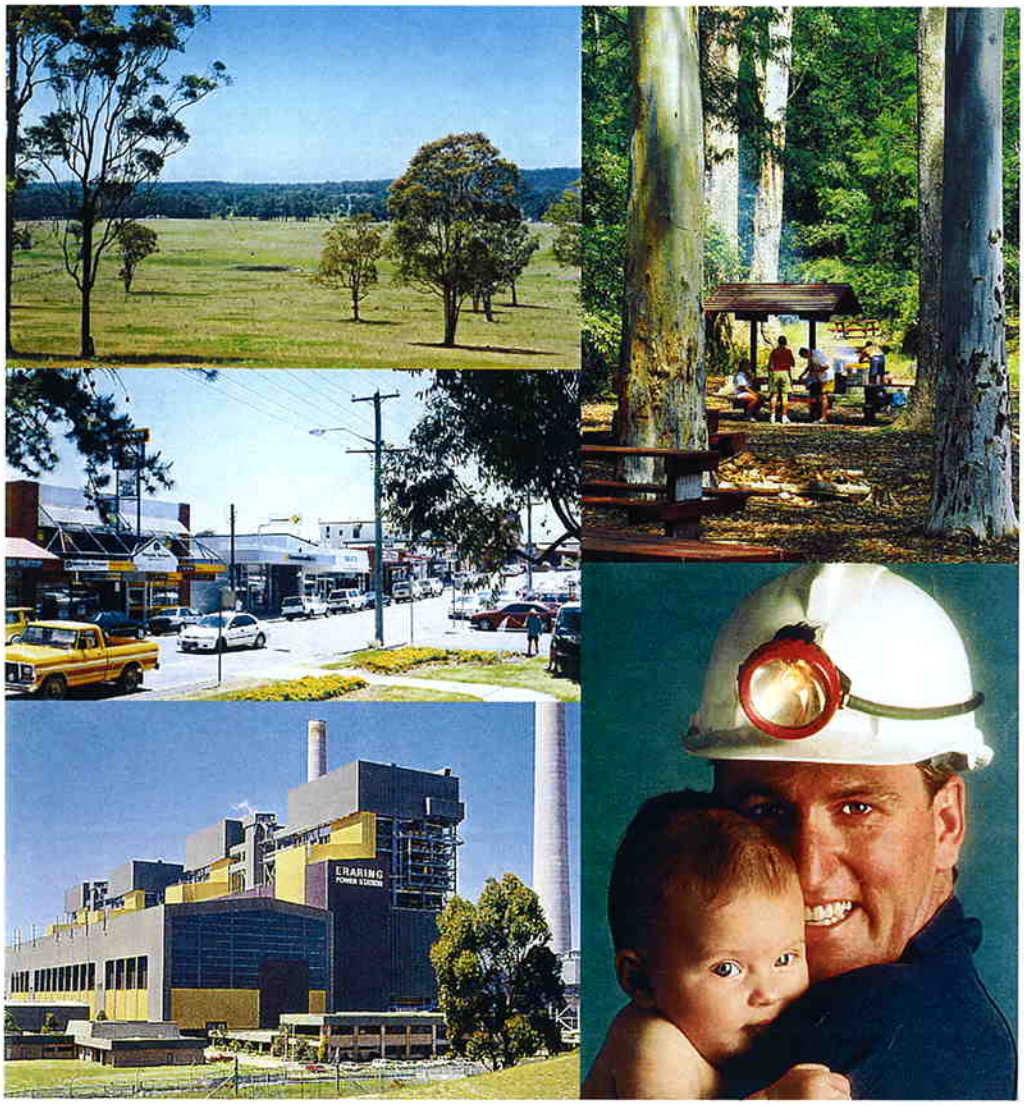
COORANBONG COLLIERY LIFE EXTENSION PROJECT

ENVIRONMENTAL IMPACT STATEMENT

VOLUME 1



Umwelt (Australia) Pty Limited

Environmental and Catchment Management Consultants

November 1997

Form 2

Submission of
environmental impact statement (EIS)
prepared under the Environmental Planning and Assessment Act 1979
Section 77

EIS prepared by

Name:	**Peter Jamieson**
Qualifications:	**B.E . (Civil)**
Address:	Umwelt (Australia) Pty Limited PO Box 838 Toronto 2283

in respect of

development application

Applicant Name	Powercoal Pty Ltd
Applicant Address	37 Yambo Street MORISSET 2264
Land to be developed: Address lot no, DP/MPS, vol/fol etc	Property Descriptions of lands that form part of the proposed development are detailed in **Section 2.1.1** and **Section 3.11** of this document.
Proposed Development	Extension to Underground Mining Activities, Establishment of Mine Access Site, Modification to Coal Preparation and Transportation System and establishment of a Coarse Reject Emplacement Area.

environmental impact statement

☑ an environmental impact statement (EIS) is attached

certificate

I certify that I have prepared the contents of this Statement and to the best of my knowledge

- it is in accordance with clauses 51 and 52 of the Environmental Planning and Assessment Regulation 1994, and
- it is true in all material particulars and does not, by its presentation or omission of information, materially mislead.

Signature: Peter Jamieson
Name: Peter Jamieson
Date: 27/11/97

bcc/bccform2

TABLE OF CONTENTS

4.0 ENVIRONMENTAL INTERACTIONS AND PROPOSED MITIGATION MEASURES 120

APPENDICES

FIGURES

PLATES

Acknowledgements

Photographs on the front covers of Volumes 1 and 2 have been kindly provided by Pacific Power, NSW Coal Association and Robert Wilson in "This is Lake Macquarie", Landsdowne Publishing Pty Ltd.

1.0 INTRODUCTION AND PROJECT SUMMARY

1.1 PROPOSED DEVELOPMENT AND OBJECTIVES

1.1.1 Cooranbong Colliery Life Extension Project

Powercoal Pty Ltd (Powercoal) seeks development consent from the Minister for Urban Affairs and Planning for the Cooranbong Colliery Life Extension Project. The proposed development seeks to extend underground mining operations from Cooranbong Colliery Mining Lease CCL 762 into the Mandalong Valley and upgrade coal preparation and handling facilities at Cooranbong Colliery. The proposed underground mining area is subject of Mining Lease Application (MLA) 88 and Part Authorisation 405 and is approximately 45 km^2. The Mining Lease Application area is bounded to the east generally by the Main Northern Railway; generally extends north to Cooranbong and south to Wyee; and is bounded to the west by the Watagan Mountains. The entire development site is located within the catchment of Lake Macquarie. The location of the proposed development area and proximity to Cooranbong Colliery is shown on **Plate 1** and **Figure 1.1**.

The principal objective of the proposed development is to enable continuity of thermal coal supplies from Cooranbong Colliery to domestic and international customers in a safe, economic and environmentally responsible manner.

The proposed development will be an extension of the existing Cooranbong Colliery mining operations and will involve the construction of new surface and access facilities within the proposed extension area. As such, the development will require granting of a new mining lease. The Department of Urban Affairs and Planning has determined that the proposed development comes under Section 101 of the Environmental Planning and Assessment Act (1979) and will be determined by the Minister for Urban Affairs and Planning. Under Section 101 of the Environmental Planning and Assessment Act (1979), the development application will be lodged with Lake Macquarie City Council. Council will be responsible for advertising the development application and compiling any submissions received during the display period.

To service the proposed mine extension, a new Mine Access Site will be established adjacent to the F3 Freeway at the Morisset interchange. The site will provide for material and personnel access to the proposed underground mine extension with production coal being conveyed underground to Cooranbong Colliery. Provision has been made for the construction of a downcast shaft and an upcast shaft to provide for future mine ventilation needs. Apart from the Mine Access Site and the ventilation shafts, no other surface development works are proposed within MLA 88 or Part A405.

Existing infrastructure at Cooranbong Colliery (see **Figure 1.1**) which is located off Gradwells Road, Dora Creek, will be upgraded to provide coal handling, processing and transport facilities for the proposed mine extension. In addition, a private haul road approximately 3.4 km in length will be constructed immediately north of Cooranbong Colliery. The haul road will cross over the Main Northern

Railway and will connect with Powercoal's existing haul road that connects Newstan Colliery with Eraring Power Station. The proposed development seeks to mine approximately 65 million tonnes of recoverable coal and at a target production level of 3 to 4 million tonnes per annum will extend the life of Cooranbong Colliery by approximately 20 years. The project will provide ongoing direct employment for 200 to 220 people.

Coal reserves within the proposed Mining Lease Application area, due to differences in thickness of the coal have been divided into two mining areas. Area 1 (which is the main target area) contains approximately 55 million tonnes of recoverable coal using longwall mining techniques and longwall panel widths of up to 250 metres. An additional 10 million tonnes of coal which is recoverable using traditional bord and pillar mining or panel extraction techniques has been identified in Area 2. The extent of the proposed mining Areas 1 and 2 is shown on **Plate 2**.

Adoption of longwall mining techniques in Area 1 and other productivity gains within the proposed extension area will improve the efficiency of Cooranbong Colliery operations. These changes will enable the colliery to remain competitive for its extended 20 year life. The achievement of these proposed efficiency gains is vital to Powercoal being able to maintain contracts for the ongoing supply of energy coal to the State's power generating utilities.

1.1.2 Powercoal's Project Aims and Commitments

Based on exploration work within the Cooranbong Colliery Life Extension Project area (see **Plate 1**), Powercoal Pty Ltd has identified 55 million tonnes of recoverable coal within Mining Area 1 that is suitable for extraction using longwall mining techniques. Mineable coal thickness within Mining Area 1 ranges from 2.5 m to 5.0 m. Approximately 91 landholders own land that either partially or fully overlies Mining Area 1 (see **Plate 2**).

An additional 10 million tonnes of recoverable coal have been identified within proposed Mining Area 2. Coal resources within this area are suitable for extraction by bord and pillar or panel extraction methods. Mineable coal thickness within proposed Mining Area 2 ranges from 1.75 metres to 2.5 metres. Maximum subsidence of approximately 420 mm is predicted as a result of mining within proposed Mining Area 2. Approximately 41 landholders, in addition to those in Mining Area 1, own land that either partially or fully overlies proposed Mining Area 2 (see **Plate 2**).

Powercoal seeks to optimise recovery of this significant State resource and through optimising resource recovery, generate benefits and wealth for the Company, the local region and Australia.

In undertaking this development Powercoal will respect the rights of individual landholders. In this regard the Company has developed specifically for this project, a detailed '*Land Access, Management and Compensation Policy*'. The policy objectives are discussed in **Section 1.2.2** and the policy is provided in full in **Appendix 6**.

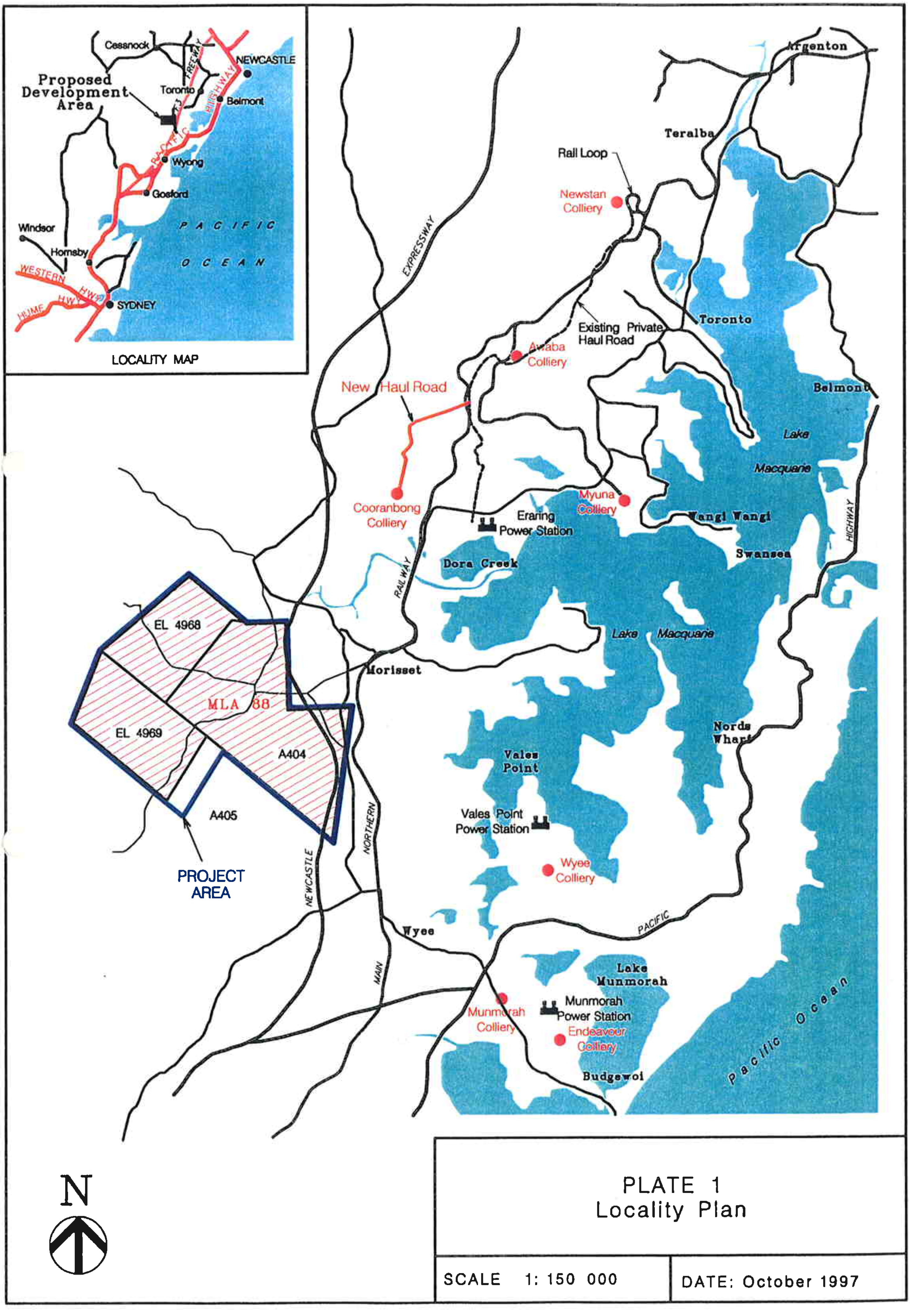


PLATE 1
Locality Plan

SCALE 1: 150 000

DATE: October 1997

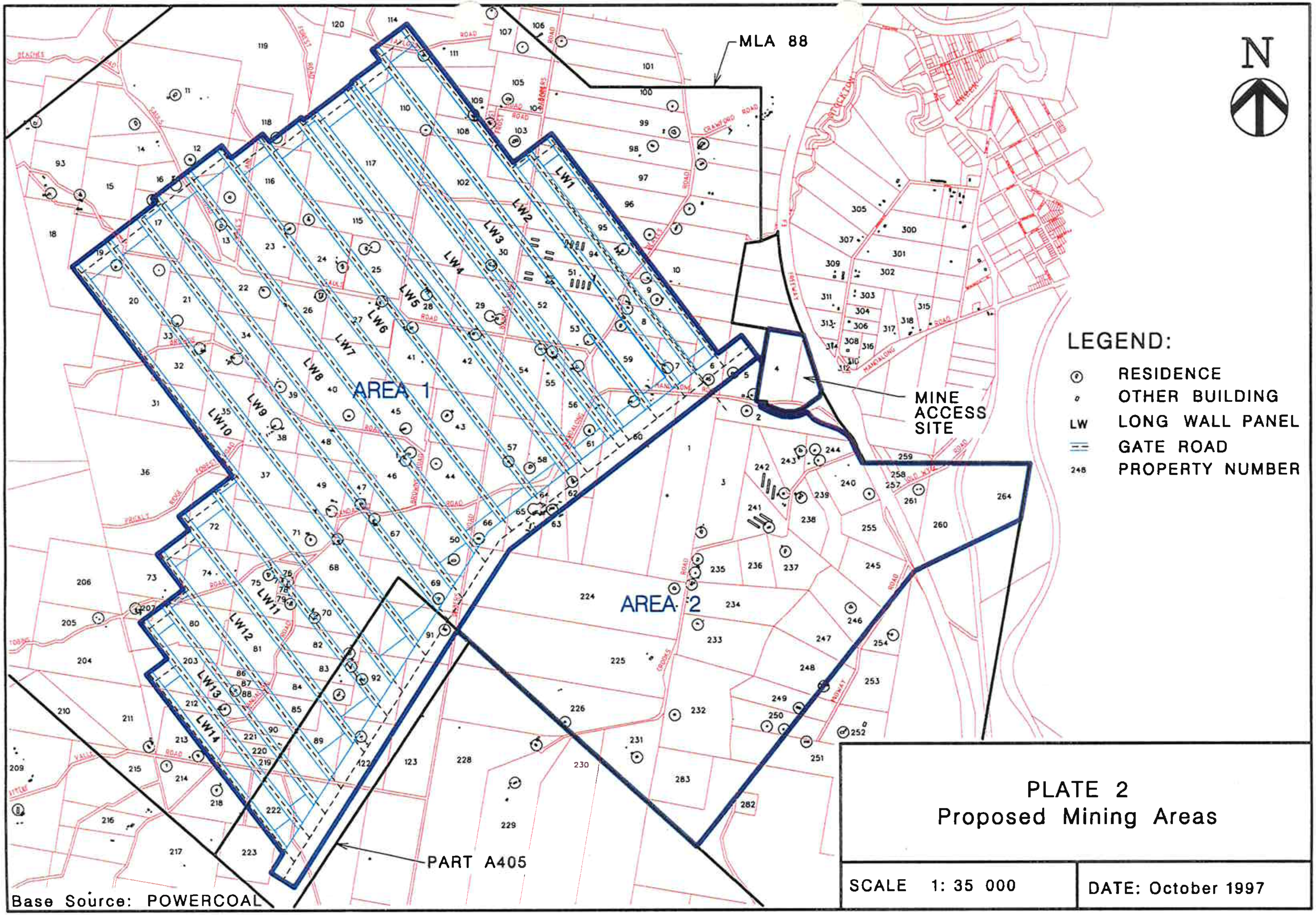


PLATE 2
Proposed Mining Areas

SCALE 1: 35 000

DATE: October 1997

The underground mining development as proposed, particularly within proposed Mining Area 1, will result in varying degrees of impact on structures, dwellings, buildings and roads and may cause inconvenience to landholders and tenants. The proposal for mining within Mining Area 1 will cause modifications to the landform and surface drainage patterns. These modifications will range from minimal changes (ie. surface subsidence of less than 0.5 metres) across approximately 62 % of the area to maximum subsidence levels of 2.5 metres to 2.9 metres across approximately 1 % of the total area affected by mining within proposed Mining Area 1. In some instances the proposed development will have a beneficial impact on surface drainage characteristics and in other instances mitigation measures will be required to minimise potentially adverse impacts such as ponding.

This environmental impact statement has been prepared to examine, assess, report on and describe mitigation measures with respect to the proposed mining generally described above. Development consent is sought for mining and associated activities within proposed Mining Areas 1 and 2 and for modifications to Cooranbong Colliery.

For proposed Mining Area 1 this assessment is based on the maximum likely impact from longwall mining with longwall panels up to 250 metres wide. As such, the EIS examines the fullest extent of impacts that may occur as a result of the proposed development. However, knowledge of the location of potential underground constraints to mining such as dykes and faults, will be refined during the course of mining. As a consequence, the location and extent of surface impacts on specific structures and improvements may vary depending on the final longwall layout that is ultimately approved by the Department of Mineral Resources prior to longwall mining occurring.

To address the dynamic nature of the proposed development and to allow for ongoing consultation with the government agencies, landholders and residents, Powercoal has developed a suite of site specific environmental assessment and management tools that will be utilised throughout the life of the project. These include:

- A detailed computer based model of the coal resource.
- A detailed mine planning model for the proposed development.
- A detailed subsidence prediction and assessment model specifically tailored for geological conditions within the proposed development area.
- A rainfall and runoff model and a Two Dimensional Hydrodynamic model of the Mandalong Valley. The hydrodynamic model has been established to enable comparison of surface flow characteristics of the existing and mined landform for a range of surface flow events.
- Establishment of 14 groundwater monitoring bores across the proposed mining area to enable fluctuations in groundwater levels to be monitored adjacent to and remote from mining.

These tools will enable mine planning and appropriate environmental management procedures to be refined, within the overall environmental impact envelope described by the EIS, prior to second workings or longwall mining commencing. To complement this suite of tools Powercoal has developed a set of development commitments to guide future assessment and consultation for the proposed development. These development commitments will form an integral component of the proposed development. As part of these development commitments, Powercoal will:

1. Consult with all landholders and tenants prior to and during the course of mining.

2. Consult with every landholder whose property is likely to be affected by the extraction of each proposed longwall or group of longwalls prior to seeking approval for that extraction under Section 138 of the Coal Mines Regulation Act 1982. Prior to seeking longwall approval, Powercoal will prepare Subsidence Management Plans for each property likely to be affected. At the time of consultation, the company will undertake to provide the landholder with the best predictions available as to the likely impacts of subsidence to the property including structures and land. Powercoal accepts its responsibility to submit to the Department of Mineral Resources fully considered plans for approval under that Section 138.

3. Cause to be undertaken a detailed structural inspection of every dwelling likely to be affected by the longwall or longwalls for which Section 138 Approval is sought. With respect to impacts compensable under the Mine Subsidence Compensation Act (1961), and on the basis of a thorough analysis of dwelling characteristics and potential mining impacts, Powercoal will seek acceptance from the property owner of works required to be undertaken by the Mine Subsidence Board to make good the impacts. A development consent condition will be sought to provide for mediation or arbitration for the circumstances where dispute arises in seeking such acceptance from a property owner. Powercoal will not mine under any dwelling that will not remain safe, serviceable and repairable within the site specific context as a result of the proposed mining activity without the prior consent of the landowner.

4. Establish a Land Management, Access and Compensation Guarantee which will be maintained at a level not less than $2 million to meet the Company's obligations to landholders, over and above the existing arrangements for compensation under the Mine Subsidence Compensation Act (1961).

5. In discussions with landholders in regard to matters not covered by the Mine Subsidence Compensation Act (1961), aim to reach agreement and fair settlement of any issues, which arise as a consequence of its mining operations. Only when resolution can not be achieved through voluntary negotiation and mediation will Powercoal refer any issue to the Mining Warden for determination.

6. Develop a Floodplain Management Plan for the Mandalong Valley in consultation with landholder representatives, the Department of Land and Water Conservation and Lake Macquarie City Council through its Floodplain Management Committee. The Floodplain Management Plan will address existing and future flood mitigation and surface drainage needs of drainage systems and land within the proposed mining areas. To facilitate development and implementation of the Floodplain Management Plan, Powercoal will assist in seeking to establish a Mandalong Valley Floodplain Management Sub-Committee. It is envisaged that the Floodplain Management Plan will be developed and approved by Lake Macquarie City Council prior to longwall mining commencing. It is envisaged that the Mandalong Valley Floodplain Management Sub-Committee will consist of representatives of landholders, the Department of Land and Water Conservation, Lake Macquarie City Council and the Department of Mineral Resources and Powercoal.

7. Carry out all drainage, flood mitigation or associated works on affected land in accordance with the approved Floodplain Management Plan.

8. Ensure that no dwellings on private land will be rendered flood prone as a result of mining without the prior consent of the land owner under the terms of a compensation agreement.

9. Monitor the impacts of mining on the land surface, drainage channels and groundwater resources within the proposed mining areas and rectify or compensate for any such impacts where not covered by the Mine Subsidence Compensation Act (1961).

10. Negotiate individual remediation agreements with private land holders to remedy specific effects of mining not covered by the Mine Subsidence Compensation Act (1961).

11. Provide an ongoing forum for community consultation, with an independent chairperson to discuss and resolve community concerns.

12. Manage all land purchased by Mandalong Pastoral Management according to "best practice" principles.

Powercoal, in developing the above project commitments, has acknowledged the dynamic nature of both the environment and the proposed development and has taken the initiative in providing for refinement and development of the proposed mine in concert with ongoing consultation and environmental management.

In regard to each specific property likely to be affected by mining of a proposed longwall or group of longwalls, prior to Approval for Longwall Mining, Powercoal will:

a) Consult in detail with all landholders likely to be affected by the longwall or group of longwalls.

b) Prepare, in conjunction with the landholder and a specialist subsidence engineer, a specific Subsidence Management Plan for each potentially affected property, with advice and negotiated agreement from the Mine Subsidence Board where appropriate. This will include but not be limited to dwellings, buildings and associated infrastructure; roads and access tracks; dams and surface reformation works if necessary.

c) Prepare, in conjunction with landholders and the Mandalong Valley Floodplain Management Sub-Committee, a specific surface water management scheme, that is consistent with the Mandalong Valley Floodplain Management Plan, for each potentially affected property.

d) On the basis of the reference criteria established in b) secure acceptance for the proposed mining activity by:

(i) The Department of Mineral Resources approving the specific longwall operation on the basis of any dwelling on the subject property remaining safe, serviceable and repairable in the context of an individual site specific Subsidence Management Plan,
<u>or</u>

(ii) Powercoal offering and the owner accepting an agreement to sell the land to Powercoal or provide other consideration,
<u>or</u>

(iii) A mediated settlement in accordance with a development consent condition.
<u>or</u>

(iv) A combination of (i), (ii) and (iii).

1.1.3 Cooranbong Colliery

Cooranbong Colliery currently provides direct employment for 267 people. Cooranbong Colliery commenced operations in 1981 and since that time has become an integral component of the local community. Since 1981 approximately 20 million tonnes of coal have been recovered from the colliery and supplied to Eraring Power Station. Over the past 16 years Powercoal Pty Ltd has established an excellent environmental record at Cooranbong Colliery and the mine is currently setting world best practice benchmarks for coal extraction using "place changer" mining techniques. Powercoal intends to maintain these high standards in productivity and environmental performance for the Cooranbong Colliery Life Extension Project.

Powercoal's current contract with Eraring Power Station has recently been extended to 2004. To ensure future renewal of such contracts and to develop export markets for coal from the proposed extension area, Powercoal needs to be in a competitive coal supply position. Maintenance of competitive coal prices will assist in ensuring that power generation facilities in the local area also remain competitive suppliers to the National power grid and continue to provide employment for a significant number of people in the Lake Macquarie area.

1.1.4 Powercoal Pty Ltd

Powercoal is a wholly owned subsidiary company of Pacific Power. Powercoal owns and operates eight underground mines within New South Wales. Seven of Powercoal's mines are located within the Newcastle Coal Fields. The location of these mines and associated mining titles are shown on **Figure 1.2**, the mines being from north to south:

- Newstan Colliery
- Awaba Colliery
- Myuna Colliery
- Cooranbong Colliery
- Wyee Colliery
- Munmorah Colliery
- Endeavour Colliery.

These mines are well positioned to supply Eraring, Vales Point and Munmorah Power Stations with domestic coal. An extensive private haul road system caters for rail loading of export coal for transfer to the ship loading facilities at the Port of Newcastle.

In addition, Powercoal's eighth mine, Angus Place Colliery, is located near Lithgow in the Western Coalfields of New South Wales.

The eight mines feature multiple coal seams yielding a range of coal types and quality. The diversity of products available enables Powercoal to provide coal of specified quality to suit a broad range of market requirements.

The mines owned and operated by Powercoal supply both thermal and coking coals to a wide range of customers. In recent times, Powercoal has supplied approximately 36% of NSW power generators' thermal coal needs and is currently developing and expanding export markets for thermal coal.

1.2 SOCIO-ECONOMIC CONSIDERATIONS

1.2.1 Future Projections for Coal Use

Although there is a growing trend towards the use of 'green' power and other alternative energy sources such as gas, co-generation and nuclear, latest forecasts indicate that coal is set to remain the major energy source and the corner stone of economic growth within the Asia-Pacific Economic Corporation (APEC) region (Blain 1997). Electricity growth projections for the APEC region indicate that coal demand will increase by 50-80% over the next decade. Projected population growth and increases in the standard of living within Third World countries are expected to lead to increases in world wide energy consumption by 2075 to be up to seven times that of today (U.S. DOE Office of Clean Coal Technology). It is expected that with further development and adoption of Clean Coal Technologies, world demand for coal will continue to increase over the next few decades. On this basis, indications are that the demand for domestic and export coal are set to increase both in the short and long term.

The Cooranbong Colliery Life Extension Project seeks to provide a continued supply of domestic coal to Eraring Power Station and to export thermal coal to meet the projected continuing demand for thermal coal.

1.2.2 Social and Economic Balance

In undertaking the mine extension, Powercoal has a statutory responsibility to the State and power users across the state, to ensure that the recovery of coal resources from MLA 88 and Part A405 is optimised. At the same time Powercoal has a responsibility to ensure that social and environmental impacts that may result from the proposed mine extension are adequately mitigated. These potential impacts principally relate to subsidence and surface water management.

The nature of coal reserves in the proposed extension area is such that adoption of mining techniques other than longwall in Area 1, could result in recoverable coal reserves decreasing from 55 million tonnes to as low as 25 million tonnes. This reduction of 30 million tonnes of coal represents approximately 55% of recoverable coal reserves. These coal reserves will be sterilised if longwall mining techniques are not adopted.

Utilisation of longwall mining techniques and adoption of the optimum mine plan within Area 1 will result in some damage to surface structures and modifications to the landform. Surface structures that will be damaged include residences, buildings and infrastructure. Modifications to the surface landform will result in lowering of access tracks and roads, changes to landform slopes particularly on the valley floor, modification to surface flow regimes and changes in the extent and location of waterlogged or low lying areas. All of these changes will have the potential to inconvenience those people living above the identified coal resource unless, as is proposed, appropriate mitigation measures are put in place.

Powercoal will act in accordance with the commitments identified in **Section 1.1.2** and will incorporate into the project a comprehensive range of mitigation and compensation measures to offset damage, modifications and inconvenience that result from the proposed mining development. These measures include:

- An undertaking to landholders within the proposed mining area to act in accordance with the requirements of all relevant legislation, licences and development consent conditions. The rights of landholders will be acknowledged and upheld at all times.

- Commitment to a comprehensive '*Cooranbong Colliery Life Extension Project Land Access, Management and Compensation Policy*' that sets out the framework for Powercoal's discussions and dealings with land holders affected by the proposed mine extension.

- Establishment of a $2 million rehabilitation and compensation guarantee to be operated in conjunction with the '*Cooranbong Colliery Life Extension Project Land Access, Management and Compensation Policy*'.

- Provision of an independent mediator with a thorough working knowledge of the Mine Subsidence Compensation Act (1961) who will be available to assist the community in making claims under the Mine Subsidence Act.

- Where possible, implementation of appropriate mitigation measures prior to mining to minimise potential impacts and inconvenience to landholders. Such works could include creek and drainage mitigation works; provision of adjustable supports under existing houses to offset impacts of subsidence; and construction of subsidence proof houses to replace houses that will be significantly damaged by mining.

- Ongoing liaison with landholders, Lake Macquarie City Council and the Floodplain Management Committee to develop appropriate surface water management strategies that address existing and future surface water management issues in the Mandalong Valley.

The '*Cooranbong Colliery Life Extension Project Land Access, Management and Compensation Policy*' has been developed specifically by Powercoal for managing subsidence impacts on surface properties that arise from the proposed mine extension. The Policy forms part of the proposed development and is detailed in **Section 6.2.2.**

The Policy objectives are:

a) To guide in the application of the current law and best practice with respect to land management and rehabilitation, and liaison with landholders within the Mine Lease area;

b) To work effectively with the community to secure community acceptance and Government approval for ongoing mining and land management within the Mine Lease area; and

c) To minimise investment risk.

Specifically, the Policy commits Powercoal to:

a) Manage land owned by Mandalong Pastoral Management (a Powercoal company) according to best practice land management systems;

b) Recognise the rights of landholders to compensation for any defined damage resulting from its underground mining operations;

c) Provide information to landholders about its operations and/or future indicative mine plans at the earliest possible time in the planning cycle;

d) Enter into agreements with relevant landholders to compensate for the effects of mining which are not covered by the provisions of the Mine Subsidence Compensation Act 1961. Such agreements may include options to purchase specific land;

e) Develop an ongoing consultation program jointly with the community;

f) Establish a dispute resolution mechanism to provide for mediation between Powercoal and any other affected parties.

1.2.3 The Proposed Mining Areas

There are 205 land parcels within or partially within the Mining Lease Application area (MLA 88) and Part A405. The land is predominantly in private ownership with 186 of the land parcels privately owned by 152 landholders. The remaining 19 land parcels are owned by Department of Land and Water Conservation (4), State Forests (6), Roads and Traffic Authority (6) and Lake Macquarie City Council (3).

Within the proposed mining areas there are 107 land parcels that are either partly or wholly within proposed Mining Area 1 and an additional 41 land parcels within proposed Mining Area 2. These land parcels are owned by 91 landholders in Area 1 and an additional 41 landholders in Area 2. There are 95 habitable dwellings and 16 chicken breeder sheds within or adjacent to the proposed mining Area 1. Approximately 27 of the 95 habitable dwellings are located on or immediately adjacent to the floor of Mandalong Valley.

There are approximately 17 habitable dwellings and 6 chicken breeder sheds within Area 2. Due to thinner mineable coal seam thickness in Area 2, structural impact on residences and surface infrastructure in the area will be of a lesser magnitude than for Area 1. There are no additional flood prone residences within Area 2 to those identified for Area 1.

Hydrodynamic modelling undertaken for this project indicates that at present 4 dwellings have floor levels either at or below the water surface resulting from a 1 in 100 year Average Recurrence Interval (ARI) rainfall event with the floor level of one additional dwelling having less than 0.5 metres of freeboard. After mining it is estimated that 3 dwellings will have floor levels either at or below the water surface resulting from a 1 in 100 year ARI rainfall event with the floor level of an additional two dwellings having less than 0.5 metres of freeboard.

The surface areas of proposed mining Areas 1 and 2 are generally used for low intensity agriculture with a small proportion at the western boundary of the area forming part of Olney State Forest. Land use also includes a turf farm, chicken breeding sheds and rural residential retreats. A hostel for the disabled which provides support services to approximately 50 people is located off Sauls Road and within the proposed mining area.

Subsidence impacts on houses, surface infrastructure and the land surface as a result of mining have the potential to cause inconvenience to property owners through damage to dwellings, surface infrastructure and the need to undertake minor reformation of the land surface and creek channels.

Results from a land use survey undertaken as part of the environmental impact assessment process indicate that a significant proportion of land holders in the valley will be seeking to subdivide their land in the future if the opportunity arises. Approximately 10% of land holders that responded to the survey indicated that they intended in the future to undertake activities to increase agricultural productivity.

The proposed mining area is close to the F3 Freeway and urban/light industrial areas of Morisset and Wyee. It is possible that pressure may exist to further subdivide the land in the future. As a result, it is possible that rural residential development within the valley will intensify. As such, delays to proposals to mine coal from the area may result in increasing impediments to the realisation of the area's coal resources.

1.2.4 Socio-Economic Study Findings

A detailed socio-economic study of the proposed full development has been undertaken by the Centre for International Economics. The key findings of the study are set out in summary form below:

- The extension of mining activity through the Cooranbong Colliery would support up to 1534 jobs State wide and contribute $194 million per annum to real Gross State Product (GSP) which measures wages, salaries and gross profits in New South Wales.

- Alternatively, the closure of the Cooranbong Colliery would lead to a reduction in real GSP of $86 million and a loss of up to 1057 jobs State wide. These results were obtained from simulations using an economy wide modelling approach.

- Coal resources within Areas 1 and 2 are planned to replace the current resource which has an expected remaining life of five years at current extraction rates. The extension project is expected to provide 220 jobs during the operations, compared to a loss of 270 direct positions if mining ceased as a result of the exhaustion of the current resource.

- The 220 jobs associated with the mine extension project represent 2.5% of employment in underground mines in New South Wales and about 1.6% of total coal mine employment in the state.

- Should the project *not* proceed, the net loss of 220 mine jobs would represent a 6.7% loss of mine employment in the Newcastle coal field.

pa?

- From the planned 4.0 million tonnes of coal production, up to 2.0 million tonnes will be exported, representing an increase in annual export of coal in New South Wales of 3.3% and an increase in Australian coal exports of 1.4%.

- The extension of the Cooranbong mine is expected to lead to a annual total output effect of approximately $234 million. Expected output is made up of $150 million of direct gross output from the mine and $84 million of indirect output induced by the mine's demand for inputs and the demand of employees for goods and services in the region. This output is estimated to support total income in the region of $29.5 million and total estimated employment of approximately 435 jobs in the Hunter Valley region.

- The results of an employee expenditure survey for Cooranbong Colliery indicate that for residents of Lake Macquarie, 75% of expenditures occur within the region, with 14% occurring in Wyong and Newcastle and 11% elsewhere (mainly as a result of holidays outside the region).

- Sixty-one percent of the mine's wages and salary earners live in the Lake Macquarie region. Given wages and salaries of $17.8 million, continuation of mine operations would mean $10.7 million in direct wages and salary income for the Lake Macquarie local government area annually. This would imply between $6.5 million and $8 million in expenditure for the Lake Macquarie region annually.

- Failure to extend the life of the mine would deprive the Lake Macquarie region of between $6.5 and $8 million annually in indirect spending from wage and salary incomes.

- A further $8.4 million expenditure on regionally sourced mine supplies would also be withdrawn from the region, $3.3 million of this from the Lake Macquarie locality.

- Should the mine extension project not proceed, the loss of 220 jobs associated with the extension could increase the unemployment rate in the Lake Macquarie area from 10.9% to 11.2%. The current level is already significantly higher than the national average of 8.7%.

- Extension of the mine life is estimated to contribute $22.1 million annually in revenue to the State Government that would otherwise be lost to it. This would accrue either as a direct result of mine activity or through induced activity in the state economy.

It is apparent from these findings that the project is of importance to the State and the region. To ensure that the proposed mine operates efficiently, it will be important to establish a balance between minimising potential surface impacts and inconvenience to landholders whilst maximising the amount of coal that can be mined and the overall efficiency of the mining operation.

1.2.5 Adoption of Alternative Mine Plans

A range of alternative mine plans and mine layouts have been explored. Each of the alternative mine plans assessed represents a sub-optimal mine plan for the area for a number of reasons. By way of example, the area could be mined using traditional bord and pillar partial extraction methods, however, a maximum mining thickness of about 3 metres would be a general limit using bord and pillar techniques. As a result a significant amount of the otherwise recoverable coal resource would be sterilised. Use of bord and pillar partial extraction techniques would result in recoverable reserves being reduced from 55 million tonnes to as low as 25 million tonnes.

The preferred mine plan for Area 1 consists of longwall panels ranging in width from 150 metres to 250 metres (see **Plate 2**). It is possible to achieve lesser surface impacts by adopting narrow longwall panel widths of about 100 metres. This would result in approximately 8.5 million tonnes of the identified 55 million tonnes of recoverable coal (based on the preferred mine plan), being left in the ground. This would represent a 15% loss of the available resource and would significantly decrease returns to the State Government and the overall wealth generated by the proposed development. Adoption of such narrow longwall panel widths would also require an increase in gate road development works required to be able to mine the coal. On a per tonne of coal basis, the amount of development required for such a narrow longwall panel width is approximately 1.7 times greater than for the preferred mine plan. This would result in a significant decrease in the overall productivity of the mine and could result in the mine being not an economically viable proposition resulting in a 100% loss of the State's resource.

Increasing longwall panel widths to 150 metres increases the amount of coal that can be mined and increases the overall productivity of the mining development. Surface impacts associated with 150 metre wide longwall panels will be considerably greater than for narrow longwalls but are not significantly less than those predicted for the mining development if it is based on a 250 metre wide longwall face. The preferred mine plan optimises the total recoverable reserves of coal and gate road development requirements.

It emerges from these considerations that to maximise the return to Powercoal from the development and to maximise the economic benefit to the State as a whole, it will be necessary to obtain government agency and local community acceptance of the preferred mine plan which consists of longwalls up to 250 metres in width. To this end, a detailed and considered *'Land Access, Management and Compensation Policy'* (see **Section 4.2.2**) has been developed. The policy addresses potential surface damage, potential surface water impacts and disruption to land use. This policy forms an integral consideration in the approval process.

A range of environmental and socio-economic mitigation measures have been explored that aim to facilitate the proposed development maximising product coal tonnages achieved and overall mining efficiency. These include:

- Detailed review of surface water management requirements and assessment of a range of suitable mitigation measures.

- Establishment of a form of option agreement with landholders which provides a landholder with the option to have properties purchased by Powercoal if the landholder is not satisfied with the potential impacts of the proposed development or the level of remediation achieved subsequent to mining. These option agreements could be linked to Powercoal applying for longwall approval pursuant to the requirements of the Coal Mines Regulation Act 1982 (CMRA) and could be subsequent to the development approval phase.

- Design of the proposed development to minimise impacts on the amenity of the area. This includes proposals to ensure that production coal is not transported via the public road system and careful design of surface infrastructure at the Mine Access Site and Cooranbong Colliery to minimise impact on the visual and acoustic environment of the area.

- Detailed studies to define the magnitude and extent of potential impacts and the feasible range of mitigation measures that can be employed to minimise impacts. These include detailed studies of surface and groundwater management requirements for the area and detailed assessment of surface infrastructure.

1.3 ENVIRONMENTAL CONSIDERATIONS

A significant component of the proposed development area consists of a broad and relatively flat floodplain that is subject to frequent and extensive flooding. It is estimated that approximately 636 hectares of the valley floor are subject to inundation resulting from runoff from a 1 in 100 year ARI rainfall event. Large tracts of the floodplain are water logged for extended periods. Over the past few decades drainage characteristics of the floodplain have been extensively modified. Modifications have included clearing, drainage works, channel realignment and replacement of river tussock and other coarse, dense native vegetation with pasture species. Surface flows have also been altered by the construction of roads, bridges and culverts. Many of these changes have occurred since the last big floods in 1988 and 1989 and have significantly altered the drainage regime of the area.

Proposed underground mining within Area 1 and Area 2 will alter the surface landform. This will change surface water and groundwater regimes within the proposed mining areas. Potential changes include alterations to the extent and depth of flooding, changes to drainage characteristics of the land surface, and modifications to groundwater resources. Modelling indicates that following mining, the area of the valley floor subject to inundation resulting from a 1 in 100 year ARI rainfall event will decrease by approximately 9% to approximately 584 hectares. Detailed studies of the surface flow regime, groundwater characteristics of the area and the thickness and nature of the alluvium under the floodplain have been undertaken to address these potential changes.

Analysis of groundwater and alluvium characteristics indicates that mining is not likely to have a significant impact on groundwater resources in the area. Consequently, existing wetlands within the area are not likely to be significantly affected by alteration to the groundwater regime, however, the position and orientation of wetland areas may alter.

Negligible impact on other environmental characteristics of the valley is predicted. This includes fauna habitat, archaeology, traffic and air quality.

Establishment of the Mine Access Site at the Morisset interchange will require clearing and disturbance to sections of woodland on the site. No archaeological resources have been found at the site. The Mine Access Site has been designed to enable the existing vegetation at the perimeter of the site to be maintained and augmented where necessary to ensure that visual amenity of the area is not reduced by the proposed development.

Background noise surveys have been undertaken for the area surrounding the Mine Access Site and Cooranbong Colliery. The surveys indicate that background noise levels at the Mine Access Site are dominated by traffic on the F3 Freeway. Detailed noise assessment for the Mine Access Site indicates that the proposed surface infrastructure can be established and operated without significantly altering the acoustic amenity of the area. Modelling indicates that noise emissions from Cooranbong Colliery will not vary significantly from existing conditions.

Coal clearance from the mine site will be via underground conveyor to Cooranbong Colliery where the coal will be brought to the surface and processed. Once processed, coal will be transported either via conveyor to Eraring Power Station or via private haul road to Newstan Rail Loading Facility. No production coal will be transported on the public road system. The preferred method of operation is for export coal transported to Newstan to be back loaded using the same trucks that bring domestic coal from Newstan to Eraring Power Station. This, and the adoption of longwall mining techniques, provides for efficient use of energy resources required for the overall development.

A 3.4 kilometre section of new private haul road will be constructed immediately north of Cooranbong Colliery to connect with the existing Newstan – Eraring private haul road. The new section will be constructed predominantly along the alignment of existing roads and will be sited, where possible, to avoid populations of *Tetratheca juncea* and *Acacia bynoeana* which are threatened plant species that occur in the area. The road will be sealed to minimise dust generation.

It is intended that fine rejects/tailings will be disposed of in disused mine workings in the existing Cooranbong Colliery. Coarse reject will be transported approximately 2.5 km north of the Colliery via the proposed new haul road to Lake Macquarie City Council's Hawkmount Quarry. There the reject material will be used in reformation and rehabilitation of the site. The project will create a net community benefit through contributing to the rehabilitation of this currently disturbed area.

Surveys of the proposed Cooranbong Colliery Coal Preparation Plant area and the proposed new haul road alignment indicate that no archaeological resources will be disturbed by the proposed developments.

The existing Cooranbong Colliery is licensed by the Environment Protection Authority to discharge excess mine water to Muddy Lake drainage system which discharges to Lake Macquarie. Establishment of a Coal Preparation Plant at Cooranbong Colliery will reduce the volume of mine water discharged from the site.

Both the Hunter Regional Environmental Plan 1989 and the Lake Macquarie Local Environmental Plan 1984 provide the foundation for the statutory considerations of the proposed development.

The proposed mining areas are identified in the Hunter Regional Environmental Plan 1989 as being located within an area which contains coal resources. The plan provides broad planning principles relating to environmental aspects of mining and these are addressed, where necessary, in the body of the environmental impact statement. Of particular significance is the equal emphasis placed by the plan in Clause 41(2) on the protection of coal, and other mineral resources and extractive materials, from incompatible development which may sterilise such resources. Clause 41(2) states:

> "Consent authorities, in considering proposals for development other than mining or extraction for land shown on the map as containing coal of open-cut mining potential, other mineral resources or extractive materials, should take into consideration the likely impact of the proposed development on those resources."

The Special Provisions (Part III) section of Lake Macquarie Local Environmental Plan provides specific controls on the development of land. The Special Provisions take precedence over the general provisions including zoning. Clause 22 of the Special Provisions allows the development of underground mines, with the consent of Council, irrespective of the zoning of the land. Clause 22 states:

> "Nothing in this plan prevents a person, with the consent of the Council, from carrying out development for the purposes of a mine where that mine is underground."

Council has confirmed in writing on 20 March 1997, the permissibility of this development under this provision (see **Appendix 1**).

A number of State Environmental Planning Policies (SEPP), by definition in those policies, apply to the City of Lake Macquarie. The nature of the operation of those Policies determines whether they are relevant in the case of a particular development. These matters have been considered and are discussed further in **Section 3.9.1**.

The nature of long term planning for the general area is at this time unresolved. Pressures have been exerted in this area and nearby rural areas for intensification of development, particularly subdivision. To date no large area rezonings have occurred to facilitate rural residential subdivision however a number of subdivisions have occurred through other mechanisms.

All of the above considerations indicate that, with the adoption of suitable environmental control measures, there are no significant environmental constraints to the development.

1.4 AUTHORITY AND COMMUNITY CONSULTATION

Government agency requirements in regard to the project were sought prior to and following the Planning Focus meeting which was held on 6 August 1997. Responses received from government agencies are summarised in **Table 1.1** and are provided in full in **Appendix 1**. Sections of the EIS in which each key issue is addressed are also noted in **Table 1.1**.

Table 1.1 - Government Agency Requirements

Agency	Requirement Details	Section of EIS
Department of Urban Affairs & Planning	Key issues:	
	Flood liability	3.5.2, 4.1.6
	Quality and quantity of surface flows, water bodies and groundwater	3.5
	Flora and fauna	3.8
	Subsidence	4.1, 4.2
1. Planning and Environmental Context	Planning Information and Permissibility	
	Zonings and Permissibility	3.9
	Land use constraints	3.12, 3.13
	Heritage items	3.9, 3.15
	Environmental Protection Areas	3.8
	Site Description and Locality Information	
	Title details, land tenure, lease details	3.11
	Existing land use	3.12
	Site description including roads, dwellings, utilities and land use	3.12, 3.13
	Overview of Affected Environment	
	Meteorological conditions	3.4
	Topography and drainage	3.1, 3.5
	Surface and groundwater characteristics	3.5
	Possible affects on threatened species	Appendix 5
	Features of heritage value or significance	3.9, 3.15
	Visual amenity and socio-economic environment.	1.2, 3.14, 3.9.1

Table 1.1 - Government Agency Requirements (cont)

Agency	Requirement Details	Section of EIS
Department of Urban Affairs & Planning (cont)	Proposal Objectives	
	Ecological sustainability	6.3
	Extent of mining	2.2
2. Description of Proposal	Quality and types of material to be mined/processed and marketed	2.2.1
	Life of operation	2.2.1
	Future land use of development site	2.3.1, 2.5.1, 4.7
	Project timing and future expansion	2.1
	Interrelationship of development with existing mine and other developments	2.5.1, 2.6, 4.8
	Coal Resource	
	Coal quality, size and occurrence	2.2.1, 3.2
	Geological factors	2.2, 3.2
	Exploration methods	2.2.1
	Proposed Works	
	Staging and construction schedule	2.0
	Location of infrastructure	2.0
	Progressive rehabilitation	4.2, 4.7
	Mining techniques and equipment used	2.2
	Proposed production volumes	2.5.1, 2.6
	Hours of operation and employment levels	2.5.2
	Energy requirements	6.4
	Constraints to increased production	2.5
	Coal handling, processing and transport	2.4 to 2.6
	Reject disposal	2.5, 2.6, 4.5,4.7
	Chemicals, materials and waste handling	4.4, 4.5
	Site Layout Plans	
	Maximum area of disturbance	2.3 to 2.6
	Significant vegetation communities	3.8
	Storage areas for coal, waste, fuels, chemicals and explosive	2.3 to 2.6
	Water and waste control facilities	2.3, 2.4, 2.5
	Acquisition Policy	
	Outline of policy	4.2.2
	Site Preparation Works	
	Construction Phase	4.4.1, 4.5.1, 4.6.1
	Infrastructure Considerations	
	Electricity supply	4.4.3, 4.5.3
	Transport requirements	2.3.2, 2.5.4, 2.6
	Water conservation and management measures	4.4.4, 4.5.4
	Alternatives and Justification	
	Coal mining techniques	5.2
	Mine design and layout	5.2
	Infrastructure location	5.4
	Disposal methods and rehabilitation options	5.5
	Coal types in relation to market demand	6.1
	Biophysical, economic and social justification	6.0
	Alternative impact mitigation options	5.6
	Alternative of not proceeding	5.7

Table 1.1 - Government Agency Requirements (cont)

Agency	Requirement Details	Section of EIS
3. Analysis of Environmental Impacts and Mitigating Measures	Cumulative Impact	4.8
	Air Quality	4.3.1, 4.4.6, 4.5.6
	Water Issues	4.4.4, 4.5.4, 4.7.1
	Erosion and soil stability issues	4.2.3, 4.4.1, 4.5.4, 4.7.1
	Noise and Vibration Impacts	4.3.2, 4.4.6, 4.5.5
	Traffic Impacts	4.4.2, 4.5.2, 4.6.5
	Visual Impact	4.4.7, 4.5.7, 4.6.7, 4.7.6
	Infrastructure constraints	4.0
	Spontaneous Combustion	4.5.10
	Subsidence	4.2
	Flood Liability	4.2.3
	Heritage issues	4.2.1, 4.4.9, 4.5.9, 4.6.4, 4.7.7
	Agricultural viability issues	4.2.1, 4.2.2
	Economic and Social Issues	6.1, 6.2
	Ecologically Sustainable Development Principles	6.3
	Flora and Fauna	4.2.1, 4.3.3,4.4.8, 4.5.8, 4.6.3, 4.7.2
	Ongoing management	4.0
4. Consultation	Consultation with: ♦ Government Agencies ♦ Local Aboriginal Land Councils ♦ Potentially affected land owners ♦ The community to be affected	3.8, Appendix 1, Appendix 2
Department of Land & Water Conservation	<u>Soil Conservation</u>	
	Topography and Landform	3.1
	Acid Sulphate Soils	3.3
	Soil type and erodibility	3.3
	Erosion and sediment control strategy	4.2.3, 4.4.4, 4.5.4, 4.6.1, 4.7.1
-	<u>Water Management</u>	
	Detailed water balance	4.4.4, 4.5.4
	Impacts on groundwater and ecosystems	4.1.5
	Management and impact of discharges	4.5.4
	Size and construction details for dams	4.4.4
	Separation and management of on-site runoff	4.4.4, 4.5.4
	Details of modelling work	3.5, 4.1.6, 4.2.3
	<u>Monitoring</u>	
	Surface water	3.5.4
	Groundwater	3.5.4
	Aquatic biology downstream of site	3.8
	Commitment to provide monitoring data to Department of Land & Water Conservation	4.2.1, 4.2.3
	<u>Creek Stability</u>	
	Longwall locations relative to creeks	4.2.3
	Subsidence rates and mitigation/monitoring proposals	4.1, 4.2.1
	Topographic information for creeks and landform	3.1, 3.5.1
	Details of activities ancillary to mining	2.0, 4.2.3

Table 1.1 - Government Agency Requirements (cont)

Agency	Requirement Details	Section of EIS
Environment Protection Authority	Mining operation including layout, infrastructure proximity to residences	2.0
	Air pollution	4.3.1, 4.4.6, 4.5.6, 4.7.3
	Noise pollution	4.4.5, 4.5.5, 4.7.4
	Blasting	4.3.2, 4.4.5
	Monitoring	4.0
	Rehabilitation	4.2 to 4.7
	Greenhouse Gas emissions	4.8.1
	EPA Approval and Licensing	4.9.4
	Sewerage treatment	4.4.3
	Water management and water pollution	4.4.4, 4.5.4, 4.6.1, 4.7.1
	Issues identified in 'Coal Mining - Environmental Impact Assessment Guidelines'	Entire EIS
energyAustralia	Electricity supply to mine access area	2.3.1
	Impact of mining on energyAustralia assets	4.1.4
	Energy usage of the mine	6.4
Rail Access Corporation	Proposed additional daily and annual rail movements	4.6.5
	Additional noise and vibration impacts	4.6.5
	Potential for a rail loop at Cooranbong	5.3
	Impact of possible double stacking of containers in regard to bridge construction	4.6.2
Heritage Office	Assessment of Heritage values	3.15
	Requirements under the Heritage Act 1997	3.9.1
State Forests	Effects of subsidence on State Forest	4.1.5
	Changes to surface runoff	4.1.6
	Potential for increased soil erosion on a soil type and slope basis	3.1, 3.3, 4.1.5
Hunter Catchment Management Trust	No requirements	-
TransGrid	Guidelines for coal mining and transmission lines with respect to subsidence	4.1.4
	Notice requirements for proposed works	noted
Land Information Centre	Details of locations and damage to survey control marks	3.13.5, 4.1.4
Mine Subsidence Board	Prediction of subsidence, strains, tilts and curvatures	4.1
	Impacts of coal extraction	4.1
	Types of surface structures and likely damage	4.1
	Subsidence mitigation measures	4.2
	Angle of draw	4.1
	Likelihood of extraction related vibrations	4.1
	Subsidence impacts on farm dams, groundwater and survey marks	4.1.3
	Subsidence monitoring	4.2.1
	Pre mining inspections	1.1
	Mine Subsidence Board requirements	4.1, 4.2

Table 1.1 - Government Agency Requirements (cont)

Agency	Requirement Details	Section of EIS
NSW Agriculture	Agricultural suitability	3.10
	Nature and value of existing agricultural uses of area	3.12
	Impacts of subsidence on local drainage, infrastructure and agricultural activities	4.1
	Mine water requirements and potential impacts on surface	4.4.4, 4.5.4
	Noise, air and traffic impacts	4.0
	Hours of operation	2.3.2, 2.5.2
	Agreements with neighbouring landholders	4.2.2
Department of Mineral Resources	Man made and natural surface features	4.1, 4.2
	Subsidence impacts on surface features	4.1
	Agreements with landholders and public utility authorities	4.2.2
	Subsidence impacts on surface and groundwater	4.1.5, 4.1.6
	Flooding impacts and proposed compensation agreements	4.1.6, 4.2.2, 4.2.3
	Impact of tidal waters	4.1.6
Environment Australia	No requirements	-
Lake Macquarie City Council	Subsidence and drainage impacts	4.1
	Section 90 heads of consideration	3.9
	Requirements of Department of Urban Affairs & Planning	see above
National Parks & Wildlife Service	Impacts on native flora and fauna	4.1.5, 4.3.3, 4.4.8, 4.5.8, 4.6.3, 4.7.2
	Aboriginal sites	3.15, 4.2.1, 4.4.9, 4.5.9, 4.6.4, 4.7.7
	Impacts on wetlands and associated vegetation	4.1.5, 4.2.1, 4.2.3
Roads and Traffic Authority	Subsidence impacts on the Freeway	4.1.3
	Traffic impacts on the Freeway ramps	4.4.2
	Proposed Mine Access Site to Mandalong Road	4.4.2
NSW Fisheries	Draws attention to Habitat Protection Plan	Noted
Commonwealth Department of Primary Industries and Energy	No requirements	-
Hunter Economic Development Council	No requirements	-
Pacific Power	No requirements	-
Rural Lands Protection Board	No requirements	-

The Mandalong Valley community has been consulted throughout the environmental impact assessment process through ongoing one on one discussions, newsletters, a land use survey and two community workshops. Details of the community consultation program, including newsletters and workshop outcomes, are provided in **Appendix 2**. At the first workshop, attendees were asked to identify issues to be addressed in preparing the environmental impact statement. A summary of these issues is provided in **Appendix 2**.

At the second workshop, the Project Team provided the community with an update of the project and findings of environmental studies. Matters raised by the community during this workshop are also summarised in **Appendix 2**.

These matters have been taken into consideration in preparing the Environmental impact statement and, where possible, are discussed in the document.

1.5 PROJECT TEAM

Members of the Project Team who have contributed to the preparation of the Environmental impact statement for the project include:

Jane Barnett, Holmes Air Sciences - Air Quality

James Beard, Centre for International Economics - Socio-Economic Studies

Steve Chamberlain, Gunninah Environmental Consultants - Flora

Mathew Chambers, Gunninah Environmental Consultants - Fauna

Ross Chapman, Centre for International Economics - Socio-Economic Studies

Liz Crawford, Umwelt (Australia) Pty Limited - Geology, hydrogeology, soils and land use

Barbara Crossley, Umwelt (Australia) Pty Limited - Soils, General Environmental Science

Liam Dagg, Umwelt (Australia) Pty Limited - Archaeology

Claire de Lacey, Gunninah Environmental Consultants - Flora

Bob Doyle, Sanders & Associates - Agricultural Suitability

Dominic Fanning, Gunninah Environmental Consultants - Flora and Fauna Impact Assessment

Dick Godson, Richard Heggie Associates Pty Ltd - Blasting and Noise

Kerry Holmes, Holmes Air Sciences - Air Quality

Nigel Holmes, Holmes Air Sciences - Air Quality

Amelia Hurren, Gunninah Environmental Consultants - Flora and Fauna

Anisul Huq, Umwelt (Australia) Pty Limited - Hydrology

Professor Ian King, Resource Management Associates - Hydrology

Peter Jamieson, Umwelt (Australia) Pty Limited – Project Management, Report Writing, Environmental Engineering

Don Kay, Waddington Kay & Associates Pty Ltd - Subsidence

Anne-Marie Moxy, Sanders & Associates - Agricultural Suitability

Allan Nelson, AB Nelson & Associates Pty Limited - Planning

Chris Schulten, Richard Heggie Associates Pty Ltd - Noise

Glen Thomas, Richard Heggie Associates Pty Ltd - Noise

Arthur Waddington, Waddington Kay & Associates Pty Ltd - Subsidence.

Technical information regarding coal mining aspects of the project has been provided by Powercoal personnel. The 'Land Access, Management and Compensation Policy' detailed in **Section 4.2.2** has been prepared by Powercoal in conjunction with The Fifth Estate Consultancy.

1.6 STRUCTURE OF THE DOCUMENT

This document has been structured to provide the reader with a clear understanding of the proposed development and its potential interactions with and impacts on the site, surrounding lands and adjoining developments.

Section 1.0 provides an overview of the proposed development, development objectives, and authority and community consultation conducted during preparation of this document. This section also summaries the social, economic and environmental aspects that have been taken into consideration in considering the merits of, and justification for, the proposal in the context of the characteristics of the site and nature of the development.

Section 2.0 gives a description of the proposed development including the method of operation, equipment to be used, life of the operation, and volume and types of coal to be produced.

Description of the five principal components of the development is provided. These are:

- Proposed underground mining operations in Areas 1 and 2 including provision for construction of a downcast shaft within Area 2

- Mine Access Site

- Coal and mine water clearance
- Coal Preparation and Handling including reject disposal
- Coal Dispatch.

Section 3.0 describes the existing environmental characteristics of the proposed development site and adjoining lands. This section provides the context within which the proposed development is to be considered.

Section 4.0 describes the potential impacts of the proposed development and details environmental management procedures that will form part of the proposed Cooranbong Colliery Life Extension Project. Environmental management procedures identified will be adopted to mitigate potential impacts of the proposed development.

Section 5.0 reviews the alternatives to the proposed development. Alternatives considered include:

- alternative coal resources
- alternative mining plans
- alternative coal transport options
- alternative coal handling and preparation proposals
- alternative reject disposal options
- alternative impact mitigation options
- alternative of not proceeding.

Section 6.0 reviews economic, social and ecological sustainability considerations for the development, detailing justification for the project as proposed.

Section 7.0 provides a bibliography of the written material referenced in the preparation of this document.

2.0 DESCRIPTION OF DEVELOPMENT

2.1 OVERVIEW OF COAL RESOURCE AND PROPOSED DEVELOPMENT

The proposed development consists of five principal components. A schematic diagram showing the interactions and linkages between each of these components of the proposed development is shown on **Figure 2.1**. An overview of each of the components of the proposed project is provided below:

- Underground mining operations within Areas 1 and 2. Proposed mining operations are detailed in **Sections 2.2.1** and **2.2.2** respectively.

- Access to Areas 1 and 2 will be via a new Mine Access Site which will be constructed immediately to the west of the Morisset Interchange on the F3 Freeway. Infrastructure and facilities to be established at this site are described in **Section 2.3**.

- Coal clearance via underground conveyor from Areas 1 and 2 to Cooranbong Colliery (see **Section 2.4**).

- Upgraded coal preparation and handling facilities at Cooranbong Colliery with existing infrastructure at the site being extended to include a coal preparation plant and increased run of mine (ROM) and product stockpiling capacity (see **Section 2.5**).

- Coal dispatch from Cooranbong Colliery either via the existing Pacific Power conveyor to Eraring Power Station or via private haul road to Newstan Rail Loading Facility from where the coal will be railed to the Port of Newcastle (see **Section 2.6**).

Areas requiring surface works to establish the proposed development are:

- Mine Access Site (Lots 5, 6, 8 and 10 DP 262159)

- Downcast Ventilation Shaft Site (Lot A DP 110119)

- Cooranbong Colliery Site (CCL 762)

- Private Haul Road and Reject Emplacement Area (CCL 746).

During the life of the mining operations, surface works may be required to rehabilitate or mitigate subsidence impacts. Such works may include repairs to buildings and infrastructure, modifications to public roads and access roads, drainage and channel improvement works, and surface reformation works. Such works could be required on any properties within proposed Mining Areas 1 and 2. Property and ownership details for Areas 1 and 2 are provided in **Section 3.11**.

Exploration drilling, coal quality analysis and mine planning indicates that there are approximately 65 million tonnes of recoverable coal within the proposed development area. Exploration work indicates that coal reserves are limited to the northeast and southwest by igneous sill intrusions that have burnt out or deteriorated the coal seam. Three dykes have been identified in the southern section of Area 1, using aerial magnetometer survey techniques. In addition, exploration work has identified the potential for two fault zones to exist in the eastern section of Area 1. Another significant fault zone exists immediately to the east of Area 1. Geological constraints to mining are shown on **Figure 2.2**.

Typical stratigraphic columns showing the relationship between coal resources and overlying sedimentary rocks are shown on **Figure 2.3**. Characteristics of the geology and coal in Area 1 make it suitable for the use of longwall mining techniques.

Approximately 55 million tonnes of recoverable coal are within Area 1 and are suitable for extraction by longwall mining. Approximately 10 million tonnes of recoverable coal are in Area 2 and are suitable for extraction by traditional bord and pillar methods using continuous miners.

The mineable coal resource varies in thickness from approximately 1.75 metres in the east of Area 2 to approximately 7 metres in Area 1. Coal quality within the proposed mining areas varies typically from approximately 16% to 20% ash with a planning limit for the mineable resource being defined as a maximum of 23% ash.

2.2 PROPOSED UNDERGROUND MINING OPERATIONS

2.2.1 Coal Resources and Reserves

Coal resources and reserves within the proposed mining areas have been determined based on results from previous drilling in the area which was undertaken by the Joint Coal Board (1975), Department of Mineral Resources (1980 and 1983), The Electricity Commission of NSW (1970 to 1982) and Australian Gas Light Company. This earlier drilling work was subsequently augmented through a three stage exploration program undertaken for the Cooranbong Colliery Life Extension Project.

The exploration program has consisted of:

- Airborne magnetometer survey
- Mini-sosie and high resolution seismic surveys
- Exploratory drilling – 68 holes
- Desorption of coal seams for seam gas determination
- Downhole geophysical logging of all boreholes
- Geotechnical logging of cored sections in each borehole

- Mechanical testing of overburden, roof and floor strata
- Analysis of coal seams recovered
- Establishment of a geological database
- Strata and seam water investigations
- Development of a geological model on Minex software
- In situ stress measurement

Results from coal quality testing undertaken on coal recovered from the Wallarah/Great Northern and Fassifern Seams used for the estimation of Mineable *In Situ* Reserves in the exploration program are summarised in **Table 2.1**.

Table 2.1 – Summary of Coal Quality Characteristics

<table>
<tr><th>Seam</th><th>Characteristic (Dry Basis)</th><th>Average</th><th>Range</th></tr>
<tr><td rowspan="4">WGN</td><td>Raw ash content (%)</td><td>19.0</td><td>14.5 – 25.3</td></tr>
<tr><td>Volatile matter (%)</td><td>26.7</td><td>23.0 – 29.0</td></tr>
<tr><td>Specific Energy (MJ/Kg)</td><td>27.37</td><td>25.27 – 28.84</td></tr>
<tr><td>Total sulphur (%)</td><td>0.30</td><td>0.25 – 0.46</td></tr>
<tr><td rowspan="4">WGNA</td><td>Raw ash content (%)</td><td>16.8</td><td>15.4 – 19.0</td></tr>
<tr><td>Volatile matter (%)</td><td>28.1</td><td>26.6 – 29.2</td></tr>
<tr><td>Specific Energy (MJ/Kg)</td><td>27.90</td><td>26.91 – 28.59</td></tr>
<tr><td>Total sulphur (%)</td><td>0.33</td><td>0.28 – 0.39</td></tr>
<tr><td>FAS</td><td>Raw ash content (%)</td><td>33.5</td><td>27.0 – 35.0</td></tr>
</table>

Source: Powercoal Pty Ltd

WGN - combined Wallarah/Great Northern seam
WGNA - combined Wallarah/Great Northern (upper section A) seam
FAS - Fassifern seam

Note: Table 2.1 summarises the exploration results across the entire exploration licence area and includes data from outside the proposed mining areas.

Using results from the exploration work and coal quality analysis, coal resources and coal reserves for a range of mine plans were determined. Resource/reserve estimates for the preferred mine plan are summarised in **Table 2.2**.

Table 2.2 – Resource/Reserve Estimates

Seam	Authorisation	Resources[1] (Mt)	Reserves[2] (Mt)
WGN (measured)	EL 4968	37.0	
	EL 4969	28.8	
	A404 W	63.6	
	Sub-total	129.4	
	Part A405[3]	7.3	
	Total	**136.7**	55
WGNA (indicated)	A404 C	28.8	**10**

1 *Resources are based on minimum seam thickness of 1.5 metres and maximum ash of 35%.*

2 ***Recoverable** reserves are based on the preferred and indicative mine plans for proposed Mining Areas 1 and 2 respectively.*

3 *Part A405 is to be transferred to Powercoal from C.O.A.L. Pty Ltd*

2.2.2 Area 1

Area 1 is located predominantly under the Mandalong Valley and has an area of approximately 30 km^2. Area 1 includes land covered by MLA 88 and Part A405. The preferred longwall layout and proposed extent of mining for Area 1 are shown on **Figure 2.4**.

Predominant land use in the area is low intensity agriculture on small rural holdings. Major surface infrastructure in the area includes Council roads and Inghams Enterprises Pty Ltd Multiplication Farm and Breeding Farm (see **Section 3.12**). In addition, approximately 95 habitable dwellings are located within or immediately adjacent to Area 1.

Mineable coal reserves in the area consist of the Wallarah seam and the Great Northern A and B seams which converge in Area 1. Ash content in Area 1 ranges from approximately 16% to 20.0%. Depth of cover to the combined Wallarah/Great Northern A and B seams varies from approximately 160 metres under the eastern end of the Mandalong Valley to approximately 365 metres under the Watagan Mountain Range in the northern section of the proposed mining area.

As can be seen from **Figure 2.2**, coal reserves within Area 1 are confined by igneous sill intrusions to the east and west of the proposed mining block. The southeastern boundary of Area 1 is defined by the split line of the Wallarah/Great Northern seam and the Wallarah/Great Northern A seam, while the northwestern boundary is defined by a planning limit of 23% ash and/or a minimum seam thickness of 2.5 metres which is the thinnest seam thickness that can be mined by the longwall mining equipment proposed for the development. Maximum thickness of the coal seam within Area 1 is approximately 7 metres. It is proposed to mine a maximum of 5 metres of this coal as at present it is not technically viable to mine a greater thickness of coal using longwall techniques.

Longwall mining is planned to commence in June 2001 with development works commencing in early 1999. An indicative schedule for mining within Area 1 is shown on **Figure 2.5**. Mining will commence in the northwest corner of Longwall 1 (LW 1) and progress in a southwesterly direction. Longwall 1 is located adjacent to the Mine Access Site. It is planned that a base load of approximately 3 million tonnes of coal will be produced from Area 1 annually with a potential annual maximum combined output from Area 1 and Area 2 of approximately 4 million tonnes. Based on current technology this is considered to be the maximum achievable production level from the proposed mine.

The total tonnage of coal that can be mined from the proposed development area is dependent on the mine layout and longwall width/chain pillar width configuration adopted. It is proposed that longwall panels ranging in width from 150 metres to 250 metres will be used in Area 1. The optimum layout for longwall mining in Area 1 is shown on **Figure 2.4**. This layout is based on current knowledge of the geology of the area and is likely to be refined over the life of the mine as more detailed information regarding the geology and coal characteristics of the area is obtained through mining. Development consent under the Environmental Planning and Assessment Act (1979) is sought for longwall mining panel widths of up to 250 metres.

The potential impacts and mitigation measures to offset these impacts, which are detailed in **Sections 4.0** and **5.0**, are based on the preferred mine plan and cover the envelope of impacts likely to occur as a result of mining activities in the proposed development area.

The amount of coal that can be mined from Area 1 is dependent on the longwall layout and longwall panel widths adopted. The mine planning process has been aimed at optimising the recovery of available coal from a technical and commercial view point whilst ensuring that the development can be undertaken in an environmentally and socially acceptable manner. This has involved an extensive investigation involving consideration of minimum and maximum coal thickness, coal quality (particularly ash content), available technology, market requirements and potential surface impacts.

Prior to commencing longwall extraction, approval for each longwall panel or group of longwall panels will need to be obtained from the Department of Mineral Resources, in accordance with the requirements of Section 138 of the Coal Mines Regulations Act 1982.

2.2.3 Area 2

Area 2 is located under an area of approximately 15 km^2, part of which drains to the Mandalong Valley with the remainder draining eastward towards the Main Northern Railway and subsequently Lake Macquarie. The constraints to mining and limit of the proposed mining area are shown on **Figures 2.2** and **2.4**, respectively.

Major surface features in the area include the Main Northern Railway, F3 Freeway, Eraring-Munmorah-Sydney West 330 kV transmission lines and Inghams Breeding facilities. The area is used predominantly for low intensity agriculture and consists of grazing land and forested areas. Approximately 17 residential dwellings are located within Area 2.

In this area the Wallarah/Great Northern A and Great Northern B coal seams are separated. Exploration work indicates that the thickness and quality of the Great Northern B coal seam make it not physically or economically viable to mine. The Wallarah/Great Northern A seam is approximately 2.5 metres thick along the western extremity of Area 2 and has an ash content in this area of approximately 20%. The seam thins to approximately 1.75 metres thick towards the eastern boundary of the site where ash content is approximately 23%. MLA 88 extends beyond the eastern limit of Area 2. Coal reserves within the portion of MLA 88 to the east of Area 2 are considered to be not economically viable to mine based on current knowledge of coal geology of the area and as such, have a low potential of being mined as part of the proposed development.

Area 2 contains approximately 10 million tonnes of recoverable coal reserves that are suitable to be mined by continuous miner. Coal reserves in Area 2 are not considered viable to be mined as a stand alone project, however do become marginally viable if mined in conjunction with Area 1. It is envisaged that Area 2 will be mined generally during the same period as Area 1 and mining could commence by 2004.

It is estimated that a base load of approximately 500,000 tonnes of ROM coal could be mined from Area 2 annually. Maximum production from Area 2 will be dependent on market requirements and is envisaged to be approximately 1 million tonnes per annum.

To meet possible ventilation requirements for the project, it is possible that it will be necessary to construct a downcast ventilation shaft within Area 2. Based on current knowledge of the geology of the area, the preferred location of the downcast airshaft, if required, is on Lot A DP 110119, and is shown on **Figure 2.4**. The Downcast Shaft will require no working components once it has been constructed. Construction techniques to establish the shaft will be similar to that described for the upcast shaft in **Section 2.3.1**.

2.3 MINE ACCESS SITE

2.3.1 Infrastructure and Services

Materials and personnel access to Areas 1 and 2 will be provided from the Mine Access Site which is to be constructed on a 40 hectare parcel of land immediately to the northwest of the Morisset F3 Freeway interchange (refer to **Figure 2.4**). Access to the site will be via Mandalong Road. It is planned that construction activities will commence at the site shortly after development consent is obtained and will take approximately two years to complete. Infrastructure to be constructed at the site is shown in plan view on **Figure 2.6a**. Typical perspective views of the site once constructed, are shown on **Figure 2.6b**. Infrastructure to be constructed at the site will include:

- An administration building and bath house. The building will have a maximum height of approximately 7.0 metres and will be of durable construction. The administration building will be fully equipped with modern telecommunication and computer facilities. The bath house will have facilities for approximately 200 personnel.

- A compressor building which will be of durable construction and will be approximately 6.5 metres high.

- A service workshop and store which will be constructed from colourbond material and will be approximately 10 metres high. The service workshop will only be used for minor maintenance work with major maintenance and rebuilding being undertaken on a contract basis off-site. Spillage and runoff from the workshop will be serviced by a sump and oil separator. Waste oil from the workshop and oil separator will be collected on a regular basis by a contractor and transported off-site for recycling or disposal at an approved depot as appropriate.

- An on-site wastewater treatment plant. Wastewater from the bath house will be treated at an on-site package treatment plant and will be disposed of by on-site irrigation. The package treatment plant will have a wet weather storage capacity of approximately 400000 litres which is the equivalent of approximately 10 days wet weather storage.

- A car parking area for up to 200 vehicles and open storage areas.

- A large cross-section, 1 in 8 grade personnel and materials access decline. It is estimated that approximately 27000 m^3 to 41000 m^3 of material will need to be excavated to construct the decline. The decline will be constructed using a road header which is expected to advance at an average rate of 5 metres per day generating approximately 150 m^3 of loose material per day. Excavated material will either be conveyed to the surface or hauled using a diesel powered Load Haul Dump (LHD) vehicle. The LHD will be able to transport approximately 3 m^3 of material per trip, requiring approximately 50 trips per day to remove excavated material. Excavated material will be used on-site to fill low lying areas and to create acoustic and visual bunds around the site. Once constructed, diesel powered wheel based transporters will be used to transport materials and personnel underground.

- A twin centrifugal fan upcast airshaft will be constructed using shaft boring techniques or blasting and excavation techniques, or a combination of techniques as appropriate. From the range of feasible techniques, shaft boring is considered to pose the worst case scenario in terms of noise emissions. If this technique is used, a shaft boring rig and compressor will be located on the surface of the site. The shaft would most likely be bored in two passes with the first pass being a pilot hole raise bored from underground to the surface followed by a second pass, being bored from the surface to the bottom. All cuttings would fall to the bottom of the shaft, with the material thus excavated from the hole being placed in underground workings. Unconsolidated material at the surface of the shaft will be excavated from the surface and utilised on-site as fill or bunding material. The fan house will be of durable construction, approximately 12.7 metres high from the shaft collar and designed to minimise noise emissions.

- A small diameter shaft to supply bulk ballast to underground mining operations.
- A water management system for surface runoff.
- A bunded fuel storage area.
- A range of mobile equipment will be used at the Mine Access Site.
- An Emergency Services Helicopter Landing Area (ESHLA).

Electricity and potable water infrastructure will be extended to the site from the western outskirts of Morisset. The water main to service the site will run along the northern road easement of Mandalong Road and cross the F3 Freeway via service ducts in the Mandalong Road bridge.

End use of the mine access site has not been determined at this time however it is considered likely that due to the proximity of the site to the Morisset Industrial Area, that the site will be used for a compatible end land use.

2.3.2 Mine Access Site Employment and Hours of Operation

During the construction phase, approximately 130 people in total are expected to be employed at the Mine Access Site over the period of construction of approximately 2 years. It is envisaged that surface construction works will occur between the hours of 7.00 am and 10.00 pm, seven days per week with underground work (ie. construction of the drift) being undertaken 24 hours per day, seven days per week. It is expected that it will take approximately 12 months to construct the 1 in 8 decline and approximately three to eight months (depending on techniques used) to construct the upcast airshaft.

Once mining within Area 1 is fully operational it is expected that approximately 200 people will be employed at the Mine Access Site or as part of the associated underground mining operation. It is expected an additional 20 people will be employed once mining activities in Area 2 commence.

The Mine Access Site has been designed to operate 24 hours a day, seven days a week for 365 days per annum. It is envisaged that a maximum of 140 people may be on-site at any time. This will translate to an estimated maximum of approximately 100 vehicles arriving at the site during any shift change and a similar number of vehicles leaving the site after any shift.

Approximately 20 administrative staff will be employed at the Mine Access Site with the administration building generally being open between 7.00 am and 4.30 pm Monday to Friday.

2.4 COAL AND MINE WATER CLEARANCE

A range of coal transport alternatives for the project were assessed and these are discussed further in **Section 5.3**.

The preferred option for coal transport from Area 1 and Area 2 is to transport coal underground, via the existing conveyor system which will require upgrading. Coal will be brought to the surface via the South Drift at Cooranbong Colliery. This option is economically feasible and has the least impact on the surrounding area of all the options considered.

Generally the existing underground conveyor system will be maintained for coal conveyance to Cooranbong Colliery. The system will be modified to be able to convey 3 million tonnes to 4 million tonnes of ROM coal per annum. It is proposed that the following modifications will be made underground to the existing system to ensure that the conveyor continues to operate in an efficient low maintenance manner for the life of the proposed development:

- Construction of underground surge bins with total capacity of 2500 tonnes
- Upgrade of existing conveyor drives
- Replacement of conveyor belting
- Repairs to existing underground roadways.
- Establishment of a maintenance strategy to obtain the optimum running level for the coal clearance system.

It is intended that mine water from Areas 1 and 2 will be piped underground to Cooranbong Colliery where the water will be used in coal preparation and handling, dust suppression and as a transport medium for tailings disposal (see **Section 2.5.3**). Mine water in excess of Cooranbong Colliery demands will be directed to the existing on-site water management system prior to being discharged at licensed discharge points. The existing water management system has sufficient capacity to handle planned water discharges.

2.5 COAL PREPARATION AND HANDLING

2.5.1 Cooranbong Colliery Infrastructure and Proposed Modifications

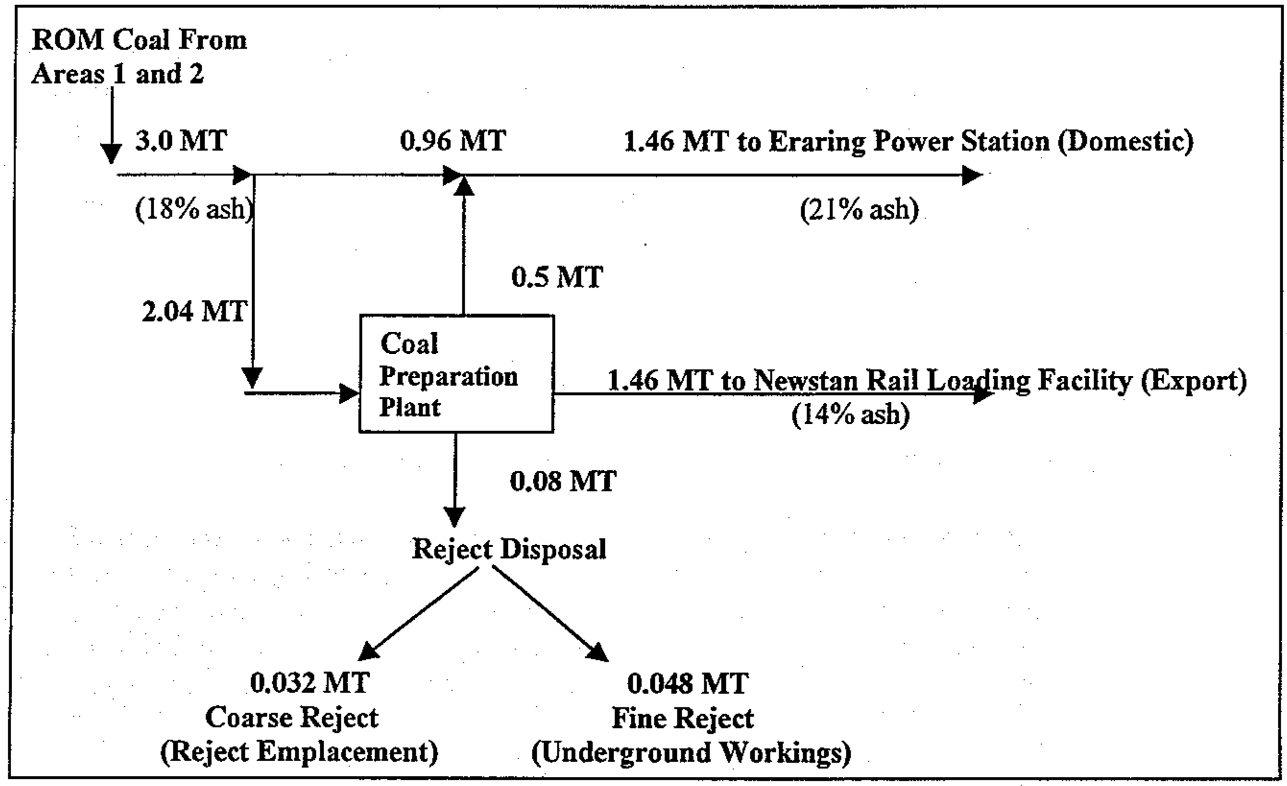
Infrastructure at the existing Cooranbong Colliery site is shown on **Figure 2.7** and consists of an administration building/bath house, parking and material storage facilities, workshop, personnel and materials access drift, a twin centrifugal fan air shaft, compressor building, an emergency services helipad and coal handling infrastructure. Coal handling infrastructure includes conveyors leading from the North and South Drifts, a rotary breaker and sizer, conveyor drive head units, storage bins and coal stockpile areas. The entire site is paved with runoff from the site being directed via a controlled water management system (see **Figure 2.7**). The water management system conveys runoff to sedimentation dams located at the northern boundary of the site. The system consists of a dual clean water/dirty water system and has an EPA licensed discharge point upstream of Muddy Lake. Coal is currently transported from the site to Eraring Power Station via an 800 tonne per hour conveyor that is owned by Pacific Power.

new stockpile area

It is proposed that the majority of the existing infrastructure will be retained as part of the proposed upgrading of the coal preparation and handling facilities. All coal from Areas 1 and 2 will be combined to produce a run of mine (ROM) coal that will be delivered to the site via the existing South Drift. To allow for surges from longwall production, it is proposed to construct a 100,000 tonne run of mine (ROM) coal stockpile area immediately to the west of the North Drift. Coal will be transferred to and from the ROM stockpile via a dual conveyor system consisting of a second conveyor to be constructed parallel to the existing conveyor as shown on **Figure 2.8** and the existing North Drift conveyor. Elevational views showing proposed modifications to the colliery infrastructure are shown on **Figures 2.9a** and **2.9b**. Runoff from the entire ROM stockpile site will be directed towards the existing sedimentation dam system (see **Figure 2.7**).

The ROM coal supply will split into two streams at the Cooranbong Colliery site as is shown in the schematic diagram shown below which shows the proportion of coal to be handled in each of the streams for a base load production of 3.0 MT per annum. As detailed earlier, depending on market demands production may increase up to 4.0 MT per annum with the proportion of coal handled by each stream expected to remain the same.

Cooranbong Colliery Coal Preparation Plant Schematic Flow Diagram



At base load, approximately 3.0 MT of Run of Mine (ROM) coal will be delivered annually and will be sized initially to minus 75 mm in the existing Cooranbong Colliery rotary breaker and then to minus 32 mm in a new sizing plant. Once sized the first stream will consist of approximately 0.96 MT of domestic coal that will be transferred directly by Pacific Power's overland conveyor to Eraring Power Station. The remaining approximately 2.04 MT will be processed at the Coal Preparation Plant that will produce three streams of material. These will typically include approximately:

- 1.46 MT of export quality coal with an ash content of approximately 14%;
- 0.5 MT of carbonaceous material that will be combined with coal from the first stream to produce approximately 1.46 MT of domestic coal with approximately a 21% ash content;
- 0.08 MT of reject material may be produced, however based on coal quality testing undertaken for the project, the processing operation has the potential to operate on a zero rejects basis.

To produce export quality coal, a modular coal wash plant will be established immediately to the south of the South Drift. The site for the Coal Preparation Plant will be cut into an existing low embankment which is located immediately to the west of the current developed area and as a result minor earthworks will be required. Coal preparation and handling requirements for the proposed development have been determined by Bateman Kinhill (May 1997). The study assessed five options for the location and layout of the proposed Coal Preparation Plant and determined that the preferred option is to cut the proposed new Coal Preparation Plant into the existing Cooranbong Colliery site, utilising the existing infrastructure where practical. Reject material from the Coal Preparation Plant is expected to typically comprise approximately 40% coarse material and 60% fine material.

The proposed Coal Preparation Plant will consist of two 300 tonne/hour modules. It is envisaged that one module will be constructed initially, with the second module being constructed and commissioned as required and as coal production increases. Each module will consist of:

- Dense Medium Cyclones (DMC) and associated screens
- Spirals and dewatering screens
- Desliming screens and cyclones
- DMC floats and spirals product dewatering centrifuge
- DMC sinks and spirals rejects dewatering centrifuge
- Tailings thickener.

Low ash coal from the Coal Preparation Plant will be stockpiled on the existing paved open storage area in the northwest corner of the Cooranbong Colliery site. Two product stockpiles will be established, each of approximately 50,000 tonnes capacity. Sufficient space exists to establish these stockpiles within the perimeter of the existing Cooranbong Colliery site. Runoff from these stockpiles will be directed to the existing water management system which has the capacity to handle planned water discharges from the Coal Preparation Plant.

The layout plan of the proposed Coal Preparation Plant and associated stockpile areas is shown on **Figure 2.8**. End land use of the site has not been determined at this time. If no compatible use has been identified at the end of the proposed development the site will be decommissioned.

2.5.2 Employment and Hours of Operation at Cooranbong Colliery

A total of approximately 50 contract personnel are expected to be employed during the upgrade and construction phase at Cooranbong Colliery. The construction phase at Cooranbong Colliery is expected to last approximately 9 months. Once commissioned, approximately 10 people will be employed at Cooranbong Colliery in administration, coal preparation and handling. When required, approximately 3 people will be employed in transporting, shaping and rehabilitating coarse reject material and up to an additional 10 contract truck drivers will be employed hauling coal from Cooranbong Colliery via the private haul road to Newstan Colliery.

The Coal Preparation Plant will be designed to operate 24 hours per day, seven days per week.

Coal reserves remaining within Cooranbong Colliery's existing Mining Lease (CCL 762) are expected to be mined out by 2001 and as such there is limited potential for overlap between mining operations in the proposed extension area and the existing Colliery.

2.5.3 Tailings Disposal (Fine Rejects)

It is intended that tailings from the Coal Preparation Plant will be disposed of underground into disused workings in the Cooranbong Colliery. This technique is currently being successfully employed at Powercoal's Newstan Colliery. Alternative tailings disposal methods that are available to the proposed development include co-disposal at the proposed reject emplacement area.

2.5.4 Coarse Reject Disposal

Coal quality analysis undertaken for Areas 1 and 2 indicates that the proposed Coal Preparation Plant has the potential to be operated on a zero coarse rejects basis. It is possible, however, that up to approximately 32,000 tonnes of coarse reject could be generated per annum from the plant. It is proposed that any coarse reject from the site will be used in the rehabilitation of Lake Macquarie City Council's Hawkmount Quarry which is located approximately 2.5 km north of the proposed Coal Preparation Plant site. It is estimated that approximately 1.5 million tonnes of coarse reject could be incorporated into rehabilitation of the quarry and as such, sufficient area exists to accommodate the coarse reject disposal needs for the 20 year life of the proposed development.

Lake Macquarie City Council also proposes to establish a new quarry approximately 4 km north of the proposed Coal Preparation Plant. An environmental impact study is to be prepared for the project. If this quarry is established, it will have an estimated life of approximately 20 years. As the quarry develops, coarse reject material could also be transported to this site and incorporated into the rehabilitated landform once areas of gravel resource are depleted.

Coarse reject will be transported to the above quarry sites (see **Figure 2.10**) via a new private haul road (see **Section 2.6.2**). Reject will be transported from the Coal Preparation Plant using semi-trailers. At the quarry site, the reject material will be shaped using a bulldozer and will then be covered with soil material from either the quarry site or overburden from the new Council quarry if established.

It is envisaged that transport of coarse reject material could generate approximately 1280 laden truck movements per annum or an average of approximately 5 laden truck movements per day based on approximately 260 transport days per annum. It is envisaged that coarse reject will be transported when the Coal Preparation Plant is operating (ie. up to seven days per week).

2.6 COAL DISPATCH

2.6.1 Cooranbong - Eraring Power Station Conveyor

At present Cooranbong Colliery dispatches approximately 1.5 million tonnes of domestic coal per annum under contract to Eraring Power Station via an 800 tonne per hour covered overland conveyor. The conveyor passes under the Main Northern Railway and is approximately 1.8 km long. The conveyor is owned by Pacific Power and will not be modified as part of the proposed development.

It is intended that as part of the proposed development, domestic coal from Cooranbong Colliery will continue to be supplied via the conveyor at a base rate of approximately 1.46 million tonnes per annum (plus or minus 20%) to Eraring Power Station.

2.6.2 Extension to Existing Private Haul Road

It is proposed that export coal from the Coal Preparation Plant will be transported by contract trucks hauling over the private haul road running from Eraring Power Station to Newstan Colliery. The private haul road is located to the east of the Main Northern Railway as shown on **Figure 2.10**. The road is owned by Powercoal. It is envisaged that as part of the proposed development on average approximately 1.5 million tonnes of coal per annum will be transported along the private haul road. This will require approximately 54545 laden truck movements per annum.

It is intended that the majority of the coal will be transported as back load with trucks bringing coal from Newstan Colliery to Eraring Power Station off loading domestic coal at Eraring Power Station then travelling to Cooranbong Colliery via the new haul road. At Cooranbong Colliery the trucks will be loaded with export coal which will then be road hauled back to the Newstan Rail Loading Facility. During periods of peak demand from Cooranbong Colliery when insufficient trucks are hauling coal from Newstan Colliery to Eraring Power Station it will be necessary for additional trucks to be used. To minimise transport costs and environmental impacts the normal mode of coal transport will be by back loading.

To provide access to the private haul from the Coal Preparation Plant, it is proposed to construct a 3.4 kilometre long private haul road which will pass over the Main Northern Railway immediately to the north of Lake Macquarie City Council's Hawkmount Quarry. To gain access over the railway a new bridge will be constructed. Discussions have been held with Rail Access Corporation and it has been determined that construction of the proposed bridge is feasible. The final design and construction of the bridge will be undertaken in accordance with the requirements of Rail Access Corporation and will take future rail transport proposals into consideration.

The new section of private haul road that will be constructed will follow the alignment of existing gravel roads for approximately 2.2 km. A portion of this section of the road is currently used by Lake Macquarie City Council to haul gravel from the Hawkmount Quarry. Two overall alternatives have been identified for the alignment of the extension of the private haul road. The first involves utilising this 2.2 km of existing road system. This alternative requires only minor widening and upgrading of the road surface.

