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Economic Impact Assessment

Continuation of Bengalla Mine Economic Impact Assessment

Prepared for

**Bengalla Mining Company Pty Limited
C/- Hansen Bailey Pty Limited**

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EXECUTIVE SUMMARY

Gillespie Economics was commissioned by Hansen Bailey Environmental Consultants, on behalf of Bengalla Mining Company Pty Limited to complete an economic impact assessment for the Continuation of Bengalla Mine (the Project). The purpose of the assessment is to form part of an Environmental Impact Statement being prepared to support an application for State Significant Development Consent for the Project under Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979*. The Project seeks approval to extract up to 15 million tonnes per annum of Run-Of-Mine coal over a period of 24 years.

From an economic perspective there are two important aspects of the Project that can be considered:

- The economic efficiency of the Project (i.e. consideration of economic costs and benefits of the Project using Benefit Cost Analysis); and
- The economic impacts of the Project (i.e. consideration of the economic activity that the Project would provide to the regional (Muswellbrook, Singleton and Upper Hunter Local Government Areas (LGAs)) and NSW economy using input-output analysis).

A BCA of the Project indicated that it would have net production benefits to Australia of \$1,790M. Provided the residual environmental, social and cultural impacts of the Project that accrue to Australia are considered to be valued at less than \$1,790M, the Project can be considered to provide an improvement in economic efficiency and hence is justified on economic grounds.

Instead of leaving the analysis as a threshold value exercise, an attempt has been made to quantify the residual environmental impacts of the Project. However, it is evident that the main potential impacts of the Project are internalised into the production costs of the Project through mitigation measures and compensation costs. Other costs not already included in the production costs of the Project include those associated with greenhouse gas costs, surface water, groundwater and Aboriginal heritage. However, these impacts to Australia are estimated at \$24M, considerably less than the estimated net production benefits of the Project to Australia. There may also be non-market benefits from the employment provided by the Project. Overall, the Project is estimated to have net social benefits to Australia of between \$1,766M and \$2,112M, and hence is desirable and justified from an economic efficiency perspective.

While the BCA is primarily concerned with the aggregate costs and benefits of the Project to Australia, the costs and benefits may be distributed among a number of different stakeholder groups at the local, state, National and global level. The total net production benefit will be distributed amongst a range of stakeholders including:

- BMC shareholders in the form of after tax (and after voluntary contributions) profits;
- The Commonwealth Government in the form of any Company tax payable (\$509M present value) and the Minerals Resource Rent Tax from the Project, which is subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the local and regional area;
- The NSW Government via royalties (\$778M present value) which are subsequently used to fund provision of government infrastructure and services across the State, including the local and regional area; and
- The local and regional community in the form of voluntary contributions to community infrastructure and services.

The environmental, cultural and social impacts of the Project may potentially accrue to a number of different stakeholder groups at the local, State, National and global level, however, are largely internalised into the productions costs of BMC.

Noise costs, air quality costs and agricultural production costs will occur at a local level. These have been incorporated into the estimation of net production benefits via acquisition costs for affected properties and mitigation costs. As such, the bearers of these costs are compensated. Road transport impacts would also occur at the local level with the costs of road works included in the estimate of net production benefits. Residual road transport impacts have not been estimated but are expected to be insignificant. Similarly, surface water and groundwater effects will occur at the local level, but have been incorporated into the analysis via inclusion of the opportunity cost of Water Access Licences and reduced flows in rivers. Greenhouse gas costs will occur at the national and global level and will be internalised through payment of the Commonwealth Government's carbon tax. The economic costs associated with the clearing of native vegetation will occur at the State level and would be counterbalanced by the Project biodiversity offset contributions.

Aboriginal archaeological impacts would accrue at the regional or State level while Aboriginal cultural heritage impacts would accrue to local Aboriginal people. Visual impacts will occur at the local level and will be internalised by BMC through the funding of visual mitigation measures. All of these measures mean that those who experience costs have them either mitigated or compensated. Other potential environmental impacts would largely occur at the local level and were found to be insignificant. Any non-market benefits associated with employment provided by the Project would largely accrue at the local or State level.

The non-market costs that accrue to NSW are estimated at less than \$24M. These are considerably less than the net production benefits (and potential non-market employment benefits) that directly accrue to NSW. Consequently, as well as resulting in net benefits to Australia the Project would result in net benefits to NSW. An economic impact analysis, using input-output analysis found that the operation of the Project is estimated to make up to the following contribution to the regional economy for up to 24 years:

- \$1,486M in annual direct and indirect regional output or business turnover;
- \$789M in annual direct and indirect regional value added;
- \$155M in annual direct and indirect household income; and
- 1,745 direct and indirect jobs.

For the NSW economy, the operation of the Project is estimated to make up to the following contribution for up to 24 years:

- \$2,408M in annual direct and indirect regional output or business turnover;
- \$1,223M in annual direct and indirect regional value added;
- \$441M in annual direct and indirect household income; and
- 4,868 direct and indirect jobs.

Cessation of the Project operation would lead to a reduction in economic activity. The significance of these Project cessation impacts would depend on:

- The degree to which any displaced workers and their families remain within the region, even if they remain unemployed. This is because continued expenditure by these people in the regional economy (even at reduced levels) contributes to final demand.
- The economic structure and trends in the regional economy at the time. For example, if Project cessation takes place in a declining economy the impacts might be felt more greatly than if it takes place in a growing diversified economy.
- Whether other mining developments or other opportunities in the region arise that allow employment of displaced workers.

1 INTRODUCTION

1.1 ECONOMIC ASSESSMENT

Gillespie Economics was commissioned by Hansen Bailey Environmental Consultants (Hansen Bailey) on behalf of Bengalla Mining Company Pty Limited (BMC) to complete an economic impact assessment for the Continuation of Bengalla Mine (the Project). The purpose of the assessment is to form part of an Environmental Impact Statement (EIS) being prepared to support an application for State Significant Development Consent for the Project under Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The scope of work completed by Gillespie Economics for this assessment included addressing the Director-General's Environmental Assessment Requirements (DGRs) relating to economics, issued on 13 March 2012, including supplementary DGRs received on the 12 July 2012. These indicate that an economic assessment is required as part of the EIS including:

- A detailed assessment of the potential direct and indirect economic benefits of the Project for local and regional communities and the State;
- A description of the measures that would be implemented to minimise the adverse social and economic impacts of the Project, including any infrastructure improvements or contributions and/or voluntary planning agreement or similar mechanism¹; and
- A detailed assessment of the costs and benefits of the development as a whole, and whether it would result in a net benefit for the NSW community.

In this respect, consideration was given to the relevant aspects of the Department of Planning and Infrastructure's (DP&I) *Draft Guideline for Economic Effects and Evaluation in EIA* (James and Gillespie, 2002) and the NSW Government (2012) *Draft Guideline for the use of Cost Benefit Analysis in mining and coal seam gas proposals*.

From an economic perspective there are two important aspects of the Project that can be considered:

- The economic efficiency of the Project (i.e. consideration of the economic costs and benefits of the Project); and
- The economic impacts of the Project (i.e. the economic activity that the Project will provide to the regional or NSW economy).

The DP&I's draft guideline (James and Gillespie, 2002) identifies economic efficiency as the key consideration of economic analysis. Benefit Cost Analysis (BCA) is the method used to consider the economic efficiency of proposals. The draft guideline (James and Gillespie, 2002) identifies BCA as essential to undertaking a proper economic evaluation of proposed developments that are likely to have significant environmental impacts. The NSW Government (2012) *Draft Guideline for the use of cost benefit analysis in mining and coal seam gas proposals* also endorses BCA as the appropriate methodology for evaluating mining proposals. This latter guideline does not provide guidance on other forms of economic assessment.

The DP&I's draft guideline indicates that economic impact assessment may provide additional information as an adjunct to the economic efficiency analysis. Economic activity to the regional and NSW economy can be estimated using input-output (I-O) analysis, computable general-equilibrium (CGE) models or macro-econometric simulation models.

¹ This DGR is mainly addressed in the Social Impact Assessment. Mitigation measures that will be implemented to minimise the adverse environmental externalities of the Project (that are considered in this economic impact assessment) are addressed in the respective specialist reports.

It is important not to confuse the results of economic impact assessment, which focuses on indicators of economic activity i.e. direct and indirect output (expenditure/revenue), value-added, income and employment, in a specific region, with the results of BCA which is concerned with the net economic efficiency benefits from the Project.

This study relates to the preparation of each of the following types of analyses:

- A BCA of the Project (Section 2); and
- An economic impact assessment of the Project (Section 3) for two regions:
 - The regional economy comprising the Local Government Areas (LGAs) of Muswellbrook, Singleton and Upper Hunter; and
 - The NSW economy.

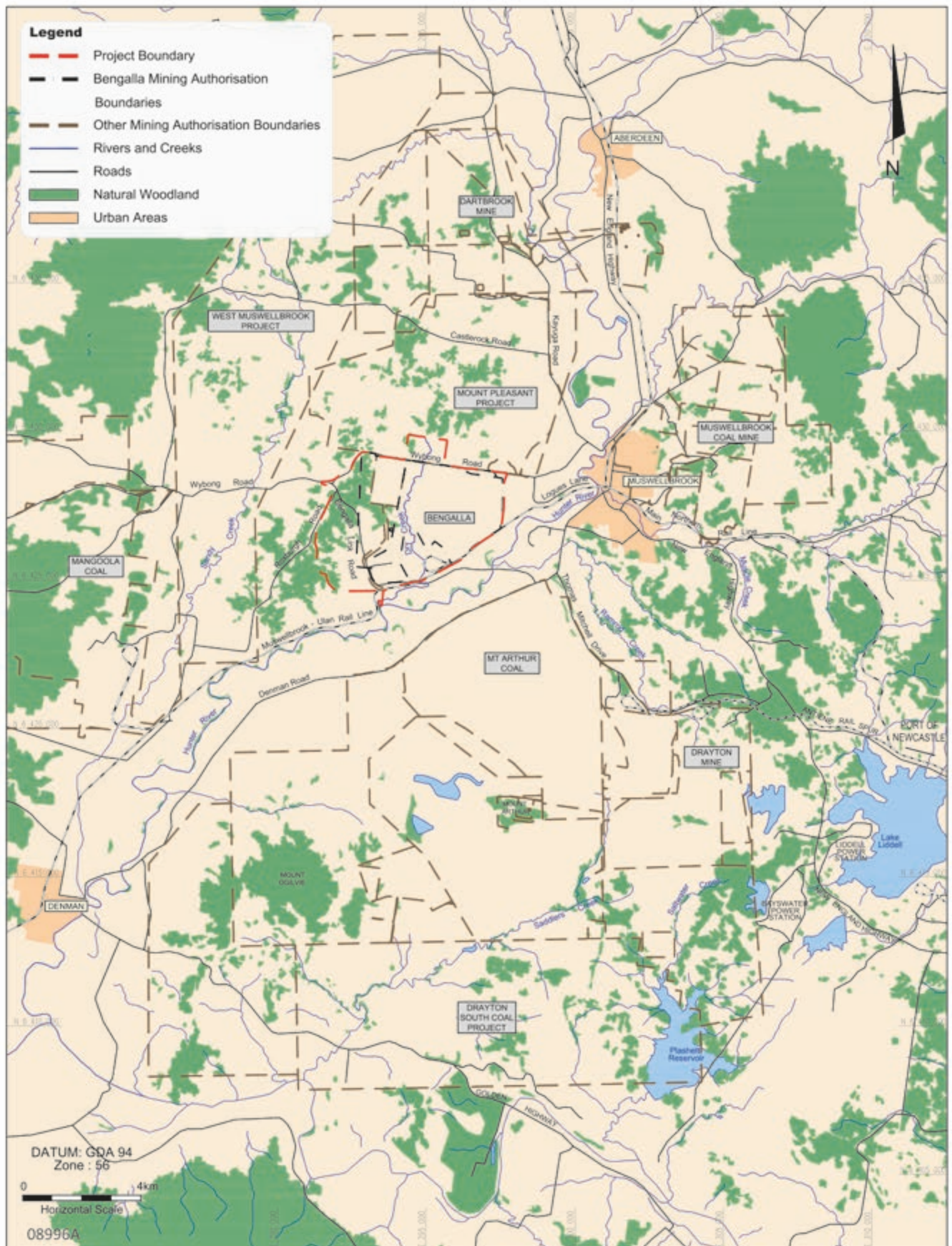
1.2 PROJECT DESCRIPTION

BMC operates the Bengalla Mine (Bengalla) in the Upper Hunter Valley of NSW, approximately 130 km north-west of Newcastle and 4 km west of Muswellbrook (see **Figure 1.1**). BMC is managed by Coal & Allied Bengalla Pty Limited. BMC has successfully operated Bengalla since 1998. The Project will enable mining to continue directly west for a 24 year period at a rate of up to 15 Million tonnes per annum (Mtpa) of Run of Mine (ROM) coal (the Project).

The Project generally comprises:

- Open cut mining towards the west at a rate of up to 15 Mtpa ROM coal for 24 years to a total of 316 Mt;
- An out of pit Overburden Emplacement Area (OEA) to the west of Dry Creek which may be utilised for excess spoil material until it is intercepted by mining;
- Continued use, extension or relocation of existing infrastructure, including administration and parking facilities, in-pit facilities (including dragline shut down and erection pad), helipad, tyre laydown area, explosives and reload storage facility, core shed workshop, roads, reject bin, ROM Hopper, stockpiles, conveyors, water management infrastructure, supporting power infrastructure, and ancillary infrastructure;
- Processing, handling and transportation of coal via the existing CHPP (to be upgraded) and rail loop for export and domestic sale;
- Continued rejects and tailings co-disposal in the Eastern OEA and temporary in pit reject emplacement;
- Relocation of a 3 km section of Bengalla Link Road during or after Year 15 near the existing mine access road to facilitate coal extraction;
- The diversion of Dry Creek via dams and pipe work with a later permanent realignment of Dry Creek through rehabilitation areas when emplacement areas are suitably advanced;
- Relocation of water storage infrastructure as mining progresses through existing dams (including the Staged Discharge Dam and raw water dam); and
- A workforce of approximately 900 full time equivalent personnel (plus contractors) at peak production;

