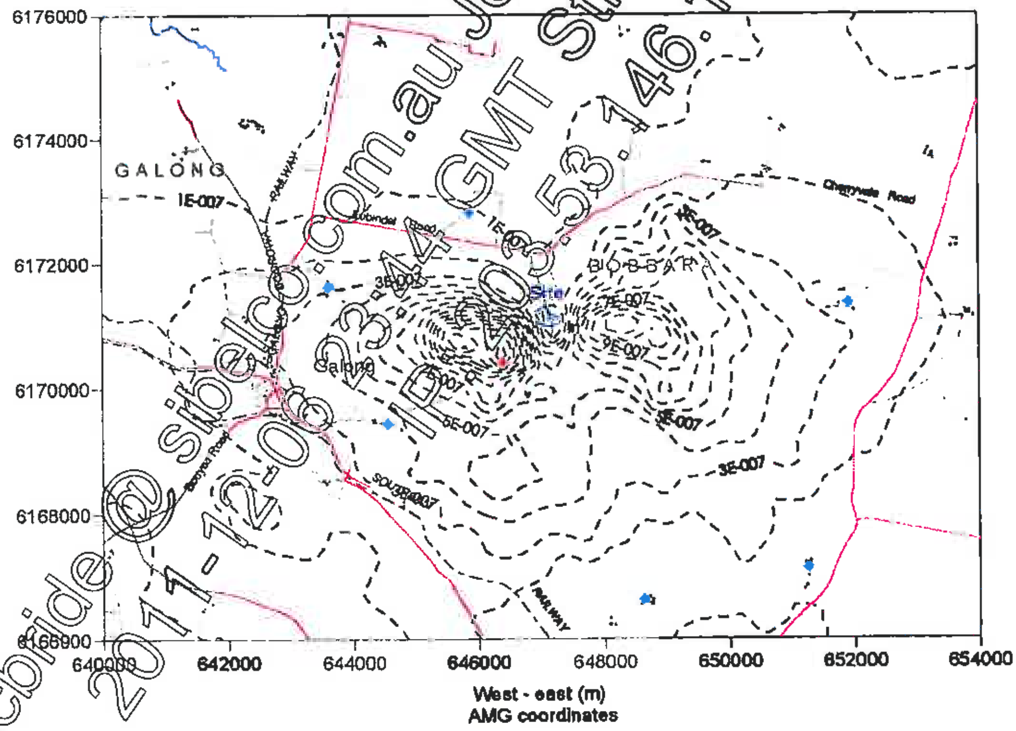


Cadmium annual average concentrations (µg/m³)

Figure 12



Chromium 3-minute average concentrations (µg/m³)

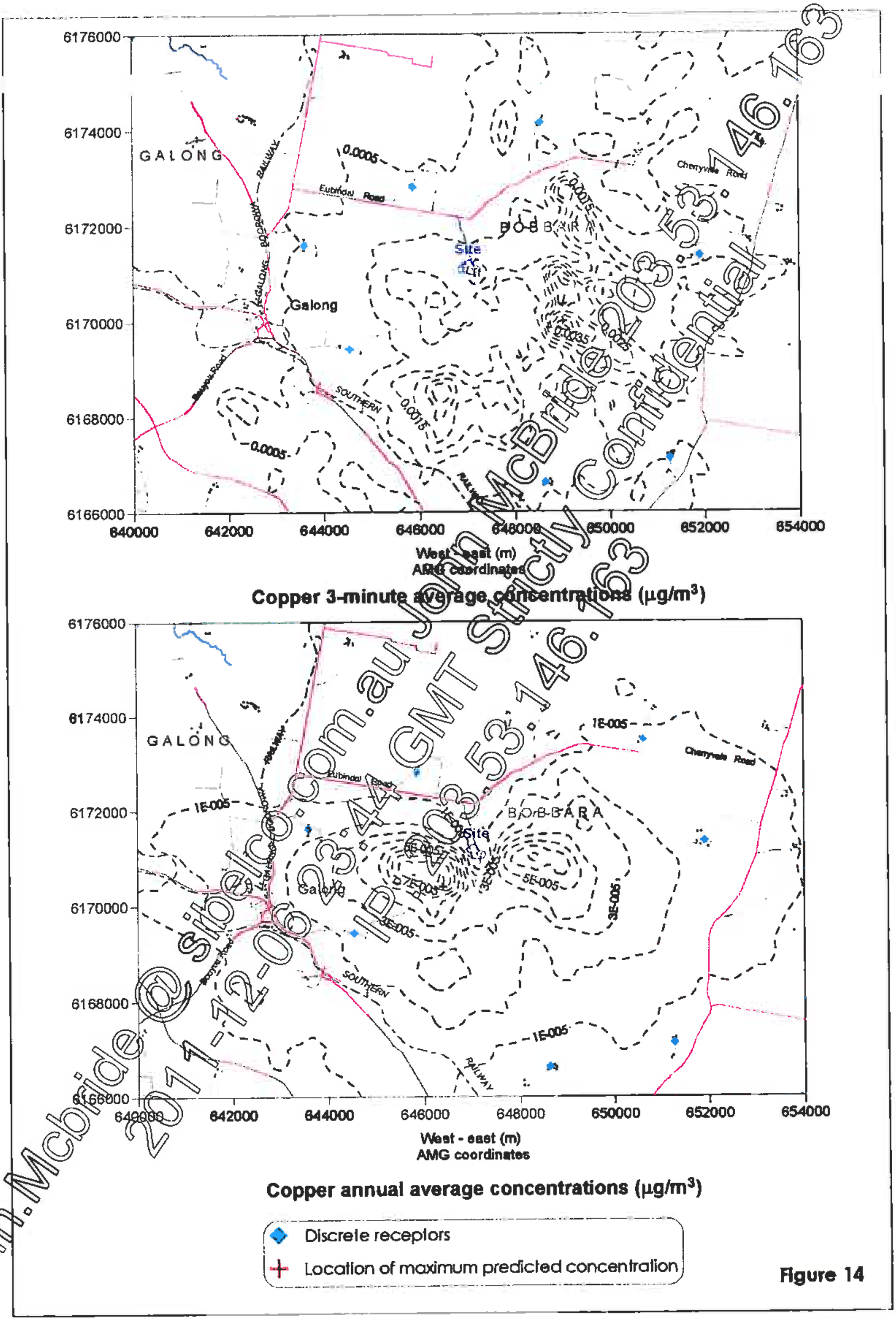


Chromium annual average concentrations (µg/m³)

Discrete receptors

Location of maximum predicted concentration

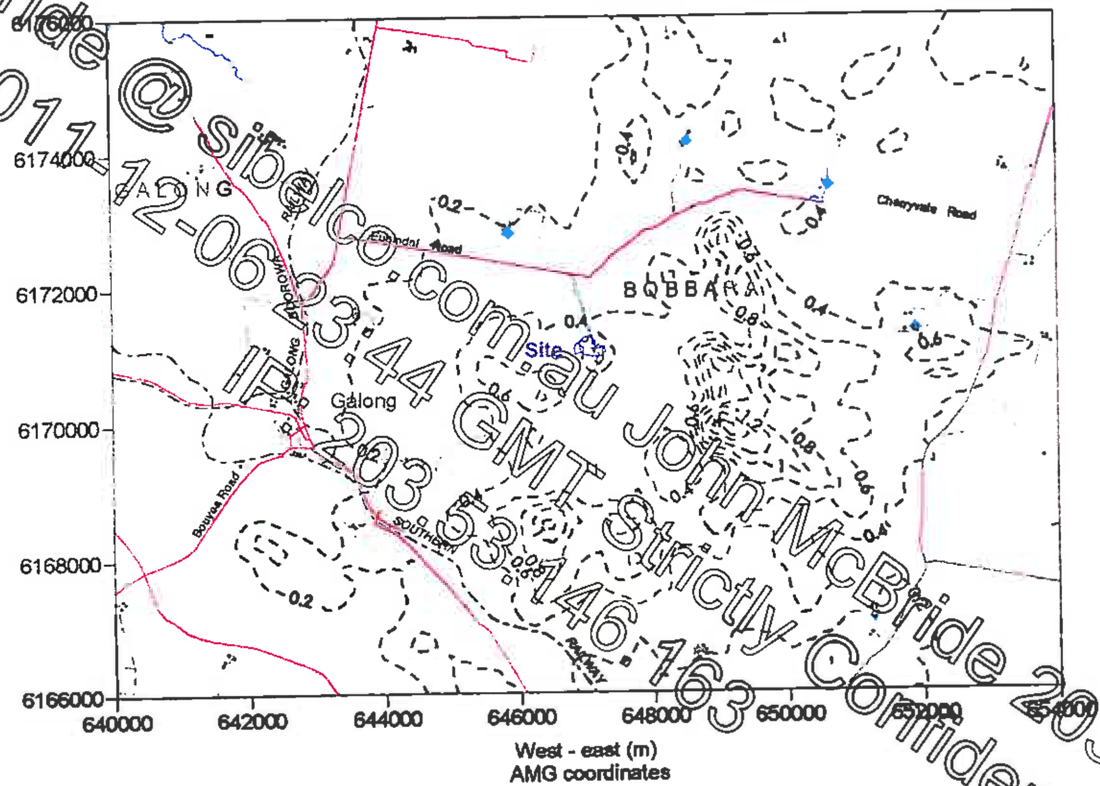
Figure 13



Copper 3-minute average concentrations (µg/m³)

Copper annual average concentrations (µg/m³)

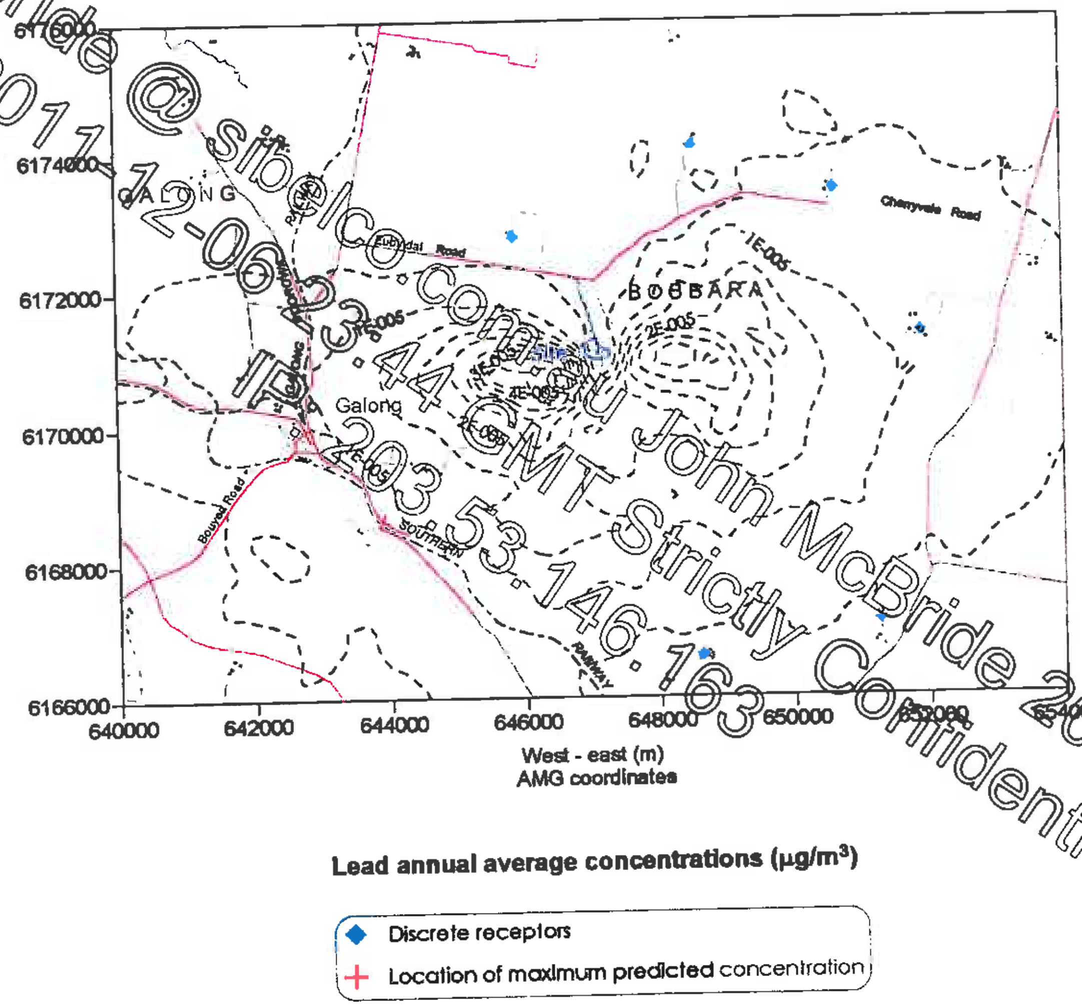
Figure 14



Hydrochloric acid 99.9th percentile 3-minute average concentrations ($\mu g/m^3$)

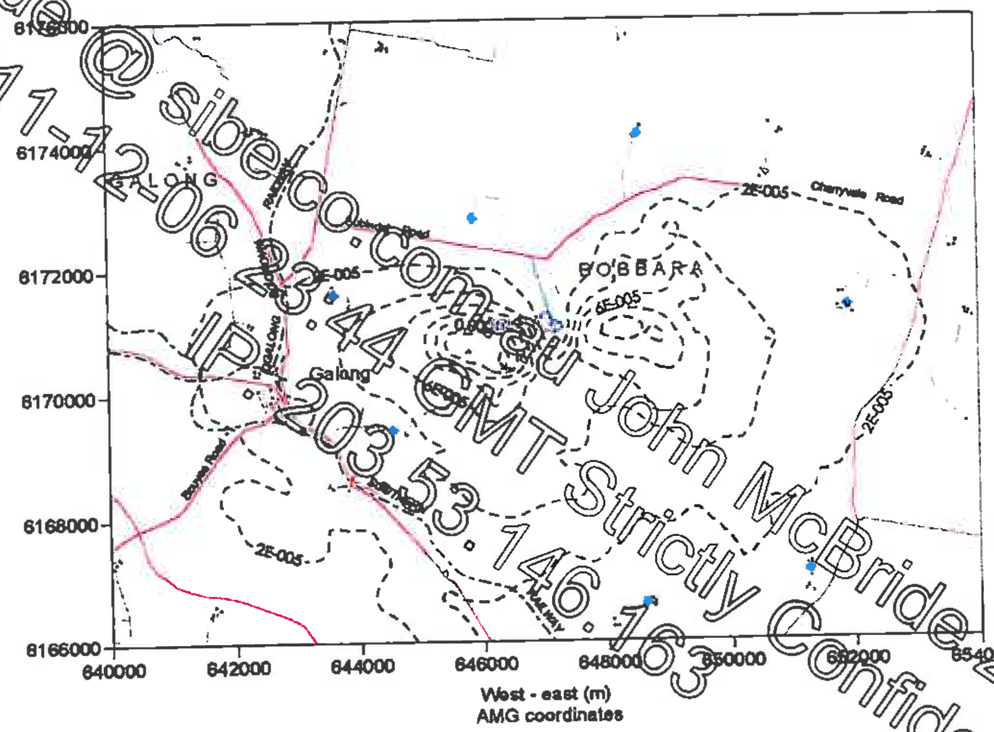
- ◆ Discrete receptors
- + Location of maximum predicted concentration

Figure 15



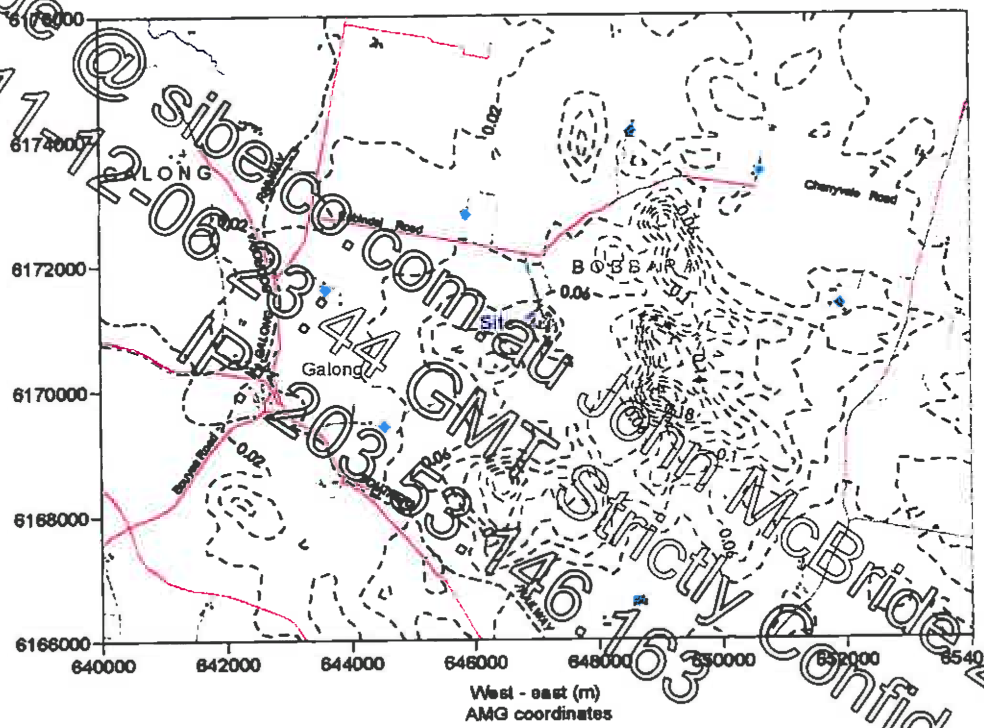
Lead annual average concentrations (µg/m³)

Figure 16



Mercury annual average concentrations (µg/m³)

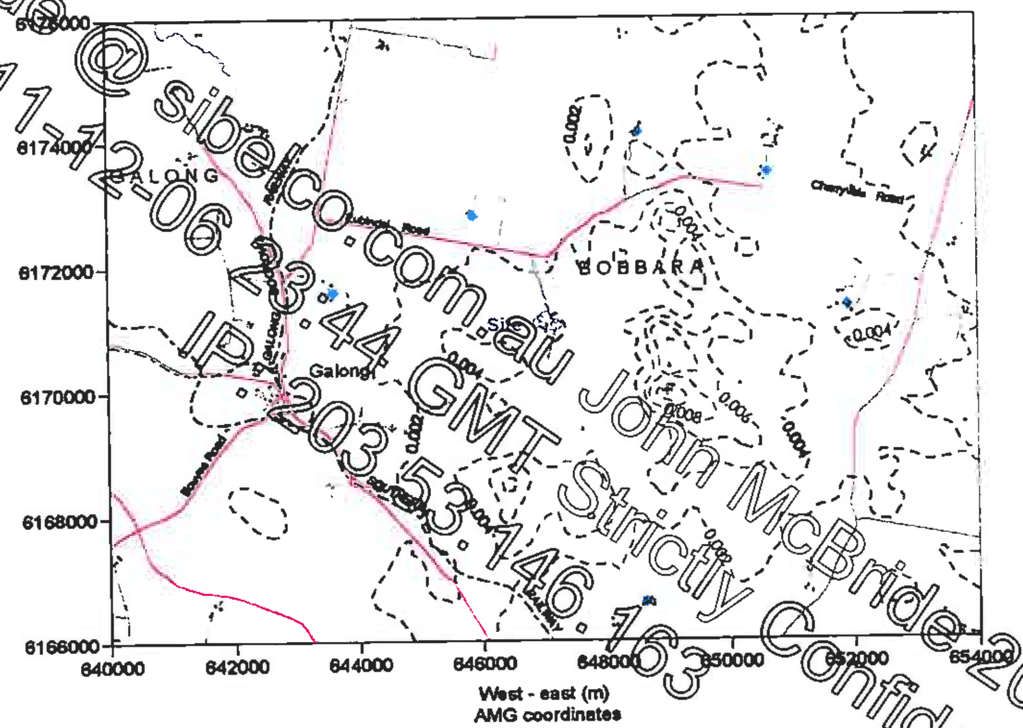
Figure 17



Sulphuric acid 99.9th percentile 3-minute average concentrations ($\mu g/m^3$)

- ◆ Discrete receptors
- + Location of maximum predicted concentration

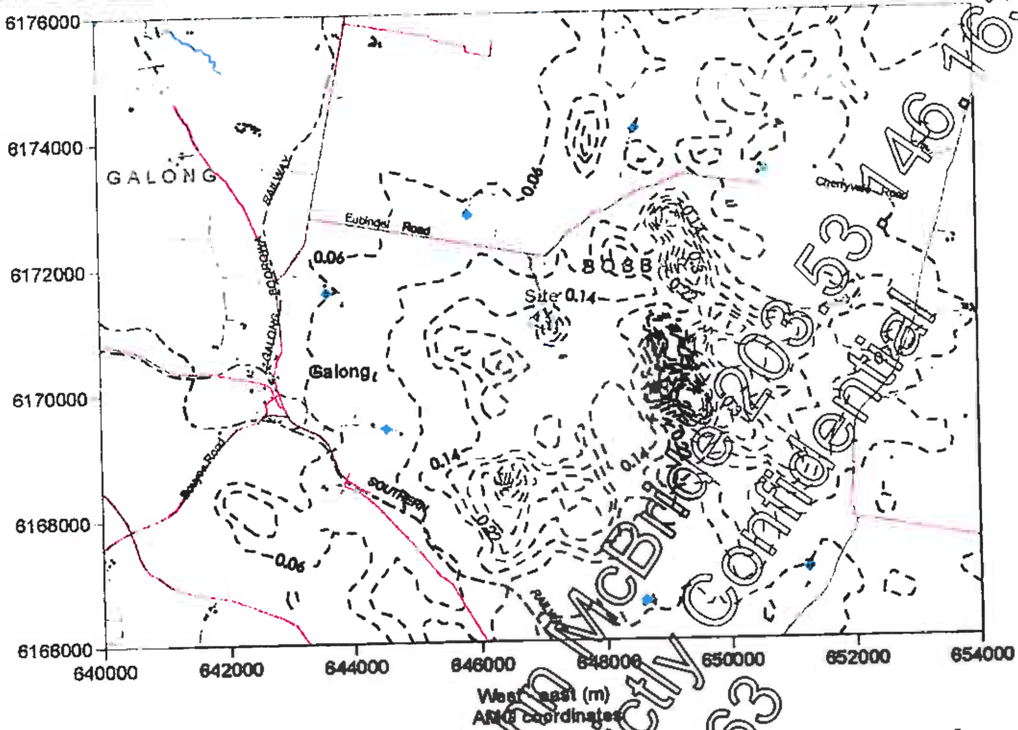
Figure 18



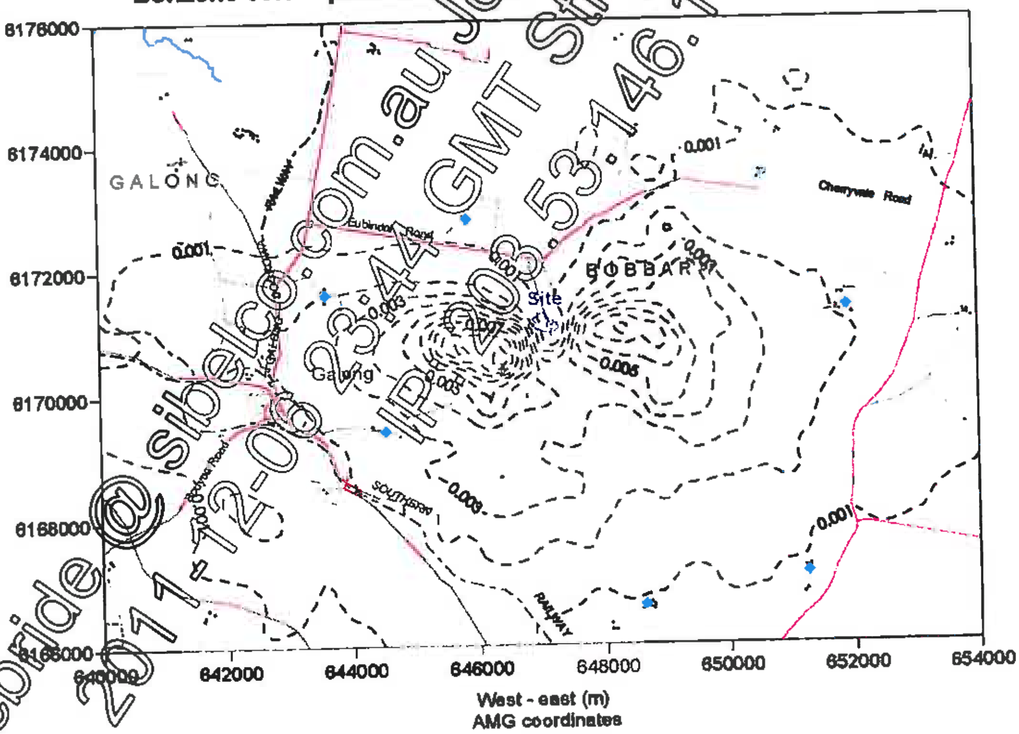
Zinc 99.9th percentile 3-minute average concentrations (µg/m³)

- Discrete receptors
- Location of maximum predicted concentration

Figure 19



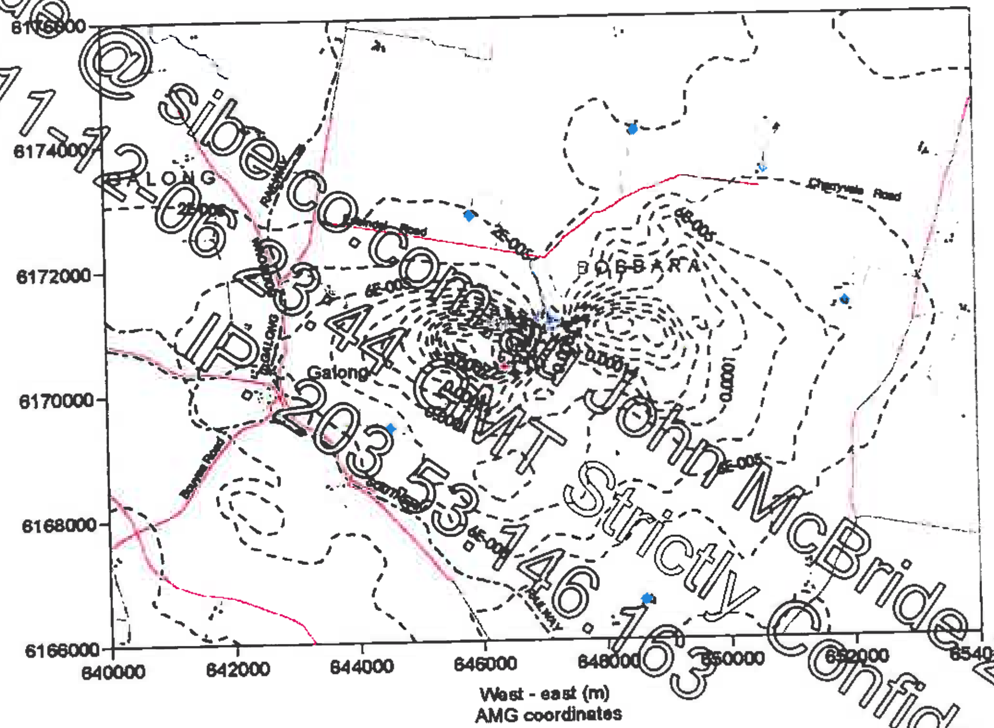
Benzene 99.9th percentile 3-minute average concentrations (µg/m³)



Benzene annual average concentrations (µg/m³)

Discrete receptors
Location of maximum predicted concentration

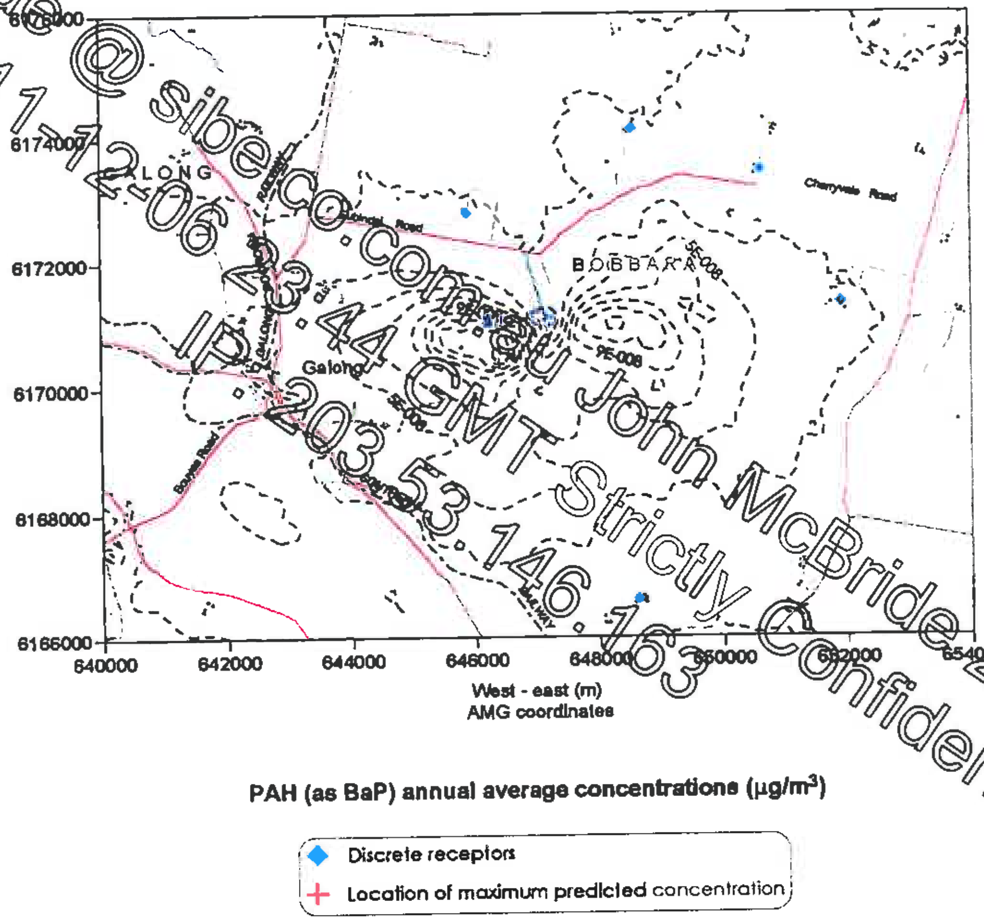
Figure 20



Formaldehyde annual average concentrations (µg/m³)

- Discrete receptors
- Location of maximum predicted concentration

Figure 21



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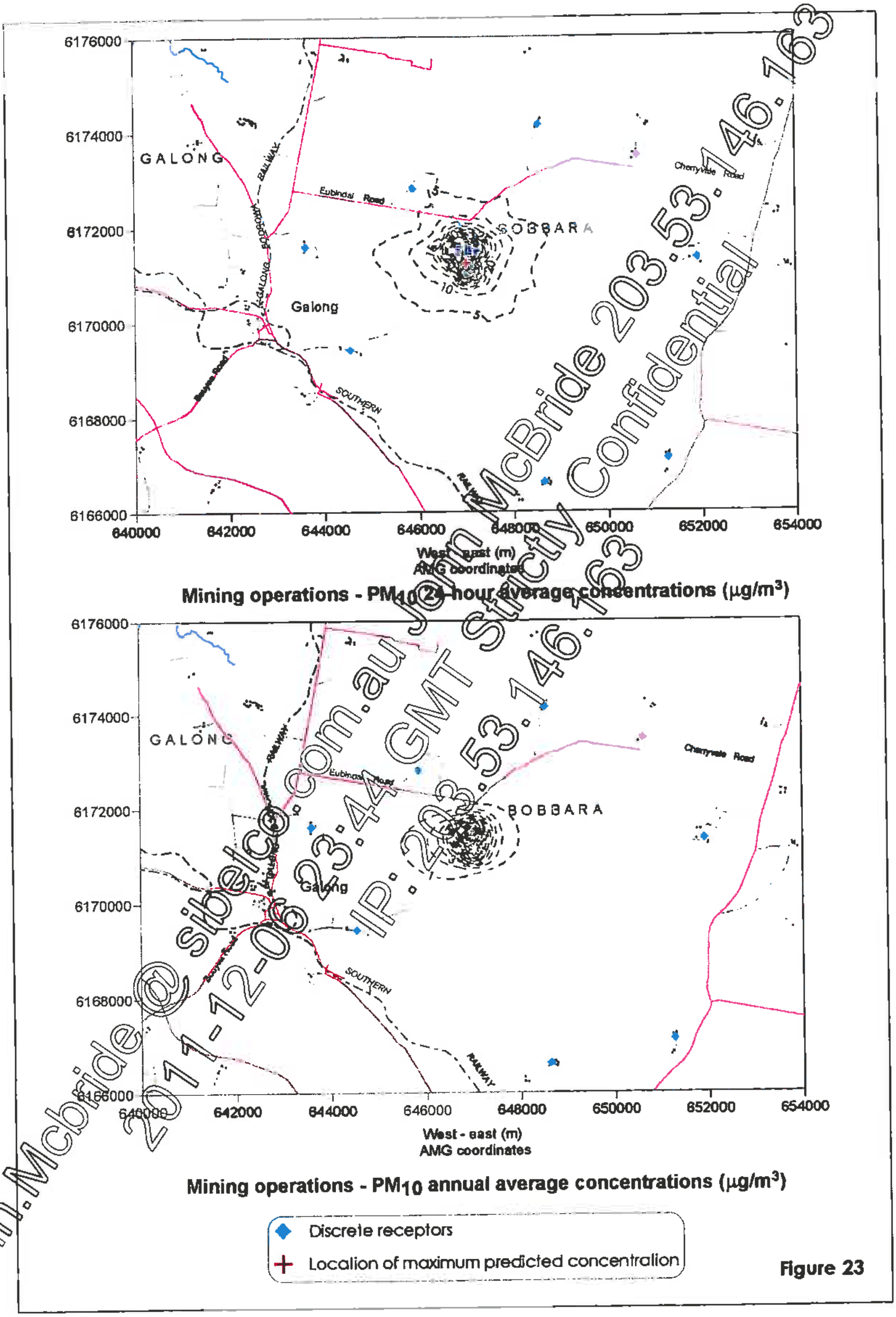
GALONG
BOBBARA
Galong
Cherryvale Road
5E-008
9E-008
West - east (m)
AMG coordinates
PAH (as BaP) annual average concentrations (µg/m³)
Discrete receptors
Location of maximum predicted concentration

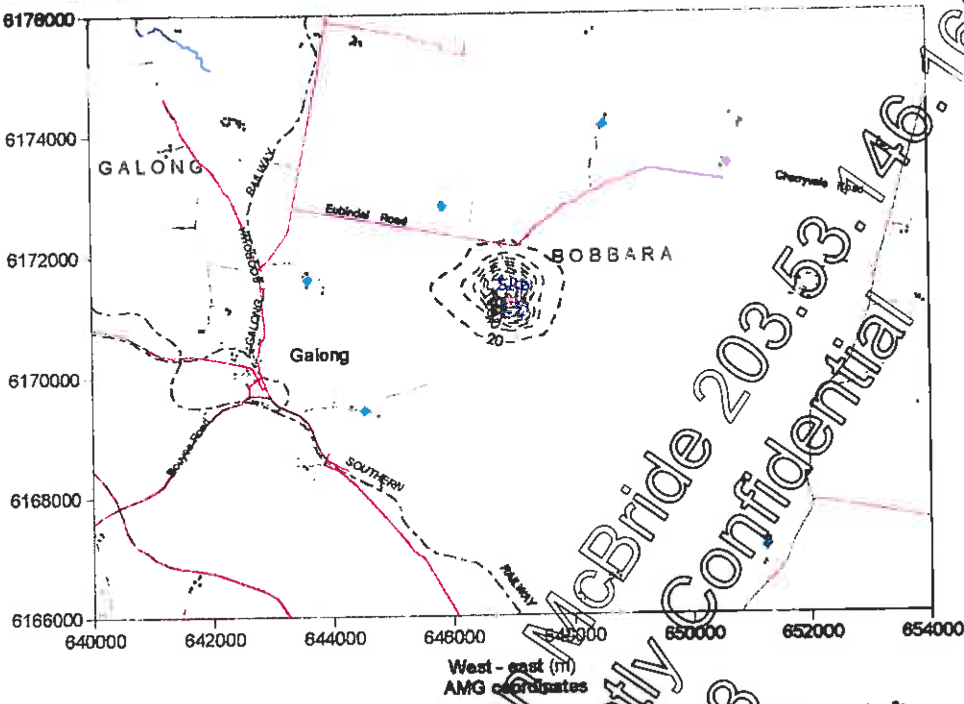
Figure 22



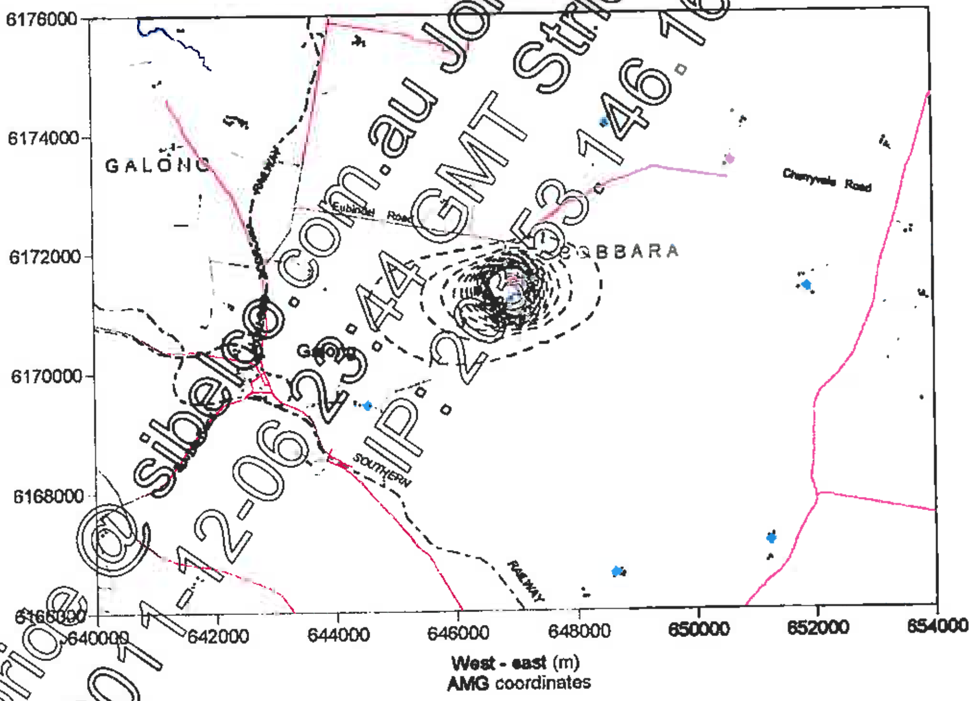
Mining operations - PM10 24-hour average concentrations (μg/m³)

Mining operations - PM10 annual average concentrations (μg/m³)

Figure 23



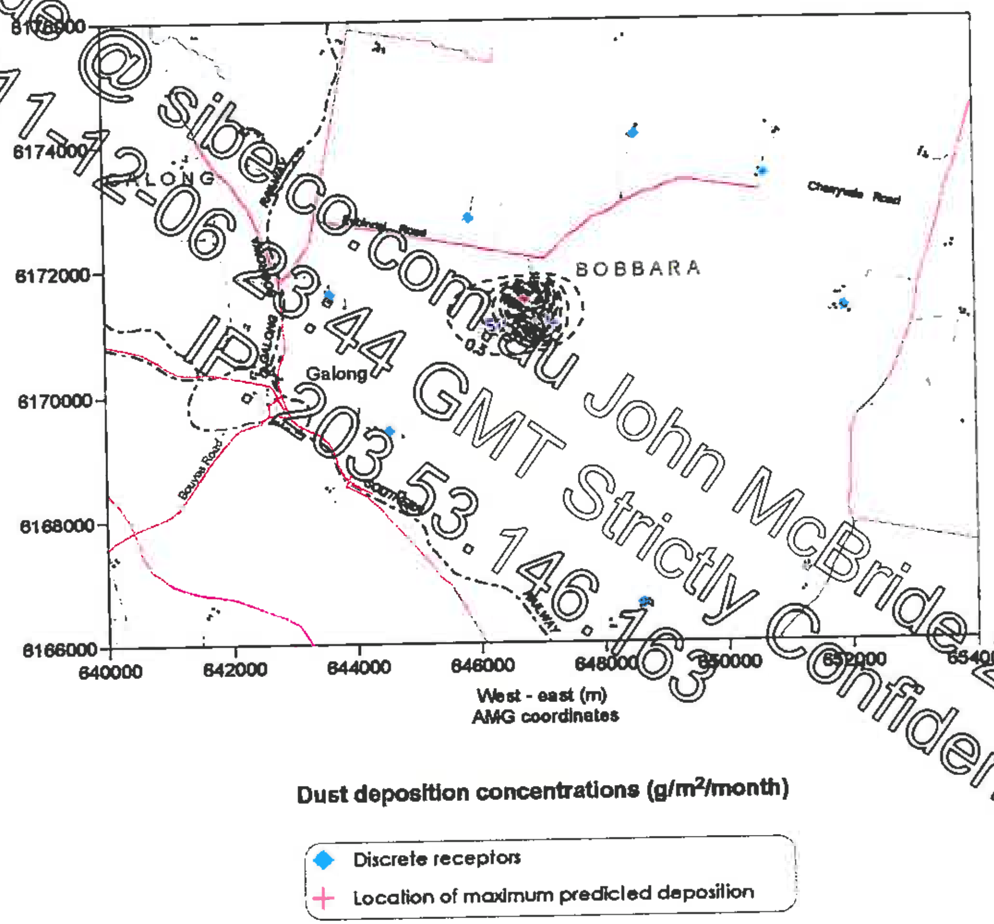
Mining operations - TSP 24-hour average concentrations (µg/m³)



Mining operations - TSP annual average concentrations (µg/m³)

Discrete receptors
Location of maximum predicted concentration

Figure 24



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654000
West - east (m)
AMG coordinates
GALONG
BOBBARA
Galong
Cherrydale Road
Bobbara Road
Bouyea Road
RAILWAY
0.3
Dust deposition concentrations (g/m²/month)
Discrete receptors
Location of maximum predicted deposition

Figure 25

GALONG LIME KILN

TRAFFIC AND TRANSPORT ASSESSMENT

Ref. 23077r

June, 2003

Prepared By

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CONTENTS

EXECUTIVE SUMMARY

Barnu Pty Ltd, a wholly owned subsidiary of Boral Ltd, operate a Limestone Mine at Galong, which supplies agricultural lime. Barnu is currently seeking development approval to expand the mine to produce up to 500,000 tonnes per annum of limestone and transport up to 350,000 tonnes per annum of crushed and milled limestone products for the mine.

Barnu are now proposing to construct and operate a Vertical Shaft Lime Kiln on the Mine site that will produce quicklime.

The Kiln will be capable of producing up to 150,000 tonnes of quicklime. The total maximum quantity of products dispatched from the site would remain at 350,000 tonne per annum consisting of 200,000 tonne per annum of agricultural lime and 150,000 tonne per annum of quicklime.

The bulk of the quicklime would be transported to the Illawarra Region and would pass through Galong Town and along to Burley Griffin Way (MR84). Transportation hours will be the same for the expanded mine which is 7am – 7pm, Monday to Saturday.

The Environmental Impact Statement for the expanded mine has already identified a range of road improvement works in Galong town as well as a Code of Conduct for truck drivers and a Complaints Hotline. In addition, Barnu has agreed to the upgrading of the Burley Griffin Way / Galong Road intersection, when sales and transportation of the lime products exceed 200,000 tonnes per annum.

The traffic generation of the mine in full production in 2008 with the lime kiln operating will be of the same order as for the expanded mine. The only additional trips per day will be 8 employee trips (4 in / 4 out), 4-6 coal truck delivery trips (2-3 in / 2-3 out) and the occasional maintenance vehicle trip.

The cumulative impacts of the additional traffic (12-14 vehicle trips per day) associated with the Lime Kiln on the road network will be minimal.

The proposed road upgrading works and other traffic management changes through the town of Galong associated with the Galong Mine Expansion Project will address amenity concerns within the Galong town. In addition, the proposed upgrading of the Burley Griffin Way / Galong Road intersection will improve potential road safety at this intersection.

An assessment of the traffic impacts during construction of the Lime Kiln has also concluded that these impacts will be satisfactory. Construction of the Kiln is expected to take some 7 months to complete and will require up to 50 additional trips per day (25 in / 25 out) during the busiest periods. Most of these trips will be employee trips and undertaken in passenger cars and small buses. The number of vehicle trips associated with the construction of the Lime Kiln is numerically small and will not have any adverse traffic impacts on the road network.

1.0 INTRODUCTION

The Galong Limestone Mine is located approximately 20km east-southeast of Harden in the Southwest Slopes region of NSW. **Figure 1** refers. The mine is owned and operated by Barnu Pty Ltd (The Proponent) and is the major supplier of agricultural lime for use as an acid soil ameliorant to the cropping areas of the Southwest Slopes grain belt.

The mine currently has development consent from Harden Shire Council to produce and dispatch 200,000 tonnes per annum of milled limestone products. Barnu is currently seeking development approval to mine up to 500,000 tonnes per annum of limestone and transport up to 350,000 tonnes per annum of crushed and milled limestone products from the mine. The development application for the expanded mine is currently being considered by Harden Shire Council.

Barnu are now proposing to construct and operate a Vertical Shaft Lime Kiln on the Mine site that will produce quicklime.

This report has been prepared for reference within the Environmental Impact Statement for the Lime Kiln to address the traffic issues associated with the construction and operation of the Lime Kiln.

2.0 PROPOSAL

The proposal is to construct and operate a Lime Kiln on the Mine site. The Kiln will include a fully enclosed building to store up to 500 tonnes of coal for use in the Kiln.

The workforce required for the Kiln will be four (4) people operating over three shifts per day as follows:

- Day shift – 2 persons
- Evening shift – 1 person
- Night shift – 1 person

The Lime Kiln Project, should it proceed, will not affect the total volume of product transported from the site described for the Mine Expansion Project. The Galong Limestone Kiln Project proposes the construction and operation of a Lime Kiln capable of producing 150,000tpa of quicklime. Approximately 300,000t of limestone is required to be processed through the Kiln in order to produce 150,000t of quicklime. The total quantity of products produced on-site would remain at 350,000tpa, consisting of 200,000tpa of agricultural lime and 150,000tpa of quicklime. If the Lime Kiln Project does not proceed, maximum agricultural lime sales would be increased to the 350,000tpa limit.

The bulk of the quicklime would be transported to the Illawarra Region and would pass through Galong and along Burley Griffin Way.

The Kiln will use between 60-70 tonnes of coal per day. The coal will be delivered by truck, resulting in two (2) B-Doubles or three (3) semi trailer deliveries per day. These vehicles will arrive and depart the mine via Burley Griffin Way through the town of Galong. Coal is also expected to come from Clarence which is north of Galong and therefore these delivery vehicles may use Burley Griffin Way west of Galong Road.

Transportation hours will be the same as for the expanded mine which is 7am – 7pm Monday to Saturday.

Vehicle access to the proposed Lime Kiln will be via the mine's access road which is located in Eubindal Road at the end of the formed section of that road.

3.0 TRANSPORT ROUTES

3.1 Transport Route

All product and delivery vehicles associated with the Kiln will use the route from Burley Griffin Way (MR84) via the town of Galong. This route includes Galong Road (Crescent Street, Bobbara Road, Ryan Street through Galong town) and Eubindal Road. These vehicles will arrive from and depart to the east along Burley Griffin Way (MR84). **Figure 1** shows the proposed transport route.

Burley Griffin Way is a State road and is constructed to a high standard. The section of Burley Griffin Way between Harden Shire boundary and the Hume Highway is currently not a B Double route, however advice from the Roads and Traffic Authority indicates that upgrading works are imminent and when completed, this section of Burley Griffin Way will become a B Double route.

There will be no dangerous goods transported to and from the proposed Lime Kiln.

3.2 Proposed Road Upgrading Works

The EIS for the Galong Mine Expansion has identified the need for the progressive upgrading of the main transportation route through Galong town through the provision of an improved and wider road surface and, subject to the agreement of Harden Shire Council and the Roads and Traffic Authority, lower speed limits through Galong town and in Eubindal Road. The proponent has given an undertaking to Harden Shire Council to work with the Council to address the concerns of the residents of Galong town.

The proponent has also agreed to the upgrading of the Burley Griffin Way / Galong Road intersection to provide for increased turning vehicles to / from Burley Griffin Way, when sales and transportation of the lime products exceed 200,000 tonnes per annum.

The other transport elements of the Mine Expansion Project, namely the Code of Conduct for truck drivers and the Complaints Hotline will apply for all product and supply vehicles to the mine including vehicles associated with the Lime Kiln.

4.0 TRAFFIC IMPACTS IN OPERATIONAL PHASE

There will be no substantial change to the traffic generation and traffic impacts as assessed for the Galong Mine Expansion, if the Lime Kiln Project is approved.

The number of product vehicles generated by the Mine with the Kiln in place will be the same as assessed for the expanded mine.

In 2008 when the mine is in full production with the Kiln operating, product truck movements using the main transportation route through Galong town will be:

- between 74-78 truck movements on the average day with 7-8 truck movements per hour;
- between 88-92 truck movements on the 85th percentile day with 9-10 truck movements per hour.

The only additional trips associated with the proposed Lime Kiln will be 12-14 trips per day consisting of:

- 4 employee trips (i.e. 4 in / 4 out) spread over the day;
- 2-3 coal truck load deliveries per day (i.e. 2-3 in / 2-3 out); and
- vehicle trips associated with maintenance of the kiln which will be 1-2 visits per week.

These additional trips will be spread over the full day resulting in a maximum of 1-2 vehicle trips per hour. Other than coal load deliveries (4-6 trips per day), the remainder of the vehicle trips will consist of cars and vans (i.e. Austroad Class 1 and 2 vehicles).

The impacts of the additional traffic (14-16 vehicle trips) associated with the Lime Kiln on the road network will be minimal.

All of these additional trips will access the mine via Eubindal Road. However, away from Eubindal Road, the employee trips (8 trips per day) will be spread over several routes. The coal deliveries and the maintenance vehicles will use Galong Road via Galong Town to and from Burley Griffin Way.

The additional 4-6 truck movements per day passing through Galong town between the Mine and Burley Griffin Way will not alter the traffic conditions on the road network. Traffic conditions on the road network and the principal intersections will remain satisfactory.

The proposed road upgrading works and other traffic management changes through the town of Galong associated with the Galong Mine Expansion Project will address amenity concerns within the Galong town. In addition, the proposed upgrading of the Burley Griffin Way / Galong Road intersection will improve potential road safety at this intersection.

Therefore it is concluded that the cumulative traffic impacts of the proposed Lime Kiln will be minimal.

5.0 CONSTRUCTIONS IMPACTS

The Lime Kiln Project will take approximately 7 months to construct. Subject to timely approval construction is expected to commence in late 2003 and be completed in mid 2004. The construction workforce will typically be 40 people. During the third quarter of construction, this figure will increase to 70 people.

It is planned to work only one shift per day, from 6am to 6pm for 6 days per week, Monday to Saturday. On occasions, Sunday work will be required to meet Project schedule requirements. Construction workforce will be transported to the site in a mix of mini-buses and private vehicles. Of the 40 people typically employed during the early part of construction, 20 will be transported to and from work in 2 small mini-buses and 20 will be transported in approximately 10 private vehicles. When the workforce increases to 70, it is expected that 50 will use mini-bus transport (4 buses) and 20 will use private vehicles (10 vehicles). At any time, up to 5 additional company vehicles per day (sedans) would access the site for supervision purposes.

Construction supplies will be delivered in a range of heavy vehicles. It is proposed to have most of the fabrication undertaken off site and components delivered to the site for assembly. Typically, up to two (2) heavy vehicles (semi-trailers) per day will be required to deliver construction material to the site between the fourth and sixth months of construction. During the first three months of construction, up to six (6) concrete agitator vehicles will access the site on some days. This is expected to occur on approximately 7-10 separate days only. Up to three (3) smaller trucks per day will deliver small construction materials and supplies. Access will be via Galong and all restrictions on heavy vehicle movements through the town will be observed.

As noted above construction of the Kiln is scheduled to occur in 2003 and 2004. Table 5.1 shows the estimated number of vehicle trips associated with the construction of the Lime Kiln. Reference to Table 5.1 shows that there will be up to 50 vehicle trips (i.e. 25 in / 25 out) per day during the construction period. These trips will be spread over the day between 6am and 6pm. The majority of these vehicles will pass through Galong town.

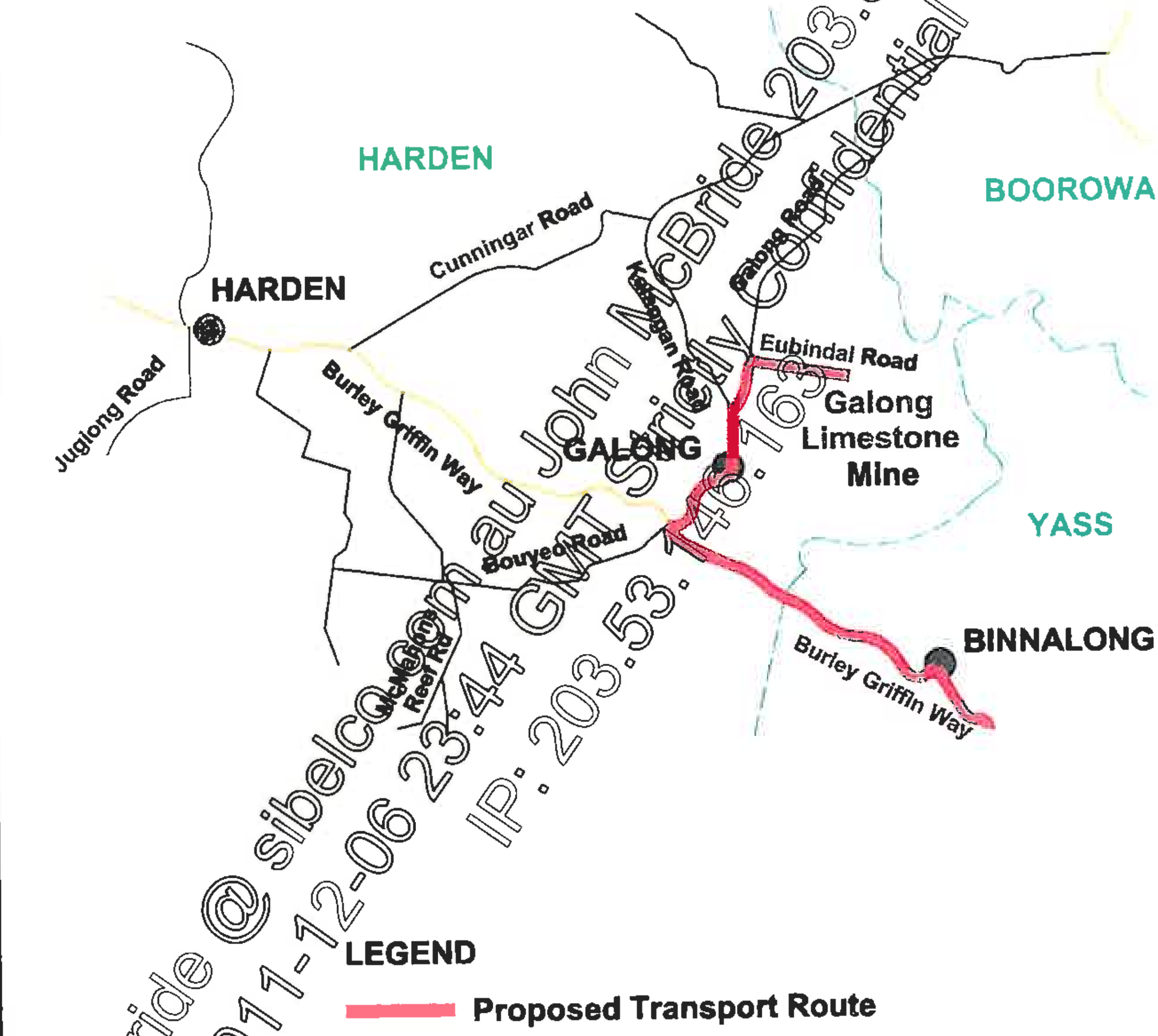
Employee and company vehicles will make up the bulk of the construction traffic and these will be undertaken in light vehicles (i.e. Austroad Class 1 and 2 vehicles).

The number of vehicle trips associated with the construction of the Lime Kiln is numerically small and will not have any adverse traffic impacts on the road network or amenity impacts within the town of Galong. Traffic conditions on the road network including at the principal intersections and within the Galong town are expected to remain satisfactory.

TABLE 5.1

PROPOSED LIME KILN
CONSTRUCTION VEHICLE TRIPS PER DAY

Type of Trip	Months (1-3)	Months (4-6)	Months (7-9)
Employee trips	12 in / 12 out	12 in / 12 out	14 in / 14 out
Company staff	5 in / 5 out	5 in / 5 out	5 in / 5 out
Concrete agitator vehicles	6 in / 6 out	-	
Deliveries – Rigid Trucks	2 in / 2 out	3 in / 3 out	3 in / 3 out
Deliveries – Prefabricated Components	-	2 in / 2 out	
Total	**25 in / 25 out**	**22 in / 22 out**	**22 in / 22 out**



TRANSPORT AND URBAN PLANNING
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Phone 02 9545 1411 Fax 02 9545 1556
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N

SCALE 1:200

FIGURE 1
GALONG LIMESTONE MINE
GALONG
PROPOSED TRANSPORT ROUTE
JOB NO.23077

AESTHETICS REPORT

PROPOSED LIME KILN

Galong NSW

BLUE CIRCLE SOUTHERN

PREPARED BY

Maurice Hayler & Associates
ARCHITECTS

Ph. 02 4229 2005 Fax. 02 4229 2471
12 Joanne Street Woonona NSW 2517

June 2003

Contents

INTRODUCTION

This report was commissioned by Olsen Environmental Consulting Pty Limited on behalf of Boral Blue Circle Southern Cement to assess the aesthetic and visual impact of the proposed Lime Kiln at the Galong Limestone Mine at Galong NSW. The objective of this report is to:

- Assess the visual impact of the proposal on the surrounding countryside
- Provide an artist's impression of the proposal to help the general public better understand the nature and appearance of the proposal
- Make recommendations as necessary regarding the visual impact of the proposal

METHOD

To assess the visual impact of the proposed Lime Kiln, photographs were taken at vantage points around the mine site and surrounding area (refer Locality Map for locations of photography):

1. From surrounding public roads where there is a potential view of the proposed lime kiln
2. Within the mine site and from adjoining Bobbara Station to illustrate the proposal within the context of the mine setting

The purpose of 1 above is to identify potential sight lines to the mine from public roads in the surrounding area and, where practical, computer photomount an image of the proposed lime kiln plant onto the photograph to evaluate the potential appearance and visibility from various locations.

Because the mine is located within the fold of a valley and remote from the general public view, it was necessary to zoom the lens of the camera to provide photographs suitable for assessment in this report.

Photography was undertaken on Thursday 10 April 2003 between the hours of 11:00am – 1:30pm and on 17 June 2003 between the hours of 9:00am – 10:00am. Camera used in April was a Sony Cyber-shot DSC-F505V digital still camera with image size set at 1856 x 1392 pixels. Camera used on 17 June 2003 (for photograph at location number 6) was a Canon AE-1 SLR 35mm analogue camera with lens zoomed 70mm.

PHOTOGRAPHIC VIEWPOINTS

Location 1 – Mine Weather Station

The photographs taken at this viewpoint within the mine leasehold are intended to give a general layout view of the existing mine site.

Location 2 & 3 – Bobbara Station

The photographs taken at this viewpoint from private land adjoining the minesite are intended to give a general contextual view of the existing mine within the rural context.

Location 4 – Eubindal Road

This photograph from the mine access road gives the best possible view of the mine site from a public road. This road is primarily used by people accessing the mine. The lime kiln and associated plant will be visible from this position which is about 1.5 kilometres away from the minesite.

Location 5 – Adjacent the Redemptionist Monastery

From this viewpoint the limestone mine is concealed behind a ridge. It is unlikely that the upper section of the proposed Lime Kiln will be seen from this location. However, if a small section is visible, it would not be readily seen without the assistance of binoculars.

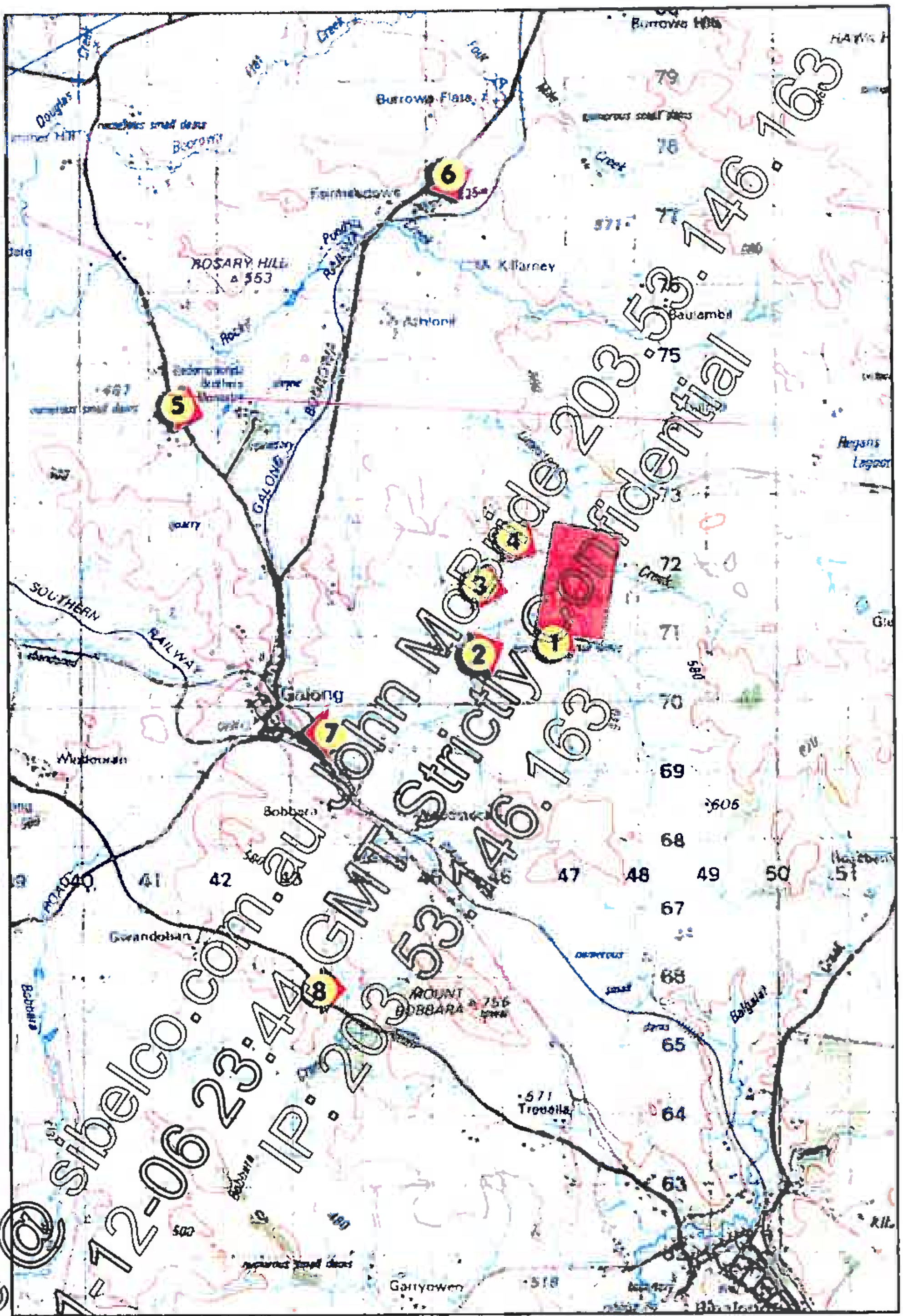
Location 6 – Galong to Boorowa Road North of Rocky Ponds Creek

From this vantage point, approximately 7 km away from the mine, there is a sightline (for an approximate 20 metre stretch along the road) along the valley to the mine site. At this point it is possible for an observer to catch a distant view of the proposed lime kiln and associated equipment. However because of the distance the lime kiln will not be prominent.

Location 7 & 8 – Photographs of Existing Prominent Structures In The Locality

These existing structures are discussed below.

OTHER PROMINENT STRUCTURES IN THE LOCALITY



Locality map of Galong area showing town, mine and locations where photographs were taken.

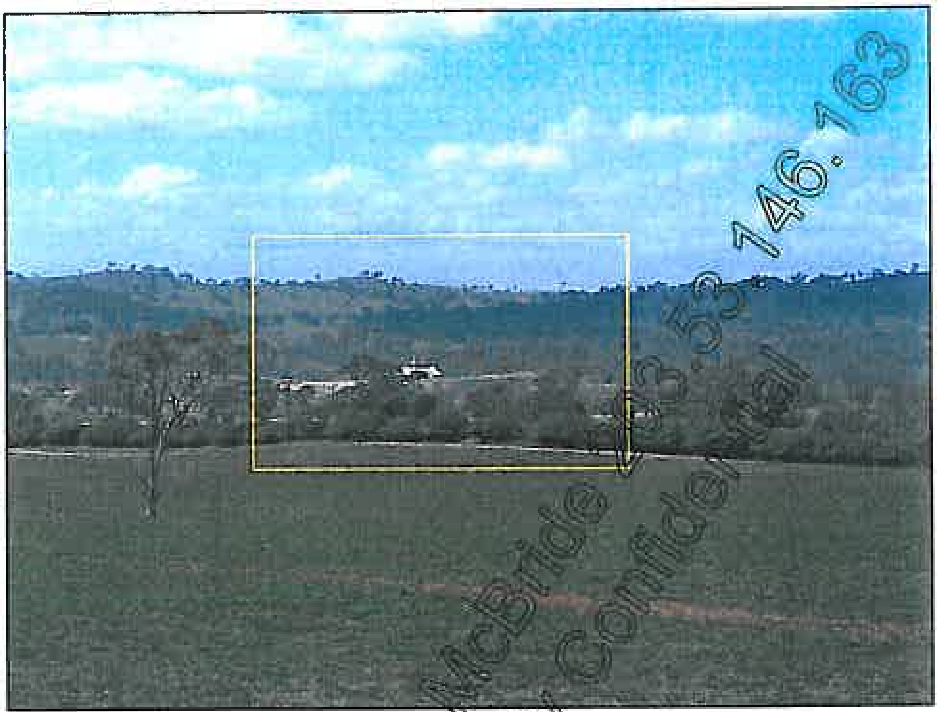
Locality Map of Galong

Location 1 – Mine Weather Station – view north east to existing mine buildings and proposed location of Lime Kiln . **(Panorama composed of 3** overlapping photographs)

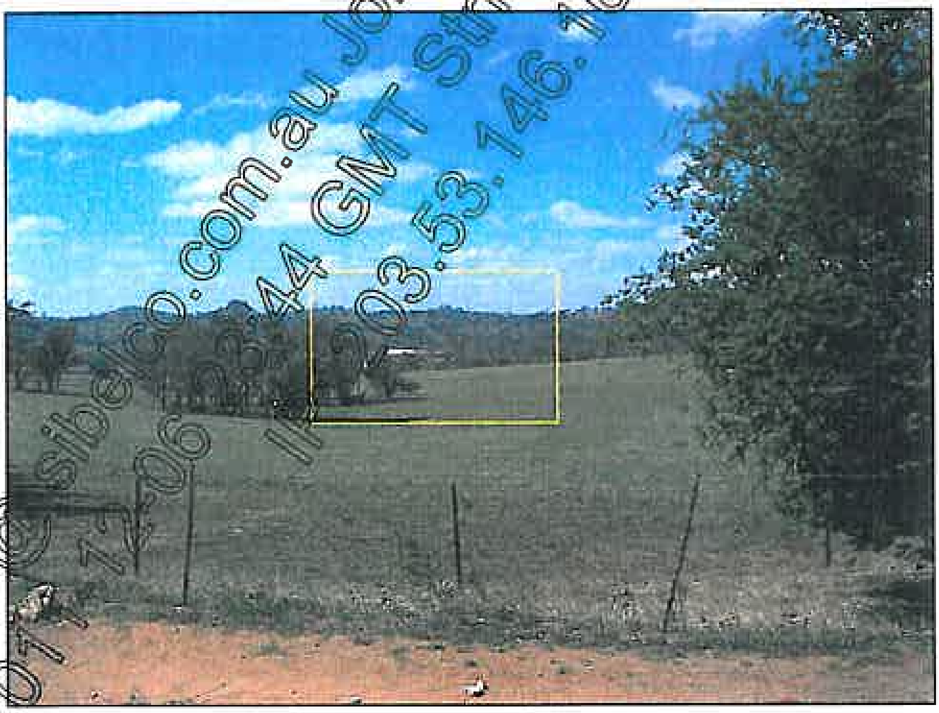
Location 1 – Mine Weather Station – view to the north showing existing mining operations.

(Panorama composed of 3 overlapping photographs)

Location 1 – Mine Weather Station



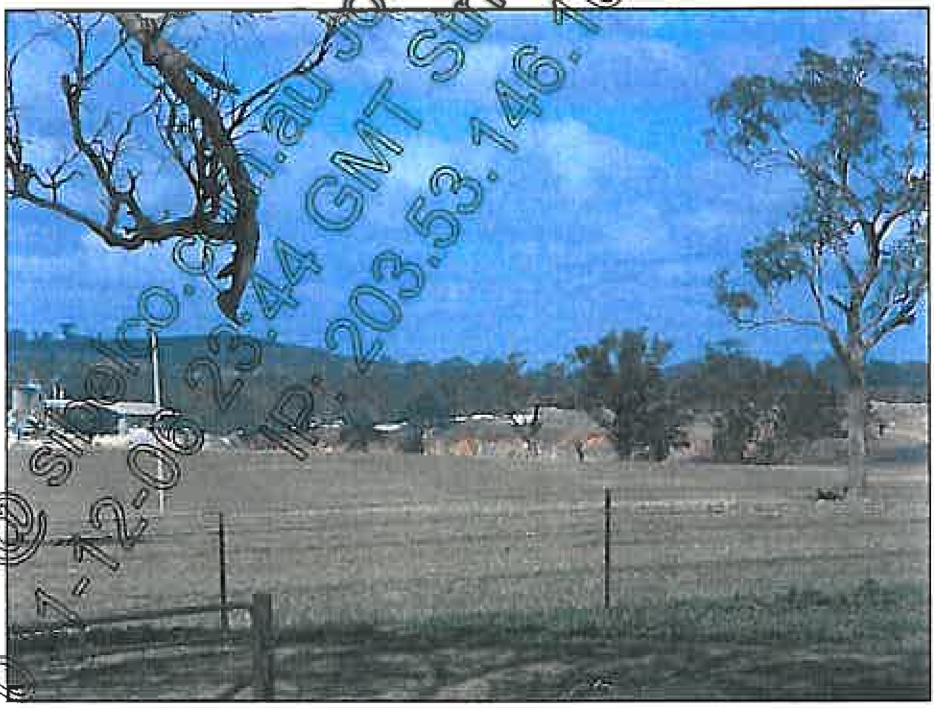
Location 2 –Bobbara Station From Water Tank. Lens zoomed 2.5x



Location 3 –Bobbara Station Water tank Access Road

Locations 2 & 3 – Bobbara Station

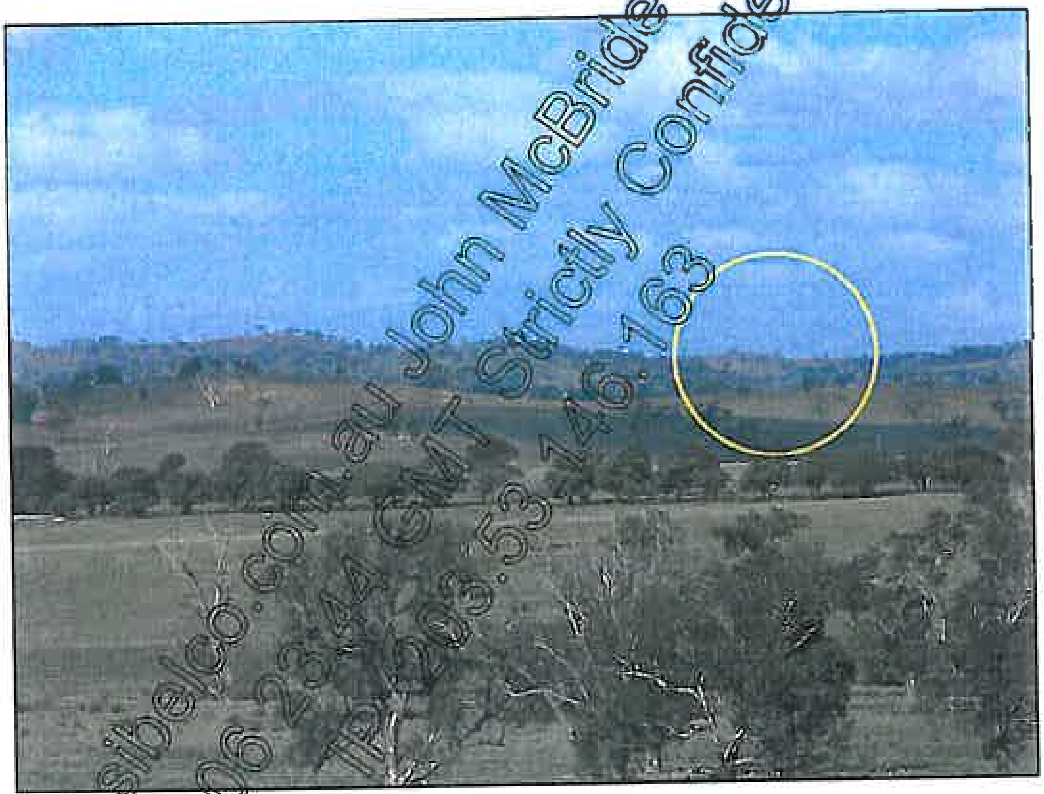
Location 4 – Eubindal Road at Bobbara Station entry gate



Location 4 – Eubindal Road at Bobbara Station entry gate. Above photo zoomed 5x.