The second alternative is to locate the haul road extension approximately 20 metres to the east of the existing road. This would allow coal haulage to be undertaken independently of Council use of the existing road system.

For both alternatives, approximately 550 metres of new road will need to be constructed at the start of the proposed haul road alignment and approximately 650 metres of new road will need to be constructed at the northern end of the proposed new haul road. The new bridge over the railway will form part of the 650 metre new section of road.

The preferred alternative is to utilise the alignment of existing roads and gravel tracks where possible. Optional alignments exist for two sections of preferred alignment. These are shown on **Figure 2.10** and are referred to as Options 1 and 2 and Options A and B respectively.

The 3.4 kilometre haul road extension will be sealed to minimise dust generation and ongoing maintenance needs.

2.6.3 Existing Private Haul Road

Coal is currently trucked from Newstan Colliery at Fassifern to Eraring Power Station via a 12 kilometre long private haul road. The road is two laned and tar sealed. It is intended that export coal from the proposed development, where possible, will be back loaded to Newstan Rail Loading Facility using the same trucks that will be hauling domestic coal from Newstan Colliery. As such, no significant increase in truck movements along the haul road is expected.

No modifications are required to this section of the private haul road as part of this development.

2.6.4 Newstan Rail Loading Facility

Export coal from Powercoal's Newstan Colliery is currently loaded from the Newstan Rail Loading Facility and transported to the Port of Newcastle for dispatch to export markets.

It is intended that export coal from the proposed development will be trucked to the rail loading facility via the private haul road (see **Section 2.6.3**) from where it will be loaded on to the rail system for dispatch to the Port of Newcastle.

The Newstan Rail Loading Facility is not proposed to be modified as part of the proposed development. Powercoal intend to lodge a separate development application for upgrading of the Newstan Rail Loading Facility to facilitate increased loading of export coal from a number of the Company's mines. Export of coal from Cooranbong Colliery is planned to commence in the middle of 2001. If consent has not been granted to upgrade Newstan Rail Loading Facility by this time, Powercoal will dedicate an adequate proportion of the existing facilities capacity for Cooranbong Colliery to load projected export coal tonnages.

3.0 DESCRIPTION OF THE EXISTING ENVIRONMENT

3.1 TOPOGRAPHY

3.1.1 MLA 88 and Part A405

Topography within the proposed Mining Lease Application area ranges in elevation from approximately 4 mAHD adjacent to the F3 Freeway near Stockton Creek to 229 mAHD at Cooranbong Trig Station in the northern sector of the proposed lease application area. Topography of the area is shown on **Figure 3.1**.

Landform within the lease application area varies dramatically and includes the broad, flat floodplain of the Stockton Creek/Morans Creek drainage system and steep rugged ridges of the Watagan Mountain range. The flood plain typically has slopes of less than 2% and occupies an area of approximately 8 km^2. Footslopes adjacent to the flood plain range in slope from 2% to 20% with upper sections of ridges having slopes in excess of 30%.

Distribution of slopes across the area is shown on **Figure 3.2**.

3.1.2 Mine Access Site

The Mine Access Site ranges in elevation from approximately 6.5 mAHD near the proposed Upcast Shaft location to approximately 12 mAHD along the southern boundary (adjacent to Mandalong Road) and eastern boundary adjacent to the F3 Freeway, as shown on **Figure 3.1**. The site is generally flat with slopes of less than 5% with steeper areas having slopes of up to 20% at the southern and eastern boundaries of the site.

3.1.3 Cooranbong Colliery

The Cooranbong Colliery site which was established in 1982, slopes at approximately 1% to the southeast and typically has an elevation of 10 mAHD to 14 mAHD (see **Figure 2.6**). The site has been excavated into the floor of a small valley and is surrounded to the south, west and north by ridges with elevations of typically 40 mAHD to 50 mAHD. Vegetated ridges to the south, west and north of the site shield it from surrounding residences.

3.1.4 Haul Road and Reject Emplacement Area

The landform traversed by the proposed private haul road alignment is undulating with slopes of typically 5% to 10% and occasionally up to 15% in gully locations. The terrain ranges in elevation from approximately 10 mAHD in the valley floor immediately north of Cooranbong Colliery to approximately 50 mAHD on ridge lines (see **Figure 2.10**).

Hawkmount Quarry has operated for over 100 years and over this time the ridge on which the quarry has been established has been lowered. At present, the outer rim of the quarry has an elevation of approximately 40 mAHD with the floor of the quarry being excavated down to approximately 32 mAHD.

3.2 GEOLOGY

3.2.1 Geological Context

Mandalong Valley is located in the Newcastle Coalfield, which is part of the Sydney Basin, the largest coal-bearing basin in New South Wales. The Sydney Basin is a sequence of sedimentary rocks deposited during Permian and Triassic periods of geological time.

During the Permian period of geological time, sediments were deposited in marine, estuarine and alluvial environments. Extensive and repeated periods of peat accumulation produced the coal seams which are interbedded with layers of conglomerate, sandstone, shale and volcanic ash deposited in the above-mentioned environments. In the Mandalong area, coal-bearing rocks are collectively known as the Newcastle Coal Measures.

Between the Permian and Triassic geological periods, about 250 million years ago, there was an hiatus or break in sedimentation which marked the end of environmental conditions suitable for peat accumulation in the Sydney Basin. No coal seams occur above this break. The Triassic coal-barren sedimentary rocks in the Mandalong area are known as the Narrabeen Group and reach a maximum thickness of about 400 metres within the lease application area.

Surface geology of the proposed mining area is shown on **Figure 3.3**. Typical stratigraphic columns showing the proximity of coal seams to the overlying sedimentary material are shown on **Figure 2.3**. The following description of the local geology is based on work by Uren (1977) and Herbert (1997).

3.2.2 Newcastle Coal Measures

The 400 metres thick Newcastle Coal Measures are more than 250 million years old and were deposited in coastal and alluvial plain environments.

Stratigraphy of the Newcastle Coal Measures is shown in **Table 3.1**.

Table 3.1 - Stratigraphy of the Newcastle Coal Measures

GROUP	FORMATION	COAL SEAMS/SIGNIFICANT UNITS
Newcastle	Moon Island Beach	Vales Point Wallarah Great Northern
	Awaba Tuff	
	Boolaroo	Fassifern Upper Pilot Lower Pilot Hartley Hill
	Warners Bay Tuff	
Coal	Adamstown	Australasian Montrose Wave Hill Fern Valley Victoria Tunnel
	Nobbys Tuff	
Measures	Lambton	Nobbys [1,2] Dudley [1,2] Yard [2] Borehole [2]
	Waratah Sandstone	

1 *The combined Nobbys and Dudley seams form the Young Wallsend seam.*
2 *The combined Nobbys, Dudley, Yard and Borehole seams form the West Borehole seam.*

Under Mandalong Valley, the coalesced Wallarah/Great Northern seam is the topmost seam of the coal measures. This is the target seam for the proposed underground coal mine and lies more than 150 metres below the surface. Depth of the seam increases as it dips (slopes) gently to the west and surface topography increases. Thus, as much as 400 metres of overburden or cover occurs under the ridges on the western margin of the valley.

3.2.3 Wallarah/Great Northern Coal Seam

The combined Wallarah/Great Northern seam ranges in thickness from 2.5 metres to more than 7 metres over Area 1, west of the convergence line. East of the convergence line, the combined Wallarah/Great Northern A seam is thinner because it lacks part of the Great Northern seam known as Split B (see **Figure 2.3**). Detail of coal quality within Areas 1 and 2 is provided in **Section 2.2**.

3.2.4 Narrabeen Group

Triassic sedimentary rocks of the Narrabeen Group overlie the Newcastle Coal Measures. Narrabeen Group sediments were deposited between 240 and 250 million years ago in dominantly fluvial to estuarine environments.

In the Central Coast area, the Narrabeen Group sequence of conglomerate, sandstones, and red and green shale, has been subdivided into five formations based on the dominance of particular rock types (see **Figure 3.3**).

Dooralong Shale

The Dooralong Shale, immediately overlying the Newcastle Coal Measures and forming the roof of the Wallarah/Great Northern Coal seam, is composed of dark grey shale which grades up to interbedded coarse-grained sandstone and green-grey shale. This geological unit is 60 to 70 metres thick and was deposited in estuarine and alluvial plain environments. This formation is completely sub surface in the lease application area.

Detailed mapping of all the natural discontinuities in all the roof core has indicated that these units, which have fracture spacings varying from less than 0.3 metres to a maximum of 2.5 to 3.0 metres are not mechanically massive.

Munmorah Conglomerate

Munmorah Conglomerate overlies the Dooralong Shale, and consists of granule and pebble conglomerate and coarse-grained sandstone interbedded with minor green-grey shale. This unit is about 70 metres thick and was deposited on an alluvial braidplain. This formation is completely sub surface in the lease application area.

This is the only massive unit within the overburden. Massive units 25 to 45 metres thick have been identified in Area 1 (Coffey et al 1996).

Tuggerah Formation

The Tuggerah Formation overlies the Munmorah Conglomerate and consists of mottled green-grey and red shales interbedded with medium to coarse-grained sandstone and rare conglomerate. Sandstone beds decrease in abundance towards the middle of the formation. Where not reduced by erosion, the Tuggerah Formation is about 200 metres thick and was deposited in alluvial and estuarine environments. This formation is exposed in the Mandalong Valley and surrounding hill slopes.

Patonga Claystone

The Patonga Claystone overlies the Tuggerah Formation and is composed of red-brown shale with interbedded fine to medium grained sandstone. It is about 90 metres thick and was deposited in an estuarine environment. It is exposed in the hills and ridges bordering the Mandalong Valley.

Terrigal Formation

The Terrigal Formation overlies the Patonga Claystone and consists of medium to coarse grained sandstone, rare conglomerate and sporadic grey, and rarely red, shale. Where not affected by erosion, it is up to 200 metres thick and was deposited in a braided alluvial environment. Only erosional remnants of the Terrigal Formation occur on ridge tops west and north of the Mandalong Valley.

3.2.5 Mandalong Valley Geomorphology

Erosion of the Mandalong Valley has exposed sedimentary rocks of the uppermost three formations of the Narrabeen Group. These are Terrigal Formation, Patonga Claystone and Tuggerah Formation (see **Figure 3.3**).

Terrigal Formation sandstones form cliffs on the crests of ridges to the west and southwest of Mandalong Valley. Below the cliffs, moderate slopes have developed by the erosion of the softer claystones of the Patonga Claystone. Interbedded sandstones and shales of the Tuggerah Formation outcrop on the lower slopes and in creeks.

Munmorah Conglomerate and Dooralong Shale do not outcrop in the Mandalong Valley. Further to the east, near Morisset, the Munmorah Conglomerate is exposed at the surface.

3.2.6 Characteristics of Alluvium

Creeks draining Mandalong Valley flow northeast into Dora Creek and subsequently to Lake Macquarie. Over long periods of time these creeks have eroded Narrabeen Group rocks and carried their bedload of sand and silt towards the sea. Changes in sea level have accelerated erosion during falling sea level or, conversely, led to accumulation of alluvium within the valley during rising sea level. Thus, the alluvial deposition in the valley (see **Figure 3.4**) is linked to the estuarine system of Lake Macquarie and was controlled by changes in sea level.

Alluvium material is derived from erosion of the rocks exposed in the catchment of Mandalong Valley. These rocks are quartz-lithic sandstones, claystones and siltstones of the Terrigal Formation, Patonga Claystone and Tuggerah Formation. The Tuggerah Formation forms the basement for the alluvium.

Samples for assessing alluvial thickness were obtained from diamond drill holes and 14 auger holes that were specifically drilled to examine alluvium characteristics in the Mandalong Valley. The locations of the auger holes is shown on **Figure 3.3**. Geophysical logs of diamond drill holes that were drilled as part of the coal exploration program were also used to determine the thickness of alluvium.

In the Mandalong Valley, alluvium has a thickness of about 20 metres (PCG1 and PGW2 in **Table 3.2**) in the vicinity of the Deaves Road/Mandalong Road intersection, and decreases gradually upstream (see **Figure 3.4**).

The alluvium generally consists of a thick clay layer (approximately 5 to 10 metres thick) at the top overlying silty sand which can be as little as 2 metres thick or as much as 8 metres thick. In some areas the upper clay layer contains one or two thin (less than 1 metre) sand layers (see **Figure 3.4**).

Auger drilling showed that the sand is generally poorly sorted with a high proportion of silt and clay. It is rarely a "clean" sand. Usually, it is saturated with water and has poor cohesion.

Table 3.2 - Thickness of Alluvium

Auger/Drill Hole	Thickness of Alluvium (m)
PGW1	12.2
PGW2	19.5
PGW3	12.2
PGW4	10.7
PGW5	>10.4
PGW6	10.4
PGW7	15.4
PGW8	16.7
PGW9	9.1
PGW10	12.5
PGW11	14.3
PGW12	14.6
PGW13	10.0
PGW14	10.0
PCG1	19.5#
PCG2	16#
PCG3	10#
PCG5	2*
PCG19	4.5#
PCG20	14#
PCG22	14#
PCG23	14#
PCG25	8#
PCG28	12#
PCG35	14#
PCG48	15.5*
PCG53	22.5*

PGW *Augured Holes*
PCG *Diamond Drill holes*
\# *Alluvium interpreted from geophysical logs.*
* *Alluvium identified in chip samples.*

Acid Sulphate Soil Potential

In order to assess the potential for acid sulphate soils in the Mandalong area, pH tests were performed on the top 2 to 3 metres of sediment in the lower part of the valley and results are presented in **Table 3.3**.

Sediment samples tested were obtained from auger holes drilled during the alluvium testing program undertaken for the project at sites PGW 1, 2, 3, 5 and 7 (see **Figure 3.3**).

The top metre of sediment, consisting of light to dark grey clay with orange mottling, had a pH of 4.5 to 5. From 1 to 3 metres depth, sediment varied between clay, silt and silty sand and pH ranged from 5 to 6. Below 3 metres depth, pH ranged from 5.5 to 7.5 (see PGW 2 and PGW 7 in **Table 3.3**). All sediments to a depth of 7 metres contained orange iron oxide mottling, which indicates oxidation and fluctuating water tables.

The pH results indicate that no actual acid sulphate soils occur in the area (actual acid sulphate soil should have a pH of less than 4.0). The presence of orange mottling in the top 7 metres of the alluvium suggests that the water table has fluctuated within the top 7 metres, allowing oxidation to proceed. Therefore it is considered that no potential acid sulphate soils will exist in the oxidised zone.

Table 3.3 - pH Testing of Alluvium

Bore No	Depth (m)	pH
PGW 1	0.6 - 1.0	5.0
	1.0 - 2.0	5.5
	2.0 - 3.0	6.0
PGW2	0.5 - 1.0	4.5
	2.0 - 2.5	5.0
	2.5 - 3.0	5.0
	3.0 - 4.0	6.0
	4.0 - 4.6	5.5
	5.5 - 7.0	5.5
PGW 3	0.9 - 1.2	4.5
	1.2 - 1.5	5.5
	1.5 - 2.1	5.5
PGW5	0.6 - 1.8	4.5
	1.8 - 3.0	4.5
	3.0 - 3.6	5.0
PGW7	1.8 - 2.7	6.0
	2.7 - 3.6	6.0
	4.6 - 5.5	6.0
	6.4 - 7.3	6.5
	7.3 - 9.1	7.5
	9.1 - 11.0	6.5
	11.9 - 12.6	6.0

3.3 SOILS

3.3.1 Areas 1 and 2

In the proposed mining areas west of Morisset, six soil landscape units have been defined and mapped at 1:100000 scale by the Department of Conservation and Land Management (Murphy 1993 and Murphy & Tille 1993).

Soil landscapes have recognisable and specifiable topographies and soils which are generically linked to their underlying bedrock. In this area, bedrock consists of sedimentary rocks of the Narrabeen Group (see **Table 3.4**). Soils occurring on the rolling to very steep forested hills on the western half of the area have been mapped as the Mandalong and Watagan Soil Landscapes. Parent material for these soils consists mostly of colluvial mass movement debris including scree and talus along with other landslide, mudflow and creep deposits derived from the sandstone and claystone bedrock. Distribution of soils in the proposed mining areas and Mine Access Site are shown on **Figure 3.5**.

Table 3.4 - Surface Geology of Proposed Mining Area

Age	Group	Subgroup	Formation	Rock Types	Soil Landscape
Quaternary				Unconsolidated sediments - sand, silt, gravel, clay	Wyong and Yarramalong
Early Triassic	Narrabeen	Gosford	Terrigal Formation	Medium to coarse quartz-lithic sandstone with grey shales	Watagan
		Clifton	Patonga Claystone	Red claystone, some fine to medium sandstone	Mandalong
			Tuggerah Formation	Lithic sandstone with red and green claystones	Watagan on steep slopes, Gorokan and Woodburys Bridge on gentler slopes

The lower, more gentle slopes of these forested hills are mapped as Gorokan Soil Landscape. This erosional landscape has been primarily sculpted by the erosive action of running water and generally lacks evidence of mass movement. It is developed on interbedded sandstones and shales of the Tuggerah Formation.

Gentle slopes in the southeastern part of the proposed mining area comprise the Woodburys Bridge Soil Landscape. These residual soils have developed on fine grained sandstones and shales of the Tuggerah Formation.

Two alluvial soil landscapes have been identified in the proposed mining area. The Wyong Soil Landscape is the most widespread of these, occupying the valley floors and alluvial flats associated with Stockton and Morans Creeks and their tributaries. A small area of Yarramalong Soil Landscape occurs in the southwestern corner of the area, in the upper reaches of Morans Creek. The features of each soil landscape are summarised in **Table 3.5**.

Soil landscape mapping at a scale of 1:100000 provides an overall assessment of soil types within the study area. However, detailed assessment of areas subject to significant disturbance (such as surface works, haul road and coal emplacement facility) is necessary to ascertain specific soil types, and suitability of topsoil for stockpiling and revegetation.

The main surface effect of underground coal mining is subsidence and its potential to alter drainage lines and areas subject to flooding. The alluvial flats have the potential to be the areas most affected by subsidence for two reasons:

1. Existing low gradients of the area could lead to changes in areas prone to waterlogging, whereas areas of steeper gradient will not.

2. Differential subsidence may lead to erosion of new creek channels.

Consequently, detailed assessment of alluvial soils is warranted, especially in terms of their erodibility and dispersibility.

Detailed transects to explore the surface soil across the alluvial flats were undertaken across the Stockton Creek and Morans Creek valleys within the study area (see **Figure 3.5**). Transects were chosen to provide a wide cross-section of alluvial soils as well as representative samples of the other soil landscapes.

Holes were hand-augured up to 80 cm into the surface soil at intervals of approximately 200 to 300 metres along each transect. The soil profiles were described using standard soil survey forms. Samples of the topsoil (A horizon) and subsoil (B horizon) were collected for further analysis. Characteristics of soils at depths greater than 80 cm were determined as part of the alluvium testing program and are detailed in **Section 3.2.2**.

Soils studied along the transects generally confirmed the soil landscape mapping of Murphy & Tille (1993).

<u>Wyong Soil Landscape</u>

The alluvial Wyong Soil Landscape covers the broad, poorly drained floodplain of the Mandalong Valley. Slope gradients are less than 2% and relief is less than 10 metres. Meander scrolls, oxbows and swamps are common.

Alluvial soils sampled on transects (see **Figure 3.5**) within the Wyong Soil Landscape ranged from Yellow Podzolic Soils (Dy 3.22, Dy 3.51, Dy 3.11) to Structured Loam (Um 6), Yellow Earths (Gn 2.41) and Grey Earths (Gn 2.81, Gn 2.82).

The topsoil (A horizon) varied from sandy loam to clay loam to silty clay loam while the subsoil (B horizons) ranged from sandy clay loam and sandy clay to medium clay and heavy clay.

Table 3.5 - Features of Soil Landscapes (after Murphy 1993)

Symbol	Name	Description	Local Relief	Slope Gradient	Vegetation	Soil Types	Limitations
ml	Mandalong Soil Landscape	Colluvial landscape. Rolling to steep low hills on Patonga Claystone in the Watagan Mountains. Narrow crests and ridges, short steep slopes and narrow closely spaced drainage lines.	to 120 m	20-60%	Regenerating tall open forest	Moderately deep to deep (100 - >150 cm). Red, Brown and Yellow Podzolic Soils on claystones. Shallow to moderately deep (<50 - 150 cm) Yellow Podzolic Soils on sandstones; clays or rock outcrops along drainage lines.	Mass movement hazard; steep slopes; erosion hazard; foundation hazard; low wet bearing strength; acid; low fertility; sodic.
wn	Watagan Soil Landscape	Colluvial landscape. Rolling to very steep hills on fine grained Narrabeen Group sediments. Narrow convex crests and ridges, steep colluvial sideslopes, occasional sandstone boulders and benches. Predominantly uncleared tall eucalypt.	50 - 220 m	>25%	Predominantly uncleared tall eucalypt open forest with closed forest in sheltered positions.	Very complex: includes shallow (<50 cm) Lithosols/Siliceous Sands and Yellow Earths on coarse sandstones; shallow to deep (<50 - >150 cm) Yellow and some Red Podzolic Soils on fine grained bedrock; deep (>150 cm) sandstone colluvial deposits; Yellow Earths, Yellow Podzolic Soils and Siliceous Sands and Alluvial Soils along drainage lines.	Mass movement hazard; steep slopes; soil erosion hazard; foundation hazard; occasional rock outcrop; localised seasonal waterlogging.
gk	Gorokan Soil Landscape	Erosional landscape. Undulating low hills and rises on lithic sandstones of the Tuggerah Fm. Broad crests and ridges, long gently inclined slopes and broad drainage lines.	<30 m	<15%	Partially cleared low open forest.	Moderately deep (50 - 150 cm) Soloths and Yellow Podzolic Soils on ridges and crests; Soloths, Yellow Podzolic and Grey-Brown Podzolic Soils on slopes; Gleyed Podzolic Soils along drainage lines.	Very high erosion hazard; localised foundation hazard; seasonal waterlogging; hardsetting; strongly acid; low fertility; plastic; impermeable.
wo	Woodburys Bridge Soil Landscape	Residual soil landscape. Gently undulating rises to rolling low hills on fine grained sedimentary rocks of the Narrabeen Group.	40-80 m	<20%	Mainly cleared tall open forest.	Deep (>150 cm) Red Podzolic Soils with some Soloths in poorly drained areas on claystone bedrock; shallow to moderately deep (50 to 150 cm) Yellow Podzolic Soils on sandstone bedrock.	Extreme erosion hazard, high foundation hazard, localised seasonal waterlogging; acid soils of very low fertility; low wet-bearing strengths and high erodibility.
wy	Wyong Soil Landscape	Alluvial landscape. Broad, poorly drained floodplains and alluvial flats of Quaternary sediments. Meander scrolls, oxbows and swamps are common.	<10 m	<3%	Extensively cleared open forest.	Deep (>200 cm) Yellow and Brown Podzolic Soils, Soloths, with some Humus Podzols around lake edges.	Flooding; seasonal waterlogging; foundation hazard; localised permanent waterlogging; localised stream bank erosion; localised acid sulphate potential; strongly acid; poorly drained; impermeable; very low fertility; saline subsoils.
Ya	Yarramalong Soil Landscape	Alluvial landscape. Level to gently undulating dissected alluvial plain on Quaternary sediments: includes meander scrolls, terraces, oxbows and backswamps.	<10 m	<5%	Extensively cleared tall open forest.	Deep (>200 cm) Alluvial Soils and Siliceous Sands in upper reaches; Deep (>150 cm) Alluvial Soils and Red Earths along levee banks; Deep (>200 cm) Yellow and Brown Podzolic Soils along the backplain; Deep (>200 cm) Alluvial Soils and Yellow Earths on terraces.	Flooding; foundation hazard; seasonal waterlogging; stream bank erosion; low fertility.

The topsoil was strongly acid with a pH of 5.5 while the subsoil was slightly acid with a pH of 6.0 to 6.5, except for soil profile PC 30 where the topsoil was very strongly acid with a pH of 5.0 and the subsoil was neutral to moderately alkaline with pH values of 7.0 and 8.0.

Topsoil was generally very dark greyish brown with colour varying from black to brown, depending on the amount of organic matter present. Roots were common but charcoal and rock fragments were absent. Surface condition was generally hardsetting but can be friable. Depth to the subsoil was 15 to 60 cm. Total soil depth is in excess of 200 cm (Murphy 1993).

Subsoil was generally mottled grey, yellowish brown or greyish brown and was more clayey than the topsoil. Distinct orange mottles were common. Roots were few, while charcoal and stone fragments were absent.

Creek banks are subject to undercutting, especially on the outside curves of meanders, where minor slumping of creek banks occurs.

Soils of the Wyong Soil Landscape have low fertility and moderate erodibility. The landscape is poorly drained and seasonal waterlogging is common.

Gorokan Soil Landscape

Gorokan Soil Landscape is an erosional landscape occurring on undulating low hills and rises on lithic sandstone and shales of the Tuggerah Formation. In the western part of the area the Gorokan Soil Landscape occurs on footslopes of the Watagan Ranges, while in the eastern part of the area the landscape unit covers broader slopes and rises. Local relief is generally less than 30 metres and slope gradients are less than 20%. Topography consists of broad crests and ridges with long, gently inclined slopes and broad drainage lines. Soils of the Gorokan Soil Landscape have low fertility and are low in organic matter. Their erodibility is moderate to very high.

Soils occurring on steep slopes and flat crests within the Gorokan Soil Landscape were investigated at four sites. All soils were Yellow Podzolic Soils (Dy 3.11, Dy 3.21 and Dy 5.21). Topsoil ranged from sandy loam to fine sandy loam to light sandy clay loam to sandy clay loam with the more clayey topsoils occurring on farming areas exposed to intensive animal use.

Topsoil (A horizons) is very dark greyish brown to dark brown (10 YR 3/2 to 7.5 YR 3/2), and 5 to 30 cm thick. Topsoil is very strongly acid to moderately acid (pH 4.5 to 6.0).

Where steep slopes have been cleared, such as for tracks, minor sheet erosion and gullying along tracks exists.

The subsoil (B horizons) is generally sandy clay, mottled brown to yellowish brown with distinct orange mottles. Fragments of weathered bedrock were encountered in two holes where the soil profiles were less than 60 cm thick.

Murphy (1993, p 55) found total soil depth ranged from 50 cm to more than 150 cm. The subsoil pH ranged from strongly acid (pH 5.5) to slightly acid (pH 6.5).

Watagan Soil Landscape

The Watagan Soil Landscape is generally located upslope of Gorokan Soil Landscape Units (see **Figure 3.5**). This soil landscape was investigated at one ridge crest site (PC 23) where a thin Yellow Podzolic (Dy 2.11) soil was developed.

The 10 cm thick topsoil consisted of brown (7.5 YR 4/3) clayey sand and was underlain by brown (10 YR 5/3) to light brownish grey (2.5 Y 6/2) medium clay to a depth of at least 38 cm. The topsoil peds were lenticular while subsoil peds were subangular and blocky. Topsoil was strongly acid (pH 5.5) while subsoil was very strongly acid (pH 4.5 to 5.0). Boulders of iron stained quartz lithic sandstone were common in the vicinity.

Murphy (1993, p 41) noted that soils in the Watagan Soil Landscape are very complex and include Shallow Lithosols, Yellow Earths, Yellow Podzolic Soils and some Red Podzolic Soils, depending on the underlying bedrock and topographic location. The soils have moderate to low fertility and generally moderate erodibility.

Seven topsoil samples (A horizons) and four subsoil samples (B horizons) were taken from 5 sites in the Wyong Soil Landscape. The samples were analysed for:

- Particle Size Analysis: to determine the range and proportion of grain sizes present;
- Dispersion Percentage: this test estimates the proportion of clay material that is easily dispersed in water after end-over-end shaking. It gives an indication of how the soil would disperse if its natural soil structure were broken down by machinery;
- Emerson Aggregate Test (EAT): an indication of potential dispersibility of undisturbed soil;
- Volume Expansion: an assessment of shrink/swell capacity;
- Unified Soil Classification System (USCS): an engineering classification defining suitability for use in earthworks and roads;
- pH: a measure of soil acidity or alkalinity;
- Electrical Conductivity (EC): a measure of the salinity of the soil.

Results are presented in **Table 3.6**.

Table 3.6 - Laboratory Results for Alluvial Soils

Sample	Lower Depth (m)	Particle Size Analysis (%)					Dispersion (%)		Emerson Aggregate Test		Volume Expansion (%)		Unified Soil Classification System		pH		EC (ds/m)
		Clay	Silt	Fine Sand	Coarse Sand	Gravel			EAT	Potential Dispersibility			USCS	Slope Stability			
TOPSOILS																	
PC20A1	0.40	15	29	50	6	<1	46	moderate	3(3)	moderate	2	low	ML-CL	poor-good	4.6	mod acid	0.09
PC22A1	0.30	17	25	50	8	0	32	moderate	3(1)	slight	10	low	ML-CL	poor-good	4.2	strongly acid	0.07
PC22A2	0.70+	16	20	54	10	0	43	moderate	3(2)	slight	15	low	ML-CL	poor-good	4.9	mod acid	0.07
PC24A	0.50	11	11	56	22	<1	44	moderate	5	slight	10	low	ML	poor	4.3	strongly acid	0.05
PC27A1	0.25	7	7	32	52	2	55	high	8/3(1)	slight	1	low	SM	average	4.1	strongly acid	0.04
PC27A2	0.43	8	8	29	53	2	77	V high	3(2)	slight	2	low	SM	average	4.4	strongly acid	0.04
PC30A1	0.35	16	31	49	4	0	40	moderate	3(1)	slight	3	low	ML	poor	4.7	mod acid	0.40
SUBSOILS																	
PC20B	0.80	21	22	54	3	0	93	V high	2(3)	very high	<1	low	CL	good	5.0	mod acid	0.36
PC24B	0.80+	15	10	66	9	0	89	V high	2(2)	high	12	low	ML-CL	poor-good	5.4	mod acid	0.12
PC27B	0.55	29	5	18	48	<1	39	moderate	3(1)	slight	28	mod	SC	average	4.3	strongly acid	0.06
PC30B2	0.80+	20	24	54	2	0	100	V high	2(2)	high	2	low	CL	good	7.5	neutral	0.29

Topsoil, including all A horizons, has a minimum thickness of 35 cm and a maximum thickness of more than 70 cm. When mechanically worked, it generally has a moderate dispersion (<50%) although two samples showed a high dispersion (>50%). However, nearly all topsoil samples showed only slight potential dispersibility for unworked soils - ie, in their natural state, these topsoils have only a slight potential to disperse in water. Emerson Aggregate Test results indicate that all topsoil samples would be suitable for soil conservation earthworks.

Volume expansion (VE) (or shrink/swell capacity) is useful in terms of assessing suitability for foundations. Volume Expansion measures the free swelling of a disturbed soil on wetting from air dry to saturated. Soils with a volume expansion of 20 – 40% indicate a large potential expansion on wetting and subsequent shrinking on drying and place limitations on the use of such soil as foundations for earthworks and small buildings. These test results show a generally low volume expansion of 15% or less.

The USCS categories suggest these topsoils have a range of slope stabilities from poor to good.

All soils were strongly to moderately acid and had low electrical conductivity indicating low salinity.

3.3.2 Mine Access Site

Most of the Mine Access Site is covered by Yellow Podzolic Soils and Lithosols developed on sedimentary rocks of the Tuggerah Formation. It is part of the Gorokan Soil Landscape. In the southwestern corner of the area, the Yellow Podzolic Soil is overlain by a thin (14 cm) alluvial soil.

Part of the area is disturbed ground where RTA stockpiles of road building materials occur.

The northern part of the area is covered by alluvial soils (Gn 3.91) of the Wyong Soil Landscape.

Topsoils range from sandy loam to sandy clay loam and are 45 to 65 cm thick. They are very strongly acid to strongly acid (pH 4.3 to 5.2). Subsoils range from sandy clay to heavy clay and are strongly acid (pH 4.5 to 5.5).

Eight soil samples from three locations in the Mine Access Site were assessed in the DLWC Scone Research Laboratory for dispersibility and suitability for topdressing purposes. Results are presented in **Table 3.7**. Dispersibility potential can be assessed from the Emerson Aggregate Test (EAT) which measures the structural stability of soil aggregates when immersed in water. The significance of the EAT classes is shown in **Table 3.8**.

Table 3.7 - Analytical Results for Samples from Proposed Mine Access Site

Sample	Texture	pH	EAT	EC (dS/m)	Dispersibility Potential	ECe (dS/m)
PC 2A1	sandy loam	4.5	3(1)	0.05	Slight	0.55
PC 2A2	sandy loam	4.6	3(1)	0.04	Slight	0.44
PC 3A1	loam	4.3	3(1)	0.05	Slight	0.50
PC 3A2	sandy clay loam	4.8	3(2)	0.05	Slight	0.50
PC 3B	light clay	4.5	5	0.06	Slight	0.54
PC 8A1 & A2	clay loam	5.2	3(1)	0.10	Slight	0.90
PC 8A3	clay loam	5.0	3(2)	0.10	Slight	0.90
PC 8B1 & B2	heavy clay	4.7	2(1)	0.21	high to moderate	1.26

EAT – Emerson Aggregate Test
EC – Electrical Conductivity of soil:water suspension
Ece – Calculated electrical conductivity of saturated extract

Table 3.8 - Dispersibility Potential

Emerson Aggregate Class	Dispersibility Potential	Significance for Surface Works
1 & 2(3), 2(4) 2(2) 2(1)	Very high High High to moderate	• low structural strength when wet • prone to erosion when disturbed • prone to compaction by heavy traffic
3(4) & 3(3) 3(2), 3(1) & 5 6, 7, 8	Moderate Slight Negligible/Aggregated	• maintains suitable structural strength when wet • generally suitable for wet weather operations • slightly dispersible once disturbed by construction activities

Source: Adapted from Charman (1978) by ERM Mitchell McCotter (1995)

Laboratory results for samples from the proposed Mine Access Site (see **Table 3.7**) show that most samples have only a slight potential for dispersibility. The only sample to show high to moderate dispersibility potential is from the B horizon, 46 cm below the surface at site PC 8. If this soil is disturbed during construction of surface works, suitable erosion control measures will need to be implemented (see **Section 4.2.1**).

Texture, pH and electrical conductivity (EC) readings show that the topsoil is generally moderately acid loam. These characteristics suggest that these soils may be susceptible to acid soil infertility with toxic levels of aluminium and/or deficiencies of calcium and molybdenum. Whilst many native species are tolerant of acid conditions, less tolerant species used during revegetation of these soils may require applications of lime or dolomite and certain fertilisers to raise the pH to a satisfactory level.

3.3.3 Haul Road and Emplacement Area

The proposed haul road alignment from Cooranbong Colliery to the existing private haul road from Newstan Colliery to Eraring Power Station traverses the Doyalson Soil Landscape for most of its length. Only the proposed bridge over the Main Northern Railway, which will connect the two haul roads, is located on the Awaba Soil Landscape.

The Doyalson Soil Landscape occurs on gently undulating hills on Munmorah Conglomerate, which consists mainly of pebble conglomerate interbedded with sandstone and minor siltstone and claystone. Soil types within the landscape vary according to the underlying rock type and topographic location.

On sandstones and conglomerates, moderately deep Yellow Earths, Yellow Podzolic Soils and Soloths occur. On fine-grained siltstones and claystone, moderately deep Yellow Podzolic Soils, Soloths and some Red Podzolic Soils occur. Along drainage lines, moderately deep to deep Yellow Leached Earths, Grey Earths, Soloths and Gleyed Podzolic Soils occur.

Fertility of soil materials in the Doyalson Soil Landscape is generally very low. The soils are gravelly, strongly acid, sodic, have little organic matter, low nutrient status, low available water holding capacity and high potential aluminium toxicity. Soil volumes for root penetration are often limited on crests, ridges and upper slopes. The soils have moderate to high erodibility. (Murphy 1993)

The Awaba Soil Landscape occurs on steeper slopes than the Doyalson Soil Landscape but on similar coarse-grained sedimentary rocks. On the steep slopes bordering the Main Northern Railway where the bridge to link the proposed and existing haul roads will be built, shallow Lithosols occur.

Soil erodibility for soils in both the Doyalson and Awaba Soil Landscapes is moderate to high. Moderate sheet and rill erosion has occurred in the Awaba Soil Landscape where vegetation has been disturbed.

3.4 CLIMATE

3.4.1 Temperature, Humidity, Rainfall and Evaporation

Average monthly evaporation for Williamtown is summarised in **Table 3.9**.

Table 3.9 - Mean Monthly Pan Evaporation (Williamtown) (mm/day)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.8	6.2	4.8	3.8	2.6	2.5	2.7	3.5	4.6	5.4	6.4	7.6

Table 3.10 presents Bureau of Meteorology temperature, humidity and rainfall data for Rathmines, northeast of Cooranbong Colliery (Bureau of Meteorology, 1988). Temperature and humidity data consist of monthly averages of 9.00 am and 3.00 pm readings. Also presented are monthly averages of maximum and minimum temperatures. Rainfall data presented include mean and median monthly rainfall and the average number of rain days per month.

From temperature data recorded over 9 years, the annual average maximum and minimum temperatures experienced are 22.3°C and 12.4°C. January and February are the hottest months with an average maximum temperature of 26.4°C. July is the coldest month, with an average minimum temperature of 6.4°C.

The annual average humidity reading from 9 years of data collected at 9.00 am is 67%, and 58% at 3.00 pm. The month with the highest humidity on average is June with a 9.00 am average of 74%, and the lowest is October with a 3.00 pm average of 47%.

Rainfall data collected over 10 years at Rathmines show that June is the wettest month, with an average rainfall of 166 mm over 15 days. The average annual rainfall is 1154 mm with an average of 155 rain days.

Rainfall data collected by Mr A Mort of Browns Road (see **Table 3.10**), Mandalong, indicate that rainfall distribution and annual rainfall received in the Mandalong Valley is similar to that of Rathmines.

Table 3.10 - Temperature, humidity and rainfall data for Rathmines
(Station Number 061063 latitude 33 deg 3 min s longitude 151 deg 36 min e elevation 9.0 m)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
9 am Mean Temperatures and Relative Humidity (%) (10 years of record)													
Dry-bulb	23.0	23.0	21.5	18.3	15.6	12.8	11.7	13.3	16.0	19.0	21.1	22.7	18.2
Wet-bulb	19.2	19.8	18.5	15.4	13.0	10.6	9.3	10.1	12.2	14.3	16.6	18.2	14.8
Humidity	68	73	73	72	73	74	71	64	61	57	61	62	67
3 pm Mean Temperatures and Mean Relative Humidity (%) (9 Years of record)													
Dry-bulb	24.3	24.7	23.4	21.2	19.2	16.6	16.4	17.3	19.0	21.5	22.4	24.0	20.8
Wet-bulb	19.8	20.7	19.4	16.8	14.8	12.8	11.7	12.0	13.4	14.2	17.4	18.8	16.1
Humidity	64	68	67	62	60	62	53	49	49	47	58	58	58
Daily Maximum Temperature (9 Years of record)													
Mean	26.4	26.4	24.9	22.4	20.2	17.5	17.3	18.7	20.4	23.1	24.4	25.9	22.3
86 Percentile	31.4	31.5	28.2	25.7	23.2	20.1	19.7	22.3	25.6	28.9	30.9	32.2	
14 Percentile	22.1	22.3	21.7	19.3	17.2	15.4	14.5	15.1	16.5	17.3	19.3	21.0	
Daily Minimum Temperature (9 Years of record)													
Mean	17.8	18.1	16.4	12.9	10.2	8.2	6.4	7.2	9.2	11.8	14.5	16.6	12.4
86 Percentile	20.9	20.8	19.2	15.8	13.8	12.1	10.1	10.4	12.7	15.6	18.1	19.6	
14 Percentile	14.7	15.0	13.3	9.4	6.8	4.3	2.7	4.1	6.1	7.9	10.8	13.8	
Rainfall (mm) (10 Years of record) (Rathmines)													
Mean	95	112	117	119	112	166	68	58	74	59	78	86	1154
Median	65	79	94	92	92	97	55	40	40	49	71	70	1063
Raindays (Number) (10 Years of record) (Rathmines)													
Mean	12	12	15	14	15	15	11	12	12	11	14	12	155
Rainfall Browns Rd[1] Mandalong	**149**	**142**	**126**	**131**	**84**	**101**	**59**	**57**	**68**	**54**	**118**	**99**	**1188**

Source - Bureau of Meteorology (1988)
- [1] *Mr A Mort, resident in Browns Road, Mandalong, 1997 (Mean Values for 13 years of record).*

3.4.2 Wind Speed and Direction

Pacific Power records wind data at Dora Creek at a site approximately 2 km south of the Cooranbong Colliery. This data has been used to prepare wind roses (**Figure 3.6**) showing the pattern of winds in the area. It can be seen that on an annual basis the dominant winds are from the western sector. This is true of wind patterns in autumn, winter and spring, while winds from the southeast predominate in summer.

The speed of the wind is an important factor in determining the quantity of wind erosion dust that is generated. The critical parameter is the percentage of time that the wind speed spends above 5.4 m/s. For the Dora Creek data set 1.2% of winds are above 5.4 m/s and the annual average wind speed is 1.7 m/s.

3.5 HYDROLOGY

3.5.1 Drainage System

Proposed Mining Area and Mine Access Site

The majority of the proposed mining area is located within the Stockton/Morans Creek drainage system (see **Figure 3.7a**), which has a catchment area upstream of the eastern boundary of the proposed mining lease (MLA 88), of approximately 4913 hectares. The drainage system conveys runoff from the Watagan Mountains and Mandalong Valley to Dora Creek, which drains to Lake Macquarie. Dora Creek has a catchment area of approximately 19600 hectares and is one of the major tributaries of Lake Macquarie.

Proposed Mining Areas 1 and 2 underlie approximately 1470 hectares of Stockton Creek/Morans Creek catchment. Approximately 148 hectares of Area 1 lies outside of the Stockton Creek drainage system. Approximately 142 hectares of this area drains directly to Dora Creek and the remaining 6 hectares drains to Dora Creek via Burnt Bridge Creek. The proposed Mine Access Site also forms part of the Stockton Creek drainage system.

The remainder of Mining Area 2 drains to Lake Macquarie via a number of intermittent creeks and drainage lines which form tributaries of Pourmalong Creek and Wyee Creek. At the eastern downstream boundary of MLA 88 Pourmalong Creek has a catchment area of 288 hectares of which approximately 171 hectares is located within Area 2. Wyee Creek has a catchment area of 144 hectares at the downstream boundary of MLA 88. Approximately 2 hectares of proposed Mining Area 2 is located within Wyee Creek catchment.

Subcatchment areas for the Stockton Creek drainage system upstream of the eastern boundary of the MLA 88 and respective proportions of each of the subcatchments within proposed Mining Areas 1 and 2 are provided in **Table 3.11**.

Table 3.11 – Subcatchment Areas and Peak Discharges

Subcatchment	Receiving Water	Total Subcatchment Area (Ha)	Catchment Area Within Proposed Mining (Ha)
Part Dora Creek	Dora Creek	867	142
Burnt Bridge Creek	Dora Creek	763	6
Stockton Ck at Freemans Drive	Dora Creek	5335	1470
Stockton Ck at Freeway	-	4913	1470
Stockton Ck at Deaves Rd	-	2241	-
Morans Ck	Stockton Ck	2284	490
Tobins Ck	Stockton Ck	676	294
Sawpit Ck	Stockton Ck	570	74

Note: At the downstream areas, especially east of Browns Road, Stockton Creek and Morans Creek catchments merge together during bigger storm events (such as 1 in 100 year ARI) when Mandalong Road is overtopped.

The Stockton Creek system typically does not exhibit a well defined channel system with creek lines giving way to undefined overland flow paths in several areas. Generally the hydraulic capacity of the existing channel system is low. Modelling undertaken for this project indicates that the majority of the channel system has only sufficient capacity to convey minor flood events (ie. Average Recurrence Interval (ARI) of less than 1 in 1 year). Typical channel dimensions and bed slopes for the Stockton Creek and Morans Creek drainage systems are listed in **Table 3.12.**

Table 3.12 – Subcatchment and Channel Characteristics

Subcatchment Section	Average Subcatchment Slope (%)	Average Channel Bed Slope (%)	Typical Valley Width (m)	Typical Channel Width (m)	Typical Channel Depth (m)
Stockton Ck Upper Reach	4.2 to 9.6	0.52	570	5-15	1.0-1.7
Stockton Ck Middle Reach	2.1 to 4.1	0.31	800	7.5-25	1.0-2.0
Stockton Ck Lower Reach	0.33 to 1.3	0.23	500	40-50	3.0-5.0
Morans Ck Upper Reach	3.5 to 7.6	0.45	370	5-20	1.0-2.0
Morans Ck Middle Reach	1.91 to 2.95	0.25	650	7-25	1.0-2.2
Morans Ck Lower Reach	0.8 to 1.0	0.31	400	12-35	1.0-4.0
Tobins Ck	1.3 to 3.7	0.41	280	7.5-20	0.6-2.0
Sawpit Ck	3.6 to 6.4	0.44	300	7.5-20	0.7-1.0

As a result of the relatively flat nature of the valley floor and poorly define drainage system, significant tracts of the floodplain are subject to prolonged periods of waterlogging. Over the past few decades the drainage characteristics of the surface have been modified in many places through changes to the road network, modification of vegetation types and drainage works on individual properties.

3.5.2 Flooding Regime

The catchments of Pourmalong Creek and Wyee Creek within proposed Mining Area 2 are elevated above the floodplain and are not subject to significant flooding.

The Mandalong Valley floor which includes part of proposed Mining Areas 1 and 2, is however subject to flooding with significant tracts of the valley floor being inundated even during minor flood events. Since the last recorded significant floods of 1988 and 1989 which flooded extensive tracts of the valley floor, significant changes to the drainage characteristics of the valley have occurred through modifications to Mandalong Road, the culvert at Morans Creek, construction of the F3 Freeway, modifications to drainage channels and pasture improvements. All of these changes have lead to alterations in the flooding regime from that which existed in 1988 and 1989.

There are no stream gauging stations on either Stockton Creek or Morans Creek and no long term pluviometers (rainfall event recorders) in the catchment. No previous studies of flood frequency, flood durations, extent of flooding and flood depths have been undertaken for Stockton and Morans Creek other than those undertaken for this project.

Flood studies of the existing situation have been undertaken as part of the environmental impact assessment program undertaken for the project. These studies included the development and refinement of a One-Dimensional flow model of the catchment using commercially available computer models XP-RAFTS to develop rainfall - runoff relationships for the catchment and HECRAS to determine water surface profiles for flood events with Average Recurrence Intervals ranging from 1 in 1 year to 1 in 100 years. This model was used for preliminary investigation of existing flooding conditions in the valley. To accommodate specific flow and landform characteristics of the valley, a Two-Dimensional hydrodynamic was developed to allow the existing flooding regime and potential impacts of mining to be explored in greater detail. Modelling was undertaken using the RMA suite of Two-Dimensional hydrodynamic models.

The XP-RAFTS, HECRAS and RMA models for the site, were set up and calibrated using:

- rainfall data from Australian Rainfall and Runoff (1987);
- detailed topographic information for the area derived from 5 metre by 5 metre grid spot height information and 0.5 metre contours across the site;

- flooding and flood level information from residents of the valley, Council records and information held by the Department of Land and Water Conservation.

Details on information used to establish the models is provided in **Appendix 3**.

The RMA two-dimensional hydrodynamic model developed for the site was used to explore flow characteristics including peak water height, velocity and depth for 1 in 1 year and 1 in 100 year ARI rainfall events for both steady state and dynamic flow conditions. Based on the steady state modelling, it was found that peak water depths for the 1 in 100 year Average Recurrence Interval rainfall event were typically only approximately 300 mm deeper than for the 1 in 5 year Average Recurrence Interval rainfall event in the upper and middle sections of the floodplain. At the downstream end of the proposed mining area, the difference in peak water depths between the 1 in 5 year ARI and 1 in 100 year ARI rainfall event increases to approximately 1.0 metre. This is considered to be principally due to the broad and flat nature of the valley in the middle and upper sections providing considerable area to convey flood flows. At the downstream end of the valley during major flood events water is backed from the Dora Creek system and by the F3 Freeway increasing downstream water levels.

Based on the dynamic modelling work undertaken for this study, it is estimated that during a 1 in 1 year ARI rainfall event, runoff will inundate approximately 345 hectares or approximately 43% of the Mandalong Valley floor. The estimated extent of flooding as a result of a 1 in 1 year ARI rainfall event is shown on **Figure 3.7a**.

Based on dynamic modelling undertaken for the study it is estimated that approximately 636 hectares or approximately 80% of the valley floor would be inundated as a result of runoff from a 1 in 100 year ARI rainfall event. The estimated extent of flooding in the Mandalong Valley resulting from a 1 in 100 year ARI rainfall event is shown on **Figure 3.7b**. Under these conditions it is estimated that the ground immediately adjacent to 11 dwellings will be under water. Of these, the floor levels of 2 residences are estimated to be either at water level or under water in these conditions.

3.5.3 Groundwater

Groundwater in Alluvium

Mandalong Valley has been partly filled with alluvium which, in the central part of the valley, generally consists of a basal sand layer overlain by approximately 5 to 10 metres of clay (see **Figure 3.4**). In some areas, particularly in the northeastern part of the valley, the clay is overlain by interbedded sand, silt and clay. The sand layers will have variable porosity and permeability depending on grain size and sorting characteristics. Water will seep into the sands via vertical infiltration from rainfall and lateral infiltration from groundwater moving down the adjacent slopes.

Groundwater in Bedrock

Information on seven licensed water bores occurring within or adjacent to the lease application area is summarised in **Table 3.13**. Bore locations are shown on **Figure 3.8**. Bores 3 and 4 were sunk in alluvium to depths of 18.3 metres and 3.6 metres respectively. Water salinity for these bores was reported as "fair".

The remaining bores were sunk in solid rock to depths ranging from 3.6 to 117.3 metres. Two of these bores tapped a "conglomerate water supply" and one reportedly tapped a "shale water supply". No information on the source of water is given for the remainder.

Water quality for the "conglomerate water supply" is reported as "poor" and "unknown" while the "shale water supply" has a salinity in the range 3001 ppm to 7000 ppm.

Overburden and Interburden

Groundwater characteristics of overburden material and coal seams were determined as part of the geological exploration program undertaken for the development. Results from this testing program are summarised in **Table 3.14**.

As can be seen from **Table 3.14**, permeabilities of overburden material from the Narrabeen Formation recorded by Pacific Power International (1997) range from 1.9×10^{-11} m/s to 3.1×10^{-9} m/s. These low permeabilities correspond with earlier measurements of permeabilities within the Narrabeen Formation (Forster and Enever 1992, Douglas & Partners 1991) and are considered typical. Measured permeabilities of the Wallarah/Great Northern A and B Coal seam range from 2.2×10^{-9} m/s to 8.8×10^{-6} m/s, depending on the level of fracturing and jointing in the seam (Pacific Power International 1997).

Testing undertaken for the project (Pacific Power International 1997), indicates that the permeability of Narrabeen Formation is very low and that no extensive aquifers exist within these strata. Results from the geological exploration program for the project indicate that some higher permeability zones do exist in the Narrabeen Formation, however, these are rare, discontinuous, and are usually the result of sheared or fractured zones in the strata.

Table 3.13 - Groundwater Information

Property Reference No	Bore No	DLWC No	Grid Reference		Portion No	Bore Type	Final Depth (m)	Standing Water Level (m)	Salinity (ppm)	Date Completed	Yield (L/s)	Comments
			Northing	Easting								
			Morisset 1:25000									
Not numbered	GW1	44189	6337640	353380	100	Well	3.60	-	0-500	-	-	Tuggerah Formation
15	GW2	15287	6335820	351290	66	Open bore	44.10	-	3001-7000*	1/9/53	-	Tuggerah Formation
26	GW3	54183	6334950	352810	10	Bore	18.30	-	Fair	1/12/80	-	Alluvium
60	GW4	21578	6334280	355280	21	Spear	3.60	2.40	Fair	1/3/64	0.13	Alluvium
302	GW5	34950	6335260	356860	20	Open bore	76.20	14.90	Poor	1/1/73	0.25	Munmorah Conglomerate
			Dooralong 1:25000									
242	GW6	52255	6333460	356340	(109) Lot 3 DP 555891	Open bore	114.00	8.70	Unknown	1/11/80	0.23	Munmorah Conglomerate
242	GW7	61226	6333460	356340	(109) Lot 3 DP 555891	Bore	117.30	83.00	3001-7000*	1/7/85	0.10	Possibly Dooralong Shale

** Very high salinity water not suitable for irrigation water under ordinary conditions; may be used for livestock with care for limited periods.*

Table 3.14 - Groundwater Characteristics (Overburden and Coal Seam)

Drill Hole & Collar Height (mAHD)	Test No	Stratum Depth below Ground Level (m)	Permeability (m/s)	Depth to Static Water Level (m)	Geologic Description of Stratum
PCG 34	P1	56.9-62.0	3.1×10^{-9}	3.9	Patonga Claystone from Narrabeen Formation. Stratum exhibits crushed reams and slickensided joints.
	P2	142.3-152.9	5.6×10^{-10}	0.6	Munmorah Conglomerate from Narrabeen Formation. Stratum typical of Munmorah Conglomerate comprising Conglomerate and Sandstone.
	P3	190.5-195.5	9.7×10^{-11}	17.6	Dooralong Shale from Narrabeen Formation. Test stratum typically sandstone with open iron oxide stained joints and fractures.
	P4	210.3-220.9	1.5×10^{-10}	5.4	Dooralong Shale from Narrabeen Formation. Test stratum predominantly sandstone and is typical of Dooralong Shales.
	P5	223.1-229.7	2.2×10^{-9}	5.5	5.47 m of Wallarah/Great Northern A and B Coal seam. Vertical fractures evident.
PCG 36	P6	296.9-307.5	1.9×10^{-11}	128.7	Dooralong Shale from Narrabeen Formation. Stratum contains some jointing and other defects.
	P7	318.9-329.5	1.9×10^{-11}	133.4	Dooralong Shale from Narrabeen Formation. Stratum comprises fine and coarse interbedded material.
	P8	349.9-360.5	1.9×10^{-11}	133.8	Dooralong Shale from Narrabeen Formation. Stratum is predominantly sandstone.
	P9	379.7-386.3	4.7×10^{-6} to 8.8×10^{-6}	140.7 to 141.7	Wallarah/Great Northern A and B Coal seam. Stratum contains numerous subvertical fractures and joints.

Source: Pacific Power International (March 1997)

3.5.4 Water Quality

Surface Water

In January 1996, Powercoal began monitoring surface water quality at five sites near the confluence of Stockton and Morans Creeks within MLA 88 and at one site downstream of the lease boundary near Beauty Point. Four additional sites were included in the monitoring program in February 1997. The additional sites enable water quality to be monitored in the upstream reaches of Stockton and Morans Creeks and in tributaries of Pourmalong Creek on the eastern side of the lease application area. Locations of these sites are shown on **Figure 3.8** and analytical results are presented in **Table 3.15**.

Water at Site 1 on Stockton Creek near Beauty Point is not suitable for livestock or irrigation as it is too saline, being influenced by the close proximity of Dora Creek, about 1 km downstream of Site 1.

Site 2 is also affected by the upstream incursion of saline water from Dora Creek and water at this site has Total Dissolved Solids (TDS) in excess of 5000 mg/L for about six months out of each year, making it unsuitable for livestock.

Salinity, as measured by TDS should not exceed 5000 mg/L for good livestock condition (ANZECC 1992) (see **Table 3.15**).

Bed level of the creek system rises upstream of Site 2 such that water quality at Sites 5 and 6 on Stockton and Morans Creeks respectively, and further upstream, is suitable for livestock all year round.

In regard to its suitability for irrigation, surface water at Sites 1 and 2 is unsuitable, being extremely high salinity water (TDS >3500 mg/L). On average, water at Sites 5 and 8 is high salinity (TDS 500 to 1500 mg/L) water which can not be used on soils with restricted drainage. At all other sites, water is medium salinity water (TDS 175 to 500 mg/L) which can be used for irrigation if moderate leaching occurs (ANZECC 1992, Table 5.6).

Values of pH also reflect the influence of saline water from Dora Creek with the pH range at Sites 1 and 2 being 5.3 to 7.6 while at other sites the pH ranges from 5.5 to 6.9 (see **Table 3.15**).

Table 3.15 - Surface Water Quality Monitoring

Site No		pH	TSS (mg/L)	TDS (mg/L)	Specific Cond. (µS/cm)	Chloride (mg/L)	Sulphate (mg/L)	Sodium (mg/L)	K (mg/L)	Iron (mg/L)	Ca (mg/L)	Mg (mg/L)
1	Max	7.6	45	34970	43600	15720	2670	8610	300	1	410	1220
	Min	6.3	3	570	4780	3910	700	2240	95	0.05	120	290
	Ave	7.2	21	17590	21600	9815	1685	5425	197.5	0.53	265	755
2	Max	7.6	57	22440	23300	5100	830	2950	100	3.03	140	390
	Min	5.3	1	230	410	110	20	75	4	0.24	8.8	13
	Ave	6.6	19	5940	9290	2605	425	1512	52	1.63	74.4	201.5
3	Max	6.8	35	700	740	170	23	100	3.8	2.38	8.7	17
	Min	5.5	<1	230	390	90	22	55	3.4	1.36	6.3	10
	Ave	6.1	13.8	410	560	130	22.5	77.5	3.6	1.87	7.5	13.5
4	Max	6.8	30	946	980	210	9.1	120	6.1	2.21	13	26
	Min	5.9	4	230	440	150	6.6	75	5.2	1.96	12	17
	Ave	6.5	15	469	690	180	7.8	97	5.6	2.08	12.5	21.5
5	Max	6.9	30	2580	1750	290	10	160	8.1	3.51	13	30
	Min	6	3	280	450	130	6.9	70	5	1.64	11	15
	Ave	6.4	17	730	950	210	8.4	115	6.6	2.57	12	22.5
6	Max	6.8	35	1530	700	140	25	85	3.9	2.01	6.4	15
	Min	5.6	<1	220	370	100	22	60	3.3	0.63	6	11
	Ave	6.3	17	470	530	120	23.5	70	3.6	1.32	6.2	13
7		6.4	25	250	420	100	11	60	3.6	3.11	9.6	9.7
8	Max	6.9	330	850	1380	150	17	75	4.9	3	11	15
	Min	6.5	20	340	630	-	-	-	-	-	-	-
	Ave	6.7	95	630	1060	-	-	-	-	-	-	-
9	Max	6.8	30	580	750	170	50	100	4	1.08	17	12
	Min	6.3	4	390	680	-	-	-	-	-	-	-
	Ave	6.6	13.5	490	710	-	-	-	-	-	-	-
10	Max	6.8	40	270	370	43	9.5	29	2.6	0.9	17	5.5
	Min	6.0	1	110	220	-	-	-	-	-	-	-
	Ave	6.4	28	200	290	-	-	-	-	-	-	-
11	Max	6.9	85	560	1010	82	14	55	3.5	1.89	4.6	8.8
	Min	6.6	4	275	360	-	-	-	-	-	-	-
	Ave	6.7	28	415	620	-	-	-	-	-	-	-

Note: *Analyses of chloride, sulphate, sodium, potassium, iron, calcium and magnesium carried out 6 monthly.*
Analyses of pH, TSS and TDS carried out monthly.
Specific Conductance analysed irregularly.

Monitoring Record

Sites 1 to 6 - January 1996 to June 1997
Site 8 - January 1996
Sites 8 to 11 - February 1997 to June 1997
(-) Only one record available

Groundwater

Groundwater seeps into dams, creeks, billabongs and wetlands in the Mandalong Valley, maintaining water levels in some areas even during times of drought.

Groundwater levels and quality were monitored in August 1997 at 14 sites in the Mandalong Valley area (see **Figure 3.8** and **Table 3.16**). The height of the groundwater table above sea level generally decreases downstream, reflecting the gradual decline in surface topography towards the northeast.

Water quality is variable with pH ranging from 5.9 to 6.7 and conductivity ranging from 277 µS/cm to 5350 µS/cm (**Table 3.16**). Groundwater quality is suitable for livestock drinking water. However, if used for irrigation, precautions would need to be taken with the water to:

- avoid wetting leaves on hot, dry days (where conductivity is 0 to 800 µS/cm);
- avoid wetting leaves during daytime (where conductivity is 800 to 2300 µS/cm); and
- avoid wetting leaves of most plants where possible (where conductivity is 2300 to 5500 µS/cm).

Table 3.16 - Groundwater Monitoring Results (29 August 1997)

Bore No PGW	Ground RL (mAHD)	Water Level		pH	Temp (°C)	Conductivity (µS/cm)	Salinity for Irrigation
		m below ground	mAHD				
1	6.5	3.29	3.2	6.5	17.9	666	Medium
2	9.0	2.32	6.7	6.5	17.8	1480	High
3	8.5	3.17	5.3	6.7	18.7	637	Medium
4	9.5	0.40	9.1	6.6	16.7	5290	Very high
5	11.0	1.03	10.0	6.5	18.6	881	High
6	12.0	2.66	9.3	6.5	18.3	1750	High
7	13.5	0.62	12.9	6.4	17.2	2520	Very high
8	16.7	1.82	14.9	6.7	17.6	432	Medium
9	17.5	2.24	15.3	6.1	17.4	470	Medium
10	20.5	1.97	18.5	6.32	19.2	776	Medium
11	16.2	0.74	15.5	6.55	18.2	277	Low
12	14.7	0.89	13.8	5.9	17.2	5350	Very high
13	17.2	0.72	16.5	6.7	16.7	2780	Very high
14	16.0	0.76	15.2	6.55	17.1	1670	High

3.5.5 Water Usage

Water usage in the proposed mining area is predominantly from dams and properties holding licences to pump directly from Morans Creek and/or Stockton Creek. Water from Stockton and Morans Creeks is used mainly for livestock and for irrigation in particular areas such as the turf farm on Mandalong Road. Department of Land and Water Conservation records indicate that six licensed bores or wells exist either within the proposed mining area or within the adjacent 1.5 km of the boundary of the proposed mining area. Characteristics of these bores are summarised in **Table 3.13** and locations are shown on **Figure 3.8**.

Of these bores, bore number 34950 (GW5) is located within the current Cooranbong Colliery Mining Lease CCL762 and does not form part of the proposed development area. Bores 44189 (GW1) and 15287 (GW2) are located approximately 160 metres to the north and west respectively of the proposed mining area and as such, are not expected to be impacted upon by the proposed development. Bore numbers 54183 (GW3) and 21578 (GW4) are located within Area 1. Both bores are shallow, penetrating less than 10 metres into the underlying alluvium and rock, and are not expected to be significantly affected by the proposed mining development. Bores 52255 (GW6) and 61226 (GW7) are deep bores and are located within Area 2.

18.2 cf p62

Apart from registered bores, groundwater is drawn from springs and from spring fed dams and wetlands. A survey of landholders living within or immediately adjacent to the proposed Mining Lease application area indicated that approximately 16% of properties utilise water from spring fed dams or springs.

3.6 AIR QUALITY

3.6.1 Air Quality Goals

Preamble

Air quality impacts from dust emissions occur in a number of ways. Firstly there is the potential for dust deposition to soil surfaces such as washing, motor vehicles and the outsides of buildings, and to lead to a build up of sediment in rainwater tanks which collect water from roofs. These are referred to as effects on amenity. These effects would occur in the absence of the mining and it is the extent to which the effects are worsened that determines the acceptability or otherwise of dust emissions from a mine.

Air borne dust also has the potential to cause health effects.

The effects of dust on amenity and health can be assessed by comparing dust deposition rates and dust concentrations with recognised air quality criteria established as a result of research both in New South Wales and overseas. To cover the full range of possible adverse impacts it is necessary to make reference to criteria for both long term (annual averages) and short term (24-hours) periods and for dust within a range of particle sizes.

Discussion regarding air quality in this document, will make reference to three classes of dust, $PM_{2.5}$, PM_{10} and Total Suspended Particulate matter (TSP):

- $PM_{2.5}$ refers to dust in the fine particle size range 0 to 2.5 µm. This dust can be inhaled into the deepest areas of the lung.

- PM_{10} dust relates to particles less than 10 µm aerodynamic size.

- TSP relates to all suspended particles (which are usually in the size range 0 to 50 µm, larger particles settling out too rapidly to be considered a significant air quality issue).

TSP concentration measurements therefore include PM_{10} particles and PM_{10} particles included $PM_{2.5}$ particles. Particles in the $PM_{2.5}$ and PM_{10} size range have recently become the focus of considerable scientific attention because of the strong correlation between excess mortality and fine particle concentration that has been noted in the Six Cities Study recently completed by Dockery et al (1993) in the United States. The correlation is weaker with TSP concentrations, presumably because a substantial fraction of TSP particles are too large to enter the sensitive areas of the respiratory system.

PM_{10} particle concentrations are of interest because these particles can reach the lower parts of the respiratory system by inhalation and can have health impacts as well as nuisance impacts. $PM_{2.5}$ particles are those that show the strongest association with health effects and it is possible that in the future the air quality goals for the protection of human health will be expressed in terms of the concentrations $PM_{2.5}$ rather than PM_{10} or TSP concentrations.

Generally most $PM_{2.5}$ particles are the result of combustion processes in motor vehicles, bushfires and industrial processes. Some $PM_{2.5}$ particles are generated by evaporation of sea-spray and from vegetation. Most mining dust is composed of coarser particles with a tendency to cause nuisance effects rather than threaten human health. Work undertaken on behalf of the SPCC (1986) shows that close to dust sources on open cut mines the mass fraction of the $PM_{2.5}$, and PM_{10} in the TSP fraction of dust is approximately 6% and 40 to 50% respectively.

Short Term Goals

Concentration

In assessing the acceptability of mining projects the New South Wales Environment Protection Authority (EPA) refers to the United States Environmental Protection Agency (US EPA) 24-hour air quality standard of 150 µg/m^3 for particles less than 10 µm (PM_{10}). This concentration should not be exceeded more than once per annum. As discussed above, in the future, goals may be set for $PM_{2.5}$ particles, but at this stage the United States review process for national air quality standards has resolved not to adopt a $PM_{2.5}$ standard and has called for further research to be undertaken before the existing air quality goals are changed. Thus at this stage no goals have been developed for $PM_{2.5}$ particles.

The NSW EPA does not specify any goal concerning acceptable short term concentrations of dust in the ambient air, for periods shorter than 24-hours. This is possibly because until recently there has been no readily available instrumentation to monitor dust concentrations over short averaging periods. (A "best-practical means" approach has been adopted by the EPA to protect the community against the effects of short term nuisance dust). However, quantitative goals would be useful for assessing the significance of nuisance dust concentrations under "episodic conditions". The US EPA provides some guidance in the form of published criteria (as opposed to standards). The US EPA (Stern et al 1984) describe 2-hour exposures to 2000 µg/m³ TSP concentrations as giving rise to "personal discomfort" and 1000 µg/m³ for 10-minutes as causing "direct respiratory mechanical changes". In Japan, a 1-hour TSP concentration of 200 µg/m³ is specified (WA EPA pers comm). It should be noted that this latter goal is more stringent than the US EPA 24-hour primary TSP standard of 260 µg/m³ formerly referred to by the NSW EPA.

US EPA 2h 2000 µg/m³ TSP
10 m 1000 µg/m³

Deposition

There are no air quality criteria for short term dust deposition rates and there is no requirement to develop such goals.

Long Term Goals

Concentration

The EPA refers to the Australian National Health and Medical Research Council (NHMRC) 90 µg/m³ annual average TSP goal when assessing long term dust impacts. This level is recommended as the maximum permissible level that should be permitted in urban environments. Also the Environment Protection Authority refers to the US EPA 50 µg/m³ annual mean concentration for particles less than 10 µm.

Deposition

NSW EPA 4 g/m²/mth

1983.

The EPA considers that residential areas begin to experience dust related nuisance impacts when annual average dust (insoluble solids) deposition levels exceeded 4 g/m²/month, and that dust impacts would be at unacceptable levels when they reached 10 g/m²/month (SPCC (now EPA) 1983). In the early 1990s the EPA (Dean et al 1990) refined these criteria. They are now expressed in terms of an acceptable increase in dust deposition over the existing background. **Table 3.17** shows the maximum acceptable increase in dust deposition over the existing dust levels.

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 had occurred.

The criteria for dust fallout levels in **Table 3.17** are set to protect against nuisance impacts and they are not relevant for interpreting the significance of dust in mine working areas, where the distinction between what is deposited dust and dumped soil or overburden is unclear. In other words there are no limits to the quantity of dust deposition that is acceptable within the working areas of the mine.

Table 3.17 - EPA Goals for Dust Deposition (Insoluble Solids)

Existing dust fallout level (g/m²/month)	Maximum acceptable increase over existing fallout levels - (g/m²/month)	
	Residential	**Other**
2	2	2
3	1	2
4	0	1

3.6.2 Existing Air Quality

Dust Deposition

Figure 3.8 shows the locations of dust deposition gauges and high volume air samplers in the study area. **Table 3.18** shows "annual" average insoluble solids deposition rates from samples collected for the first six months of 1997.

Deposition gauges D1, D2 and D3 and high volume air sampler HV1 are located in the vicinity of the Mine Access Site. Gauge D4 and HV4 are located at 41 Gradwells Road, Dora Creek approximately 600 metres south of the proposed Coal Preparation Plant at Cooranbong Colliery.

The site with the highest deposition rate is D3 which is close to Doyalson Road. Other sites show low levels of dust deposition, well below the EPA goal of 4 g/m^2/month

Table 3.18 - Dust Deposition Data (Total Insoluble Solids) for the Surrounding Area ($g/m^2/Month$)

½ ~~old~~ yr. record won't be able to show summary look at the range of D29

Static Dust Gauge	D1 (Mine Access Site)	D2 (Mandalong Road)	D3 (Wyee Road)	D4 (Gradwells Road)
Date (1997)				
January	0.8	1.0	0.4	0.4
February	0.7	0.6	0.4	0.7
March	0.7	0.7	1.8	0.5
April	0.6	0.4	2.7	1.5
May	0.5	0.6	10.6	1.0
June	0.2	2.6	3.8	0.4
"Annual" Average	**0.6**	**1.0**	**3.3**	**0.8**

Historical dust deposition data collected by Pacific Power from 1973 to 1980 and from 1987 to 1988 at a site D29 (see **Figure 3.8**) are summarised in **Table 3.19**. Data presented are annual averages. There is clearly variation from year to year but generally dust deposition levels are low and are always below the EPA goal of an annual average of less than 4 g/m^2/month.

An increase in dust deposition rates of between 1-2 g/m^2/month could occur before air quality was perceptibly altered.

Table 3.19 - Annual Average Dust Deposition Levels (Total Insoluble Solids) ($g/m^2/Month$) at Pacific Power Site (D29) off Mandalong Road

Year	Deposition level
1973	2.9
1974	0.9
1975	1.2
1976	1.6
1977	3.6
1978	1.5
1979	1.5
1980	2.1
1987	2.0
1988	2.3

range fr. 0.9 to 3.6

<u>Particulate Matter Concentration</u>

The high volume air sampler data are summarised in **Table 3.20**. Concentrations in the vicinity of the Mine Access Site are generally lower than at the Coal Preparation Plant site.

Samples collected were analysed for TSP rather than PM_{10}. On average the measured levels were well below the NHMRC annual TSP goal of 90 $\mu g/m^3$. Assuming that

PM_{10} constitutes approximately 40% of the measured TSP, concentrations of PM_{10} would be less than 40 μg/m^3 which is well below the 24-hour PM_{10} goal of 150 μg/m^3.

An increase in annual average dust concentrations of between 20 and 40 μg/m^3 could occur before air quality was considered unacceptable.

Table 3.20 - Dust Concentration Data (TSP) Collected in the Vicinity of the Project (μG/M^3)

High Volume Sampler	HV1 (Mine Access Site)	HV4 (Gradwells Road)
Date		
22 Dec 96	29	27
28 Dec 96	27	85
3 Jan 97	12	11
9 Jan 97	26	43
15 Jan 97	52	36
Average	29	42

3.7 ACOUSTIC ENVIRONMENT

3.7.1 Overview of Acoustical Terminology and Assessment Procedures

Sound or noise may be defined as any pressure variation that the human ear can detect. Sound is transmitted in the air by pressure waves which have two important characteristics: amplitude and frequency. Amplitude and frequency determine the effect that noise has at the receptor.

Amplitude is perceived as loudness and is measured in units of decibels (dB). The sound pressure level (SPL) is the parameter used to describe the relative "strength" of the noise. SPL is expressed in decibels (dB), which relate the amplitude of the sound pressure to a reference sound pressure. This reference corresponds to the threshold of hearing, the minimum audible sound pressure at 1000 Hz:20 μPa. The decibel scale ranges from the threshold of hearing at 0 dB to above the threshold of pain at about 140 dB.

Frequency is perceived as pitch and is measured in hertz (Hz) or kilohertz (kHz - 1,000 Hz). The frequency of the sound produces its distinctive tone.

When measuring noise it is important to understand that the decibel scale is not linear but logarithmic. This scale has been adopted because the range of sound levels detected by the ear is so large. As noise sources increase or decrease in loudness the ear does not perceive the change in dB level as proportional to the loudness. For example a 3 dB increase in noise level, though not very noticeable to the ear, represents a doubling of sound energy, while a 10 dB increase, which is perceived as twice as loud, represents a ten-fold increase in sound energy.

Another consequence of the use of a logarithmic scale for noise measurement is that noise levels can not be simply added together. Thus, the combined noise level of two different noise sources which separately produce 87 dB and 89 dB, when placed together, will be 91 dB, not 176 dB.

Sound levels can be measured in a variety of ways depending upon the scientific need and instrument used. For assessing environmental noise the weighting, or the frequency response, of the measuring meter is required to conform to a set standard - the "A" weighting. The "A" weighting of the meter's response corresponds approximately to how the human ear perceives sound at low to moderate levels. The corresponding measured value is expressed as dBA.

As suggested above, a change of 1 dBA or 2 dBA change in sound level represents only a marginal difference and is difficult for most people to detect, whilst a 3 dBA to 4 dBA change corresponds to moderate but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness. A range of typical noise levels is presented in **Table 3.21**.

Table 3.21 - Typical Noise Levels

Sound Pressure Level - dBA	Typical Source	Subjective Evaluation
130 120 110	Threshold of pain Jet take-off Rock concert	Extremely noisy Intolerable
100 90	Pneumatic hammer Heavy truck	Very noisy
80 70	Busy street traffic Loud radio or television	Loud
60 50	Department store General office	Moderate to quiet
40 30	Living room Bedroom	Quiet to very quiet
20	Unoccupied recording studio	Almost silent
10/0	Threshold of hearing	Silent

Environmental noise levels were determined by measuring statistical noise exceedance levels over a 15 minute sample period. The exceedance levels (LAN) are the levels exceeded for N% of the sample interval. The LA_{90} represents the level exceeded for 90% at the interval period and is referred to as the average minimum or background noise level. The LA_{10} is the level exceeded for 10% of the time and is usually referred to as the average maximum noise level. The LAeq is the equivalent continuous sound pressure level and represents the steady sound level which is equal in energy to the fluctuating level over the interval period.

The assessment of environmental noise emissions from mining projects involves the establishment of acceptable noise planning levels based on existing background levels which are determined prior to the construction of the mine. In general terms, the noise emission from the project is limited to the level of existing background noise plus an additional 5 dBA.

It is often the case therefore, that noise emissions from established mining projects are audible at some of the nearest residential receivers, particularly at night, whilst remaining within their predetermined noise emission limits.

3.7.2 Existing Acoustical Environment and Recommended Planning Levels

The study nominates six Key Monitoring Locations (BG0 to BG5), selected to be representative of the noise environment of the potentially affected areas. Monitoring sites BG0, BG1, BG2 and BG3 are located within or surrounding the Mine Access Site and are shown on **Figure 3.8**. Monitoring sites BG4 and BG 5 are located near Cooranbong Colliery (see **Section 4.5.5**). Unattended continuous noise logging was conducted during the summer season commencing 19 December 1996 to 2 January 1997, and during the winter season commencing Friday 23 May 1997 to Monday 9 June 1997 and was supplemented by a series of operator-attended surveys.

The daytime (0700 hrs to 2200 hrs) and night-time (2200 hrs to 0700 hrs) $LA_{10(15minute)}$ and $LA_{90(15minute)}$ background noise levels for the summer and winter season have been determined using cumulative frequency distribution statistical calculations. On the basis of the $LA_{90(15minute)}$ background noise levels and the EPA's Noise Control Manual, the recommended $LA_{10(15minute)}$ contributed noise design limits and planning levels for construction and mine operations respectively are summarised and presented in **Table 3.22**.

Table 3.22 - Recommended Design Limits and Planning Goals

Property Name	Site	$LA90_{(15minute)}$ Background - dBA		Noise Limit $LA_{10(15minute)}$	$LA_{90(15minute)}$ Planning Levels - dBA		$LA_{10(15minute)}$ Planning Levels - dBA		$LA_{1(15minute)}$ Planning Levels - dBA	
		Day	Night	4 to 26 Weeks	Day	Night	Day	Night	Day	Night
BG1 McLean	MAS[1]	50	36	60	40	38	55	41	65	51
BG2 Menzies	MAS[1]	37	34	47	42	39	42	39	52	49
BG3 Ferris	MAS[1]	35	34	45	40	39	40	39	50	49
MA1 Hunt	MAS[1]	37	34	47	42	39	42	39	52	49
MA2 Kildey	MAS[1]	36	34	46	41	39	41	39	51	49
MA3 Lee	MAS[1]	36	34	46	41	39	41	39	51	49
MA4 Lee	MAS[1]	35	34	45	40	39	40	39	50	49
BG4 Zaska	CC[2]	35	32	45	39	37	40	37	50	47
BG5 Fuller	CC[2]	37	36	47	42	38	42	41	47	51
CP1	CC[2]	36	34	46	41	38	41	39	49	49

[1] - *Mine Access Site*
[2] - *Cooranbong Colliery Site*

Sites MA1 to MA4 are noise modelling sites chosen to represent surrounding residences to the Mine Access Site (see **Section 4.4.5**). CP1 is a noise modelling location for noise emissions from Cooranbong Colliery (see **Section 4.5.5**).

3.8 FLORA AND FAUNA

3.8.1 Survey Rationale

<u>Areas 1 and 2 - Mandalong Valley</u>

Given that the potential for adverse impacts on vegetation communities and fauna habitats throughout the majority of the Mandalong Valley study area is slight, broad surveys for flora and fauna were considered appropriate. Flora and fauna characteristics of proposed mining Areas 1 and 2 are shown on **Figures 3.9a** and **3.9b** respectively.

Whilst fauna surveys were concentrated in those areas which were considered to provide the most valuable habitat for fauna (**Figure 3.9b**), detailed investigations were also conducted in those areas where the potential for adverse impacts was considered greatest (ie wetland and floodplain areas). Aquatic surveys downstream of the proposed mining area were not undertaken as the development will not disturb these areas and will not discharge pollutants to the Stockton Creek drainage system.

The proposed site for the Downcast Shaft has long been cleared, and supports only heavily grazed pasture grasses and as such, detailed fauna investigations were not considered necessary, although a brief habitat assessment was conducted. A summary of fauna survey methods is provided in **Table 3.23**.

Flora investigations aimed at describing the vegetation communities throughout the Mandalong Valley study area, and providing an inventory of plant species (**Appendix 5**). Again, given the limited potential for adverse surface impacts throughout the majority of the study area, specific and detailed investigations were not considered necessary. A detailed investigation was conducted in the area to be disturbed by the proposed Downcast Shaft.

Table 3.23 - Fauna Survey Summary - MLA 88 and Part A405

Mandalong Valley	
Flora - 10 days	
Fauna - 18 Days:	
Ground Trapping	1375 Elliot Trap-nights 55 Cage trap-nights 165 Hair tube nights.
Spotlighting	52 person-hours (including owl and amphibian call playback and investigation of wetland areas)
Microchiropteran Bats	23 harp trap nights (at 11 locations) Anabat II detectors employed at 25 locations.
Diurnal surveys	9 days 144 person-hours
NB	approximately 8 hours each day were spent in diurnal observations of birds, herpetofauna and habitat assessment throughout Areas 1 and 2.

Mine Access Site

Whilst the Mine Access Site has been designed to avoid as much remnant vegetation as possible, this area will be subjected to some disturbance, and detailed fauna and flora investigations were conducted in this area. Flora and fauna characteristics of the Mine Access Site are shown on **Figures 3.10a** and **3.10b** respectively.

Fauna surveys concentrated on the woodland and paperbark forest (referred to as Floodplain Vegetation on **Figure 3.10a**) around the boundaries of this area (**Figure 3.10b**). This was done as these communities provide substantially more habitat resources for native fauna than the cleared and disturbed areas in the centre of this site. A summary of fauna survey methods is provided in **Table 3.24**.

Table 3.24 - Fauna Survey Summary - Mine Access Site

Mine Access Site	
Flora - surveys conducted as part of the Mining Lease Application area surveys	
Fauna - 5 Days	
Ground Trapping	250 Elliot Trap-nights 10 Cage trap-nights 30 Hair tube nights.
Spotlighting	approximately 5 person-hours (including owl and amphibian call playback and investigation of wetland areas)
Microchiropteran Bats	5 harp trap nights Anabat II detectors placed at 4 locations
Diurnal surveys	2 days 32 person-hours
NB	approximately 8 hours were spent in diurnal observations of birds, herpetofauna and habitat assessment.

<u>Cooranbong Colliery (incorporating the Coal Preparation Plant, Stockpile Area and Haul Road)</u>

Detailed flora investigations were conducted on the proposed site for the Coal Preparation Plant and coal stockpile area, and along the haul road alignment (see **Figure 3.11a**). Flora surveys were conducted in consultation with surveyors to identify a suitable alignment for the haul road which has the least potential for adverse impacts on threatened flora species. Specific searches were conducted for threatened plant species in these areas.

Fauna surveys were conducted in areas which support the most valuable habitat for native fauna, as well as focussing on the areas where disturbance is likely to be greatest (**Figure 3.11b**). The proposed waste emplacement site is in a highly disturbed condition and due to its lack of native vegetation, this area is considered to provide minimal habitat for native fauna species.

A summary of survey durations and methods is provided in **Table 3.25**.

Table 3.25 - Flora and Fauna Survey Summary - Cooranbong Colliery, Haul Road and Emplacement Area Sites

Cooranbong Colliery Site (incorporating the haul road, waste emplacement and coal stockpile and preparation plant)	
Flora - 6 days	
Fauna - 5 days	
Ground Trapping	200 Elliot trap-nights 8 cage trap nights
Spotlighting	approximately 12 person-hours (including owl and amphibian call playback and investigation of the coal stockpile area)
Microchiropteran Bats	5 harp trap nights Anabat II detectors placed at 4 locations along the haul road alignment
Diurnal surveys	2 days 32 person-hours
NB	approximately 8 hours each day were spent in diurnal observations of birds, herpetofauna and habitat assessment.

3.8.2 Flora

The areas which are the subject of investigations under the proposed Cooranbong Colliery Life Extension Project consist of a range of different vegetation communities (see **Figures 3.9a**, **3.10a** and **3.11a**) and plant species (see **Appendix 5**). Different geological and topographical features are represented on the subject sites (such as ridgelines, valleys and creeklines), and these variations are reflected in the vegetation communities present.

The plant species of each community vary according to a range of factors such as aspect, topography, soil type, microclimate and hydrology. The density of the vegetation also varies, depending on the above factors as well as past and present land uses. The shrub layer ranges from fragmented or absent in highly disturbed areas (including agricultural areas in the floodplain of the Mandalong Valley and the Coal Preparation Plant), to very diverse and dense in more intact, less disturbed areas.

In areas which have been subjected to disturbance, such as logging, fire and clearing for agriculture, residential development and tracks, weeds have invaded parts of the understorey and herb layer.

Areas 1 and 2 - Mandalong Valley

The vegetation of the Mandalong Valley study area forms a complex mosaic of different communities (see **Figure 3.9a** and **Appendix 5**). Principal community types are:

- riparian forest on floodplains, around wetlands and along lower reaches of major creeks;

- open forest/tall open forest in the north, west and south;

- open forest/woodland in the southeast;

- forest/tall open forest along middle reaches of larger creeks;

- forest/closed forest in sheltered sites on minor tributaries in the northwest; and

- disturbed and regenerating communities, through the central portion of the site.

Whilst no threatened plants were recorded in the study area, a range of species known from the vicinity could potentially occur. Given that there is a low potential for adverse surface impacts over much of the site, specific and detailed searches for species of conservation significance were not conducted. However, a range of species known from the vicinity could potentially occur within the study area.

Mine Access Site

The Mine Access Site consists of four vegetation communities (**Figure 3.10a** and **Appendix 5**):

- open forest/woodland along the eastern boundary (adjacent to the Sydney-Newcastle freeway);

- cleared and disturbed through the central and southeastern portions of the site;

- a small patch of open forest in the southwestern corner; and

- floodplain vegetation, consisting of dense Paperbark forest along the southern, western and northern boundaries.

The cleared areas through the centre of the site support existing infrastructure, and have been subjected to rubble and landfill storage and considerable erosion. The Mine Access Site supports a high proportion of introduced plant species, reflecting the level of existing disturbance. No plant species of conservation significance were recorded on the Mine Access Site, and given the high levels of existing disturbance, none are expected.

Downcast Shaft Site

The proposed Downcast Shaft will be located in an area which has long been cleared and has been subjected to ongoing cattle grazing. Vegetation communities on and adjacent to the proposed site are (see **Appendix 5**):

- cleared/disturbed on and surrounding the site for the Downcast Shaft;
- wetland/sedgeland around a small farm dam located downslope of the proposed Downcast Shaft site;
- open forest/forest around the boundaries of the study area, along the existing fencelines and upslope of the proposed Downcast Shaft site.

The Downcast Shaft site has been cleared of all trees and most shrubs. Both the Downcast Shaft site and general vicinity have been heavily grazed and support sparse shrublayers and groundcovers, mainly comprising pasture grasses.

One Rare Or Threatened Australian Plant (ROTAP) species, *Eucalyptus fergusonii* spp *fergusonii*, was recorded adjacent to the Downcast Shaft site. This species has a conservation rating of 3KC- (Briggs & Leigh 1996 - Table 1) and occurs in wet sclerophyll forest or woodland on sandy soils from Bulahdelah to Morisset (Harden 1991).

Cooranbong Colliery Site

Coal Preparation Plant

The proposed site for the Coal Preparation Plant has been subjected to considerable past and ongoing disturbance. However, this area does support some remnant vegetation between a previous waste emplacement area and an artificial embankment merging with more intact open forest/woodland and riparian communities to the south. The communities which will be disturbed by the coal preparation plant site are (see **Appendix 5**):

- open forest/woodland on the majority of the area; and
- cleared/disturbed along an existing track and in other small patches.

Four *Acacia bynoeana* plants were recorded in a disturbed remnant patch of vegetation which is immediately adjacent to Cooranbong Colliery. The four plants are located within the area where the coal preparation plant is proposed to be constructed (see **Figure 3.11a**). The plants are rapidly declining in health, showing signs of dieback and leaf discolouration. *Acacia bynoeana* has a conservation rating of 3VC- (Briggs & Leigh 1996 - **Table 3.26**) and is listed as a Vulnerable species on Schedule 2 of the NSW Threatened Species Conservation Act 1995.

Coal Stockpile Area

The proposed coal stockpile area consists mainly of:

- cleared/disturbed communities (including existing infrastructure) within the colliery boundary (to the immediate southwest of the fenceline);
- open forest/woodland communities outside of the colliery boundaries; and
- highly degraded riparian communities to the south of the existing stockpile.

A large population of *Tetratheca juncea* was recorded in the intact open forest communities to the west and northwest of the existing fenceline, extending beyond the proposed disturbance area (**Figure 3.12**). This species has a conservation rating of 3VCa (Briggs & Leigh 1996 - **Table 3.26**), and is included in Schedule 2 of the Threatened Species Conservation Act 1995 as a Vulnerable species.

Table 3.26 - National Conservation Status Codes for Native Flora of Relevance to this Project (Briggs & Leigh 1996)

Distribution Category

2	Species with a geographic range of less than 100 km.
3	Species with a geographic range of greater than 100 km.

Conservation Status

V	**Vulnerable**: not currently endangered; at risk of disappearing from the wild state within 20-50 years.
K	**Poorly Known**: taxon that is suspected, but not definitely known, to belong to one of the above categories. At present, accurate field distribution information is inadequate.
C	**Reserved**: has at least one population within a National Park, Conservation Reserve, or area dedicated for the protection of flora.

Size-class of all Reserved Populations

a	1000 plants or more are known to occur within a Conservation Reserve(s).
-	reserved population size is not accurately known.

New Haul Road

The vegetation along the haul road alignment forms a complex mosaic of different communities (**Figure 3.11a**). Principal community types occurring on the study area are (see **Appendix 5**):

- open forest/forest to the west of the haul road alignment and along creeks and drainage lines;
- open forest/woodland in the remaining areas; and
- disturbed and regenerating communities, predominantly within and surrounding the existing quarries and in the powerline easements.

Where disturbance is evident, weeds have colonised parts of the understorey and herb layer, notably within and adjacent to the quarry sites, within the powerline easement and along access tracks. However, weed infestation is generally limited to forest edges in these communities.

Both *Acacia bynoeana* and *Tetratheca juncea* were recorded at several locations along the haul road alignment, and in the immediate vicinity (see **Figure 3.11a**).

Waste Emplacement Area

Hawkmount Quarry (the proposed location for the waste emplacement area) is highly disturbed as a result of ongoing extraction activities. The site is devoid of native vegetation, and no threatened plant species were recorded in this area.

3.8.3 Fauna

<u>Fauna Habitats</u>

The areas under investigation support a range of habitats for native fauna species, with some areas providing substantially more resources than others. In this regard, the cleared agricultural areas in the Mandalong Valley (including the Downcast Shaft site), the Mine Access Site, the proposed waste emplacement area (Hawkmount Quarry) and Coal Preparation Plant site support substantially less resources for native fauna than do other areas.

Areas which support most valuable resources for native fauna include the coal stockpile area (outside of the presently disturbed area), along and adjacent to the haul road alignment and the natural wetlands, forest and woodland in Areas 1 and 2 of the proposed mining lease. Fauna habitat features occurring in these areas include mature hollow-bearing trees, creeklines and extensive natural and man-made wetlands (in the Mandalong Valley), dense understorey and groundcover vegetation and tree-debris (such as leaf litter and fallen hollow logs) which provide shelter for ground-dwelling fauna.

Substantial habitat for native fauna occurs throughout the general locality. The Morisset Forestry District which encompasses the study area contains a number of State Forests (including Olney, Watagan and Awaba), all of which are known to support an array of native species (including threatened species) and are considered to provide a significant conservation resource in the region. Whilst some limited habitat will be removed as a result of the proposed Cooranbong Colliery Life Extension Project, substantial resources will remain intact in the general locality.

Fauna Species

An array of native fauna species (including threatened species) was recorded throughout the study areas (**Appendix 5**). In addition, a range of species has been recorded in the vicinity of the site during previous investigations and in databases for the region (NPWS Wildlife Atlas, RAOU Bird Atlas, NSW Bird Atlassers)[1], including those threatened species listed in **Appendix 5**.

Areas 1 and 2 - Mandalong Valley (including the Downcast Shaft site)

A total of 153 species of native vertebrate fauna was recorded during investigations in the study area, including 90 bird, 16 amphibian, 17 reptile and 30 mammal species (**Appendix 5**), reflecting the wide range of habitats represented. In addition, six introduced species were also recorded. The majority of the species recorded are common to widespread and are frequently recorded in a variety of habitats and localities.

Seven of the species recorded are listed as threatened in the Threatened Species Conservation Act 1995 (**Table 3.27**). Two arboreal mammals (the Squirrel Glider *Petaurus norfolcensis* and Yellow-bellied Glider *Petaurus australis*), three microchiropteran bats (the Little Bent-wing Bat *Miniopterus australis*, Large Bent-wing Bat *Miniopterus schreibersii* and Eastern Freetail Bat *Mormopterus norfolkensis*), one threatened bird (the Powerful Owl *Ninox strenua*) and one amphibian (the Giant Barred Frog *Mixophyes iteratus*) were recorded during the field investigations (**Figure 3.9b**). In addition, the Black-necked Stork *Ephippiorhynchus asiaticus* has been observed on the site by a resident, but was not located during the field investigations.