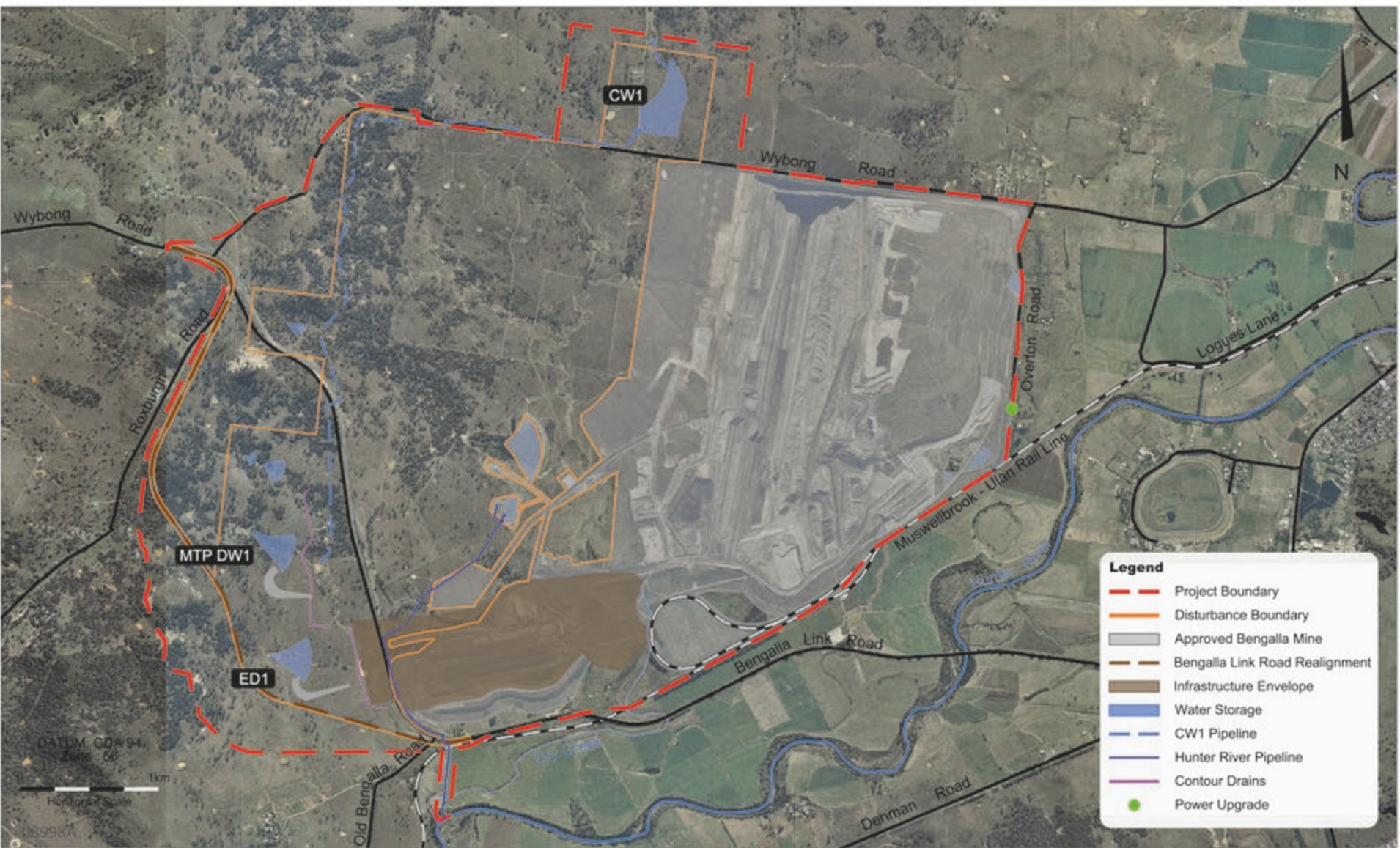
The Project will generally be undertaken within the Disturbance Boundary as illustrated on Figure 1.2. The infrastructure will be located within the Infrastructure Envelope shown on Figure 1.2 and may be aligned or located differently to what is depicted on the detailed infrastructure plans but will be within the Infrastructure Envelope.



BENGALLA MINE

Regional Locality

FIGURE 1



BENGALLA MINE
Conceptual Project Layout

FIGURE 2



Hansen Bailey
ENVIRONMENTAL CONSULTANTS

2 BENEFIT COST ANALYSIS

2.1 INTRODUCTION

Introduction to BCA

BCA has its theoretical underpinnings in neoclassical welfare economics. Applications in NSW are guided by these theoretical foundations as well as the NSW Treasury (2007). BCA applications within the NSW environmental assessment framework are further guided by the NSW DP&I *Draft Guidelines for Economic Effects and Evaluation in EIA* (James and Gillespie 2002) and the NSW Government (2012) *Draft Guidelines for the use of Cost Benefit Analysis in mining and coal seam gas proposals*.

BCA is concerned with a single objective of the EP&A Act and governments i.e. economic efficiency. It provides a comparison of the present value of aggregate benefits to society, as a result of a project, policy or program, with the present value of the aggregate costs. These costs and benefits are defined and valued based on the microeconomic underpinnings of BCA. In particular, it is the values held by individuals in the society that are relevant, including both financial and non-financial values. Provided the present value of aggregate benefits to society exceed the present value of aggregate costs (i.e. a net present value of greater than zero), the project is considered to improve the well-being of society and hence is desirable from an economic efficiency perspective.

While BCA can provide qualitative and quantitative information on how costs and benefits are distributed, welfare economics and BCA are explicitly neutral on intra and intergenerational distribution of costs and benefits. There is no welfare criterion in economics for determining what constitutes a fair and equitable distribution of costs and benefits. Judgements about equity are subjective and are therefore left to decision-makers.

Similarly BCA does not address other objectives of the EP&A Act and governments. Decision-makers therefore need to consider the economic efficiency implications of a project, as indicated by BCA, alongside the performance of a project in meeting other conflicting goals and objectives of the EP&A Act and government.

Definition of Society

BCA includes the consideration of costs and benefits to all members of society i.e. consumers, producers and the broader society as represented by the government.

As a tool of investment appraisal for the public sector, BCA can potentially be applied across different definitions of society such as a local area, state, nation or the world. However, most applications of BCA are performed at the national level. This national focus extends the analysis beyond that which is strictly relevant to a NSW government planning authority. However, the interconnected nature of the Australian economy and society creates significant spillovers between States. These include transfers between States associated with the tax system and the movement of resources over state boundaries.

Nevertheless, “where major impacts spill over national borders, then BCA should be undertaken from the global as well as the national perspective” (Boardman et al 2001). For mining projects, impacts that spill over national borders include greenhouse gas costs and benefits to foreign owners.

BCA at a sub-national perspective is not recommended as it results in a range of costs and benefits from a project being excluded, making BCA a less valuable tool for decision-makers (Boardman et al 2001).

BCAs of mining projects are therefore often undertaken from a global perspective i.e. including all the costs and benefits of a project, no matter who they accrue to, and then truncated to assess whether there are net benefits to Australia. A consideration of the distribution of costs and benefits can then be undertaken to identify the benefits and costs that accrue to NSW and other regions. However, a project is considered to improve the well-being of society if it results in net benefits to the nation, even if it results in net costs to the local area.

Definition of the Project Scope

The definition of the Project for which approval is being sought has important implications for the identification of the costs and benefits of a project. Even when a BCA is undertaken from a global perspective, and includes costs and benefits of a project that accrue outside the national border, only the costs and benefits associated with the defined project are relevant. For mining projects, typically only the costs and benefits from mining the coal and delivering it to Port or domestic users, are relevant.

Coal is an intermediate good i.e. it is an input to other production processes such as production of electricity and steel making. However, these other production processes themselves require approval and, in BCA, would be assessed as separate projects.

Net Production Benefits

BCA of mining proposals invariably involves a trade-off between:

- The net production benefits of a project; and
- The environmental, social and cultural impacts (most of which are costs of mining but some of which may be benefits).

Net production benefits can be estimated based on market data on the projected financial² value of coal less the capital and operating costs of projects, including opportunity costs of capital and land already in the ownership of mining companies. This is normally commercial in confidence data provided by the proponent. Production costs and benefits over time are discounted to a present value.

Environmental, Social and Cultural Impacts

The consideration of non-market impacts in BCA relies on the assessment of other experts contributing information on the biophysical impacts. The environmental impact assessment process results in detailed (non-monetary) consideration of the environmental, social and cultural impacts of a project and the proposed means of mitigating the impacts.

At its simplest level, BCA may summarise the consequences of the environmental, social and cultural impacts of a project (based on the assessments in the EIS), for people's well-being. These qualitatively described impacts can then be considered alongside the quantified net production benefits, providing important information to the decision-maker about the economic efficiency trade-offs involved with a project.

² In limited cases the financial value may not reflect the economic value and therefore it is necessary to determine a shadow price for the coal.

At the next level of analysis, attempts may be made to value some of the environmental, social and cultural impacts. These environmental, social and cultural impacts generally fall into three categories, those which:

- “Can be readily identified, measured in physical terms and valued in monetary terms;
- Can be identified and measured in physical terms but cannot easily be valued in money terms; and
- Are known to exist but cannot be precisely identified, measured or value” (NSW Treasury 2007).

Impacts in the first and second category can potentially be valued in monetary terms using benefit transfer or, subject to available resources, primary non-market valuation methods. Benefit transfer involves using information on the physical magnitude of impacts and applying per unit value estimates obtained from non-market valuation studies undertaken in other contexts.

Primary non-market valuation methods include choice modelling and the contingent valuation method where a sample of the community is surveyed to ascertain their willingness to pay to avoid a unit change in the level of a biophysical attribute. Other methods include the property valuation approach where changes in environmental quality may result in changes in property value.

In attempting to value the impacts of a project on the well-being of people there is also the practical principle of materiality. Only those impacts which are likely to have a material bearing on the decision need to be considered in BCA (NSW Government, 2012).

Where benefits and costs cannot be quantified these items should be included in the analysis in a qualitative manner (NSW Treasury 2007).

Consideration of Net Social Benefits

The consideration of the net social benefits of a project combines the value estimate of net production benefits and the qualitative and quantitative estimates of the environmental, social and cultural impacts.

In combining these considerations it should be noted that the estimates of net production benefits of a project generally includes accounting for costs aimed at mitigating, offsetting or compensating for the main environmental, social and cultural impacts. This includes the costs of purchasing properties adversely affected by noise and dust, providing mitigation measures for properties moderately impacted by noise and dust, the costs of providing ecological offsets and the cost of purchasing groundwater and surface water entitlements in the water market etc. Including these costs effectively internalises the respective and otherwise, non-monetary environmental, social and cultural costs. To avoid double counting of impacts, only residual impacts, after mitigation, offset and compensation, require additional consideration.

Even when no quantitative valuation is undertaken of the environmental, social and cultural impacts of a project, the threshold value approach can be utilised to inform the decision-maker of the economic efficiency trade-offs. The estimated net production benefits of a project provides the threshold value that the non-quantified environmental, social and cultural impacts of a project (based on the assessments in the EIS), after mitigation, offset and compensation by the proponent, would need to exceed for them to outweigh the net production benefits.

Where the main environmental, social and cultural impacts of a project are valued in monetary terms, stronger conclusions can be drawn about the economic efficiency of a project i.e. the well-being of society.

Any other residual environmental, cultural or social costs that remain unquantified in the analysis³ can also be considered using the threshold value approach. The costs of these unquantified environmental, cultural and social impacts would need to be valued by society at greater than the quantified net social benefit of a project to make it questionable from an economic efficiency perspective.

Steps in BCA

BCA of the Project involves the following key steps:

- Identification of the base case;
- Identification of the Project and its implications;
- Identification and valuation of the incremental benefits and costs;
- Consolidation of value estimates using discounting to account for temporal differences;
- Application of decision criteria;
- Sensitivity testing; and
- Consideration of non-quantified benefits and costs.

What follows is a BCA of the Project based on financial, technical and environmental advice provided by BMC and its' specialist consultants.

2.2 IDENTIFICATION OF THE BASE CASE AND THE PROJECT

Identification of the "base case" or "without" Project scenario is required in order to facilitate the identification and estimation of the incremental economic benefits and costs of the Project.

Under the base case, the current mining operation at Bengalla would cease in 2017 and the residual value of land and capital equipment being used for that operation would be able to be realised by sale or alternative use. Under the base case the additional land required for the Project would continue to be used for rural and other purposes.

In contrast, the Project (as described in Section 1.2) is open-cut mining up to 15 Mtpa of ROM coal for a period of up to 24 years, and delivery of coal to the Port of Newcastle for export or available for domestic use.

At the end of the Project it is assumed that the residual value of capital equipment and land would be realised through sale or alternative use.

BCA is primarily concerned with the evaluation of a project relative to the counterfactual of no project. Where there are a number of alternatives to a project then these can also be evaluated using BCA. However, alternatives need to be feasible to the proponent and to this end a number of alternatives to the Project were considered by BMC in the development of the Project description. Section 4 of the Main Volume of the EIS provides more detail on the consideration of Project alternatives.

The Project assessed in the EIS and evaluated in the BCA is considered by BMC to be the most feasible alternative for minimising environmental and social impacts whilst maximising resource recovery and operational efficiency. It is therefore this alternative that is proposed by BMC and was subject to detailed economic analysis.

³ Including potential impacts that were unknown at the time of the preparation of the EIS or arise during the EIA process due to differences in technical opinions.

2.3 IDENTIFICATION OF BENEFITS AND COSTS

Relative to the base case or “without” Project scenario, the Project may have the potential incremental economic benefits and costs shown in Table 2.1. The main potential economic benefit is the producer surplus (net production benefits) generated by the Project and any non-market employment benefits it provides, while the main potential economic costs relate to any environmental, social and cultural costs.

Table 2.1 - Incremental Economic Benefits and Costs of the Project

Category	Costs	Benefits
Net production benefits	Opportunity costs of capital equipment Opportunity cost of land ¹ Development costs including labour, capital equipment and acquisition costs for impacted properties and offsets ¹ Operating costs of mine including labour and mitigation measures Rehabilitation and decommissioning costs at end of the Project life	Avoided decommissioning and rehabilitation costs in 2017 Value of coal production Residual value of capital equipment and land at end of Project life
Potential environmental, social and cultural impacts	Noise impacts and blasting impacts Air quality and greenhouse gas impacts Surface water and groundwater impacts Agricultural impacts ¹ Geochemical impacts Ecology impacts Road transport impacts Aboriginal heritage impacts Non-Aboriginal heritage impacts Visual impacts	Any non-market benefits of employment Value of ecological offsets

¹ The value of foregone agricultural production is included in the value of land.

It should be noted that the potential environmental, social and cultural costs, listed in Table 2.1, are only economic costs to the extent that they affect individual and community well-being through direct use of resources by individuals or non-use. If the potential impacts do not occur or are mitigated to the extent where community wellbeing is insignificantly affected (i.e. those bearing the costs are fully compensated), then no environmental, social or cultural economic costs should be included in the Project BCA.

2.4 QUANTIFICATION/VALUATION OF BENEFITS AND COSTS

Consistent with NSW Treasury (2007) guidelines, the analysis has been undertaken in real values with discounting at 7 percent (%) and sensitivity testing at 4% and 10%. The analysis period is 25 years. Where competitive market prices are available, they have generally been used as an indicator of economic values. Environmental, cultural and social impacts have been initially been left unquantified and interpreted using the threshold value method⁴. An attempt has also been made to estimate environmental, cultural and social impacts using market data and benefit transfer⁵.

⁴ The threshold value method uses the value of quantified net production benefits as the amount that unquantified environmental, social and cultural costs would need to exceed to make a project questionable from an economic efficiency perspective.

⁵ Benefit transfer refers to borrowing economic values that have been determined for other study sites.

2.4.1 *Production Costs and Benefits*⁶

Production Costs

Opportunity Cost of Land and Capital

Under the base case or without Project scenario, the current mining operation at Bengalla would cease in 2017 and the value of land and capital equipment used in that mining operation would be able to be realised through sale or alternative use. There is an opportunity cost associated with continuing to use this land and capital equipment for the Project instead of its next best use. An indication of the opportunity cost of this land and capital equipment can be gained from its market value, estimated at \$61M and \$579M, respectively. The market value of land reflects among other things, the present value of the expected stream of profits from the next best alternative land use (e.g. agriculture).