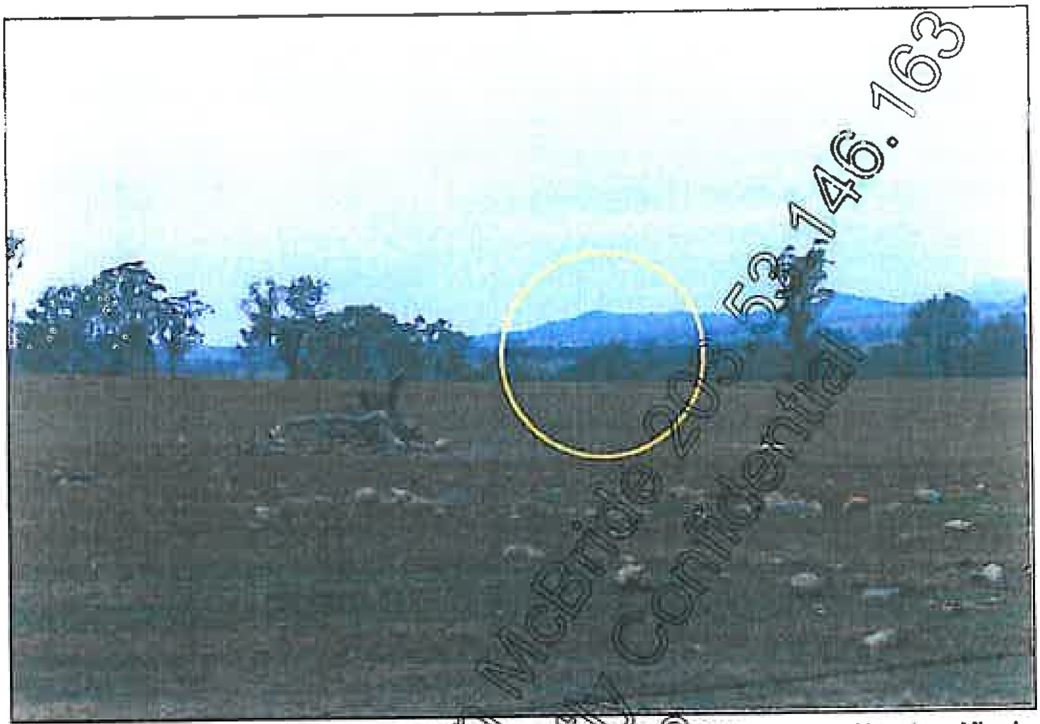
Location 4 – Eubindal Road

Location No. 5 - View from Kalangan **Road near** Rosary **Hill looking east through to southeast. note the** Redemptionist **Monastery at left.** The **Limestone Mine is** located **approximately** 7 km **in the distance behind** the **ridge in the area shown** circled. **(Panorama above composed of 3 overlapping photographs taken with camera zoomed 5X)**



Location No. 5 - Enlargement **from the** photograph **above to show more detail. The Limestone Mine is located behind the ridge in the area shown** circled. **Photograph was taken with lens zoomed 5X. It is** unlikely that **the upper section of the proposed Lime kiln may be seen from this location. However. If the** upper **section** is **visible it would not be noticeable** without **the assistance of binoculars.**

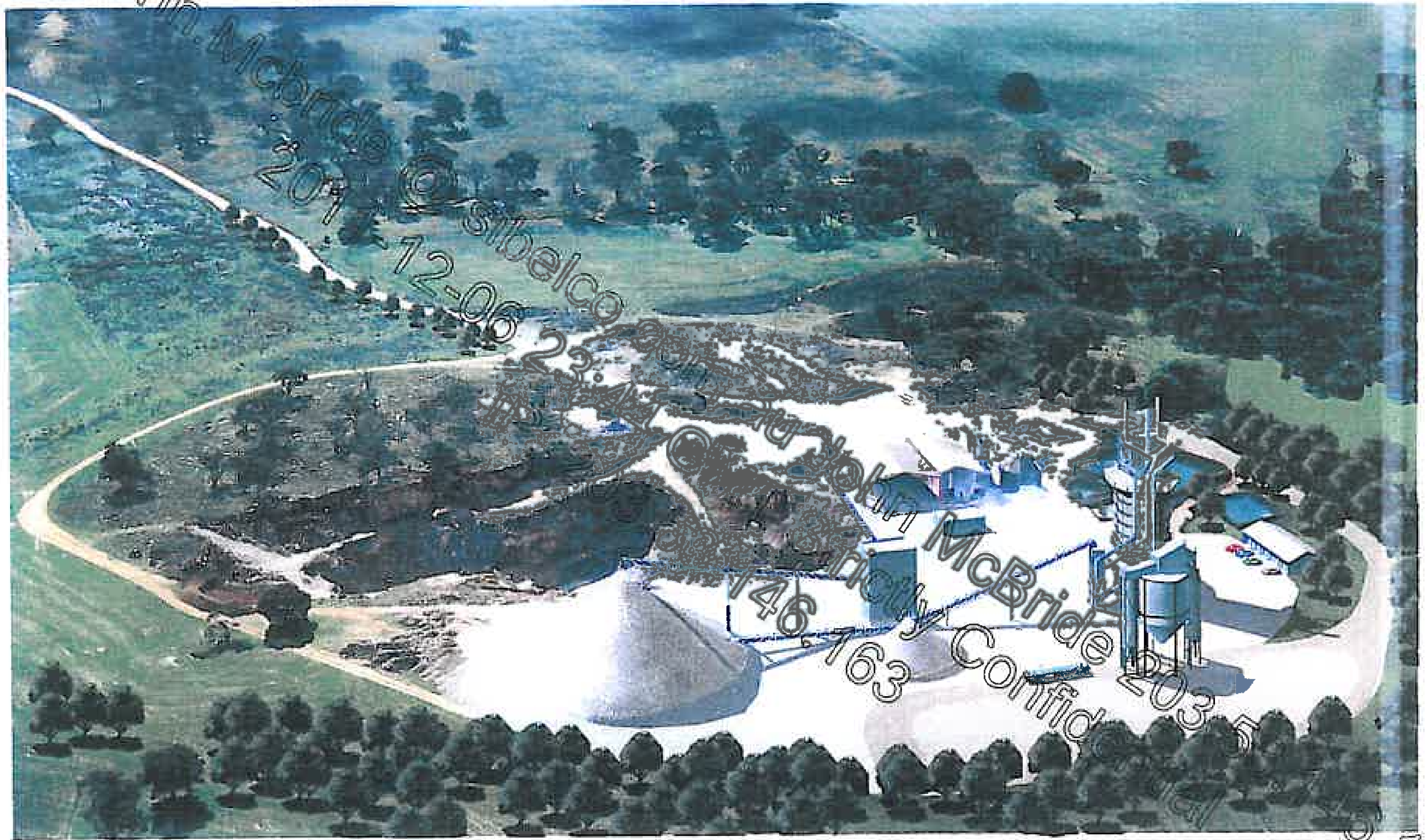
Location 5 – Adjacent Redemptionist Monastery



Location No. 6 - View from the Galong - Boorowa road looking south-south east. The Limestone Mine is located approximately 7 km in the distance. (Photo taken with analogue camera - lens zoomed 70mm). From this vantage point (after climbing a 1 metre high embankment along the road) an observer is able (for an approximately 20 metre stretch along the road) to see directly along the valley to the mine site.

Location No. 6 – (Enlargement of photo above)

Location 6 – Galong - Boorowa Road
North of Rocky Ponds Creek



Maurice Hayler & Associates
ARCHITECTS

Artists Impression

June 2003

BLUE CIRCLE SOUTHERN

PROPOSED LIME KILN
Galong NSW

02.03.22.15

Environmental Impact Statement

GALONG LIME KILN PROJECT

Volume 3

Specialist Consultant Reports Prepared for Mine Expansion Project Referenced in Lime Kiln Project EIS

Proposed by
Barnu Pty Limited
A subsidiary of
Boral Limited

Olsen Environmental Consulting
June 2003

oec

Environmental Impact Statement

GALONG LIME KILN PROJECT

Volume 3

Specialist Consultant Reports Prepared for Mine Expansion Project Referenced in Lime Kiln Project EIS

Proposed by
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A subsidiary of
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Ref No. 536/07

PREFACE

This document reproduces the Specialist Consultant Studies prepared for the Galong Limestone Mine Expansion which was the subject of a separate EIS prepared by R.W. Corkery & Co. Pty. Limited on behalf of Barnu Pty Limited.

Each of the studies included in this volume have been referenced throughout the Lime Kiln Project EIS, with the exception of the Noise and Vibration Study. A specific noise assessment has been compiled for the Lime Kiln Project and is included in Volume 2.

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* A specific noise report relating to the Kiln Project is included in Volume 2.

Barnu Pty Ltd

Galong Limestone Mine Expansion

Soils and Land Capability Assessment

March, 2003

Prepared by
Geoff Cunningham Natural Resource Consultants Pty Ltd

SPECIALIST CONSULTANT STUDIES

PART 1

SOILS AND LAND CAPABILITY ASSESSMENT

OF THE PROPOSED

GALONG LIMESTONE MINE EXPANSION

Prepared For: R.W. Corkery & Co. Pty. Limited
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March, 2003

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1.0 INTRODUCTION

The study was carried out on behalf of Barnu Pty Ltd [the Proponent].

The Project Site comprises a total area of approximately 160 hectares and coincides with the boundary of Mining Lease 1496 (**Figure 1**). The centre of the Project Site is located some 4 kilometres east-northeast of Galong.

Field sampling of the study area was carried out on the 5th and 21st February 2003.

2.0 DESCRIPTION OF THE STUDY AREA

The area for which the soils study (study area) was conducted covers approximately 21.6ha and includes the area proposed for incorporation within the expanded open-cut mine (expanded pit area) as well as the proposed location for the main overburden emplacement.

This study area is underlain by limestone with only a few instances of outcrop or large surface floaters evident within the actual proposed expanded open-cut mine area, although there is a major outcrop near the northern boundary of the mining lease, but outside the study area.

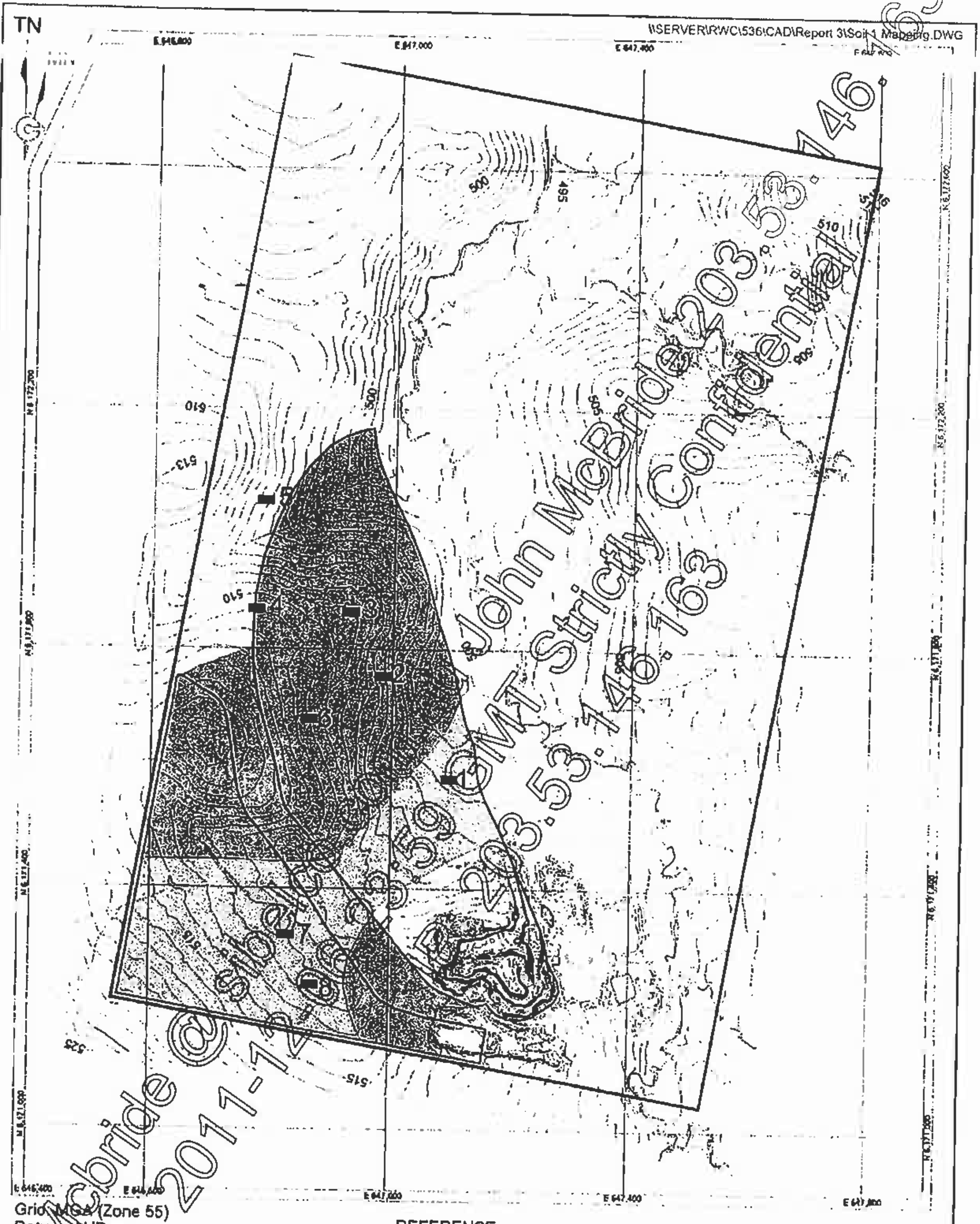
That part of the study area to be covered by the expanded open-cut mine is largely cleared and much had been cropped for cereals in 2002. The remainder of the study area had been sown to improved [exotic] pastures.

3.0 STUDY LIMITS

3.1 Study Brief

The brief for the soils study involved the preparation of a report on the soils and land capability of the study area based on field studies and laboratory analysis of a selection of representative soil samples.

The report was required to include a sufficient level of detail to satisfy the Department of Mineral Resources in relation to Mine Operations Plan guidelines and to satisfy the requirements of the Department of Land and Water Conservation's specifications for soil surveys associated with proposed mining operations.



REFERENCE
- Boundary of Mining Lease 1496
- Proposed Limit of Mining
- Proposed Main Overburden Emplacement
- 515 Contour (5m Interval)
- Soil Test Excavation Site
- 7 Test Excavation Site Identifier
- Soil Mapping Unit 1
- Soil Mapping Unit 2

SCALE 1:10 000

100 0 100 200 300 400 500 m

Source: Geo-Spectrum (Australia) Pty Ltd

Figure 1
SOIL MAPPING UNITS

Specifically, the report was to include:

- an introduction and detail of the studies undertake;
- a report of the results of field survey and laboratory testing of samples;
- discussion of the results of field survey and laboratory physical and chemical analysis in technical as well as "Plain English" terms;
- a discussion of the stripping suitability of the soil materials found at the site;
- details of soil handling strategies and recommendations about soil stripping and stockpiling; and
- details of the land capability at the site.

3.2 Current Information on the Soils of the Study Area

3.2.1 Previous Soil Studies in the Area

3.2.1.1 Soil Landscapes of the Goulburn 1: 250 000 Sheet

Hird [1990, 1991] describes the soil landscapes of the Goulburn 1: 250 000 map sheet area including the site of the Galong Limestone Mine.

The mine is located within the Boorowa soil landscape that is described by Hird [1991] as comprising:

> *"Gently undulating to undulating rises near Boorowa and between Yass and Murrumbateman. On crests and slopes are yellow to light reddish duplex soils most often with A_2 horizons and neutral reaction trends. They are similar to Yellow Podzolic Soils [Dy3.42]. Mottling of the subsoil is common, and this usually overlies a slightly alkaline grey-yellow mottled medium to heavy clay layer which may have an undulating upper boundary.*
>
> *..." Other soils include Red and Yellow Earths [Gn2] and Non-calcic Brown Soils [Dr2.22] with Yellow Solodic Soils [Dy3.43] in drainage lines.*

Hird [1991] notes that the underlying geology for this soil landscape is the Douro Volcanics comprising:

> *"Coarse porphyritic rocks with generally 50% phenocrysts comprising coarse crystals of quartz-feldspar-biotite, quartz-feldspar-biotite-hornblende, or quartz-feldspar-hornblende in a fine grained blue grey to greenish matrix. Textures are frequently tuffaceous, occasionally brecciated or agglomeratic. They are usually massive rocks, sometimes interbedded with fine acid tuffaceous sandstone and siltstone. Soils have probably formed on an old land surface which overlies the volcanics."*

Hird fails to record the presence of limestone as a parent material within this soil landscape.

3.2.1.2 *Soil Profile Attribute Data Environment [SPADE] Database*

The SPADE database was consulted on-line on 31st January, 2003 to ascertain whether or not any soil profile data was available for the study area.

The result of this exercise was that there is no publicly available data for the area.

3.2.1.3 *The 1993 Environmental Impact Statement [EIS] for the Galong Site*

This EIS basically repeats the description provided by Hird [1991] and appears not to add any detailed information gained from site surveys.

3.3 Geology

The study area is shown on the Goulburn Metallogenic Map Sheet [Felton, 1977a] as an area of "undifferentiated limestone, sandstone, shale" within the Douro Group.

It is surrounded by other Douro Group materials that are described by Felton [1977a] as "Undifferentiated fine to coarse rhyolitic to dacitic tuffs; rhyolite, dacite, andesite, dellenite with interbedded limestone, sandstone, and shale. Includes Laidlaw Formation and Hawkins Volcanics."

Lishmund, Dawood and Langley [1986] note the occurrence of the deposit and indicate that it was quarried for production of burnt lime many years before the present operation commenced.

4.0 METHODOLOGY

4.1 Preparations

Prior to field investigations, the study area was subjected to photographic interpretation to ascertain the nature of the landforms present at the site and to develop a broad appreciation of the landform units that would require sampling.

The study area was assessed using a colour airphoto produced by Geo-Spectrum [Australia] Pty Ltd and supplied by the Proponent prior to the field survey.

This photo was used during field survey to determine appropriate soil sampling sites.

4.2 Field Procedures

The mapping techniques used and the intensity of sampling are consistent with specifications provided by the Department of Land and Water Conservation contained in the document titled *"Specifications for soil surveys to determine the stripping depths of soil material to be removed and used in association with the rehabilitation of land disturbed during the period of Open-cut Approval"* [soil survey requirements]

These specifications require *that "... At least one soil profile shall be examined and fully described for each 25 hectares of soil survey area, or for each major soil type encountered which ever is the greater in frequency."*

To fulfill this requirement, two test pits were excavated [using an excavator] to a depth where bedrock was encountered, where the excavator refused to penetrate further or to a depth of 2.5 metres where bedrock was deeper.

These locations are shown in **Figure 1** along with the sites of the additional six check pits that were used to confirm stripping suitability.

The soil profiles at each of the two test pit locations were fully described in the field after a detailed examination of the different layers. Details of the field descriptions are contained in **Appendix 1**.

For soil profiles at each of the test pits, details of the following soil properties were noted.

- Texture
- Fabric
- Structure
- Consistence
- Boundary sharpness
- Colour [moist and dry]
- Gravel / stone occurrence
- Presence of roots
- Presence of lime
- pH

Soil pH was measured using the Raupach method [Raupach indicator and barium sulphate].

Soil colour [moist and dry] was determined using Munsell soil colour charts [Macbeth, 1992].

The classification of the soils that were described was based on Isbell [1996].

In determining the soil classifications the CD-ROM titled "The Australian Soil Classification. An Interactive Key" [Jacquier et al [2001] was used.

The information obtained was recorded in a form that is compatible with that required for entry on soil data cards used in the Department of Land and Water Conservation's Soil Data System.

Samples from seven of the profiles were forwarded to the Department of Land and Water Conservation's NATA - registered soil testing laboratory at Scone for more detailed analysis to determine the following properties.

- Range of particle size [particle size analysis]
- Dispersion percentage
- Coherence [Emerson aggregate test]
- pH
- electrical conductivity

4.3 Soil Stripping Suitability

The Department of Land and Water Conservation's soil survey requirements also state that "...soil observations should be made to confirm the soil types and establish the boundaries between different stripping depths" and that "there shall not be less than one observation every 6.5 hectares and the location of the observation point shall be marked on the plan, but not necessarily numbered."

The additional six excavator pits that were sunk to depths up to 3.5 metres, bedrock or refusal, enabled the properties of the upper layers of the soils to be determined and to confirm soil mapping unit boundaries. The locations are shown in **Figure 1**.

The stripping suitability of the soils at the sites sampled using the excavator pits was determined on the basis of the procedure outlined by Elliott and Veness [1981] as required in the Department of Land and Water Conservation's soil survey requirements.

From the data gained in this process, recommendations on the depths of topsoil and subsoil stripping were developed.

5.0 RESULTS

From the information gained from both the detailed soil profile descriptions, and the additional check pits, two Soil Mapping Units [SMUs] were identified.

These SMUs were:

> **Soil Mapping Unit 1** soils developed on slopes and crests and primarily influenced by the underlying limestone; and
>
> **Soil Mapping Unit 2** – soils developed in broad drainage depressions and not primarily influenced by limestone.

The soil mapping unit boundaries are shown in **Figure 1**.

It is important to note that not all soil layers described for each of the Soil Mapping Units are present in every profile. Soils are inherently variable in nature and while they may have similar overall characteristics they may vary in layer detail and properties.

Appendix 1 contains detailed information on the layers present in the twelve pits that were described in detail.

5.1 Soil Mapping Unit Descriptions

Descriptions of the layers found in the profiles of the two SMUs identified within the study area are set out below.

In each case, the soil within each unit is described in two ways – a "Plain English" version followed by a technical description.

Definitions of the technical terms used in the descriptions can be found in McDonald et al [1990] or Houghton and Charman [1986].

5.1.1 Soil Mapping Unit 1 – soils developed on slopes and crests and primarily influenced by underlying limestone

5.1.1.1 "Plain English" Description:

Soil more than 250 - 330 cm deep, surface loose to firm, sometimes hardsetting; surface stone absent.

Topsoil - silty clay loam, clay loam, sandy clay loam, fine sandy clay loam soil about 11 - 20cm deep; sometimes hydrophobic; pH 6.5 to 8.0; roots common; stones and gravel absent; brown to reddish brown colour, well structured.

Subsoil - three to four layers recorded within the excavations; light, medium to heavy clay; pH 6.0 to 7.5, sometimes 9.0; well structured; upper horizon with a type of "mottled" red / brown colour; lower horizons often variously red, yellow, grey and brown mottled.

Overlies - in all cases, soil material that extended below the base of the excavation.

5.1.1.2 Technical Description [based on test pits]

[a] Australian Soil Classification Name – Red Chromosol

[b] Field Description:

Layer 1 - ALWAYS PRESENT - A1 Horizon - depth 11 to 20 cm:

- silty clay loam, clay loam, sandy clay loam, fine sandy clay loam texture; sometimes hydrophobic; pH 6.5 to 8.0; surface loose to firm, sometimes hardsetting, surface stone absent; roots common; brown [7.5YR4/4, 7.5YR5/4], yellowish brown [10YR5/4] to reddish brown [5YR5/4] dry, dark reddish brown [5YR3/3], dark yellowish brown [10YR3/4], reddish brown [5YR4/3] moist; peds earthy, highly pedal [100%], polyhedral, 2-15mm; weak to firm consistence [airdry]; coherent; *clear to underlying horizon*

Layer 2 - ALWAYS PRESENT - B1 Horizon - depth 15 to 59 cm:

- *light, medium to heavy clay; pH 6.5 to 7.0; roots common; stones and gravel absent;* ***"mottled red"*** *dusky red [2.5YR3/4, 2.5YR4/4], dark red [2.5YR4/6], red [10YR4/6], brown [7.5YR4/4], reddish brown [5YR4/4] dry, dusky red [2.5YR3/4, 2.5YR3/3, 2.5YR4/4], dark red [10R3/6], dark reddish brown [5YR3/3] moist; peds earthy to smooth, highly pedal [100%], polyhedral, 5-15mm; very firm to strong consistence [airdry]; coherent; gradual to underlying horizon*

Layer 3 - ALWAYS PRESENT - B21 Horizon - depth 65 to 174 cm:

- medium to heavy clay; pH 7.0 to 7.5; roots few to common; gravel and stones absent; some to much manganese staining; red [10YR4/6] to dark red [10YR3/6, 2.5YR4/6] dry, dark red [10YR3/6, 2.5YR3/6], dusky red [2.5YR3/4] moist; **sometimes mottled** brown [10YR5/3], strong brown [7.5YR5/8], dusky red [2.5YR4/4; 2.5YR3/4], yellowish red [5YR5/6] dry; brown [2.5YR4/3], strong brown [7.5YR4/6], dusky red [2.5YR3/4], yellowish red [5YR4/6] moist; peds earthy to smooth, highly pedal [100%], polyhedral, 3-15mm; firm to very strong consistence [airdry[;coherent; *clear to diffuse to underlying horizon*

Layer 4 - ALWAYS PRESENT - B22 Horizon - depth 36 to 105 cm:

- medium to heavy clay; pH 6.0 to 7.5; roots few; stones and gravel absent; some manganese stains, some strong, some concretions; whole coloured red [10R4/6] dry, dusky red [2.5YR3/4] moist; **or mottled** - red [10YR 4/6], dusky red [2.5YR3/4, 2.5YR4/4], yellow [10YR7/6], light yellowish brown [2.5Y6/3], yellowish red [5YR5/6], strong brown [7.5YR4/6], light brownish grey [10YR6/2], greyish brown [2.5Y5/2] dry, dark red [2.5YR3/6, 2.5YR4/6], 2.5YR4/6], dusky red [2.5YR4/4], brownish yellow [10YR6/6], strong brown [7.5YR4/6], light olive brown [2.5Y5/3], grey [10YR6/1], greyish brown [2.5Y5/2] moist; peds earthy to smooth to shiny, highly pedal [100%], polyhedral, 5-20mm; very strong consistence [airdry[;coherent; *clear to diffuse to underlying horizon or continues beneath excavation*

Layer 5 - SOMETIMES PRESENT - B23 Horizon - depth 50+ to 130+ cm:

- medium to heavy clay; pH 7.0 to 9.0; few to nil roots; gravel and stones absent; nil to very strong manganese staining; white [5Y8/1] dry and moist **or mottled** dusky red [2.5YR4/4, 2.5YR4/3], yellow [10YR7/8], pale yellow [2.5Y8/2], reddish yellow [7.5YR6/6], grey [10YR5/1] dry, dusky red [2.5YR3/4, 2.5YR4/3, 2.5YR4/4], brownish yellow [10YR6/6], very pale brown [10YR7/4], red [7.5YR5/6], grey [10YR5/1] moist; peds smooth to earthy smooth, highly pedal [100%], polyhedral, 5-15mm; strong to very strong consistence [airdry];coherent; *continues beneath excavation*

5.1.2 Soil Mapping Unit 2 – soils developed in broad drainage depressions and not primarily influenced by limestone

5.1.2.1 "Plain English" Description:

Soil recorded to be more than 260 to 350cm deep as excavated but bedrock was not encountered in any pit; surface loose to hardsetting; surface stone absent.

Topsoils 30 - 48 cm deep; sometimes consisting of three layers.

- The **A11** horizon that is always present; loam fine sandy to clay loam; pH 5.5 to 7.0; some surfaces hydrophobic; generally brown or light brown in colour; stone / gravel content negligible; roots common; generally well structured but sometimes partly massive.

- The **A12** horizon that is sometimes present; clay loam recorded texture; pH 5.5 to 6.5; pinkish grey to yellowish brown; lacking stone or gravel; roots common; well structured.

- The **A13** horizon that is sometimes present; fine sandy clay loam textured; pH 6.0; very pale brown coloured; lacking stone or gravel; roots common; well structured.

- The **A2** horizon that is sometimes present; loam fine sandy / sandy clay loam or medium clay textured; pH 5.5 to 6.5; bleached ; light grey to very pale brown coloured; lacking stone or gravel; roots few to common; massive to partly structured.

Subsoils up to 310cm deep; consisting of a number of layers.

- The **B1** horizon that is always present; light to medium to heavy clay textured; sometimes gritty; pH 5.5 to 8.5; mottled; lacking stones or gravel; roots few; well structured.

- The **B 21** horizon that is always present; medium to heavy clay textured; sometimes gritty; pH 9.0; mottled; lacking stones or gravel; few roots.

- The **B22** horizon that is sometimes present; medium to heavy clay textured; pH 9.5; mottled; lacking stones or gravel; few roots.

Overlying - in all cases, soil material that extended below the base of the excavation.

5.1.2.2 *Technical Description [based on test pits]*

[a] Australian Soil Classification Name – ~~Red~~ Chromosol

[b] Field Description:

Layer 1 - ALWAYS PRESENT - A11 Horizon - 10 to 16cm depth:

- loam fine sandy to clay loam; pH 5.5 to 7.0; surface loose to hardsetting; surface stone cover absent; often hydrophobic; roots common; stones and gravel lacking; brown [10YR4/3] to pale brown [10YR6/3] dry, brown [7.5YR4/2, 7.5YR4/3] to dark brown [10YR3/3] moist; peds earthy, massive to highly pedal [100%], polyhedral, 2-15mm; very weak to weak consistence [airdry]; coherent; *abrupt underlying horizon.*

Layer 2 - SOMETIMES PRESENT - A12 Horizon - about 14 to 16cm depth:

- clay loam; sometimes hydrophobic; pH 5.5 to 6.5; roots common; stones and gravel lacking; pinkish grey [7.5YR 6/2] to yellowish brown [10YR5/4] dry, brown [7.5YR4/2, 10YR4/3] moist; peds earthy, highly pedal [100%], polyhedral, 2-15mm; weak consistence [airdry]; coherent; *abrupt to underlying horizon.*

Layer 3 - SOMETIMES PRESENT - A13 Horizon - about 24cm depth:

- fine sandy clay loam; pH 6.0; roots common; stones and gravel lacking; very pale brown [10YR7/3] dry, light brown [10YR6/3] moist; peds earthy; highly pedal [100%], polyhedral, 2-6mm; weak consistence [airdry]; coherent; *abrupt to underlying horizon.*

Layer 4 - SOMETIMES PRESENT - A2 Horizon - about 20cm depth:

- loam fine sandy to sandy clay loam or medium clay; pH 5.5 to 6.5; roots few to common; stones and gravel lacking; **bleached**; light grey [10YR7/2] to very pale brown [10YR7/3] dry, pale brown [10YR6/3] to brown [7.5YR4/2] moist; peds when present earthy, massive to partly pedal [10 -50%], polyhedral, 5-10mm; weak consistence [airdry]; coherent; *abrupt to underlying horizon.*

Layer 5 - ALWAYS PRESENT - B1 Horizon - 24 to 117cm depth:

- medium to heavy clay, sometimes gritty; pH 5.5 to 8.5; roots few; stone and gravel lacking; **mottled**; dark grey [2.5YR4/1,10YR4/1], light yellowish brown [10YR6/4], yellowish red [5YR5/8], greyish brown [10YR5/2], white [2.5Y8/1], yellowish brown [10YR5/6], dusky red [2.5YR4/4], strong brown [7.5YR5/6] dry, yellowish brown [10YR5/4], strong brown [10YR5/3], light yellowish brown [10YR6/4], dark red [2.5YR4/6], greyish brown [10YR5/2], brown [7.5YR5/4] moist; peds smooth or earthy smooth, highly pedal [100%], polyhedral, 5-15mm, strong consistence [airdry]; coherent; *abrupt to gradual to underlying horizon.*

Layer 6 - ALWAYS PRESENT - B21 Horizon - 97 to 143cm depth:

- medium to heavy clay; sometimes gritty; pH 9.0; stones and gravel lacking; manganese stains; **mottled**; grey [2.5Y5/1], light grey 10YR7/2], dark reddish grey [2.5Y4/1], brown [7.5YR5/3], pale brown [10YR6/3], reddish brown [5YR4/3], strong brown [7.5YR5/6] dry, brown [10YR5/3, 7.5YR4/3], yellowish brown [10YR5/4], strong brown [7.5YR5/6], yellowish red [5YR4/6, 7.5YR4/6], light brownish grey [10YR6/2] moist; peds smooth, highly pedal [100%], polyhedral, 5-10mm; strong to very strong consistence [airdry]; coherent; *gradual to underlying horizon or continues.*

Layer 7 - SOMETIMES PRESENT - B22 Horizon - 90 to 146cm recorded depth

- medium to heavy clay; sometimes gritty; pH 8.0 to 9.5; roots absent to few; manganese stains variable; yellowish brown [10YR5/6, 10YR5/4], reddish yellow [7.5YR6/6], brown [7.5YR5/4] dry, yellowish brown [10YR5/4, 10YR5/6], strong brown [7.5YR4/6], brown 10YR5/3] moist; peds smooth, highly pedal [100%], polyhedral, 5-15mm; strong consistence [airdry]; coherent; *continues.*

5.2 Soil Laboratory Analyses

Nine samples from the two test pit soil profiles were selected for laboratory analysis at the Department of Land and Water Conservation's Soil and Water testing Laboratory at Scone.

The tests performed aimed at assessing the potential erodibility of the soils [Particle Size Analysis [PSA], Dispersion % [D%] and Emerson Aggregate Test [EAT]] as well as the pH [water and $CaCl_2$] and Electrical Conductivity [EC].

5.2.1 Physical and Chemical Analyses

Tables **1** and **4** show the results obtained from laboratory analysis of the samples from the two test pits at the Galong site.

Samples from one profile from within SMU 1 and one profile from SMU 2 were analysed in the laboratory.

TABLE 1
Physical Laboratory Analysis Data for Selected Galong Soil Profiles
[Whole Soil Particle Size Analysis]

SOIL MAPPING UNIT and SITE	LAYER	TEXTURE [fine earth]	DEPTH [cm]	PSA % CLAY	PSA % SILT	PSA % FINE SAND	PSA% COARSE SAND	PSA % TOTAL SAND	PSA % GRAVEL	D %	EAT
SMU 1 [SITE 6]	1	clay loam	0 - 20	24	13	52	11	63	0	12	3[1]
	2	clay	20 - 50	41	13	36	10	46	0	12	3[1]
	3	clay	50 - 115	52	10	29	9	38	0	10	5
	4	clay	115 - 310	65	8	21	6	27	<1	8	5
SMU 2 [SITE 1]	1	silt loam	0 - 14	18	29	46	7	53	<1	19	3[1]
	2	silt loam	14 -30	21	30	40	9	49	<1	30	3[1]
	3	loam to silt loam	30 - 50	17	25	43	15	58	<1	59	3[2]
	4	clay	50 - 167	48	9	31	12	43	<1	27	3[2]
	5	clay	167 - 292	61	5	24	10	34	<1	18	3[2]

Note: PSA = Particle Size Analysis D = Dispersion EAT = Emerson Aggregate Test

6.0 DISCUSSION OF SOIL ANALYSES

6.1 Physical Attributes

The laboratory analysis results contained in **Table 1** are important in assessing the erodibility of the soil units found within the study area.

The three tests [Particle Size Analysis, Dispersion %, Emerson Aggregate Test] carried out on samples from each of the horizons within the two selected soil profiles, when considered together, provide a good indication of the soil's likely behaviour in relation to the erosive forces encountered in the field.

6.1.1 Particle Size Analysis

The Particle Size Analysis [PSA] test shows the amounts of gravel, clay, silt, fine sand and coarse sand contained within each sample.

The results shown in **Table 1** are those contained in the laboratory test report.

From this data it is evident that the soils in SMUs 1 and 2 generally contain little or no gravel throughout the profile.

The texture class of each soil layer is determined by analysis of the material [fine earth fraction] that is less than 2mm in size – i.e. the sample from each tested horizon with the gravel removed. The calculated texture of the fine earth fraction of each of the layers tested in the laboratory is shown in **Table 1.**

It should be noted that the field textures of many layers of the eight profiles that were examined [sample pits plus check pits] indicated that the soils were generally more clayey than was shown in the laboratory analyses.

6.1.2 Dispersion Percentage

The Dispersion Percentage [D%] test indicates the proportion of the soil material less than 0.005 mm in size that will disperse on wetting [i.e. the clay and some of the silt fractions].

Hazelton and Murphy [in press] provide the following guides to the interpretation of D% values **[Table 2]**

TABLE 2
Interpretation of Dispersion Percentage Values [after Hazelton and Murphy, in press]

D% Value	Dispersion Rating
< 6	negligible
6 – 30	slight
30 – 50	moderate
50 – 65	high
> 65	very high

In interpreting the results of the values of dispersion percentage obtained in laboratory testing it is important to consider other related soil attributes such as the Particle Size Analysis [PSA] and Emerson Aggregate Test [EAT] data.

Soil horizons with high clay contents and high Dispersion % values will be more dispersive in practice than those with a high Dispersion % value and a low clay content in the soil.

The D% values shown in **Table 1** indicate that the actual surface soils in both SMUs have negligible to slight D% values [i.e. slight dispersibility].

In fact, all of the layers in the profile analysed for SMU 1 showed only slight dispersibility values.

However, the second and third layers [***included in topsoils for stripping purposes***] sampled in the profile analysed for SMU 2 had slight to moderate and high dispersibility values, respectively, indicating that if these materials are exposed during stockpiling or rehabilitation work, the potential for erosion is high.

Some of the subsoils, particularly in SMU 2, contain moderate to high levels of clay and this fact undoubtedly makes them more dispersive than the analyses indicate - although for many this is difficult since they already exhibit high and very high values.

Given this, the erosion potential is undoubtedly high to very high for any areas of exposed subsoil.

Consequently, appropriate measures need to be taken to protect the stockpiles of stripped subsoil. The same material, when respread, should be afforded protection from soil erosion in the form of vegetative cover.

6.1.3 Emerson Aggregate Test

This test provides a measure of the coherence of soil aggregates when they are immersed in water. Natural peds are used [Houghton and Charman, 1986] and the method used by the Department of Land and Water Conservation to determine the Emerson Class Number is fully described in Craze et al [1993].

Basically, the degree of soil aggregate stability increases from Class 1 through to Class 8. Classes 2 and 3 have a number of subclasses based on the degree of dispersion.

Aggregates in Emerson Classes 1 and 2 are generally regarded as being unstable while those in classes 4 to 8 are considered to be stable.

Hazelton and Murphy [in press] present a summary of the Emerson Aggregate Classes. This is contained in **Table 3.**

TABLE 3
Comparison of Aggregate Dispersibility and Emerson Aggregate Classes [after Hazelton and Murphy, in press]

Aggregate Dispersibility	Emerson Aggregate Classes*
Very High	1 and 2[3]
High	2[2]
High to Moderate	2[1]
Moderate	3[4] and 3[3]
Slight	3[2], 3[1] and 5
Negligible / Aggregated	6,7,and 8

* **NOTE** – the subclasses of the Emerson Aggregate Test [EAT] Classes are as follows:

[1] slight milkiness immediately adjacent to the aggregate

[2] obvious milkiness, less than 50% of the aggregate affected

[3] obvious milkiness, more than 50% of the aggregate affected

[4] total dispersion, leaving only sand grains [NB – Class 2[4] is equivalent to Class 1]

The EAT data in **Table 3** show that all layers of the soils analysed for SMUs 1 and 2 have a slight dispersibility rating.

Despite these ratings, topsoil and subsoil material in both SMUs should be adequately protected from soil erosion by vegetative cover in the stockpile and rehabilitation stages.

6.2 Soil Chemical Attributes

Laboratory testing of the Galong samples extended only to an examination of the soil pH and electrical conductivity. The results of the analyses are contained in **Table 4**.

TABLE 4
Chemical Analyses Laboratory Analysis Data for Selected Galong Soil Profiles

SOIL MAPPING UNIT and SITE	LAYER	TEXTURE [fine earth]	DEPTH [cm]	pH [water]	EC [dS/m]
SMU 1 [SITE 6]	1	clay loam	0 - 20	6.7	0.16
	2	clay	20 - 50	6.2	0.06
	3	clay	50 - 115	7.0	0.05
	4	clay	115 - 310	6.7	0.04
SMU 2 [SITE 1]	1	silt loam	0 - 14	6.9	0.13
	2	silt loam	14 - 30	6.3	0.05
	3	loam to silt loam	30 - 50	6.8	0.04
	4	clay	50 - 167	8.4	0.09
	5	clay	167 - 292	8.6	0.15

6.2.1 Soil pH

In general, the pH [water] range in most soils is between 4.0 and 8.5 although pH values above and below this range are measured at times [Glendinning, 1990].

This range of soil pH levels is generally accepted as being one that is suitable for plant growth.

The pH 6.0 to 6.5 range is usually regarded as the optimum for growth of most plants and there are some more serious impacts on the growth of many species at the lower, or acid, end of the range.

As the pH scale [between 0 and 14] is a logarithmic one, a soil with a pH of 5.0 is ten times as acid as a soil of pH 6.0 and 100 times as acid as one with a pH of 7.0.

Perusal of the data in the pH [water] column in **Table 4** indicates that all but one of the nine samples tested showed pH levels within the 4.0 to 8.5 range. Field pH tests, however, showed that a number of layers deeper in the profile in SMU 2 showed pH readings of the order of nine.

However, the analyses and field testing show that most layers have a pH within the acceptable range for plant growth and so will be suitable for use in the final rehabilitation work.

6.2.2 Electrical Conductivity

Soil salinity is a measure of the presence of water-soluble salts, mainly of sodium, calcium and magnesium in the soil solution. These salts may be chlorides, sulphates or carbonates and can have a major impact on plant growth if they occur in sufficiently large quantities.

The level of salinity in a soil sample is determined by measuring the electrical conductivity [EC] of a 1:5 soil / water suspension.

As the published salinity tolerance data for crops and pastures is based on the electrical conductivity of a saturated extract of the soil solution, a series of conversion factors, based on the estimated water holding capacity of soil sample, are used to convert the measured EC value to one for the conductivity of the saturated extract [EC_e].

The electrical conductivity of the 1:5 soil / water suspension and that of the saturated extract are measured in units called deciSiemens / metre [dS/m].

The measured level of electrical conductivity of the 1:5 soil / water suspension is multiplied by the appropriate factor in **Table 5** [extracted from Hazelton and Murphy, in press] based on the measured soil texture.

TABLE 5
Texture Class Multipliers for Calculating EC_e Values

Soil Texture Class	Multiplier Factor
loamy sand, clayey sand, sand	23
sandy loam, fine sandy loam, light sandy clay loam	14
loam, loam fine sandy, silt loam, sandy clay loam	9.5
clay loam, silty clay loam, fine sandy clay loam, sandy clay, silty clay, light clay	8.6
light medium clay	7.5
medium clay	5.8
heavy clay	5.8

Table 6 shows the calculated EC_e values for the samples analysed in the laboratory and shows the salinity status of the various horizons based on these EC_e values.

Hazelton and Murphy [in press] note that EC_e values below 2.0 indicate non-saline horizons while values between 2 and 4 indicate slight salinity. Values between 4 and 8 indicate moderate salinity while those between 8 and 16 indicate high salinity.

The data in **Table 6** indicate that all topsoil materials within the two SMUs are non-saline.

TABLE 6
Calculated EC_e Values and Salinity Status for Selected Galong Soil Profiles

SOIL MAPPING UNIT and SITE	LAYER	TEXTURE	DEPTH [cm]	EC [dS/m]	MULTI-PLIER	CALCULATED EC_e	SOIL SALINITY STATUS
SMU 1 [SITE 6]	1	clay loam	0 - 20	0.16	8.6	1.38	non - saline
	2	clay	20 - 50	0.06	7.5	0.45	non - saline
	3	clay	50 - 115	0.05	5.8	0.29	non - saline
	4	clay	115 - 310	0.04	5.8	0.23	non - saline
SMU 2 [SITE 1]	1	silt loam	0 - 14	0.13	9.5	1.24	non - saline
	2	silt loam	14 -30	0.05	9.5	0.48	non - saline
	3	loam to silt loam	30 - 50	0.04	9.5	0.38	non - saline
	4	clay	50 - 167	0.09	5.8	0.52	non - saline
	5	clay	167 - 292	0.15	5.8	0.87	non - saline

6.2.3 Likelihood of Encountering Acid Sulfate Soils

Acid sulfate soils are basically confined to coastal estuarine floodplain areas in New South Wales.

These soils are extremely acidic soil layers that develop as a consequence of the aeration of soil materials that are rich in iron sulfides, primarily pyrite [FeS].

When drainage or excavation brings these previously waterlogged soil layers into contact with oxygen, the pyrite is oxidised to form sulfuric acid.

If the production of acid exceed the neutralising capacity of the particular soil such that the pH falls below 4.0, these soils are known as acid sulfate soils.

The soils of the study area almost universally increase in alkalinity with depth [often to pH 9.0] and are not waterlogged. There is a considerable quantity of neutralising capacity in all soils at the site.

As a consequence of these features and the fact that the study area is not located on a coastal estuarine floodplain it is extremely unlikely that any acid sulfate soils will impact in any way on the mine during its working life or on the success of subsequent rehabilitation.

6.3 Erosion Potential

The soils within the study area are currently generally stable except for some minor areas of sheet erosion on the slopes.

Contour banks have been constructed on land owned by Bobbara Pastoral Company to the southwest of the study area and Project Site and provide a large measure of control of runoff water from upslope areas with the consequence that little erosion is evident.

Enlargement of the open-cut mine and construction of the main overburden emplacement will require some diversion of water flowing towards Limestone Creek from the west.

Care should be taken to minimise soil erosion associated with this diversion and the assistance of the local staff of the Department of Land and Water Conservation should be sought to design and construct alternative water disposal systems where they are required.

Groundcover varies over the study area, however, the cleared and remnant vegetation areas generally support a good cover of litter as well as native and naturalised species.

The cropped areas supported a good stubble and litter cover at the time of inspection. It is understood rains in late February and March 2003 have caused some soil movement downslope.

It will be essential, if erosion is to be minimised, to maintain an adequate groundcover on the existing landscape, on any stockpiles during the mine's operation and on the reformed landscapes after rehabilitation work is carried out.

6.4 SOILOSS Program

An appropriate method of assessing the erosion hazard associated with the soils of the study area is to use the SOILOSS computer program devised by Rosewell and Edwards [1988] and updated by Rosewell [1993].

This program computes soil loss values for a given site under various land uses and climatic [rainfall] conditions and so provides an indication of erosion hazard.

SOILOSS is based on the Universal Soil Loss Equation or USLE described by Wischmeier and Smith [1978] and subsequently updated as the Revised Universal Soil Loss Equation or RSLE [Renard et al, 1993].

The USLE is $$A = R * K * L * S * P * C$$ where

- A is the average annual soil loss [tonnes / hectare]
- R is the rainfall erosivity factor, a measure of the erosive power of the rain
- K is the soil erodibility factor, a measure of the resistance of the soil to erosion
- L is the slope length factor
- S is the slope steepness factor
- P is the support practice factor, a measure of the effect on erosion of soil conservation measures such as contour cultivation and bank systems
- C is the crop and cover management factor

In using SOILOSS, the rainfall erosivity factor is obtained from maps provided with the program manual [Rosewell, 1993].

Soil erodibility is either estimated from details of the soil type and soil surface texture by comparison with a table of soils presented by the program or is derived from a knowledge of soil particle size analysis, organic matter content, surface soil structure and profile permeability.

Slope length and steepness factors are derived from field measurements and / or examination of topographic maps or airphotos.

The support practice factor is estimated by the program from a description of the land management practices in use, details of cultivation direction and information on contour / diversion bank systems if these are present.

To determine the value of the 'K' factor for use in the program, a generic or standard method can be utilised from within the program to indicate the likely soil losses from a range of crop rotations and management practices.

In addition, a more detailed approach can be used to determine likely soil loss given the availability of precise detail relating to sowing dates, cultivation practices etc.

Provision is made within the program for estimating soil loss from areas with a range of non-arable uses.

Table 7 provides details of the calculated erodibility values [K] and erodibility ratings for topsoils and subsoils from a selection of soil profiles in the study area. The erodibility estimates contained in **Table 7** for the two Soil Mapping Units have been calculated using part of the overall SOILOSS program capability and the Particle Size Analysis and other data for two typical soil profiles from the Galong site.

The only value for which estimates were used in the calculations were those for organic matter %. From experience, values of 2.4% [topsoils] and 0.4% [subsoils] were chosen.

The Erodibility classes used were < 0.020 = LOW; 0.020 – 0.040 = MODERATE; > 0.040 = HIGH.

TABLE 7
Soil Erodibility Values and Ratings for Two Soils from the Galong Study Area

SOIL MAPPING UNIT	PIT NUMBER	TOPSOIL LAYER	TOPSOIL 'K' RATING	SUBSOIL LAYER	SUBSOIL 'K' RATING	AVERAGE 'K' RATING [WHOLE SOIL]	SOIL MAPPING UNIT ERODIBILITY
1	6	0-20cm	0.040 HIGH	115-310 cm	0.015 LOW	0.028	MODERATE
2	1	0-14cm	0.048 HIGH	50-167cm	0.023 MODERATE	0.036	MODERATE

The data in **Table 7** show that the SOILOSS program predicts that the soils sampled at the site, on average, have a MODERATE erodibility.

Because of the MODERATE erodibility of the soils as assessed by the SOILOSS analysis, they should be managed carefully during the stripping and rehabilitation stages to ensure that soil structure damage is minimal and that they are suitably protected by vegetation or some other medium at all times.

7.0 STRIPPING SUITABILITY OF SOIL MATERIALS

An approach has been developed by Elliott and Veness [1981] to determine the stripping suitability of soil materials found at a site where stripping of upper soil layers is required. The key used in this method of stripping suitability assessment is contained in **Appendix 2**.

This method has been used in the present study.

The basis for the Elliott and Veness approach is that not all soil material that might be available for topdressing of disturbed sites is suitable for agricultural or pastoral use: some may be poorly structured, too sandy or gravelly or too poorly drained to allow a stabilising vegetative cover to develop.

In their work, Elliott and Veness established that there are a number of critical soil physical attributes that can be used to distinguish between suitable and unsuitable topdressing materials. These are:

[a] soil structure

[b] soil macrostructure

[c] soil coherence

[d] soil texture

[e] the force necessary to disrupt peds.

NOTE: The following descriptions of soil materials are based on the detail gained from the two profiles sampled in the field and the 4 observation profiles.

7.1 Stripping Recommendations for Soil Mapping Unit 1

7.1.1 Layer 1

[0 - 15cm depth] - silty clay loam, sandy clay loam, fine sandy clay loam, clay loam texture; some profiles contain medium to heavy clay soil within this layer; surface loose to firm, sometimes hardsetting; surface stone absent; pH 7.5 to 8.0; roots common; reddish brown [5YR4/4] to brown [7.5YR5/4] dry; reddish brown [5YR4/3] to dark reddish brown [5YR3/3] moist; highly pedal, peds earthy, polyhedral, <5-15mm, weak to firm consistence [airdry], coherent.

Suitability Assessment: structure grade 3; coherent dry, mottles absent; macrostructure suitable; force to disrupt peds suitable; texture suitable; layer contains slightly more than 60% sand and gravel; pH levels suitable; salt content marginal.

This material is suitable for topsoiling on the basis of the Elliott and Veness key and also contains valuable seed, organic matter, nutrient reserves and has other favourable attributes.

It does, however have a salinity rating greater than that acceptable under the Elliott and Veness standard but as it contains seed and nutrients that are important for rehabilitation, it should still be stripped and stockpiled as **topsoil** provided suitable stripping and storage methods are used [discussed later in this report].

Recommendation – Strip all of the Layer 1 topsoil to a depth of 15cm.

[NOTE: Topsoil stripping should be carried out on all areas that will be disturbed by mining and associated infrastructure development. It should not be necessary to further strip areas that are only to be used for roads, buildings, hardstand areas etc.

However, on areas where the disturbance is deeper - i.e. areas to be mined, waste rock emplacements etc - the subsoil should be stripped as indicated for layers 2 and 3 below.]

7.1.2 Layer 2

[15 - 50cm] - light clay, medium clay to heavy clay; pH 6.5 - 7.0; gravel and stones absent; red [10YR4/6], dark red [2.5YR4/610YR3/6], dusky red [2.5YR4/4], reddish brown [5YR4/4]; one profile with this material in a type of mottle, dry; dusky red [2.5YR3/4, 2.5YR3/4], dark red [10R3/6] moist; highly pedal, peds earthy, polyhedral, <5-15mm, very firm to strong consistence [airdry], coherent.

Suitability Assessment: structure grade 3; coherent dry, traditional mottles absent; macrostructure suitable; force to disrupt peds generally suitable; texture suitable; layer contains <60% sand and gravel; pH levels suitable; salt content suitable.

This material is suitable for use as subsoil on the basis of the Elliott and Veness key. This allows it to be stripped and stockpiled as **subsoil** provided suitable stripping and storage methods are used [discussed later in this report].

> **Recommendation** – Strip all of the Layer 2 subsoil to a depth of 35cm below the base of Layer 1 - i.e. a total depth from the surface of 50cm. Although there is some variation in soil texture within this SMU, the subsoil material from all parts of the SMU 1 area can be mixed and stored in the same subsoil stockpiles.

7.1.3 Layer 3 [Remainder of the Profile]

The material below 50cm depth [the base of layer 2] is predominantly medium to heavy clay in texture. pH readings were generally in the 6.0 to 7.0 range. The material is not dispersible.

This material could be stripped to 100cm depth [i.e. an extra 50cm] and stockpiled if additional subsoil material is required as the traditional mottled material is not encountered until about this depth in most profiles.

If additional subsoil material is not required, the soil material below the base of Layer 2 should be used to cover emplaced rock and to form a soil base over which Layers 1 and 2 can be spread during the rehabilitation process.

> **Recommendation** – Strip the remainder of the profile down to bedrock and use it to cover emplaced rock material as a base for subsoil and topsoil respreading or if additional subsoil material is require, strip appropriate depths of this material for this use.
>
> This soil material has generally high pH levels and as such will assist in neutralising acidity (if any) that may be generated from the broken rock overburden material.

Initially this layer should be stockpiled to allow the sections of the overburden emplacement to be constructed and shaped. The layer can then be respread or maintained in a stockpile until mine closure.

If the latter alternative is utilised, the initial sections of the overburden emplacement can be shaped and prepared for rehabilitation by progressive direct transfer of the Layer 3 material from sites being prepared for mining.

7.2 STRIPPING RECOMMENDATIONS FOR SOIL MAPPING UNIT 2

7.2.1 Layer 1

[0 - 15 cm]- sandy loam, clay loam, loam fine sandy in texture; surface loose to hardsetting, some hydrophobic; surface stone absent; pH 5.5 to 7.0; stone and gravel absent; lime accumulations generally absent; manganese staining absent; mottles absent; bleached layers absent; pale brown [10YR6/3], brown [10YR6/3] dry; brown [7.5YR4/2, 7.5YR4/3], dark brown [10YR3/3]moist; generally highly pedal but some massive material, peds generally earthy, mainly polyhedral, <5 -15mm, loose to weak consistence [airdry]; coherent dry.

Suitability Assessment: structure grade 2 and 3; coherent dry, mottles absent; macrostructure suitable; force to disrupt peds generally suitable; texture suitable; layer contains <60% sand and gravel; pH levels suitable; salt content suitable.

This material is suitable for topsoiling on the basis of the Elliott and Veness key. This material also contains valuable seed, organic matter, nutrient reserves and has other favourable attributes. These allow it to be stripped and stockpiled as **topsoil** provided suitable stripping and storage methods are used [discussed later in this report].

> **Recommendation** – Strip all of the Layer 1 topsoil to a depth of 15cm. Although there is some slight variation in soil texture within this SMU, the soil material from all parts of the SMU 2 area can be mixed and stored in the same topsoil stockpiles.

[NOTE: Topsoil stripping should be carried out on all areas that will be disturbed by mining and associated infrastructure development. It should not be necessary to further strip areas that are only to be used for roads, buildings, hardstand areas etc.

However, on areas where the disturbance is deeper - i.e. areas to be mined, waste rock emplacements etc - the subsoil should be stripped as indicated for layers 2 and 3 below.]

7.2.2 Layer 2

[15 - 50cm]- texture range includes clay loam, loam fine sandy, sandy clay loam, fine sandy clay loam, medium clay, gritty medium to heavy clay; pH 5.5 to 7.0; gravel and stones absent; lime accumulations absent; pinkish grey[7.5YR6/2], yellowish brown [10YR5/4], very pale brown [10YR7/3], light grey [10YR7/2] dry; brown [7.5YR4/2, 7.5YR4/3], pale brown [10YR6/3]; **sometimes part mottled** light yellowish brown [10YR6/4] [70%], yellowish red [5YR5/8] [10%], greyish brown [10YR5/2] [15%], white [2.5Y8/1] [5%] dry, light yellowish brown [10YR6/4]

[70%], dark red [2.5YR4/6] [10%], greyish brown [10YR5/2] [15%], light brownish grey [10YR6/2] [5%] moist; highly pedal [occasional massive material], peds generally earthy some smooth, <5-15mm, consistence mainly firm to strong [airdry], occasional weak; coherent dry.

Suitability Assessment: usually structure grade 3 [occasionally massive]; coherent dry, mottles rare though occasionally present in part of layer; macrostructure suitable; force to disrupt peds generally suitable; texture suitable; layer usually contains <60% sand and gravel; pH levels generally suitable although approaching the high range; salt content suitable.

This material is suitable for use as subsoil on the basis of the Elliot and Veness key. Some material within this layer may be dispersible [as evidenced by the soil laboratory analyses] and so the stockpiles should at all times be adequately protected from soil erosion.

The presence of mottles in part of this layer in some profiles will not place any major limitations on the use of this material as their impact will be ameliorated by the mixing process. This allows it to be stripped and stockpiled as **subsoil** provided suitable stripping and storage methods are used [discussed later in this report].

> **Recommendation** – Strip all of the Layer 2 subsoil to a depth of 35cm below the base of Layer 1 - i.e. a total depth from the surface of 50cm. Although there is some variation in soil texture within this SMU, the soil material from all parts of the SMU 2 area can be mixed and stored in the same subsoil stockpiles.

7.2.3 Layer 3 [Remainder of the Profile]

The material below 50cm depth [the base of layer 2] is predominantly medium to heavy clay in texture with some grit. Mottles are prominent in these layers. In addition, the pH of many of the layers sampled was >8.5.

Because of these characteristics, it is considered that the remaining soil material below the base of Layer 2 should be used to cover emplaced rock and to form a soil base over which Layers 1 and 2 can be spread during the rehabilitation process.

> **Recommendation** – Strip the remainder of the profile down to bedrock and use it to cover emplaced rock material as a base for subsoil and topsoil respreading.
>
> This soil material has generally high pH levels and as such will assist in neutralising acidity (if any) that may be generated from the broken rock overburden material.
>
> Initially this layer should be stockpiled to allow overburden to be constructed and shaped. The layer can then be respread or maintained in a stockpile until mine closure. If progressive rehabilitation work is carried out during the life of the mine, then as rock dumps are shaped and prepared for rehabilitation progressive direct transfers of the Layer 3 material can be made from sites being prepared for mining.

8.0 HANDLING STRIPPED SOILS

Stripping of topsoil materials is proposed for those sections of the Galong soils study area to be used for the enlargement of the existing open-cut mine and construction of a new overburden emplacement.

In addition, subsoil material will need to be stripped from the area to be disturbed by the proposed mine expansion and overburden emplacement for later use in rehabilitation. It is appropriate to consider, in this report, the techniques for handling the soil materials that are to be stripped, stockpiled and then respread during the rehabilitation phase.

The recommendations made are based on an interpretation of the results of soil survey at the site and the associated laboratory analysis data.

As a general rule in soil stripping, stockpiling etc, the weaker [more sandy] the *in situ* structure of the soil being removed, the more care that is required in all phases of handling. The soil needs to be handled [disturbed] as little as possible to minimise mechanical damage to soil structure that will be detrimental to rapid establishment of ground cover once rehabilitation works commence.

There have been a number of studies in the past relating to the impact of the stripping and stockpiling of soils associated with mining and similar activities.

Working of soils in situations where the soil moisture content is unfavourable can have detrimental impacts on soil structure [Elliott and Veness, 1985; Hunter and Currie, 1956]. There are also unfavourable effects related to mixing of soil materials with different fertility levels, textures and other critical soil properties.

Stockpiling also has its effects although there is evidence that the impacts are, at least to some degree, reversible. Jenkin et al [1987] have noted that these effects seem similar to those of normal agricultural uses on soils.

Dougall [1950] has noted that stockpiling of soil results in some structure breakdown and changes associated with some other physical and chemical properties.

However, despite these negative impacts, Elliott and Veness [1985] conclude that the quality of stockpiled soil can, in fact, improve with time – especially in the outer layers of material.

8.1 STRIPPING AND STOCKPILING RECOMMENDATIONS

8.1.1 Earthmoving Procedures

As mentioned previously, the topsoils and subsoils to be moved within the study area generally have good structure although the force required to pulverise the topsoil aggregates is small. However, the topsoil structure is generally somewhat weaker than that of the subsoils - particularly in the moist state.

As a consequence, improper or excessive handling of the material during the stripping and stockpiling operation has the potential to destroy the soil structure by mechanically breaking down the soil aggregates that are present.

Notwithstanding the comments above, the generally good structure grades of both topsoils and subsoils will allow the stripping operation to be carried out using machines such as open-bowl scrapers or bulldozers. All earthmoving equipment used in the stripping operation would be operated to ensure minimum handling of the soil and minimise the risks to soil structure. Scrapers should dump their loads neatly to form a uniform dump that requires little further forming prior to establishment of a vegetation cover. Bulldozers should only be used to push topsoil and subsoils a limited distance to temporary stockpiles prior to loading and transportation to the stockpile area.

Even so, care should be taken also to ensure that topsoils are not stripped when they are too moist as greater damage will occur at this time.

Similar precautions should be taken with the subsoils.

Driving of machinery on the topsoil and subsoil stockpiles, other than the scrapers during unloading, should be kept to an absolute minimum to maximise soil aggregation and prevent compaction.

Ideally the topsoil stockpiles should be 60cm to one metre high but, if necessary, higher stockpiles can be used. These should not exceed about 2 metres in height.

The subsoil stockpiles should not exceed 3 metres in height.

8.1.2 Soil Conservation Measures

Stockpiles should preferably be positioned where runoff water from upslope does not pose a problem, with the best stockpile sites being on a level ridgetop or an upper slope position.

If the stockpiles are not located on a level ridgetop or some other relatively level area, an appropriate protective soil conservation bank design will be required immediately above the site to prevent erosion of the stockpile by runon water.

In addition, measures should be taken to minimise loss of soil material from the stockpiles, especially in the period before they are stabilised - such as by using geotextile "silt-stop fences" or lines of hay bales etc.

The stockpile surfaces should be left with a "rough'" but even surface to assist in runoff control and seed retention and germination. They should be sown with appropriate stabilising species as soon as possible after placement.

Advice on suitable seed mixtures for the site should be obtained from local staff of NSW Agriculture or the Department of Land and Water Conservation.

Where stockpile construction is conducted in stages, the stockpile sections should be progressively stabilised.

9.0 LAND CAPABILITY

9.1 Methodology

Houghton and Charman [1986] in their "Glossary of Terms Used in Soil Conservation" define land capability as follows.

> "The ability of land to accept a type and intensity of use permanently, or for specified periods under specific management, without permanent damage."

They further note that land capability is "...an expression of the effect of biophysical land resources, including climate, on the ability of land to sustain use without damage under various uses such as crop production requiring regular tillage, grazing, woodland or wildlife. Land capability involves consideration of:

- the various land resources;
- the production to be obtained from the land;
- the activities or inputs required to achieve that production;
- the risks of damage to the land, on-site or off-site, resulting from those activities; and
- the inter-relations of the above."

Houghton and Charman note that land capability is taken into account in determining land suitability – another form of land classification relating to use for various purposes.

Land that is used beyond its capability ultimately loses its productive capacity as a consequence of exhaustion of soil nutrient supplies or the development of various forms of land degradation.

The land capability classification system used in New South Wales has been described by Emery [undated] and is a modification of the system devised and used by the former USDA Soil Conservation Service in the United States of America.

Emery's paper [in its Table 1] contains details of the Land Capability legend used on land capability maps prepared by the former Soil Conservation Service of New South Wales [now Department of Land and Water Conservation].

This shows the hierarchical classification used in the eight class system based on the management and protection needs of different types of land ranging from land needing no special soil conservation works or practices [Class 1] through to land that is unsuitable for agricultural or pastoral production [Class 8].

Emery's table also shows two other land capability classes – Mining and Urban land use – and also deals with class subscripts used to further subdivide some capability classes. The information presented by Emery is contained in **Appendix 3**.

9.2 Land Capability and Suitability Classification of the Study Area

It should be noted that both the NSW Soil Conservation Service Land Capability mapping and the Land Suitability mapping of NSW Agriculture were carried out at a very different scale to that of the present study and in most cases the assessments were subjected to only limited field checking.

As a consequence, there are often differing assessments that result from more detailed examination of relatively small study areas.

9.2.1 Soil Conservation Service Mapping

The 1: 100 000 scale Land Capability map of the Yass map sheet area prepared by the former Soil Conservation Service of NSW [Department of Land and Water Conservation, Yass] shows the study site to comprise Class 3 land.

Class 3 land [*land suited to regular cultivation provided it is suitably protected by soil conservation measures and practices*].

9.2.2 Current Assessment

Field inspection revealed that the land within SMU 1 [slopes and crests] was used mainly for cropping without use of structural soil conservation measures while the bulk of the SMU 2 land [drainage depressions] was sown to pasture.

It is evident that:

- the lands within SMU 1 are correctly classed as Class 3 land; but
- the SMU 2 lands are probably, more realistically, Class 4 land - i.e. *land suitable for grazing with occasional cultivation and suitable soil protection measures such as pasture improvement, fertiliser application and adequate stock management*].

9.3 Land Suitability Classification

9.3.1 NSW Agriculture Assessment

Information supplied by NSW Agriculture at Goulburn [Wendy Goodburn, pers.comm.] indicates that the Department has classified the lands of the area around Galong Limestone Mine using its suitability system.

The map showing the Galong study area indicates that the lands are **Class 3**.

The NSW Agriculture Land Suitability classification defines these land classes as follows.

- **Class 3 lands** are grazing lands or those well suited to pasture improvement. These lands have a moderate productivity and may be cultivated or cropped in rotation with pasture although soil and environmental constraints [e.g. erosion hazard and soil structure breakdown] limit productivity.

9.3.2 Current Assessment

A detailed study of the Galong soils study area indicates that the Class 3 [Suitability] category assigned by NSW Agriculture on the broader scale land suitability map for the area is correct.

10. CONCLUSION

Soils in the Galong soils study area have been described and two Soil Mapping Units have been identified.

The physical and chemical attributes of the soils of the study area have been quantified through a combination of field assessment and laboratory testing and indicate:

- the soils are currently stable but have a generally moderate to high erodibility rating as determined using the laboratory data obtained from samples from the study area in the SOILOSS computer model;
- the soils have a generally high structure grade and so can be stripped and respread using scrapers;
- the topsoil material [to 15cm depth] and the subsoil [to about 50cm total depth below the original soil surface] is favourable for use in rehabilitating the disturbed landscape;
- in SMU 1 additional subsoil could be stripped and stockpiled if desired. The material in question is that below Stripping Layer 2 - i.e. 50cm to 100cm depth below the current surface; and
- all soils will be subject to structural degradation if worked when too moist.

Depth of stripping recommendations have been provided along with advice on stabilising the soil stockpiles in the period between stripping and respreading.

The pre-mining land capability and land suitability of the Galong site has been determined. SMU 1 falls into land capability Class 3 and Land Suitability Class 3 while SMU 2 falls into Land Capability Class 4 and Land Suitability Class 3.

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APPENDICES

APPENDIX 1

(No. of pages excluding this page = 1)

SOIL PROFILE DESCRIPTIONS FROM REQUIRED EXCAVATOR TEST PITS - FIELD DESCRIPTIONS

APPENDIX 1

SOIL PROFILE DESCRIPTIONS FROM REQUIRED EXCAVATOR TEST PITS - FIELD DESCRIPTIONS

[a] Profile 6 SMU 1 [location - ridge crest]

0 - 20cm: clay loam; pH 7.5, surface firm to hardsetting, surface stone absent; roots common; brown [7.5YR4/4] dry, dark reddish brown [5YR3/3] moist; peds earthy, highly pedal [100%], polyhedral, 3-10mm; weak consistence [airdry]; coherent; *clear to*

20 - 50cm: light clay; pH 7.0; roots common; red [7.5YR4/4] dry, dark red [10R3/3] moist; peds earthy / smooth, highly pedal [100%], polyhedral, 5-10mm; very firm consistence [airdry]; coherent; *clear to*

50 - 115cm: medium to heavy clay; pH 7.0; roots common; red [10YR4/6] dry, dusky red [2.5YR3/4] moist; peds smooth, highly pedal [100%], polyhedral, 4-15mm; very firm consistence [airdry]; coherent; *clear to*

115 - 310cm: medium clay; pH 6.0; roots few; red [10R4/6] dry, dusky red [2.5YR3/4] moist; strong manganese stains; peds smooth, highly pedal [100%], polyhedral, 4-10mm; very strong consistence [airdry]; coherent; *profile continues*

[b] Profile 1 SMU 2 [location drainage depression]

0 - 14cm: clay loam; pH 7.0; surface hardsetting, surface stone absent; roots common; pale brown [10YR6/3] dry, brown [7.5YR4/2] moist; peds earthy, highly pedal [100%], polyhedral, 5-15mm; weak consistence [airdry]; coherent; *clear to*

14 - 30cm: clay loam; pH 6.5; roots common; pinkish grey [7.5YR6/2] dry, brown [7.5YR4/2] moist; peds earthy, highly pedal [100%], polyhedral, 5-15mm; strong consistence [airdry]; coherent; *clear to*

30 - 50cm: medium clay; pH 6.5; few roots; bleached; light grey [10YR7/2] dry, brown [7.5YR4/2] moist; peds earthy vesicular, massive to pedal [50%], polyhedral where present, 5-10mm; strong consistence [airdry]; coherent; *clear to*

50 - 167cm: heavy clay; pH 8.5; few roots; **mottled**; dark grey [2.5Y4/1] [90%], brown [7.5YR5/4] [10%] dry, dark grey [10YR4/1] [90%], yellowish brown [10YR5/4] moist; peds smooth, highly pedal [100%], 5-10mm, polyhedral, very strong consistence [airdry]; coherent dry; *diffuse to*

167 - 292cm; medium to heavy clay; pH 9.0; **mottled**; grey [2.5Y5/1] [60%], yellowish red [5YR4/6] [40%]dry, dark reddish grey [2.5Y4/1] [60%], yellowish red [7.5YR4/6] [40%] moist; peds smooth, highly pedal [100%], polyhedral, 5-10mm; very strong consistence [airdry]; coherent; *profile continues*

APPENDIX 2

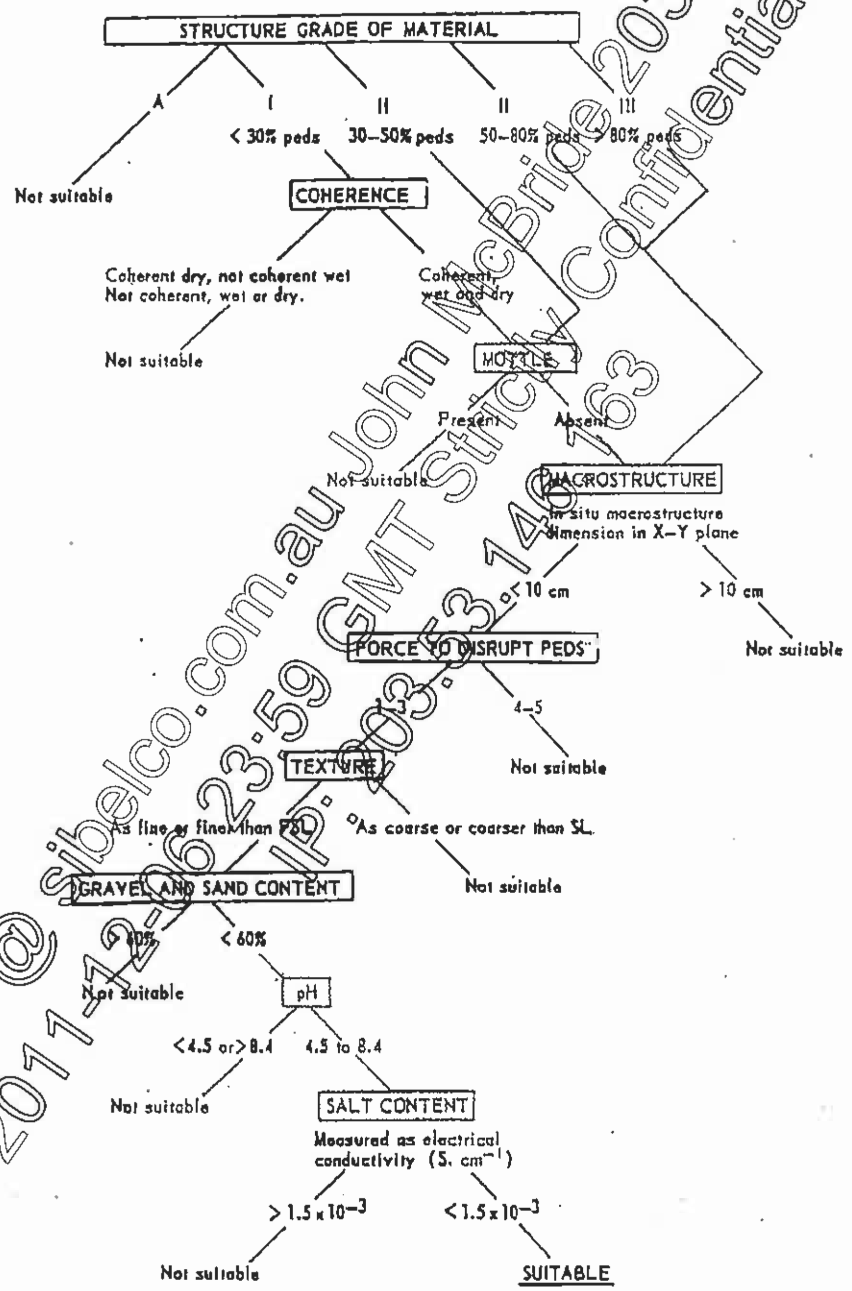
(No. of pages excluding this page = 1)

TOPSOIL STRIPPING SUITABILITY KEY [after Elliott and Veness, 1981]

APPENDIX 2

TOPSOIL STRIPPING SUITABILITY KEY [After Elliott and Veness, 1981]

Procedure for the selection of material for use in topdressing of disturbed areas.



