Wallarah 2
COAL PROJECT

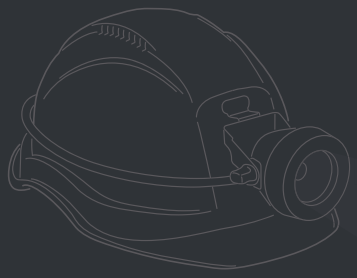
Wallarah 2 Coal Project

Environmental Impact Statement

April 2013

Appendix W

Economic Impact Assessment



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Wallarah 2 Coal Project
Economic Impact Assessment

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST ATTACHMENTS

EXECUTIVE SUMMARY

The Wyong Areas Coal Joint Venture (WACJV) seeks a Development Consent under Division 4.1 in Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the Wallarah 2 Coal Project (the Project). The Project includes the construction and operation of an underground mine extracting up to 5.0 Mtpa of export quality thermal coal by longwall methods at a depth of between 350 m and 690 m below the surface.

Gillespie Economics was commissioned by Hansen Bailey Environmental Consultants, on behalf of WACJV, to complete an Economic Impact Assessment for the Project.

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 including the opportunity cost of using agricultural resources); and
- the economic impacts of the Project (i.e. the economic activity that the Project would provide to the regional and NSW economies).

A Benefit Cost Analysis (BCA) of the Project indicated that it would have total net production benefits of $671M, with a minimum of $346M of these net production benefits accruing to Australia. 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. The threshold value indicates the price that the community must value the residual environmental impacts (be willing to pay) to justify in economic efficiency terms the no further development option.

For the Project to be questionable from an economic efficiency perspective, all incremental residual environmental impacts from the Project to Australia would need to be valued by the community at greater than the estimate of the Australian net production benefits i.e. greater than $346M. This is equivalent to each household in the region[1] and in NSW valuing residual environmental impacts at $1,725 and $130, respectively.

The threshold value may also be interpreted as the opportunity cost to Australia of not proceeding with the Project.

Instead of leaving the analysis as a threshold value exercise, an attempt has been made to quantify the residual environmental impacts of the Project. The main quantifiable environmental impacts of the Project that have not already been incorporated into the estimate of net production benefits, relate to forestry impacts, agricultural impacts and greenhouse gas impacts. These impacts are estimated at $56M globally and $1M 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 $186M.

Overall, the Project is estimated to have net community benefits to Australia of between $346M and $531M 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 is potentially distributed amongst a range of stakeholders including:

[1] Lake Macquarie, Wyong and Gosford Local Government Areas.

- WACJV in the form of any after tax profits;
- the Commonwealth Government in the form of any Company tax payable (estimated at $926M in total or $139M, present value at 7% discount rate) 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 region;
- the NSW Government via royalties (estimated at $661M in total or $207M present value at 7% discount rate) which are subsequently used to fund provision of government infrastructure and services across the State, including the region; and
- the local community in the form of any 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 WACJV.

Noise costs occur at a local level, but have already been incorporated into the estimation of net production benefits via acquisition costs for affected properties. Subsidence impacts would also occur at the local level but are included in the costs of production via the Mine Subsidence Levy. Local flooding impacts and visual amenity impacts would also occur at the local level but have been incorporated into the estimated net production benefits by an allowance in the capital and operating costs for mitigation measures. Greenhouse gas costs occur at the national and global level and will be internalised into production costs through the Commonwealth Government's carbon tax. The economic costs associated with the clearing of native vegetation would occur at the state level and would be counterbalanced by the offset actions proposed by WACJV. Other potential environmental impacts would largely occur at the local level and were found to be minor or negligible. Non-market benefits associated with employment provided by the Project would largely accrue at the local or state level[2].

The non-market costs that accrue to NSW are estimated at $1M. These are considerably less than the net production benefits (and potential non-market employment benefits) that directly accrue to NSW through royalties[3]. 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 both the construction and operation phases of the Project would provide economic activity to the regional and NSW economy, with the main impacts being from Project operation. The operation of the Project is estimated to make up to the following contribution to the regional economy[4]:

- $625M in annual direct and indirect regional output or business turnover;
- $381M in annual direct and indirect regional value-added;
- $79M in annual direct and indirect household income; and
- 805 direct and indirect jobs.

For the NSW economy, the operation of the Project is estimated to make up to the following contributions:

- $900M in annual direct and indirect output;

[2] It should be noted that the study from which the employment values were transferred surveyed NSW households only.
[3] Noting that NSW will also share some of the benefits that accrue to the Commonwealth through company taxes and MRRT, as well as any direct contributions through the VPA.
[5] The threshold value method uses the value of quantified net benefits as the amount that unquantified costs would need to exceed to make a project questionable from an economic efficiency perspective.

- $507M in annual direct and indirect regional value added;
- $154M in annual direct and indirect household income; and
- 1,711 direct and indirect jobs.

Ultimate 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.