Development Cost of the Project

Development costs of the Project are associated with the purchase of mining equipment, upgrade of the CHPP, associated conveyors and stockpile areas, upgrades to the existing site infrastructure, construction of a radio tower, relocation of the Explosives Magazine and Reload Facility, relocation of section of Bengalla Link Road, land acquisitions, the interim diversion and realignment of Dry Creek, construction of raw water dams and a clean water dam and sustaining capital. These costs include labour costs during the development of the Project, which reflect the value of labour resources in their next best use.

These incremental development costs over the life of the mine are estimated at \$1.4 billion (B). These development costs include an allowance for acquisition of land for properties adversely affected by noise/dust/vibration and ecological offsets. Development costs are included in the economic analysis in the years that they are expected to occur.

Annual Operating Costs of the Project

The operating costs of the Project include those associated with mine operation (including topsoil and overburden stripping, ROM coal mining and haulage and rehabilitation), plant and infrastructure operations (including CHPP operation), coal delivery (rail freight and Port handling and loading) and general costs (including overheads and administration, marketing and the research levy). These costs include labour costs, which reflect the value of labour resources in their next best use. Average annual operating costs (excluding depreciation and royalties) are estimated at approximately \$559M per annum for the 24 year period.

While royalties are a cost to BMC, they are part of the overall net production benefit of the mining activity that is redistributed by government. Royalties are therefore not included in the calculation of the resource costs of operating the Project. Nevertheless, it should be noted that the Project would generate total royalties in the order of \$1,833M (\$778M present value).

Depreciation has also been omitted from the estimation of operating costs since depreciation is an accounting means of allocating the cost of a capital asset over the years of its estimated useful life. The economic capital costs are included in the development costs of the Project in the years in which they occur.

⁶ All values reported in this section are undiscounted Australian dollars unless otherwise specified.

Rehabilitation and Decommissioning Costs

Decommissioning and rehabilitation costs at the end of the Project life are estimated at \$69M.

Production Benefits*Avoided Rehabilitation and Decommissioning Costs*

At the end of the current approval life in 2017 the site infrastructure area would require decommissioning at an estimated cost of \$49M. With the Project these costs in 2017 would be avoided and hence represent a benefit of the Project.

Value of Coal

Total incremental ROM coal production is estimated at 285 Mt⁷ with peak production at 15 Mtpa ROM. Product coal is thermal coal, primarily for export.

Both demand for and supply of coal influences current and projected prices.

Projected prices for the Project product thermal coal were provided by BMC and averaged AUD\$99/tonne. There is uncertainty around future coal prices (valued in USD) as well as the AUD/USD exchange rate and hence assumed coal prices have been subjected to sensitivity testing (see Section 2.6).

Residual Value at End of the Evaluation Period

At the end of the Project, capital equipment and land (excluding offsets) may have some residual value that could be realised by sale or alternative use. The residual value of capital equipment and land is estimated at \$0M and \$16M, respectively.

2.4.2 Environmental, Social and Cultural Costs and Benefits**Greenhouse Gases**

The Project is predicted to generate in the order of 14.2 Mt of direct carbon dioxide equivalent (CO₂-e) emissions (Scope 1 emissions) over the lifetime of the Project. Approximately 1.9 Mt CO₂-e of Scope 1 emissions will be generated through on-site electricity consumption. The Project will also generate 1.5 Mt CO₂-e of Scope 3 emissions through the transportation of coal to the Port of Newcastle. The economic analysis has included these emissions as a potential environmental cost of the Project.

To place an economic value on CO₂-e emissions, a shadow price of CO₂-e is required that reflects its global social costs. The global social cost of CO₂-e is the present value of additional economic damages now and in the future caused by an additional tonne of CO₂-e emissions. There is great uncertainty around the global social cost of CO₂-e with a wide range of estimated damage costs reported in the literature. An alternative method to trying to estimate the global damage costs of CO₂-e is to examine the price of CO₂-e credits/taxes. Again, however, there is a wide range of prices. For this analysis, a shadow price of AUD\$23/t CO₂-e rising at 2.5 per cent per year in real terms for three years and then remaining constant was used. Sensitivity testing assuming a shadow price from AUD\$8/t CO₂-e to AUD\$40/t CO₂-e was also undertaken (refer to Attachment 1).

⁷ The Project description refers to mining of a total of 316 Mt. The mining of some of this resource is already permitted under the existing approval.

This represents the global social cost of carbon i.e. the cost of carbon emissions to the population of the whole world. In the absence of any studies that have focused on the social damage cost of carbon emissions to Australians, some means of apportioning global damage costs borne by Australians is required. For the purpose of the economic assessment this has been undertaken using Australia's share of global gross domestic product (around 1%). An alternative approach would be Australia's share of world population which is considerably less than 1%.

Agricultural Production

The present value of foregone agricultural production is reflected in land prices. The value of foregone agricultural production, as a result of the Project, has therefore been incorporated into the BCA through inclusion of the full land value (opportunity cost) of affected properties.

Operational Noise

Mining

During Project operation there are three private receivers, situated on two different properties, predicted as being significantly impacted by noise⁸. A further four receivers (excluding residences that are currently entitled to acquisition by other mining developments) will be moderately impacted by noise and fall with the noise management zone for the Project. An additional four properties (excluding residences that are currently entitled to acquisition by other mining developments) will experience mild noise impacts from the Project. There are no additional properties predicted to experience a significant noise impact over more than 25% of vacant land in contiguous landownership.

The impact of Project noise on nearby properties can potentially be valued using the property value method, where the change in property value as a result of the noise impacts are estimated. It is expected that the owners of the property would be granted the opportunity to be acquired via conditions of the Development Consent. Instead of incorporating the partial property value impact on these properties the full cost of acquiring the affected property has been incorporated into the development costs associated with the Project⁹. This value is expected to be an over-estimate of the cost of noise caused by the Project.

Contemporary Development Consent conditions for residences in the moderate noise management zone typically require proponents to provide at receiver noise mitigation on request by the landholder. The costs of these mitigation impacts are included in the development costs of the Project, reported above. It is recognised that to the extent that any residual noise impacts occur, after mitigation, noise costs of the Project included in the BCA will be understated.

Road and Rail Noise

Existing noise levels along Denman Road, including in the town of Muswellbrook are above the road traffic noise criteria. The Project will not significantly increase these noise levels. Consequently, no economic effects have been included in the BCA.

⁸ This excludes residences that are currently entitled to acquisition by other mining developments.

⁹ It is noted that there may also be some consumer surplus losses to these property owners above and beyond changes in property values. Inclusion of the full cost of acquisition is considered likely to more than allow for these consumer surplus losses. Sensitivity testing on capital cost assumptions is also undertaken to determine the impact of changes in assumptions regarding noise impacts.

Existing and future background rail traffic noise levels, in the absence of the Project, are expected to exceed relevant noise criteria at various locations near Muswellbrook, along both the Main Northern Railway and the Ulan Line. Additional rail traffic noise associated with the Project would result in a train noise increase of approximately 0.7 LAeq,24hr at residences near the Ulan Line between the Project and Muswellbrook, and an increase of under 0.5 LAeq,24hr at residences near the Main Northern Railway south east of the Ulan Line Junction. This is considered insignificant. Consequently, no economic costs have been included in the BCA for rail noise impacts.

Blasting

Blasting at the Project has the potential to cause structural damage or human discomfort at properties within 1,600m of the Project. However, all residences within 1,600m of the Project are either owned by BMC, another mining company, entitled to acquisition by another mining company or have been determined to be within the acquisition zone for the Project. Consequently, no additional economic costs have been included in the BCA for blasting impacts.

Air Quality

The Project will result in significant air quality impacts on four properties (excluding residences that are currently entitled to acquisition by other mining developments). An additional three properties (excluding residences that are currently entitled to acquisition by other mining developments) are predicted to experience dust levels above the assessment criteria for more than 25% of the property. In total, the Project will significantly impact on seven properties which will require acquisition.

The impacts on these properties can potentially be valued using the property value method, where the change in property value as a result of the air quality impacts are estimated. Instead of incorporating the partial property value impact on these properties, the full cost of acquiring the affected property has been incorporated into the development costs associated with the Project¹⁰.

Surface Water

The Project is estimated to require up to 2,200ML / year of water from the Hunter River, which will be obtained under appropriate Water Access Licences. The Project will also result in a reduction in the catchment area draining to receiving watercourses of up to 1,074 ML during the Project life and by 376 ML/year after mining. These impacts have been included in the BCA by applying an estimated market value of water of \$2,000/ML.

The Project will discharge up to 1,000 ML/year of saline water into the Hunter River in accordance with the Hunter River Salinity Trading Scheme. The opportunity cost of holding Hunter River Salinity Trading Scheme credits is included in the analysis.

Groundwater

Groundwater drawdown as a result of the Project could potentially result in a change in surface water flows and groundwater users in the surrounding region. Groundwater inflows as a result of the Project are expected to peak at 365 ML/year with an additional 220 ML from the Hunter River Alluvial Aquifer. This impact has been included in the BCA by applying an estimated market value of water of \$2,000/ML.

No privately owned bores are within the zone of depressurisation. Consequently, no economic effects are included in the BCA.

¹⁰ It is noted that there may also be some consumer surplus losses to these property owners above and beyond changes in property values. However, inclusion of the full cost of acquisition is considered likely to more than allow for these consumer surplus losses. Sensitivity testing on capital cost assumptions is also undertaken to determine the impact of changes in assumptions.

Ecology

The Project will disturb 950 ha of vegetation within the Project Boundary, comprising 881 ha of native vegetation and 69 ha of non-native vegetation (with additional areas currently being used of existing infrastructure including the Bengalla Link Road and farm dams). The Project will result in:

- Clearance of 554 ha of NSW and Commonwealth listed ecological communities, including 535 ha of box gum woodland and derived native grassland;
- Removal of 260 ha of potential forest and woodland habitat for the Tiger Orchid and 881 ha of potential forest, woodland and grassland habitat for the Lobed Blue Grass;
- The loss of 270 ha of habitat for nine threatened fauna species;
- Clearing of 9.4 ha of groundwater dependent ecosystems (Hunter Floodplain Box Gum Woodland); and
- Insignificant impacts on Stygofauna as result of groundwater drawdown.

BMC propose to fund biodiversity offsets via the Upper Hunter Biodiversity Plan to compensate for impacts that will occur to native vegetation and threatened species habitats within the Project boundary. An estimated 2,310 ha of land with appropriate offset vegetation would be acquired by the government within a strategically located area of the Upper Hunter Valley and immediate surrounds to the north and west. The cost to fund the offset land acquisition and its management has been included in the capital costs of the Project.

The impacted flora and fauna, is likely to have non-use values to the community that would be lost as a result of the Project. These values could potentially be estimated using non-market valuation methods. Similarly, the provision of offsets is also likely to have non-use values to the community that would be gained as a result of the Project. Provided the values held by the community for the offsets are equal or greater than values that would be lost then no additional economic costs warrant inclusion in the BCA. The Government's offsets policy and the DGRs for the Project requires that offsets maintain or improve biodiversity values.

Road Transport

The traffic impact assessment found that all intersections and roads in the vicinity of the Project will not exceed capacity as a result of the Project. The Project will result in the realignment of the Bengalla Link Road and the cost of this realignment is included in the development costs of the Project. The traffic assessment identifies that this realignment may result in some minor increase in travel times (36 seconds) for those using the road. This may result in some minor increase in travel times and vehicle operating costs to road users which remain unquantified in the BCA but are expected to insignificant.

Aboriginal Heritage

The Project Aboriginal archaeology assessment identified 262 sites that will be impacted by the Project including one stone quarry and three potential scarred trees. The stone quarry is of high archaeological significance and the three scarred trees are of moderate significances. There are also two artefact scatters that are of moderate archaeological significance.

Any impacts on Aboriginal heritage sites may impact the well-being of the Aboriginal community. However, monetisation of these impacts is problematic and so these impacts are best left to consideration as part of the Aboriginal Cultural Heritage Assessment.

Impacts on highly significant Aboriginal heritage sites have been shown to affect the well-being of the broader community (Gillespie Economics, 2009a). Using benefit transfer of the average value per site from Gillespie Economics (2008, 2009a, 2009b) the value of the impact on highly significant Aboriginal sites is estimated at \$16M¹¹. The potential economic non-use values of impacts on sites of moderate or moderate significance have not been estimated in this analysis, but are assumed to be minor.

Non-Aboriginal Heritage

The Project will directly impact four items of historical heritage. None of these items are heritage listed and therefore no significant economic effects would arise with respect to non-Aboriginal heritage that would warrant inclusion in the BCA.

Visual Impacts

There are a number of residences that for periods of time during the Project life may experience moderate to high visual impacts as a result of the Project. This is particularly the case for residences to the west of the mine.

Visual intrusion to surrounding landholders can potentially impact their property value¹². The costs of onsite treatments to reduce visual effects and treatments at viewer locations to reduce visual sensitivity are included the capital and operating costs of the Project. However, it is recognised that to the extent that any significant residual visual impacts occur, after mitigation, visual impact costs of the Project included in the BCA will be understated.

Non-market Value of Employment

Historically employment benefits of projects that are enjoyed by people other than those who are employed, have tended to be omitted from BCA on the implicit assumption that labour resources used in a proposal would otherwise be employed elsewhere and that there are no costs associated with transferring from one job to another. Where this is not the case and labour resources would otherwise be unemployed for some period of time, Boardman et al (2001) identifies that these labour resources should be valued in a BCA at their opportunity cost (e.g. wages less social security payments and income tax) rather than the wage rate. Adopting this approach would have the effect of increasing the net production benefits of the proposal. In addition, there may be social costs of unemployment that require the estimation of employees' willingness to pay to avoid the trauma created by unemployment (Streeter and Hamilton, 1991). These values have not been included in the Project BCA and so the net social benefits of the Project may be underestimated.

Although employees' willingness to pay to avoid the trauma created by unemployment are omitted from the Project BCA, it has also been recognised that the broader community may hold non-market values (Portney, 1994) for social outcomes such as employment (Johnson and Desvousges, 1997).

In a study of the Metropolitan Colliery in the NSW Southern Coalfields, Gillespie Economics (2008) estimated the value the community would hold for the 320 jobs provided over 23 years at \$756M (present value). In a similar study of the Bulli Seam Operations, Gillespie Economics (2009a) estimated the value the community would hold for the 1,170 jobs provided over 30 years at \$870M (present value). In a study of for the Warkworth Mine extension, Gillespie Economics (2009b) estimated the value the community would hold for 951 jobs from 2022 to 2031 at \$286M (present value).

¹¹ This represents a public good value i.e. the sum of the values held by all households in NSW.

¹² And potentially consumer surplus.

The Project will directly employ on average approximately 665 people for up to 24 years compared to 400 approved direct employees for a further five years (until 2017) under the base case. Using benefit transfer from the more conservative Bulli Seam Operation study and applying the employment value to the estimated incremental direct employment of the Project¹³ gives an estimated \$342M for the non-market employment benefits of the Project. There may be some contention about the inclusion of this value and so the results have been reported both with and without it.

2.5 CONSOLIDATION OF VALUE ESTIMATES

2.5.1 Aggregate Costs and Benefits

The present value of costs and benefits, using a 7% discount rate, is provided in Table 2.2. The main decision criterion for assessing the economic desirability of a project to society is its net present value (NPV). NPV is the present value of benefits less the present value of costs. A positive NPV indicates that it would be desirable from an economic perspective for society to allocate resources to the Project, because the community as a whole would obtain net benefits from the Project.