APPENDIX 3

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BASIS OF LAND CAPABILITY CLASSIFICATION [after Emery, undated]

APPENDIX 3

BASIS OF LAND CAPABILITY CLASSIFICATION [after Emery, undated]

Table 1 *Land Capability Map Legend*

			LAND CLASSIFICATION AND SOIL CONSERVATION PRACTICES	INTERPRETATIONS AND IMPLICATIONS
SUITABLE FOR REGULAR CULTIVATION		I	No special soil conservation works or practices.	Land suitable for a wide variety of uses. Where soils are fertile, this is land with the highest potential for agriculture, and may be cultivated for vegetable and fruit production, cereal and other grain crops, energy crops, fodder and forage crops, and sugar cane in specific areas. Includes "prime agricultural land".
		II	Soil conservation practices such as strip cropping, conservation tillage and adequate crop rotation.	Usually gently sloping land suitable for a wide variety of agricultural uses. Has a high potential for production of crops on fertile soils similar to Class I, but increasing limitations to production due to site conditions. Includes "prime agricultural land".
		III	Structural soil conservation works such as graded banks, waterways and diversion banks, together with soil conservation practices such as conservation tillage and adequate crop rotation.	Sloping land suitable for cropping on a rotational basis. Generally used for the production of the same type of crops as listed for Class I, although productivity will vary depending upon soil fertility. Individual yields may be the same as for Classes I and II, but increasing restrictions due to the erosion hazard will reduce the total yield over time. Soil erosion problems are often severe. Generally fair to good agricultural land
SUITABLE FOR GRAZING	Occasional Cultivation	IV	Soil conservation practices such as pasture improvement, stock control, application of fertiliser and minimal cultivation for the establishment or re-establishment of permanent pasture.	Land not suitable for cultivation on a regular basis owing to limitations of slope gradient, soil erosion, shallowness or rockiness, climate, or a combination of these factors. Comprises the better classes of grazing land of the State and can be cultivated for an occasional crop, particularly a fodder crop, or for pasture renewal. Not suited to the range of agricultural uses listed for Classes I to III. If used for "hobby farms", adequate provision should be made for water supply, effluent disposal and selection of safe building sites and access roads.
		V	Structural soil conservation works such as absorption banks, diversion banks and contour ripping, together with the practices as in Class IV.	Land not suitable for cultivation on a regular basis owing to considerable limitations of slope gradient, soil erosion, shallowness or rockiness, climate, or a combination of these factors. Soil erosion problems are often severe Production is generally lower than for grazing lands in Class IV. Can be cultivated for an occasional crop, particularly a fodder crop or for pasture renewal. Not suited to the range of agricultural uses listed for Classes I to III. If used for "hobby farms" adequate provision should be made for water supply, effluent disposal, and selection of safe building sites and access roads.
	No Cultivation	VI	Soil conservation practices including limitation of stock, broadcasting of seed and fertiliser, prevention of fire and destruction of vermin. May include some isolated structural works.	Productivity will vary due to the soil depth and the soil fertility. Comprises the less productive grazing lands. If used for "hobby farms", adequate provision should be made for water supply, effluent disposal, and selection of safe building sites and access roads.
OTHER		VII	Land best protected by green timber.	Generally comprises areas of steep slopes, shallow soils and/or rock outcrop. Adequate ground protection must be maintained by limiting grazing and minimising damage by fire. Destruction of trees is not generally recommended, but partial clearing for grazing purposes under strict management controls can be practised on small areas of low erosion hazard. Where clearing of these lands has occurred in the past, unstable soil and terrain sites should be returned to timber cover.
		VIII	Cliffs, lakes or swamps and other lands unsuitable for agricultural and pastoral production.	Land unsuitable for agricultural or pastoral uses. Recommended uses are those compatible with the preservation of the natural vegetation, namely: water supply catchments, wildlife refuges, national and state parks, and scenic areas.
		U	Urban areas	
		M	Mining and quarrying areas.	

CLASS SUBSCRIPTS	SPECIAL USES
c	Terrain developed for a specific crop (capability class range IV to VII) as a result of the combination of particular soil, terrain, climatic and economic conditions. The class includes such crops as grapes, bananas, avocados and pineapples.
d	Terrain developed for intensive agricultural production and associated with flood irrigation. The class includes land developed for cotton and rice production.

Barnu Pty Ltd

Galong Limestone Mine Expansion

Surface Water Assessment

April, 2003

Prepared by
Hughes Trueman Pty Ltd

SPECIALIST CONSULTANT STUDIES

PART 2

SURFACE WATER ASSESSMENT

OF THE PROPOSED

GALONG LIMESTONE MINE EXPANSION

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April, 2003

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1.0 INTRODUCTION

1.1 Background

The Galong Limestone Mine is located approximately 20 km east-southeast of Harden in the Southwest Slopes region of NSW. The mine is owned and operated by Barnu Pty Ltd and is the major supplier of agricultural lime for use as an acid soil ameliorant to the cropping areas of the Southwest Slopes grain belt.

The mine currently has development consent from Harden Shire Council to produce 200 000 tonnes per annum of milled limestone products. However, Barnu now wishes to obtain approval to:

- mine up to 500 000 tonnes per annum of limestone through both the lateral and depth expansion of the existing open-cut mine area; and
- produce up to 350 000 tonnes per annum of crushed and milled limestone.

Consequently, the Company is required to prepare a new development application supported by an Environmental Impact Statement (EIS) to cover the expanded mining operation and increased traffic movements on local roads. This Surface Water Assessment has been prepared as a supporting document for the EIS.

1.2 Project Site Location

The Project Site is located entirely on land owned by Bobbara Pastoral Company and corresponds to the boundary of Mining Lease No 1496. The Project Site covers an area of approximately 160 hectares, incorporating all of Portion 139 and parts of Lots 1, 2 and 3, DP 747544, all within the Parish of Bobbara, County of Harden. The Project Site also incorporates approximately 1 km of Crown Road Reserve. **Figure 1.1** illustrates the location of the Galong Limestone Mine.

1.3 Outline of Proposed Mine Expansion

The expansion of mine operations includes increased extraction activities using drill and blast methods and the continued operation of a variety of heavy earth-moving equipment, including excavators, trucks and dozers. Blasting / operational practices are unlikely to change significantly, although blast sizes are likely to increase. Mining will progressively become a full-time activity.

The proposed mine expansion will be carried out in stages as shown on **Figure 1.2**.

As part of the mine expansion, a soil bund will be constructed adjacent to the mine access road, between Limestone Creek and the proposed mine extension. The bund, referred to as the "eastern soil bund" is designed primarily as a safety feature to prevent inadvertent vehicular access into the open-cut mine. It would also prevent floodwaters from Limestone Creek entering the mine site during a substantial flood event. The location of the eastern soil bund is shown on **Figure 1.2**.

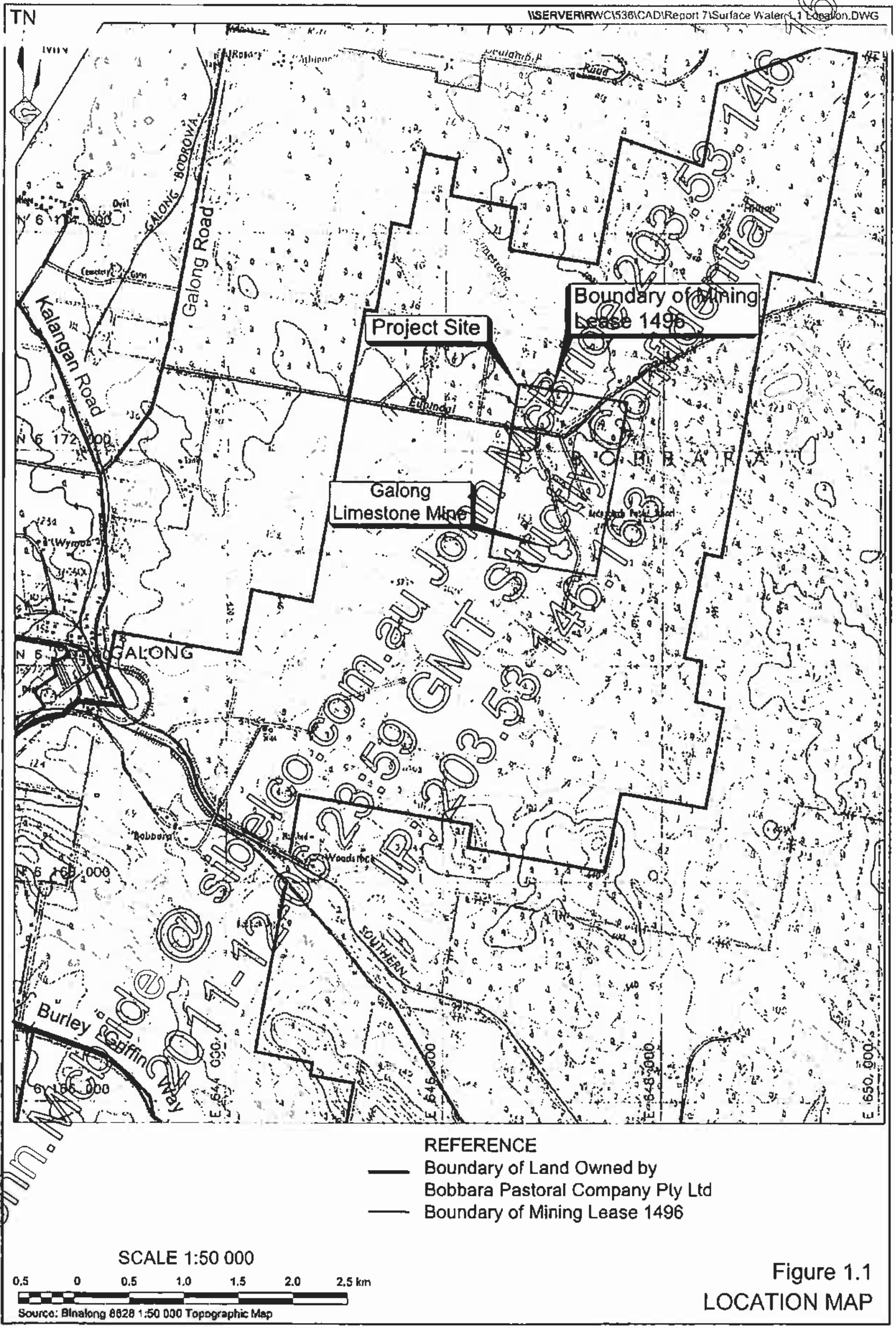


Figure 1.1
LOCATION MAP

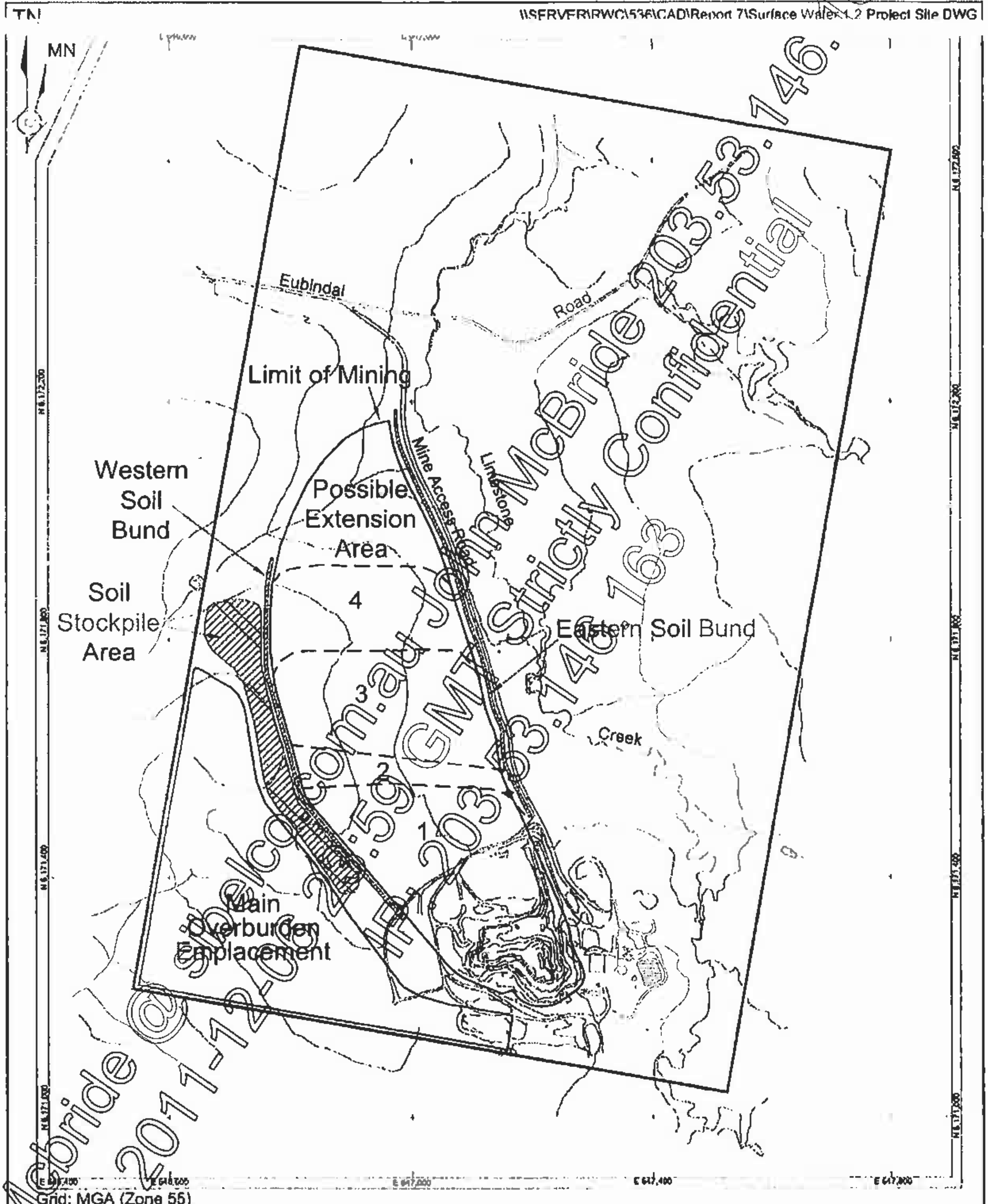


Figure 1.2
PROPOSED MINE EXPANSION

The Company currently has approval to discharge groundwater inflows (157 ML per annum: 430 kL per day) from the existing mine onto Lot 3, DP747544 which includes a 1.3km section of Limestone Creek. The point of discharge is located near the northern end of the Project Site. It is anticipated that there will be no increase in the discharge from the site to Limestone Creek in the short term, however, based on conservative predictions by Peter Dundon & Associates (2003), the rate of discharge may double in the longer term, i.e. approaching 2043. This assessment only addresses a discharge of 430 kL/day. Should the need arise for an increase in discharge at some time in the future, approval will be sought from the Department of Sustainable Natural Resources (DSNR) (formerly DLWC).

1.4 Surface Water Assessment

This surface water assessment has been prepared as part of the supporting documentation for the EIS for the proposed mine expansion. The assessment provides information regarding the:

(i) existing catchment hydrology;

(ii) hydraulic conditions in Limestone Creek adjacent to the mine site;

(iii) constraints surface water may pose for the proposal;

(iv) assessment of the impact of the proposed mine expansion on the surface water environment surrounding the Project Site and on the catchment in general; and

(v) possible mitigation measures, including an assessment of the safe working distance required between Limestone Creek and the eastern faces of the open-cut mine to ensure that extraction operations are not adversely affected by surface water associated with the creek, particularly flood events.

The assessment of the existing catchment hydrology references the report prepared recently for DLWC (now DSNR) to obtain approval to discharge from the mine site to Limestone Creek (*Galong Limestone Mine Surface Water Assessment*, prepared by Hughes Trueman, February 2003). That report provided a detailed analysis of hydrologic conditions within the catchment and presented design flows for Limestone Creek at the mine site.

As part of this current report, a hydraulic model has been set up to assess flood levels, velocities and flood extents in Limestone Creek and adjoining the mine site. This hydraulic analysis has been carried out for both existing mine and post-mine expansion conditions with the eastern soil bund in place, to determine the impact of the construction of the bund.

2.0 CATCHMENT HYDROLOGY

2.1 Catchment Description

The open-cut mine and proposed mine expansion area are located adjacent to Limestone Creek. Limestone Creek has a catchment area of about 38 km^2 above the Galong - Boorowa railway line. About 7.6 km^2 of this catchment lies upstream of the Galong Limestone Mine. Immediately west of the railway line, Limestone Creek is joined by some minor tributaries from the south before its confluence with Rocky Ponds Creek about 2 km downstream of the railway line. The total catchment area of Rocky Ponds Creek and Limestone Creek at the confluence is about 88 km^2. The location of the mine and the various catchments are shown on the catchment plan (**Figure 2.1**).

2.2 Hydrologic Analysis

2.2.1 Data Sources

The DLWC "Pineena" stream gauging database shows no gauging stations on Rocky Ponds Creek or any river systems in the immediate vicinity. To overcome the lack of available streamflow records in the immediate vicinity, a desktop assessment was undertaken using regional hydrologic analysis techniques, based on the available streamflow records from catchments in the region. The identified catchments and a brief description of each are provided in **Table 2.1**.

Table 2.1
Stream Gauging Records Used in Analysis

River/Creek	Station Number	Major Catchment	Catchment Area (km^2)	Average Daily Flow (ML/day)	Average Annual Flood (m^3/s)	Period of Record (years)
Begalia Ck @ Begalia	412135	Lachlan	1.8	0.7	1.5	1989 - 99
Demondrille Ck @ Woengabara	410126	Murrumbidgee	171	8.9	12.3	1975 - 89
Pudmans Ck @ Kenny's Ck Rd	412096	Lachlan	332	56.0	84.1	1975 - 99
Cunninghams Ck @ Harden	410092	Murrumbidgee	901	23.7	25.9	1976 - 88
Jugiong Ck @ Inverlockie	410025	Murrumbidgee	2120	175.6	42.1	1915 - 99

Source: Pineena Database, DLWC 2001

For each gauging station, the data and relationships described in the following sections were derived. **Appendix A** contains the derived relationships presented graphically, as well as other data used in the analysis.

2.2.2 Average Daily Flow

Long term average daily flow was calculated for all available records at each station. The average daily flow was used to:

- derive "normalised" flow duration curves for each station (see below); and
- prepare a graph of average daily flow versus catchment area (**Figure A1**).

The data in **Figure A1** show that the average daily flow for Pudmans Creek (Station 412096) is inconsistent with the flows at the other four stations. The data for Pudmans Creek was therefore not taken into account in estimating the flow regime for catchments in the vicinity of Galong Limestone Mine.

2.2.3 Flow Duration

Daily flow duration curves for each season, expressed as a proportion of the average daily flow, were derived for each station. For purposes of this analysis, the seasons were taken to be:

- Summer: December – February
- Autumn: March – May
- Winter: June – August
- Spring: September – November.

Figure A2 shows the seasonal flow duration curves for each station. These daily flow duration curves were subsequently used to estimate the flow duration curves in the vicinity of the Galong Limestone Mine. Jugiong Creek (Station 410025) was omitted from this analysis because, as a result of its large catchment area, it exhibited far more constant flow than other stations. The main noteworthy features of these flow duration curves are as follows.

- Flow patterns in winter and spring are very similar and are significantly higher than in autumn or summer.
- Flows in summer are consistently lower than in autumn.
- As catchment area decreases, zero flow can be expected for a greater proportion of time in autumn and summer.
- Zero flow is a relatively rare occurrence in winter and spring.

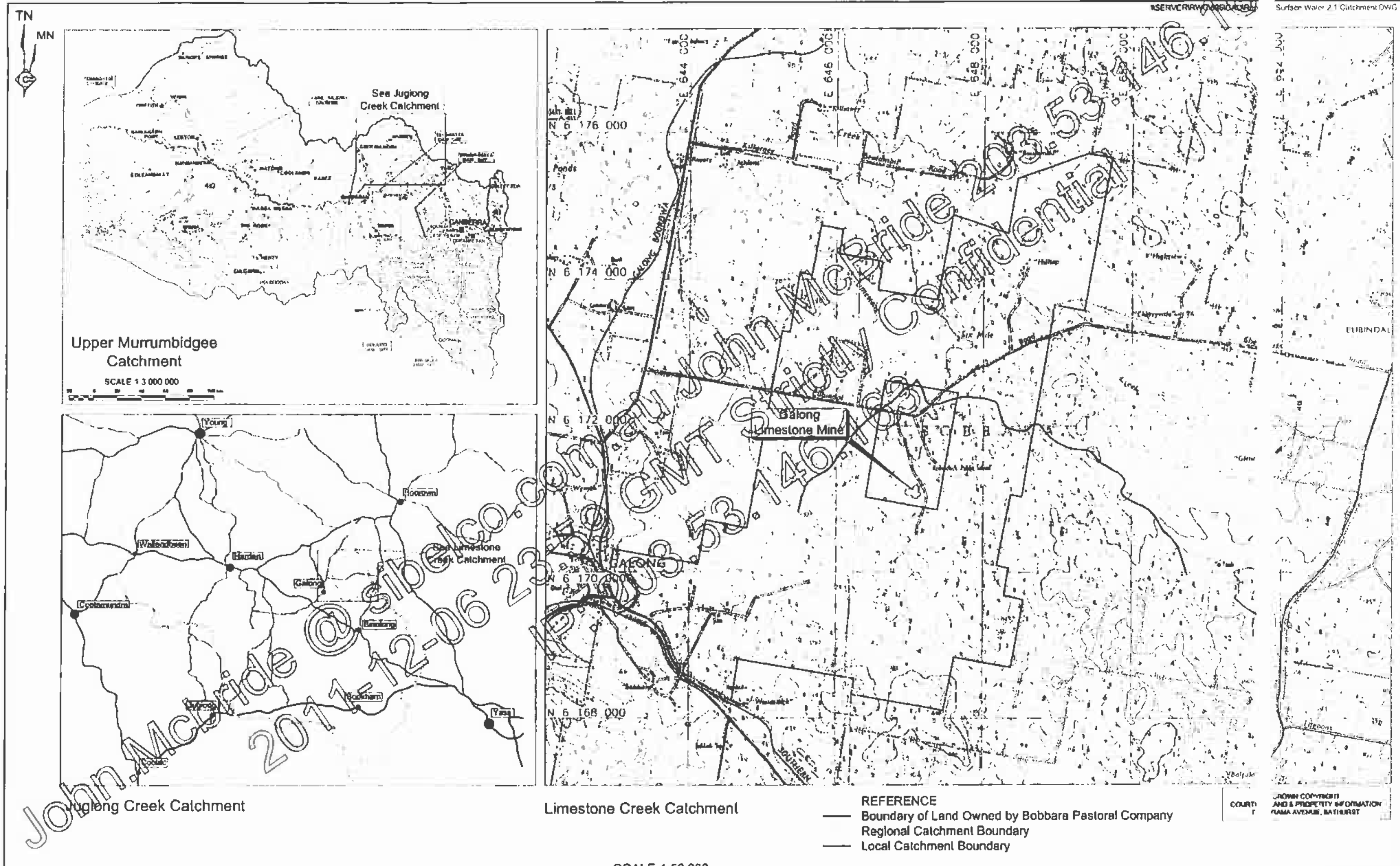


Figure 2.1
CA CHMENT AREAS

2.2.4 Annual Floods

The annual peak floods for each station were extracted. These data were then used in the flood frequency analysis described below. The 10 year ARI floods derived from historic data were plotted against catchment area (**Figure A3**). Estimates of the 10 year ARI flood for different catchment areas were also prepared using the Probabilistic Rational Method *(Institution of Engineers Australia, 1998).*

2.2.5 Flood Frequency

Flood frequency analysis was undertaken using "normalised" flood data expressed as a proportion of the average annual flood. Flood frequency curves were derived for each station, based on the peak annual floods using the methods set out in Australian Rainfall and Runoff (1997). These curves are provided in **Figure A4**. The data in **Figures A4(a) – (e)** were used to derive regional flood frequency factors relating the flood of a nominated frequency to the 10 year ARI flood. Flood frequency factors for the area were also derived using the Probabilistic Rational Method. **Table 2.2** summarises this analysis and provides the values adopted for estimation of the flood flow regime for creeks in the vicinity of the Galong Limestone Mine.

Table 2.2
Flood Frequency Factors

Flood ARI (y)	Begalla Creek	Demondrille Creek	Putmans Creek	Cunninghams Creek	Juglong Creek	Probabilistic Rational	Adopted
2	0.59	0.48	0.28	0.46	0.14	0.51	0.50
5	0.92	0.88	0.70	0.60	0.58	0.76	0.75
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	1.03	1.05	1.27	1.39	1.44	1.34	1.40
50	1.04	1.08	1.58	1.87	2.01	1.92	2.00
100	1.05	1.08	1.78	2.18	2.40	2.49	2.40

Source: Pineena Database, DLWC 2001

2.3 Results

2.3.1 Seasonal Flow Regime

The generalised regional data were used as the basis for deriving estimates of seasonal flow variability at the following locations.

- Limestone Creek at the mine site (7.6 km^2 catchment)
- Limestone Creek at the Galong – Boorowa railway (38 km^2 catchment)
- Rocky Ponds Creek immediately downstream of the junction with Limestone Creek (88 km^2 catchment)

For each of the nominated locations, estimated seasonal flow duration curves for "natural" conditions and "with existing mine flow" conditions were derived using the following procedure.

- Based on the seasonal flow duration curves for the recorded stations, a "normalised' daily flow duration curve (fraction of average daily flow) was assessed. This process took account of the relationship between catchment area and the percentage of zero flow occurring in autumn and summer.
- The estimated average daily flow for each catchment was derived from the data in **Figure A1**.
- The seasonal daily flow duration curve for each catchment was then derived by multiplying the "normalised" flow duration data by the estimated average daily flow for the catchment.
- The mine dewatering discharge (430 kL/day) was added to the "natural" flow duration data to produce a daily flow duration curve that would occur assuming a constant daily dewatering discharge into Limestone Creek. It should be noted that this aspect of the analysis does not take account of channel losses and evaporation from the swamp area located downstream of Six Mile Creek. The analysis will therefore tend to overestimate the contribution of flow from the mine to flows at the Galong-Boorowa railway line and below the confluence with Rocky Ponds Creek.

The resulting daily flow duration curves for each season at the three selected locations are shown in **Figures A5(a) – (c)**.

For summary purposes, key statistics are presented in **Table 2.3** showing flow estimates for the 10th percentile (dry), median and 90th percentile (wet) under current mine conditions.

Table 2.3
Derived Discharges for Various Catchments (ML/day)

Percentile	Summer	Autumn	Winter	Spring
Catchment Upstream of Galong Limestone Mine (7.6 km²)				
10	0.59	1.19	3.92	3.11
Median	0.44	0.59	1.99	1.70
90	0.44	0.44	0.70	0.57
Limestone Creek Catchment Above Confluence with Rocky Ponds Creek (38 km²)				
10	1.14	3.24	8.56	6.67
Median	0.61	1.66	4.07	3.39
90	0.44	0.44	1.06	0.74
Rocky Ponds Creek Catchment Downstream of Limestone Creek Junction (88 km²)				
10	2.39	8.26	23.13	17.85
Median	0.93	3.86	10.58	8.70
90	0.44	0.44	2.17	1.29

Note that these discharges occur under current mine operations and will not increase under the expanded operations in the short term.

2.3.2 Flood Flow Regime

The data derived from the regional flood frequency analysis and the probabilistic rational were used to estimate the average annual flood and the flood frequency distribution for the following locations, assuming a constant flow from mine dewatering.

- Limestone Creek at the mine site.
- Limestone Creek at the Galong – Boorowa railway.
- Rocky Ponds Creek immediately downstream of the junction with Limestone Creek.

The results of these analyses are summarised in **Table 2.4**.

Table 2.4
Estimated Flood Flows for Various Catchments

	Flood Flows (m^3/s)		
ARI (years)	Galong Limestone Mine (7.6 km^2)	Limestone Creek (38 km^2) *	Rocky Ponds Creek (88 km^2) *
1	1.8	5.4	13.8
2	2.7	8.0	20.6
5	4.0	12.00	30.8
10	5.2	15.7	40.3
20	7.0	21.0	53.9
50	10.0	30.1	77.3
100	13.0	39.0	100.3
3 x 100	39.0	117	300.9

* Includes maximum licenced discharge from open-cut mine

Table 2.4 also includes an estimation of the discharges for an extreme flood event. The discharges for the extreme flood were estimated based on three times the 100 year ARI discharges. This estimate was used as input to the hydraulic model (refer Section 3.0) in order to assess flood levels and extents in Limestone Creek adjacent to the mine site for an extreme event.

3.0 HYDRAULIC ANALYSIS

In order to assess the impact of the mine operations, a hydraulic analysis was carried out using the HEC-RAS hydraulic model. Flows generated using the hydrologic analysis outlined above were input to the hydraulic model in order to identify flood levels, velocities and extents in Limestone Creek adjacent to the mine site.

3.1 Hydraulic Model

The hydraulic modelling was carried out using HEC-RAS version 3.1 (*US Army Corps of Engineers, Hydrologic Engineer Center*). HEC-RAS is an integrated package of hydraulic analysis programs capable of performing one-dimensional steady and unsteady flow water surface profile calculations.

The steady flow component can handle a full network of channels, a dendritic system or a single river reach. It is capable of modelling subcritical, supercritical and mixed flow water surface profiles.

The basic computational procedure is based on the solution of the one-dimensional energy equation. Energy losses are evaluation by friction (Manning's Equation). The effects of various obstructions such as bridges, culverts, weirs and obstructions in the floodplain may be considered in the computations.

3.1.1 Model Setup and Assumptions

A schematic layout of the HEC-RAS model is shown on **Figure 3.1**. Cross-sections were extracted from detailed field survey of the site and surrounds. The modelled cross sections adjacent to the proposed expansion (cross sections 1 – 4) are shown in elevation in **Figure 3.2**.

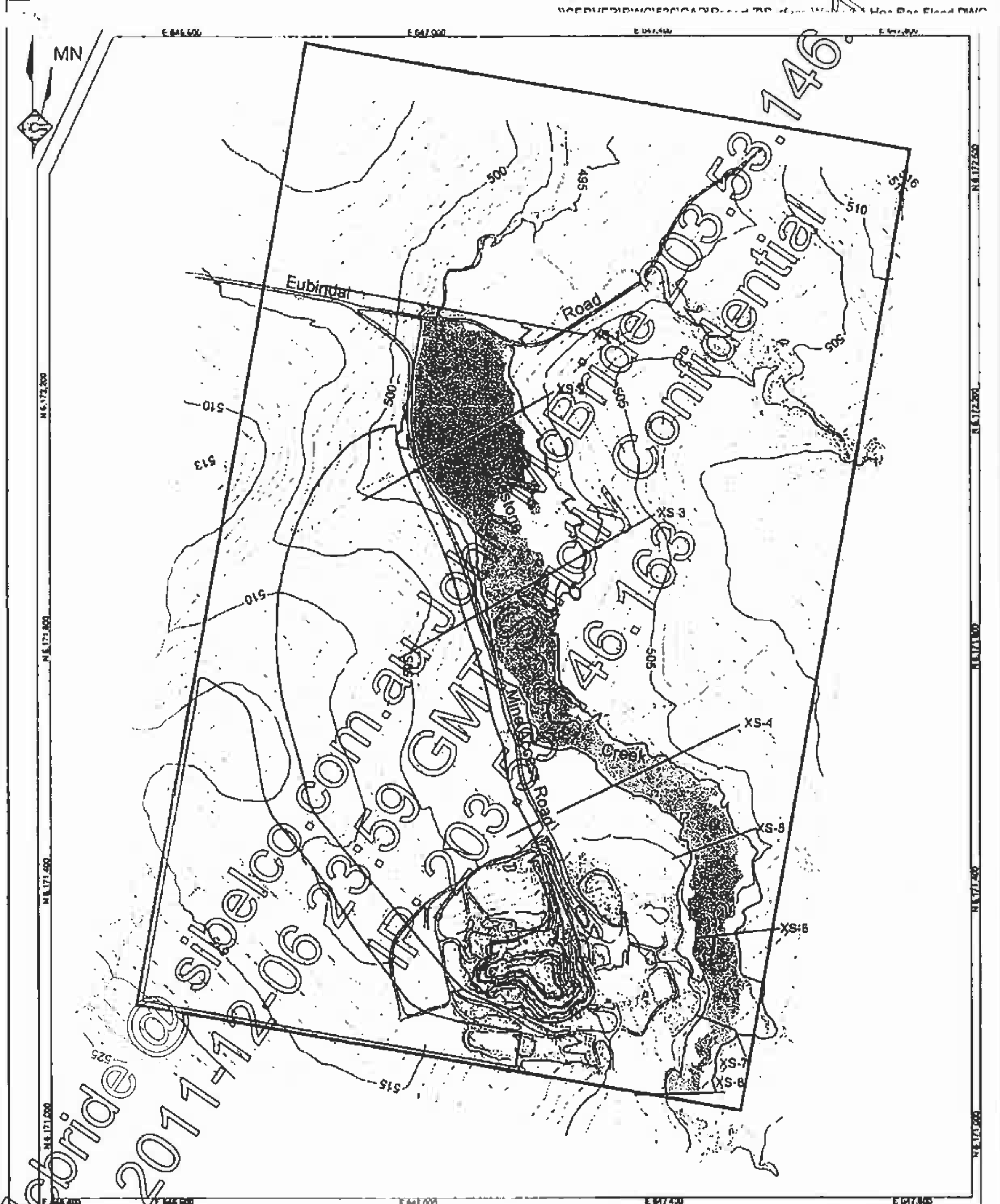
The model was operated with Manning's roughness values of 0.04 within the main channel and 0.06 on the overbank areas. These values represent a channel that is clean and winding with some pools and shoals and an overbank area that comprises light brush and trees and are based on aerial photographs of the modelled area.

Modelling was carried out for the 5, 20, 100 and 3 x 100 year ARI storm events, based on the flows derived in the hydrologic analysis (refer **Table 2.4**).

Modelling was carried out for both existing (ie current mine) conditions and for the proposed mine expansion. A 2m eastern soil bund is proposed to be located between the expanded mine and the mine access road which would assist in protecting the mine site from flood flows. This bund has been included in cross sections 2, 3 and 4 of the post-expansion model.

3.1.2 Results

The results of the analysis are contained in **Table 3.1** which contains flood levels and velocities for the cross-sections shown on **Figure 3.1** (which are the same for both existing and post-expansion conditions). The plotted extents for the 100 and 3 x 100 year ARI floods are also shown on this figure.



Grid: MGA (Zone 55)
Datum: AHD

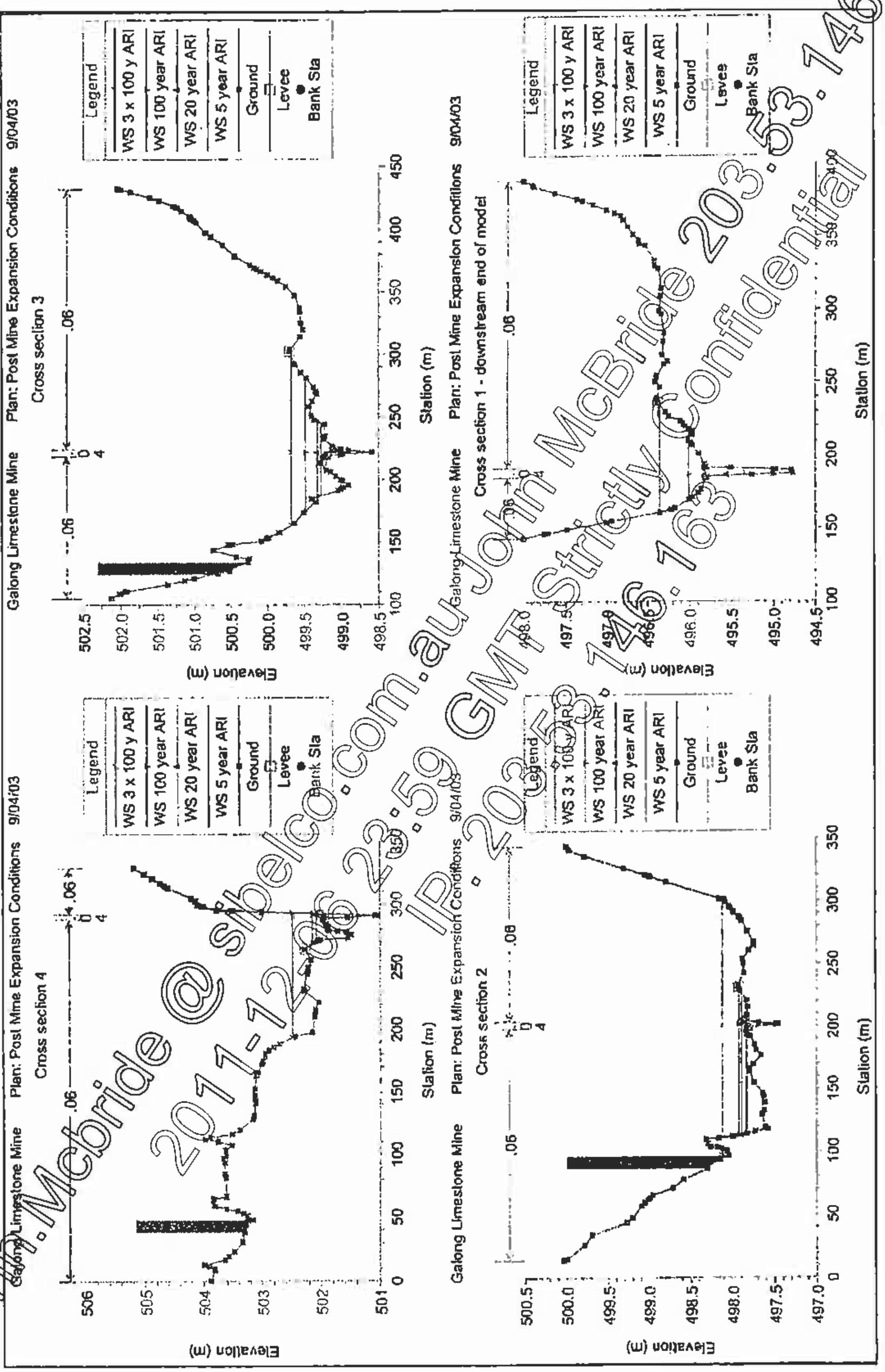
REFERENCE
Boundary of Mining Lease 1496
Proposed Limit of Mining
Proposed Main Overburden Emplacement
615 Contour (5m Interval)
1 in 100 Year Flood Level
3 x 1 in 100 Year Flood Level
XS-6 HEC RAS Model Setup

SCALE 1:10 000

100 0 100 200 300 400 500 m

Source: Geo - Spectrum (Australia) Pty Ltd

Figure 3.1
HEC-RAS MODEL SETUP
AND FLOOD EXTENTS



\\SERVER\RWC\536\CAD\Report 7\3.1 Hec Ras Sections.DWG

Figure 3.2
HEC-RAS MODEL CROSS-SECTIONS

Figure 3.2 contains the model cross-sections adjacent to the proposed mine expansion (cross sections 1 to 4). The cross sections show the 5, 20, 100 and 3 x 100 year ARI flood levels together with the proposed eastern soil bund adjacent to the mine access road. It can be seen from **Figure 3.2** that the extent of flooding does not extend to the proposed eastern soil bund for the modelled events.

Table 3.1
Flood Levels and Velocities adjacent to Mine Site

Cross Section	Discharge (m^3/s)	Water Level (m AHD)	Velocities (m/s)		
			Left O'bank	Channel	Right O'bank
3 x 100 year ARI					
8	39	508.58	0.41	1.77	0.64
7	39	507.42	0.86	2.42	0.86
6	39	505.87	0.80	2.09	0.88
5	39	504.19	0.89	2.52	0.79
4	39	502.48	0.83	2.20	0.54
3	39	499.68	0.77	1.78	0.62
2	39	498.12	0.67	1.09	0.48
1	39	496.35	0.82	2.56	0.73
100 year ARI					
8	13	508.25	0.10	1.31	0.30
7	13	507.14	0.28	1.78	0.39
6	13	505.57	0.59	1.75	0.60
5	13	503.97	0.59	1.70	0.31
4	13	502.14	1.03	2.29	0.33
3	13	499.46	0.48	1.15	0.32
2	13	497.92	0.57	0.97	0.29
1	13	496.00	0.38	1.93	0.32
20 year ARI					
8	7	508.07	-	1.12	-
7	7	506.93	-	1.54	0.22
6	7	505.48	0.34	1.39	0.39
5	7	503.79	0.42	1.66	0.24
4	7	502.07	0.65	1.47	0.15
3	7	499.32	0.48	1.22	0.34
2	7	497.89	0.36	0.63	0.16
1	7	495.55	-	2.31	-
5 year ARI					
8	4	507.85	-	1.07	-
7	4	506.80	-	1.21	-
6	4	505.38	0.14	1.27	0.26
5	4	503.65	0.11	1.49	-
4	4	501.90	0.63	1.47	-
3	4	499.27	0.34	0.93	0.20
2	4	497.83	0.30	0.56	0.06
1	4	495.34	-	2.03	-

4.0 IMPACTS OF PROPOSED MINE EXPANSION

4.1 Hydrological Impacts

In view of there being no impact on flood flows and negligible impact on the daily flow regime, no management of discharge is required. The proposed mine expansion is expected to have a negligible impact on the surface water surrounding the Project Site and on the catchment in general.

4.2 Hydraulic Impacts

The results of the analysis presented in Section 3 above show that the construction of the 2m eastern soil bund between the mine and the mine access road would have no impact on existing flood levels, velocities and extents, as it is not located within the existing flood extents, even for an extreme flood event.

5.0 CONSTRAINTS

In view of there being no impact on flood flows and negligible impact on the daily flow regime, no existing constraints have been identified.

The proposed mine expansion is expected to have a negligible impact on the surface water surrounding the Project Site and on the catchment in general. The proposed expansion and construction of the 2m high eastern soil bund adjacent to the mine access road would create no impact on existing flood levels, velocities and flood extents and therefore no constraints have been identified.

6.0 MITIGATION MEASURES

In view of there being no impact on flood flows and negligible impact on the daily flow regime, no mitigation measures are required in addition to the proposed soil bund.

The mine access road would not be overtopped in floods up to an extreme event (3 x 100 year ARI). Construction of the eastern soil bund between the access road and the open-cut mine will provide an additional safeguard against flooding for any events greater than the 3 x 100 year ARI flood. This bund will provide protection to any extraction works carried out on the western side of the eastern soil bund and therefore it is not necessary to specify the safe working distance required between Limestone Creek and the mine.

7.0 REFERENCES

Hughes Trueman (February 2003). *Galong Limestone Mine Surface Water Assessment.*

Institution of Engineers Australia (1998). *Australian Rainfall & Runoff.*

US Army Corps of Engineers, Hydrologic Engineer Center (November 2002). *HEC-RAS Version 3.1.*

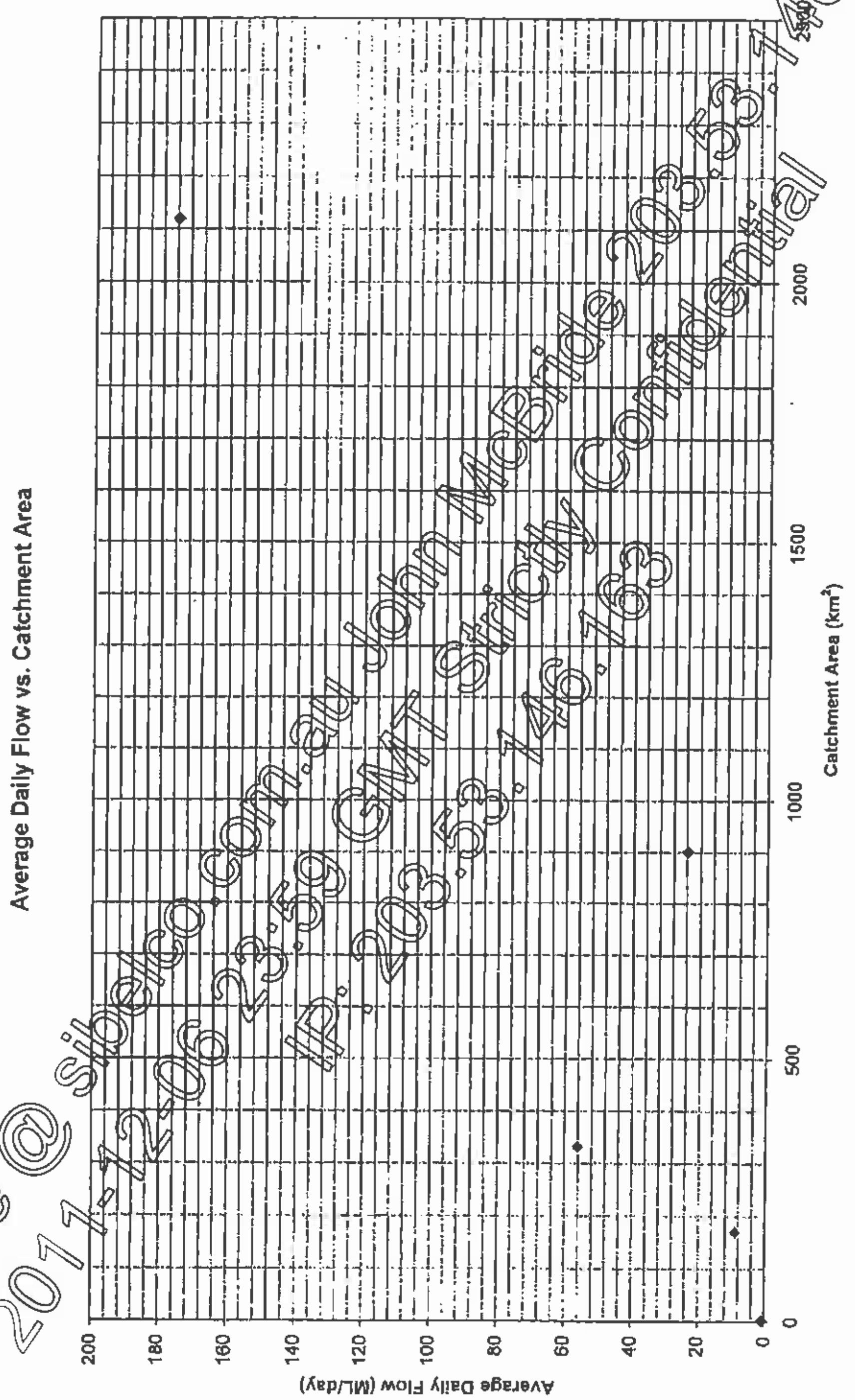
APPENDICES

Appendix A Plots for Hydrological Analysis

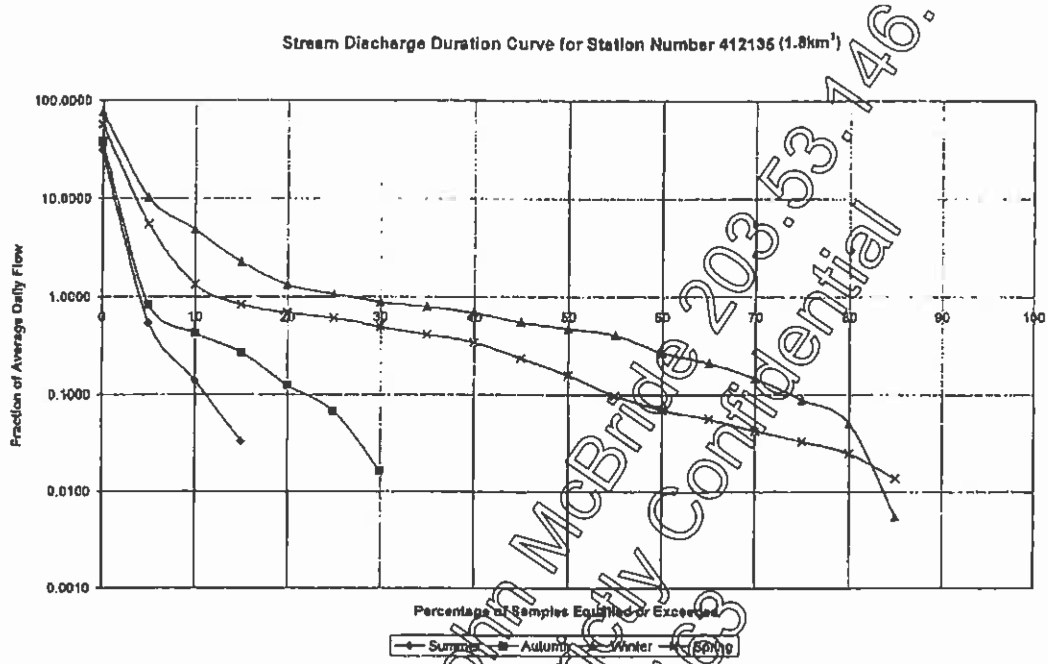
APPENDIX A

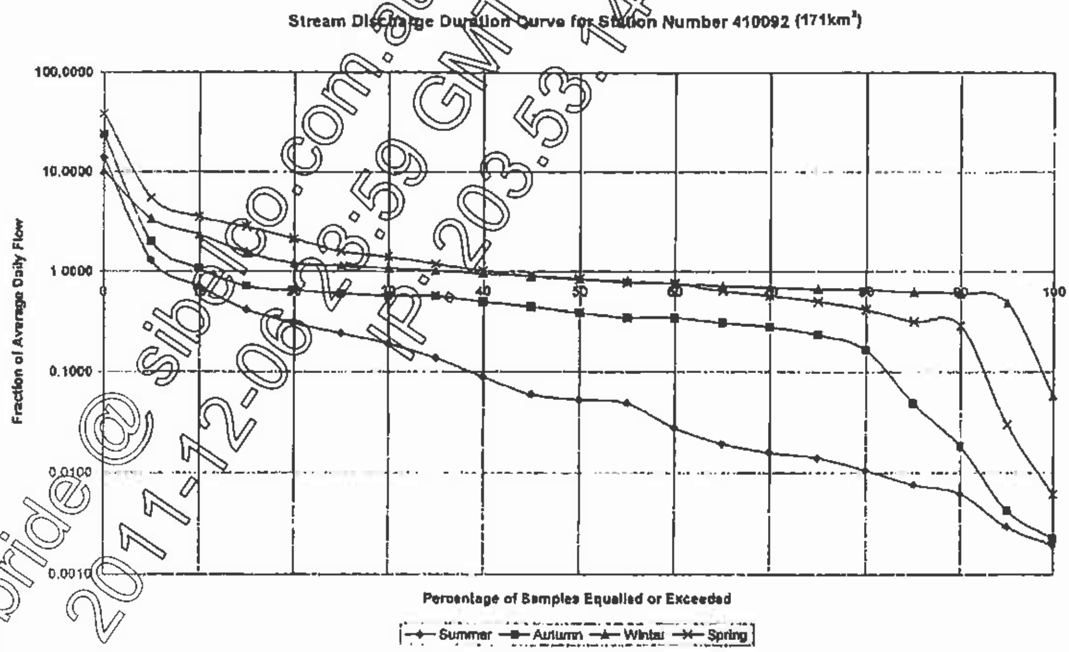
(No. of pages excluding this page = 12)

PLOTS FOR HYDROLOGICAL ANALYSIS

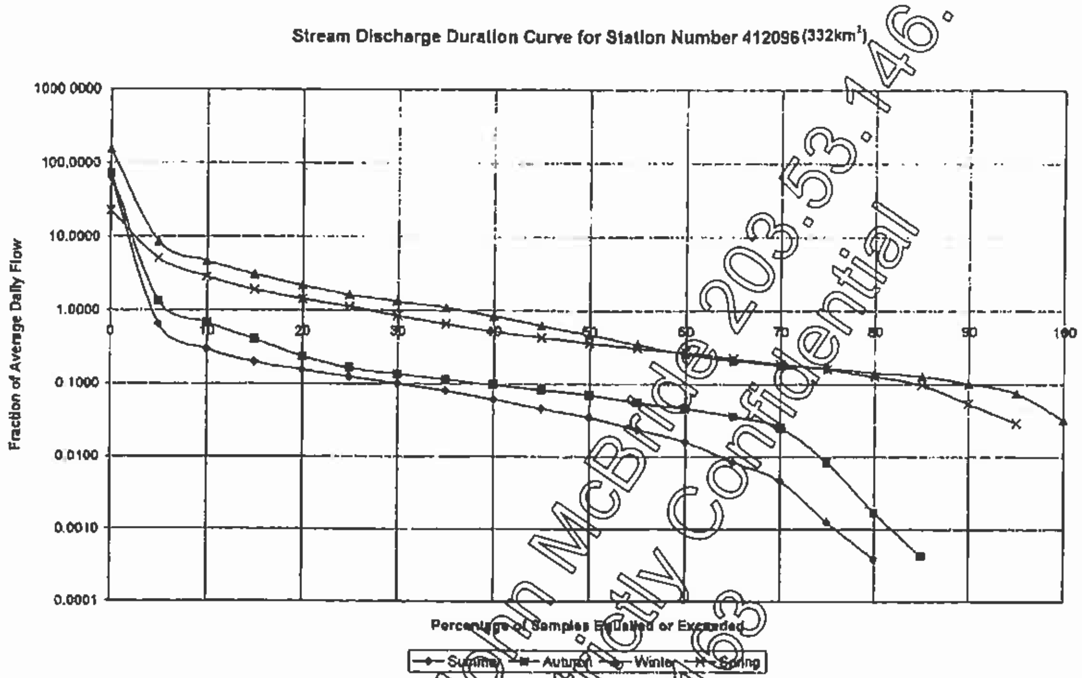


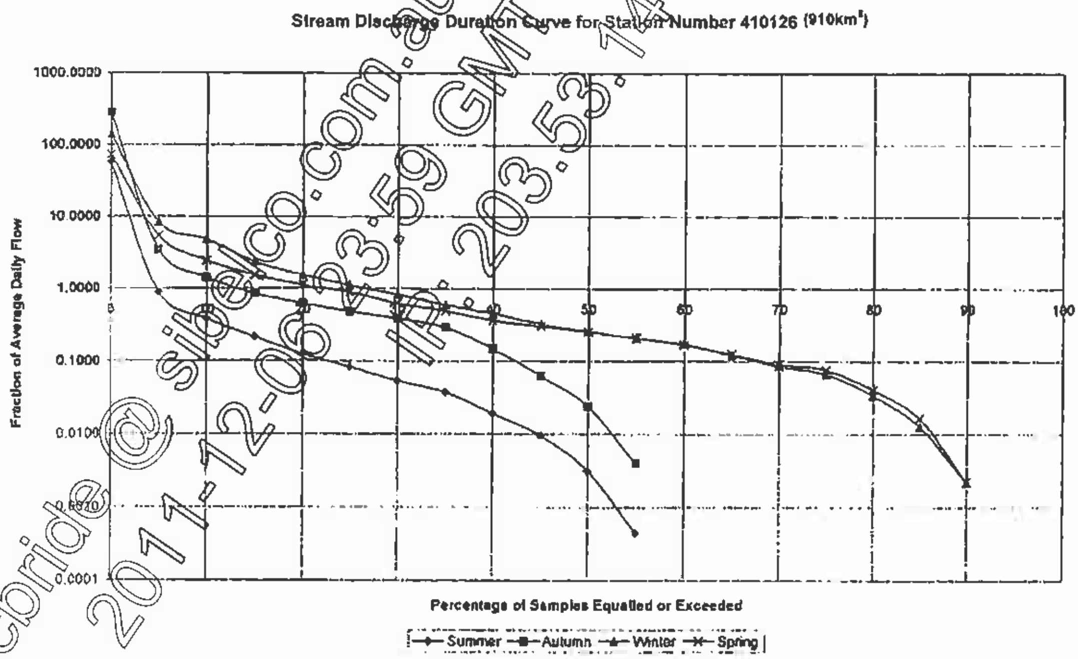
GALONG LIMESTONE MI
Figure A1
Average Daily Flow Agains
Catchment Area



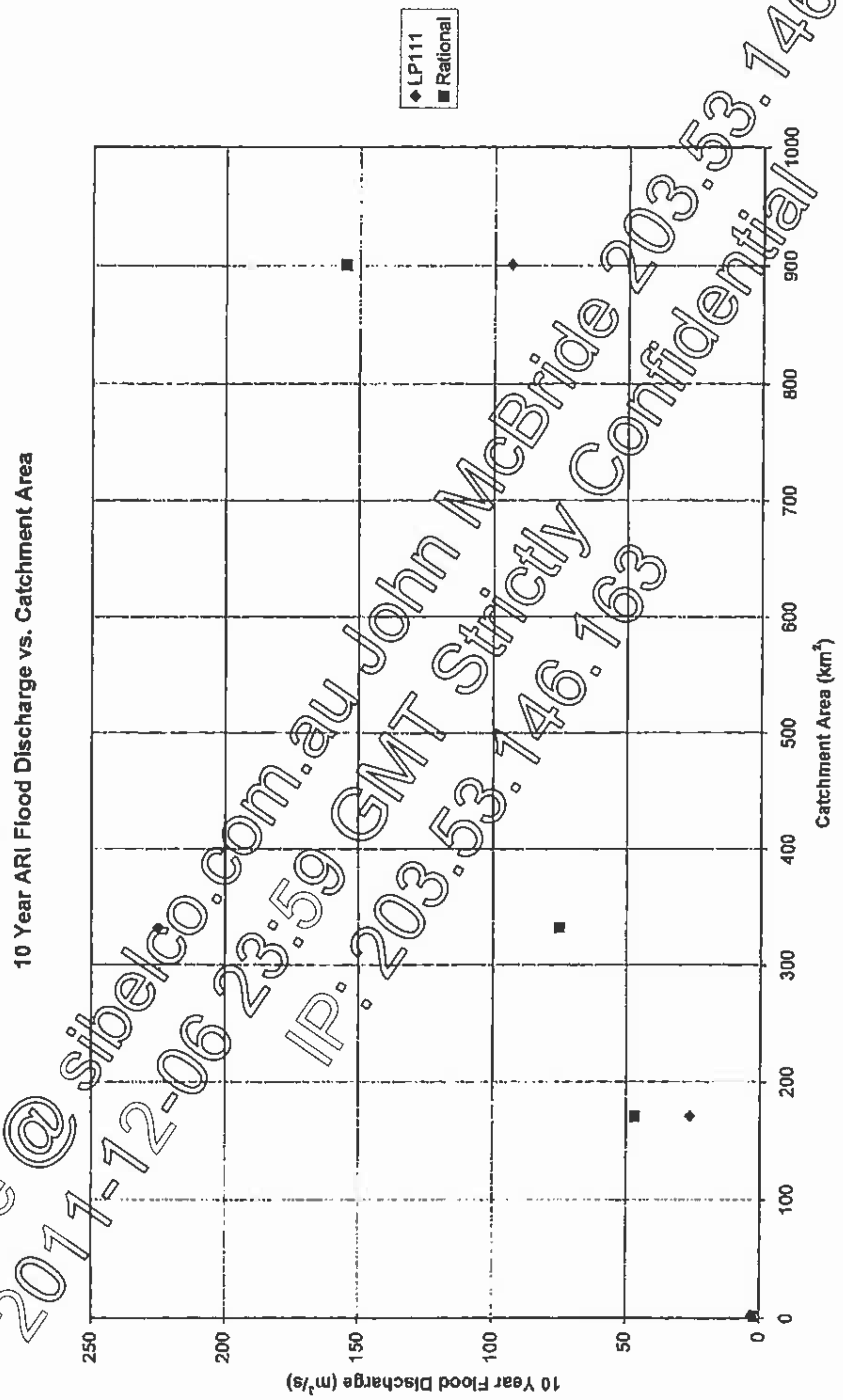


GALONG LIMESTONE MINE
Figure A2 (a), (b).
Stream Discharge Duration Curve

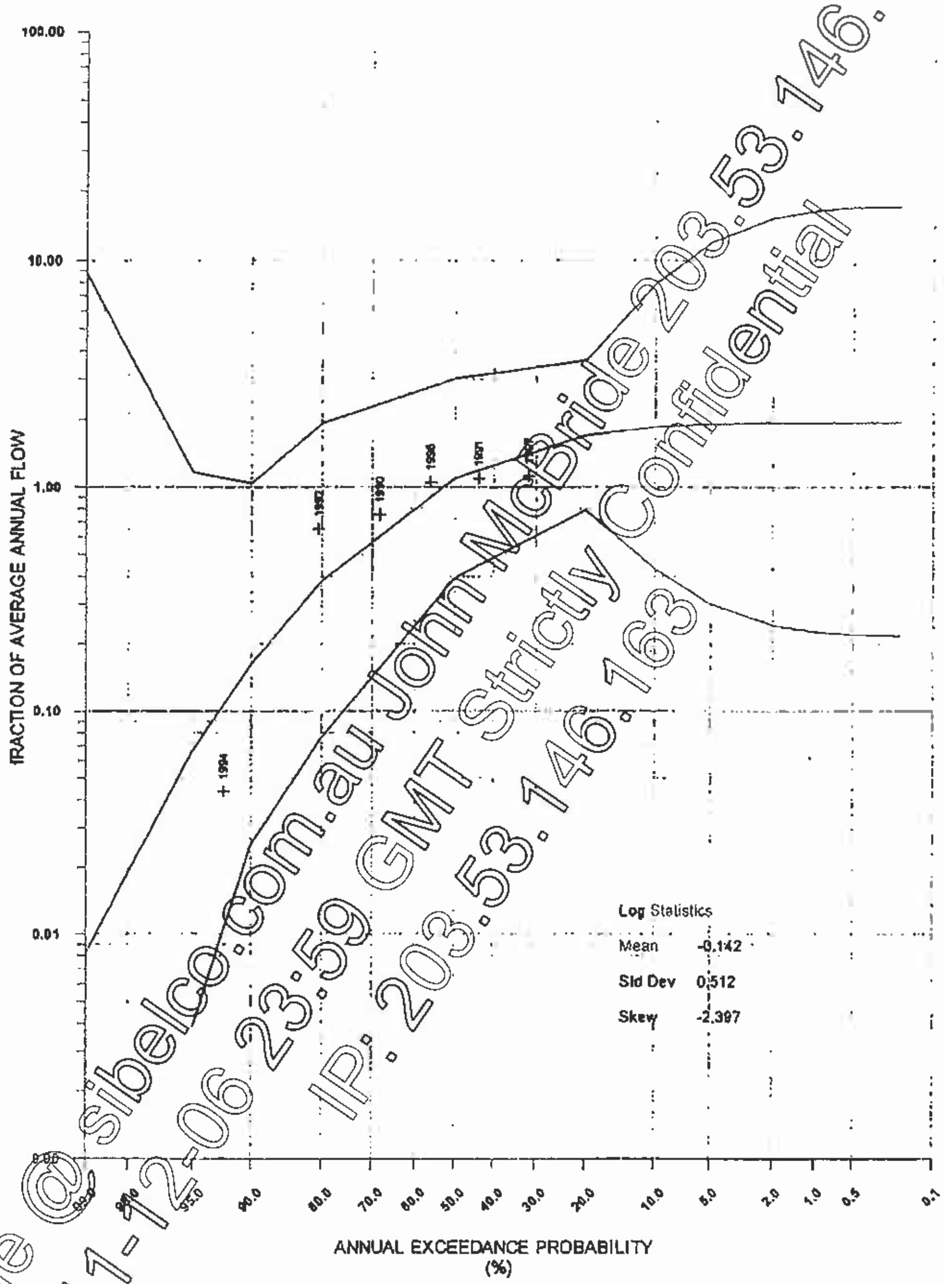




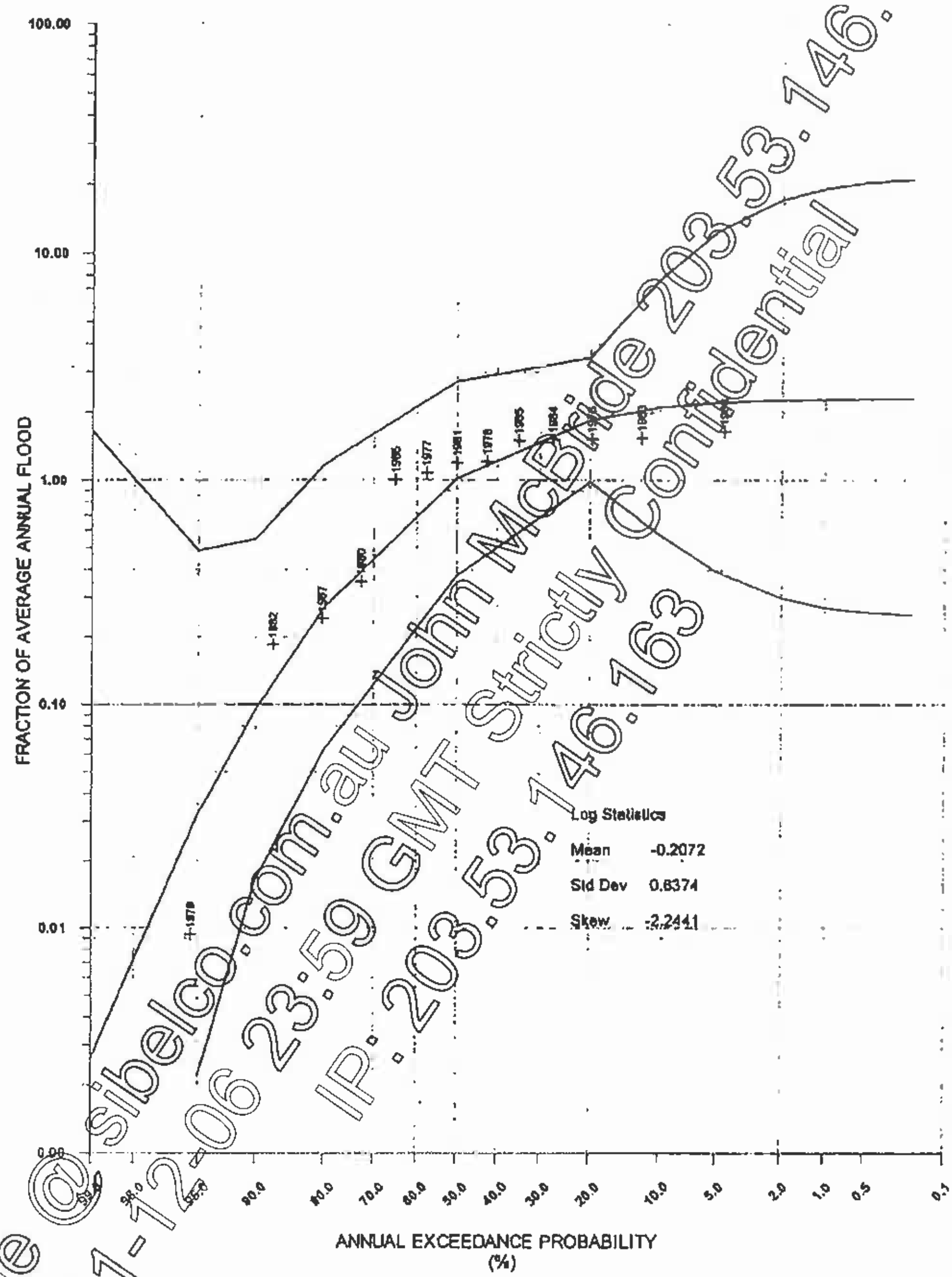
GALONG LIMESTONE MINE
Figure A2 (c), (d).
Stream Discharge Duration Curve



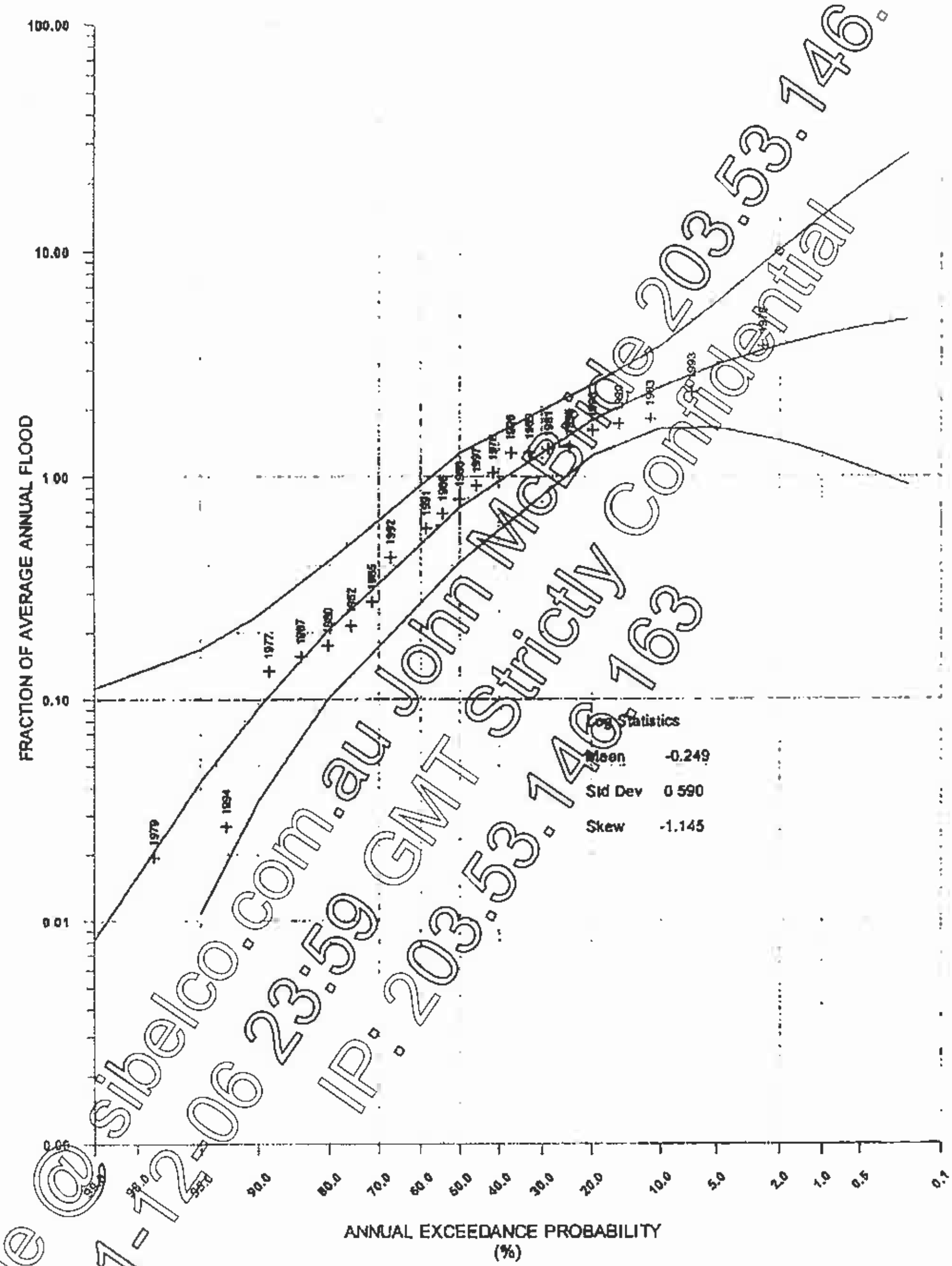
GALONG LIMESTONE MIN
Figure A3
10-Year ARI Flood Discharg
Against Catchment Area