1 INTRODUCTION

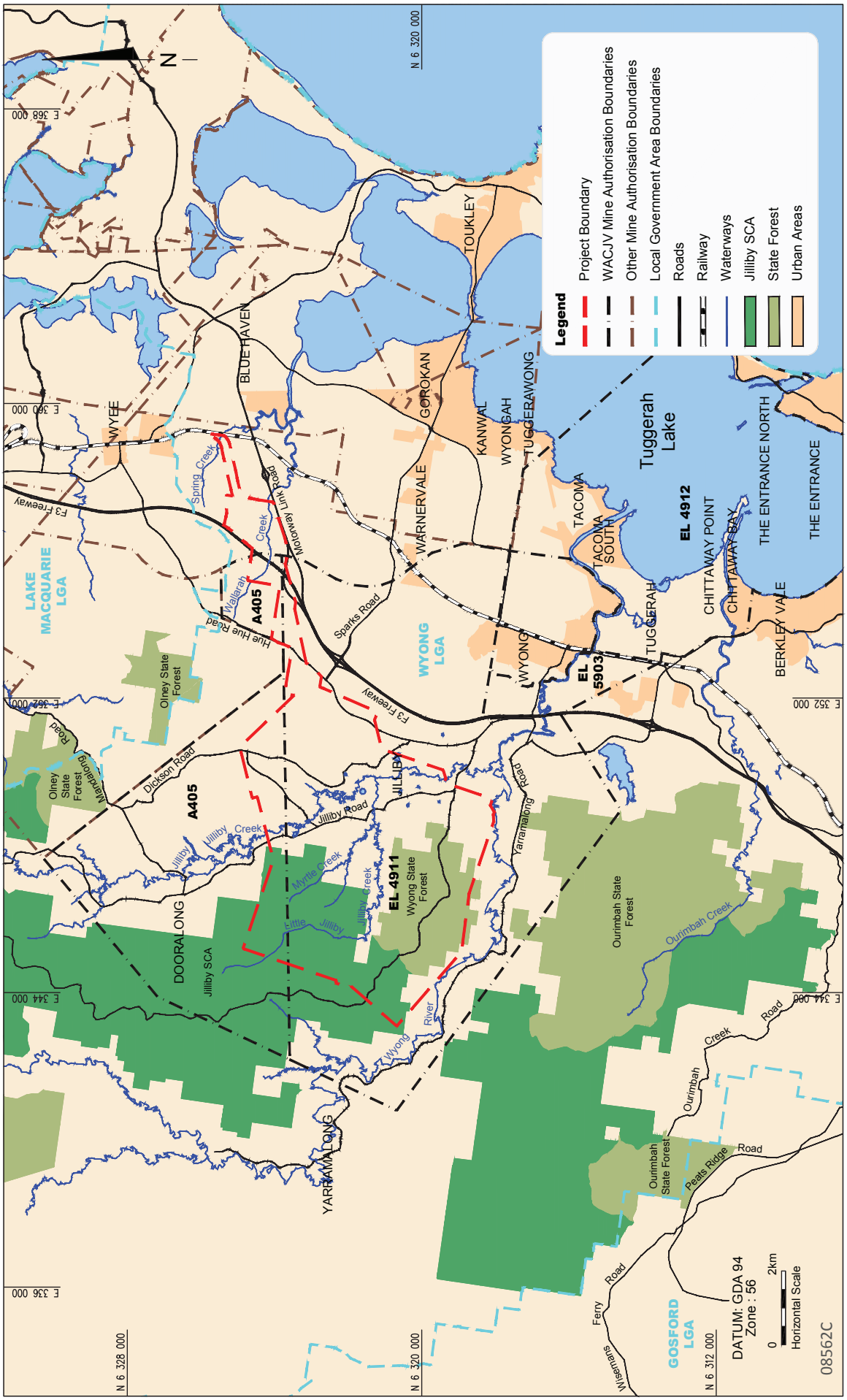
The Wyong Areas Coal Joint Venture (WACJV) seeks a Development Consent under Division 4.1 in Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the Wallarah 2 Coal Project (the Project). This Economic Impact Assessment supports 'The Wallarah 2 Coal Project Environmental Impact Statement' (Wallarah 2 EIS) prepared by Hansen Bailey Environmental Consultants to support the application.

This Economic Impact Assessment has been prepared in accordance with the Director-General's Environmental Assessment Requirements (DGRs) for the Project issued 12 January 2012 in accordance with the requirements in Part 2 in Schedule 2 to the *Environmental Planning & Assessment Regulation 2000* (EP&A Regs).

Development Consent is sought to mine coal within the Extraction Area for a period of 28 years. The majority of this resource lies beneath the Wyong State Forest and surrounding ranges (including the Jilliby State Conservation Area (SCA)) while a proportion, to be extracted first, lies beneath a section of the Dooralong Valley and the Hue Hue area. The location of the Project is shown on Figure 1.1.

Key features of the Project include:

- The construction and operation of an underground mining operation extracting up to 5.0 Mtpa of export quality thermal coal by longwall methods at a depth of between 350 m and 690 m below the surface within the underground Extraction Area;
- Mining and related activities will occur 24 hours a day 7 days a week for a Project period of 28 years;
- Tooheys Road Site surface facilities on company owned and third party land (subject to a mining lease) between the Motorway Link Road and the F3 Freeway which will include (at least) a rail loop and spur, stockpiles, water and gas management facilities, workshop and offices;
- Buttonderry Site Surface Facilities on company owned land at Hue Hue Road between Sparks Road and the Wyong Shire Council's (WSC) Buttonderry Waste Management Facility. This facility will include (at least) the main personnel access to the mine, main ventilation facilities, offices and employee amenities;
- An inclined tunnel (or "drift") constructed from the coal seam beneath the Buttonderry Site to the surface at the Tooheys Road Site;
- Construction and use of various mining related infrastructure including water management structures, water treatment plant (reverse osmosis or similar), generator, second air intake ventilation shaft, boreholes, communications, water discharge point, powerlines, and easements to facilitate connection to the WSC (after July 2013, the Central Coast Water Corporation) water supply and sewerage system;
- Capture of methane for treatment initially involving flaring as practicable for greenhouse emission management and ultimately for beneficial use of methane such as electricity generation at the Tooheys Road Site;
- Transport of coal by rail to either the Newcastle port for export or to domestic power stations;
- A workforce of approximately 300 full-time company employees (plus an additional 30 contractors);and



WALLARAH 2 COAL PROJECT

Regional Locality

FIGURE 1-1

Wallarah 2 COAL PROJECT

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- Rehabilitation and closure of the site at cessation of mining operations.

The DGRs for the Project indicate that economic assessment is required as part of the EIS including:

- *a detailed assessment of the costs and benefits of the project as a whole, and whether it would result in a net benefit for the NSW community; and*
- *potential direct and indirect economic benefits of the project for local and regional communities and the state.*

In this respect, consideration was given to the relevant aspects of the Department of Planning's draft *Guideline for Economic Effects and Evaluation in EIA* (James and Gillespie, 2002).

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); and
- the regional economic impacts of the Project (i.e. the economic activity that the Project would provide to the regional economy).

The Department of Planning's draft *Guideline for Economic Effects and Evaluation in EIA* (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 identifies BCA as essential to undertaking a proper economic evaluation of proposed developments that are likely to have significant environmental impacts.

The above draft guideline indicates that regional economic impact assessment may provide additional information as an adjunct to the economic efficiency analysis. Economic stimulus to the local economy can be estimated using input-output modelling of the regional economy (regional economic impact assessment).

It is important not to confuse the results of the regional 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 benefits to Australia from the Project.

This Economic Impact Assessment relates to the preparation of each of the following types of analyses:

- a BCA of the Project (Section 2); and
- a regional economic impact assessment of the Project (Section 3).

2 BENEFIT COST ANALYSIS

2.1 INTRODUCTION

For the Project to be economically desirable from a community perspective, it must be more economically efficient than the base case or "without" Project scenario. Technically, a project is more economically efficient than the "without" project scenario if the benefits to society exceed the costs (James and Gillespie, 2002). For mining projects, the main 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 are any adverse environmental, social and cultural impacts.

While some producer surplus benefits and environmental impacts may accrue internationally, these outcomes are normally excluded from BCA which is focused on surpluses which accrue to the consumers and producers who are the constituents of public policy decision-makers. This national focus extends the analysis beyond that which is strictly relevant to a NSW Government planning authority. However, it is considered the correct approach both conceptually and pragmatically given the interconnected nature of the Australian economy and society and the spillovers between states, including those associated with the tax system and the movement of resources over state boundaries.