Mine Access Site

A total of 44 species of native vertebrate fauna were recorded on the Mine Access Site (**Appendix 5**), including 12 mammals, 21 birds, 5 reptiles and 6 amphibians. In addition, one threatened species (the Greater Broad-nosed Bat *Scoteanax rueppellii*) was tentatively recorded (**Figure 3.10b**). With the exception of this species, the

---

1 The area covered by these databases also encompasses a range of habitats (including coastal environments and Lake Macquarie) which are not represented in the study area. Consequently, several of the additional species, in particular coastal waterbirds (including threatened species), are not expected to occur on the subject sites, given the absence of suitable habitat.

majority of the fauna species recorded are common to widespread and frequently recorded in a range of habitats and locations.

The nature and abundance of fauna species recorded on this site reflects its highly disturbed and fragmented character. Whilst this site supports some dense paperbark forest around its boundaries, this community provides limited habitat for native fauna species, given a lack of tree hollows and other shelter resources. However, many species could use this area for foraging. Conversely, the largely cleared and disturbed environment in the centre of the site is likely to only provide habitat for the most disturbance-tolerant species.

<u>Cooranbong Colliery (incorporating the Coal Preparation Plant, Stockpile Area and Haul Road)</u>

A total of 70 species of native vertebrate fauna was recorded during field investigations throughout the Cooranbong Colliery subject site (**Appendix 5**), including 37 bird, 22 mammal, 9 reptile and 2 amphibian species. With the exception of the five threatened species (described below and in **Table 3.27**), the majority of the fauna species recorded are common to widespread and frequently recorded in a range of habitats and locations.

One threatened arboreal mammal (the Squirrel Glider *Petaurus norfolcensis*) was recorded during field investigations throughout the study area. One threatened microchiropteran bat species (the Eastern Freetail Bat *Mormopterus norfolkensis*) was positively recorded on the Cooranbong Colliery site. An additional two species (the Little Bent-wing Bat *Miniopterus australis* and the Large Bent-wing Bat *Miniopterus schreibersii*) were tentatively recorded from Anabat II echolocation recordings. One threatened bird, the Glossy Black Cockatoo *Calyptorhynchus lathami* was recorded during investigations throughout the area **(Figure 3.11b)**.

Table 3.27 - Threatened Fauna Species Recorded During Investigations in all of the Study Areas

Species	Habitat Requirements	Location
Black-necked Stork *Ephippiorhynchus asiaticus*	Occurs in tropical and warm-temperate terrestrial wetlands, estuarine and littoral habitats, and occasionally grass and woodlands. Forages in fresh or saline waters up to 0.5m deep (Marchant & Higgins 1990). Rare south of Newcastle (Slater *et al* 1986).	Proposed mining lease (resident's observation - Area 1)
Powerful Owl *Ninox strenua*	Requires closed or open forest and woodland communities which support large tree-hollows for nesting and a supply of arboreal mammals for feeding (Debus & Chafer 1994).	Proposed mining lease (Areas 1 and 2)

Table 3.27 - Threatened Fauna Species Recorded During Investigations in all of the Study Areas (cont)

Species	Habitat Requirements	Location
Glossy Black Cockatoo *Calyptorhynchus lathami*	Inhabits forest and woodland, feeding on the cones of *Allocasuarina torulosa* and *A littoralis* (Garnett 1992). Roosts and nests in large eucalypts with hollows. Uses both uncleared and partly cleared agricultural land (Garnett 1992).	Cooranbong Colliery site.
Yellow-bellied Glider *Petaurus australis*	Inhabits eucalypt forest, in particular moist gullies, and requires tree-hollows for nesting (Russell 1995).	Proposed mining lease (Area 1)
Squirrel Glider *Petaurus norfolcensis*	Dry sclerophyll forest and woodland, rarely recorded in dense wet forest. Requires medium sized tree-hollows for shelter and nesting (Suckling 1991).	Proposed mining lease (Area 1); Haul road alignment
Eastern Freetail Bat *Mormopterus norfolkensis*	Occurs from southern NSW to southern Queensland, primarily inhabiting dry eucalypt forest and woodland, where it roosts in trees (Allison & Hoye 1995).	Proposed mining lease (tentative); Haul road alignment
Greater Broad-nosed Bat *Scoteanax rueppellii*	Requires forest and woodland communities which provide foraging habitat and tree-hollows for roosting, although it has also been recorded roosting in old buildings (Richards 1991).	Mine Access Site (tentative)
Little Bent-wing Bat *Miniopterus australis*	Roosts in caves and tunnels, often sharing roosting and nursery sites with the Large Bent-wing Bat (Dwyer 1995a). Primarily inhabits rainforest and dry sclerophyll forest from Cape York to the NSW central coast (Dwyer 1995a).	Proposed mining lease; Haul road alignment
Large Bent-wing Bat *Miniopterus schreibersii*	Occurs in treed valleys along the east coast of Australia where it forages above the canopy and roosts in caves and other man-made structures (Dwyer 1995b)	Proposed mining lease (tentative); Haul road alignment (tentative)
Giant Barred frog *Mixophyes iteratus*	Rainforest and wet sclerophyll forest, usually close to small permanent streams (Cogger 1992; Ehmann 1997)	Proposed mining lease (Area 1)

3.9 PLANNING CONTEXT

3.9.1 Existing Planning Policy

Hunter Regional Environmental Plan and Lake Macquarie Local Environmental Plan

Both the Hunter Regional Environmental Plan 1989 and the Lake Macquarie Local Environmental Plan 1984 provide the foundation for the statutory considerations of the proposed development.

This site is identified in the Hunter Regional Environmental Plan 1989 as being located within an area which contains coal resources. The plan provides broad planning principles relating to environmental aspects of mining and these are addressed, where necessary, in this document. Of particular significance is the emphasis placed by the plan on the protection of coal, and other mineral resources and extractive materials, from incompatible development which may sterilise such resources.

The Lake Macquarie Local Environmental Plan 1984 provides general controls in relation to the development of specific sites. These general provisions control development by way of land zonings which denote the permissibility, or otherwise, of certain types of development in certain zones. The proposed development site contains land within the following zones: -

- Rural 1(a),
- Rural 1(b),
- Rural 1 (d),
- Special Uses 5(a),
- Special Use 5(b) (Proposed Arterial Road Reservation),
- Open Space 6(a) (Public Recreation),
- Open Space 6(b) (Special Recreation),
- Open Space 6(c) (Local Recreation),
- Environmental Protection 7(a) (Scenic), and
- Unzoned Land.

Some of these zones permit mining development and others prohibit it. Unzoned land only occurs in this area in the case of road reserves. The adjoining land zoning under Clause 14 of the Environmental Planning and Assessment Model Provisions 1980 controls development of unzoned land.

The Special Provisions (Part III) section of Lake Macquarie Local Environmental Plan provides specific controls on the development of land. The Special Provisions take precedence over the general provisions including zoning. Clause 22 of the Special Provisions allows the development of underground mines, with the consent of Council, irrespective of the zoning of the land. Council has confirmed, in writing on 20 March 1997, the permissibility of this development under this provision (see **Appendix 1**).

Cooranbong Colliery is zoned 4(b) Special Uses Coal Mining and the Coarse Reject Emplacement Area 1(a) Rural under Lake Macquarie Local Environmental Plan 1984. Under both this 4(b) zoning and the 1(a) zoning, coal mining is permissible "Only with Development Consent".

As emplacement of coarse reject material is an integral function of the overall development, it is also covered by the operation of Clause 22 of the special provisions of the LEP, which override the land use zones in the case of underground mines.

Draft Lake Macquarie Local Environmental Plan 1984 (Amendment No. 87) has recently been exhibited. The amendment provides revised provisions and listings of heritage items in the City. One item, a grave by the name of "Frost's Rest', listed in the plan is located in the Mining Lease Application area. The development will have no effect on this item, as the proposed mining operations do not extend under that part of the lease application area.

<u>Directions under Section 101 of the Environmental Planning and Assessment Act and State Environmental Planning Policies</u>

<u>Directions under Section 101 of the Act</u>

On 4 June 1987 the then Minister for Planning and Environment issued a Direction under Section 101 of the Environmental Planning and Assessment Act to nominated Councils including Lake Macquarie City Council. This Direction specifies that all development applications for new coal mines, that require new mining leases, are to be determined by the Minister. This development is by definition a new mine and requires a new mining lease and consequently the Minister is the determining authority.

State Environmental Planning Policies

A number of State Environmental Planning Policies (SEPP), by definition in those policies, apply to the City of Lake Macquarie. The nature of the operation of those Policies determines whether they are relevant in the case of a particular development. With respect to the proposed development only SEPP 34 - "Major Employment-Generating Industrial Development", SEPP 44 - "Koala Habitat Protection" and SEPP 46 - "Protection and Management of Native Vegetation" are potentially relevant.

SEPP 44 - "Koala Habitat Protection"

This Policy applies to the extent that Council is restricted from granting consent to development which, the Council considers, is "core Koala Habitat". No "core Koala Habitat" has been identified in or adjacent to any areas to be disturbed as part of the proposed development.

SEPP 46 - "Protection and Management of Native Vegetation"

This Policy places consent requirements on the clearing of native vegetation. These consent requirements are negated in relation to the holder of a Mining Lease "where such clearing is necessary, or incidental to, the carrying out of a mining operation under such a lease" (DLWC).

SEPP 34 - "Major Employment-Generating Industrial Development"

This policy is not relevant due to the exclusion contained in Schedule 1 part d (iii) in respect of new coal mines that require new mining leases.

SEPP 14 - "Coastal Wetlands" and SEPP 19 - "Bushland in Urban Areas" are not relevant as the development site does not contain, respectively, any land identified as wetlands under the relevant policy or land zoned or reserved for public open space purposes.

3.9.2 Strategic Planning Implications

The nature of long term planning for the general area is at this time unresolved. Pressures have been exerted in this area and nearby rural areas for intensification of development, particularly subdivision. To date no large area rezonings have occurred to facilitate rural residential subdivision however a number of subdivisions have occurred through other mechanisms.

Council has initiated a Rural Planning Study as an element of the Lifestyle 2020 strategic planning program. The study is expected to be completed by the end of 1999. It is reasonable to presume that the existing planning controls applying to rural lands in general will be updated. Strategic planning principles and current planning policies and guidelines which aim to avoid the sterilisation of identified mineral resources are unlikely to be disregarded by the introduction of increased development potential, particularly in terms of subdivision. The most likely development scenario for this area is for limited infill development only, or developments which are permissible generally within rural areas.

3.10 AGRICULTURAL SUITABILITY AND LAND CAPABILITY

3.10.1 Assessment of the Land

The Mandalong Valley consists of a range of different land types which are utilised for a number of different enterprises. The land areas range from fairly level country in which the majority of the area has been cleared, to steep heavily timbered country which is not capable of sustaining an economically viable agricultural operation.

The different enterprise operations conducted on the land in the Mandalong Valley consist of beef cattle, dairy farming, poultry, horticulture, turf farming, small scale market gardens and horses for racing, competition and pleasure.

The area under assessment has been classified for both Land Capability and Agricultural Suitability. Land Capability classification is used by the NSW Department of Land and Water Conservation and classifies land into eight different classes, whereas, Agricultural Suitability classification is used by the NSW Department of Agriculture and classifies land into five different classes.

The Land Capability system classifies land on the basis of the capability of the land to remain stable under particular land uses and does not imply any aspects of agricultural suitability. The Land Capability system classifies land in terms of its inherent physical characteristics or constraints and denotes measures needed to protect the land from soil erosion and other forms of land degradation. This system therefore considers the optimum rather than the maximum use of the land.

The Agricultural Suitability system classifies land based on the potential productivity of the land in the relevant social and economic context. This system uses the Land Capability classification as a basis and then incorporates other factors such as market situation and location, availability of water and processing facilities. The Agricultural Suitability system classifies land in terms of its suitability for general agricultural use, including both cropping and pastoral purposes. This system takes into account factors other than just the inherent physical characteristics of the land, which may vary the agricultural use of the land. Agricultural Suitability of the proposed mining areas is shown on **Figure 3.12a** and Land Capability for the area is shown on **Figure 3.12b**.

The Land Capability of an area of land will not, in general, change over time, whereas the Agricultural Suitability of the same area of land may change if product demand or factors relating to its location change. The land is assigned a class, in both systems of classification, after the following factors are considered:

- climate - any adverse features;
- soil characteristics:
  - * physical nature of the soil, limiting physical characteristics, particularly for cultivation;
  - * chemical fertility of the soil, any deficiencies in nutrients or toxicity which may limit plant growth;
  - * stoniness and/or the presence of rock outcrops;
  - * shallow soils or occurrence of hard pans;
- drainage - frequency of inundation
- topography - any adverse topographic features;
- the accumulated experience of cropping and livestock husbandry in the area concerned.

3.10.2 Land Capability Assessment

The Land Capability of the area mapped is based on the definitions from the Soil Conservation Service of NSW *Rural Land Capability Mapping*.

The Land Capability of the assessed land in the Mandalong Valley ranges from III to VIII. The valley floor has drainage and flooding constraints restricting land use to grazing or carefully managed cultivation. These constraints eliminate the possibility of Land Capabilities I and II.

Land Capability III

The majority of the productive land areas in the Mandalong Valley have a Land Capability of III as these land areas are suitable for regular cultivation on a rotational basis to maintain soil structure and productivity. Productivity of these areas may be high, however, constraints such as soil fertility, erosion hazard and poorly drained soils which are prone to waterlogging or flooding for prolonged periods will reduce the total production of this land. Structural soil conservation works may be required along with practices such as conservation tillage and adequate crop rotation.

The areas with a Land Capability of III are generally classified as "fair" to "good" with regards to agricultural productivity, however, there are no "prime agricultural land" areas in the Mandalong Valley.

Land Capability IV and V

Those land areas in the Mandalong Valley with a Land Capability of IV and V are suitable for grazing with occasional cultivation. These areas have constraints such as slope gradient, soil erosion and soil shallowness or rockiness. These limitations are generally more severe in those areas with a Land Capability of V compared to those areas which have a Land Capability of IV.

Class IV lands consist of the better grazing land areas and are suited to cultivation for an occasional fodder crop or for pasture renewal. The productivity of those areas with a Land Capability of V is generally lower than that with a Capability of IV, however, they may also be cultivated for an occasional fodder crop or for pasture renewal.

Soil conservation practices such as pasture improvement, stock control, application of fertiliser and minimal cultivation for the establishment or re-establishment of permanent pasture may need to be implemented on both Land Capability areas IV and V, however, those areas with a Capability of V may also require structural soil conservation works.

Land Capability VI

Those areas in the Mandalong Valley with a Land Capability of VI are only suitable for grazing and are not capable of being cultivated. These land areas consist of the less productive of the grazing land areas with productivity depending a great deal on the soil fertility and depth. Soil conservation practices such as limitation of stock, broadcasting of seed and fertiliser, prevention of fire and destruction of vermin are generally required. Structural soil conservation works may also be required. Those land areas in the Mandalong Valley with a Land Capability of VI may also have physical limitations consisting of impeded drainage and areas frequently or regularly inundated.

Land Capability VII

Those areas in the Mandalong Valley that have a Land Capability of VII are generally the steep sloping, shallow soil and rocky outcrop areas. These areas are best protected by green timber as adequate ground protection must be maintained in order to avoid soil erosion. Destruction of trees is not generally recommended, but partial clearing for grazing purposes under strict management controls may be practised on areas of low erosion hazard. Those areas which have been cleared in the past and are suffering from unstable soil or are erosion sites should be returned to full ground cover. Areas which can not be returned to full ground cover should be returned to timber.

Land Capability VIII

There are two areas in the Mandalong Valley which were assessed as having a Land Capability of VIII as they are subjected to permanent inundation. Therefore, these areas are unsuitable for agricultural or pastoral uses.

3.10.3 Agricultural Suitability Assessment

The Agricultural Suitability of the area mapped is based on the definitions from the Department of Urban Affairs and Planning's *Rural Land Evaluation Manual.*

The Agricultural Suitability of the assessed land in the Mandalong Valley ranges from 3 to 5 (see **Figure 3.12a**) with the current land use being a reasonable indication of the Agricultural Suitability. None of the assessed areas has an Agricultural Suitability of either 1 or 2 as the land is not capable of sustaining intensive or regular cultivation and can not produce moderate to high levels of agricultural production on a continuing basis.

<u>Agricultural Suitability 3</u>

The majority of the arable land areas in the Mandalong Valley have an Agricultural Suitability of 3 as these land areas are suited to grazing and limited cultivation in rotation with pasture. These land areas have a moderate agricultural production potential and are being utilised for agriculture in most cases. The majority of assessed properties, located in this class, are too small to enable the potential of this land to be achieved. The horse enterprises rely heavily on hand feeding due to limited areas which is not an uncommon practice in this industry, however, the beef cattle properties are unable to run herds large enough to be viable as a stand alone enterprise in a grazing situation. The possibility of hand feeding cattle in order to increase stock numbers is not a viable option at present due to the current and forecast cattle market. Also, the majority of these properties are too small to justify owning tractors and associated machinery. A reduced level of production potential is the result of the above factors combined.

The level of productivity is further limited by environmental and edaphic constraints with the possibility of soil conservation works being required in order to avoid erosion hazard and soil structure breakdown when cultivated. These land areas have all been cleared with some timber left for shade and shelter. All these land areas are gently sloping and are the more productive areas of the Mandalong Valley.

<u>Agricultural Suitability 4</u>

Some of the arable land areas and slightly timbered land areas in the Mandalong Valley have an Agricultural Suitability of 4 as these land areas are not suitable for cultivation but are quite suitable for grazing. These areas tend to have a greater slope than those areas with an Agricultural Suitability of 3 or are prone to waterlogging. These land areas can sustain either native or improved pastures established with minimum tillage techniques. The agricultural productivity of these areas may be seasonally high but overall is generally low due to a number of constraints, including scale or size of the land and operations.

Land Use of Agricultural Suitability 3 and 4 in the Mandalong Valley

Where the land is cleared the primary use is grazing cattle or horses on native or semi-improved pasture. The majority of the horse enterprises rely on hand feeding of their stock in order for them to maintain optimum performance in either the racing, competition or pleasure industries. A dairy farm is also operating in these suitability areas and it can continue to operate as a viable enterprise. There is no irrigation on the dairy which does limit the production potential of the farm, however, considering the low lying flats the rainfall is adequate to maintain the dairy as a viable enterprise. There is enough high ground to continue production in times of flood.

Areas of highly improved pasture are limited, indicating restrictive parameters to high agricultural production. The edaphic and environmental constraints, combined with the current beef cattle industry forecasts and small land holding sizes, will restrict further improvement of the land for beef cattle production.

The turf farm land has been classified as Agricultural Suitability 3. It is a high Agricultural Suitability 3 and could possibly be classed as Agricultural Suitability 2. There are a number of environmental restraints which render this land Agricultural Suitability 3, significantly, susceptibility to flooding is a risk which restricts regular cultivation. The management of the farm is such that risk of erosion is minimised by removal of only a thin layer of turf. The extensive root system of the turf remains in place. The harvesting of turf does not effectively cultivate the soil. The high yields of the agricultural system are largely a result of high levels of fertiliser application.

Agricultural Suitability 5

The majority of the timbered land areas in the Mandalong Valley have an Agricultural Suitability of 5 as they are either not suitable to agricultural production, due to major constraints, or are land areas which require substantial expenditure in order for them to be productive for agriculture.

Land Use of Agricultural Suitability 5 in the Mandalong Valley

The beef cattle forecasts along with the new native vegetation regulation and the current local Council planning will severely limit the opportunity to achieve agricultural production from the heavily timbered land areas with an Agricultural Suitability of 5 even though the Land Capability of some of these areas would allow clearing and successful pasture improvement.

The timbered land that has been classed as Agricultural Suitability 5 has varying land capability. Those timbered areas with Land Capability V and VI have been classed as Agricultural Suitability 5 primarily for economic reasons. The costs associated with improving this land to a productive level outweighs the return associated with the current beef cattle market and other more viable industries.

The timbered land, regardless of the current beef cattle market situation, will be difficult to improve due to the need to comply with the regulations of the State Environmental Planning Policy No 46 - Protection and Management of Native Vegetation (SEPP 46). Development consent would be required in the proposed development area before undertaking clearing of native vegetation which is not covered by the following exemptions:

- Minimal Clearing - Clearing of up to 2 hectares of land per annum for any contiguous land holding in the same ownership.

- Minimal Tree Cutting - Cutting no more than seven trees per hectare in any period of one year for on farm uses, including fence posts and firewood.

- Stock Fodder - Lopping for stock fodder in any period declared drought provided the vegetation's health is not affected.

- Mistletoe Control - Lopping for mistletoe control to the minimum extent necessary for the vegetation's continued health.

- Rural Structures - Clearing to a minimum extent if it is necessary for the construction, operation and maintenance of farm structures (such as dams, tracks, fences and sheds).

- Burning - Clearing if it is authorised under the Bush Fires Act 1949.

- Public Utilities and Emergency Work - Clearing to a minimum extent for the maintenance of public utilities such as power lines or which may reasonably be thought likely to be at risk of causing personal injury or damage to property.

- Planted Native Vegetation - Clearing native vegetation planted for forestry, agriculture, agroforestry, woodlots, gardens and horticultural purposes.

- Private Native Forestry - Clearing native forest in the course of its being selectively logged on a sustainable basis or managed for forestry purposes (timber production).

- Regrowth - Clearing of regrowth of less than 10 years of age if the land has been previously cleared for cultivation, pastures or forestry plantation purposes.

- Noxious Weeds and Vermin Control - Clearing to the minimum extent necessary for vermin control and clearing of proclaimed noxious weeds.

3.10.4 Conclusion

The assessed land areas range from moderately productive land areas to areas which can not be utilised for agricultural or pastoral uses at all. The majority of the Mandalong Valley can be utilised for grazing of horses and cattle with some areas suitable for rotation between crops and improved pastures. The main constraints reducing the potential for further improvement of the land are as follows:

- The valley floor has a drainage problem which restricts cultivation of the soil and pasture improvement through prolonged waterlogging, flooding and erosion;
- The size of the land holdings limit the viability of each industry on a size and scale basis and does not warrant the purchase of machinery capable of further improving the land;
- The current beef cattle market does not warrant further improvement, for this industry, at this stage;
- The regulations which have to be adhered to, with regards to timber removal, will make it more difficult to clear and improve the land currently covered with timber which is suitable for agricultural production.

3.11 LAND OWNERSHIP

3.11.1 Mining Areas

Land holdings in the subject area are principally under private ownership except for land owned by State Forests, Department of Land and Water Conservation, Roads and Traffic Authority and Lake Macquarie City Council.

91 + 24

Ninety one landholders own properties that either partially or fully overlie Area 1, while 24 landholders own property within MLA 88 and Part A405 around the western margin of Area 1.

41 + 9

Forty one landholders own property within Area 2, while nine landholders own property within MLA 88 on the eastern margin of Area 2.

Altogether, there are 150 landholders within MLA 88 (some landholders own property within Areas 1 and 2).

Properties in MLA 88 vary in size from 1 hectare to 78 hectares but most properties in Area 1 are about 16 hectares in size.

Ownership, cadastral details and proximity to the proposed mining area for each of the properties within the proposed mining areas and immediate surrounds are listed in

match 1
outside
MLA 88 ?

Table 3.28. Property locations are shown on **Figure 3.8** and are cross referenced to ownership details listed in **Table 3.28**.

Table 3.28 - Land Ownership Details – Proposed Mining Areas and Immediate Surrounds

Property Reference No	Owner	Lot/DP	Proximity of Property to Proposed Mining Areas	Residence on Property
1*	Mandalong Pastoral Management	Lot A DP 110119	Partly Area 1, partly Area 2	No
2*	Ms MG Kildey	Lot 10 DP 261891	Partly Area 2	Yes
3*	Mr & Mrs W & DA Joester	Lot 1 DP 555891	Wholly Area 2	Yes
4*	Powercoal Pty Ltd	Lots 5, 6, 8 & 10 DP 262159	Site Access	No
5*	Mr LJ Lee	Lot 55 DP 9632	Partly Area 1, partly Area 2	Yes
6*	Mrs AL Ferris	Lot 2 DP 557230	Partly Area 1, partly Area 2	Yes
7*	Mr & Mrs AM & DL Hanlen	Lot 1 DP 557230	Wholly Area 1	Yes
8*	Mr AM Hanlen	Lot 3 DP 557230	Mainly Area 1	Yes
9*	Estate Late FJ Hunkin & Mrs GG Hunkin	Lot 60 DP 9632	Partly Area 1	Yes
10*	Mr GP Andrews & Ms AM Boyton	Lot 61 DP 9632	Partly Area 1	Yes
11	Mr & Mrs R & J Kemmis	Lot 141 DP 755238	MLA 88-1	Yes
12	Mr BK Pinkerton	Lot 1 DP 248590	Partly Area 1	Yes
13	Mr & Mrs DC & LG Prescott	Lot 2 DP 248590	Wholly Area 1	Yes
14	Mr TSP Molloy & Ms JM Heffernan	Lot 4 DP 248590	MLA 88-1	Yes
15	Mr & Mrs GR & KJ Martin	Lot 66 DP 755238	MLA 88-1	Yes
16	Ms RM Trinder & Ms KJ Robinson	Lot 3 DP 248590	Partly Area 1	Yes
17*	Mr & Mrs JBC & LM Sweeney	Lot 68 DP 755238	Mainly Area 1	Yes
18	State Forests of NSW (Olney State Forest)	Lot 38 DP 755238	Partly Area 1	No
19	Mr & Mrs GR & KJ Martin	Lot 65 DP 755238	Partly Area 1	Yes
20*	Mr & Mrs MN & SG Davies	Lot 11 DP 111906	Mainly Area 1	Yes
21*	Mr & Mrs LJ & JG Monnox	Lot 47 DP 755238	Wholly Area 1	Yes
22*[1]	Mr & Mrs IR & MF Duncan	Lot 117 DP 755238	Wholly Area 1	Yes

Table 3.28 - Land Ownership Details – Proposed Mining Areas and Immediate Surrounds (cont)

Property Reference No	Owner	Lot/DP	Proximity of Property to Proposed Mining Areas	Residence on Property
23*	Mr L Jayaweera, Mr W Ariyaratne, Mr KH Karunaratne, and Mr DC Gunasekera	Lot 4 DP 755238	Wholly Area 1	Yes
24*	Mr & Mrs A & IP Anthony	Lot 33 DP 755238	Wholly Area 1	Yes
25*	Mr & Mrs RM & BD O'Hara	Lot 1041 DP 630642	Wholly Area 1	Yes
26*	Gemhulk Pty Ltd	Lot 10 DP 650915	Wholly Area 1	Yes
27*	Mr AV Bench	Lot 49 DP 815727	Wholly Area 1	Yes
28*	Mr & Mrs PJ & SM Banks	Lot 105 DP 658253	Wholly Area 1	Yes
29*	Mr PC & Mrs AM Witchard	Lot 6 DP 111906	Wholly Area 1	Yes
30*	Mr & Mrs TJ & R Patience	Lot 88 DP 755238	Wholly Area 1	Yes
31	State Forests of NSW	Lot 95 DP 755238	Partly Area 1	No
32*	Mr PD Martin & Deceased JC Martin	Lot 862 DP 835160	Mainly Area 1	Yes
33*	Mr & Mrs PR & SF Pannekoek	Lot 861 DP 835160	Wholly Area 1	No
34*	Mr TW Brown	Lot 69 DP 772148	Wholly Area 1	Yes
35*	Mr TW Brown	Lot 24 DP 755238	Wholly Area 1	No
36	State Forests of NSW	Lot 94 DP 755238	Partly Area 1	No
37*	Mandalong Pastoral Management	Lot 46 DP 755238	Wholly Area 1	No
38*	Mr & Mrs BJ & RE Howe	Lot 732 DP 719040	Wholly Area 1	Yes
39*	Eltro Investments Pty Ltd	Lot 731 DP 719040	Wholly Area 1	Yes
40*	Mr & Mrs K & JM Satchwell	Lot 51 DP 851636	Wholly Area 1	Yes
41*	Mr & Mrs MW & SL McCready	Lot 29 DP 755238	Wholly Area 1	Yes
42*	Mr & Mrs SW & KM Pitt	Lot 25 DP 755238	Wholly Area 1	Yes
43*	Mr & Mrs JH & EJ Catterson	Lot 8 DP 755238	Wholly Area 1	Yes
44*	Mrs EM Ruytenberg	Lot 9 DP 800491	Wholly Area 1	Yes
45*	Mr & Mrs BJ & BD Brockhill	Lot 311 DP 625394	Wholly Area 1	Yes
46*	Tinkerbell Rentals Pty Ltd	Lot 18 DP 813385	Wholly Area 1	Yes
47*	Mr ER Smith and Mr & Mrs BI & AR Baillie	Lot 17 DP 813385	Wholly Area 1	Yes
48*	Mr & Mrs K & JM Satchwell	Lot 52 DP 851636	Wholly Area 1	No
49*	Mandalong Pastoral Management	Lot 28 DP 755238	Wholly Area 1	Yes
50*	Mr & Mrs RG & LR Hall	Lot 57 DP 755238	Wholly Area 1	Yes
51*	Inghams Enterprises Pty Ltd	Lots 94 & 95 DP 9632	Wholly Area 1	No
52*	Mr RK Douglas	Lot 93 DP 9632	Wholly Area 1	No
53*	Mr RK Douglas	Lot 92 DP 9632	Wholly Area 1	Yes
54*	Mr DC Melrose	Lot 181 DP 859434	Wholly Area 1	Yes
55*	Mr KM Walker	Lot 11 DP 582283	Wholly Area 1	Yes
56*	Mandalong Pastoral Management	Lot 12 DP 582283	Wholly Area 1	Yes
57*	Mr & Mrs GJ & DA Jones	Lot 180 DP 859434	Wholly Area 1	Yes

Table 3.28 - Land Ownership Details – Proposed Mining Areas and Immediate Surrounds (cont)

Property Reference No	Owner	Lot/DP	Proximity of Property to Proposed Mining Areas	Residence on Property
58*	Mr & Mrs R & VM Birt	Lot 1 DP 125136	Wholly Area 1	Yes
59*	Mandalong Pastoral Management	Lot 580 DP 733227	Wholly Area 1	No
60*	Mandalong Pastoral Management	Lot 902 DP 541065	Partly Area 1, partly Area 2	Yes
61*	Mr & Mrs JN & BJ Frost	Lot 903 DP 542306	Mainly Area 1, partly Area 2	Yes
62*	Mr & Mrs AB & MM Heaney	Part Lot PT902 DP 542306	Partly Area 1, partly Area 2	Yes
63*	Mr & Mrs GR & MK Jones	Part Lot PT901 DP 542306	Partly Area 1, partly Area 2	Yes
64*	Mr & Mrs JM & LE Ednie	Lot 2 DP 504749	Wholly Area 1	Yes
65*	Ms MB Muller	Lot 6 DP 800491	Partly Area 1, partly Area 2	Yes
66*	Mr AP & Ms LJ Prpic	Lot 7 DP 800491	Wholly Area 1	Yes
67*	Chapman Productions Pty Ltd (Mr E Chapman)	Lot 16 DP 813385	Wholly Area 1	Yes
68*	Mr & Mrs JE & JM Howe	Lot 22 DP 812406	Wholly Area 2	Yes
69*	Mr & Mrs MJ & A Astles	Lot 61 DP 755238	Wholly Area 1	Yes
70*	Mr M Tunbridge	Lot 54 DP 755238	Wholly Area 1	Yes
71*	State Forests of NSW	Lot 45 DP 755238	Wholly Area 1	Yes
72*	State Forests of NSW	Lot 90 DP 755238	Mainly Area 1	No
73*	Mr John Allen	Lot 93 DP 755238	Partly Area 1	No
74*	Mr & Mrs WP & V Kelly	Lot 76 DP 755238	Wholly Area 1	No
75*	Mr RJ Parker	Part Lot 75 DP 755238 and Lots 20 & 23 DP 812406	Wholly Area 1	Yes
76*	Mr GD & Mrs JV Marr	Lot 178 DP 755238	Wholly Area 1	No
77*	Mr GD & Mrs JV Marr	Lot 42 DP 755238	Wholly Area 1	Yes
78*	Department of Land & Water Conservation	Lot 43 DP 755238	Wholly Area 1	No
79*	Mr & Mrs FN & JM Lee	Lot 1 DP 382470	Wholly Area 1	Yes
80*	Mr ET Chapman	Lot 1 DP 126594	Mainly Area 1	No
81*	Mr RB Ward, Miss JS Ward, Ms JR Ward	Lot 24 DP 812406	Wholly Area 1	No
82*	Mr RJ Armstrong	Lot 1 DP 957458	Wholly Area 1	Yes
83*	Mr & Mrs SM & MD Hamman	Lot 31 DP 826779	Wholly Area 1	Yes
84*	Mr & Mrs TR & AJ Whittaker	Lot 3 DP 957458	Wholly Area 1	Yes
85*	Mr WJ Page	Lot 4 DP 957458	Wholly Area 1	No
86*	Mr ET Chapman	Lot 28 DP 829792	Wholly Area 1	No
87*	Mr ET Chapman	Lot 27 DP 829792	Wholly Area 1	No
88*	Mr ET Chapman	Lot 1 DP 126595	Wholly Area 1	Yes
89*	Mr PA Hunkin	Lot 41 DP 755238	Wholly Area 1	No

Table 3.28 - Land Ownership Details – Proposed Mining Areas and Immediate Surrounds (cont)

Property Reference No	Owner	Lot/DP	Proximity of Property to Proposed Mining Areas	Residence on Property
90*[1]	Mrs JG Hunkin	Lot 1 DP 168774	Wholly Area 1	No
91*	Mr & Mrs TG & LH James	Lot 6 DP 755238	Mainly Area 1	Yes
92*	Mr & Mrs GJ & MC Hellier	Lot 56 DP 755238	Wholly Area 1	Yes
93	Mrs EA Miller	Lot 67 DP 755238 & Lot 1 DP 111906	MLA 88-1	Yes
94*	Inghams Enterprises Pty Ltd	Lot 95 DP 9632	Mainly Area 1	Yes
95*	Mrs CJ Deaves	Lot 96 DP 9632	Partly Area 1	Yes
96*	Mrs CJ Deaves	Lot 97 DP 9632	Partly Area 1	No
97*	Mrs CJ Deaves	Lot 98 DP 9632	Partly Area 1	No
98*	K & C Gibson & Son Pastoral Co	Lot 99 DP 9632	Partly Area 1	Yes
99	Mrs KA Buchanan	Lot 100 DP 9632	MLA 88-1	Yes
100	Mr & Mrs NS & RC McGlynn	Lot 101 DP 9632	MLA 88-1	Yes
101	Mrs NM Munro	Lot 102 DP 9632	MLA 88-1	Yes
102	Mr AB Putnam, Mr D Cowan & Mr RB Putnam	Lot 97 DP 755238	Wholly Area 1	No
103	Mr & Mrs LD & KV Emerson & Mrs DA Emerson	Lot 81 DP 755238	Partly Area 1	Yes
104	Mr M Brown	Lot 1 DP 919600	MLA 88-1	No
105	Mr & Mrs KA & MI Dunn	Part Lot 7 DP 755238	MLA 88-1	Yes
106	Mr MC Fitzpatrick & Miss YE Chapman	Lot 154 DP 755238	MLA 88-1	Yes
107	Ms N Wells	Lot 16 DP 755238	MLA 88-1	Yes
108	Mr & Mrs WJ & AA Vandenberg	Lot 113 DP 755238	Mainly Area 1	Yes
109	Mrs JM Loebel	Lot 18 DP 755238	Partly Area 1	Yes
110	Mr & Mrs BM & SM Moir	Lot 51 DP 854475	Mainly Area 1	Yes
111	Fernlic Pty Ltd	Lot 50 DP 854475	Partly Area 1	Yes
112	Mr & Mrs WLA & HE Wheeler	Lot 134 DP 755223	MLA 88-1	Yes
113	Mr & Mrs RJ & RI Arrow	Lot 95 DP 755223	MLA 88-1	Yes
114	Mrs CJ Deaves	Lots 1, 2 & 3 DP 868955 (previously Lot 133 DP 755223)	Partly Area 1	No
115	Mr & Mrs D & BJ See	Lot 1042 DP 630642	Wholly Area 1	Yes
116*	Mr & Mrs RS & SG Wall	Lot 89 DP 755238	Mainly Area 1	Yes
117	Mr & Mrs BM & SM Moir	Lot 158 DP 755238	Mainly Area 1	No
118*	Mr & Mrs PP & L Calvert	Lot 96 DP 755238	Partly Area 1	Yes
119	Miss MB & Miss HE Deaves	Lot 130 DP 755238	Partly Area 1	No
120	Department of Land & Water Conservation	DP 19545	MLA 88-1	No
121	Mrs CJ Deaves	Lot 149 DP 755223	MLA 88-1	No
122*	Mr & Mrs BW & JL Radnidge	Lot 116 DP 755238	Partly Area 1	Yes
123	Mr & Mrs LM & BA Mitchell	Lot 153 DP 755238	Partly Area 1	No

Table 3.28 - Land Ownership Details – Proposed Mining Areas and Immediate Surrounds (cont)

Property Reference No	Owner	Lot/DP	Proximity of Property to Proposed Mining Areas	Residence on Property
201	Mr & Mrs RW & DM Ford	Lot 2 DP 552883	MLA 88-1	No
202	Silver Wings Farm Pty Ltd	Lot 151 DP 755238	MLA 88-1	Yes
203	Mr ET Chapman	Lot 2 DP 126594	Partly Area 1	No
204	Ms CE Kuivisto	Lot 2 DP 840145	MLA 88-1	No
205	Ms CE Kuivisto	Lot 1 DP 840145	MLA 88-1	Yes
206*	Mr & Mrs IR & EM Sparks	Lot 70 DP 755238	MLA 88-1	Yes
207*	Mr & Mrs M & P Roberts	Lot 1 DP 3039	Partly Area 1	Yes
208	Mr & Mrs GIS & ER Smith	Pt Lot 146 DP 755238	Outside MLA 88	Yes
209	Mr & Mrs RW & DM Ford	Lot 4 DP 568228	Outside MLA 88	Yes
210	Mr & Mrs JT & HA Fawcett	Lot 2 DP 851648	MLA 88-1	Yes
211*	Mr AE Hodges	Lot 1 DP 851648	MLA 88-1	Yes
212*	Mr & Mrs ET & JH Chapman	Lot 3 DP 3039	Partly Area 1	Yes
213*	Mr & Mrs RJ & MA Woodorth	Lot 2 DP 755238	Partly Area 1	Yes
214*	Mr & Mrs MR & LM Evans	Lot 198 DP 727714	MLA 88-1	Yes
215	Mr AJ Millar & Miss TM Clark	Lot 3 DP 553093	MLA 88-1 (house outside lease application area)	Yes
216	Mr & Mrs A & P Brunyee	Lot 2 DP 553093	Outside MLA 88	Yes
217	Mr ET Chapman	Lot 44 DP 755238 & Lot 53 DP 755238	MLA 88-1	No
218*	Estate Late Mr W Chapman	Lot 17 DP 755238	Partly Area 1	Yes
219*	Estate Late Mr W Chapman	Lot 4 DP 168774	Wholly Area 1	No
220*	Mr & Mrs WW & T Corkery	Lot 3 DP 168447	Wholly Area 1	No
221*	Mrs JG Hunkin	Lot 2 DP 168774	Wholly Area 1	No
222*	Mr ET Chapman	Lot 179 DP 755238 and Lot 180 DP 755238	Partly Area 1	No
223	Mr ET Chapman and Mr W Chapman	Lot 52 DP 755238	Partly Area 1	No
224*[1]	Mr & Mrs T & MA Mansfield	Lot 2 DP 862597	Wholly Area 2	Yes
225*	Mr & Mrs ETW & JR Marland	Lot 6 DP 261460	Partly Area 1, mainly Area 2	No
226	Mrs NP Fisher	Lot 52 DP 867220	Partly Area 2	Yes
226A	Mr NJ Harland	Lot 51 DP 867220	Partly Area 2	No
227	Fernlic Pty Ltd	Lot 1 DP 862597	Partly Area 1, partly Area 2	No
228	Mr JF Hennessy	Lot 1 DP 261460	Outside MLA 88	Yes
229	Mrs HM White	Lot 2 DP 261460	Outside MLA 88	Yes
230	Mr & Mrs KH & JA Hasler	Lot 3 DP 261460	Partly Area 2	Yes
231	Mr & Mrs GE & EM Hanks	Lot 4 DP 261460	Partly Area 2	Yes
232	Mr & Mrs LJ & F Hall	Lot 19 DP 13318	Wholly Area 2	No
233[1]	Mr & Mrs DM & KA Brierley	Lot 18 DP 13318	Wholly Area 2	Yes
234	Mr JR Lain & Ms MJ King	Lot 17 DP 13318	Wholly Area 2	Yes
235	Mr & Mrs RP & LJ Sutherland	Pt Lot 8 DP 13318	Wholly Area 2	Yes

Table 3.28 - Land Ownership Details –
Proposed Mining Areas and Immediate Surrounds (cont)

Property Reference No	Owner	Lot/DP	Proximity of Property to Proposed Mining Areas	Residence on Property
236	Mr CV Crook	Lot 9 DP 13318	Wholly Area 2	No
237	Mr CV Crook	Pt Lot 10 DP 13318	Wholly Area 2	Yes
238	Mr & Mrs S & I Denmark	Lot 5 DP 324031	Wholly Area 2	Yes
239	Lake Macquarie City Council	Lot 1 DP 324031	Wholly Area 2	No
240	Mr & Mrs LJ & JM Alexander	Lot 4 DP 324031	Wholly Area 2	Yes
241*	Inghams Enterprises Pty Ltd	Lot 2 DP 555891	Wholly Area 2	No
242*	Inghams Enterprises Pty Ltd	Lots 2 & 3 DP 555891	Mainly Area 2	Yes
243*	Mr H Menzies	Lot 4 DP 555891	Partly Area 2	Yes
244	Mrs MJ Hunt	Lot 3 DP 13318	Partly Area 2	Yes
245	Lake Macquarie City Council	Lot 2 DP 324031	Wholly Area 2	No
246	Mr & Mrs VK & PI Thomas	Lot 15 DP 13318	Mainly Area 2	Yes
247	Mr F Bukowski	Lot 16 DP 13318	Mainly Area 2	No
248	Mr & Mrs JD & MI Moore	Lot 22 DP 13318	Mainly Area 2	Yes
249	Mr & Mrs LR & BJ Arnett	Lot 212 DP 553196	Partly Area 2	Yes
250	Mr & Mrs KC & AT Howard	Lot 211 DP 553196	Partly Area 2	Yes
251	Mr & Mrs AE & GM Mould	Lot 20 DP 13318	Partly Area 2	Yes
252	Mr & Mrs NW & R Greenwood	Lot 23 DP 13318	MLA 88-2	Yes
253	Mr SD Smith & Ms DJ McCann	Lot 24 DP 13318	MLA 88-2	Yes
254	Mr CA Schmidt	Lot 25 DP 13318	Partly Area 2	Yes
255	Lake Macquarie City Council	Lot 14 DP 661114	Wholly Area 2	No
256	The Commissioner for Main Roads	Lot 14 DP 261890	Partly Area 2	No
257	Lake Macquarie City Council	Lot 12 DP 261890	Partly Area 2	No
258	The Direct Access Group Pty Ltd	Lot 2 DP 502305	Partly Area 2	No
259	The Direct Access Group Pty Ltd	Lot 6 DP 613014	Partly Area 2	No
260	Department of Land and Water Conservation	Part R 91166	Mainly Area 2	No
261	Mr & Mrs BR & DJ Arthurson	Lot 30 DP 702647	Wholly Area 2	Yes
262	Roads & Traffic Authority of NSW	Lot 31 DP 702647	Wholly Area 2	No
263	Roads & Traffic Authority of NSW	Lot 10 DP 261890	Wholly Area 2	No
264	AW Mutch Pty Ltd	Lot 481 DP 755242	Partly Area 2	No
265	Roads & Traffic Authority of NSW	Lot 13 DP 621372	MLA 88-2	No
266	Roads & Traffic Authority of NSW	Lot 12 DP 621372	MLA 88-2	No
267	Roads & Traffic Authority of NSW	Lot 1 DP 623517	MLA 88-2	No
268	Palmarc Investments Pty Ltd	Lot 5 DP 701643	Partly Area 2	No

Table 3.28 - Land Ownership Details – Proposed Mining Areas and Immediate Surrounds (cont)

Property Reference No	Owner	Lot/DP	Proximity of Property to Proposed Mining Areas	Residence on Property
269	Mr & Mrs DC & RM Ford	Lot 1 DP 775563	MLA 88-2	Yes
270	Mr & Mrs J & LM Tracey	Lot 2 DP 775563	MLA 88-2	Yes
271	Department of Land and Water Conservation	Lot 470 DP 755242	Outside MLA 88	No
272	Department of Land and Water Conservation	Lot 501 DP 755242	Outside MLA 88	No
273	Mr A Moss	Lot 1 DP 629027	Outside MLA 88	No
274	Mr A Moss	Lot 2 DP 629027	Outside MLA 88	No
275	Mr A Moss	Lot 1 DP 129520	Outside MLA 88	No
276	Mr A Moss	Lot 2 DP 129520	Outside MLA 88	No
277	Mr A Moss	Lot 3 DP 629027	Outside MLA 88	No
278	Ms KT Lendon & Mr GJ Lendon	Lot 1 DP 357347	MLA 88-2	No
279	Mature Adult Communities Pty Limited	Lot 34 DP 610386	MLA 88-2	No
281	Mr BC Curvey-Moore	Lot 33 DP 610386	MLA 88-2	Yes
282	Department of Land & Water Conservation	Lot TR DP 19006	Partly Area 2	No
283	Palmarc Investments Pty Ltd	Lot 159 DP 755238	Wholly Area 2	No
284	Asher Broiler Co Pty Ltd	Lot 63 DP 858044	MLA 88-2	Yes

* *Land holdings which are wholly or party located on the Mandalong Valley floodplain.*
1 *Properties that have been sold since land ownership details were compiled.*

3.11.2 Mine Access Site

The proposed Mine Access Site forms part of Lots 5, 6, 8 and 10 DP 262159 which have a combined area of approximately 40 hectares and are owned by Powercoal. In considering potential impacts of establishing and operating the Mine Access Site, ownership details for properties immediately to the east of the F3 Freeway have been compiled and are listed in **Table 3.29**. Locations of these properties are shown on **Figure 3.8**. Properties to the south and west of the Mine Access Site form part of MLA 88 and ownership details for these properties are listed in **Table 3.28**.

Table 3.29 - Properties East of Mine Access Site

Property Reference No	Owner	Lot/DP	Proximity of Property to Proposed Mining Areas	Residence on Property
300	Mr & Mrs BR & BD Martin	Lot 32 DP 9632	Outside MLA 88	Yes
301	Mr & Mrs BR & BD Martin	Lot 34 DP 9632	Outside MLA 88	Yes
302	Mr & Mrs ML & JA Arthur	Lot 36 DP 9632	Outside MLA 88	Yes
303	Ms N Hine	Lot 1 DP 10720	Outside MLA 88	Yes
304	Mr CP Magill	Lot 2 DP 10720	Outside MLA 88	No
305	Mr & Mrs VH & CB Deaves	Lot 48 DP 9632 & Lot 5 DP 775655	Outside MLA 88	Yes
306	Mr CP Magill	Lot 3 DP 10720	Outside MLA 88	Yes
307	Commissioner for Main Roads	Lot 10 DP 775655	Outside MLA 88	No
308	Mr & Mrs JB & MT Enright	Lot 1 DP 262159	Outside MLA 88	Yes
309	Mr & Mrs KW & LP Smith	Lot 11 DP 262159	Outside MLA 88	Yes
310	Unknown (recently sold)	Lot 2 DP 262159	Outside MLA 88	Yes
311	Mrs KL Case	Lot 9 DP 262159	Outside MLA 88	Yes
312	Mr R McLean	Lot 3 DP 262159	Outside MLA 88	No
313	Mr RB Mullard	Lot 7 DP 262159	Outside MLA 88	Yes
314	Mr R McLean	Lot 4 DP 262159	Outside MLA 88	Yes
315	Mr D Waldon	Lot 2 DP 529914	Outside MLA 88	Yes
316	Mr & Mrs MJ & LE Hine	Lot 5 DP 10720	Outside MLA 88	Yes
317	Mr & Mrs G & CJA Flipp	Lot 12 DP 777034	Outside MLA 88	Yes
318	Mr RN Munro	Lot 11 DP 777034	Outside MLA 88	Yes

3.11.3 Cooranbong Colliery

Cooranbong Colliery site is owned by Powercoal and forms part of CCL 762.

3.11.4 Private Haul Road Extension and Reject Emplacement Area

The proposed private haul road and reject emplacement area are located on Crown Land which forms part of CCL746 which is held by Powercoal. Lake Macquarie City Council currently operates Hawkmount Quarry (the proposed reject emplacement area) and has a permissive occupancy for the site from Department of Land and Water Conservation. It is envisaged that within approximately 2 to 3 years, viable gravel reserves at the quarry will be exhausted and at this time the permissive occupancy for the site will be cancelled and the site will form part of CCL746.

The proposed new haul road will cross over the corridor for the Main Northern Railway.

3.12 LAND USE

Land use within the lease application area has been classified according to dominant use. This classification also takes into consideration the amount of native forest that remains within each of land use areas (see **Table 3.30** and **Figure 3.13**).

Approximately half of Area 1, the proposed mining area, has been cleared, mainly for grazing cattle and horses and the other half remains forested. A small percentage (3%) of Area 1 is State Forest, while about a quarter of Area 1 (24%) is native forest associated with residences or not developed in any way. A further quarter of Area 1 (24%) is native forest associated with grazing. It is likely that cattle and/or horses have access to these forested areas.

Specialised land uses occurring in Area 1 are shown on **Figures 3.13** and **3.14**. Specialised land uses include:

- market gardening;
- turf farming;
- chicken farming;
- boarding kennels;
- hostel for disabled people;
- transmission lines.

Land holdings supporting these uses occupy a small percentage of Area 1 (about 3.7%).

Land bordering Area 1 within the Mining Lease Application area is largely covered with native forest, approximately half of which is State Forest.

Area 2 consists mainly of cleared land (58%) devoted to cattle and horse grazing. About 33% of Area 2 is covered with native forest. About a quarter of this native forest is wildlife refuge and a third is associated with grazing. The remaining native forest is either undeveloped or associated with residences. A small percentage (2%) of Area 2 is occupied by chicken farming. The remaining 9% of Area 2 is occupied by the F3 Freeway, Chicken Breeding farms, a mulch processing site and a small part of Morisset Golf Course in the north eastern corner of Area 2.

The remaining area within MLA 88 to the east of Area 2 is mainly covered with native forest (83%) which is largely undeveloped. About half of this forest is a Reserve for Flora and Fauna. About 9% of this area has been cleared for grazing cattle and horses. The Sydney-Newcastle Freeway occupies a significant part of this area (8%).

Table 3.30 - Land Use

			Area 1		Area 2	
			(ha)	% of Area	(ha)	% of Area
CLEARED LAND	Residential		41	3	9	1.5
	Grazing	Total	618	42	333	58
		Cattle	(399)	(27)	(310)	(54)
		Horses	(172)	(12)	(4)	(0.7)
		Cattle and horses	(47)	(3)	(19)	(3.3)
	Special Uses	Nursery	0.07			
		Market garden	0.3			
		Turf farm	3	0.2		
		Chicken farm	25	1.7	14	2
		Hostel for disabled people	2	0.1		
		Transmission lines	26	1.7		
		Sydney-Newcastle Freeway			9	1.5
		Processing mulch			7	1.5
		Golf Course			12	2
NATIVE FOREST	Residential or not developed		366	24	82	14
	Associated with grazing		359	24	60	11
	Flora & Fauna Reserve					
	Wildlife Refuge		4	0.3	48	8
	State Forest		51	3		
TOTAL AREA			1495	100	574	99.5
TOTAL CLEARED LAND			715	48.7	384	66.5
TOTAL NATIVE FOREST			780	51.3	190	33

3.13 INFRASTRUCTURE AND PUBLIC SERVICES

3.13.1 Electricity

One 330kV transmission line (No. 24 owned by TransGrid) traverses Area 1 (see **Figure 3.14**). Thirteen pylons ranging in height from 18.8m to 33.8m are located on the proposed mine plan. Their heights, measured from ground level to the bottom of the steel crossarm, are summarised in **Table 3.31**.

13 pylons
traverses Area 1

Table 3.31 - Heights of Pylons on Transmission Line No 24

Pylon No	Height (m)
46	28.34
47	25.90
48	30.48
49	18.80
50	28.34
51	24.68
52	28.04
53	28.34
54	31.70
55	29.26
56	30.48
57	33.80
58	25.90
59	24.60

No 330 kV transmission lines cross Area 2.

Another 330 kV transmission line (No. 25/26 - Eraring-Munmorah-Sydney West, owned by TransGrid) crosses the southern corner of the area to the east of Area 2. Pylons 23, 24 and 25 are located within MLA 88 to the east of Area 2.

Electricity distributor, energyAustralia, maintains an extensive network of electricity supply lines throughout the lease application area (see **Figure 3.14**). There are approximately 6 km of pole-mounted 11 kilovolt electricity lines and about 0.5 km of low voltage (433 volts) cables in Area 1.

In Area 2, there are approximately 1.7 km of pole-mounted 11 kilovolt electricity lines, with approximately 0.7 km in the area to the east of Area 2. In addition, approximately 150 metres of low voltage (433 volts) lines occur within MLA 88 to the east of Area 2.

3.13.2 Water

There are no public water mains in Area 1 or Area 2.

A privately installed water supply connected to the Hunter Water Corporation's main at the southern end of residential development on Crawfords Road, Cooranbong provides water to Inghams Chicken Breeder Farm (Reference No. 94). This water supply is delivered to a storage tank on the chicken farm via a buried polythene pipe which is located along the western side of Crawfords Road. The pipe passes under Deaves Road at its intersection with Crawfords Road, and lies along the western side of Deaves Road as shown on **Figure 3.14**. The storage tank and about 50 metres of polythene pipe are included in Area 1.

Water is distributed within Inghams Chicken Breeder Farm and the adjacent chicken farm through PVC pipes. It is pumped from the storage tank to a header tank near the northwestern corner of Inghams Chicken Breeder Farm and gravity fed to buildings on both farms.

Underground irrigation systems have been installed on several other properties within Area 1 (eg Property Reference Nos 27, 40, 47 (see **Figure 3.8**)).

3.13.3 Telephone

Telstra has an extensive network of buried cables throughout the area, as shown on **Figure 3.14**. All the cables are buried except for 150 metres of pole-mounted cable along Mandalong Road. Telstra has also installed optical fibre cable along Deaves Road and Sauls Road.

Buried optical fibre cables connecting Sydney and Brisbane are installed parallel to the Sydney-Newcastle Freeway. Telstra's optical fibre cable is on ~~the western side of~~ the freeway and Optus' optical fibre cable is on the eastern side.

3.13.4 Roads

Two major sealed roads traverse Area 1 - Deaves Road and Mandalong Road. Deaves Road provides access to Cooranbong to the north and Mandalong Road provides access to the Sydney-Newcastle Freeway and Morisset to the east, and Dooralong to the south.

Sealed roads in Area 1 total 6.6 km. In addition, 14.5 km of unsealed roads traverse Area 1.

A total of 6.6 km of roads traverse Area 2.

The roads are summarised in **Table 3.32**.

Table 3.32 - Road Types

Area 1			
Road Name	**Total Length Within Area 1 (km)**	**Length Sealed (km)**	**Length Unsealed (km)**
Babers Road (discontinuous)	1.4		1.4
Browns Road	2.3	0.4	1.9
Deaves Road	1.1	1.1	
Frost Road	0.1		0.1
Little Valley Road	1.0		1.0
Mandaluck Chase	0.9		0.9
Mandalong Road	5.1	5.1	
Prickly Ridge Forest Road	1.3		1.3
Sauls Road	3.5		3.5
Taylors Road	0.7		0.7
Tobins Road	1.0		1.0
Unnamed Forest Track	2.3		2.3
Walls Lane	0.4		0.4
Totals	21.1	6.6	14.5
Area 2			
Road Name	**Total Length Within Area 1 (km)**	**Length Sealed (km)**	**Length Unsealed (km)**
Crooks Road	3.2		3.2
Mandalong Road	0.4	0.4	
Midway Road	0.2		0.2
Old Maitland Road	0.9		0.9
Old Wyee Road	0.5		0.5
Sydney-Newcastle Freeway	0.8	0.8	
Wyee Road	0.6	0.6	
Totals	6.6	1.8	4.8

3.13.5 Survey Marks

A total of 33 survey marks are located within the lease application area. Their position, height and accuracy details are given in **Table 3.33**. Only those marks with horizontal and vertical accuracies of 1 to 5 are considered sufficiently accurate for use in survey work. Thirteen marks achieve this level of accuracy.

Nine survey marks are located within Area 1; these are highlighted in **Table 3.33**. Only one of these marks, SSM 20774, has a sufficiently high accuracy for use in survey work. No trigonometrical stations are located within Area 1.

One trigonometrical station, named Russell, occurs in Area 2, located at the northern end of a gravel road at a location referred to as "Off Binbrook Road".

Table 3.33 – Land Information Survey Marks within MLA 88

Counter	Station Type	Station Number	Easting	Northing	RL	Accuracy Horizontal	Accuracy Vertical
1	PM[1]	22916	344323.978	1332859.001	37.035	2	2
2	PM	23871	344410	1331840	25.180	8	1
3	PM	23872	344348.068	1332883.450	36.777	2	1
4	PM	31949	344213.385	1333276.986	25.148	2	2
5	PM	31950	344252.377	1333276.548	23.626	2	2
6	PM	45988	344035.274	1330307.550	67.75	3	6
7	PM	45989	344326.609	1331121.796	51.30	3	6
8	PM	45990	344303.521	1331885.428	35.10	3	6
9	PM	47600	343041.457	1333629.489	0	3	
10	PM	56249	340540	1333160	0	8	
11	PM	56257	340820	1333300	0	8	
12	PM	73087	339190	1331900	0	8	
13	PM	73090	338900	1331580	0	8	
14	SSM[2]	9451	343170	1333930	16.973	8	2
15	SSM	9452	342960	1332950	20.236	8	2
16	SSM	9453	342267.68	1332864.44	23.0	5	7
17	SSM	9458	341500	1334300	13.165	9	2
18	SSM	9459	340200	1334500	24.027	9	2
19	SSM	9460	339100	1334900	20.491	9	2
20	SSM	10583	344410	1332110	23.311	8	2
21	SSM	20774	339957.68	1336620.11	171.04	5	5
22	SSM	28353	344102.708	1332222.264	25.39	3	5
23	SSM	28354	344042.474	1332625.585	42.40	3	5
24	SSM	28355	343884.157	1332996.547	39.71	3	5
25	SSM	28356	343744.512	1333294.230	41.19	3	5
26	SSM	28358	343134.384	1333913.701	18.092	3	3
27	SSM	28359	342699.228	1333963.182	13.831	3	3
28	SSM	39127	337172.06	1335679.86	43.4	5	7
29	SSM	39129	342290.06	1332885.65	20.8	5	7
30	SSM	39130	341147.91	1336195.58	23.4	5	7
31	SSM	43169	338892.5	1334980.1	0	6	
32	TRIG[3]	Cooranbong	339670.336	1336764.756	228.6	1	7
33	TRIG	Russell	342656.604	1331000.838	182.39	1	5

Information as at 8 July 1997 supplied by Survey Services – Land Information Centre
[1]PM Permanent Mark
[2]SSM State Survey Mark
[3]TRIG Trigonometrical Station
Highlighted survey marks occur within Area 1.

3.13.6 Bushfire Brigade

Mandalong Bushfire Brigade equipment is housed in a galvanised iron shed on Mandalong Road in Area 1.

3.13.7 Dwellings

Ninety-five dwellings of varied construction are located within or adjacent to Area 1 (see **Figure 2.4**). These include Tallowood Lodge, a hostel on Sauls Road for disabled people.

Seventeen dwellings are located in Area 2 and eight dwellings are located within the Mining Lease Application area to the southeast of Area 2 (see **Figure 2.4**). Materials used to construct the dwellings are summarised in **Tables 3.34** and **3.35** for Area 1 and Area 2 respectively.

Table 3.34 – Dwellings within or adjacent to Proposed Mining Area 1

Type	Foundation Unspecified	Piers	Slab	Total
Area 1				
Single Storey Brick	6	7	29	42
Double Storey Brick			2	2
Single Storey Light Weight Cladding	6	28	14	48
Other	2[1]		1[2]	3
Total				95

1 *Two storey stone house and two storey light weight cladding.*
2 *Two storey mud brick house.*

Table 3.35 – Dwellings within Area 2

Type	Foundation Unspecified	Piers	Slab	Total
Area 2				
Single Storey Brick	4	1	3	8
Single Storey Light Weight Cladding	2	6	1	9
Total				17

1 *Two Storey Stone*
2 *Two Storey Mud Brick*

3.13.8 Other Major Buildings

Sixteen sheds used for chicken breeding are also located within Area 1. These steel-framed sheds are constructed on concrete slabs which are 58 metres long by 14 metres wide.

Six sheds used for chicken farming are located in Area 2. These sheds are 101 metres long and 14 metres wide, built on piers with slatted floors.

3.13.9 Other Private Infrastructure

Privately built infrastructure varies with land use and includes:

* Garages
* Sheds
* Access Tracks
* Pools
* Underground irrigation systems
* Dairies
* Stables
* Stockyards
* Tennis Courts
* Feed Bins
* Training Tracks
* A Cricket Pitch
* A small Airstrip

3.14 VISUAL AMENITY

The Lower Hunter Landscape Improvement Study (DEP 1983) and Draft Lake Macquarie Council Scenic Quality Plan (Clouston 1997) provide principles for consideration of the visual amenity of the proposed development sites.

<u>Mining Lease Application Area (Areas 1 and 2)</u>

The lease application area consists primarily of rural and rural-residential development in rolling terrain leading to the base of the Watagan Mountains. Significant areas have been cleared for purposes associated with these rural and rural-residential land uses. The lease application area is contained within a transition zone between the urban areas of Morisset, Wyee and Cooranbong. The transition is interrupted by the F3 expressway running adjacent to, and in part inside, the eastern boundary of the lease application area effectively separating Morisset and Wyee from the lease application area.

<u>Mine Access Site</u>

The Mine Access Site is located immediately adjacent to the western side of the Freeway and to the north of Mandalong Road. The site is gently sloping with extensive vegetation around the perimeter. From residences towards the southern end of Gimberts Road the site provides a vegetated distant foreground to the Watagan Mountains. The immediate foreground, for those residences, is dominated by vegetation on the eastern side the southbound exit from the Freeway and by the dual carriageways of the Freeway together with the entry and departure ramps serving Mandalong Road. Residences further to the north along Gimberts Road are unobstructed by vegetation on that side of the Freeway but the views are generally towards the north of this site. The site is also more distant from these residences with more ground intervening between these residences and the Freeway.

Cooranbong Colliery

Cooranbong Colliery site is shielded visually from surrounding residences by intervening terrain and vegetation.

Coarse Reject Emplacement Area and Private Haul Road

The Coarse Reject Emplacement Area is within a forested area on undulating terrain. The proposed emplacement site has been previously quarried and consequently contributes little to the visual amenity of the area. The Private Haul Road is composed primarily of existing gravel roads within the Cooranbong Colliery Lease. Short extensions of the existing gravel roads to the south and north respectively, connect the proposed haul road to the colliery site and existing haul road.

3.15 ABORIGINAL HERITAGE

The assessment of Aboriginal heritage included a desktop study and field survey within all areas proposed to be disturbed by surface works. Surface surveys included the Mine Access Site, Downcast Shaft site, two extensions to the Cooranbong Colliery (Coal Preparation Plant and Run of Mine stockpile area), the private haul road (and associated options) and the coarse reject emplacement area.

Underground mining will predominantly only affect the ground surface in terms of mine subsidence. Subsidence may lower the elevation of archaeological material as the ground surface lowers but in general terms has low potential for destruction of archaeological sites. Surface drainage works may have the potential to impact on archaeological resources. The location and extent of these works will be determined in consultation with land holders and relevant government authorities. It is considered most appropriate that archaeological surveys for any surface works be conducted, in accordance with an appropriate consent condition, prior to these works being undertaken.

For these reasons a review of previous archaeological research was conducted which when related to the environmental characteristics of Areas 1 and 2 and the results of field survey undertaken in other areas for this project, predicts with a high level of confidence the nature and extent of archaeological evidence. This is discussed further in **Section 4.1.5**.

A principal component of the desktop study was a search of the NPWS Aboriginal Site Register. The data obtained from the Site Register indicated that:

- a broad range of site types had been previously recorded in the broader Cooranbong - Mandalong - Morisset region (see **Table 3.36**);

- no sites had previously been recorded in the areas to be impacted by any of the surface works;

- no sites had been recorded within Areas 1 and 2.

Table 3.36 - Site Type Frequency
(Morisset, Dooralong, Catherine Hill Bay and Swansea 1:25 000 sheets)

Site Type		Frequency (n)
Single Component Site	Midden	109
	Open campsite	62
	Isolated find	19
	Rock shelter with art	17
	Axe grinding grooves	16
	Scarred tree	4
	Rock shelter with deposit	3
Multi-Component Sites	Rock shelter with deposit and axe grinding grooves	1
	Midden and burial	1
	Midden and quarry	1
	Rock engraving and open campsite	1
	Rock shelter with deposit and art	1
Total		**237**

The desktop study indicated that the most likely site types to be recovered by field survey were open campsites, isolated finds, axe grinding grooves, rock shelters and scarred/carved trees. This was based on a consideration of the landforms that comprised each development area, and the type of sites that had been recovered on similar landforms in the broader Morisset-Cooranbong region. The archaeological sensitivity of landforms that comprise Areas 1 and 2 are discussed in further detail in **Section 3.15.1**.

The archaeological field work was carried out on 11 and 20 June 1997 and involved the participation of and consultation with the Koompahtoo Local Aboriginal Land Council on both occasions.

No Aboriginal sites were located during field survey. No locations were inferred to have the potential for significant Aboriginal sites.

3.15.1 Areas 1 and 2

As discussed above, no field survey was undertaken within Areas 1 and 2 to assess the impacts of ground subsidence. However, the Downcast Shaft site is located within Area 2 and was subjected to detailed field assessment due to proposed surface disturbance of the area. No archaeological material was observed, or considered likely to occur, within this area.

The distribution of registered sites in relation to Areas 1 and 2 is shown in **Figure 3.15**. Although no sites have been previously recorded within Areas 1 and 2, four sites are located in the immediate vicinity and include three open campsites and a set of axe grinding grooves (see **Table 3.37**). Other site types that occur in the general vicinity are rock shelters with art and/or archaeological deposit.

Table 3.37 – Registered Sites Adjacent to Areas 1 and 2

NPWS #	Site Type	Easting	Northing	Reference
45-3-2459	Open campsite	350	6334	Grinberg 1994
45-3-1310	Open campsite	357	6330	-
45-3-1309	Open campsite	357	6330	-
45-3-1235	Axe grinding grooves	355	6331	-

Based on this information, it can reasonably be assumed that this is the range of site types that are likely to occur within Areas 1 and 2. The most likely areas for archaeological sites to occur include:

- the stream banks of drainage lines (eg. open campsites, middens);
- ridge and hill crests, particularly if they overlook some form of drainage;
- mature trees in any environmental context, but particularly in proximity to a water source;
- sandstone formations (rock shelters and axe grinding grooves). Axe grinding grooves are generally located in close proximity to, or within the stream channel of drainage lines.

The total surface area of archaeologically sensitive land is significantly reduced when existing developments are considered. The proposed management recommendations for areas with potential for archaeological sites to occur are detailed in **Section 4.1.5**.

3.15.2 Mine Access Site

The field survey was undertaken on 20 June 1997 by Liam Dagg and representatives of the Koompahtoo Local Aboriginal Land Council.

The survey included an inspection of all tracks and clearings, both in and around the perimeter of the Mine Access Site. Not all of the ground surface could be traversed as access to some areas was impeded by the thick stands of paperbark regrowth. A large proportion of the site did not warrant field survey, due to impacts from existing developments. These included the depot currently operated by Lake Macquarie City Council and Powercoal's core shed area.

No Aboriginal sites were located by field survey. The predictive model indicated that the most likely site types to occur were open campsites, isolated finds, scarred/carved trees and axe grinding grooves.

The greatest impediment to the recovery of open campsites/isolated finds was extremely low ground surface visibility. In cleared sections, visibility was impeded by grass cover and leaf litter. As noted above, areas covered by middle/upper storey vegetation were inaccessible.

Although mature trees (predominantly Eucalypt species) are sporadically distributed across the surface infrastructure site, no scars which could be attributed to Aboriginal activities were observed. No sandstone formations are present within the study area, which precludes the presence of axe grinding grooves or rock shelters/overhangs.

Previous archaeological research has indicated that drainage lines and ridge crests are sensitive for the location of Aboriginal sites. Both of these landforms occur within the study area. However, both have been severely impacted by the construction on the sites. Other sections of the ridge crest were thickly vegetated with paperbark regrowth. The drainage line consists of a thickly vegetated drainage depression which had no definable banks. As with the ridge crest, assessment was impeded by low ground surface visibility and inaccessibility. However, ground surface exposures on adjacent landforms did not have evidence which would indicate the presence of archaeological sites (eg. stone artefacts).

3.15.3 Cooranbong Colliery

Two areas were surveyed at Cooranbong Colliery; the proposed site for the Coal Preparation Plant and the ROM stockpile area.

The proposed site for the Coal Preparation Plant is located on a gently inclined hill slope. On the basis of previous archaeological research, this landform has a predicted low level of archaeological sensitivity. The level of sensitivity was further reduced by the extensive disturbance within the area. Disturbance included two dams, associated embankments, an access track, a cleared area for the housing of machinery and a large section of the hill slope that had been filled and rehabilitated. Unimpacted ground surface constituted a thin band approximately 10 to 20 metres wide, immediately above an existing embankment. No archaeological material, such as stone artefacts, was observed in this area. None of the mature trees bore Aboriginal carvings or scars. No sandstone formations are present within the proposed site for the Coal Preparation Plant.

The proposed ROM stockpile area is located on a gently inclined hill slope. A large proportion of this study area is currently being used as the existing ROM stockpile. Unimpacted areas were thickly vegetated by lower, middle and upper storey vegetation. The hillslope has a predicted low archaeological sensitivity. However, it does occur in proximity to a drainage line (unnamed tributary) which has a relatively higher potential for the presence of archaeological material. The slope gradient is not steep and would not have presented an impediment to Aboriginal habitation.

Field survey included an inspection of unsealed tracks in and around the proposed development area, and a series of 'off-track' surveys which investigated the thickly vegetated sections. The survey of tracks beyond the development area was undertaken to assess the presence of archaeological material in the immediate proximity of the drainage line.

No archaeological sites were found. Although a number of ground surface exposures were present, none of them contained stone artefacts. None of the mature trees bore markings which could be attributed to Aboriginal activities. No sandstone formations are present within this survey area.

3.15.4 Haul Road and Emplacement Area

The proposed route for the haul road was surveyed on foot and by vehicle. The greatest proportion of the proposed route for the haul road crosses existing roads. The northern and southern sections of the proposed haul road crosses relatively unimpacted areas of land.

The proposed emplacement area occupies an existing quarry. Survey of this area constituted a transect (approximately 10 to 20 metres wide) around the perimeter of the existing quarry.

No Aboriginal sites were located in the area surveyed. Possible explanations include:

- a real absence of archaeological sites;
- sites have been obscured by existing vegetation;
- sites have been destroyed by existing developments (eg. existing roads and quarries).

The most likely site type to have gone undetected by field survey is open campsites, due to low ground surface visibility. However, the most likely area for these sites (ridge crests, drainage lines) have already been heavily impacted by previous developments.

3.16 TRAFFIC

3.16.1 Mine Access Site

The proposed Mine Access Site is located immediately west of the F3 Freeway at the Morisset Interchange. The site itself will be accessed from Mandalong Road which overpasses the F3 Freeway at the Morisset Interchange. The Morisset Interchange is a full diamond interchange. The interchange provides ingress and egress ramps to the F3 Freeway for east bound and west bound traffic using Mandalong Road and ingress and egress ramps to Mandalong Road for north bound and south bound traffic using the F3 Freeway. The F3 Freeway at the Morisset Interchange is a six lane dual carriageway and carries an Average Annual Daily Traffic (AADT) volume of 26890 vehicles (1996 figures, Barry Armstrong RTA pers comm).

Mandalong Road west of the Morisset Interchange converges to a two lane sealed rural road which carries approximately 1500 vehicles per day. Adjacent to the proposed access site, Mandalong Road has an 80 km/hr speed limit which increases to 100 km/hr towards the western boundary of the proposed access site. The intersection for the proposed Mine Access Site will be constructed directly on to Mandalong Road. Sight distance to this intersection is in excess of 400 metres for east bound traffic and in excess of approximately 200 metres for west bound traffic.

To the east of the Morisset Interchange on Main Road 217 (which is the extension of Mandalong Road), traffic volumes increase significantly to an AADT volume of approximately 3000 vehicles per day west of Freemans Drive. AADT volumes increase to 9160 vehicles per day from Morisset to Dora Creek (SMEC Australia Pty Ltd 1996). Existing and projected traffic levels for Mandalong Road/Main Road 217 are listed in **Table 3.38**.

Table 3.38 - Traffic Volumes on Mandalong Road/Main Road 217

Road Segment	1996 AADT	2001 AADT	2011 AADT	Level of Service
Mandalong Road west of Morisset Interchange	1500[1]	-	-	A[2]
MR 217 Morisset Interchange to Freemans Drive	3000	3243	4074	B
Freemans Drive to Bridge Street, Morisset	9160	10648	12669	C
Morisset to Dora Creek	9160	11134	13155	C
Dora Creek to Summerhill Road, Wangi Wangi	8469	9745	11727	C
Summerhill Road to Buttaba Hills Road, Buttaba	7778	8275	9952	B
Buttaba Hills Road to Dorrington Road	12523	14498	15953	D
Dorrington Road to Wilton Road	17780	20255	21799	F
Wilton Road to Ridge Road	12523	15380	16927	C
Ridge Road to The Boulevarde, Toronto	17787	20644	22191	C

Source: SMEC Australia Pty Ltd
[1] *LMCC*
[2] *Umwelt (Australia) Pty Limited*

3.16.2 Cooranbong Colliery Site

Cooranbong Colliery is located north of Dora Creek and is accessed via Gradwells Road off Newport Road, Dora Creek. Access to Newport Road is either via Main Road 217 or from Freemans Drive. The majority of existing traffic movements on Gradwells Road are associated with Cooranbong Colliery. It is estimated that Gradwells Road carries a maximum of 400 vehicles per day.

4.0 ENVIRONMENTAL INTERACTIONS AND PROPOSED MITIGATION MEASURES

4.1 EFFECTS OF SURFACE SUBSIDENCE FROM UNDERGROUND MINING

4.1.1 Overview of Mining and Subsidence

Longwall Mining

In longwall mining, a panel of coal, typically around 200 to 250 metres wide, 1500 to 4000 metres long and 2 to 5 metres thick, is totally removed by longwall shearing machinery, which travels back and forth across the coalface. The machinery cuts a slice of coal from the coalface on each pass and a face conveyor, running along the full length of the coalface, carries this away to discharge on to a belt conveyor, which carries the coal out of the mine.

The area immediately in front of the coalface is supported by a series of hydraulic roof supports, which temporarily hold up the roof strata and provide a working space for the shearing machinery and face conveyor. After each slice of coal is removed, the hydraulic roof supports, the face conveyor and the shearing machinery are moved forward. The layout of a typical longwall panel and a cross-section through a typical longwall face are shown in **Plates 3** and **4** respectively.

Before the longwall extraction commences, continuous mining equipment extracts coal to form roadways (headings) around the longwall panel (see **Plate 3**). These roadways form the mine ventilation passages and provide access for people, machinery, electrical supply and communication systems and water and gas drainage lines. The roadways, which provide access from the mine entrance to the longwalls, are referred to as the main headings. The longwall face equipment is established at the end of the panel that is remote from the mine entrance and coal is extracted within the panel as the longwall equipment moves towards the main headings. This configuration is known as retreat mining. Typically, a longwall face retreats at a rate of 50 to 60 metres per week, depending on the seam thickness and mining conditions.

When coal is extracted using this method, the roof immediately above the seam is allowed to collapse into the void that is left as the face retreats. This void is referred to as the goaf. Miners working along the coal face, operating the machinery, are shielded from the collapsing strata by the canopy of the hydraulic roof supports. As the roof collapses into the goaf behind the roof supports, the fracturing and settlement of the rocks progresses through the overlying strata and results in sagging and bending of the near surface rocks and subsidence of the ground above.

In some instances where the geological strata overlying the coal seam being mined is massive the roof does not collapse on a continual basis leaving the roof strata 'hanging' over the mined area. In these instances, when the roof strata does finally collapse it can result in vibrations on the surface. The tendency for roof strata to 'hang' is greater with narrower longwall panel widths and vibration

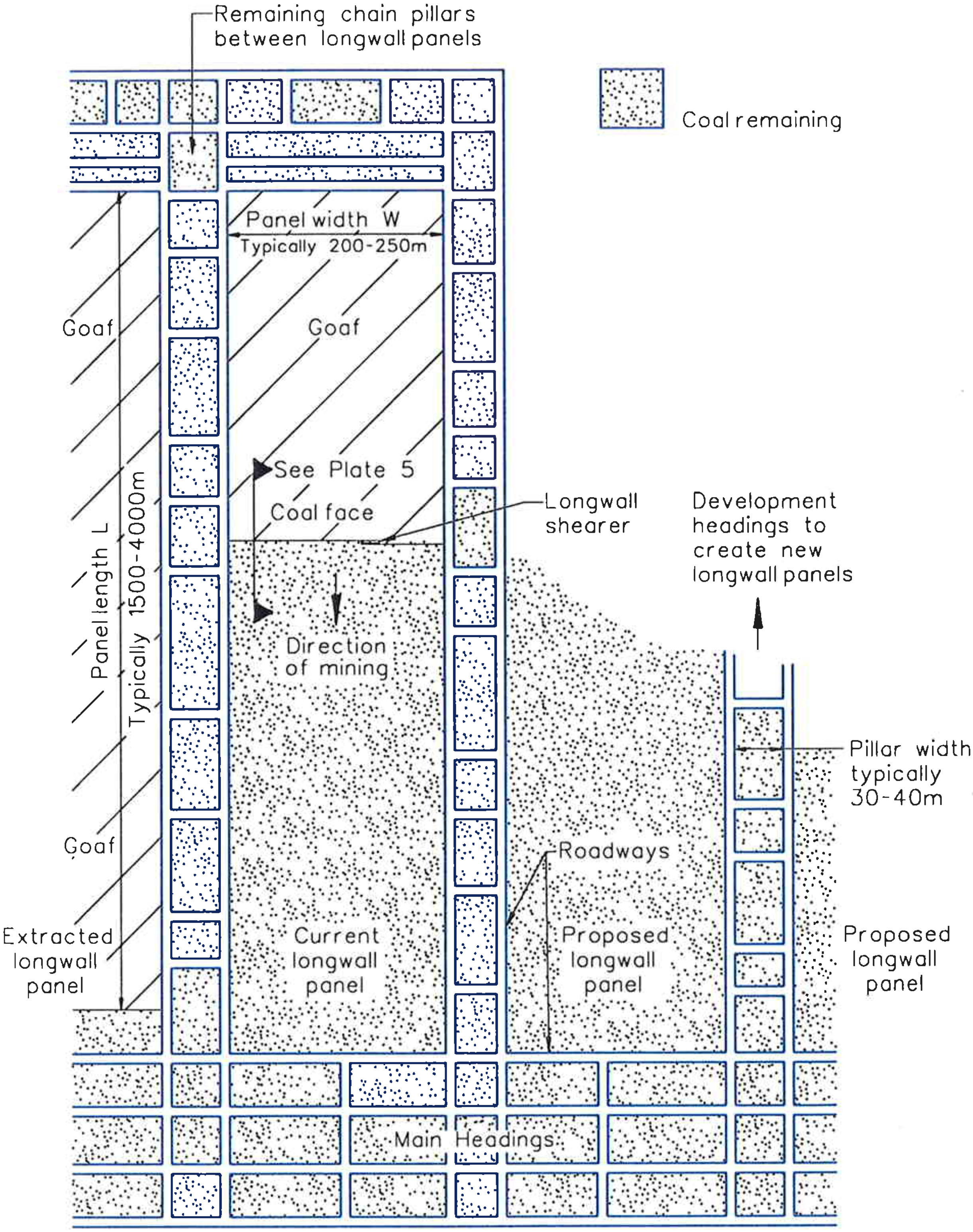
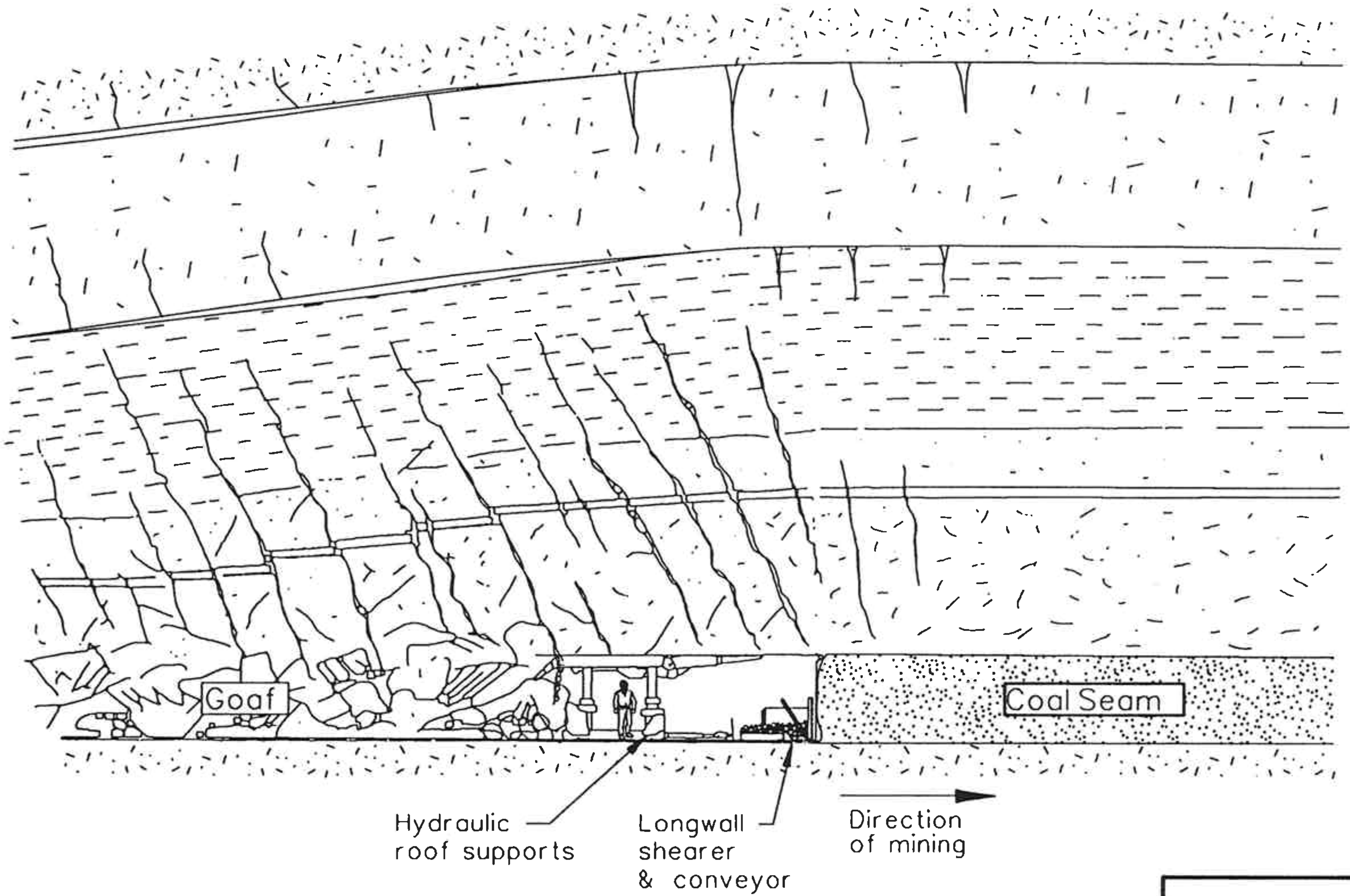


PLATE 3
Typical Layout of a Series of Longwall Mining Panels

Base Source: Waddington Kay & Assoc.	SCALE Not to Scale	DATE: October 1997



Notes:

1. After cutting a slice of coal from the coal face, (typically a slice of 1 metre width is removed), the shearer, conveyor and hydraulic roof supports are pushed forward allowing further collapse of the strata behind the supports into the goaf.

2. The extent of the roof collapse and the associated shearing and cracking of the stata depends upon the strata geology, the longwall width, the extracted seam thickness and the depth of cover.

PLATE 4
Cross Section of a Typical Longwall Face

SCALE: Not to Scale	**DATE: October 1997**

Base Source: Waddington Kay & Associates

impacts on the surface tend to be greater when the depth of cover to the mined coal seam is less. The geology of the proposed mining area does not consist of significant massive units. The geological strata of the mining area also tends to exhibit close fracture spacing. On this basis it is considered that the potential for the roof strata within Areas 1 and 2 to 'hang' is low.

Panel Mining

Panel mining is similar to longwall mining but the coal is removed using a continuous miner, which is a self propelled machine with a rotating, toothed, coal cutting drum mounted at the front. The rotating drum can be raised and lowered to cut the coal to the required height, as the machine moves forward. As the coal is cut, it falls on to the apron of the machine and is conveyed through the machine to discharge into a transporter, typically a vehicle known as a shuttle car. The shuttle car transports the coal to a loading point where it discharges the coal on to a belt conveyor. This conveyor then carries the coal out of the mine.

Before the panel extraction commences, the continuous mining equipment extracts coal to form roadways (headings) around the panel. Once these roadways have been completed, the extraction of coal from the panel commences. The coal is extracted by removing sections of coal within the panel and as the coal is cut, small pillars are left in place to temporarily hold up the roof strata and protect the continuous miner. As the machinery retreats and the extracted void increases in size, the roof immediately above the seam starts to collapse into the goaf but, so long as the mining is continuous, the mining machinery always remains ahead of the collapsing area. Generally, the small, remnant, pillars, which are left as temporary support, represent around 15% of the total coal in the panel.

As the roof collapses into the goaf, the fracturing and settlement of the rocks progresses through the overlying strata and results in sagging and bending of the near surface rocks and subsidence of the ground above. The mechanism of subsidence for panel mining is essentially the same as for longwall mining but, for identical mining geometry, the remnant pillars slightly reduce the amount of subsidence.

Subsidence Mechanisms

If the width of an extracted panel of coal is small and the rocks above the seam are sufficiently strong, it is possible that the roof will not collapse and hence no appreciable subsidence will occur at the surface. However, for economic reasons, wide panels of coal are generally extracted and, in most cases, the roof is unable to support itself. Longwall panel widths of between 230 and 250 metres are becoming common.

As the immediate roof strata, ie the rocks immediately above the seam, collapse into the goaf, the rocks above them lose support and sag to fill the void beneath them. The mechanism progresses towards the surface and the effected width increases so that at the surface an area larger than the extracted panel of coal undergoes settlement.

The angle at which the subsidence spreads out towards the limit of subsidence at the surface, is referred to as the angle of draw. The angle of draw typically lies between 10 and 40 degrees from the vertical, depending on how the limit of subsidence is defined. It also depends upon the strength of the strata, the lithology and various other parameters.

It is generally accepted that subsidence of less than 20 mm will have negligible effect on surface infrastructure and this is normally adopted as the cut off point for determination of the angle of draw. Often, the cut off point is taken as a point on the surface defined by an angle of draw of 26.5 degrees from the edge of the extraction, ie a point on the surface at a distance of half the depth of cover from the goaf edge.

The subsidence of the surface is considerably less than the thickness of coal removed due to the voids that are left within the collapsed strata. The extent of the settlement at the surface is therefore dependent upon the strength and nature of the rocks overlying the coal seam and is a direct function of their capacity to bridge over the voids.

When a panel has a width that is small, relative to the depth of the seam below the surface, the fractured rocks have a tendency to bridge over the goaf by arching between the solid abutments on each side of the panel, thus reducing the amount of subsidence.

However, as the panel width is increased, the overlying rocks are less able to arch over the goaf and a limiting panel width is reached where no support is available and maximum subsidence occurs. This limiting panel width is referred to as the critical width and is usually taken to be 1.4 times the depth of cover. It does, however, depend upon the nature of the strata.

Where several panels are mined in a series and chain pillars are left between the panels, the maximum subsidence does not occur unless each panel is, at least, of critical width. The chain pillars crush and distort as the coal is removed from both sides of them but, usually, they do not totally collapse and hence the pillars provide a considerable amount of support to the strata.

Where large supercritical areas are extracted, the maximum possible subsidence is typically 65% of the extracted seam thickness (ie the thickness of mined coal) but, because chain pillars are left in place and provide some support, this maximum possible subsidence is rarely reached. The actual maximum subsidence is typically between 20% and 40% of the seam thickness.

Where the panels are narrower than the critical width, the effects of mining neighbouring or adjacent panels overlap. The amount of subsidence is determined by the extent of these overlaps. In this situation, the first panel in a series will generally exhibit the least subsidence and the second and subsequent panels will exhibit greater subsidence due to fracturing of the strata caused by mining the preceding panels.

The subsidence at the surface does not occur suddenly but develops progressively as the coal is extracted within the area of influence of the extracted panel. In many cases, when the cover over the coal seam is deep, a point on the surface will be affected by the extraction of several adjacent panels.

The subsidence effect at the surface occurs in the form of a wave, which moves across the ground at approximately the same speed as the longwall face retreats within the longwall panel. The extraction of each panel creates its own wave as the panels are mined in sequence.

The resulting depression in the surface of the ground covers an area that extends beyond the limits of the extracted panels by a distance on all sides of approximately half the depth of cover. The depression is referred to as a subsidence trough. Subsidence is greatest within the depression and typically, the observed subsidence levels around the goaf edges (ie at the chain pillars) is 10 to 30% of this maximum subsidence value.

Subsidence Parameters

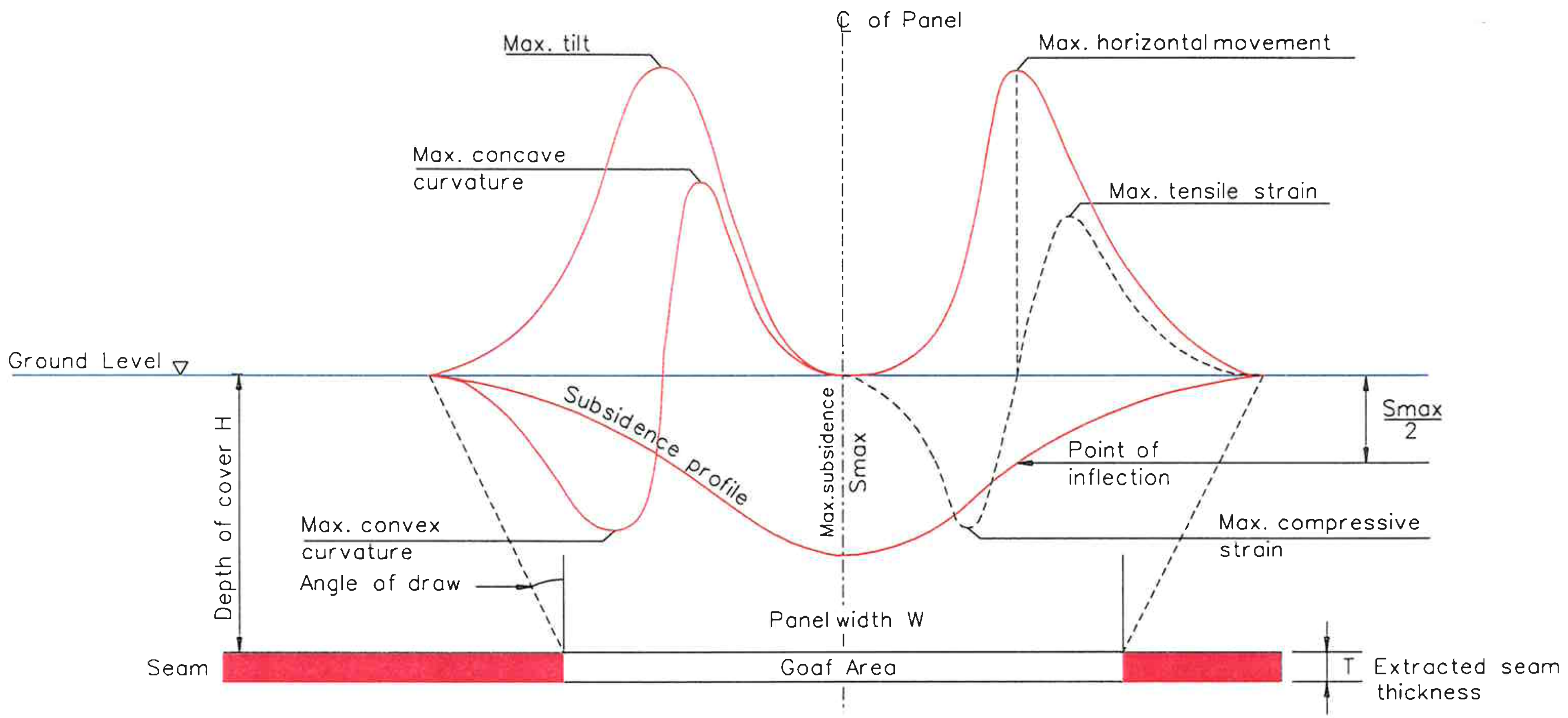
Vertical subsidence, tilt, curvature and strain are the subsidence parameters normally used to define the extent of the surface movements that will occur as mining proceeds and form the basis for the assessment of the impacts of subsidence. These parameters are illustrated in **Plate 5**.