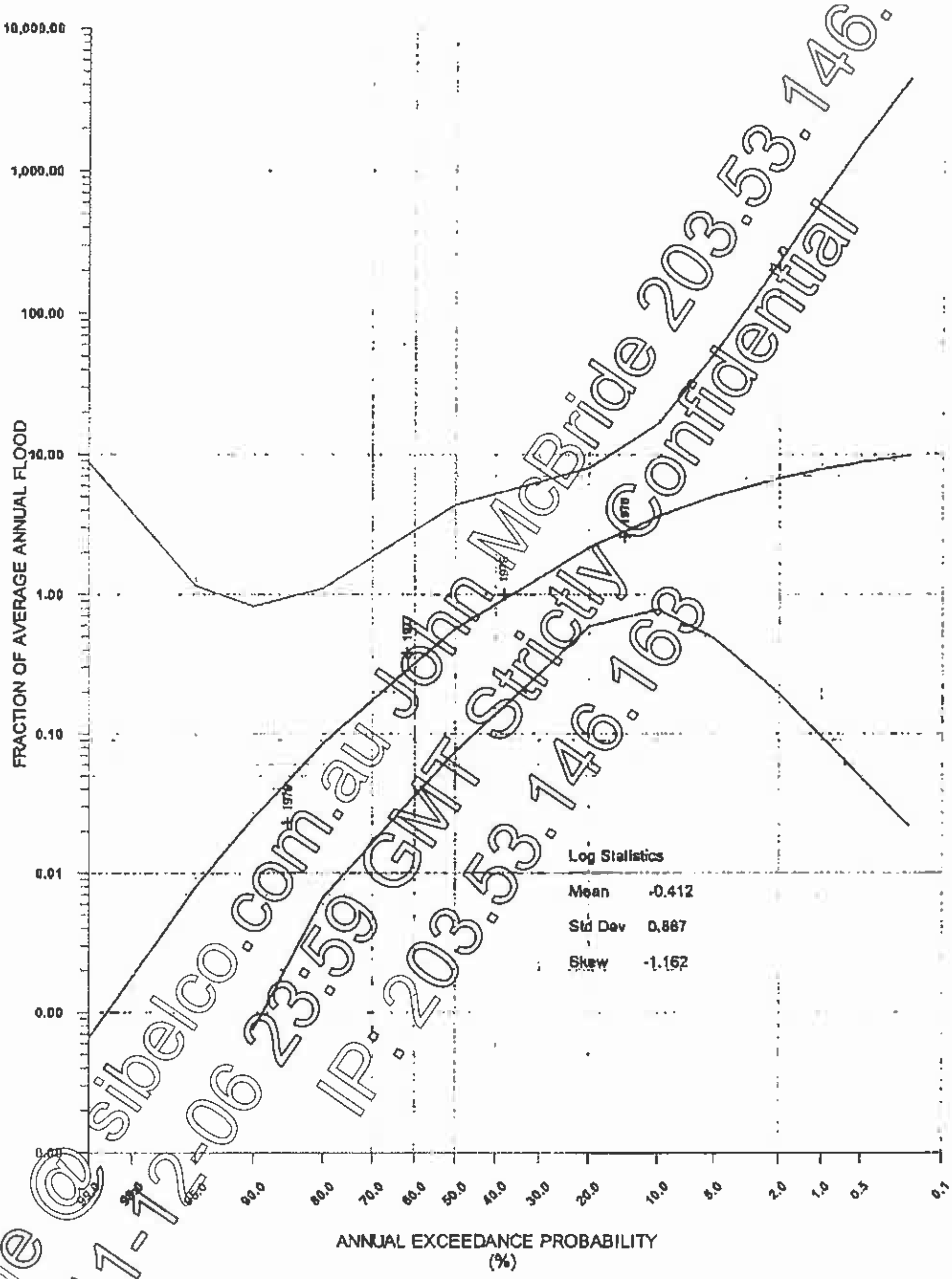
GALONG LIMESTONE MINE
Figure A4 (a)
Flood Frequency Distribution
Gauging Station 412135



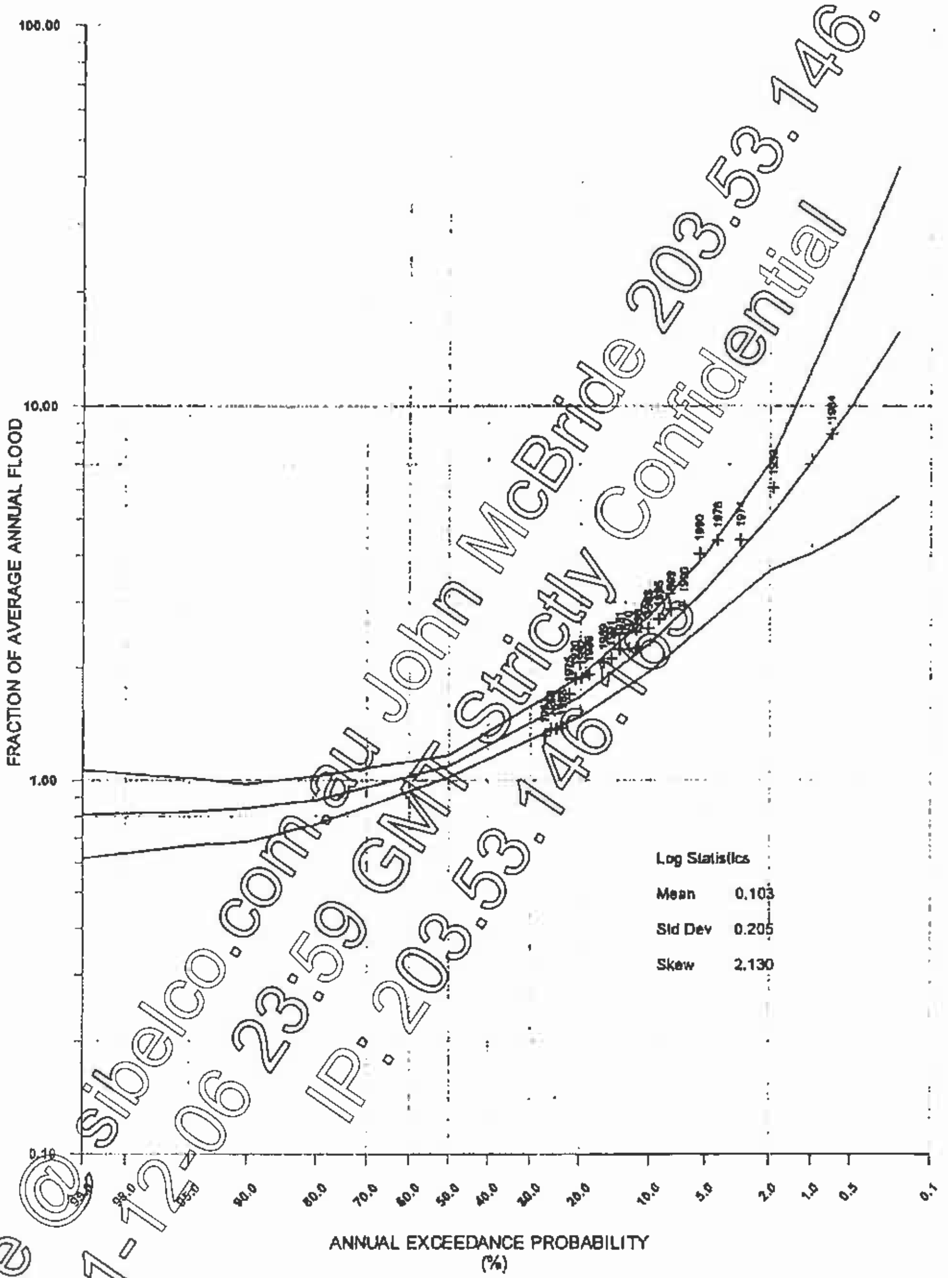
GALONG LIMESTONE MINE
Figure A4 (b)
Flood Frequency Distribution
Gauging Station 410126



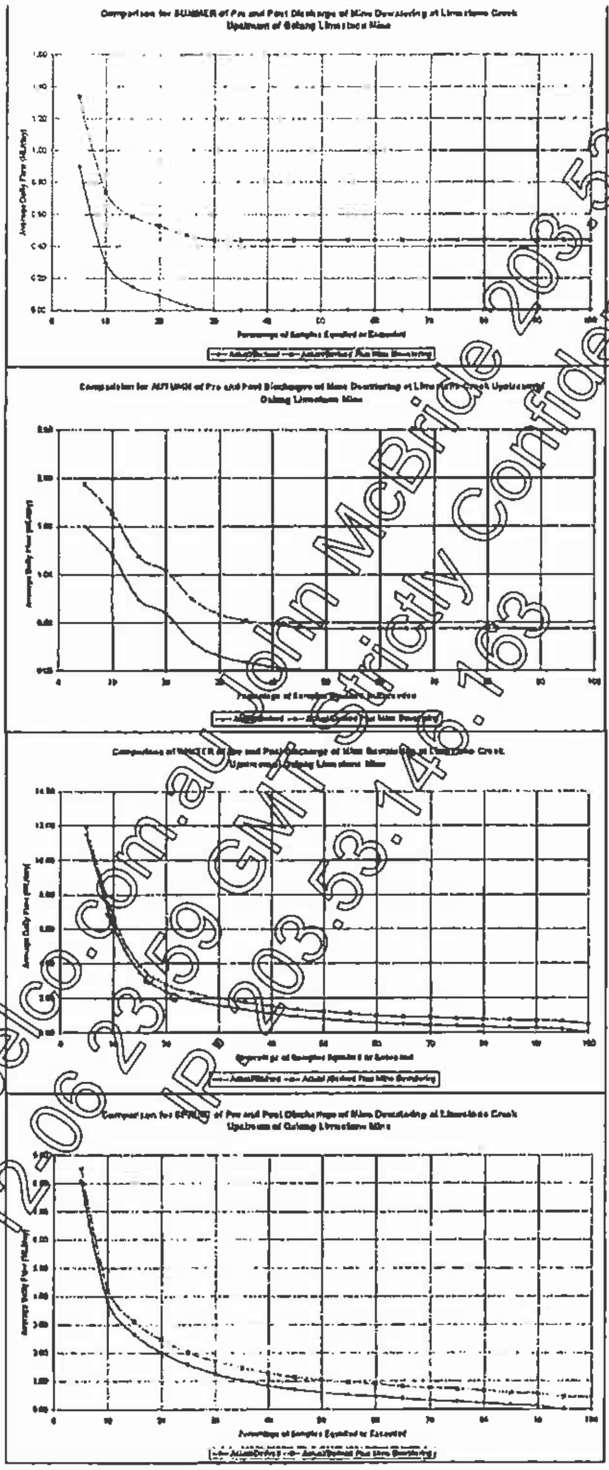
GALONG LIMESTONE MINE
Figure A4 (c)
Flood Frequency Distribution
Gauging Station 412096



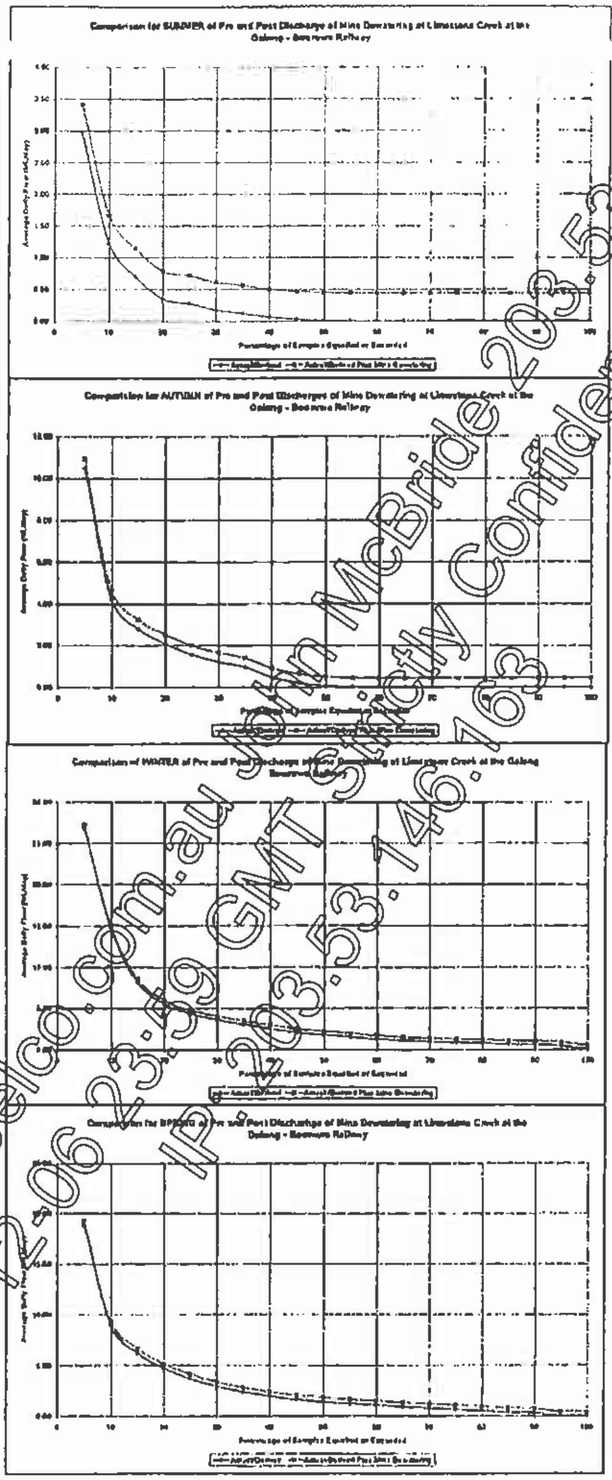
GALONG LIMESTONE MINE
Figure A4 (d)
Flood Frequency Distribution
Gauging Station 410092



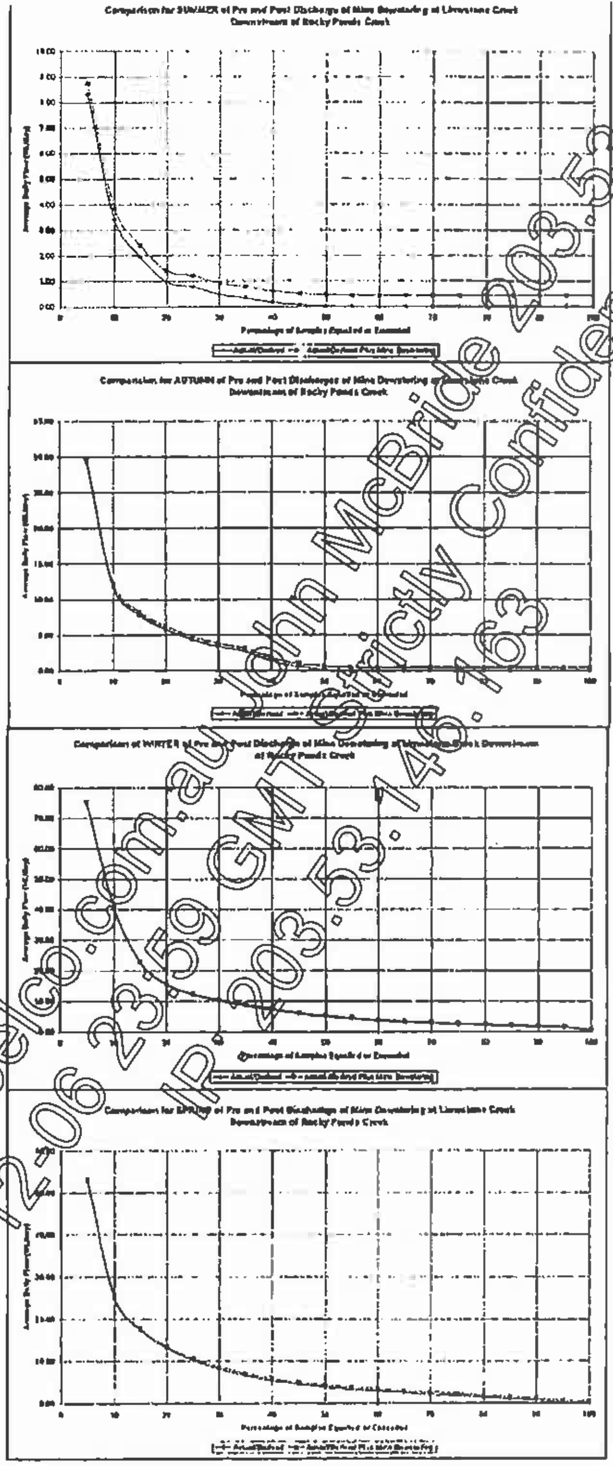
GALONG LIMESTONE MINE
Figure A4 (e)
Flood Frequency Distribution
Gauging Station 410025



GALONG LIMESTONE MINE
Figure A5 (a)
Estimated Flow Duration Curves
Limestone Creek at Galong Mine



GALONG LIMESTONE MINE
Figure A5 (b)
Estimated Flow Duration Curves
Limestone Creek at Galong –
Boorowa Railway Line



GALONG LIMESTONE MINE
Figure A5 (c)
Estimated Flow Duration Curves
Rocky Ponds Creek

Barnu Pty Ltd

Galong Limestone Mine Expansion

Groundwater Assessment

April, 2003

Prepared by
Peter Dundon and Associates Pty Ltd

SPECIALIST CONSULTANT STUDIES

PART 3

GROUNDWATER ASSESSMENT

OF THE PROPOSED

GALONG LIMESTONE MINE EXPANSION

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April, 2003

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EXECUTIVE SUMMARY

A groundwater assessment has been carried out to assess the potential impacts of the proposed expansion of the Galong Limestone Mine.

The assessment involved review of the available groundwater levels, groundwater inflow rates and water quality, surface water quality, and the impacts of dewatering pumping to date from the open-cut mine which has already extended to about 10 metres below the groundwater table in the mine area.

The groundwater in the mine area is of low salinity, and is in fact better quality than the surface water in Limestone Creek upstream of the mine. The streamflow water quality improves downstream from the mine due to the discharge of mine inflow water to the creek. Groundwater levels are several metres below the creek-bed level. Groundwater levels have been lowered by up to 10 metres in the mine area due to past dewatering pumping.

The limestone body within which the mine is developed is an elongated localised outcrop surrounded to the east and west by low permeability volcanic rocks. The limestone itself is intrinsically a low permeability formation as well, but derives localised permeability in association with shear zones and other fracturing. One prominent shear zone on the southern face of the open-cut is responsible for the bulk of the groundwater inflow to the mine. No similarly permeable structure has been intersected in the extensive resource drilling carried out northwards from the existing open-cut mine, nor has any solution-channel development been revealed in the limestone. Hence it is not anticipated that any major water inflow zone will be encountered as the open-cut mine is expanded, but due to the heterogeneous nature of limestone aquifers, it is recommended that a cautious and conservative approach to groundwater inflows be adopted.

A groundwater model of the mine area was set up. This was initially calibrated against the observed impact of dewatering to date, to provide some confidence in using the model for predicting future impacts. Once an acceptable calibration was achieved, a series of predictive model simulation runs was carried out to predict the progressive impacts on groundwater levels of the proposed five stage mine expansion. Allowance was also made in the model for natural recharge from infiltration of rainfall, infiltration through the streambed of Limestone Creek, and disposal of the mine discharge to Limestone Creek at a point about 500 metres north of the current open-cut mine near Eubindal Road.

With the aid of the groundwater model, the groundwater inflow rate is predicted to increase in stages as the mine is expanded, reaching an average inflow rate during Stage 5 (2033-2043) of 1070 m^3/day (390 ML/year). Groundwater levels are predicted to be lowered in the vicinity of the mine, but with limited lateral extent. Groundwater drawdowns of greater than 1 metre are predicted to be limited to within about 1 kilometre or less of the open-cut mine. Drawdowns greater than 10 metres are predicted to be contained within 600 metres of the open-cut mine.

Disposal of the dewatering discharge to Limestone Creek is predicted to result in some increase in recharge rate downstream of the discharge point, with groundwater levels predicted to rise by up to 5 metres for a distance of up to 500 metres north of Eubindal Road.

Streamflow volumes are predicted to increase downstream of the mine, and to be of improved quality. The mine expansion is not predicted to cause any detrimental impact on streamflow volumes in Limestone Creek adjacent to the open-cut mine.

The groundwater inflows to the open-cut mine are not expected to have a detrimental impact on any current groundwater user. Likewise, there is not expected to be any significant impact on any groundwater dependent ecosystem downstream of the project.

1. INTRODUCTION

1.1 Overview of the Proposal

The Galong Limestone Mine is located 4.5 kilometres east of Galong in southern New South Wales (**Figure 1**), approximately 250 kilometres west-southwest from Sydney. The open-cut mine is currently about 100 metres in diameter and about 40 metres deep. The floor level of the existing open-cut is approximately 475 metres AHD. Limestone production from the mine is currently approximately 145 000 tonnes per year.

The Proponent (Barnu Pty Ltd) is proposing an expansion of the mine to increase production progressively to around 500 000 tonnes per year. The expansion of the open-cut mine will be achieved by a major extension to the north and to greater depth. Ultimately, the open-cut mine would cover an area of about 800 metres by 300 metres, with a final planned floor elevation of 435 metres AHD.

Figure 2 illustrates the current layout of the Project Site, together with the Proponent's proposal for the expansion of extraction operations.

1.2 Current Management of Groundwater Inflows

The roughly circular open-cut is currently about 40m deep, and extends below the regional groundwater level. The main water inflow to the open-cut occurs from a fracture system exposed on the southern wall of the open-cut mine. This is the deepest part of the existing void. Smaller seepages have been noted from a location on the northwestern face, at a higher bench level.

The total inflow rate to the open-cut mine has been estimated by Barnu Pty Ltd at 5 L/sec (i.e. 430 kL/day or 157 ML/annum). The water is transferred from the open-cut mine sump to the water storage dam located just east of the open-cut mine, between the open-cut mine and Limestone Creek. From there, water is allowed to flow into the surface drainage. There is evidence also that some water is lost via seepage through the dam bank on the downslope (eastern) side.

Seepage may also be occurring to the groundwater system from the floor of the water storage dam. It is possible therefore that some water is being recirculated from the storage dam back into the open-cut mine.

On the basis of visual inspection by the writer during a site visit on Wednesday 7th August 2002, the rate of streamflow entering the mining lease from the south (upstream) of the open-cut mine appeared at that time to be significantly greater than the rate of flow of open-cut mine water to the creek.

The Proponent holds a Bore Licence 40BL189001 granted by the Department of Land and Water Conservation for a five year period on 11 March 2003. The licence allows the Proponent to discharge groundwater inflows from the open-cut mine to Lot 3, DP747544 (including Limestone Creek) up to a maximum of 430 kL per day or 157 ML per annum.

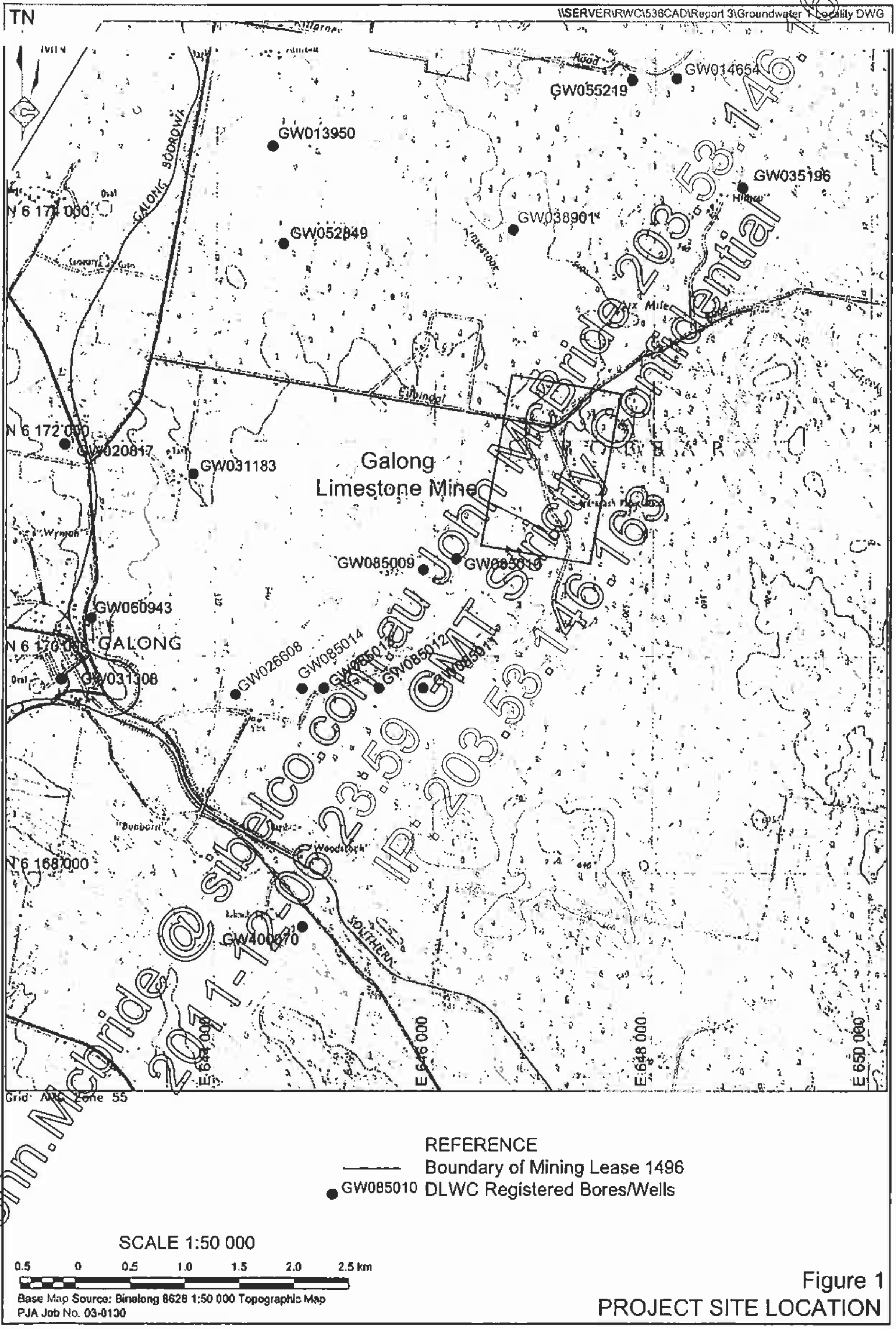

Figure 1
PROJECT SITE LOCATION

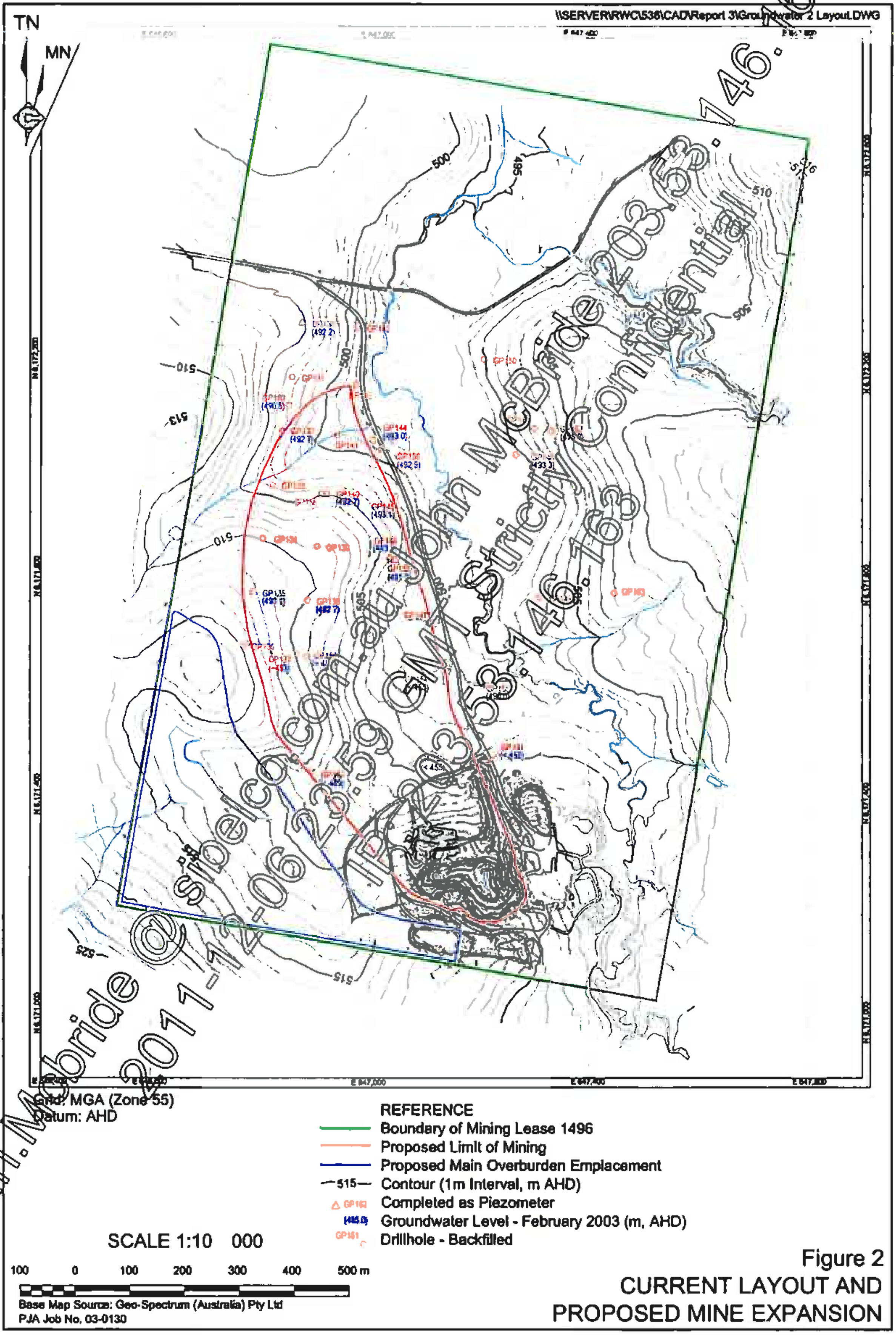

Figure 2
CURRENT LAYOUT AND
PROPOSED MINE EXPANSION

2. DESCRIPTION OF EXISTING HYDROGEOLOGICAL ENVIRONMENT

2.1 Regional Geology and Hydrogeology

The limestone being mined at Galong forms part of the Late Silurian Douro Group. The deposit occurs as a narrow elongated outcrop aligned north-south along the contact between Silurian volcanics and interbedded sediments of the Douro Group to the west and Early Devonian Mountain Creek Volcanics formation to the east (Felton, 1974).

The published geological map of the area (Felton, 1974) describes the Douro Group volcanics and interbedded sediments to the west as *"... undifferentiated fine to coarse rhyolitic to dacitic tuffs; rhyolite, dacite, andesite, dellenite with interbedded limestone, sandstone and shale."* Felton also describes the Mountain Creek Volcanics as *"... rhyolite, dacite, andesite, agglomerate."*

The limestone is generally poorly permeable. Moderate permeability is believed to occur in association with infrequent shear zones or other fracturing/jointing, but the bulk of the limestone is believed to possess very low permeability. Where fractured/sheared, the limestone can be considered an aquifer. The volcanic rocks (dacite, rhyolite, andesite, etc) to the east and west of the limestone deposit are believed to be less permeable than the limestone. Fracturing in these rocks is expected to be tight and clay-filled, and therefore much less permeable than fracturing in the limestone.

The basement rocks are overlain by up to about 10 metres of clayey weathered rock, in turn overlain by a shallow soil cover.

2.2 Groundwater Quality

Copies of water analysis results from sampling completed in July 2002 were made available by Barnu Pty Ltd in the course of this study. They included a sample of the open-cut mine water inflow, and surface water samples from Limestone Creek both upstream and downstream from the open-cut mine (denoted as LCU and LCD on **Figure 3**).

Sampling was undertaken from similar locations in 1993. Surface water samples, labelled "Galong 1" to "Galong 4", were collected from:

- 1.3 km downstream,
- 0.25 km downstream,
- 0.2 km upstream, and
- 0.75 km upstream

respectively from the open-cut mine. Sample "Galong 5" was from the open-cut. These water sampling locations are also shown on **Figure 3**.

The analysis results of further water samples from the open-cut mine collected in May 1998, and in February, March and April 2002 were also made available.

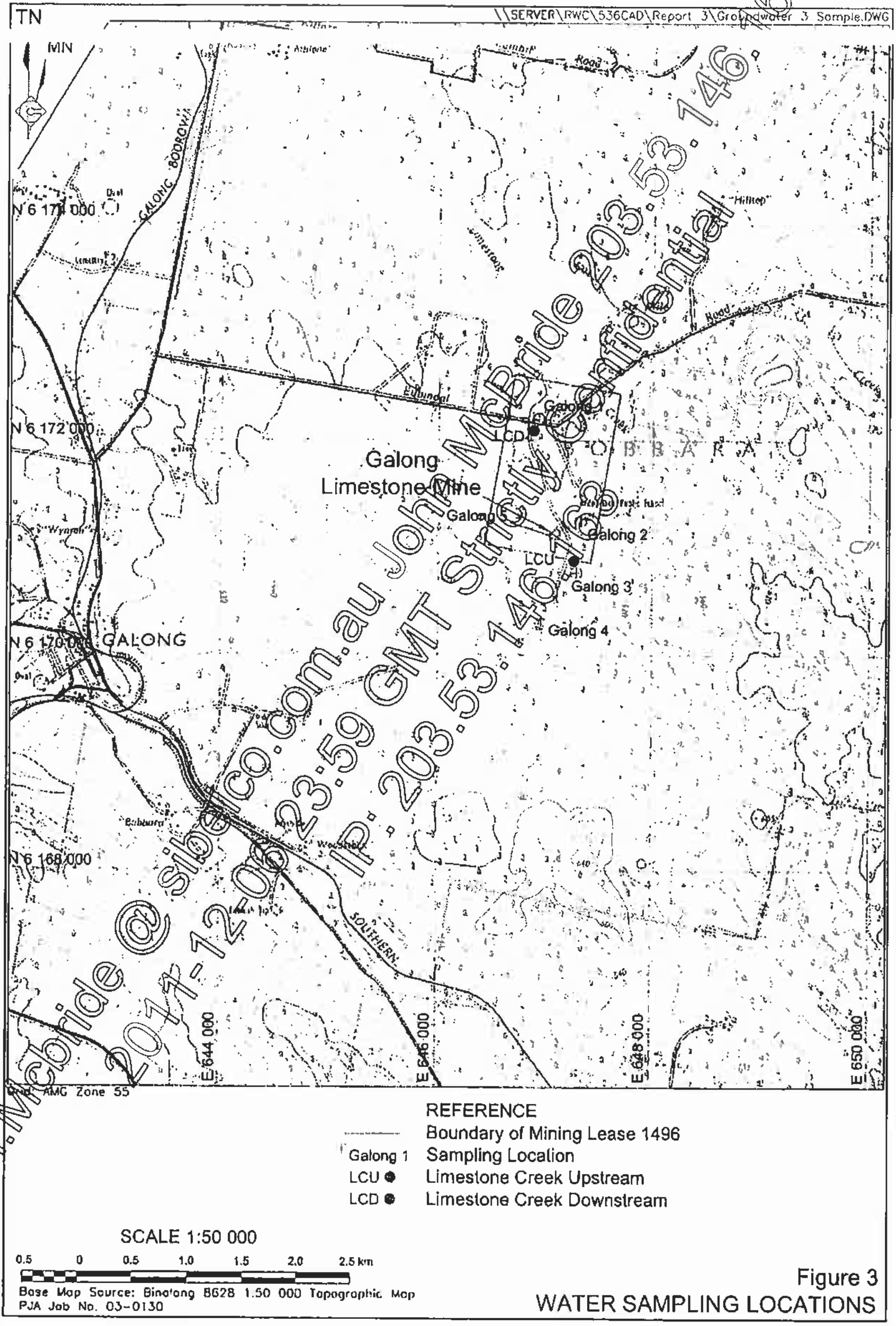

Figure 3
WATER SAMPLING LOCATIONS

The analysis results for the groundwater samples are presented in **Table 1** and the surface water samples in **Table 2**.

The water sample collected from the open-cut mine in July 1993 had a very low salinity of 180 mg/L. By comparison with later samples, it is suspected that the July 1993 sample may have been affected by rainwater, and may not be truly representative of the quality of groundwater inflow.

The water quality data have been used to construct a Piper Trilinear Diagram, shown as **Figure 4,** which plots each water sample according to the relative concentrations of the major ions in solution. The July 1993 mine water sample plots well apart from the other samples on **Figure 4**, which would support the view that that sample was potentially contaminated with rain water.

Subsequent samples of water inflow to the open-cut mine show a consistent salinity of 670-970 mg/L TDS (conductivity of 1000-1300 µS/cm), although there is a possible suggestion of a very slight increase in salinity over time. The major ions in solution are calcium and bicarbonate, reflecting the contact between the groundwater and the limestone mass. pH is close to neutral, and ranges from 6.9 to 7.5.

By comparison, the surface water quality shows reasonable variability, with recorded salinity values ranging from 800 to 2400 mg/L TDS (conductivity from 845 to 3500 µS/cm). Sodium and chloride are the dominant ions in solution. pH is marginally alkaline, and ranges from 7.0 to 8.0.

The highest surface water salinities have been recorded from Limestone Creek upstream of the open-cut mine – TDS of 1680 mg/L in sample Galong 4 in July 1993, and 2400 mg/L in the upstream sample in July 2002. Water quality improves noticeably as Limestone Creek flows through the mining lease.

2.3 Groundwater Levels

Two drilling programs (involving 22 drill holes in 2002 and a further 13 in 2003) were carried out recently on ML 1496 to delineate the northerly extent of limestone occurrence to the north of the existing mine area. The locations of bores drilled in these programs are shown on **Figure 5.**

Details of drilled depth, depth of alluvium above the limestone bedrock, depth at which groundwater was intersected, and the standing water levels measured in the bores at three dates between October 2002 and February 2003, are presented in **Table 3**. The first water levels (October 2002) were measured approximately 5 weeks after completion of drilling of the first group of holes.

Selected drillholes as indicated on **Table 3** have been cased to preserve them as monitoring piezometers. Other holes have either collapsed or have been backfilled.

Table 1: Water Quality Analyses –Open-cut Mine Groundwater Inflows

Parameter	Galong 5					
	July 1993	May 1998 Pit water	20 Feb 2002 480 level	28 Feb 2002 Pit water	1 April 2002 Pit water	July 2002 Pit water
pH	7.85	7.4	6.9	6.9	7.0	7.5
TDS (mg/L)	180		670	730	740	970
conductivity (µS/cm)	270	1040	1000	1130	1140	1300
suspended solids (mg/L)	7		<2	<2	<2	5.8
alkalinity (mg/L $CaCO_3$)	104	250	210	240	250	294.7
bicarbonate (mg/L)	127		260	290	310	358.9
carbonate (mg/L)	0					0
chloride (mg/L)	<5	180	200	180	190	170
sulphate (mg/L)	5		33	25	26	32
nitrate (mg/L)	15		14	73	57	7.8
calcium (mg/L)	42		120	130	130	160
magnesium (mg/L)	2.3		18	19	20	17
potassium (mg/L)	3.7		1.5	2.0	1.7	2
sodium (mg/L)	6.3		71	67	69	66
dissolved iron (mg/L)	0.05		<0.01	<0.01	<10	<0.01
total iron (mg/L)	0.15					<0.02
dissolved copper (µg/L)	30		<10	<10	<10	3.8
total copper (µg/L)	30					2
diss cadmium (µg/L)	<2		<1	<1	<1	<0.05
total cadmium (µg/L)	<2					<0.05
diss manganese (µg/L)	<50		<10	<10	<10	2.4
total manganese (µg/L)	<50					11
dissolved zinc (µg/L)	<50		<10	<10	<10	2.9
total zinc (µg/L)	<50					5
dissolved lead (µg/L)	<5		<1	<1	<1	0.11
total lead (µg/L)	<5					<0.2
sodium cyanide			<0.1	<0.1	<0.1	
$CaCO_3$ saturation index		+ 0.5				
Adjusted SAR		2.3				

Table 2: Water Quality Analyses – Limestone Creek

Parameter	Surface Water Samples					
	July 1993 (Galong 4)	July 1993 (Galong 3)	July 1993 (Galong 2)	July 1993 (Galong 1)	July 2002 (Limestone Ck up-stream)	July 2002 (Limestone Ck down-stream)
pH	8.00	7.60	7.35	7.00	8.0	7.6
total solids (mg/L)	1680	980	800	960	2400	1300
conductivity (µS/cm)	2660	1405	845	660	3500	1900
suspended solids (mg/L)	15	85	250	450	0.8	4.3
alkalinity (mg/L $CaCO_3$)	268	107	65	44	478.9	236.0
bicarbonate (mg/L)	325	130	80	53	583.9	287.7
carbonate (mg/L)	0	0	0	0	0	0
chloride (mg/L)	710	330	190	142	690	340
sulphate (mg/L)	30	70	45	50	66	63
nitrate (mg/L)	5	15	<5	<5	<0.02	2.8
calcium (mg/L)	68	43	25	20	110	110
magnesium (mg/L)	86	44	26	21	150	59
potassium (mg/L)	7.4	5.5	5.0	6.0	5	4
sodium (mg/L)	340	165	93	72	310	140
dissolved iron (mg/L)	0.18	0.30	1.4	4.2	0.01	0.02
total iron (mg/L)	0.55	0.85	1.5	2.7	0.04	0.09
dissolved copper (µg/L)	20	20	20	10	4.2	2.2
total copper (µg/L)	60	100	60	10	4	2
diss cadmium (µg/L)	<2	<2	<2	<2	<0.05	<0.05
total cadmium (µg/L)	<2	<2	7	<2	<0.05	<0.05
diss manganese (µg/L)	<50	<50	<50	<50	29	88
total manganese (µg/L)	150	200	150	200	32	86
dissolved zinc (µg/L)	<50	<50	<50	<50	5	10
total zinc (µg/L)	<50	50	<50	<50	<5	<5
dissolved lead (µg/L)	<5	<5	<5	<5	0.09	0.16
total lead (µg/L)	9	<5	36	17	<0.2	<0.2

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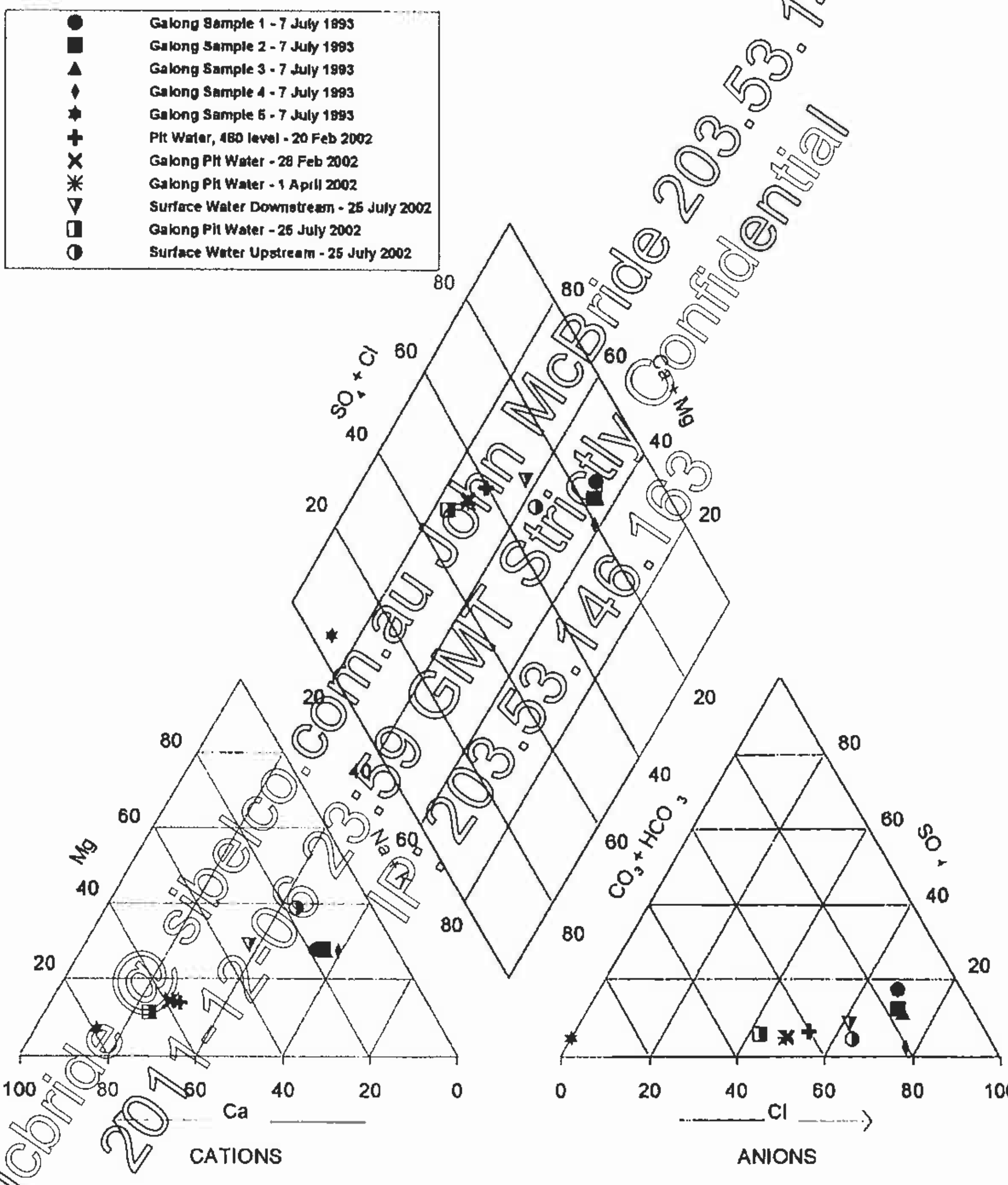

Figure 4
PIPER DIAGRAM
GALONG WATER SAMPLES

PJA Job No. 03-0130

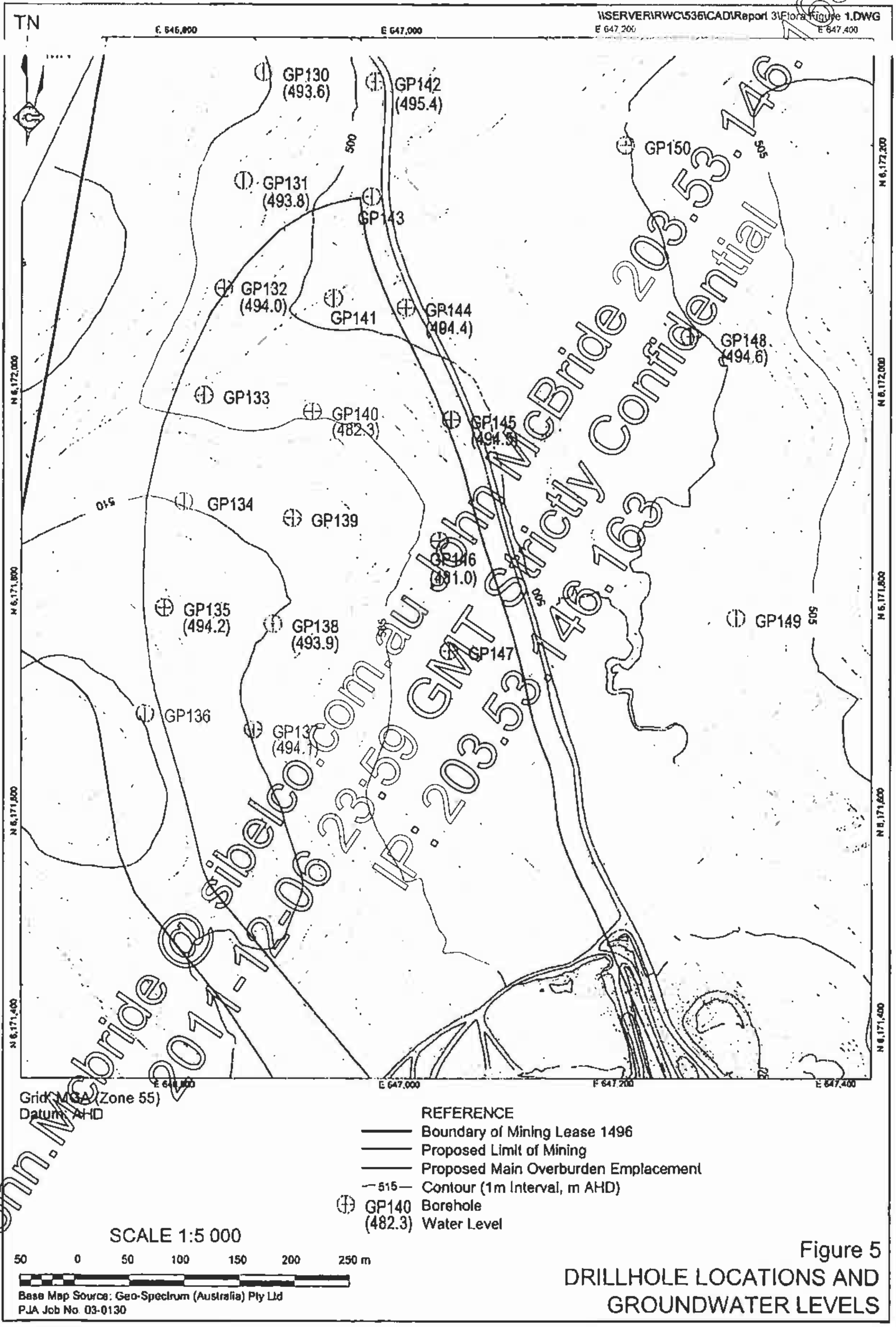

Figure 5
DRILLHOLE LOCATIONS AND GROUNDWATER LEVELS

Table 3: Groundwater Levels

Bore	Surveyed surface elevation (m AHD)	Depth drilled (m)	Depth to top of limestone (m)	Depth water intersected (m)	Static Water Level 1 Oct 2002 mbgl	1 Oct 2002 m AHD	17 Jan 2003 mbgl	17 Jan 2003 m AHD	26 Feb 2003 mbgl	26 Feb 2003 m AHD	Status
GP130	**505.05**	**20.5**	**7.5**	**18.8**	**11.5**	**493.6**	**12.5**	**492.6**			**Cased Piezometer**
GP131	503.61	26.2	3.3	24.5	9.8	493.8	blocked				Collapsed
GP132	503.16	27.8	9.2	16.0	9.2	494.0	11.75	491.4	10.5	492.66	Backfilled
GP133	503.60	21.7	8.0	NI[1]							Collapsed
GP134	509.78	27.8	24.6	NI			blocked				Collapsed
GP135	**512.15**	**27.8**	**10.4**	**NI**	**17.9**	**494.2**			19.1	493.05	**Cased Piezometer**
GP136	514.71	23.7	-	NI							Collapsed
GP137	509.79	24.7	9.3	21.0	15.7	494.1	blocked				
GP138	509.77	27.2	2.9	22.6	15.9	493.9			17.1	492.67	Backfilled
GP139	509.04	27.0	20.0	26.0							Collapsed
GP140	504.70	27.8	7.1	NI	22.4	482.3	13.75	491.0	12.0	492.70	Backfilled
GP141	499.28	10.2	8.0	NI							Collapsed
GP142	498.83	27.8	15.9	16.4	3.4	495.4	blocked				Collapsed
GP143	497.86	27.8	4.5	NI							Collapsed
GP144	**498.62**	**27.8**	**5.5**	**NI**	4.2	494.4	5.5	493.1			**Cased Piezometer**
GP145	501.50	13.1	2.0	9.5	7.0	494.5			8.4	493.10	
GP146	503.95	27.8	4.6	NI	23.0	481.0			10.7	493.25	Backfilled
GP147	501.61	8.0	-	NI							Collapsed
GP148	499.27	17.0	4.3	16.5	4.7	494.6	blocked		6.0	493.27	Backfilled
GP149	502.46	15.3	8.9	NI							Collapsed
GP150	499.82	15.0	3.0	NI							Collapsed
GP151	504.5	70	2.7	NI			dry to 50m				
GP152	504.8	70	8	NI			dry to 50m				
GP153	514	20	5.5	NI			dry				
GP154	502.5	70	2	NI			dry to 50m				Cased Piezometer
GP155	502	16		15			4	*498*			Cased Piezometer
GP156	509	21	5	18			dry				
GP157	503.5	70	4.5	15			12.5	*490.5*			Cased Piezometer
GP158		70	9	NI			blocked				Collapsed
GP159	499	57	7	21			6	*493*	6.1	492.90	Backfilled
GP160	503	19	3.8	16			12.5	*490.5*			Collapsed
GP161		11	10	NI			blocked				Collapsed
GP162	503.5	51	8	27			8.5	*494.5*			Cased Piezometer
GP163		15	5	NI							

mbgl = metres below ground level

The groundwater levels measured on 1[st] October 2002 were all within the range 493.5 to 495.5 metres AHD, except for two bores – GP140 and GP146, in which the water levels were approximately 481-482 metres AHD. Neither bore intersected visible groundwater during drilling, and the water levels reported for 1[st] October 2002 probably represent a transitional level as groundwater was seeping slowly into the bores from poorly permeable limestone at those sites. It is noted that by January 2003, the water level had risen in both to approximately the same elevation as the other bores on the site (**Figure 6A** and **Table 3**). The long time being taken for seepage to fill these two bores up to the regional water level indicates that the permeability at those two sites is extremely low.

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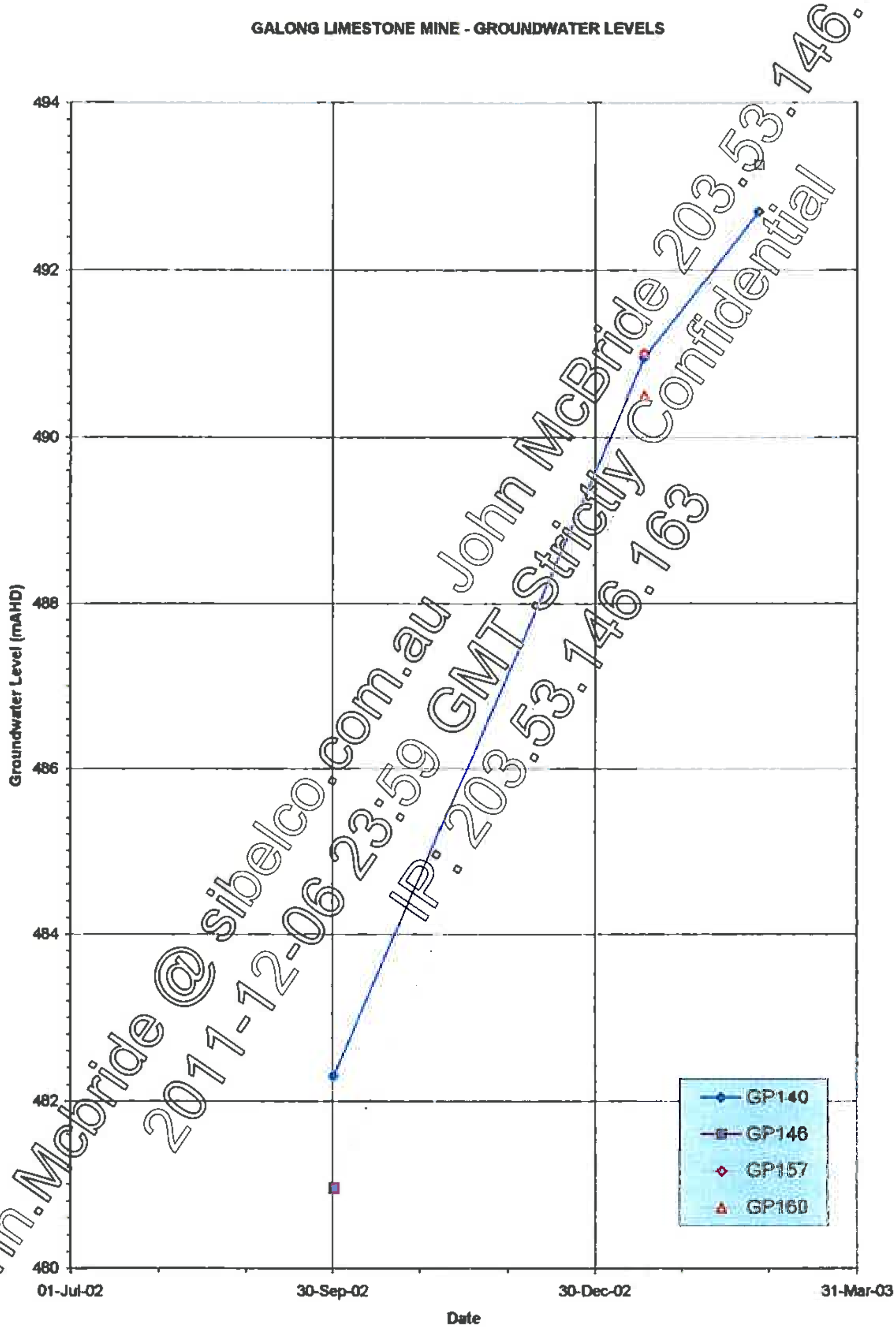

Figure 6A
GROUNDWATER LEVEL HYDROGRAPHS

PJA Job No. 03-0130

Apart from GP146 and GP148, the other bores show a pattern of steadily declining groundwater levels between October 2002 and February 2003 (**Figure 6B** and **Table 3**). A consistent groundwater level decline of 1.2 - 1.5 metres was observed during that period, consistent with a seasonal recession between major recharge events. Groundwater levels were generally in the range 492 to 493.5 metres AHD when measured on 26 February 2003.

The elevation of the main groundwater seepage into the open-cut mine is reported to be approximately 485 metres AHD, i.e. about 6-7 metres above the mine floor. This would indicate approximately the present water table elevation in the area immediately south of the open-cut mine. By comparison with the groundwater levels in the bores, it suggests that the water table has been lowered by around 10 metres (i.e. from around 495 metres AHD).

Bores GP 151 to GP154, located 150 to 300 metres north of the open-cut mine, were reported to be dry to at least 50 metres depth when measured on 17 January 2003. It is unlikely that groundwater levels in that area would be lower than the existing floor elevation of the open-cut mine, i.e. approximately 475 metres AHD. It is concluded, therefore that the limestone is probably very poorly permeable in that area. Over time, slow seepage is expected to gradually fill up those bores up to the water table level, which would be somewhere between about 485 and 490 metres AHD. GP 154 has been cased as a piezometer, even though no water level has yet been measured in the bore.

2.4 Groundwater Recharge and Discharge

The highest groundwater levels were recorded in bores close to the creek (**Figure 5**). The elevation of the creek bed where Limestone Creek passes beside the open-cut mine is approximately 505 metres AHD, and at the northern end of ML 1496 where the creek passes under Eubindal Road, the elevation is approximately 495 metres AHD (**Figure 5**). These elevations are several metres higher than the groundwater levels measured in the bores. Thus the creek-bed level is probably higher than the measured groundwater levels right across the property. Since the creek bed is higher than the groundwater levels, and there appears to be a groundwater gradient away from the creek, it is concluded that the groundwater is being recharged by the creek.

However, it is believed that the groundwater is also receiving local recharge by infiltration of incident rainfall through the alluvium. The reason for this conclusion is the water quality differences between the surface water from Limestone Creek and the groundwater. If the groundwater in the limestone were being recharged solely from Limestone Creek, then the groundwater would be expected to be more saline than the surface water. Consequently, there must be an additional recharge source. This local recharge mechanism is almost certainly direct infiltration of incident rainfall, and downward percolation to the water table.

Natural discharge from the limestone aquifer system would occur by down-gradient throughflow, generally to the north-west, in a similar direction to the surface drainage.

The presence of the open-cut mine has caused a temporary depression in groundwater levels, and the open-cut mine is currently acting as a local sink for groundwater flow. The effect of the open-cut mine on groundwater levels is believed to be limited to the immediate vicinity of the open-cut mine, certainly less than a distance of 500 metres (**Figure 8**).

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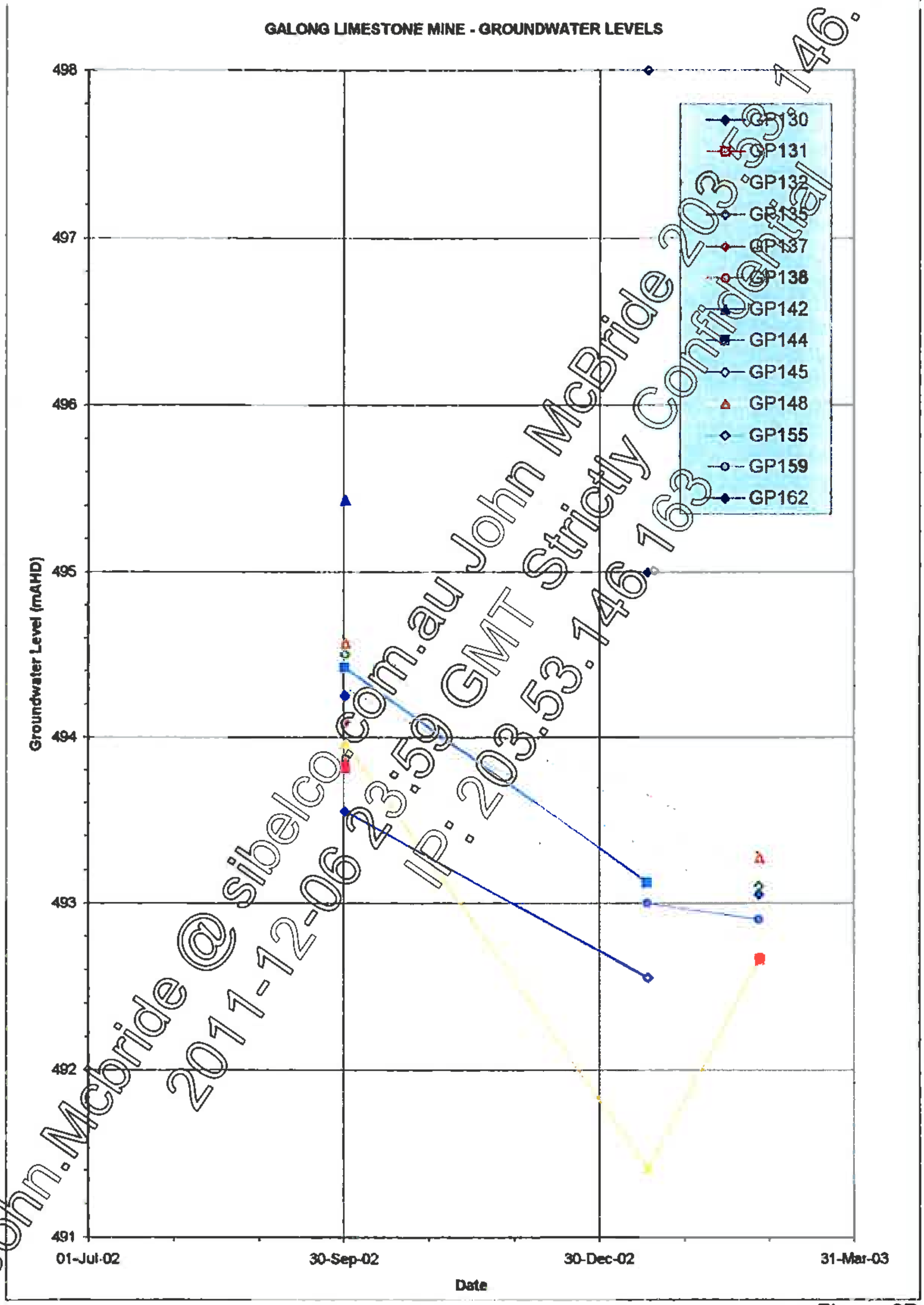


Figure 6B
GROUNDWATER LEVEL HYDROGRAPHS

PJA Job No. 03-0130

2.5 Surface Water / Groundwater Interaction

The salinity of Limestone Creek streamflow upstream of the open-cut mine is noticeably higher than the salinity of the groundwater inflows into the open-cut mine. The surface water quality then improves as it flows past the open-cut mine, suggesting an influx of better quality water. This is almost certainly attributed to the flow and/or seepage from the main water storage dam into which the mine dewatering discharge is currently pumped.

This suggests that there is probably some recirculation of water taking place. Groundwater inflows from the open-cut mine are currently pumped to the water storage dam located between the open-cut mine and Limestone Creek. Water from the storage dam is then allowed to flow to the creek, some of which in turn probably recharges the groundwater as it flows northwards across the property.

Based on an upstream Limestone Creek salinity of 2400 mg/L TDS, mine inflow salinity of 970 mg/L, and downstream Limestone Creek salinity of 1300 mg/L (July 2002 water qualities in **Tables 1** and **2**), it can be calculated that approximately 75% of the surface water flow at the downstream sampling point would be derived from the mine dewatering. This is derived by a simple weighted arithmetic average as follows:

(Surface inflow x inflow salinity) + (mine discharge x mine inflow salinity) = (surface outflow x outflow salinity)

i.e. (25% x 2400 mg/L) + (75% x 970 mg/L) = (100% x 1300 mg/L) approx.

It is likely therefore that the current mining operations are causing a net discharge of groundwater from the area. This would be leading to about a three-fold increase in the volume of streamflow in Limestone Creek where it leaves the open-cut mine, based on the sampling in July 2002. It would also be causing a noticeable improvement in water quality in Limestone Creek, from about 2400 mg/L TDS upstream of the open-cut mine, to 1300 mg/L downstream.

The mining operation is therefore deemed to be having a beneficial impact on Limestone Creek at present.

2.6 Current Groundwater Use in Project Vicinity

A search of the database maintained by the Department of Land and Water Conservation has revealed few licensed bores in the vicinity of the Galong Limestone Mine. Locations of licensed bores revealed by the search are shown on **Figure 1**. Copies of the bore records are presented in **Appendix 1**.

The nearest licensed bores are a group of shallow Landcare monitoring bores 0.5 to 1.0 kilometres west and southwest from the open-cut mine (GW085009 to GW089014). The nearest licensed water supply bores are at least 1.5 kilometres from the open-cut mine.

Most water supply bores in the vicinity are recorded as having intersected water in granite. GW038901, located about 1.5 kilometres north of the open-cut mine, reportedly intersected water in an unidentified green rock, which could conceivably be limestone, although it is more likely to be one of the volcanic rock units. If it is part of the same limestone body as the open-cut mine, it is located well downstream and downgradient from the open-cut mine, and would not be being impacted by the dewatering of the open-cut mine, but could be benefiting from the additional streamflow and improved quality of flow in Limestone Creek as a result of the dewatering discharges.

The current mine dewatering operations are not impacting adversely on any of the licensed bores shown on **Figure 1**. I am confident that there are no other water supply bores (i.e. either unlicensed or not yet included in the DLWC database) in the area that are being impacted, or are likely to be impacted in the future.

2.7 Potential Groundwater Constraints upon Proposed Expansion of Galong Limestone Mine

Groundwater could impact on the proposed expansion of the Galong Limestone Mine in the following ways:

- groundwater inflow rates could increase as the open-cut mine is expanded to a much larger area and significantly greater depth below the regional groundwater table;
- groundwater inflows to the open-cut mine would need to be either used in the operation or discharged to the environment, potentially requiring groundwater extraction and/or discharge licences;
- discharge of the groundwater that inflows to the open-cut mine could impact on Limestone Creek or other watercourse;
- removal of groundwater from the open-cut mine would cause a lowering of groundwater levels in the mine vicinity, and could have an impact on groundwater quality;
- removal of groundwater could potentially impact on other nearby groundwater users in the project vicinity; and
- removal of groundwater or the disposal of surplus water to the surface drainages could have an impact on downstream dependent ecosystems.

Each of the above potential issues has been addressed to ascertain the level of constraint they could impose on the project, and to identify if any issue poses an unacceptable level of constraint.

3. ASSESSMENT OF POTENTIAL IMPACTS OF THE PROPOSAL

3.1 Groundwater Modelling

A groundwater model has been set up to assess the likely inflow rates or dewatering pumping rates required for the proposed mine expansion. The model is a one-layered finite difference model, set up using MODFLOW (McDonald and Harbaugh, 1988). MODFLOW is the industry standard groundwater modelling software, and enjoys wide acceptance by practitioners and regulators as a reliable simulation model.

mine vicinity increasing in size to 800 by 800 metres at the model margins. The boundaries of the model were set at distances well beyond the expected extent of impact from the mining or dewatering activity. No flow conditions were assigned to all model boundaries, as well as constant head values at cells coinciding with the headwaters and discharge ends of the Limestone Creek catchment in which the open-cut mine is situated.

Different hydraulic conductivity (permeability) values were assigned to the limestone and the volcanics. Various values were used to test the sensitivity of the model to errors in the assumed values. A uniform storativity value was assumed for both limestone and volcanics. Likewise, uniform recharge and evapotranspiration values were assumed for both units.

Finally, cells coinciding with the course of Limestone Creek through the model area were assigned as river cells, which allow water to pass from the river to the groundwater or vice versa, according to whether the groundwater levels in the river cells are higher or lower than the river levels in those cells at any time during the model simulations.

The model was firstly run in steady state mode without any assumed influence from mining on groundwater levels to ensure that the model was able to replicate the likely equilibrium groundwater conditions within the model area. Once a reasonable head distribution was achieved with steady state modelling, further model runs were carried out in transient mode, to try to calibrate the model against the observed groundwater level pattern around the existing Galong mine. During the steady state and the transient calibration modelling, adjustments were made to the assumed hydraulic parameter values and to the model geometry until acceptable calibrations were achieved.

Finally, the model was then used to simulate the proposed future expansion and deepening of the open-cut mine up to 2043, to assess both the groundwater inflow or dewatering pumping rates, and the regional drawdowns in groundwater levels resulting from the groundwater abstractions. The proposal to dispose of the dewatering discharge by release to Limestone Creek just north of the Eubindal Road crossing was simulated in the model by assuming that portion of the dewatering discharge would be recharged back into the aquifer system in that vicinity.

3.2 Hydraulic Properties of Limestone Aquifer

No hydraulic testing has been carried out to enable aquifer hydraulic properties to be determined. However, it is possible to make an estimate of the aquifer permeability based on the drawdown in groundwater level that is believed to have occurred to date. The current mine inflow rate is estimated at approximately 5 L/sec (430 m^3/day). This has resulted in an estimated water level decline around the open-cut mine of approximately 10 metres.

The level at which the main inflow to the open-cut mine occurs has apparently not altered noticeably in recent years, even as the open-cut mine has deepened. It is therefore likely that the water level decline has reached an approximate state of equilibrium with the inflow rate. It is appropriate therefore to apply a steady state approach to the hydraulic analysis.

I have used the Thiem-Dupuit method of analysis (Kruseman and de Ridder, 1990). I have assumed a drawdown of 10 metres in the open-cut mine, and assumed an effective mine radius of 50 metres. I have further assumed that there is zero drawdown at a distance of 250 metres from the open-cut mine, which is the distance to the nearest bore reporting a groundwater level believed to be unaffected by the open-cut mine. Finally, I have assumed (conservatively) that the zone of high permeability in the limestone will extend to a depth of 50 metres below the current base of the open cut mine. Based on these assumptions, the Thiem-Dupuit method suggests an average permeability value for the limestone of 0.2 m/d.

If the main zone of high permeability in the limestone had an effective thickness of 100 metres below the current floor level of the open-cut mine, the average value of permeability for the limestone would be 0.1 m/d.

In order to test the reasonableness of the above calculated values, the groundwater model described above was first run to try to replicate the current observed distribution of groundwater levels, assuming this water level pattern was the response to inflows to the open-cut mine of 5 L/sec for a period of 5-6 years.

Using a permeability of 0.1 or 0.2 m/d for all of the limestone, it was not possible to generate sufficient drawdown to match the observed groundwater level impacts. However, by adopting a higher value of 1 m/d for the limestone adjacent to and south of the open-cut mine, and a much lower value of 0.01 m/d for the remainder of the limestone extending north from the existing open-cut mine area, a good calibration with the present groundwater levels was achieved, with a dewatering rate of 5 L/sec.

The distribution of hydraulic parameters that resulted in this acceptable calibration were then adopted for the model. The distribution of groundwater levels derived as output from this initial model (**Figure 8**) run were also used as starting heads for the simulation modelling of the proposed ongoing mine expansion.

3.3 Simulation Modelling of Dewatering for the Proposed Mine Expansion

Five separate transient model runs were undertaken, coinciding with the five stages of proposed mine expansion as portrayed on **Figure 7**, viz

- Stage 1 – 2003-2008 (mine floor level 480 mAHD)
- Stage 2 – 2008-2013 (mine floor level 465 mAHD)
- Stage 3 – 2013-2023 (mine floor level 465 mAHD)
- Stage 4 – 2023-2033 (mine floor level 450 mAHD)
- Stage 5 – 2033-2043 (mine floor level 435 mAHD)

Two alternative approaches were modelled.

In the first, model cells coinciding with the open-cut mine area defined for each stage were set as "drain" cells in the model. Drain cells allow water to be extracted from the model, by setting the groundwater level within those cells to the specified mine floor elevation and allowing water to flow into those cells from adjoining cells. The resulting head distribution at the end of each simulation would represent the groundwater levels at the end of the stage if the open-cut mine had been instantly deepened to the specified floor level at the beginning of the stage, and the inflowing groundwater pumped out to maintain a dry mine floor. The head distribution at the end of each stage was used as starting heads for the subsequent simulation.

The second modelling approach used was to set a "pumping well" in each cell within the proposed open-cut mine area for each stage. By a process of trial and error, appropriate pumping rates for each "well" were determined, that would achieve drawdown to the specified mine floor level for that stage by the end of the simulation period.