BCA of the Project involves the following key steps:

- identification of the "base case";
- specification 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 the WACJV and its specialist consultants.

2.2 IDENTIFICATION OF THE BASE CASE AND PROJECT

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

In this Economic Impact Assessment, the base case or "without" Project scenario involves the continuation of existing rural residential, forestry and other land uses in the Project Boundary. In contrast to the "base case", the Project is as outlined in Section 1.

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 WACJV in the development of the current Project. The Wallarah 2 EIS provides more detail on the consideration of Project alternatives.

The Project assessed in the Wallarah 2 EIS and evaluated in the BCA is considered by WACJV to be a feasible alternative for minimising environmental and social impacts whilst maximising resource recovery and operational efficiency. It is therefore this alternative that is proposed by WACJV and was subject to detailed economic analysis.

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.

Table 2.1
Potential Economic Benefits and Costs of the Project

Category	Costs	Benefits
Production	• Opportunity cost of land • Capital costs of development including land acquisitions, ancillary works and sustaining capital • Operating costs, including administration, mining, coal handling, transportation to port and port charge • Decommissioning costs at cessation of the Project	• Value of coal • Residual value of capital and land at the cessation of the Project
Potential environmental, social and cultural impacts	• Forestry impacts • Local Water Supply Scheme • Subsidence impacts • Flooding • Groundwater impacts • Surface water impacts • Air quality impacts • Noise and vibration impacts • Ecology and biodiversity • Aboriginal heritage impacts • Historic heritage impacts • Traffic and transport impacts • Visual amenity impacts • Greenhouse gas generation • Agricultural impacts	• Any nonmarket benefits of employment

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 adversely affect individual and community wellbeing. If the potential impacts are mitigated to the extent where individual or community wellbeing is insignificantly affected, then no economic costs arise.

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 30 years. Where competitive market prices are available, they have generally been used as an indicator of economic values. Environmental, cultural and social impacts have initially been left unquantified and interpreted using the threshold value method[5]. An attempt has also been made to estimate environmental, cultural and social impacts using market data and benefit transfer[6].

[5] The threshold value method uses the value of quantified net benefits as the amount that unquantified costs would need to exceed to make a project questionable from an economic efficiency perspective.
[6] Benefit transfer refers to borrowing economic values that have been determined for other study sites.

2.4.1 Production Costs and Benefits[7]

Economic Costs

Opportunity Cost of Land

The majority of the land required for the Project is already in WACJV ownership. There is an opportunity cost associated with using land that is already in WACJV ownership for the Project instead of its next best use (e.g other industrial purposes). An indication of the opportunity cost of the land can be gained from the land's market value. This is estimated at $25 million (M).

Capital Cost of the Project

Capital costs of the Project include for design and project management, capital equipment, mine development, coal handling infrastructure, a rail loop and spur, powerlines, gas plant, water treatment plant, associated minor infrastructure, land acquisitions for properties adversely affected by noise, dust, vibration and for properties required for biodiversity offsets. These capital costs over the life of the Project are estimated by WACJV at $1.5 billion (B). These costs are included in the economic analysis in the years that they are expected to occur.

Annual Operating Costs of the Project

The annual operating costs of the Project include those associated with mining, environmental management and monitoring, ROM coal processing, water treatment, administration and coal rail transport. Average annual operating costs of the Project (excluding royalties) are estimated at $192M.

While royalties are a cost to WACJV, they are part of the overall producer surplus benefit of the Project that is paid to and then 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 over its life in the order of $661M, or $207M in present value terms (at 7% discount rate).

Decommissioning and Rehabilitation Costs of Facilities

The Project infrastructure would be decommissioned and rehabilitated or decommissioned and on sold for industrial uses at the cessation of the Project. No estimate is available of the decommissioning and rehabilitation costs however it is assumed that these are offset by the residual value of land and capital equipment at the end of the Project life.

Economic Benefits

Value of Coal

The main economic benefit of the Project is the value of the product coal exported. This can be estimated from the thermal coal volumes that would be produced, together with assumed export prices of coal. For the purpose of the analysis the export coal price is assumed to average AUD $99 per tonne (/t). There is obviously considerable uncertainty around the economic value of coal from the Project (and the USD/AUD exchange rate). Consequently, variations in the assumed economic value of coal from the Project have been included in the sensitivity analysis in Section 2.6.

[7] All values reported in this section are undiscounted Australian dollars unless otherwise specified.

Residual Value at End of the Evaluation Period

At the end of the Project, capital equipment and land (excluding environmental offsets) will have some residual value that could be realised by sale or alternative use. As identified above, this is assumed to offset the decommissioning and rehabilitation of surface infrastructure areas at the end of the Project life.

2.4.2 Non-market Costs and Benefits

Forestry Production – the Project will result in up to 3.2 ha of clearing in the Wyong State Forest for the construction and operation of the Western Ventilation Shaft. There is an opportunity cost associated with using this land for the Ventilation Shaft instead of forestry. The typical "average" standing timber value of Wyong State Forest, assuming the removal of 100% of the harvestable timber, has been estimated at $3,600 per ha (GHD 2012). Therefore for the 3.2 ha of affected land, the value of standing timber is estimated at $11,520 in royalties. No harvesting and haulage costs were estimated and hence this value could be considered to be a maximum estimate of the net value of foregone timber as a result of the Project.

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 infrastructure areas and offsets, has therefore been incorporated in the BCA through inclusion of the opportunity cost of land used in the Project. An additional potential agricultural impact relates to potential subsidence impacts on a turf farm which may result in some lost production while subsidence effects are remedied. The cost of this remediation action and worst case assumed lost production for 2-years was included in the BCA (Scott Barnett and Associates 2012).

Local Water Supply Scheme – the Project has been designed to safeguard surface and underground water regimes. Groundwater modelling has shown that effects on the alluvial groundwater system will be minor and transient. The Extraction Area of the Project covers only a small percentage of the entire combined Gosford Wyong Water Supply Scheme catchment area, the majority of which lies within the Wyong State Forest. There will be some minor alterations to flows of drainage lines in these areas as a result of subsidence. However, the overall impact to the water supply will be negligible.

Subsidence impacts – the Extraction Area of the Project will occur completely within two Mine Subsidence Districts and has been designed to minimise subsidence and to meet subsidence criteria for these areas. The Project is predicted to result in some serviceability impacts on houses from tilt, curvature and strain (Wyong Areas Coal Joint Venture 2012; Mine Subsidence Engineering Consultants 2013). Conceptually, property damage costs from subsidence can be estimated by combining the probability of damage occurring with an estimate of the cost of damage, for each year of the analysis. In the absence of this detailed information, an alternative approach to making some allowance for subsidence damage to houses and other property was via inclusion of the Mine Subsidence Fund contributions in the economic costs of the Project. To allow for the uncertainty about how accurately these contributions reflect the actual impacts of the Project, sensitivity analysis around the operating costs of the Project (including Mine Subsidence Fund contributions) is undertaken in Section 2.6.