The Project is estimated to have total net production benefits of \$2,475M, with \$1,790M of these net production benefits accruing to Australia¹⁴. The estimated net production benefits that accrue to Australia can be used as a threshold value or reference value against which the relative value of the residual environmental impacts of the Project, after mitigation, may be assessed. This threshold value is the opportunity cost to society of not proceeding with the Project. The threshold value indicates the price that the community must value any residual environmental impacts of the Project (be willing to pay) to justify in economic efficiency terms the no development option.

For the Project to be questionable from an economic efficiency perspective, all incremental residual environmental impacts from the Project, that impact Australia¹⁵, would need to be valued by the community at greater than the estimate of the Australian net production benefits i.e. greater than \$1,790M. This is equivalent to each household in the region valuing residual environmental impacts at \$41,000. The equivalent figure for NSW and Australian households is \$700 and \$216, respectively.

Instead of leaving the analysis as a threshold value exercise, an attempt has been made to quantify the residual environmental impacts of the Project. From Section 2.4 it is evident that the main potential impacts of the Project are internalised into the production costs of the Project through mitigation measures and compensation costs. Other costs not already included in the production costs of the Project include those associated with greenhouse gas costs, surface water, groundwater and Aboriginal heritage, although from Table 2.2 it is evident that these impacts to Australia are estimated at \$24M, considerably less than the estimated net production benefits of the Project to Australia. There may also be non-market benefits from the employment provided by the Project.

Overall, the Project is estimated to have net social benefits to Australia of between \$1,766M and \$2,112M, and hence is desirable and justified from an economic efficiency perspective.

While the major environmental, cultural and social impacts have been quantified and included in the Project BCA, any other residual environmental, cultural or social impacts that remain unquantified would need to be valued at greater than between \$1,766M and \$2,112M for the Project to be questionable from an Australian economic efficiency perspective.

¹³ This is consistent with the non-market valuation studies which focused on direct employment.

¹⁴ This is the net production benefits of the Project minus net profit accruing to overseas shareholders, assuming 42% Australian ownership.

¹⁵ Consistent with the approach to considering net production benefits, environmental impacts that occur outside Australia would be excluded from the analysis. This is mainly relevant to the consideration of greenhouse gas impacts.

Table 2.2
Benefit Cost Analysis Results of the Project (Present Values @7% discount rate)

	Costs		Benefits	
	Description	Value (\$M)	Description	Value (\$M)
Production	Opportunity cost of land	\$44	Avoided decommissioning and rehabilitation costs in 2017	\$35
	Opportunity cost of capital	\$413	Value of coal	\$9,486
	Development costs	\$858	Residual value of land and capital	\$3
	Operating costs	\$5,722		
	Decommissioning and rehabilitation costs	\$13		
	Sub-total	\$7,049	Sub-total	\$9,526
	Net Production Benefits			\$2,475 (\$1,790)
Non-market Impacts	Greenhouse gas impacts	\$194 (\$2)	Non-market values of employment	\$346
	Agricultural impacts	Included in opportunity cost of land and development costs (land acquisitions)		
	Noise impacts	Cost of acquisition and noise mitigation measures are included in development costs.		
	Blasting	Insignificant		
	Air quality impacts	Cost of acquisition is included in development costs		
	Surface water	\$6		
	Groundwater	\$1		
	Ecology	Some loss of values but offset. Cost of biodiversity offset included in development costs		
	Road transport impacts	Cost of realignment of the Bengalla Link Road included in development costs. However, some minor increase in travel time and vehicle operating costs		
	Aboriginal heritage	\$16		
	Non-Aboriginal heritage impacts	Insignificant		
	Visual impacts	Some impacts. Costs of mitigation included in development costs		
	Non-market impacts sub-total	\$217 (\$24)		\$346
NET SOCIAL BENEFITS – including employment benefits				\$2,604 (\$2,112)
NET SOCIAL BENEFITS – excluding employment benefits				\$2,258 (\$1,766)

Note: totals may have minor discrepancies due to rounding. When impacts accrue globally, the numbers in brackets relates to the level of impact estimated to accrue to Australia

2.5.2 Distribution of Costs and Benefits

Introduction

As identified above, BCA is only concerned with the single objective of economic efficiency. BCA and welfare economics provide no guidance on what is a fair, equitable or preferable distribution of costs and benefits. Nevertheless, BCA can provide qualitative and quantitative information for the decision-maker on how economic efficiency costs and benefits are distributed.

Intra Generational

The net production benefit shown in Table 2.3 is potentially distributed amongst a range of stakeholders including:

- BMC shareholders in the form of after tax (and after voluntary contributions) profits;
- The Commonwealth Government in the form of any Company tax payable (\$509M present value) and the Minerals Resource Rent Tax from the Project, which is subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the local and regional area;
- The NSW Government via royalties (\$778M present value) which are subsequently used to fund provision of government infrastructure and services across the State, including the regional area; and
- The local community in the form of voluntary contributions to community infrastructure and services.

The environmental, cultural and social impacts of the Project may potentially accrue to a number of different stakeholder groups at the local, State, National and global level, however, are largely internalised into the production costs of BMC.

Noise costs, air quality costs and agricultural production costs will occur at a local level. These have been incorporated into the estimation of net production benefits via acquisition costs for affected properties and mitigation costs. As such, the bearers of these costs are compensated. Road transport impacts would also occur at the local level with the costs of road works included in the estimate of net production benefits. Residual road transport impacts have not been estimated but are expected to be insignificant. Similarly, surface water and groundwater effects will occur at the local level, but have been incorporated into the analysis via inclusion of the opportunity cost of Water Access Licences and reduced flows in rivers. Greenhouse gas costs will occur at the national and global level and will be internalised through payment of the Commonwealth Government's carbon tax. The economic costs associated with the clearing of native vegetation will occur at the State level and would be counterbalanced by the Project biodiversity offsets. Aboriginal archaeological impacts would accrue at the regional or State level¹⁶ while Aboriginal cultural heritage impacts would accrue to local Aboriginal people. Visual impacts will occur at the local level and will be internalised by BMC through the funding of visual mitigation measures. All of these measures mean that those who experience costs have them either mitigated or compensated. Other potential environmental impacts would largely occur at the local level and were found to be insignificant. Any non-market benefits associated with employment provided by the Project would largely accrue at the local or State level¹⁷.

¹⁶ Non-market valuation studies that have surveyed NSW households have found that they value the conservation of highly significant Aboriginal heritage (Gillespie Economics 2008, 2009a, 2009b).

¹⁷ It should be noted that the study from which the employment values were transferred, surveyed NSW households only.

Table 2.3 - Distribution of Benefits and Costs (Present Values at 7% Discount Rate)

Value (\$M)		Distribution			
		Local	State	National	Global
Net Production Benefits					
Net production benefits to BMC	\$1,188	✓	✓	✓	✓
Net production benefits to Commonwealth Government – Company tax	\$509	✓	✓	✓	-
Net production benefits to NSW Government – Royalties	\$778	✓	✓	-	-
Net production benefits to local and regional community in the form of voluntary contributions	Unquantified	✓	-	-	-
Total	\$2,475				
Non-market Costs and Benefits					
Benefits					
Non-market benefit of employment	\$346	✓	✓	-	-
Total	\$346				
Costs					
Greenhouse gas emissions rest of the world ¹	\$192	-	-	-	✓
Greenhouse gas emissions Australia ²	\$2	✓	✓	✓	
Agricultural impacts	Included in opportunity cost of land and development costs (land acquisitions)	✓	-	-	-
Noise impacts	Cost of acquisition and noise mitigation measures are included in development costs.	✓	-	-	-
Blasting	Insignificant	✓	-	-	-
Air quality impacts	Cost of acquisition is included in development costs	✓	-	-	-
Surface water	\$6	✓	-	-	-
Groundwater	\$1	✓	-	-	-
Ecology	Some loss of values but offset. Cost of biodiversity offset included in development costs	✓	✓	-	-
Road transport impacts	Cost of realignment of the Bengalla Link Road included in development costs. However, some minor increase in travel time and vehicle operating costs	✓	-	-	-
Aboriginal heritage	\$16	✓	✓	-	-
Non-Aboriginal heritage impacts	Insignificant	✓	-	-	-
Visual impacts	Some impacts. Costs of mitigation included in development costs	✓	-	-	-
Total	\$217				
Net Social Benefits	\$2,604				

Note: Totals may have minor discrepancies due to rounding.

¹Assuming the global social damage cost of carbon is distributed in accordance with relative share of global gross domestic product.

The non-market costs that accrue to NSW are estimated at less than \$24M. These are considerably less than the net production benefits that directly accrue to NSW through royalties (\$778M). NSW will obtain additional benefits through voluntary contributions to the local and regional community, infrastructure and services provided with a share of Commonwealth Government Company tax and minerals resource rent tax (MRRT) receipts from the Project and dividends to NSW BMC shareholders. There are also additional benefits to NSW from the potential non-market employment benefits (\$346M). Consequently, as well as resulting in net social benefits to Australia the Project would result in net social benefits to NSW.

Intergenerational

Some of the environmental, social and cultural impacts of the Project may be felt by future generations. This is particularly the case for non-market environmental impacts. However, as identified above BCA is not concerned with distributional issues. The consideration of intergenerational equity issues is therefore outside the scope of BCA.

Nevertheless, it should be noted that the costs and benefits in BCA are defined and valued based on the microeconomic underpinnings of BCA. They are based on the values held by individuals in the current generation. There is no way to measure the value that future generations hold for impacts of current day projects as they are not here to express it.

Nevertheless, as identified by Boardman et al (2001) this is not considered a serious problem for BCA because:

- Few policies involve impacts that only appear in the far future. Consequently, the willingness to pay of people alive today can be used to predict how future generations will value them;
- Most people alive today care about the well-being of their children, grandchildren and great grandchildren, whether or not they have yet been born. They are therefore likely to include the interests of these generations to some extent in their own valuations of impacts. Because people cannot predict with certainty the place that their future offspring will hold in society, they are likely to take a very broad view of future impacts; and
- Discounting used in BCA also reduces the influence of costs and benefits that occur a long way into the future.

Furthermore, increased wealth (e.g. royalties and taxes) generated by projects that have a net benefit to the current community can be used to improve the services (e.g. health, school and community services) and environment (e.g. protected areas) that are passed on to future generations.

2.6 SENSITIVITY ANALYSIS

The NPV presented in Table 2.2 is based on a range of assumptions around which there is some level of uncertainty. Uncertainty in a BCA can be dealt with through changing the values of critical variables in the analysis (James and Gillespie, 2002) to determine the effect on the NPV.

In this analysis, the BCA result was tested for 20% (+ and -) changes to the following variables at a 4%, 7% and 10% discount rate:

- Opportunity costs of land;
- Opportunity cost of capital;
- Development costs;
- Operating costs;
- Decommissioning and rehabilitation costs;
- Value of coal;
- Level of Australian ownership;
- Greenhouse costs;
- Surface water impacts;
- Groundwater impacts;
- Aboriginal heritage impacts; and
- Non-market employment impacts.

What this analysis indicates (refer to Attachment 2) is that the results of the BCA are not sensitive to the changes made in assumptions regarding any of these variables. In particular, significant increases in the values used for external impacts such as Aboriginal heritage impacts, greenhouse gas costs, surface water and groundwater impacts did not change the positive sign of the net present value of the Project. Hence the Project's desirability from an economic efficiency perspective is not changed.

The results were most sensitive to any potential decreases in the sale value of coal. A sustained reduction in coal price (over 37%) would be required to make the Project result in a reduction in economic efficiency.

3 ECONOMIC IMPACT ASSESSMENT

3.1 INTRODUCTION

The BCA in Section 2 is concerned with whether the incremental benefits of the Project exceed the incremental costs and therefore whether the community would, in aggregate, be better off 'with' the Project compared to 'without' it. In contrast, the focus of the regional economic impact assessment is the effect (impact) of the Project on the economy in terms of a number of specific indicators of economic activity, such as gross regional output, value-added, income and employment.

These indicators can be defined as follows:

- **Gross regional output** – the gross value of business turnover;
- **Value-added** – the difference between the gross regional output and the costs of the inputs of raw materials, components and services bought in to produce the gross regional output;
- **Income** – the wages paid to employees including imputed wages for self employed and business owners; and
- **Employment** – the number of people employed (including full-time and part-time).

An impacting agent may be an existing activity within an economy or may be a change to a regional economy (Powell *et al.*, 1985; Jensen and West, 1986). This assessment is concerned with the economic impact of average annual production of the Project (i.e. up to 15 Mtpa ROM coal production).

The economy on which the impact is measured can range from a township to the entire nation (Powell *et al.*, 1985). In selecting the appropriate economy, regard needs to be had to capturing the local expenditure and employment associated with the production scenarios, but not making the economy so large that the impact of the proposal becomes trivial (Powell and Chalmers, 1995). For this study, the economic impacts have been estimated for two regions:

- The regional economy comprising the Local Government Areas (LGAs) of Muswellbrook, Singleton and Upper Hunter; and
- The NSW economy.

A range of methods can be used to examine the economic impacts of an activity on an economy including economic base theory, Keynesian multipliers, econometric models, mathematical programming models and input-output models (Powell *et al.*, 1985). Economic base theory and Keynesian multipliers are relatively simple approaches that provide impact measurement only in aggregate terms. Mathematical programming models are especially useful in micro-level studies of firms and industries but become complex for whole economies. Mathematical programming models are therefore sometimes used to estimate direct effects on an industry or sector with input-output analysis used to assess economy-wide effects. Econometric models, particularly those of the general equilibrium type, have the potential to measure economic impacts in a similar way to that of input-output models with relaxation of some of the limitations of input-output analysis (Powell *et al.*, 1985). However, development of these models at the regional scale is complex and there are difficulties associated with estimating a large number of coefficients and parameters when there is virtually no local data available. Input-output analysis assumes full employment with no capacity constraints, and thus prices have no role to play in the input-output model (unlike general equilibrium modelling). However, if the area under study is a small open economy relative to the rest of the nation, where factors of production can easily move into and out of the region and local prices gravitate to external prices (subject to transport margins, etc.), then the input-output model provides a reasonable and cost effective approach to estimating disaggregated impacts by sector at the regional level (Powell *et al.*, 1985; West, undated). This study uses input-output analysis, consistent with DP&I's draft guideline.

Input-output analysis essentially involves two steps:

- Construction of an appropriate input-output table (regional transaction table) that can be used to identify the economic structure of the region and multipliers for each sector of the economy; and
- Identification of the initial impact or stimulus of the Project (construction and/or operation) in a form that is compatible with the input-output equations so that the input-output multipliers and flow-on effects can then be estimated (West, 1993).

The input-output method is based on a number of assumptions that are outlined in Attachment 3. These result in estimated impacts being an upper bound impact estimate.

3.2 INPUT-OUTPUT TABLE AND ECONOMIC STRUCTURE OF THE REGION

A 2012 input-output table of the regional economy was developed using the Generation of Input-Output Tables (GRIT) procedure (Attachment 4), an input-output table of the NSW economy (developed by Monash University) as the parent table and ABS 2011 census data on employment by industry in the region. The 109 sector input-output table of the regional economy was aggregated to 30 sectors and 6 sectors for the purpose of describing the economies.