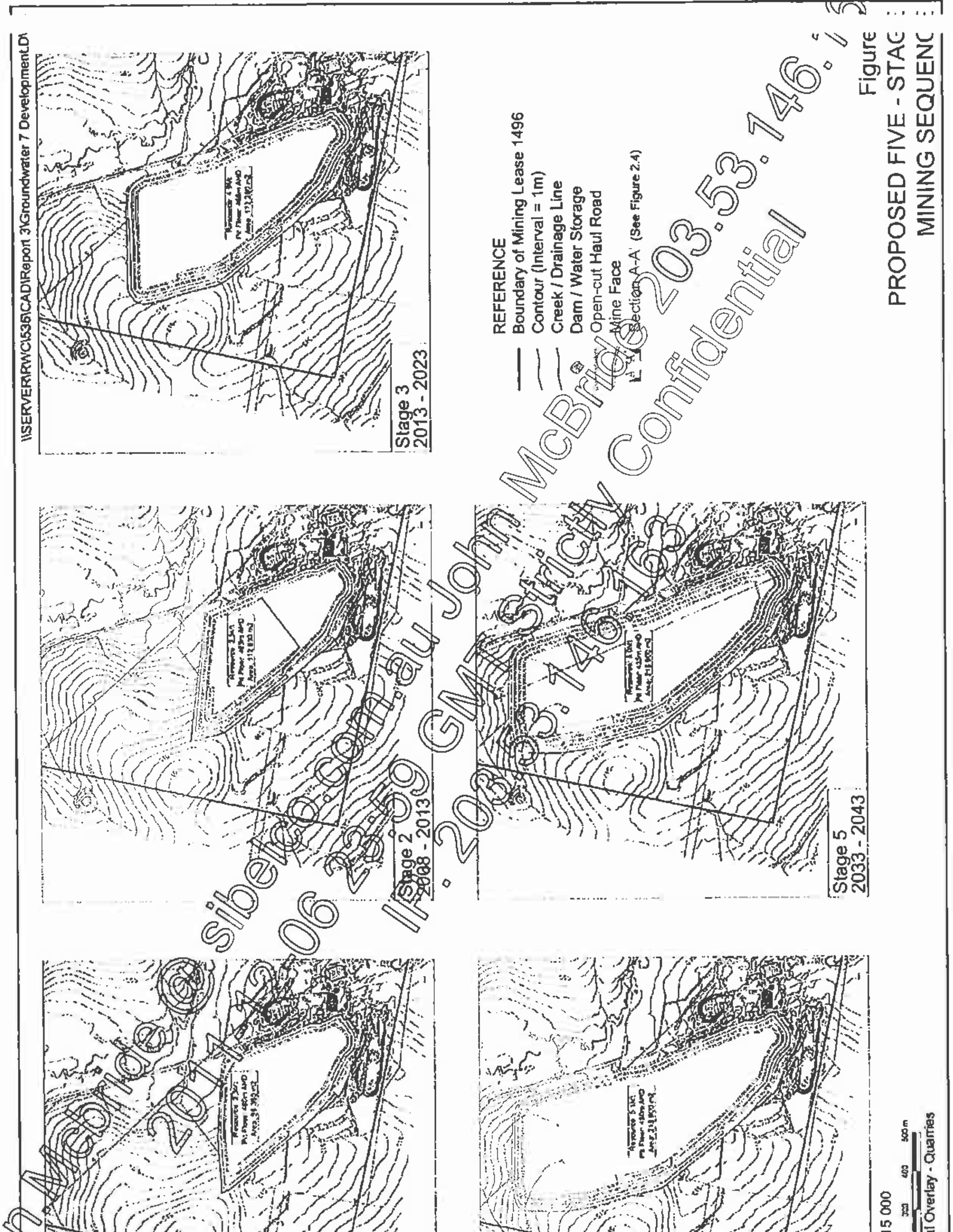


Figure
PROPOSED FIVE - STAG
MINING SEQUENC

Both alternative approaches have some short comings. However, it is considered that the second approach is more realistic as it assumes that groundwater levels are gradually drawn down to the specified mine floor level through the duration of the stage, rather than having to be instantaneously drawn down to that level as required for the first approach.

Average dewatering rates determined using the "pumping well" approach for each of the five mine expansion stages are listed in **Table 4**.

Table 4: Model Determined Average Dewatering Rates for Proposed Mine Expansion

Stage	Years	Specified Mine Floor Elevation	Average Pumping Rate Required	
		mAHD	m^3/d	ML/year
0	Pre-2003	475 mAHD	430	160
1	2003-2008	480 mAHD	385	140
2	2008-2013	465 mAHD	615	225
3	2013-2023	465 mAHD	565	205
4	2023-2033	450 mAHD	810	295
5	2033-2043	435 mAHD	1070	390

Stage 0 represents the mining operation prior to the present time, which has seen pit development to around 475 mAHD, with accompanying drawdown to this level, and a reported inflow rate of 5 L/sec (430 m^3/d). It is noted that Stage 1 involves areal expansion of the pit over the five year period 2003-2008, with no deepening below current pit floor elevation. The model predicts a dewatering rate slightly lower than the present rate. The dewatering rate is predicted to increase during Stage 2 (2008-2013), which involves limited areal expansion but deepening from 480 to 465 mAHD. The predicted dewatering rate then declines slightly in Stage 3, during which significant areal expansion of the pit is proposed, but no deepening of the pit floor elevation.

The final two stages involve further mine deepening, and the dewatering rate is predicted to increase once again. Predicted average dewatering pumping rate for Stage 5 is about 2.5 times higher than the present rate.

By 2008, it will be necessary to increase the discharge capacity as covered by the existing Bore Licence recently granted by the DLWC. This licence currently authorises the extraction of up to 430 m^3/d (157 ML/annum) of groundwater inflows from the open-cut mine. This licence, subject to its renewal at the end of the current three-year term, will be adequate for the predicted rate of inflows up to the end of Stage 1 (2008), but not beyond that date.

It should be noted that the model has determined <u>average</u> dewatering rates for each stage, which are based on the assumption that there will be gradual expansion and/or deepening in each stage. The actual dewatering rate in each stage may fluctuate above and below the average rates determined, depending on the detailed mine development carried out within each stage. Early deepening of the pit within a stage would result in higher initial dewatering rates than the predicted average rate, whereas if deepening of the pit occurs late in a stage, the dewatering rates early in that stage could be lower than the predicted average rate.

3.4 Predicted Impacts of Mine Expansion on Groundwater Levels and Recharge Rates

The model simulated groundwater contours for January 2003 (i.e. at the completion of Stage 0 in **Table 4** above) are shown on **Figure 8**. The simulated groundwater contours for the completion of Stage 5 are shown on **Figure 9**. Comparison of these two figures indicates that the drawdown impacts from dewatering of the open-cut mine will extend only for a limited distance from the open-cut mine. The model predicts that by the end of forty years of mining, dewatering-imposed drawdowns of 1 metre or more will be limited to a radius of less than 1 kilometre in all directions. Drawdowns of 10 metres or more will be confined within a radial distance of less than 600 metres.

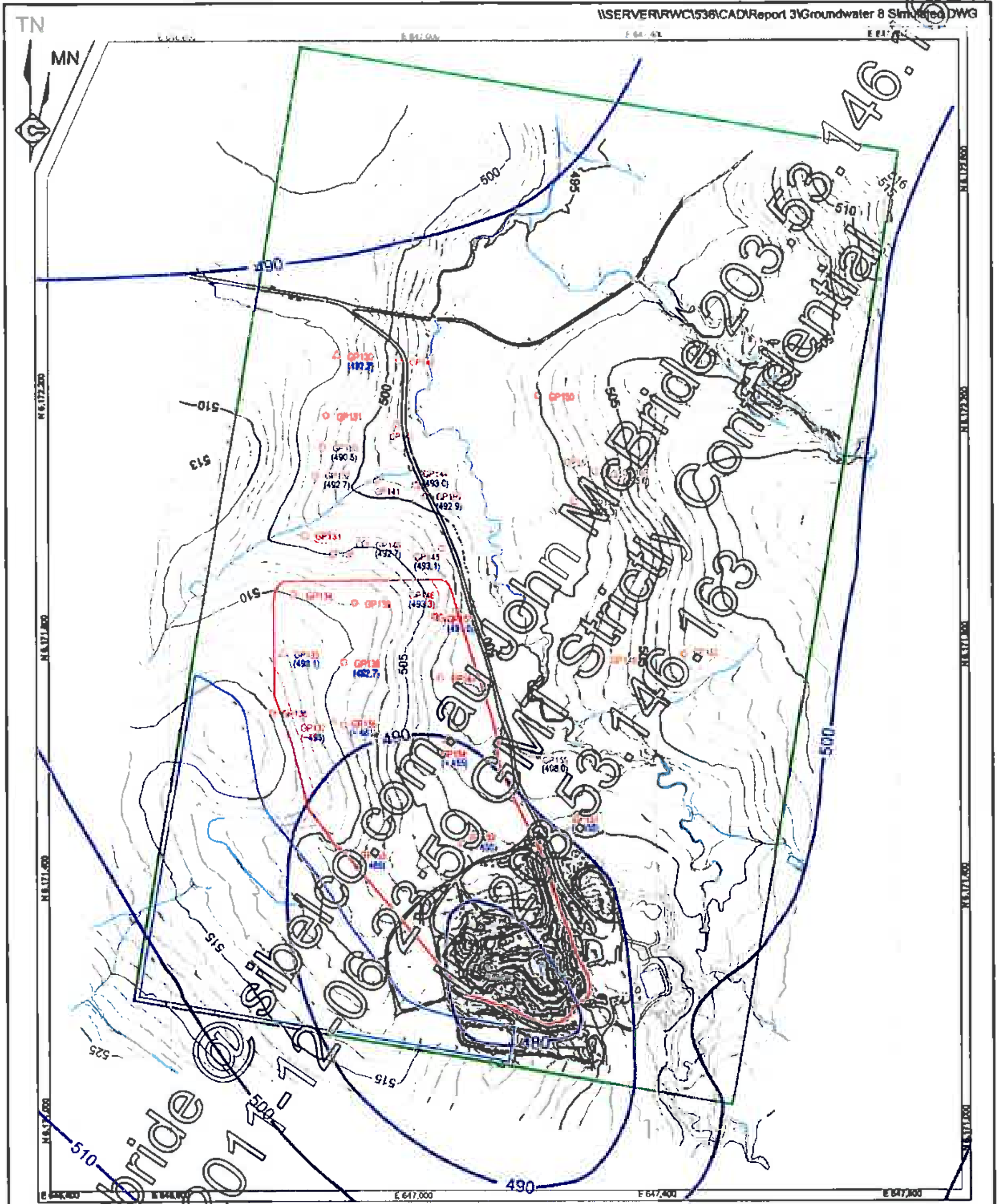
It is proposed to pipe the dewatering discharge from the pit to a disposal point in Limestone Creek downstream of the open-cut mine, nominally at the Eubindal Road crossing, close to the present entrance gate to the property on which the open-cut mine is situated. Downstream of this point, streamflow volumes are predicted to be similar to present flows until the end of Stage 1 (2008), and will increase thereafter as the dewatering discharge rate increases. Based on estimates of current streamflow rates (Hughes Trueman, 2003), the groundwater discharge currently represents around 35% of total streamflow on average. When groundwater discharge rates reach their maximum during Stage 5 (2033-2043), the groundwater discharge rate will be almost double the average streamflow derived from the catchment upstream from the open-cut mine.

The increased streamflow is likely to result in some increase in recharge rates from the streambed downstream to the north, with the result that some elevation of the groundwater surface will occur to the north of Eubindal Road. Based on the recharge assumptions used in the model, it is predicted that groundwater levels could rise by up to 5 metres in the area adjacent to Limestone Creek for a distance of about 500 metres north of Eubindal Road.

It is expected that the lowering of groundwater levels in the open-cut mine area will not significantly reduce the streamflow volumes in Limestone Creek where it flows past the open-cut mine. Streambed elevations are currently several metres above the groundwater levels, indicating that the surface water and groundwater are currently not in direct hydraulic connection. Any water infiltrating through the creekbed will therefore have to pass through the unsaturated zone to reach the water table, and therefore the rate of recharge from the creekbed into the underlying groundwater system will not be dependent on the groundwater levels. The recharge rate will be unchanged, regardless of the extent of groundwater lowering that accompanies dewatering of the open-cut mine.

3.5 Reliability of Model Predictions

The groundwater model used assumes uniform hydraulic properties within each cell. It assumes that groundwater will flow in accordance with Darcy's Law, which describes flow within homogeneous media. The limestone is not a homogeneous material, but rather is likely to be characterised by flow within discrete preferential flow paths, such as shear zones, faults, joints or enlarged solution channels formed over time by dissolution of the limestone by groundwater flowing along these fracture pathways.



REFERENCE
- Boundary of Mining Lease 1496
- Proposed Limit of Mining
- Proposed Main Overburden Emplacement
- 516 — Contour (1m Interval, m AHD)
- 490 — Groundwater Contour (m, AHD)
- Completed as Piezometer
- Groundwater Level - February 2003 (m, AHD)
- Drillhole - Backfilled

SCALE 1:10 000

100 0 100 200 300 400 500 m

Base Map Source: Geo-Spectrum (Australia) Pty Ltd
PJA Job No. 03-0130

Figure 8
SIMULATED GROUNDWATER CONTOURS JANUARY 2003

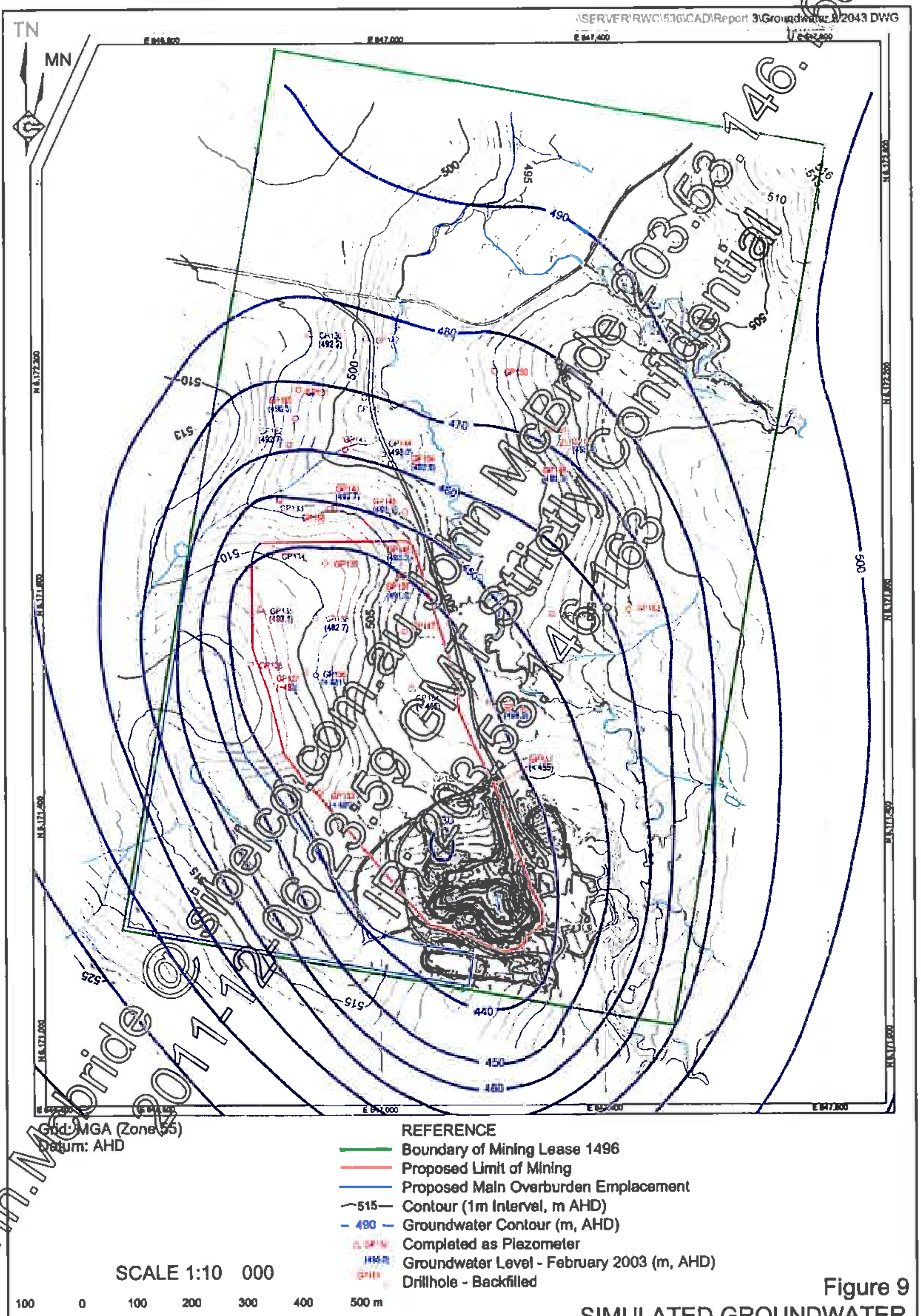


Figure 9
SIMULATED GROUNDWATER CONTOURS 2043

Consequently, there is some uncertainty in the model predictions due to the representation of the heterogeneous limestone as a homogeneous material in the model. It is common practice to represent such aquifers as homogeneous media in groundwater modelling, because there is usually insufficient information available about the location and nature of individual fracture flow pathways to set up a reliable fracture flow model. This approach is considered valid since these types of aquifers tend to behave as quasi-homogeneous media when viewed on a large scale.

The validity of this approach is improved if there is any historical data on the aquifer response to dewatering abstractions, as there is in the case of the Galong mine.

However, it is possible that the approach may either underestimate or overestimate the required dewatering rate for a larger or deeper mine. If a significantly more permeable flow pathway were to be encountered as the open-cut mine expands laterally or to depth, compared to those encountered to date, then a higher rate of water inflows could result. Alternatively, lower inflow rates than those predicted could be encountered if the shear zone on the southern side of the pit that is currently the main source of water inflow turns out to be significantly more permeable than other fracture pathways to be encountered by the expanding pit.

Because of this uncertainty, it is common practice when dealing with heterogeneous aquifer systems like limestones to adopt the model predictions as the most reliable estimates available, but to monitor performance as dewatering proceeds, and if necessary to periodically adjust the predicted inflow rates accordingly. It is prudent therefore to be prepared for a higher inflow rate than that predicted, by building in appropriate contingency pumping capacity and cost provisions. It is considered that a doubling of the predicted flow rate would provide more than adequate contingency in this case. Thus, an ultimate pumping rate of up to about 2000 m^3/d should be allowed for.

Notwithstanding the above recommendation, I believe it is unlikely that the model predictions will be exceeded. In all the drilling carried out to date, no evidence of any solution channel feature has been detected. Nor has any significant zone of shearing or fracturing been intersected. Indeed, several drillholes were dry during and following drilling, and many others took months of slow seepage to establish an equilibrium water level, due to the very low permeability of the limestone intersected.

It is more likely that the model predictions could turn out to be overestimates, rather than underestimates. Nevertheless, because of the nature of limestone aquifers, it is recommended that a conservative approach be followed, and the above contingency should be adopted.

4. RECOMMENDED MONITORING PROGRAM

It is recommended that discharges from the open-cut be monitored for both quantity and quality. Discharge volumes should be monitored continuously by the installation of flow meter(s) in the discharge line(s). Water quality should be monitored twice per year, in mid-winter and mid-summer. Water should also be sampled at these times from Limestone Creek, both upstream and downstream of the open-cut mine, for comparative purposes (at Sites LCU and LCD on **Figure 3**).

It is further recommended that water levels be monitored quarterly in the cased monitoring piezometers (**Figure 5**).

The location and elevation of any seepages into the open-cut should also be recorded quarterly, i.e. coinciding with the periods of measurement in the surrounding monitoring bores.

The monitoring program is necessary because of the inherent uncertainty in the predictions of future inflow rates and regional impacts. Firstly, no hydraulic testing has been done, and the hydraulic parameters I have deduced are approximations based on limited monitoring data. Secondly, the limestone aquifer is heterogeneous, with inflows to the open-cut mine expected to occur from discrete zones which are difficult to predict ahead of time. On a regional scale, the aquifer performance may be reasonably predictable, but due to its heterogeneity, specific inflow rates are difficult to predict for specific times and depths of mining.

Consequently, ongoing monitoring is necessary both to enable trends in the rate of inflow to be established, and also to allow more accurate periodic re-assessment of future inflow rates and volumes.

5. CONCLUSIONS

The main conclusions drawn from these groundwater studies are as follows:

- Groundwater inflow rates are predicted to increase in stages as the open-cut mine is expanded a really and to depth, eventually reaching a rate of 1070 m^3/day (390 ML/annum), about 2.5 times the current inflow rate.
- Groundwater inflow rates are not predicted to increase during Stages 1 and 3, when the mine expansion involves only an increase in area, but is predicted to increase in other stages when the open-cut mine is being deepened.
- Groundwater levels are predicted to be lowered around the open-cut mine, but at the end of forty years drawdowns of 1 metre or more will be limited to a radius of less than 1 kilometre from the open-cut mine. Drawdowns exceeding 10 metres are predicted to be limited to less than 600 metres from the open-cut mine.
- Discharge of groundwater pumped from the open-cut mine is expected to increase flows in Limestone Creek, and to result in an overall improvement in water quality of streamflow.
- Some of the discharged water is expected to return to the groundwater as increased recharge from Limestone Creek, leading to a rise of up to 5 metres in groundwater levels for about 500 metres downstream of the discharge point near Eubindal Road.
- Groundwater inflow to the open-cut mine is expected to be of lower salinity than streamflow in Limestone Creek adjacent to the open-cut mine. Discharge of this water to Limestone Creek is expected to improve the streamflow quality downstream.
- The proposed mine expansion is not expected to interfere with any existing groundwater user.
- While groundwater levels will be lowered in the vicinity of Limestone Creek adjacent to the open-cut mine, it is not expected to disrupt streamflow in that area, as the

surface water and the groundwater are not in direct hydraulic connection. Some [illegible] from Limestone Creek by infiltration through the creek-bed and unsaturated flow down to the water table. This will be unaffected by future lowering of groundwater levels.

- The main mechanism of groundwater recharge is believed to be direct infiltration of rainfall. This process will continue both during and post mining.

- The project is not expected to impact deleteriously on any downstream groundwater dependent ecosystem.

- None of the predicted impacts is considered to pose an unacceptable constraint on the proposed expansion of the Galong Limestone Mine.

6. REFERENCES

Felton, E A, 1974. Goulburn 1:250,000 Metallogenic Map, Geol Surv NSW, Sydney.

Hughes Trueman, 2003. *Galong Limestone Mine Expansion, Surface Water Assessment.* Consultant report dated April 2003.

Kruseman, G P and N A de Ridder, 1990. *Analysis and Evaluation of Pumping Test Data*, second edition, ILRI publication 47, publ 1990.

McDonald, M G and A E Harbaugh, 1988. *A modular Three-Dimensional Finite-Difference Ground-Water Flow Model.* Techniques of Water-Resources Investigations of the United States Geological Survey, Book 6, Modeling Techniques.

7. GLOSSARY OF TERMS

aquiclude	A saturated unit of rock or soil that is incapable of transmitting significant quantities of water under ordinary hydraulic gradients.
aquifer	A saturated permeable unit of rock or soil which is able to transmit significant quantities of water under ordinary hydraulic gradients.
aquitard	A saturated unit of rock or soil that is capable of transmitting water to and between aquifers, but is not sufficiently permeable to allow water to flow into a bore a rate that will allow the bore to be pumped at a useful rate.
bedrock	In this report, bedrock refers to the geological unit that underlies the geological units that are active media for the movement of groundwater.
discharge	Groundwater discharge from an aquifer is the loss of water from the aquifer, either by natural processes (such as evapotranspiration, outflow to the ocean or other water body, or to another aquifer) or by artificial means (such as pumped extraction). Under conditions of dynamic equilibrium, the average rate of natural discharge from an aquifer is usually equivalent to the average long-term rate of recharge. See "recharge".
DLWC	Department of Land and Water Conservation
drawdown	The lowering of the water level or the potentiometric head in an aquifer due to the removal of water from a nearby bore or excavation.
ephemeral	Temporary or seasonal.
groundwater	Water that occurs beneath the water table in rock or soil that is fully saturated.
groundwater modelling	Use of mathematical functions to simulate the flow of water below the ground surface.
groundwater table	See "water table".

head	The head in an aquifer is the height above a reference datum of the surface of a column of water that can be supported by the hydraulic pressure in the aquifer against atmospheric pressure. It equates to the elevation of the water table above the datum, and is the sum of the *elevation* head, or the elevation of the point of measurement, and the *pressure* head, or the pressure of the water at that point relative to atmospheric pressure.
hydraulic conductivity	A measure of the ability of a rock or soil to transmit water under a prevailing hydraulic gradient. It has the units of metres/day. In this report, the term is used synonymously with the term "permeability".
hydraulic gradient	The change in head per unit distance in a particular direction, usually the direction of maximum change, perpendicular to the groundwater contours (equipotentials).
hydrogeological unit	A unit of rock or soil which has reasonably consistent hydraulic properties of permeability and storage
hydrograph	A linear plot of water level versus time.
infiltration	Movement of water through the surface of the ground into the saturated or unsaturated zone beneath.
MODFLOW	A modular three-dimensional groundwater flow model which was developed by the USGS (McDonald and Harbaugh, 1988).
monitoring piezometer	Bore drilled in a location and constructed specifically to enable the sampling and ongoing measurement of groundwater levels, pressure changes and groundwater quality. It is ideally constructed so as to minimise the potential for contamination or interference from external influences, and to enable accurate and reliable sampling and hydraulic measurements from a specific aquifer or zone within an aquifer.
permeability	The permeability of a rock or soil is a measure of the ease with which fluids can flow through it, and is independent of the properties of the fluid. In this report, the term is used synonymously with the term "hydraulic conductivity".
piezometric surface	See "potentiometric surface".
porosity	The proportion of a volume of rock or soil that is occupied by voids, or the ratio of the total void space to the total rock or soil volume. For the movement or release of water, only the proportion of porosity that is interconnected is significant, and is referred to as the "effective" porosity, which is often very much less than the total porosity. In a saturated material, the porosity comprises two components – the proportion of porosity that will freely drain under gravity, known as the specific yield, and the proportion that will not drain under gravity, known as the specific retention.

potentiometric surface	An imaginary surface defined by the heads at all points within a particular plane in an aquifer. Where the vertical component of hydraulic gradient is much smaller than the horizontal component, the potentiometric surface can be said to apply to the aquifer as a whole.
pumping test	Test carried out to determine hydraulic properties of the aquifer.
recharge	Groundwater recharge is the addition of water to an aquifer, either by direct infiltration at the ground surface, by percolation through an unsaturated zone, or by inflow of discharge from another aquifer.
runoff	The portion of rainfall precipitation which collects on the surface and flows to surface streams.
saturated zone	That part of a soil or rock in which all the interconnected voids are filled with water under pressure equal to or greater than atmospheric pressure. The top of the saturated zone is defined by the surface at which the water pressure is equal to atmospheric pressure. [Parts of the saturated zone may be temporarily unsaturated due to air entrapment; likewise, in parts of the "unsaturated zone", the voids may be all filled with water, but at less than atmospheric pressure.]
slug test	A type of permeability test conducted by introducing to (or removing from) a bore, a known volume of water and monitoring the progressive return of the water level in the bore back to its former level.
specific yield	The volume of water that will freely drain under gravity from a unit volume of a saturated soil or rock.
transmissivity	The rate at which water is transmitted through a unit width of an aquifer under a unit hydraulic gradient. It is equal to the product of the average hydraulic conductivity and the saturated thickness of the aquifer. It is expressed in units of metres^2/day.
water table	The surface within an unconfined aquifer at which the water pressure is equal to atmospheric pressure. It is defined by the level to which water would rise in a bore which just penetrates the top of the aquifer.

APPENDICES

Appendix 1 DLWC Groundwater Database – Registered Bores

APPENDIX 1

(No. of pages excluding this page = 21)

DLWC GROUNDWATER DATABASE – REGISTERED BORES

Date/Time :01-Jul-2002 4:49 PM
User :MAMITCHELL
Report :RMGW001D.QRP
Executable :S:\GS\PROD32\GROUND.EXE
Exe Date :05-Dec-2001
System :Groundwater
Database :Dlwcp

DEPARTMENT OF LAND & WATER CONSERVATION
Work Summary

GW013950 *Converted From HYDSYS*

License :

Authorised Purpose(s)
Intended Purpose(s) GENERAL USE

Work Type : Bore
Work Status : (Unknown)
Construct. Method : Cable Tool
Owner Type : Private

Commenced Date :
Completion Date : 01-Jan-1957
Final Depth : 25.00 m
Drilled Depth : 0.00

Contractor Name :
Driller :

Property :
GWMA :
GW Zone :
Standing Water Level :
Salinity : (Unknown)
Yield :

Site Details

Site Chosen By

County
Form A : HARDEN
Licensed :

Parish BOBBARA

Portion/Lot DP 140

Region : 40 - MURRUMBIDGEE
River Basin : 410 - MURRUMBIDGEE RIVER
Area / District :

CMA Map :8628-4N GALONG
Grid Zone :55/3 **Scale :** 1:25,000

Elevation :
Elevation Source : (Unknown)

Northing : 6174700
Easting : 644525

Latitude (S) : 34° 33' 33"
Longitude (E) : 148° 34' 31"

GS Map : 0073C3 **AMG Zone :** 55 Coordinate Source :GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture GS-Grain Size,Q-Quantity

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	Threaded Steel	0.00	14.00	152			Suspended in Clamps

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
25.90	25.90	0.00	(Unknown)	4.60		0.08			(Unknown)

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments

Pumping Tests - Summaries

Pumping Test Type	Date	Duration (hr)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By
Single-Rate Pumping Test	25-Jan-1957	0.50	4.60		0.95	18.30	Bailer			

Pumping Tests - Readings

Pumping Test Type	Date	Time (mins)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By

(No Pumping Test Reading Details Found)

Remarks

*** End of GW013950 ***

Warning To Clients: This raw data has been supplied to the Department of Land and Water Conservation (DLWC) by drillers, licensees and other sources. The DLWC does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

1

DEPARTMENT OF LAND & WATER CONSERVATION
Work Summary

GW014654 *Converted From HYDSYS*

Licence :40BL115776

Work Type :Bore open thru rock
Work Status :(Unknown)
Construct. Method :Cable Tool
Owner Type :Private

Authorised Purpose(s) STOCK
Intended Purpose(s) STOCK

Commenced Date :
Completion Date :01-Jun-1961
Final Depth : 10.70 m
Drilled Depth : 10.70 m

Contractor Name :
Driller :

Property : - BEULAMBIL
GWMA : -
GW Zone : -

Standing Water Level :
Salinity : 1001-3000 ppm
Yield :

Site Details

Site Chosen By

County	Parish	Portion/Lot DP
Form A :HARDEN	BOBBARA	145
Licensed :HARDEN	BOBBARA	145

Region :40 - MURRUMBIDGEE
River Basin :410 - MURRUMBIDGEE RIVER
Area / District :

CMA Map :8628-4N GALONG
Grid Zone :55/3 **Scale** :1:25,000

Elevation :
Elevation Source :(Unknown)

Northing :6175315
Easting :648200

Latitude (S) :34° 33' 11"
Longitude (E) :148° 36' 55"

GS Map :0073C3 **AMG Zone** :55 **Coordinate Source** :GD ,ACC MAP

Construction

Negative depths indicate Above Ground Level;H-Hole,P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	Threaded Steel	-0.40	8.50	152			(Unknown)

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
7.00	7.00	0.00	(Unknown)			0.00			(Unknown)
10.10	10.60	0.50	(Unknown) (natural flow)	-0.30		0.63			1001-3000 ppm

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	3.66	3.66	Clay	Clay	
3.66	6.10	2.44	Conglomerate	Conglomerate	
6.10	7.01	0.91	Rock Bars Clayey Silt	Rock Bars	
7.01	10.61	3.60	Rock Hard Water Supply	Rock	
10.61	10.67	0.06	Rock Solid	Rock	

Pumping Tests - Summaries

Pumping Test Type	Date	Duration (hr)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By
Single-Rate Pumping Test	26-Jun-1961	6.00	-0.30	6.50	0.91	4.70	Cylinder Pump			

Pumping Tests - Readings

Pumping Test Type	Date	Time (mins)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By

(No Pumping Test Reading Details Found)

Remarks

*** End of GW014654 ***

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2

DEPARTMENT OF LAND & WATER CONSERVATION
Work Summary

GW020817 *Converted From HYDSYS*

License :

Authorised Purpose(s)

Intended Purpose(s) STOCK

Work Type : Bore
Work Status : (Unknown)
Construct. Method : Cable Tool
Owner Type : Private

Commenced Date :
Completion Date : 01-Aug-1963
Final Depth : 20.10 m
Drilled Depth : 20.10 m

Contractor Name :
Driller :

Property :
GWMA :
GW Zone :

Standing Water Level :
Salinity : (Unknown)
Yield :

Site Details

Site Chosen By

County Form A : HARDEN
Licensed :
Parish GALONG
Portion/Lot DP 132

Region : 40 - MURRUMBIDGEE
River Basin : 410 - MURRUMBIDGEE RIVER
Area / District :

CMA Map : 8628-4N GALONG
Grid Zone : 55/3
Scale : 1:25,000

Elevation :
Elevation Source : (Unknown)

Northing : 6171960
Easting : 642625

Latitude (S) : 34° 35' 3"
Longitude (E) : 148° 33' 18"

GS Map : 0073C3 **AMG Zone :** 55 **Coordinate Source :** GD., ACC.MAP

Construction

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	Threaded Steel	0.30	15.40	152			Seated

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
14.30	15.20	0.90	(Unknown)						(Unknown)
11.30	20.10	1.80	(Unknown)	6.10		0.76			(Unknown)

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	6.10	6.10	Pug Yellow	Pug	
6.10	14.33	8.23	Granite Rotten	Granite	
14.33	20.12	5.79	Granite Grey Water Supply	Granite	

Pumping Tests - Summaries

Pumping Test Type	Date	Duration (hr)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By
...gle-Rate Pumping Test	11-Aug-1963	2.00	6.10		0.76	11.90	Bailer			

Pumping Tests - Readings

Pumping Test Type	Date	Time (mins)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By

(No Pumping Test Reading Details Found)

Remarks

***** End of GW020817 *****

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DEPARTMENT OF LAND & WATER CONSERVATION
Work Summary

GW026608 *Converted From HYDSYS*

License :

Authorised Purpose(s)

Intended Purpose(s) STOCK

Work Type : Bore open thru rock
Work Status : (Unknown)
Construct. Method : Rotary Air
Owner Type : Private

Commenced Date :
Completion Date : 01-Feb-1967

Final Depth : 15.20 m
Drilled Depth : 15.20 m

Contractor Name :
Driller :

Property :
GWMA :
GW Zone :

Standing Water Level :
Salinity : Fresh
Yield :

Site Details

Site Chosen By

County Form A : HARDEN
Licensed :

Parish BOBBARA

Portion/Lot DP 61

Region : 40 - MURRUMBIDGEE
River Basin : 410 - MURRUMBIDGEE RIVER
Area / District :

CMA Map : 8628-4N GALONG
Grid Zone : 55/3
Scale : 1:25,000

Elevation :
Elevation Source : (Unknown)

Northing : 6169640
Easting : 644190

Latitude (S) : 34° 36' 17"
Longitude (E) : 148° 34' 21"

GS Map : 0073C3
AMG Zone : 55

Coordinate Source : GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	Threaded Steel	-0.50	6.00	[illegible]			Driven into Hole

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
3.00	3.00	0.00	Unconsolidated	1.50		0.25			Fresh
11.30	11.60	0.30	Fractured	[illegible]		4.55			Fresh

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	3.05	3.05	Clay Red	Clay	
3.05	8.53	5.48	Granite Decomposed Water Supply	Granite	
8.53	15.24	6.71	Granite Black Water Supply	Granite	

Pumping Tests - Summaries

Pumping Test Type	Date	Duration (hr)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By
Single-Rate Pumping Test	21 Feb 1967	24.00	0.00	[illegible]	0.76		Airlift			

Pumping Tests - Readings

Pumping Test Type	Date	Time (min)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By

(No Pumping Test Reading Details Found)

Remarks

*** End of GW026608 ***

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4

DEPARTMENT OF LAND & WATER CONSERVATION
Work Summary

GW031183 *Converted From HYDSYS*

License :

Authorised Purpose(s) **Intended Purpose(s)** STOCK

Work Type : Bore
Work Status : (Unknown)
Construct. Method : (Unknown)
Owner Type : Private

Commenced Date :
Completion Date : 01-Jan-1969
Final Depth : 25.60 m
Drilled Depth : 25.60 m

Contractor Name :
Driller :

Property :
GWMA :
GW Zone :
Standing Water Level :
Salinity : (Unknown)
Yield :

Site Details

Site Chosen By
County Form A : HARDEN
Licensed :
Parish BOBBARA
Portion/Lot DP 101

Region : 40 - MURRUMBIDGEE
River Basin : 410 - MURRUMBIDGEE RIVER
Area / District :
CMA Map : 8628-4N GALONG
Grid Zone : 55/3 **Scale :** 1:25,000

Elevation :
Elevation Source : (Unknown)
Northing : 6171690
Easting : 643800
Latitude (S) : 34° 35' 11"
Longitude (E) : 148° 34' 5"

GS Map : 0073C3 **AMG Zone :** 55 **Coordinate Source :** GD.,ACC MAP

Construction

Negative depths indicate Above Ground Level;H-Hole;P-Pipe,OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	Welded Steel	-0.30	10.40	168			Seated
1	1	Opening	Slots	8.50	16.60	168			SL: 0mm, A: 3.18mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
7.90	12.20	4.30	Fractured	9.10		0.31			(Unknown)
14.00	14.60	0.60	Fractured	9.10		2.78			(Unknown)
14.60	18.90	4.30	Fractured	9.10		4.04			(Unknown)

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	0.91	0.91	Soil	Soil	
0.91	7.92	7.01	Conglomerate	Conglomerate	
7.92	12.19	4.27	Granite Broken Water Supply	Granite	
12.19	14.02	1.83	Granite	Granite	
14.02	14.63	0.61	Granite Red Water Supply	Granite	
14.63	18.29	3.66	Granite Red Water Supply	Granite	
18.29	25.60	7.31	Granite Water Supply	Granite	

Pumping Tests - Summaries

Pumping Test Type	Date	Duration (hr)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By
Single-Rate Pumping Test	01-Jan-1969		9.10		4.04		Airlift			

Pumping Tests - Readings

Pumping Test Type	Date	Time (mins)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By

(No Pumping Test Reading Details Found)

Remarks

*** End of GW031183 ***

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DEPARTMENT OF LAND & WATER CONSERVATION
Work Summary

GW031308 *Converted From HYDSYS*

License :

Authorised Purpose(s)

Intended Purpose(s) DOMESTIC

Work Type : Bore
Work Status : (Unknown)
Construct. Method : (Unknown)
Owner Type : Private

Commenced Date :
Completion Date : 01-May-1967
Final Depth : 53.30 m
Drilled Depth : 53.30 m

Contractor Name :
Driller :

Property :
GWMA :
GW Zone :

Standing Water Level :
Salinity : Fresh
Yield :

Site Details

Site Chosen By

County Form A : HARDEN
Licensed :

Parish GALONG

Portion/Lot DP 123

Region : 40 - MURRUMBIDGEE
River Basin : 410 - MURRUMBIDGEE RIVER
Area / District :

CMA Map : 8628-4N GALONG
Grid Zone : 55/3
Scale : 1:25,000

Elevation :
Elevation Source : (Unknown)

Northing : 6169780
Easting : 642600

Latitude (S) : 34° 36' 14"
Longitude (E) : 148° 33' 19"

GS Map : 0073C3
AMG Zone : 55
Coordinate Source : GD., ACC. MAP

Construction

Negative depths indicate Above Ground Level; H-Hole; P-Pipe; OD-Outside Diameter; ID-Inside Diameter; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	Threaded Steel	-0.10	21.30	142			Driven into Hole
1	1	Opening	Slots		1.80	139		1	SL: 0mm; A: 0mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
21.30	21.30	0.00	Unconsolidated	21.30		0.13			Fresh

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	0.30	0.30	Topsoil	Topsoil	
0.30	2.44	2.14	Clay	Clay	
2.44	21.64	19.20	Sand Granite Water Supply	Sand	
21.64	53.34	31.70	Granite Black	Granite	

Pumping Tests - Summaries

Pumping Test Type	Date	Duration (hr)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By
gle-Rate Pumping Test	23-May-1967		21.30		0.13		Airlift			

Pumping Tests - Readings

Pumping Test Type	Date	Time (mins)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By

(No Pumping Test Reading Details Found)

Remarks

ROYAL HOTEL SECT 1 GALONG

*** End of GW031308 ***

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DEPARTMENT OF LAND & WATER CONSERVATION
Work Summary

GW035196 *Converted From HYDSYS*

License :

Authorised Purpose(s)

Intended Purpose(s) STOCK

Work Type : Bore open thru rock
Work Status : (Unknown)
Construct. Method : (Unknown)
Owner Type : Private

Commenced Date :
Completion Date : 01-Dec-1972

Final Depth : 30.40 m
Drilled Depth : 30.50 m

Contractor Name :
Driller :

Property :
GWMA :
GW Zone :

Standing Water Level :
Salinity : Fresh
Yield :

Site Details

Site Chosen By

County Form A : HARDEN
Licensed :

Parish BOBBARA

Portion/Lot DP 146

Region : 40 - MURRUMBIDGEE
River Basin : 410 - MURRUMBIDGEE RIVER
Area / District :

CMA Map : 8628-4N GALONG
Grid Zone : 55/3 **Scale :** 1:25,000

Elevation :
Elevation Source : (Unknown)

Northing : 6174320
Easting : 648815

Latitude (S) : 34° 33' 43"
Longitude (E) : 148° 37' 20"

GS Map : 0073C3 **AMG Zone :** 55 **Coordinate Source :** GD., ACC.MAP

Construction

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	(Unknown)	0.00	0.10	152			(Unknown)

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
13.70	16.40	2.70	Fractured						Fresh
23.10	24.60	1.50	Fractured	7.30		0.45			Fresh

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	0.91	0.91	Topsoil	Topsoil	
0.91	3.35	2.44	Clay Topsoil	Clay	
3.35	8.23	4.88	Granite Decomposed	Granite	
8.23	11.58	3.35	Clay Sandy	Clay	
11.58	16.46	4.88	Granite Decomposed Water Supply	Granite	
16.46	23.16	6.70	Granite Porphyry	Granite	
23.16	24.69	1.53	Granite Fractured Water Supply	Granite	
24.69	30.48	5.79	Granite	Granite	

Pumping Tests - Summaries

Pumping Test Type	Date	Duration (hr)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By
Single-Rate Pumping Test	01-Dec-1972		7.30		0.45		(Unknown)			

Pumping Tests - Readings

Pumping Test Type	Date	Time (mins)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By

(No Pumping Test Reading Details Found)

Remarks

*** End of GW035196 ***

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DEPARTMENT OF LAND & WATER CONSERVATION
Work Summary

GW052849

Converted From HYDSYS

Licence :

Authorised Purpose(s)

Intended Purpose(s) DOMESTIC STOCK

Work Type : Bore
Work Status : (Unknown)
Construct. Method : Cable Tool
Owner Type : Private

Commenced Date :
Completion Date : 01-May-1950

Final Depth : 24.00 m
Drilled Depth : 0.00

Contractor Name :
Driller :

Property :
GWMA :
GW Zone :

Standing Water Level :
Salinity : (Unknown)
Yield :

Site Details

Site Chosen By

County Form A : HARDEN
Licensed :

Parish BOBBARA

Portion/Lot DP 91

Region : 40 - MURRUMBIDGEE
River Basin : 410 - MURRUMBIDGEE RIVER
Area / District :

CMA Map : 8628-4N GALONG
Grid Zone : 55/3 **Scale :** 1:25,000

Elevation :
Elevation Source : (Unknown)

Northing : 6173810
Easting : 644625

Latitude (S) : 34° 34' 2"
Longitude (E) : 148° 34' 36"

GS Map : 0073C3 **AMG Zone :** 55 **Coordinate Source :** GD., ACC MAP

Construction

Negative depths Indicate Above Ground Level;H-Hole,P-Pipe;OD-Outside Diameter;ID-Inside Diameter,C-Cemented,SL-Slot Length;A-Aperture,GS-Grain Size;Q-Quantity

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	Threaded Steel	0.00	0.00	152			Driven into Hole
1	1	Opening	Slots	16.00	19.00	139		1	SL: 0mm A: 6.35mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

(No Water Bearing Zone Details Found)

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments

Pumping Tests - Summaries

Pumping Test Type	Date	Duration (hr)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By
...gle-Rate Pumping Test	01-Nov-1979	4.00	6.00	[illegible]	0.36	22.00	Bailer			

Pumping Tests - Readings

Pumping Test Type	Date	Time (mins)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By

(No Pumping Test Reading Details Found)

Remarks

*** End of GW052849 ***

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DEPARTMENT OF LAND & WATER CONSERVATION
Work Summary

GW055219 *Converted From HYDSYS*

License : 40DL119694

Work Type : Bore open thru rock
Work Status : (Unknown)
Construct. Method : Rotary Air
Owner Type : Private

Authorised Purpose(s) STOCK
Intended Purpose(s) STOCK

Commenced Date :
Completion Date : 01-Apr-1981
Final Depth : 69.00 m
Drilled Depth : 76.00 m

Contractor Name :
Driller :

Property : - BEULAMBIL
GWMA : -
GW Zone : -

Standing Water Level :
Salinity : (Unknown)
Yield :

Site Details

Site Chosen By

	County	Parish	Portion/Lot DP
Form A	HARDEN	BOBBARA	145
Licensed	HARDEN	BOBBARA	145

Region : 40 - MURRUMBIDGEE
River Basin : 410 - MURRUMBIDGEE RIVER
Area / District :

CMA Map : 8628-4N GALONG
Grid Zone : 55/3 **Scale :** 1:25,000

Elevation :
Elevation Source : (Unknown)

Northing : 6175300
Easting : 643790

Latitude (S) : 34° 33' 12"
Longitude (E) : 148° 36' 39"

GS Map : 0073C3 **AMG Zone :** 55 **Coordinate Source :** GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1		Backfill	Backfill	69.00	76.00	0			
1	1	Casing	Threaded Steel	0.00	5.00	168			Driven into Hole

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
30.00	33.00	3.00	Fractured			0.45			(Unknown)
55.00	59.00	4.00	Fractured			0.13			(Unknown)
59.00	69.00	10.00	Fractured			0.42			(Unknown)

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	1.00	1.00	Soil	Soil	
1.00	4.00	3.00	Clay	Clay	
4.00	50.00	46.00	Granite Fractured	Granite	
50.00	76.00	26.00	Shale White Water Supply	Shale	

Pumping Tests - Summaries

Pumping Test Type	Date	Duration (hr)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By
Single-Rate Pumping Test	26-Apr-1981		0.00		1.00		Airlift			

Pumping Tests - Readings

Pumping Test Type	Date	Time (mins)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By

(No Pumping Test Reading Details Found)

Remarks

*** End of GW055219 ***

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DEPARTMENT OF LAND & WATER CONSERVATION
Work Summary

GW085009 - Landcare Binalong 50

License :

Authorised Purpose(s)

Intended Purpose(s) MONITORING BORE

Work Type : Bore
Work Status : Test Hole
Construct. Method : Auger
Owner Type : Landcare Group

Commenced Date :
Completion Date : 01-Jan-1992
Final Depth : 6.28 m
Drilled Depth :

Contractor Name :
Driller :

Property :
GWMA :
GW Zone :
Standing Water Level : 5.30 m
Salinity :
Yield :

Site Details

Site Chosen By

County Form A : HARDEN
Licensed :
Parish BOBBARA
Portion/Lot DP 106

Region : 40 - MURRUMBIDGEE
River Basin : 410 - MURRUMBIDGEE RIVER
Area / District :
CMA Map : 8628-N BINALONG
Grid Zone : 55/3
Scale : 1:50,000

Elevation :
Elevation Source :
Northing : 6170800
Easting : 645900
Latitude (S) : 34° 35' 39"
Longitude (E) : 148° 35' 28"

GS Map :
AMG Zone : 55
Coordinate Source : Map Interpretation

Construction

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1		Hole	Hole	0.00	6.28	50			
1	1	Casing	P.V.C	-1.00	6.28	50			
1	1	Opening	Slots	1.28	6.28	50			PVC

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

(No Water Bearing Zone Details Found)

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments

Pumping Tests - Summaries

Pumping Test Type	Date	Duration (hr)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By

(No Pumping Test Summary Details Found)

Pumping Tests - Readings

Pumping Test Type	Date	Time (mins)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By

(No Pumping Test Reading Details Found)

Remarks

Property : Bobbara Station

*** End of GW085009 ***

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DEPARTMENT OF LAND & WATER CONSERVATION
Work Summary

GW085010 - Landcare Binalong 51

License :

Authorised Purpose(s)

Intended Purpose(s) MONITORING BORE

Work Type : Bore
Work Status : Test Hole
Construct. Method : Auger
Owner Type : Landcare Group

Commenced Date :
Completion Date : 01-Jan-1992

Final Depth : 4.18 m
Drilled Depth :

Contractor Name :
Driller :

Property :
GWMA :
GW Zone :

Standing Water Level : 2.00 m
Salinity :
Yield :

Site Details

Site Chosen By

County	Parish	Portion/Lot DP
Form A : HARDEN	BOBBARA	106
Licensed :		

Region : 40 - MURRUMBIDGEE
River Basin : 410 - MURRUMBIDGEE RIVER
Area / District :

CMA Map : 8628-N BINALONG
Grid Zone : 55/3 **Scale :** 1:50,000

Elevation :
Elevation Source :

Northing : 6170900
Easting : 646200

Latitude (S) : 34° 35' 36"
Longitude (E) : 148° 35' 39"

GS Map : **AMG Zone :** 55 **Coordinate Source :** Map Interpretation

Construction

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1		Hole	Hole	0.00	4.18	50			
1	1	Casing	P.V.C.	-1.00	4.18	50			
1	1	Opening	Slots	0.18	4.18	50			PVC

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

(No Water Bearing Zone Details Found)

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments

Pumping Tests - Summaries

Pumping Test Type	Date	Duration (hr)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By

(No Pumping Test Summary Details Found)

Pumping Tests - Readings

Pumping Test Type	Date	Time (mins)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By

(No Pumping Test Reading Details Found)

Remarks

Property - Bobbara Station

*** End of GW085010 ***

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DEPARTMENT OF LAND & WATER CONSERVATION
Work Summary

GW400070

License :40BL186339

Work Type : Bore
Work Status : Supply Obtained
Construct. Method : Rotary Air
Owner Type : Private

Authorised Purpose(s): DOMESTIC, STOCK
Intended Purpose(s): DOMESTIC, STOCK

Commenced Date :
Completion Date : 20-Aug-1996
Final Depth : 32.70 m
Drilled Depth : 32.70 m

Contractor Name : Robert John NOLAN
Driller : 1557 NOLAN, Robert John

Property : - NA
GWMA : -
GW Zone : -

Standing Water Level :
Salinity :
Yield :

Site Details

Site Chosen By

	County	Parish	Portion/Lot DP
Form A :	HARDEN	BOBBARA	149
Licensed :	HARDEN	BOBBARA	149

Region : 40 - MURRUMBIDGEE
River Basin :
Area / District :

CMA Map :
Grid Zone :
Scale :

Elevation :
Elevation Source :

Northing : 6167495
Easting : 644805

Latitude (S) : 34° 37' 27"
Longitude (E) : 148° 34' 47"

GS Map :
AMG Zone : 55
Coordinate Source :

Construction

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1		Hole	Hole	0.00	8.00	150			Rotary Air
1		Hole	Hole	8.00	32.70	143			
1	1	Casing	P.V.C	0.00	8.00	150			Glued

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
20.60	20.90	0.30		6.00		0.39	23.00		
24.80	25.30	0.50		6.00		0.39	30.00		

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	0.50	0.50	TOP SOIL		
0.50	4.00	3.50	CLAY		
4.00	8.00	4.00	SOFT SHALE		
8.00	20.90	12.90	SHLE ROCK		
20.90	25.70	4.80	GRANITE		
25.70	26.00	0.30	QUARTZ GRANITE		
26.00	32.70	6.70	GRANITE		

Pumping Tests - Summaries

Pumping Test Type	Date	Duration (hr)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By
Single Rate Pumping Test	20-Aug-1996	1.00	6.00	30.00	0.80	30.00	Airlift			

Pumping Tests - Readings

Pumping Test Type	Date	Time (mins)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By

(No Pumping Test Reading Details Found)

Remarks

*** End of GW400070 ***

*** End of Report ***

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Barnu Pty Ltd

Galong Limestone Mine Expansion

Flora Study and Assessment

March, 2003

Prepared by
Geoff Cunningham Natural Resource Consultants Pty Ltd

SPECIALIST CONSULTANT STUDIES

PART 4

CONTENTS

1.0 INTRODUCTION

The study was carried out on behalf of Barnu Pty Ltd [the Proponent].

The Project Site comprises a total area of approximately 160 hectares and is shown in **Figure 1.** The centre of the Project Site is located some 4 kilometres east-northeast of Galong.

A field inspection of the Project Site was carried out on 4th and 5th February, 2003.

Traverses were made by four-wheel drive vehicle and, on foot where the timber cover, fencing and topography precluded driving.

2.0 DESCRIPTION OF THE PROJECT SITE

The Project Site comprises the existing Galong Limestone Mine and coincides with the boundary of Mining Lease 1496. The Project Site includes the area proposed for incorporation within the expanded open-cut mine as well as the area proposed for the main overburden emplacement. In addition, the Project Site comprises a section of Limestone Creek that runs to the east of the existing mine and an area of lower and mid-slopes of the hills to the east.

The Project Site is underlain by limestone with only a few instances of outcrop or large surface floaters evident within the expanded pit area, although there is a major outcrop near the northern boundary of the mining lease.

The area to be covered by the expanded open-cut mine and main overburden emplacement is largely cleared and much had been cropped for cereals in 2002.

The creek line supports an open-timber cover while the slopes are characterised by clumps of remnant native trees.

The creek line and slopes are generally used for grazing although there was evidence of improved pastures being sown on parts of the more open slopes. Much of the area appears to have been cultivated in the past.

3.0 SURVEY METHODOLOGY

The Project Site was assessed using a colour airphoto produced by Geo-Spectrum [Australia] Pty Ltd and supplied by the Company prior to the field survey.

This photo was used during the field survey to locate determine vegetation community features and boundaries.

A total of 24 sample sites were described.

At these selected sites, quadrats 50m x 50 m in area were examined to record the occurrence of all tree, shrub and ground cover species present.

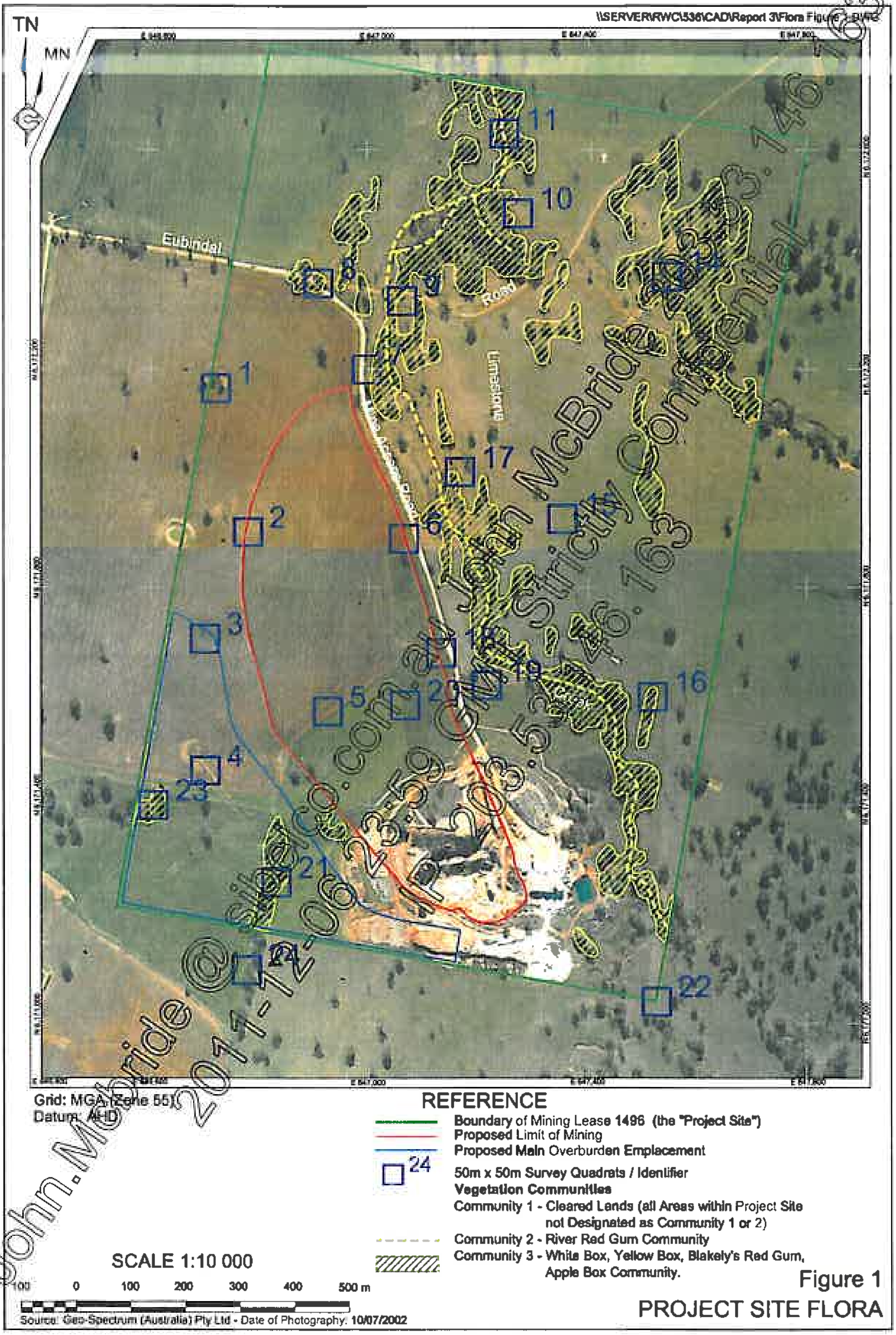

Figure 1
PROJECT SITE FLORA

4.0 VEGETATION OF THE PROJECT SITE

4.1 Previous Botanical Studies

4.1.1 General Information

The Project Site is situated in a region that has received little detailed attention in terms of botanical surveys in the past.

4.1.2 Environmental Impact Statement [EIS] for Galong Limestone Mine

This was prepared in April, 1993 and noted that the area had been highly cleared for grazing, firewood and cropping and that pastures had been improved with clover and exotic grasses.

In the EIS, the main tree species identified on the area studied were White Box [*Eucalyptus albens*], Yellow Box [*Eucalyptus melliodora*], Apple Box [*Eucalyptus bridgesiana*], Blakely's Red Gum [*Eucalyptus blakelyi*] and River Red Gum [*Eucalyptus camaldulensis*].

The Tree of Heaven [*Ailanthus altissima*] thicket between the current pit and Limestone Creek was noted as spreading towards the creek. The EIS also contained, as an Appendix, a more detailed flora and flora report including a listing of species recorded at the site.

The majority of the ground flora species recorded were introduced.

4.1.3 Yass Soil Conservation Service Technical Manual

The Project Site lies largely within the area covered by the Yass District Technical Manual published by the former Soil Conservation Service of New South Wales [Anon, 1974].

The Yass District Technical Manual maps the original vegetation of the general area in which the site is located as being a White Box - Red Gum community dominated by White Box [*Eucalyptus albens*] and Blakely's Red Gum [*Eucalyptus blakelyi*].

The Manual notes that this community occurs as a savannah woodland on lower parts of the regional landscape and has been extensively cleared for agricultural production.

Little further specific detail is supplied in the Yass District Technical Manual.

4.2 The Present Study

The present field study identified three separate vegetation communities within the Project Site.

These are:

- Cleared Lands - Used for Grazing and/or Cultivation;
- River Red Gum Community; and
- White Box - Yellow Box - Blakely's Red Gum - Apple Box Community.

Details of the tree and shrub cover recorded at each quadrat site are contained in Table 1.

*Note: * denotes an introduced species*

TABLE 1
Tree and Shrub Species Occurring in the Vegetation Communities within the Galong Project Site

QUADRAT	LOCATION	DESCRIPTION
1	upper slope	Largely treeless with a clump of Blakely's Red Gum [*Eucalyptus blakelyi*] close by
2	upper slope	Largely treeless with a clump of Blakely's Red Gum [*Eucalyptus blakelyi*] close by
3	upper slope	Treeless. A White Box tree [*Eucalyptus albens*] in the vicinity.
4	lower slope	Treeless. Blakely's Red Gum [*Eucalyptus blakelyi*] and Yellow Box [Eucalyptus melliodora] nearby in depression.
5	lower to mid-slope	Treeless
6	mid-slope	Treeless
7	lower slope	Treeless. Yellow Box in vicinity
8	low crest	T1-5. White Box clump
9	drainage line floodplain [Limestone Creek]	T1-5-10. River red Gum [*Eucalyptus camaldulensis*]
10	drainage line	T<1-5-10 River Red Gum in main creek line closer to Limestone Creek. Apple Box [*Eucalyptus bridgesiana*] in depression further upstream. Mistletoe [*Amyema miquelii*] in Apple Box and River Red Gum. River Red Gum regeneration. Some Briar Rose [*Rosa rubiginosa*]
11	drainage line [Limestone Creek]	T5-15 River Red Gum
12	drainage line	Scattered River Red Gum, some young saplings
13	drainage line	Scattered River Red Gum. Some T3 clumps
14	lower slope	T5-30. Blakely's Red Gum, White Box, Yellow Box, Apple Box
15	lower slope	Treeless
16	lower slope	Treeless
17	creek line [Limestone Creek]	T10-20 River Red Gum
18	floodplain [Limestone Creek]	Treeless
19	floodplain / lower slope [Limestone Creek]	T<1 Tree of Heaven [*Ailanthus altissima*] clump. T<1-5 River Red Gum in Limestone Creek. Occasional Blakely's Red Gum
20	depression	Treeless.
21	lower slope	T1-15 Blakely's Red Gum, Yellow Box, Apple Box
22	lower slope	Treeless
23	lower slope	T5-15 Yellow Box, Blakely's Red Gum, Apple Box; shrubs absent
24	lower slope	T5-15 Yellow Box, White Box, Blakely's Red Gum, Hickory Wattle [*Acacia implexa*]; shrubs absent

***NOTE** - numbers after the symbols 'S' and 'T' denote the spacings [in metres] of shrubs and trees respectively at each site.*

4.2.1 Community 1 - Cleared Lands - Used for Grazing and / or Cultivation

[Quadrats 1,2,3,4,5,6,7,18,20,23]

This community is basically treeless although some shade trees remain as single trees or small clumps of White Box [*Eucalyptus albens*], Blakely's Red Gum [*Eucalyptus blakelyi*], Yellow Box [*Eucalyptus melliodora*] and Apple Box [*Eucalyptus bridgesiana*].

Some of the area has been cropped and other parts appear to have been sown to improved pasture species in the past.

All sections have a high component of introduced species [some of them noxious weeds] in the ground cover layer.

The main ground cover species include Wild Oats [*Avena* sp.*], Mustardweed [Brassicaceae - unidentifiable*], Great Brome [*Bromus diandrus**], Paterson's Curse [*Echium plantagineum**], Annual Ryegrass [*Lolium sp.*]*, Skeleton Weed [*Chondrilla juncea**], Lucerne [*Medicago sativa**], Scotch Thistle [*Onopordum acanthium**], Phalaris [*Phalaris aquatica**], Wireweed [*Polygonum* sp.*] and Wheat [*Triticum aestivum**]

A complete listing of the species recorded in this community is contained in **Table 2**.

4.4.2 Community 2 - River Red Gum [*Eucalyptus camaldulensis*] Community

[Quadrats 9,10,11,12,13,17,19]

This community occurs along Limestone Creek and comprises a high proportion of the remnant native timber stands within the Project Site.

The main species present is River Red Gum with scattered individuals of Blakely's Red Gum [*Eucalyptus blakelyi*] and Apple Box [*Eucalyptus bridgesiana*].

A large clump of the introduced Tree of Heaven [*Ailanthus altissima**] occurs to the east of the present mine, near Limestone Creek and there are scattered occurrence of the noxious Briar Rose *or Sweet Briar* [*Rosa* rubiginosa*] throughout the community.

The main ground cover species are Wild Oats [*Avena* sp.*], Spear Thistle [*Cirsium vulgare**], Couch Grass [*Cynodon dactylon**], Paterson's Curse [*Echium plantagineum**], Paspalum [*Paspalum dilatatum**], Scotch Thistle [*Onopordum acanthium**], Phalaris [*Phalaris aquatica**], Wireweed [*Polygonum* sp.*], Slender Dock [*Rumex brownii*] and Cumbungi [*Typha* sp.].

A complete listing of the species recorded in this community is contained in **Table 2**.

TABLE 2
Ground Cover Species Recorded In Quadrats Within the Galong Project Site

Page 1 of 3

SPECIES	1	2	3	4	5	6	7	8
*Acetosella vulgaris** [Sorrel]	-	-	-	-	-	-	-	-
*Anagallis arvensis** [Scarlet Pimpernell]	-	-	-	P	-	-	-	-
Austrodanthonia sp. [Wallaby Grass]	-	-	-	-	-	-	-	-
Austrostipa bigeniculata [Yanganbil]	-	-	-	-	-	-	-	-
*Avena sp.** [Wild Oats]	P	P	P	P	-	-	P	-
Bothriochloa macra [Red Grass]	-	-	-	-	-	-	-	-
*Brassica napus** [Canola]	-	-	-	P	-	-	-	-
*Brassicaceae species** [Mustardweed]	P	P	P	-	-	-	-	-
*Bromus catharticus** [Prairie Grass]	-	-	-	-	-	-	-	-
*Bromus diandrus** [Great Brome]	P	P	P	P	-	-	P	-
Carex appressa [Tall Sedge]	-	-	-	-	-	-	-	-
*Carthamus lanatus** [Saffron Thistle]	-	-	-	-	-	-	-	-
*Centaurea calcitrapa** [Star Thistle]	-	-	-	-	-	-	-	-
*Centaurea solstitialis** [St Barnaby's Thistle]	-	-	-	-	-	-	-	-
*Chondrilla juncea** [Skeleton Weed]	-	-	-	-	P	-	-	-
*Cichorium intybus** [Chicory]	-	-	-	-	-	-	-	-
*Cirsium vulgare** [Spear Thistle]	-	-	-	-	-	-	-	-
*Cucumis myriocarpus** [Paddy melon]	-	-	-	P	-	-	-	-
*Cynodon dactylon** [Couch Grass]	-	-	-	P	-	-	-	-
*Cynosorus sp.** [Dogstail]	-	-	-	-	-	-	-	-
Cyperaceae species [Sedge]	-	-	-	-	-	-	-	-
*Dactylis glomerata** [Cocksfoot]	-	-	-	-	-	-	-	-
*Echium plantagineum** [Paterson's Curse]	P	P	P	-	-	-	-	-
Epilobium hirtigerum [Willow Herb]	-	-	-	-	-	-	-	-
*Hordeum leporinum** [Barley Grass]	-	-	-	-	-	-	-	-
*Hypochaeris radicata** [Flatweed]	-	-	-	P	-	-	-	-
Juncus sp. [Rush]	-	-	-	-	-	-	-	-
Lolium sp.* [Ryegrass]	P	P	P	P	-	-	-	-
*Malva parviflora** [Small-flowered Mallow]	-	-	-	P	-	-	-	-
*Marrubium vulgare** [Horehound]			-	-	-	-	-	P
*Medicago sativa** [Lucerne]			-	P	-	-	P	-
*Onopordum acanthium** [Scotch Thistle]		-	-	P	-	-	P	P
*Paspalum dilatatum** [Paspalum]	-			-	-	-	-	-
*Phalaris aquatica** [Phalaris]	-	-	-	-	-	-	P	-
*Plantago lanceolata** [Ribwort]	-	-	-	-	-	-	-	-
*Polygonum sp.** [Wireweed]		-	-	P	-	-	P	-
Rumex brownii [Slender Dock]	-	-	-	-	-	-	-	-
*Rumex crispus** [Curled Dock]		-	-	-	-	-	-	-
Rumex sp. [Dock]			-	-	-	-	P	-
*Salvia verbenaca** Wild Sage]	-		-	-	-	-	-	-
*Sonchus oleraceus** [Sowthistle]	-	-	-	P	-	-	P	-
*Trifolium angustifolium** [Narrow-leaf Clover]	-	-	-	-	-	-	-	-
*Trifolium glomeratum** [Cluster Clover]	-	-	-	-	-	-	-	-
*Trifolium subterraneum.** [Subterranean Clover]	-	-	-	-	-	-	-	-
*Triticum aestivum** [Wheat]	P	P	P	-	P	P	P	-
*Trifolium subterraneum** [Subterranean Clover]	-	-	-	-	-	-	-	-
Typha sp. [Cumbungi]	-	-	-	-	-	-	-	-
*Verbascum virgatum** [Twiggy Mullein]	-	-	-	P	-	-	P	-
*Vulpia sp.** [Silver Grass]	-	-	-	-	-	-	-	-

NOTE: Quadrat 14 showed no identifiable ground cover species due to the heavy stocking rate and hand feeding being carried out in the paddock.

TABLE 2 (Continued)
Ground Cover Species Recorded In Quadrats Within the Galong Project Site

Page 2 of 3

SPECIES	9	10	11	12	13	14	15	16
*Acetosella vulgaris** [Sorrel]	-	-	-	-	-	-	P	P
*Anagallis arvensis** [Scarlet Pimpernell]	-	-	-	-	-	-	-	-
Austrodanthonia sp. [Wallaby Grass]	P	-	-	-	-	-	-	-
Austrostipa bigeniculata [Yanganbil]	-	-	-	P	-	-	-	-
*Avena sp.** [Wild Oats]	-	-	P	-	-	-	-	-
Bothriochloa macra [Red Grass]	P	-	-	-	-	-	-	-
*Brassica napus** [Canola]	-	-	-	-	-	-	-	-
*Brassicaceae species** [Mustardweed]	-	-	-	-	-	-	-	-
*Bromus catharticus** [Prairie Grass]	P	-	-	-	-	-	-	-
*Bromus diandrus** [Great Brome]	-	-	-	P	-	-	-	-
Carex appressa [Tall Sedge]	P	-	-	-	-	-	-	-
*Carthamus lanatus** [Saffron Thistle]	-	-	-	-	-	-	-	-
*Centaurea calcitrapa** [Star Thistle]	-	-	-	-	-	-	-	-
*Centaurea solstitialis** [St Barnaby's Thistle]	-	-	-	-	-	-	-	-
*Chondrilla juncea** [Skeleton Weed]		-			-	-	P	P
*Cichorium intybus** [Chicory]	-	-	-	-	-	-	-	-
*Cirsium vulgare** [Spear Thistle]	-	P	P	P	-	-	-	-
*Cucumis myriocarpus** (Paddy melon)	-	-	-	-	-	-	-	-
*Cynodon dactylon** [Couch Grass]	P	P	-	-	-	-	-	-
*Cynosorus sp.** [Dogstail]	-	P	-	-	-	-	-	-
Cyperaceae species [Sedge]	-	-	-	-	-	-	-	-
*Dactylis glomerata** [Cocksfoot]	-	-	-	-	-	-	-	-
*Echium plantagineum** [Paterson's Curse]	P	P	-	P	-	-	-	-
Epilobium hirtigerum [Willow Herb]	-	-	-	-	-	-	-	-
*Hordeum leporinum** [Barley Grass]	-	P	-	-	-	-	-	-
*Hypochaeris radicata** [Flatweed]	P	P	-	-	-	-	-	-
Juncus sp. [Rush]	P	P	-	-	-	-	-	-
Lolium sp.* [Ryegrass]	P	-	-	-	-	-	-	-
*Malva parviflora** [Small-flowered Mallow]	-	-	-	-	-	-	-	-
*Marrubium vulgare** [Horehound]	-	-	-	-	-	-	-	-
*Medicago sativa** [Lucerne]	-	-	-	P	-	-	P	P
*Onopordum acanthium** [Scotch Thistle]	P	P	P	-	-	-	P	P
*Paspalum dilatatum** [Paspalum]	P	P	P	-	-	-	-	-
*Phalaris aquatica** [Phalaris]	P	P	P	P	P	-	P	P
*Plantago lanceolata** [Ribwort]	P	-	P	-	-	-	-	-
*Polygonum sp.** [Wireweed]	P	P	-	-	-	-	-	-
Rumex brownii [Slender Dock]	P	-	P	-	-	-	-	-
*Rumex crispus** [Curled Dock]	-	-	-	P	-	-	-	-
Rumex sp. [Dock]	-	P	-	-	-	-	-	-
*Salvia verbenaca** Wild Sage]	-	-	-	-	-	-	-	-
*Sonchus oleraceus** [Sowthistle]	-	-	-	-	-	-	-	-
*Trifolium angustifolium** [Narrow-leaf Clover]	-	-	-	-	-	-	-	-
*Trifolium glomeratum** [Cluster Clover]	P	-	-	-	-	-	-	-
*Trifolium subterraneum.** [Subterranean Clover]	-	-	-	-	-	-	-	-
*Triticum aestivum** [Wheat]	-		-	P	-	-	-	-
*Trifolium subterraneum** [Subterranean Clover]	P	-	-	P	-	-	-	-
Typha sp. [Cumbungi]	-	P	-	P	P	-	-	-
*Verbascum virgatum** [Twiggy Mullein]	-	-	-	P	-	-	-	-
*Vulpia sp.** [Silver Grass]	-	-	-	-	-	-	-	-

TABLE 2 (Continued)
Ground Cover Species Recorded In Quadrats Within the Galong Project Site

SPECIES	17	18	19	20	21	22	23	24
*Acetosella vulgaris** [Sorrel]	-	-	-	-	-	[illegible]	-	-
*Anagallis arvensis** [Scarlet Pimpernell]	-	-	-	-	-	-	[illegible]	-
Austrodanthonia sp. [Wallaby Grass]	-	-	-	-	-	[illegible]	[illegible]	-
Austrostipa bigeniculata [Yanganbil]	-	-	-	-	-	P	[illegible]	-
*Avena sp.** [Wild Oats]	-	-	-	-	P	P	-	-
Bothriochloa macra [Red Grass]	-	-	-	-	[illegible]	-	-	-
*Brassica napus** [Canola]	-	-	-	-	-	[illegible]	-	-
*Brassicaceae species** [Mustardweed]	-	-	-	-	[illegible]	-	-	-
*Bromus catharticus** [Prairie Grass]	-	-	-	-	-	-	-	-
*Bromus diandrus** [Great Brome]	-	P	-	P	P	-	-	-
Carex appressa Tall Sedge]	-	-	-	[illegible]	-	-	-	-
*Centaurea calcitrapa** [Star Thistle]	-	-	-	[illegible]	-	-	-	-
*Centaurea solstitialis** [St Barnaby's Thistle]	-	-	-	[illegible]	[illegible]	-	-	-
*Chondrilla juncea** [Skeleton Weed]	-	-	-	[illegible]	[illegible]	-	-	-
*Cichorium intybus** [Chicory]	-	-	-	P	[illegible]	-	P	-
*Cirsium vulgare** [Spear Thistle]	-	-	P	-	-	-	P	P
*Cucumis myriocarpus** (Paddy melon]	-	-	[illegible]	[illegible]	-	-	-	-
*Cynodon dactylon** [Couch Grass]	-	-	[illegible]	[illegible]	-	-	-	-
*Cynosorus sp.** [Dogstail]	-	-	[illegible]	-	-	-	-	-
Cyperaceae species [Sedge]	P	-	-	-	[illegible]	-	-	-
*Dactylis glomerata** [Cocksfoot]	-	-	P	-	[illegible]	-	-	-
*Echium plantagineum** [Paterson's Curse]	-	P	P	-	P	P	P	P
Epilobium hirtigerum [Willow Herb]	-	[illegible]	-	P	-	-	-	-
*Hordeum leporinum** [Barley Grass]	-	-	-	[illegible]	-	-	P	P
*Hypochaeris radicata** [Flatweed]	-	-	[illegible]	[illegible]	-	-	-	-
Juncus sp. [Rush]	P	-	-	[illegible]	-	-	-	-
Lolium sp.* [Ryegrass]	-	-	-	-	P	-	-	-
*Malva parviflora** [Small-flowered Mallow]	[illegible]	[illegible]	-	-	-	-	-	-
*Marrubium vulgare** [Horehound]	[illegible]	[illegible]	[illegible]	-	-	-	-	-
*Medicago sativa** [Lucerne]	[illegible]	-	-	-	-	-	-	-
*Onopordum acanthium** [Scotch Thistle]	-	P	P	-	P	-	P	P
*Paspalum dilatatum** [Paspalum]	-	-	[illegible]	-	-	-	-	
*Phalaris aquatica** [Phalaris]	P	P	P	-	-	-	P	P
*Plantago lanceolata** [Ribwort]	[illegible]	-	-	-	-	-	-	-
*Polygonum sp.** [Wireweed]	-	-	-	-	-	-	-	-
Rumex brownii [Slender Dock]	[illegible]	-	-	-	-	-	-	-
*Rumex crispus** [Curled Dock]	P	-	-	-	-	-	-	-
Rumex sp. [Dock]	-	[illegible]	-	-	-	-	-	-
*Salvia verbenaca** [Wild Sage]	-	-	-	-	-	P	-	-
*Sonchus oleraceus** [Sowthistle]	-	-	-	-	-	-	-	-
*Trifolium angustifolium** [Narrow-leaf Clover]	-	-	-	-	-	P	-	-
*Trifolium glomeratum** [Cluster Clover]	-	-	-	-	-	-	-	-
*Trifolium subterraneum.** [Subterranean Clover]	-	-	-	P	-	-	P	P
*Triticum aestivum** [Wheat]	-	-	-	-	-	-	-	-
*Trifolium subterraneum** [Subterranean Clover]	-	-	-	-	-	-	-	-
Typha sp. [Cumbungi]	-	-	-	-	-	P	-	-
*Verbascum virgatum** (Twiggy Mullein)	-	-	-	-	-	-	-	-
*Vulpia sp.** [Silver Grass]	-	-	-	P	P	-	-	-

4.4.3 Community 3 - White Box [*Eucalyptus albens*] - Yellow Box [*Eucalyptus melliodora*] - Blakely's Red Gum [*Eucalyptus blakelyi*] Apple Box [*Eucalyptus bridgesiana*] Community

[Quadrats 8,14,21,23,24]

This community is comprised of scattered clumps and some larger remnants of woodland. White Box and Blakely's Red Gum tend to be most common on the upper slopes and crests while Yellow Box and Apple Box are more common on the lower slopes - although all species except White Box can be found over much of the area occupied by this community.