Flooding – the Project will result in some subsidence–induced topographic changes near water courses and floodplains. Six dwellings will experience major adverse impacts, 11 dwellings will experience moderate adverse impacts and 10 dwellings will experience minor adverse impacts. Options available to mitigate these impacts include minor channel improvements, construction of individual flood levees, raising houses in-situ and relocating or reconstruction of houses on higher ground within the property. Access roads in six locations will likely become untrafficable for longer durations during flood events (Wyong Areas Coal Joint Venture 2012; Herman and Associates (2013).

Options available to mitigate these impacts include raising bridges, raising low sections of roads, and improving the hydraulic capacity of channels in some locations. The BCA includes an allowance for these mitigation measures in the capital and operating costs of the Project.

Groundwater –groundwater ingress into the underground working of the Project will be pumped to the surface and treated in the water treatment plant in accordance with the Site Water Management Plan. The reject stream will be disposed of in the underground workings and the fresh water product used for mine purposes and / or discharged into adjoining streams in accordance with an appropriate Environmental Protection Licence. Groundwater modelling has shown that effects on the alluvial groundwater system will be minor and result in negligible effects on stream flows. No impacts are expected from the Project on groundwater users within the regional aquifers (Mackie Environmental Research 2013. Consequently, no economic implications associated with the Projects impacts on groundwater have been included in the BCA.

Surface water – no significant changes to stream flow regimes are anticipated as a result of the Project. However, some catchment areas will be affected on Wallarah and Buttonderry Creeks. The relevant water licences will be applied for these water takes from the catchment (WRM Water & Environment Pty Ltd 2013). An allowance has been included in the capital cost of the Project for the purchase of these water licences.

Air quality – the results of the dispersion modelling indicate that the predicted incremental ground level concentrations for PM_{10}, $PM_{2.5}$, TSP and dust deposition at the closest residential receptors during construction and operation of the Project are all below the impact assessment criteria. A cumulative assessment, incorporating existing background levels, indicates that the Project is unlikely to result in any additional exceedances of relevant impact assessment criteria at the neighbouring receivers. Cumulative impacts from NO_2 as a result of flaring were found to be minor when added to existing background levels (PAEHolmes 2012). No economic implications associated with air quality have therefore been identified for inclusion in the BCA.

Noise and vibration – impacts of the Project potentially arise from operational noise, operational road traffic noise, rail traffic noise and construction noise and vibration. Noise modelling for the Buttonderry sites shows that Project Specific Noise Criteria (PSNC) are not predicted to be exceeded at any private residential receiver but that PSNC for the Tooheys Road Site would be exceeded over more than 25% of a single land ownership at two private properties (Atkins Acoustics and Associates Pty Ltd 2012). 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 change in the noise environment is estimated. Instead of incorporating the partial property value impact on this property, conservatively, the full cost of acquiring them has been incorporated into the capital costs the Project[8].

No significant operational road traffic noise impacts, rail traffic noise impacts or construction noise and vibration impacts are predicted as a result of the Project (Atkins Acoustics and Associates Pty Ltd 2012), and hence no additional economic costs are included in the BCA.

Ecology and biodiversity –the Project will have a total direct impact area of 103 ha of which 66.4 ha is native vegetation (including 13.2 ha of Endangered Ecological Community (EEC)). The proposed offset area is 261.0 ha comprising protection of 200.7 ha of existing native vegetation (including 83.0 ha of EEC) and 60.3 ha of remediation/regeneration activities (Cumberland Ecology 2013).

The impacted vegetation and associated fauna is likely to have non-use values to the community that can potentially be estimated using non-market valuation methods. Similarly, the provision of offsets is also likely to have non-use values to the community. The cost of providing offsets is included in the

[8] 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.

opportunity cost of land estimate (as existing WACJV-owned land would be involved) and operating cost estimates. To the extent that the offsets provide community values that are equivalent to the values lost from clearing, there will be no net loss in community values.

Aboriginal heritage – 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 preparation of the Aboriginal Heritage Impact Assessment.

Impacts on highly significant Aboriginal heritage sites have also been shown to affect the well-being of the broader community (Gillespie Economic 2009a, 2009b, 2010). However, no highly scientific significant Aboriginal heritage sites are predicted to be directly or indirectly impacted by the Project (OzArk Environmental & Heritage Management Pty Ltd 2012a). Consequently, no economic implications associated with heritage have been included in the BCA.

Historic heritage – no items of Historic heritage will be directly impacted by the Project (OzArk Environmental & Heritage Management Pty Ltd 2012b). Historic heritage sites above the underground workings will be considered in subsidence management planning with appropriate adaptive management plans prepared. Indirect impacts on Historic heritage are therefore included in the consideration of subsidence impacts, above.

Traffic and transport – the Traffic and Transport Impact Assessment (Parsons Brinckerhoff 2013) found that the Project would not impose any adverse impacts on the surrounding road network as a result of the increased traffic associated with construction and operational activities. The main contributor to future traffic volumes is the Wyong Employment Zone, scheduled to be in operation in 2018. Consequently, no economic implications associated with traffic and transport have been included in the BCA.

Visual amenity – visual impacts of the Project can potentially arise from the Tooheys Road Site, the Buttonderry Site and Western Ventilation Shaft. However, the Visual Impact Assessment (The Design Partnership 2012) found that the potential for visual impacts at the Tooheys Road Site are generally minimal, particularly if a landscaped buffer area is maintained or enhanced along the key arterial routes. The proposed development at the Buttonderry Site was found to have a minimal to low Visual Impact Result on the existing and proposed landscape character of the area. No negative visual impacts were identified as a result of the Western Ventilation Shaft. The Economic Impact Assessment has included the costs of landscaping to minimise visual impacts.

Greenhouse gas generation – the Project will generate in the order of 6 million tonnes (Mt) of greenhouse gas emissions from mining and transport of product coal by rail to the port[9] (PAEHolmes 2012). To place an economic value on carbon dioxide equivalent (CO_2-e) emissions, a shadow price of emissions is required that reflects its social damage costs. The social damage cost of carbon is the present value of additional economic damages now and in the future caused by an additional tonne of carbon emissions. There is great uncertainty around the global social damage cost of carbon, with a wide range of estimated damage costs reported in the literature.