A highly aggregated 2012 input-output table for the regional economy is provided in Table 3.1. The rows of this table indicates how the gross regional output of an industry is allocated as sales to other industries, to households, to exports and other final demands (OFD), which includes stock changes, capital expenditure and government expenditure. The corresponding column shows the sources of inputs to produce that gross regional output. These include purchases of intermediate inputs from other industries, the use of labour (household income), the returns to capital or other value-added (OVA), which includes gross operating surplus and depreciation and net indirect taxes and subsidies and goods and services imported from outside the region. The number of people employed in each industry is also indicated in the final row.

Table 3.1 - Aggregated Transactions Table: Regional Economy 2012 (\$'000)

	Ag, forestry, fishing	Mining	Manuf.	Utilities	Building	Services	TOTAL	Household Expenditure	OFD	Exports	Total
Ag, forestry, fishing	24,250	171	70,285	7	241	3,596	98,549	8,021	68,101	200,562	375,233
Mining	42	192,113	6,276	60,867	1,722	1,150	262,170	374	-173,849	5,012,765	5,101,460
Manuf.	13,759	97,101	126,741	3,743	36,284	72,799	350,428	48,118	205,079	736,066	1,339,690
Utilities	2,777	34,280	16,598	473,737	4,018	22,337	553,747	18,614	12,125	413,115	997,601
Building	2,152	33,922	2,022	11,336	108,610	32,712	190,753	0	426,398	18,364	635,515
Services	25,970	176,752	141,818	18,493	56,814	372,600	792,446	422,470	583,047	837,744	2,635,708
TOTAL	68,949	534,338	363,739	568,184	207,690	505,193	2,248,093	497,597	1,120,901	7,218,616	11,085,207
Household Income	109,263	682,120	263,658	73,109	167,962	1,049,953	2,346,066	0	0	0	2,346,066
OVA	75,587	3,158,100	122,492	173,655	64,873	237,214	3,831,920	93,353	39,633	12,974	3,977,881
Imports	121,433	726,901	589,802	182,653	194,990	843,348	2,659,127	1,100,964	212,941	511,754	4,484,786
TOTAL	375,233	5,101,460	1,339,690	997,601	635,515	2,635,708	11,085,207	1,691,914	1,373,475	7,743,344	21,893,940
Employment	2,127	8,037	2,550	783	1,707	13,455	28,660				

Gross regional product (GRP) or value-added for the regional economy is estimated at \$6,324M, comprising \$2,346M to households as wages and salaries (including payments to self employed persons and employers) and \$3,978M in OVA.

The employment total working in the region was 28,660 people.

The economic structure of the regional economy can be compared with that for NSW through a comparison of results from the respective input-output models (Figures 3.1 and 3.2). This reveals that the agriculture sectors, mining sectors and utilities sectors in the regional economy are of greater relative importance than they are to the NSW economy, while the manufacturing sectors and building sectors are of less relative importance than they are to the NSW economy. Mining sectors are the most significant sectors in the regional economy.

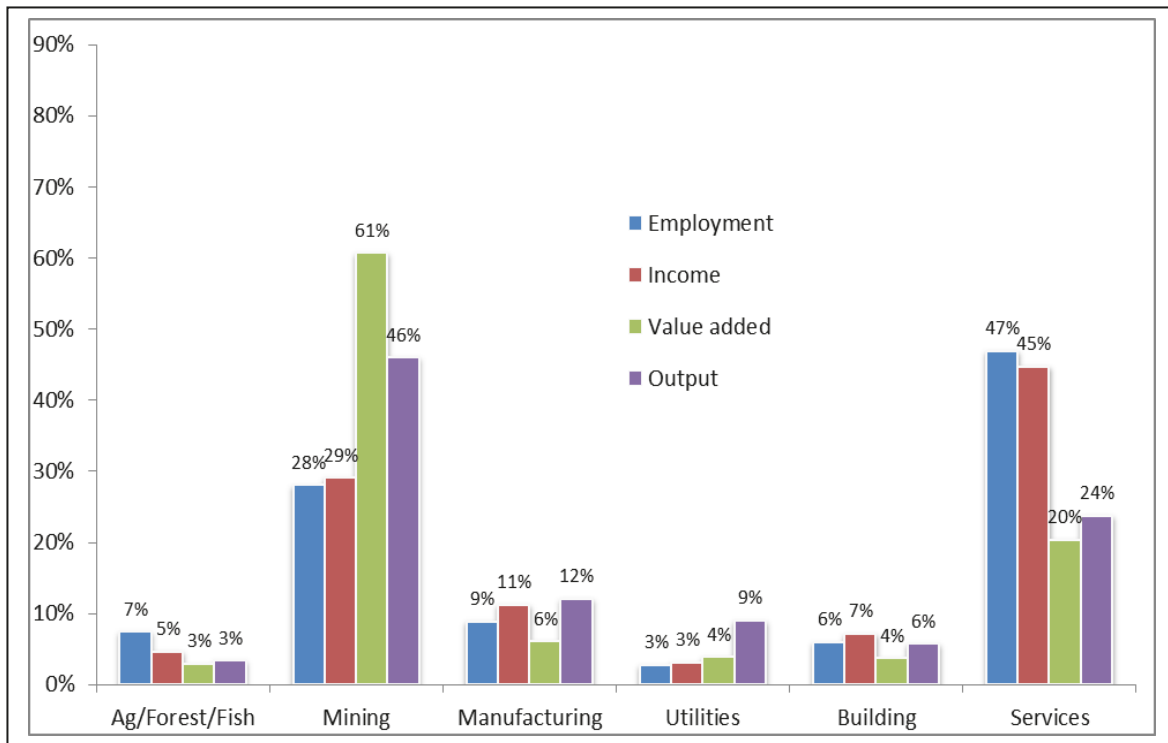


Figure 3.1 - Summary of Aggregated Sectors: Regional Economy

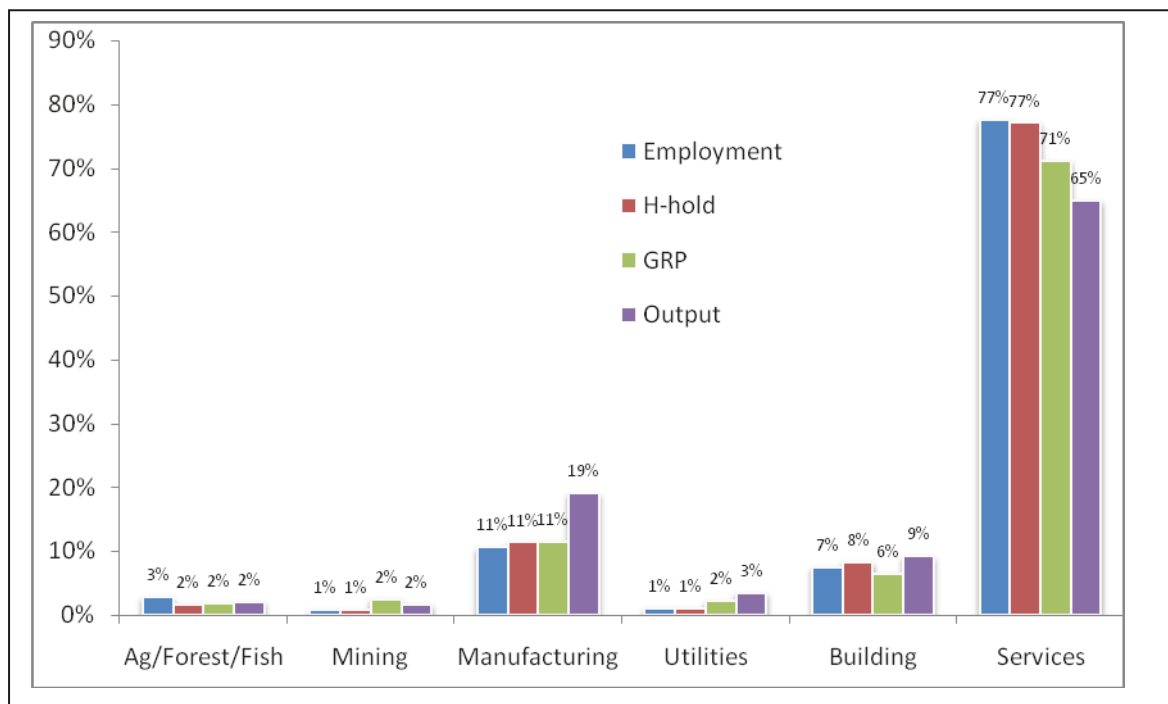
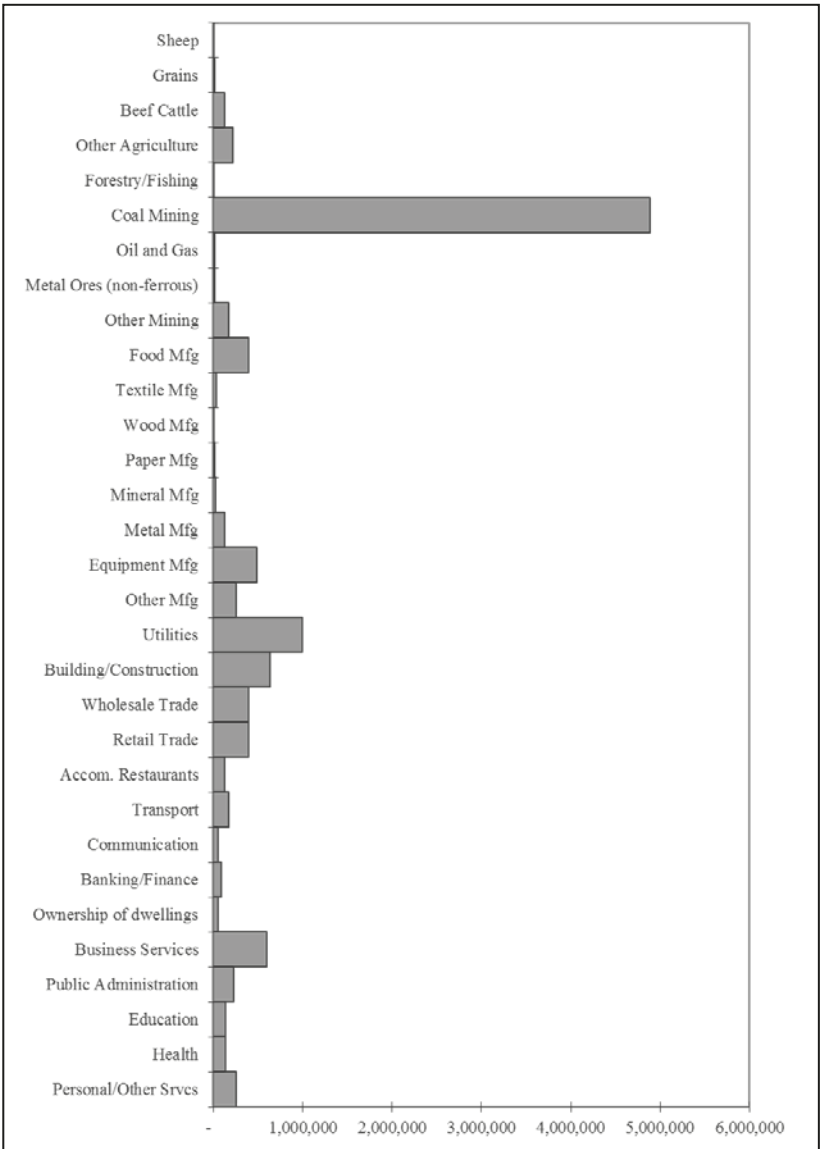


Figure 3.2 - Summary of Aggregated Sectors: NSW Economy

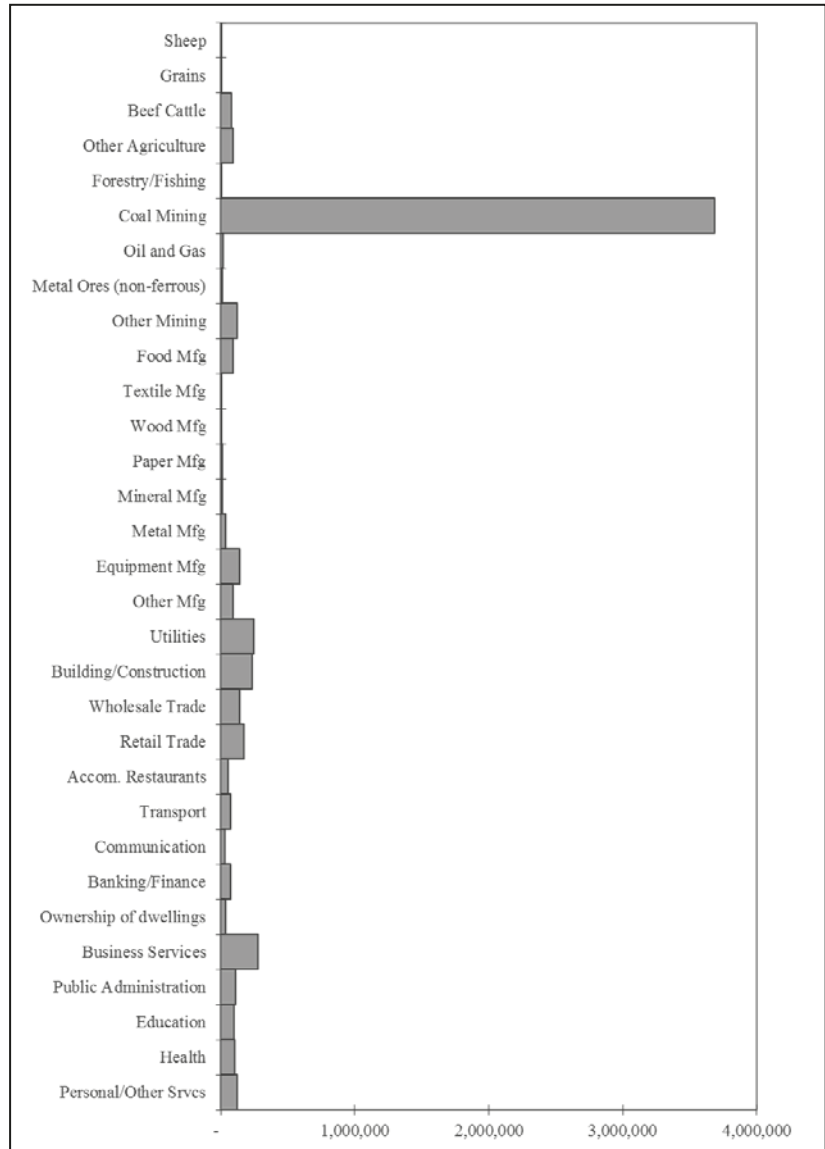
Figures 3.3 to 3.5 provide a more expansive sectoral distribution of gross regional output, employment, household income, value-added, exports and imports, and can be used to provide some more detail in the description of the economic structure of the economy.

What is clear from these figures is that in terms of gross regional output, value-added, income, employment, imports and exports, coal mining is the most significant sector of the regional economy. The next most significant sectors for output and value-added are the utilities sectors, business services sectors and building/construction sectors. For income and employment the next most significant sectors are business services, retail trade and building/construction. The equipment manufacturing sectors, building/construction sectors and business services sectors are the next most significant sectors for imports. The food manufacturing sectors, utilities sectors and wholesale trade sectors are the next most important sectors in the region for exports.

For comparison, the horse breeding and grape growing sectors are located in the other agriculture sector in Figures 3.3 to 3.5, while wine manufacturing is located in the food manufacturing sector.