The main ground cover species include Wild Oats [*Avena* sp.*], Great Brome [*Bromus diandrus**], Paterson's Curse [*Echium plantagineum**], Annual Ryegrass [*Lolium* sp.*], Scotch Thistle [*Onopordum acanthium**] and Silver Grass [*Vulpia* spp.*].

A complete listing of the species recorded in this community is contained in **Table 2.**

4.4 Noxious Weed Considerations

The Project Site is invaded to various degrees by weed species that are listed as being NOXIOUS for Harden Shire on the NSW Agriculture Website. [*search date 12th February, 2003*]

These are:

- *Echium plantagineum* [Paterson's Curse]
- *Marrubium vulgare* [Horehound]
- *Onopordum acathium* [Scotch Thistle]
- *Rosa rubiginosa* [Sweet Briar]

All of these species will need to be controlled.

In addition, the Tree of Heaven [*Ailanthus altissima**] clump near the current mine and adjacent to Limestone Creek should be removed to prevent any further spread of this species.

5.0 KOALA HABITAT CONSIDERATIONS

Circular B35 issued to Councils by the Department of Urban Affairs and Planning provides information on State Environmental Planning Policy No 44 - Koala Habitat Protection (SEPP 44).

The Project Site is situated within Harden Shire

Schedule 1 of the Policy does not list the Harden Shire as a local government area to which the Policy applies.

Therefore, further consideration of possible impacts of the proposed development on Koalas is not required.

6.0 THREATENED SPECIES ISSUES

Prior to the field survey, requests were made to the NSW National Parks and Wildlife Service 'Atlas of NSW Wildlife' database for details of occurrences of any Threatened Species of plants listed in Schedules 1 and 2 of the Threatened Species Conservation Act 1995.

6.1 The 'Atlas of NSW Wildlife' Data

The database was searched for records from within a 60km x 60km square centred on the Project Site that is located within the Yass 1: 100 000 map sheet [8628]. [*date of search 24th January, 2003*]

Six collections of one Threatened flora species are recorded for this map sheet area.
The collection records are for:

Ammobium craspedioides **[Yass Daisy]** - recorded from 14km west of Yass; between Yass and Rye Park; near Bowning cemetery; 1km west of Binalong; 1km west of Bookham.

This species is discussed in **Table 3.**

The National Parks and Wildlife Service also has, for some 1: 100 000 map sheet areas additional data about threatened species that are likely to occur within the particular region based on predictions using the **Bioclim** Model.

Unfortunately there is no data of this nature available for the Yass sheet.

6.2 Predicted Occurrences [Ayres et al, 1996]

The predictions contained in Ayres et al [1996] indicate the possible occurrence of two Threatened flora species in the region around Galong.

These species are:

- *Lepidium hyssopifolium*
- *Swainson recta*

In addition to the species covered by Ayres et al [1996], details of recorded occurrences of thirteen other plant species listed in the Schedules of the Threatened Species Conservation Act 1995 but for which Ayres et al provide no information have been checked to ascertain if these species are likely to occur in the Project Site.

These latter species are:

- *Amphibromus fluitans*
- *Calotis glandulosa*
- *Eucalyptus cannonii*
- *Goodenia macbarronii*
- *Thesium australe*
- *Caesia parviflora* var. *minor*
- *Diuris sheaffiana [tricolor]*
- *Euphrasia arguta*
- *Senecio garlandii*
- *Zieria obcordata*

[illegible]
Table 3.

6.4 Commonwealth Environment Protection and Biodiversity Conservation Act [EPBC Act] Online Database Listing

A search of the Commonwealth Environment Protection and Biodiversity Conservation Act Online Database revealed that five plant species listed as threatened species under this Act were likely to occur in the 30 km radius of the centre of the Project Site [34^0 35' 30" S; 148^0 36' 00" E]. [search date 2nd February, 2003]

These species are:

- *Ammobium craspedioides* [Yass Daisy]
- *Caladenia concolor* [Crimson Spider-orchid]
- *Diuris sheaffiana* [Tricolour Diuris]
- *Goodenia macbarronii* [Narrow Goodenia]
- *Prasophyllum petilum*

These species are discussed in **Table 3**.

6.5 Endangered Ecological Communities and Populations

The Schedules of the New South Wales Threatened Species Conservation Act 1995 have been checked and it has been ascertained that there are no Endangered plant populations recorded for the site. [search date 12th February, 2003]

However, the Endangered Ecological White Box, Yellow Box, Blakely's Red Gum Woodland Community [see **Appendix 1** for description] that is listed in the Schedules of the NSW Threatened Species Conservation Act 1995 is likely to occur in the Galong region.

The Commonwealth Environment Protection and Biodiversity Conservation Act 1999 Schedule of Threatened Ecological Communities also lists *Grassy White Box Woodlands* as likely to occur in the region surrounding the Project Site.

This community has the status of 'Endangered' under the EPBC Act.

TABLE 3
Assessment of the Likelihood of Occurrence of Threatened Flora Species at the Galong Limestone Mine Site

SPECIES	ASSESSMENT
Ammobium craspedioides	This species is basically restricted to the Yass district. It has been recorded from between Yass and Rye Park, near Binalong, Bookham and Bowning and from sites about 14km west of Yass. It is found in sclerophyll woodlands and forests and along roadsides. **A POSSIBLE OCCURRENCE AT THE SITE.** The species was not recorded during the field inspection and there are no records of its presence at the site in the past. IT IS CONCLUDED THAT THIS SPECIES IS NOT PRESENT AT THE SITE.
Diuris sheaffiana [tricolor]	A terrestrial orchid now included in *Diuris tricolor* along with *Diuris colemanae*; grows in sclerophyll forest among grass, often with *Callitris* trees: Bishop [1996] notes that it occurs predominantly in the western slopes, extending from south of Narrandera all the way to the far north of NSW, but sporadically distributed; usually in Callitris woodland, growing in sandy soils, in flat country or often on tops of small hills. **A POSSIBLE, THOUGH UNLIKELY, OCCURRENCE AT THE SITE**, as preferred soils are absent. The species was not recorded during the field inspection and there are no records of its presence at the site in the past. IT IS CONCLUDED THAT THIS SPECIES IS NOT PRESENT AT THE SITE.
Caesia parviflora var. *minor*	This lily grows in heath, woodland and dry sclerophyll forest on sandstone derived soils, south from the Corindi area. **A POSSIBLE, THOUGH UNLIKELY, OCCURRENCE AT THE SITE**, as preferred soils are absent. The species was not recorded during the field inspection and there are no records of its presence at the site in the past. IT IS CONCLUDED THAT THIS SPECIES IS NOT PRESENT AT THE SITE.
Caladenia concolor	A terrestrial orchid known from old records at Tumbarumba, Cootamundra and Albury. It favours clay soils in hilly areas in eucalypt forest that support a shrubby understorey [Bishop, 1996]. **A POSSIBLE OCCURRENCE AT THE SITE.** The species was not recorded during the field inspection and there are no records of its presence at the site in the past. IT IS CONCLUDED THAT THIS SPECIES IS NOT PRESENT AT THE SITE.
Calotis glandulosa	Erect or ascending branched herb to 35cm high, +/- woody at base; grows in grasslands and sclerophyll forest at higher altitudes, from Eden to the Dubbo area. **A POSSIBLE OCCURRENCE AT THE SITE.** The species was not recorded during the field inspection and there are no records of its presence at the site in the past. IT IS CONCLUDED THAT THIS SPECIES IS NOT PRESENT AT THE SITE.
Eucalyptus cannonii	Tree to 15m high that is locally frequent but restricted, grows in sclerophyll woodland on shallow soils on rises; Rylstone to upper Wolgan Valley. **A POSSIBLE, BUT UNLIKELY, OCCURRENCE AT THE SITE** which is well away from its normal range. The species was not recorded during the field inspection and there are no records of its presence at the site in the past. IT IS CONCLUDED THAT THIS SPECIES IS NOT PRESENT AT THE SITE.
Euphrasia arguta	An erect annual herb 20-35 cm high; recorded in grassy areas near rivers, from Bathurst to Walcha area (possibly extinct). Elliott and Jones [1986] also note that it is evidently extinct as it has not been collected since about 1911. A POSSIBLE, THOUGH UNLIKELY, **OCCURRENCE AT THE SITE**, as preferred habitat is absent. The species was not recorded during the field inspection and there are no records of its presence at the site in the past. IT IS CONCLUDED THAT THIS SPECIES IS NOT PRESENT AT THE SITE.
Goodenia macbarronii	Annual or short-lived perennial herb with leaves up to 11cm long and flowerheads to 30cm high; grows in damp sandy soils south from the Guyra and Inverell districts; ranges from NE Victoria, western slopes and plains and the tablelands of NSW and Darling Downs of Queensland; records from Ovens River [Vic], 1853; Maryland [1885], Tingha [1917], Chandlers Peak, Guyra [1917], Warrumbungle Ranges [1883], 24km east of Rylstone [1953], Fletcher [Stanthorpe district, Queensland]. **A POSSIBLE, THOUGH UNLIKELY,** OCCURRENCE **AT** THE SITE, as preferred habitat is absent. The species was not recorded during the field inspection and there are no records of its presence at the site in the past. IT IS CONCLUDED THAT THIS SPECIES IS NOT PRESENT AT THE SITE.
Homoranthus darwinioides	A spreading shrub usually 1 to 1.5 m high; grows in dry sclerophyll forest or woodland; usually on sandstone outcrops or ridges; rare; recorded from the Putty district to Dubbo; **A POSSIBLE, THOUGH UNLIKELY, OCCURRENCE AT THE SITE**, as preferred habitat is absent. The species was not recorded during the field inspection and there are no records of its presence at the site in the past. IT IS CONCLUDED THAT THIS SPECIES IS NOT PRESENT AT THE SITE.
Lepidium hyssopifolium	Recorded from the Bathurst district and near the Queensland border; a specimen from Cooma in which the hairs on the leaves are atypical is doubtfully included. **A POSSIBLE OCCURRENCE AT THE SITE.** The species was not recorded during the field inspection and there are no records of its presence at the site in the past. IT IS CONCLUDED THAT THIS SPECIES IS NOT PRESENT AT THE SITE
Prasophyllum petilum	A terrestrial orchid known only from three localities - one in the Australian Capital territory and the other two from the Central Tablelands. Bishop notes that it is recorded from silty loam soil flats in remnant grassland among *Themeda* [Kangaroo Grass] plants [Bishop, 1996] **A POSSIBLE OCCURRENCE AT THE SITE.** The species was not recorded during the field inspection and there are no records of its presence at the site in the past. IT IS CONCLUDED THAT THIS SPECIES IS NOT PRESENT AT THE SITE.
Swainson recta	An erect and ascending perennial forb to 20 cm high; grows in grassland and open woodland, often on stony hillsides; Thompson [1993] notes that it is recorded from the central and southern western slopes and tablelands of NSW and adjacent parts of Victoria; it occurs in grassland and open woodland, often on stony hillsides; recorded from Wellington [1886], Mudgee [1885], between Carcoar and Canowindra [1888], Wagga Wagga [1900]. . **A POSSIBLE OCCURRENCE AT THE SITE.** The species was not recorded during the field inspection and there are no records of its presence at the site in the past. IT IS CONCLUDED THAT THIS SPECIES IS NOT PRESENT AT THE SITE.
Thesium australe	A widespread but rare herb that grows in grassland or woodland, often in damp sites; probably widespread but rare and possibly endangered; not recorded recently. **A POSSIBLE, THOUGH UNLIKELY, OCCURRENCE AT THE SITE** [The only suitable habitat would be near Limestone Creek and this area has been subjected to domestic livestock grazing for many years, making it unlikely that this species would occur]. The species was not recorded during the field inspection and there are no records of its presence at the site in the past. IT IS CONCLUDED THAT THIS SPECIES IS NOT PRESENT AT THE SITE.
Zieria obcordata	A shrub that grows in eucalypt woodland or shrubland dominated by species of Acacia, on rocky hillsides; occurs near Wellington and Bathurst; rare. **A POSSIBLE, THOUGH UNLIKELY, OCCURRENCE AT THE SITE.** The species was not recorded during the field inspection and there are no records of its presence at the site in the past. IT IS CONCLUDED THAT THIS SPECIES IS NOT PRESENT AT THE SITE.

6.6 Field Survey Data

6.6.1 Threatened Plant Species

The list of threatened plants likely to occur in the general region of the Project Site was kept in mind during the field survey of the Galong Limestone Mine area.

No Threatened plant species were recorded within the area.

6.6.2 Endangered Ecological Communities

The overall mining lease area contains remnant vegetation that can be described as representative of the Endangered White Box - Yellow Box - Blakely's Red Gum Woodland Community [NSW] and the Grassy White Box Woodlands [EPBC Act].

6.6.2.1 The Extended Open-Cut Mine Area

The proposed expansion of the pit will involve the eventual removal of a small number of trees [probably less than 10] that are constituents of the floral assemblages that are of these two endangered communities.

However, given the degree of clearing that has taken place within the expanded pit area, and the heavily invaded nature of the ground flora over this area, the vegetation present **cannot** be classed as a remnant of these Endangered communities.

6.6.2.2 The Overburden Emplacement Site

The area proposed for the overburden emplacement does however contain remnants of this community.

There are in the vicinity of twenty trees that will need to be removed to enable the progressive construction of the emplacement as shown in **Figure 1**. The species involved include Yellow Box, Apple Box, Blakely's Red Gum and White Box [very few].

Most of the trees to be removed are approaching maturity, and even senescence. No shrub layer species are present and the ground layer species are almost entirely introduced.

These remnants are quite poor representatives of the original White Box - Yellow Box - Blakely's Red Gum Woodland [NSW] and Grassy White Box Woodlands [EPBC Act] Communities.

Perusal of the 1: 25 000 scale airphotos covering the region around Galong indicates that there is a much wider distribution of these communities within the local area.

Removal of the twenty or so mature trees within the waste dump site will not significantly impact on the area of the Endangered original White Box - Yellow Box - Blakely's Red Gum Woodland [NSW] and Grassy White Box Woodlands [EPBC Act] community remnant occurring within the region nor on its overall survival.

6.6.3 Endangered Flora Populations

There are no Endangered Flora Populations listed in the Schedules of the Threatened Species Conservation Act 1995 for the Project Site.

6.6.4 Critical Habitat

There are no areas of critical habitat listed for the Project Site or its environs.

6.6.5 Introduced Plant Species

Of the 47 ground cover [pasture] species recorded in the Project Site, some 38 [81%] are introduced.

These are either naturalised exotics or weed species or have been sown as improved pasture species.

The proportion of the cover provided by introduced species on ALL sections of the Project Site is quite significant - to the extent that an estimated >95% of the cover and bulk of groundcover species is provided by exotic species.

The only areas where there is a noticeable component of native ground cover species are in the vicinity of sections of Limestone Creek.

This groundcover dominance by introduced species would be further exacerbated in the cooler months when the introduced annuals and many of the perennial pasture species are more prevalent.

6.6.6 Eight Part Test

The likelihood of the occurrence of the Threatened flora species has been assessed in **Table 3**.

The Project Site has been highly modified from its original condition and habitat values as a consequence of previous agricultural use including thinning of the tree cover and complete clearing for grazing and cropping.

Many sections of the Project Site have been sown to improved pastures and groundcover weed species are prevalent.

It should also be noted that much of the proposed area of disturbance with the Project Site is located mainly on land that has been cropped and which supports few native trees and groundcover species. The remaining part of the Project Site is highly invaded by improved and naturalised [introduced] pasture species.

There is no suitable habitat present at the Project Site for many of the Threatened flora species likely / predicted to occur there.

Field observations have failed to record any Threatened flora species and there are no past records of any Threatened flora species at the within the Project Site.

The outcome of the assessments and field survey observations has been the conclusion that [illegible]

Galong occurs at the Galong Limestone Mine site.

For the purposes of the Environmental Planning and Assessment Act the following factors must be taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

[a] in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction,

No threatened flora species were recorded during the field survey and there are no records of collections of threatened flora species from the Project Site. Consequently there will be no disruption to the life cycle of a Threatened flora species caused by the proposed development.

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

No threatened plant populations have been listed in the Schedules of the NSW Threatened Species Conservation Act 1995 or the Commonwealth Environment Protection and Biodiversity Conservation Act for the Project Site. As a consequence, the proposed development will not disrupt / compromise any local populations of threatened plant species.

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

The Project Site is not considered to constitute a significant habitat for any threatened plant species or flora population. No threatened populations of flora are listed for the Project Site, and none were recorded during field survey, and so there will not be any significant modification or removal of habitat of threatened flora species or flora populations.

The proposed expansion of the open-cut mine will involve the removal of a small number of eucalypts that are constituent species of the original White Box - Yellow Box - Blakely's Red Gum Woodland [NSW] and Grassy White Box Woodlands [EPBC Act] Endangered Ecological Community. However these trees are scattered through cultivation paddocks and vary in condition. They are NOT considered to form a remnant of these Endangered Ecological Community.

Creation of the main overburden emplacement to the west of the existing open-cut mine will result in the removal of about twenty trees within a small remnant of the original White Box - Yellow Box - Blakely's Red Gum Woodland [NSW] and Grassy White Box Woodlands [EPBC Act].

This remnant is comprised of aged Yellow Box, White Box[few], Blakely's Red Gum and Apple Box trees. A shrub layer is absent and the ground layer species are almost entirely introduced weed and pasture species.

Given the condition of this remnant and the small number of trees to be removed when considered in the light of the number of remaining trees of these species to be found in the vicinity and the region generally, it is concluded that this action will not have a significant impact on the areal extent or survival of these Endangered Ecological Communities.

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

The Project Site does not constitute a known habitat for any threatened plant species or population. The Project Site is surrounded by remnants of the original White Box - Yellow Box - Blakely's Red Gum Woodland [NSW] and Grassy White Box Woodlands [EPBC Act] Endangered Ecological Community. The proposed development will not cause any isolation. Consequently there will no significant impact.

[e] whether critical habitat will be affected,

No critical habitat exists at the Project Site. Therefore the proposed development will not affect critical habitat.

[f] whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves [or similar protected areas] in the regional environment of the species, population or community,

The Project Site in its present state does not support any threatened plant species or population and so this part is not relevant to consider in the context of threatened species or flora populations.

However, in relation to the White Box - Yellow Box - Blakely's Red Gum Woodland [NSW] and Grassy White Box Woodlands [EPBC Act] it is notes that this community is regarded as being poorly represented in conservation reserves although it is recorded from Border Ranges National Park, Goulburn River National Park, Mount Kaputar National Park, Oxley Wild Rivers National Park, Queanbeyan Nature Reserve, Warrumbungle National Park, and Wollemi National Park. It also occurs in Copeton, Lake Glenbawn and Lake Keepit State Recreation Areas [Scientific Committee, 2002].

[g] whether the development or activity is of a class of development or activity that is recognised as a threatening process,

'Clearing of Native Vegetation' has been listed as a Key Threatening Process on Schedule 3 to the Threatened Species Conservation Act 1995.

'Land Clearance' is also listed as a Key Threatening Process under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999.

The proposed expansion of the open-cut mine and establishment of the main overburden emplacement will involve some clearance of native vegetation, but this will be minimal.

However, as a consequence of past clearing, grazing and cropping as well as invasion of the site by a wide range of exotic weed species, the native plant communities have been heavily modified over almost all of the Project Site.

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

No.

6.6.7 Threatened Species Overview

[i] There are no records of threatened plant species contained in the Atlas of NSW Wildlife' or the Commonwealth Environment Protection and Biodiversity Conservation Act on-line database for the Project Site.

[ii] No Threatened plant species were recorded from the Project Site during field survey, despite predictions and records that indicated that a number of Threatened flora species might be likely to occur within the Project Site. The likely occurrence of these species has been assessed in **Table 3** above.

[iii] Much of the Project Site has been cleared, cropped and sown to improved pastures for many years. The Project Site has been heavily invaded by introduced weed species.

[iv] Remnants of the White Box - Yellow Box - Blakely's Red Gum Woodland [NSW] and Grassy White Box Woodlands [EPBC Act] Endangered Ecological Community occur within the Project Site. Expansion of the open cut mine will not impact on these communities. However, creation of the main overburden emplacement will involve removal of about 20 mature trees of the species typical of these Communities. In view of the present condition of the community and the quantity of remnants of this community present within the locality and the region it has been concluded that there will be no significant impact from construction of the main overburden emplacement.

[v] There is no critical habitat listed for the Project Site or its environs.

[vi] It is concluded that there will be no significant impact on Threatened flora species, Endangered Ecological Communities or Endangered Flora Populations or Critical Habitat as a consequence of the expansion of the Galong Limestone Mine.

7.0 OVERVIEW

7.1 General Considerations

On the basis of the flora survey conducted in February, 2003, the assessment of the data obtained from the National Parks and Wildlife Service database and the details of Endangered Ecological Communities listed in the Schedules of the *Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999* it is concluded that no Threatened flora species or populations exist on the Galong Project Site.

However, remnants of the original White Box - Yellow Box - Blakely's Red Gum Woodland [illegible] Site.

The proposed development involves the removal of about twenty trees within a poor condition remnant of these communities. This clearing is not considered to have a significant impact on the local or regional extent of these communities nor on their survival.

The vegetation is relatively heavily invaded by introduced plants.

Completion of the 8-Part Test indicates that there will be no significant impact on any Threatened flora species, populations, Endangered Ecological Communities or critical habitat resulting from development of the Galong Project Site.

7.2 Required Operational Safeguards

The remnants of native vegetation communities are in a highly invaded state.

The main area of native trees is associated with part of the limestone outcrop that will be mined and so most of these will be removed over time.

Wherever possible throughout the Project Site, the remnant trees not required to be removed to allow mining should be retained.

Given the large scale clearing, the long-term agricultural land use and the widespread improved pasture species introduction that has occurred on the Galong Limestone Mine site it is highly unlikely that any threatened flora species would be found at the site during the life of the mine.

If, by some chance, an apparently unusual plant species is found on the site in the future, operations that might jeopardise the survival of that species should cease immediately.

A plant ecologist who is suitably qualified and experienced in identification of threatened flora species should be:

- contacted and requested to inspect the site as soon as possible;
- asked to determine whether or not the species is listed on the schedules of the NSW Threatened Species Conservation Act 1995 or the Commonwealth Environment Protection and Biodiversity Conservation Act 1999; and
- requested to advise on any future management and conservation requirements that may be necessary.

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APPENDICES

Appendix 1 **Listing of Plant Species Recorded from the Galong Limestone Mine Project Site During the February, 2003 Survey**

APPENDIX 1

(No. of pages excluding this page = 2)

LISTING OF PLANT SPECIES RECORDED FROM THE GALONG LIMESTONE MINE PROJECT SITE DURING THE FEBRUARY, 2003 SURVEY

APPENDIX 1

LISTING OF PLANT SPECIES RECORDED FROM THE GALONG LIMESTONE MINE PROJECT SITE DURING THE FEBRUARY, 2003 SURVEY

Acacia implexa [Hickory Wattle]
*Acetosella vulgaris** [Sorrel]
*Ailanthus altissima** [Tree-of-Heaven]
*Anagallis arvensis** [Scarlet Pimpernell]
Austrodanthonia sp. [Wallaby Grass]
Austrostipa bigeniculata [Yanganbil]
*Avena sp.** [Wild Oats]
Bothriochloa macra [Red Grass]
*Brassica napus** [Canola]
*Brassicaceae species** [Mustardweed]
*Bromus catharticus** [Prairie Grass]
*Bromus diandrus** [Great Brome]
Carex appressa Tall Sedge]
*Centaurea calcitrapa** [Star Thistle]
*Centaurea solstitialis** [St Barnaby's Thistle]
*Chondrilla juncea** [Skeleton Weed]
*Cichorium intybus** [Chicory]
*Cirsium vulgare** [Spear Thistle]
*Cucumis myriocarpus** [Paddy melon]
*Cynodon dactylon** [Couch Grass]
*Cynosorus sp.** [Dogstail]
Cyperaceae species [Sedge]
*Dactylis glomerata** [Cocksfoot]
*Echium plantagineum** [Paterson's Curse]
Epilobium hirtigerum [Willow Herb]
Eucalyptus albens [White Box]
Eucalyptus blakelyi [Blakely's Red Gum]
Eucalyptus bridgesiana [Apple Box]
Eucalyptus camaldulensis [River Red Gum]
Eucalyptus melliodora [Yellow Box]
*Hordeum leporinum** [Barley Grass]
*Hypochaeris radicata** [Flatweed]
Juncus sp. [Rush]
*Lolium sp.** [Ryegrass]
*Malva parviflora** [Small-flowered Mallow]
*Marrubium vulgare** [Horehound]
*Medicago sativa** [Lucerne]
*Onopordum acanthium** [Scotch Thistle]
*Paspalum dilatatum** [Paspalum]
*Phalaris aquatica** [Phalaris]
*Plantago lanceolata** [Ribwort]
*Polygonum sp.** [Wireweed]
*Rosa rubiginosa** [Briar Rose]
Rumex brownii [Slender Dock]
*Rumex crispus** [Curled Dock]

APPENDIX 1 (Continued)

LISTING OF PLANT SPECIES RECORDED FROM THE GALONG LIMESTONE MINE PROJECT SITE DURING THE FEBRUARY, 2003 SURVEY

Rumex sp. [Dock]
*Salvia verbenaca** [Wild Sage]
*Sonchus oleraceus** [Sowthistle]
*Trifolium angustifolium** [Narrow-leaf Clover]
*Trifolium glomeratum** [Cluster Clover]
*Triticum aestivum** [Wheat]
*Trifolium subterraneum** [Subterranean Clover]
Typha sp. [Cumbungi]
*Verbascum virgatum** [Twiggy Mullein]
*Vulpia sp.** [Silver Grass]

Barnu Pty Ltd

Galong Limestone Mine Expansion

Fauna Study and Assessment

April, 2003

Prepared by
Countrywide Ecological Service

SPECIALIST CONSULTANT STUDIES

PART 5

FAUNA STUDY AND ASSESSMENT

OF THE PROPOSED

GALONG LIMESTONE MINE EXPANSION

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EXECUTIVE SUMMARY

The Galong Limestone Mine is located approximately 20km east-southeast of Harden, NSW. The Project Site covers some 160ha and includes approximately 1.0km of a Crown Road Reserve. The Proponent, Barnu Pty Ltd, proposes to expand mining operations and increase production from the mine.

This report details the methods used and the results obtained from a fauna survey conducted on 5 and 6 February 2003 over parts of the Project Site likely to be impacted by the Proponent's proposed development. It discusses and assesses the likely impact this proposed development may have on all protected fauna and, in particular, on any threatened species, populations and communities that were recorded or those that may occur in the area and immediate environs, including a "wetland" area ("the Survey Area").

The area sampled consists of the riparian habitat River Red Gum corridor and Tree of Heaven thicket along Limestone Creek, the largely cleared and cultivated paddocks to the northwest and west of the existing open-cut mine and sporadic tree lines along some of the fences and drainage lines. These habitat types correspond to Communities 1 to 3 in Geoff Cunningham Natural Resource Consultants (2003).

The results of this fauna survey and assessment must be considered in the light of the very severe drought the region has been experiencing. Notwithstanding the highly altered ecology of the habitat from its long history of agricultural landuse, the drought must have a significant impact on the fauna community in the Survey Area. Limestone Creek, which runs through the Survey Area, was completely dry at the time of the survey.

Section 5A assessments were conducted only on the threatened species that may be affected by this proposed activity, viz. the species that may occur in the Survey Area, i.e. the Superb and Swift Parrots and the species that were recorded in the Survey Area, the Yellow-bellied Sheathtail Bat and the Large Bent-wing Bat.

The proposed for expansion of the Galong Limestone Mine appears:

i) unlikely to significantly affect any of the listed threatened species, fauna populations or communities;

ii) unlikely to augment or significantly contribute to any of the Federal or State listed key threatening processes;

iii) unlikely to significantly affect any RAMSAR wetland or CAMBA /JAMBA listed species;

iv) unlikely to significantly affect Limestone Creek if adequate safeguards are adopted;

v) unlikely to significantly affect any regionally significant species;

vi) unlikely to affect any core or potential Koala habitat; and

vii) consistent with ESD principles with regards to fauna and will not adversely affect the local biodiversity.

Thus, the proposed activity should not be considered to constitute a controlled action, no SIS is warranted and SEPP 44 does not apply to Harden Council LGA, hence no Koala Habitat Management Plan should be required. Nevertheless, a number of safeguards are recommended to minimise or ameliorate any adverse impact on the fauna, in particular the threatened species that can potentially occur on the Project Site.

1.0 INTRODUCTION

The Galong Limestone Mine is located approximately 20km east-southeast of Harden, NSW (**Figure 1**). The Project Site (Portion 139 and parts Lots 1, 2 & 3 of DP 747544) covers some 160ha and includes approximately 1.0km of a Crown Road Reserve. The Project Site coincides with the boundary of Mining Lease 1496 and covers the existing mine site as well as the area proposed for expansion of the open-cut mine and the proposed location of the main overburden emplacement.

The Proponent, Barnu Pty Ltd, proposes to expand mining operations and increase production from the mine. The expanded open-cut mine will extend over the area north of the existing open-cut mine. The main overburden emplacement will be located to the west of the existing open-cut mine (refer **Figure 2**).

This report details the methods used and the results obtained from a fauna survey conducted on 5 and 6 February 2003 over parts of the Project Site likely to be impacted by the Proponent's expanded activities. It discusses and assesses the likely impact this proposed development may have on all protected fauna and, in particular, on any threatened species, populations and communities that were recorded or those that may occur in the area and immediate environs, including a "wetland" area ("the Survey Area"). This area is downstream from an approved mine sump water discharge point along Limestone Creek.

It makes recommendations to ameliorate and minimise any adverse impact this proposed development may have on the local fauna community. Pursuant to Section 5A of the *Environmental Planning and Assessment Act 1979* (hence EP&A Act) it provides information for the determining authority to consider whether there is a need for a Species Impact Statement (SIS) according to the *Threatened Species Conservation Act 1995* (hence TSC Act) and the *Fisheries Management Act 1994* (hence FM Act)

This report also discusses the proposed development with regards to both the State and Federally listed Key Threatening Ecological Processes, Ecological Sustainable Development (ESD) Principles and the clearing of native vegetation under the *Native Vegetation Conservation Act 1997* (hence NVC Act) relating to the loss and fragmentation of fauna habitat and wildlife corridor.

Further, it considers whether this proposal should be considered to be a controlled action under the *Environmental Protection and Biodiversity Conservation Act 1999 (C'th)* (hence EPBC Act).

Harden Local Government Area (LGA) is not listed in Schedule 1 of *State Environmental Planning Policy No. 44, "Koala Habitat Protection,* (SEPP 44) putting it outside this planning instrument and no further consideration of a need for a Koala Habitat Management is warranted.

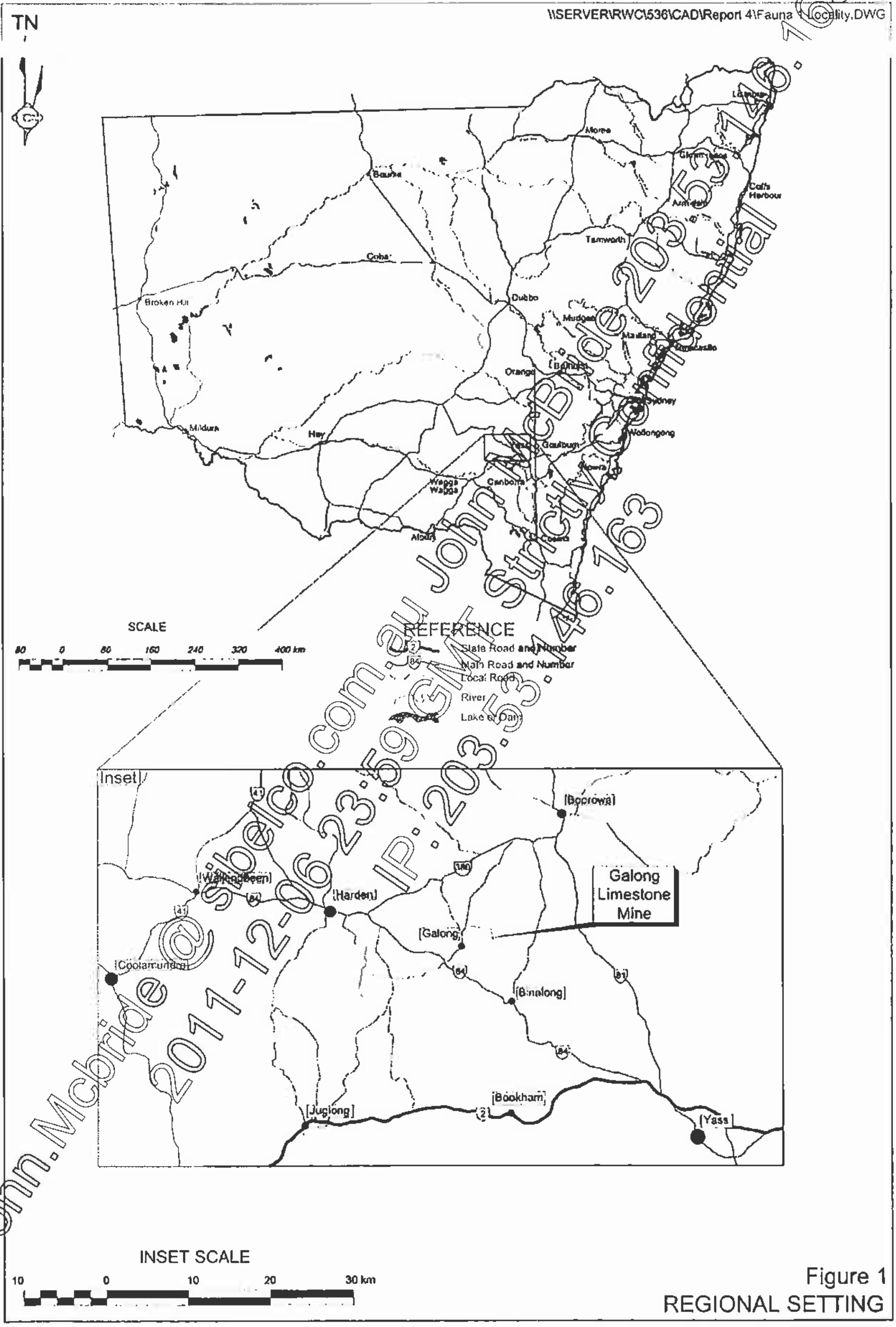


Figure 1
REGIONAL SETTING

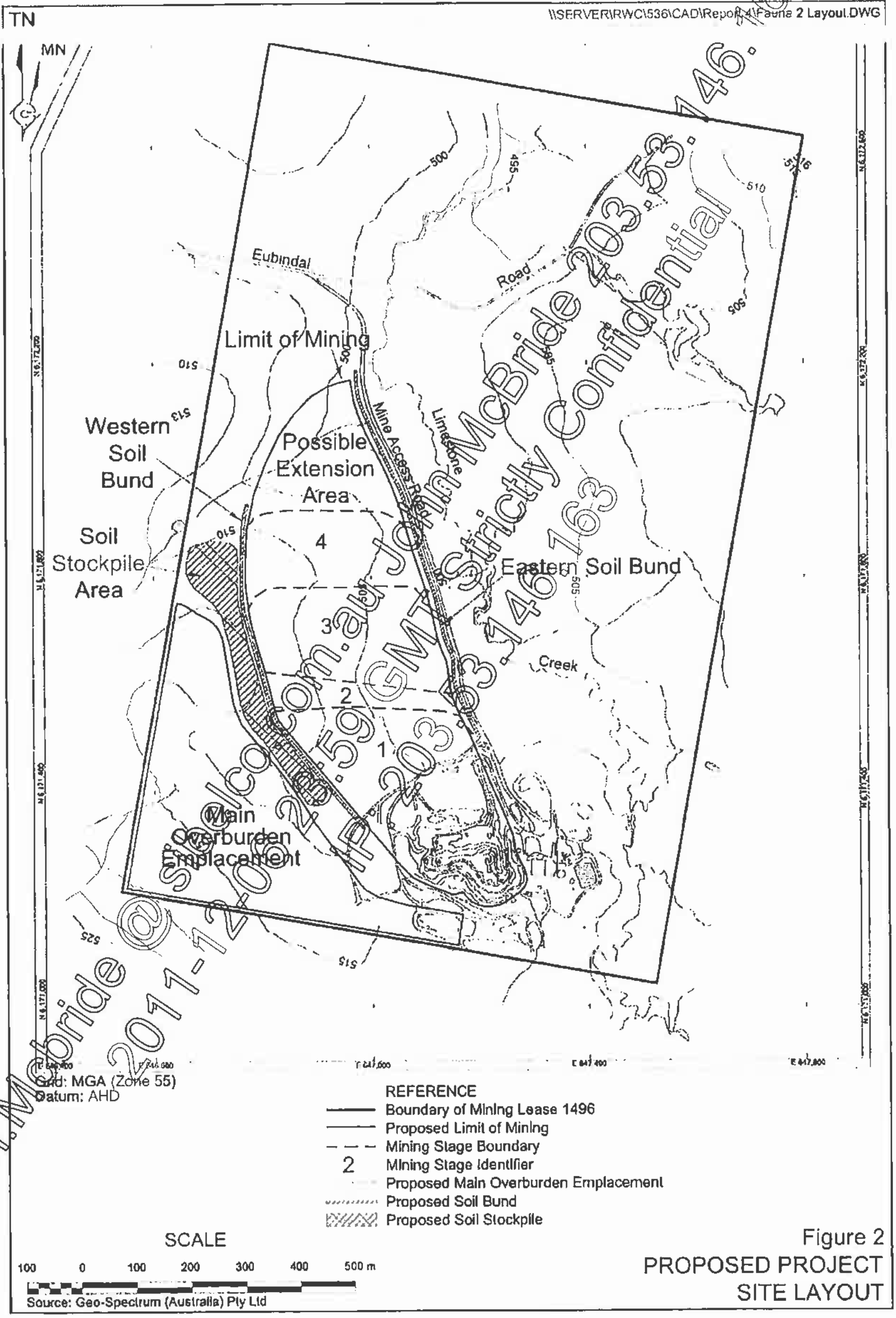


Figure 2
PROPOSED PROJECT SITE LAYOUT

SURVEY AREA

The area sampled consists of the riparian habitat River Red Gum corridor and Tree of Heaven thicket along Limestone Creek, the largely cleared and cultivated paddocks to the northwest and west of the existing open-cut mine and sporadic tree lines along some of the fences and drainage lines (see Barnu 1993). An ephemeral "wetland area" along Limestone Creek, downstream of the proposed discharge point, was also examined to assess its habitat significance.

GCNRC (2003) described the above habitat types on the Project Site as corresponding to:

Community 1 - Cleared Grazing and/or Cultivation

This community is basically treeless although some shade trees remain as single trees or small clumps of White Box *Eucalyptus albens*, Blakely's Red Gum, *Eucalyptus blakelyi*, Yellow Box, *Eucalyptus melliodora* and Apple Box (*Eucalyptus bridgesiana*).

Some of the area has been cropped and other parts appear to have been sown to improved pasture species in the past.

All sections have a high component of introduced species (marked with an '*'), some of them noxious weeds in the ground cover layer.

The main ground cover species include Wild Oats, *Avena* sp.*, Mustardweed, *Brassicaceae - unidentifiable**, Great Brome, *Bromus diandrus**, Paterson's Curse, *Echium plantagineum**, Annual Ryegrass, *Lolium sp.**, Skeleton Weed, *Chondrilla juncea**, Lucerne, *Medicago sativa**, Scotch Thistle, *Onopordum acanthium**, Phalaris, *Phalaris aquatica**, Wireweed, *Polygonum* sp.* and Wheat, *Triticum aestivum**.

Community 2 - River Red Gum, *Eucalyptus camaldulensis* Community

This community occurs along Limestone Creek and comprises a high proportion of the remnant native timber stands within the Survey Area – see **Plate 1**.

The main species present is River Red Gum with scattered individuals of Blakely's Red Gum, *Eucalyptus blakelyi* and Apple Box, *Eucalyptus bridgesiana*.

A large clump of the introduced Tree of Heaven, *Ailanthus altissima**, occurs to the east of the present mine, near Limestone Creek and there are scattered occurrences of the noxious Briar Rose, *Rosa rubiginosa**, throughout the community.

The main ground cover species are Wild Oats, *Avena* sp.*, Spear Thistle, *Cirsium vulgare**, Couch Grass, *Cynodon dactylon**, Paterson's Curse, *Echium plantagineum**, Paspalum, *Paspalum dilatatum**, Scotch Thistle, *Onopordum acanthium**, Phalaris, *Phalaris aquatica**, Wireweed, *Polygonum* sp.*, Slender Dock, *Rumex brownii*, and Cumbungi, *Typha* sp.

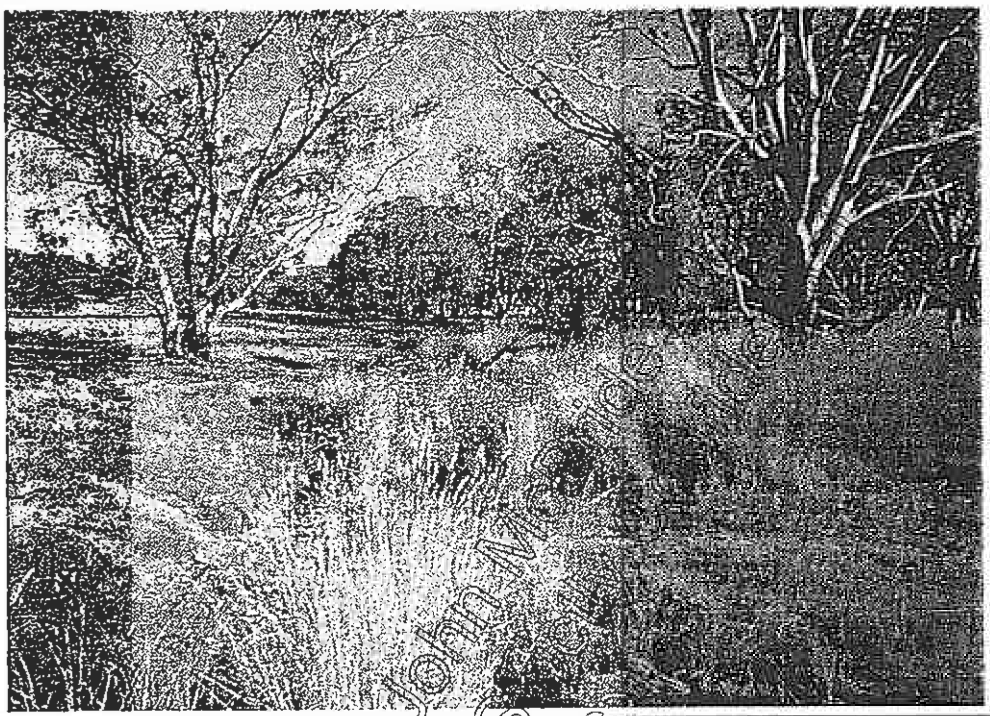


Plate 1: Riparian Corridor of River Red Gum

Community 3 - White Box (*Eucalyptus albens*) – Yellow Box (*Eucalyptus melliodora*) – Blakely's Red Gum (*Eucalyptus blakelyi*) – Apple Box (*Eucalyptus bridgesiana*) Community

This remnant box community is comprised of scattered clumps and some larger remnants of woodland. White Box and Blakely's Red Gum tend to be most common on the upper slopes and crests while Yellow Box and Apple Box are more common on the lower slopes - although all species except White Box can be found over much of the area occupied by this community.

The main ground cover species include Wild Oats, *Avena* sp.*, Great Brome, *Bromus diandrus**, Paterson's Curse, *Echium plantagineum**, Annual Ryegrass, *Lolium* sp.*, Scotch Thistle, *Onopordum acanthium**, and Silver Grass, *Vulpia* spp.*.

(* denotes exotic species)

3.0 METHODS AND MATERIAL

A variety of methods were used to sample the fauna. Some of the methods used targeted more than one fauna group. Trap and recording sites are shown on **Figure 3**. Field identifications of fauna observed were made in accordance with Anstis (2002), Barker et al (1995), Menkhorst and Knight (2001), Slater (1990), and Swan (1990). Sampling was conducted according to approved animal welfare protocol.

REFERENCE

- Boundary of Mining Lease 1496
- Proposed Limit of Mining
- Proposed Main Overburden Emplacement
- Detailed Fauna Survey Areas
- Spotlight Traverses
- Callback Broadcast Site

SCALE 1:10 000

100 0 100 200 300 400 500 m

Source: Geo-Spectrum (Australia) Pty Ltd - Date of Photography: 10/07/2002

Figure 3
FAUNA SURVEY

3.1 Amphibians

Searches for frogs were made during the early evening of the 5 February 2003 along Limestone Creek and all the dams within and near the Survey Area. The Green and Golden Bell Frog, *Litoria aurea*, was especially targeted.

3.2 Birds

The birds on and around the Survey Area were identified from calls and direct observation on the morning of the 6 February 2003 and opportunistically throughout the afternoon of the 5 February 2003. The area sampled included the road access corridors and the "wetland area" to the north of the Project Site. The calls of the relevant listed threatened owl species were broadcast from positions "C1" to determine the presence of these species in the area.

Special attention was placed on the occurrence of the Turquoise Parrot, *Neophema pulchella*, Superb Parrot, *Polytelis swainsonii*, and Swift Parrot, *Lathamus discolor*, and their habitat. However, the Swift Parrot is only likely to be in the area between March and early October during the annual migration from Tasmania to the mainland for the winter months.

3.3 Mammals

A variety of methods were used to sample mammals in the Survey Area (See **Figure 3**). Ground searches for signs and body remains were carried out throughout the Survey Area during the daylight hours on each day for mammals generally.

Other targeted methods are detailed below.

3.3.1 Small Mammals

No sampling was conducted to target live small mammals, as the areas that will be impacted by the Proponent's proposal are mostly cultivated areas or cleared pastures with isolated trees.

3.3.2 Microbats

Recordings of bat calls were made along the spotlight transect (refer **Figure 3**), using an ANABAT ultrasonic recorder (Titley Electronics, Ballina, N.S.W.).

3.3.3 Nocturnal Species and Arboreal Mammals

Two 2-hr spotlight searches were conducted along the mine access road, Eubindal Road near Limestone Creek and access tracks around the existing open-cut mine using a 50-watt spotlight on each side of a slow moving vehicle on the evening of 5 February 2003. Each track indicated on **Figure 3** was traversed at least once and the fauna observed noted.

Recorded calls of the threatened species listed in **Table 1** were played at point "C1" while spotlighting within the area encompassing ML 1496.

Threatened Species' Recorded Calls Played at Point C1

Common Name	Scientific Name
Koala	*Phascolarctos cinereus*
Yellow-bellied Glider	*Petaurus australis*
Squirrel Glider	*Petaurus norfolcensis*
Bush Stone-curlew	*Burhinus grallarius*
Barking Owl	*Ninox connivens*
Sooty Owl	*Tyto tenebricosa*
Masked Owl	*T. novaehollandiae*

3.4 Reptiles

Systematic searches were made for reptiles in the leaf litter, along Limestone Creek, and under rocks and logs in the Survey Area.

3.5 Invertebrates

Daytime searches were made for giant dragonfly adults and larvae in all potential habitat in the Survey Area.

3.6 Fish

Sampling for fish is not appropriate, as the Survey Area does not contain any flowing rivers or streams.

4.0 REGIONAL FAUNA

The fauna checklist for the Galong area compiled from NPWS (2003), published and unpublished sources including Blakers et al (1984), Cogger (2000), Strahan (1995), NPWS (1999) and Churchill (1998), has up to 11 species of frogs, at least 111 birds, 40 mammals and 20 reptiles in the region covered by the Yass 1:100 000 Map Sheet within the Southeastern Highlands Bioregion (see NPWS 1996).

A number of listed threatened terrestrial species were noted to potentially occur in the Harden local government area. These are listed in **Table 2**.

TABLE 2

Potentially Occurring Listed Threatened Terrestrial Species in the Harden Local Government Area

Page 1 of 2

Common Name	Scientific Name	Status
Amphibians		
Green and Golden Bell Frog	*Litoria aurea*	E1
Southern Bell Frog	*Litoria raniformis*	E1
Booroolong Frog	*Litoria booroolongensis*	E1
Birds		
Square-tailed Kite	*Lophoictinia isura*	V
Grey Falcon	*Falco hypoleucos*	V
Barking Owl	*Ninox connivens*	V
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	V
Hooded Robin	*Melanodryas cucullata*	V
Swift Parrot	*Lathamus discolor*	E1
Superb Parrot	*Polytelis swainsonii*	V
Turquoise Parrot	*Neophema pulchella*	V
Grey-crowned Babbler	*Pomatostomus temperalis*	V
Speckled Warbler	*Chthonicola sagittata*	V
Painted Honeyeater	*Grantiella picta*	V
Regent Honeyeater	*Xanthomyza phrygia*	E1
Diamond Firetail	*Stagonopleura guttata*	V

TABLE 2 Cont'd

Potentially Occurring Listed Threatened Terrestrial Species in the Harden Local Government Area

Page 2 of 2

Common Name	Scientific Name	Status
Reptiles		
Earless Dragon	*Tympanocryptis lineata*[1]	E1
Pink-tailed Worm-lizard	*Aprasia parapulchella*	V
Striped Legless Lizard	*Delma impar*	V
Mammals		
Yellow-bellied Sheathtail	*Saccolaimus flaviventris*	V
Great Pipistrelle	*Falsistrellus tasmaniensis*	V
Large (Common) Bent-wing Bat	*Miniopterus schreibersii*	V
Koala	*Phascolarctos cinereus*	V
Squirrel Glider	*Petaurus norfolcensis*	V
Spotted-tailed Quoll	*Dasyurus maculatus*	V
Greater Bilby	*Macrotis lagotis*	E4
V - Vulnerable E1 - Endangered E4 - Presumed Extinct		

4.2 Invertebrates

The Survey Area is not within the known distribution range of the listed endangered Giant Dragonfly, *Petalura gigantea*.

4.3 Fish

The subject site is not within the distribution range of any fish listed as threatened under the FM Act (also see 3.6 above). This notwithstanding, the Survey Area is in the catchment of the threatened species listed in **Table 3**.

[1] This species was included in the *Tympanocryptis lineata* complex; in this part of its range it was previously recognised as *T. lineata pinguicolla* but now considered a separate species *T. pinguicolla*

TABLE 3

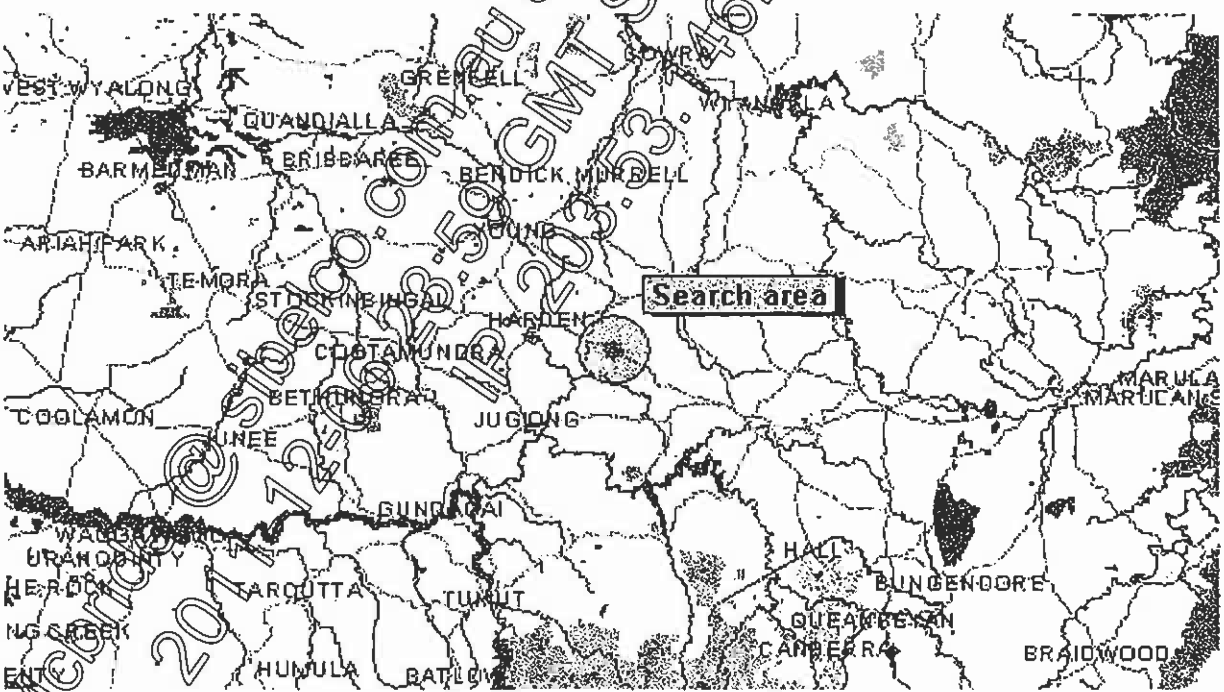
Threatened Species in Catchment of Survey Area

Common Name	Scientific Name	Status
Trout Cod	*Maccullochella macquariensis*	E1
Silver Perch	*Bidyanus bidyanus*	V
Macquarie Perch	*Macquaria australasica*	V
Murray Hardy Head	*Craterocephalus fluviatilis*	E1

V – Vulnerable E1 – Endangered

4.4 Commonwealth Listings

A search was undertaken of the Environment Australia on-line database at the point 148.548 East, 34.62 South with a 10km radius buffer. The search area is indicated on **Figure 4**.



Source: © Environment Australia, C'wth.

Figure 4
SEARCH AREA - ENVIRONMENT AUSTRALIA ON-LINE DATABASE

i) Threatened species listed under the EPBC Act 1999 are listed in **Table 4**.

TABLE 4

Threatened Species Listed Under EPBC Act 1999

Common Name	Scientific Name
Macquarie Perch	*Macquaria australasica*
Swift Parrot	*Lathamus discolor*
Superb Parrot	*Polytelis swainsonii*
Regent Honeyeater	*Xanthomyza phrygia*
Golden Sun Moth	*Synemon plana*
Spot-tailed Quoll	*Dasyurus maculatus maculatus* (s. lat.)
Eastern Long-eared Bat	*Nyctophilus timoriensis* (South-eastern form)

ii) Terrestrial species covered by migratory provisions of the EPBC Act, 1999 are listed in **Table 5**.

TABLE 5

Terrestrial Species Covered by Migratory Provisions of the EPBC Act 1999

Common Name	Scientific Name
White-bellied Sea-Eagle	*Haliaeetus leucogaster*
Satin Flycatcher	*Myiagra cyanoleuca*
White-throated Needletail	*Hirundapus caudacutus*
Regent Honeyeater	*Xanthomyza phrygia*
Latham's Snipe	*Gallinago hardwickii*
Painted Snipe	*Rostratula benghalensis*

iii) Wetland species covered by migratory provisions of the EPBC Act, 1999 are listed in **Table 6**.

TABLE 6

Wetland Species Covered by Migratory Provisions of the EPBC Act 1999

Common Name	Scientific Name
Latham's Snipe	*Gallinago hardwickii*
Painted Snipe	*Rostratula benghalensis*

iv) Species covered by marine provisions of the EPBC Act, 1999 are listed in **Table 7**.

TABLE 7

Species Covered by Marine Provisions of the EPBC Act 1999

Common Name	Scientific Name
Latham's Snipe, Japanese Snipe	*Gallinago hardwickii*
White-bellied Sea-Eagle	*Haliaeetus leucogaster*
White-throated Needletail	*Hirundapus caudacutus*
Swift Parrot	*Lathamus discolor*
Satin Flycatcher	*Myiagra cyanoleuca*
Painted Snipe	*Rostratula benghalensis* (s. lat).

Note that CAMBA and JAMBA also include listed threatened species of the respective countries in the agreements, hence for example the Swift Parrot appears on those lists even when it is not a migratory species outside Australia.

5.0 FAUNA IN THE SURVEY AREA

5.1 Amphibians

No frog species were recorded on or in areas adjoining the Survey Area. All the frogs likely to be recorded in the Survey Area will be common species (see Section 6.0 for discussion).

5.2 Birds

Table 8 lists the bird species observed in the Survey Area.

Other than the exotic species indicated in **Table 8**, all are protected native species. The

TABLE 8

Bird Species Observed in the Survey Area

Common Name	Scientific Name	Status
Variegated Wren	*Malurus assimilis*	P
Australian White Ibis	*Threskiornis molucca*	P
Pacific Duck/Mallard* Cross	*Anas superciliosa/platyrhynchos*	P(?)
Wedge-tailed Eagle	*Aquila audax*	P
Stubble Quail	*Coturnix pectoralis*	P
Brown-headed Honeyeater	*Melithreptus brevirostris*	P
Brown Falcon	*Falco berigora*	P
Yellow Thornbill	*Acanthiza nana*	P
Sulphur-crested Cockatoo	*Cacatua galerita*	P
Galah	*Cacatua roseicapilla*	P
Australian Magpie	*Gymnorhina tibicen*	P
Laughing Kookaburra	*Dacelo novaeguineae*	P
Rainbow Bee-eater	*Merops ornatus*	P/J
Magpie-lark	*Grallina cyanoleuca*	P
Eastern Rosella	*Platycercus eximius*	P
Crested Pigeon	*Ocyphaps lophotes*	P
Australian Wood Duck	*Chenonetta jubata*	P

* Introduced species   ? Hybrids with exotic species are not protected under the NP&W Act

(J) JAMBA listed species – this species was not listed in the EA database as occurring in the 10km search area centred around the Survey Area

P - Protected

5.3 Mammals

The mammals listed in **Table 9** were identified from body tissues and bones or observed in and around the Survey Area.

TABLE 9
Mammals Identified in and around the Survey Area

Common Name	Scientific Name
Eastern Grey Kangaroo	*Macropus giganteus*
Ring-tailed Possum	*Pseudocheirus peregrinus*
Brush-tailed Possum	*Trichosurus vulpecula*
Swamp Wallaby	*Wallabia bicolor*
House Mouse*	*Mus domesticus*
Cattle*	*Bos tauris*
European Red Fox*+	*Vulpes vulpes*
Farm Dog*	*Lepus familairis*
Brown Hare*	*Lepus capenis*
European Rabbit *+	*Oryctolagus cuniculus*
Feral Cat *+	*Felis cattus*
These are either common native species or exotic (*) species. The exotic species recorded included the European Red Fox, European Rabbit and the Feral Cat which are listed a Key Threatening Processes (+) in NSW (TSC Act) and by the Commonwealth (EPBC Act).	

Five fox scats found in the Survey Area and examine macroscopically did not yield any evidence of animal remains (hairs, feathers, bones, nails or scales) other than insects.

The bat species listed in Table 10 were detected from analysis of taped calls.

TABLE 10
Bat Species Detected

Common Name	Scientific Name	Status
Family Molossidae		
White-striped Mastiff-bat	*Nyctinomus (Tadarida) australis*	P
Little Mastiff-bat	*Mormopterus planiceps (sp 2)*	P
Undescribed Mastiff-bat @ 27KHz	*Mormopterus sp nov.*	P
Family Vespertilionidae		
Chocolate Wattled Bat	*Chalinolobus morio*	P
Gould's Wattled Bat	*Chalinolobus gouldii*	P
Large Forest Eptesicus	*Vespadelus (Eptesicus) darlingtoni*	P
Large (Common) Bent-wing Bat	*Miniopterus schreibersii*	V
Family Emballonuridae		
Yellow-bellied Sheathtail	*Saccolianus flaviventris*	V

P – Protected V - Vulnerable

The bats recorded included 2 listed vulnerable species, albeit they were only from a single call

5.4 Reptiles

The reptiles recorded during searches under barks, rocks, logs and leaf-litter are listed in **Table 11**.

TABLE 11

Reptiles Recorded in the Survey Area

Common Name	Scientific Name	Status
Marbled Gecko	*Christinus marmoratus*	P
Lace Monitor	*Varanus varius*	P
Marbled Gecko	*Christinus marmoratus*	P
South-eastern Morethia Skink	*Morethia boulengeri*	P

All these reptiles recorded in the Survey Area are common protected species.

5.5 Invertebrates

No listed threatened invertebrates were recorded or likely to be recorded in the Survey Area.

6.0 DISCUSSION

The results of this fauna survey and assessment must be considered in the light of the very severe drought the region has been experiencing. Notwithstanding the highly altered ecology of the habitat from its long history of agricultural landuse, the drought must have a significant impact on the fauna community in the Survey Area. Limestone Creek, which runs through the Survey Area, was completely dry at the time of the survey.

The environmentally sensitive areas along Limestone Creek are presumed to remain unaffected by the proposed expanded activities. The approved discharge of groundwater inflows from the open-cut mine to Limestone Creek will presumably benefit the creek and in particular the ephemeral wetland area downstream of the approved discharge point.

This assessment is also caveat upon the fact that any increase in water discharge from the expanded open-cut mine to Limestone Creek will not adversely affect the water table or water quality to the detriment of the creek habitat or downstream "wetland" area.

Galong. The only water on the Project Site is held in the main water storage dam for water pumped from the existing open-cut mine. No frogs were heard calling at this dam. There was no sign of tadpoles or egg masses.

The Green & Golden Bell-frog, *Litoria aurea*, was known historically from the Southwest Slopes, the mid and upland areas between the Monaro and Bathurst, but has disappeared completely from these areas. The species would not occur on the Project Site.

The Booroolong Frog, *Litoria booroolongensis*, is a stream dwelling frog that is known to occur along the ranges from New South Wales to Victoria. It has not been recorded as far west as Galong, and the absence of a permanent running stream would preclude its possible occurrence in the Survey Area.

The Southern Bell Frog, *Litoria raniformis*, inhabits woodland, shrubland and disturbed areas where it is usually associated with large relatively still water bodies. Known historically from the Australian Capital Territory and highland areas to the north, it has disappeared from these regions and now only occurs in New South Wales in the Murray River Valley and at a few places along the Murrumbidgee River. It was not located on the Survey Area and is most unlikely to be found there.

No listed endangered reptiles are known from the general region and none have been recorded from the immediate area (Swan *pers. comm.*). The Grassland Earless Dragon, *Tympanocryptis pinguicolla* is known from the Australian Capital Territory, Cooma, Bathurst and Armidale, so the site is within its known distribution. It is an inhabitant of treeless native grasslands, which no longer occur in the Survey Area. No evidence was found of this species during intensive searching. Given the intensively grazed and cropped surrounding countryside it is highly improbable that it occurs in this region.

No listed vulnerable reptiles are known from the general area and none have been recorded from the immediate area. The Pink-tailed Worm-lizard, *Aprasia parapulchella* has been recorded to the north-west in the West Wyalong region, and occurs to the south-west at Tarcutta and the north-east at Bathurst. However, it is mainly found around rocky outcrops or areas of scattered rock in open woodland with an understorey of native grasslands. This type of habitat is no longer present in the Survey Area and no Pink-tailed Worm-lizards were located during searches.

The Striped Snake-lizard, *Delma impar*, is associated with native grassland, or woodland with native grassland understorey. It is known from the Tarcutta and Goulburn areas. No suitable habitat is now present on the site and none of these lizards were located during searches.

No bird was observed nesting in the Survey Area and no listed threatened bird that could occur in the Harden LGA was recorded during this survey. The highly altered ecology and poor habitat quality over most of the Survey Area and the drought have resulted in a drop in bird abundance and breeding activity during the survey.

The removal of some 20 mature trees that occur as a remnant stand along the fence or as isolated trees in paddocks within the Project Area is unlikely to affect any listed threatened owls, raptors or honeyeaters. The proposed tree removal may affect the listed threatened tree hollow nesting parrots but the Glossy Black-Cockatoo, *Calyptorhynchus lathami*, is unlikely to use the Project Area because the Galong area lack its Casuarina feed trees.

birds that are dependent on native grass or an understorey habitat layer such as the Turquoise Parrot, *Neophema pulchella*, Hooded Robin, *Melanodryas cucullata*, Speckled Warbler, *Chthonicola sagittata*, Grey-crowned Babbler, *Pomatostomus temperalis*, and Diamond Firetail, *Stagonopleura guttata*.

The assessment of the likely impact of this proposed mine extension on the listed vulnerable Superb Parrot, *Polytelis swainsonii*, that is likely to occur locally (see Barnu 1993) and the listed endangered Swift Parrot, *Lathamus discolor*, that is dependent on the Eucalypts on the mainland during winter migration from Tasmania are discussed in detail below.

Leaving aside the Greater Bilby, *Macrotis lagotis*, which is presumed to be extinct in NSW, the degraded and exposed habitat in the Project Area is unsuitable for the listed vulnerable Koala, *Phascolarctos cinereus*, Squirrel Glider, *Petaurus norfolcensis*, Spotted Quoll, *Dasyurus maculatus* and Great Pipistrelle, *Falsistrellus tasmaniensis*. These species require habitats making up of substantial wooded area with an intact habitat structure with mature trees and a good canopy and understorey cover.

The likely impact on the cave and hollow roosting microbats recorded in the Project Area that are listed as vulnerable species, the Large Bent-wing Bat, *Miniopterus schreibersii*, and the Yellow-bellied Sheathtail Bat, *Saccolaimus flaviventris*, are assessed in detail below.

6.1 Likely Impact on Threatened Species

Based on the rationale in the discussion above, Section 5A assessments are thus conducted only on the threatened species that may be affected by this proposed activity, viz. the species that may occur in the Survey Area, ie. the Superb and Swift Parrots and the species that were recorded in the Survey Area, the Yellow-bellied Sheathtail Bat and the Large Bent-wing Bat.

Matters for consideration relating to the EPBC Act are dealt with in Section 6.2 below.

6.1.1 Superb Parrot, *Polytelis swainsonii*

The Galong Limestone Mine Survey Area is close to the eastern limit of the known breeding range of the Superb Parrot (Webster and Ahern, 1992) on the Southwest Slopes of NSW. The nearest known nest site to the Survey Area is about 4.0 km to the west, near Galong village (Brown pers comm in Barnu, 1993). Immediately after fledgling, the population on the South-West Slopes disperses to box-gum woodlands further west. From mid-January to early April, the breeding habitats are not frequented and the Superb Parrot is only rarely seen on the South-West Slopes during winter (Webster and Ahern, 1992).

a) **Whether the life cycle of a threatened species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.**

This species uses the region on a seasonal basis and this species is not known to nest with the Survey Area. The proposed activities will involve a small number of trees which will be further detrimentally affected by the recent construction of a contour bank upslope from them. This is within the scope of "normal agricultural practice". Thus, the proposed activity would not place upon the population any additional risk of extinction and the relatively minor scale of the proposed total disturbance confined to less than 53.0 ha is unlikely to have a significant impact on a viable local population of this bird.

b) **Whether the life cycle of an endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.**

No endangered population has been listed under the TSC Act in the region.

c) **Whether a significant area of known habitat of a threatened species, population or ecological community in the region is to be modified or removed.**

No threatened fauna population or community has been listed under the TSC Act in this region.

No significant area of the known habitat of the Superb Parrot will be modified or removed (refer b) above for rationale).

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

No known habitat of the Superb Parrot is likely to become isolated as a result of this proposed activity.

e) **Whether critical habitat will be affected.**

No critical habitat has been listed under the TSC Act for this region.

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

The consideration of whether this species or its habitat is adequately represented in reserves here is not relevant as this threatened species will not be significantly affected by the proposed activity.[2]

g) **Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.**

The mining operation is included in the range of activities that contribute to the listed key threatening processes, namely the Clearing of Native Vegetation.

The proposed mine expansion will be over mostly cleared land. Assuming that the recommended safeguard of replacement and compensatory planting are adopted, the few trees that will be removed will be replaced in time.

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

No listed threatened fauna population or ecological community occurs in this region.

The Survey Area on the southwest slopes is near at the eastern limit of this species distribution and it is in a region that the species uses on a seasonal basis for breeding.

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[2] This sub-section has been deleted from the amended Section 5A that will come into effect later this year.

The Swift Parrot breeds only in Tasmania and its offshore islands during September-December. Most birds migrate in March-June from Tasmania to southeast Australia and return to Tasmania in the August-October period. On the Mainland, it is nomadic and its range extends from the Mount Lofty Ranges, S.A., through Victoria, eastern New South Wales, inland as far as Griffith-Warialda and north to Bowen in coastal east Queensland.

The Swift Parrot is listed as an endangered species that feeds on a range of foods (mainly nectar and pollen) from eucalypts and banksias, but lerps, insects, larvae, grass seeds, fruits and berries are all included in the diet. The region is adequately endowed with the diversity of drier sclerophyll forests and woodland habitats supplying this food resource. There is, however, some cause for concern that there is little to no tree recruitment in the region due to extensive cropping and grazing.

(a) Whether the life cycle of a threatened species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

There is no resident local population of this species and the life cycle is most unlikely to be disrupted by this proposed extended activities.

(b) Whether the life cycle of an endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

No endangered population has been listed in the region.

(c) Whether a significant area of known habitat of a threatened species, population or ecological community in the region is to be modified or removed.

The Swift Parrot is nomadic in this part of its Australian mainland range. The proposed area of expanded activities of less than 53.0 ha does not represent a significant area of the known habitat of this bird.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

No known habitat of the Swift Parrot is likely to become isolated as a result of this proposed activity. Nor will the activity disrupt any interconnections between habitat areas. See reason given above.

(e) Whether critical habitat will be affected.

No critical habitat has been listed under the TSC Act in this region.

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

No threatened population or community has been listed under the TSC Act in the region.

Refer to footnote 2 on Page 5-25.

(g) **Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.**

See 6.1.1 (g) above.

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

This listed endangered parrot will only use the habitat around the Survey Area on a seasonal basis during the non-breeding winter months. The Survey Area is not at the limit of this bird's distribution (see Blakers *et al* 1984).

6.1.3 Yellow-bellied Sheathtail Bat, *Saccolaimus flaviventris*

The following is extracted from Richards (1998) in relation to the Yellow-bellied Sheathtail Bat, *Saccolaimus flaviventris*:

"Very little is known about the biology of this species, though breeding has been analysed from museum specimens by Chimimba and Kitchener (1987). The general ecology has been reviewed by Richards (1983 and 1995).