An alternative method to trying to estimate the global damage costs of emissions is to examine the price of carbon credits/taxes. Again, however, there is a wide range of permit prices. For this analysis, a global damage cost of emissions of AUD$30/t CO_2-e was used, with sensitivity testing from AUD$8/t CO_2-e to AUD$40/t CO_2-e. Refer to Attachment 1. The damage costs to Australia have been apportioned on the basis of Australia's share of global GDP.

[9] It should be noted that greenhouse gas generation associated with sea transport and usage of the product coal is considered to be outside of the scope of the BCA of the Project.

Social and economic value of employment - historically the employment benefits of projects have tended to be omitted from BCA on the implicit assumption that labour resources used in a Project would otherwise be employed elsewhere. Where this is not the case, Streeting and Hamilton (1991) and Bennett (1996) outline that otherwise unemployed labour resources utilised in a project should be valued in a BCA at their opportunity cost (wages less social security payments and income tax) rather than the wage rate which has the effect of increasing the net production benefits of the Project. 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. These are non-market values.

It has also been recognised that the broader community may hold non-environmental, non-market values (Portney, 1994) for social outcomes such as employment (Johnson and Desvouges, 1997) and the viability of rural communities (Bennett *et al*., 2004).

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).

The Project will provide an estimated 300 direct jobs, initially for 25 years. Using the more conservative Bulli Seam Operation employment value gives an estimated $208M for the employment benefits of the Project. This value has been included in the BCA. In the context of a fully employed economy there may be some contention about the inclusion of this value, particularly as it requires benefit transfer from a study of an existing mining operation in another region of NSW. Consequently, sensitivity testing that excludes this value has also been undertaken in Section 2.6.

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 $671M, with $346M accruing to Australia. 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. The threshold value indicates the price that the community must value the residual environmental impacts (be willing to pay) to justify in economic efficiency terms the no further development option.

For the Project to be questionable from an economic efficiency perspective, all incremental residual environmental impacts from the Project, that impact Australia[10], would need to be valued by the community at greater than the estimate of the Australian net production benefits i.e. greater than $346M. This is equivalent to each household in the region[11] valuing residual environmental impacts (after implementation of mitigation measures) at $1,725. The equivalent figure for NSW households is $130.

[10] 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.
[11] Lake Macquarie, Wyong and Gosford local government areas.

The threshold value may also be interpreted as the opportunity cost to Australia of not proceeding with the Project.

Instead of leaving the analysis as a threshold value exercise, an attempt has been made to quantify the residual environmental, cultural and impacts of the Project. As shown in Table 2.2, the environmental, cultural and social impacts to Australia that are not already incorporated in the estimate of net production benefits are estimated at $1M, considerably less than the estimated net production benefits of the Project. There is also potential non-market benefits of employment provided by the Project estimated at $186M.

Overall, the Project is estimated to have net benefits to Australia of between $346M and $531M and hence is desirable and justified from an economic efficiency perspective.

2.5.2 Distribution of Costs and Benefits

While BCA is primarily concerned with the aggregate benefits and costs of the Project to Australia, the distribution of costs and benefits may also be of interest to decision-makers.

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

- WACJV in the form of any after tax profits;
- the Commonwealth Government in the form of any Company tax payable ($139M, 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 Central Coast region;
- the NSW Government via royalties (estimated at $661M in total or $207M present value at 7% discount rate) which are subsequently used to fund provision of government infrastructure and services across the State, including the local region; and
- the local community in the form of any 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 WACJV.

Noise costs occur at a local level, but have already been incorporated into the estimation of net production benefits via acquisition costs for affected properties. Subsidence impacts would also occur at the local level but are included in the costs of production via the Mine Subsidence Levy. Local flooding impacts and visual amenity impacts would also occur at the local level but have been incorporated into the estimated net production benefits by an allowance in the capital and operating costs for mitigation measures. Greenhouse gas costs occur at the national and global level and will be internalised into production costs through the Commonwealth Government's carbon tax. The economic costs associated with the clearing of native vegetation would occur at the state level and would be counterbalanced by the offset actions proposed by WACJV. Other potential environmental impacts would largely occur at the local level and were found to be minor or negligible. Non-market benefits associated with employment provided by the Project would largely accrue at the local or state level[12].

[12] It should be noted that the study from which the employment values were transferred surveyed NSW households only.

Table 2.2
Benefit Cost Analysis Results of the Project ($M Present Values at 7% Discount Rate)

	Costs	**$M**	**Benefits**	**$M**
Production	Opportunity cost of land	$23	Sale value of coal	$3,155
	Opportunity cost of capital	$0		
	Capital costs	$785		
	Operating costs ex royalties and carbon tax	$1,676		
	Rehabilitation and decommissioning costs	Offset by residual value of land and capital	Residual value of land and capital	Offset by rehabilitation and decommissioning costs
	Production Sub-total	***$2,484***		***$3,155***
	Net Production Benefit	**$0**		**$671 ($346*)**
	Forestry impacts	$0**		
	Agricultural impacts	$0** Also in opportunity cost of land above		
Externalities	Local water supply	Negligible		
	Subsidence impacts	Accounted for through Mine Subsidence Levy	Social and economic value of employment	$186
	Flooding	Allowance in capital and operating costs		
	Groundwater	Negligible		
	Surface water	Negligible		
	Air quality	Negligible		
	Noise and vibration	Costs of acquisition included capital costs		
	Ecology and biodiversity	Some loss of values but offset. Cost of offset included in opportunity cost of land and operating costs		
	Aboriginal heritage	Negligible		
	European heritage	Accounted for through Mine Subsidence Levy		
	Transport and traffic	Negligible		
	Visual amenity	Costs of mitigation included in operating costs		
	Greenhouse gas	$56 ($1*)		
	Externality sub-total	***$56 ($1*)***		***$186***
Net Community Benefits (including employment)				**$801 ($531*)**
Net Community Benefit (excluding employment)				**$615 ($346*)**

*where some impacts accrue internationally, the number in brackets represents the impact to Australia.
**The value is estimated at $0.01M but is rounded down.
***The value is estimated at $0.3M but is rounded down.
Note: Totals may have minor discrepancies due to rounding.