Vertical Subsidence is the distance (usually in millimetres) that the ground surface lowers as a result of mining.

A typical subsidence trough for an extracted panel is shown in **Plate 5**, together with a series of curves that show the way in which each of the subsidence parameters vary across the width of the panel on completion of the extraction. IT SHOULD BE NOTED THAT THE SUBSIDENCE PROFILE IS SHOWN AT A **GREATLY EXAGGERATED VERTICAL SCALE** to illustrate the nature of change in subsidence parameters across a longwall panel. In reality, slope changes are typically less than 2% (ie 1 metre drop over a 50 metre length).

Tilt is calculated as the change in subsidence between two points divided by the distance between those points (ie the change in slope of the surface landform as a result of mining). The maximum tilt, or the steepest portion of the subsidence profile, occurs at the point of inflection in the subsidence trough where the subsidence is roughly equal to one half of maximum subsidence. Tilt is usually expressed in millimetres per metre.

In regard to buildings, **tilt** that results from mining causes the whole building to rotate as a consequence of the change in slope in the ground underneath the building. Tilt of a building is calculated as the difference in level between the highest and lowest points of the ground floor of the building, measured after mining, less the difference in level between the points measured before mining divided by the distance between the points. Tilting does not cause shear or bending in a structure unless tilts are extremely high.



NOTE:
Vertical Scale Is Exaggerated.

Base Source: Waddington Kay & Assoc.

PLATE 5
Subsidence Parameter Profile
Above an Extracted Panel

SCALE: Not to Scale

DATE: October 1997

Curvature describes the rate of change of tilt and is calculated as the change in tilt between two adjacent sections of the tilt profile divided by the average length of those sections. Curvature is usually expressed as the inverse of the radius of curvature with the units of km^{-1}.

Curvature is convex or 'hogging' over the goaf edges and concave or 'sagging' toward the bottom of the subsidence trough. The convention usually adopted is for concave curvature to be positive and convex curvature to be negative.

Mining induced building curvature is the change in the curvature of a building structure resulting from differential subsidence of the building foundations. When the centre of a building subsides less than the ends of a building, the curvature is described as convex. When the centre of a building subsides more than the ends of the building, the curvature is described as concave. Curvature results in shearing and bending of the building superstructure.

Strain is determined by calculating the horizontal change in length of a section of the land surface and dividing this by the initial horizontal length of that section. If the section has been extended, the ground is in tension and the change in length and resulting strain are both positive. If the section has been shortened, the ground is in compression and the change in length and strain are both negative. The unit of measurement adopted for strain is millimetres/metre. The maximum strains coincide with the maximum curvature and hence the maximum tensile strains occur over the sides of the panel whilst the maximum compressive strains occur towards the bottom of the subsidence trough.

Mining induced building strain is a measure of the horizontal lengthening or shortening of a building structure caused by the transfer of ground strains into the foundations of a structure. Strain is measured as the change in the horizontal length of a building divided by the original horizontal length. If the building increases in length, the strain is tensile and if the building decreases in length the strain is compressive. Strain can result in tensile cracking and compressive buckling of a structure.

4.1.2 The Prediction of Subsidence Parameters

The potential impacts of subsidence, on surface infrastructure, have been determined using a subsidence prediction model, developed specifically for the Cooranbong Colliery Life Extension Project. This model has been developed using the <u>Incremental Profile Method</u>. This empirical model is founded upon subsidence monitoring data from local collieries and additional data, where appropriate, from other collieries in NSW and has been specifically tailored to suit the geology of the Mandalong Valley.

The model enables values of the required subsidence parameters to be determined, at any point within the proposed mining area, at any stage during the life of the mine. It is based upon the prediction of incremental subsidence profiles for each longwall panel from which, by adding the profiles together, the total or final subsidence profile above a series of longwalls can be obtained. When the final subsidence profile has been established, values of tilt, curvature and strain can be predicted at any point on the surface.

The model has been used to assist in the evaluation of a number of alternative mine layouts during the project definition stage and has been a major factor in the evolution of the preferred mine layout. Six alternative longwall layouts were considered for the longwall area, Area 1 and several alternative generic panel layouts were considered for the panel extraction area, Area 2. An outline assessment of the impacts of subsidence, for the preferred longwall layout in Area 1 and the conceptual panel layout in Area 2 is provided below.

(a) Longwall Mining Area 1

Eighteen prediction lines, at right angles to the longitudinal axes of the longwalls, were used in the subsidence modelling for the preferred layout. Subsidence parameters were determined along each of these lines and graphs were produced to show the variations in subsidence, tilt and strain along each line as the longwalls are mined in sequence. The modelling showed that overlapping of incremental subsidence profiles, in the longwall area, was generally limited to neighbouring panels and only occurred in the vicinity of the chain pillars. Points on the surface were therefore affected by a maximum of two longwalls.

The maximum predicted subsidence of 2945 mm occurred above Longwall 5 whilst above the wider pillars zero subsidence was predicted. The highest predicted subsidence above the narrower pillars was 1060 mm over the chain pillar between Longwalls 2 and 3. The differential in the subsidence levels within the panels and between the panels will therefore result in wide flat troughs with undulations of average height 2 metres.

Table 4.1 shows the results of a statistical analysis of final subsidence predictions from all prediction lines. It can be seen that 66.7% of the subsidence values were less than 1000 mm and 45% of the subsidence values were less than 500 mm.

Table 4.1 - Statistical Analysis of Subsidence Predictions

Subsidence levels (mm)	Proportion of subsidence values less than subsidence level
100	21.9%
500	45.0%
1000	66.7%
1500	78.7%
2000	88.8%
2500	97.5%
2945	100%

Table 4.2 shows the result of a statistical analysis of final tilt predictions on all prediction lines. It was found that 42.3% of the tilt values along all the prediction lines were less than 5 mm/m. The predicted maximum tilts generally ranged from 20 to 30 mm/m whilst the highest maximum tilt was 33.7 mm/m above Longwall 6.

The maximum tensile strains generally ranged from 3 mm/m to 5 mm/m and the highest value was 8 mm/m above Longwall 8. The maximum compressive strains generally ranged from 6 mm/m to 10 mm/m and the highest value of 12 mm/m occurred above Longwall 2.

Table 4.2 - Statistical Analysis of Tilt Predictions

Tilt levels (mm/m)	Proportion of tilt predictions less than tilt levels
<5	42.3%
7	50.9%
10	60.2%
15	72.4%
20	83.4%
30	99.3%
33.7	100%

Table 4.3 shows the result of a statistical analysis of the occurrence of tensile and compressive strains from all prediction lines.

Table 4.3 - Statistical Analysis of Tensile and Compressive Strains

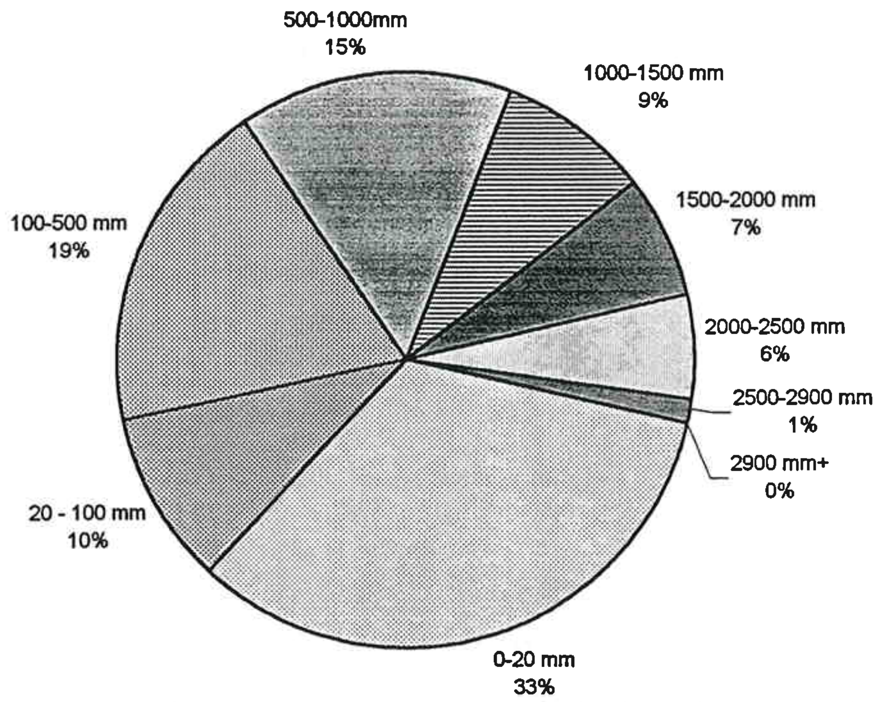
Tensile strain levels (mm/m)	Proportion of tensile strain values less than strain level	Compressive strain levels (mm/m)	Proportion of compressive strain values less than strain level
2	66.9%	-2	37.8%
5	98.3%	-5	61.3%
7	99.9%	-10	97.4%
8	100%	-12	100%

The transverse prediction lines, referred to above, provided subsidence parameters throughout the longwall area. Another 54 prediction lines were used in the longitudinal direction over the commencing and finishing ends of the longwalls. Altogether, a total of 61,400 subsidence values were predicted. From these, a surface contour plan **(Figure 4.1)** was produced, which defines the predicted shape of the final subsidence trough over the longwall panels of the preferred mine layout.

The surface areas, in plan, below each subsidence contour line were calculated and are summarised on **Plate 6**. It can be seen that only 38% of the subsided land area would experience subsidence greater than 500 mm and only 7% of the subsided land surface would experience subsidence levels greater than 2000 mm.

Plate 6

Predicted Subsidence Depth Composition as a Percentage of the Total Area Affected by Mining in Area1



(b) Panel Mining Area 2

At this stage, the conceptual mine plan for Area 2 was assessed by considering the maximum possible subsidence parameters for a range of alternative mining scenarios. Predictions were made using the Incremental Profile Method for a range of panel widths, pillar sizes and depths of cover that are representative of the panel extraction area. Panel widths of 80 metres, 100 metres and 120 metres for both 20 metre and 30 metre wide pillars were assessed. A coal seam extracted thickness of 1.9 metres was adopted for assessing impacts within Area 2.

For this range of alternatives, the maximum predicted subsidence is 417 mm with maximum tilts of around 6 mm/m and maximum tensile and compressive strains of around 2 mm/m and 2.5 mm/m respectively.

4.1.3 Assessment of Subsidence Impact on Man-made Structures and Other Improvements

A comprehensive assessment of the impacts of mine subsidence, on surface infrastructure and land drainage systems, has been carried out using the predicted subsidence parameters.

The impacts of strain on building structures have been assessed and the levels of damage have been classified using the damage categories shown in **Table 4.4**. The classification of damage with reference to walls in **Table 4.4**, has been reproduced from Table C1 of Australian Standard 2870-1996. For the purposes of this study, the classification of damage has been extended by the addition of Category 5.

Table 4.4 - Classification of Damage with Reference to Strains

Damage category	Description of typical damage to Walls and required repair
0	Hairline cracks.
1	Fine cracks.
2	Cracks noticeable but easily filled. Doors and windows stick slightly
3	Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weather-tightness often impaired
4	Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window or door frames distort. Walls lean or bulge noticeably. Some loss of bearing in beams. Service pipes disrupted.
5	As above but worse, and requiring partial or complete rebuilding. Roof and floor beams lose bearing and need shoring up. Windows broken with distortion. If compressive damage, severe buckling and bulging of the roof and walls.

Predicted levels of damage to buildings, arising from curvature and strain are drawn from information published by the former National Coal Board of the U.K.

The strains used in the predictions have included both the horizontal strains and bending strains due to curvature. As a consequence the predictions are conservative. However, the assessments have recognised that some types of structure have a greater capacity to accommodate bending strains, than brick structures, and, in such cases, the damage classifications have been adjusted to values that are more realistic.

The damage categorisation used for tilt is given in **Table 4.5**.

Table 4.5 - Categorisation of Damage with Reference to Tilt

Damage Category	Tilt (mm/m)	Description [1]
A	< 5	Unlikely that remedial work will be required.
B	5 to 7	Adjustment to roof drainage may be required.
C	7 to 10	Adjustment to roof drainage will probably be required and remedial work to surface drainage might be necessary.
D	> 10	Considerable work might be required to rectify tilt. Jacking to level or rebuilding could be necessary in the worst cases.

1 *Waddington Kay & Associates*

(a) Area 1

Predictions of the maximum values of vertical subsidence, tilt, curvature and strain have been made for all identified surface buildings and structures. These values have been used to assess the potential levels of impact to buildings situated above the longwalls and access roadways within the mine subsidence zone of influence. Separate assessments have been made for the effects of curvature and strain and for the effects of tilt and these are shown in **Table 4.6**.

Generally, a conservative approach has been adopted in the prediction of subsidence parameters and hence the assessments are expected to overstate the levels of impact rather than to understate them. Notwithstanding this, it has been recognised that the values of the subsidence parameters will vary across the width or length of a building and, in some places, may be higher than has been predicted at the centre of the building. In addition, local geology can affect the magnitude of the ground movements and the exact position of the maximum values of the parameters can vary from those that have been predicted.

Alternative assessments have therefore been made for each building based upon the predicted values of the subsidence parameters within ±10 metres of the centre of each building. If the maximum values are used, the assessments become even more conservative. In practice, the curvatures and strains over the length or breadth of a building will tend to average out. The average curvature and strain transmitted into a building structure will be considerably less than the maximum values. The tilts however will not vary to the same extent and will generally be reasonably represented by the average tilt value within ±10 metres of the centre of the building.

It can be seen from **Table 4.6** that a total of 358 buildings and associated structures have been identified within or adjacent to Area 1, which are likely to be affected by subsidence as Longwalls 1 to 14 are mined. Of these, 95 are habitable dwellings and 236 are sheds or farm buildings. The remaining structures consist of tanks, bridges, pools and tracks.

The potential maximum impacts of subsidence on these buildings and structures, due to the effects of curvature and strain, at the centre of the building or structure, have been assessed. Classifications of the predicted levels of damage have been made, in accordance with **Table 4.5**, and the overall assessments have been shown in **Table 4.6**. Approximately 73% of residential buildings have been classified within damage Categories 0, 1 and 2. Around 17% have been included within damage Category 3 whilst 8% have been included within damage Category 4. The remaining 2%, i.e. only two houses, have been rated within the highest damage category.

27% cat 3

Around 94% of the sheds and farm buildings have been classified within the lower damage categories with 75% included in damage Category 0 and 20% included in damage Categories 1 and 2. The remaining 5% have been predicted to lie within damage Categories 3 and 4.

sheds 5% 3-5

Tilt.

The impacts of tilt are of greater consequence. Around 63% of residential buildings have been classified within tilt Categories A and B and a further 11% have been included in tilt Category C. The remaining 26% of buildings are predicted to potentially have maximum residual tilts greater than 10 mm/m and have been included within tilt Category D. Similarly, around 63% of sheds have been predicted to lie within the lower tilt categories. A further 6% have been included within tilt Category C, leaving around 31%, with potential predicted maximum residual tilts greater than 10 mm/m, rated within tilt Category D.

res: x% cat D. 31% D

It is worth noting that the majority of the buildings included within damage Categories 3 to 5, due to the effects of curvature and strain, are also predicted to lie within tilt Category D.

When the alternative assessments are made, using the maximum predicted values of curvature and strain within ±10 metres from the centre of the building, the predicted levels of impact increase slightly with approximately 35% of residential buildings falling within damage Categories 3 to 5.

res: 27% 35% cat 3-5

Similarly, the predicted levels of impact on sheds and farm buildings increase, with around 6% rated within damage Categories 3 to 5.

farm: 5% 6% 3-5.

When the average tilts within ±10 metres of the centre of buildings are used, the assessments vary only slightly with 25% of residential buildings and 31% of sheds falling within tilt Category D.

In some instances, the levels of damage to a particular structure could be worse than predicted due to the presence of faults, fissures or other geological structures. Similarly, some buildings could be affected to a lesser extent if such geological structures lead to a concentration of ground strains outside of the perimeter of the building. In general, the method of assessment would be expected to provide a realistic, if rather conservative, appraisal of the potential impacts of subsidence on building structures, due to the extraction of Longwalls 1 to 14 of the preferred layout.

It is anticipated that the mining of Longwalls 1 to 14 will take around 18 years to complete. The rate of mining will vary from around 40 metres per week to 70 metres per week and, hence, the time required to mine each of the longwalls will vary considerably from longwall to longwall..

As the longwalls are mined in sequence, settlement of the ground will occur above each of the longwalls and a series of troughs will develop. Generally, the settlement of the surface will commence immediately as the coal is extracted beneath it and around 90% of the subsidence will occur within a period of six weeks.

The residual subsidence of around 10% will occur over a period of time. The rate at which the residual subsidence takes place reduces with time and, for the purposes of carrying out remedial works, it can generally be assumed that all significant subsidence from the mining of a particular longwall will be complete within a period of one year. Any subsequent settlement will be very small and though the settlement may continue for several years the impact of this will be negligible.

The impact on buildings and other surface structures will depend upon the position of each structure relative to the longwall panels. Many buildings, because of their position, will be affected by the mining of more than one longwall and hence the duration of the impact will be increased. Out of the 358 buildings and associated structures that have been studied, 149 will be affected by the mining of two longwalls.

Allowing twelve months for the residual subsidence to occur, the duration of the impacts will thus vary from a minimum of around 14 months to a maximum of around 33 months. Approximately 58% of the buildings studied would be affected for the shorter duration and 42% would be affected for a period of up to 33 months.

(b) Area 2

Predicted subsidence parameters have been determined (see **Section 4.1.2**) for alternative layouts within Area 2 (ie the panel extraction area). It can be seen from these parameters that the impact of subsidence on buildings within Area 2 will be considerably less than that which is predicted for the longwall area.

5yr.

This area will be mined at the same time as the longwall mining operation in Area 1, and hence is likely to continue over a period of approximately 20 years. Since the panels will have relatively low width to depth ratios, the overlapping of the effects of adjacent panels could result in some points at the surface being affected by up to five panels as they are extracted in sequence. The duration of the subsidence impact at a point on the surface could therefore be as long as 36 months.

dur'n? of sub impact
3 yr.

However, at the predicted levels of tilt and strain, the impacts of subsidence on surface buildings will generally be negligible to very slight.

Table 4.6 - Assessment of Damage to Buildings and Associated Structures – Area 1

	Damage classification due to strain assessment at the centre of the building							Damage classification due to strain assessment within +/- 10 metres						
	Category 0	Category 1	Category 2	Category 3	Category 4	Category 5	Totals	Category 0	Category 1	Category 2	Category 3	Category 4	Category 5	Totals
Houses up to 10 metres max length	7	0	0	0	0	0	7	5	2	0	0	0	0	7
Houses from 10 to 15 metres max length	11	9	2	4	0	0	26	11	6	5	4	0	0	26
Houses from 15 to 20 metres max length	12	7	6	8	4	0	37	10	7	3	13	4	0	37
Houses from 20 to 25 metres max length	4	2	2	3	2	0	13	3	1	4	3	2	0	13
Houses from 25 to 30 metres max length	2	1	1	1	1	0	6	2	1	0	2	0	1	6
Houses from 30 to 35 metres max length	1	1	0	0	1	0	3	1	0	0	1	0	1	3
Houses above 35 metres max length	1	0	0	0	0	2	3	1	0	0	0	0	2	3
Subtotal	38	20	11	16	8	2	95	33	17	12	23	6	4	95
Sheds up to 5 metres max length	89	6	0	0	0	0	94	85	10	0	0	0	0	95
Sheds from 5 to 10 metres max length	44	10	2	0	0	0	56	36	16	4	0	0	0	57
Sheds from 10 to 15 metres max length	24	11	3	0	0	0	38	21	12	5	0	0	0	38
Sheds from 15 to 20 metres max length	11	5	3	0	0	0	19	9	3	7	0	0	0	19
Sheds from 20 to 30 metres max length	4	3	1	2	0	0	10	3	3	2	2	0	0	10
Sheds from 30 to 40 metres max length	1	0	0	0	0	0	1	1	0	0	0	0	0	1
Sheds above 40 metres max length	3	0	2	2	9	0	16	1	1	1	3	10	0	16
Subtotal	176	35	11	4	9	0	235	156	45	19	5	10	0	235
Water tanks	19	0	0	0	0	0	19	19	0	0	0	0	0	19
Miscellaneous small items and bridges	5	0	0	0	0	0	5	5	0	0	0	0	0	5
Tracks	2	0	0	0	0	0	2	2	0	0	0	0	0	2
Pools	1	1	0	0	0	0	2	1	1	0	0	0	0	2
Totals	241	56	22	20	17	2	358	216	62	31	28	16	4	358
Percentage of total	67%	16%	6%	6%	4%	1%	100%	60%	18%	9%	8%	4%	1%	100%

	Damage classification due to tilt assessment at the centre of the building					Damage classification due to average tilt assessment within +/- 10 metres				
	Category A	Category B	Category C	Category D	Totals	Category A	Category B	Category C	Category D	Totals
Houses up to 10 metres max length	1	1	5	0	7	1	1	5	0	7
Houses from 10 to 15 metres max length	16	3	1	6	26	16	3	1	6	26
Houses from 15 to 20 metres max length	20	5	1	11	37	20	4	2	11	37
Houses from 20 to 25 metres max length	8	0	3	2	13	8	0	3	2	13
Houses from 25 to 30 metres max length	3	1	0	2	6	3	1	0	2	6
Houses from 30 to 35 metres max length	1	0	0	2	3	1	0	0	2	3
Houses above 35 metres max length	1	0	0	2	3	1	0	1	1	3
Subtotal	50	10	10	25	95	50	9	12	24	95
Sheds up to 5 metres max length	66	3	4	22	95	66	4	3	22	95
Sheds from 5 to 10 metres max length	28	3	4	21	56	28	3	4	21	56
Sheds from 10 to 15 metres max length	18	5	2	13	38	18	5	2	13	38
Sheds from 15 to 20 metres max length	11	0	1	7	19	11	0	1	7	19
Sheds from 20 to 30 metres max length	8	0	0	2	10	8	0	0	2	10
Sheds from 30 to 40 metres max length	1	0	0	0	1	1	0	0	0	1
Sheds above 40 metres max length	6	0	2	8	16	6	0	2	8	16
Subtotal	138	11	13	73	236	138	12	12	73	235
Water tanks	14	1	2	2	19	14	1	1	3	19
Miscellaneous small items and bridges	3	0	0	2	5	3	0	0	2	5
Tracks	2	0	0	0	2	2	0	0	0	2
Pools	1	0	0	1	2	1	0	0	1	2
Totals	208	22	25	103	358	208	22	25	103	358
Percentage of total	58%	6%	7%	29%	100%	58%	6%	7%	29%	100%

4.1.4 Assessment of Subsidence Impact on Services and Infrastructure

(a) Transmission Towers and Lines

The TransGrid, 330 kV, No. 24 (TL24), Vales Point to Newcastle, Transmission Line crosses the site from northeast to southwest directly above the main headings and passes over the southeastern ends of Longwalls 11 to 14.

Along the length of TL24 it is supported by a series of transmission towers numbered from TT44 to TT60. All of these towers are suspension structures with heights from ground level to the underside of the steel cross-arms varying from 18.8 metres to 33.8 metres.

Where?

Towers numbered TT45 to TT52 and TT59 are located in positions that could be affected by subsidence as Longwalls 1 to 14 are mined. It is possible that Towers TT53 to TT56 could be affected by the panel and pillar mining in Area 2 but whatever layout is ultimately chosen for this area, the subsidence impacts will be relatively small at these tower locations.

The predicted ground movements at the tower locations would result in tilting of some of the towers, changes of stress in the tower structures and changes in the tensile stresses in the transmission lines unless preventive measures are carried out prior to mining. It is also possible that changes in the tensile stresses could lead to some reduction in ground clearances but such changes are unlikely to be critical and can be easily remedied.

A 132kV overhead transmission line, owned by energyAustralia, crosses the panel extraction area, Area 2, from northeast to southwest, in the section south of Crooks Road. This line will be affected by the extraction of coal from the panels within Area 2.

Copper cables can withstand strains of up to 20 mm/m without damage. The impact on the cables at the predicted levels of strain should therefore be negligible. It should be noted that, in practice, the tensile and compressive strains tend to average out over the distance between supporting structures and the average strains are much lower than the predicted maximum values.

Tilting of the ground could however result in movements at the top of the supporting structures, which would cause additional strains in the conductors. At the predicted levels of tilt, however, it is probable that the power cables would be able to accommodate the predicted ground movements without harm. If it is shown to be necessary, the cables can be protected by the installation of stringing sheaves before mining occurs.

(b) Electricity Distribution Cables

The electrical supply and distribution cables in the area are overhead services ranging from 11kV distribution lines to low voltage consumer lines.

The major 11kV lines follow the alignments of Mandalong Road, Sauls Road, Deaves Road, Babers Road, Browns Road and Crooks Road (see **Figure 3.14**).

With the exception of the service in Crooks Road, all of the 11kV services will be affected by the mining of Longwalls 1 to 9. The service in Crooks Road and part of the service in Mandalong Road will be affected by the extraction of panels in Area 2.

Within Area 1, the predicted levels of strain are well within the capacity of the copper cables and hence the impact of subsidence on the cables should be negligible. In practice, the tensile and compressive strains tend to average out over the distance between supporting structures and the average strains are much lower than the maximum predicted values.

However, the high levels of tilt predicted in the longwall mining area could result in movements at the top of the supporting structures, which would cause additional strains in the conductors. When these effects are added to the direct ground strains it is possible that the desirable levels of stress in the conductors could be exceeded. It is also possible that changes in tension could lead to reduced ground clearances which, in some instances could be less than the acceptable minimum. Measures to mitigate impacts are discussed in **Section 4.2.1**.

In Area 2, the predicted subsidence parameters are much lower than in the longwall extraction area and the predicted levels of subsidence, tilt, curvature and strain will not cause unacceptable impacts on the power cables.

(c) Telephone Service Cables

Telephone service and distribution cables within the area are owned by Telstra and are generally laid in buried conduits. The services follow the public road alignments and are, in the main, conventional copper cables. A local optical fibre cable is laid along the western side of Deaves Road and along Sauls Road. The main Sydney to Brisbane optical fibre service is laid in conduits along the western side of the F3 Freeway.

The buried copper cables will be affected by mining subsidence from the mining of Longwalls 1 to 14 in Area 1 and the panel extraction in Area 2. Those cables which cross the longwalls at right angles to their longitudinal centrelines, or cross the ends of the longwalls parallel to their longitudinal axes, will suffer the greatest impact. The cables in Deaves Road, which cross Longwalls 2 and 3, and those in Mandalong Road, which cross Longwalls 9 and 10 will therefore experience the highest levels of tilt, curvature and strain.

As a consequence of the direct tensile strains and differential movements of the ground, which will occur as longwall mining proceeds, it is possible that some conduits and cables could be damaged, though generally the level of impact is expected to be low.

All of the cables are constructed of reasonably elastic materials, which should allow some elongation without damage. A report, produced by Telstra engineers in 1992, entitled "Effect on Telecom Australia Plant due to Mine Subsidence", indicates that copper cables can tolerate strains of 2%, which is around three times as high as the maximum predicted tensile ground strain.

The optical fibre cables are of greater concern since they are less robust than the copper cables and carry much more information. The loss of revenue and cost of repair in the event of damage are therefore potentially higher than for conventional cables.

"Effect on Telecom Australia Plant due to Mine Subsidence" indicates that the allowable maximum strain on optical fibre cables should not exceed 1% and that any stretched length should have an unstretched length adjacent to it that is at least five times larger than the stretched length. This effectively means that the average strain over the length of the cable should not exceed 0.16%, i.e. 1.6 mm/m.

This is considerably lower than the predicted maximum tensile strains in both the longwall mining area and the panel extraction area and hence the optical fibre cables could potentially be at risk, particularly in Deaves Road over Longwalls 2 and 3. However, it should be noted that only a small proportion of the ground strain would be transferred into cables laid within conduits.

The level of risk to the main Sydney to Brisbane fibre optic cable is small, since it would only be affected by the panel extraction in Area 2, but this is a major communications cable and it should be protected. The cable is located within the F3 Freeway corridor and as such will be subject to minimal subsidence. Measures to mitigate impacts are discussed in **Section 4.2.1**.

(d) Water Supply Services

A private underground service exists in Deaves Road, providing a pressurised supply from the Hunter Water Corporation's main in Crawfords Road to Inghams Breeder Farm and this will be affected by subsidence from the mining of Longwall 1.

Damage is unlikely to occur to the supply line but there is a possibility that damage could occur at the junction of the supply line and the branch line into the farm property. Such damage could be prevented by temporarily uncovering a section of the branch line to allow it to bend when tensile strain occurs in the main.

(e) Freeway, Gas Pipe Line and Roads

The F3 Freeway crosses over the southeast corner of Area 2 and could be affected by the panel extraction mining, which is planned in this section of the mine.

The Natural Gas Pipeline is laid within an easement on the eastern side of the F3 Freeway and could also be affected by the panel extraction mining in Area 2.

The levels of strain, which have been predicted for the alternative layouts in this area, indicate that any impacts on the F3 Freeway or the pipeline would be small.

There are a number of public roads and private access roads within the Area 1 and the majority of them will be affected by mining subsidence. Mandalong Road, Deaves Road, Sauls Road, Babers Road, Little Valley Road, Tobins Road, Prickly Ridge Forest Road, and Browns Road all cross the proposed longwall mining area. Mandalong Road, Tobins Road and Deaves Road are aligned, in places, almost at right angles to the longitudinal axes of the longwalls and will experience the maximum levels of tilt, curvature and strain.

A section of Mandalong Road and most of Crooks Road lie within Area 2 and although these will be affected by the proposed panel extraction mining, the level of impact will be negligible.

Wherever the tensile strain exceeds 1 mm/m, noticeable tension cracks would be expected to develop in the road surface. However, surfacing materials are quite flexible and crack widths would generally be small. Normally the riding quality of the surface would not be impaired but in the worst cases, the integrity of the surface may be lost and repairs may be necessary in some areas to maintain a safe passage for road users. Who pays?

Where a section of road is located at points of high tilt, the changes in the surface levels could have an adverse impact on road gradients or super elevation and regrading of the road surface may be required in some instances. Changes in tilt might also affect the road drainage system but such problems are likely to be infrequent and can be easily overcome by regrading channels if this proves to be necessary.

In areas of high compressive strains, rippling or buckling of the road surface may occur with localised failure of the road surfacing material. In these circumstances, repairs may be necessary to some sections of the road surface.

Subsidence and changes in tilt can affect surface drainage culverts, which pass under the roads. Normally these are laid with little fall and the predicted maximum levels of tilt in the longwall area could result in some reversal of the gradients and some loss of capacity. The predicted maximum strains, however, are unlikely to result in noticeable damage to the culverts since they are relatively short in length. If it became necessary, culverts could be easily replaced or relaid, to restore their capacity, following completion of mining in the immediate area.

(f) Land Control Survey Marks

There are 18 state survey marks and 13 permanent marks located within the proposed mining area (see **Section 3.12**), many of which will be affected by mining subsidence. The Russell and Cooranbong Trig Stations are located to the northwest of the longwall mining area and to the southeast of the panel extraction area respectively and will not be affected. Liaison between the Colliery Survey section and the Department of Land and Water Conservation will be required throughout the mining period to ensure that these survey marks are reinstated at an appropriate time.

4.1.5 Assessment of Subsidence Impact on Natural and Cultural Features

(a) Groundwater

Pacific Power International (1997) estimates that the zone of interconnected fracturing above each longwall following mining would extend some 60 to 90 metres through Dooralong Shale Formation into the base of the Munmorah conglomerate. On this basis, as the depth of cover ranges from 160 metres (which in places consists of up to 20 metres of alluvium) to approximately 365 metres, it is considered unlikely that mining will result in any significant vertical drainage of the surface alluvial aquifer.

As discussed in **Section 3.5.3**, permeability of rock types within the Narrabeen Formation and the Wallarah/Great Northern coal seams is very low and as such, groundwater inflow to the mine from the coal seam and overburden will not be significant (Pacific Power International 1997) with discharges from the mine estimated to be less than for the existing Cooranbong Colliery.

Impacts on Aquifers, Water Table and Farm Dams

As mining occurs, individual depressions, or troughs, will remain in the surface of the ground above each of the extracted longwalls or panels and the ground in the centre of these depressions will be in compression.

Around the perimeter of each trough the ground will remain in tension. Within these tensile zones the potential for surface cracking exists, however, it is expected that this will be minimal due to the plasticity of the upper soil layers on the valley floor where drilling has indicated that an upper layer typically 5 metres to 10 metres thick of clay, clay/sand and silt exists (see **Figure 3.4**). If cracks do occur, through natural erosion of the surface soils, these cracks will be filled and will no longer be apparent.

Cracking will also occur in the underlying rocks. Temporarily the cracks might allow the passage of some water to occur from layer to layer. However, the cracks in a particular layer of rock will not normally continue directly into the layer above or below it and the paths along which these movements of water can occur, will generally be indirect. Over a short period of time, small cracks will be sealed by fine soil particles washed into them and claystone layers, exposed to water, will often expand to fill the fissures caused by subsidence.

Sometimes, after undermining, water can be permanently lost from an aquifer but it is more usual for an aquifer to recover as the ground stabilises and the cracks are sealed. In the Mandalong Valley the alluvial layers contain sand aquifers which are overlain by clay deposits several metres in thickness. Beneath the sand aquifers is a layer of weathered bedrock, described in the borehole logs as clay, claystone and clayey sandstone. Field inspection of this weathered material indicates that it is plastic in nature and could be expected to considerably restrict groundwater movement to the underlying interlinked fractured zone should it extend this far. Cracking in the weathered bedrock, sufficient to allow the ingress of water, should therefore be sealed by expansion or extrusion of the clay materials into the cracks.

It is therefore considered unlikely that any permanent leakage of the aquifer within the floodplain area will occur. Due to the thickness of the upper clay layer and the presence of the weathered bedrock that underlies the sand aquifer it is considered unlikely that any significant lowering of the water table will result from the longwall mining activity.

The farm dams that exist in the area are earth dams established within the surface soils on the lines of natural watercourses or positioned at low points in the alluvial clays. Relatively high tensile strains are predicted in the longwall area, which could lead to cracking in the base or walls of earth dams with consequential loss of water. Where this occurs it may be possible to seal the dams using bentonite though in some cases it may be necessary to drain the dams and reline them. In these circumstances, alternative supplies of water may have to be provided.

Since all of the dams in the area are relatively small, it is unlikely that any major problems will result from the impacts of subsidence. However, all dams will be monitored as mining proceeds, to ensure that they remain safe and operational.

(b) Flora and Fauna - Mining Areas 1 and 2

Subsidence has the main potential to have significant adverse impact on flora and fauna as a result of the proposed underground mine. Inspections undertaken of previously mined areas similar forest and woodland areas to the subject site, showed no apparent changes to the structure of vegetation communities or the habitat value of the area after mining. From this evidence, no adverse impacts on the flora and fauna occurring in the forest and woodland communities in the elevated and steeper parts of the site are anticipated.

Hydrologic modelling has indicated that the preferred longwall design will result in some substantial changes to the existing wetlands within the Mandalong Valley, and as a result it is possible that the current extent of wetlands will increase if drainage mitigation work is not undertaken. None of the wetlands occurring within the proposed mining area is gazetted under SEPP 14. Whilst the alteration to contours over the site may result in some of the current wetlands drying out or changing in shape or extent, other areas are likely to become inundated, with new wetland areas forming adjacent to or interconnected with the original wetlands.

Potential amelioration techniques include manually creating channels between the new and existing wetland areas to maintain these areas, or draining newly formed wetlands where they have inundated remnant forest and woodland communities. Long term monitoring should be implemented, and site specific surveys of the wetland areas that will be modified by mining should be conducted prior to disturbance to enable the ecological characteristics of the wetland to documented for rehabilitation purposes. The character of rehabilitated wetlands should be monitored post-mining to ensure the wetland is reinstated to at least the equivalent of its pre-mining condition. Amelioration and management of the wetland areas should be done progressively. The progressive assessment of the site, and development of ameliorative measures should be done in consultation with landholders, and flora and fauna experts. Amelioration should aim to retain a network of vegetated wetlands across the site to provide habitat for species which currently, or could potentially, occur.

Loss of Habitat

There will be no clearing of vegetation or removal of habitats or resources for native flora and fauna as a result of the proposed mining operation. Given that the areas which constitute the most valuable habitat for flora and fauna are in the woodland and forest on the foothills and upper slopes of the study area (which are not likely to be subjected to adverse surface impacts), resources for species which do, or may, occur will remain on the site.

As discussed above, some wetland areas will dry up, others will change in location and extent, while new wetlands will be created. However, amelioration can control or enhance the extent and location of wetlands and will aim to retain a network of wetland areas within the Mandalong Valley. Consequently, habitat for those species which occur in the wetlands on the site will remain, despite being altered by the proposed underground mining activities.

Impacts on Threatened Fauna and Flora

With the exception of the Black-necked Stork (which was not directly recorded by the study team), all of the other threatened fauna species rely on the woodland and forest habitats which will remain intact. Whilst some species (such as microchiropteran bats) are likely to use the wetland areas for foraging or as a source of water, such resources for these species will remain on the site. The Giant Barred Frog relies on the smaller tributaries in the steeper parts of the site. Hydrologic modelling has indicated that during normal flow conditions, flow rates and alignments in both these smaller creeks and the larger creeklines in the valley will remain largely unaffected, and this species is, therefore, unlikely to be subjected to adverse impacts.

No threatened plant species were recorded in the study area, but several could occur, given the habitats and resources present. The woodland areas on the foothills and upper slopes of the site are considered to be potential habitat for a range of threatened flora species. However, these areas are not likely to be adversely affected by potential subsidence levels and as a consequence any threatened species which occur in these areas will not be affected.

There is the potential for threatened plant species to occur in the wetland and floodplain areas of the subject site. Detailed surveys of any areas to be disturbed by remedial works or areas that will change from predominantly terrestrial to aquatic habitats or vice versa, are recommended both before and after mining. These surveys should be followed up with ongoing monitoring and should aim at locating any threatened species and defining appropriate impact amelioration measures to ensure that there are no adverse impacts upon their long term survival.

Significance of Impacts

The potential for the underground mine to have a "*significant effect on threatened species, populations or ecological communities, or their habitats*" has been assessed as specified in Section 5A of the EP&A Act 1979 (as modified by the Threatened Species Conservation Act 1995), and a Species Impact Statement is not required for the proposed activities **(Appendix 5)**.

SEPP 44 - Koala Habitat Protection

Preferred Koala food trees (as specified under Schedule 2 of SEPP 44) generally comprise greater than 15% of the total canopy cover in the area. Therefore, the study area generally is considered to constitute "*potential koala habitat*", as defined under SEPP 44. Despite historical sightings in the vicinity, there is no evidence of a resident breeding population in the study area. Therefore, the area is not considered to constitute "*core koala habitat*", as defined in SEPP 44, and a Koala Plan of Management is not required.

SEPP 14 - Coastal Wetlands

This policy does not apply to the Mandalong Valley study area, despite the presence of man-made and natural wetlands. None of the wetlands in the study area are identified under SEPP 14 as of conservation significance.

(c) Aboriginal Archaeology

No archaeological sites have been recorded previously within Areas 1 and 2. This absence may be directly related to a low quantity of archaeological surveys carried out in these areas, and low ground surface visibility.

N Inferences from archaeological research undertaken in the general region would indicate that a number of landforms and features within Areas 1 and 2 are potentially archaeologically sensitive. These include: N

- stream channels and banks;
- ridge and hill crests;
- sandstone outcrops on any landform.

The first two are likely locations for a broad range of site types (in particular, open campsites), while sandstone outcrops may contain rock shelters and/or axe grinding grooves.

The most likely impacts to archaeological sites from underground mining will be through inundation and/or fracturing of sandstone strata. Potentially, archaeologically sensitive landforms exist in areas which may be subject to significant levels of subsidence.

Other disturbances to the ground surface includes creek channelisation works and associated drainage works. These works are likely to impact on a small proportion of the land surface within Areas 1 and 2. The specific location of these types of disturbance are subject to further mine planning and consultation and are not able to be established at this time. To allow for this, an archaeological survey of areas to be disturbed will be carried out prior to the commencement of surface works. A component of this investigation should also be an investigation of sensitive landforms which do occur in areas that will be subject to disturbance, to establish the presence of archaeological material and make appropriate management recommendations. This should be done following mining when areas of required works have been identified.

(d) European Heritage

The 1992-1993 City of Lake Macquarie Heritage Study identified a number of items of the heritage of the City which are located in the general area of the proposed Cooranbong Colliery Life Extension Project. Other than 'Frosts Rest' which is outside the proposed mining areas as discussed in **Section 3.9.1**, items identified in the Heritage Study in the proximity of the proposed Cooranbong Colliery Life Extension Project included:

- The Great Northern Railway located to the east of the site;
- General Cemetery in Little Valley Road, Mandalong; and
- Early Wagon Road near Cut Rock Road, Cooranbong.

With regard to the General Cemetery, enquiries reveal that the cemetery Reservation was revoked and the land sold into private ownership in 1989. This action resulted from investigations of the physical site characteristics and historical records which indicated that no burials had occurred in the cemetery.

how far, how about

The Early Wagon Road is difficult to locate and the study diagram does not clearly depict its location, indicating that there may be some uncertainty as to its siting. Based on information contained in the Heritage Study , the Early Wagon Road is to the north of the proposed mining area and will not be affected by the proposed development.

(e) Visual Amenity

The underground mining operations will only result in surface disturbance due to subsidence and surface water mitigation works. The extent of subsidence is detailed in **Section 4.1**. The subsidence will to a limited extent alter the landform. This will be particularly more obvious in the floodplain area, however in the context of the visual setting no appreciable change will occur and therefore, no significant visual impact is expected.

(f) Impacts on Steep Slopes

The local effects of subsidence can sometimes be exaggerated by surface topography particularly in hilly and mountainous terrains. Escarpments can be rendered unstable if they are directly undermined or fall within the zone of influence of an underground extraction.

Undermining of steep slopes or escarpments can affect their stability and in some circumstances may result in collapse, due to the formation of shear planes within them. Mining below steeply sloping surfaces can in some instances lead to increased displacements down the slope and increased tensile stresses on the downhill side of the subsidence trough. The resultant surface cracking can impact both on the drainage of the hillside and the stability of the surface soils.

Within the proposed mining areas, the majority of the land is flat or gently sloping. There are no cliffs and less than 5% of the area has slopes steeper than 1 in 3. There is some small potential for slippage or slope instability wherever the slopes are steeper than 1 in 2 but slopes of this magnitude only occur in a few isolated cases. Major landslips are not therefore anticipated though some additional down slope movement may occur on some of the steeper sections.

4.1.6 Assessment of Impact on Surface Water

As described in **Section 3.5.2**, a detailed Two-Dimensional hydrodynamic model of surface flows within the Stockton/Morans Creek drainage system has been developed specifically for this project using RMA2. In the RMA 2 model the flow characteristics of the Mandalong Valley are represented as a flow network comprising some 13835 nodes and 4870 elements. This network has been used to describe topographic and hydraulic roughness characteristics of the valley.

A model of the existing landform was used in calibrating the RMA 2 hydrodynamic model developed for the valley. Topography of the valley was determined using detailed aerial photogrammetry with height information being provided on a 10 metre by 10 metre grid for all topography up to 30 mAHD. This information was supplemented with culvert/bridge information, detailed road height information and detailed bed level and bank height information for each of the creek lines that form part of the Stockton Creek/Morans Creek drainage system. In excess of 400,000 data points were used to describe the topography of the valley floor and channel system.

To assess the impact of subsidence from mining on surface water movement, the Two-Dimensional RMA 2 model that was developed and calibrated for the existing landform was modified. In modifying the model, the only changes that were made were to the topographic information used with the topographic representation of the existing landform being replaced with the predicted post-mining landform shown on **Figure 4.2**. No other parameters, such as rainfall, infiltration rates, hydraulic roughness characteristics and the finite element flow network used to represent existing conditions were changed from that used for the existing landform. This was done to ensure that modelled surface flow characteristics for the existing landform and the mined landform can be readily compared.

Changes to the landform after mining were drawn directly from subsidence predictions as detailed in **Section 4.2.1** and shown on **Figure 4.1**. From this information, a 10 metre by 10 metre grid of predicted subsidence across the proposed mining area was derived and was then used to develop an indicative post mining landform (see **Figure 4.2**). This information was then used to modify bed elevations in the RMA 2 Two-Dimensional hydrodynamic model developed for the site. Using this model, post mining water surface elevations and extent of flooding resulting from a critical duration 1 in 1 year and 1 in 100 year Average Recurrence Interval rainfall events were estimated and are shown on **Figures 4.3a** and **4.3b** respectively.

a) Extent of Inundation During a 1 in 1 Year ARI Rainfall Event

Modelling indicates that for the post mining landform, water surface elevations resulting from a 1 in 1 year Average Recurrence Interval rainfall event will be lower than for the existing landform. Based on the predicted water elevations the area of the valley floor subject to inundation will reduce from approximately 345 hectares for the existing valley floor to approximately 309 hectares for the subsided or post-mining valley floor. Modelling indicates that the area subject to surface ponding will increase as a result of mining unless drainage mitigation works are undertaken. Drainage mitigation works will include creek bed lowering and construction of additional surface drainage.

Modelling indicates that with drainage works to reduce surface ponding and minor lowering of creek beds at specific locations the area subject to inundation will be further reduced to approximately 286 hectares.

On this basis, the proposed mining development will reduce the area inundated during a 1 in 1 year Average Recurrence Interval rainfall event by approximately 35 hectares or approximately 12%. Minor drainage works and stream bed lowering over chain pillars will reduce the inundated area by an additional 23 hectares resulting in a net reduction in the total area inundated of approximately 21%.

b) Extent of Inundation During a 1 in 100 Year ARI Rainfall Event

Modelling indicates that for the post mining landform, water surface elevations resulting from a 1 in 100 year ARI rainfall event will typically be 0.05 metres to 2.35 metres lower than for the existing landform. Following mining it is estimated that the area inundated from a 1 in 100 year rainfall event will reduce by approximately 9% from 636 hectares for the existing landform to 584 hectares.

c) Surface Water Impacts on Dwellings

Estimated changes in surface water elevations at habitable dwellings on the floor of Mandalong Valley resulting from a 1 in 100 year ARI rainfall event are summarised in **Table 4.7**.

As is indicated by the results listed in **Table 4.7**, without flood mitigation works being undertaken, it is estimated that of the 27 habitable dwellings located on the valley floor, 16 dwellings will have an increase in freeboard above the water surface resulting from a 1 in 100 year ARI rainfall event and the remaining 11 will have less freeboard. Estimated changes in freeboard range from 0.047 metres to 1.451 metres for those dwellings with greater freeboard than prior to mining and –0.059 metres to -1.985 metres for those dwellings with less freeboard.

Prior to mining, it is estimated that 4 dwellings have floor levels either at or below the water surface resulting from a 1 in 100 year ARI rainfall event with the floor level of an additional dwelling having less than 0.5 metres freeboard. After mining it is estimated that 3 dwellings will have floor levels either at or below the water surface resulting from a 1 in 100 year ARI rainfall event with the floor level of an additional two dwellings having less than 0.5 metres freeboard. Estimates indicate that the floor levels of the 3 dwellings will be 0.226 metres, 0.451 metres and 0.637 metres below the estimated 1 in 100 year ARI water surface.

Apart from altering the flood regime within the Mandalong Valley, subsidence of the landform also has the potential to change the flooding regime and flood levels within Dora Creek through altering peak discharge levels and altering the time it takes for peak flood levels to occur. Dynamic modelling undertaken for the project using the existing landform and post mining landform RMA 2 models discussed above indicate that peak discharge at the F3 Freeway resulting from a critical duration 1 in 100 year ARI rainfall event is estimated to reduce from 402 m^3/s for the existing landform to 390 m^3/s following mining. Hydrographs for Stockton Creek immediately downstream of the F3 Freeway are shown on **Figure 4.4**.

Modelling also indicates that the time for peak discharge to occur at the F3 Freeway will increase from approximately 9 hours for the existing landform to approximately 9 hours and 10 minutes for the post mining landform. The small increase in time to achieve peak discharge is expected to be offset by the small reduction in peak discharge. Time to achieve peak discharge in Dora Creek at Dora Creek township is estimated to be approximately 12 hours and as such the estimated small changes in Stockton Creek discharge hydrograph characteristics are expected to have a negligible impact on the flooding regime of Dora Creek.

Table 4.7 – Comparison of Pre and Post Mining Water Surface Elevations - Area 1

Property Ref. No	Structure	Observed Water Level (mAHD)	Ground Level (mAHD)	Floor Level (mAHD)	Existing Water Level (mAHD)	Existing Floor Level Freeboard (m)	Predicted Subsidence (mm)	Subsided Ground Level (mAHD)	Subsided Floor Level (mAHD)	Subsided Water Level (mAHD)	Subsided Floor Level Freeboard	Change in Floor Level Freeboard (m)
10C	Stables	6.5	6.12	6.43	6.41	0.02	37	6.083	6.393	6.35	0.043	0.023
10A	Residence	5.9	5.8	7.001	6.38	0.621	523	5.277	6.478	6.28	0.198	-0.423
9A	Residence	8	7.39	7.75	7.75	0	1207	6.183	6.543	7.18	-0.637	-0.637
94-O	Residence		6.76	10.56	6.38	4.18	1069	5.691	9.491	6.35	3.141	-1.039
9E	Residence		9	9.4	7.65	1.75	0	9	9.4	6.86	2.54	0.79
8C	Residence		9.95		8.57		0	9.95		8.34		0.23
8A	Residence		11.05	11	9.73	1.27	524	10.526	10.476	9.45	1.026	-0.244
8B	Shed		10.2		9.18		56	10.144		9.03		0.094
6A	Residence		8.52	9.4	8.39	1.01	0	8.52	9.4	8.32	1.08	0.07
59b	Dairy	9.82	9.35		9.7		717	8.633		9.48	-9.48	-9.48
56A	Residence		12.35	13.99	11.75	2.24	129	12.221	13.861	11.15	2.711	0.471
60A	Residence	10.9	10.15	11.27	10.31	0.96	329	9.821	10.941	10.04	0.901	-0.059
61A	Residence	11.3	11.55	12.37	11.43	0.94	734	10.816	11.636	11.33	0.306	-0.634
62A	Residence		11.49	12.32	11.88	0.44	0	11.49	12.32	11.76	0.56	0.12
58A	Residence		12.51	14.08	13.5	0.58	1381	11.129	12.699	13.15	-0.451	-1.031
44A	Residence	14.18	13.7	16.29	14.15	2.14	2365	11.335	13.925	13.77	0.155	-1.985
47A	Residence	16.31	16.41	18	15.95	2.05	104	16.306	17.896	15.75	2.146	0.096
67A	Residence		16.19	17.15	15.6	1.55	82	16.108	17.068	15.15	1.918	0.368
70A	Residence	17.81	16.98	18.43	17.62	0.81	73	16.907	18.357	17.5	0.857	0.047
82A	Residence	18.1	19.5	21.29	18.2	3.09	3	19.497	21.287	17.67	3.617	0.527
26A	Hostel		19.8	20.21	20.05	0.16	899	18.901	19.311	17.7	1.611	1.451
26B	Residence		19.73	20.21	20.05	0.16	770	18.96	19.44	17.7	1.74	1.58
26C	Office/garage	19.78	19.59	19.88	19.95	-0.07	1935	17.655	17.945	17.48	0.465	0.535
27A	Residence		19.5	20.64	17.8	2.84	633	18.867	20.007	15.74	4.267	1.427
57A	Residence		13.2	15.17	14.05	1.12	408	12.792	14.762	13.73	1.032	-0.088
41A	Residence		18.3	19.1	15.7	3.4	680	17.62	18.42	14.5	3.92	0.52
51-I	Shed		7	7.75	6.61	1.14	130	6.87	7.62	6.53	1.09	-0.05
212	Residence	22.43	22.05	22.96	22.25	0.71	962	21.088	21.998	21.35	0.648	-0.062
6-nth	Paddock	7.75	7.7		7.61					7.48		0.13
6-sth	Paddock	8.67	8.3		8.72					8.67		0.05
7A	Residence		8.3	8.724	9.01	-0.286	0	8.3	8.724	8.95	-0.226	0.06
43A	Residence		16.45		15.05		2486	13.964	-2.486	13.96		-1.396
88A	Residence		22.3		20.9		242	22.058	-0.242	20.85		-0.192
61B	Shed		11.55		11.25		0	11.55		11.18		0.07
60F	Shed		9.45		9.65		74	9.376		9.51		0.066
5A	Residence		9.27		8.05		0	9.27		7.88		0.17

Two Dimensional Hydrodynamic Modelling of the Mandalong Valley indicates that following mining there will be approximately a 9% reduction in the area subject to inundation from runoff from a 1 in 100 year critical duration rainfall event. Modelling also indicates that of the 27 habitable dwellings on the floor of Mandalong Valley, 16 will have greater freeboard above estimated water surface elevations following mining and 11 will have less freeboard than for the existing landform. Of these 11, only 4 will have a freeboard less than a critical 500 mm. On this basis it is considered that the proposed underground mining development will not have a significant adverse impact on the surface water regime, nor on the surface flow characteristics of the Mandalong Valley nor on the flooding regime of Dora Creek.

Through flood mitigation works the potential exists to further reduce existing and post mining surface water impacts. A range of mitigation measures are discussed in **Section 4.2.3**.

d) Surface Water Velocities

Output from the RMA model of the Mandalong Valley floor indicates that overland flows resulting from a 1 in 100 year ARI rainfall event typically have velocities of less than 1 m/s with peak out of channel velocities of less than 1.5 m/s being predicted. Assessment of maximum out of channel velocities for the post mining land form indicates that peak velocities typically less 1.5 m/s are predicted. The valley floor typically supports a stable vegetative cover of grasses, shrubs and trees which typically would not be subject to significant erosion from the predicted existing or post mining velocities even during significant flood events. On this basis it is considered that mining will not increase the erosion potential of the valley during significant flood events. Short term susceptibility to erosion may occur while a stable vegetative cover is being achieved following any surface works that may be undertaken for drainage and land reformation purposes.

e) Inundation by Tidal Waters

The bed levels of Stockton Creek and Morans Creek at the downstream boundary of Area 1 will be in excess of 6 mAHD and as such no tidal inundation of the Mandalong Valley will occur as a result of the proposed development.

4.1.7 Transient Impacts

a) Buildings and Structures

Within the area directly above the longwalls, the principal tilts, curvatures and strains will occur in the traverse direction, ie at right angles to the direction of mining. As coal is extracted from the longwall, an incremental subsidence trough will develop above the longwall panel and this trough will extend in length at approximately the same rate as the face retreats below it. The longitudinal profile, at the moving end of the trough will be a similar, but flatter shape to the traverse profile and will include points of maximum tilt, curvature and strain in the longitudinal direction. These longitudinal transient profiles can in some cases exhibit greater tilts in the longitudinal direction than the residual tilts at the completion of mining from the transverse profiles.

Whilst these impacts are only transient, they can result in higher levels of damage than those assessed from the predicted final transverse parameters. To explore this further, an assessment of these transient impacts on major building structures which lie directly above longwalls panels has been undertaken. Of the 42 buildings considered, it was found that 7 would experience greater tilts in the longitudinal direction than they would in the traverse direction and the level of impact for these 7 buildings would be greater therefore than indicated in **Table 4.6**.

These tilts however would be transient and whilst they might be inconvenient to the occupants for a few weeks, would reduce to assessed residual levels on the completion of mining. In four cases it was found that the transient curvatures and strains in the longitudinal direction would be greater than the residual traverse values however the maximum transient values of strain were less than 1.5 mm/m and as such would have a negligible impact on the buildings.

b) Surface Water

During the proposed twenty year development life, the landform will be continually changed by the proposed development and as a result the potential exists for short term impacts or transient surface water impacts to impact on dwellings and the land surface to a level beyond that of the impacts of the overall development as discussed in **Section 4.1.6**. These impacts may include short term flooding of dwellings and buildings if a significant flood event occurs prior to mining being undertaken under downstream surface control features. Based on the preferred mine plan described in **Section 2.0**, two dwellings within Mining Area 1 will be prone to flooding impacts beyond that of those assessed for the indicated final landform. Modelling indicates that these dwellings could potentially be prone to potential increased flooding impacts for periods of 5 weeks to 17 weeks. Potential transient surface water impacts on dwellings are summarised in **Table 4.8**.

Transient surface water impacts may also include increased areas of ponding and waterlogging prior to the completion of mining in respective areas or prior to surface drainage works and creek bed lowering works being undertaken where necessary. In some instances surface drainage works may be required on adjoining properties to provide for draining of ponded water on specific properties. This will be particularly the case in the area bounded by Mandalong Road, Deaves Road and Sauls Road and includes the area known as Joeys Swamp. In this area the flat nature of the existing landform will, based on the preferred mine plan, result in substantial areas of surface ponding if adequate drainage and mitigation measures are not implemented. The level to which drainage is undertaken will be determined through consultation with landholders, the Department of Land and Water Conservation and Lake Macquarie City Council and Powercoal Pty Ltd.

The potential also exists for the proposed development to result in short term losses of water from dams and water bodies while mitigation works (see **Section 4.2**) are being implemented.

Table 4.8 - Transient Surface Water Impacts (1 in 100 year ARI Rainfall Event)

Prop Ref. No	Structure	Predicted Subsidence (mm)	Existing Water Level (mAHD)	Subsided Water Level (mAHD)	Change in Water Level (m)	Floor Level (mAHD)	Subsided Floor Level (mAHD)	Existing Floor Level Freeboard (m)	Subsided Floor Level Freeboard (m)	Comments
9A	Residence	1207	7.75	7.18	0.58	7.75	6.543	0	-0.637	LW1, middle floodplain floor level below subsided water surface level
9E	Residence	0	7.65	6.86	0.79	9.4	9.4	1.75	2.54	Between LW1 and LW2 in zero subsidence area
56A	Residence	129	11.75	11.15	0.60	13.99	13.861	2.24	2.711	Between LW3 & LW4, adequate freeboard
82A	Residence	3	18.2	17.67	0.53	21.29	21.287	3.09	3.617	Between LW10 & LW11, negligible subsidence and adequate freeboard
26A	Hostel	899	20.05	17.7	2.35	20.21	19.311	0.16	1.611	LW7, subsidence greater than existing freeboard however on upslope edge of floodplain. May suffer flooding impact if has not progressed more than approximately 1 kilometre past or approximately 17 weeks after mining near the structures prior to a significant flood event occurring.
26B	Residence	770	20.05	17.7	2.35	20.21	19.44	0.16	1.74	
26C	Office/ Garage	1935	19.95	17.48	2.43	19.88	17.945	-0.07	0.465	
27A	Residence	633	17.8	15.74	2.06	20.64	20.007	2.84	4.267	LW6 has adequate freeboard to be above existing water level even after subsidence
41A	Residence	680	15.7	14.5	1.20	19.1	18.42	3.4	3.92	LW5 has adequate freeboard to be above existing water level even after subsidence
44A	Residence	2365	14.15	13.77	0.38	16.29	13.93	2.14	0.155	LW7 Water Level controlled by flow perpendicular to direction of longwall panel and as such water level will drop either prior to or at the time of mining
58A	Residence	1381	13.50	13.15	0.35	14.08	12.70	0.58	-0.451	LW5 Floor level of Dwelling will be below significant flood level after mining
212	Residence	962	22.25	21.35	0.90	22.96	22.00	0.71	0.648	LW13 immediately upstream of negligible subsidence zone. Subsidence greater than existing freeboard and may suffer temporary inundation above floor level if significant flood event occurs with approximately 8 weeks of mining past dwellings.
43A	Residence	2486	15.05	13.96	1.09	16.45	13.96	1.40*	0	LW6. Dwelling is located on a ridge between Joeys Swamp and Stockton Creek floodplain. Previous mining in LW5 and LW6 will lower water levels at the residence to approach subsided water level. Floor level information for the dwelling is estimated. Modelling indicates that the dwelling will have zero freeboard after mining.

NB: *Dwellings 5A, 6A, 8A, 8C, 10A, 47A, 57A, 60A, 61A, 62A, 67A, 70A, 88A & 94O are estimated to all have subsided floor levels that will be higher than the estimated existing water surface resulting from a 1 in 100 year ARI rainfall event. As such these dwellings will not be subject to transient flooding impacts.*

Dwelling 7A has a floor level that is currently 0.286 m below the existing predicted water surface and 0.226 m below the subsided water surface.

4.2 MEASURES TO MITIGATE SUBSIDENCE IMPACTS

4.2.1 Management of Impacts on Buildings, Infrastructure, Natural and Cultural Features

(a) Buildings and Other Improvements

As discussed in **Section 1.1**, prior to longwall mining commencing a Subsidence Management Plan will be developed for each property likely to be affected by mining of the longwall or groups of longwalls for which longwall approval is sought. The Subsidence Management Plan will detail predicted impacts to buildings and other improvements and will set out appropriate mitigation measures to minimise subsidence impacts.

Measures employed to lessen the impact of subsidence on buildings are generally directed towards:

- reduction of the ground strain transferred into the structure;
- strengthening of the structure to accommodate ground strains;
- introduction of vertical joints to allow the structure to articulate.

These measures are most effective where the strains are high and the tilts are small.

The most significant impact in Area 1 is potentially high levels of residual tilting. If a building is supported totally on piers and access to the underside of the ground floor is available, it is possible to install a series of hydraulic jacks and relevel the building as mining subsidence occurs. This method can also be used to correct the tilt of steel framed structures.

Generally, brick veneer structures have concrete footings beneath the external brick veneer walls and internal load bearing walls, making it difficult to install jacking systems in such cases. Buildings constructed with raft or slab foundations can not be easily jacked unless they have been specifically designed to allow it.

Where the tilts are relatively small, slabs can be lifted and adjusted in level by the injection of an expanding, resin based, grout through holes drilled in the slab. Generally, it can be assumed that the practical limit for this method is a maximum lift of 300 mm, which for a typical house, 20 metres in length, represents a tilt of 15 mm/m.

(b) Services and Infrastructure

At the predicted levels of tilt, some of the power cables will probably need to be protected by the installation of slinging sheaves before mining occurs. It is also possible that some of the tension structures and guys, at changes in direction of the cables, will require monitoring and adjustment throughout the mining period to prevent damage to the cables. Some of the supporting poles could be badly affected by tilt and it is possible that they would require some adjustment on completion of mining.

Low voltage consumer lines could equally be affected and whilst the consequences of a break in a consumer line are generally less serious then a break in a high voltage line, it would nevertheless result in inconvenience to one or more consumers. It is therefore equally important to study and monitor the impacts on these services as mining proceeds.

In regard to transmission lines, TransGrid has indicated, as a general rule, that it is possible to protect suspension structures against the effects of subsidence. To accommodate tilt, in suspension structures, it is generally possible to place the conductors in stringing sheaves to allow the tower to move without pulling on the conductors. At the same time, this allows redistribution of the tensile stresses to occur.

Cruciform foundations can be installed to tower structures, before mining, to prevent the transfer of ground strains into the structures and to provide a facility for jacking of the structures to level as subsidence occurs.

Based upon the predicted subsidence parameters for the preferred layout and the general requirements stipulated by TransGrid, it would seem that Towers TT46 to TT49 will require stringing sheaves and Towers TT48 and TT49 will require some work to the tower foundations. The final requirements will need to be established in discussion with TransGrid and this will occur well ahead of any anticipated impact.

An inspection should be carried out prior to mining to enable any problems to be identified in advance. Protective and preventive measures are readily available and can be undertaken as necessary to minimise the effects. Close monitoring during the subsidence events would also be advisable so that corrective action, where necessary, can be taken to protect the installations before damage occurs.

Gas pipelines have been successfully undermined on a number of occasions without damage. If necessary and with the approval of the owner, the pipeline can be protected, by temporarily uncovering it, to prevent transfer of ground strain into the pipe.

NC here.

The layout of the panel mining system planned for Area 2 can be readily adjusted to ensure that the impact of subsidence on surface infrastructure remains within acceptable limits.

In regard to roads, the Subsidence Management Plan will identify the location and heights of access tracks and will detail appropriate mitigation measures to be implemented such as raising/reshaping sections of access tracks. The effects of subsidence on roads will be monitoring of the effects, as the subsidence troughs develop, will ensure that immediate action can be taken to maintain safe passage for vehicles and pedestrians. During subsidence events, where appropriate additional signs will be provided along major roadways to warn road users of the possibility of mining subsidence.

In some areas, the vertical subsidence might result in the lowering of the road pavement below an acceptable flood level. If this occurs, the affected section of road will need to be reconstructed to achieve a satisfactory vertical alignment and adequate clearance above an appropriate design flood level. Subsidence mitigation works for the road system will be determined in consultation with Lake Macquarie City Council and will be consistent with the Mandalong Valley Floodplain Management Plan (see **Section 4.2.3**).

(c) Natural and Cultural Features

Detailed mitigation measures to protect natural and cultural features on the surface of the proposed mining areas will ~~be refined, in consultation with~~ landholders during the preparation of ~~Subsidence Management Plans (see~~ **Section 1.1**). At this time a further site specific assessment of subsidence impacts on natural surface features will be undertaken and surface disturbance for mitigation works such as drainage works and surface rehabilitation will be defined. It is envisaged that the majority of such works will be confined to the floor of the Mandalong Valley however some works may be required to avoid head cut erosion in drainage lines particularly at the upstream boundaries of Area 1. As discussed in **Section 3.3.1**, subsoils generally have high potential dispersibility, variable but generally low volume expansion and generally good slope stability, with moderately acid to neutral pH. Due to the high dispersibility of some subsoils, earthworks to prevent head cut erosion and the exposure of the subsoils following differential subsidence will be necessary to control erosion.

like what?

Prior to commencement of each group of longwall mining further surveys of riparian vegetation and wetland areas that may be affected by mining will be undertaken and appropriate mitigation measures such as replanting of wetland species, replanting of riparian vegetation will be determined. Following completion of remediation works, sites will be monitored on an ongoing basis until stable and viable vegetation communities are established.

Proposed underground mining activities have limited potential to adversely impact on archaeological resources. In areas of potential archaeological sensitivity where surface works are required, a detailed archaeological survey of the site to be disturbed will be undertaken prior to remediation works commencing and remediation works will be designed to minimise impact on these resources. Areas potentially sensitive to subsidence, such as sandstone rock outcrops which may contain rock shelters, will be further investigated to determine the need or otherwise for specific ameliorative measures.

Surface impacts of underground mining activities will be monitored on an ongoing basis to allow subsidence predictions to be continually revised and to ensure that changes to land surface that require remediation measures are detected and rectified.

The importance of ongoing monitoring as the subsidence occurs can not be over stressed and it is essential that the process is carried out in conjunction with all statutory authorities and landowners so that necessary strategies can be developed and put in hand at the appropriate time.

Apart from potential changes to the land surface, mining has the potential to alter groundwater characteristics in the area. Field investigations of the groundwater and alluvium has indicated that this potential is low. To monitor changes in groundwater characteristics, Powercoal has established a series ~~of 14 groundwater monitoring bores~~ in the alluvium and regularly monitors groundwater levels and water quality. Monitoring will continue through the life of the mine and monitoring results will be available for relevant government agencies to review.

In addition to the regular monitoring of groundwater bores, it is proposed to establish a continuous groundwater level monitoring unit at the monitoring bore closest to the longwall panel being mined at the time. This will allow any rapid fluctuations in groundwater levels that potentially may result from mining to be detected and if such a case arises, appropriate mitigation measures to be taken. Mitigation measures may include surface reshaping and reformation works and the provision of water if required.

4.2.2 Policy on Land Access, Management and Compensation

In addition to the environmental mitigation measures identified in **Section 4.2.1** that will be incorporated into the development, Powercoal intends to implement a comprehensive range of mitigation and compensation measures to offset damage, modifications and inconvenience that result from the proposed mining development. These measures include:

- An undertaking to landholders within the proposed mining area to act in accordance with the requirements of all relevant legislation, licences and development consent conditions. The rights of landholders will be acknowledged and upheld at all times.

- Development of a comprehensive '*Cooranbong Colliery Life Extension Project Land Access, Management and Compensation Policy*' that will set out the framework for Powercoal's discussions and dealings with land holders affected by the proposed mine extension.

- Establishment of a $2 million rehabilitation and compensation guarantee to be operated in conjunction with the '*Cooranbong Colliery Life Extension Project Land Access, Management and Compensation Policy*'. The guarantee will be administered by an independent mediator who will have the power to call upon the monies and have works done, should Powercoal inadvertently fail to fulfil its obligations under the Mining Act (1992) and the Environmental Planning and Assessment Act (1979). If monies are drawn from the rehabilitation and compensation guarantee, Powercoal will re-establish the guarantee level to ensure that the total amount accessible is not less than $2 million.

- Provision of an independent mediator with a thorough working knowledge of the Mine Subsidence Compensation Act (1961) who will be available to assist the community in making claims under the Mine Subsidence Act.

- Where possible, implementation of appropriate mitigation measures prior to mining to minimise potential impacts and inconvenience to landholders. Such works could include creek and drainage mitigation works; provision of adjustable supports under existing houses to offset impacts of subsidence; and construction of subsidence proof houses to replace houses that will be significantly damaged by mining.

- Ongoing liaison with landholders, Lake Macquarie City Council and the Floodplain Management Committee to develop appropriate surface water management strategies that address existing and future surface water management issues in the Mandalong Valley (see **Section 4.2.3**).

The '*Cooranbong Colliery Life Extension Project Land Access, Management and Compensation Policy*' has been developed specifically by Powercoal for managing subsidence impacts on surface properties that arise from the proposed mine extension. The Policy forms part of the proposed development and is detailed in **Appendix 6**.

The Policy objectives are:

(i) To guide in the application of the current law and best practice with respect to land management and rehabilitation, and liaison with landholders within the Mine Lease area;

(ii) To work effectively with the community to secure community acceptance and Government approval for ongoing mining and land management within the Mine Lease area; and

(iii) To minimise investment risk.

Specifically, the Policy commits Powercoal to:

a) Manage land owned by Mandalong Pastoral Management (a Powercoal company) according to best practice land management systems;

b) Recognise the rights of landholders to compensation for any defined damage resulting from its underground mining operations;

c) Provide information to landholders about its operations and/or future indicative mine plans at the earliest possible time in the planning cycle;

d) Enter into agreements with relevant landholders to compensation for the effects of mining which are not covered by the provisions of the Mine Subsidence Compensation Act 1961. Such agreements may include options to purchase specific land;

e) Develop an ongoing consultation program jointly with the community;

f) Establish a dispute resolution mechanism to provide for mediation between Powercoal and any other affected parties.

4.2.3 Management of Impacts on Surface Water

a) Surface Ponding

Based on the preferred mine plan, subsidence modelling indicates that in parts of the central proportion of Mandalong Valley (in the vicinity of Joeys Swamp particularly) surface ponding may occur as a result of mining. Analysis of the indicative final landform (see **Figure 4.2**) indicates that the extent of surface ponding can be minimised if drainage works are undertaken as mining progresses.

The extent to which drainage works will be undertaken will depend on the level of subsidence that results from the mine plan that is implemented and the results of discussions with each of the affected landholders. A considerable degree of flexibility exists as to the level of drainage that could be achieved ranging from works that will completely drain the majority of the ponded areas through to the establishment of large tracts of wetland habitat. The level of drainage works constructed will be largely driven by the preference of relevant landholders in terms of the type of final landform (ie. fully drained land through to wetland/dam) the landholder prefers.

As part of the ongoing monitoring program, surface water quality will be monitored at several locations through the proposed mining area and at its downstream boundaries. Monitoring results will be available to relevant government departments for review.

b) Surface Water Levels

In regard to general surface water levels during flood events, hydrodynamic modelling undertaken for the project indicates that significant tracts of the existing valley landform are subject to inundation and water logging. Modelling also indicates that benefits in terms of the extent and duration of inundation by surface water could be achieved through the implementation of flood mitigation works. Such works would improve surface drainage characteristics of the area and improve the hydraulic conductivity of flow structures that currently impede flow. As discussed above, following mining it is envisaged that some surface drainage works will be undertaken to minimise the extent of ponding and additional work may be undertaken to reduce flooding impacts in the valley.

It is envisaged that the nature and extent of works to be undertaken will be determined through consultation with landholders, relevant government agencies and Lake Macquarie City Council. Lake Macquarie City Council have established a Floodplain Management Committee whose responsibility it is to develop Floodplain Management Plans for low lying areas. It is considered that this committee, with additional landholder representation, may provide the most appropriate forum for determining the extent and nature of surface water management works to be undertaken within the valley. It is proposed that the Mandalong Valley Floodplain Management Sub-Committee be established to oversee the development and implementation of a Mandalong Valley Floodplain Management Plan.

It is envisaged that the Floodplain Management Plan will be developed prior to longwall mining commencing. Hydrodynamic modelling ~~work undertaken as~~ part of the project has ~~completed a substantial~~ component of the modelling work required to allow the Plan to be developed. The Plan will set the general principles for floodplain management in the Mandalong Valley and identify those works that can be undertaken independent of mining activities and provide guidelines for works to be undertaken to mitigate subsidence impacts. Works required to mitigate subsidence impacts on surface waters on a property by property basis, will be determined in consultation with landholders and will be consistent with the overall objectives of the Mandalong Valley Floodplain Management Plan. These works will be detailed in the Subsidence Management Plans that will be prepared for each property prior to longwall mining commencing.

4.3 DOWNCAST SHAFT

4.3.1 Air Quality

No dust emissions are expected from underground operations within Areas 1 and 2 other than during the construction phase of the Downcast Shaft.

The major source of dust will arise from boring the shaft, blasting and erosion from exposed areas and stockpiles. This will however be limited in extent and relatively short-lived (approximately 3 months). No quantitative estimation of the impacts has therefore been made.

As the shaft is a Downcast Shaft (ie an air intake), there will be no air emissions during the operational phase.

4.3.2 Blast Emissions Impact Assessment

Blasting may be required in the construction of the proposed Downcast Shaft. It is estimated that the Maximum Instantaneous Charge (MIC) of explosive required for blasting during construction of the Downcast Shaft will be 3 kg. To determine the impact of the proposed blasting during construction, blast emissions prediction charts were used to determine the levels of ground vibration and airblast that are likely to occur at the nearest potentially affected residential dwellings as a result of blasting at the nearest point of the proposed downcast air shaft. The results are presented in **Table 4.8**.

Table 4.8 - Predicted Blasting Emissions

Property/Distance from Blasting	PVS Ground Vibration Velocity	Peak Airblast
Crooks Road Site - 240 m	1.09 mm/s	111 dB Linear

The predicted levels of ground vibration and airblast resulting from a 3Kg MIC blast at all residential properties comply with the EPA's recommended human comfort criteria of 5 mm/s and 115 dB Linear, respectively, for daytime blasting and therefore comply with the appropriate structural damage criteria. As such, it is not considered that blasting will have a significant impact on adjacent residences.

4.3.3 Flora and Fauna

Given that the site for the proposed Downcast Shaft has been subjected to long term clearing and grazing, few resources for native flora or fauna are present. The Downcast Shaft will not require the removal of any trees, and the potential for adverse impacts on flora and fauna, and their habitats is considered to be minimal.

Whilst individuals of the ROTAP species *Eucalyptus fergusonii* spp *fergusonii* were recorded in areas adjacent to the proposed Downcast Shaft site, through controlling construction and stockpiling to cleared areas, there will be no requirement for any removal of vegetation (other than pasture grasses, and common shrubs), and this species is highly unlikely to be adversely affected.

However, there are some potential indirect impacts which may result from the construction phase of the project, particularly erosion and sedimentation in adjacent habitats. The farm dam near the proposed Downcast Shaft site, whilst somewhat disturbed as a result of access by cattle, provides habitat for waterbirds and other species. The quality of this habitat is likely to be reduced by sediment deposition. These impacts can all be controlled by standard amelioration techniques, such as the implementation of sediment control structures.

Significance of Impacts

The potential for the Downcast Shaft to have a "*significant effect on threatened species, populations or ecological communities, or their habitats*" has been assessed as specified in Section 5A of the EP&A Act 1979 (as modified by the Threatened Species Conservation Act 1995), and a Species Impact Statement is not required for the proposed activities (**Appendix 5**).

SEPP 44 - Koala Habitat Protection

Preferred Koala food trees (as specified under Schedule 2 of SEPP 44) do not comprise greater than 15% of the total canopy cover in the area of the proposed Downcast Shaft site. Therefore, the Downcast Shaft site is not considered to constitute "*potential koala habitat*", as defined under SEPP 44. The Downcast Shaft site can not constitute "*core koala habitat*", as defined in SEPP 44, and a Koala Plan of Management is not required.

4.4 MINE ACCESS SITE

4.4.1 Construction Phase

As detailed in **Section 2.3**, construction of the Mine Access Site will require disturbance to the existing landform in terms of clearing and excavation/reshaping works. A maximum of approximately 12 hectares of land will be disturbed at any point in time and approximately 2 hectares of trees will be cleared. The amount of land required to be cleared or disturbed has been minimised during the design phase for the layout of the site by positioning structures, where possible, to avoid timbered areas. As a result of this design process, a buffer strip of timbered land will be maintained around the perimeter of the site to provide habitat continuity and screening of the site.

Potential impacts during the construction phase include:

- Noise and Blasting Emissions (see **Section 4.4.5**)
- Air Quality (see **Section 4.4.6**)
- Visual Amenity (see **Section 4.4.7**)
- Flora and Fauna (see **Section 4.4.8**).

In addition, the construction phase may have the potential to res~~ult in erosion and water quality~~ impacts. To mitigate these impacts, a detailed Soil and Water Management Plan will be developed for the site once construction details are ~~finalised and~~ prior to commencement of construction activities on the site. Soil and Water Management measures to be incorporated in development of the site will include:

how to minimise? when to be at one time?

- Minimisation of areas disturbed at any time and flagging of 'no go' areas where no disturbance is to occur.
- Construction of sedimentation dams at the northern boundary of the Mine Access Site (see **Figure 2.6**) and construction of a series of catch drains to collect potentially sediment laden runoff from the site and convey it to the sedimentation dam system. Sedimentation dams will be regularly maintained.
- Stripping and stockpiling of topsoil for later use in topsoiling vegetated areas on the site such as cut batters and acoustic/vegetated mounds. All topsoil stockpiles will be located away from drainage paths to minimise potential for re-entrainment of stockpiled material. bunded?
- Constructing cut and fill batters and embankments to have a maximum slope of 3 Horizontal as to 1 Vertical. All batters will be topsoiled and vegetated as soon as is practicable and will be maintained until a stable vegetative cover is achieved.
- Sealing of all hardstand and traffic areas as soon as practical to minimise potential for sediment generation.

4.4.2 Traffic

Access to the Mine Access Site will be off Mandalong Road at a location approximately 300 metres west of the Morisset Interchange on the F3 Freeway (see **Figure 2.6**). To accommodate traffic ingress and egress for the Mine Access Site, it is proposed to construct a Type C intersection on Mandalong Road. The proposed Type C intersection will have more than adequate capacity to accommodate Mine Access Site traffic both during construction phase and the ongoing use of the site.

It is estimated that the proposal will generate up to an additional 400 vehicle movements per day on Mandalong Road west of the F3 Freeway with a maximum of 100 one way vehicle movements associated with shift changes. Workers travelling to the site are likely to commute from destinations in the Lower Hunter, Central Coast and Lake Macquarie areas and as such, will access the site from north and south bound lanes of the F3 Freeway and from east and west bound lanes of Main Road 217 (Mandalong Road). Generally, traffic movements to and from the site are not expected to coincide with the direction or timing of periods of peak traffic movements on Main Road 217 east of the Freeway. As such, traffic movements generated by the proposed development are not expected to have a significant impact on traffic movements on Main Road 217.

Actual traffic movements generated by the development will depend on shift hours and durations adopted at the site and travel routes used by workers employed at the site.

4.4.3 Services

As discussed in **Section 2.3.1**, electricity and water supply for the site will be extended from existing service infrastructure in Morisset. A services conduit exists in the Mandalong Road bridge over the F3 Freeway and this will be used to convey reticulated water to the site. Water will be used for bathhouse, underground uses, washdown and dust suppression purposes at the site. Annual water demand is estimated to be 21 ML for surface facilities with up to an additional 168 ML being required annually for underground uses. Peak daily demand is estimated at 58 KL for surface facilities with up to an additional 460 KL/day being used for underground purposes (Rust PPK 1997).

Effluent from the bathhouse will be treated on-site in a package treatment plant. Treated effluent will be disposed of through on-site irrigation of vegetated areas adjacent to Mine Access Site infrastructure and on land owned by Powercoal Pty Ltd immediately to the north of the site. In the future, the opportunity to re-use treated effluent to irrigate nearby grazing land will be explored. Effluent will be disposed of on-site in accordance with EPA guidelines (EPA 1995).

4.4.4 Water Management

Once construction is completed at the Mine Access Site, sedimentation dams will be cleaned out and will be used to collect and detain runoff from the developed site. Where possible, water in the detention basin will be trickle discharged or pumped to adjoining pastures and vegetated areas to provide detention storage for subsequent storm events. Detention basins will be sized to treat peak runoff from a 1 in 10 year storm event.

To minimise potential for water pollution, all fuel, oil and chemical storage areas on the site will be bunded and collection sumps will be constructed either within or adjacent to all workshop and wash down areas. Collection sumps will discharge to an oil separator with runoff from the separator being directed to the detention basin system. All runoff from trafficked and operational areas will be directed to the collection sump/detention basin system. Runoff from vegetated and undisturbed areas on the site will be diverted around the detention basin and collection sump system.

An emergency response plan will be developed for the site for use in case of accidental spills of material on-site. All water management systems will be regularly maintained and kept in a fully operational condition.

4.4.5 Acoustic Amenity

To determine the acoustical impact of the project at the Mine Access Site, the major sources of noise and vibration emissions may be grouped into three distinct areas for the purpose of impact assessment and are as follows:

- Noise emission from mobile equipment and other plant during the Mine Access Site construction phase.
- Noise emission from mine operations including fixed plant and mine transportation vehicles.
- Blast emission during construction of the upcast airshaft.

Evaluation of Noise Emission Levels

In order to determine the acoustical impact of the proposed mining operation, a computer model was developed incorporating the significant noise sources, the surrounding terrain and nearby potentially affected residential properties.

For the purpose of predicting the noise emission levels during the mine's construction and operational phases of development, the following operating scenarios at the Mine Access Site were assessed:

- Mine Access Site Construction Phase - Month 6 to 12 — 6mth constructn? while
- Mine Access Site Operating Phase - Year 1 to 20

The contributed $LA_{10(15minute)}$ noise emissions for the proposed operating scenarios to the nearest potentially affected residential properties have been calculated with the following range of meteorological parameters.

1) Acoustically "neutral" atmospheric conditions as advocated by the EPA, which would generally apply to the assessment of mining and processing operations in the absence of temperature inversion and wind.

   As shown by the wind flow diagrams the actual percentage of absolute calm periods is extremely infrequent. For the purposes of impact assessment however, it is assumed that "near neutral" conditions would coincide with light winds (less than 1.5 m/s) in any direction and would have an approximate 15% frequency of occurrence during the year.

2) A light north-westerly wind condition which is likely to occur up to 8% of days throughout the year.

3) Strong (3°C/100 m) temperature inversion conditions which are likely to occur up to 30% of nights throughout the year, although strong inversions are likely to be more common during the winter months.

Mine Construction Phase

The predicted overall contributed $LA_{10(15minute)}$ noise emission levels for the Mine Access Site construction phases to the seven nearest potentially affected residential properties are presented in **Table 4.9** together with the recommended $LA_{10(15minute)}$ contributed noise emission limits.

Table 4.9 - Construction Phase Noise Emissions - Mine Access Site

Property Name		Predicted Noise Emission Levels Month 6-12		Noise Limits		
		Neutral	NW Wind	Up to 4 weeks	4 to 26 weeks	Over 26 weeks
BG1	McLean	51 dBA	51 dBA	70 dBA	60 dBA	55 dBA
BG2	Menzies	41 dBA	47 dBA	57 dBA	47 dBA	42 dBA
BG3	Ferris	41 dBA	36 dBA	55 dBA	45 dBA	40 dBA
MA1	Hunt	41 dBA	47 dBA	57 dBA	47 dBA	42 dBA
MA2	Kildey	42 dBA	42 dBA	56 dBA	46 dBA	41 dBA
MA3	Lee	47 dBA	45 dBA	56 dBA	46 dBA	41 dBA
MA4	Lee	45 dBA	43 dBA	55 dBA	45 dBA	40 dBA

Considering the short duration of construction activities associated with the Upcast Shaft, the contributed $LA_{10(15minute)}$ noise emissions during neutral and adverse meteorological conditions comply with the recommended daytime noise limits at all residential assessment locations.

It is concluded that the contributed $LA_{10(15minute)}$ construction noise emissions at all assessment locations comply with or only marginally (1 dBA) exceed the recommended daytime noise limits, during neutral meteorological and adverse light north-westerly wind conditions.

Mining and Processing Operations - Years 1 to 20

The predicted overall contributed ($LA90_{(15minute)}$, $LA_{10(15minute)}$ and $LA_{1(15minute)}$) noise emission levels for the Mine Access Site operating scenario under neutral atmospheric conditions to the seven nearest potentially affected residential properties are presented in **Table 4.10** together with the corresponding EPA recommended noise ~~planning levels~~.

Table 4.10 - Operation Phase Noise Emissions Under Neutral Conditions - Mine Access Site

Property Name	Predicted Noise Emission Levels					
	Continuous LA_{90}		Variable LA_{90}		Intermittent LA_1	
	Predicted	Limit	Predicted	Limit	Predicted	Limit
BG1 McLean	37 dBA	38 dBA	41 dBA	41 dBA	45 dBA	51 dBA
BG2 Menzies	34 dBA	39 dBA	34 dBA	39 dBA	34 dBA	49 dBA
BG3 Ferris	32 dBA	39 dBA	32 dBA	39 dBA	33 dBA	49 dBA
MA1 Hunt	34 dBA	39 dBA	34 dBA	39 dBA	35 dBA	49 dBA
MA2 Kildey	35 dBA	39 dBA	35 dBA	39 dBA	36 dBA	49 dBA
MA3 Lee	37 dBA	39 dBA	38 dBA	39 dBA	39 dBA	49 dBA
MA4 Lee	34 dBA	39 dBA	34 dBA	39 dBA	35 dBA	49 dBA

The contributed ($LA_{90(15minute)}$, $LA_{10(15minute)}$ and $LA_{1(15minute)}$) Mine Access Site noise emissions at all assessment locations comply with or only marginally (1 or 2 dBA) exceed the recommended night-time noise limits, during neutral meteorological, adverse north-westerly wind and adverse temperature inversion conditions. Predicted noise contours for the operation phase under neutral, adverse north-westerly wind and adverse temperature inversion conditions are shown on **Figures 4.5a**, **4.5b** and **4.5c** respectively.

Assessment of Noise Impact and Recommended Mitigation

To assess the likely noise impacts from the mining operations, a subjective assessment of the mine's audibility and potential noise impact during night-time operations is presented in **Table 4.11**.

Table 4.11 - Noise Impact Assessment - Night-time Operations

Location Number	Property Name	Site	Night-time Operations Audibility Assessment	Noise Impact
BG1	McLean	MAS	Occasionally just audible throughout life of mine	Low
BG2	Menzies	MAS	Occasionally just audible throughout life of mine	Low
BG3	Ferris	MAS	Infrequently just audible throughout life of mine	Negligible
MA1	Hunt	MAS	Occasionally just audible throughout life of mine	Low
MA2	Kildey	MAS	Infrequently just audible throughout life of mine	Negligible
MA3	Lee	MAS	Occasionally audible throughout life of mine	Low
MA4	Lee	MAS	Infrequently just audible throughout life of mine	Negligible

In most cases, any adverse noise impacts would generally be confined to night-time mine operations. During the daytime, mine operations would be mostly inaudible and would have no appreciable adverse noise impact at the nearest potentially affected residences.

The noise emission potential from the proposed mine operations has been considered during the mine design phase and the following noise mitigation measures have been incorporated:

- 3.5 metre earth bund wall along the eastern perimeter of the Mine Access Site.
- 3 metre earth bund wall along the western side of the compressor building of the Mine Access Site.
- 2 metre earth bund wall along the southern side of the compressor building at the Mine Access Site.

Road Traffic Noise Impact Assessment

In view of the proximity of the Mine Access Site to the Morisset Interchange and F3 Freeway, the assessment of additional traffic noise associated with employee vehicle movements is not warranted.

Blast Emissions Impact Assessment

Blasting may be required in the construction of the proposed Upcast Shaft. It is estimated that the Maximum Instantaneous Charge (MIC) required during construction of the Upcast Shaft will be 3 kg. To determine the impact of the proposed blasting constructions, the blast emissions prediction charts were used to determine the levels of ground vibration and airblast at the nearest potentially affected residential dwellings from blasting at the nearest point of the proposed upcast air shaft. The results are presented in **Table 4.12**.

Table 4.12 - Predicted Blasting Emissions

Property/Distance from Blasting	PVS Ground Vibration Velocity	Peak Airblast
Mine Access Site - 400 m	0.8 mm/s	106 dB Linear

The predicted levels of ground vibration and airblast at all residential properties comply with the EPA's recommended human comfort criteria of 5 mm/s and 115 dB Linear, respectively, for daytime blasting and therefore comply with the appropriate structural damage criteria.

4.4.6 Air Quality

During Construction

Stockpiling of the excavated material 41,000 m³ [illegible] area.

Up to 41,000 m^3 of material will be excavated at the site to construct the 1:8 grade access decline, using a road header. As discussed in **Section 2.3** the material will be either conveyed or hauled to the surface. Neither operation will not contribute substantially to overall dust emissions.

2 ha + 12

Wind erosion will also cause dust emissions from any exposed areas, including the areas where excavated material has been placed before it is revegetated. These areas include any visual bunds that may be created from this material.

The major dust sources during the construction of the Mine Access Site will therefore be as follows:

- Excavation of material during construction of the access decline, and

- Wind erosion from exposed areas including bunds and stockpiles.

what's the mitigation measures.

During Operation

There are not expected to be any significant dust emissions during the operational phase of the Mine Access Site as all coal will be conveyed underground from the site to the Coal Preparation Plant at Cooranbong.

Emission calculations for the construction phase of the Mine Access Site have been made assuming that a maximum of 41,000 m^3 of material will be excavated to construct the decline, and that a maximum of 12 ha could be exposed at any one time. It has been assumed that the 41,000 m^3 of material will be excavated over two years, therefore resulting in 20,500 m^3 per annum. Assuming a density of 2.4 t/cm this is equivalent to 49,200 t. Emissions are summarised in **Table 4.13**.

Table 4.13 - Emissions Inventory for the Mine Access Site

Activity	Emission factor	Emission (g/s)
Excavation of material (49,200 t/y)	0.02 kg/t	0.00003
Wind erosion from exposed areas	0.4 kg/ha/hr	1.333

Air quality impacts have been assessed using a computer-based dispersion model known as DUSTGLC. DUSTGLC has been widely used in the Hunter Valley and a full technical description is presented in the Environmental impact statement for the Lemington Northern Open Cut Extension (Dames & Moore, 1984). Validation of the model, in which predicted dust deposition levels are compared with measured deposition levels at two operating mines in the Hunter Valley, is also presented in the same report. The model uses work by Slinn (1982) to estimate dust deposition rates and is based on the sector average model outlined by Turner (1970).

Dust emissions during the construction of the mine site has been assessed for both dust concentration and deposition over a grid 5 km by 5 km around the site. Dust deposition has been averaged over the year and expressed as monthly deposition levels.

Concentration

2d level

Figure 4.6a shows the predicted dust concentrations due to emissions at the Mine Access Site during the construction phase. It can be seen that while the extent of the impact is not wide, there is a potential for impacts close to the boundary, particularly to the southeast. Increases in dust concentrations of over 50 $\mu g/m^3$ are predicted to occur in this area. There is one residence to the southwest within 100 metres of the boundary of the Mine Access Site. Although this residence and residences further south are not predicted to be excessively affected, it is clear that there is potential for impacts close to the boundary of the site.