Gross Regional Output



Gross Value-Added

Figure 3.3 Sectoral Distribution of Gross Regional Output and Value-Added (\$'000)

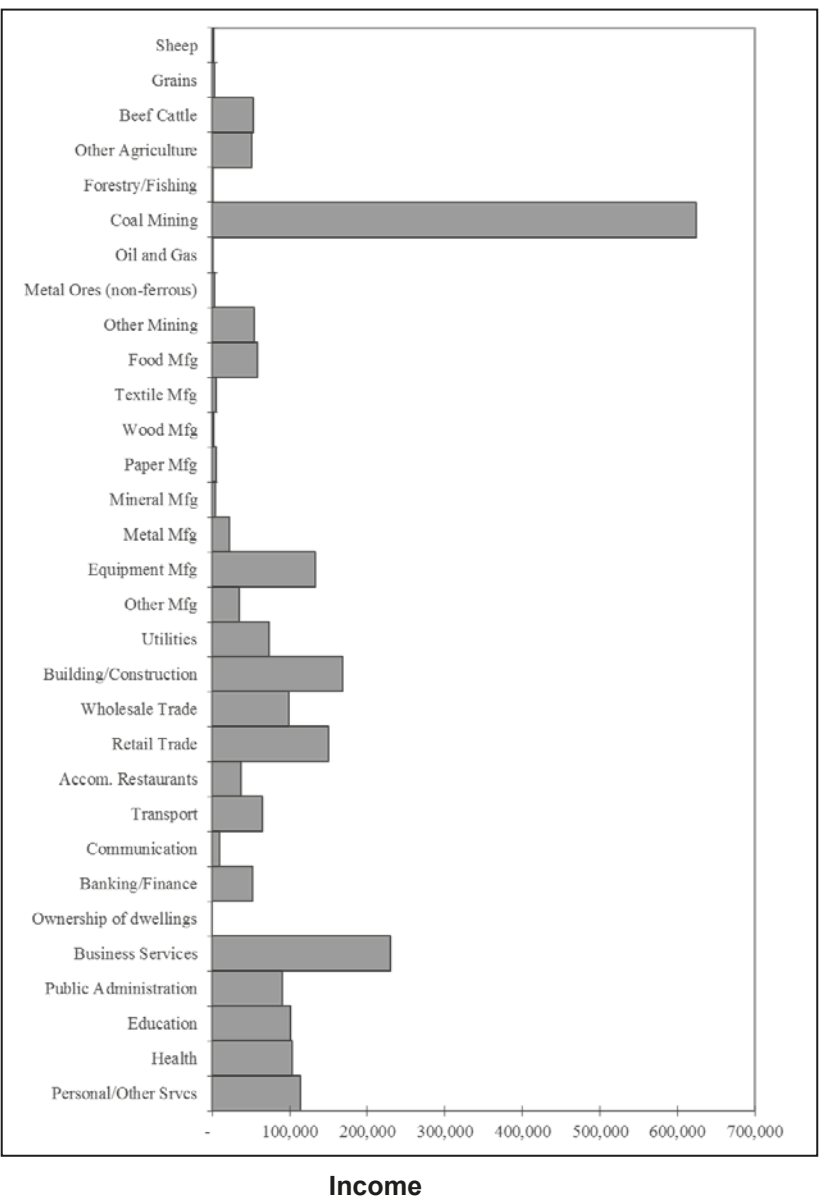
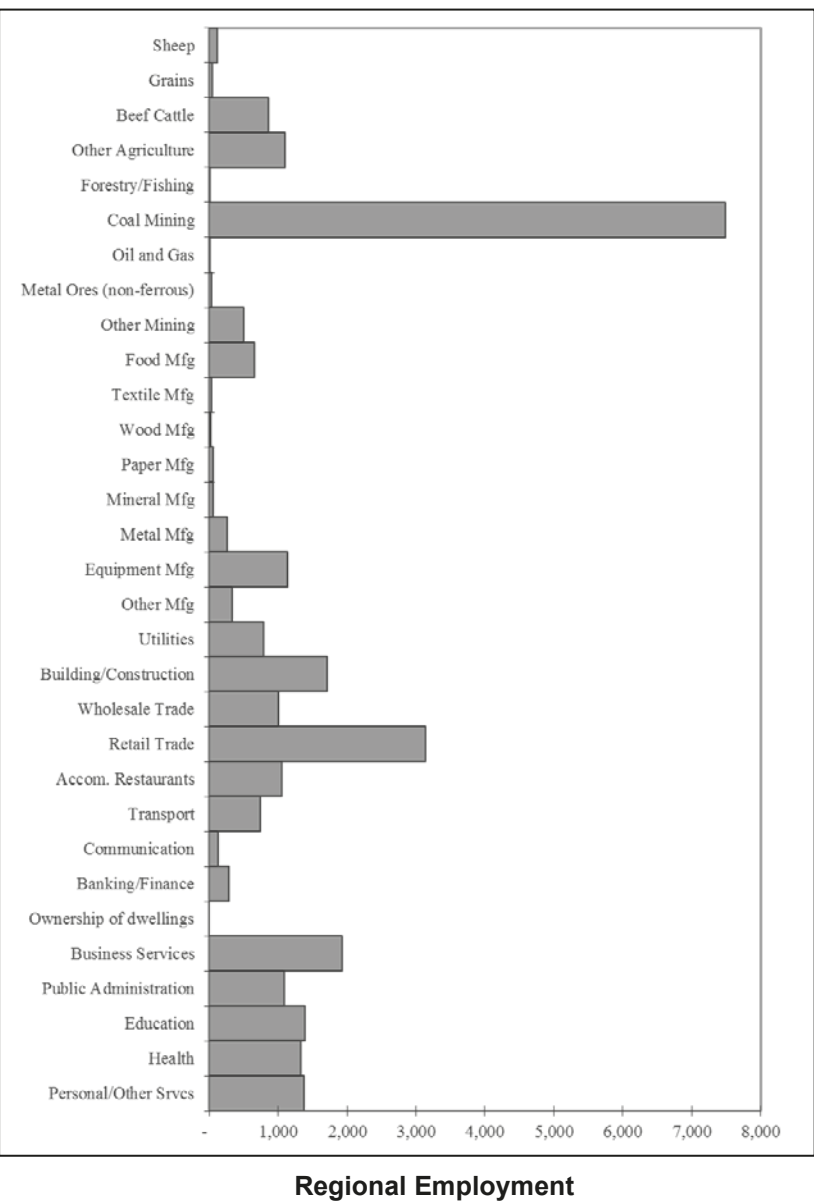


Figure 3.4 Sectoral Distribution of Gross Regional Income (\$'000) and Employment (No.)

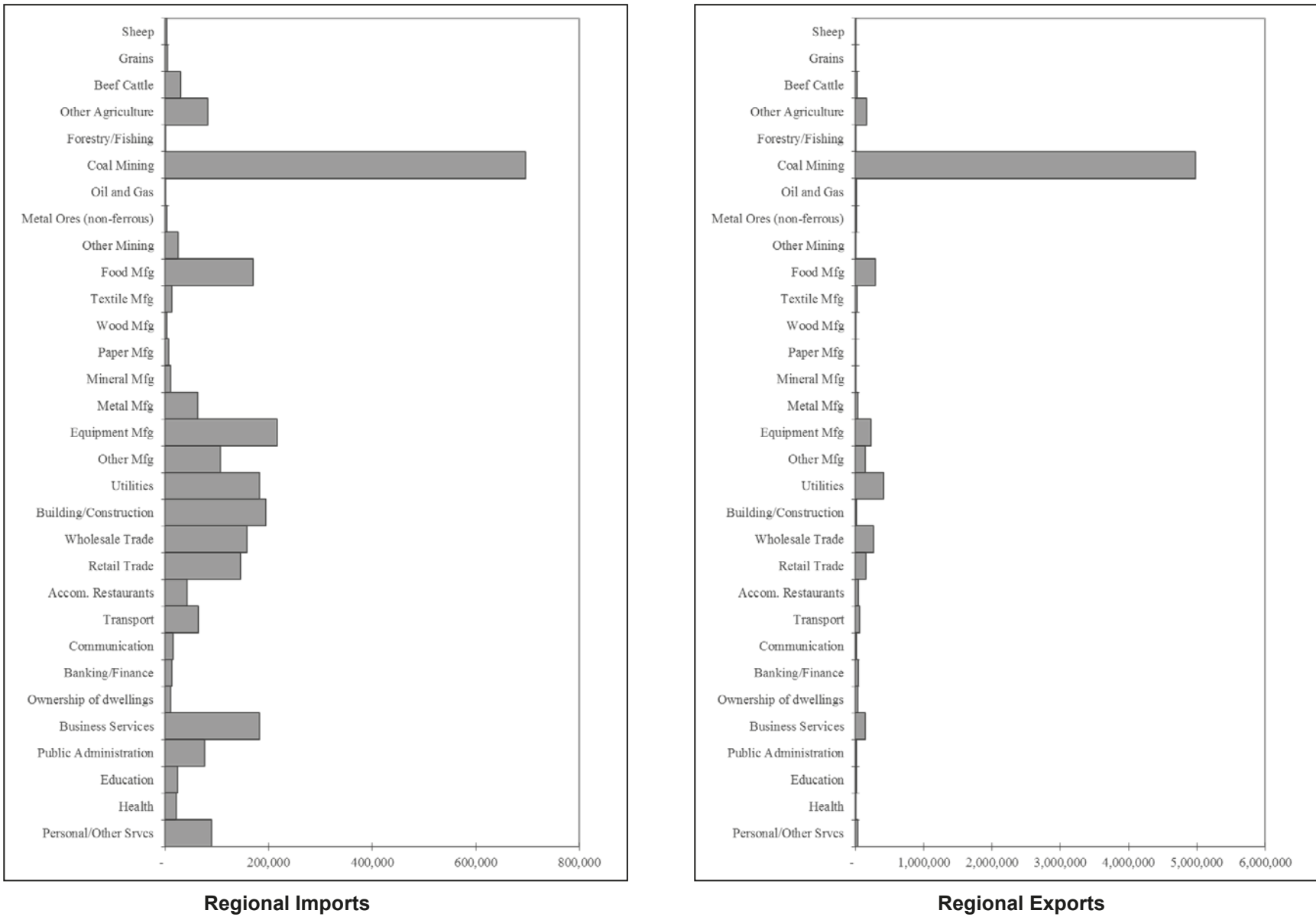


Figure 3.5 Sectoral Distribution of Imports and Exports (\$'000)

3.3 ECONOMIC IMPACT OF THE PROJECT

The revenue, expenditure and employment associated with the construction and operation of the Project would stimulate economic activity for the regional economy, as well as for the broader NSW economy. The regional impacts of both these stimuli are estimated for the indicators of output, value-added, income and employment.

3.3.1 Construction Phase

Introduction

Economic activity associated with the Project construction phase is estimated to potentially mainly occur within five sectors of the economy:

- The *other construction sector* which includes businesses involved in the construction of non-residential buildings and sites, including port terminals;
- The *construction trade services sector* which includes businesses involved in plumbing, electrical, and other trades;
- The *other property services sector* which includes businesses involved in the leasing of industrial machinery, plant or equipment;
- The *agriculture, mining and construction machinery, lifting and material handling equipment manufacturing sector*; and
- *Other machinery and equipment manufacturing sector*.

Impact on the Regional Economy

Given the largely specialist nature of capital equipment and the relatively small size of the regional economy, for the purpose of this analysis an assumption is made that all such purchases and the leasing of machinery are made outside the regional economy. Thus regional economic activity from the Project construction phase primarily relates to the *other construction sector* and *construction trade services sector*.

The average annual construction workforce required for the Project during the peak year of construction (Year 2) is 218, with average annual construction workforce of 70 in Year 1 and 101 in Year 3. Based on the input-output coefficients of the *other construction sector* and *trade services sector* in the regional economy transactions table, approximately \$79M of the development costs in the peak year of construction would need to be spent on the *other construction sector* and *construction trade services sector* within the region to result in a workforce of 208 people. The direct and indirect regional economic impact of this level of expenditure in the regional economy is reported in Table 3.2.

Impacts

Table 3.2 - Regional Economic Impacts of Construction of the Project on the Regional Economy

	Direct	Production induced	Consumption induced	Total Flow on	Total
OUTPUT (\$'000)	79,431	34,846	9,561	44,407	123,838
<i>Type 11A Ratio</i>	1.00	0.44	0.12	0.56	1.56
VALUE ADDED (\$'000)	30,790	14,710	4,432	19,142	49,932
<i>Type 11A Ratio</i>	1.00	0.48	0.14	0.62	1.62
INCOME (\$'000)	13,468	9,142	3,110	12,253	25,721
<i>Type 11A Ratio</i>	1.00	0.68	0.23	0.91	1.91
EMPL. (No.)	218	156	53	209	426
<i>Type 11A Ratio</i>	1.00	0.72	0.24	0.96	1.96

Note: Income only relates to that income that will accrue to local labour. Employment relates to employment working in the region.

In estimating the total regional impacts, it is important to separate the flow-on effects that are associated with firms buying goods and services from each other (production-induced effects) and the flow-on effects that are associated with employing people who subsequently buy goods and services as households (consumption-induced effects). This is because these two effects operate in different ways and have different spatial impacts.

Production-induced effects occur in a near-proportional way within a region, whereas the consumption-induced flow-on effects only occur in a proportional way if workers and their families are located in the region or migrate into the region. Where workers commute from outside the region some of the consumption-induced flow-on effects leak from the region. However, this has already been taken into account in this analysis by adjusting the income row of the input-output model to only include the income associated with workers who reside in the region¹⁸.

In total, the peak construction year of the Project is estimated to make up to the following total annual contribution to the regional economy:

- \$124M in annual direct and indirect regional output or business turnover;
- \$50M in annual direct and indirect regional value added;
- \$26M in annual direct and indirect household income; and
- 426 direct and indirect jobs.

Multipliers

Multipliers are summary measures used for predicting the total impact on all industries in an economy from changes in the demand for the output of any one industry (ABS, 1995). There are many types of multipliers that can be generated from input-output analysis (refer to Attachment 3). Type 11A ratio multipliers summarise the total impact on all industries in an economy in relation to the initial own sector effect (e.g. total income effect from an initial income effect and total employment effect from an initial employment effect, etc).

The Type 11A ratio multipliers for the construction phase of the Project in the regional economy range from 1.56 for output up to 1.96 for employment.

Main Sectors Affected

Flow-on impacts from the construction phase of the Project are likely to affect a number of different sectors of the regional economy. The sectors most impacted by output, value-added, income and employment flow-ons are likely to be *construction trade-services, wholesale and retail trade, scientific research, technical and computer services, other property services, other business services, health services and accommodation, cafes and restaurants*.

Impact on the NSW Economy

When the impact of \$79M of expenditure in the *other construction sector* and *construction trade services sector* is assessed for the NSW economy, the impacts are greater because of the larger inter-sectoral linkages and hence multipliers for the larger economy.

¹⁸ Based on ABS 2011 Census data on the residential location of workers.

*Impacts***Table 3.3 - Regional Economic Impacts of Construction of the Project on the NSW Economy**

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT (\$'000)	79,431	72,915	83,845	156,759	236,190
<i>Type 11A Ratio</i>	1.00	0.92	1.06	1.97	2.97
VALUE ADDED (\$'000)	30,790	31,461	42,707	74,167	104,957
<i>Type 11A Ratio</i>	1.00	1.02	1.39	2.41	3.41
INCOME (\$'000)	21,943	25,910	24,440	50,350	72,292
<i>Type 11A Ratio</i>	1.00	1.18	1.11	2.30	3.30
EMPL. (No.)	217	292	319	611	827
<i>Type 11A Ratio</i>	1.00	1.35	1.47	2.82	3.82

Based on the above approach, the construction phase of the Project may result in impacts on the NSW economy of up to:

- \$236M in annual direct and indirect output;
- \$105M in annual direct and indirect regional value added;
- \$72M in annual direct and indirect household income; and
- 827 direct and indirect jobs.