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

Value ($M)		Distribution			
		Local	State	National	Global
Benefits					
Net production benefits to WACJV	$325	-	-	-	✓
Net production benefits to Commonwealth Government – Company tax	$139	✓	✓	✓	-
Net production benefits to NSW Government – Royalties	$207	✓	✓	-	-
Social benefit of employment	$186	✓	✓	-	-
Total	***$857***				
Costs					
Forestry impacts	$0	✓	-	-	-
Agricultural impacts	$0 Also in opportunity cost of land above	✓	-	-	-
Local water supply	Negligible	✓	-	-	-
Subsidence impacts	Accounted for through Mine Subsidence Levy	✓	-	-	-
Flooding	Allowance in capital and operating costs	✓	-	-	-
Groundwater	Negligible	✓	-	-	-
Surface water	Negligible	✓	-	-	-
Air quality	Negligible	✓	-	-	-
Noise and vibration	Costs of acquisition included capital costs	✓	-	-	-
Ecology and biodiversity	Some loss of values but offset. Cost of offset included in opportunity cost of land and operating costs	✓	✓	-	-
Aboriginal heritage	Negligible	✓	-	-	-
European heritage	Accounted for through Mine Subsidence Levy	✓	-	-	-
Transport and traffic	Negligible	✓	-	-	-
Visual amenity	Costs of mitigation included in operating costs	✓	-	-	-
Greenhouse gas (rest of world)	$55	-	-	-	✓
Greenhouse gas (Australia)[1]	$1	✓	✓	✓	-
Total	***$56***				
Net Benefits	**$801**				

Note: Totals may have minor discrepancies due to rounding.

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

While BCA is not recommended to be undertaken at the sub-national level, Table 2.3 indicates that there are significant net production benefits that directly accrue to NSW. NSW would also benefit from the provision of government infrastructure and services as a result of Company tax generated from the Project. These benefits to NSW are significantly greater than the environmental, social and cultural costs of the Project. Consequently, as well as resulting in net benefits to Australia, the Project would result in net benefits to NSW.

2.6 SENSITIVITY ANALYSIS

The NPV presented in Table 2.3 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 changes to the following variables:

- opportunity cost of land;
- capital costs;
- operating costs;
- coal value;
- forestry impacts;
- agricultural impacts;
- greenhouse gas impacts; and
- social value of employment.

This analysis indicated (Attachment 2) that the results of the BCA are not sensitive to reasonable changes in assumptions regarding any of these variables. In particular, significant increases in the values used for impacts of greenhouse gas emissions, agricultural impacts and forestry impacts had little impact on the overall economic desirability of the Project.

The results were most sensitive to decreases in the value of product coal, although substantial and sustained reductions in assumed coal prices would be required to make the Project undesirable from an economic efficiency perspective.

2.7 DOWNSTREAM COSTS AND BENEFITS

A persistent issue that has arisen in relation to coal mining projects concerns potential greenhouse gas emissions from the use of the coal that is exported. However, these impacts are not considered relevant to a BCA of the Project.

Traditional and continuing practice in BCA is to undertake the analysis from a national perspective. This is based on pragmatic grounds as well as the view that projects should be assessed from the view point of the nation which undertakes the projects, incurs the costs and is responsible for decision-making. In the BCA above, production benefits (value of export coal) and costs are valued within the national boundary e.g. coal is valued at the Newcastle Port (free-on-board), and costs up to and including loading the coal at Newcastle Port are included. The net production benefit accruing to Australia is then estimated.

After coal leaves Australia it becomes an input into a different production process. In the case of thermal coal this production process is concerned with the burning of coal to generate electricity. This production process has its own set of costs and benefits. Costs of coal fired power generation include the costs of coal, labour, land and capital inputs, electricity distribution costs and environmental costs, such as greenhouse gas generation. Benefits include the community's willingness to pay for electricity. There may also be externality benefits of electricity for economic development, education, and medical care. All of these costs and benefits are relevant considerations at this next stage of the production process, not just the greenhouse gas costs.

Where these different production processes occur overseas they are not subject to the Australian or NSW Governments' development approval processes. Decisions by the Australian and NSW Governments about whether to supply additional coal for export are likely to have little impact on

decisions other countries take with regard to coal fired electricity generation. While NSW is well placed to supply some of the projected additional world demand for coal (10% of the increased world coal production to 2035 is expected to come from Australia/New Zealand), 75% of growth in coal production is expected to come from China (US Energy Information Administration 2010), and with NSW containing less than 1% of total recoverable coal reserves in the world, there are significant coal supply source substitution possibilities (US Energy Information Administration 2010).

3 REGIONAL ECONOMIC IMPACT ASSESSMENT

3.1 INTRODUCTION

The BCA reported 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 regional economic impact assessment is the effect of an impacting agent on an economy in terms of a number of specific indicators of economic activity.

These indicators can be defined as follows:

- ***Gross regional output*** – the gross value of business turnover.
- ***Value-added*** – the difference between the gross value of business turnover and the costs of the inputs of raw materials, components and services bought in to produce the gross regional output.
- ***Household income*** – the wages paid to employees including imputed wages for self employed and business owners.
- ***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 local economy (Powell *et al.,* 1985; Jensen and West, 1986). This Economic Impact Assessment is concerned with the impact of annual ROM coal production of up to 5 Mtpa from the Project.

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 Project, but not making the economy so large that the impact of the Project becomes trivial (Powell and Chalmers, 1995). For this Economic Impact Assessment, the economic impacts of the Project have been estimated for the regional economy comprising the Australian Bureau of Statistics (ABS) Local Government Areas (LGAs) of Gosford, Wyong and Lake Macquarie.

There are a range of methods that can be used to examine the regional 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). This Economic Impact Assessment uses input-output analysis.

Input-output analysis essentially involves two steps:

- development 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, and result in estimated impacts being an upper bound impact estimate.

A 2005-06[13] input-output table of the regional economy (Gosford, Wyong and Lake Macquarie LGAs) was developed using the Generation of Input-Output Tables (GRIT) procedure (Attachment 4) with a 2005-06 input-output table of the NSW economy (developed by Monash University) as the parent

[13] A key driver in developing regional input-output tables is detailed employment by industry data from the Census. Only 2006 Census data was available at the time of the preparation of this report. However, structural change in an economy occurs slowly and hence a 2006 input-output table is considered a reasonable basis on which to undertake the analysis.

table. The 109 sector input-output table of the regional economy was aggregated to 30 sectors and six sectors for the purpose of describing the economies.

The initial regional impact of the Project (from construction and operation expenditure) was estimated from information provided by WACJV in relation to annual revenue, expenditure and employment profiles within the region. Flow-on effects were estimated by using the average output, expenditure and employment relationships in the input-output table.

3.2 INPUT OUTPUT TABLE AND ECONOMIC STRUCTURE OF THE REGION

A highly aggregated 2005-06 input-output table for the regional economy is provided in Table 3.1[14]. The rows of Table 3.1 indicate 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). For example, the mining sector in the region sells $11,000 worth of output to the agriculture, forestry and fishing sector of the regional economy, $29,423,000 worth of output to the mining sector of the regional economy etc. It also sells $1,216,000 of output directly to households and exports $699,476,000 worth of output from the region.