While these impacts may not be long term and the assessment has assumed a worst-case in terms of exposed area and rate of excavation, the construction phase of the project will need to be carefully monitored and adequate dust control measures applied.

Deposition

Figure 4.6b shows the predicted dust deposition rates around the Mine Access Site. The 2 g/m²/month contour extends outside the boundary to the southeast and some impacts are likely to occur in this area without adequate control of the construction activities.

It is concluded that during construction of the Mine Access Site, there is a potential for dust impacts to occur at the residences close by. While the direction of the prevailing winds favours the residences to the southwest, which are in fact the closest, there is still the possibility for short-term nuisance impacts to occur.

Dust controls during the construction phase of the mine access will include:

- restricting the areas of ground disturbance to the minimum practicable,
- rehabilitating disturbed areas as soon as possible after construction, and
- keeping haul roads and unsealed access roads damp using water trucks.

4.4.7 Visual Amenity

The location of the proposed Mine Access Site in an area with substantial existing vegetation and the opportunity for supplemental landscaping will minimise any visual impact from this component of the project. In particular, those residences immediately to the west along Mandalong Road from the site are presently screened by extensive vegetation along the western boundary of the Mine Access Site. The only visible impact would occur ~~from the projection of the Fan House~~ structure above the tree canopy line. Any such impact will be minimal.

For residences at the eastern end of Gimberts Road, any visual impact will consist only of filtered glimpses of buildings and the projection of the Fan House above the tree canopy line. Such impacts will be substantially reduced by existing vegetation on the Mine Access Site and the eastern side of the Freeway, the intervening distance and the Freeway construction.

Residences generally to the south of the site along Crooks Road are be screened from development on the Mine Access Site by the intervening topography and vegetation.

Night lighting for the site will be established at the lowest practical elevation and will be pointed into the site to minimise impacts on surrounding residences.

4.4.8 Flora and Fauna

Loss of Habitat for Native Flora and Fauna

Given the current levels of disturbance on the Mine Access Site, its proximity to the Sydney-Newcastle Freeway, and its fragmentation from other areas of suitable habitat by surrounding cleared agricultural land, this area is not likely to provide an important resource for any native fauna species.

Whilst some removal of native vegetation will be required on the Mine Access Site, the development has been designed to avoid as much vegetation as possible by the concentration of disturbance in the areas of the site which have already been largely cleared and disturbed. Provided that the vegetation is protected from disturbance (*eg* by flagging 'no go' areas during construction phase) habitat features for native flora and fauna will be retained, and the potential for adverse impacts on those species which do, or may, occur is considered to be small.

Impacts on Threatened Fauna

The Greater Broad-nosed Bat was tentatively recorded on the Mine Access Site. However, the site is not considered to particularly satisfy the habitat requirements of this species (given the lack of tree-hollows and dense nature of much of the vegetation). If present, it is likely that this species would use this area (and the adjacent dam) as part of a wider foraging resource, relying on adjacent areas for nesting and roosting. Even if present, the Greater Broad-nosed Bat is not likely to rely on the limited extent of vegetation which will be removed as part of the development, and its conservation in the locality will not be adversely affected.

Other Impacts

Other types of impacts which may arise include the effects of erosion and subsequent sedimentation, weed invasion and the discharge of contaminants. However, the extensive previous clearing has already resulted in erosion and weed invasion, and this impact is not likely to be increased beyond that which already exists at this location. Conversely, there is some potential for polluted runoff (including overflows from the proposed sewage ponds) degrading adjacent habitats. These impacts can all be controlled by standard amelioration techniques, such as the bunding of potentially contaminated areas and the implementation of sediment control structures.

Significance of Impacts

The potential for the Mine Access Site to have a "*significant effect on threatened species, populations or ecological communities, or their habitats*" has been assessed as specified in Section 5A of the EP&A Act 1979 (as modified by the Threatened Species Conservation Act 1995), and a Species Impact Statement is not required for the proposed activities (**Appendix 5**).

SEPP 44 - Koala Habitat Protection

Preferred Koala food trees (as specified under Schedule 2 of SEPP 44) do not comprise greater than 15% of the total canopy cover. Therefore, the Mine Access Site is not considered to constitute *"potential koala habitat"*, as defined under SEPP 44. The Mine Access Site can not constitute "*core koala habitat*", as defined in SEPP 44, and a Koala Plan of Management is not required.

4.4.9 Archaeology

Two potentially sensitive areas are currently heavily vegetated. The need for vegetation removal in these areas has been minimised through the proposed positioning of facilities at the site.

In the event that Aboriginal artefacts are located during construction, work is to cease immediately and the National Parks and Wildlife Service notified to expedite an assessment of the recovered material.

4.5 COORANBONG COLLIERY SITE

4.5.1 Construction Phase

As detailed in **Section 2.5**, construction work at the Cooranbong Colliery Site will require only limited disturbance to the existing landform in terms of clearing and excavation/reshaping works. A maximum of approximately 1 hectare of land will be disturbed at any point in time and approximately 0.5 hectares of vegetation will be cleared. The amount of land required to be cleared or disturbed has been minimised during the design phase for the layout of the site by utilising existing infrastructure and hardstand areas where possible.

Potential impacts during the construction phase include:

- Traffic (see **Section 4.5.2)**
- Noise and Blasting Emissions (see **Section 4.5.5)**
- Air Quality (see **Section 4.5.6)**
- Visual Amenity (see **Section 4.5.7)**
- Flora and Fauna (see **Section 4.5.8**).

In addition, the construction phase may have the potential to result in erosion and water quality impacts however this will be minimised as all construction works are to occur within an area serviced by the existing water management system and sediment control system.

4.5.2 Traffic

Access to the Cooranbong Colliery site is via Gradwells Road, Dora Creek and at present this road is used by the colliery's 270 employees. During construction phase it is estimated an additional 58 vehicle movements per day may occur. As current traffic levels on Gradwells Road are expected to be less than 400 vehicles per day, an additional 58 vehicles per day will not have a significant impact on the flow capacity of the road. Any impact will be short term and once the construction phase is completed and the Coal Preparation Plant is commissioned, traffic levels on Gradwells Road will reduce dramatically from the existing situation.

4.5.3 Services and Fuel Storage

No significant modifications are required to existing services and fuel storage facilities as part of the proposed development.

4.5.4 Soil and Water Management

Once construction is completed at the Cooranbong Colliery Site, sedimentation dams will be cleaned out and will be used to collect and detain runoff from the developed site.

To minimise potential for water pollution, all fuel, oil and chemical storage areas on the site will be bunded and collection sumps will be constructed either within or adjacent to all workshop and wash down areas. Collection sumps will discharge to an oil separator with runoff from the separator being directed to the detention basin system. All runoff from trafficked and operational areas will be directed to the collection sump/detention basin system. Runoff from vegetated and undisturbed areas on the site will be diverted around the detention basin and collection sump system.

4.5.5 Acoustic Amenity

To determine the acoustical impact of the project at the Cooranbong Colliery Site, the major sources of noise and vibration emissions may be grouped into three distinct areas for the purpose of impact assessment and are as follows:

- Noise emission from mobile equipment and other plant during the upgrading construction phase.
- Noise emission from colliery operations including stockpiling, coal preparation and handling plant as well as transportation of reject and export coal.
- Employee vehicle movements associated with construction and operating phases along the mine access road.

For the purpose of predicting the noise emission levels during the mine's construction and operational phases of development, the following operating scenarios at the Cooranbong Colliery site were assessed:

- Cooranbong Colliery Site Construction Phase - Week 4 to 11
- Cooranbong Colliery Site Operating Phase - Year 1 to 20

As for the Mine Access Site, modelling was undertaken for neutral, adverse wind and adverse temperature inversion conditions. The predicted overall contributed $LA_{10(15minute)}$ noise emission levels for the Cooranbong Colliery Site construction phase to the three nearest potentially affected residential properties are presented in **Table 4.14** together with the recommended $LA_{10(15minute)}$ contributed noise emission limits.

Table 4.14 - Construction Phase Noise Levels - Cooranbong Colliery

Property Name	Predicted Noise Emission Levels Week 4 to 11		Noise Limits
	Neutral	**NW Wind**	**4 to 26 weeks**
BG4 Zaska	22 dBA	27 dBA	45 dBA
BG5 Fuller	22 dBA	31 dBA	47 dBA
CP1	15 dBA	22 dBA	46 dBA

The predicted overall contributed $LA_{10(15minute)}$ noise emission levels for the Cooranbong Colliery Site operating scenario under neutral atmospheric conditions to the three nearest potentially affected residential properties are presented in **Table 4.15** together with the corresponding EPA recommended $LA_{10(15minute)}$ noise planning levels.

Table 4.15 - Operation Phase Noise Levels - Cooranbong Colliery

Property Name	Predicted Noise Emission Levels (dBA) – Neutral Conditions					
	Existing Plant		**All Plant with Module 1**		**All Plant with Modules 1 and 2**	
	Predicted	**Limit**	**Predicted**	**Limit**	**Predicted**	**Limit**
BG4 Zaska	28 dBA	37 dBA	32 dBA	37 dBA	33 dBA	37 dBA
BG5 Fuller	30 dBA	38 dBA	34 dBA	38 dBA	35 dBA	38 dBA
CP1	19 dBA	38 dBA	25 dBA	38 dBA	26 dBA	38 dBA

Noise contours for neutral, adverse wind and adverse temperature inversion conditions are shown on **Figures 4.7a, 4.7b** and **4.7c** respectively.

It is concluded that the contributed, $LA_{10(15minute)}$ Cooranbong Colliery Site noise emissions at all assessment locations comply with the recommended night-time noise limits, during neutral meteorological, adverse north-westerly wind and adverse temperature inversion conditions, except at BG4 (Zaska) and BG5 (Fuller) where noise emissions may marginally exceed the criterion during adverse weather conditions.

To assess the likely noise impacts from activities at the Colliery, a subjective assessment of the mine's audibility and potential noise impact during night-time operations is presented in **Table 4.16**.

Table 4.16 - Operation Phase Impact Summary

Location Number	Property Name	Site	Night-time Operations Audibility Assessment	Noise Impact
BG4	Zaska	CCS	Infrequently just audible throughout life of mine	Negligible
BG5	Fuller	CCS	Occasionally clearly audible throughout life of mine	Moderate
CP1		CCS	Infrequently just audible throughout life of mine	Negligible

Road Traffic Noise Impact Assessment

Access to the Cooranbong Colliery Site via Gradwells Road would be subject to the EPA's traffic noise guidelines.

There are nine (T1 to T9) properties located adjacent to Gradwells Road. The estimated residence offset distances from Gradwells Road are presented in **Table 4.17** together with the property name, where identified.

Table 4.17 - Distance of Residence from Gradwells Road

Number and Property Name	Offset Distance (m)
T1	40
T2	110
T3 Zaska	60
T4 Fuller	60
T5	130
T6	60
T7	180
T8	20
T9	30

The anticipated daily and peak hour vehicle movements associated with both construction and mine operations on the Gradwells Road are presented in **Table 4.18**.

Table 4.18 - Estimated Peak Traffic Movements

Phase/Operation Average Employees	Period (Hours)	Peak Hourly Vehicle Movements		Average Daily Vehicle Movements	
		Light	Heavy	Light	Heavy
Construction Phase 50 Employees	0500 to 0600 1730 to 1830	24[1]	8[1]	48	10
Mine Operations	0630 to 0730 1430 to 1530	4 [2]	5[2]	4	5
270 Employees	2230 to 2330	4[3]	1[3]		

Note 1 Assuming 25% staggering, 25% heavy vehicles and 1.2 persons per vehicle.
Note 2 Assuming worst case of 4 employees change per shift with 1 person per car and 5 heavy vehicles per day.
Note 3 Assuming worst case of 4 employees change per shift with 1 person per car and 1 heavy vehicles per night.

The calculated peak hour $LA_{eq(1hour)}$ noise levels for the mine-generated vehicle movements along Gradwells Road are presented in **Table 4.19**.

The contributed peak hour $LA_{eq(1hour)}$ traffic noise levels from the Gradwells Road comply with the respective noise planning goals at all residences during normal mine operation. During the construction phase the predicted noise levels for existing mine operating traffic moderately (up to 5 dBA) exceed the recommended daytime and night-time mine operating criteria of 50 dBA and 45 dBA respectively at the two closest residences T8 and T9.

In view of the reduced numbers in the total mine operation workforce at the Cooranbong Colliery Site once the construction is complete, when material access for underground working is available at the Mine Access Site, road traffic noise will have a negligible impact on residences at Gradwells Road during the construction phase and long-term mine operations.

Table 4.19 - Estimated Traffic Noise Emission Levels

Receiver		Mine Generated Traffic - Gradwells Road		
Distance (m)	Number	Construction Phase LAeq(1hour)	Mine Operations LAeq(1hour) - Day	Mine Operations LAeq(1hour) - Night
20	T8	53 dBA	50 dBA	44 dBA
30	T9	50 dBA	48 dBA	41 dBA
40	T1	48 dBA	46 dBA	39 dBA
50	-	47 dBA	44 dBA	38 dBA
60	T3, T4, T6	45 dBA	43 dBA	37 dBA
70	-	44 dBA	42 dBA	36 dBA
80	-	44 dBA	41 dBA	35 dBA
90	-	43 dBA	40 dBA	34 dBA
100	-	42 dBA	40 dBA	33 dBA
110	T2	41 dBA	39 dBA	33 dBA
120	-	41 dBA	38 dBA	32 dBA
130	T5	40 dBA	38 dBA	33 dBA

Table 4.19 - Estimated Traffic Noise Emission Levels (cont)

Receiver		Mine Generated Traffic - Gradwells Road		
Distance (m)	Number	Construction Phase LAeq(1hour)	Mine Operations LAeq(1hour) - Day	Mine Operations LAeq(1hour) - Night
140	-	40 dBA	37 dBA	31 dBA
150	-	39 dBA	37 dBA	31 dBA
160	-	39 dBA	37 dBA	30 dBA
170	-	39 dBA	36 dBA	30 dBA
180	T7	38 dBA	36 dBA	29 dBA

4.5.6 Air Quality - Coal Preparation Plant

<u>During Construction</u>

The minor earthworks required at the Coal Preparation Plant site are not expected to cause significant dust emissions.

<u>During Operation</u>

Operation of the Coal Preparation Plant at the Cooranbong Colliery site is expected to produce dust emissions from a number of operations. These are as follows:

- Loading ROM coal to stockpiles;
- Unloading stockpiles to the Coal Preparation Plant;
- Loading product coal to stockpiles;
- Loading product coal to trucks;
- Wind erosion from stockpiles; and
- Maintaining both ROM and product stockpiles.

Dust from haulage will not be significant since the haul roads will be sealed. Also, there will not be any significant dust emissions from the conveyors as they will be partially covered.

The emissions calculations have been made on the assumption that a maximum of approximately 2.72 Mt/y of coal will pass through the Coal Preparation Plant and to the loadout facility (a maximum of 4 Mt/y mined would result in approximately 2.72 Mt/y transferred to the Coal Preparation Plant, 2.62 Mt/y of this will emerge as product coal). Each operation has different emission factors and these are summarised in **Table 4.20**. The total area of all stockpiles has been estimated to be approximately 2 hectares at maximum capacity.

Table 4.20 - Emissions Inventory for the Coal Preparation Plant

Activity	Emission factor	Emission (g/s)
Loading ROM coal to stockpile	0.01 kg/t	0.863
Loading ROM coal to Coal Preparation Plant hopper	0.01 kg/t	0.863
Loading product coal to stockpiles	0.0004 kg/t	0.033
Loading product coal to trucks	0.0004 kg/t	0.033
Wind erosion from all stockpiles	0.4 kg/ha/hr	0.2
Stockpile maintenance (1 hour per day)	37.8 kg/h	0.044

Deposition

Figure 4.8a shows the predicted dust deposition rates around the Coal Preparation Plant. Using the 2 g/m²/month contour to define the zone of affectation, it does not affect any sensitive receptors.

The dust emissions from the operational phase of the Coal Preparation Plant are more substantial but the operation is at a greater distance from sensitive receptors than the Mine Access Site. It is therefore considered unlikely that this part of the project will cause a dust nuisance.

Dust controls during the construction phase will be the same as for the Mine Access Site, and for the operational phase will include:

- fitting dust suppression sprays to the ROM receival area, dump hoppers and product stockpile areas,
- activating sprays at the dump hopper and other areas when the wind speed reaches a pre-determined speed,
- enclosing the conveyor system with sheet cladding on three sides, and
- keeping unsealed access roads damp using water trucks.

Concentration

The predicted dust concentrations due to the operational stage of the Coal Preparation Plant are shown in **Figure 4.8b**. The area of impact is significantly larger than for the construction phase of the Mine Access Site area. However there are no sensitive receptors within the zone of affectation defined by the 50 $\mu g/m^3$ contour.

4.5.7 Visual Amenity

The proposed amplification of handling facilities at the Cooranbong Colliery site will not be visible from any residences in the area or any public areas. Consequently no visual impact will result from these works.

4.5.8 Flora and Fauna - Coal Preparation Plant and Run of Mine Coal Stockpile

Loss of Habitat for Native Flora and Fauna

Given the highly disturbed and fragmented nature of the remnant vegetation on the proposed site for the Coal Preparation Plant, and given the lack of habitat resources of value for native fauna (such as tree hollows), any loss of vegetation is highly unlikely to reduce the extent of fauna habitat in the general locality. However, some habitat for the threatened plant *Acacia bynoeana* will be adversely affected by the proposed development (as discussed below).

The proposed Run of Mine coal stockpile area which extends outside the Colliery surface facilities boundaries, provides a range of habitat features of native fauna, including tree hollows and fallen hollow logs. However, only a small area of habitat will require removal, and given the extent of suitable habitat in adjacent areas and in the general locality (including the Cooranbong Colliery site and State Forests), there is not likely to be a significant loss of habitat for native fauna and flora as a result of the coal stockpile area. Conversely, some habitat for the threatened plant *Tetratheca juncea* will be adversely affected (as discussed below).

Impacts on Threatened Flora

As mentioned, the threatened plant *Acacia bynoeana* occurs on the area to be disturbed by the proposed Coal Preparation Plant. This small population is in a degraded and fragmented community of four plants, which is subjected to considerable ongoing disturbance. Given the rapidly declining health of the individual plants, it is unclear whether this population will survive in the long term, regardless of the proposed development. Consequently, it is proposed to propagate these plants and re-plant them in a suitable area, which will be chosen on the basis of similarities in microclimate, soils, drainage, and other factors, to sites in which this species is known to occur and thrive. Provided that these activities are carried out in the most careful manner, by a qualified botanist, the continued survival of this species is anticipated.

The proposed Run of Mine stockpile area supports a large population of *Tetratheca juncea* in woodland outside of the existing fenceline. This species is not only widespread in the general locality (including on the Cooranbong Colliery site), but has been successfully propagated (Mt Annan Botanic Gardens, the Australian National Botanic Gardens *pers comm*) and transplanted (Tame *pers comm*). Furthermore, this species is not restricted to the area to be disturbed, but occurs widely throughout the forest and woodland communities adjacent to the proposed coal stockpile area. It is proposed to transplant the plants within the disturbance area to adjacent retained habitat. Provided that disturbance is kept to a minimum and remnant vegetation is protected (*ie* fenced), the proposed coal stockpile will not affect the long term viability of this species either in the immediate vicinity or general locality.

Other Impacts

Other types of impacts which may arise from the coal stockpile and Coal Preparation Plant include the effects of erosion and subsequent sedimentation, weed invasion and the discharge of contaminants. These impacts can all be controlled by standard amelioration techniques, such as fencing of the proposed disturbance areas to avoid unnecessary disturbance in remnant vegetation communities, the bunding of potentially contaminated areas (particularly the coal stockpile), the installation of sediment control structures and the implementation of weed management protocols.

Significance of Impacts

The potential for the coal stockpile and Coal Preparation Plant to have a "*significant effect on threatened species, populations or ecological communities, or their habitats*" has been assessed as specified in Section 5A of the EP&A Act 1979 (as modified by the Threatened Species Conservation Act 1995) and a Species Impact Statement is not required for the proposed activities (**Appendix 5**).

SEPP 44 - Koala Habitat Protection

Preferred Koala food trees (as specified under Schedule 2 of SEPP 44) generally comprise greater than 15% of the total canopy cover. Therefore, the study area generally is considered to constitute "*potential koala habitat*", as defined under SEPP 44. Despite historical sightings in the vicinity, there is no evidence of a resident breeding population in the study area. Therefore, the area is not considered to constitute "*core koala habitat*", as defined in SEPP 44, and a Koala Plan of Management is not required.

4.5.9 Archaeology

No archaeological material has been identified at the colliery site and as such, there are no constraints to the development on archaeological grounds.

In the event that Aboriginal artefacts are located during construction, work is to cease immediately and the National Parks & Wildlife Service notified to expedite an assessment of the recovered material.

4.5.10 Tailings and Reject Disposal

Tailings and reject disposal will involve a combination of underground disposal in disused workings and emplacement in an existing quarry void (see **Section 4.7**). Neither of these activities is expected to have a significant adverse impact on the surrounding environment. Further discussion regarding potential impacts associated with coarse reject emplacement and proposed management procedures is provided in **Section 4.7**.

4.6 PRIVATE HAUL ROAD EXTENSION

4.6.1 Construction Phase

A number of feasible alternative haul road options and alignments were explored (see **Section 5.3**) with the alignment that provides all round minimal impact being adopted as the preferred route. As discussed in **Section 4.5.3**, apart from engineering considerations, the principal determinant of the preferred haul road alignment was avoiding disturbance of threatened plant species *Tetratheca juncea* and *Acacia bynoeana*. To ensure that minimal impact on these species is achieved, locations of each of the identified plants have been flagged and surveyed and the haul road realigned so that these sites will not be disturbed by construction activities. To this end, prior to commencement of construction activities, the centre line and limits of disturbance of the haul road and associated sediment and erosion controls will be surveyed and flagged and 'no go' areas clearly defined.

Where possible, the haul road alignment follows existing gravel tracks. In these areas, only minor widening and drainage works are required. In areas where it is necessary for clearing to take place, vegetation will be windrowed along the perimeter of the flagged road corridor and topsoil will be stripped and stockpiled within the corridor and away from drainage lines. Silt fences will be erected downslope of windrows and stockpiles.

Cut and fill batters along the haul road will be constructed with maximum side slopes of 3 Horizontal to 1 Vertical. Once constructed, batters will be seeded with native grass species where possible, and will be maintained in a stable vegetated condition.

Once the road is constructed, it will be sealed to minimise erosion and dust emissions. A detailed Soil and Water Management Plan will be developed for the haul road prior to construction commencing.

4.6.2 Railway Bridge

A bridge will be constructed over the Main Northern Railway line to provide a connection to the existing Newstan - Eraring private haul road. Conceptual design requirements for the bridge have been provided by Rail Access Corporation and a suitable bridge design is currently being developed based on these requirements.

No threatened species have been identified in the vicinity of the proposed bridge.

The bridge will be constructed in accordance with the requirements of Rail Access Corporation and a detailed Soil and Water Management Plan will be developed for the site prior to commencement of construction.

4.6.3 Flora and Fauna

Loss of Habitat

Several possible haul road alignments were investigated in detail by flora specialists with the aim of reducing the potential impacts on threatened flora. As a result of these investigations, and consultation with surveyors, the proposed haul road alignment is considered unlikely to reduce the quality or quantity of habitat for any species of flora or fauna (including threatened species). However, in some instances, a potential conflict was identified between limiting the general damage to vegetation (eg removal of mature hollow-bearing trees and adverse impacts on drainage line communities) and avoiding *Tetratheca juncea*. Consequently, two haul road route options have been defined and these are shown on **Figures 3.11a** and **3.11b**.

The first option, whilst avoiding threatened plants in most instances, requires substantial earthworks and will require clearing of a significantly larger area of native vegetation (including mature hollow-bearing trees) and other habitat features for native fauna (such as fallen hollow logs). The second option (involving following within, or close to, the existing Hawkmount Road and fire trail alignments) requires no earthworks and substantially less clearing of native vegetation. However, this option does involve the removal of one *Tetratheca juncea* plant.

Given the small area to be disturbed by the proposed haul road (particularly if the second option is adopted), the extent of vegetation to remain intact in the immediate vicinity (including on the Cooranbong Colliery site), and the expanse of native vegetation reserved within the several State Forests in the general locality, the loss of habitat is considered to be small. Clearing of native vegetation should be kept to the minimum possible, and where appropriate, the haul road will follow existing gravel road and fire trails, reducing the requirement for clearing.

The haul road may, in fact, contribute to the protection of habitat for native flora and fauna on the site. As a result of the haul road, public access to the tracks and fire trails through the site will be restricted. This is likely to reduce the currently high levels of rubbish dumping along tracks, which is reducing the quality of the vegetation and the habitats for flora and fauna, as well as potentially directly covering threatened plants.

Impacts on Threatened Flora

Tetratheca juncea and *Acacia bynoeana* occur in several locations along the proposed haul road alignment. The alignment of the haul road has been designed through on-site consultation between botanists and surveyors to avoid these populations of threatened plants. Whilst a small number of individual plants may require removal (particularly where they occur at the edge of existing tracks), the long term viability of the populations occurring in this locality will not be adversely affected. Even if the second haul road option is adopted, the removal of an individual plant is highly unlikely to adversely affect the long-term viability of the remaining plants, or this species.

In addition to direct removal, the proposed haul road has the potential to indirectly affect these threatened plant species, by such things as increased nutrients and pH in runoff, sedimentation and erosion of stockpiled materials, trampling or crushing from access by humans and machinery and coal dust from haul trucks. To minimise this potential, 'no go' areas will be flagged and runoff will be carefully managed along the extent of the haul road, particularly where the haul road is upslope from the populations of threatened plants, where runoff will be diverted. Rehabilitation of 'no go' areas during construction should prevent damage from access. Covering of coal loads on trucks will prevent coal dust from affecting retained plants. Again, standard amelioration techniques should be implemented to avoid adverse impacts on flora and fauna.

Impacts on Threatened Fauna

The loss of habitat for threatened fauna species (particularly the Squirrel Glider and threatened microchiropteran bats) is considered to be a potential adverse impact. The loss of large-hollow bearing trees, fallen hollow logs, exposed rock, food trees (such as *Allocasuarina* species) and damage to creeklines within the alignment could be detrimental to threatened fauna. Given that the first option for the haul road, whilst avoiding threatened plants, involves substantial earthworks and considerably more clearing than the second option, the potential for habitat loss for native fauna is substantially greater. The second haul road option will involve upgrading an existing track for much of its length and as such, impacts on threatened fauna are considered to be less. Given the small extent of necessary clearing in relation to the extent of suitable habitat in the general locality and the implementation of impact amelioration measures (such as retaining felled hollow trees in adjacent areas), impacts on threatened species can be largely avoided.

A potential adverse impact on threatened fauna as a result of the haul road is the imposition of a barrier to movement. Given that the haul road will follow an existing road for much of its length, this impact is not likely to be significantly increased beyond that which already exists at this location. However, where a new alignment is constructed, the haul road will impose a new movement barrier. The retention of mature trees adjacent to the haul road, and the installation of culverts under the road will provide a movement path for fauna.

Other Impacts

Other types of impacts which may arise from the haul road include the effects of dust generation, erosion and subsequent sedimentation, damage to adjacent vegetation, fauna road-kills and the discharge of contaminants. Given the extent of earthworks required for the first haul road option, the potential for sediment discharge into nearby creeklines is considerably greater than if the second option is adopted.

The road will be sealed to limit the potential for dust adversely affecting the quality of adjacent vegetation communities. The other impacts can all be controlled by standard amelioration techniques, such as fencing of the proposed haul road alignment during construction to avoid unnecessary disturbance in remnant vegetation communities, the covering of haul truck loads, the imposition of speed limits and the installation of sediment control structures during construction.

Significance of Impacts

The potential for the haul road to have a "*significant effect on threatened species, populations or ecological communities, or their habitats*" has been assessed as specified in Section 5A of the EP&A Act 1979 (as modified by the Threatened Species Conservation Act 1995) and a Species Impact Statement is not required for the proposed activities **(Appendix 5)**.

SEPP 44 - Koala Habitat Protection

Preferred Koala food trees (as specified under Schedule 2 of SEPP 44) generally comprise greater than 15% of the total canopy cover. Therefore, the study area generally is considered to constitute "*potential koala habitat*", as defined under SEPP 44. Despite historical sightings in the vicinity, there is no evidence of a resident breeding population in the study area. Therefore, the area is not considered to constitute "*core koala habitat*", as defined in SEPP 44, and a Koala Plan of Management is not required.

4.6.4 Archaeology

It is proposed that the haul road follow the existing unsealed tracks where possible. No archaeological material has been identified within the proposed corridor and as such there is no constraint from an archaeological perspective to the construction of the haul road.

4.6.5 Traffic

The proposed haul road follows the alignment of an existing fire trail. The northern section of the fire trail has been upgraded by Lake Macquarie City Council and is currently used as Hawkmount Quarry haul road. None of the sections of road that form the proposed haul road alignment are public roads and none traverse unformed Crown roads.

It is proposed to commence hauling coal along the preferred alignment in 2001. It is understood by this time gravel reserves within the existing Hawkmount Quarry will be exhausted and as such, Council trucks will no longer use this section of the road to haul quarry product.

It is intended that the road be upgraded and closed to public access other than for fire fighting purposes. In the past, the area has been subject to uncontrolled dumping of car bodies and rubbish. As such, controlled access in this area should reduce the potential for further rubbish dumping.

4.6.6 Bushfire Hazard

Bushfire hazard in the area is high with the area being burnt on frequent occasions. Powercoal, in conjunction with Lake Macquarie City Council, has over a number of years developed a Fire Management Plan for the area surrounding the proposed haul road. Regular and controlled use of the area along with the provision of a higher standard road through the area will reduce the potential for uncontrolled bushfire and will facilitate quick response to fires in the area, should they occur.

4.6.7 Visual Amenity

The private Haul Road is composed mostly of existing gravel roads within the Cooranbong Colliery Mine Lease area. Short extensions of the existing colliery roads to the south and north respectively, connect the proposed haul road to the colliery site and existing haul road. This Haul Road will generally only be visible from limited sections of the Main Northern Railway and therefore will have limited visual impact.

4.7 COARSE REJECT EMPLACEMENT

4.7.1 Soil and Water Management

Runoff from the existing Hawkmount Quarry currently drains to sedimentation dams within and immediately downslope of the quarry. Over the past century, the quarry has been excavated into a ridge with the side slopes of the ridge retained to form a rim around the current extraction area. The existing rim of the quarry serves to separate runoff from undisturbed areas which naturally drain to surrounding vegetated areas and potentially sediment laden runoff from disturbed areas within the quarry rim.

At the proposed emplacement rate of approximately 32000 tonnes per annum, it will take many years until the existing water and sediment control system at the site needs to be significantly modified. It is understood that in the future Lake Macquarie City Council may seek to initially emplace overburden from the proposed new Hawkmount Quarry site in the area. Once details of this proposal are finalised, a detailed Soil and Water Management and Rehabilitation Plan will be developed for the quarry.

Coarse reject emplaced in the quarry will have very low coal content and a high clay and moisture content. Reject will be emplaced in a controlled manner in accordance with a managed emplacement program to minimise the potential for spontaneous combustion. Emplacement controls will include rolling of the reject and covering the reject with overburden material.

4.7.2 Flora and Fauna

The location for the proposed reject emplacement area is an existing quarry, which is cleared of all vegetation, in a highly disturbed condition, and is not considered to provide suitable habitat for any species of native fauna or flora. Consequently, no adverse impacts on flora and fauna are anticipated. Rehabilitation of the reject emplacement area with native flora species at the end of reject emplacement operations will increase the habitat values of the quarry.

Impacts which may arise from the coal reject emplacement area include the effects of erosion and subsequent sedimentation, damage to adjacent retained vegetation and the discharge of contaminants. These impacts can all be controlled by standard amelioration techniques, such as fencing of the proposed disturbance areas to avoid unnecessary disturbance in remnant vegetation communities, the bunding of potentially contaminated areas, the installation of sediment control structures and the watering of the emplaced material to prevent dust generation.

Significance of Impacts

The potential for the reject emplacement to have a "*significant effect on threatened species, populations or ecological communities, or their habitats*" has been assessed as specified in Section 5A of the EP&A Act 1979 (as modified by the Threatened Species Conservation Act 1995) and a Species Impact Statement is not required for the proposed activities (**Appendix 5**).

SEPP 44 - Koala Habitat Protection

Given that the reject emplacement site is a quarry on which all vegetation has been removed, this site is not considered to constitute "*potential koala habitat*" or "*core koala habitat*", as defined under SEPP 44. Therefore, a Koala Plan of Management is not required for the proposed reject emplacement.

4.7.3 Air Quality

As previously discussed, it is envisaged that the proposed mining development will emplace only up to approximately 32000 tonnes of coarse reject material at the quarry site per annum. At present, Lake Macquarie City Council extract, process and transport approximately 125000 tonnes of quarry material from the site annually and as such, dust emissions from the proposed development are expected to be considerably less than for the existing situation. In addition, progressive rehabilitation of the quarry through coarse reject emplacement and subsequent reshaping and revegetating will reduce the exposed or disturbed area at the quarry site and further reduce dust generation potential.

need to detail →

4.7.4 Acoustic Amenity

Existing quarry activities include blasting, crushing, operation of a pug mill, and transport of 125000 tonnes of quarry product per annum. The proposed development will involve typically three or four truck movements to and from the site per day and the use of a bulldozer on an intermittent basis to spread the emplaced material. The nearest residence from the site is in excess of 1.2 km away and as such, the reduced levels of activities at the site are not expected to generate significant noise levels at the nearest receivers.

4.7.5 Bushfire Hazard

As for the haul road, bushfire hazard of the surrounding area is high. Construction of the haul road and more frequent controlled use of the area should assist in reducing bushfire hazards of the area.

4.7.6 Visual Amenity

The coarse reject emplacement area is currently used as a quarry. The site is remote with visibility of the northern site generally only occurring from the Main Northern Railway. The Coarse Reject Emplacement Area will therefore have limited visual impact.

4.7.7 Archaeology

As the proposed reject emplacement site is heavily disturbed and void of archaeological material, there are no constraints to using the proposed coarse reject emplacement area on archaeological grounds.

4.8 CUMULATIVE IMPACTS

4.8.1 Greenhouse Gas

Integral Energy Partners (1997a) have completed an Estimate of Change in Annual Greenhouse Gas Emissions due to the Cooranbong Colliery Life Extension Project. The key results of these investigations are outlined below.

Previous investigation of each of Powercoal's mine sites, including the existing Cooranbong Colliery, has determined that the major greenhouse gases resulting from these operations are:

- Methane as a fugitive emission. Methane gas is extracted in ventilation exhaust air. Although methane gas represents a very small portion of the total ventilation air (0.01% to 0.8%), it represents a major proportion (82% to 87%) of Powercoal's total emissions (Integral Energy Partners 1997b).

- Carbon Dioxide resulting from electricity and petroleum fuel use.

The assessment of potential fugitive emissions from the Cooranbong Colliery Life Extension Project focuses on methane as the major potential emission.

Fugitive emissions of carbon dioxide are known to occur but there is currently no accepted methodology or data available to assess such emissions.

Integral Energy Partners assessment of fugitive emissions has been conducted in accordance with the "Australian Methodology for Estimation of Greenhouse Gas Emissions and Sinks, Workbook for Fugitive Emissions, 1996". This methodology considers the relationship between mine production levels and fugitive emissions of methane in addition to emissions from post mining activities such as coal preparation, transportation, storage and crushing.

Potential greenhouse gas emissions due to energy use, that is electricity and petroleum (diesel consumption), have been calculated using the "Full Fuel Cycle CO_2 emission factors" provided in the Greenhouse Challenge Workbook produced by the Commonwealth Government Greenhouse Challenge Office (1997). The energy use estimates used in the assessment are as outlined in **Section 6.4**.

Estimated Greenhouse Gas Emissions

Integral Energy Partners (1997a) has estimated the net change in greenhouse gas emissions as a result of the proposed Cooranbong Colliery Life Extension Project. These estimates are provided in **Table 4.21** and consider the pre-development situation, with only existing Cooranbong Colliery operations, and post-development with the Cooranbong Colliery Life Extension Project in operation. Greenhouse gas emissions have been calculated as equivalent tonnes of carbon dioxide.

Table 4.21 - Estimated Greenhouse Gas Emissions (Tonnes Carbon Dioxide Equivalent)

	Fugitive Mining Emissions	Fugitive Post Mining Emissions	Energy Related Emissions	Total Emissions
Pre-development (1996/97)	414000	22000	103000	539000
Post-development (2001/2)	926000	46000	155000	1127000
Net Increase	**512000**	**24000**	**52000**	**588000**

Source: Integral Energy Partners (1997a)

The methane emissions and energy usage associated with an increase in coal production from 1.7 MT in 1996/97 to 3 MT in the year 2001, results in an estimated net increase in greenhouse gas emissions of 588000 tonnes carbon dioxide equivalent. In comparison with the total Australian emissions provided in the Australian National Inventory, this represents a 0.01% increase in total carbon dioxide emissions.

Minimisation of Greenhouse Gas Emissions

Powercoal has voluntarily joined the Greenhouse Challenge program. The Greenhouse Challenge works on a voluntary, non-regulatory basis by prompting government and industry bodies to act in partnership and reduce greenhouse gas emissions. It aims to reduce these emissions while returning benefits to industry in the form of reduced running costs found by improving energy efficiency.

To participate in the initiative and reach a cooperative agreement with the Federal Government, Powercoal has had to first develop a policy, formulate an Energy Management Plan (EMP), and develop Greenhouse Gas Abatement Strategies. This has been achieved by adopting the ISO 14000 Environmental Management System model which contains all the requirements to achieve results in terms of energy management, cultural change and financial savings. The proposed three to five year EMP developed for Powercoal is expected to deliver:

- Benchmarking assessment of group energy management versus best practice.
- Energy/greenhouse baselines and benchmarking tools within the group.
- Energy/greenhouse saving opportunities and cost/benefit analyses for each.
- Action plan prioritising identified projects.
- Cashflow analysis of implementing proposed actions.
- Corporate energy policy.
- Greenhouse Challenge Cooperative Agreement.
- Training requirements.

By implementing the EMP, Powercoal is voluntarily taking responsibility for its energy use and greenhouse gas emissions.

Apart from Powercoal's corporate commitment to the Greenhouse Challenge program, specific procedures have been developed for minimisation of greenhouse gas emissions from the Cooranbong Colliery Life Extension Project. These measures are listed in **Table 4.22**.

Table 4.22 - Greenhouse Gas Emission Controls

Location	Proposed Action
Surface Installation	
Office bathhouse building	Energy efficient building design to reduce the heating and cooling energy requirements.
Bathhouse heating (space heating)	Air conditioning system.
Bathhouse water heating	Use of the air compressor heat exchanger to heat bath water.
Electricity supply	A powerfactor corrected system will be provided as well as a maximum demand limitation system.
Air compressors	The air compressor installation will have load sharing and shut down control from a PLC system.
Surface lighting	Light control to be daylight controlled.
Workshop store building	Energy efficient building design.
Underground Installation	
Conveyor installations	All new motors will be energy efficient motors, the drives will be modular with the control provided to switch off modules when the load drops. Control system to only run conveyors when coal is available.
Electrical reticulation system	System design to minimise system losses, ie voltage drop, under utilised capacity.
Compressed air reticulation	Compressed air reticulation system designed and installed to minimise leaks.
Mine dewatering system	Dewatering system designed to take advantage of the seam grades to reduce the pumping energy requirements.
Mobile vehicle travel	Mine setup with an underground service workshop to limit the distance travelled by the equipment.
Ventilation system	Install and maintain the stoppings and overcasts to minimise leakage. Seal off unused districts to reduce the area of the mine to be ventilated. Minimise the resistance of the mine to reduce the air power required for the system.
Establish transport rules	These rules will be designed to reduce the number of machine movements up and down the drift. The design of the trailer system will be important to allow this action to be undertaken.
Equipment efficiency	The mine is to have an effective maintenance system to ensure the equipment is operated at the maximum efficiency.
Methane emissions	Methane emissions will be minimised by sealing the goaf areas. Possible ways to use Methane and burn it off are currently being investigated.

4.8.2 Morisset Industrial Area

Establishment of the proposed Morisset Industrial Area adjacent to the site on the southeastern side of the F3 Freeway has the potential for cumulative impacts in terms of noise, air quality, visual amenity and demands on existing service infrastructure. These potential cumulative impacts will be minimised through careful design of the Mine Access Site and the adoption of appropriate environmental control measures as detailed throughout **Section 4.0**.

4.8.3 Transport of Coal

Coal conveyance will be underground to Cooranbong Colliery from where it will be either transported by the existing Pacific Power conveyor to Eraring Power Station or hauled by road to Newstan Rail Loading Facility. Coal conveyed to Eraring Power Station will be a continuation of existing coal conveyance and as such will not result in a cumulative increase. Export coal hauled along the new haul road has the potential to increase truck movements in the area however this potential increase will be minimised through backloading coal to the Newstan Rail Loading Facility. This will be done by using the same trucks that deliver domestic quality coal from Newstan Colliery to Eraring Power Station and will be offset through the envisaged relocation of Hawkmount Quarry prior to commence of haulage along the private haul road. Potential cumulative impacts in terms of dust generation will also be offset by sealing of the haul road and progressive rehabilitation and revegetation of the quarry site.

Potential cumulative impacts resulting from rail transport of export coal from the Newstan Rail Loading Facility are not expected to result as part of this development as it is proposed that existing rail loading capacity and storage space at the facility will be dedicated to the Cooranbong Colliery Life Extension Project. Any upgrading of the rail loading facilities or increases in transport of coal from the site by rail and associated cumulative impacts will be assessed as part of a separate development application.

4.8.4 Impacts on Threatened Flora Species

The proposed development through disturbance to vegetated areas could result in cumulative loss of threatened plant species such as *Tetratheca juncea* and *Acacia bynoeana* in the area. The potential for cumulative loss of these threatened species is discussed in **Appendix 5** and will be minimised through avoiding disturbance to these species where possible and through either transplanting or propagating replacement plants where disturbance can not be avoided. In the longer term establishing controlled access to the area surrounding the proposed new haul road and careful management of the fire regime in the future should significantly contribute to the long term viability of these threatened plant species in the area.

4.9 LEGISLATIVE CONTROLS

Development and operation of the Cooranbong Colliery Life Extension Project including environmental management and rehabilitation requirements will initially be established by conditions associated with the Environmental Planning and Assessment Act 1979 and Mining Act 1992. A wide range of other environmental control legislation also applies to this development and is briefly described in this section.

4.9.1 Environmental Planning and Assessment Act 1979

This EIS will accompany a development application under the Environmental Planning and Assessment Act 1979. The development application and EIS will be lodged with and exhibited by Lake Macquarie City Council. The Minister for Urban Affairs and Planning will be the determining authority for the development application, in accordance with Section 101 of the Environmental Planning and Assessment Act 1979.

Detailed conditions of consent will be associated with any granting of the development application under this legislation and Powercoal will be required to demonstrate compliance with these conditions at all times.

4.9.2 Mining Act 1992

The Mining Act is administered by the Department of Mineral Resources and, amongst other procedures, places controls on methods of exploration and mining, the disposal of mining waste and land rehabilitation and environmental management activities. A mining lease can not be issued until development consent is granted under the Environmental Planning and Assessment Act 1979.

The mining lease entitles Powercoal to mine and market coal produced from the deposit but there are a number of conditions which must be met effecting safety, environmental management, waste disposal and payment to the State of a royalty for each tonne of coal recovered. In New South Wales, for underground mines a mining lease only entitles coal operations to undertake first workings by bord and pillar methods. Any other form of underground mining and surface mining requires specific approval before mining actually commences.

In the case of underground mining, this relates to proposals to undertake second workings such as longwall and panel extraction. Once the mining lease is issued, secondary extraction of coal is conducted in accordance with an approval which is granted for each longwall panel or group of panels separately. Detailed proposals for rehabilitation and environmental management must be provided in regard to any longwall approval application. Information which must be submitted in conjunction with a longwall approval application includes detailed mining plans, geological data, detailed plans of surface features and predicted subsidence effects on surface features.

4.9.3 Other Environment Protection Legislation

Powercoal will be required to operate in compliance with other environment protection legislation. Such legislation is defined in the Protection of the Environment Administration Act to include the Clean Air Act, Clean Waters Act, Dangerous Goods Act, Environmentally Hazardous Chemicals Act, Noise Control Act, Ozone Protection Act, and the Pollution Control Act. The Environmental Offences and Penalties Act 1989 is also applicable to mining operations. This pollution control legislation is administered in New South Wales by the Environment Protection Authority and a brief outline of the relevant legislation is provided below.

<u>Pollution Control Act 1970</u>

This establishes the procedures for issue of approvals for works and licences under the Clean Air Act 1961, Noise Control Act 1975 and Clean Waters Act

1970. Coal mines are required to hold annually renewable licences and there are conditions associated with these licences which must be complied with at all times. New legislation termed the Protection of the Environment Operations Bill is expected to be implemented during 1998. Amongst other regulations changes, the new legislation will consolidate many of NSW's pollution control laws into one Act.

Environmentally Hazardous Chemicals Act 1985

A licence is required for any storage, transport or use of prescribed chemicals.

Dangerous Goods Act 1975

Dangerous goods include explosives, gases, flammable liquids and radioactive substances. These goods must be labelled with a symbol in accordance with a type and quantity classification. Storage of particular quantities may require a WorkCover Authority licence.

Environmental Offences and Penalties Act 1989

Any breach of the environmental protection legislation and other provisions within the Environmental Offences and Penalties Act is an offence for which there are penalties for a company and its officers. A range of offences is categorised in the Environmental Offences and Penalties Act which relate to the scale of a pollution event and the degree of wilfulness or negligence involved. Penalties can range from on the spot fines of up to $600 to fines of up to $1,000,000 for corporations or $250,000 for individuals or seven years gaol or both. This legislation ensures that all employees and company directors are directly accountable for site environmental management. In addition, the Environmental Offences and Penalties Act provides for orders to be made for the prevention, control or mitigation of the harm; reimbursement of loss or damage to property; and reimbursement of expenses incurred by a public authority.

Threatened Species Conservation Act 1995

In assessing a development application, the determining authority must consider whether there is likely to be a significant effect on threatened species populations or ecological communities or their habitats. If a significant effect is identified, then a species impact statement must be prepared and assessed as part of the development application. **Appendix 5** of this document provides the "Eight Point Test" in accordance with the requirements of the Environmental Planning and Assessment Act (1979) and concludes that a species impact statement is not required for this development.

Commonwealth Legislation

Environment Protection (Impact of Proposals) Act 1974

This legislation provides for Commonwealth review and assessment of the environmental impacts associated with development proposals which involve foreign investment or require Federal approval or finance. As there is no foreign investment or Federal approval or finance required for this project, the Commonwealth legislation is not applicable to this project.

4.9.4 Post-EIS Approvals and Licences

Powercoal will be required to comply with detailed conditions of consent on granting of the development application and conditions associated with the Mining Lease for the operation. In addition, approval and/or licences will be required from various authorities in terms of the legislation outlined in preceding sections, and other requirements. The necessary further approvals and/or licences following development consent are:

- Longwall approval pursuant to Section 138 of the Coal Mine Regulation Act 1982 from the Department of Mineral Resources prior to any mining within each longwall panel or series of panels.

- Approval from the EPA under the Pollution Control Act 1970 to construct and operate the mine extension and new surface facilities and licensing in terms of the Clean Waters Act 1970 and Clean Air Act 1961 for all mining and associated operations.

- Department of Land and Water Conservation approval for any development within 40 metres of the banks of any prescribed stream. Any stream rehabilitation, dam construction and water management works impacting on natural watercourses will require a permit under Part 3A of the Rivers and Foreshores Improvement Act 1948.

- A Consent to Destroy Application will be required to be approved by the National Parks and Wildlife Service in accordance with the National Parks and Wildlife Act 1974, prior to destruction of any archaeological sites by the proposed development. The archaeology survey reported in **Section 3.13** did not identify any archaeological sites likely to be impacted by the development. Any sites observed during construction activities or during further archaeological survey preceding any surface rehabilitation works within the lease application area will require assessment and lodgement of a Consent to Destroy application, if appropriate.

- Design details for any works impacting on the F3 Freeway will require approval from the Roads and Traffic Authority prior to construction.

- Detailed consultation, provision of design details and approval from the relevant organisations will be required prior to any works affecting public utilities including electricity, water, sewerage, telephone, or public road infrastructure.

5.0 ALTERNATIVES

5.1 ALTERNATIVE COAL RESOURCES

As stated in **Section 1.2**, the proposed objectives of the development are to provide ongoing employment opportunities at Cooranbong Colliery and a continued supply of energy coal from Cooranbong Colliery in an economically viable and environmentally acceptable manner, whilst maximising returns to Powercoal Pty Ltd and the State.

Significant areas of igneous intrusion in the western portion of CCL 762 and constraints to mining under Lake Macquarie and its foreshore limit remaining coal reserves within CCL 762. Cooranbong Colliery is currently mining the remaining available coal reserves in the southwestern sector of CCL 762 near Morisset. Current underground workings extend to within about 1 km of the proposed Mine Access Site, making the extension of mining into proposed Mining Areas 1 and 2 a logical and operationally practical extension of the existing Cooranbong Colliery operations.

To the southeast of Area 2, outside of the CCL 762 boundary, coal quality and thickness deteriorate, making coal reserves in this area not economically viable to mine.

Coal reserves in the Great Northern seam to the north of Cooranbong Colliery form part of the Awaba Colliery lease (CCL 746) and are currently being mined from Awaba Colliery. Mineable coal reserves in the Great Northern seam in this area are approximately 15 to 100 metres below the surface. Young Wallsend and West Borehole coal seams are approximately 100 to 200 metres deeper than the Great Northern seam where they occur in this area. Due to the depth at which these seams occur, they are not accessible from current Cooranbong Colliery workings and are more practically accessed from existing workings in Powercoal's Newstan Colliery. Taking into account these considerations, no alternative coal reserves that could be accessed from Cooranbong Colliery exist other than those identified in Area 1 and Area 2.

5.2 ALTERNATIVE MINE PLANS

During the project definition stage several alternative longwall mine layouts were considered, for Area 1, with longwall widths of 100, 150, 165, 200, 210 and 250 metres. In this area the proposed extracted seam thickness varies from 2.5 metres to 5.0 metres and the depth of cover ranges from 157 metres to 365 metres.

Within Area 1, with the exception of the longwalls that are 100 metres wide, where the depth of cover is less than 250 metres all of the longwall alternatives considered have relatively high width to depth ratios. Therefore, the predicted levels of subsidence, tilt, curvature and strain were found to be high in all of these cases.

For the panel extraction area, Area 2, panel widths of 80 to 120 metres were considered. In Area 2, the proposed extracted seam thickness generally varies from 1.7 metres to 2.4 metres, apart from two small sections, adjacent to the main headings, where the seam thickness increases to 2.75 metres and 3.6 metres respectively. The depth of cover in Area 2 ranges generally from 120 metres to 220 metres apart from two small areas, on the south-west boundary, where the depth of cover increases to 285 metres and 255 metres respectively.

Within Area 2, where the depth of cover is 160 metres and the seam thickness is 1.9 metres, the 100 metre and 120 metre panels, with 30 metre pillars, were found to result in maximum tilts of 3.3 mm/m and 5.6 mm/m respectively and maximum strains of 1.4 mm/m and 2.3 mm/m respectively. Strains of this magnitude would have negligible or only very slight impact on surface infrastructure. Predicted relationship between tilts and depth of cover for a range of panel widths for Area 2 is shown on **Plate 7**.

The most significant impact within the longwall area (Area 1) is that of tilt, since any building tilted more than 7 mm/m will probably require, at least, some remedial work to roof gutters and drainage systems. Some of the longer buildings tilted more than 7 mm/m may need to be relevelled. Buildings tilted more than 10 mm/m, in most cases, would need to be relevelled.

Parametric studies have shown that for an extracted seam thickness of 3 metres, the predicted maximum tilt for a longwall panel 150 metres wide at a depth of cover of 160 metres is around 15 mm/m. For a longwall panel 200 metres wide the maximum predicted tilt at a depth of cover of 160 metres is around 30 mm/m. For a longwall panel 100 metres wide at a depth of cover of 160 metres, the maximum tilt reduces to 4.2 mm/m. However, where the extracted seam thickness increases to 5 metres, then the maximum tilt increases to 7 mm/m. **Plate 8** provides a comparison of maximum tilts relative to cover depth for a range of longwall panel widths. As can be seen from **Plate 8**, longwall panel widths of 155 metres are predicted to result in tilts in excess of 7 mm/m for cover depths of 260 metres or less. Only approximately 7.5% of houses and 9% of sheds within the proposed longwall mining area have cover depths greater than 260 metres.

The impacts of strain and curvature are not significantly different for any of the alternatives, though the impacts do increase with increase in the panel width. The impacts of subsidence on the land drainage systems and flooding within the Mandalong Valley are very similar for all alternative mine layouts.

Due to the costs of development and reductions in mineable resource the adoption of 100 metre wide longwall panels across all of Area 1 is not considered financially viable and widths in excess of 150 metres are required. All of the alternatives, shown to be financially viable, result in impacts due to tilt that will require mitigation and remediation works to be undertaken for a significant number of buildings. There is therefore little advantage in minimising the panel widths as remediation works will be required regardless of the longwall configuration adopted and as a consequence where possible, widths of 250 metres are preferred.

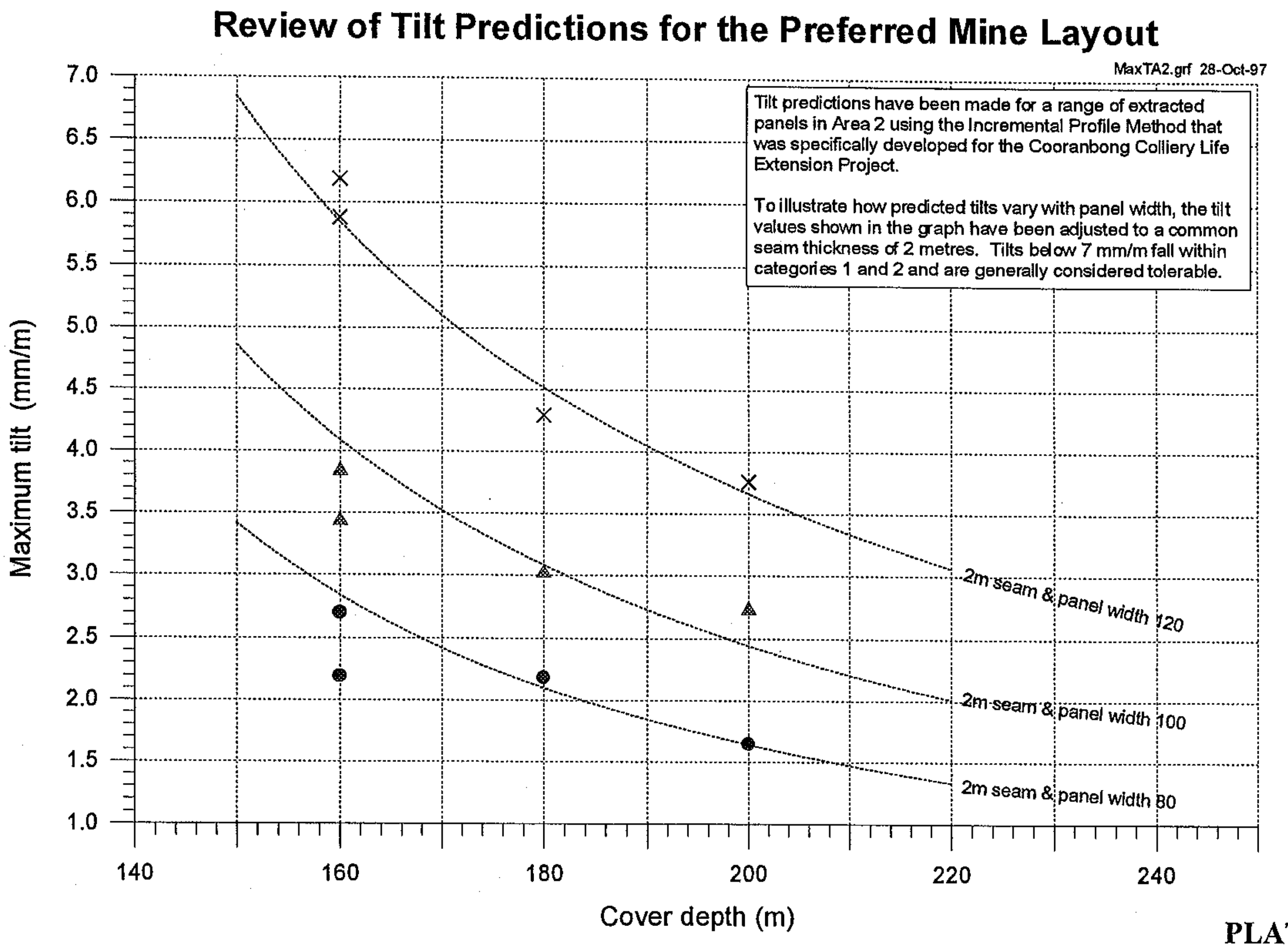


PLATE 7

Review of Tilt Predictions for the Preferred Mine Layout - Area 2

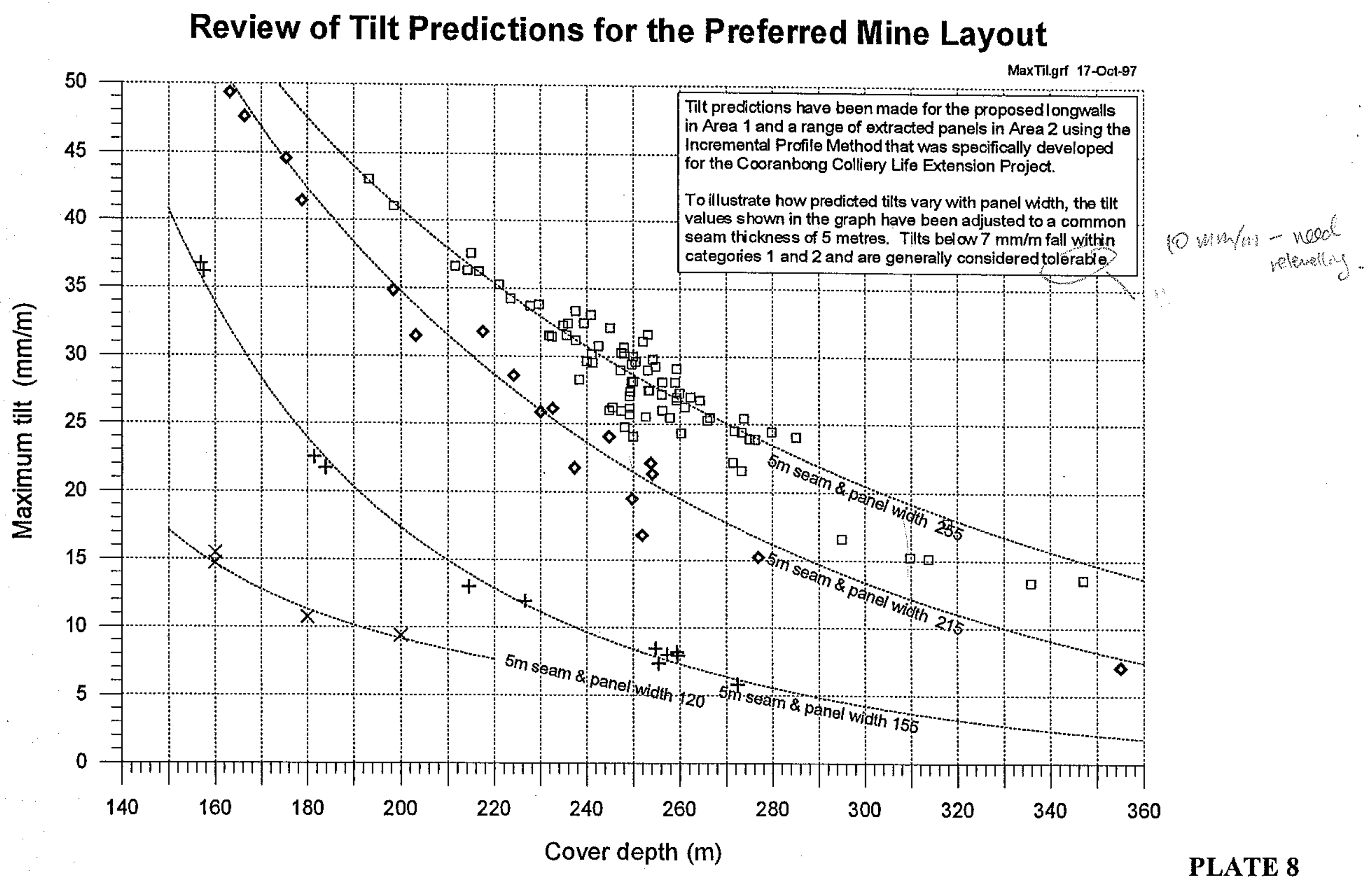


PLATE 8

Review of Tilt Predictions for the Preferred Mine Layout - Area 1

The geological structures, however, also play a major part in determining the mine layout since they limit the possible positions of the development headings and dictate the viable longwall panel arrangements. In some places the use of wider panels is possible and provides maximum recovery of the resource. In other places the panels have to be reduced in width to fit between the geological structures.

The identification of the geological structures has resulted from continuous exploration of the area, throughout the project definition stage. As the geological structures have been identified, their presence has dictated the alternative longwall arrangements. The evolution of the preferred longwall layout has thus been a consequence of many factors and the layout has been selected because it is financially viable, avoids the geological structures, provides optimum recovery of the resource and has no greater overall impact on surface infrastructure than any of the other viable alternatives.

5.3 ALTERNATIVE COAL TRANSPORT OPTIONS

Coal from Areas 1 and 2 is of a quality which is suitable for supply to both the domestic power generation market and the export coal market. As such, any transport options considered need to be able to supply coal to both of these markets.

Powercoal currently supplies, and will seek to continue to supply, coal to Eraring Power Station which is adjacent to Cooranbong Colliery. Transport options to supply coal to Eraring Power Station include:

a) Road haulage via the public road system. To achieve this, coal would need to be brought to the surface of the Mine Access Site and subsequently stockpiled and loaded for transport to Eraring Power Station. This option was not adopted as it would result in a significant long term impact in terms of use of the public road system and would require a substantially greater amount of disturbance and infrastructure at the Mine Access Site.

b) Transfer coal via a new underground tunnel to Wyee Rail Loop. This option would require construction of a large diameter tunnel under the F3 Freeway and upgrading of storage and loading facilities at the Wyee Rail Loop and at Eraring Power Station. This option was not adopted as it would require duplication of infrastructure that already exists at Cooranbong Colliery, whilst making the infrastructure at the Colliery redundant and due to prohibitive costs associated with construction of the underground tunnel and a conveyor system to Wyee Rail Loop.

c) Transfer of coal underground to Cooranbong Colliery via the existing underground conveyor system with the coal then being transported from Cooranbong Colliery to Eraring Power Station via the existing Pacific Power conveyor. This option was adopted as it was found to be technically and economically feasible and could be utilised in the long term with a negligible environmental impact.

In terms of transporting coal to export markets, options include:

i) Conveying export coal from Cooranbong Colliery to Eraring Power Station. At the planned rate of export, this would involve duplicating the existing 800 tph conveyor and creating additional stockpiling facilities at Eraring Power Station, and then dispatching coal to the Port of Newcastle by either loading trains at the rail loop at Eraring Power Station or by utilising the existing private haul road. The rail loop at Eraring Power Station is at present only a receival facility and as such, would need to be upgraded. Utilisation of the existing haul road would require the establishment of stockpiling areas at Eraring Power Station. Capital expenditure considerations and issues of interfacing with the operation of Eraring Power Station precluded these alternatives from final consideration.

ii) Constructing a new section of haul road to connect Cooranbong Colliery to the existing private haul road that runs from Newstan Colliery to Eraring Power Station. This option requires traversing land that forms part of the Awaba Colliery holding and construction of a bridge over the Main Northern Railway. Several locations for the bridge were investigated with the most feasible site being located approximately 300 metres north of Hawkmount Quarry. Several possible alignments for the haul road to connect Cooranbong Colliery to the bridge location were explored. These included alignments adjacent to the Main Northern Railway corridor and an alignment that principally follows existing gravel tracks that traverse the central ridge line of the area. Alignments adjacent to the railway corridor were ruled out through engineering difficulties associated with the steep terrain that exists along the route. In terms of minimising site disturbance, earthworks required and ultimate travel distance, the central alignment along existing gravel roads was adopted as the preferred route.

   Following detailed flora and fauna studies the preferred route was realigned in the southern section to avoid threatened flora species and minimise site disturbance.

5.4 ALTERNATIVE COAL HANDLING AND PREPARATION PROPOSALS

Several locations and configurations for the Coal Preparation Plant were considered for the Cooranbong Colliery site. These included constructing the coal washplant on the ridge immediately to the west of the existing infrastructure, constructing the Coal Preparation Plant immediately to the north of the 500 kVA transmission line easement which is located at the northern boundary of the colliery site and 'cutting' the Coal Preparation Plant into the existing colliery site to maximise the use of existing infrastructure and minimise disturbance to surrounding areas.

A detailed feasibility study of coal handling and preparation options was undertaken and it was found that it is technically and economically feasible to upgrade existing infrastructure and establish the Coal Preparation Plant within the existing boundaries of the Cooranbong Colliery site. This option was subsequently adopted and forms part of the current development proposal.

5.5 ALTERNATIVE REJECT DISPOSAL OPTIONS

Reject from Cooranbong Colliery is expected to be comprised of approximately 40% coarse material and 60% fine material. Disposal options for coarse reject from the proposed Cooranbong Colliery Coal Preparation Plant include:

a) Establishment of a new emplacement area either to the west or to the north of Cooranbong Colliery. These options either require substantial disturbance of existing vegetation or have size constraints and were accordingly ruled out.

b) Use of existing quarries (ie. a small private quarry and Hawkmount Quarry) located approximately 1.5 km and 2.5 km to the north of Cooranbong Colliery. Department of Land and Water Conservation (Ian Tapper pers comm) has subsequently advised that the small private quarry is to be rehabilitated by the Department of Land and Water Conservation in the future and will not be available for use as a reject emplacement site. The Hawkmount Quarry which is currently operated by Lake Macquarie City Council has an estimated emplacement capacity of approximately 1.5 million tonnes and has more than adequate capacity to meet the coarse reject emplacement needs of the proposed development.

Disposal options for fine reject include:

i) Co-disposal with coarse reject at the Hawkmount Quarry.

ii) Disposal of fine rejects as a slurry into disused underground workings within Cooranbong Colliery. This technique is currently being successfully utilised at Newstan Colliery and is currently the preferred fine reject disposal option for Cooranbong Colliery.

5.6 ALTERNATIVE IMPACT MITIGATION OPTIONS

Impact mitigation options considered range from adopting alternate mine plans, as discussed in **Section 5.2**, to undertaking a range of surface mitigation measures. Adoption of alternate mine plans will result in significant coal resources being sterilised and a less than optimal mining operation being implemented. An extensive range of surface mitigation measures has been identified and through ongoing consultation with landholders and government authorities, the most appropriate measures will be implemented. Finalisation of the most suitable measures to be implemented will occur prior to commencement of second workings.

5.7 ALTERNATIVE OF NOT PROCEEDING

If the development does not proceed:

- Long term employment opportunities for 220 people directly and up to 1534 people State wide will be lost with approximately 435 of these jobs being in the Hunter Valley Region. It is estimated that closure of Cooranbong Colliery would result in the loss of 1057 jobs State wide.

- Loss of employment opportunities would result in a reduction in expenditure in Lake Macquarie Local Government Area from wages and salary income alone of between $6.5 and $8.0 million annually. An estimated additional $3.3 million of annual expenditure on mine supplies sourced from the Lake Macquarie area would also be lost.

- The opportunity to recover approximately 65 million tonnes of coal that has an estimated value of approximately $2 billion will be foregone, resulting in the lost potential to contribute an additional $194 million per annum to real Gross State Product (GSP). This translates to a loss in potential revenue to the State government of $22 million per annum.

- The potential to utilise existing infrastructure at Cooranbong Colliery would also be foregone.

6.0 JUSTIFICATION

6.1 ECONOMIC CONSIDERATIONS

6.1.1 Potential Future Demand for Coal

World coal use is expected to increase from approximately 118.75 $*10^{18}$ Joules/year equivalent in 2000 to approximately 131.25 $*10^{18}$ Joules/year equivalent in 2025 with world coal use expected to increase to approximately 800 $*10^{18}$ Joules/year equivalent by 2075 (US DOE Office of Clean Coal Technology). This represents approximately a 10.6% increase in world coal use by 2025 and a 674% in world coal use by 2075. With the global adoption of Clean Coal Technology, world greenhouse gas emissions are expected to decrease from approximately 10625 million tons of CO_2 in 2000 to 10200 million tons of CO_2 by 2025.

In excess of 50% of the world's coal demand is consumed in power stations and industries of Asia-Pacific Economic Cooperation (APEC) countries. Electricity growth projections (Blain 1997) indicate that coal demand within APEC economies will increase by 50% to 80% over the next decade with demand in developing and/or newly industrialised APEC economies increasing by 170% to 270% by 2010. At the same time coal fired electricity generation capacity is expected to increase from 37% to 42%.

6.1.2 Economic Significance of Project

The proposed development seeks to produce 65 million tonnes of coal for export and domestic markets. A detailed socio-economic study of the proposed development has been undertaken by the Centre for International Economics. The full report is provided in **Appendix 7** and key findings of the study are set out in summary form below:

- The extension of mining activity through the Cooranbong Colliery would support up to 1534 jobs State wide and contribute an additional $194 million per annum to real Gross State Product (GSP) which measures wages, salaries and gross profits in New South Wales.

- Alternatively, the closure of the Cooranbong Colliery would lead to a reduction in real GSP of $86 million and a loss of 1057 jobs State wide. These results were obtained from simulations using an economy wide modelling approach.

- The new workings are planned to replace the current resource which has an expected life of five years at current extraction rates. The extension project is expected to provide 220 jobs during the operations, compared to a loss of 270 direct positions if mining ceased as a result of the exhaustion of the current resource.

- The 220 jobs associated with the mine extension project represent 2.5% of employment in underground mines in New South Wales and about 1.6% of total coal mine employment in the state.

- Should the project *not* proceed, the net loss of 220 mine jobs would represent a 6.7% loss of mine employment in the Newcastle coal field.

- From the planned maximum of 4.0 million tonnes of coal production, up to 2.0 million tonnes will be exported, representing an increase in annual export of coal in New South Wales of 3.3% and an increase in Australian coal exports of 1.4%.

- The extension of the Cooranbong mine is expected to lead to a total output effect of approximately $234 million, comprising $150 million of direct gross output from the mine and $84 million of indirect output induced by the mine's demand for inputs and the demand of employees' for goods and services in the region. This output is estimated to support total income in the region of $29.5 million and total estimated employment of approximately 435 jobs in the Hunter Valley region.

- The results of an employee expenditure survey for Cooranbong Colliery indicate that for residents of Lake Macquarie, 75% of expenditures occur within the region, with 14% occurring in Wyong and Newcastle and 11% elsewhere (mainly as a result of holidays outside the region).

- Sixty-one percent of the mine's wages and salary earners live in the Lake Macquarie region. Given wages and salaries of $17.8 million, continuation of mine operations would mean $10.7 million in direct wages and salary income for the Lake Macquarie local government area. This would imply between $6.5 million and $8 million in expenditure for the Lake Macquarie region annually.

- Failure to extend the life of the mine would deprive the Lake Macquarie region of between $6.5 and $8 million annually in indirect spending from wage and salary incomes.

- A further $8.4 million expenditure on regionally sourced mine supplies would also be withdrawn from the region, $3.3 million of this from the Lake Macquarie locality.

- Should the mine extension project not proceed, the loss of 220 jobs associated with the extension could increase the unemployment rate in the Lake Macquarie area from 10.9% to 11.2%. The current level is already significantly higher than the national average of 8.7%.

- Extension of the mine life is estimated to contribute $22.1 million annually in revenue to the State Government that would otherwise be lost to it. This would accrue either as a direct result of mine activity or through induced activity in the state economy.

It is apparent from these findings that the project is of importance to the State and the region. To ensure that the proposed mine operates efficiently, it will be important to establish a balance between minimising potential surface impacts and inconvenience to landholders whilst maximising the amount of coal that can be mined and the overall efficiency of the mining operation.

By way of example, for Area 1 it is possible to achieve lesser surface impacts by adopting narrow longwall panel widths of in the order of 100 metres. This would result in approximately 8.5 million tonnes of the identified 55 million tonnes of recoverable coal (based on the preferred mine plan), being left in the ground. This would represent a 15% loss of the available resource and would significantly decrease returns to the State Government and the overall wealth generated by the proposed development. Adoption of such narrow longwall panel widths would also require an increase in gate road development works required to be able to mine the coal. On a per tonne of coal basis, the amount of development required for narrow longwall panel widths is approximately 1.7 times greater than for the preferred mine plan. This would result in a significant decrease in the overall productivity of the mine.

Increasing longwall panel width to 150 metres increases the amount of coal that can be mined and increases the overall productivity of the overall mining development. Surface impacts associated with a 150 metre width longwall panel mine will be considerably greater than for narrow longwalls but are not significantly less than those predicted for the mining development if it is based on a 250 metre wide longwall face. The preferred mine plan optimises the total recoverable reserves of coal and gate road development requirements.

It emerges from these considerations that to maximise the return to Powercoal from the development and to maximise the economic benefit to the State as a whole, it will be necessary to obtain government agency and local community acceptance of the preferred mine plan which consists of longwalls up to 250 metres in width. To this end, a detailed and considered compensation policy (see **Appendix 6**) that addresses potential surface damage, potential flooding impacts and disruption to land use has been developed. This policy forms an integral consideration in the approval process.

6.1.3 Agricultural and Other Production

Agricultural suitability of the area has been assessed using definitions from Department of Planning (1988). The agricultural suitability ranges from 3 to 5. Class 3 land can be used for grazing, is well suited to pasture improvement and may be cultivated or cropped in rotation with pasture. Class 4 is land suitable for grazing but not for cultivation and Class 5 land is unsuitable for agriculture or at best is suited to light grazing only. The current land use is a reasonable indication of agricultural suitability.

Where the land is cleared, the primary use is grazing cattle or horses on native or semi-improved pasture. Areas of highly improved pasture are limited, indicating a restrictive parameter to high agricultural production. There is no land suitable for intensive cultivation. Land suitable for regular cultivation is very limited and then only with a high level of risk management to minimise environmental problems such as soil erosion.

heed to prior to lease.

The principal agricultural activities in the valley from an economic perspective are Inghams Chicken Breeder farms and the turf farm operated by Mr and Mrs Ferris. The proposed development will result in disruption to chicken breeding activities within the first two years of commencing longwall mining and will potentially require the relocation of these facilities. Powercoal Pty Ltd has entered into discussions with Inghams in regard to these predicted impacts with a view to developing suitable mitigation or offset measures.

Subsidence and hydrodynamic predictions indicate that turf farm activities will not be adversely affected by the proposed mining operation.

Agricultural productivity of the of the remainder of the proposed mining areas is not high. Based on Australian Bureau of Statistics 1991 Census data, economic returns from agricultural activities within the proposed mining areas are estimated to be typically less than $22,500 per annum per landholding.

Typically unimproved pastures in the Mandalong Valley would carry approximately 1 cow and weaner calf per 4 hectares. On this basis estimated gross margin return would be approximately $50/hectare. Improved pastures within the Mandalong Valley would carry approximately 1 cow and weaner calf per 2 hectares. It is estimated that on this basis gross margin returns of $80 to $100 per hectare are estimated. Taking into account the above considerations it would require approximately 100 hectares of improved pasture running a cow and calf operation to generate $10,000 of income.

It is not considered that the proposed mining development will significantly reduce the agricultural potential of the proposed mining area. With the adoption of appropriate surface drainage and mitigation works, it is feasible that the agricultural potential of the area could be improved. This is particularly relevant to those areas that are currently subject to prolonged waterlogging.

Based on the preferred mine plan, it is predicted that, in approximately Year 8 of the proposed longwall mining operations, subsidence impacts will cause disruption to the operation of a hostel for the disabled off Sauls Road that is currently operated by Mr and Mrs Martin.

Powercoal Pty Ltd is committed to the implementation of the *Land Access, Management and Compensation Policy* that has been specifically developed for this project. It is intended through the implementation of this policy to offset and mitigate any adverse impacts on economic productivity of the proposed development area, should they occur.

6.2 SOCIAL CONSIDERATIONS

Within the proposed mining areas there are 107 land parcels that are either partly or wholly within proposed Mining Area 1 and an additional 41 land parcels within proposed Mining Area 2. These land parcels are owned by 91 landholders in

Area 1 and an additional 41 landholders in Area 2. There are 95 habitable dwellings and 16 chicken breeder sheds within the proposed mining Area 1. Approximately 27 of the 95 habitable dwellings are located on or immediately adjacent to the floor of Mandalong Valley.

There are approximately 17 habitable dwellings and 6 chicken breeder sheds within Area 2. Due to thinner mineable coal seam thickness in Area 2, structural impact on residences and surface infrastructure in the area will be of a lesser magnitude than for Area 1. There are no additional flood prone residences within Area 2 to those identified for Area 1.

Hydrodynamic modelling undertaken for this project indicates that at present 4 dwellings have floor levels either at or below the water surface resulting from a 1 in 100 year ARI rainfall event with the floor level of one additional dwelling having less than 0.5 metres freeboard. After mining it is estimated that 3 dwellings will have floor levels either at or below the water surface resulting from a 1 in 100 year ARI rainfall event with the floor level of an additional two dwellings having less than 0.5 metres freeboard.

Subsidence impacts on houses, surface infrastructure and the land surface as a result of mining have the potential to cause inconvenience to property owners through damage to dwellings, surface infrastructure and minor reformation of the land surface and creek channels. Through the implementation of appropriate mitigation measures and through enactment of the *Land Access, Management and Compensation Policy*, Powercoal Pty Ltd intends to minimise or mitigate impacts and inconvenience that may result from mining.

In terms of population changes, the population within the Collector Districts centred on the Mining Lease Application area was 1655 persons for the 1991 Census. The population at the 1991 Census had grown 42.1% from 1981. This increase is substantially higher than increases for Lake Macquarie and the Lower Hunter and may in part result from increased accessibility and proximity to urban centres.

Between 1981 and 1997 some 166 Development Approvals were granted in the lease application area by Lake Macquarie City Council, of which 104 related to the erection of dwellings. The remaining approvals were for a variety of uses including agricultural activities and rural pursuits, while a limited number were for tourist related developments. Subdivision applications within the lease application area which have been approved total nine between 1987 and 1997. Only one of these applications proposed the creation of more than a single additional lot.

The existing capacity for new dwellings has been estimated on the basis of property ownerships without dwellings although this does not take into account the statutory requirements for the obtaining of consent to such dwellings. On this basis, there are some 30 property ownerships which could eventually result in additional dwellings in or adjacent to the lease application area.

6.3 ECOLOGICAL SUSTAINABILITY

The principles of ecologically sustainable development which must be considered in the environmental impact assessment process are:

- the precautionary principle;
- inter and intra generational equity;
- conservation of biodiversity and ecological integrity; and
- valuation and pricing of resources.

6.3.1 The Precautionary Principle

The Intergovernmental Agreement on the Environment 1992 defines the precautionary principle as "Where 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".

Application of the precautionary principle to mining proposals needs to ensure that there has been careful evaluation of the proposal and that decision making for the proposal has been predictable and transparent. This environmental impact statement documents the extensive and careful evaluation of project components which have been undertaken over a period in excess of 12 months. Detailed assessment of all potential impacts and necessary management procedures has been conducted and is also comprehensively documented in this environmental impact statement.

The decision making process for the design of the proposed development and proposed management procedures has been predictable and transparent in the following respects:

- All relevant government authorities and landholders potentially affected by the proposed development were consulted early in the environmental impact statement preparation. This enabled comment and discussion regarding potential environmental impacts and proposed environmental management procedures (refer to **Section 1.5**).

  Government authority consultation included an initial consultation letter, followed by a planning focus meeting. The planning focus meeting involved presentation of available project details and environmental impact assessment. Discussion regarding key issues of concern was held at the planning focus meeting and mechanisms were established to enable any further discussion with individual authorities in order to resolve any outstanding matters.

  The community was consulted through both direct mailing and two workshops. The conduct of two workshops throughout the environmental impact statement process enabled potential issues of concern to be raised and progressively reported throughout the workshop process. Specific meetings were also held with key government agencies or landholders with particular concerns in order to resolve details regarding particular issues of concern.

- An annual Environmental Management Plan and Environmental Report is prepared for the current Cooranbong Colliery operations. This report incorporates details of site environmental management, monitoring and environmental response procedures. Current environmental management and monitoring by Powercoal is consistent with best management practice and the proposed Cooranbong Colliery Life Extension Project will incorporate these standard practices together with the additional controls proposed in **Section 4.0**. Powercoal will continually reference and adhere to best practice environmental management guidelines such as those outlined by the Environment Protection Agency (1995). These best practice techniques will include strict monitoring and enforcement procedures for the entire operation. The responsibilities of the proponent and government agencies for environmental management and enforcement of the proposed development are clearly identified in **Section 4.9** of this document. All relevant Powercoal personnel and on-site contractors will be advised of these responsibilities and directed to maintain adequate environmental management procedures at all times.

6.3.2 Inter-generational Equity

A key objective in project construction and operation will be overall project management and investment in plant and equipment that minimises pollution and waste and is energy efficient. Powercoal has volunteered to participate in the Greenhouse Challenge, which is a joint initiative between industry and the Commonwealth Government (see **Section 4.8.1**).

6.3.3 Conservation of Biodiversity and Ecological Integrity

All environmental characteristics and habitat values that could be affected by the proposal are described in **Section 3.0** of this document. Likely environmental impacts on these characteristics and values have been assessed in **Section 4.0** and measures proposed to be implemented to minimise these potential impacts are also described in **Section 4.0**.

Adoption of underground mining techniques within this area minimises potential surface impacts on biological diversity or ecological integrity. Areas disturbed during construction of surface infrastructure will be rehabilitated using endemic species in order to minimise the long term effects on biological diversity. Where possible, recyclable and recycled materials and water will be used in the operation and all employees will be educated regarding waste minimisation, reuse and recycling.

6.3.4 Improved Valuation and Pricing of Resources

The proposed development will improve the valuation and pricing of the Cooranbong Colliery coal resources by:

- providing access to a further long term resource within the life extension area, which will enable Powercoal to compete for long term supply contracts;
- extracting all possible mineable coal within the working areas within economic, technical and environmental constraints;
- avoiding isolation and sterilisation of coal through the appropriate mine planning and location of surface infrastructure;
- maximising coal recovery by entering into appropriate compensation options with landholders, where required;
- providing appropriate facilities for washing and blending of coal in order to produce maximum yields for required coal quality;
- continually reviewing geological data, coal parameters, mine planning and environmental factors in order to optimise coal production, value and price.

6.4 ENERGY BALANCE

An energy balance compares the energy used in coal production to the potential energy produced by making the coal available for various usages.

Estimates of energy use for existing and proposed operations have been provided by Powercoal, as listed in **Table 6.1**. Energy usage includes electricity and diesel fuel consumption.

Table 6.1 shows that existing mining operations result in net energy production of in the order of 4.647×10^{16} J/year and that future operations will increase net energy production to 8.249×10^{16} J/year.

Table 6.1 - Energy Balance

Energy Usage	1996/97 Joules/year	2001/2 Joules/year
Electricity		
Existing Cooranbong Mine	1.296×10^{11}	4.86×10^{10}
CCLEP	0	1.944×10^{11}
Diesel		
Existing Cooranbong Mine	9.32×10^{14}	0
CCLEP	0	1.24×10^{15}
Total Energy Usage		
Coal Production [1]	9.321×10^{14}	1.240×10^{15}
Existing Cooranbong Mine	4.74×10^{16}	0
CCLEP	0	8.37×10^{16}
Net Energy Production	4.647×10^{16}	8.249×10^{16}

[1] *A conversion factor of 27.91 GJ ($J \times 10^9$) per tonne of coal (Department of National Development, 1978) has been used to calculate energy production from coal. This value is typical of coal quality of existing resources at Cooranbong Colliery and within the proposed extension area.*

7.0 REFERENCES

Allison FR & Hoye GA, 1995. Eastern Freetail-bat *Mormopterus norfolkensis*. *In* Strahan R (ed) The Mammals of Australia. Australian Museum / Reed Books, Chatswood.

ANZECC, 1992. Australian Water Quality Guidelines for Fresh and Marine Waters. Australian and New Zealand Environment and Conservation Council, ISBN 0 642 18297 3.

Bateman Kinhill, 1997. Cooranbong Colliery Life Extension Project Coal Handling and Preparation Facility *prepared for* Powercoal Pty Ltd.

Blain M, 1997. Coal - Essential for Strong, Stable Regional Growth. Australian Department of Primary Industries and Energy.

Briggs JD and Leigh JH, 1996. Rare or Threatened Australian Plants. CSIRO, Australia.

Bureau of Meteorology, 1988. Climatic Averages Australia, Australian Government Publishing Service Canberra., ISBN 0 644 06943 0.

Charman PEV (Ed), 1978. Soils of New South Wales, Their Characteristics, Classification and Conservation, Soil Conservation Service Technical Handbook No. 1, Soil Conservation Service of New South Wales.

Clouston, 1997. Draft Lake Macquarie Recreation and Open Space Plan: Scenic Quality Plan *prepared for* Lake Macquarie City Council.

Coffey Partners International Pty Ltd, 1996. Preliminary Panel and Pillar Dimensions for Greenfields Area *prepared for* Powercoal Pty Ltd. Report No Z284/2-AE.

Cogger HG, 1992. Reptiles and Amphibians of Australia. AH & AW Reed, Sydney.

Commonwealth Government Greenhouse Challenge Office, 1997. Greenhouse Challenge Workbook. Electricity Supply Business.

Dames & Moore, 1984. Environmental Impact Statement Northern Open Cut Extension CSR Lemington Mine Volume 2.

Dean M, Holmes N and Mitchell, 1990. Air Pollution from Surface Coal Mining: Community Perception, Measurement and Modelling. Proceedings of International Clean Air Conference, Auckland, NZ, March 25-30.

Debus SJS and Chafer CJ, 1994. The Powerful Owl Ninox strenua in NSW. Australian Birds 28 (supplement): 21-39.

Department of Land and Water Conservation, 1996. State Environmental Planning Policy No 46 - Protection and Management of Native Vegetation. Definitions and Exemptions.

Department of Planning, 1988. Rural Land Evaluation. A Manual for Conducting a Rural Land Evaluation Exercise at the Local Planning Level.

Department of Environment and Planning, 1983. The Lower Hunter Landscape Improvement Study.

Dockery DW, Pope CA, Xiping Xu, Spengler JD, Ware JH, Fay ME, Ferris BG and Speizer FE, 1993. An association between air pollution and mortality in six US cities. *In* The New England Journal of Medicine, Volume 329, Number 24,1753-1759.

Douglas & Partners, 1991. Report on the Potential for Groundwater Inflow to Longwall Panels 5 - 7 Beneath Jigadee Creek, Cooranbong Colliery.

Dwyer PD, 1995a. Little Bentwing-bat *Miniopterus australis*. *In* Strahan R (ed) The Mammals of Australia. Reed Books, Chatswood, NSW.

Dwyer PD, 1995b. Common Bent-wing Bat *Miniopterus schreibersii*. *In* Strahan R (ed) The Mammals of Australia. Reed Books, Chatswood.

Ehmann H, 1997. Threatened Frogs of New South Wales: Habitat, Status and Conservation. Frog and Tadpole Study Group of NSW Inc, Sydney South.

Emery KA. Rural Land Capability Mapping. Soil Conservation Service of NSW.

Environment Protection Agency, 1995. Best Practice Environmental Management in Mining. A modular series including "Environmental Management and Performance" and "Overview of Best Practice Environmental Management in Mining".

Environment Protection Authority, 1995. The Utilisation of Treated Effluent by Irrigation. Draft Environmental Guideline for Industry.

ERM Mitchell McCotter, 1995. Morisset Forestry District Environmental Impact Statement, Soils Report *prepared for* State Forests of NSW.

Forster I and Enever J, 1992. Hydrogeological Response of Overburden Strata to Underground Mining. Office of Energy, Sydney.

Garnett S, 1992. The Action Plan for Australian Birds. Australian National Parks and Wildlife Service, Canberra.

Harden G (ed), 1991. Flora of New South Wales, Vol 2. NSW University Press, Sydney.

Herbert C, 1997. Sequence Stratigraphic Analysis of Early and Middle Triassic Alluvial and Estuarine Facies in the Sydney Basin, Australia. Australian Journal Earth Sciences 44, pp 125-143.

Integral Energy Partners, 1997a. Estimate of Change in Annual Greenhouse Gas Emissions due to the Cooranbong Life Extension Project *prepared for* Powercoal Pty Ltd.

Integral Energy Partners, 1997b. Summary of Energy and Greenhouse Impacts at Powercoal Collieries *prepared for* Powercoal Pty Ltd.

Lake Macquarie City Council, 1984. Lake Macquarie Local Environmental Plan (1984) as amended.

Lake Macquarie City Council, 1997. Draft Lake Macquarie Local Environmental Plan 1984 (Amendment No 87).

Marchant S and Higgins PJ (eds), 1990. Handbook of Australian, New Zealand and Antarctic Birds. Volume 1 - Pelicans to Petrels. Oxford University Press, Melbourne.

Murphy CL, 1993. Soil Landscapes of the Gosford - Lake Macquarie 1:100000 Sheet. Report, Department of Conservation and Land Management.

Murphy CL and Tille PJ, 1993. Soil Landscapes of the Gosford - Lake Macquarie 1:100000 Sheet Map, Department of Conservation and Land Management.

Pacific Power International, 1997. Cooranbong Colliery Life Extension Project Overburden Strata Groundwater Study *prepared for* Powercoal Pty Ltd. Report No GEO 100.

Richards GC, 1991. Greater Broad-nosed Bat *Scoteanax rueppellii*. *In* Strahan R (ed) The Australian Museum Complete Book of Australian Mammals. Angus & Robertson, Sydney.

Russell R, 1995. Yellow-bellied Glider *Petaurus australis*. *In* Strahan R (ed) The Mammals of Australia. Reed Books, Chatswood.

Rust PPK Pty Ltd, 1997. Sewer and Water Investigation Cooranbong Life Extension Project *prepared for* Powercoal Pty Ltd.

SMEC Australia Pty Ltd, 1996. Final Report Main Road 217 Route Development Study *prepared for* Lake Macquarie City Council.

Slater P, Slater P and Slater R, 1986. The Slater Field Guide to Australian Birds. Griffin Press, Adelaide.

Slinn WGN, 1982. Predictions for Particle Deposition to Vegetative Canopies. *In* Atmospheric Environment, Volume 16, 1785-94.

SPCC, 1983. Air pollution from coal mining and related developments.

SPCC, 1986. "Particle size distributions in dust from open cut coal mines in the Hunter Valley", Report Number 10636-002-71 *prepared for* the State Pollution Control Commission of NSW (now EPA) by Dames & Moore, 41 Mclaren Street, North Sydney, NSW 2060.

Stern AC, Boubel RW, Turner DB and Fox DL, 1984. Fundamentals of air pollution. Published by Academic Press, Inc, ISBN 0-12-666580-X.

Suckling GC, 1995. Squirrel Glider *Petaurus norfolcensis*. *In* Strahan R (ed) The Mammals of Australia. Reed Books, Chatswood.

Turner DB, 1970. Workbook of Atmospheric Dispersion Estimates, Environment Protection Agency, Office of Air Programs, Research Triangle Park, North Carolina.

Uren R, 1977. The Geology and Low Cost Extractive Resources of the Gosford - Lake Macquarie Area. Geological Survey of NSW, Department of Mines unpubl report GS 1974/431 (modified May 1977).

US DOE Office of Clean Coal Technology, 1997. Potential Impact of the Global Deployment of Clean Coal Technology on Greenhouse Gas Emissions Reduction.

Appendix 1

Government Agency Responses

New South Wales Government
Department of Urban Affairs and Planning

Mr Peter Jamieson
Umwelt (Australia) Pty Ltd
P O Box 838
TORONTO NSW 2383

Contact: Miranda Yue

Our Reference: N92/00275

Your Reference:

28 AUG 1997

Dear Mr Jamieson,

Proposed Cooranbong Colliery Extension, Morisset, Lake Macquarie City

Thank you for your letter of 28 May 1997 seeking consultation with the Director-General for the preparation of an environmental impact statement (EIS) for the above development. I also refer to the Planning Focus Meeting held on 6 August 1997, the Planning Focus Report and the subsequent correspondences.