The Yellow-bellied Sheathtail Bat has never been recorded in caves and large colonies (around 40 individuals) have been found in some roosts (L.S. Hall, *pers. comm.*). It has been hypothesised, based on flight characteristics, that this species may be restricted to roosts in emergent trees because it needs a clear space below the roost to gain flight speed (Richards and Hall 1997).

Saccolaimus flaviventris appears to be quite rare, especially in southern latitudes. Field surveys by the consultant in the Murwillumbah-Lismore area indicated that a large foraging range may be required, because detector passes were low and it appeared from these data that just a few individuals were making large circuits (Richards, unpublished). During an intensive survey in the Shoalwater Bay Military Training Area in central Queensland, that comprised 9 weeks of field work using 55 sites across two seasons, *S. flaviventris* was patchily distributed and restricted to denser habitats (Richards, 1992 and 1993).

This species is listed as Vulnerable in the NSW TSC Act, but is not listed in the national Bat Action Plan (Richards and Hall 1997) because of its widespread distribution. Dickman (1994, **Table 2**) considers that the status of this species is "stable" in western NSW, as does Stephens (1992) for the Murray Mallee area."

Ayers *et al* (1996-99) at page 144 identified the threats to this species as being:

- Clearing of old trees with hollows which eliminates roosting sites.
- Grazing at severe levels which may reduce regeneration of roost trees.
- Predation by feral cats at roost sites may have localised impacts. (However, I consider this to be nothing more than a speculative comment – LL.)

The bat call recordings indicate that this species forages and ranges extensively over the Survey Area and appears to occur more frequently in or near more densely wooded areas.

a) Whether the life cycle of a threatened species is likely to be disrupted such that a

Richards (1998) suggests, *ad idem*, that:

"In order to assess potential impacts on the life cycle of *S. flaviventris* it is necessary to address the primary components of its ecology, such as breeding, foraging, roosting and movement/migration accordingly."

i) Breeding

Females of this species have the typical pattern of breeding in summer, with a single young being weaned by the following early autumn (Chimimba and Kitchener 1987).

Proposed safeguards for this mine extension include clearing in late summer or autumn only after a pre-start inspection to ascertain that no roosting listed threatened bats are unduly affected.

ii) Foraging

This species can be assumed to forage primarily upon insects that are hunted by aerial intercept, which is typical of species with long tapered wings (high aspect ratio) and a high wing loading. This indicates (supported by field observations) that flight is fast, with little manoeuvrability, and given the loud, long-range echolocation call, insects would be captured by interception rather than being pursued.

Considering that this species apparently forages over a wide range (Richards, unpublished) the net effect of a loss of a small patch or patches of habitat is most likely to be insignificant.

iii) Roosting

S. flaviventris roosts only in tree hollows, and as mentioned above, these are predicted to be large, located high in a tree, and situated such that there is enough clear space at the exit to allow an unencumbered drop until the bat attains normal flight speed.

The proposed mine expansion will necessitate the removal of a number of mature trees, some with tree hollows.

(iv) Movement/Migration

There is no information available in relation to movement or migration patterns that this species may exhibit. Richards (1983, 1995) concluded that because some *S. flaviventris* had been caught during the 1980's in situations where they appeared to be exhausted, and in open view of the public, that they may have been undertaking pre-winter migrations. This hypothesis has been repeated in other publications, including, for example, Ayers *et al* (1996). Because several individuals of this species have been recorded over the last year or so to have been infected with Lyssavirus (similar to rabies) the individuals observed may not have been exhausted but instead may have been diseased and unable to fly. The "migration" hypothesis therefore needs to be revised.

This proposed mine expansion area represents only a small portion of the normal extensive home range of this bat and the proposed activity will not preclude it from hunting and foraging over the surrounding area.

b) Whether the life cycle of an endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

No threatened fauna population has been listed in this region under the TSC Act.

c) Whether a significant area of known habitat of a threatened species, population or ecological community in the region is to be modified or removed.

No threatened fauna population or community has been listed for this region thus no known habitat of a threatened fauna population or ecological community in the region will be affected by the proposed mine.

A few large trees will be lost along existing fences but none of the creek line gallery habitat will be affected. It is thus unlikely that the proposed total disturbance over less than 53.0 ha will affect this species in this part of its distribution.

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

The proposed activity is unlikely to isolate the local population of Sheathtail Bats from any currently interconnecting or proximate areas of habitat of this species because of its mobility and large foraging ranges.

e) Whether critical habitat will be affected.

No critical fauna habitat has been listed in this region of NSW.

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

Given the broad distribution of this species, it would be expected to occur in all the reserves this region, as well as those in coastal areas of the State. Also refer footnote 2 above.

g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

Refer 6.1.1 above.

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

The Survey Area in not at the limit of this listed vulnerable bat which has an extensive distribution ranging over the eastern and northern half of the Australian Continent (see Churchill 1998).

6.1.4 The Large Bent-wing Bat, Miniopterus schreibersii

This is one of the most common and widespread microbat species (see eg Dwyer 1995) and is known from numerous locations in the region due to the proximity of caves along the western escarpment of the Great Dividing Range. It is only listed as a vulnerable species because of its colonial breeding behaviour. It is known to breed in large colonies and congregates only in a small number of maternal caves in winter.

It also occurs in urban environments and breeds in artificial structures such as coverts and large concrete water pipes where it has access to suitable microhabitat inside those structures (Hoye pers comm Oct 2001; in press).

Non-breeding individuals are also generally vulnerable to disturbance in winter when they are hibernating in caves and hollows.

This is the only listed vulnerable bat species that was recorded again in the study area in the subsequent sample in March 2000.

(a) Whether the life cycle of a threatened species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

There is no cave in the Survey Area. No roosting habitat or nursery sites will be affected by the proposed development. Thus the local population will not be placed at risk of extinction.

(b) Whether the life cycle of an endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

No threatened fauna population has been listed in the region under the TSC Act.

(c) Whether a significant area of known habitat of a threatened species, population or ecological community in the region is to be modified or removed.

No threatened fauna population or ecological community has been listed in the region under the TSC Act.

The area potentially affected by the proposed activities comprises less than 53.0 ha of mostly cleared agricultural land and this area does not constitute a significant amount of known foraging habitat within the region for this species. Planned rehabilitation of the mine area will re-establish some of the disturbed areas to similar agricultural pastures and woodland.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

Given its aerial mobility, the proposed mining operations will not create a barrier which would isolate any areas of habitat or disrupt interconnection between areas of habitat for this bat (also see above b and c).

(e) Whether critical habitat will be affected.

No critical fauna habitat has been listed under the TSC Act in this region.

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

Refer to footnote 2 on Page 19 above.

(g) Whether the development or activity proposed is of a class of development or activity that is recognized as a threatening process.

Refer 6.1.1.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution.

The Large Bent-wing Bat has an extensive distribution along the ranges of eastern Australia extending from Cape York to southern Victoria and a sub-species inhabits the north-west region of West Australia. The Survey Area is not at the limit of this species' distribution.

In summary, the proposed extractive activity is unlikely to significantly affect these listed threatened parrots and bats. Therefore, no SIS should be warranted.

6.2 Environmental Protection and Biodiversity Conservation Act 1999

It is noteworthy that the application of the EPBC Act threatened species status listings does not only apply to Commonwealth Territories and activities. Where it is likely that there will be significant impact on matters and things listed under international agreement, such proposals would also trigger its controlled action provisions. Thus the following matters are considered below:

6.2.1 International Agreement Listings

The only species recorded in the Survey Area that is listed under JAMBA is the migratory Rainbow bee-eater. As it is a transient, it is unlikely to be significantly adversely affected by the proposed expansion of the Galong Limestone Mine.

No other CAMBA or JAMBA listed species are likely to be adversely affected by this proposed development. Although other wetland species may, from time to time, visit the nearby "Wetland" area downstream, no further consideration of any of the international agreement listed species is warranted for this proposal.

6.2.3 Listed Threatening Ecological Processes

The European Red Fox, Feral Cat and the European Rabbit are listed as threatening processes but its application outside Commonwealth land is unclear. Irrespective, the proposal will destroy the small rabbit warren identified on the survey. The proposed expansion of the Galong Limestone Mine is likely to have an adverse impact on the Feral Cat, European Red Fox and European Rabbit populations in the area by denying them the free range of the open pastures in the Survey Area for foraging. This will assist in reversing some of the effects of the adverse impact these exotic species have on local native fauna.

The implications of Key Threatening Processes that are listed under the TSC Act as well as the EPBC Act have been addressed in Section 6.1.1 (g) above.

In summary, from the considerations above, the proposed activity is thus unlikely to have any significant impact on matters that would constitute or construe to be a controlled action under the EPBC Act.

6.3 Native Vegetation Conservation

The proposed expansion of the Galong Limestone Mine will involve the removal of a limited number of trees (about 20) from the isolated Remnant Box Community (Community 3) along the fence line as well as some isolated trees in the cleared land. As there has not been a Regional Vegetation Plan adopted for this region (cf Riverina Highlands Regional Vegetation Management Plan 2002) or a Farm Management Plan for this property, the transitional provisions for the NVC Act applies.

The removal of these native trees is not considered a significant loss of fauna habitat for the following reasons:

(i) These trees do not form part of a wildlife corridor. The removal of these trees will not isolate any wildlife corridor in the Survey Area and environs.

(ii) The trees are either isolated individuals or part of small remnant stands.

(iii) The impact of the removal of these trees is less than what results from "normal agricultural practices".

(iv) Some of these trees will also probably die from a lack of water due to a recent construction of a contour bank in the adjoining paddock.

6.4 Fisheries Management Act 1994

Further to the listed threatened species detailed in Section 4.6, the Survey Area is within the listed Endangered Aquatic Ecological Community in the natural drainage system of the lower Murray River Catchment. The proposed activity is, however, at a location in the upper reaches of the Murrumbidgee River Catchment where the approved discharge into Limestone Creek is unlikely to affect any of the aquatic ecological community.

It is noteworthy that "The installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams" and "the degradation of riparian vegetation along NSW water courses" are listed as Key Threatening Processes. Neither the riparian vegetation nor the natural flow regime of rivers and streams will be affected by the proposed activities.

6.5 Ecologically Sustainable Development Principles

The proposed expansion of the Galong Limestone Mine is not likely to adversely affect the biodiversity locally or otherwise. It therefore does not raise any issue of either intergenerational equity or value-added consideration relating to fauna or their habitats. It is thus consistent with ESD principles in this respect.

7.0 RECOMMENDED SAFEGUARDS

A number of safeguards can be put in place to minimise or ameliorate any adverse impact on the fauna, in particular the threatened species that potentially can occur on the Project Site. These are as follows.

- Where possible, the removal of any native trees should be avoided.
- Where necessary, trees should be removed in late summer or early autumn to avoid impacting upon spring nesting birds and over-wintering bats, after a pre-start inspection.
- Stags (dead standing trees) should be left standing where no safety issues dictate their removal.
- Fallen stags and trees should be left on the ground in suitable places as logs and ground cover habitats and refuges for native fauna and not disposed off by burning[3].
- A supplementary planting program be formulated and implemented as part of the proposed mine plan to augment tree recruitment and habitat strata cover in suitable areas of the riparian and woodland habitats.
- Any revegetation should be carried out with stock from local trees and should be consistent with the composition of the original local vegetation community where applicable.
- A pest control program be instituted as part of the mine management plan to remove rabbits, feral cats and foxes from the proposed mine site and environs (this would be preferable if it is done in conjunction with baiting programs co-ordinated by the Rural Lands Protection Board)

[3] The taking of firewood has been preliminary listed as a key threatening process. The burning of cleared timber has a similar, if not more profound effect, as the taking of firewood on fauna habitats.

CONCLUSION

Having given considerations to the above and the nature of the Proponent's proposal for expansion of the Galong Limestone Mine it would appear that the proposal is:

i) unlikely to significantly affect any of the listed threatened species, fauna populations or communities.

ii) unlikely to augment or significantly contribute to any of the Federal or State listed key threatening processes.

iii) unlikely to significantly affect any RAMSAR wetland or any CAMBA or JAMBA listed species.

iv) unlikely to significantly affect Limestone Creek if adequate safeguards are adopted.

v) unlikely to significantly affect any regionally significant species.

vi) unlikely to affect any core or potential Koala habitat.

vii) consistent with ESD principles with regards to fauna and will not adversely affect the local biodiversity.

Thus, the proposed activity should not be considered to constitute a controlled action, no SIS is warranted and SEPP 44 does not apply to Harden Council LGA, hence no Koala Habitat Management Plan should be required.

Nevertheless, a number of safeguards are recommended to minimise or ameliorate any adverse impact on the fauna, in particular the threatened species that can potentially occur on the Project Site.

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Barnu Pty Ltd

Galong Limestone Mine Expansion

Traffic and Transport Assessment

April, 2003

Prepared by
Transport & Urban Planning

SPECIALIST CONSULTANT STUDIES

PART 7

TRAFFIC AND TRANSPORT ASSESSMENT

OF THE PROPOSED

GALONG LIMESTONE MINE EXPANSION

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EXECUTIVE SUMMARY

Introduction and Proposal

The Galong Limestone Mine is located approximately 20km east-southeast of Harden in the Southwest Slopes region of NSW. The mine is owned and operated by Barnu Pty Ltd (The Proponent) and is the major supplier of agricultural lime for use as an acid soil ameliorant to the cropping areas of the Southwest Slopes grain belt.

The mine currently has development consent from Harden Shire Council to produce 200 000 tonnes per annum of milled limestone products. However, Barnu now wishes to obtain approval to mine up to 500 000 tonnes per annum of limestone and transport up to 350 000 tonnes per annum of crushed and milled limestone products from the mine.

The expansion program would be undertaken in a series of five stages programmed over a 40 year period.

Crushed and milled limestone products would continue to be despatched from the mine site using trucks of varying capacities and configurations that include rigid-bodied tippers, semi-tippers, trucks with dog trailers and B-doubles.

The Proponent's proposal to stage the increase in production of crushed and milled limestone products would result in a progressive increase in vehicle movements through time that reflects this staged approach.

Initially, it is proposed that products would be transported on the same road routes currently used by product vehicles. The Proponent proposes to gradually increase the volume of mine products transported through Galong via the southern transportation routes from the current approved volume of 200 000tpa up to approximately 340 000tpa. It is envisaged that a further 10 000tpa to 30 000tpa would be distributed via the northern transportation routes towards Harden and Boorowa, specifically along Kalangan and Cunningar Roads, which are currently being used to transport a small amount of product from the mine.

As part of the proposal, the Proponent proposes to implement traffic management safeguards to minimise any impacts associated with increased truck movements using the road network due to the proposal. The safeguards have been formulated following community consultation and discussions with officers of Harden Shire Council. The measures include:

- Applicable Section 94 Contributions for the staged upgrading of the road pavement, where necessary, and future road maintenance through the Galong Township to minimise noise impacts.
- Investigate with Council and the RTA the possibility of reducing the speed limit through the town for heavy vehicles and other vehicles together with appropriate advance warning signs.
- A Code of Conduct for truck drivers and a Complaints Hot line that would apply to all truck drivers transporting products from the Galong Limestone Mine.
- Investigate with Council and the RTA the possibility of reducing the speed limit along Eubindal Road for all vehicles.

Assessment of Existing Traffic Conditions

The immediate road network (local and regional roads) around Galong Limestone Mine carry low traffic volumes. The proportion of heavy vehicles varies on these roads, based on seasonal factors. The traffic counts for the period of 1-7 February 2003 show that the proportion of heavy vehicles on weekdays on those local roads in and around Galong (except Eubindal Road) varied between 7% and 27%. During this period, the Galong Limestone Mine averaged 13-14 loads or 26-28 truck movements on the weekdays. Previous traffic counts undertaken by Harden Shire Council on these roads has shown a higher number of heavy vehicles with heavy vehicles representing a higher proportion of the total traffic on these roads.

Burley Griffin Way (MR 84), a State Road, carries higher traffic volumes with average weekday volumes in the order of 1348 vpd and heavy vehicles representing around 21% of total volumes. Burley Griffin Way is constructed and maintained to a high standard two lane undivided rural road providing adequate widths for safe usage by heavy vehicles.

The local road network servicing the Galong Limestone Mine, except Eubindal Road, provides sealed pavement widths between 5.5 metres to 7.0 metres and unsealed shoulders. An assessment of traffic conditions on these roads indicates that traffic conditions are generally satisfactory.

Assessment of Traffic Impacts

The proposal will increase vehicle trips associated with employees and mine maintenance by 10 vehicle trips per day. Increased vehicle trips associated with product transportation will be more significant and more noticeable on the road network.

The mine has approvals to mine and transport 200 000 tonnes of produce per annum, however current production (2003) is 144 000 tonnes.

Table 1 shows the total product truck movements per day and per hour for the staged approach of the proposal.

Table 2 shows the increase in product truck movements due to the proposal per day and per hour in 2004 which is for the current approved tonnage of 200 000 tonnes per annum and in 2008 which is when sales and transportation are expected to be at 350 000 tonnes per annum.

TABLE 1

Total Product Truck Movements Generated by Galong Mine Proposal

Period	Existing 2003 144 000tpa	2004 200 000tpa	2005 250 000tpa	2008 350 000tpa
Average day	34	48	60	82
85^{th}% day	58	76	88	96
Hourly Average Day	3-4	4-5	6	8-9
Hourly 85^{th}% Day	5-6	7-8	8-9	9-10

TABLE 2
Increase in Product Truck Movements Due to Proposal
Total Increase in Product Truck Movements

Period	**2004 Current Approval 200 000tpa Increase from Existing**	**2008 Proposed 350 000tpa Increase from Current Approval**
Average Day	+14	+34
85^{th}% Day	+18	+20
Hourly Average Day	+1	+4
Hourly 85^{th}% Day	+2	+2

Approximately 95% of all product trucks will travel via the southern transportation routes to Burley Griffin Way (MR 84) via Galong Township with the remaining 5% using the northern transportation routes of Kalangan Road / Cunningar Road.

The assessment has found that the increase in product truck movements will be noticeable on the local road network. However, the impacts associated with the increased truck movements relate mainly to amenity issues within the Galong town and the Proponent is proposing a number of traffic management measures / safeguards that will mitigate any potential adverse impacts within the town.

The traffic and other impacts on the wider road network including the Northern Transport Route (Kalangan Road / Cunningar Road) and on Burley Griffin Way will be minimal and traffic conditions on these roads will remain satisfactory after the proposal is in place.

1.0 INTRODUCTION

The Galong Limestone Mine is located approximately 20km east-southeast of Harden in the Southwest Slopes region of NSW (see **Figure 1**). The mine is owned and operated by Barnu Pty Ltd (The Proponent) and is the major supplier of agricultural lime for use as an acid soil ameliorant to the cropping areas of the Southwest Slopes grain belt.

The mine currently has development consent from Harden Shire Council to produce 200 000 tonnes per annum of milled limestone products. However, Barnu now wishes to obtain approval to mine up to 500 000 tonnes per annum of limestone and transport up to 350 000 tonnes per annum of crushed and milled limestone products from the mine.

This report has been prepared for reference within the Environmental Impact Statement to assess the traffic issues associated with the increased level of product transportation.

2.0 GALONG LIMESTONE MINE EXISTING OPERATION

2.1 Existing Consents

Galong Limestone Mine is located off Eubindal Road, Galong. The existing development consents for the Galong Limestone Mine allow production and transportation for 200 000 tonnes of lime products per year. For the 2001-2002 year, the mine's sales were for 144 000 tonnes.

2.2 Product Transportation

Milled limestone products are currently despatched from the mine site using trucks of varying capacities and configurations that include rigid-bodied tippers, semi-tippers, trucks with dog trailers and B-doubles. The main transportation routes used by product trucks travelling from the mine and the current tonnage / percentage of product trucks using these routes is illustrated on Figure 2.

All product trucks travelling from the mine do so via the private mine access road to Eubindal Road, from where they turn left and travel to the intersection with Galong Road. Unless delivering mine products to nearby landholders, product trucks turn left onto Galong Road, from where they head in a southerly direction towards Galong.

The vast majority of product trucks (~95%) travel via the 'southern transportation routes' through Galong. These vehicles travel along Galong Road (known as Ryan Street and Bobbara Road within the town limits) and via the heavy vehicle bypass that includes Bobbara Road and Crescent Street. After crossing the railway line, product trucks travel approximately 3km further along Galong Road to its intersection with Burley Griffin Way (Main Road 84) from where they can either travel east towards Yass, or west to Harden. Company information indicates that the majority of product trucks that travel through Galong turn right onto Burley Griffin Way and travel towards Harden.

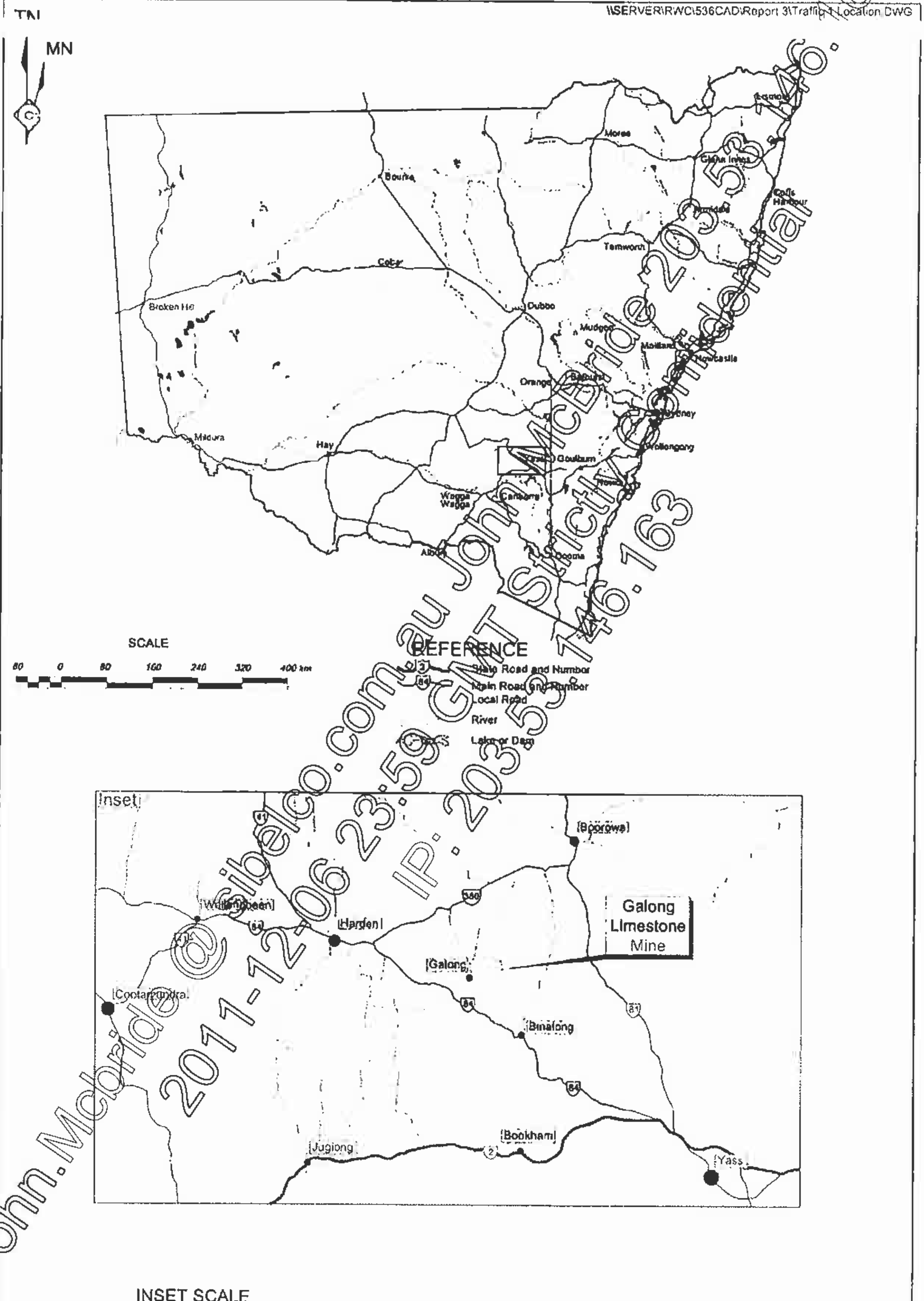

Figure 1
REGIONAL SETTING

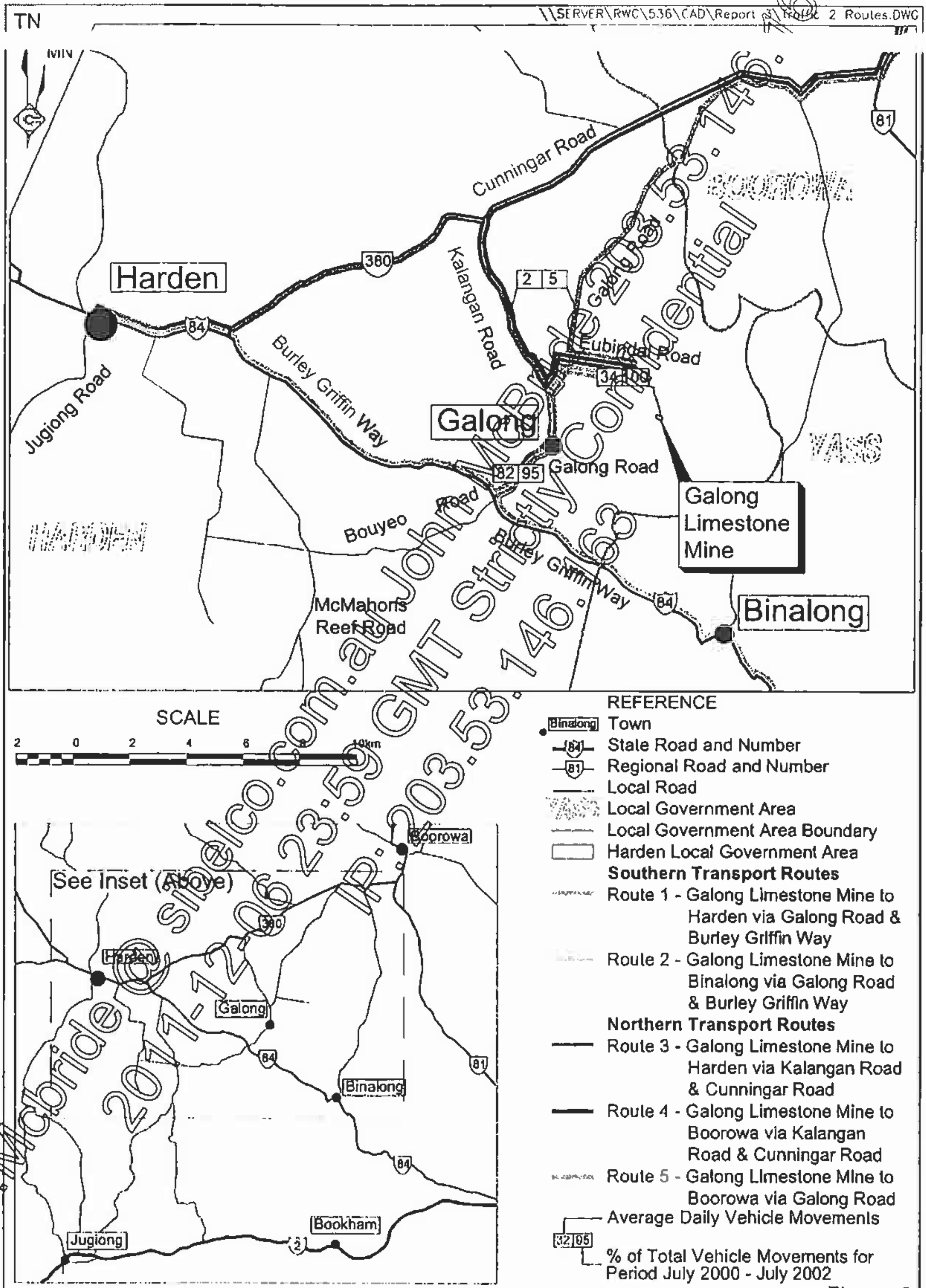

Figure 2
EXISTING PRODUCT TRANSPORT ROUTES

Approximately 5% of product trucks travel to Harden or Boorowa via Kalangan and Cunningar Roads or to Boorowa via Galong Road (referred to as the 'northern transportation routes'). Product trucks travelling to Harden or Boorowa via the northern transportation routes turn right off Galong Road onto Kalangan Road, from where they travel approximately 9km in a north-westerly direction to the intersection with Cunningar Road (Main Road 380). Product trucks travelling to Harden turn left onto Cunningar Road and travel for approximately 12km in a south-westerly direction to the intersection with Burley Griffin Way, located approximately 5km east of Harden. Product trucks travelling to Boorowa turn right onto Cunningar Road at its intersection with Kalangan Road, before travelling approximately 25km in a north-easterly direction to Boorowa.

Product trucks are discouraged from travelling to Boorowa via Galong Road as the road has a nominated 8t load limit. On occasions, product trucks may use other local roads for the transportation of mine products (e.g. Fairview Road, Boorowa Road east of Galong). Although the Proponent discourages the use of these roads for product transportation, it is unable to dictate which transportation routes are used by product trucks that are owned and/or operated by other organisations.

Despatch records are maintained by the Proponent which identify the transport route used by all product trucks transporting products from the mine. The vehicle movement statistics summarised in **Table 2.1** are derived from these despatch records and relate to the transportation of 144 000t of product during 2001/2002, based on average loads of 30 tonnes.

TABLE 2.1

Existing Traffic Movements

Road Route	Total Products Transported			Average Vehicle Movements		
	Tonnes	%	Hourly	Daily	Weekly	Daily 85th%*
Southern Transportation Routes: Mine to Harden or Binalong via Galong Road and Burley Griffin Way	137 000	95	3.2	32	160	58
Northern Transportation Routes: Mine to Harden or Boorowa via Kalangan and Cunningar Roads; Mine to Boorowa via Galong Road	7 000	5	0.2	2	12	N/A
*85th percentile movements						

In 2001/2002, the Proponent payed Harden Shire Council approximately $48 000 towards the upgrading of the roads used by the trucks travelling to and from the mine in accordance with the prevailing Section 94 Contributions Plan.

3.0 PROPOSAL

3.1 Project Site

The Project Site is located entirely on land owned by Bobbara Pastoral Company Pty Ltd and corresponds to the boundary of Mining Lease No. 1496. The Project Site covers an area of approximately 160 hectares, incorporating all of Portion 139 and parts of Lots 1, 2 and 3, DP 747544, all within the Parish of Bobbara, County of Harden (**Figure 3**). The Project Site also incorporates approximately 1km of Crown Road Reserve.

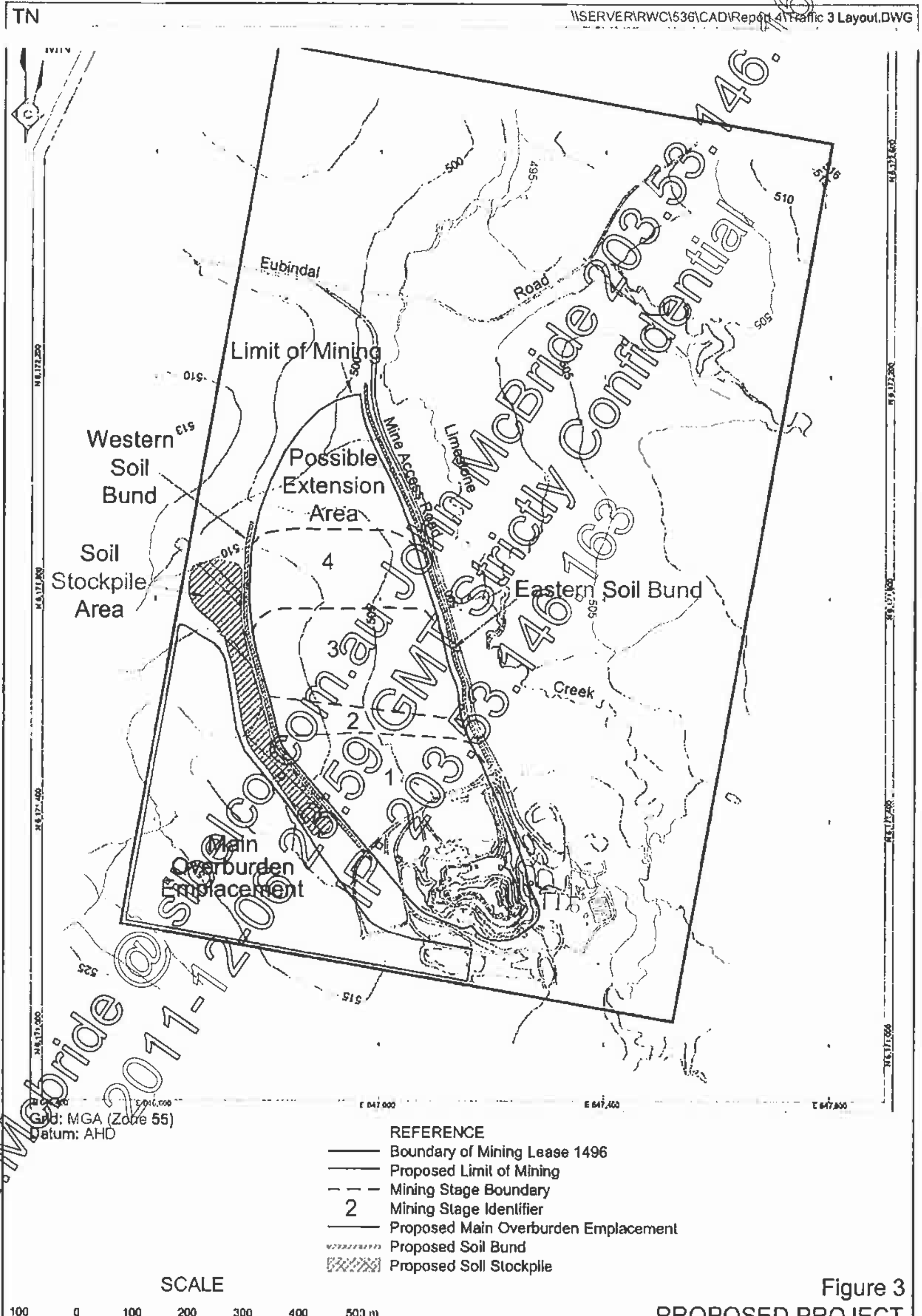

Figure 3
PROPOSED PROJECT
SITE LAYOUT

3.2 Proposal

The proposal is to:

- expand mining operations on the site increasing the mining of limestone to 500 000 tonnes per annum; and
- process and transport up to 350 000 tonnes per annum of crushed and milled limestone products from the mine.

The expansion program would be undertaken in a series of five stages programmed over a 40 year period.

3.3 Product Transportation

Crushed and milled limestone products would continue to be despatched from the mine site using trucks of varying capacities and configurations that include rigid-bodied tippers, semi-tippers, trucks with dog trailers and B-doubles.

The Proponent's proposal to stage the increase in production of crushed and milled limestone products would result in a progressive increase in vehicle movements through time that reflects this staged approach.

Initially, it is proposed that products would be transported on the same road routes currently used by product vehicles (refer Section 2.2). The Proponent proposes to gradually increase the volume of mine products transported through Galong via the southern transportation routes from the current approved volume of 200 000tpa up to approximately 340 000tpa. It is envisaged that a further 10 000tpa to 30 000tpa would be distributed via the northern transportation routes towards Harden and Boorowa, specifically along Kalangan and Cunningar Roads.

Table 3.1 illustrates the Proponent's staged approach to transportation of increased product volumes from the mine and the resultant increase in traffic volumes that are expected. This is based on average loads of 30 tonnes and 10 hours of transportation for 290 days per year. The total number of 30 tonne loads despatched per day would be in the order of 50 (i.e. 100 truck movements) for an 85th percentile day. It is envisaged that heavy vehicle movements through Galong would gradually increase over a five year period to reflect the progressive increase in transport of mine products up to the maximum volume of 340 000tpa. This would equate to a maximum average of 78 vehicle movements per day i.e. 39 laden and 39 unladen trucks. Heavy vehicle movements along Kalangan and Cunningar Roads are unlikely to change significantly, with expected daily vehicle movements likely to continue to average 2 vehicle movements per day but range from 4 to 8 per day. **Figure 4** illustrates the envisaged changes to vehicle movements as a result of the Proponent's proposal to increase the volume of crushed and milled limestone products transported from the Galong Limestone Mine.

The rate of product despatch would continue to vary during the year to reflect seasonal demands for agricultural lime products. However, the Proponent believes that the large fluctuations in daily vehicle movements presently experienced would decrease with increased production, such that the 85th percentile of vehicle movements on all transportation routes would more closely approach the average daily vehicle movements for these routes. The Proponent would continue to pay contributions for road maintenance to Council under Section 94 of the *Environmental Planning and Assessment Act 1979*, and in accordance with Council's Section 94 Contributions Plan.

TABLE 3.1

Proposed Staged Production and Transportation

Road Route	Total Products Transported			Average Vehicle Movements		
	Tonnes	%	Hourly	Daily	Weekly (5 day)	Daily 85th%*
Current Production Level - 144 000tpa						
Southern Transportation Routes: Mine to Harden or Binalong via Galong Road and Burley Griffin Way	137 000	95.1	3.2	32	160	56
Northern Transportation Routes: Mine to Harden or Boorowa via Kalangan and Cunningar Roads; or Mine to Boorowa via Galong Road	7 000	4.9	0.2	2	10	2
Stage 1 (by 2004) Increase Production to Current Consent Limit of 200 000tpa						
Southern Transportation Routes: Mine to Harden or Binalong via Galong Road and Burley Griffin Way	170 000 to 190 000	0.85 to 95.0	4.0 to 4.4	40 to 44	200 to 220	68 to 72
Northern Transportation Routes: Mine to Harden or Boorowa via Kalangan and Cunningar Roads	10 000 to 30 000	5.0 to 15.0	0.2 to 0.8	4 to 8	20 to 40	4 to 8
Stage 2 (by 2005) Increase Production to 250 000tpa						
Southern Transportation Routes: Mine to Harden or Binalong via Galong Road and Burley Griffin Way	220 000 to 240 000	88.0 to 96.0	5.2 to 5.6	52 to 56	260 to 280	80 to 84
Northern Transportation Routes: Mine to Harden or Boorowa via Kalangan and Cunningar Roads	10 000 to 30 000	4.0 to 12.0	0.2 to 0.8	4 to 8	20 to 40	4 to 8
Stage 3 (by 2008) Increase Production to 350 000tpa						
Southern Transportation Routes: Mine to Harden or Binalong via Galong Road and Burley Griffin Way	320 000 to 340 000	91.4 to 97.2	7.4 to 7.8	74 to 78	370 to 390	88 to 92
Northern Transportation Routes: Mine to Harden or Boorowa via Kalangan and Cunningar Roads	10 000 to 30 000	2.8 to 8.6	0.2 to 0.8	4 to 8	20 to 40	4 to 8

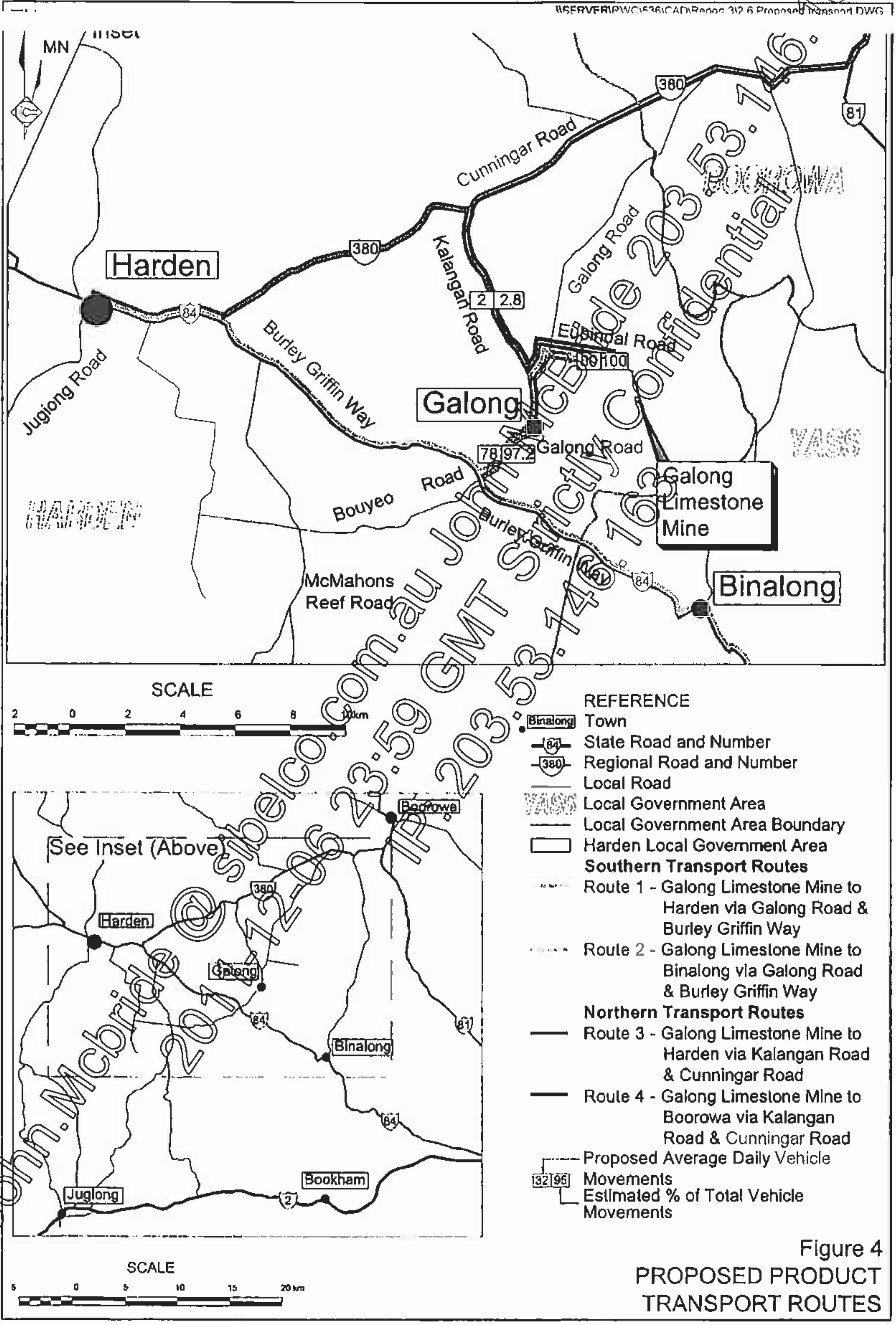

Figure 4
PROPOSED PRODUCT TRANSPORT ROUTES

Two options were considered by the Proponent to transport its products to Burley Griffin Way for distribution to its main market area beyond Harden. **Figure 5** shows the location of the alternative transportation route options.

Option 1 - Galong Limestone Mine to Burley Griffin Way via Galong (preferred option)

The most direct route for the transportation of mine products to Burley Griffin Way (MR84) is via the town of Galong. This route extends over a distance of 10.2km from the mine access road along Eubindal Road, then south along Galong Road via the town of Galong to Burley Griffin Way. The route would enable mine products to be transported from the mine to Harden over a distance of 28.3km. The assessment of impact for this option (Section 4) has supported its use as the preferred route.

Option 2 - Galong Limestone Mine to Burley Griffin Way via Kalangan and Cunningar Roads

The most obvious and only feasible alternative route for the transportation of the majority of the Proponent's products to Burley Griffin Way is via Kalangan and Cunningar Roads. The route comprises the following road sections and covers a distance of 24.8km to Burley Griffin Way.

- Galong Road - a distance of 1.2km from Eubindal Road to Kalangan Road.
- Kalangan Road - a distance of 8.9km from Galong Road to Cunningar Road.
- Cunningar Road - a distance of 11.9km from Kalangan Road to Burley Griffin Way.

Use of this route would result in mine products being transported from the mine to Harden over a distance of 29.4km. This route is presently used by a small number of product trucks, the majority of which distribute product directly to landholdings close to the road route. It is envisaged that up to approximately 30 000tpa of mine products could be transported along this route without the need for major road upgrade works.

3.5 Other Transportation Routes

The Proponent has also assessed the viability of the transportation of mine products to Burley Griffin Way via Galong Road and the unsealed section of Bobbara Road that extends from the heavy vehicle bypass at Galong, to the intersection with Burley Griffin Way located approximately 1.5km northwest of Binalong.

However, this route has been discounted as a feasible alternative transportation route due to:

(i) the inappropriate width and surface condition of the road;

(ii) the condition of the intersection of Bobbara Road and Burley Griffin Way; and

(iii) Harden Shire Council's current proposal to place an 8t weight restriction on the road.

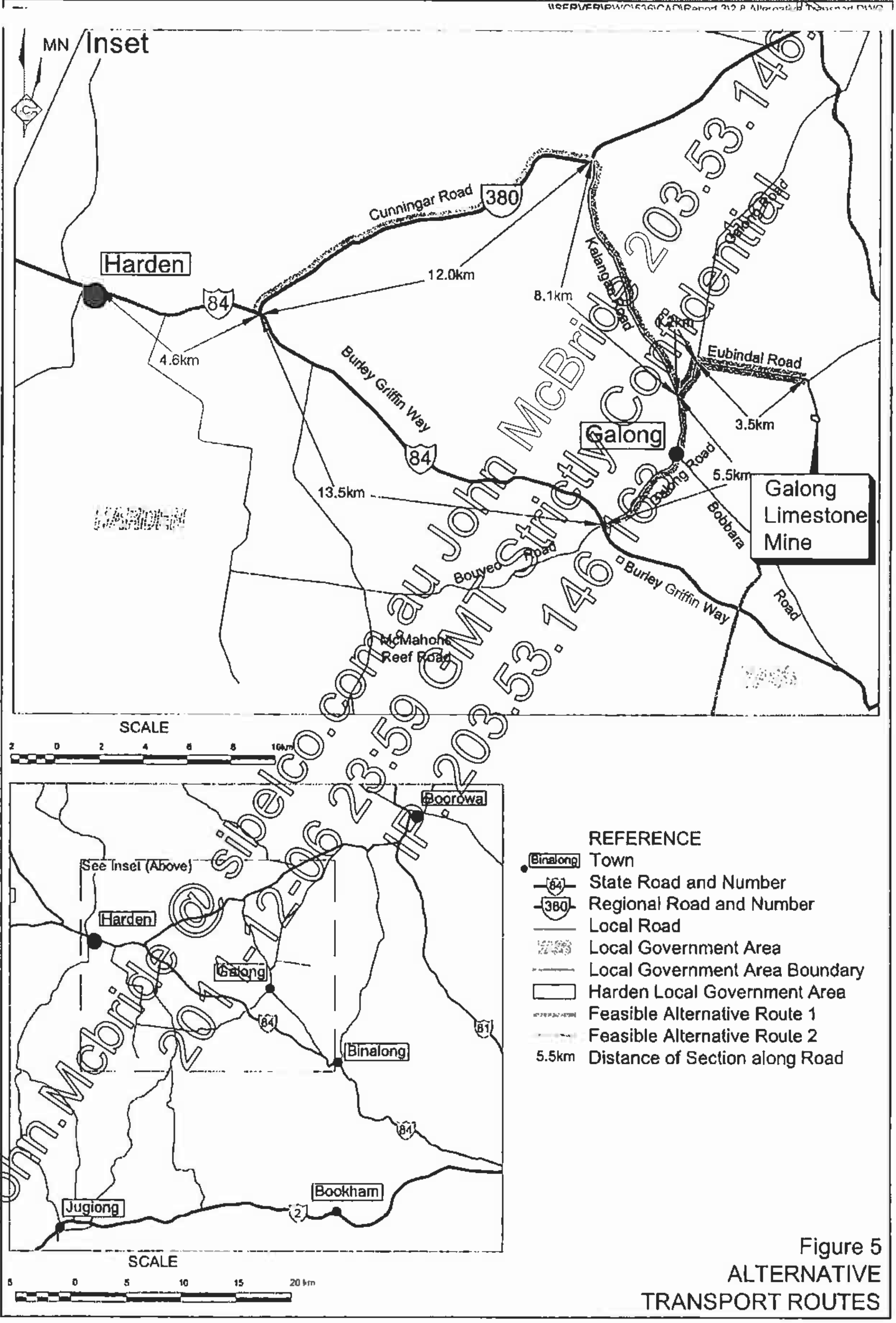

Figure 5
ALTERNATIVE
TRANSPORT ROUTES

3.6 Preferred Option

3.6.1 Proposed Transport Routes

The Proponent's preference is clearly for the majority of its products (up to 340 000tpa) to be transported via the shortest route to Burley Griffin Way (MR84), for distribution to the major Southwest Slopes market area. The Proponent would prefer to commit to progressively upgrading this transportation route as an improved road network would not only benefit Galong residents, but all motorists who travel through Galong. Upgrading of the Kalangan and Cunningar Roads would involve substantially higher costs because of the greater distance and fewer local residents would benefit.

However, the Proponent proposes to classify both transportation routes (Options 1 and 2) as 'designated routes' for the transportation of products from the Galong Limestone Mine, even though the majority of product would continue to be transported to Burley Griffin Way via Galong (Option 1). The volume of mine products transported to Burley Griffin Way via Kalangan and Cunningar Roads is unlikely to exceed 30 000tpa.

3.6.2 Proposed Traffic Management Safeguards

The proponent proposes to implement traffic management safeguards to minimise any impacts associated with increased truck movements using the road network due to the proposal. The safeguards have been formulated following community consultation and discussions with officers of Harden Shire Council. Details of the proposed measures are detailed in Section 5.1 of this report.

4.0 EXISTING TRAFFIC CONDITIONS

4.1 Existing Road Network

The principal road network within Harden Shire that provides access to the Galong Limestone Mine and forms the existing and/or proposed transport routes include:

- Eubindal Road – local (Shire Road No. 62) road under the control of Harden Shire Council;
- Galong Road – local (Shire Road No. 58) road under the control of Harden Shire Council;
- Burley Griffin Way (MR 84) – State road under the control of the Roads and Traffic Authority;
- Cunningar Road (MR 380) – regional road maintained by Harden Shire Council with joint funding from the Roads and Traffic Authority;
- Kalangan Road – local (Shire) road under the control of Harden Shire Council.

A description and assessment of these roads follows. **Figures 2** and **4** show the location of each of the above roads.

4.2 Description and Assessment of Roads

4.2.1 Eubindal Road

Eubindal Road provides access to the Galong Limestone Mine and is approximately 3.5km long between Galong Road and the mine access road, where the formed section of Eubindal Road ends. Eubindal Road provides property access to Bobbara Station, two (2) other properties and the mine.

Eubindal Road is a two lane gravel road with a graded carriageway width of approximately 7.0 metres. The alignment is straight with several moderate crests and sags along its length. A concrete ford and 8m wide, 600m long sealed section are respectively located along Eubindal Road, approximately 500m and 1.8km east of the intersection with Galong Road. While the speed limit on Eubindal Road is nominally 100km/h, vehicle speeds are much lower than this due principally to the corrugations.

Eubindal Road forms a T junction intersection with Galong Road (Austroad Type A treatment) approximately 1km north of Kalangan Road. Sight distances at the intersection are satisfactory.

4.2.2 Galong Road

Galong Road provides direct access to the Galong Limestone Mine from Burley Griffin Way (MR 84). Galong Road also connects to Cunningar Road (MR 380) approximately 11km west of Boorowa. The description and assessment of Galong Road is presented for the sections south and north of Eubindal Road.

<u>Galong Road between Burley Griffin Way (MR 84) and Eubindal Road</u>

Galong Road between Burley Griffin Way (MR 84) and Eubindal Road passes through the town of Galong and is approximately 6km in length.

In the section between MR 84 and the town, Galong Road is a two lane undivided rural road with a sealed road pavement 7.0 metres (wide) and 1.0 – 2.0 metre road shoulders. A centre line is provided together with guide posts and delineators. The speed limit is 100km/h and the condition of the pavement is good. The edges of this road were upgraded by Harden Shire Council in about 2000 with funds obtained from the Proponent's Section 94 road maintenance contributions.

The route through Galong township uses Crescent Street, Bobbara Road and Ryan Street (see **Figure 6**), the heavy vehicle bypass route designated by Harden Shire Council and Barnu Pty Ltd. The road pavement width varies between 6.0 – 7.0 metres, although wider pavement and flaring is provided at the Bobbara Road / Crescent Street intersection. The route through Galong provides a single lane of travel in each direction and crosses the railway line in two locations. Road bridges (over the railway line) are provided in Ryan Street near McMahons Road and in Crescent Street just north of Station Street.

The road pavement through Galong town is uneven and damaged in some locations. Regular maintenance is required to repair rough / uneven pavement sections.

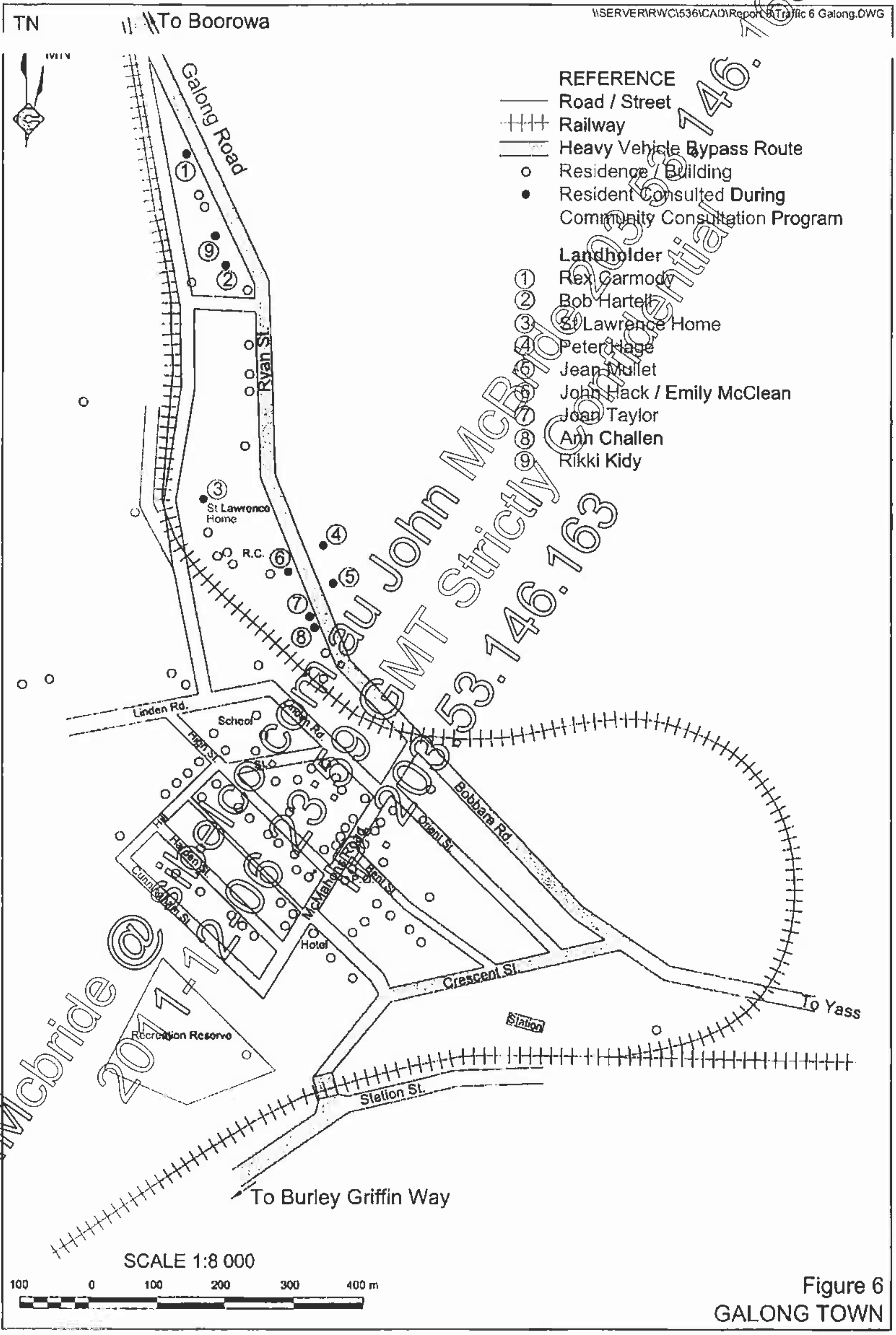

Figure 6
GALONG TOWN

The speed limit in Galong is 60km/h. The road alignment at the southern / western end of the town at the rail overbridge near Station Street reduces vehicle speeds approaching from Burley Griffin Way. The 60km/h speed limit at the northern end of town is positioned adjacent the most northern properties with limited transition for vehicles travelling south to reduce their speeds from 100km/h before entering the town.

Sight distances at intersections through the town are generally satisfactory, although the alignment at the railway overbridge limits sight distance at Station Street for vehicles travelling towards Burley Griffin Way.

The section of Galong Road north of the town to Kalangan Road has a road pavement width of 7.0 metres with 1.0 – 1.5 metre road shoulders. The speed limit in this section is 100km/h.

Principal intersections in this section of Galong Road include:

- Burley Griffin Way (MR 84) / Galong Road / Bouyeo Road – a cross intersection;
- Galong Road / Crescent Street – T junction;
- Crescent Street / Bobbara Road – T junction;
- Galong Road / Kalangan Road – T junction; and
- Galong Road / Eubindal Road – T junction.

Burley Griffin Way / Galong Road / Bouyeo Road is located at the start of a crest in the south / eastern approach of Burley Griffin Way. The intersection affords good sight distance to and from both approaches of Burley Griffin Way. The intersection treatment includes a modified Austroad Type A treatment in Burley Griffin Way with a sealed shoulder area in the eastern approach of Burley Griffin Way and a short 30 metre long left turn lane in the western approach of Burley Griffin Way. Galong Road and Bouyeo Road are subject to Give Way control. Sight distance at the intersection meets Austroad requirements for the posted speed limit of 100km/h at the intersection.

The Galong Road / Crescent Street and Crescent Street / Bobbara Road intersections are located in the town and subject to a 60km/h speed limit. Sight distances at these intersections are satisfactory.

The Galong Road / Kalangan Road intersection is an angled T junction with an Austroad's Type A treatment. Sight distances at the intersection are good and meet Austroad requirements for the posted 100km/h speed limit.

The Galong Road / Eubindal Road intersection is a standard Austroad's Type A treatment. Sight distances at the intersection are satisfactory.

<u>Galong Road between Eubindal Road and Cunningar Road (MR 380)</u>

This section of Galong Road is 17km in length and provides the most direct route to Boorowa with Galong Road intersecting Cunningar Road (MR 380) some 11km west of Boorowa. The road passes through rural areas and the road alignment is predominantly straight with some curves with moderate grade changes along the length of the road.

The road is an undivided two lane rural road and has a pavement width of 5.5 – 6.0 metres with 1.0 – 2.0 metre wide unsealed shoulders.

The road currently has an 8.0 tonne load limit and a speed limit of 100km/h. Guide posts and reflectors are intermittently spaced along the road. The pavement condition was considered to be satisfactory to good condition along its length.

Intersection treatments along the route are Austroad Type A treatments.

Galong Road forms a T junction intersection with Cunningar Road. An Austroad's Type A treatment is provided in Cunningar Road and sight distance at the intersection is good and meets Austroad requirements for the 100km/h posted speed limit.

4.2.3 Burley Griffin Way (MR 84)

Burley Griffin Way provides the main east-west route between Harden and the Hume Highway and provides the principal route from Galong to these destinations.

Burley Griffin Way is a State road and is generally constructed and maintained to a high two lane undivided rural road standard.

It generally provides a 7.0 metre wide road pavement and 1.0 to 2.5 metre shoulders along its length. Between the Hume Highway and Harden, it passes through the towns of Bowning and Binalong where the speed limit is 60km/h. Outside these towns, the speed limit is 100km/h.

Overtaking lanes are provided for the eastbound direction between Harden and Cunningar Road and between Galong Road and Binalong.

A high level of traffic management is provided with centre line markings, reflective pavement markers and edge lines. Guide posts and reflectors as well as advisory warning signs are also provided along the route.

Intersection treatments in the 100km/h speed limit areas are either Austroad Type B treatments on principal intersections or Type A treatments.

Sight distances along the road and at the intersections are considered to be satisfactory and meet Austroad requirements for the posted speed limits and estimated vehicle operating speeds.

4.2.4 Cunningar Road (MR 380)

Cunningar Road (MR 380) connects the towns of Harden and Boorowa, a distance of approximately 36km.

Cunningar Road between Burley Griffin Way (MR 84) and Galong Road is a good standard two lane undivided rural road and passing through rural countryside. The road alignment is generally straight with moderate curves and grades. The sealed road pavement is generally 6.5 to 7.0 metres along its length with 1.0 – 2.0 metre wide unsealed shoulders.

Traffic management includes a centre line, guide posts and reflectors and advisory warning signs as appropriate. The speed limit is predominantly 100km/h and the condition of the road pavement is generally good, although in some sections the pavement condition was fair to satisfactory.

Intersection treatments along this section of Cunningar Road are standard Austroad Type A treatments and sight distance at these intersections was considered to be satisfactory for the vehicle operating speeds.

Cunningar Road has a rail level crossing some 200 metres east of Burley Griffin Way (MR 84). The level crossing is provided with boom gates and flashing lights.

Cunningar Road forms a T junction intersection with Burley Griffin Way (MR 84) and is subject to Give Way control. A modified Austroad Type B treatment is provided at the intersection with:

- an extended passing lane approximately 150 metres long in the southeastern approach of Burley Griffin Way to cater for the right turn movement;
- a left turn lane together with a deceleration lane approximately 150 metres long in the northwestern approach of Burley Griffin Way;
- a left turn acceleration lane approximately 150 metres long in the southeastern approach of Burley Griffin Way for the left turn out of Cunningar Road; and
- two lane approach for some 100 metres in Cunningar Road at the intersection.

Sight distances at the intersection are good and meet the Austroad requirements for the posted 100km/h speed limit.

4.2.5 Kalangan Road

Kalangan Road provides another north-south route to Cunningar Road (MR 380) from Galong, intersecting Cunningar Road approximately 18km east of Harden. This route is normally used by trucks travelling to and from Boorowa given the 8 tonne load limit on the northern section of Galong Road.

Kalangan Road is approximately 9km long and passes through rolling rural land. The road is a two lane undivided rural road and generally provides a sealed road pavement width of 6.0 – 6.5 metres with unsealed road shoulders 1.0 – 1.5 metres wide. The road alignment consists of moderate curves in the undulating section and straight sections.

The road pavement is in good condition and the speed limit is 100km/h. There is a narrow (single lane) bridge (no passing on bridge) located approximately 3km from Galong Road. Sight distance of the bridge is good from both approaches and warning signs are provided.

Kalangan Road forms a split T junction intersection with Cunningar Road (MR 380). Standard Type A treatments are provided at both intersections and Kalangan Road is subject to Give Way control.

Vehicle approach speeds in Cunningar Road are reduced by curves (bends) on the western and eastern approaches to the Kalangan Road (western and eastern intersections). These curves also reduce entering sight distance from the Kalangan Road approaches, however, the available sight distance is considered to be adequate for the estimated vehicle operating speeds in Cunningar Road.

4.3 Existing Traffic Volumes Using the Road Network and Traffic Conditions

Traffic volumes using the road network have been collected from a number of sources including the RTA, Harden Shire Council and traffic counts undertaken as part of the EIS investigation.

Table 4.1 shows the RTA's AADT traffic volumes (7 day average and volumes equivalent to axle pairs, i.e. passenger vehicles) as measured in the Year 2000.

TABLE 4.1

2000 AADT Volumes

Location	AADT Volume
Burley Griffin Way (MR 84) east of Cunningar Road, Cunningar	2071
Cunningar Road (MR 380) northeast of Burley Griffin Way	335

Source: RTA Traffic Volume Data for South Western Region 2000

Table 4.2 shows weekday average (5 day) and average day (7 day) traffic volumes on the road network around the Galong Limestone Mine and the adjacent area, as measured in vehicle classification counts between 1-7 February 2003. These counts were commissioned by Transport and Urban Planning and includes some count locations of Harden Shire Council (see **Figure 7**). Reference to **Table 4.2** shows the following.

- Burley Griffin Way carried the highest traffic volumes with average weekday (5 day) traffic volumes of 1348 vehicles east of Galong Road. Heavy vehicles (Austroad Classes 3-12) represented 21.2% of the total volumes.
- Other roads carried much lower traffic volumes with traffic volumes ranging between 76 – 294 vehicles per day on an average weekday (5 day).

Traffic volumes on the road network immediately adjacent the Galong Limestone Mine and Galong Town on an average weekday (5 day) were as follows.

- Eubindal Road – 76 vehicles per day with 45.5% being heavy vehicles;
- Ryan Road (Galong Road) in Galong – 294 vehicles per day with 14.3% heavy vehicles;
- Galong Road north of Eubindal Road – 76 vehicles per day with 15.8% heavy vehicles;
- Kalangan Road north of Galong Road – 138 vehicles per day with 7.2% heavy vehicles;
- Galong Road north of Burley Griffin Way – 128 vehicles per day with 27.3% heavy vehicles.

The number and proportion of heavy vehicles using the road network varies considerably based on seasonal factors and weather conditions. Heavy vehicle numbers in the week of 1-7 February, 2003 are lower than previous traffic volume counts undertaken by Harden Shire Council.

TABLE 4.2

Location	Average Weekday (5 Day Average)				Average Day (7 Day Average)			
	North/East Volume	South/West Volume	Total Volume	% of Heavy Vehicles	North/ East Volume	South/ West Volume	Total Volume	% of Heavy Vehicles
Burley Griffin Way (MR84) east of Galong Road	708 * (147)	640 (139)	1348 (286)	21.2%	721 * (125)	679 (122)	1400 (247)	17.6%
Burley Griffin Way (MR84) west of Binalong	744 * (146)	732 (161)	1476 (307)	20.8%	757 * (125)	756 (142)	1513 (267)	17.6%
Cunningar Road (MR 380) east of Kalangan Road	140 * (24)	152 (25)	292 (49)	16.8%	125 * (19)	135 (20)	260 (39)	15.0%
Galong Road north of Burley Griffin Way	64 (17)	64 * (18)	128 (35)	27.3%	55 (13)	53 * (13)	108 (26)	24.1%
Ryan Road (Galong Road) in Galong Town north of railway line	148 (20)	146 * (22)	294 (42)	14.3%	128 (15)	125 * (17)	253 (32)	12.6%
Galong Road north of Eubindal Road	38 * (6)	38 (6)	76 (12)	15.8%	35 * (5)	35 (7)	70 (12)	17.1%
Kalangan Road north of Galong Road	70 * (5)	68 (5)	138 (10)	7.2%	61 * (4)	60 (5)	121 (9)	7.4%
Eubindal Road east of Galong Road	34 (15)	32 * (15)	66 (30)	45.5%	25 (11)	23 * (11)	48 (22)	45.8%
Juglong Road south of Burley Griffin Way	166 (34)	165 * (34)	331 (68)	20.5%	153 (26)	153 (27)	306 (55)	18.0%

Source: Vehicle Classification Counts (1 – 7 February, 2003 – Commissioned by Transport and Urban Planning and Harden Shire Council)

* *Indicates direction away from Galong Limestone Mine*
( ) *Number of heavy vehicles (Austroad Class 3-12)*

Tables 4.3 to **4.9** show the hourly traffic volumes for the average weekday (5 day) and average day (7 day) on the road network around Galong Mine as measured in the traffic counts between 1-7 February, 2003.

Reference to these tables shows that maximum hourly traffic volumes on an average week day (5 day) on the road network were as follows:

- Eubindal Road : 7-8 vehicles per hour;
- Ryan Road (Galong Town) : 27-31 vehicles per hour;
- Galong Road, north of Burley Griffin Way : 11-12 vehicles per hour;
- Galong Road, north of Eubindal Road : 7-8 vehicles per hour;
- Kalangan Road, north of Galong Road : 12-15 vehicles per hour;
- Burley Griffin Way, east of Galong Road : 100-105 vehicles per hour;
- Cunningar Road, east of Kalangan Road: 25-28 vehicles per hour.