The corresponding mining sector 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. For the mining sector to produce $811,129,000 worth of output, it purchases $69,000 of inputs from the agriculture, forestry and fishing sector of the regional economy, $29,423,000 of inputs from the mining sector of the regional economy etc. It also imports $107,800,000 of inputs from outside the region, generates $502,351,000 in other value added, employs 1,590 people and pays $102,015,000 in wages and salaries.

Table 3.1
Aggregated Transactions Table: Regional Economy 2005-06 ($'000)

	Ag, forestry, fishing	Mining	Manuf.	Utilities	Building	Services	Total Intermediate	Household Expenditure	OFD	Exports	TOTAL OUTPUT
Ag, forestry, fishing	3,436	69	42,227	12	544	19,452	65,740	48,650	11,908	63,210	189,508
Mining	11	29,423	24,358	73,195	4,188	2,877	134,053	1,216	-23,618	699,478	811,129
Manuf.	15,271	17,590	821,791	13,578	308,692	698,470	1,875,391	706,675	383,682	2,557,953	5,523,701
Utilities	1,335	5,252	68,085	570,058	9,535	120,967	775,232	115,333	9,548	328,886	1,229,000
Building	979	6,617	14,596	18,096	623,519	143,656	807,464	0	1,532,130	129,178	2,468,772
Services	19,709	40,013	714,251	33,285	254,643	2,987,296	4,049,197	3,902,371	3,398,699	5,361,656	16,711,923
Total Intermediate	40,741	98,963	1,685,309	708,224	1,201,121	3,972,719	7,707,077	4,774,245	5,312,349	9,140,361	26,934,032
Household Income	40,412	102,015	984,579	84,361	634,627	6,087,695	7,933,688	0	0	0	7,933,688
OVA	36,242	502,351	613,755	231,419	212,194	2,700,357	4,296,318	617,389	187,836	16,428	5,117,971
Imports	72,112	107,800	2,240,058	204,996	420,831	3,951,152	6,996,949	5,797,782	1,009,203	647,993	14,451,928
TOTAL OUTPUT	189,508	811,129	5,523,701	1,229,000	2,468,772	16,711,923	26,934,032	11,189,417	6,509,388	9,804,783	54,437,619
Employment	1,049	1,590	15,163	1,237	9,657	104,552	133,248				

Note: Totals may have minor discrepancies due to rounding.
Shaded cells are totals that are referred to in the text below.

[14] A key driver for the development of regional input output tables is detailed employment by industry data. This data from the 2011 census was unavailable at the time of the preparation of this report.

Value-added for the regional economy is estimated at $13,051M, comprising $7,934M to households as wages and salaries (including payments to self employed persons and employees) and $5,118M in OVA (Table 3.1).

A total of 133,248 people were working in the region during 2005-06 (Table 3.1).

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 for those areas (Figures 3.1 and 3.2). This reveals that the regional economy and NSW economy are quite similar. Although in the regional economy the agriculture, forestry and fishing sectors, and the value-added and output of the services sectors are of lower relative significance than they are to the NSW economy. The value-added and output of the mining sectors, the household income, value-added and output of the manufacturing sector and the output of the utilities sectors, and employment of the service sectors are of slightly greater significance in the regional economy than they are to the NSW economy.

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

From these figures, it is evident that in terms of gross regional output, retail trade, business services and building/construction are the most significant sectors (Figure 3.3). In terms of value-added retail trade, business services and health are the most significant sectors (Figure 3.3). The retail trade sector is the most significant sector in terms of regional employment (Figure 3.4) while the retail trade sector, business services sectors and health sector are the most significant sectors in terms of income (Figure 3.4). Major importing sectors include retail trade, food manufacturing, business services and personal/other services sectors, while major exporting sectors include retail trade, wholesale trade and ownership of dwellings (Figure 3.5).

Figure 3.1
Summary of Aggregated Sectors: Regional Economy (2005-06)

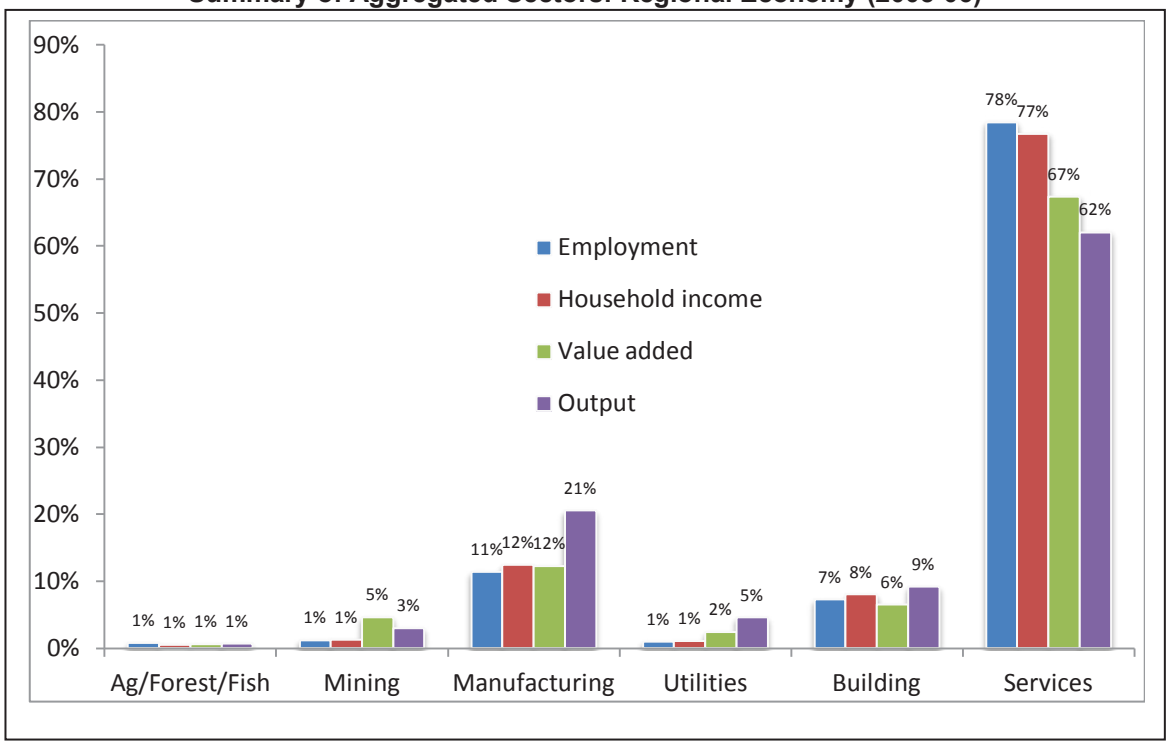


Figure 3.2
Summary of Aggregated Sectors: NSW Economy (2005-06)