The proposal is subject to a direction under section 101 of the Environmental Planning and Assessment Act, 1979, and the Minister for Urban Affairs and Planning will determine the application. A development application and an EIS should be lodged with Lake Macquarie City Council. Council will process the development application up to the point of making a decision which has taken into account of the heads of consideration contained in section 90 of the Act, and then refer it to the Secretary of the Department.

The Director-General requires, in accordance with clause 52 of the Regulation, that the issues outlined in Attachment 1 be specifically addressed in the EIS. The key issues for this proposal include:

- flood liability
- quality and quantity of surface flows, waterbodies and ground water
- flora and fauna, and
- subsidence.

Schedule 2 of the Regulation spells out the general requirements for the form and contents of an EIS. A copy of Schedule 2 is attached as Attachment 2.

Should you have any further enquiries please do not hesitate to contact Miranda Yue on phone (02) 9391-2201.

Yours sincerely,

for
David Mutton
Acting Manager
Major Assessments and Hazards Branch
As Delegate for the Director-General

Governor Macquarie Tower
1 Farrer Place, Sydney 2000
Box 3927 GPO, Sydney 2001

Telephone: (02) 9391 2000
Facsimile: (02) 9391 2111

Department of Urban Affairs and Planning

ATTACHMENT NO. 1 - DIRECTOR-GENERAL'S REQUIREMENTS
COORANBONG COLLIERY EXTENSION
LAKE MACQUARIE CITY COUNCIL

The matters listed below should be clearly and succinctly outlined in the text and where appropriate supported by adequate maps, plans, diagrams or other descriptive details to enable all concerned to gain a clear understanding of the full scope of the development and its likely impact on the environment.

Issues contained in the requirements are not necessarily a comprehensive identification of all issues which may arise in respect of this proposal relevant to the preparation and consideration of an EIS. There may be other issues that are appropriate for consideration in the EIS. It is the applicant's responsibility to identify and address as fully as possible the matters relevant to the specific development proposal in complying with the requirements for EIS preparation (see Attachment No.2).

It is essential that the EIS focuses on key environmental issues. The level of analysis of individual issues should reflect the level of significance of their impacts. When prioritising issues, consideration should be given to the potential severity, temporal and spatial extent of any beneficial and adverse effects; their direct impacts as well as any indirect, secondary, tertiary or cumulative impacts; and whether the effects are continuous or intermittent, temporary and reversible or permanent and irreversible.

1. Planning and environmental context

i. Planning information:

The following information should be provided:

- relationship with the objectives and planning provisions of the Hunter Regional Environmental Plan 1989, Lake Macquarie Local Environmental Plan 1984 and any relevant Development Control Plans
- zonings, permissibility and any land use constraints; and
- any environmental protection areas or heritage items identified in planning instruments, or areas affected by conservation agreements.

ii. Site description & locality information

The following information should be provided:

- ? title details, land tenure, lease details
- existing land uses; and
- ? site description and maps, plans, aerial photographs clearly identifying the location of the proposal relative to surrounding roads, communities, residences and any land use likely to be affected by the development, utilities, including transmission lines, pipelines, cables or easements, sightlines from dwellings and public roads.

iii. Overview of the affected environment

This should provide an overview of the environment in the vicinity of the development and also of aspects of the environment likely to be affected by any facet of the proposal. Baseline information should be provided on the following:

- meteorological characteristics which may influence erosion, flood liability, dust or noise impacts
- surface contours and general topography (including slope, catchment size and drainage)
- presence and condition of watercourses and waterbodies, drainage pattern, flood liability, any water storage or drinking water catchments, groundwater bore, watertable and the relationship with the excavation depth
- assessment of the likelihood of the area supporting any threatened species, populations or ecological communities, or their habitats, including:
  - ~ a description of the area, including details of the types and condition of the habitat(s) in, and adjacent to, the land to be affected by the proposal
  - ~ a list of those threatened species, populations or ecological communities known to occur in the same or similar habitats in the region, and
  - ~ an assessment of the likelihood of those species, populations or ecological communities identified above occurring within the area given the habitat requirements of the species, populations or ecological communities and the habitats present within the area.
- features of heritage, conservation or archaeological value, including any features of special significance to Aborigines
- visual amenity; and
- social and economic aspects of the environment.

2. Description of the proposal

The description of the proposal should provide information on:

i. Proposal objectives

Clearly identify objectives of the proposal, having regard to:

- ecological sustainability
- the quantity and types of material to be mined and processed
- coal to be marketed
- duration/expected life of the operation
- any proposal for future expansion, including staging and proposed timing
- proposed future use of the site following expiration of the proposal; and
- interrelationship of the proposed mine with the existing operation and other developments in the vicinity.

ii. Coal resource

Describe the characteristics and economic significance of the resource. Information should include:

- the geological factors influencing coal quality and occurrence, size and quality of any proven, possible or probable reserves; and
- exploration methods and summary of results.

iii. Proposed works

Fully describe the proposed mining and processing operations. This should include:

- staging and construction schedule
- proposed location of infrastructure
- coal mining techniques
- depth and rate of mining; estimated daily, weekly and annual volumes of material to be extracted and transported; constraints on increased volumes including equipment, market demand etc.
- types of machinery and equipment to be used
- plans of operations and facilities
- details of any coal preparation to be undertaken, including screening, crushing and processing
- estimated volumes of material to be handled and transported
- employment during construction and operation
- hours of operation for construction, extraction, coal handling, processing, transport and storage, and maintenance
- quantities and management of rejects and tailings and coal to be stockpiled or stored
- disposal of waste, including coarse and fine rejects
- methods of loading and transport of material within the site and from the site, access roads, conveyors, coal loaders
- proposals for progressive rehabilitation of any areas disturbed by the activity
- energy requirements
- quantities and method of transport and storage of fuels and chemicals, including explosives, on the site; and
- sanitary and waste disposal arrangements.

iv. Site layout plans

Plan or plans clearly indicating the location of the following:

- maximum area to be disturbed at the various stages
- any significant vegetation communities to be cleared
- processing, storage, loading or transport plant
- storage areas for ROM and product coal
- storage of waste, fuels, chemicals and explosives
- drainage network, bunding, sedimentation dams
- mine access site
- bathroom and sewerage treatment facilities
- landscaping; and
- parking, queuing and turning areas and truck wash-down areas.

v. **Acquisition policy**

Outline the policy of acquisition for properties or residences likely to be detrimentally affected by the proposal. Include a report on the status of land acquisition or leasing arrangements for the project, including identification of land required but not yet committed to the project.

vi. **Site preparation works**

Description of works required prior to mining operations commencing, including:

- any clearing, including chipping or mulching, removal and storage of overburden
- construction of access roads, dams, drainage and sediment control systems
- construction of loading or storage facilities and equipment; and
- any conservation works on heritage items, including the excavation or recording of sites.

vii. **Infrastructure considerations**

Description of the nature, extent and proposed location of any additional infrastructure, on- and off-site, necessary to meet the project's construction and operational needs.

The following factors should be considered:

- electricity supply; measures to protect or relocate transmission lines, easements or cable
- transport (road, overbridge and rail) requirements
- water requirements, source of water supply, demands on water resources, proposed supply or storage, identify water recycling and reuse options; measures to protect or relocate pipelines; and
- waste disposal requirements, proposed methods and locations for disposal.

viii. **Alternatives & justification**

An assessment of the environmental impacts or consequences of adopting alternatives, including:

- mining techniques or technology
- mine design, site layout or access roads
- proposed infrastructure location
- disposal methods
- alternative impact mitigation options; and
- not proceeding with the proposed mine.

The selection of the preferred option should be justified in terms of:

- type, quality and quantities of coal in relation to market demand; and
- environmental factors, including bio-physical, economic and social factors.

3. Analysis of environmental impacts and mitigating measures

The potential environmental impacts of the proposal should be addressed in satisfactory detail and suitably quantified. The proposed mitigation and management strategies should be identified and take account of the effectiveness of the measures proposed. Appropriate monitoring programs should be included to assist in ongoing environmental management.

i. Transport & traffic management issues

Issues to consider include:

- estimated average and maximum current and predicted levels (hourly, daily and weekly transport movements) for rail and road transportation, both during construction and operation of the mine
- proposed transport routes, frequency and hours/time of movement, and possible alternative routes or transport modes
- adequacy of the local and regional road and rail network to accommodate associated transport and traffic demands
- potential impacts on road or rail maintenance programs
- implications of varying arrangements for road haulage of coal when emergency situations arise; and
- road safety issues, including measures to improve safety.

ii. Air quality issues

Issues to consider include:

- identification of fixed and mobile sources of air pollution, such as mining, processing, handling, storage or transport operations
- likely impact of the proposal on the local and regional air quality (this should include baseline data on ambient air quality, projected dust emissions and deposition rates and frequency and times of significant emissions)
- meteorological conditions under which nearby residences and sensitive land uses are likely to be affected
- mitigation and management measures to minimise the generation of dust and to ensure compliance with air quality objectives, especially in the transportation, handling and storage of coal on-site
- dust monitoring program and monitoring locations (deposition and concentration)
- details of mine ventilation, air quality within the mine, and compliance with the relevant health based air quality standards, and
- mine air quality monitoring system and emergency measures.

iii. Noise & vibration issues

Issues to consider include:

- existing acoustic environment, including a statistical breakdown of the meteorological conditions (predominant wind, temperature, humidity and inversion details) and any topographical features which will influence the noise or vibration impacts
- proposed hours of operation and traffic movements
- noise levels from fixed and mobile noise sources, including predictive noise levels at potentially affected dwellings during construction and operation
- residential amenity issues associated with additional coal-train movements to the Port of Newcastle
- details of mitigation and management measures to control the generation of noise to ensure compliance with relevant noise standards
- details of compliance of any blasting with EPA adopted guidelines; and
- proposed monitoring program and monitoring locations.

iv. Water issues

This should address both hydrological impacts and impacts on water quality, including:

- the condition of natural watercourses and waterbodies, including wetlands, which could be impacted by -
  - demand on water resources
  - any change in the surface or groundwater hydrology as a result of the proposal
  - any change in the water quality as a result of any activity on the site
- description of potential sources of water pollution
- details of stormwater diversion works, their capacity and stabilisation
- drainage and sediment management system
- water balance
- any effects on the local or regional watertable and groundwater quality and implications for other users and the impacts on wetlands in the area
- adequacy of measures to ensure no contamination of the groundwater; and
- a plan for ongoing maintenance and monitoring of water quality controls to ensure their correct installation, operation and effectiveness.

v. Flood liability

- assessment of potential impact of floods on the proposal, including existing flood status, the consideration of the local designated flood standard; the vulnerability of any facilities or storage areas to flooding; the degree of flood-proofing of facilities; potential impacts of inundation both on- and off-site; measures to minimise these impacts; the safety of personnel and equipment
- detail of the hydraulic modelling of likely flood flows
- any likely effects of the proposal on drainage patterns and flooding characteristics of the area, an assessment of the potential to alter flood flow patterns (levels, velocities and flow direction), flood scour and deposition behaviour, flood sediment transport
- the potential of the proposal to change the existing flow regime through creation of any side or cut-off channels, to increase sediments mobility or to encourage overbank scour
- flood mitigation schemes that may influence the impacts of the proposal on the environment and details of measures proposed to address flooding issues
- the compatibility of the proposal with *Floodplain Development Manual* (NSW Public Works, 1986) and any flood policy of Lake Macquarie City Council, and
- proposed monitoring program and monitoring locations.

vi. Erosion & soil stability issues

Issues to consider include:

- meteorological data, soil properties and characteristics and attributes of soil units
- landform characteristics which influence the erosion hazard, ratio of the

rate of runoff to rate of rainfall
- integrated erosion and sediment control measures; and
- maintenance program of all erosion control works.

vii. Subsidence

An assessment of subsidence impacts needs to be undertaken. Issues to consider include:

- surface areas likely to be affected by subsidence including all structures, transmission lines, survey control marks and trigonometrical stations, infrastructure and other improvements
- results of a comprehensive geological investigation and analysis of strata underlying overburden and hydrological interactions of bedrock and overburden
- an assessment of the risk of interconnections forming between the goaf, overlying strata and the surface alluvium, and any required mitigation and monitoring measures to be put in place
- assessment should include any necessary contingency arrangements to compensate water users by loss of useable water from mine capture or contamination
- the possibility of subsidence under any nearby watercourses and wetlands, and
- the impacts of subsidence on the drainage pattern, flood behaviour and flood liability of the area

viii. Infrastructure constraints

Identify any infrastructure constraints and assess the implications on the proposal's construction and operational needs should augmentation not occur at the required time.

ix. Visual issues

Issues to consider include:

- effects of surface facilities on the visual environment, particularly in relation to any landscapes of local or regional significance
- visibility from general surrounds, including major roads and nearby properties
- lighting impacts from lights for security and night operations; and
- proposed mitigation measures to reduce visual impacts, including bunding and the location, layout and species composition of screening landscaping.

x. Flora & fauna issues

Issues to consider include:

- identify flora and fauna known likely to occur in the area and on the site and their significance, including any threatened species, populations, or ecological communities or their habitats
- values of the vegetation, watercourses and wetlands as wildlife corridors/refuge
- an assessment of the likely impact (direct or indirect) on threatened species, populations, ecological communities or their habitat; in the context of the eight part test contained in section 5A of the Environmental Planning and Assessment Act, 1979 and the need to prepare a species impact statement

- details of proposed mitigation measures to protect, retain and enhance (as necessary) identified conservation values; and
- proposed monitoring program.

xi. Heritage issues

Issues should include:

- identification and assessment of the heritage significance of any items, relics or places of Aboriginal, archaeological or European heritage value (including industrial heritage) located on or in the vicinity of the proposed operations
- any likely impact on the heritage significance of items, relics or places of Aboriginal, archaeological or European heritage value (including industrial heritage); and
- proposed measures to mitigate impacts or conserve the heritage significance of the items, relics or places, including a monitoring program.

xii. Spontaneous combustion

Consider the likelihood of spontaneous combustion of coal to be stockpiled or stored. Detail proposed monitoring and management practices.

xiii. Agricultural viability issues

Issues to consider include:

- agricultural uses in the area; and
- any effects on the agricultural viability of thearea, particularly in relation to risk of flooding, subsidence, water flows and quality.

xiv. Economic and social issues

Issues should include:

- changes in the amenity of the area
- impacts on the health of the community from any potential changes in air quality, noise and vibration, safety on the roads and risk of flooding
- costs and benefits to the community, taking into consideration environmental impacts identified in the EIS
- changes in local employment patterns; and
- impact on municipal finances.

xv. Cumulative issues

Issues to consider include:

- identification of other activities in the area which could act cumulatively with the development, having regard to dust, noise, visual impacts, water issues, traffic impacts, and any loss of heritage items, vegetation or fauna habitat
- identification of the extent to which the surrounding environment is already stressed by existing development
- opportunities for co-ordinating mining activities of this proposal with other activities in the area to minimise cumulative impacts; and
- proposed monitoring program.

xvi. ESD principles

Basic concepts of ESD to be applied include:

The precautionary principle: Show decision making proposals that are predictable and transparent. This should include:

- making information available at an early stage and establishing appropriate conflict resolution mechanisms from project planning stage, assessment and determination process
- discussion of Best Practice Environmental Management Techniques, including the potential use of environmental management plans and environmental audits
- ensuring that best practice monitoring and enforcement procedures are proposed; and
- identifying the responsibilities of the proponent and government agencies of environmental management and enforcement.

Inter and intra generation equity: Overall project management and investment in plant and equipment that minimises pollution and waste and is energy efficient.

Conservation of biodiversity and ecological integrity: Including:
- the identification and assessment of all environmental characteristics and habitat values that could be affected by the proposal
- the assessment of likely environmental impacts on these characteristics and values
- implementation of measures designed to minimise likely environmental impacts; and
- consideration given to adopting a whole of life cycle through use of environmentally benign materials, products and processes (eg fuel efficient motors, use of recyclable and recycled materials) and integrated waste minimisation, reuse and recycling.

Valuation and pricing of resources: The costs and benefits of all aspects of the proposal should be considered. This should include non-economic environmental resources within a defined area around the subject site using methodologies such as contingency valuation.

Consideration should be given to measuring positive environmental initiatives (eg energy savings) for possible use as a trade-off for other environmental concessions.

xvii. Ongoing management

Outline the proposed ongoing management for the proposal. This should provide a comprehensive framework for managing or mitigating individual and total environmental impacts for the life of the operation and should:
- include environmental management principles to be followed in the planning, design, construction, operation and decommissioning of the proposal
- identify all government licensing and approval requirements and demonstrate how the plan will facilitate compliance with these requirements; and
- set out the framework of a monitoring program of all key impacts on the environment (indicating what specific information will be monitored, the monitoring intervals, procedures to be undertaken should the

monitoring indicate an environmental problem, and the reporting procedures.

4. Consultation

The results of consultation with:

- Environment Protection Authority
- Department of Mineral Resources
- Department of Land and Water Conservation
- National Parks and Wildlife Service
- NSW Agriculture
- NSW Fisheries
- State Rail Authority
- Rail Access Corporation
- Roads and Traffic Authority
- Mine Subsidence Board
- Lake Macquarie City Council
- Energy Australia
- TransGrid
- local Aboriginal land councils and tribal councils
- potentially affected landowners
- the community to be affected.

It is the responsibility of the person preparing the EIS to determine other Departments, groups and individuals relevant to the proposed development.

DEPARTMENT OF URBAN AFFAIRS AND PLANNING

Attachment No. 2

STATUTORY REQUIREMENTS FOR THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT UNDER PART 4 OF THE ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

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 51 of the *Environmental Planning and Assessment Regulation 1994* (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:
   (a) the consequences of not carrying out the development or activity; and
   (b) the reasons justifying the carrying out of 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, having regard to:
      (i) the nature and extent of the development or activity; and
      (ii) the nature and extent of any building or work associated with the development or activity; and
      (iii) the way in which any such building or work is to be designed, constructed and operated; and
      (iv) any rehabilitation measures to be undertaken in connection with 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.
5. The reasons justifying the carrying out of the development or activity in the manner proposed, having regard to biophysical, economic and social considerations and the principles of ecologically sustainable development.
6. A compilation, (in a single section of the environmental impact statement) of the measures referred to in item 4(d).
7. A list of any approvals that must be obtained under any other Act or law before the development or activity may lawfully be carried out.
8. For the purposes of Schedule 2, the principles of **ecologically sustainable development** are as follows:
   (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.
   (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.
   (d) Improved valuation and pricing of environmental resources.

<u>Note</u>

The matters to be included in item (4)(c) might include such of the following as are relevant to the development or activity:

(a) the likelihood of soil contamination arising from the development or activity;
(b) the impact of the development or activity on flora and fauna;

(c) the likelihood of air, noise or water pollution arising from the development or activity;
(d) the impact of the development or activity on the health of people in the neighbourhood of the development or activity;
(e) any hazards arising from the development or activity;
(f) the impact of the development or activity on traffic in the neighbourhood of the development or activity;
(g) the effect of the development or activity on local climate;
(h) the social and economic impact of the development or activity;
(i) the visual impact of the development or activity on the scenic quality of land in the neighbourhood of the development or activity;
(j) the effect of the development or activity on soil erosion and the silting up of rivers or lakes;
(k) the effect of the development or activity on the cultural and heritage significance of the land.

An environmental impact statement referred to in Section 77(3)(d) of the Act shall be prepared in written form and shall be accompanied by a copy of Form 2 of the Regulation signed by the person who has prepared it.

Procedures for public exhibition of the EIS are set down in clauses 55 to 57 of the Regulation.

Attention is also drawn to clause 115 of the Regulation regarding false or misleading statements in EISs.

Note

Should the development application to which the EIS relates not be made within 2 years from the date of issue of the Director-General's requirements, under clause 52(5) of the Regulation the proponent is required to reconsult with the Director-General.

– ✧ –

your ref:
our ref: ER 446

LAND & WATER CONSERVATION

MANAGER
UMWELT (AUSTRALIA) PTY. LTD.,
PO BOX 838,
TORONTO. 2283

FAXED 26.6.97

ATTENTION: Mr. P. Jamieson

Thursday, 26 June, 1997

Dear Sir

COORANBONG COLLIERY LIFE EXTENSION PROJECT.

I refer to your letter dated 28 May requesting this Department's comments in regard to the above proposal. I apologise for the delay,but the Department has now reviewed this matter and provides the following information addressing the principle issues:

SOIL CONSERVATION

In relation to soil erosion, sedimentation and land degradation in general the Department advises that the Environmental Impact Statement (EIS) should address at least, but not be limited to the following issues:-

· topography and landform
· soil type and soil erodibility
· acid sulfate and potential acid sulfate soils
· vegetation management and SEPP46, if applicable
· Protected Land (Soil Conservation Act 1938), if applicable
· erosion and sediment control strategy, including techniques

WATER MANAGEMENT

The EIS must discuss the on-site management of water, including:

* a detailed water balance, including water make, increased seepage rates and methodology to estimate groundwater potentials, and on site use of mine water
* detailed assessment of impacts and management of any proposed discharges from the site to downstream areas
* detailed explanation of any impoundments to be constructed, in terms of construction techniques and management of on site water
* segregation of clean and dirty water management circuits, and construction techniques and design elements of any diversion system for clean water around the site.

An explanation of all modelling developed for the mine site must be included in the EIS, and a separate report on the working for groundwater and surface water models developed for the EIS should be provided for the Department's assessment.

MONITORING

The EIS must include a detailed assessment of monitoring requirements for surface and ground waters. This includes locations of current monitoring sites, assessment of groundwater ingress monitoring points, surface water monitoring points, and an explanation of monitoring frequencies and parameters to be assessed. The Department requires that monitoring should include biological assessment of impacts downstream of the site. The EIS must include a commitment to report monitoring data to this Department.

CREEK STABILITY

The EIS should address the following issues associated with the stability of Stockton and Morans Creeks.

* Location details of the proposed longwall mining areas must be given in relation to the Creeks.
* Details of anticipated subsidence rates should be given and discussion of any proposed mitigation measures and monitoring plans should be included.
* Current invert levels of the Creeks and the surrounding land should be surveyed and survey plans supplied with the EIS.
* Details of activities ancillary to mining, such as construction of vehicular accesses across the Creeks, must be given. It may be necessary to obtain Part 3A Permits (issued under the Rivers and Foreshores Improvemet Act, 1948) from the Department prior to commencement of these activities.

I trust the above information is of assistance in regard to your consideration of this proposal. Should there be any further enquiry on this matter, please contact Mr. Jeff Hunt, Catchment Planning Manager, at our Newcastle Office on 049 294346.

Yours Faithfully

J. Hunt

Jeff Hunt, CATCHMENT PLANNING MANAGER
for MANAGER, RESOURCE ASSESSMENT AND PLANNING
HUNTER REGION

your ref:
our ref: ER 513

LAND & WATER CONSERVATION

MANAGER
UMWELT (AUSTRALIA) PTY. LTD.,
PO BOX 838,
TORONTO. 2283

Tuesday, 09 September, 1997

ATTENTION: Mr. P. Jamieson

FAXED 9-9-97

Dear Sir

PROPOSED COORANBONG LIFE EXTENSION - PLANNING FOCUS MEETING.

I refer to your letter dated 18 July 1997 requesting this Department's comments in regard to the above proposal. I apologise for the delay, but the Department has now reviewed this matter and provides the following information additional to that provided in our response dated 26/6/97 reference ER446.

GROUNDWATER.

Additional information is required for this assessment.
- impacts of the proposal on the groundwater resources, effects on bore water supplies, springs and other waterbeds and ecosystems.
- location and rates of extraction from rewatering bores (if any).
- Impacts of effluent disposal on the groundwater system.
- groundwater monitoring, reporting and data transfer.
- contingency plans for remediation if groundwater is contaminated as a result of the development.

I trust the above information is of assistance in regard to your consideration of this proposal. Should there be any further enquiry in this matter, please contact Mr Jeff Hunt, Catchment Planning Manager, at our Newcastle Office on 049 294346.

Yours Faithfully

J Hunt

Jeff Hunt, CATCHMENT PLANNING MANAGER
for MANAGER, RESOURCE ASSESSMENT AND PLANNING
HUNTER REGION

EPA

Environment
Protection
Authority
New South Wales

NSW Government Offices
117 Bull Street Newcastle West NSW 2302
PO Box 488G Newcastle NSW 2300
Tel .049. 26 9971 Fax .049. 29 6712

Umwelt (Australia) Pty Limited
PO Box 838
TORONTO NSW 2283

Our Reference: 270149A59

Your Reference:

Contact: Michelle Bruce

16 JUL 1997

Attention: Peter Jamieson

Dear Sir

Re: Environmental Impact Statement - Cooranbong Colliery Life Extension Project

I refer to your letter of 28 May 1997 requesting the Environment Protection Authority (EPA) to comment on the issues to be addressed in the proposed Environmental Impact Statement (EIS) for the abovementioned project.

In commenting I note that the guideline produced by the then Department of Planning entitled "Coal Mining - Environmental Impact Assessment Guidelines" (DoP, 89/71) identifies the majority of issues of interest to the EPA. accordingly it is suggested that these guidelines be used as a general guide in the preparation of the EIS.

Issues not specifically mentioned in the abovementioned guideline and which the EPA would expect to be considered in the EIS include:

Sewage Treatment

The EIS should qualitatively and quantitatively describe the measures proposed to collect, treat and reuse and/or dispose of sewage wastes. If there is a potential to adversely affect the environment the EIS should identify the impacts and propose measures to mitigate the impacts.

Water Management

The EIS should quantitatively and qualitatively evaluate the management of clean and dirty water on the site. If it is necessary to discharge polluted water from the site the EIS should describe the potential impacts and proposed measures to mitigate the impacts with an emphasis on beneficial reuse.

If you have any questions regarding this matter do not hesitate to write or contact Michelle Bruce on (049) 269997 or alternatively Irwin Perring on (049) 269994.

Yours sincerely

GRAHAME CLARKE
Head Regional Operations Unit, Hunter
for <u>Director-General</u>

EPA

Environment
Protection
Authority
New South Wales

NSW Government Offices
117 Bull Street Newcastle West NSW 2302
PO Box 488G Newcastle NSW 2300
Tel .049. 26 9971 Fax .049. 29 6712

Umwelt (Australia) Pty Limited
PO Box 838
TORONTO NSW 2283

Our Reference: 270149A59

Your Reference:

21 AUG 1997

Contact: Michelle Bruce

Attention: Peter Jamieson

Dear Sir

Re: Environmental Impact Statement - Cooranbong Life Extension Project

Thank you for the opportunity to attend the planning focus meeting for the proposed Cooranbong life extension project at Morisset RSL on 6 August 1997. The presentation raised a number of environmental issues that were flagged in the Environment Protection Authority's (EPA) letter of the 16 July 1997.

To ensure that the EIS contains sufficient information to allow the EPA to fully assess the environmental impacts associated with the project a more detailed outline of the information to be included in the EIS is attached as Appendix 1.

You are also advised that, subject to all the necessary approvals being granted, any commitments made in the EIS may be formalised as a condition of either a Pollution Control Approval or Licence. Consequently, pollution control measures should not be proposed if they will not be implemented or are unrealistic.

If you have any questions concerning these matters do not hesitate to write or contact Michelle Bruce on (049) 269997 or Mr Colin Charters on (049) 269701.

Yours sincerely

GRAHAME CLARKE
Head Regional Operations Unit, Hunter
for Director-General

Appendix 1

Cooranbong Life Extension Project

The following information must be provided in the EIS (or documentation in support of a Pollution Control Approval) to accurately assess the environmental implications of the proposal.

1 MINING OPERATION

1.1 Details of the mine and infrastructure including layout and map of the general locality.

1.2 Location of nearby residences and any land use likely to be affected by the operation.

2 AIR POLLUTION

The EIS should demonstrate that the operation will be able to operate within the EPA's requirements and objectives for dust generation. The EPA's objective is to control, to the maximum extent practicable, the generation of dust on-site. It is also to contain any dust generated within the property to minimise any adverse affects of the operation on the amenity of local residents on sensitive land uses and to limit the effects of dust on regional air quality. The EIS should also include:

2.1 Anticipated dust emissions and TSP/deposition rates.

2.2 An indication of the projected impact on air quality

2.3 An assessment of short-term, worst-case impacts of dust emissions by postulating hypothetical meteorological conditions under which nearby residences and sensitive land uses may be affected by the operation.

2.4 A description of dust control measures to be implemented during the construction and ongoing phases of the development and in particular from emplacement areas, stockpiles, coal loading and trafficable areas on new and existing sites.

3 WATER POLLUTION

The EIS must detail measures to be implemented to prevent adverse impacts, by wastewater and contaminated stormwater, on the water quality of local streams and groundwater. The EIS should also include:

3.1 A water management plan and site water balance incorporating the following principles:

3.1.1 Maximum on-site reuse and disposal of wastewater together with the use of control and storage works to avoid, to the maximum practicable extent, any dry weather discharge.

3.1.2 Minimisation of wet weather overflows of contaminated stormwater.

3.1.3 Segregation of contaminated water from non-contaminated water to minimise the volume of polluted water to be dealt with.

3.1.4 Allocating priorities in water use so that the poorest quality stored water is reused first.

3.2 Plans to manage contaminated water accumulated in excess of re-use or storage capacity. If, notwithstanding implementation of the principles contained in section 3.1 above, a discharge is found to be unavoidable, the water management plan must incorporate procedures to manage such releases in an environmentally acceptable manner. The plan should also quantitatively identify the levels of pollutants likely to be present in the discharge and their potential impact on the receiving waters.

3.3 Details of stormwater diversion works particularly in regard to their capacity and stabilisation.

3.4 Control measures which will be adopted to prevent pollution of waters by pit water, leachate, stormwater runoff, etc.

3.5 Details of the fuel storage arrangements.

3.6 Details of the proposed wastewater treatment system and the on-site effluent management system for the bath house at the proposed Morisset interchange mine access site. A land capability assessment will be required to support a PCA application.

4 NOISE POLLUTION

4.1 GENERAL

Mining and coal treatment, handling and transport operations must not cause offensive levels of noise at neighbouring residences. The proposal will be assessed in accordance with EPA criteria described in the "Environmental Noise Control Manual". The EIS should also include:

4.1.1 Noise levels of fixed and mobile equipment to be used.

4.1.2 An assessment of the existing acoustic environment and a noise assessment to identify and predict future noise levels at affected residences.

4.1.3 Details of any noise control measures to be implemented.

4.1.4 Hours of operation.

4.1.5 The extent to which rail traffic will cause increased noise along haulage routes.

4.1.6 Construction noise - emissions, impacts and control measures.

It is also recommended that the acoustic assessment include provisions for a follow-up study to validate predictive modelling and to identify any noise source(s), impacts which impact on sensitive receives more severely than predicted and require additional remedial measures.

4.2 BACKGROUND NOISE

The EPA policy in regard to establishing background noise level is to apply the concept of the **lowest repeatable minimum** value.

4.3 BLASTING

The EPA has adopted the Australian & New Zealand Environment Conservation Council (ANZECC) guideline titled "Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure & Ground Vibration". This supersedes the EPA's blasting guideline contained in Chapter 154 of the Environmental Noise Control Manual.

The ANZECC guideline recommends that blasting not take place outside the hours of 9.00 am - 5.00 pm Monday to Saturday. Blasting should not take place on Sundays or Public Holidays. The EIS must apply the ANZECC guideline for blasting criteria.

5 GENERAL

5.1 MONITORING PROGRAM

An on-going, environment monitoring program should be designed to ensure the necessary data is available against which future environmental impacts can be measured and performance evaluated.

5.2 REHABILITATION

The EIS must contain proposals for progressive rehabilitation. Because disturbed land has the potential to erode and cause sedimentation, the EPA has an interest in achieving prompt, high quality rehabilitation. Precise requirements in this regard are primarily the responsibility of the Department of Land and Water Conservation.

5.3 WASTE MANAGEMENT

The company should prepare a waste management plan which details the company's philosophy and proposals for minimising and disposing of waste, other than mine spoil.

5.4 ENVIRONMENTAL MANAGEMENT PLAN

The company will rely on effective management and a high level of day-to-day supervision to ensure its compliance with its legal responsibilities. We strongly recommend a site environmental management plan be developed to ensure management and staff are fully conversant with their obligations at all times.

5.5 CONSTRUCTION PHASE

Impacts of specific activities involved in site preparation should be identified. Details of appropriate erosion and sedimentation controls, dust suppression and, if relevant, noise controls, should be included in the EIS.

All areas disturbed during construction, which are not included in the working area, must be revegetated to a high standard.

5.6 ENVIRONMENTALLY SUSTAINABLE DEVELOPMENT (ESD) PRINCIPLES

Although the mining sector processes non-renewable resources the basic concepts of ESD can still be applied.

5.6.1 The Precautionary Principle

* The proposal should include decision making processes that are predictable and transparent. This should include;
  - making information available at an early stage so that major issues can emerge and be addressed during the project planning stage;

- adopting consultative mechanisms between the proponent and the community as a means of minimising disputation at the formal environmental assessment stage;

- establishing appropriate conflict resolution mechanisms for use during the project approval process.

* Discussion of Best Practice Environmental Management techniques including the potential use of environmental management plans and environmental audits.

* Ensuring that best practice monitoring and enforcement procedures are proposed.

* Identifying the responsibilities of the proponent and government agencies for environmental management and enforcement.

5.6.2 Inter and Intra Generational Equity

* Overall project management and investment in plant and equipment that minimises pollution and waste and is energy efficient.

* Ensure rehabilitation of disturbed land for a predetermined land use.

5.6.3 Conservation of Biodiversity and Ecological Integrity

* The identification and assessment of all environmental characteristics and habitat values that could be affected by the proposal.

* The identification and assessment of the likely environmental impacts on these characteristics and values.

* The implementation of measures designed to minimise likely environmental impacts.

* Consideration given to adopting a whole of life cycle approach through:

    - use of environmentally benign materials, products and processes. eg. fuel efficient motors, use of recyclable and recycled materials.

- integrated waste minimisation, reuse and recycling.

5.6.4 Valuation and Pricing of Resources

The costs and benefits of all aspects of the proposal should be considered.
This should include non-economic environmental resources within a defined area around the subject site using methodologies such as contingency valuation.

Consideration could be given to measuring positive environmental initiatives (e.g. energy savings) for possible use as a trade off for other environmental concessions.

5.7 GREENHOUSE GAS EMISSIONS

5.7.1 Using the methodologies published with the National Greenhouse Gas Inventory (1994) estimate the total annual volume of all major greenhouse gases that are likely to be emitted from all aspects of the proposed development. Major greenhouse gases include carbon dioxide, methane, nitrous oxide, carbon monoxide, oxides of nitrogen, non methane volatile organic compounds and perfluorocarbons.

5.7.2 Estimate the net increase or decrease in greenhouse gas emissions from the proposed development and compare it to estimates in the 1990 National Greenhouse Gas Inventory for total Australian emissions and for the energy and transformation industry sector.

5.7.3 Specific consideration should be given to measures to minimise the emission of all major greenhouse gases from the proposed development

5.7.4 The use of coal bed methane or renewable energy technologies such as solar and/or wind energy should be considered for on site power generation.

6 EPA APPROVAL AND LICENSING

Mining activities are classified as 'Scheduled premises' as defined by the Clean Air Act and Noise Control Act. Installation of wastewater collection, treatment and storage facilities are covered by the Clean Waters Act. Consequently, the operation will require EPA approval under the Pollution Control Act before construction commences or equipment is installed. Approvals are issued subject to appropriate conditions aimed at controlling or minimising the generation of air and water pollution and offensive noise.

The company is required to obtain formal EPA approval to conduct the proposed works to extend Cooranbong Colliery prior to construction commencing. A Pollution Control Licence must also be obtained prior to the operation of the Morisset Interchange Mine Access Site. Operating conditions as well as monitoring and reporting conditions will be attached to that licence.

FAXED 19·6·97

19 June 1997

energyAustralia

Mr Peter Jamieson
Umwelt (Australia) Pty Limited
PO Box 838
Toronto 2283

145 Newcastle Road
Wallsend NSW Australia
Telephone (049) 51 9555
+61 49 51 9555
Facsimile (049) 51 9320

Address all mail to
PO Box 487
Newcastle NSW
2300 Australia
DX 7853 Newcastle

Phone: 049 51 9465
Fax No: 049 51 9459

Dear Sir

Cooranbong Colliery Life Extension Project

I refer to your letter dated 28 May 1997 concerning the EIS for this proposed development.

There are three broad issues that the EIS will need to address that will involve EnergyAustralia as follows.

1. The means by which electricity will be supplied to the new surface facilities.
2. The impact underground workings and mine subsidence may have on our existing assets.
3. The energy usage of the mine.

In respect of the first item we envisage that it will be necessary to construct on site a substation similar to the one that exists at the present mine head near Dora Creek. To supply this substation it will probably be necessary to build new 33 kV transmission lines. The extent, number and type of such new lines has not yet been determined. It may be necessary to extend additional at least one and possibly two lines from the present Cooranbong Colliery Substation to the new development.

We are presently negotiating with Powercoal staff over the supply arrangements. The impact of the electricity supply arrangements should be dealt with in the EIS for the mine as the mine development is likely to bring forward by several years the need to amplify the electricity supply in the Morisset area.

Impacts arising from our installations will include the visual impact of both the substation and transmission lines, the possible requirement for tree clearing/trimming for overhead transmission lines, and the use of mineral insulating oil in some substation equipment.

3160 - 989/97

Regarding the second point we have not attempted at this point to determine what assets may be affected by underground mining activity. I would envisage that as part of your detailed work on the EIS you would be visiting the offices of the various utilities to obtain plans of possible affected assets.

Further to the last point we have been provided with projected electrical load data and as the mine plan develops we would expect Powercoal to refine the projected figures. However, there seems to be a trend for the community to demand information on the energy consumption and the consequent amounts of CO_2 generated in the production of that energy. While we will not require the publication of such data it should perhaps be included in the EIS for the sake of completeness.

The electricity requirements for the mining operation will be so high that the use of renewable energy sources are, in my opinion, not likely to form a significant part of the energy consumption. At this point the possibility of generating electricity from waste methane liberated from the coal seam(s) has not been explored. The generation of methane, a greenhouse gas, may become an issue and may warrant an investigation. As our organisation is involved with generation from gas produced at a former garbage tip we would have an interest in such a development at this mine if the issue arises.

If you require further information please contact me.

Yours faithfully

K.M. Carmody

Keith Carmody
Customer Supply North (Hunter)

3160 - 989/97

20 June 1997

Peter Jamieson
UMWELT (AUSTRALIA) PTY LTD
PO BOX 838
TORONTO 2283

RAIL ACCESS CORPORATION

Dear Peter

Thank you for consulting the Rail Access Corporation about the EIS for the Cooranbong Colliery Life Extension Project. I have made some comments below for your consideration.

I should like to mention that given the sensitivity of the rail related noise and vibration impact from coal haulage in this area the RAC regards it as necessary for the proponent, Powercoal Pty Ltd, to consider this impact as part of the EIS and contribute to the mitigation of the impact. The rail related noise and vibration impacts are very close to the maximum allowable target figures in the EPA Licence. It is also likely that if the increased noise and vibration and other rail related environmental impacts are not covered there may be an appeal against the validity of the EIS in the Land and Environment Court. In this regard please note the current case of Bell V Minister for Urban Affairs and Planning and Minister for Housing (first respondent) and Port Waratah Coal Services (second respondent), which relates to the PWCS proposed Stage 3 expansion.

There are a number of other issues which should also be addressed by this EIS:

* The proposed additional rail movements per annum and per day and impact on the existing network and train paths

* The potential for a rail loop to Cooranbong as an alternative to road haul - this will reduce the need for road and bridge construction and may provide a better alternative to Newstan Colliery - with its attendant operational constraints

* If a road and bridge over the Main North Line is preferred then the impact of possible future double stacking of containers on this route should be considered in the design of the bridge and clearance over the rail line.

Yours sincerely

ALEX PIRIE
Manager Environmental Services

25 August 1997

Peter Jamieson
UMWELT (AUSTRALIA) PTY LTD
PO BOX 838
TORONTO 2283

RAIL ACCESS
CORPORATION

Dear Peter

Following the conversation which I had with you last Friday, I have made some comments below. These comments are in addition to those contained in the previous letter which I sent to you from the RAC.

There are a number of matters which should also be addressed as part of this EIS:

* the proposed additional rail movements per annum and per day and impact on the existing network and train paths; please consult with Eugene Saw of Operations Division in the Rail Access Corporation (RAC), on (02) 9224 4787 (N.B. this is an expansion of the first dot point in the previous letter)

* the quantities and method of haulage; please consult with Bruce Farrar of Access Division in the RAC, on (02) 9224 3068

* the interactions between the proposal and the essential rail transport infrastructure (including the third dot point in the previous letter); please consult with Bruce McComas, Infrastructure Manager Metro North, in the Railway Services Authority, on (02) 9847 8914 and/or David Foldi, Senior Assets Manager Metro North West, of Assets Division in the RAC, on (02) 9224 2436

* regarding the potential for a rail loop (see second dot point in the previous letter), please refer to Lisa Jansen of the Network Planning and Development Division of the RAC, on (02) 9224 2063

* the additional noise and vibration impact from the railway as a result of this proposal; please consult with Ron Yardley of Operations Division in the RAC, on (02) 9224 3546.

Yours sincerely

RHYardley

RON YARDLEY
Environmental Compliance Engineer (Standards)

New South Wales
Government

HERITAGE OFFICE

Level 17, Governor Macquarie Tower, 1 Farrer Place, Sydney
Postal Address: Governor Macquarie Tower, 1 Farrer Place, Sydney, NSW, 2000
Telephone (02) 9391-2255 Fax (02) 9391-2336

Mr Peter Jamieson
Umwelt (Australia) Pty Ltd
PO Box 838
TORONTO NSW 2283

Contact: C. Burke
Telephone: (02) 9391-2079
File: S90/7462/2
Your Ref:

Dear Mr Jamieson

Cooranbong Colliery Life Extension Project

Thank you for your letter dated 28 May 1997 asking us to identify issues that the Heritage Office feel should be included in the EIS for the Cooranbong Colliery Life Extension Project. As surface and subsurface disturbance will occur in the project area, an assessment of the heritage values should be undertaken. The assessment would identify above ground buildings and features as well as archaeological deposits of heritage significance that may be affected by mining, road construction and any other development within the project area. The consultants for the EIS should also be aware that disturbance of archaeological remains requires an excavation permit under the Heritage Act 1977.

If you have any further enquires relating to heritage issues for the EIS please contact Christine Burke on 9391 2079.

Yours sincerely

for C. Burke 25/6/97

Rosalind Strong,
Acting Director.

Your reference

Our reference DO. 851 SS:PJ

26 June 1997

Peter Jamieson
Umwelt (Aust) Pty Ltd
PO Box 838
TORONTO NSW 2283

STATE FORESTS
CENTRAL REGION

State Forests of
New South Wales

Morisset District
PO Box 171
Morisset NSW 2264
Phone (049) 73 3733
Fax (049) 70 5079

Dear Peter

Re: Cooranbong Colliery Life Extension Project
Your Letter Dated 28 May 1997

As your proposal, where it effects State Forests, is underground the only likely effects on the forest environment appear to be associated with subsidence.

Your EIS should therefore consider the effects of subsidence, the consequential effects of changes in water run-off and the associated potential for increases in soil erosion. Each area of subsidence is a potential source for reactivated erosion which can then work uphill until it reaches a stable/non-erosive (e.g. rock) area.

You should consider the issue for each soil type, slope and specific site which will be involved in your proposal.

Yours faithfully

Steve Shaw
DISTRICT FORESTER/MORISSET

Hunter Catchment Management Trust

HUNTER CATCHMENT MANAGEMENT TRUST
Care for the land

Mr Peter Jamieson
Umwelt (Australia) Pty Ltd
PO Box 838
TORONTO 2283

PO Box 204
Maitland NSW 2320
Email: hunter.trust@hunterlink.net.au

Telephone: (049) 335 455
Facsimile: (049) 335 164

Our ref: 1325

Your ref:

Dear Sir

Re : Cooranbong Colliery Life Extension Project

Thank you for your letter of 28 May 1997 requesting comments on matters to be address in the EIS. As the area is outside the Hunter Catchment Management Trust District, the Trust will not have any input to the EIS.

Yours faithfully

Glenn Evans

Glenn Evans
Chief Executive Officer per

27 June 1997

TCM

Total Catchment Management

Community And Government Working Together

Trans Grid

NETWORK/NEWCASTLE
Telephone: (049) 678 671
Our Reference: File NC/531 N/N/EBW:UC[P66412]:6847

Northern Region - Newcastle Area
Wirra Cresent (off University Drive)
PO Box 93 Waratah
New South Wales 2298 Australia
Facsimile (049) 678 783
Telephone (049) 678 678

Umwelt (Australia) Pty Ltd
2/20 The Boulevarde
TORONTO NSW 2283

Attention: Mr Peter Jamieson

Dear Sir

RE : COORANBONG COLLIERY LIFE EXTENSION PROJECT

TransGrid has reviewed your letter, dated 28th May, 1997, regarding Cooranbong Collieries Extension Project. The area of the proposed extension affects a number of our assets, which include No 24 Vales Point to Newcastle Substation and No 25/26 Eraring - Munmorah - Sydney West 330kV Transmission Lines.

TransGrid would like to offer the following information and comments on the proposal for consideration.

The transmission lines in the proposal area are major components of the NSW transmission network and are critical to the supply of electricity to Central NSW. Any proposal which affects these assets may have severe implications on the supply of electricity to this area.

The "Guidelines for Coal Mining and Transmission Lines with respect to Subsidence", available from the Mines Subsidence Board, provide details on the requirements for mining under transmission lines.

References in these guidelines to the Electricity Commission of NSW now applies to TransGrid. These guidelines should be followed to ensure that all affects on the transmission lines are properly considered.

With regard to mining which will affect the transmission lines, TransGrid will require accurate documentation and adequate notice to ensure that assessment and precautionary work can be carried out prior to any mining commencement. In cases where it is necessary to deviate a transmission line, approximately 5 years notice will be required to allow planning, design and construction work to be carried out.

With regard to underground mining under transmission lines, we can advise that it is generally possible to take precautionary measures to allow mining to occur under suspension structures, but usually not possible to protect termination structures against the effects of subsidence. The precautionary measures required, will be dependent on the level of subsidence and could cost up to $75,000 per structure. The installation of precautionary measures generally require a minimum of 6 months notice.

RE: COORANBONG COLLIERY LIFE EXTENSION PROJECT
FILE NC/531

The costs of any precautionary work will be required to be reimbursed to TransGrid by the appropriate body. The costs for precautionary work may be substantial in the event of a transmission line requiring deviation and should be taken into account when assessing the economic viability of the mining proposal.

If you require any further information, please contact the Acting Mains & Environment Engineer, Mr Andrew Power on (049) 678 678.

Yours faithfully

J. Cox
J COX
MANAGER/NEWCASTLE

4/6/97

Trans

NETWORK/NEWCASTLE
Telephone: (049) 678 671
Your Reference: File C97/2374
Our Reference: File NC/531 N/N/EBW:UC[P66412]:7351

Northern Region - Newcastle Area
Wirra Crescent (off University Drive
PO Box 93 Waratah
New South Wales 2298 Australia
Facsimile (049) 678 783
Telephone (049) 678 678

UMWELT Australia Pty Ltd
P O Box 838
TORONTO NSW 2283

Attention: Mr Peter Jamieson

Dear Sir

RE : PROPOSED COORANBONG LIFE EXTENSION

With reference to proposed life extension of Cooranbong Colliery and the Planning Focus Meeting held at Morisset RSL on 6th August,1997, TransGrid can advise that we have two transmission lines and associated structures in the proposed mining area. The following list identifies the issues and constraints that should be considered when mining under steel tower transmission lines.

1. The attached maps show the approximate location of transmission lines, including the structures, in the mining area.

2. There are two transmission lines in the area. No 24 Vales Point to Newcastle and No 25/26 Vales Point to Sydney West double circuit transmission line.

3. There are basically two types of transmission line structures, suspension and termination. These have been marked on the attached map as S or T.

4. As a general rule it is possible to protect suspension structures against the effects of subsidence and not possible to protect termination structures. There are of course some exceptions.

5. Whether precautions are required and the type of precautions required will depend on the levels of subsidence that will be experienced by the structure.

6. For tilt affecting suspension structures it is generally possible to place the conductors in stringing sheaves to allow the tower to move without pulling on the conductors.

7. For tilt affecting termination structures, individual analysis would be required.

8. A transmission line structure is able to cope with a small level of strain, up to 2.5mm/m.

   At greater levels of strain, work needs to be undertaken to ensure that the structure is not damaged. At present this is achieved by installing a cruciform foundation on the structure. The cost of this work is approximately $50K per structure.

   The steel structure could be temporarily be dismantled and replaced with a wood pole structure.

RE : PROPOSED COORANBONG LIFE EXTENSION
FILE NC/531

9. Each structure will require an individual assessment to determine the effects once predicted subsidence is available.

10. There is a booklet produced by the MSB "Guidelines for Coal Mining and Transmission Lines with Respect to Subsidence" which outlines the procedure to be followed when mining is proposed under transmission lines. A new version of the book is currently being prepared.

11. TransGrid will carry out regular inspections during mining to monitor the effects on the structure.

12. All costs to TransGrid to be met by Mines Subsidence Board or Mine.

If you require any further information, please do not hesitate to call our Acting Mains & Environment Engineer/Newcastle on (049) 678 678.

Yours faithfully

P J DUNKIN
ACTING MANAGER/NEWCASTLE
13/8/97

Encl.

Mr. Peter Jamieson
Umwelt (Australia) Pty Ltd
PO Box 838
TORONTO NSW 2283

LAND INFORMATION CENTRE
~~SURVEY CONTROL BRANCH~~
SURVEY SERVICES, SYDNEY.
Our Ref: H091 H205 Vol.8
Contact: B. Preston
Tel: (02) 92674991
Fax: (02) 92674942

5 June, 1997

Dear Mr. Jamieson

RE: COORANBONG COLLIERY LIFE EXTENSION PROJECT

Thank you for your letter of 28 May 1997. The question of possible damage to survey control marks will need to be considered in any environmental impact statement prepared in respect of the project.

As you are no doubt aware survey control marks are co-ordinated and levelled marks on an integrated State Survey Grid. The value of the marks is in their co-ordinate values, rather than the hardware itself. Underground mining will disturb these marks and make their co-ordinate values useless.

The cost of reinstatement of individual survey control marks may vary from about $800 for a Permanent Mark to about $5,000 for a Trigonometrical Station. This cost has been met by the Mine Subsidence Board for past projects.

A list of all of the survey marks that will be affected by your mining has not been supplied as the scale of your map makes this difficult. TS Cooranbong and about thirty Permanent Marks will most likely be involved. TS Russell and TS Mandalong may also be close to your workings. It would be advantageous to the State and to your Mine Surveyor if the zone of influence of your mining stopped short of the Trigonometrical Stations.

Mr. Peter O'Kane, the Senior Surveyor, Land Information Centre, in Newcastle has spoken to Mr. Paul Duncan of Cooranbong Colliery about this proposal. Mr. Duncan should be able to help you with more information on the survey control marks involved.

It would be appreciated if you could advise Mr. O'Kane before commencing each Longwall Panel, so that it can be ascertained which marks are likely to be disturbed. The details can then be relayed to you.

If you have any enquiries regarding our concerns, please contact Peter O'Kane on (049) 269972.

B Preston

B. PRESTON
MANAGER, SURVEY SERVICES.

14th Floor 175 Liverpool Street GPO Box 39 Sydney NSW 2001
Phone (02) 9267 4988 Fax (02) 9267 4942

In reply please send to: Newcastle

Our reference: 12.10 GCC:JR

Your reference:

Contact: Greg Cole-Clark (049) 26 9995

Mr P Jamieson
Umwelt (Australia) Pty Limited
PO Box 838
TORONTO 2283

10th June 1997

Dear Mr Jamieson

COORANBONG COLLIERY LIFE EXTENSION PROJECT

Thank you for seeking our input regarding matters to be addressed in the EIS for the abovementioned project, I am interested to know whether you intend holding a planning focus meeting and will be providing us with a draft EIS for comment prior to exhibition.

Some of the issues which you may consider addressing are:

1. Prediction of maximum subsidence, strains, tilts and curvatures.
2. Assessment of likely impacts of coal extraction.
3. Type of surface structures and likely damage.
4. Measures which might be employed to mitigate the effects of mine subsidence.
5. Details regarding the angle of draw.
6. Vibration monitoring and likelihood of extraction related vibrations.
7. Effect of subsidence on farm dams, ground water systems and survey marks.
8. Subsidence monitoring.
9. Pre-mining inspections.
10. Mine Subsidence Board requirements.

MINE SUBSIDENCE BOARD

The Mine Subsidence Board OFFICES:

NEWCASTLE:
Ground Floor,
NSW Government Offices,
117 Bull Street,
Newcastle West 2302
Postal Address:
PO Box 488G,
Newcastle 2300
Telephone: (049) 26 9750
Facsimile: (049) 29 1032
DX 4322 Newcastle West

SPEERS POINT:
143 Main Road,
Speers Point 2284
Postal Address:
PO Box 9, Boolaroo 2284
Telephone: (049) 50 8088
Facsimile: (049) 50 8101
DX 7820 Newcastle

WYONG:
Suite 3 Feldwin Court,
30 Hely St,
Wyong 2259
Postal Address:
PO Box 157, Wyong 2259
Telephone: (043) 52 1646
Facsimile: (043) 52 1757
DX 7317 Wyong

SINGLETON:
Joint Coal Board Building
1 Civic Avenue,
Singleton 2330
Postal Address:
PO Box 524, Singleton 2330
Telephone: (065) 72 4344
Facsimile: (065) 72 4504

PICTON:
100 Argyle Street,
Picton 2571
Postal Address:
PO Box 40, Picton 2571
Telephone: (046) 77 1967
Facsimile: (046) 77 2040

If you would like to discuss any of these matters further, please do not hesitate to contact me.

Yours faithfully

G J Cole-Clark
Chief Executive Officer

[redacted]

NSW Agriculture

PO Box 123 Maitland NSW 2320
Phone (049) 302 444 Fax (049) 302410

Our Ref: Glenda Briggs
Agricultural Environmental Officer

18 June, 1997

Umwelt(Aust) Pty Ltd
2/20 The Boulevard,
Toronto, 2283

Dear Peter Jamieson

Extenstion to Coorangbong Colliery

I refer to your letter of 28 May 19997 seeking Departmental comment on critical issues to consider in undertaking studies for the Environmental Impact Statement for the proposed extension of undeground minining operations associated with the Coorangbong Colliery Life Extension Project.

To enable adequate consideration of any possible effects on agriculture and the rural environment NSW Agriculture advises that the major issues which should be addressed are:

- The agricultural quality of the surface areas within and immediately adjoining the proposed mining lease area, as determined by land classification assessment.
- The nature and value of existing agricultural activities undertaken within this area, including use of surface and ground water resources.
- The likely extent of mine subsidence and potential impacts on local drainage patterns, infrastructure and agricultural activities.
- Mining requirements for water and any potential impacts on surface and ground water resources. Particular, attention should be given to the presence of pyrite or other material likely to oxidise and result in acid groundwater.
- Any other potential areas of impact associated with surface facilities such as noise, exhaust / air intakes and traffic.
- Proposed arrangements regarding access, hours of operation, vehicles and any agreements reached with neighbouring landholders.

Should you require further details of these suggestions, please contact Glenda Briggs, Agricultural Environmental Officer, telephone (049) 302 444.

Yours faithfully

Glenda Briggs
Agricultural Environmental Officer
Hunter Region

MINERAL RESOURCES

Mr. Peter Jamieson
Umwelt (Australia) Pty Limited
P O Box 838
Toronto NSW 2283

NSW DEPARTMENT OF MINERAL RESOURCES
Joint Coal Board Bldg 1 Civic Avenue
(P.O. Box 51), Singleton, NSW 2330, Australia
Phone (065) 72 1899 · Fax (065) 72 1201
DX 7071

C97/2002

Dear Peter,

Cooronbong Colliery - Life Extension Project

I refer to your letter of 28 May 1997, requesting our requirements for the EIS for the above project.

As discussed at the presentation of 13 February 1997, the main issue is subsidence and the impacts thereof on the surface. These will have to be assessed in detail in the EIS and the document should contain a policy outlining proposed treatment of impacted landholders. Attached for your information are the requirements of our Principal Subsidence Engineer and a Draft Departmental Policy on mining under flood prone land.

The EIS should also contain a statement on coal resources and reserves. To assist with the preparation of this statement, attached is guideline for the preparation of such statements.

Once the EIS is close to a draft stage there will be a need to hold a Planning Focus Meeting for this project. In our response to the February meeting we stated that prior to Planning Focus, we would require resolution of the situation regarding EL 4911 held by Coal Operations Australia and a policy on subsidence impacts.

Should you have any further queries, please contact me on (065) 724200.

Yours sincerely,

23/6/97

David Agnew
Regional Manager (Northern)
Titles

M82/4240

COORANBONG COLLIERY LIFE EXTENSION PROJECT

I refer to your minute dated 30 May 1997 requesting my advice on matters required to be addressed in the EIS. The following comments relate to mine subsidence matters.

The letter by Umwelt does not indicate the surface structures and features in the proposed mining area. In this situation my comments can only be broad and general. In essence the EIS should make a comprehensive assessment of the impact of mining on the surface environment addressing the following aspects:

- Identify all existing and proposed (within approximately the next five years) surface features, both man-made and natural, likely to be affected by the proposed mining
- Assess the subsidence effect on all surface features in terms of their safety and serviceability
- Discuss the agreements proposed to be reached with major public utility authorities and owners of major business and production facilities
- Assess the subsidence effect on global and local drainage patterns, surface and underground water resources and flooding patterns
- Assess the flooding impact on private and public land and the structures erected upon them including the proposed compensation agreements covering all compensation issues
- Assess the impact on tidal waters and their impact on surrounding land including compensation procedures

In summing up, a comprehensive impact of mine subsidence on the surface environment should be made.

L Holla
Principal Subsidence Engineer
18 June 1997

D Agnew
Regional Manager

MINERAL RESOURCES

NSW DEPARTMENT OF MINERAL RESOURCES
Level 1, 1 Civic Avenue
(P.O. Box 51), Singleton, NSW 2330, Australia
INSPECTORATE: Phone (065) 72 1899 · Fax (065) 72 1201
GEOLOGY: Phone (065) 72 4200 · Fax (065) 72 1201
MINING TITLES: Phone (065) 72 4200 · Fax (065) 72 1201
DX 7071

Mr. Peter Jamieson
Umwelt (Australia) Pty Limited
P O Box 838
TORONTO NSW 2283

C97/2374

Dear Peter,

COORONBONG COLLIERY LIFE EXTENSION PROJECT
COMMENTS ON PLANNING FOCUS MEETING

I refer to the Planning Focus Meeting held on the 6 August 1997.

Please find outlined below the comments of our Environmental Officer with regard to the information presented at the meeting.

Generally, the content of the presentation was good and there do not appear to many major issues. His only comment was in relation to subsidence of the Mandalong Valley as a result of the longwall operation.

It was stated at the meeting that subsidence could be in the order of 1600 mm - 2400 mm (depending upon the panel being extracted. The main concern with the effects of subsidence is the increase in potential energy of waters entering the valley floor (and any subsequent increase in surface erosion), the increase (if any) in retention time of waters within the valley, or the increase in the discharge of waters from the valley.

These issues will be dependent upon the pattern and timing of any subsidence and the relative subsidence at various points along the valley. If there is unequal subsidence, or significant time differences in subsidence effects across the valley, the drainage, discharge and erosion patterns may have a significant effect upon the landform.

While this issue was covered at the planning focus meeting, he believed greater detail of information will need to be provided in the final EIS - together with the results of the modeling undertaken.

Other issues raised by our technical staff, namely the geologists and mines inspectors will no doubt be resolved at the presentation on 27 August.

Should you have any further queries, please contact me.

Yours sincerely,

21/8/97

David Agnew
Regional Manager
Titles

Environment Australia

Environment
Protection Group

Mr Peter Jamieson
Umwelt (Australia) Pty Limited
PO Box 838
TORONTO NSW 2283

Dear Mr Jamieson

I refer to your letter of 28 May 1997 regarding Powercoal Pty Limited's application to for development consent to extend the existing Cooranbong Colliery underground mining operation.

I understand that this proposal does not have foreign investment and recent changes to export licence requirements means that the Commonwealth does not have a decision to make that might initiate environmental impact assessment under the *Environment Protection (Impact of Proposals) Act 1974* .

However, it could be useful for the company to address the specific concerns of the *Endangered Species Protection Act 1992* and the *Australian Heritage Act 1975* in the State assessment process as this would simplify matters if any Commonwealth involvement in an approval process does eventuate. The recent Commonwealth environmental assessment of the neighbouring Awaba coal mine, also owned by Powercoal Pty Limited, may be of assistance as a guide to how Commonwealth requirements can be met.

Thank you for providing us with the opportunity to comment on this proposal.

Yours sincerely

Gerry Morvell
Assistant Secretary
Environment Assessment Branch

6 June 1997

Administrative Centre
126-138 Main Road, Speers Point NSW 2284
Box 1906, Hunter Region Mail Centre NSW 2310
Newcastle Document Exchange DX 7869
Telephone **(049) 21-0333** Facsimile **(049) 58-7257**

Lake Macquarie City Council
Quality Lifestyle

ALH:LAH Ext 469
3/56/584/001

20 March 1997

Director
A B Nelson & Associates Pty Ltd
P O Box 92
TORONTO NSW 2283

Dear Mr Nelson

RE: COORANBONG COLLIERY LIFE EXTENSION PROJECT

I refer to your letter of 18 March 1997 and I advise that under Clause 22 LMLEP underground mining may be carried out, with consent of Council, without having regard to surface zoning and other provisions of the Plan.

Yours faithfully

Al Hargrave

ALLAN HARGRAVE
DEVELOPMENT MANAGER
DEVELOPMENTAL SERVICES DIVISION

LHLTHU.292/HARNETTL

Affiliated Sister Cities
Hakodate, Japan
Round Rock, Texas, USA
Friendship City
Tanagura, Japan

Administrative Centre
126-138 Main Road, Speers Point NSW 2284
Box 1906, Hunter Region Mail Centre NSW 2310
Newcastle Document Exchange DX 7869
Telephone **(049) 21-0333** Facsimile **(049) 58-7257**

Lake Macquarie City Council
Quality Lifestyle

ZH:TK Ext 311
3/56/584/001

12 August 1997

Mr P Jamieson
Umwelt (Australia) P/L
2/20 The Boulevarde
TORONTO NSW 2283

Dear Sir

RE: COORANBONG COLLIERY LIFE EXTENSION - ENVIRONMENTAL IMPACT STATEMENT (EIS).

Further to the Planning Focus meeting held on 6 August 1997 I advise that Council has no additional comment to its letter of 6 June 1997.

That letter identified the issues of subsidence and drainage as the major community concerns in preparation of the EIS.

Yours faithfully

ZENON HELINSKI
PLANNING & DEVELOPMENT DIVISION

TKLTUE.031/CLERKET

Administrative Centre
126-138 Main Road, Speers Point NSW 2284
Box 1906, Hunter Region Mail Centre NSW 2310
Newcastle Document Exchange DX 7869
Telephone **(049) 21-0333** Facsimile **(049) 58-7257**

Lake Macquarie City Council
Quality Lifestyle

ZH:TK Ext 311
3/56/584/001

6 June 1997

Mr P Jamieson
Umwelt (Australia) P/L
2/20 The Boulevarde
TORONTO NSW 2283

Dear Sir

RE: COORANBONG COLLIERY LIFE EXTENSION - ENVIRONMENTAL IMPACT STATEMENT (EIS).

In reply to your letter of 29th May 1997 I advise that Council has received a number of enquiries relating to the proposed development.

They predominantly focussed on subsidence and drainage, consequently it is important to clearly address both of these issues in preparation of the EIS.

In addition Council would expect the heads of consideration in Section 90 of Environmental Planning & Assessment Act to be addressed as well as any matters specifically identified by the Department of Urban Affairs and Planning.

Yours faithfully

ZENON HELINSKI
PLANNING & DEVELOPMENT DIVISION

TKLFRI.090/CLERKET

NSW
NATIONAL
PARKS AND
WILDLIFE
SERVICE

Peter Jamieson
Umwelt (Australia)Pty Ltd
PO Box 838
TORONTO NSW 2283

Our ref: SZT/ME/96/35

Dear Mr Jamieson

Cooranbong Colliery Life Extension Project

Thank you for your letter dated 2nd June 1997 in which you consulted with the National Parks and Wildlife Service on the above proposal.

The Service has a statutory responsibility for the protection and care of native flora, native fauna and Aboriginal sites, and for the management of Service estate. Accordingly the Service has an interest in ensuring that potential impacts to these attributes are appropriately assessed.

To assist you in this regard, it is recommended that the matters referred to in the attached guidelines be addressed in your assessment where appropriate. The attached guidelines also provide information on any approvals that may be relevant under the National Parks and Wildlife Act and a summary of the Service's databases which may be of assistance to you in your assessment.

If you have any questions concerning this matter, please contact Ms Meagan Ewings, Environmental Planning Officer, on (02) 9585 6921.

Yours sincerely,

M. Ewings.

for Ms Lou Ewins
Manager, Environmental Planning Unit
SYDNEY ZONE

Sydney Zone
Level 6
43 Bridge Street
Hurstville NSW 2220
Australia
P.O. Box 1967
Hurstville 2220
Fax: (02) 9585 6442
Tel: (02) 9585 6678

c:\corbonc.doc

GENERAL GUIDELINES FOR IMPACT ASSESSMENT

The National Parks and Wildlife Service (NPWS) has an interest in the potential impacts of the proposal on the following:

- areas of native vegetation,
- areas of potential value as habitat for native fauna,
- sites and places of Aboriginal heritage, and
- land dedicated under the National Parks and Wildlife Act (NPW Act).

If these attributes are anticipated to be present in your study area and / or likely to be impacted, it is recommended that assessments by a suitably qualified person be undertaken to determine the extent of impact. Details of the qualifications and experience of the person undertaking the work should be provided. In addition, a detailed description of survey methodology including survey design, sampling methods, weather conditions, time and duration of surveys and location of survey sites and transect lines should also be provided.

The matters recommended to be addressed in the assessment are as follows:

- description of the proposal and the way in which the environment will be modified;
- map(s) placing the proposal in a regional and local setting;
- applicability of Local Environmental Plans, Regional Environmental Plans and State Planning Policies (including SEPP 44 and SEPP 46)to the proposal should be discussed;
- information on the current and past land uses of the site and that of the surrounding area;
- detailed description and mapping of all vegetation communities in the study area;
- identification of any vegetation communities or plant species which are of local, regional or state conservation significance (including threatened communities, plant species or populations listed under the Threatened Species Conservation Act, 1995). The criteria for establishing significance should be documented;
- description of known or expected fauna assemblages within the study area;
- identification of fauna habitat likely to be of local, regional or state significance (including habitat of threatened fauna species or

In providing this information, the Service will provide advice as to the archaeological potential of the site and whether further surveying is recommended.

If the site does have archaeological potential then it is recommended that a survey be undertaken in consultation with the Local Aboriginal Land Council.

Should Aboriginal archaeological sites be present in the study area, you should consider the requirements of the NP&W Act with regard to Aboriginal relics. Under s90 of the Act it is an offence to knowingly damage or destroy relics without the prior permission of the Director-General of the NPWS.

Databases
The NPWS has two GIS databases which may provide information of use to you if you proceed to undertake further assessment. These are:

- Atlas listing of fauna and flora records in NSW;
- Aboriginal Sites register.

The material from these databases is available upon written application and the receipt of the appropriate fee. If you are interested in obtaining access to the Atlas database, please contact the Data Licensing Officer, GIS Division, on (02) 9585-6684. Records from the Aboriginal Sites register may be obtained upon written application to the Registrar, Cultural Heritage Conservation Division, on (02) 9585-6471.

NSW
NATIONAL
PARKS AND
WILDLIFE
SERVICE

Peter Jamieson
Umwelt Australia, Pty Ltd
PO Box 838
TORONTO NSW 838

Our ref: SZT/ME/96/35

Dear Mr Jamieson

Cooranbong Colliery Life Extension Project, Planning Focus Meeting.

Thankyou for inviting the National Parks and Wildlife Service (NPWS) to the Planning Focus Meeting (PFM) held on the 6th August 1997 at Morisset, to discuss the proposal and the assessment to date. The NPWS offers the following comments in response to the information presented at the PFM and provided in the Planning Focus Report.

The NPWS has statutory responsibilities for the protection and care of native flora, native fauna and aboriginal sites, and for the management of Service estate. Accordingly the NPWS has an interest in ensuring that potential impacts to these attributes are appropriately assessed.

Flora and Fauna

The NPWS understands that Gunninah Environmental Consultants have been contracted to complete the assessment of the proposal on flora and fauna, including threatened species. The NPWS trusts that following issues are addressed as indicated at the PFM taking into consideration the NPWS *General Guidelines for Impact Assessment* provided in previous correspondence:

- impacts on flora and fauna, including threatened species due to the construction activities at the access site,
- impacts on flora and fauna, including threatened species due to the construction of the haul road,
- impacts on the wetlands, associated vegetation and fauna due to subsidence and possible alterations to the water catchment of the area, and
- impacts on remaining vegetation and its habitat value for flora and fauna, including threatened species, due to subsidence.

The NPWS will refrain from commenting on the brief comments and preliminary conclusions presented at the PFM on the information already obtained through survey work, until full documentation is provided to the

Sydney Zone
6th Floor
43 Bridge Street
Hurstville NSW
Australia
PO Box 1967
Hurstville 2220
Fax: (02) 9585 6442
Tel: (02) 9585 6678

NPWS for review when the Environmental Impact Statement (EIS) is exhibited.

Aboriginal Cultural Heritage

The NPWS understands that an Archaeological survey has been conducted and no sites have been identified. The NPWS trusts that this assessment has been completed as per the NPWS guidelines and will be provided for the NPWS to review when the EIS is exhibited.

The NPWS looks forward to commenting on the EIS and if you require any further information, please contact Meagan Ewings, Environmental Planning Officer on (02) 9585 6921.

Yours sincerely,

Lou Ewins 18/8/97

Ms Lou Ewins
Manager, Environmental Planning Unit
SYDNEY ZONE

Roads and Traffic
Authority
New South Wales

RTA

Better Roads. Safer Roads.
Saving Lives.

Zone Planning Section
59 Darby Street
Locked Bag 30
Newcastle NSW 2300
Telephone (049) 24 0331
Facsimile (049) 24 0342
DX 7813 Newcastle

252.5395/97
G Weymer
Tel: (049) 240 337
Fax: (049) 240 342

Mr Paul Duncan
Powercoal Pty Ltd
P O Box 487
MORISSET NSW 2264

POWERCOAL PTY LTD - COORANBONG COLLIERY LIFE EXTENSION PROJECT

Dear Sir

I refer to your letter dated 17 January 1997 regarding a scoping workshop to be held on the evening of 10 February 1997.

I regret that a representative will not be able to attend.

However, as the purpose of the workshop is to identify issues and matters that should be considered at the Environmental Impact Assessment stage, the following is offered for inclusion.

- The impact of the proposed development on the surrounding road network is to be fully investigated, including consideration of projected traffic volumes of accessing traffic against peak flows and background volumes.
- The level of usage of particular roads and routes should be specified, including haulage service and emergency vehicle demand and access.
- The capacity and safety of relevant intersections are to be assessed, and recommendations for their improvement are to be forwarded to this office if they are needed.

I hope this information is of assistance

Yours faithfully

G Weymer
Planner
Hunter Region 7.2.97

rm-s\councils\lakemacq\539597-1

File: 252.5395/97;1
Mr C R Johnstone
Tel: (02) 4924 0332
Fax: (02) 4924 0342

Roads and Traffic Authority
New South Wales

RTA

Better Roads. Safer Roads. Saving Lives.

Hunter Region
59 Darby Street
(Locked Bag 30)
Newcastle NSW 2300
Telephone: (049) 240 240
DX 7813 Newcastle

Umwelt (Australia) Pty Limited
PO Box 838
TORONTO NSW 2283

Attention: Mr Peter Jamieson

F3 FREEWAY - SYDNEY TO NEWCASTLE FREEWAY. CITY OF LAKE MACQUARIE. PROPOSED COORANBONG LIFE EXTENSION PLANNING FOCUS MEETING. COMMENTS

Dear Sir

Following the Planning Focus Meeting for the proposed extension to Cooranbong Colliery held on 6 August 1997 several issues emerge which are of concern to the Roads and Traffic Authority . These are:

1. **Subsidence Impacts on the Freeway**

   The F3 Freeway has been designed and constructed to subsidence design criteria supplied and approved by the Mine Subsidence Board. These should not be exceeded by any subsidence in the vicinity of the Freeway including the impact of the drift under the Freeway.

   The functionality of the Freeway must be maintained. Public Safety must not be placed at risk, and any damage to the road or bridges resulting from the mine operations must be repaired at no cost to the Roads and Traffic Authority .

2. **Traffic Impacts on the Freeway Ramps**

   The impacts of traffic from the proposed new mine access site on the intersections at the Freeway ramps should be addressed particularly in relation to the peak hour operation and changes of shift at the mine. Any ameliorative measures required should be included in the Environmental Impact Statement.

3. **Proposed Mine Site Access to Mandalong Road**

   The proposed intersection on Mandalong Road should ensure the merge, diverge and stopping sight distances are in accordance with those required by current design standards for the expected travel speed on Mandalong Road. It should be noted that the intersection site is on a curve and is reasonably close to the ramps on the western side of the Freeway.

The property information requested in your letter of 4 June 1997 could not be supplied as the properties could not be identified from the information given. If this is still required please supply the relative Lot and Deposited Plan numbers to aid their identification.

Yours faithfully

C W Nunn
Development Manager
Hunter Region
28 August, 1997

NSW FISHERIES

Our Ref: CM(C) JH:JP 3870

Mr Peter Jamieson
Umwelt (Australia) Pty Limited
P O Box 838
TORONTO
N S W 2283

10 September 1997

Dear Mr Jamieson

Cooranbong Colliery Life Extension Project

Thank you for forwarding the planning focus document to NSW Fisheries for comment.

To assist you with the preparation of your EIS for the above proposal, I have attached a copy of our habitat protection plan which lists the issues to be considered and approvals required under the Fisheries Management Act (1994).

For further information, please do not hesitate to contact me on (0249) 80 4907.

Yours sincerely

Dr John Holliday
CONSERVATION MANAGER (CENTRAL)
Enc

CENTRAL REGION
Port Stephens Research Centre - Taylors Beach Road - Taylors Beach NSW 2316 - Australia
Telephone: (049) 82 1232 • **Facsimile:** (049) 82 1107

NSW

FISH HABITAT PROTECTION PLAN 1

MARCH 1995

FISHERIES

fish habitat protection plan
No. 1, March 1995

Introduction

1.1 The Fisheries Management Act 1994 (the Act) was proclaimed, and came into effect, on 16 January 1995.

1.2 The objectives of the Act are to conserve, develop and share the fisheries resources of the State for the benefit of present and future generations, and in particular:

i) to conserve fish stocks and protect key fish habitats;
ii) to promote viable commercial fishing and aquaculture industries;
iii) to provide quality recreational fishing opportunities; and
iv) to promote ecologically sustainable development.

1.3 To assist in the protection of key fish habitats, the Act enables the Minister to make Habitat Protection Plans for the protection of **any habitat of fish**, "whether the habitat is critical for the survival of the species or required to maintain harvestable populations of fish".

1.4 The Act requires the Minister to seek public comment on a Habitat Protection Plan before gazettal. Once gazetted, the Minister and Public Authorities must have regard to any Habitat Protection Plan that is relevant to the exercise of their functions.

1.5 This is the first Habitat Protection Plan to be developed under the Act. It deals broadly with dredging and reclamation activities, fish passage requirements, the protection of mangroves, seagrasses and other marine vegetation, and the importance of snags.

Objectives of this Plan

2.1 The objectives of this Plan are:

i) to provide protection, where necessary, for all fish habitat, and in particular those habitat features which may be affected by the activities subject to this plan;
ii) to restate the relevant requirements of the habitat provisions of the Act in a form which can be readily distributed to and understood by other Government agencies and the community;
iii) to establish a requirement for public authorities who propose to remove snags from waterways to notify the Minister; and
iv) to outline the process for individuals or agencies to follow when consent, notification or consultation is required, and to described how each application will be processed.

Definitions Relating to the Plan

3.1 In this Plan, *Minister* refers to the Minister responsible for the Fisheries Management Act 1994.

3.2 *Waters* and *fish* have the same meanings as they have in the Fisheries Management Act 1994. *Waters* includes all waters within the territorial limits of NSW, including those waters within three nautical miles of the coastline; *fish* means marine, estuarine or freshwater fish (or other aquatic animal life) at any stage of their life history, and includes aquatic molluscs, crustaceans, echinoderms and worms, but excludes mammals, birds, reptiles and amphibians.

FISHCARE

3.3 *Notify* means advise the details of any proposal at least 28 days (or as otherwise mutually agreed) prior to the commencement of any development, works or activities.

Duration of the Plan

4.1 This Plan will be reviewed within five years of the date of gazettal, and at least every five years thereafter.

Habitats to Which this Plan Applies

5.1 This plan applies to all waters to which the Fisheries Management Act 1994 applies. The habitats and habitat features to which this Plan applies are those required for the spawning, nursery, shelter and feeding activities of fish and include:

i) quantity and quality of waters;
ii) mangroves;
iii) seagrasses;
iv) saltmarshes;
v) wetlands;
vi) mudflats;
vii) sand and gravel substrates;
viii) rocky reefs;
ix) reed beds, and other aquatic plants; and
x) snags, including primarily fallen trees and rocks.

5.2 All of these habitats have been shown by scientific research to be important in the life cycles of one or more species of fish. Further information on the importance of these habitats is available in a variety of publications (see reading list).

Activities to which this Plan Applies

6.1 This plan applies to the following developments, works or activities, each of which can impact on fish habitat:

(i) dredging and/or reclamation;
(ii) impeding fish passage;
(iii) damaging marine vegetation; and
(iv) desnagging.

Dredging and Reclamation

6.2 Dredging and reclamation can destroy fish habitat (e.g. seagrasses and mangroves), reduce habitat diversity (e.g. by removing deep holes) and affect water quality.

6.3 Under Sections 200 and 201 of the Act, the Minister's consent is required for dredging or reclamation works carried out by any person or local government authority unless those works are authorised by a relevant public authority or under the Crown Lands Act 1989.

6.4 **If dredging or reclamation works are carried out in contravention of Sections 200 or 201 the Minister may, under Section 203 of the Act, order remedial works to be carried out to rectify any damage caused to fisheries or fish habitats.**

6.5 Under Section 199 of the Act, **the Minister is required to be consulted over any dredging or reclamation works carried out, or proposed to be authorised, by a public authority (other than a local government authority).** This Section also establishes consultation and dispute resolution procedures.

6.6 Under Section 198, the Minister's consent is not required where the dredging or reclamation is for the purpose of mining; or is approved by Public Works and is for the restoration or maintenance of a navigation channel; or is on land vested in the Maritime Services Board and is for the passage or accommodation of seagoing vessels; or is for the removal of accumulated silt from a stormwater channel. All such works can affect fish habitat, however, and should not be carried out without carefully considering ways to minimise their impacts. **In order to facilitate these considerations, Public Authorities are hereby required to notify the Minister of any proposals for dredging or reclamation, whether they propose to undertake the work or merely to authorise it, and whether or not the Minister's consent is required.**

6.7 Where consultation with the Minister or NSW Fisheries is already required for such works under other legislation (as is the case, for example, in the Mining Act 1992, the Petroleum (Onshore) Act 1993 and SEPP35), or where an EIS is prepared and referred to NSW Fisheries, that consultation satisfies the notification requirement specified in Section 6.5 of this Plan.

Impeding Fish Passage

6.8 The construction of weirs, dams, bridges, roads, culverts, causeways and reservoirs has impeded the passage of fish, and has been one of the main causes of declines in populations of estuarine and freshwater fish and species with a migratory phase in their life cycle.

6.9 Under Section 218 of the Act, **the Minister may require any person who constructs, alters or modifies a dam, weir or reservoir to carry out works to enable the passage of fish; the Minister may also require the person responsible to maintain the fish passage facility.**

6.10 **Any public authority that proposes to construct, alter or modify a dam, weir or reservoir on a waterway (or to authorise any such construction, alteration or modification) is required to notify the Minister and, if the Minister so requests, to include a suitable fishway or fish by-pass in those works.**

Damaging Marine Vegetation

6.11 Mangroves and seagrasses are important fish nursery grounds, and sources of food and shelter for many species of fish and other aquatic organisms.

6.12 Under Section 205 of the Act, **the Minister's consent is required for any cutting, removal, damage or destruction of mangroves, seagrasses or any other prescribed marine vegetation (a) on Crown land, or (b) on land vested in a public authority (or trustees for public recreation or for any other public purpose), or (c) on an aquaculture lease, or (d) on the foreshore of any such land or lease.**

Desnagging

6.13 Snags provide essential habitat for some species of fish, offering them shelter and opportunities to feed and spawn. Desnagging operations destroy fish habitat and should not be conducted without carefully considering ways to minimise that impact.

6.14 **In order to facilitate these considerations, public authorities are hereby required to notify the Minister of any proposal to remove or relocate snags, in particular fallen trees or rocks, from any waterway, whether or not they propose to undertake the work or to authorise it under the legislation.**

6.15 Where a snag is causing a hazard to navigation or public safety, and needs to be removed or relocated as a matter of urgency, a Public Authority may do so without complying with the notification period, but must promptly inform the Minister of the work undertaken and the reasons for it.

What to Do

7.1 If you propose to carry out any development, works or activities which may require notice to, or consent by, the Minister then the process you should follow is:

a) Consult with your local NSW Fisheries Office over the proposed activity to determine whether any consent, notification or further consultation is required.

b) If the Minister's consent is required, provide the relevant information on an approved permit application form (these forms are available at NSW Fisheries Offices) and submit it, together with any fee required. Notification or consultation can be effected by a letter to the Minister. The completed form or letter must provide sufficient information to enable the Minister to assess the proposal and to give effect to the objects of the Act and plan. No work should be undertaken prior to notification or consent requirements being met.

Assessment Process

8.1 Any forms received seeking the Minister's consent for a development, work or activity, will be processed as follows;

a) The completed form will first be assessed for completeness. If sufficient information is available, the Minister will respond within 28 days of the application being received. If the information provided is inadequate, the Minister may object to the development, works or activities proceeding until further information is provided.

b) In some cases, site inspections may be needed before a decision can be made. Any inspections necessary to assess an application will be carried out at a time agreed with the applicant and following the payment of any inspection fee required.

c) The Minister may attach conditions to any consent given. These conditions may relate to the term, area, or method of the development, work or activity; to the suspension or cancellation of the consent; or to any works required to restore, or compensate for any loss of, habitat; or to any other matter necessary for the Minister to give effect to the objects of the Act or Plan.

d) The conditions attached may also include a requirement for monitoring. Monitoring requirements may relate to any increase or decrease in fish populations, or seagrasses, or mangroves, or to water quality or any other thing relevant to the consent. Where the required monitoring is not carried out, or where monitoring indicates a significant impact on fish or fish habitat, the Minister may suspend or cancel any consent given, and may require restoration (or compensation) work to be carried out at the applicant's expense.

8.2 Any letters received notifying the Minister of, or consulting the Minister about, any development, work or activity, will be responded to within 28 days if sufficient information is available. If not, additional information may be requested.

8.3 Any application, approval, refusal or notice referred to in this Plan will be entered into a register which will be available for inspection at NSW Fisheries' Head Office, Sydney.

Further Reading

Billyard, R. (1993). Fishcare - our freshwater rivers and streams. Fishnote DF/33, NSW Fisheries, Sydney.

Burchmore, J.J. (1992). Fishcare - protecting fish habitats. Fishnote DF/20, NSW Fisheries, Sydney.

Harris, J.H. (1989). The conservation of threatened fishes and their habitats. Proceedings of a National Conference, Sydney, March 1987. Editors M. Hicks & P. Eiser. Australian Committee for IUCN, Canberra.

Larkum, A.W.D., McComb, A.J. & Shepherd, S.A. (eds) (1989). Biology of Seagrasses. Elsevier Science Publishers, Amsterdam.

Mallen-Cooper, M. (1994). How high can a fish jump? New Scientist. 16 April, pp. 32-37.

McDowall, R.M. (1980). Freshwater Fishes of South-Eastern Australia. Reed, Sydney.

NSW Fisheries (1992). Education kit: Why do we depend on estuaries? NSW Fisheries, Sydney.

NSW Fisheries (1993). Estuarine Habitat Management Guidelines. Edited by J.J. Burchmore, D.A. Pollard, M. J. Middleton & R.J. Williams. NSW Fisheries, Sydney.

NSW Fisheries (1993). Freshwater Habitat Management Guidelines. Edited by J.J. Burchmore. NSW Fisheries, Sydney.

State Pollution Control Commission and Division of Fisheries (undated). A Guide to Mangrove Transplanting.

West, R.J. (1985). Mangroves. Agfact F2.0.1. NSW Agriculture and Fisheries, Sydney.

West, R.J. (1989). Seagrasses. Agfact F2.0.2. NSW Agriculture and Fisheries, Sydney.

This Fish Habitat Protection Plan was released for public comment on 31 January 1995 and Gazetted on 10 March 1995.

Appendix 2

Community Consultation

APPENDIX 2 - COMMUNITY CONSULTATION PROGRAM

Community consultation for the project commenced in May 1995 when a Newsletter providing details of the project was prepared and a briefing session was held with Lake Macquarie City Councillors. Following this, one on one consultation continued as exploration activities developed. In August 1995, Powercoal addressed two representatives of Mandalong Progress Association and in October 1995, Mr Jeff Hunter (local Member of Parliament) and representatives of Mandalong Progress Association met with Powercoal.

On 25 November 1995, 17 residents from the Mandalong area visited Cooranbong Colliery and inspected surface and underground facilities.

In May 1996, Powercoal representatives gave a presentation to Cooranbong Progress Association.

Following this, one on one consultation with community members continued through the exploration program and through base line studies that had commenced as part of the environmental impact assessment program.

In January 1997, a second newsletter outlining current operations and details of exploration and environmental work was mailed out to approximately 200 landholders who live within or adjacent to the proposed mining areas and Mine Access Site.

On 10 February 1997, a Scoping Workshop was held at which a brief overview of the project was provided and community representatives were encouraged to identify matters to be addressed during the environmental assessment program. Matters identified are summarised in **Table 1**.

Table 1 - Matters to be Addressed in the Environmental Impact Assessment Process - Input From Scoping Workshop held on Monday, 10 February 1997

Matters to be Addressed:	Components:
Project Justification	Why new mine vs rationalisation of other resources? Need for coal Solar vs electricity
Eco-Politics of Proposal	Consultant independence Consultant responsibility
Surface water and groundwater	Dams - impacts Flooding Effect on water table Underground effects Spring water effects re: recharge for dams Ability to pump water Wetlands - spring fed
Other development	Subdivision possibility being placed on hold Rural study west of Freeway Powercoal donation to rural study
Land values	Future land use impacts Visual impacts Air quality Land acquisition policy
Visual impacts	Surface Infrastructure site
Soils	Salinity Structure Fertility

Table 1 - Matters to be Addressed in the Environmental Impact Assessment Process - Input From Scoping Workshop held on Monday, 10 February 1997 (cont)

Matters to be Addressed:	Components:
Turf Farm	Surface water retention Soil waterlogging Harvesting machinery Effect on new turf Turf farm needs level, stable ground
Vibration	Blasting impacts on surface integrity for turf
Air quality	Cumulative impact with Freeway
Noise	Amenity impact Service vehicles - Ambulance - Maintenance vehicles Continuous noise
Topography / Whole Valley	Long wall impacts
Property Value	Compensation - Lands Compensation Act Coal Compensation Board - Closing Who's responsibility?
Community Consultation	Lack of information Whole community Southcoast Mail Article - facts? Future input Community Consultation Committee Individual access EIS - Discussion papers as things are addressed Why?
Land value	Lobby for decreased land rates through reducing Valuer-General valuations
Long term impacts	Sustainability of land surface
Flooding	Access roads, bridges Tidal impact Different guidelines in areas of tides? Water quality
Subsidence	Area of influence Duration/timing of subsidence Notification Compensation levels - House Contents At property level Geological - folding - fractures Bushland Clearing Grids for subsidence monitoring Heritage Flora and Fauna Mines Subsidence Board Land improvements only Uniform? - extent Damage to surface structures

Table 1 - Matters to be Addressed in the Environmental Impact Assessment Process - Input From Scoping Workshop held on Monday, 10 February 1997 (cont)

Matters to be Addressed:	Components:
Project Details	Consideration of pillar vs longwall Comparison with Cooranbong No. of jobs Project Controls and ongoing regulation Life of Project Time for stabilisation after mining Potential for increased size of operation over time Hours of operation Wyee resource area - previously too shallow Only longwalling? Traffic flows Mine plans Timing
Farm Access Roads	Maintenance Compensation Monitoring of effects
EIS	Relevance of studies, eg flora/fauna
Mining methods	To minimise surface impacts Control of width of cut Leaving coal
Land acquisition	Management of purchased property Agricultural productivity
Transport	Routes
Social	Impacts
Guidelines	DUAP
Land purchase	Purpose of Powercoal purchasing properties Disclose fully Company's intentions Why are elevated prices being paid by Powercoal? Forward planning - long term 1980 previous proposal What about those left?
Consultants	List of specialists to be used Time scale for reporting Access to specialists
Social impact	Stress / Health of people being impacted Lifestyle impacts Reassurance
Stress	Stakeholder list - Personal negotiation by Powercoal - Agreed price to move out

The names of community representatives who attended the Scoping Workshop are provided in **Table 2.**

Table 2 - Scoping Workshop, 10 February 1997 - Community Representatives

Reginald Jones	Jean Whittaker
Danny Jones	F Bukowski (and two members of Bukowski family)
Lyall Lee	Darryl Ford
Narelle Lee	Phillip Witchard
Noel Ferris	Alison Witchard
Anne Ferris	Noel Woodland
Allan Hanlen	Mrs Deaves
Donna Hanlen	Russell Mclean
Thomas Brown	Marie Kildey
Mr Satchwell	Gwyn Hunkin
Mrs Satchwell	Elizabeth Ruytenberg
Keith Walker	Mr A Mort
Roger Birt	Mike Astle
Alan Heaney	Robbie Economos-Shaw
Margaret Heaney	Kevin Howard
Max Tunbridge	Foveaux Kirby
Robert Armstrong	Michael Chamberlain

On 12 May 1997, a second workshop was held to provide the community with an overview of the project, exploration details and results from environmental assessment work undertaken up to that time. The names of community representatives who attended the Project Description workshop are provided in **Table 3.**

Table 3 - Project Description Workshop, 12 May 1997 - Community Representatives

John Allen	Gwyn Hunkin
Alice Arnett	Julie Hunkin
Beverley Arnett	Paul Hunkin
Lewis Arnett	Linda James
Mick Astles	Trevor James
Jean Brown	Ivor Jones
Tom Brown	Marie Kildey
Joe Bukowski	Foveaux Kirby
Tracey Corkery	Ilkka Kuivisto
Wayne Corkery	Lyall Lee
Ann Ferris	Rus McLean
Noel Ferris	Gabrielle McNeely
Darrell Ford	Megan McNeely
Beverley Frost	Tom McNeely
Neville Frost	Eric Marland
Rohan Hall	Jean Marland
Alan Hanlen	W J Page
Donna Hanlen	Rod Parker
Councillor Hargraves	Michael Pullen (Local Newspaper Reporter)
Alan Heaney	Keith Satchwell
Margaret Heaney	Joan Satchwell
Kevin Howard	Keith Walker
	Jean Whittaker

During the course of the Project Description Workshop, it was requested by the community that landholders' intended future land use be taken into consideration as part of the environmental assessment program. To comply with this request and To assist in identifying land use within MLA 88 and Part A405, a questionnaire was sent out to each of the 184 landholders in the area. A copy of the questionnaire is provided as Attachment A. Responses detailing land use / building information for 127 land parcels from 88 landholders was received. Current land use details obtained from the questionnaire are summarised in **Table 4**.

Table 4 - Current Land Use

Land Use	No of Landholders
Grazing	65
Forestry	10
Cropping	2
Organic Farming	2
Animal Husbandry	2
Turf Farm	1
Nursery	1
Herbs	1
Market Garden	1
Hydroponic Garden	1
Ostrich Farm	1
Dog / Cat Breeders	1

Sixteen landholders indicated that they used spring water or water from spring fed dams.

As part of the questionnaire, landholders were also requested to identify future intentions for their land. Results from the survey in regard to land use and development are listed in **Table 5**.