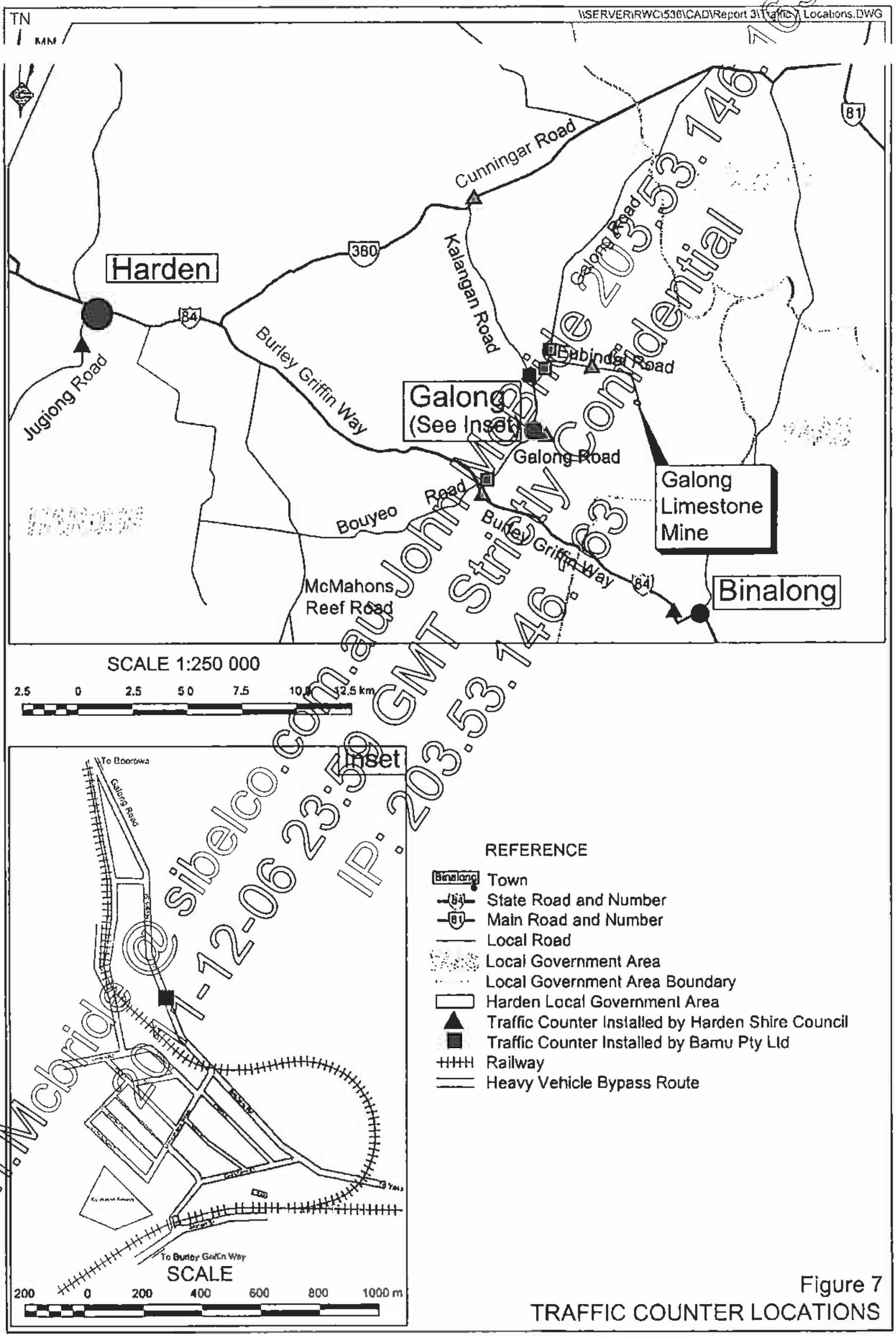

Figure 7
TRAFFIC COUNTER LOCATIONS

TABLE 4.3

Eubindal Road East of Galong Road
Hourly Traffic Volume on Average Weekday and Average Day

Time	Weekday Average (5 Day)			Average Day (7 Day)		
	East	West *	Total	East	West *	Total
Midnight – 1am	0	0	0	0	0	0
1am – 2am	0	0	0	0	0	0
2am – 3am	0	0	0	0	0	0
3am – 4am	0	0	0	0	0	0
4am – 5am	0	0	0	0	0	0
5am – 6am	0	0	0	0	0	0
6am – 7am	6	0	6	4	0	4
7am – 8am	2	2	4	1	1	2
8am – 9am	1	2	3	1	1	2
9am – 10am	5	2	7	3	1	4
10am – 11am	3	2	5	2	2	4
11am – Midday	5	3	8	3	2	5
Midday – 1pm	3	3	6	2	2	4
1pm – 2pm	3	3	6	2	2	4
2pm – 3pm	1	3	4	1	2	3
3pm – 4pm	2	6	8	2	4	6
4pm – 5pm	1	2	3	1	1	2
5pm – 6pm	1	1	2	1	1	2
6pm – 7pm	1	4	5	1	3	4
7pm – 8pm	0	0	0	0	0	0
8pm – 9pm	0	0	0	0	0	0
9pm – 10pm	0	0	0	0	0	0
10pm – 11pm	0	0	0	0	0	0
11pm – Midnight	1	0	1	0	0	0
Total	**34**	**32**	**66**	**25**	**23**	**48**

Source: Vehicle Classification Counts (1-7 February 2003)

** Indicates direction away from Galong Mine*

TABLE 4.4

Ryan Road# in Galong Town
Hourly Traffic Volume on Average Weekday and Average Day

Time	Weekday Average (5 Day)			Average Day (7 Day)		
	North	South *	Total	North	South *	Total
Midnight – 1am	0	0	0	0	0	0
1am – 2am	0	0	0	0	0	0
2am – 3am	0	0	0	0	0	0
3am – 4am	0	0	0	0	0	0
4am – 5am	0	0	0	0	0	0
5am – 6am	1	2	3	1	1	2
6am – 7am	7	3	10	6	2	8
7am – 8am	9	7	16	7	5	12
8am – 9am	12	11	23	10	9	19
9am – 10am	11	9	22	10	9	19
10am – 11am	17	10	27	14	10	24
11am – Midday	17	9	26	13	7	20
Midday – 1pm	10	11	21	8	9	17
1pm – 2pm	9	22	31	8	16	24
2pm – 3pm	8	9	17	7	7	14
3pm – 4pm	9	14	23	8	12	20
4pm – 5pm	12	13	25	11	11	22
5pm – 6pm	7	8	15	6	8	14
6pm – 7pm	7	7	14	6	6	12
7pm – 8pm	5	5	10	5	5	10
8pm – 9pm	3	3	6	3	3	6
9pm – 10pm	2	3	5	3	3	6
10pm – 11pm	1	1	2	1	1	2
11pm – Midnight	1	1	2	1	1	2
Total	**148**	**146**	**294**	**128**	**125**	**253**

Source: Vehicle Classification Counts (1-7 February 2003)

** Indicates direction away from Galong Mine*
*# See **Figure 7** for counter location*

TABLE 4.5

Hourly Traffic Volume on Average Weekday and Average Day

Time	Weekday Average (5 Day)			Average Day (7 Day)		
	North	South *	Total	North	South *	Total
Midnight – 1am	0	0	0	0	0	0
1am – 2am	0	0	0	0	0	0
2am – 3am	0	0	0	0	0	0
3am – 4am	0	0	0	0	0	0
4am – 5am	0	0	0	0	0	0
5am – 6am	0	1	1	0	1	1
6am – 7am	7	4	11	5	3	8
7am – 8am	4	3	7	3	3	6
8am – 9am	5	5	10	4	5	9
9am – 10am	6	4	10	5	4	9
10am – 11am	6	4	10	5	3	8
11am – Midday	5	5	10	4	4	8
Midday – 1pm	6	5	11	4	4	8
1pm – 2pm	4	5	9	3	4	7
2pm – 3pm	4	5	9	3	4	7
3pm – 4pm	4	8	12	3	6	9
4pm – 5pm	3	4	7	3	4	7
5pm – 6pm	4	3	7	3	3	6
6pm – 7pm	3	4	7	3	3	6
7pm – 8pm	1	1	2	1	1	2
8pm – 9pm	1	0	1	1	0	1
9pm – 10pm	1	0	1	2	0	2
10pm – 11pm	1	1	2	1	1	2
11pm – Midnight	0	0	0	1	1	2
Total	**64**	**64**	**128**	**55**	**53**	**108**

Source: Vehicle Classification Counts (1-7 February 2003)

** Indicates direction away from Galong Mine*

TABLE 4.6

Hourly Traffic Volume on Average Weekday and Average Day

Time	Weekday Average (5 Day)			Average Day (7 Day)		
	North *	South	Total	North *	South	Total
Midnight – 1am	0	0	0	0	0	0
1am – 2am	0	0	0	0	0	0
2am – 3am	0	0	0	0	0	0
3am – 4am	0	0	0	0	0	0
4am – 5am	0	0	0	0	0	0
5am – 6am	0	1	1	0	1	1
6am – 7am	0	3	3	0	3	3
7am – 8am	3	2	5	3	1	4
8am – 9am	3	5	8	3	4	7
9am – 10am	3	4	7	3	3	6
10am – 11am	4	2	6	3	2	5
11am – Midday	2	3	5	2	3	5
Midday – 1pm	3	2	5	2	2	4
1pm – 2pm	2	3	5	2	2	4
2pm – 3pm	3	2	5	3	3	6
3pm – 4pm	2	2	4	2	2	4
4pm – 5pm	3	3	6	3	3	6
5pm – 6pm	3	3	6	3	3	6
6pm – 7pm	4	2	6	3	1	4
7pm – 8pm	1	1	2	1	1	2
8pm – 9pm	1	0	1	1	0	1
9pm – 10pm	1	0	1	1	0	1
10pm – 11pm	0	1	1	0	0	0
11pm – Midnight	0	0	0	1	1	2
Total	**38**	**38**	**76**	**35**	**35**	**70**

Source: Vehicle Classification Counts (1-7 February 2003)

** Indicates direction away from Galong Mine*

TABLE 4.7

Hourly Traffic Volume on Average Weekday and Average Day

Time	Weekday Average (5 Day)			Average Day (7 Day)		
	North *	South	Total	North *	South	Total
Midnight – 1am	0	0	0	0	0	0
1am – 2am	0	0	0	0	0	0
2am – 3am	0	0	0	0	0	0
3am – 4am	0	0	0	0	0	0
4am – 5am	0	0	0	0	0	0
5am – 6am	0	0	0	0	0	0
6am – 7am	4	3	7	3	2	5
7am – 8am	5	3	8	4	2	6
8am – 9am	6	5	11	6	4	10
9am – 10am	5	6	11	5	6	11
10am – 11am	6	6	12	5	6	11
11am – Midday	3	4	7	3	4	7
Midday – 1pm	6	3	9	5	3	8
1pm – 2pm	5	3	8	4	3	7
2pm – 3pm	4	6	10	4	5	9
3pm – 4pm	7	8	15	6	7	13
4pm – 5pm	4	5	9	4	5	9
5pm – 6pm	4	4	8	4	4	8
6pm – 7pm	5	3	8	4	2	6
7pm – 8pm	2	3	5	2	3	5
8pm – 9pm	2	2	4	1	2	3
9pm – 10pm	1	2	3	1	2	3
10pm – 11pm	0	0	0	0	0	0
11pm – Midnight	0	0	0	0	0	0
Total	**70**	**68**	**138**	**61**	**60**	**121**

Source: Vehicle Classification Counts (1-7 February 2003)

** Indicates direction away from Galong Mine*

TABLE 4.8

Hourly Traffic Volume on Average Weekday and Average Day

Time	Weekday Average (5 Day)			Average Day (7 Day)		
	East *	**West**	**Total**	**East ***	**West**	**Total**
Midnight – 1am	10	6	16	10	5	15
1am – 2am	5	3	8	6	4	10
2am – 3am	3	4	7	3	4	7
3am – 4am	5	4	9	5	3	8
4am – 5am	5	5	10	4	5	9
5am – 6am	8	13	21	8	11	19
6am – 7am	18	19	37	14	20	34
7am – 8am	24	34	58	20	29	49
8am – 9am	37	38	75	34	39	73
9am – 10am	44	54	98	43	56	99
10am – 11am	38	48	86	39	52	91
11am – Midday	44	47	91	50	52	102
Midday – 1pm	43	42	85	44	48	92
1pm – 2pm	40	36	76	44	40	84
2pm – 3pm	56	41	97	56	46	102
3pm – 4pm	55	50	105	58	56	114
4pm – 5pm	52	48	100	55	51	106
5pm – 6pm	50	36	86	54	42	96
6pm – 7pm	49	32	81	51	36	87
7pm – 8pm	35	24	59	38	24	62
8pm – 9pm	26	22	48	27	22	49
9pm – 10pm	28	17	45	27	16	43
10pm – 11pm	18	9	27	17	10	27
11pm – Midnight	14	9	21	14	9	25
Total	**708**	**640**	**1348**	**721**	**679**	**1400**

Source: Vehicle Classification Counts (1-7 February 2003)

** Indicates direction away from Galong Mine*

TABLE 4.9

Hourly Traffic Volume on Average Weekday and Average Day

Time	Weekday Average (5 Day)			Average Day (7 Day)		
	East *	**West**	**Total**	**East ***	**West**	**Total**
Midnight – 1am	0	0	0	0	0	0
1am – 2am	0	0	0	0	0	0
2am – 3am	0	0	0	0	0	0
3am – 4am	0	0	0	0	0	0
4am – 5am	1	0	1	1	0	1
5am – 6am	1	1	2	1	1	2
6am – 7am	5	6	11	3	5	8
7am – 8am	10	11	21	8	8	16
8am – 9am	10	14	24	9	11	20
9am – 10am	11	10	21	10	9	19
10am – 11am	14	10	24	13	9	22
11am – Midday	7	11	18	7	9	16
Midday – 1pm	9	10	19	8	11	19
1pm – 2pm	10	8	18	9	8	17
2pm – 3pm	11	14	25	9	13	22
3pm – 4pm	9	11	20	8	9	17
4pm – 5pm	11	17	28	10	14	24
5pm – 6pm	15	13	28	13	11	24
6pm – 7pm	8	7	15	7	7	14
7pm – 8pm	3	3	6	3	3	6
8pm – 9pm	2	3	5	2	3	5
9pm – 10pm	1	3	4	2	2	4
10pm – 11pm	1	0	1	1	0	1
11pm – Midnight	1	0	1	1	0	1
Total	**140**	**152**	**292**	**125**	**135**	**260**

Source: Vehicle Classification Counts (1-7 February 2003)

** Indicates direction away from Galong Mine*

4.4 Traffic Generated by the Existing Mine Operation

A review of the mine's records indicates that some 95% of product is transported southeast via Galong Road through Galong Town to Burley Griffin Way and towards the Hume Highway. The remaining 5% of product is transported to the north and northwest via Kalangan Road and Cunningar Road either to Boorowa (2%) or to Harden (3%).

Product sales currently fluctuate considerably based on seasonal factors and weather conditions (particularly drought) with high sales in the period generally between September to the end of May.

The products are transported by contractors engaged by customers of the mine. Typical product vehicles include rigid bodied tippers, (rigid trucks with 13 tonne capacity), semi-trailer tippers (up to 28 tonne capacity), rigid trucks with dog trailers (33 tonne capacity) and B double trucks (42 tonne capacity). Average loads are approximately 30 tonnes.

The maximum amount of product transported in a day is restricted by the mine's loading capacity which is limited to 4 semi-trailer trucks per hour, which provides a maximum daily figure of 40 loads per day over the 10 hours of product despatch. Higher vehicle numbers are generated on some days, if trucks are loaded from an external stockpile and on days when smaller vehicles are used for product transportation on that day. The highest number of trucks loaded in 2002 was 55 and more recently (in February 2003), the highest number of trucks loaded in one day was 69.

The daily and hourly traffic volumes have been calculated for existing production of the Galong Mine (144 000 tonnes per year) for the average and 85th percentile days and are detailed below.

- Average day – 17 loads per day with 34 (two way) truck movements per day and 3 to 4 truck movements to and from the mine per hour.
- 85th percentile day – 29 loads per day resulting in 58 (two way) truck movements per day and 5 to 6 truck movements to and from the mine per hour.

Based on the current sales pattern, 32 truck movements per day go via Galong Road to Burley Griffin Way on an average day and 56 truck movements on the 85th percentile day, with 2 truck movements via either Galong Road to Boorowa or Kalangan Road / Cunningar Road to Harden.

During the week of 1-7 February 2003, average product truck movements to and from Galong Mine averaged 26-28 movements per day (13-14 loads) on the weekdays.

4.5 Summary Assessment Of Existing Road Network and Traffic Conditions

The immediate road network (local and regional roads) around Galong Limestone Mine carry low traffic volumes. The proportion of heavy vehicles varies on these roads, based on seasonal factors.

The traffic counts for the period of 1-7 February 2003 show that the proportion of heavy vehicles on weekdays on those local roads in and around Galong (except Eubindal Road) varied between 7% and 27%. During this period, the Galong Limestone Mine averaged 13-14 loads or 26-28 truck movements on the weekdays.

Previous traffic counts undertaken by Harden Shire Council on these roads has shown a higher number of heavy vehicles with heavy vehicles representing a higher proportion of the total traffic on these roads.

Burley Griffin Way (MR 84), a State Road, carries higher traffic volumes with average weekday volumes in the order of 1348 vpd and heavy vehicles representing around 21% of total volumes.

Burley Griffin Way is constructed and maintained to a high standard two lane undivided rural road providing adequate widths for safe usage by heavy vehicles.

The local road network serving the Galong Limestone Mine, except Eubindal Road, provides sealed pavement widths between 5.5 metres to 7.0 metres and unsealed shoulders.

Table 4.10 shows the Austroad Rural Road Design Standards as well as Harden Shire Council's "Guide to Road Standard" as shown in Council's *"Section 94 Contribution Plan for Road Works as a Result of Unpredictable Development Which Generates Additional Heavy Vehicle Traffic Movements"*.

Harden Shire Council standards are higher than Austroad Standards and appear to be based on a high proportion of heavy vehicles using shire and regional roads.

TABLE 4.10
Road Standards Required

Design Traffic (AADT) veh/day	Lane Width 2 lane road (m)	Shoulder Width 2 lane road (m)
AUSTROADS – Rural Road Design - 1993		
1-500	3.0	1.0-1.5
500-1000	3.0-3.5	1.0-2.0
>1000	3.5	1.0-3.0
Harden Shire Council - Guide to Road Standard		
1-1000	4.0	1.0-1.5
>1000	4.0	1.0-3.0

Source: Harden Shire Council Section 94 Contributions Plan

5.0 ASSESSMENT OF TRAFFIC IMPACTS OF PROPOSAL

5.1 Proposed Traffic Management Safeguards

The Proponent proposes to implement a range of safeguards and management procedures to minimlse the impacts that increased traffic movements associated with increased transportation of mine products would have on the residents of Galong and surrounding district, as well as the broader Community. Details of these safeguards are as follows.

Road Improvements

The Proponent acknowledges its responsibilities in relation to upfront capital contributions and ongoing road maintenance contributions under Harden Shire Council's Section 94 Contributions Plan. The Proponent is also keen to ensure through continued negotiation with Council that not only future contributions, but previously paid unallocated contributions, are appropriately allocated to road upgrading works that would most benefit those residents of the Galong district affected by mine-related traffic.

In this regard, the Proponent would continue to negotiate with Council for the progressive upgrading of sections of the main transportation route through Galong town, to ensure that the concerns of residents with respect to potential safety and traffic-related noise are reduced, through the provision of an improved and wider road surface.

Initial emphasis would be given to the design and implementation of appropriate upgrade works to the section of Ryan Street between the 60km/h speed limit sign at the northern end of Ryan Street, to east of the railway crossing near the intersection with McMahons Road.

The Proponent would also investigate with the appropriate authorities the possibility of reducing the speed limit for all heavy vehicles travelling through Galong town, possibly as part of a general reduction of the speed limit to 50km/h. It is also recommended that advance warning signs of Galong Town and the lower speed limit be provided on the road approaches to Galong Town.

Code of Conduct for Truck Drivers

The Proponent would implement a *Code of Conduct* for truck drivers that would apply when the Proponent's requirements for the safe and responsible transportation of mine products and would need to be signed by all product truck drivers and owners.

The *Code of Conduct* would be supported by a Complaints Hotline managed by the Proponent where complaints relating to a specific driver's performance would be recorded, validated and addressed. A protocol would be enforced that would result in repeat offenders being prevented from transporting products from the mine.

5.2 Proposed Traffic Levels

The activities associated with the proposed expansion of the Galong Limestone Mine that would increase traffic levels on the road network are:

- additional vehicle trips associated with employees and other activities such as mine maintenance; and
- additional truck movements associated with increased mine production and sales, i.e. product transportation

Vehicle trips associated with employees and mine maintenance represent a small number of daily vehicle movements. Currently these vehicle movements are in the order of 30 trips (15 each way) per day and for the proposal at full production and sales in 2008 are estimated to be 40 vehicle trips (20 each way) an increase of 10 vehicle movements per day.

The product truck movements associated with increased sales are more significant and would be noticeable on the local road network. The projected product truck movements associated with the stage production of the mine proposal are shown in **Table 5.1**. These product truck numbers are based on the information detailed in Section 3.3 and **Table 3.1**.

Table 5.1 also shows the distribution of the truck movements on the southern and northern transportation routes (**Figure 4**) per hour and per day for the average day and 85th percentile day of transportation.

TABLE 5.1
Total Product Truck Movements Generated by Galong Mine Proposal

Period	Existing 2003	2004	2005	2008
Average day	34	48	60	82
85th% day	58	76	88	96
Hourly Average Day	3-4	4-5	6	8-9
Hourly 85th% Day	5-6	7-8	8-9	9-10

Product Truck Movements on Southern Transportation Routes

Period	Existing 2003	2004	2005	2008
Average day	32	40-44	52-56	74-78
85th% day	56	68-72	80-84	88-92
Hourly Average Day	3-4	4-5	5-6	7-8
Hourly 85th% Day	5-6	7-8	8-9	9-10

TABLE 5.1 (cont'd)

Northern Transportation Routes

Period	Existing 2003	2004	2005	2008
Average day	2	4-8	4-8	4-8
85th% day	2	4-8	4-8	4-8
Hourly Average Day	<1	1	1	1
Hourly 85th% Day	<1	1	1	1

Source: Table 3.1

5.3 Assessment of Impact Associated with Increased Traffic Levels

5.3.1 Increased Traffic Levels

At full production, there would be an increase of 10 vehicle trips per day associated with increased employment and maintenance at the mine. The majority, if not all of these vehicles, would be Austroad Class 1 vehicles (i.e. light vehicles). Apart from Eubindal Road, these trips would be dispersed over several roads and would have minimal impact on the local road network.

The increased truck movements associated with increased product sales would be the most noticeable traffic impact associated with the proposal. As noted previously, the Proponent proposes to gradually increase mine production and sales from the existing production level of 144 000 tonnes per annum to 350 000 tonnes per annum by 2008. The current approval for the mine allows production and sales of 200 000 tonnes of limestone product per annum.

For the purpose of assessing the traffic impacts of the proposal, the increased traffic levels associated with increase in production and sales between the currently approved 200 000 tonnes per annum and the proposed 350 000 tonnes per annum have been examined and referenced to the existing level of production of 144 000 tonnes per annum.

Table 5.2 shows the total increase in truck movements per hour and per day associated with increased product sales for these scenarios, as well as the increase on the proposed southern and northern transportation routes.

Reference to **Table 5.2** shows that the initial increase in product truck movements from existing levels of production (144 000 tonnes per annum) to the current approved level of production (200 000 tonnes per annum) would be:

- up to 14 truck movements and 18 truck movements in Eubindal Road on the average day and 85th percentile day respectively with 1-2 additional truck movements per hour.
- up to 12 truck movements and 16 truck movements on the southern transportation routes through Galong to Burley Griffin Way (MR84) on the average day and 85th percentile day respectively with 1-2 additional truck movements per hour; and
- up to 6 truck movements on the northern transportation routes on the average and 85th percentile day with less than 1 additional truck movements per hour.

In 2008, when production and sales reach 350 000 tonnes per annum, the additional truck movements using the road network as compared to the current approved level of 200 000 tonnes per annum would be:

- 34 truck movements and 20 truck movements in Eubindal Road on the average and 85th percentile day respectively with between 2-4 additional truck movements per hour;
- 34 truck movements and 20 truck movements on the Southern transportation routes through Galong to Burley Griffin Way on the average day and 85th percentile day respectively with between 2-3 additional truck movements per hour; and
- No change in truck movements on the Northern transportation routes.

TABLE 5.2

Increase in Product Truck Movements Due to Proposal
Total Increase In Product Truck Movements

Period	2004 Current Approval 200 000tpa Increase from Existing	2008 Proposed 350 000tpa Increase from Current Approval
Average Day	+14	+34
85th% Day	+18	+20
Hourly Average Day	+1	+4
Hourly 85th% Day	+2	+2

Increase in Product Truck Movements
On Southern Transportation Routes

Period	2004 Current Approval 200 000tpa Increase from Existing	2008 Proposed 350 000tpa Increase from Current Approval
Average Day	+8 to +12	+34
85th% Day	+12 to +16	+20
Hourly Average Day	+1	+3
Hourly 85th% Day	+2	+2

Increase in Product Truck Movements
On Northern Transportation Routes

Period	2004 Current Approval 200 000tpa Increase from Existing	2008 Proposed 350 000tpa Increase from Current Approval
Average Day	+2 to +6	Nil
85th% Day	+ 2 to +6	Nil
Hourly Average Day	<+1	Nil
Hourly 85th% Day	<+1	Nil

5.3.2 Impact on Road Network Around Galong

Traffic volumes on the road network around Galong would increase due to the proposal. For the initial increase in production to the current approved level of 200 000 tonnes per annum, the traffic volumes[1] on the average weekday would change as follows:

- Eubindal Road – from 76vpd to 96vpd with maximum hourly volumes increasing from 8vph to 10vph.
- Ryan Road in Galong Town (southern transportation routes) – from 294vpd to 312vpd with maximum hourly volumes increasing from 31vph to 39vph;
- Kalangan Road (northern transportation routes) – from 138vpd to 144vpd with maximum hourly volumes increasing from 15vph to 16vph.

In 2008, when the Galong Limestone Mine is at full production and product transportation is for 350 000 tonnes per annum, the traffic volumes using the road network on an average weekday would be as follows assuming no increase from other traffic:

- Eubindal Road – 130vpd on the average weekday with maximum hourly volumes of 14vph.
- Ryan Road in Galong Town (southern transportation routes) – 346 vpd on the average weekday with maximum hourly volumes of 42-43vph.
- Kalangan Road (northern transportation routes) – 144vpd with maximum hourly volumes of 16vph (i.e. no change from 2004).

The increase in traffic volumes due to the proposal would be quite small in real terms, and traffic volumes using the road network around Galong would continue to be low on weekdays, with the proposal in place. Notwithstanding this, it is accepted that the increase in product trucks passing through Galong township would be noticeable to residents on weekdays and may affect the amenity in the town.

The Proponent is seeking to ensure that road network through Galong township is gradually upgraded and maintained to Harden Shire Council's road standards to minimise any adverse impacts on amenity. In this regard, the Proponent would continue to make contributions towards road upgrading and maintenance in accordance with Council's Section 94 Contribution Plan.

The change in traffic volumes on the northern transportation routes (i.e Kalangan Road / Cunningar Road) due to the proposal is very small and does not warrant any upgrading works, other than the regular maintenance of the road pavement.

5.3.3 Impact on the State Road Network

The proposal would increase traffic levels using Burley Griffin Way and its intersection with Galong Road and Bouyeo Road which is the State road that connects Galong to Harden in the west and the Hume Highway in the east.

[1] Volumes on all roads increased to reflect the average weekday base volume for average day at existing production of 144 000 tonnes per annum.

The majority of the increased product trucks associated with the proposal (approximately 95%) would access Burley Griffin Way via Galong Road.

Based on current production levels, an additional 12-16 product truck movements would use the intersection of Burley Griffin Way / Galong Road / Bouyeo Road on an average day and 85th percentile day in 2004 when production reaches the current approved 200 000 tonnes per annum. The increase in hourly movements would be 1-2 product truck movements.

In 2008 at full production and transportation for 350 000 tonnes per annum, the increase in product truck movements using the intersection would be 34 and 20 truck movements on the average day and 85th percentile days as compared to traffic levels of 200 000 tonnes per annum. The increase in hourly product truck movements would be between 2-4 truck movements.

Galong Road, north of Burley Griffin Way currently carries a total of 128vpd on an average week day. Burley Griffin Way east of Galong Road carries some 1348vpd on weekdays.

Maximum hourly volumes at this intersection are 8vph in Galong Road and 100-105vpd in Burley Griffin Way.

Galong Mine at full production and transportation in 2008 would result in an additional 2 to 4 product truck movements using the intersection per hour (i.e. 1 to 2 truck movements travelling towards the mine and 1 to 2 truck movements travelling away from the mine).

While product trucks travelling towards the mine would either turn left or right from Burley Griffin Way, this level of increase would not alter traffic conditions at the intersection and in Burley Griffin Way and traffic conditions at the intersection and in Burley Griffin Way would remain satisfactory.

5.4 Summary

This assessment has found that the increased product truck movements on the local road network due to the proposal would be noticeable on the local road network and in particular on the southern transportation routes, which pass through the town of Galong, between the mine and Burley Griffin Way.

The impacts associated with the increased truck movements relate mainly to amenity issues within the town. The Proponent is proposing a number of traffic management measures / safeguards that would mitigate any potential adverse impacts within the town. The Proponent would also continue to make contributions in accordance with Council's Section 94 Contributions Plan and would work with Harden Shire Council and other Authorities to ensure appropriate measures are implemented.

The traffic and other impacts on the wide road network including the Northern transportation routes (Kalangan Road / Cunningar Road) and on Burley Griffin Way would be minimal and traffic conditions on these roads would remain satisfactory after the proposal is in place.

Barnu Pty Ltd

Galong Limestone Mine Expansion

Aboriginal Heritage Assessment

June, 2003

Prepared by
Robert Paton Archaeological Studies Pty Ltd

SPECIALIST CONSULTANT STUDIES

PART 8

ABORIGINAL HERITAGE ASSESSMENT

OF THE PROPOSED

GALONG LIMESTONE MINE EXPANSION

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PROSPECT NSW 2148

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1.0 INTRODUCTION

1.1 Project Overview

Barnu Pty Ltd proposes to expand the current Galong Limestone Mine (**Figure 1**) to meet increased demand for their product. The Proponent proposes to achieve its objectives through its plans to:

- expand mining operations deeper and to the north of the existing open-cut mine to enable the recovery of 20 million tonnes of high-grade limestone;
- increase mining of limestone to 500 000 tonnes per annum (tpa);
- operate all four grinding mills concurrently; and
- transport up to 350 000tpa of crushed and milled limestone products from the mine.

The expansion program would be undertaken in a series of five stages programmed over a 40 year period. The Proponent is seeking to mine more limestone that it would process by the existing three mills and the approved fourth mill, as it is currently evaluating the feasibility of establishing a kiln at Galong to produce up to 150 000tpa of hydrated lime. Approximately 300 000t of limestone is required to produce 150 000t of hydrated lime. In the event that the feasibility study proves to be positive and a kiln is approved and constructed, the total quantity of products produced on site would remain at 350 000tpa, i.e. 200 000tpa of agricultural lime and 150 000tpa of hydrated lime. Conversely, if the kiln is not constructed, maximum agricultural lime sales would be boosted to the full 350 000tpa limit.

The proposed layout of the Project Site, along with the principal features of the Proponent's proposal for the expansion of mining operations, including the proposed limit of disturbance caused through future mine development and the location of the main overburden emplacement and soil stockpile areas, are illustrated on **Figure 2**. A range of modifications are also proposed to existing mine site infrastructure including an upgrade of the on-site road network, weighbridge and office facilities.

Robert Paton Archaeological Studies Pty Ltd was commissioned by R. W. Corkery & Co. Pty Limited, to carry out the Aboriginal Heritage Assessment component of the environmental assessment. This report presents the findings of the Aboriginal Heritage Assessment for the Project Site, hereafter referred to as the Study Area (refer **Figure 2**). The Study Area measures about 1.6 kilometres (N-S) by 1 kilometre (E-W), and includes the existing mine and processing facility and overburden emplacement.

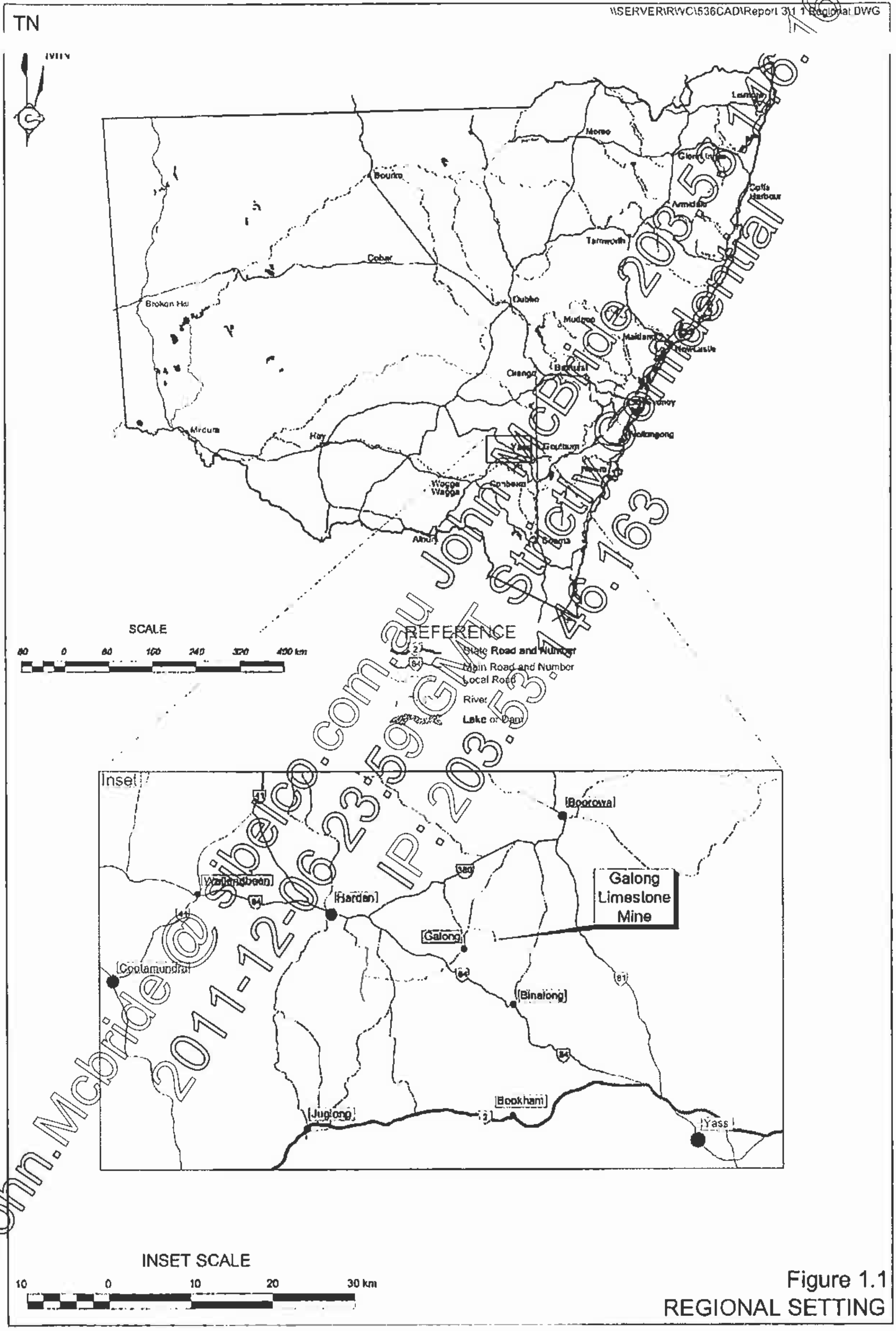
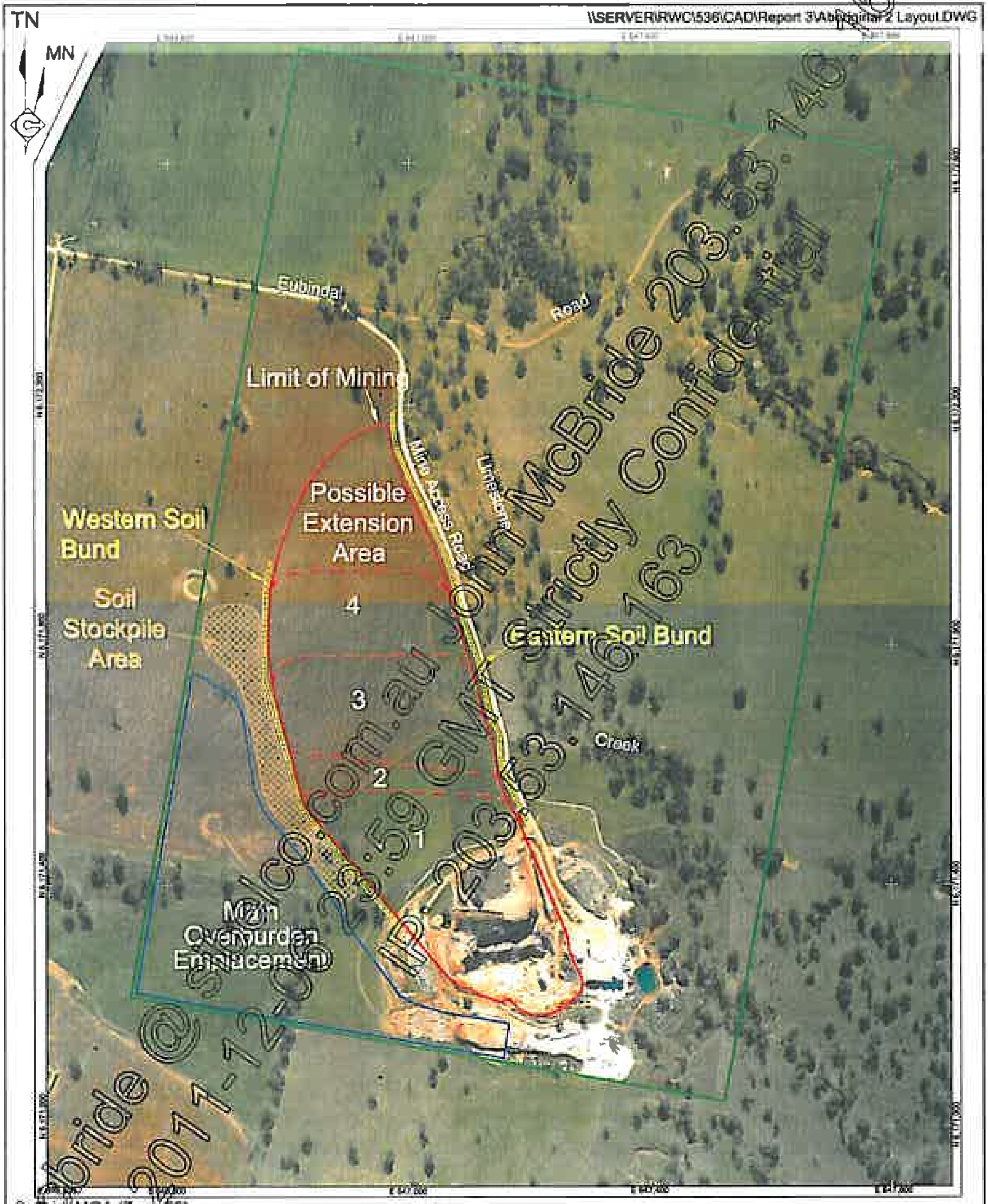


Figure 1.1
REGIONAL SETTING



Grid: MGA (Zone 55)
Datum: AHD

REFERENCE
- Boundary of Mining Lease 1496
- Proposed Limit of Mining
- Mining Stage Boundary
- 2 Mining Stage Identifier
- Proposed Main Overburden Emplacement
- Proposed Soil Bund
- Proposed Soil Stockpile Area

SCALE
100 0 100 200 300 400 500 m

Source: Geo-Spectrum (Australia) Pty Ltd - Date of Photography: 10/07/2002

Figure 2
PROPOSED PROJECT SITE LAYOUT

1.2 Project Aims

The principal aims of this project are as follows.

- To identify any Indigenous cultural heritage sites or areas which may have been previously recorded in the Study Area.
- Review the available archaeological information for the study region.
- Carry out a field survey assessment of the proposed development area.
- Record and plot the location of any identified Indigenous cultural heritage sites within the Study Area.
- Identify areas of potential archaeological sensitivity within the Study Area.
- Assess the significance of all Indigenous cultural heritage sites or objects identified within the Study Area.
- Develop a set of management procedures for all heritage sites and areas of potential archaeological sensitivity identified within the Study Area.

2.0 Consultation With Indigenous Groups

Bowdler (1983:26) recognises two kinds of sites that are significant to Aboriginal people. The first relates to pre-contact times, the second to the period since colonisation. Some of these sites may be recognisable due to landscape modification or material remains whereas others may consist of a noticeable but natural physical feature. Bowdler (1983:30) stresses that,

> "identification of sacred sites and sites of significance to Aboriginal people is of necessity a matter for Aboriginal people. No-one else can decide either the fact of significance or the degree of that significance to an Aboriginal community, except members of that community."

It is for this reason that members of the Aboriginal community are consulted during heritage studies such as this.

The NSW National Parks and Wildlife Service (NSW NPWS) also have a policy that Local Aboriginal Land Councils and any relevant groups should be consulted and actively involved in the Cultural Heritage Assessment process. The proposed development site falls within the boundary of the Onerwal Local Aboriginal Land Council.

Representatives from this organisation have been involved in the field assessment process and in the formulation of the significance assessments and management recommendations developed for Aboriginal sites identified in the project area. A letter from the Land Council is to be provided separately.

3.0 Legislative Requirements

3.1 State Legislation

The protection of indigenous cultural heritage in New South Wales is principally governed by the *National Parks and Wildlife Act 1974* ("the NSW Act").

When seeking approval for development, certain conditions will usually be imposed - one of which is that an assessment be made of any potential impact on sites or places of indigenous cultural heritage.

For the purposes of dealing with indigenous land issues, NSW has been 'divided' into areas each of which are under the control of Local Aboriginal Land Councils ("LALCS"). NSW NPWS requires that 'sufficient consultation' be undertaken with each LALC in which the development is to take place. In addition, NSW NPWS requires that Traditional Owners of land who have lodged a Native Title claim may also be included in the consultation process.

Section 86 of the NSW Act requires that any disturbance of the land (to collect indigenous artefactual material) or collection of that material can only be undertaken under a permit issued by NSW NPWS. The permit will be issued subject to any terms and conditions that the Director General of NSW NPWS thinks fit (s.88). Again these terms and conditions will include sufficient consultation with LALCs and Native Title claimants. Failure to do so will result in a rejection of the permit application and the inability to undertake any collection of artefactual material (outside of the developmental area) or sub-surface testing.

Penalties payable under the NSW Act (s.90) for damage/destruction etc of indigenous cultural heritage (relics or areas) are:

- $5,500.00 for individuals + restitution costs and/or 6 months' gaol; and
- $22,000.00 for Corporations + restitution costs

Litigious remedies are also available. Any person (whether they have a 'legal interest' in the area or not) can bring proceedings against a person damaging or destroying indigenous cultural heritage in the Land and Environment Court (NSW) to prevent or remedy that damage or destruction (s.176). In addition to individual penalties of up to $11,000, an order can also be made that compensation is to be paid for the damage or destruction of the relic or area.

If the Director-General of NSW NPWS believes that an action will or could have a significant effect on the 'environment of native plants' (which is also an indigenous issue) he can issue a Stop Work Order for 40 days, without any prior notice needed to be given (ss.91AA-EE). That Order can be extended for as many 40 day periods as the Director-General sees fit. If the action that has been stopped is not able to be modified sufficiently to protect the environment in question, the Director-General must recommend an Interim Protection Order be made (s.91EE) that will last for up to 2 years (s.91D). The Director-General can also direct that an Interim Protection Order be put in place if, in his opinion, an area of cultural significance is at risk of damage (s.91A).

period of time unless they have reason to believe that NSW NPWS is already aware of its existence (s.91).

Unless otherwise stated, all legislative section references relate to the National Parks and Wildlife Act 1974 (NSW) which can be accessed at the following Website: http://www.austlii.edu.au/au/legis/nsw/consol_act

3.2 Commonwealth of Australia

Indigenous cultural heritage is also protected by Federal legislation in the form of the *Aboriginal and Torres Strait Islander Heritage Protection Act 1987*. Any Aboriginal or Torres Strait Islander person or organization may apply to the Commonwealth Minister for a temporary or permanent 'Stop Order' for protection of threatened areas or objects of significant indigenous cultural heritage.

Accordingly failure to carry out a thorough assessment and management process pursuant to the State requirements may result in such an application being made to the Commonwealth, with resultant delays in development.

The Commonwealth Act 'overrides' State legislation if the Commonwealth Minister is of the opinion that the State legislation (or undertaken process) is insufficient to protect the threatened areas or objects. Thus, in the event that an application is made to the Commonwealth Minister for a Stop Order, the Commonwealth Minister will, as a matter of course, contact the Queensland Environmental Protection Agency to ascertain what protection is being imposed by the State and/or what mitigation procedures have been proposed by the landuser/developer.

In addition to the threat of a 'Stop Order' being imposed, the Act also provides for the following:

- If the Federal Court, on application to the Commonwealth Minister, is satisfied that a person has engaged or is proposing to engage in conduct that breaches the 'Stop Order', it may grant an injunction preventing or stopping such a breach (s.26). Penalties for breach of a Court Order can be substantial and may include a term of imprisonment;
- If a person contravenes a declaration in relation to a significant Aboriginal area, penalties for an individual are a fine up to $10,000.00 and/or 5 years gaol and for a Corporation a fine up to $50,000.00 (s.22);
- If the contravention is in relation to a significant Aboriginal object, the penalties are $5,000.00 and/or 2 years gaol and $25,000.00 respectively (s.22);
- In addition, offences under s.22 are considered 'indictable' offences that also attract an individual fine of $2,000 and/or 12 months gaol or, for a Corporation, a fine of $10,000.00 (s.23). Section 23 also includes attempts, inciting, urging and/or being an accessory after the fact within the definition of 'indictable' offences in this regard.

Unless otherwise stated, all legislative section references relate to the Aboriginal and Torres Strait Islander Heritage Protection Act 1987 (Cth) which can be accessed at the following Website:http://www.austlii.edu.au/au/legis/cth/consol_act

4.0 Description of Study Area

Numerous investigations within Eastern Australia have revealed that the nature and distribution of archaeological sites across the landscape are strongly influenced by environmental factors. The bedrock geology of a region, its landforms, soils, vegetation, and climate, all combine to influence the distribution and availability of resources considered to be of importance to prehistoric Aboriginal groups (these being, plant and animal foods, water, raw materials for tool making, ochre and suitable campsites). Such factors will also affect the ease with which people could travel across the landscape. It stands to reason then, that in order to properly understand, or indeed predict patterns of Aboriginal activity within a region, one must first be familiar with the environmental setting of the study region.

The terrain of the Study Area is flat to mildly undulating ground. A low, but broad, ridgeline runs in a north-south direction and takes in the proposed mine expansion area. This ridgeline is slightly more raised in the north near Eubindal Road and its intersection with the mine access road. The slope off this ridgeline is a 2 to 3 degree gradient, sloping to the east and draining into Limestone Creek which runs through the centre of the Study Area in a north-south direction. The terrain to the east of Limestone Creek is slightly less prominent than the ridge where the proposed mine expansion is planned. The south and north of the Study Area are relatively flat and featureless.

Soils comprise a mixture of clay and limestone overlying the competent limestone deposit and reach an average depth of approximately 6m. In some localised areas, overburden is as much as 20 metres deep whereas in other areas it is only a few metres. The deeper soils are generally very old, weathered bedrock. Only the thin veneer of reddish brown top soil shows any signs of recent pedogenic development. It is within this topmost sediment that any archaeological materials will potentially be located.

Vegetation within the Study Area consists principally of native and introduced grasses. Many introduced weeds (such as thistles) thickly line the creek banks and have spread out across the Study Area. Although the area has been extensively cleared of its tree cover, numerous older isolated eucalypts are left standing. There is also a stand of older trees and mixed regrowth in the southwest corner of the Study Area.

In terms of archaeology, perhaps the most significant feature of the landscape is its heavily disturbed character. The mine and processing facilities have been operating for a number of decades and have effectively removed or remobilised most sediments in the southwest quarter of the Study Area. Large portions of the creekline have also be severely affected by mining and dumping of imported materials. Very little of the creek appears to follow a natural course. In addition to the effects of mining, the entire Study Area has been substantially effected by agriculture. Trees have been mostly cleared and the paddocks that are not being mined are under cultivation and are regularly ploughed.

5.0 Project Methodology

In order to fulfil the outlined project aims, a three stage methodological approach has been adopted for this study.

Stage 1 (The Background Research)

undertaken:

- The Queanbeyan office of the NSW NPWS was contacted and informed of the project details. The purpose for this initial contact was to provide the NSW NPWS with the opportunity to raise any concerns or requirements that they may have regarding Aboriginal cultural heritage.

- The Onerwal Local Aboriginal Land Council (LALC) was contacted by phone and informed of the project details. The purpose of this initial contact was to gauge any concerns that these groups may have, and to invite representatives from the groups to participate in the assessment process.

- A review was made of the NSW NPWS heritage site register, to determine if any previously identified Aboriginal sites were located within, or in close proximity to the Study Area.

- The following information was collated :
  - 1 : 50 000maps of the Study Area;
  - Ethnohistoric and Anthropological literature for the region;
  - Archaeological reports for the Study Area and surrounding region;
  - Environmental reports;
  - References to the land use history of the Study Area.

Stage 2 (Field Work)
Stage 2 of the project entailed the implementation of a field survey program to locate and record sites within the selected Study Area. The field survey was carried out on the 16th of June, 2003, by archaeologist Rob Paton and Seraphim Slade (Onerwal LALC).

The Study Area was surveyed by walking numerous transects (**Figure 3**). The transects were placed to achieve optimal coverage of localities likely to suffer impact. Thus the focus was on the mine expansion area, the soil stockpile areas, and the haul road. Within these areas the surveyors inspected any places where visibility was good or there seemed to be a prime site location based on the predictive model below. Where such areas were noted (such as trees, raised flat ground or erosion scalds) the surveyors would divert from the transects to investigate for sites. In addition, all areas of very high ground surface visibility, such as roads and tracks, were surveyed. By this method a total of approximately 14 linear kilometres was inspected. Approximately 50 metres could be inspected along each transect by each surveyor.

Less attention was paid to areas where no impact was planned such as the far north and eastern portion of the Study Area. Less attention was also paid to these areas as they had very poor conditions of surface visibility at the time of the survey. For example, along Limestone Creek surface visibility was generally less than 1 percent because of recent vegetation growth and the dumping of large amounts of imported material. Also limited attention was paid to the current mine site itself, even though some additional development is planned for this area. This is because none of the original ground surface remains in this area. Excavations have been made to bedrock and material has buried other areas under several metres of overburden. Where any ground surface was visible, it was inspected.

Recording Methods

For this investigation when a site was located the following variables were recorded.

Site type: The type of site identified eg. Aboriginal surface artefact scatter. In this survey, sites were classified under the following categories:

- isolated find (a single artefact);
- open artefact scatter (2 or more artefacts, each of which is situated within 50 metres of another);
- scarred tree (scarring of a tree caused by a human agent).

Location: Description of how to get to the site, including the best route either by foot or vehicle.

Grid reference: The location of sites were plotted on a 1:50,000 scale map. The grid references were identified using a Global Positioning System. GPS references were recorded at roughly the centre of each site.

Environmental setting: This describes the sites' environmental context including such things as geomorphology, geology, vegetation and local hydrology.

Aspect: Direction and degree of the ground slope at the site. Aspect is thought to be a prime determinant of site location.

Visibility: A measurement of the conditions of ground surface visibility in the surveyed areas. Ground visibility conditions will effect whether sites are detected, and whether their full extent has been recorded.

Site contents: This is a description of the artefacts and/or any other archaeological features that constitute a site. At sites consisting of stone artefact scatters, descriptions involve recording measurements of particular variables on the artefacts, including raw material, artefact type, presence of retouch or usewear, and any general comments considered relevant. Of course, these variables are only very general in nature and for this reason, any sites considered to have greater research potential are indicated and the potential avenue of research is discussed. The density and extent of an artefact scatter site would determine if only a sample of the artefacts was to be recorded.

Site size: Refers to the dimensions over which artefacts or features are visible. When recording artefact scatters it is often difficult to establish the parameters of a site, due mainly to poor surface visibility. In these instances, site boundaries are defined as the limit of artefact distribution visible on the surface. Using this method, the observed site may be considered to constitute a representative sample of the total site. However, it must be acknowledged that intra-site spatial variations in artefact distribution may bias results to an unknown degree.

Site condition: Describes the condition of the site in terms of factors which may have disturbed it (such as road works, fluvial erosion, etc.) or which have the potential to disturb.

Site Significance: An assessment of the archaeological importance of the site. The basis of assigning a sites' significance is discussed more fully later.

Management considerations: This details the potential threat to the site specifically in terms of future potential developments. In addition, specific ameliorative measures are recommended if warranted.

Photographs were taken of all sites located during surveying, as a supplement to the written

Stage 3

Stage three of the project involved the analysis of the data obtained from the field survey. In the analysis specific attention was paid to:

- the material and artefact types represented within each of the sites ;
- variability in the assemblages both within and between sites ;
- the relationship between site types, site densities and environmental factors ;
- an assessment of the results, which takes into account variability in such factors as surface visibility, survey intensity and surveying approaches.

5.1 Conditions of Visibility

Clearly conditions of ground surface visibility will affect how many sites are found. Visibility may also skew the results of a survey. If, for example, conditions of ground surface visibility vary dramatically between environmental zones, then this in turn will be reflected in the numbers of sites reported for each zone. Zones with the best visibility may be reported as having the most sites (because they are visible on the ground), while another zone with less visibility, but perhaps more sites, will be reported as having very little occupation. It is important therefore to consider the nature of ground surface visibility as part of any archaeological investigation.

The main constraint encountered during the course of this survey was average surface visibility (15-20 percent). Although, the landscape has been subjected to tree clearance, current grass growth patterns limit today's surface visibility in much of the Study Area. The original ground surfaces in the Study Area have been highly modified by past farming practices, including clearances and associated infrastructure such as roads, drains, dams, over burden, mining etc. Fortunately, just prior to the survey, the proposed mine expansion area had been cleared of vegetation and freshly ploughed, giving 100 percent surface visibility in this area of highest proposed impact.

5.2 Coverage Analysis

Witter (Witter and Hughes 1983) discusses the concept of *actual* area surveyed for any study, given that conditions of ground surface visibility and sedimentation, etc, will vary from area to area. This is a useful measurement to allow cultural resource managers to assess surveys from adjacent areas and it also allows some meaningful calculation of the actual sample size surveyed.

D1 = area in metres square surveyed. In this case approximately 700,000 square metres was intensively surveyed in the Study Area given that 14,000 metres in distance was walked (2 surveyors x 7 kilometres each) and an area of about 50 metres around the line was closely inspected (i.e. 14,000 metres surveyed and about 50 metres around the transects closely inspected: 14,000 x 50 = 700,000).

s = index of sedimentation
0.1 = aggrading surface
0.5 = stable or uncertain
1.0 = degrading surface

v = index of visibility
0.1 = negligible visibility
0.2 = 10% visibility
0.5 = 20% visibility
1.0 = 30% and greater visibility

b = background effects (i.e. the presence of natural quartz)
0.1 = massive amounts of natural quartz
0.5 = small amounts of natural quartz
0.9 = minimal amount of natural quartz **(applies generally in this case)**
1.0 = no natural quartz

D2 = distance in square metres of effective coverage.

Applying the formula the following calculations results (see **Table 1**):

The total area of the study is 1,600,000 square metres. This area has been divided according to the microtopography of the Study Area or its varying degrees of visibility. The results for each area are shown in **Table 1**. A total of 70,000 square metres was inspected. This means that about 46 percent of the Study Area was inspected in some form. However, actual coverage is considerably less when the formula is applied. **Table 1** shows the different areas, their visibility and the actual amount covered. When the formula is applied, the actual amount covered is 447,250 square metre, or about 29.8percent of the total Study Area. This is a relatively high percentage, mainly because of the excellent conditions of visibility due to clearing and ploughing. The areas where visibility is poorest, tend to be those areas where no development is planned, thus making the figure more poignant in terms of the aims of this study.

Visibility Data and Coverage Analysis

Land Unit	% of Study Area (Actual Area [m²]	Visibility [m]	Linear metres surveyed [m]	Area Surveyed [m] (= Linear m X 50m)	Coverage [m] (% covered)
Mine site	20 (300,000)	0	500	25,000	1250 (0.5)
Mine Expansion	30 (450,000)	100	5500	275,000	248,000 (90)
Overburden Areas	20 (300,000)	30	4000	200,000	180,000 (60)
Limestone Creek	10 (150,000)	1	2000	100,000	9,000 (9)
Undulating Flats	20 (300,000)	2	2000	100,000	9,000 (9)

6.0 Ethnohistoric Accounts for the Region

6.1 Background

Ethnohistory entails the use of historical literature as a source for constructing ethnographic analogies and models in the study of the prehistory and contact history of indigenous peoples (McBryde 1979). Although ethnohistoric accounts have been recognised as a valuable source for providing insights into the lifeways of prehistoric people, their application can be problematical. These problems relate primarily to the nature of the sources, their accuracy and validity.

Kelton (2000) gives a good summary of the known primary and relevant secondary sources for the region around the Study Area. The major water sources such as the Lachlan River and to a lesser degree the Boorowa River valley appeared to be the focus of occupation by the local Wiradjuri groups (Evans 1813-1814; Mathews 1901 [in Kelton 2000]). Early records from around 1810-30 seem to support the view that these river systems were a rich foci for occupation. Typically, as with such landscapes in Australia, these were also the prime focus for European occupation when they entered an area. A similar story can be told for most of the large river systems: the thin, rich but fragile ecosystem was able to support a large and healthy Aboriginal population. Unfortunately however, such ectotones tend to be marginal only a few hundred metres away from the river corridors, thus making them less than ideal when two cultures clash. Certainly, the clash of cultures occurred abruptly and with some violence in this region. Read (1988) documents numerous skirmishes between European settlers and the Indigenous inhabitants. This led to the declaration of martial law by Governor Brisbane in 1823 at Bathurst and on the Upper Macquarie (Read 1988).

from wide ranging archaeological surveys (Pearson 1981) and models of environmental determinism (Kelton 2000: 11). The supposed pattern based on these sources is occupation of the rivers and major waterways during the hotter drier months and a fanning out of people when rains filled smaller creeks and soaks. There is nothing to suggest this model has any major flaws, other than it requires more research to test its viablity.

According to the best sources, the people living in the Study Area came from two language or 'tribal' groups of people, the Wiradjuri and the Onerwal (with various spelling and pronunciations). Subsequent research has shown Tindale's tribal delineations to be more flexible than is implied by a strict 'boundary', and that this Study Area was inhabited by both language groups (Clark 1977; White 1986).

The two language groups interacted socially and ceremonially as well as commercially (White and Cane 1986); the nature of this interaction was reciprocal exchange between the two groups. Marriage partners, material resources, hunting rights, rights to water sources, and kin for initiation ceremonies and 'pay back' killings all formed part of this exchange system. Therefore contact between the Onerwal and Wiradjuri would have been frequent and considerable (White and Cane 1986).

This period of occupation by Aboriginal people has left a legacy of archaeological sites in the region including open campsites, rock shelters, caves with living floors, axe grinding grooves, art sites, 'bora' rings, burial grounds, scarred trees, and ceremonial grounds.

Both the Onerwal and the Wiradjuri had a ceremony for the initiation of the young men which was of great significance to both groups. This ceremony, known as Burbung to the Wiradjuri and Bunan to the Onerwal, was actually a ceremonial process which extended over a number of years (White and Cane 1986). Both language groups had specific ceremonial sites for these and other ceremonies and both had sacred sites in addition to traditional secular sites associated with the day-to-day activities of hunting, food gathering and preparation, and tool manufacture.

With the arrival of European people into the region came dramatic disruption to the social and political structure of the Wiradjuri and the Onerwal. Eventually, the Aboriginal people were moved by the government from their traditional lands elsewhere. This culminated in the 1880's with the formation of the Aborigines Protection Board (Read 1988). To manage the Aboriginal "problem" governments established numerous mission and fringe camps around major towns. These establishments gradually changed and then in more recent times were dismantled. Today, many of the representatives from the two language groups around the area live locally in Yass.

7.0 Archaeological Background

No archaeological surveys have been undertaken of the Study Area, and the NSW NPWS register shows that there are no recoded sites or surveys within a 10 kilometres radius of the locality.

A number of archaeological surveys have been carried out in the wider region surrounding the Study Area, and these can provide useful information regarding site patterning in the landscape. By and large these have been small-scale linear surveys less than 200 metre wide (Barber 1999; Bonhomme 1986, 1987; Dallas 1985; Hughes and Koettig 1983; Kelton 1997, 2000; Koettig 1986; Koettig and Silcox 1983; Kuskie 1992; Mills 1995; Packard and Hughes

regional studies have been done by Pearson (1981) and Witter (1992) for the general region.

Even though the range of environmental zones sampled by the majority of these surveys has been necessarily limited, the results when assessed at a general level show a distinct patterning in site location, with most sites being recorded on creek banks or high ground adjacent to permanent or semi-permanent water sources.

In Koettig's (1983) survey of the Goulburn area 50 percent of the sites occurred on slopes; in the Cullerin Range all of the sites were situated on ridges adjacent to wetlands (Dallas 1985; Koettig and Silcox 1985; Koettig 1986; Mills 1995); between Bowning and Yass (Barber 1999; Kelton 2000; Koettig 1986; Paton 1993) the sites were located on spurs and ridges as were 78 percent of sites along the Yass By-Pass routes (Koettig and Silcox 1983; Silcox and Koettig 1985). Bonhomme's (1987) survey around Young recorded 98 percent of sites on slopes adjacent to permanent or semi-permanent water. Similarly the Murrumburrah-Yass and Dalton surveys recorded most sites along water courses.

The majority of these sites have been open campsites, surface scatters of artefacts with little or no sub-surface material and stratigraphy. The largest sites with stratigraphy have been found associated with sandy deposits along larger water courses, eg. along the Goulburn River (Koettig 1983) and Lachlan River (Hughes and Koettig 1983).

Other sites recorded on the NSW NPWS Site Register for this wide area include scarred and carved trees, bora rings and ceremonial grounds, stone arrangements, water holes, wells and burials.

However, by far the most frequently occurring site type is the open scatter. Most of these are small sites containing less than 50 artefacts (often less than 10), with medium sized sites of up to 300 artefacts occurring intermittently. Very occasionally large sites with several hundred artefacts occur. The artefacts at these sites are usually manufactured from quartz, silcrete and fine-grained siliceous and volcanic rock. Quartz is the material most frequently used: in some sites at Cullerin Range and Murrumburrah all of the artefacts were made of quartz. At other sites in these two areas, quartz represented 57 percent and 80 percent respectively of the raw material used; and the Dalton, Yass, Bowning and Goulburn studies reported quartz as the predominant raw material. Silcretes and fine-grained siliceous material were reported at Yass and Cullerin Range, and fine-grained volcanics at Yass and Young.

The artefacts types located during these surveys included flakes, flaked pieces, amorphous flakes (all sites), backed blades and hammer-stones (Yass), an axe (Yass), a ground piece of quartzite (Yass). Several sites had bipolar artefacts. Bipolar technology is thought to have been employed more extensively in the past 1500 years, and the presence of these 'types' may be useful for dating sites.

7.1 Previously Identified Aboriginal Sites

A search of the NSW NPWS Sites Register shows that there are no sites located within a 10 kilometres X 10 kilometres square of the Study Area. The site search was expanded to a 30 kilometres X 30 kilometres square and this revealed seven sites. These consist of five open artefacts scatters, one isolated stone artefacts and a burial. Such sites are typical for the region.

8.0 Archaeological Sensitivity and Predictive Modelling

The Study Area consists of a combination of landscapes which vary in their potential archaeological sensitivity. These are summarised below:

1. *Present Mine Site:* This area comprises about 20 percent of the Study Area. It is very highly disturbed and has no archaeological potential.

2. *Overburden Areas:* These are in the southwest and west of the Study Area and comprise about 20 percent of the Study Area. This ground is flat and featureless and well away from water sources. It is unlikely that any artefact scatters will be found in such areas. There are some mature eucalypts in the southwest corner of the Study Area which could possibly have scars from the removal of bark.

3. *Creek:* Limestone Creek crossed the centre of the Study Area in a north-south direction. Including its banks and the small valley in which it runs, it comprises about 10 percent of the Study Area. Any ridges, slopes or spurs in this creek valley would have a moderate potential to contain artefacts scatters. Scarred trees may also be found. A caveat should be placed on this assessment, given that much of the creek has been highly disturbed over the years since mining has occurred. This factor is likely to diminish the likelihood of finding any sites. In addition the dense ground cover along the creek would make finding any sites very difficult in the present study.

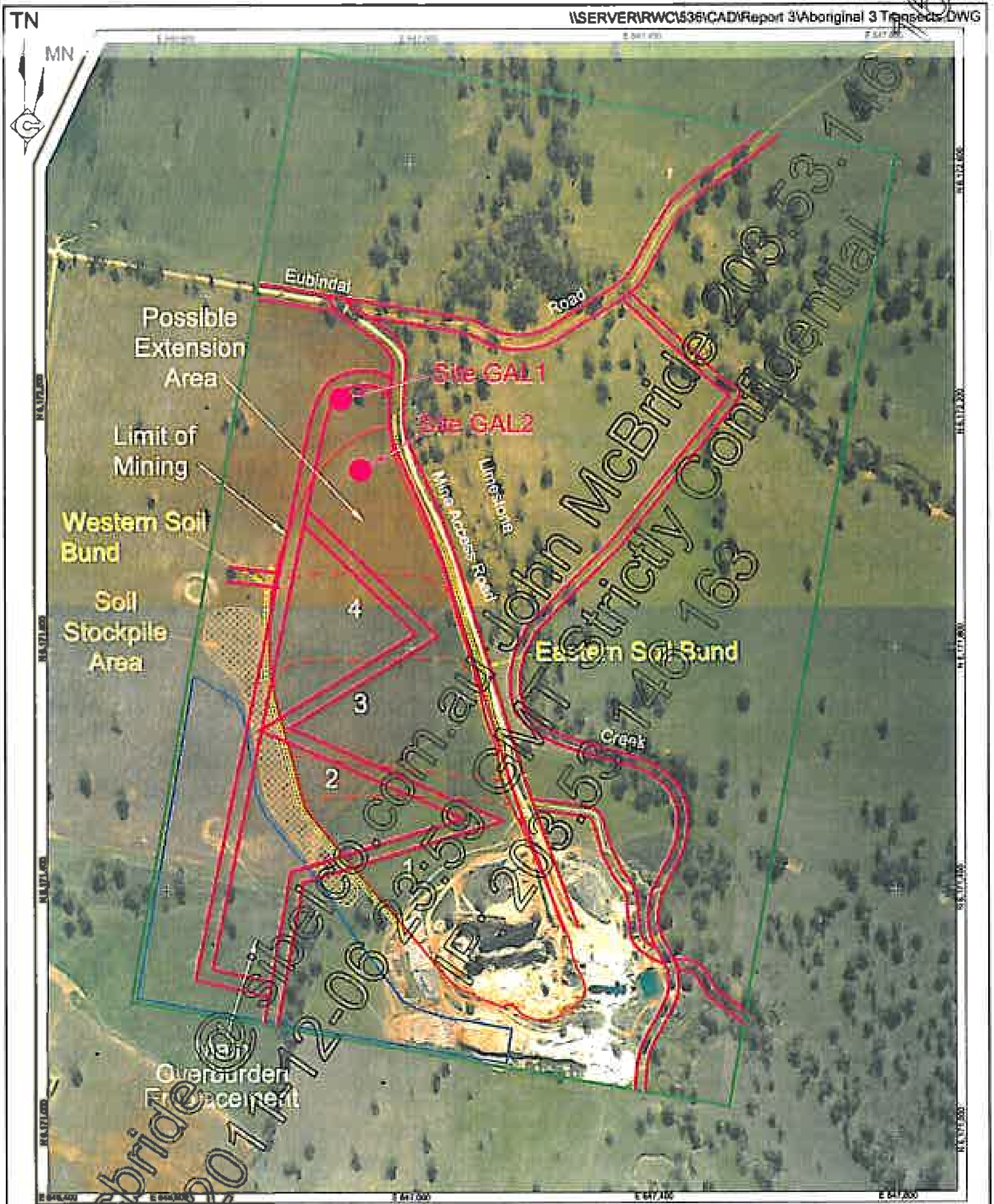
4. *Mine Expansion Area:* This land unit is a long low ridge which rises higher towards the north. It comprises about 30 percent of the Study Area. Given that this ridge runs adjacent to the creek, it would be expected that sites, consisting of artefacts scatters, will be found here. The chances of finding sites is enhanced by the fact that this entire land unit has recently been ploughed and has almost 100 percent ground surface visibility. Scarred trees are unlikely to be found in this unit which only has three trees.

5. *Mildly Undulating Flats:* This land unit comprises about 20 percent of the Study Area and includes the land to the north of Eubindal Road and most of the land to the east of Limestone Creek. Such terrain typically has low archaeological potential. Given the poor conditions of ground surface visibility in this unit, it is unlikely that any sites will be located. There is a small chance of locating a scarred tree in this land unit, although most of the trees appear to be recent regrowth.

Although it is possible that other types of sites (mentioned above) may be located during the survey, the probability of this occurring is low because very few of these site types have been recorded in the region.

9.0 Results and Discussion

A total of two Aboriginal archaeological sites were identified during the surface archaeological survey. The Aboriginal sites comprise 1 artefact scatter and 1 isolated find. Their locations are shown in **Figure 3,** and their salient features are described below.



Grid: MGA (Zone 55)
Datum: AHD

REFERENCE
- Boundary of Mining Lease 1496
- Proposed Limit of Mining
- Mining Stage Boundary
- 2 Mining Stage Identifier
- Proposed Main Overburden Emplacement
- Proposed Soil Bund
- Proposed Soil Stockpile Area
- Survey Transect
- Site Location

SCALE
100 0 100 200 300 400 500 m

Source: Geo-Spectrum (Australia) Pty Ltd
Date of Photography: 10/07/2002

Figure 3
ABORIGINAL HERITAGE SURVEY - SURVEY TANSECTS AND SITE LOCATIONS

expansion. This location fits well with the known site patterning for the region, where sites tend to occur on high ground overlooking creeks. Ground surface visibility and coverage may have played a significant factor in the location of these sites.

Prior to this survey being undertaken parts of the Study Area were inspected by a member of the Onerwal LALC. Several potential scarred trees were noted in the proposed overburden area in the south west of the Study Area. These trees were all relocated using photographs. Inspections showed that all of the apparent scarring is in fact the product of natural events e.g. limb breakages.

9.1 Aboriginal Site Descriptions

Note: The Aboriginal sites have been given the reference name "GAL #", which stands for "Galong", followed by the site number.

SITE GAL 1

Site Type: Artefact Scatter (see Plates 1-3)

Grid Reference: 55H E646783 N6172087 (AustGeod. 84)

Environmental Setting: This small artefact scatter is located near the crest of a low lying, broad ridge overlooking Limestone Creek (200 metres). The site is in a ploughed paddock which would have originally been open woodland. The sediments at the site are deep weathered clays underlain by decomposed limestone.

Site Aspect: Easterly 2 degrees.

Site Size: The two artefacts are located about 70 metres apart. Given the excellent conditions of ground surface visibility, it is unlikely that the site extends beyond this.

Site Contents: Stone Artefacts

1. Flake; fine grained volcanic; 22 x 18 x 6 millimetres.
2. Flake; FGV; 34 x 21 x 6 millimetres.

Site Condition: Farm activities over many years have disturbed the entire area.

archaeological significance. It may be disturbed if the far northern section of the proposed mine expansion is developed. If this is the case further investigations at this site should be undertaken prior to development (see Recommendations). It is an offence to disturb or destroy an archaeological site without the prior written consent of the Director of the NSW NPWS.

SITE GAL 2

Site Type: Isolated Find (see **Plate 4**)

Grid Reference: 55H E646717 N6171867 (AustGeod 84)

Environmental Setting: This small artefact scatter is located near the crest of a low lying, broad ridge overlooking Limestone Creek (200 metres). The site is in a ploughed paddock which would have originally been open woodland. The sediments at the site are deep weathered clays underlain by decomposed limestone.

Site Aspect: Easterly 2 degrees.

Site Size: Isolated artefact. Given the excellent conditions of ground surface visibility, it is unlikely that the site extends beyond this.

Site Contents: Stone artefact

1. Flake; Silcrete 30 x 12 x 6mm millimetres.

Site Condition: Farm activities over many years have disturbed the entire area.

Management Considerations: The site is highly disturbed and of relatively low archaeological significance. It may be disturbed if the far northern section of the proposed mine expansion is developed. If this is the case further investigations at this site should be undertaken prior to development (see Recommendations). It is an offence to disturb or destroy an archaeological site without the prior written consent of the Director of the NSW NPWS.

10.0 Site Significance Assessment

10.1 Assessment Guidelines

There are several different ways of defining types of significance, and many practitioners have developed their own system of significance assessment. However, as Sullivan and Pearson (1995) point out, there seems to be a general advantage in using a set of criteria which is already widely accepted. The Burra Charter provides a process for significance assessment for heritage practitioners. More recently, Australian ICOMOS has produced *The Illustrated Burra Charter*, which further illustrates significance assessment (See Pearson & Sullivan 1995).

The guidelines to the Burra Charter comment:

Although there are a variety of adjectives used in definitions of cultural significance in Australia, the adjectives 'aesthetic', 'historic', 'scientific' and 'social' ... can encompass all other values.

The following provides the descriptions given for each of these terms.

Aesthetic Value
Aesthetic value includes aspects of sensory perception for which criteria can and should be stated. Such criteria may include consideration of the form, scale, colour, texture and materials of the fabric; the smells and sounds associated with the place and its use (Marquis-Kyle & Walker 1992).

Historic Value
A place may have historic value because it has influenced, or has been influenced by, an historic figure, event, phase or activity. It may also have historic value as the site of an important event. For any given place the significance will be greater where evidence of the association or event survives in situ, or where the settings are substantially intact, than where it has been changed or evidence does not survive. However, some events or associations may be so important that the place retains significance regardless of subsequent treatment (Marquis-Kyle & Walker 1992).

Scientific Value
The scientific or research value of a place will depend upon the importance of the data involved or its rarity, quality or representativeness and on the degree to which the place may contribute further substantial information.

A site or a resource is said to be scientifically significant when its further study may be expected to help current research questions. That is, scientific significance is defined as research potential (Marquis-Kyle & Walker 1992).

Social Value
Social values embraces the qualities for which a place has become a focus of spiritual, political, national or other cultural sentiment to a majority or minority group (Marquis-Kyle & Walker 1992).

10.2 Significance Criteria Relevant to Aboriginal Sites

Aboriginal sites and places may have educational, tourism and other values to groups in society. However, their two principal values are likely to be in terms of their cultural / social significance to Aboriginal people and their scientific / archaeological significance. These are the two criteria, which are commonly used in establishing the significance of Aboriginal sites. The following provides an explanation of these criteria.

10.2.1 Aboriginal Cultural / Social Significance

This relates to the value placed upon a site or suite of sites by the local or regional Aboriginal community. Bowdler (1983) states that the identification and assessment of those sites that are significant to Aboriginal people is a matter for Aboriginal people. This assessment can only be made by the appropriate Aboriginal representatives of the relevant communities.

10.2.2 Scientific (Archaeological) Significance

Archaeological significance values (or scientific values) generally are assessed on the potential of a site or place to generate knowledge through archaeological research or knowledge. Bowdler (1984) states that the scientific significance should be assessed according to timely and specific research questions (research potential) and representativeness.

Research potential entails the potential of a site or suite of sites for scientific research and excavation. This is measured in terms of a sites' ability to provide information on aspects of Aboriginal culture. In this respect, the contents of a site and their state of preservation are important considerations.

Representativeness takes account of how common a site type is (Bowdler 1984). That is, it allows sites to be evaluated with reference to the known archaeological record within the given region. The primary goal of cultural resource management is to afford greatest protection to a representative sample of sites throughout a region. The corollary of a representative site is the notion of a rare or unique site. These sites may help to understand the patterning of more common sites in the surrounding area, and are therefore often considered of archaeological significance. The concept of a rarity cannot be easily separated from that of representativeness. If a site is determined to be rare, then it will by definition be included as part of the representative sample of that site type.

The notions of both research potential and representativeness are ever changing variables. As research interests shift and archaeological methods and techniques change, then the criteria for assessing site significance are also re-evaluated. As a consequence, the sample of site types which are used to assess site significance must be large enough to account for the change in these variables.

10.3 Significance Assessment for Sites

The Onerwal community have indicated, as they have in the past, that all archaeological sites are of significance to their members. This is because the remanent sites are an ever diminishing resource as a result of urban sprawl and continued rural developments. The archaeological sites serve as cultural reminders of the Onerwal peoples prior existence and relationship to this region. They are also important to the custodians in ensuring their cultural identity through connection with their land, and knowledge of past practices is kept alive. A letter detailing the Onerwal community concerns is to be provided separately.

On the basis of the results of previous archaeological investigations within the region reviewed and information held by the NSW NPWS, it appears that isolated find and artefact scatter, such as those identified during this survey are widespread in the general region. Overall, the artefact scatter and isolated find located during this study would rate low, from a scientific point of view.

11.0 Recommendations

Based on the findings of this study it is recommended that plans for the proposed development should be allowed to proceed, subject to implementation of the following conditional recommendations.

1. Poor visibility along Limestone Creek means that the survey undertaken at this time is not regarded as being sufficient, given the potential archaeological sensitivity of this ecotone. No development is planned for this area at present. However, should future development plans be proposed for this area, another survey should be undertaken when conditions of ground surface visibility are improved.

2. Should development proceed to the northern portion of the proposed expansion area, the artefact scatter (GAL1) and the isolated find (GAL2) should be salvaged under the auspices of a NPWS Permit. Salvage should include a shovel test pitting programme to ascertain if the site has a sub-surface aspect, and collection of the artefacts. On completion of the salvage programme a Section 90 Consent must be obtained from the NSW NPWS prior to disturbance of the site.

3. The Onerwal LALC should be invited to monitor the removal of the top 50 centimetres of topsoil from the proposed mine expansion area. Their representative expressed concern that burials and undetected artefacts may be present in this sediment unit. Given the medium level of sensitivity of this land unit, and the fact that two sites were found on it, monitoring seems prudent.

4. The Onerwal Local Aboriginal Land Council should continue to be consulted in matters pertaining to archaeological site management for this proposed sub-division.

5. If any further archaeological relics are uncovered during the course of the proposed development, work at the area should cease and the Proponent must contact the NSW NPWS for advice. It is an offence under the Acts to disturb or destroy Aboriginal relics without permission. The Proponent should also make all its staff and contractors aware of their responsibilities in this regard under the NSW NPWS Act 1974.

6. Copies of this report should be supplied to:

   The NSW NPWS;
   Onerwal Local Aboriginal Land Council

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Plates

PLATE 1 Showing disturbance at the mine site.

PLATE 2 Showing disturbance along Limestone Creek.

PLATE 3 Site GAL1 looking north.

PLATE 4 Site GAL2 looking south.