The above estimated impacts on the NSW economy are likely to be understated because expenditures in NSW may not be limited to expenditures in the *other construction* sector and *construction trade services* sector. This is because the larger NSW economy is likely to be able to also supply some machinery and equipment manufacturing and machinery leasing that could not be supplied by the smaller regional economies.

3.3.2 Operation Phase

Introduction

For the analysis of the operational phase of the Project, two new sectors were separately inserted in the regional input-output table. The first sector reflected the average annual production under the current approval i.e. up to 10.7 Mtpa ROM. The second reflected the average annual production under the Project i.e. up to 15 Mtpa ROM. The average annual revenue, operating costs and employment levels under each of these scenarios was obtained from financial information provided by BMC. For these sectors:

- The estimated gross annual revenue was allocated to the *Output* row;
- The estimated wage bill of those residing in the region was allocated to the *household wages* row with the remainder allocated to a separate *household wages* row that is not included in the calculation of flow-on effect;
- Non-wage expenditure was initially allocated across the relevant *intermediate sectors* in the economy, *imports* and *other value-added*;
- Allocation was then made between *intermediate sectors* in the regional economy and *imports* based on advice from BMC and regional location quotients;
- Purchase prices for expenditure in the each sector in the region were adjusted to basic values and margins and taxes and allocated to appropriate sectors using relationships in the National Input-Output Tables;

- The difference between total revenue and total costs was allocated to the *other value-added* row; and
- Direct employment provided by the Project that was allocated to the *employment* row.

Impacts on the Regional Economy

Economic Activity

The total and disaggregated average annual impacts of the current approval and the Project on the regional economy (in 2012 dollars) are shown in Tables 3.4 and 3.5.

Table 3.4
Economic Impacts of the Current Approval on the Regional Economy (\$2012)

	Direct Effect	Production Induced	Consump. Induced	Total Flow-on	TOTAL EFFECT
OUTPUT (\$'000)	825,844	181,041	37,952	218,992	1,044,836
<i>Type 11A Ratio</i>	1.00	0.22	0.05	0.27	1.27
VALUE ADDED (\$'000)	454,674	71,058	23,462	94,520	549,194
<i>Type 11A Ratio</i>	1.00	0.16	0.05	0.21	1.21
INCOME (\$'000)	58,428	31,325	12,346	43,671	102,099
<i>Type 11A Ratio</i>	1.00	0.54	0.21	0.75	1.75
EMPL. (No.)	491	462	209	671	1,162
<i>Type 11A Ratio</i>	1.00	0.94	0.43	1.37	2.37

Table 3.5
Economic Impacts of the Project on the Regional Economy (\$2012)

	Direct Effect	Production Induced	Consump. Induced	Total Flow-on	TOTAL EFFECT
OUTPUT (\$'000)	1,174,064	254,535	57,621	312,156	1,486,220
<i>Type 11A Ratio</i>	1.00	0.22	0.05	0.27	1.27
VALUE ADDED (\$'000)	657,035	105,600	26,710	132,310	789,345
<i>Type 11A Ratio</i>	1.00	0.16	0.04	0.20	1.20
INCOME (\$'000)	92,146	44,122	18,745	62,867	155,014
<i>Type 11A Ratio</i>	1.00	0.48	0.20	0.68	1.68
EMPL. (No.)	768	659	318	977	1,745
<i>Type 11A Ratio</i>	1.00	0.86	0.41	1.27	2.27

The current approval to mine to 2017 is estimated to make up to the following annual contribution to the regional economy:

- \$1,045M in annual direct and indirect regional output or business turnover;
- \$549M in annual direct and indirect regional value added;
- \$102M in annual direct and indirect household income; and
- 1,162 direct and indirect jobs.

The Project is estimated to make up to the following annual contribution to the regional economy for 24 years:

- \$1,486M in annual direct and indirect regional output or business turnover;
- \$789M in annual direct and indirect regional value added;
- \$155M in annual direct and indirect household income; and
- 1,745 direct and indirect jobs.

Multipliers

The Type 11A ratio multipliers for the Project impact on the regional economy range from 1.20 for value added up to 2.27 for employment.

Capital intensive industries such as coal mining tend to have a high level of linkage with other sectors in an economy thus contributing substantial flow-on employment while at the same time only having a lower level of direct employment (relative to output levels). This tends to lead to a relatively high ratio multiplier for employment. A lower ratio multiplier for income (compared to employment) also generally occur as a result of comparatively higher wage levels in the mining sectors compared to incomes in the sectors that would experience flow-on effects from the Project. Capital intensive mining projects also typically have a relatively low ratio multiplier for output and value-added reflecting the relatively high direct output and value-added compared to that in flow-on sectors.

Main Sectors Affected

Flow-on impacts from the Project are likely to affect a number of different sectors of the regional economy. The sectors most impacted by output, value-added and income flow-ons are likely to be the:

- *Services to mining sector;*
- *Agricultural and mining machinery manufacturing sector;*
- *Retail trade sector;*
- *Wholesale trade sector;*
- *Basic chemicals sector;*
- *Scientific, research, technical and computer services sector; and*
- *Road transport sector.*

Examination of the estimated direct and flow-on employment impacts gives an indication of the sectors in which employment opportunities would be generated by the Project (Table 3.6).

Table 3.6
Sectoral Distribution of Employment Impacts on the Regional Economy

	Regional Economy			
Sector	Average Direct Effects	Product.-induced	Consump.-induced	Total
Primary	0	1	8	9
Mining	768	147	0	915
Manufacturing	0	186	12	198
Utilities	0	22	4	26
Wholesale/Retail	0	110	88	198
Accommodation, cafes, restaurants	0	6	47	53
Building/Construction	0	10	2	12
Transport	0	46	10	56
Services	0	131	146	277
Total	768	659	318	1,745

Note: Totals may have minor discrepancies due to rounding.

Table 3.6 indicates that direct, production-induced and consumption-induced employment impacts of the Project on the regional economy are likely to have different distributions across sectors. Production-induced flow-on employment would occur mainly in the *manufacturing sectors, mining sectors, services sectors, wholesale/retail trade sectors and transport sectors* while consumption induced flow-on employment would be mainly in *services sectors, wholesale/retail trade sectors and accommodation/cafes/restaurants sectors*.

Businesses that can provide the inputs to the production process required by the Project and/or the products and services required by employees would directly benefit from the Project by way of an increased economic activity. However, because of the inter-linkages between sectors, many indirect businesses also benefit.

Impact on the NSW Economy

Introduction

The NSW economic impacts of the Project were assessed by separately inserting two new sectors in the NSW input-output table in the same manner described in Section 3.2.1. The primary difference from the sectors identified for the regional economy was that a greater level of expenditure was captured by NSW economy compared to the regional economy.

Economic Activity

The total and disaggregated average annual impacts of the current approval and Project on the regional economy (in 2012 dollars) are shown in Tables 3.7 and 3.8.

Table 3.7
NSW Economic Impacts of the Current Approval (\$2012)

	Direct Effect	Production Induced	Consump. Induced	Total Flow-on	TOTAL EFFECT
OUTPUT (\$'000)	825,844	516,063	351,184	867,246	1,693,090
<i>Type 11A Ratio</i>	1.00	0.63	0.43	1.05	2.05
VALUE ADDED (\$'000)	457,030	217,740	178,877	396,616	853,647
<i>Type 11A Ratio</i>	1.00	0.48	0.39	0.87	1.87
INCOME (\$'000)	60,783	139,647	102,366	242,013	302,796
<i>Type 11A Ratio</i>	1.00	2.30	1.68	3.98	4.98
EMPL. (No.)	491	1,507	1,366	2,873	3,364
<i>Type 11A Ratio</i>	1.00	3.07	2.78	5.85	6.85

Table 3.8
NSW Economic Impacts of the Project (\$2012)

	Direct Effect	Production Induced	Consump. Induced	Total Flow-on	TOTAL EFFECT
OUTPUT (\$'000)	1,174,064	723,454	510,975	1,234,429	2,408,493
<i>Type 11A Ratio</i>	1.00	0.62	0.44	1.05	2.05
VALUE ADDED (\$'000)	657,035	305,242	260,267	565,509	1,222,545
<i>Type 11A Ratio</i>	1.00	0.47	0.40	0.86	1.86
INCOME (\$'000)	95,860	195,768	148,943	344,711	440,571
<i>Type 11A Ratio</i>	1.00	2.04	1.55	3.60	4.60
EMPL. (No.)	768	2,112	1,988	4,100	4,868
<i>Type 11A Ratio</i>	1.00	2.75	2.59	5.34	6.34

The current approval to mine to 2017 is estimated to make up to the following annual contribution to the NSW economy:

- \$1,693M in annual direct and indirect regional output or business turnover;
- \$854M in annual direct and indirect regional value added;
- \$303M in annual direct and indirect household income; and
- 3,364 direct and indirect jobs.

The Project is estimated to make up to the following average annual contribution to the NSW economy for 24 years:

- \$2,408M in annual direct and indirect regional output or business turnover;
- \$1,223M in annual direct and indirect regional value added;
- \$441M in annual indirect household income; and
- 4,868 indirect jobs.

The impacts on the NSW economy are substantially greater than for the regional economy, as the NSW economy is able to capture more mine and household expenditure, and there is a greater level of intersectoral linkages in the larger NSW economy.

3.4 MINE CESSATION

As outlined in Sections 3.2 and 3.3, the Project will stimulate demand in the regional and NSW economy, for up to 24 years, leading to increased business turnover in a range of sectors and increased employment opportunities. Conversely, the cessation of the mining operations in the future would result in a contraction in regional and NSW economic activity.

The magnitude of the regional economic impacts of cessation of the Project would depend on a number of interrelated factors at the time, including:

- The movements of workers and their families;
- Alternative development opportunities; and
- Economic structure and trends in the regional economy at the time.

Ignoring all other influences, the impact of Project cessation on the regional economy would depend on whether the workers and their families affected would leave the regional area. If it is assumed that some or all of the workers remain in the regional economy, then the impacts of Project cessation would not be as severe compared to a greater level leaving the area. This is because the consumption-induced flow-ons of the decline would be reduced through the continued consumption expenditure of those who stay (Economic and Planning Impact Consultants, 1989). Under this assumption, the regional economic impacts of Project cessation would approximate the direct and production-induced effects in Table 3.5. However, if displaced workers and their families leave the region then impacts would be greater and begin to approximate the total effects in Table 3.5.

The decision by workers, on cessation of the Project, to move or stay would be affected by a number of factors including the prospects of gaining employment in the regional economy compared to other regions, the likely loss or gain from homeowners selling, and the extent of "attachment" to the regional areas (Economic and Planning Impact Consultants, 1989).

To the extent that alternative development opportunities arise in the regional economy, the regional economic impacts associated with mining closure that arise through reduced production and employment expenditure can be substantially ameliorated and absorbed by the growth of the region. One key factor in the growth potential of a region is its capacity to expand its factors of production by attracting investment and labour from outside the region (BIE, 1994). This in turn can depend on a region's natural endowments. In this respect, the regional area is highly prospective with considerable coal resources (NSW DPI, 2010).

It is therefore likely that, over time, new mining developments would occur, offering potential to strengthen and broaden the economic base of the regional area and hence buffer against impacts of the cessation of individual activities.

Ultimately, the significance of the economic impacts of cessation of the Project would depend on the economic structure and trends in regional economy at the time. For example, if Project cessation takes place in a declining economy, the impacts might be significant. Alternatively, if Project cessation takes place in a growing diversified economy where there are other development opportunities, the ultimate cessation of the Project may not be a cause for concern.

Nevertheless, given the uncertainty about the future complementary mining activity in regional economy it is not possible to foresee the likely circumstances within which Project cessation would occur.

4 CONCLUSION

A BCA of the Project indicated that it would have net production benefits to Australia of \$1,790M. Provided the residual environmental, social and cultural impacts of the Project that accrue to Australia are considered to be valued at less than \$1,790M, the Project can be considered to provide an improvement in economic efficiency and hence is justified on economic grounds.

Instead of leaving the environmental, cultural and social impacts unquantified, an attempt was made to quantify them. The main quantifiable environmental impacts of the Project that have not already been incorporated into the estimate of net production benefits, relate to greenhouse gas emissions, Aboriginal heritage impacts and surface water and groundwater impacts. These impacts are estimated at \$217M globally or \$24M to Australia, considerably less than the estimated net production benefits of the Project. There may also be some non-market benefits of employment provided by the Project which are estimated to be in the order of \$346M. Overall, the Project is estimated to have net social benefits to Australia of between \$1,766M and \$2,112M and hence is desirable and justified from an economic efficiency perspective.

While the BCA is primarily concerned with the aggregate costs and benefits of the Project to Australia, the costs and benefits may be distributed among a number of different stakeholder groups at the local, state, National and global level. The total net production benefit will be distributed amongst a range of stakeholders including:

- BMC shareholders in the form of after tax (and after voluntary contributions) profits;
- The Commonwealth Government in the form of any Company tax payable (\$509M present value) and the Minerals Resource Rent Tax from the Project, which is subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the local and regional area;
- The NSW Government via royalties (\$778M present value) which are subsequently used to fund provision of government infrastructure and services across the State, including the local and regional area; and
- The local and regional community in the form of voluntary contributions to community infrastructure and services.

The environmental, cultural and social impacts of the Project may potentially accrue to a number of different stakeholder groups at the local, State, National and global level, however, are largely internalised into the productions costs of BMC.

The non-market costs that accrue to NSW are estimated at less than \$24M. These are considerably less than the net production benefits (and potential non-market employment benefits) that directly accrue to NSW. Consequently, as well as resulting in net benefits to Australia the Project would result in net benefits to NSW.

An economic impact analysis, using input-output analysis found that the operation of the Project is estimated to make up to the following contribution to the regional economy for up to 24 years:

- \$1,486M in annual direct and indirect regional output or business turnover;
- \$789M in annual direct and indirect regional value added;
- \$155M in annual direct and indirect household income; and
- 1,745 direct and indirect jobs.

For the NSW economy, the operation of the Project is estimated to make up to the following contribution for up to 24 years:

- \$2,408M in annual direct and indirect regional output or business turnover;
- \$1,223M in annual direct and indirect regional value added;
- \$441M in annual direct and indirect household income; and
- 4,868 direct and indirect jobs.

Cessation of the Project operation may lead to a reduction in economic activity. The significance of these Project cessation impacts would depend on:

- The degree to which any displaced workers and their families remain within the region, even if they remain unemployed. This is because continued expenditure by these people in the regional economy (even at reduced levels) contributes to final demand;
- The economic structure and trends in the regional economy at the time. For example, if Project cessation takes place in a declining economy the impacts might be felt more greatly than if it takes place in a growing diversified economy; and
- Whether other mining developments or other opportunities in the region arise that allow employment of displaced workers.