Table 5 - Proposed Future Changes to Land Use

Future Change	No of Landholders
Improved Grazing	10
Mushroom Farm	2
Forestry	3
Yabbies / Fish Farm	2
Hydroponics	3
Cropping	2
Nursery	2
Herb Garden	2
Market Garden	2
Flowers	2
Poultry	1
Organic Farming	3
Hobby Farming	1
Animal Husbandry	1
Bird Breeding	1
Bonsai	1
Dog / Cat Breeding	1
New Buildings / Building Extensions	16
Future Subdivision	12

ATTACHMENT A

PROPERTY DESCRIPTION (Ref No.)

Property Owner:

Property Address:

1. Land Use (ie. Grazing land, horse stud, forest, intensive animal husbandry, etc).

2. Types and number of buildings (ie. Single storey brick with concrete slab floor, etc).

3. Water supply (ie. Dams, creeks, groundwater).

4. Other

5. Firm future intentions for land.

Appendix 3
Hydrodynamic Modelling

source ?

RMA2 TWO DIMENSIONAL HYDRODYNAMIC MODEL
MANDALONG VALLEY

1.0 Surface Hydrology

No stream gauging or flood recurrence interval information is available for the Stockton Creek drainage system. To explore the surface water regime and potential impacts of proposed mining development, rainfall-runoff characteristics of the Mandalong Valley and the Stockton Creek/Morans Creek drainage system were calculated using XP-RAFTS and landform and rainfall information drawn from the following sources:

- Catchment and sub-catchment boundaries drawn from 0.5 metre contour information drawn from project specific aerial photogrammetry undertaken by AAM Surveys and ground-truthed by C.R. Hutchinson & Co. using GPS equipment.
- Vegetation type and distribution drawn from aerial photography and field surveys.
- Soils information obtained from field surveys undertaken by Umwelt (Australia) Pty Limited specifically for the project.
- Statistical rainfall events derived from Australian Rainfall & Runoff 1987

Rainfall intensity was calculated using the IFD procedure described in Australian Rainfall and Runoff. Indicative rainfall intensities are listed in **Table 1**.

Table 1 – Indicative Rainfall Intensities

Average Recurrence Interval	Rainfall Intensity (mm/hr) for Duration of		
	1 hr	12 hr	72 hr
2 year	32	8.25	2.65
50 year	65	17.45	5.9

Soils in the catchment principally consist of soils from 3 landscape units. Those being:

- Wyong - loam to silty clay loam
- Gorokan - loamy sand to sandy loam
- Watagan - sandy loam to sandy clay loam

Based on these soil types an initial and continuing loss rates for rainfall of 12.5 mm and 1.0 mm/hr respectively were adopted.

Using this information peak discharges for 1 in 1 year ARI, 1 in 10 year ARI and 1 in 100 year ARI storm events were determined for storm durations of 1 hr, 3 hr, 6 hr, 9 hr, 12 hr, 24 hr and 36 hrs were modelled to determine peak discharges from the catchment. This information was then used in a Two Dimensional Hydrodynamic Model to determine water surface profiles for a range of recurrence interval storm events.

2.0 Hydrodynamic Modelling Program

Hydrodynamic modelling for the project was undertaken using 'Finite Element Method for Fluid Flow - RMA-2V Two-dimensional Hydrodynamics in the Horizontal Plane, Version 6.4 June, 1997'.

Hydraulic roughness values used in calibrating the RMA 2 model are listed in **Table 2.**

Table 2 - Mannings Roughness Coefficients 'n'

Vegetation Type	Bed Friction	Side Friction
Pasture & Cultivated Areas	0.035 - 0.045	0.045 - 0.06
Roads & Road Reserves	0.06	0.065
Light Forest	0.065	0.075
Dense Forest	0.085	0.090
Very Dense Forest	0.125	0.145

Network Characteristics

The finite element network used to represent Mandalong Valley was constructed using 0.5 metre contour information and drainage line locations as a background. The finite element network used to describe the system contains a total of 13835 nodes and 4870 elements. Bed elevations for the finite element network were derived from spot height information drawn from a 10 metre by 10 metre grid with extra height information provided for creek channels and banks and road systems.

Stage - Discharge Relationships used in the Model

To model flows under the F3 Freeway, Mandalong Road and Deaves Road, flow characteristics of each of the culverts/openings was modelled using HECRAS for a range of discharges to develop stage-discharge relationships for each structure. Modelled stage-discharge relations for the structures are listed in **Tables 3, 4** and **5** respectively.

Table 3 – Stage-Discharge Relationship for F3 Freeway Bridge over Stockton Creek

Discharge (m^3/s)	Height (mAHD)
10	2.35
30	2.81
50	3.13
83	3.58
218	4.71
250	4.96
352	5.72
400	6.03
500	6.62

Table 4 – Stage-Discharge Relationship for Mandalong Road over Morans Creek

Discharge (m^3/s)	Height (mAHD)
30	5.594
50	5.883
75	6.260
100	6.585
140	7.635
200	7.535
300	7.932

Table 5 – Stage-Discharge Relationship For Deaves Road over Stockton Creek

Discharge (m^3/s)	Height (mAHD)
5	9.29
10	9.55
20	9.97
35	10.48
40	10.63
55	12.30
100	13.17

Using the information presented in **Tables 3** to **5**, equations were derived for stage discharge relationships at each of the structures. These equations were then input into the RMA model for modelling of the surface water regime. Equations used for modelling are listed below:

1) Stockton Creek at Freeway Bridge

Discharge (Q) = 0.230 + 0.8892 * (H - H$_0$)$^{3.4697}$

$$Q = 0.230 + 0.8892 * (H - H_0)^{3.4697}$$

Where H=Water Surface Elevation
H_0 = 0.10 mAHD

2) Morans Creek Culvert at Mandalong Road

$$Q = 0.0216 + 0.01447(H)^{4.5872}$$

Manning's 'n' values used in determining this equation are:

Bed Friction: n = 0.011
Side Friction: n = 0.06

3) Stockton Creek Culvert at Deaves Road

Discharge (Q) = -0.1784 + 4.04E-7 * $(H)^{6.8949}$

Manning's 'n' values used in determining this equation are:

Bed Friction: n = 0.017
Side Friction: n = 0.045

Surface Runoff from the Mandalong Valley and Model Output

A total of 21 hydrographs and uniform element flows for the entire floodplain area were used to represent flow into the Stockton Creek/Morans Creek system. Flood levels from previous flooding events were used to calibrate the Two Dimensional Hydrodynamic Model. Flood level information was drawn from anecdotal evidence from local residents and from information held by Lake Macquarie City Council.

Observed flood levels and predicted water surface levels resulting from a 1 in 100 year Average Recurrence Interval rainfall event are listed in **Table 6**.

Using the RMA 2 model developed for the Stockton Creek/Morans Creek drainage system, peak discharges for 1 in 1, 1 in 10 and 1in 100 year ARI rainfall events were determined for both steady state and dynamic flow situations. Modelling results for these flow scenarios are summarised in **Table 7.**

Table 6 – Water Surface Elevations – Observed and Predicted

Prop Ref. No	Structure	Observed Water Level (mAHD)	Ground Level (mAHD)	Floor Level (mAHD)	Predicted Existing Water Level 1 in 100 year rainfall event (mAHD)	Predicted Subsidence (mm)	Subsided Ground Level (mAHD)	Subsided Floor Level (mAHD)	Predicted Subsided Water Level 1 in 100 year rainfall event (mAHD)
10C	Stables	6.5	6.12	6.43	6.41	37	6.083	6.393	6.35
10A	Residence	5.9	5.8	7.001	6.38	523	5.277	6.478	6.28
9A	Residence	8	7.39	7.75	7.75	1207	6.183	6.543	7.18
94-O	Residence		6.76	10.56	6.38	1069	5.691	9.491	6.35
9E	Residence		9	9.4	7.65	0	9	9.4	6.86
8C	Residence		9.95		8.57	0	9.95		8.34
8A	Residence		11.05	11	9.73	524	10.526	10.476	9.45
8B	Shed		10.2		9.18	56	10.144		9.03
6A	Residence		8.52	9.4	8.39	0	8.52	9.4	8.32
59b	Dairy	9.82	9.35		9.7	717	8.633		9.48
56A	Residence		12.35	13.99	11.75	129	12.221	13.861	11.15
60A	Residence	10.9	10.15	11.27	10.31	329	9.821	10.941	10.04
61A	Residence	11.3	11.55	12.37	11.43	734	10.816	11.636	11.33
62A	Residence		11.49	12.32	11.88	0	11.49	12.32	11.76
58A	Residence		12.51	14.08	13.5	1381	11.129	12.699	13.15
44A	Residence	14.18	13.7	16.29	14.15	2365	11.335	13.925	13.77
47A	Residence	16.31	16.41	18	15.95	104	16.306	17.896	15.75
67A	Residence		16.19	17.15	15.6	82	16.108	17.068	15.15
70A	Residence	17.81	16.98	18.43	17.62	73	16.907	18.357	17.5
82A	Residence	18.1	19.5	21.29	18.2	3	19.497	21.287	17.67
26A	Hostel		19.8	20.21	20.05	899	18.901	19.311	17.7
26B	Residence		19.73	20.21	20.05	770	18.96	19.44	17.7
26C	Office/garage	19.78	19.59	19.88	19.95	1935	17.655	17.945	17.48
27A	Residence		19.5	20.64	17.8	633	18.867	20.007	15.74
57A	Residence		13.2	15.17	14.05	408	12.792	14.762	13.73
41A	Residence		18.3	19.1	15.7	680	17.62	18.42	14.5
51-I	Shed		7	7.75	6.61	130	6.87	7.62	6.53
212	Residence	22.43	22.05	22.96	22.25	962	21.088	21.998	21.35
6-nth	Paddock	7.75	7.7		7.61				7.48
6-sth	Paddock	8.67	8.3		8.72				8.67
7A	Residence		8.3	8.724	9.01	0	8.3	8.724	8.95
43A	Residence		16.45		15.05	2486	13.964		13.96
88A	Residence		22.3		20.9	242	22.058		20.85
61B	Shed		11.55		11.25	0	11.55		11.18
60F	Shed		9.45		9.65	74	9.376		9.51
5A	Residence		9.27		8.05	0	9.27		7.88

Table 7 – Estimated Peak Discharges in Stockton Creek – Downstream of the F3 Freeway

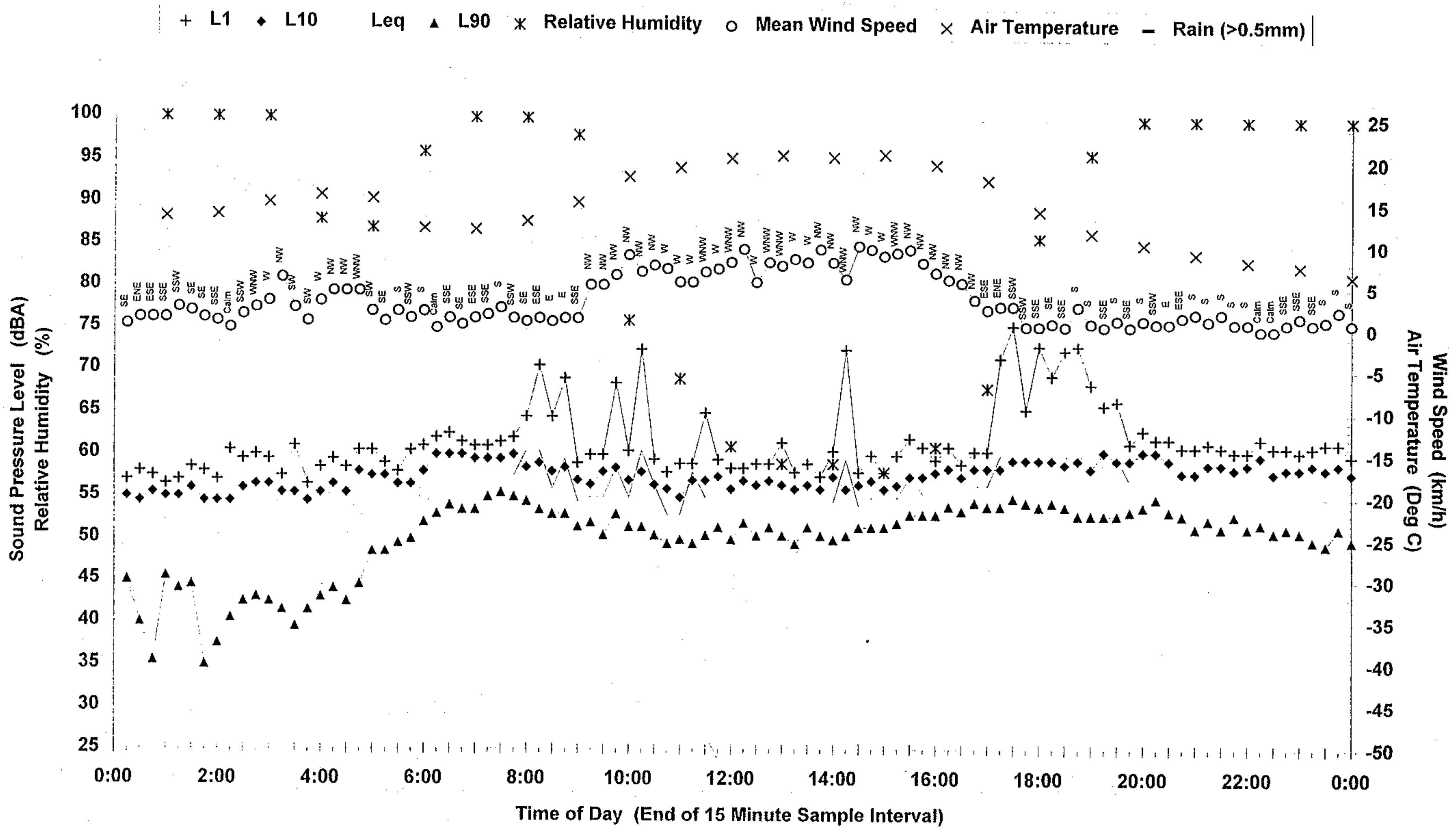
sensitivity test

Flow Situation Modelled	Average Recurrence Interval Rainfall Event	Peak Discharge from Existing Catchment (m^3/s)	Peak Discharge Post Mining (m^3/s)
Steady State Flow	1 in 1 year	125.8	125.3
	1 in 10 year	367.7	373.1
	1 in 100 year	604.9	603.3
Dynamic Flow	1 in 100 year	401.00	395.00

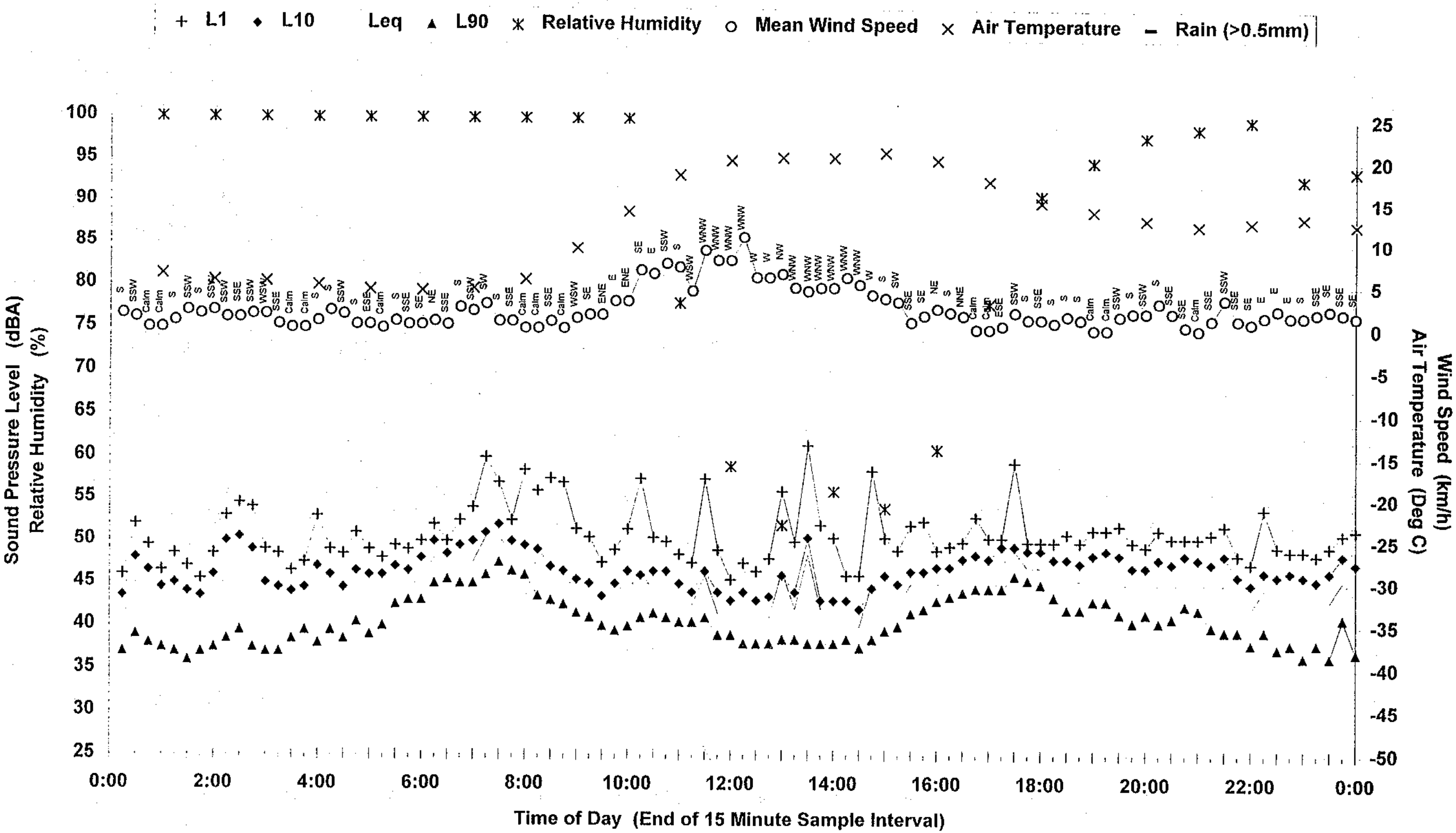
Appendix 4

Typical Sound Pressure Levels

Baseline Ambient Noise Levels and Weather Conditions - Infrastructure Site
Location BG1 McLean, 28 Gimberts Rd Morisset - Thursday 29 May 1997

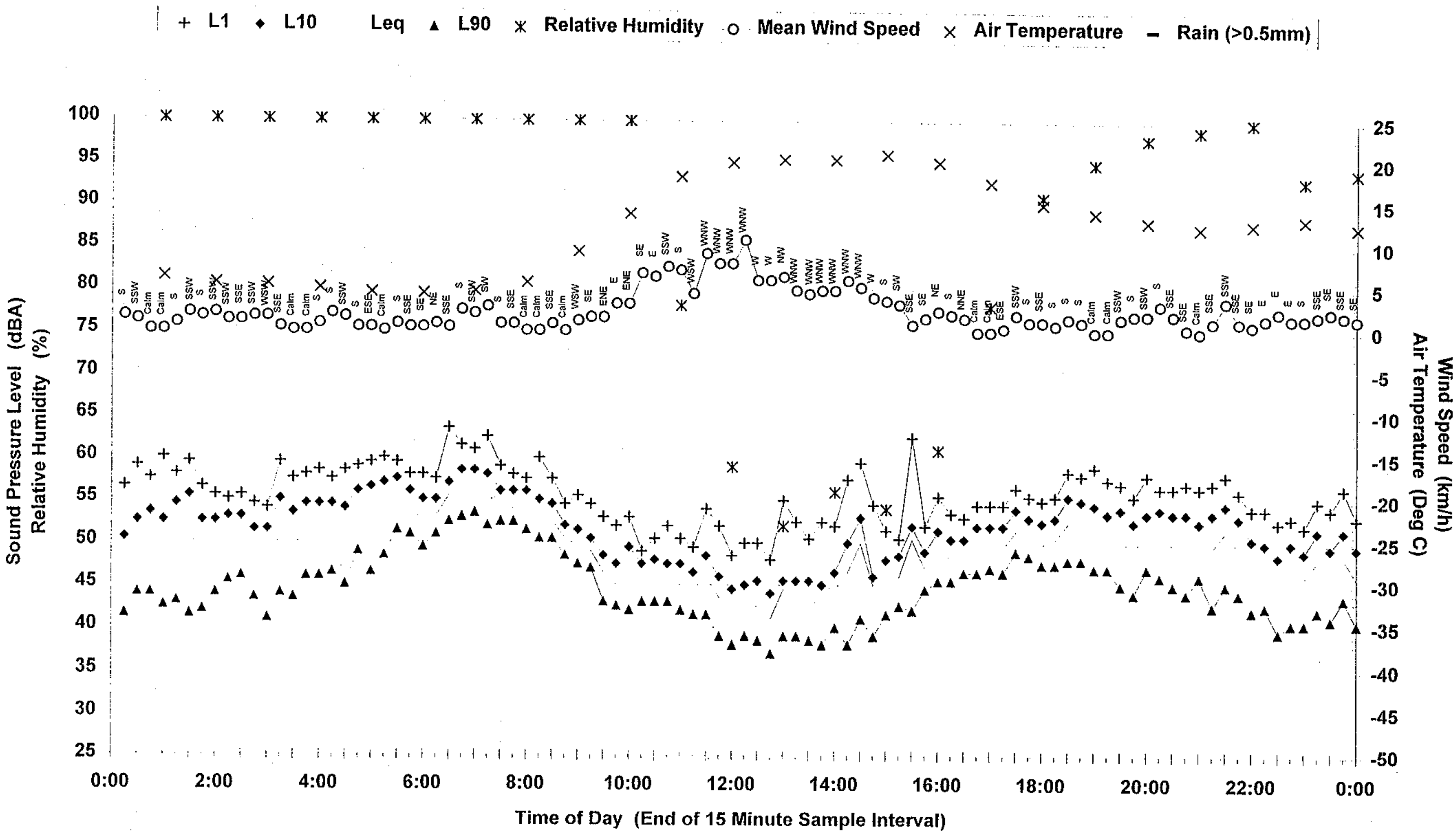


Baseline Ambient Noise Levels and Weather Conditions - Infrastructure Site
Location BG2 Menzies, 12 Crooks Rd Mandalong - Monday 26 May 1997



BG2.xls

Baseline Ambient Noise Levels and Weather Conditions - Infrastructure Site
Location BG3 Ferris, 173 Mandalong Rd Mandalong - Monday 26 May 1997



BG3.xls

Appendix 5

Flora and Fauna

COORANBONG COLLIERY
LIFE EXTENSION PROJECT

POWERCOAL PTY LTD

APPENDIX 5a

Flora Species Recorded on the Subject Sites

Codes

★	Threatened Species (*NSW Threatened Species Conservation Act 1995*) V Vulnerable
✤	Regionally Significant (*ie* at limits of known distribution)
*	Introduced Species
?	Tentative Identification
A	Mine access site
B	Mandalong Valley (including Mining lease application area and Ventilation shaft site)
C	Haul road alignment and waste emplacement site
D	Cooranbong Colliery surface facilities site (including coal preparation and stockpile areas)
E	Cooranbong Colliery management area

Gunninah Environmental Consultants
PO Box 513 Crows Nest NSW 2065
ph: 02 - 9906 5436 fax: 02 - 9906 7770 email: gecon@gunninah.com.au

APPENDIX 5a Flora species recorded during investigations for the Cooranbong Colliery Life Extension Project.

FAMILY NAME	SPECIES NAME	A	B	C	D	E
LYCOPSIDA						
Lycopodiaceae	*Lycopodium deuterodensum*		X			
FILICOPSIDA						
Adiantaceae	*Adiantum aethiopicum*	X	X	X	X	X
	Adiantum formosum		X			
	Adiantum hispidulum	X	X			
	Cheilanthes sieberi	X	X	X	X	X
Aspleniaceae	*Asplenium aethiopicum*		X			
	Asplenium australasicum		X			
Azollaceae	*Azolla filiculoides* var *rubra*		X			
	Azolla pinnata		X			X
Blechnaceae	*Blechnum ambiguum*		X			
	Blechnum cartilagineum	X	X	X	X	X
	**Blechnum indicum*	X	X			
	Blechnum nudum		X	X		
	Doodia aspera	X	X			
	Doodia caudata var *caudata*		X			
Davalliaceae	*Davallia pyxidata*		X			
	**Nephrolepis cordifolia*	X	X			
Dennstaedtiaceae	*Histiopteris incisa*		X			
	Hypolepis muelleri	X	X			
	Pteridium esculentum	X	X	X	X	X
Dicksoniaceae	*Calochlaena dubia*		X			
Dryopteridaceae	*Polystichum australiense*		X			
Gleicheniaceae	*Gleichenia dicarpa*		X	X		X
Lindsaeaceae	*Lindsaea linearis*		X	X	X	X
	Lindsaea microphylla	X	X		X	
Pteridaceae	*Pteris tremula*		X			
Schizaeaceae	*Schizaea bifida*		X			X
Selaginellaceae	*Selaginella uliginosa*		X	X		X
Sinopteridaceae	*Pellaea falcata* var *falcata*		X			
CONIFEROPSIDA						
Cupressaceae	*Callitris rhomboidea*		X			
Pinaceae	**Pinus radiata*				X	

APPENDIX 5a Flora species recorded during investigations for the Cooranbong Colliery Life Extension Project.

FAMILY NAME	SPECIES NAME	A	B	C	D	E
Podocarpaceae	*Podocarpus elatus*		×			
MAGNOLIOPSIDA - MONOCOTYLEDONS						
Anthericaceae	*Arthropodium milleflorum*		×		×	×
	Arthropodium minus		×			
	Laxmannia gracilis		×	×	×	×
	Thysanotus tuberosus		×			
Araceae	*Gymnostachys anceps*	×	×			
Arecaceae	*Archontophoenix cunninghamiana*		×			
	Livistona australis		×			
Asparagaceae	**Myrsiphyllum asparagoides*	×	×		×	×
	**Protasparagus aethiopicus*	×	×			
Asteliaceae	*Cordyline stricta*					
Commelinaceae	*Aneilema acuminatum*	×	×			
	Commelina cyanea	×	×	×	×	×
	Pollia crispata		×			
	**Tradescantia albiflora*	×	×			
Cyperaceae	*Baumea articulata*		×	×		
	Carex appressa	×	×	×	×	×
	Carex inversa		×	×	×	×
	Caustis flexuosa		×			
	Caustis petandra			×	×	×
	Cyathochaeta diandra			×	×	×
	Cyperus difformis	×	×	×		×
	**Cyperus eragrostis*	×	×	×	×	×
	Cyperus polystachyos	×	×	×		×
	Eleocharis acuta		×			
	Eleocharis sphacelata		×	×		×
	Fimbristylis dichotoma		×	×	×	×
	Gahnia aspera			×		×
	Gahnia melanocarpa	×	×	×	×	×
	Gahnia sieberiana		×	×	×	×
	Isolepis inundata		×			
	Isolepis nodosa	×	×			×
	Lepidosperma filiforme		×			
	Lepidosperma flexuosum		×	×	×	×
	Lepidosperma gunnii					×
	Lepidosperma laterale	×	×	×	×	×
	Lepidosperma lineare			×	×	
	Lepidosperma longitudinale		×			×
	Ptilothrix deusta		×	×	×	×
	Schoenoplectus mucronatus		×	×	×	×
	Schoenoplectus validus		×			
	Schoenus apogon					×
	Schoenus brevifolius		×	×		×
	Schoenus paludosus					×
	Schoenus villosus					×
	Scleria mackaviensis					×
	Tetraria capillaris			×	×	×
Haemodoraceae	*Haemodorum corymbosum*			×		×

APPENDIX 5a Flora species recorded during investigations for the Cooranbong Colliery Life Extension Project.

FAMILY NAME	SPECIES NAME	A	B	C	D	E
Hydrocharitaceae	*Ottelia ovalifolia*		X			X
	Vallisneria gigantea			X		X
Hypoxidaceae	*Hypoxis hygrometrica*		X	X	X	X
Iridaceae	**Crocosmia* x *crocosmiifolia*	X	X			
	Patersonia glabrata		X	X	X	X
	Patersonia sericea			X	X	X
Juncaceae	**Juncus cognatus*			X		X
	Juncus continuus		X	X	X	X
	Juncus mollis	X	X	X	X	X
	Juncus planifolius					X
	Juncus polyanthemus		X	X		X
	Juncus prismatocarpus		X	X		
	Juncus subsecundus				X	X
	Juncus usitatus	X	X	X	X	X
Juncaginaceae	*Triglochin procerum*		X	X		X
Liliaceae	✣ *Blandfordia grandiflora*			X		X
	Stypandra glauca		X			X
	Thysanotus tuberosus			X		X
	Thysanotus virgatus					X
Lomandraceae	*Lomandra cylindrica*		X		X	X
	Lomandra filiformis ssp *filiformis*		X	X	X	X
	Lomandra glauca	X	X			
	Lomandra longifolia	X	X	X	X	X
	Lomandra multiflora	X	X	X	X	X
	Lomandra obliqua	X	X	X	X	X
Lemnaceae	*Spirodela pusilla*		X			
Luzuriagaceae	*Eustrephus latifolius*	X	X			
	Geitonoplesium cymosum	X	X			
Marsileaceae	*Marsilea hirsuta*		X			
	Marsilea mutica		X			
Orchidaceae	*Arthrochilus prolixus*					X
	Caladenia catenata		X			X
	Cymbidium suave		X			
	Dipodium punctatum		X			X
	Genoplesium baueri ?					X
	Spiranthes sinensis					X
Phormiaceae	*Dianella caerulea* var *caerulea*	X	X			
	Dianella caerulea var *longifolia*				X	
	Dianella caerulea var *producta*		X	X	X	X
	Dianella longifolia var *longifolia*			X		X
	Dianella revoluta var *revoluta*		X			
Phylidraceae	*Philydrum lanuginosum*		X	X	X	X
Poaceae	*Agrostis avenacea*		X			
	**Andropogon virginicus*		X			
	Aristida calycina					X
	Aristida jerichoensis					X

APPENDIX 5a Flora species recorded during investigations for the Cooranbong Colliery Life Extension Project.

FAMILY NAME	SPECIES NAME	A	B	C	D	E
Poaceae contd	*Aristida ramosa* var *ramosa*	X	X	X	X	X
	Aristida ramosa var *speciosa*					X
	Aristida vagans	X	X	X	X	X
	**Arundo donax*	X				
	**Avena fatua*	X	X	X	X	X
	Bothriochloa decipiens			X		
	Bothriochloa macra		X			
	**Bromus catharticus* var *africanus*	X	X	X	X	X
	**Chloris gayana*	X	X	X	X	X
	**Cortadiera selloana*	X	X		X	
	Cymbopogon refractus	X	X	X		X
	Cynodon dactylon	X	X	X	X	X
	Danthonia monticola					X
	Danthonia pilosa	X	X	X		
	Danthonia tenuior		X	X	X	X
	Dichelachne micrantha		X			
	Digitaria parviflora		X			
	Echinopogon caespitosus var *caespitosus*	X	X	X	X	X
	Echinopogon ovatus			X		X
	Entolasia marginata	X	X	X	X	X
	Entolasia stricta		X	X	X	X
	Eragrostis brownii	X	X	X	X	X
	Eriochloa pseudoacrotricha			X		X
	**Glyceria maxima*	X	X	X	X	X
	Hemarthria uncinata					X
	Imperata cylindrica var *major*	X	X	X	X	X
	**Lolium perenne*				X	X
	**Melinis affinis*	X	X	X		
	Microlaena stipoides var *stipoides*	X	X	X	X	X
	Oplismenus aemulus var *aemulus*	X	X			
	Oplismenus imbecillis	X	X			
	**Paspalum dilatatum*	X	X	X		
	Paspalum distichum		X			
	**Pennisetum clandestinum*	X	X			
	**Phalaris aquatica*	X	X	X		
	Poa affinis		X			X
	Poa labillardieri		X			
	**Setaria pumila*	X	X	X		
	**Sporobolus africanus*				X	X
	**Sporobolus capensis*	X	X			
	**Sporobolus indicus* var *capensis*			X		
	Stipa pubescens		X	X	X	X
	Stipa setacea		X	X		X
	Themeda australis	X	X	X	X	X
Potamogetonaceae	*Potamogeton tricarinatus*		X	X		X
Restionaceae	*Empodisma minus*			X		X
	Hypolaena fastigiata					X
	Leptocarpus tenax			X	X	X
	Lepyrodia gracilis			X		
	Lepyrodia scariosa		X	X	X	X
Smilacaceae	*Smilax australis*		X			
	Smilax glyciphylla	X	X			
Typhaceae	*Typha orientalis*	X	X	X	X	X

APPENDIX 5a Flora species recorded during investigations for the Cooranbong Colliery Life Extension Project.

FAMILY NAME	SPECIES NAME	A	B	C	D	E
Xanthorroeaceae	*Xanthorrhoea fulva*		X			X
	Xanthorrhoea latifolia subsp *latifolia*	X	X	X	X	X
	Xanthorrhoea media subsp *media*		X	X	X	X
	✣ *Xanthorrhoea resinifera*		X			X
Zingiberaceae	*Alpinia arundeliana*		X			
MAGNOLIOPSIDA - DICOTYLEDONS						
Acanthaceae	*Brunoniella australis*	X	X	X	X	X
	Pseuderanthemum variabile	X	X	X		X
Amaranthaceae	*Alternanthera denticulata*	X	X			
Anacardiaceae	*Euroschinus falcata* var *falcata*		X			
Apiaceae	*Actinotus helianthi*		X	X		X
	Actinotus minor		X	X	X	X
	Centella asiatica	X	X	X	X	X
	**Foeniculum vulgare*	X	X			
	**Hydorcotyle bonariensis*	X	X			
	Hydrocotyle peduncularis					X
	Hydrocotyle tripartita				X	X
	Platyscae ericoides			X		X
	Platysace lanceolata		X		X	X
	Platysace linearifolia				X	
	Trachymene incisa ssp *incisa*	X	X	X	X	X
	Xanthosia pilosa		X			
	Xanthosia tridentata	X	X	X	X	X
Apocyanceae	*Parsonsia straminea*	X	X			X
Araliaceae	*Astrotricha latifolia*		X			
	Polyscias sambucifolius			X	X	X
	Polyscias sambucifolius sp A	X	X			
Asclepiadaceae	**Araujia sericiflora*	X	X		X	X
	Leichhardtia leptophylla					X
	Marsdenia rostrata		X			
	Marsdenia suaveolens		X			
	Tylophora barbata		X			
Asteraceae	**Ageratina adenophora*	X	X	X	X	
	**Bidens pilosa*	X	X	X	X	X
	Brachycome angustifolia var angustifolia	X	X	X	X	X
	Cassinia aculeata		X	X		X
	**Cirsium vulgare*	X	X	X	X	X
	**Conyza albida*	X	X			
	**Conyza bonariensis*			X	X	X
	**Conyza canadensis*	X	X	X	X	X
	**Conyza parva*				X	X
	Epaltes australis	X	X	X	X	X
	**Erechtites valerianifolia*		X			
	Gnaphalium gymnocephalum		X			
	Gnaphalium involucratum	X	X			
	Helichrysum apiculatum		X	X		X
	**Hypochaeris radicata*	X	X	X	X	X

APPENDIX 5a Flora species recorded during investigations for the Cooranbong Colliery Life Extension Project.

FAMILY NAME	SPECIES NAME	A	B	C	D	E
Asteraceae contd	**Lactuca serriola*		X			
	Lagenifera stipitata	X	X	X	X	X
	Ozothamnus diosmifolius	X	X	X	X	X
	Pseudognaphalium luteoalbum		X			
	Senecio diaschides	X	X			
	Senecio hispidulus var *dissectus*		X			
	Senecio hispidulus var *hispidulus*	X	X			
	Senecio linearifolius		X			
	**Senecio madagascariensis*	X	X	X	X	X
	**Senecio tamoides*		X			
	**Sigesbeckia orientalis*		X			
	**Sonchus oleraceus*	X	X	X	X	X
	Vernonia cinerea var *cinerea*	X	X			
Atherospermataceae	*Doryphora sassafras*		X			
Bignoniaceae	*Pandorea pandorana*	X	X	X	X	X
Boraginaceae	*Ehretia acuminata* var *acuminata*		X			
Brassicaceae	**Capsella bursa-pastoris*	X	X			
	**Lepidium bonariense*		X			
	**Lobularia maritima*		X			
	**Raphanus raphanistrum*	X	X			
Cactaceae	**Opuntia* sp	X				
Campanulaceae	*Wahlenbergia communis*			X		X
	Wahlenbergia stricta			X		X
Caprifoliaceae	**Lonicera japonica*		X			
Cassythaceae	*Cassytha glabella*	X	X	X	X	X
	Cassytha pubescens	X	X	X	X	X
Casuarinaceae	*Allocasuarina distyla*			X		X
	Allocasuarina littoralis		X	X	X	X
	Allocasuarina torulosa	X	X	X		
	Casuarina glauca	X	X	X	X	X
Celastraceae	*Maytenus silvestris*		X			
Chenopodiaceae	*Atriplex hastata*		X			
	Atriplex semibaccata	X	X			
Convolvulaceae	*Convolvulus erubescens*		X			
	Dichondra repens	X	X	X	X	X
	**Ipomoea indica*	X	X			
	Polymeria calycina	X	X	X	X	X
Cunoniaceae	*Callicoma serratifolia*		X	X		X
	Ceratopetalum apetalum		X			
Dilleniaceae	*Hibbertia aspera*	X	X	X	X	X
	Hibberia dentata			X		
	Hibbertia diffusa	X	X	X	X	X
	Hibbertia linearis		X			
	Hibbertia monogyna				X	X
	Hibbertia obtusifolia	X	X	X		X
	Hibbertia pedunculata		X			
	Hibbertia scandens	X	X	X		X

APPENDIX 5a Flora species recorded during investigations for the Cooranbong Colliery Life Extension Project.

FAMILY NAME	SPECIES NAME	A	B	C	D	E
Droseraceae	*Drosera pygmaea*			×	×	×
Elaeocarpaceae	*Elaeocarpus reticulatus*		×			
	Sloanea australis		×			
Epacridaceae	*Acrotriche divaricata*		×			
	Astroloma humifusum		×	×	×	×
	Brachyloma daphnoides		×	×		×
	Epacris microphylla		×	×		×
	Epacris pulchella	×	×	×	×	×
	Leucopogon attenuatus	×	×	×	×	×
	Leucopogon juniperinus	×	×	×	×	×
	Leucopogon lanceolatus var *lanceolatus*		×			
	Lissanthe strigosa	×	×			×
	Melichrus procumbens			×		×
	Monotoca elliptica			×		×
	Monotoca scoparia		×	×		×
	Trochocarpa laurina		×			
Ehretiaceae	*Ehretia acuminata*		×			
Escalloniaceae	*Abrophyllum ornans*		×			
Euphorbiaceae	*Breynia oblongifolia*	×	×	×		×
	**Euphorbia peplus*	×	×			
	Glochidion ferdinandi var *ferdinandi*	×	×	×	×	×
	Omalanthus nutans		×			
	Phyllanthus gasstroemii	×	×			
	Phyllanthus hirtellus	×	×		×	
	Poranthera ericifolia			×		×
	Poranthera microphylla	×	×	×	×	×
Fabaceae: Caesalpinioideae	**Senna pendula* var *glabrata*	×	×			
Fabaceae: Faboideae	*Aotus ericoides*			×		×
	Bossiaea buxifolia		×			
	Bossiaea ensata		×			
	Bossiaea heterophylla		×	×	×	×
	Bossiaea obcordata	×	×	×	×	×
	Bossiaea rhombifolia subsp *rhombifolia*			×	×	×
	Bossiaea stephensonii					×
	Daviesia acicularis		×	×	×	×
	Daviesia corymbosa		×			
	Daviesia corymbosa/alata hybrid					×
	Daviesia genistifolia			×		×
	Daviesia mimosoides subsp *mimosoides*					×
	Daviesia squarrosa		×		×	
	Daviesia ulicifolia	×	×			
	Desmodium brachypodum	×	×			
	Desmodium varians	×	×			
	Dillwynia floribunda var *floribunda*			×	×	×
	Dillwynia phylicoides sp complex		×	×	×	×
	Dillwynia retorta sp complex		×	×	×	×
	Gompholobium glabratum		×			
	Glycine clandestina	×	×	×	×	×
	Glycine microphylla	×	×	×	×	×
	Glycine tabacina		×			

APPENDIX 5a Flora species recorded during investigations for the Cooranbong Colliery Life Extension Project.

FAMILY NAME	SPECIES NAME	A	B	C	D	E
Fabaceae: Faboideae contd	*Gompholobium glabratum*			×		
	Gompholobium latifolium			×	×	×
	Gompholobium pinnatum			×	×	×
	Hardenbergia violacea	×	×	×	×	×
	Hovea linearis			×	×	×
	Indigofera australis		×			
	Jacksonia scoparia	×	×			
	Kennedia rubicunda	×	×	×	×	×
	Mirbelia rubiifolia	×	×	×	×	×
	Oxylobium aciculiferum		×			
	Oxylobium ilicifolium		×	×	×	×
	Phyllota phylicoides			×	×	×
	Phyllota squarrosa					×
	Pultenaea blakelyi					×
	Pultenaea elliptica	×	×	×	×	×
	Pultenaea hispidula		×	×	×	×
	Pultenaea linophylla		×			
	Pultenaea palacea	×	×	×	×	×
	Pultenaea retusa		×		×	×
	Pultenaea rosmarinifolia			×	×	×
	Pultenaea villosa	×	×	×	×	×
	**Trifolium repens*	×	×	×		
	Vigna vexillata	×	×	×		×
Fabaceae: Mimosoideae	*#Acacia baileyana*				×	
	Acacia brownii			×	×	×
	★(V) *Acacia bynoeana*			×	×	×
	Acacia decurrens	×				
	Acacia elata		×			
	#Acacia falcata	×	×	×	×	×
	Acacia fimbriata		×	×		×
	Acacia floribunda	×	×	×	×	×
	Acacia implexa		×			
	Acacia irrorata subsp *irrorata*	×	×	×	×	×
	Acacia linifolia	×	×			
	Acacia longifolia	×	×	×	×	×
	Acacia maidenii		×			
	Acacia myrtifolia	×	×	×	×	×
	Acacia parramattensis	×	×	×	×	×
	Acacia schinoides	×	×			
	Acacia suaveolens	×	×	×	×	×
	Acacia terminalis	×	×	×	×	×
	Acacia trinervata			×		×
	Acacia ulicifolia	×	×	×	×	×
Flacourtiaceae	*Sclopia braunii*		×			
Gentianaceae	**Centaurium tenuiflorum*	×	×	×	×	×
Geraniaceae	*Erodium crinitum*			×		×
	Geranium homeanum		×			
	Geranium solanderi					×
Goodeniaceae	*Dampiera stricta*		×	×	×	×
	Goodenia glomerata			×		×
	Goodenia hederacea var *hederacea*		×	×	×	×
	Goodenia heterophylla subsp *heterophylla*	×	×	×	×	×

APPENDIX 5a Flora species recorded during investigations for the Cooranbong Colliery Life Extension Project.

FAMILY NAME	SPECIES NAME	A	B	C	D	E
Goodeniaceae contd	*Goodenia ovata*				X	X
	Goodenia paniculata	X	X	X		X
	Scaevola ramosissima			X		X
Grossulariaceae	*Abrophyllum ornans*		X			
Haloragaceae	*Gonocarpus tetragynus*		X			X
	Gonocarpus teucrioides	X	X	X	X	
	Myriophyllum propinquum			X		X
	Myriophyllum variifolium		X			
Hypericaeae	*Hypericum gramineum*	X	X	X	X	X
Lamiaceae	*Ajuga australis*		X			
	Plectranthus parvifolius		X	X		X
	**Prunella vulgaris*	X	X	X		X
	Veronica plebeia			X	X	X
Lauraceae	*Cryptocarya glaucescens*		X			
	Cryptocarya microneura		X			
	Endiandra sieberi		X			
Lentibulariaceae	*Utricularia biloba*			X	X	X
Lobeliaceae	*Lobelia alata*					X
	Pratia pedunculata			X		X
	Pratia purpurascens	X	X		X	X
Loganiaceae	*Logania albiflora*					X
Loranthaceae	*Amyema pendulum* ssp *pendulum*	X	X			X
	Dendrophthoe vitellina	X	X			
	Muellerina eucalyptoides		X			
Malvaceae	*Hibiscus heterophylla*		X			
	**Sida rhombifolia*	X	X	X	X	X
Meliaceae	*Melia azedarach*		X			
	Synoum glandulosum		X			
	Toona ciliata		X			
Menispermaceae	*Legenophora moorei*		X			
	Sarcopetalum harveyanum		X			
	Stephania japonica		X			
Menyanthaceae	*Nymphoides geminata*					X
	Villarsia exaltata					X
Monimiaceae	*Doryphora sassafras*		X			
	Wilkiea huegeliana		X			
Moraceae	*Ficus coronata*		X			
Myrsinaceae	*Rapanea howitteana*		X			
	Rapanea variabilis		X			
Myrtaceae	*Angophora costata*	X	X	X	X	X
	Angophora floribunda	X	X			X
	Acmena smithii		X			

APPENDIX 5a Flora species recorded during investigations for the Cooranbong Colliery Life Extension Project.

FAMILY NAME	SPECIES NAME	A	B	C	D	E
Myrtaceae contd	*Backhousia myrtifolia*		×			
	Baeckea densifolia			×		×
	Baeckea ramosissima			×		×
	Baeckea virgata			×	×	×
	Callistemon linearis			×		×
	Callistemon rigidus	×	×			
	Callistemon salignus	×	×			×
	Choricarpia leptopetala		×			
	Corymbia gummifera		×	×	×	×
	Corymbia maculata	×	×	×		
	#Corymbia maculata/citriodora				×	
	Eucalyptus agglomerata		×			
	Eucalyptus amplifolia ssp *amplifolia*	×	×			×
	Eucalyptus capitellata		×	×	×	×
	Eucalyptus fibrosa					×
	Eucalyptus haemastoma	×	×	×	×	×
	Eucalyptus globoidea	×	×	×		×
	Eucalyptus microcorys		×		×	
	Eucalyptus paniculata ssp *paniculata*		×			
	Eucalyptus pilularis		×			
	Eucalyptus piperita		×	×		×
	Eucalyptus punctata		×			
	Eucalyptus resinfera subsp *resinifera*		×	×		×
	Eucalyptus robusta	×	×			×
	Eucalyptus saligna		×			
	Eucalyptus saligna/grandis intergrade					×
	Eucalyptus sparsifolia		×	×		
	Eucalyptus tereticornis		×			
	Eucalyptus umbra	×	×			
	Kunzea ambigua	×	×	×	×	×
	Kunzea capitata			×		×
	Leptospermum arachnoides	×	×		×	×
	Leptospermum laevigatum	×				×
	Leptospermum liversidgei	×	×			
	Leptospermum polygalifolium subsp *cismontanum*			×		×
	Leptospermum polygalifolium subsp *polygalifolium*	×	×	×	×	×
	Leptospermum trinervium	×	×	×	×	×
	Melaleuca armillaris	×				×
	Melaleuca decora	×	×	×	×	×
	Melaleuca ericifolia					×
	Melaleuca linariifolia	×	×	×	×	×
	Melaleuca nodosa	×	×	×	×	×
	Melaleuca quinquenervia		×			
	Melaleuca sieberi	×	×	×		×
	Melaleuca squarrosa	×	×			
	Melaleuca styphelioides	×	×	×	×	×
	Melaleuca thymelifolia					×
	Rhodamnia rubescens		×			
	Syncarpia glomulifera		×			
	Syzygium oleosum		×			×
	Tristaniopsis laurina		×			
Oleaceae	**Ligustrum lucidum*		×			×
	**Ligustrum sinense*	×	×	×		×
	Notelaea longifolia forma *intermedia*		×	×		×

APPENDIX 5a Flora species recorded during investigations for the Cooranbong Colliery Life Extension Project.

FAMILY NAME	SPECIES NAME	A	B	C	D	E
Oleaceae contd	*Notelaea longifolia* forma *longifolia*		×			
	Notelaea ovata					×
	Notolaea venosa		×			×
	**Olea europaea* ssp *africana*		×			
Onagraceae	*Ludwigia peploides* subsp *montevidensis*		×	×		×
	**Oenothera* sp (*affinis*?)	×	×			
Oxalidaceae	**Oxalis corniculata*	×	×	×	×	×
	**Oxalis perennans*	×	×			
	Oxalis pes-caprae		×			
Papaveraceae	**Argemone ochroleuca* ssp *ochroleuca*	×	×			
Passifloraceae	**Passiflora edulis*	×	×			
	Passiflora herbertiana		×			
Phytolaccaceae	**Phytolacca octandra*	×	×			
Piperaceae	*Piper novae-hollandiae*		×			
Pittosporaceae	*Billardiera scandens* var *sericata*	×	×	×	×	×
	Bursaria spinosa	×	×		×	
	Citriobatus pauciflorus	×	×			
	Pittosporum revolutum		×			
	Pittosporum undulatum	×	×	×		×
Plantaginaceae	**Plantago lanceolata*	×	×	×	×	×
	**Plantago major*	×	×			
Polemoniaceae	**Collomia grandiflora*					×
Polygalaceae	*Comesperma ericinum*	×	×	×	×	×
Polygonaceae	**Acetosa sagittata*	×	×			
	Persicaria decipiens		×	×	×	×
	Persicaria hydropiper					×
	Persicaria lapathifolia		×	×	×	×
	Persicaria strigosa		×			×
	Rumex brownii		×			
	Rumex crispus	×	×			
Primulaceae	**Anagallis arvensis*	×	×	×	×	×
Proteaceae	*Banksia aemula*		×			×
	Banksia ericifolia		×			
	Banksia serrata		×	×		×
	Banksia spinulosa var *collina*	×	×	×	×	×
	Banksia spinulosa var *spinulosa*		×	×	×	×
	Grevillea buxifolia subsp *buxifolia*		×	×		×
	Grevillea linearifolia - Hawkesbury Sandstone form					×
	Grevillea linearifolia - Northern form		×	×	×	×
	Grevillea sericea			×	×	×
	✥ *Hakea bakeriana*				×	
	Hakea dactyloides	×	×	×	×	×
	Hakea gibbosa	×	×	×	×	×
	Hakea pinifolia					×

APPENDIX 5a Flora species recorded during investigations for the Cooranbong Colliery Life Extension Project.

FAMILY NAME	SPECIES NAME	A	B	C	D	E
Proteaceae contd	*Hakea sericea*		×	×	×	×
	Hakea teretifolia			×	×	×
	Isopogon anemonifolius		×	×	×	×
	Isopogon anethifolius				×	
	Lambertia formosa	×	×	×	×	×
	Lomatia silaifolia		×	×	×	×
	Persoonia levis		×	×	×	×
	Persoonia linearis	×	×	×		×
	Persoonia pinifolia					×
	Xylomelum pyriforme		×	×		×
Ranunculaceae	*Clematis aristata*	×	×			
	Clematis gkycinoides		×			
	Ranunculus inundatus	×	×			
	**Ranunculus repens*	×	×			
	Ranunculus sessiflotis					×
Rhamnaceae	*Alphitonia excelsa*		×			
	Pomaderris discolor		×			
	Pomaderris ferruginea	×	×			
	Pomaderris lanigera		×			
Rosaceae	**Rubus fruticosus* species aggregate	×	×	×	×	×
	Rubus hillii		×			
	Rubus parvifolius	×	×			
	Rubus rosifolius		×			
Rubiaceae	*Asperula conferta*			×	×	×
	Galium propinquum		×			
	Morinda jasminoides		×			
	Opercularia diphylla		×	×	×	×
	Opercularia varia	×	×	×	×	×
	Pomax umbellata	×	×	×	×	×
	Psychotria loniceroides		×			
Rutaceae	*Asterolasia correifolia*		×			
	Boronia parviflora					×
	Boronia pinnata		×			
	Eriostemon australasius		×	×		×
	Eriostemon hispidulus					×
	Melicope micrococca		×			
	Phebalium squamulosum subsp *squamulosum*		×	×	×	×
	Sarcomelicope simplicifolia		×			
	Zieria smithii		×			
Sambucaceae	*Sambucus australasicus*	×	×	×	×	×
Santalaceae	*Exocarpos cupressiformis*	×	×	×		×
	Exocarpus strictus					×
Sapindaceae	*Diploglottis australis*		×			
	Dodonaea triquetra	×	×	×	×	×
	Guioa semiglauca		×			
Scrophulariaceae	*Veronica plebeia*	×	×			

APPENDIX 5a Flora species recorded during investigations for the Cooranbong Colliery Life Extension Project.

FAMILY NAME	SPECIES NAME	A	B	C	D	E
Solanaceae	*Lycopersicum* sp				×	
	**Physalis peruviana*		×			
	**Solanum mauritianum*		×			×
	**Solanum nigrum*		×	×		
	Solanum prinophyllum		×			
	**Solanum pseudocapsicum*	×	×	×	×	×
Stackhousiaceae	*Stackhousia nuda*					×
	Stackhousia viminea		×	×		×
Sterculiaceae	*Commersonia fraseri*		×			
Thymeliaceae	*Pimelea linifolia* subsp *linifolia*	×	×	×	×	×
Tremandraceae	★(V)*Tetratheca juncea*			×	×	×
	Tetratheca thymifolia				×	×
Ulmaceae	*Trema australis*		×			
Urticaceae	*Urtica incisa*		×			
Verbenaceae	**Lantana camara*		×		×	×
	**Verbena bonariensis*	×	×	×	×	×
	**Verbena rigida*	×	×	×	×	×
Violaceae	*Hybanthus monopetalus*				×	×
	Viola hederacea		×	×		×
Vitaceae	*Cayratia clematidea*	×	×			
	Cissus antarctica		×			
	Cissus hypoglauca		×			

COORANBONG COLLIERY
LIFE EXTENSION PROJECT

POWERCOAL PTY LTD

APPENDIX 5b

Fauna Species Recorded during investigations in the Mandalong Valley and throughout the Cooranbong Colliery site

Key

★ Threatened Species as listed in the *NSW Threatened Species Conservation Act 1995.*

E Schedule 1 - Endangered species
V Schedule 2 - Vulnerable species

* introduced species

? tentative identification

A Species recorded during investigations in the Mandalong Valley (including the Mine Access and Ventilation Shaft sites).

B Species recorded during investigations on the Coorabong Colliery site (including the Haul Road and Coal Preparation and Stockpile sites).

Gunninah Environmental Consultants
PO Box 513 Crows Nest NSW 2065
ph: 02 - 9906 5436 fax: 02 - 9906 7770 email: gecon@gunninah.com.au

APPENDIX 5b Fauna species recorded during investigations for the Cooranbong Colliery Life Extension Project.

COMMON NAME	SCIENTIFIC NAME	A	B
BIRDS			
Phasianidae			
Brown Quail	*Coturnix ypsilophora*	×	
Anatidae			
Black Swan	*Cygnus atratus*	×	
Australian Wood Duck	*Chenonetta jubata*	×	×
Pacific Black Duck	*Anas superciliosa*	×	×
Chestnut Teal	*Anas castanea*	×	
Podicipedidae			
Australasian Grebe	*Tachybaptus novaehollandiae*	×	
Phalacrocoracidae			
Little Pied Cormorant	*Phalacrocorax melanoleucos*	×	×
Little Black Cormorant	*Phalacrocorax sulcirostris*	×	
Ardeidae			
White-faced Heron	*Egretta novaehollandiae*	×	×
Intermediate Egret	*Ardea intermedia*	×	
Cattle Egret	*Ardeola ibis*	×	
Threskiornithidae			
Australian White Ibis	*Threskiornis molucca*	×	
Straw-necked Ibis	*Threskiornis spinicollis*	×	
Royal Spoonbill	*Platalea regia*	×	
Accipitridae			
Little Eagle	*Hieraaetus morphnoides*		×
Falconidae			
Brown Falcon	*Falco berigora*		×
Rallidae			
Spotless Crake	*Porzana tabuensis*	×	
Purple Swamphen	*Porphyrio porphyrio*	×	
Dusky Moorhen	*Gallinula tenebrosa*	×	
Charadriidae			
Masked Lapwing	*Vanellus miles*	×	×
Columbidae			
White-headed Pigeon	*Columba leucomela*	×	
* Spotted Turtle-Dove	*Streptopelia chinensis*	×	
Peaceful Dove	*Geopelia placida*	×	×
Bar-shouldered Dove	*Geopelia humeralis*	×	
Crested Pigeon	*Ocyphaps lophotes*	×	
Wonga Pigeon	*Leucosarcia melanoleuca*	×	
Cacatuidae			
Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*	×	
★(V) Glossy Black Cockatoo	*Calyptorhynchus lathami*		×
Galah	*Cacatua roseicapilla*	×	
Little Corella	*Cacatua sanguinea*	×	
Sulphur-crested Cockatoo	*Cacatua galerita*	×	
Psittacidae			
Rainbow Lorikeet	*Trichoglossus haematodus*	×	
Little Lorikeet	*Glossopsitta pusilla*		×
Australian King-Parrot	*Alisterus scapularis*	×	
Eastern Rosella	*Platycercus eximius*	×	
Cuculidae			
Brush Cuckoo	*Cuculus variolosus*	×	
Centropdidae			
Pheasant Coucal	*Centropus phasianinus*	×	

APPENDIX 5b Fauna species recorded during investigations for the Cooranbong Colliery Life Extension Project.

COMMON NAME	SCIENTIFIC NAME	A	B
Strigidae			
★(V) Powerful Owl	*Ninox strenua*	×	
Southern Boobook	*Ninox noveseelandiae*	×	
Podargidae			
Tawny Frogmouth	*Podargus strigoides*	×	×
Aegothelidae			
Australian Owlet-nightjar	*Aegotheles cristatus*	×	
Alcedinidae			
Azure Kingfisher	*Alcedo azurea*	×	
Halcyonidae			
Laughing Kookaburra	*Dacelo novaeguineae*	×	×
Sacred Kingfisher	*Todiramphus sancta*	×	
Coraciidae			
Dollarbird	*Eurystomus orientalis*	×	
Menuridae			
Superb Lyrebird	*Menura novaehollandiae*	×	
Climacteridae			
White-throated Treecreeper	*Cormobates leucophaea*	×	×
Maluridae			
Superb Fairy-wren	*Malurus cyaneus*	×	×
Variegated Fairy-wren	*Malurus lamberti*	×	
Southern Emu-wren	*Stipiturus malachurus*	×	
Pardolotidae			
Spotted Pardalote	*Pardalotus punctatus*	×	×
Yellow-throated Scrubwren	*Sericornis citreogularis*	×	
White-browed Scrubwren	*Sericornis frontalis*	×	×
Weebill	*Smicrornis brevirostris*	×	
White-throated Gerygone	*Gerygone olivacea*	×	
Brown Thornbill	*Acanthiza pusilla*	×	×
Buff-rumped Thornbill	*Acanthiza reguloides*	×	
Yellow Thornbill	*Acanthiza nana*	×	×
Meliphagidae			
Little Wattlebird	*Anthochaera chrysoptera*	×	
Noisy Friarbird	*Philemon corniculatus*	×	
Bell Miner	*Manorina melanophrys*	×	
Noisy Miner	*Manorina melanocephala*	×	×
Lewin's Honeyeater	*Meliphaga lewinii*	×	×
Yellow-faced Honeyeater	*Lichenostomus chrysops*	×	×
White-eared Honeyeater	*Lichenostomus leucotis*		×
Brown Honeyeater	*Lichmera indistincta*	×	
New Holland Honeyeater	*Phylidonyris novaehollandiae*		×
White-cheeked Honeyeater	*Phylidonyris nigra*	×	×
Eastern Spinebill	*Acanthorhynchus tenuirostris*	×	×
Petroicidae			
Eastern Yellow Robin	*Eopsaltria australis*	×	×
Jacky Winter	*Microeca leucophaea*	×	
Cinclosomatidae			
Eastern Whipbird	*Psophodes olivaceus*	×	×
Spotted Quail-thrush	*Cinclosoma punctatum*	×	×
Neosittidae			
Varied Sittella	*Daphoenositta chrysoptera*	×	
Pachycephalidae			
Golden Whistler	*Pachycephala pectoralis*	×	×
Rufous Whistler	*Pachycephala rufiventris*	×	
Grey Shrike-thrush	*Colluricincla harmonica*	×	×

APPENDIX 5b Fauna species recorded during investigations for the Cooranbong Colliery Life Extension Project.

COMMON NAME	SCIENTIFIC NAME	A	B
Dicruridae			
Magpie-lark	*Grallina cyanoleuca*	×	
Rufous Fantail	*Rhipidura rufifrons*	×	
Grey Fantail	*Rhipidura fuliginosa*	×	×
Willie Wagtail	*Rhipidura leucophrys*	×	
Campephagidae			
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	×	×
Cicadabird	*Coracina tenuirostris*	×	
Artamidae			
Masked Woodswallow	*Artamus personatus*	×	
Dusky Woodswallow	*Artamus cyanopterus*		×
Grey Butcherbird	*Cracticus torquatus*	×	
Pied Butcherbird	*Cracticus nigrogularis*	×	
Australian Magpie	*Gymnorhina tibicen*	×	×
Pied Currawong	*Strepera graculina*	×	
Corvidae			
Australian Raven	*Corvus coronoides*	×	×
Little Raven	*Corvus mellori*	×	
Corcoracidae			
White-winged Chough	*Corcorax melanorhamphos*	×	
Ptilonorhynchidae			
Satin Bowerbird	*Ptilonorhynchus violaceus*	×	
Passeridae			
* House Sparrow	*Passer domesticus*	×	
Red-browed Finch	*Neochmia temporalis*	×	×
Fringillidae			
* European Goldfinch	*Cardeulis carduelis*		×
Dicaeidae			
Mistletoebird	*Dicaeum hirundinaceum*	×	
Hirundinidae			
Welcome Swallow	*Hirundo neoxena*	×	×
Tree Martin	*Hirundo nigricans*	×	
Zosteropidae			
Silvereye	*Zosterops lateralis*	×	
Sturnidae			
* Common Starling	*Sturnus vulgaris*	×	
* Common Mynah	*Acridotheres tristis*	×	
AMPHIBIANS			
Myobatrachidae			
Common Eastern Froglet	*Crinia signifera*	×	
Eastern Banjo Frog	*Limnodynastes dumerilii*	×	
Brown-striped Frog	*Limnodynastes peronii*	×	
Spotted Grass Frog	*Limnodynastes tasmaniensis*	×	
Great Barred Frog	*Mixophyes fasciolatus*	×	
★(V) Giant Barred Frog	*Mixophyes iteratus*	×	
Brown Toadlet	*Pseudophryne bibronii*	×	
Red-backed Toadlet	*Pseudophryne coriacea*	×	×
Smooth Toadlet	*Uperoleia laevigata*	×	
Hylidae			
Eastern Dwarf Tree Frog	*Litoria fallax*	×	
Freycinet's Frog	*Litoria freycineti*	×	
	Litoria latopalmata		×
	Litoria nasuta	×	
Peron's Tree Frog	*Litoria peronii*	×	
Leaf Green Tree Frog	*Litoria phyllochroa*	×	

APPENDIX 5b Fauna species recorded during investigations for the Cooranbong Colliery Life Extension Project.

COMMON NAME	SCIENTIFIC NAME	A	B
Hylidae cont			
	Litoria tyleri	X	
	Litoria verreauxii	X	
REPTILES			
Chelidae			
Long-necked Tortoise	*Chelodina longicollis*	X	
Gekkonidae			
Southern Leaf-tailed Gecko	*Phyllurus platurus*	X	
Agamidae			
Jacky Lizard	*Amphibolurus muricatus*	X	X
Eastern Water Dragon	*Physignathus lesueurii*	X	
Bearded Dragon	*Pogona barbata*	X	
Varanidae			
Lace Monitor	*Varanus varius*	X	X
Scincidae			
Striped Skink	*Ctenotus robustus*	X	X
She-oak Skink	*Cyclodomorphus casuarinae*		X
Land Mullet	*Egernia major*	X	
White's Skink	*Egernia whitii*	X	
Scincidae			
Barred-sided Skink	*Eulamprus tenuis*	X	
Grass Skink	*Lampropholis delicata*	X	X
Pale-flecked Garden Sunskink	*Lampropholis guichenoti*	X	X
Weasel Skink	*Saproscincus mustelinus*	X	
Elapidae			
Golden Crowned Snake	*Cacophis squamulosus*	X	
Yellow-faced Whip Snake	*Demansia psammophis*	X	X
Black-bellied Swamp Snake	*Hemiaspis signata*	X	
Red-bellied Black Snake	*Pseudechis porphyriacus*	X	X
Eastern Brown Snake	*Pseudonaja textilis*		X
MAMMALS			
Dasyuridae			
Brown Antechinus	*Antechinus stuartii*	X	X
Peramelidae			
Northern Brown Bandicoot	*Isoodon macrourus*	X	
Petauridae			
★(V) Yellow-bellied Glider	*Petaurus australis*	X	
Sugar Glider	*Petaurus breviceps*	X	X
★(V) Squirrel Glider	*Petaurus norfolcensis*	X	X
Pseudocheiridae			
Common Ringtail Possum	*Pseudocheirus peregrinus*	X	X
Acrobatidae			
Feathertail Glider	*Acrobates pygmaeus*		X
Phalangeridae			
Mountain Brushtail Possum	*Trichosurus caninus*	X	
Common Brushtail Possum	*Trichosurus vulpecula*	X	X
Macropodidae			
Eastern Grey Kangaroo	*Macropus giganteus*	X	X
Red-necked Wallaby	*Macropus rufogriseus*	X	X
Swamp Wallaby	*Wallabia bicolor*	X	X
Pteropodidae			
Grey-headed Flying Fox	*Pteropus poliocephalus*	X	

APPENDIX 5b Fauna species recorded during investigations for the Cooranbong Colliery Life Extension Project.

COMMON NAME	SCIENTIFIC NAME	A	B
Rhinolophidae			
Eastern Horseshoe-bat	*Rhinolophus megaphyllus*	×	×
Molossidae			
★(V) Eastern Freetail Bat	*Mormopterus norfolkensis*	×	×
Little Freetail Bat	*Mormopterus* sp.1	×	×?
White-striped Mastiff-bat	*Nyctinomus australis*	×	×
Vespertilionidae			
Gould's Wattled Bat	*Chalinolobus gouldii*	×	×?
Chocolate Wattled Bat	*Chalinolobus morio*	×?	
★(V) Little Bent-wing Bat	*Miniopterus australis*	×	×?
★(V) Large Bent-wing Bat	*Miniopterus shreibersii*	×?	×?
Lesser Long-eared Bat	*Nyctophilus geoffroyi*	×	
Gould's Long-eared Bat	*Nyctophilus gouldi*	×	×
Long-eared Bat	*Nyctophilus* sp	×	
★(V) Greater Broad-nosed Bat	*Scoteanax rueppellii*	×?	
Eastern Broad-nosed Bat	*Scotorepens orion*	×	
Broad-nosed Bat	*Scotorepens* sp	×	
Large Forest Bat	*Vespadelus darlingtoni*	×?	×?
Little Forest Bat	*Vespadelus vulturnus*	×	×
Muridae			
Bush Rat	*Rattus fuscipes*	×	×
Swamp Rat	*Rattus lutreolus*	×	×
Introduced Mammals			
*Fox	*Vulpes vulpes*	×	
*Black Rat	*Rattus rattus*	×	×
*Cow	*Bos taurus*		×

PROPOSED UNDERGROUND COAL MINE, MINE ACCESS SITE and VENTILATION SHAFT

COORANBONG COLLIERY

POWERCOAL Pty Ltd

APPENDIX 5c

Assessment of Significance under Section 5A of the *Environmental Planning & Assessment Act 1979*

Gunninah Environmental Consultants
PO Box 513 Crows Nest NSW 2065
ph: 02 - 9906 5436 fax: 02 - 9906 7770 email: gecon@gunninah.com.au

PROPOSED UNDERGROUND MINE
VENTILATION SHAFT and MINE ACCESS SITE

Assessment of Significance under Section 5A of the EP&A Act

August 1997

1 INTRODUCTION

The NSW *Threatened Species Conservation Act 1995* (TSC Act) has modified the *Environmental Planning & Assessment Act 1979* (EP&A Act) by including (in Section 5A) eight factors which are to be considered when determining "*whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats*". These factors "*must be taken into account*" by a consent or determining authority in administering Sections 77, 90 and 112 of the EP&A Act.

This assessment considers the proposed extension of the existing Cooranbong Colliery underground mining operation by the establishment of a new underground coal mine in the Mandalong Valley, to the west of Morisset, on the Newcastle Coalfields. The proposed mining lease area is generally bordered to the east by the Sydney-Newcastle Freeway (although a small area exists to the east of the Freeway) and to the east and north by privately owned agricultural and forested land. Olney State Forest occurs to the immediate south and west of the subject site. The proposal also involves a mine access site in the eastern portion of the mining lease area (covering approximately 20ha) and a ventilation shaft in grazing land to the north off Crooks Road (Area 2).

This assessment of the significance of impacts on threatened fauna or flora on the proposed mining lease, and mine access and ventilation shaft sites is based on information obtained for this report, data included in previous investigations conducted in the vicinity (Benson 1986; Wellington & Wells 1995; Webster 1995; Hoye 1995; Ecotone 1995; Binns 1996; Gunninah 1997) and database information (from the NP&WS Wildlife Atlas, RAOU Atlas and Birds Australia databases). This assessment is based on the proposed underground mine, mine access infrastructure and ventilation shaft, and on the implementation of the impact amelioration measures which are included in the main Fauna & Flora Assessment Report.

2 FACTORS for CONSIDERATION

(a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

No "*viable local population*" of any threatened plant species was recorded either on the mine access site or on the ventilation shaft site. Given the highly disturbed nature of much of the mine access site, and the cleared and heavily grazed condition of the proposed ventilation shaft site, it is considered unlikely that a "*viable local population*" of any threatened plant species will occur in these areas. It is even more unlikely that any such population will be "*placed at risk of extinction*" by the proposed activities, given that no clearing of native vegetation (other than heavily grazed pasture grasses) will be required for the ventilation shaft, and only limited clearing will be required for the mine access site.

Similarly, no threatened plant species were recorded in the mining lease area, despite numerous records of *Tetratheca juncea* and *Acacia bynoeana* from within 10km of the site (NP&WS Atlas; Payne 1993; McReaddie 1996; Winning 1996; Gunninah 1997), and the presence of suitable habitat for a number of other threatened flora species known from the general locality (Binns 1996; NP&WS Atlas). Most of the threatened plant species known from the general vicinity inhabit forest and woodland communities, and any "*viable local population*" of such species will predominantly occur in the forested foothills and upper slopes of the Mandalong Valley. The potential for surface impacts in these areas is minimal, and if any threatened plants do occur in these areas, they will not be "*placed at risk of extinction*" by the proposed underground mine.

Investigations in the floodplain of the Mandalong Valley did not reveal the presence of a "*viable local population*" of any threatened plant species. Despite the largely cleared and disturbed nature of much of the floodplain area through the centre of the study area (as a result of cattle grazing and other agricultural activities), these areas could provide potential habitat for threatened flora species, particularly where clearing and access by stock has been controlled, and the riparian communities have remained relatively intact.

The potential for adverse surface impacts in the floodplain areas of the Mandalong Valley is substantially greater, with floodplain modelling to date indicating that existing wetlands are likely to alter substantially in both size and location. However, any impact that the proposed subsidence may have on the "*life cycle*" of threatened flora species is regarded as limited in comparison to the long-term and continuing impacts of grazing and other agricultural pursuits in the study area.

Supplementary surveys for threatened plants should be conducted both during the longwall approval stage (when impacts can be more accurately predicted) and throughout the period of mining activities, to enable the implementation of supplementary impact amelioration and recovery plans, if necessary. Management plans to accommodate the needs of threatened plants may be implemented, although it is considered unlikely that "*a viable local population*" of any threatened species "*is likely to be placed at risk of extinction*" as a result of the proposed mining development.

A total of five threatened fauna species were positively recorded during field investigations in the study area, with a further four tentatively identified. Eight of these species were recorded on the proposed mining lease area, with only one species tentatively recorded on the mine access site. The study area supports an array of habitat features suitable for threatened fauna species, such as wetlands, creeklines, grasslands, rainforest, rock outcrops and mature hollow-bearing trees. Given the limited potential for adverse surface impacts in the majority of the study area as a result of the proposed underground mine, these resources are likely to remain intact, and will continue to provide habitat for those threatened species which do currently, or may potentially, occur.

The Powerful Owl *Ninox strenua* was recorded at three locations in Areas 1 and 2 of the underground mining lease area (see main report). This species is known from Olney State Forest, and is considered widespread throughout the Morisset Forestry District, which encompasses the study area (Ecotone 1995). Given its large home range, this wide-ranging species is unlikely to rely solely on the study area, and individuals doubtlessly also use the adjacent State Forests and other forested land in the general locality. Few resources for the Powerful Owl exist in the cleared floodplain areas, and this species is likely to only utilise the forest and woodland portions of the study area. Given that surface impacts will be minimal in these areas, resources for the Powerful Owl (large hollow-bearing trees, arboreal mammals) will remain in the study area. Therefore, "*the life cycle*" of the Powerful Owl is highly unlikely to be "*disrupted*", and this species will not be "*placed at risk of extinction*" by the proposed underground mine, mine access site and ventilation shaft developments.

The Yellow-bellied and Squirrel Gliders were both recorded in the forested portions of the study area. The Squirrel Glider *Petaurus norfolcensis* was recorded in forest near the western boundary of Area 1 (adjacent to Olney State Forest), and a Yellow-bellied Glider *Petaurus australis* colony was recorded in forested foothills in the northern portion of Area 1. Again, given that these species rely on the forested slopes in the study area (which will remain largely unaffected by the proposed underground mine), neither species' "*life cycle*" will be disrupted, such that any "*viable local population*" will be "*placed at risk of extinction*" by the proposed activities. Furthermore, given the large home-range of the Yellow-bellied Glider (approximately 35ha) and the proximity of the Squirrel Glider record to Olney State Forest, both species are unlikely to rely solely on the study area, and are likely to also utilise adjacent resources (*eg* Olney State Forest) which will remain intact.

The Eastern Freetail Bat *Mormopterus norfolkensis*, Large Bent-wing Bat *Miniopterus schreibersii* and Greater Broad-nosed Bat *Scoteanax rueppellii* were all tentatively identified, with the latter the only threatened species recorded on the mine access site. The Little Bent-wing Bat *Miniopterus australis* was also recorded, with one positive and four tentative identifications. The subject site supports a range of resources for microchiropteran bats, including tree-hollows, small caves and house roofs for roosting and nesting, and forest, woodland and wetlands for foraging. Conversely, the mine access and ventilation shaft sites support few such resources, with the former providing only Paperbark forest for foraging, and the latter comprising cleared paddocks. Given the highly mobile and wide-ranging habits of microchiropteran bats, it is unlikely that a "*viable local population*" of any such species relies on the limited resources to be removed as a result of the proposed activities. It is even more unlikely that any such population will be "*placed at risk of extinction*" by the proposed underground mine, mine access facilities and ventilation shaft.

For all of the above threatened fauna species known from the study area, the resources upon which they might rely (primarily forest and woodland with mature trees to provide roosting, nesting and foraging resources), will remain largely unaffected by the proposed underground mine. The mine and ventilation shaft are not expected to cause the loss of mature trees, or require any degree of clearing of native vegetation. Whilst some removal of native vegetation will be required on the mine access site, the development has been designed to avoid as much of the remnant Paperbark forest and woodland as possible, concentrating the proposed disturbance in the already largely cleared central and southeastern portions of the site. This area supports few resources of relevance for threatened fauna species, with the possible exception of foraging habitat for microchiropteran bats. The limited clearing required will not "*place at risk of extinction*" any of the threatened species recorded on the mine access site.

The Giant Barred Frog *Mixophyes iteratus* was recorded at one location on the mining lease area, in a rainforest creekline in the steep northeastern portion of the study area. Whilst a "*viable local population*" appears to exist in the study area, it is unlikely to be "*placed at risk of extinction*" given that these steep forested areas will remain largely unaffected by the proposed activities. This "*viable local population*" is likely to be at greater "*risk of extinction*" from the long-term and continuing impacts of clearing, logging, water quality degradation and other such impacts in the study area than from the proposed underground coal mine.

The Black-necked Stork *Ephippiorhynchus asiaticus* apparently utilises wetland areas on the proposed underground mining lease area (resident's observations). Despite few recent records south of Kempsey, this is a mobile and wide-ranging species, thought to have a large home range (Purcell 1993). It is unlikely that a "*viable local population*" of the Black-necked Stork inhabits the proposed underground mining lease, given that this species was not directly observed during the field investigations and on the basis of its primarily northern distribution.

The potential impacts on the wetlands through the central portion of the study area are considerably greater than in the foothills and upper slopes. Floodplain modelling has indicated that the preferred longwall design will result in some substantial changes to the existing wetlands within the Mandalong Valley, and it appears that the current extent of wetlands across the study area will increase.

Amelioration measures (as discussed in the main report) aim to retain a network of vegetated wetlands across the site and to provide habitat for fauna and flora species which currently, or could potentially, occur. Whilst the surveys in these floodplain areas did not locate a "*viable local population*" of any threatened fauna species, several could potentially occur. Given the implementation of appropriate impact amelioration measures (as described in the main report), no "*viable local population*" of any threatened fauna species occurring in the wetland areas will be "*placed at risk of extinction*" by the proposed underground mine.

A number of additional threatened fauna species have been recorded within 10km of the study area (Wellington & Wells 1995; Webster 1995; Hoye 1995; Ecotone 1995; Gunninah 1997), including birds, mammals, reptiles and amphibians (as discussed in some detail in the main report). Whilst a number of the wide-ranging and highly mobile species could potentially be present in the study area, at least on occasions, some are not expected to occur (including coastal and pelagic species), given the lack of specific habitat requirements. There was no evidence on the site for a "*viable local population*" of any of these additional species, and although some may occur, the habitats which currently exist will be largely retained and will continue to support those species which currently occur.

The likelihood of any species of threatened flora or fauna being "*placed at risk of extinction*" as a result of the proposed underground mine, mine access infrastructure and ventilation shaft is considered slight. Given that direct clearing of native vegetation is restricted to a small area on the mine access site, habitat resources for the "*viable local population*[s]" recorded on the site will be retained. Furthermore, any impact that the proposed subsidence may have on the "*life cycle*" of threatened flora or fauna species is regarded as limited in comparison to the long-term and continuing impacts of grazing and other agricultural pursuits in the study area.

(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

An "*endangered population*" is defined in the TSC Act as "*a population specified in part 2 of Schedule 1*".

At the time of preparation of this report, no relevant "*endangered population*" of any fauna or flora species has been defined. Consequently, it is not possible to assess the potential effects of the proposed underground mining lease, mine access facilities and ventilation shaft on the viability of any such populations.

(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 proposed mining lease area and mine access and ventilation shaft sites do not support "*known habitat*" for any threatened flora species. Given the highly disturbed and cleared nature of the majority of the areas to be disturbed by the proposed activities (*ie* parts of the mine access site, the ventilation shaft site, and the floodplain of the Mandalong Valley), the possibility of threatened plant species occurring in these areas is considered remote. Whilst several threatened plant species are considered likely to occur in the forested foothills and upper slopes of the mining lease area, surface impacts in these areas will be minimal. No habitat for any species occurring in these areas will be "*modified or removed*" as a result of the underground mine.

Habitat for threatened flora species occurring in the floodplain areas of the Mandalong Valley may be "*modified or removed*" as a result of subsidence. However, the current modification and removal of habitat as a result of the ongoing grazing and agricultural activities in these areas is considered a greater threat to any such species which may be present. As discussed above and in the main report, supplementary surveys aimed at locating threatened flora species in the areas to be affected will be conducted at the longwall approval stage of the project. Subsequent monitoring and amelioration during the mining operations will aim to ensure that the modification or removal of "*known habitat*" for any such species is minimised.

The proposed mining lease area and mine access site provide "*known habitat*" for five, and possibly nine, threatened fauna species. The Powerful Owl, Giant Barred Frog, Yellow-bellied and Squirrel Gliders and the Little Bent-wing Bat were all positively identified during investigations on the subject site, with the Eastern Freetail Bat, Large Bent-wing Bat, Greater Broad-nosed Bat and Black-necked Stork tentatively identified or observed by local residents. Given the limited potential for adverse surface impacts from the proposed underground mine, and the limited requirement for clearing on the mine access and ventilation shaft sites, it is considered unlikely that any "*known habitat*" for threatened fauna species will be "*modified or removed*". Whilst there will be some surface impacts in the floodplain of the Valley, there is no "*known habitat*" for any threatened fauna species in these areas.

In terms of "*the regional distribution*" of habitat, the small area which is to be affected by the proposed activities can not be regarded as significant for any of the threatened species which do, or could potentially, occur there. Region is defined in the TSC Act as "*a bioregion defined in a national system of bioregionalisation that is determined (by the Director-General by order published in the Gazette) to be appropriate for those purposes*". The only "*national system of bioregionalisation*" which has been universally adopted by state and federal government authorities is the *Interim Biogeographic Regionalisation for Australia* (IBRA), published by the Australian Nature Conservation Agency (ANCA). This has been identified as the relevant definition of "*region*" for the TSC Act by the NP&WS Director-General (24th May 1996).

On the basis of the IBRA, the subject site is located within the Sydney Basin region, which stretches from approximately Batemans Bay in the south to Port Stephens in the north, and includes essentially the whole of the Hunter Valley, the Sydney Basin and the Blue Mountains.

Any "*known habitat*" which is to be "*modified or removed*" is considered insignificant when compared to the extent of similar forest and woodland, or wetland, habitats in the locality (within 10km) and the substantially greater distribution within the IBRA region. The proposed activities clearly involve only an extremely small proportion of the "*regional distribution of the habitat*" of any threatened fauna or flora species or populations which are, or could potentially be, present.

Consequently, it appears highly unlikely that "*in relation to the regional distribution*" of potential or suitable habitat, "*a significant area of known habitat is to be modified or removed*" for any threatened fauna of flora species by the proposed activities.

(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 mining lease area (including the mine access and ventilation shaft sites) largely comprise a cleared floodplain surrounded by forested foothills and slopes. Olney State Forest surrounds the study area, abutting its western and southern boundaries, and also occurring some 3km to the north. As a result of the extensive clearing and habitat modification which has occurred within the Mandalong Valley itself, this area essentially comprises a barrier to the movement of fauna (except highly mobile species) between forested areas to the north and south.

Given that the proposed underground mine will not involve the direct removal of native vegetation, there is no potential for an "*area of known habitat*" to "*become isolated from currently interconnecting or proximate areas of habitat*" for any species, beyond the isolation which currently exists.

Whilst there is a requirement for some limited clearing on the mine access site, the remnant vegetation on this site is already isolated from "*proximate areas of habitat*" as a result of the adjacent Sydney-Newcastle Freeway (which constitutes a significant barrier to movement for all but the most mobile species) and the surrounding cleared agricultural land. Consequently, the vegetation to be removed is not likely to further isolate "*currently interconnecting or proximate areas of habitat*" beyond that which currently exists at this location.

(e) whether critical habitat will be affected

The TSC Act defines "*critical habitat*" as "*habitat declared to be critical habitat under Part 3*" of the Act.

At the time of preparation of this report, no "*critical habitat*" had been declared by the Director-General of the NSW NP&WS. As a consequence, the issue of whether "*critical habitat will be affected*" by the proposed mining operation is not of relevance.

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

In general, threatened fauna and flora species are not likely to be "*adequately conserved in conservation reserves (or other similar protected areas) in the region*". Furthermore, it is unlikely that there is sufficient data available to indicate the adequacy of representation in conservation reserves of any of the threatened species which may occur on the subject site.

Whilst it is possible that all of the threatened species recorded in the study area occur within National Parks or other conservation reserves in the region (the Sydney region, as defined above), it is generally considered unlikely that any of these species would be "*adequately represented*" in such reserves. A combination of moderate to large home-ranges and wide-ranging habits for some species (*eg* the Powerful Owl and microchiropteran bats), and (in many cases) low abundance, even where relatively widely distributed (*eg* the Squirrel Glider), indicates that conservation reserves are unlikely to support significant populations of these species. Even including State Forests, which constitute a significant and substantial conservation resource in most parts of coastal NSW, and which are of particular relevance to the proposed mining lease area (given their proximity), it is considered unlikely that most of the threatened fauna or flora species which occur in the region would be "*adequately represented in conservation reserves*".

(g) whether the development or activity is of a class of development or activity that is recognised as a threatening process

The TSC Act defines "*threatening process*" as "*a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities*".

Schedule 3 of the TSC Act is intended to provide a list of the threatening processes which are regarded of relevance to the Act and its implementation. However, Schedule 3 has not been completed, and there are currently no "*threatening processes*" listed for NSW. Consequently, it is not possible to consider the relevance of the proposed ventilation shaft in this regard.

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

Of the threatened fauna species recorded or known from the subject site, the Giant Barred Frog, Black-necked Stork and Little Bent-wing Bat appear to be near their southern distributional limits.

The Little Bent-wing Bat is primarily distributed from Cape York in the north to approximately Newcastle in the south. However, it has been recorded from the Hawkesbury region, to the south of the Mandalong Valley study area (NP&WS Wildlife Atlas). Given its high mobility and wide-ranging nature, this species is likely to be using the study area as part of a wider home range, which is likely to include the adjacent State Forests.

The former distribution of the Giant Barred Frog was from the south coast of NSW (near Nowra) to southeastern Queensland (Mahony *et al* 1997). However, there have been few recent records (*ie* within 5 years) of this species south of the Hunter River catchment, and it now appears to mainly occur in the northeast of the state (Mahony *et al* 1997). However, from State Forests records, this species is known from the general locality, including several records in Watagan and Olney State Forests (Wellington & Wells 1996) and from Ourinbah Creek, to the south of the study area (Mahony 1993). The population recorded in the study area is unlikely to be an isolated population, with suitable habitat occurring in the adjacent and surrounding State Forests. Whilst the study area would appear be near this species' southern distributional limits, it is also known to occur nearby, including sites further south. In any case, habitat for this species will remain in the study area, and this population is unlikely to be adversely affected by the proposed activities.

The Black-necked Stork also had a more extensive distribution, occurring from the NSW south coast across to Broome, and was also known from inland areas, despite being primarily coastal in habit (Purcell 1993). Infrequent records of this species south of Kempsey are considered to be outside this species' normal range (Purcell 1993). The record of this species on the site was not confirmed during the field investigations, but even if the Black-necked Stork does occur, wetlands will remain both in the study area and in the locality.

Whilst the study area may provide resources or features of significance with regard to the distributional limits or habitat requirements of threatened fauna or flora species, given the nature of the proposed development (underground mining) and the limited potential for adverse impacts (other than subsidence and some limited clearing on the mine access site), any potential habitat will remain intact in the study area.

The other threatened species identified, or tentatively recorded, in the study area are not at or near their distributional limits, and are generally widely distributed along the east coast of Australia. The Greater Broad-nosed Bat is primarily distributed along the Great Dividing Range from Victoria to Queensland (Hoye & Richards 1995) and the Large Bent-wing Bat is distributed from Cape York to the Mount Lofty Ranges in South Australia (Dwyer 1995). The Powerful Owl occurs on the slopes of the Great Dividing Range from southern Queensland to southern Victoria (Lindsey 1992), the Squirrel Glider occurs from northern Queensland to central Victoria (Suckling 1995), and the Yellow-bellied Glider is distributed from southern Queensland to northern Victoria (Russell 1995). The study area does not provide resources of relevance with regard to the distributional limits of any of these species.

3 CONCLUSIONS

The eight factors which are required to be considered under the EP&A Act in the determination of "*whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats*" as a result of the proposed mining development are discussed in detail above.

On the basis of the deliberations above, it is considered unlikely that the proposed underground mine, mine access infrastructure and ventilation shaft will involve a significant adverse effect upon any threatened species.

No threatened plants were positively recorded in the study area, and it is considered unlikely that the proposed activities will involve a significant adverse impact upon any threatened species, even if any are present. Given the limited requirement for clearing of native vegetation, the limited potential for adverse surface impacts over most of the study area and the extent of similar native vegetation communities in the surrounding area, no threatened plant populations will be placed at risk of extinction as a result of the proposed activities.

Similarly, whilst five (and possibly nine) threatened fauna species occur within the study area, none are likely to be adversely affected by the proposal such that their conservation status in the locality or general region will be adversely affected. In general, habitat and resources for threatened fauna species will remain, and the species which currently utilise the study area are expected to continue to do so.

It is considered that a Species Impact Statement is not required for the proposed underground coal mine, mine access facilities and ventilation shaft in the Mandalong Valley.

PROPOSED SURFACE FACILITIES UPGRADE

COORANBONG COLLIERY

POWERCOAL Pty Ltd

APPENDIX 5d

Assessment of Significance under Section 5A of the *Environmental Planning & Assessment Act 1979*

Gunninah Environmental Consultants
PO Box 513 Crows Nest NSW 2065
ph: 02 - 9906 5436 fax: 02 - 9906 7770 email: gecon@gunninah.com.au

PROPOSED SURFACE FACILITIES UPGRADE

Assessment of Significance under Section 5A of the EP&A Act

August 1997

1 INTRODUCTION

The NSW *Threatened Species Conservation Act 1995* (TSC Act) has modified the *Environmental Planning & Assessment Act 1979* (EP&A Act) by including (in Section 5A) eight factors which are to be considered when determining "*whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats*". These factors "*must be taken into account*" by a consent or determining authority in administering Sections 77, 90 and 112 of the EP&A Act.

Cooranbong Colliery propose to upgrade their existing surface facilities which are located near Cooranbong, to the north of Morisset. This upgrade, along with the proposed new underground mining lease, will extend the life of the Colliery by approximately 20 years. The proposed upgrade involves the construction of a new coal preparation plant and stockpile within, and immediately adjacent to, the existing surface facilities site, and a haul road and coal waste emplacement, on land to the north of the existing colliery infrastructure. The Cooranbong Colliery site is bounded to the east by the Northern Railway, to the north by Crown Land, to the south and west by agricultural land and forest, and is approximately 3km northwest of Lake Macquarie.

The assessment of the significance of impacts on threatened fauna or flora on the proposed coal stockpile and preparation plant, along the haul road alignment and on the waste emplacement area, is based on information obtained for this report, data included in previous investigations conducted in the vicinity (Benson 1986; Wellington & Wells 1995; Webster 1995; Hoye 1995; Ecotone 1995; Binns 1996; Gunninah 1997a, 1997b) and database information (from the NP&WS Wildlife Atlas, RAOU Atlas and Birds Australia databases). The assessment is based on the proposed development of the new colliery infrastructure, which includes implementation of the impact amelioration measures which are included in the main Fauna & Flora Assessment Report (*ie* these measures are part of the development activities).

2 FACTORS for CONSIDERATION

(a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

Flora

Whilst there appears to be a "*viable local population*" of *Tetratheca juncea* on the site for the proposed coal stockpile area, there are no precise guidelines as to what constitutes a 'population' of this species (R Payne *pers comm*). Payne (1993) defines a small population as including "*between 20 and 50 plant clumps*", with a large population containing "*more than 50 clumps*". However, this definition is arbitrary and may not reflect the true situation in all circumstances (R Payne *pers comm*).

Nevertheless, the group of plants that occur within the proposed coal stockpile area are not isolated from other individuals or aggregations of this species, and *T juncea* appears to occur widely throughout the area (see main report for extent). Consequently, the plants within the disturbance area appear to constitute only part of a larger "*viable local population*", and whilst a few individual plants will be removed, the whole population will not be "*placed at risk of extinction*" by the proposed activities.

Whilst *Tetratheca* species are apparently relatively easy to propagate from cuttings (Mount Annan Botanical Gardens, the Australian National Botanic Gardens *pers comm*), trials on the propagation of *Tetratheca juncea* have reportedly been unsuccessful (R Payne *pers comm*; T Tame, Hunter Valley Region Botanic Gardens *pers comm*). However, transplantation of this species has been successfully conducted, and is recommended for those plants within the disturbance area (see main report). On the basis that the plants to be affected constitute only part of a larger "*viable local population*", and given the widespread distribution of *Tetratheca juncea* in the general locality, neither the population within and adjacent to the coal stockpile site nor the species in general will be "*placed at risk of extinction*", particularly if transplantation is conducted.

It is unclear whether the *Acacia bynoeana* plants on the proposed coal preparation plant constitute a "*viable local population*". Only a few individual plants occur, and they are presently subjected to ongoing disturbance as a result of activities associated with the existing management of the coal mine, and from run-off containing high nutrient and pollutant loads. Whilst the plants have clearly been in this locality for some time and have survived high levels of past and current disturbance, they are in a poor state of health, which (from ongoing observations during the current investigations) appears to be declining rapidly. Furthermore, it is considered likely that more individuals existed in the past but have not survived the current regime of disturbance. The remaining habitat of these plants is fragmented, with an abandoned waste emplacement to the southwest and the colliery infrastructure to the east. For these reasons, the viability of the population in the long term is considered poor, at best.

Given the poor health of the plants, and the difficulty in transplantation of this species, their re-location is not recommended. However, propagation from cuttings has been successful (T Tame *pers comm*) and should be conducted to prevent these plants being placed "*at risk of extinction*". Unless propagated, the current levels of disturbance are considered likely to involve the "*extinction*" of this group of *A bynoeana*, regardless of the proposed coal preparation plant.

The proposed development requires that the land which supports the *A bynoeana* plants be cleared for the construction of a coal preparation plant, and involves the propagation of *A bynoeana* from cuttings and re-location in an alternative suitable location. This approach is intended to enable the re-establishment of a "*viable local population*" elsewhere.

Numerous "*viable local population*[s]" of both *Acacia bynoeana* and *Tetratheca juncea* occur along the proposed haul road alignment. Following intensive searches and on-site consultation with surveyors, the haul road has been located along an alignment which largely avoids the existing threatened plant populations, and is generally downslope of any retained populations. However, in some instances, a potential conflict was identified between limiting the general damage to vegetation (eg removal of mature hollow-bearing trees and adverse impacts on drainage line communities) and avoiding *Tetratheca juncea*. Consequently, two haul road route options have been defined (see main report).

The first option, whilst avoiding *T juncea* and *A bynoeana* in most instances, requires substantial earthworks and will require clearing of a significantly larger area of native vegetation (including mature hollow-bearing trees) and other habitat features for native fauna (such as fallen hollow logs). The second option (involving following within, or close to, the existing Hawkmount Road and fire trail alignments) requires no earthworks and substantially less clearing of native vegetation. However, this option does involve the removal of a few individual *T juncea* plants. On the basis that the plants to be affected constitute only part of a larger "*viable local population*", and given the widespread distribution of *Tetratheca juncea* in the general locality, neither the populations along and adjacent to the either haul road option, nor the species in general, will be "*placed at risk of extinction*", particularly if transplantation is conducted.

Whilst the removal of some individuals or small groups of *Tetratheca juncea* and *Acacia bynoeana* may be unavoidable (particularly where they occur at the edge of existing tracks), these individuals generally comprise part of larger "*viable local population*[s]". As a consequence, the removal of a few individuals will not place the remainder of the populations "*at risk of extinction*".

Fauna

The Cooranbong Colliery site and surrounding vegetated lands support four, and possibly five, threatened fauna species. The study area supports an array of habitat features for threatened fauna species, such as creeklines, grasslands, and mature hollow-bearing trees. Given the limited requirement for clearing for the surface facilities development and haul road (particularly if the second option is adopted), and the extent of habitat to remain unaffected, these resources will remain intact to a significant degree, and will continue to provide habitat for the threatened species which do, or may potentially, occur. Furthermore, given the extent of suitable habitat in the general locality, it is not regarded as likely that "*a viable local population*" of any threatened species would be reliant solely or principally upon those areas of woodland, forest or riparian vegetation which are to be disturbed by the proposed activities.

The Squirrel Glider was recorded at two locations in the study area - adjacent to the existing Hawkmount Quarry haul road, and in forest between Hawkmount Road and the Cooranbong Colliery surface facilities site to the south of the powerline easements. Whilst a "*viable local population*" of this species doubtless occurs in the study area, it is entirely unlikely to be "*placed at risk of extinction*" as a result of the limited removal of native vegetation required for the proposed coal stockpile, preparation plant and haul road (particularly if the second option is adopted). No significant resources for this species will be removed as a result of the proposed development.

The Glossy Black Cockatoo was recorded in the vicinity of the proposed coal stockpile area. In addition, the Little and Large Bent-wing Bats (the a latter tentative record only) and the Eastern Freetail Bat were also recorded in several locations across the study area. Given the highly mobile and wide-ranging nature of all of these species, and the extent of potential habitat to remain, both in the study area and general locality, any "*viable local population*[s]" will not be placed "*at risk of extinction*" by the proposed activities. Furthermore, there is no suitable roosting and nesting resources in the disturbance areas for the cave-dwelling bats.

A number of additional threatened fauna species have been recorded within 10km of the study area (Wellington & Wells 1995; Webster 1995; Hoye 1995; Ecotone 1995; Gunninah 1997b), including birds, mammals, reptiles and amphibians (as discussed in some detail in the main report). Whilst a number of the more wide-ranging and highly mobile species could potentially be present in the habitats in the study area, at least on occasion, many are not expected to occur (such as coastal and rainforest-dwelling species) given the lack of specific habitat requirements. There was no evidence in the study area for a "*viable local population*" of any of these additional species, and although some may occur, the habitats which currently exist will be largely retained and will continue to support those species which do occur.

The likelihood of any species of threatened flora or fauna being "*placed at risk of extinction*" as a result of the proposed haul road, waste emplacement, coal preparation plant and coal stockpile activities is considered slight. Given that direct clearing of native vegetation will be minimal, habitat resources for the "*viable local population*[s]" recorded in the study area, and which could potentially occur, will be retained.

(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

An "*endangered population*" is defined in the TSC Act as "*a population specified in part 2 of Schedule 1*".

At the time of preparation of this report, no relevant "*endangered population*" of any fauna or flora species has been defined. Consequently, this issue is not of relevance to the proposed surface facilities upgrade.

(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 coal stockpile and coal preparation plant will require the removal of some limited habitat for threatened flora and fauna species. The second option for the haul road, whilst substantially reducing the requirement for clearing in general, will 'modify' or 'remove' a small area of "*known habitat*" for *Tetratheca juncea*. However, given that the majority of the haul road has been aligned to largely avoid all threatened plant populations, and given the small extent of clearing required and the extent of potential habitat to remain both on the Cooranbong Colliery site and on adjacent lands, the proposed activities will not 'modify' or 'remove' a "*significant area of known habitat*" for any threatened flora or fauna species.

In terms of "*the regional distribution*" of habitat, the small area which is to be affected by the proposed activities can not be regarded as significant for any of the threatened species which do, or could potentially, occur there. Region is defined in the TSC Act as "*a bioregion defined in a national system of bioregionalisation that is determined (by the Director-General by order published in the Gazette) to be appropriate for those purposes*". The only "*national system of bioregionalisation*" which has been universally adopted by state and federal government authorities is the *Interim Biogeographic Regionalisation for Australia* (IBRA), published by the Australian Nature Conservation Agency (ANCA). This has been identified as the relevant definition of "*region*" for the TSC Act by the NP&WS Director-General (24th May 1996).

On the basis of the IBRA, the study area is located within the Sydney Basin region, which stretches from approximately Batemans Bay in the south to Port Stephens in the north, and includes essentially the whole of the Hunter Valley, the Sydney Basin and the Blue Mountains.

With regard to *Tetratheca juncea*, the proposed activities will require the 'modification' or 'removal' of only a small area of "*known habitat*", because of the extent of this species in the locality and the design of the road to avoid populations wherever possible. This species is widespread in the locality, and is (at least locally) abundant. Only isolated individuals will require removal for the haul road, even if the second option is adopted, and a small portion of one population will be removed for the coal stockpile. In both instances, individuals are to be transplanted to appropriate areas to be rehabilitated as part of the project. On this basis, the area of "*known habitat*" for *T juncea* which is to be "*modified or removed*" for the proposed activities is considered inconsequential, particularly in terms of the "*regional distribution of habitat*".

Similar considerations apply to *Acacia bynoeana*. The haul road has been specifically aligned to avoid known populations of this species, thus avoiding "*known habitat*". On the colliery site, one small population (occupying "*known habitat*") is to be removed, although ongoing and long-term adverse impacts has reduced the quality of this habitat, and the viability of this population in the long-term is considered poor. Given the extent of this species in the general locality, and its retention in most areas, the area of "*known habitat*" which "*is to be modified or removed*" for the proposed development is minimal.

No threatened fauna are considered likely to be significantly affected by the proposed activity, and the extent of "*known habitat*" for any threatened fauna species known from the general area which will be "*modified or removed*" is inconsequential, particularly if the second haul road option is adopted. The fauna known from the area are highly mobile, and many are wide-ranging. The extent of habitat removal is minimal, and no species are considered likely to be disturbed by the modification or removal of "*known habitat*", particularly "*in relation to the regional distribution of the habitat*".

Any "*known habitat*" which is to be "*modified or removed*" is considered insignificant when compared to the extent of similar forest and woodland habitat in the locality (within 10km) and the substantially greater area within the IBRA region. The proposed activities clearly involve only an extremely small proportion of the "*regional distribution of the habitat*" of any threatened fauna or flora species or populations which are, or could potentially be, present.

Consequently, it appears highly unlikely that "*in relation to the regional distribution*" of potential or suitable habitat, "*a significant area of known habitat is to be modified or removed*" for any threatened fauna of flora species by the proposed activities.

(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 coal preparation plant site supports "*known habitat*" for one threatened flora species and no threatened fauna species. The coal preparation plant is to be located within the Cooranbong Colliery surface facilities site, which provides limited habitat for threatened fauna, given its disturbed state and condition. Furthermore, the habitat for *A bynoeana* is already "*isolated*" from any other areas of habitat by the abandoned coal stockpile to the immediate southwest and the surrounding existing infrastructure. Consequently, the proposed coal preparation plant will not isolate "*currently interconnecting or proximate areas of habitat*" for any threatened fauna or flora species.

The proposed coal stockpile area is also located within and adjacent to the boundaries of the existing Colliery infrastructure. The portion of the stockpile outside of the existing fenceline supports "*known habitat*" for *T juncea* and potential habitat for a number of threatened fauna species. However, given that potential habitat for threatened species does not surround the site, but only occurs to the west, the removal of this habitat on the site will not result in the isolation of "*currently interconnecting or proximate areas of habitat*".

The existing Cooranbong Colliery infrastructure and the gravel tracks and fire trails which occur throughout the study area, whilst already isolating "*currently interconnecting or proximate areas of habitat*" for less mobile species, do not constitute a barrier to the movements of highly mobile threatened fauna (such as the Glossy Black Cockatoo and microchiropteran bats), which forage widely throughout the surrounding area. The proposed haul road, whilst involving the removal of some habitat or potential resources, will not involve an area of "*known habitat*" becoming "*isolated from currently interconnecting or proximate areas of habitat*" for these mobile species.

Although not as mobile as the above fauna species, the Squirrel Glider can glide for over 50m (Suckling 1995), which is greater than twice the width of the proposed haul road. The existing tracks are not considered likely to currently restrict the movements of this species through the study area, and the proposed new haul road will not isolate "*currently interconnecting or proximate areas of habitat*" for the Squirrel Glider.

Furthermore, the incorporation of fauna movement structures into the project (such as culverts under the haul road), and the retention of large trees adjacent to the haul road (as recommended in the main report) will reduce the potential for the isolation of "*currently interconnecting or proximate areas of habitat*" for any species, beyond that which already exists at this location.

Two threatened flora species were recorded in numerous locations along the proposed haul road alignment. It likely that the construction of the existing gravel tracks and fire trails, and subsequent rubbish dumping, has involved the past and ongoing isolation of "*currently interconnecting or proximate areas of habitat*" for these species to a certain extent. Whilst the haul road has been aligned to avoid as many plants as possible (except where they occur adjacent to the existing tracks), and will largely follow the existing tracks, the second alignment option does clip the edge of a population of *Tetratheca juncea*. The majority of the population will remain intact, with only one or two individual plants becoming "*isolated*". However, the fact that plants have become isolated as a result of past activities (such as the construction of the existing haul road, fire trails and quarry) and have continued to survive suggests that the potential isolation of "*currently interconnecting or proximate areas of habitat*" as a result of the haul road construction will not adversely affect the survival of the remaining population or individual plants.

The proposed surface facilities upgrade, whilst involving the removal of a small area of "*known habitat*" for six, and possibly seven, threatened flora and fauna species, will not involve the isolation of "*currently interconnecting or proximate areas of habitat*". Furthermore, the existing connections between habitat within the study area and habitat in the general vicinity (including Awaba State Forest) will remain unaffected by the proposal.

(e) whether critical habitat will be affected

The TSC Act defines "*critical habitat*" as "*habitat declared to be critical habitat under Part 3*" of the Act.

At the time of preparation of this report, no "*critical habitat*" had been declared by the Director-General of the NSW NP&WS. As a consequence, it is not possible to assess whether "*critical habitat will be affected*" by the proposed development.

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

In general, threatened fauna and flora species are not likely to be "*adequately conserved in conservation reserves (or other similar protected areas) in the region*". Furthermore, it is unlikely that there is sufficient data available to indicate the adequacy of representation of most of the threatened species which may occur in the study area in conservation reserves.

Whilst all of the threatened fauna species recorded in the study area occur within National Parks or other conservation reserves in the region (the Sydney region, as defined above), or are likely to do so, it is generally considered unlikely that any of these species would be "*adequately represented*" in such reserves. Moderate to large home-ranges and wide-ranging habits for some species (*eg* the Powerful Owl and microchiropteran bats), and (in many cases) a relatively sparse abundance, even where relatively widely distributed (*eg* the Squirrel Glider), indicates that conservation reserves are generally unlikely to support significant populations of these species.

Similarly, it is unlikely that the threatened flora species are be "*adequately represented in conservation reserves*" in the Sydney region. *Acacia bynoeana* is conserved in Royal National Park and Blue Mountains National Park, but the actual size of the conserved populations is unknown (Briggs & Leigh 1996). *Tetratheca juncea* is conserved in Glenrock and Munmorah State Recreation Areas and Awabakal Nature Reserve (Briggs & Leigh 1996). Given the presence of *A bynoeana* in the study area, and the widespread occurrence of *T juncea* both in the study area and in adjacent areas, these species appear to be substantially represented on private land.

Even including State Forests, which constitute a significant and substantial conservation resource in most parts of coastal NSW, and which are of particular relevance to the proposed surface facilities upgrade (given their proximity), it is considered unlikely that most of the threatened fauna and flora species which occur in the region would be "*adequately represented in conservation reserves*".

The study area itself may provide a conservation resource for the threatened species recorded, given the extent of existing forest and woodland habitats. The implementation of the proposed Environmental & Bushfire Management Plan on the Cooranbong Colliery site, and the restriction of public access to the gravel roads and fire trails through the study area will increase the conservation value of the remnant vegetation communities and will provide a valuable habitat resources for fauna and flora.

(g) whether the development or activity is of a class of development or activity that is recognised as a threatening process

The TSC Act defines "*threatening process*" as "*a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities*".

Schedule 3 of the TSC Act is intended to provide a list of the threatening processes which are regarded of relevance to the Act and its implementation. However, Schedule 3 has not been completed, and there are currently no "*threatening processes*" listed for NSW. Consequently, it is not possible to consider the relevance of the proposed ventilation shaft in this regard.

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

Of the threatened fauna species recorded during field investigations, only one is near "*the limit of its known distribution*" in the Cooranbong Colliery study area. The Little Bent-wing Bat is primarily distributed from Cape York in the north to approximately Newcastle in the south. However, it has been recorded from the Hawkesbury region, to the south of the Cooranbong study area (NP&WS Wildlife Atlas). On this basis, the study area does not constitute a distributional limit for the Little Bent-wing Bat.

All of the other threatened fauna species recorded, or tentatively identified, in the study area are distributed widely along the east coast of Australia. The Eastern Freetail Bat occurs from southern NSW to southern Queensland (Allison & Hoye 1995), the Large Bent-wing Bat is distributed from Cape York to the Mount Lofty Ranges in South Australia, the Squirrel Glider occurs from northeastern Queensland to central Victoria (Suckling 1995), and the Glossy Black Cockatoo occurs from Rockhampton to southeastern Victoria (Lindsey 1992). Consequently, none of these species is "*at the limit of its known distribution*" in the study area.

With regards to the threatened flora species recorded, *Tetratheca juncea* occurs primarily in coastal districts from Bulahdelah to Lake Macquarie (Harden 1992). Consequently, the study area appears to be near the southern distributional limits of this species. However, in the vicinity of the study area, *Tetratheca juncea* is also known from Munmorah (Payne 19930, approximately 10km to the southeast.

Acacia bynoeana occurs from approximately Port Hacking in the south to Morisset in the north (Harden 1991). The study area appears to be near the northern distributional limits of *A bynoeana*. Whilst the study area may provide resources or features of particular relevance with regard to the distributional limits or habitat requirements of *A bynoeana*, no such resources will be adversely affected by the proposed activities.

3 CONCLUSIONS

The eight factors which are required to be considered under the EP&A Act in the determination of "*whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats*" as a result of the proposed development at Cooranbong are discussed in detail above.

Four species of threatened fauna (the Glossy Black Cockatoo, Squirrel Glider, Eastern Freetail Bat and Little Bent-wing Bat) were positively identified in the study area, with one additional species (the Large Bent-wing Bat) tentatively identified. Two threatened flora species (*Tetratheca juncea* and *Acacia bynoeana*) were also recorded.

Given the limited extent of clearing required for the haul road, preparation plant and coal stockpile, the existing levels of disturbance in many places, and the extent of habitat to remain intact both on the Cooranbong Colliery site and on adjacent lands, and on the basis that the haul road has been aligned to largely avoid threatened plant populations and individuals, the proposed activities are unlikely to constitute a "*significant effect*" on any threatened species.

Furthermore, on the basis that impact amelioration measures are conducted as outlined in the main report and above (particularly the transplantation and/or propagation of the threatened plant species recorded), any potential for adverse impacts to be imposed on these species as a result of the proposal will be minimal. It is likely that the proposed activities will increase the conservation value of the vegetation communities on the Cooranbong Colliery site and adjacent lands, given that public access and associated disturbance are to be restricted.

It is considered highly unlikely that the proposed works associated with the Cooranbong Colliery will impose "*a significant effect on threatened species, populations or ecological communities or their habitats*". There is no requirement for the preparation of a Species Impact Statement for the proposed surface facilities upgrade at Cooranbong Colliery.

Appendix 6

Land Access, Management and Compensation Policy

Cooranbong Colliery Life Extension Project

Land Access, Management and Compensation Policy

Contents

Purpose of this Policy

Cooranbong Colliery has been operating an underground mine in the Morisset area for over 15 years. By 2001 the current underground resource will be mined out.

To maintain jobs and production at the colliery for a further 20 years, the company is proposing to extend its underground mining operations to new coal resources in the Mandalong Valley area.

This policy has been developed as a guide to the application of the current law and best practice with respect to land management and rehabilitation, and effective liaison with landholders within the Mine Lease area.

1. Overview

Cooranbong Colliery is at present advancing a proposal for the extension of its underground mining operations within the coal resources underlying Mandalong Valley. Access to these new coal resources will avoid mine closure in 2002 by extending the life of the colliery by a further 20 years.

A detailed and extensive environmental impact assessment and community consultative program is currently underway.

As the development will involve some subsidence of the mining lease area above where mining occurs, an essential part of the approval for the development is the provision of mechanisms to restore or make-good certain adverse effects of mining on properties.

This policy provides the basis for those mechanisms to be implemented.

2. The policy objectives

The objectives of this policy are:

a) To guide in the application of the current law and best practice with respect to land management and rehabilitation, and liaison with landholders within the Mine Lease area;

b) To work effectively with the community to secure community acceptance and Government approval for ongoing mining and land management within the Mine Lease area; and

c) To minimise investment risk.

3. The stakeholders

This policy is directed at the following stakeholder set:

a) The owners of land and/or residents within the Mining Area

b) Government officials, including officers of the Department of Land and Water Conservation, the Environment Protection Authority, the Department of Mineral Resources, the Mine Subsidence Board, the National Parks & Wildlife Service, State Forests of NSW, and NSW Agriculture.

c) The Minister for Mineral Resources and local Members of Parliament

d) Lake Macquarie City Council

4. Corporate philosophy and operational principles

4.1 Powercoal's corporate philosophy

Cooranbong Colliery is part of the Powercoal group of mines.

Powercoal's corporate philosophy and vision are anchored in the belief that its operations contribute to quality living. In that context, Powercoal's vision is to:

- Supply coal products to its customers' total satisfaction.
- Develop proud teams of people, technology and support innovation.
- Have a positive impact on the environment, and
- Continually improve the value of its business

<u>4.1.1 The community</u>

Powercoal believes that its mines are an integral part of the community through the employees and their families. As such, the community requires it to be a good corporate citizen, and to enhance the quality of life through economic growth and care of the environment.

<u>4.1.2 Environmental Policy</u>

Powercoal is committed to the principles of sound environmental management and the concept of sustainable development, and will undertake all of its operations to optimise environmental, economic and social benefits to the community as a whole, in both present and future generations.

The company has committed to achieve this by:

- Incorporating measures for the protection of the environment into mining operations and projects from the earliest planning stage.
- Preparing an Environmental Management Plan for each mine site which incorporates details of environmental controls and systems in place, ensures, as a minimum, compliance with all environmental laws, and which sets goals for continuous improvement of standards.
- Undertaking routine monitoring of the impact of operations on the environment and auditing processes and practices.
- Ensuring that any land affected by mining is rehabilitated to a condition appropriate to its subsequent use.

- Ensuring that all employees and contractors are aware of Powercoal's Policy and of their responsibilities, and receive the training necessary to achieve Powercoal's objectives.
- Acting as a responsible corporate citizen working in cooperation with its community and government agencies.

The Company is committed to accomplishing its objective by operating its facilities in an efficient and environmentally sensitive manner.

4.2 Past record of Cooranbong Colliery operations

Cooranbong Colliery has established a strong reputation for communication with the community during its past 16 years of successful underground operations at the mine. This has resulted in an excellent performance record and level of harmony between its underground operations and the interests of surface property-holders in the current mining area.

To continue this record, and with the aim of developing a mechanism for responding to any effects of future underground mining on properties in the new mining lease area, Cooranbong Colliery will have regard to a series of operational principles, which are set out in the following sections.

4.3 Operational principles

4.3.1 Principle 1: Respect for individual property rights

Cooranbong Colliery acknowledges that some of its operations may generate a degree of uncertainty and/or anxiety in the community. Such reactions are understandable in areas where underground mining has not been a feature of past land use, or where landholders are engaged in land uses which they may feel are incompatible with underground mining.

Accordingly, Cooranbong Colliery will seek to provide information to landholders about its operations and/or future indicative mine plans at the earliest possible time in the planning cycle.

In this way, as well as recognising the need to address broad *community* issues, Cooranbong Colliery will respect the property rights of *individual* landholders in the area affected by its colliery holdings and exploration areas.

As far as is practicable, to ensure the best level of communication, information provided to individual landholders will be framed in a form which will be understandable to people who are perhaps not familiar with mining terminology. The information will be directed *personally* to individual landholders to ensure specific concerns or issues can be raised and addressed.

4.3.2 Principle 2: Acknowledgment of obligations to landholders

In respecting the individual property rights of landholders, Cooranbong Colliery acknowledges its statutory responsibilities as a coal producer, and undertakes to fulfil those responsibilities.

In this regard, Cooranbong Colliery recognises at least four levels of rights and obligations for dealing with the surface effects of underground mining. These are:

a) the obligations of Cooranbong Colliery and the rights of landholders under the Mining Act 1992, with respect to agreements for land access for surface works,

b) the rights of landholders for restoration by the Mine Subsidence Board (MSB) of damage caused to improvements to properties,

c) the obligations arising from *contractual undertakings* between Cooranbong Colliery and individual land-holders in the mining lease area, and

d) the obligations of Cooranbong Colliery to comply with the statutory requirements of the Department of Mineral Resources, conditions which may attach to the development consent or mine lease, and any statutory licences or authorities for the project.

4.3.3 Principle 3: Recognition of Mine Subsidence Board obligations

The declaration of the Mine Subsidence District by the NSW Government provides for checks on future land use in the mining lease area. For existing uses, the MSB administers a mechanism for restoration and/or compensation for damage caused by mining on improvements of landholders.

Cooranbong Colliery will assist this process through the provision of relevant information from its pre-mining surveys of properties and/or landforms in collaboration with the MSB, and through the promulgation to landholders of relevant information about the activities and responsibilities of the MSB[1].

4.3.4 Principle 4: Recognition of the need for firm contractual mechanisms

Cooranbong Colliery recognises that it may need to enter into agreements with relevant landholders with respect to specific, identifiable effects of mining on certain land. Such agreements may include options for sale/purchase of land.

---

[1] The Mine Subsidence Board is a statutory authority established to protect the community's property and to compensate for damage to structures caused by the effects of underground mining. The Mine Subsidence Board office in the Lake Macquarie area is at 143 Main Road, Speers Point (Phone 02-4950-8088).

These agreements will be initiated by Cooranbong Colliery on a case-by-case basis, and will be subject to commercial confidentiality.

Such agreements will cater for effects outside the ambit of the Mine Subsidence Compensation Act 1961.

Cooranbong Colliery will recognise three levels of restoration or restitution for adverse surface effects of underground mining. These may involve, separately or in combination:

- Company-funded and organised surface earthworks for correction to disturbance effects,
- contribution by Cooranbong Colliery towards partial or full restoration where such restoration is not covered by Mine Subsidence Board obligations, and
- subject to agreement with the landholder, outright purchase by Mandalong Pastoral Management of properties affected or predicted to be affected by underground mining, at terms based on market value, negotiated confidentially between buyer and seller.

4.3.5 Principle 5: Compliance with statutory and other licence conditions

The development consent and associated operational licences obtained by Cooranbong Colliery following the approval process will prescribe obligations to minimise any adverse effects of the mining operation on the mining lease area and Mandalong Valley residents.

Cooranbong Colliery undertakes to comply fully with all consent and licence conditions which are associated with the development approval.

4.3.6 Principle 6: Commitment to ongoing community consultation

Cooranbong Colliery will maintain, during the life of the mine, an effective community consultation program.

This will include at least the following elements:

- provision of an ongoing forum - with an independent chairperson - for listening to, discussion and resolution of community concerns,
- the regular provision of information on the environmental performance of the mine,
- relevant feedback on the project's compliance with lease, licence and other statutory conditions, and
- a community consultation program which will be developed jointly by Cooranbong Colliery and the community and will be implemented at the earliest possible time.

5. Policy provisions

The application of the policy will depend upon the particular status of land within the mining lease area. Land status will be determined according to ownership, access requirement, the degree to which the surface water patterns of the land may be altered by mining, and degree of improvements on the land.

A "decision tree" based on the above criteria has been prepared to assist in the interpretation of this policy. This is included at Annexure 1.

In addition to the policy positions set out below, Cooranbong Colliery reserves the right to approach and negotiate with any landholder in the mining lease area for the purpose of acquiring that land, or of entering into any other agreement.

5.1 Land owned by Mandalong Pastoral Management

Mandalong Pastoral Management Pty Ltd is a company established by Powercoal to provide it with expert land management services for its rural landholdings.

For land owned by Mandalong Pastoral Management, the company has appointed a professional land manager and implement "best practice" land management systems which will:

a) aim to achieve sustainable management of the land,

b) aim to maintain agricultural productivity

c) maintain and/or enhance fences,

d) aim to maintain biodiversity of the property's agro-ecological system.

The land management system(s) adopted will include at least the following elements:

a) a commitment to meet all statutory requirements for feral animal and noxious weed control

b) implementation of a pollution control policy applying to fertilizer use, agricultural chemical use, chemical residues and waste management

c) development and implementation of a weeds policy which considers all weeds and their impact on agricultural production and native habitat

d) development and implementation of a wetland and waterways policy specific to the land owned by the Mandalong Pastoral Management

e) development and implementation of an Environmental Management Plan, and

f) development and implementation of a bushfire management plan.

5.2 Land not owned by Mandalong Pastoral Management

5.2.1 Crown land

For government-owned land (for example, transmission line easements, road reserves, pipelines, State Forests), Cooranbong Colliery will maintain a knowledge of and compliance with the principles of management plans and protocols governing management of the land.

These may include, for example, guidelines prepared by the Department of Mineral Resources in respect of mining coal under or near railways, coal mining under transmission lines, etc., and State Forests of NSW Management Plans (Wyong Management Area).

Cooranbong Colliery will maintain ongoing dialogue with the relevant government agencies responsible for the Crown land.

5.2.2 Unimproved[2] private land where surface water patterns are not likely to be altered as a result of mining

5.2.2.1 Where surface access is required for mine surface facilities

In the case of the Cooranbong Colliery Life Extension Project, the main area required for surface access is already owned by Mandalong Pastoral Management. However, if surface access is required for mine surface infrastructure elsewhere in the mining lease area, then Cooranbong Colliery will enter into agreements with the relevant landholders.

Such agreements will specify restoration or remediation of any damage to land (excluding improvements as defined under the Mine Subsidence Compensation Act 1961[3]).

This may include grading, filling, protection fencing and flood mitigation works, but will be limited to "compensable loss" as defined by the Mining Act 1992[4]).

---

2 For the purposes of this Policy, "unimproved land" is considered to be land which has on it no purpose-built structures (as defined under the Mine Subsidence Compensation Act 1961). Land with "improved pastures", but no purpose-built structures, is considered to be "unimproved land" for the purposes of this Policy.

3 "**Improvement**" includes any building or work erected or constructed on land; any formed road, street, path, walk or drive-way; any pipeline, water, sewer, telephone, gas or other service main, whether above or below the surface of the land. (Mine Subsidence Compensation Act 1961)

5.2.2.2 Where surface access is required for rehabilitation works

In the event that rehabilitation works are required on unimproved land affected by subsurface mining, Cooranbong Colliery will negotiate directly with the affected landholders as to the remediation required, and will carry out such agreed works consistent with any development consent, the requirements of relevant government agencies, and any approved Flood Management Plan.

5.2.2.3 Where no surface access is required

Where no surface access is required, prior agreement with landholders is not mandatory. Section 265(4) of the Mining Act 1992 is limited to activities on the surface.

In such circumstances, Cooranbong Colliery will comply with the provisions of the Mining Act 1992. In particular, Cooranbong Colliery will observe the provisions of section 262[4] and section 265(3)[5], which provides for the payment of defined compensation for compensable loss incurred, in accordance with the terms of a voluntary agreement, mutually-agreed independent mediation, or a determination of the Warden's Court.

It should be noted that such "compensable loss" does *not* include compensation for losses covered under the separate procedures under the Mine Subsidence Compensation Act 1961 (see specific definitions in footnotes 3 and 4).

---

4 **"compensable loss"** means loss caused, or likely to be caused, by:

(a) damage to the surface of land, to crops, trees, grasses or other vegetation (including fruit and vegetables) or to buildings, structures or works, being damage which has been caused by or which may arise from prospecting or mining operations; or

(b) deprivation of the possession or of the use of the surface of land or any part of the surface; or

(c) severance of land from other land of the owner or occupier of that land; or

(d) surface rights of way and easements; or

(e) destruction or loss of, or injury to, disturbance of or interference with, stock; or

(f) damage consequential on any matter referred to in paragraph (a)–(e),

but does not include loss that is compensable under the Mine Subsidence Compensation Act 1961.

5 If a valid agreement is not entered into under this section within such period as may be prescribed by the regulations, the holder of a mining lease, or an owner or occupier of land, may apply to a warden to assess the amount of compensation payable, and a warden is to assess the compensation payable.

5.2.3 Unimproved private land where surface water patterns are likely to be altered as a result of mining

5.2.3.1 Land where no surface access is required

Where no surface access is required, but where the surface water patterns on the land are likely or predicted to be changed[6] as a result of mining, Cooranbong Colliery will:

a) enter into an agreement for works to manage the impacts of any changed surface water patterns due to mining. Such agreement and works shall not be inconsistent with achieving the objectives of any approved Flood Management Plan, or

b) offer the landholder an option of purchase of the land at the landowner's call.

5.2.3.2 Land where surface access is required

Where surface access is required to unimproved land which may be subject to changed surface water patterns as a result of mining, Cooranbong Colliery will seek to negotiate with the landholder an access agreement. Such agreement shall include provisions for rectification of the adverse surface water effects, consistent with the terms of an approved Flood Management Plan.

5.2.4 Improvements on private land

5.2.4.1 Improvements not likely to be rendered flood prone[7]

Improvements, as defined under the Mine Subsidence Compensation Act 1961 (see footnote 3) come under the responsibility of the Mine Subsidence Board, under the terms set out in the Mine Subsidence Compensation Act 1961.

Cooranbong Colliery will liaise closely with the landholder, the Department of Mineral Resources and the Mine Subsidence Board to maximise coal resource recovery and mitigate surface impacts of mining.

Cooranbong Colliery considers dwellings and residences to be a special case in this regard, and will implement a program of full consultation on any potential mining impacts and their mitigation on a case-by-case basis.

---

[6] That is, be subject to runoff resulting from a 1:100 rainfall event and/or subject to ponding of remnant water through changed landform as a result of mining.

[7] For the purposes of this Policy, "rendered flood prone" means where significant *damage* is caused by flooding

5.2.4.2 *Improvements likely to be rendered flood prone*

No improvement on private land (as defined in footnote 3) will be rendered flood prone as a result of mining without the prior consent of the landowner under the terms of a compensation agreement. Where appropriate, Cooranbong Colliery will either render the improvements non-flood prone, and/or, with the agreement of the owner, purchase the land so affected.

Irrespective of any other agreements with landholders, any drainage, flood mitigation or associated works will be in accordance with any approved Flood Management Plan prepared by Lake Macquarie City Council and the Department of Land and Water Conservation, including compliance with any requirements of the appropriate authority administering that Plan.

6. Dispute resolution

This Policy is designed to provide for a high degree of certainty in transactions regarding the effects of underground mining on landholders' property and rights. It is thus expected that most issues of contention will be resolved by the careful application of this Policy.

However, where a dispute arises in relation to a commercial arrangement made under this Policy, or in relation to any other arrangement under this Policy not covered explicitly by relevant legislation, Cooranbong Colliery will seek the appointment of a mediator to work with the parties to resolve the dispute.

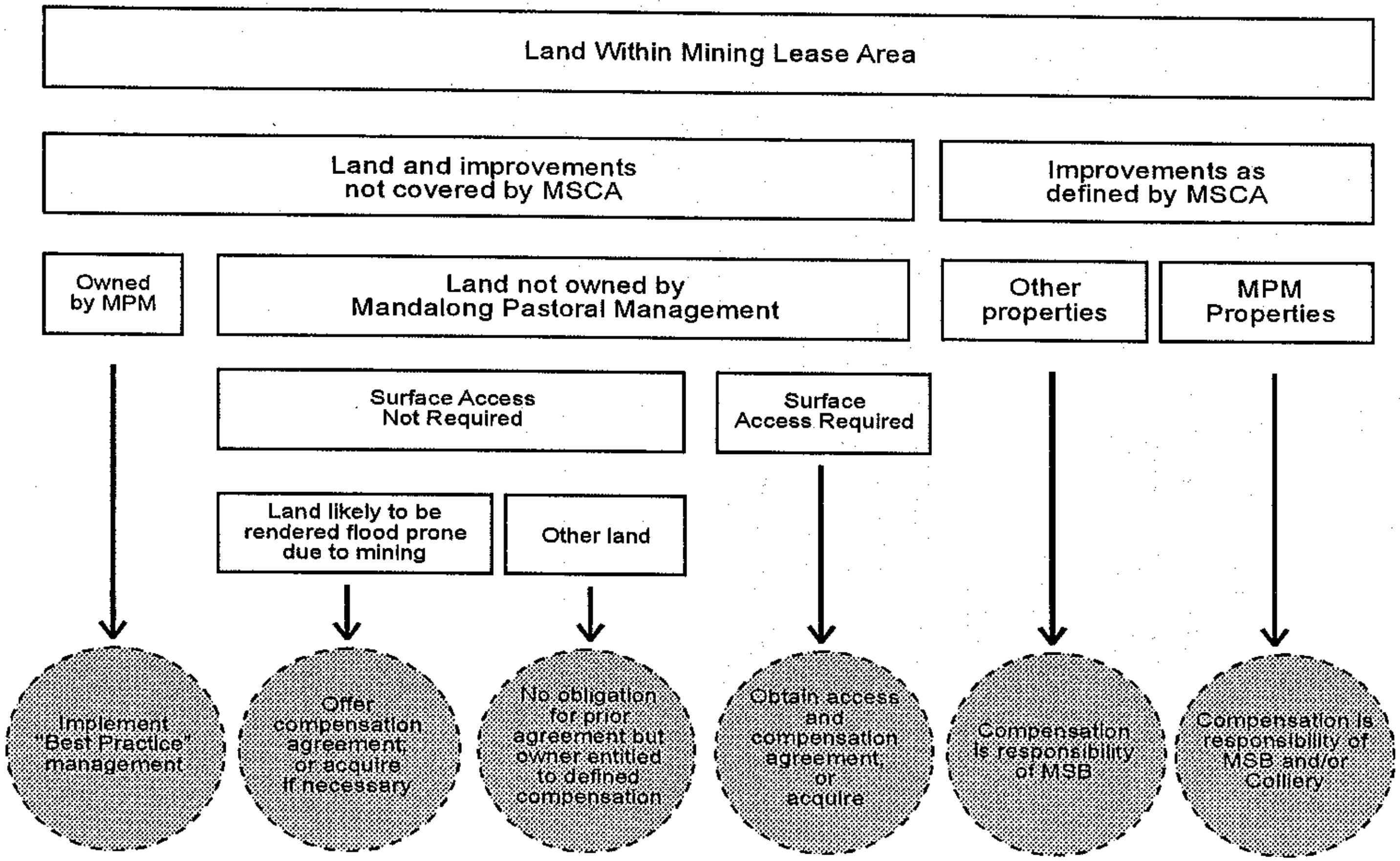
In the event that the dispute cannot be resolved to the satisfaction of an affected party or parties, they may apply to have the matter resolved in the Mining Warden's Court.

***

..../Annexure 1 - Policy *Decision Tree*

Cooranbong Colliery
Land Access, Management and Compensation Policy

Decision Tree



Appendix 7

Socio-Economic Study

REPORT

CENTRE FOR INTERNATIONAL ECONOMICS

The significance of the Cooranbong Colliery to jobs and the economy

Socioeconomic impact analysis of the proposed mine extension

Final Report

Centre for International Economics
Canberra & Sydney

August 1997

Contents

Executive summary

An independent study into the social and economic implications of maintaining production at the Cooranbong Colliery has been conducted by the Centre for International Economics (CIE).

The study was commissioned to provide information on the significance of gaining approval for 'Cooranbong Colliery Life Extension Project' to maintain coal supplies to the existing production facility at Cooranbong Colliery near Morisset.

The key findings of the study are set out in summary form below:

- The extension of mining activity at the Cooranbong Colliery would contribute an additional $194 million per annum to real Gross State Product (GSP) — a measure of wages, salaries and gross profits in New South Wales. This output is estimated to support between 790 and 1534 additional jobs in New South Wales. The exact employment impacts will depend on the extent to which additional output could be produced using slack capacity across the state.
- Alternatively, the closure of the Cooranbong Colliery would lead to a reduction in real GSP of $86 million and a loss of 1057 jobs statewide. These results were obtained from simulations using an economywide modelling approach.
- The new workings are planned to replace the current resource which has an expected life of five years at current extraction rates. The extension project is expected to provide 220 direct jobs during the operations phase, compared to a loss of 270 direct positions if mining ceased as a result of the exhaustion of the current resource.
- The 220 jobs associated with the mine extension project represent 2.5 per cent of employment in underground mines in New South Wales and about 1.6 per cent of total coal mine employment in the state.
- Should the project *not* proceed, the net loss of 220 mine jobs would represent a 6.7 per cent loss of mine employment in the Newcastle coal field.
- From the planned 4 million tonnes of coal production, 2 million tonnes will be exported, representing an increase in annual exports of coal in New South Wales of 3.3 per cent and an increase in Australian coal exports of 1.4 per cent.

- The extension of the Cooranbong mine is expected to lead to a total output effect for the Hunter region, of approximately $234 million, comprising $150 million of direct gross output from the mine and $84 million of indirect output induced by the mine's demand for inputs and the demand of employees' for goods and services in the region. This output is estimated to support total income in the region of $29.5 million and total estimated employment of approximately 435 jobs in the Hunter Valley region.
- The results of an employee expenditure survey indicate that for residents of Lake Macquarie, 75 per cent of expenditures occur within the region, with 14 per cent occurring in Wyong and Newcastle and 11 per cent elsewhere (mainly as a result of holidays outside the region).
- Sixty-one per cent of the mine's wages and salary earners live in the Lake Macquarie region. Given wages and salaries of $17.8 million, continuation of mine operations would mean $10.7 million in direct wages and salary income for the Lake Macquarie local government area. This would imply between $6.5 million and $8 million in expenditure for the Lake Macquarie region annually.
- This means that failure to extend the life of the mine would deprive the Lake Macquarie region of between $6.5 and $8 million annually in indirect spending from wage and salary incomes.
- A further $8.4 million expenditure on regionally sourced mine supplies would also be withdrawn form the region, $3.3 million of this from the Lake Macquarie locality.
- Should the mine extension project not proceed, the loss of 220 jobs associated with the extension could increase the unemployment rate in the Lake Macquarie area from 10.9 per cent to 11.2 per cent. The current level is already significantly higher than the national average of 8.7 per cent.
- Extension of the mine life is estimated to contribute $22.1 million in revenue annually to the state government that would otherwise be lost to it. This would accrue either as a direct result of mine activity or through induced activity in the state economy.

Introduction

Powercoal Pty Ltd, a wholly owned subsidiary of the state owned Pacific Power Corporation, operates the Cooranbong Mine on the Newcastle coal field, producing $62 million worth of coal annually and employing 270 people. The current resource is nearing the end of its economic life, offering only about five more years of viable coal extraction. Powercoal is proposing to extend the life of the Cooranbong Colliery by extending its underground operations into a new lease area south east of its current workings.

The Centre for International Economics (CIE) has been commissioned to provide an independent assessment of the socioeconomic impact of the Cooranbong Colliery Life Extension Project. This report presents the CIE's analysis and results. The analysis has been based on an initial project specification provided by Powercoal.

This report includes:

- a description of the project;
- an illustration of the importance of coal mining to the regional, state and national economies;
- a discussion of the importance of the Cooranbong Colliery to the regional economy and local communities; and
- an assessment of the likely impact of the mine extension on the regional, state and national economies.

Description of the project

The Cooranbong Colliery Life Extension Project will develop an underground coal resource area in the Mandalong Valley, south-west of the existing workings at the Cooranbong Colliery. The first stage of construction is proposed for mid-1998. Underground development is scheduled to commence in mid-1999, with the first longwall coal being produced in mid-2000. The extension area has an estimated 65 million tonnes (Mt) of saleable coal with an estimated project life of twenty years.

> The new workings are planned to replace the current resource which has an expected life of five years at current extraction rates. The extension project is expected to provide 220 direct jobs during the operations phase. A total of 270 positions at the mine will be lost if the mine closes as a result of the exhaustion of the current resource.

An outline of key project parameters for the proposed mine extension project is presented in table 1.

A total capital investment of $116 million is expected to be outlaid over the first four years of the project, the majority of which is expected to be spent during the third and fourth years, coal production having commenced in third year of the project. The total investment consists of $69.1 million on engineering works, $43.5 million on mining equipment and vehicles, and $3.4 million on environmental works and services.

In addition to these one-off capital expenditures, ongoing capital expenditures of $38 million are expected from the fifth year of the project onward. Other recurrent costs include labour ($24.4 million), fuel and energy inputs ($2.3 million), repairs and maintenance ($10 million), rail transport ($8.0 million), and port charges ($6.1 million).

Up to 4 Mt are expected to be extracted annually with 50 per cent expected to be exported and the remainder sold in the domestic market. Powercoal advises that for some years production may be lower than this level, however for modelling purposes annual production of 4 Mt is assumed. These sales are expected to raise a total of $150 million in annual revenue — $66 million from domestic sales and $84 million from export sales given expected coal prices. This revenue breakdown assumes that 2 Mt of the total production is exported. It is understood that there is a possibility that up to 2.5 Mt could be sold on export markets. Expected production under

Table 1 **A profile of key project parameters**[a]

Capital investment	
Engineering works[b]	$69.2m
Mining equipment and vehicles[b]	$43.5m
Environmental works and services[b]	$3.4m
Ongoing capital expenditures	$38m
Revenue	
Domestic sales	$66m
Export sales	$84m
Costs	
Labour costs, wages and oncosts	$24.4m
Fuel and energy inputs	$2.3m
Repairs and maintenance	$10m
Rail transport to Port of Newcastle[c]	$8m
Port charges[d]	$6.1m
Taxes, royalties, etc	
Coal royalties	$6.4m
Federal taxes (PAYE)	$6.2m
State taxes (payroll)	$1.25m
Local government taxes (rates and charges)	$0.1m
Employment — operations phase (including washery and direct transport)	220

[a] All figures annual unless otherwise specified. Based upon production of 4 Mt annually. [b] One-off expenditure. [c] Based upon estimated exports of 2 Mt and rail transport charges of $4.03 per tonne. [d] Based on estimated exports of 2 Mt and port charges of $3.07 per tonne.
Source: Powercoal

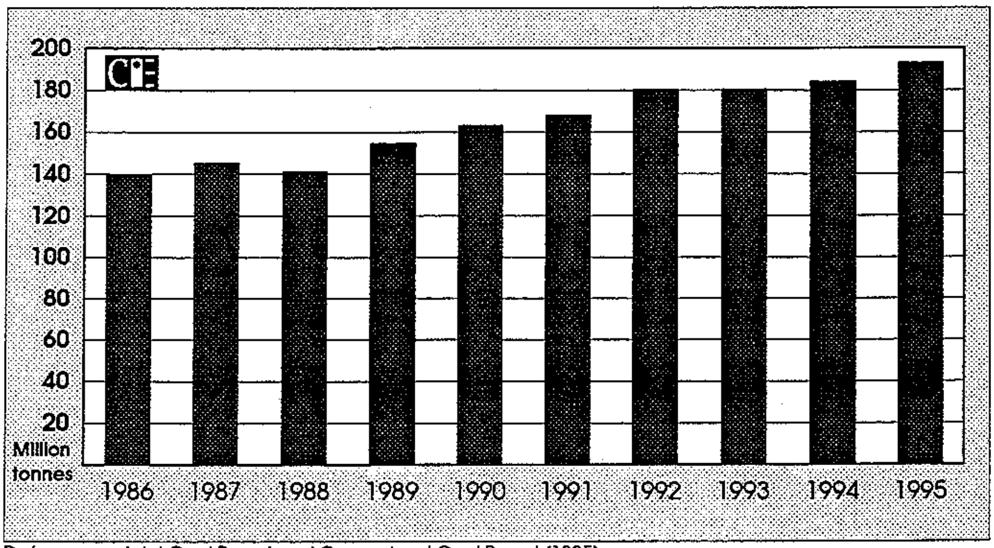
the extension project represents a significant increase over present levels. Currently 1.5 Mt are produced annually and sold, almost exclusively, to the Eraring Power Station under long term contracts, raising revenue of $62 million dollars annually. It is anticipated that new contracts for supply into Eraring can be negotiated for 2001 onwards but at a lower price due to increased competition from other coal suppliers and other forms of energy.

Recent trends in the coal industry

Black coal forms the majority of coal produced in Australia and is the only export coal. Chart 1 shows that the production of saleable (black) coal has increased steadily, increasing from 139 million tonnes in 1986 to 192 million tonnes in 1995. Only black coal is produced in New South Wales, where saleable coal production has increased from 66 million tonnes in 1986 to 90 million tonnes in 1995.

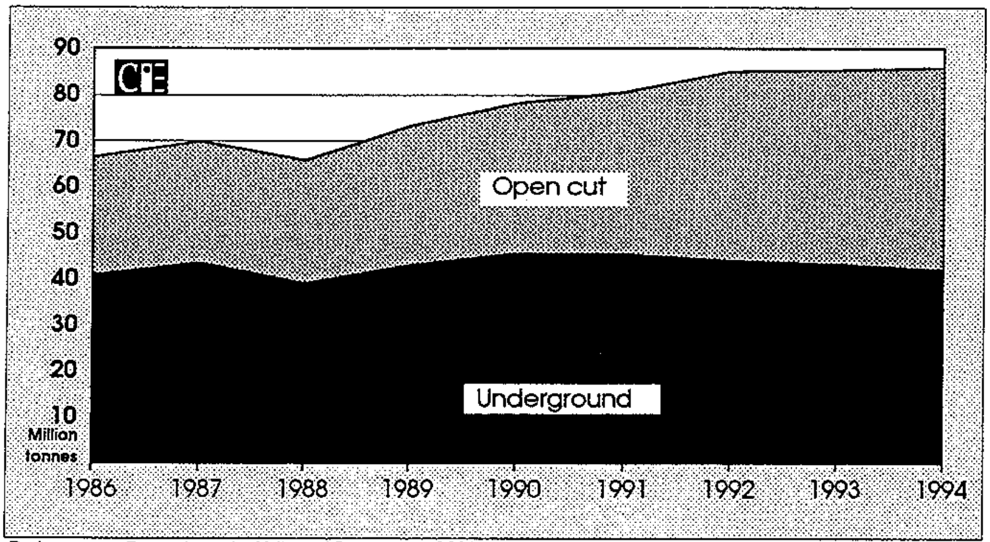
Nationally around 30 per cent of black coal is produced in underground mines. In New South Wales underground operations are relatively more important with around 49 per cent of coal sourced from underground mines (chart 2). While underground production in Australia has increased, more significant growth has occurred in open cut mining where there has been an increase in production of 46 per cent since 1986 compared to a 22 per cent increase in underground production (Joint Coal Board and Queensland Coal Board 1995). In New South Wales a similar trend has emerged — although to a much higher degree — with production from open cut and underground mines increasing by 79 per cent and 5 per cent

Chart 1 **Saleable black coal production 1986–95**



Data source: Joint Coal Board and Queensland Coal Board (1995).

Chart 2 **Production of saleable black coal in NSW by method**



Data source: Department of Mineral Resources (1996).

respectively over the same period (Department of Mineral Resources 1996).

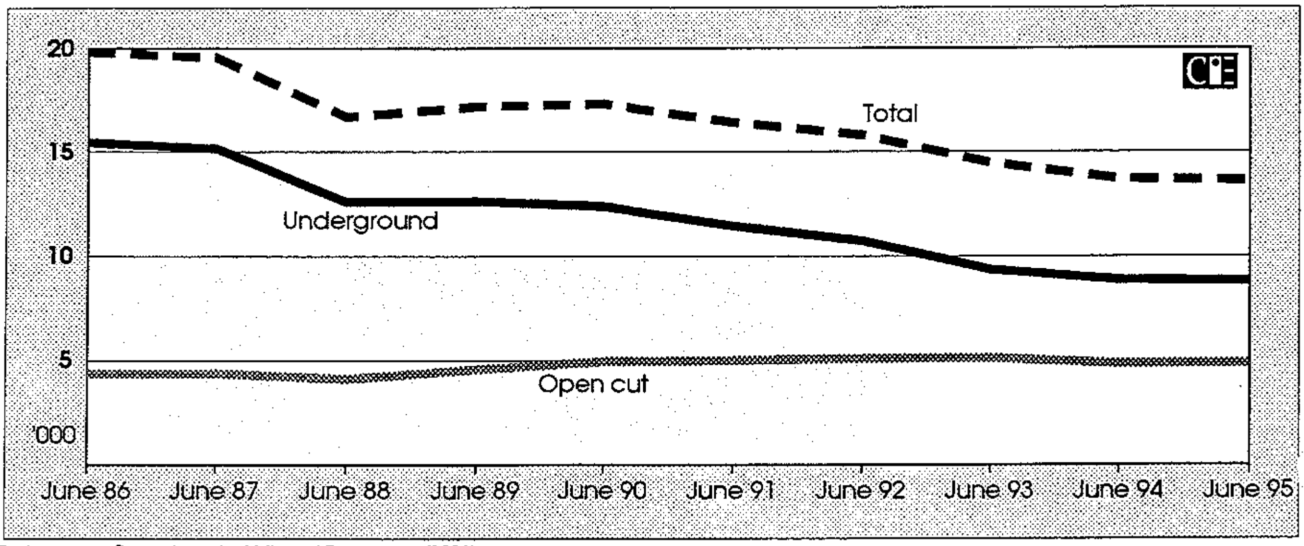
This lower growth in underground production has come about largely because of a reduction in the number of operating underground mines. Currently there are 45 underground mines in New South Wales, down from 66 in 1986. This is in contrast to the number of open cut mines, which increased in number from 20 to 24 over the same period.

Despite increasing total coal production, employment opportunities have fallen. The replacement of underground workings with open cut mines, the relatively capital intensive nature of open cut mining, and the adoption of more capital intensive methods in underground mines, have all contributed to a fall in total employment in the coal mining sector of New South Wales over the period 1986 to 1995. Employment in underground mines in New South Wales declined from 15 500 in 1986 to 8781 in 1995, while in open cut mines total employment increased from 4400 to 4800 in 1995 (chart 3).

The 220 jobs associated with the mine extension project represents 2.5 per cent of employment in underground mines in New South Wales and about 1.6 per cent of total coal mine employment in the state.

In the Newcastle coal field almost all mining is carried out underground. Nearly 3100 persons are employed in underground mines in the Newcastle coal field which represents around 94 per cent of total employment in the coal mines in the region.

Chart 3 **Employment, NSW coal mines**



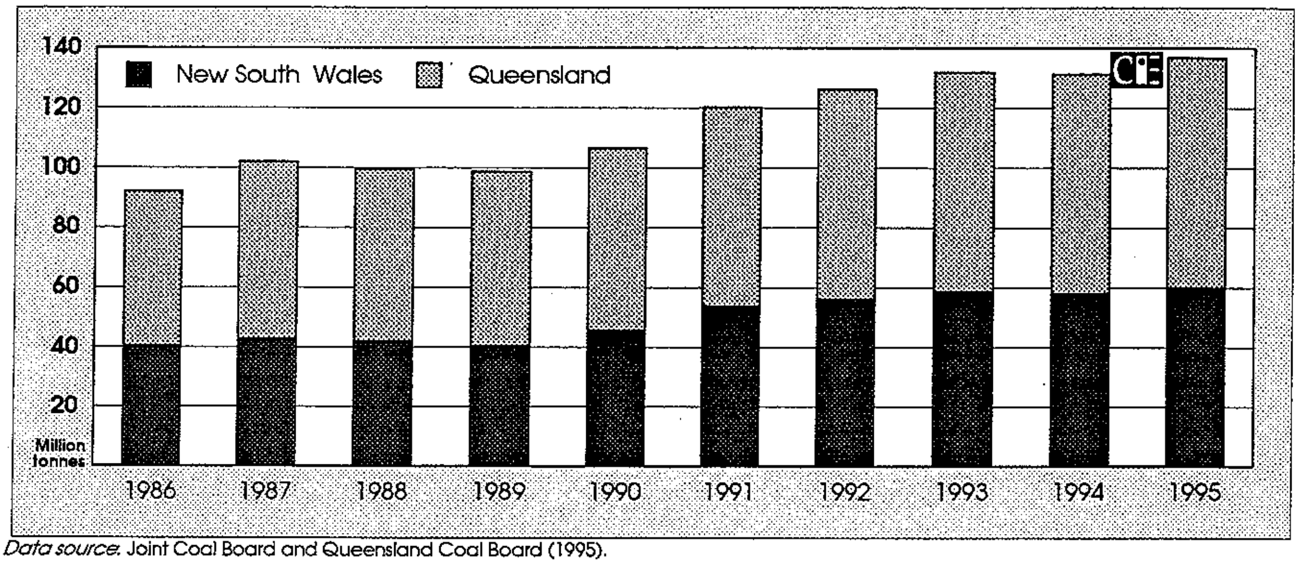
Data source: Department of Mineral Resources (1996).

The net loss of 220 mine jobs should the project not proceed would represent a 6.7 per cent loss of mine employment in the Newcastle coal field.

Black coal exports are a significant foreign currency earner for Australia, representing over 10 per cent of exports by value. Chart 4 shows how coal exports have grown over the last 10 years. On average, coal exports have grown by approximately 4 per cent each year, and were worth nearly $7.5 billion in 1995. Only Queensland and New South Wales produce coal for export markets, with New South Wales producing 43.7 per cent of these exports.

In this context the planned annual exports of 2 million tonnes from the mine extension project represent an increase in annual exports of coal in New South Wales of 3.3 per cent and an increase in Australian coal exports of 1.4 per cent.

Chart 4 **Coal exports by state**



Data source: Joint Coal Board and Queensland Coal Board (1995).

Socioeconomic impact of the proposed mine extension

Impact at the regional level

The continuation of operations at the Cooranbong Colliery will have significant positive economic benefits for the local community. These benefits would arise because the extension of the mine would:

- avoid 220 job losses which would otherwise occur as a result of a winding down in activity at the existing mine site as the current resource is depleted;
- create additional jobs during the construction phase of the project; and
- maintain demand for the goods and services of local input suppliers.

As well as these direct impacts on regional economic activity, there would be significant flow-on benefits for the lower Hunter region. These flow-on effects occur because local businesses benefit from selling goods and services to the mine and its employees. Extending the life of the mine will help maintain the incomes of these businesses, their owners, their employees and their input suppliers.

The construction phase of the mine extension project will stimulate economic activity directly through increased employment and demand for inputs, and indirectly as the impact of these increased demands flow through the rest of the economy. However, because much of the construction activity will be subject to tender, details of expected employment or input sources are unknown. This has prevented a detailed analysis of the construction phase. The following analysis focuses primarily on the operations phase of the mine extension project.

Measuring the direct and flow-on effects of the proposed mine extension

The direct and flow-on effects of mining activity at the Cooranbong mine can be estimated at the regional level with the aid of input–output multipliers for the Hunter Valley regional economy. Input–output models produce a set of multipliers which measure the flow-on effects of industries in the region. These multipliers variously show output, income and employment effects. A number of studies have presented estimates of these multipliers for mining activity in the Hunter region (and for smaller regional centres). These estimates are presented in table 2.

It is apparent from table 2 that the various multiplier estimates are reasonably consistent, with relatively low variation in values observed across the studies. The output multipliers (which measure the total value of output in the region supported by $1 worth of output in the coal mining sector) range between 1.5 and 1.76. Similarly, estimates of income multipliers (which measure the total income generated in the region as a result of each $1 of income earned from production in the coal mining sector) range from 1.5 to 1.7. Estimates of employment multipliers (measuring total employment generated as a result of the employment of one person in the coal mining sector) range from 1.39 to 2.31. For the purposes of this study it was decided to adopt the Centre for Transport Policy Analysis estimates which are the most recent, complete set of estimates and which are mid range for all three multipliers.

Table 2 **Estimated multipliers for coal mining activity in the Hunter region**

	Multiplier [a]		
Study	*Output*	*Income*	*Employment*
Garner et al. (1980)	1.76	1.7	1.78
Mitchell McCotter (1990, 1992)	1.5	1.5	2
Department of Minerals and Energy (1991)			1.39 - 2.31 [b]
Sinclair Knight (1992)			1.85 (Singleton)
			1.46 (Muswellbrook)
			2.17 (Kandos)
Centre for Transport Policy Analysis (1991) [c]	1.56	1.66	1.98

[a] Type 2A multiplier — that is, includes direct, indirect and flow-on effects as defined by the Australian Bureau of Statistics in Australian National Accounts: Input-Output Tables, cat. no. 5215.0. [b] Range reported by Association of Coal Related Councils. [c] Quoted in Envirosciences Pty Ltd (1993).

The estimated impact of the proposed mine extension

At full operations the Cooranbong mine extension would produce $150 million worth of coal and employ 220 people including those engaged in a new coal washery and indirect transport operations. Total labour costs are expected to be $24.4 million, of which, $17.8 million is expected to be paid to employees. Given these estimates of the direct effects of the mine, table 3 presents estimates of the total output, income and employment effects on the Hunter region economy of extended operation of the Cooranbong mine when multiplier effects are taken into account.

The extension of the Cooranbong mine is expected to lead to a total output effect of approximately $234 million, comprising $150 million of direct output from the mine and $84 million of indirect output induced by the mine's demand for inputs and the demand of employees for goods and services in the region. This output is estimated to support total income in the region of $29.5 million and total estimated employment of approximately 436 jobs in the Hunter Valley region.

The estimated income effect for the region includes only salaries and wages from the mine and excludes profit from the mine operation because the disposition of profits is ultimately a matter for the owner, the New South Wales government. Profits therefore accrue outside the region. To the extent that unemployment benefits would be paid to the displaced 220 employees should the project not proceed, the estimated $29.5 million wages and salaries will overstate the *net* direct regional income effects of the project, and relative flow-on effects. However, the need to provide unemployment benefits may reduce the capacity for other beneficial government spending in the region.

Because the project is an extension of an existing mine rather than a greenfields operation, the net increase in output, income and employment over *present* levels will be smaller than the levels presented in table 3. However, the values presented in table 3 are appropriate estimates of the impact of the mine extension project because in the absence of the mine extension, output, income and employment to that order of magnitude is likely to be foregone.

Table 3 **Estimated impact of mine extension**

	Output	*Income*	*Employment*
Multiplier	1.56	1.66	1.98
Direct effects	$150 m	$17.8 m	220
Flow-on effects	$84 m	$11.7 m	216
Total effects	$234 m	$29.5 m	436

Source: CIE calculations.

Effects on the local community

While the input–output multipliers used to calculate the regional impacts in table 3 provide a guide to the likely impact on the Hunter Valley region, they are unable to provide any insights into which communities in the Hunter are likely to be most affected. An analysis of where mine employees live, where they spend their income and where the mine purchases its inputs should help in this regard.

Mine employment and employee expenditure patterns

As discussed previously, the proposed extension project will provide 220 jobs at the colliery and wage income of $17.8 million when operations at the existing Cooranbong workings wind down. The effect of this employment on the Hunter region was discussed above. The economic impact on particular localities within the Hunter region will depend upon where employees live, and on what and where they spend their incomes.

Table 4 presents a breakdown of residential locations of employees at the Cooranbong mine according to local government area. The majority of employees reside in the City of Lake Macquarie local government area but a significant number also live in the Cessnock City and Wyong Shire local government areas.

The Australian Bureau of Statistic (ABS) publishes data on household expenditure patterns. However, published data is not available for individual local regions and the survey does not identify where households purchase their goods and services. The Household Expenditure Survey (HES) does, however, provide an expenditure profile for non-metropolitan urban households in New South Wales. To check how well this average profile represents the spending patterns of mine employees and to obtain an idea of where employees spend their incomes, a survey of

Table 4 **Location of residences by local government area**

Local government area	*Number of resident employees*
Lake Macquarie City	163
Cessnock City	57
Wyong Shire	36
Maitland City	4
Newcastle	6

Source: Powercoal.

Table 5 **Summary of results — expenditure composition**

Good/service	*Proportion of expenditure on goods/services %* CIE Survey	ABS HES — NSW non-metropolitan urban average
Housing	26.7	17.6
Energy	2.7	2.7
Groceries	26	22.5
Clothing and footwear	4.6	5
Transportation	15.4	15.7
Household services & equipment	4.6	12.2
Medical	4.1	4.4
Recreation & personal care	9.7	13.1
Other (including education)	6.2	6.8

Source: CIE survey of mine workers, ABS 1993-94 Household Expenditure Survey (HES) Australia, Detailed Expenditure Items, cat. no. 6535.0.

mine workers was initiated. The results from a pilot survey of 20 administration staff and some miners are presented in tables 5 and 6 and discussed below. A full survey of all mine workers was not completed in time for this report.

It is clear from table 5 that the results of the survey match the HES results reasonably well. The only major discrepancies between the two surveys are in the housing and household services and equipment categories. The survey of mine workers estimates a higher proportion for expenditure on housing and a lower proportion for household services compared with the HES. This may be due to the small pilot sample, category definition problems or may simply reflect higher housing costs (and lower expenditure on household items) in the region than in other non-metropolitan urban centres across the state. For instance, it is possible that respondents to the CIE survey have identified as 'housing costs' some expenditure items classified as 'household services' in the HES. These discrepancies notwithstanding, the closeness of the results suggests that the HES is a reasonable guide to the expenditure patterns of Cooranbong employees.

Table 6 describes *where* respondents to the survey spend their incomes. The results indicate that for residents of Lake Macquarie, 75 per cent of expenditures occur within the region, with 14 per cent occurring in Wyong and Newcastle and 11 per cent elsewhere (mainly as a result of holidays outside the region).

Items commonly purchased in Wyong and Newcastle included clothing and footwear, major household items, and medical services. Similar results were obtained for respondents living in Wyong, although they tended to spend more in Lake Macquarie than in Newcastle. The result that

Table 6 **Summary of survey results — expenditure locations**

	Proportion of expenditure in				
Area of residence	***Lake Macquarie***	***Wyong***	***Newcastle***	***Cessnock/Maitland***	***Other***
	%	*%*	*%*	*%*	*%*
Lake Macquarie	75	8	6	1	10
Wyong	19	77	1	0	3
Newcastle	5	0	90	0	5
Cessnock/Maitland	0	0	7	93	0

Source: CIE survey of mine employees.

90 per cent of expenditure by Newcastle residents occurs in Newcastle is not surprising given the size and facilities of Newcastle.

An alternative approach to estimating expenditure by households in the region would be to allocate HES expenditures according to a 'best guess' as to where expenditure on each category item would occur. For example, rental payments or grocery purchases are likely to occur within the region while insurance or motor vehicle registration would be 'out of region' payments. (Such 'out of region' expenditures may nevertheless support 'branch office' activities which contribute to the regional economy.) For others, such as clothing and footwear, and major household items, the distinction is less clear. By allocating the HES expenditure estimates for each item to 'inside' or 'outside' of the region categories and assuming (on the basis of the pilot survey) that 75 per cent of expenditure on those categories which are less clear occurs within the region, we estimate that 61 per cent of total expenditure would occur within the region of residence.

Given wages and salaries of $17.8 million and assuming that the pattern of residency of the 220 employees to be employed in the mine extension matches that in table 4, continuation of mine operations would mean $10.7 million in direct wages and salary income for the Lake Macquarie local government area. Depending on which approach to determining location of spending is taken, this would imply between $6.5 million and $8 million in expenditure for the Lake Macquarie region annually.

This figure represents the direct impact on the region and therefore understates the total impact. Successive rounds of expenditure will increase the total impact on the region of the mine extension. Other areas such as Wyong, Cessnock and Maitland will be similarly affected, although to a lesser degree than Lake Macquarie because of the greater proportion of workers residing in the Lake Macquarie area.

Mine expenditure in the local region

In addition to payments to employees, Cooranbong Colliery injects substantial funds into the local economy through purchases of mine inputs from local and regional suppliers.

Over 70 per cent of the Cooranbong Colliery's expenditure (with its top 40 suppliers) occurs in the Hunter region. The Colliery injects over $8.4 million into the regional economy in this way. Table 7 presents a breakdown of the Colliery's expenditure on inputs by local government area for the period July 1995 to June 1996. Approximately 28 per cent of total expenditure occurs in the City of Lake Macquarie local government area. A further 26 per cent of expenditures are made in Newcastle and 17 per cent in Cessnock and Maitland.

In summary, closure of the mine would deprive the Lake Macquarie region of between $6.5 and $8 million annually in direct spending from wage and salary incomes. A further $8.4 million expenditure on regionally sourced mine supplies would also be withdrawn from the region, $3.3 million of this from the Lake Macquarie locality.

The preceding analysis suggests that the greatest impact of mine closure (and hence the benefits of mine extension) would be felt in the Lake Macquarie area where the mine is located. However, because a number of mine employees travel from outside of the area and the number of input suppliers are located within the Hunter region but outside Lake Macquarie, there will also be significant effects in other areas such as Cessnock and Wyong. These impacts are implicit in the regional multipliers presented in table 3.

Cooranbong Colliery and the community groups

Cooranbong Colliery provides financial and other support to a significant

Table 7 **Cooranbong Colliery — expenditure on inputs by area**[a]

Local government area	*Expenditure* $	*Share of total* %
Lake Macquarie	3 335 580	28.1
Newcastle	3 096 582	26.1
Maitland and Cessnock	1 981 901	16.7
Sydney	2 257 268	19.0
Other	1 197 337	10.1
Total	**11 868 668**	**100**

[a] Top 40 suppliers — accounting for around 90 per cent of total expenditure.
Source: Powercoal.

number of community groups and organisations in the local region for a wide variety of purposes. Table 8 presents a list of recent beneficiaries of support from Cooranbong and the uses to which that funding has been put. Closure of Cooranbong and subsequent loss of financial support would cause a significant adverse financial impact on these community groups.

The implications of mine closure for the Lake Macquarie community

Box 1 presents a profile of the City of Lake Macquarie in terms of population, employment and unemployment and income. The major conclusion to be drawn from the profile of Lake Macquarie and the economic assessment of the proposed mine extension is as follows.

> Should the mine extension project not proceed, the loss of 220 jobs associated with the extension could increase the unemployment rate in the Lake Macquarie area from 10.9 per cent to 11.2 per cent. The current level is already significantly higher than the national average of 8.7 per cent.

Other implications include the following:

- Closure of the Cooranbong mine would continue a trend of mine closures and falling employment in coal mining in the region — in underground mines in particular.

Table 8 **Recent beneficiaries of donations/assistance from Cooranbong**

Organisation	*Purpose*
Constable Care	Child awareness and road safety
South Lakes Basketball Association	Electronic scoreboard
Cooranbong community school	Build cricket nets
Morisset soccer club	Ground improvements
South Lakes country fair	Street dance and BBQ
Morisset swimming pool	Pool ladder
Martinsville bushfire brigade	TV & video for training
Cooranbong tidy town	Tidy towns campaign
Cooranbong country music concert	Music concert
Morisset soccer club	Team uniforms
Dora Creek cricket club	Junior cricket team sponsorship
Morisset Hospital - golf day	Charity golf day
Native animal trust fund	Assist with vets fees
South Lakes junior RLFC	100 club
Morisset golf club	Tree planting
Mandalong bush fire brigade	Access to forest
WEC camp centre	Access to land for subs monitoring

Source: Powercoal.

- A loss of job opportunities may encourage further migration out of the region by younger people and further skew the age distribution toward the older age brackets where fixed incomes are more prevalent. The impact of this on the local economy is likely to be negative, especially in the retail sector.

- Total retail expenditure in Lake Macquarie in 1991-92 was estimated at around $730 million (Hunter Valley Research Foundation 1995). Allowing for nominal growth of 8 per cent annually (the New South Wales retail sales average), this would be equivalent to approximately $1158 million in 1997 dollar terms. The estimated direct retail expenditure supported by the mine ($7.9 million) then represents nearly 1 per cent of total retail turnover. The impact of a reduction of this amount would represent a significant shock to the Lake Macquarie economy. The impact on employment is likely to be strong given the importance of the wholesale and retail trade sector as an employer.

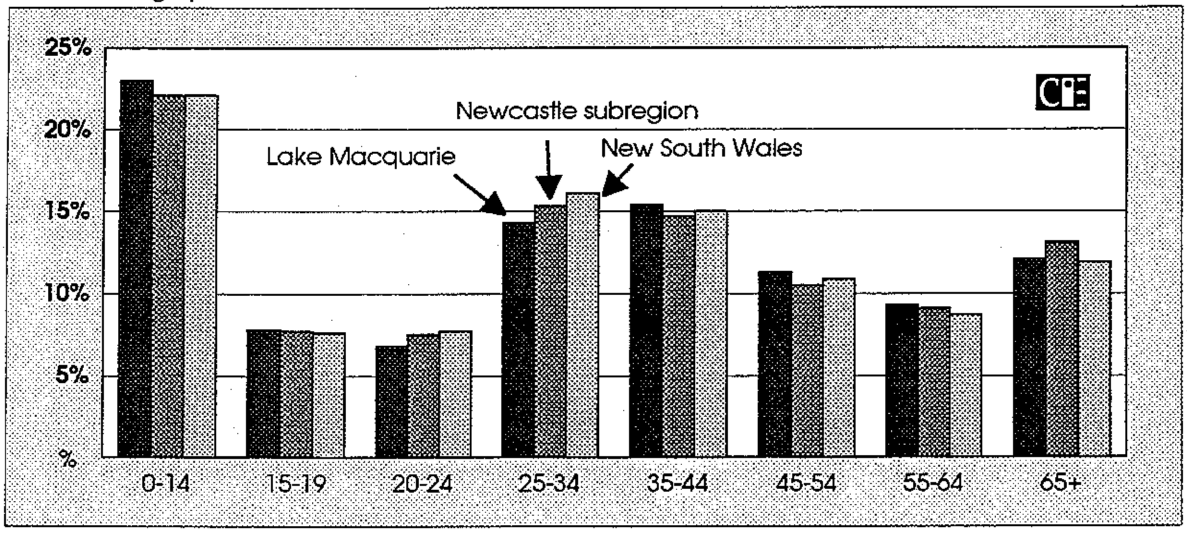
- The sales of $3.3 million by local firms to the mine represents average annual transactions of $330 000 per firm — an amount which, if denied to a smaller firm in the event of mine closure, may undermine survival.

Box 1 **City of Lake Macquarie community profile**

Population

Located in the area surrounding Lake Macquarie, the City of Lake Macquarie is one of the fastest growing areas in New South Wales. With a population of 173 000 Lake Macquarie experienced the third largest increase in population in 1993-94, increasing by 1.3 per cent over the 1992-93 level. Chart B.1 illustrates the age distribution of Lake Macquarie residents relative to the rest of New South Wales.

Chart B.1 Age profile



Data source: ABS , Basic Community Profiles, Lake Macquarie, Newcastle and NSW, 1993, cat no. 2722.1.

In comparison to the rest of New South Wales, Lake Macquarie has a relatively older population. There is a higher proportion of the population in the older age groups of 35 years and above. It is in the bracket 65–74 years where the greatest growth in population has occurred over recent years, with this age group contributing to over one quarter of the rise in Lake Macquarie's population over 1993-94. In fact Lake Macquarie recorded the biggest population rise of any area in New South Wales in that age bracket (3.7 per cent) (Tonkin 1995).

Between 1986 and 1991 Lake Macquarie suffered a decline in population in the younger age groups. Population in the 0–14 year age group declined by 3 per cent, in the 15–24 year age group population declined by 3.3 per cent and in the 25–39 year age group there was a 2.9 per cent fall. To some extent this shift of younger people out of the region will reflect a lack of job opportunities especially for the 15–24 year age group.

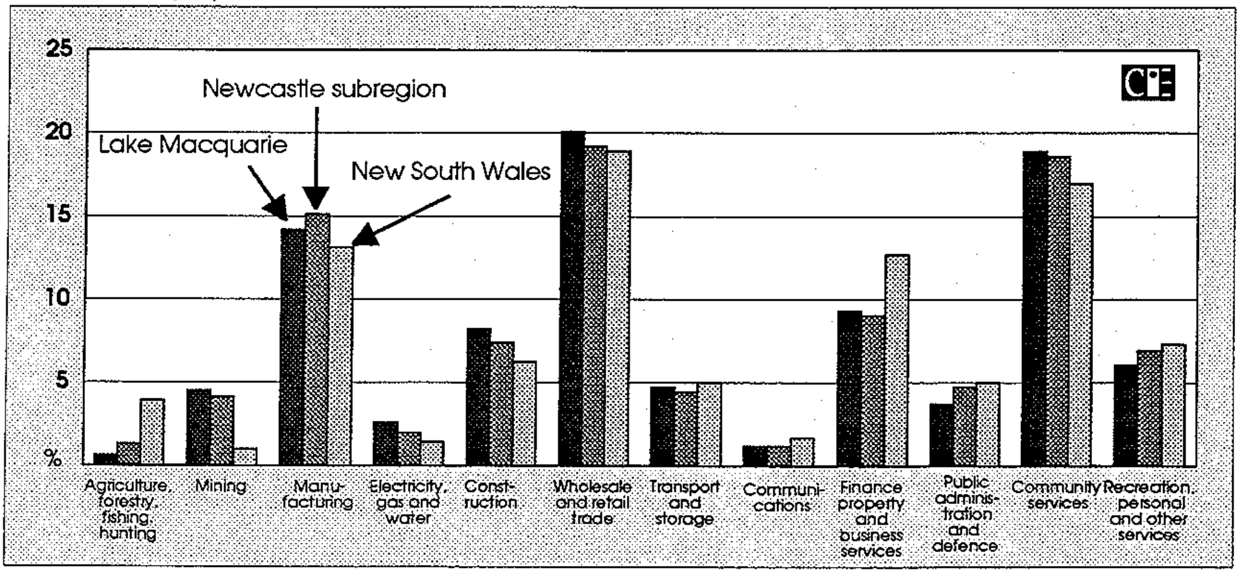
Employment

Employment in the Lake Macquarie and the Newcastle statistical sub-region reflects the relative importance of coal mining, electricity generation and manufacturing activities in the region. Chart B.2 presents the structure of industry employment in Lake Macquarie, Newcastle subregions and New South Wales.

Relative to the rest of New South Wales, wholesale and retail trade; mining; electricity, gas and water; and manufacturing are significant employers. Manufacturing is particularly important in the broader Newcastle subregion which is reflective of industrial activity in Newcastle City. Construction is also a relatively large employer, which is a likely reflection of construction activity following the 1989 Newcastle earthquake.

Box 1 **City of Lake Macquarie community profile** cont

Chart B.2 Employment structure



Data source: ABS, Basic Community Profiles, Lake Macquarie, Newcastle and NSW, 1993, cat no. 2722.1.

While mining remains a significant employer in the region, employment in coal mines has fallen. Since 1986 employment in underground mines in the Newcastle coal fields has fallen by over 50 per cent, currently standing at around 3000. Open cut mines provide relatively few jobs with a total employment of only 200 workers. Further up the valley, employment in underground mines has similarly contracted. Although employment in open cut mines has increased since 1986, numbers have been declining since 1992.

Unemployment

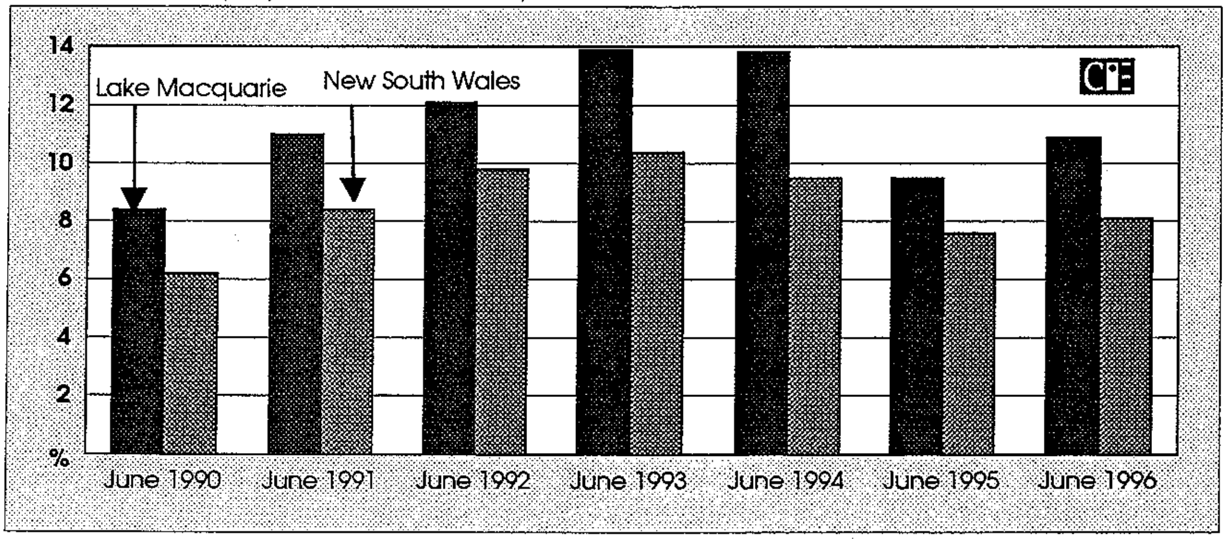
Chart B.3 shows how unemployment has varied in Lake Macquarie and in New South Wales. As in many other regional centres, unemployment in Lake Macquarie is significantly higher than the statewide average. Over the period reported, the rate of unemployment has generally been 3 to 4 percentage points higher than in the rest of New South Wales.

When assessing the impact of reduced employment which would result from closure of the Cooranbong Colliery, it is necessary to consider the wider regional labour market. Anecdotal evidence suggests that people are prepared to travel significant distances for a position in a mine. This means the prospects for displaced workers will depend on the number of job seekers and positions vacant right through the Hunter Valley rather than in the Lake Macquarie area alone.

The Department of Employment, Education, Training and Youth Affairs estimates that in the wider region of the Upper Hunter, Newcastle, Lake Macquarie and Wyong approximately 55 persons were registered as unemployed and searching for positions as mine labourers in the last quarter of 1996 (Personal Communication, 10 September 1996).

Box 1 **City of Lake Macquarie community profile** cont

Chart B.3 Unemployment in Lake Macquarie and New South Wales

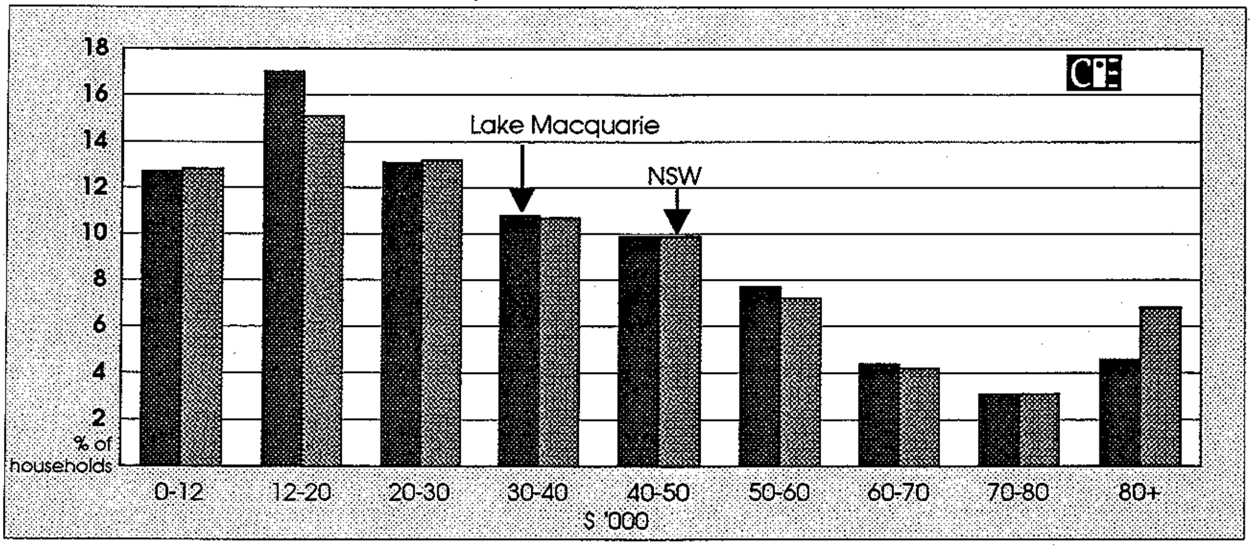


Data source: DEETYA (1996), ABS, Labour Force, NSW and ACT, cat. no. 6201.1.

Incomes

Chart B.4 shows a comparison between household incomes in Lake Macquarie and New South Wales as a whole. Relative to New South Wales, Lake Macquarie has fewer high income households ($80 000+) and greater number of households in the $12 000–$20 000 income range. This may reflect a greater number of retirees and higher than average unemployment levels in the region.

Chart B.4 Annual household income



Data source: ABS (1993) Basic Community Profiles, cat. no. 2722.1.

Impacts at the state level

The impacts at the wider state level will arise via the flow through effects of continued mining activity in the Hunter region. These statewide effects, along with the national effects, have been modelled using an economywide model of the Australian economy — the Multiregional Monash (MRM) model. The MRM model distinguishes eight regions (the six states and two territories) and thirteen commodities/industries. This allows analysis of economywide impacts both at the state and national levels.

Economywide models such as MRM take account of key linkages between industries, imports, exports and households. The MRM model can be used to capture the direct effects of the mine extension on mining activity, as well as the flow-on effects in the sectors supplying inputs to the mine and supplying goods and services to households whose incomes are affected by the activity of the mine and its suppliers.

The analysis has a short term focus, specifically concentrating on the effect of continued mine operation. Key assumptions concerning the state and national economies are:

- real wage rates would not be influenced by the closure of the Cooranbong Colliery and employees displaced would join the pool of unemployed and would not be employed elsewhere in the economy in the short run;
- export prices for coal would be unaffected by closure or extension of the Cooranbong Colliery;
- in simulating the closure of the mine, based on information supplied by Powercoal, domestic output of the mining sector is assumed to fall by $62 million and direct employment is assumed to fall by 270 persons; and
- extension of mining activity at Cooranbong is assumed to lead to coal output worth $50 million, $84 million of this being exported and 220 jobs are created which would have otherwise have been lost if the mine closed. Again this assumption is based on projections supplied by Powercoal.

The results of the simulations using this modelling approach are presented in table 9. These show that the closure of the Cooranbong Colliery could, under the assumptions described above, lead to a reduction in real Gross State Product (GSP) of $86 million and a loss of 1057 jobs statewide. The extension of mining activity could add $194 million to real GSP and create up to 1536 jobs statewide.

Table 9 **Estimated annual impacts on the NSW state economy**

	Units	*Effect of closure*	*Effect of extension*	*Net effect*
Real Gross State Product	*$ 1995-96*	-$86m	$194m	$108m
Aggregate employment	*No. of persons*	-1057	1536	479

Source: CIE calculations.

As with the regional analysis these latter effects are the appropriate measures of the impact of the mine extension on the state. The net addition to the state economy over *present* levels of GSP and employment are $108 million and 479 jobs respectively — arising from the higher output (and exports) from the mine extension when compared with present levels. However, without the project, present levels of output will decline to zero.

The ABS's latest mining industry survey indicates that value added (wages and salaries plus profits) is 58 per cent of turnover in New South Wales mining. The estimates in table 9 suggest that a total value added of $129 million is created in the state's economy outside of the mining sector in New South Wales as a result of this project. With 1316 jobs created in other areas of New South Wales's economy, this amounts to $98 024 of value added per job. This compares with total value added (across all industries and nationally) of around $80 000 per full time employee.

The estimates in table 9 broadly reflect average labour to capital input combinations across the various industries in New South Wales and therefore yield quite high estimates of employment impacts. To the extent that additional output increases can be met through the utilisation of slack capacity in the economy, the employment impacts will be overstated (that is, at the margin, production would be less labour intensive, so much of the additional value added would be in the form of profits rather than as wage incomes generated by additional employment).

Clements and Ye Qiang (1995) have conducted an analysis of the impact of mining on the Western Australian economy. They estimate that the coal, oil and gas mining sector has an employment multiplier of around 3.6. If a similar multiplier is appropriate in New South Wales then the employment effects of extending the life of the Cooranbong Colliery could be as low as 790. We would expect that the employment impacts would be closer to this level if much of the additional output demands could be met through utilisation of slack capacity. Even at this level, the incremental employment effects remain substantial.

Impacts on state government revenue

The proposed extension project will contribute to state government revenue through:

- payroll tax — both directly, from continued employment at the Cooranbong Colliery, and indirectly, as a result of flow through employment throughout the state;
- coal royalties;
- electricity charges;
- rail transport charges; and
- port charges.

Table 10 presents estimates of the likely annual revenue benefits for the state government of continued mine operation.

> Overall the five main sources of revenue are estimated to contribute $22.1 million in revenue to the state government that would otherwise be lost to it. Other less significant sources of revenue include fuel taxes, motor vehicle registration and other indirect taxes. These would accrue either as a direct result of mine activity or through induced activity in the state economy.

If the lower employment impacts identified above were observed then payroll tax from indirect sources would be $0.8 million resulting in a total revenue for the state government of $21.2 million.

As a subsidiary of a state owned enterprise, the profits that Powercoal earn from its activities at the Cooranbong mine will benefit the state government, through either dividend payments or increasing the value of the state's equity in the parent company (Pacific Power) through debt reduction or accumulation of reserves. In the year ending 30 June 1996 Cooranbong contributed earnings of $14 million to Powercoal.

Table 10 **Estimated annual effects on state government revenue**

Revenue source	*Revenue $ million per year*
Payroll tax	
Direct	1.3
Indirect[a]	1.7
Electricity charges	2.1
Rail transport charges	6.0
Port charges	4.6
Coal royalties	6.4
Total	22.1

[a]Based on employment impacts derived from MRM modelling.
Source: CIE calculations, Powercoal.

Impacts at the national level

The impacts at the national level have been estimated using the MRM model and are basically calculated as an aggregate of the impacts on all regions. The methodology behind the MRM model simulations are discussed above. The estimated results at the national level are presented in table 11 for selected key variables.

The results at the national level suggest that the majority of the impact of the mine extension will be felt in New South Wales. National Real Gross Domestic Product (GDP) is expected to increase by $206 million per annum if mining activity is extended at Cooranbong, compared with an estimated $194 million increase in the GSP of New South Wales. Similarly national employment would be higher by about 1584 jobs compared to an increase in employment in New South Wales of 1536. Positive benefits are expected for the Balance of Trade, driven primarily by increased exports from Cooranbong.

As with the statewide employment impacts, the impacts at the national level could be lower if additional output could be met through utilisation of slack capacity in the economy. The ABS estimate a national employment multiplier for mining of 3.98, which would imply that the extension of the Cooranbong Colliery would support total employment of 875 persons nationally. If much of the output could be produced using slack capacity, then the national employment impacts are likely to be closer to this level.

Impacts on Commonwealth government revenue

Personal and company income tax are likely to increase as sources of revenue for the Commonwealth budget as a result of continued activity at Cooranbong. Table 12 illustrates the likely magnitudes of the effects on Commonwealth revenue. To the extent that lower employment outcomes eventuate (so profits form a greater share of value added), any loss of PAYE income for the Commonwealth would be offset by gains in company income taxes.

Table 11 **Estimated impact on the national economy**

	Units	*Effect of closure*	*Effect of extension*	*Net effect*
Real Gross Domestic Product	*$ 1995-96*	-$95m	$206m	$111m
Aggregate employment	*No. of persons*	-1104	1584	480
Balance of Trade	*$ 1995-96*	-$25m	$81m	$56m

Source: CIE calculations.

Table 12 **Estimated impacts on Commonwealth government revenue**

Revenue source	***Estimated revenue $ million***
Direct taxes	
Paid directly by Cooranbong	6.2
From flow-on impacts[a]	14.5
Indirect taxes[a]	8.5
Total	**29.2**

[a] Based on employment estimates from MRM modelling
Source: CIE estimates, Powercoal.

Other costs and benefits of the project

In addition to the impacts captured in the analysis above, there will be two further effects which we have been unable to quantify in economic terms but which should be noted.

It is anticipated that there will be some local surface water control costs linked in part to some instances of subsidence created by the project. There may be some loss to the income earning capacity (and hence value) of a limited number of rural holdings in the Mandalong Valley as a result of such negative externalities. Mine Subsidence Board contributions to remediation of damage to developments will have a mitigating effect on any such loses sustained by individual property owners. Such payments represent an internalisation of these costs to the mining industry. Without a fully articulated mine plan it is not possible to quantify these effects, as part of this socioeconomic study.

Similarly the extension of power, water and waste water services to the mine may create opportunities for cost sharing with a local industrial development estate, the development of which is understood to be presently impeded by high utilities costs. Again, no quantification of such benefits (which would have to be offset against the negative external effects) is possible on the basis of presently available information.

References

ABS, 1992, *Australian National Accounts – Input-Output Tables (Commodity details),* Cat No. 5215.0.

Centre for Transport Policy Analysis, University of Wollongong, 1991, *Road Pricing in a Regional Context: the ISC Scheme and Coal Transport in NSW,* Wollongong.

Clements, K.W. and Ye Qiang, 1995, *Multiplier effects of the Western Australian Mining and Mineral Processing Industries,* Results Statement No.1, Economic Research Centre, Perth.

Department of Mineral Resources, 1996, *New South Wales Coal Industry Profile Incorporating Joint Coal Board Statistical Supplement,* Sydney.

Department of Mineral Resources and Energy, 1991, *A Strategic Study of the New South Wales Northern Coalfield,* Discussion paper, DME 90/11.

Envirosciences Pty Ltd, 1993, *EIS for Bengalla Open Cut Mine.*

Garner, B.J., Holsman, A., Phibbs, P,. and van Kempen, T., 1980, Assessing the socioeconomic effects of coal mine developments with special references to the Upper Hunter, NSW; in J.C. Hannon (ed) *Environmental Controls for Coal Mining,* proceedings from the first national seminar, University of Sydney, Nov 24-28.

Joint Coal Board and Queensland Coal Board, 1995, *Australian Black Coal Statistics* 1995, Sydney.

Mitchell McCotter Pty Ltd, 1990, *EIS for Bulga Coal Project.*

Mitchell McCotter Pty Ltd, 1992, *EIS for South Bulga Colliery.*

Sinclair Knight, 1992, *EIS for Charbon Colliery 3rd Entry and Associated Infrastructure.*

The Hunter Valley Research Foundation, *1994/95 Lake Macquarie At a Glance.*

Tonkin, D. ,1995, *Lake Macquarie Local Government Area — Community Profile.*