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ATTACHMENT 1 – VALUING GREENHOUSE GAS EMISSIONS

To place an economic value on carbon dioxide equivalent (CO₂-e) emissions a shadow price of carbon is required that reflects its social costs. The social cost of carbon is the present value of additional economic damages now and in the future caused by an additional tonne of carbon emissions.

A prerequisite to valuing this environmental damage is scientific dose-response functions identifying how incremental emissions of CO₂-e would impact climate change and subsequently impact human activities, health and the environment on a spatial basis. Only once these physical linkages are identified is it possible to begin to place economic values on the physical changes using a range of market and non market valuation methods. Neither the identification of the physical impacts of additional greenhouse gas nor valuation of these impacts is an easy task, although various attempts have been made using different climate and economic modelling tools. The result is a great range in the estimated damage costs of greenhouse gas.

The *Stern Review: Economics of Climate Change* (Stern, 2006) acknowledged that the academic literature provides a wide range of estimates of the social cost of carbon. It adopted an estimate of United States (US) \$85 per tonne (/t) of carbon dioxide (CO₂) for the "business as usual" case (i.e. an environment in which there is an annually increasing concentration of greenhouse gas in the atmosphere).

Tol (2006) highlights some significant concerns with Stern's damage cost estimates including:

- that in estimating the damage of climate change Stern has consistently selected the most pessimistic study in the literature in relation to impacts;
- Stern's estimate of the social cost of carbon is based on a single integrated assessment model, PAGE2002, which assumes all climate change impacts are necessarily negative and that vulnerability to climate change is independent of development; and
- Stern uses a near zero discount rate which contravenes economic theory and the approach recommended by Treasury's around the world.

All these have the effect of magnifying the social cost of the carbon estimate, providing what Tol (2006) considers to be an outlier in the marginal damage cost literature.

Tol (2005) in a review of 103 estimates of the social cost of carbon from 28 published studies found that the range of estimates was right-skewed: the mode was US\$0.55/t CO₂ (in 1995 US\$), the median was US\$3.82/t CO₂, the mean US\$25.34/t CO₂ and the 95th percentile US\$95.37/t CO₂. He also found that studies that used a lower discount rate and those that used equity weighting across regions with different average incomes per head, generated higher estimates and larger uncertainties. The studies did not use a standard reference scenario, but in general considered 'business as usual' trajectories.

Tol (2005) concluded that "it is unlikely that the marginal damage costs of CO₂ emissions exceed US\$14/t CO₂ and are likely to be substantially smaller than that". Nordhaus's (2008) modelling using the DICE-2007 Model suggests a social cost of carbon with no emissions limitations of US\$30 per tonne of carbon (US\$8/t CO₂).

Tol (2011) surveyed the literature on the economic impact of climate change. Tol (2011) identifies the mean estimated from published studies is a marginal cost of carbon of \$177/t C (\$48/ tCO₂-e) and a modal estimate of \$49/t C (\$13 tCo₂-e) reflecting the fact that the mean estimate is driven by some very large estimates. For peer reviewed studies only, the mean estimate of the social cost of carbon is \$80/tC (\$22/tCo₂-e).

An alternative method to trying to estimate the damage costs of CO₂ is to examine the price of carbon credits. This is relevant because emitters can essentially emit CO₂ resulting in climate change damage costs or may purchase credits that offset their CO₂ impacts, internalising the cost of the externality at the price of the carbon credit. The price of carbon credits therefore provides an alternative estimate of the economic cost of greenhouse gas. However, the price is ultimately a function of the characteristics of the scheme and the scarcity of permits, etc. and hence may or may not reflect the actual social cost of carbon.

In the first half of 2008 the carbon price under the European Union Emissions Trading Scheme was over €20/t CO₂. The average price was €22/t CO₂ in the second half of 2008, and €13/t CO₂ in the first half of 2009. In March 2012, the permit price reduced to under €10 /t CO₂.

In 2008, spot prices in the Chicago Climate Exchange were in the order of US\$3.95/t CO₂. However, the Chicago Climate Exchange cap and trade system ended on December 31, 2010.

In 2011, the greenhouse penalty for benchmark participants in the New South Wales Government Greenhouse Gas Reduction Scheme that fail to reduce emissions rose to \$15.50 t CO₂.

Under the Australian Commonwealth Government's Climate Change Plan (Department of Climate Change and Energy Efficiency 2011) around 500 of the biggest polluters in Australia will need to buy and surrender to the Government a permit for every tonne of carbon pollution they produce. For the first three years, the carbon price will be fixed like a tax, before moving to an emissions trading scheme in 2015. In the fixed price stage, starting on 1 July 2012, the carbon price will start at \$23 a tonne, rising at 2.5 per cent a year in real terms. From 1 July 2015, the carbon price will be set by the market.

Given the above information and the great uncertainty around damage cost estimates, the BCA uses the carbon price proposed by Australian Government's Climate Change Plan i.e. \$23 a tonne, rising at 2.5 per cent a year in real terms for three years, as reflective of the global social damage cost of carbon. From 2015 it is assumed that the carbon price remains constant. A range for the social cost of greenhouse gas emissions from AUD\$8/t CO₂-e to AUD\$40/t CO₂-e was used in the sensitivity analysis described in Section 2.6 of this report.

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ATTACHMENT 2 – BCA SENSITIVITY TESTING

Table A2-1
Benefit Cost Analysis Sensitivity Testing, Project Australian Net Present Value (\$Millions)

	4% Discount Rate	7% Discount Rate	10% Discount Rate
CENTRAL ANALYSIS	\$3,033	\$2,112	\$1,523
INCREASE 20%			
Opportunity cost of land	\$3,027	\$2,107	\$1,519
Opportunity cost of capital	\$2,976	\$2,063	\$1,480
Development costs	\$2,910	\$2,009	\$1,436
Operating costs	\$2,073	\$1,429	\$1,022
Decommissioning and rehabilitation costs	\$3,035	\$2,115	\$1,526
Coal value	\$4,629	\$3,244	\$2,352
Level of Australian ownership	\$3,193	\$2,213	\$1,587
Residual value of land	\$3,034	\$2,112	\$1,523
Surface water	\$3,034	\$2,112	\$1,523
Groundwater	\$3,033	\$2,112	\$1,523
Aboriginal heritage impacts	\$3,029	\$2,109	\$1,520
Non-market employment benefits	\$3,104	\$2,181	\$1,590
GREENHOUSE COSTS @ \$40/TONNE (T)	\$3,031	\$2,110	\$1,522

	4% Discount Rate	7% Discount Rate	10% Discount Rate
DECREASE 20%			
Opportunity cost of land	\$3,039	\$2,117	\$1,528
Opportunity cost of capital	\$3,090	\$2,161	\$1,566
Development costs	\$3,156	\$2,214	\$1,610
Operating costs	\$3,994	\$2,795	\$2,024
Decommissioning and rehabilitation costs	\$3,031	\$2,109	\$1,520
Coal value	\$1,437	\$980	\$694
Level of Australian ownership	\$2,873	\$2,011	\$1,459
Residual value of land	\$3,032	\$2,112	\$1,523
Surface water	\$3,033	\$2,112	\$1,523
Groundwater	\$3,033	\$2,112	\$1,523
Aboriginal heritage impacts	\$3,037	\$2,115	\$1,526
Non-market employment benefits	\$2,962	\$2,043	\$1,456
GREENHOUSE COSTS @ \$8/T	\$3,035	\$2,113	\$1,524

ATTACHMENT 3 – UNDERLYING ASSUMPTIONS AND INTERPRETATIONS OF INPUT-OUTPUT ANALYSIS AND MULTIPLIERS

1. "The *basic assumptions* in input-output analysis include the following:

- there is a fixed input structure in each industry, described by fixed technological coefficients (evidence from comparisons between input-output tables for the same country over time have indicated that material input requirements tend to be stable and change but slowly; however, requirements for primary factors of production, that is labour and capital, are probably less constant);
- all products of an industry are identical or are made in fixed proportions to each other;
- each industry exhibits constant returns to scale in production;
- unlimited labour and capital are available at fixed prices; that is, any change in the demand for productive factors will not induce any change in their cost (in reality, constraints such as limited skilled labour or investment funds lead to competition for resources among industries, which in turn raises the prices of these scarce factors of production and of industry output generally in the face of strong demand); and
- there are no other constraints, such as the balance of payments or the actions of government, on the response of each industry to a stimulus.

2. The multipliers therefore describe *average effects*, *not marginal effects*, and thus do not take account of economies of scale, unused capacity or technological change. Generally, average effects are expected to be higher than the marginal effects.

3. The input-output tables underlying multiplier analysis only take account of one form of *interdependence*, namely the sales and purchase links between industries. Other interdependence such as collective competition for factors of production, changes in commodity prices which induce producers and consumers to alter the mix of their purchases and other constraints which operate on the economy as a whole are not generally taken into account.

4. The combination of the assumptions used and the excluded interdependence means that input-output multipliers are higher than would realistically be the case. In other words, they tend to *overstate* the potential impact of final demand stimulus. The overstatement is potentially more serious when large changes in demand and production are considered.

5. The multipliers also do not account for some important pre-existing conditions. This is especially true of Type II multipliers, in which employment generated and income earned induce further increases in demand. The implicit assumption is that those taken into employment were previously unemployed and were previously consuming nothing. In reality, however, not all 'new' employment would be drawn from the ranks of the unemployed; and to the extent that it was, those previously unemployed would presumably have consumed out of income support measures and personal savings. Employment, output and income responses are therefore overstated by the multipliers for these additional reasons.

6. The most *appropriate interpretation* of multipliers is that they provide a relative measure (to be compared with other industries) of the interdependence between one industry and the rest of the economy which arises solely from purchases and sales of industry output based on estimates of transactions occurring over a (recent) historical period. Progressive departure from these conditions would progressively reduce the precision of multipliers as predictive device" (ABS 1995, p.24).

Multipliers therefore do not take account of economies of scale, unused capacity or technological change since they describe average effects rather than marginal effects (ABS, 1995).

Multipliers indicate the total impact of changes in demand for the output of any one industry on all industries in an economy (ABS, 1995). Conventional output, employment, value-added and income multipliers show the output, employment, value-added and income responses to an initial output stimulus (Jensen and West, 1986).

Components of the conventional output multiplier are as follows:

Initial effect - which is the initial output stimulus, usually a \$1 change in output from a particular industry (Powell and Chalmers, 1995; ABS, 1995).

First round effects - the amount of output from all intermediate sectors of the economy required to produce the initial \$1 change in output from the particular industry (Powell and Chalmers, 1995; ABS, 1995).

Industrial support effects - the subsequent or induced extra output from intermediate sectors arising from the first round effects (Powell and Chalmers, 1995; ABS, 1995).

Production induced effects - the sum of the first round effects and industrial support effects (i.e. the total amount of output from all industries in the economy required to produce the initial \$1 change in output) (Powell and Chalmers, 1995; ABS, 1995).

Consumption induced effects - the spending by households of the extra income they derive from the production of the extra \$1 of output and production induced effects. This spending in turn generates further production by industries (Powell and Chalmers, 1995; ABS, 1995).

The *simple multiplier* is the initial effect plus the production induced effects.

The *total multiplier* is the sum of the initial effect plus the production-induced effect and consumption-induced effect.

Conventional employment, value-added and income multipliers have similar components to the output multiplier, however, through conversion using the respective coefficients show the employment, value-added and income responses to an initial output stimulus (Jensen and West, 1986).

For employment, value-added and income, it is also possible to derive relationships between the initial or own sector effect and flow-on effects. For example, the flow-on income effects from an initial income effect or the flow-on employment effects from an initial employment effect, etc. These own sector relationships are referred to as ratio multipliers, although they are not technically multipliers because there is no direct line of causation between the elements of the multiplier. For instance, it is not the initial change in income that leads to income flow-on effects, both are the result of an output stimulus (Jensen and West, 1986).

A description of the different ratio multipliers is given below.

$$\text{Type 1A Ratio Multiplier} = \frac{\text{Initial} + \text{First Round Effects}}{\text{Initial Effects}}$$

$$\text{Type 1B Ratio Multiplier} = \frac{\text{Initial} + \text{Production Induced Effects}}{\text{Initial Effects}}$$

$$\text{Type 11A Ratio Multiplier} = \frac{\text{Initial} + \text{Production Induced} + \text{Consumption Induced Effects}}{\text{Initial Effects}}$$

$$\text{Type 11B Ratio Multiplier} = \frac{\text{Flow-on Effects}}{\text{Initial Effects}}$$

Source: Centre for Farm Planning and Land Management (1989).

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ATTACHMENT 4 – THE GENERATION OF REGIONAL INPUT-OUTPUT TABLES

The Generation of Regional Input-Output Tables (GRIT) system was designed to:

- combine the benefits of survey based tables (accuracy and understanding of the economic structure) with those of non-survey tables (speed and low cost);
- enable the tables to be compiled from other recently compiled tables;
- allow tables to be constructed for any region for which certain minimum amounts of data were available;
- develop regional tables from national tables using available region-specific data;
- produce tables consistent with the national tables in terms of sector classification and accounting conventions;
- proceed in a number of clearly defined stages; and
- provide for the possibility of ready updates of the tables.

The resultant GRIT procedure has a number of well-defined steps. Of particular significance are those that involve the analyst incorporating region-specific data and information specific to the objectives of the study. The analyst has to be satisfied about the accuracy of the information used for the important sectors; in this case the coal mining sector. The method allows the analyst to allocate available research resources to improving the data for those sectors of the economy that are most important for the study.

An important characteristic of GRIT-produced tables relates to their accuracy. In the past, survey-based tables involved gathering data for every cell in the table, thereby building up a table with considerable accuracy. A fundamental principle of the GRIT method is that not all cells in the table are equally important. Some are not important because they are of very small value and, therefore, have no possibility of having a significant effect on the estimates of multipliers and economic impacts. Others are not important because of the lack of linkages that relate to the particular sectors that are being studied. Therefore, the GRIT procedure involves determining those sectors and, in some cases, cells that are of particular significance for the analysis. These represent the main targets for the allocation of research resources in data gathering. For the remainder of the table, the aim is for it to be 'holistically' accurate (Jensen, 1980). This means a generally accurate representation of the economy is provided by the table, but does not guarantee the accuracy of any particular cell. A summary of the steps involved in the GRIT process is shown in Table A4-1 (Powell and Chalmers, 1995).

Table A4-1
The GRIT Method

Phase	Step	Action
PHASE I	1	ADJUSTMENTS TO NATIONAL TABLE Selection of national input-output table (106-sector table with direct allocation of all imports, in basic values).
	2	Adjustment of national table for updating.
	3	Adjustment for international trade.
PHASE II		ADJUSTMENTS FOR REGIONAL IMPORTS (Steps 4-14 apply to each region for which input-output tables are required)
	4	Calculation of 'non-existent' sectors.
	5	Calculation of remaining imports.
PHASE III		DEFINITION OF REGIONAL SECTORS
	6	Insertion of disaggregated superior data.
	7	Aggregation of sectors.
PHASE IV	8	Insertion of aggregated superior data.
		DERIVATION OF PROTOTYPE TRANSACTIONS TABLES
	9	Derivation of transactions values.
PHASE V	10	Adjustments to complete the prototype tables.
	11	Derivation of inverses and multipliers for prototype tables.
		DERIVATION OF FINAL TRANSACTIONS TABLES
	12	Final superior data insertions and other adjustments.
	13	Derivation of final transactions tables.
	14	Derivation of inverses and multipliers for final tables.

Source: Bayne and West (1988).

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