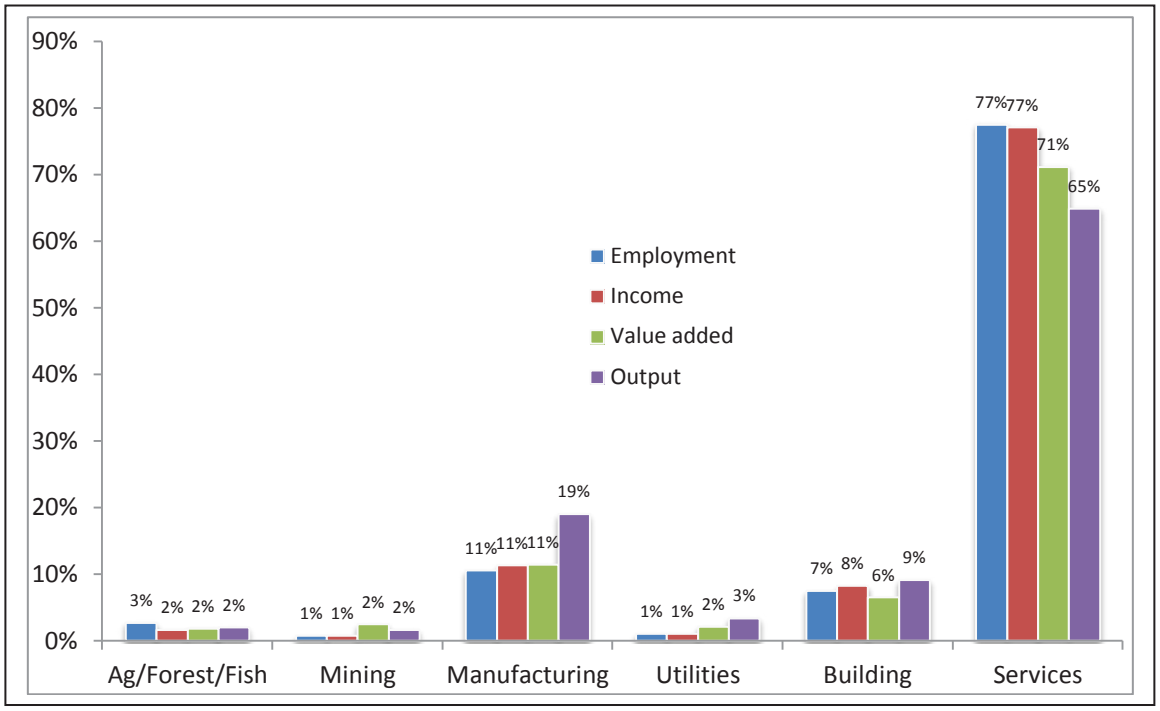


Figure 3.3 Sectoral Distribution of Gross Regional Output and Value-Added ($'000)

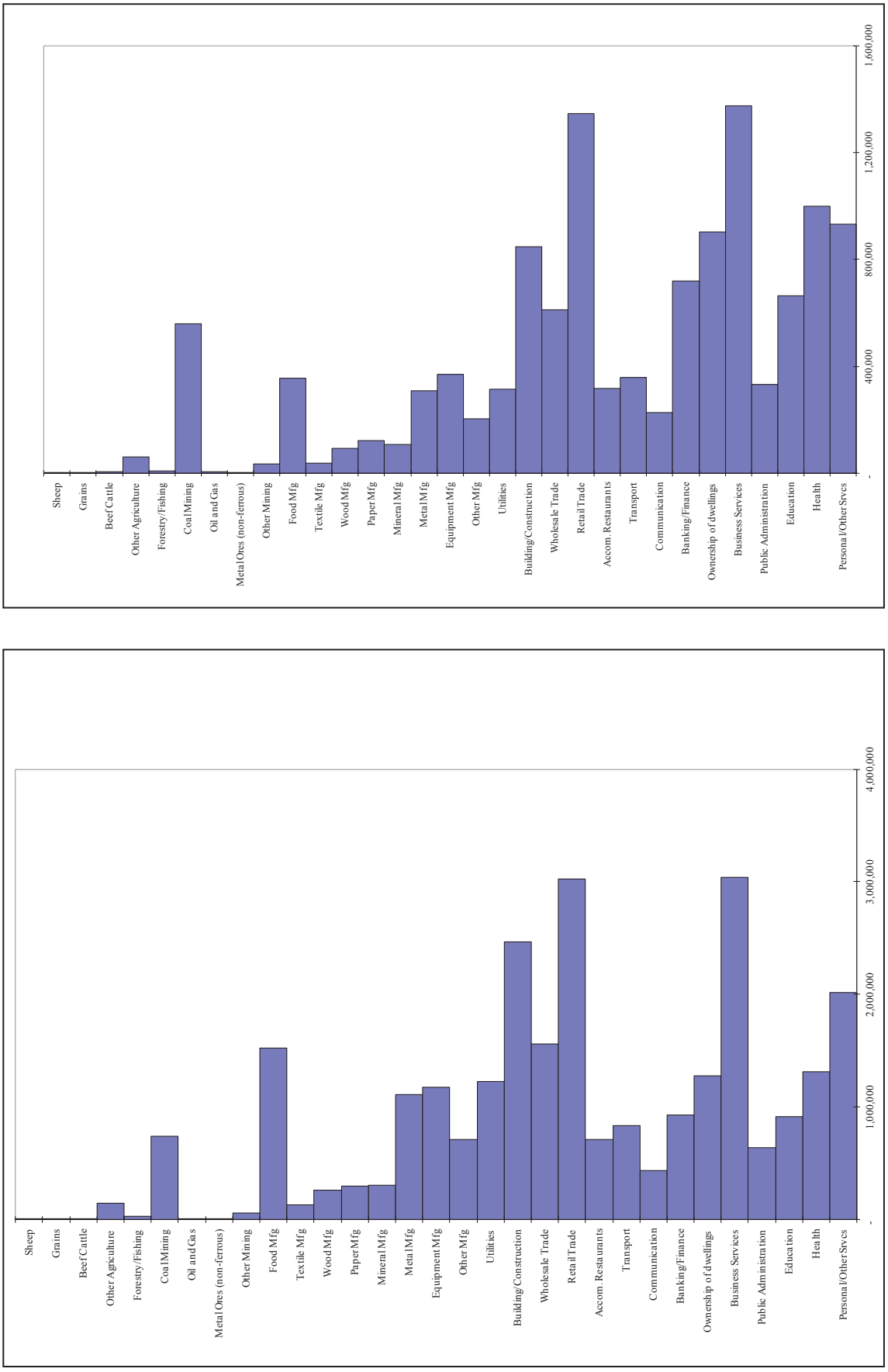
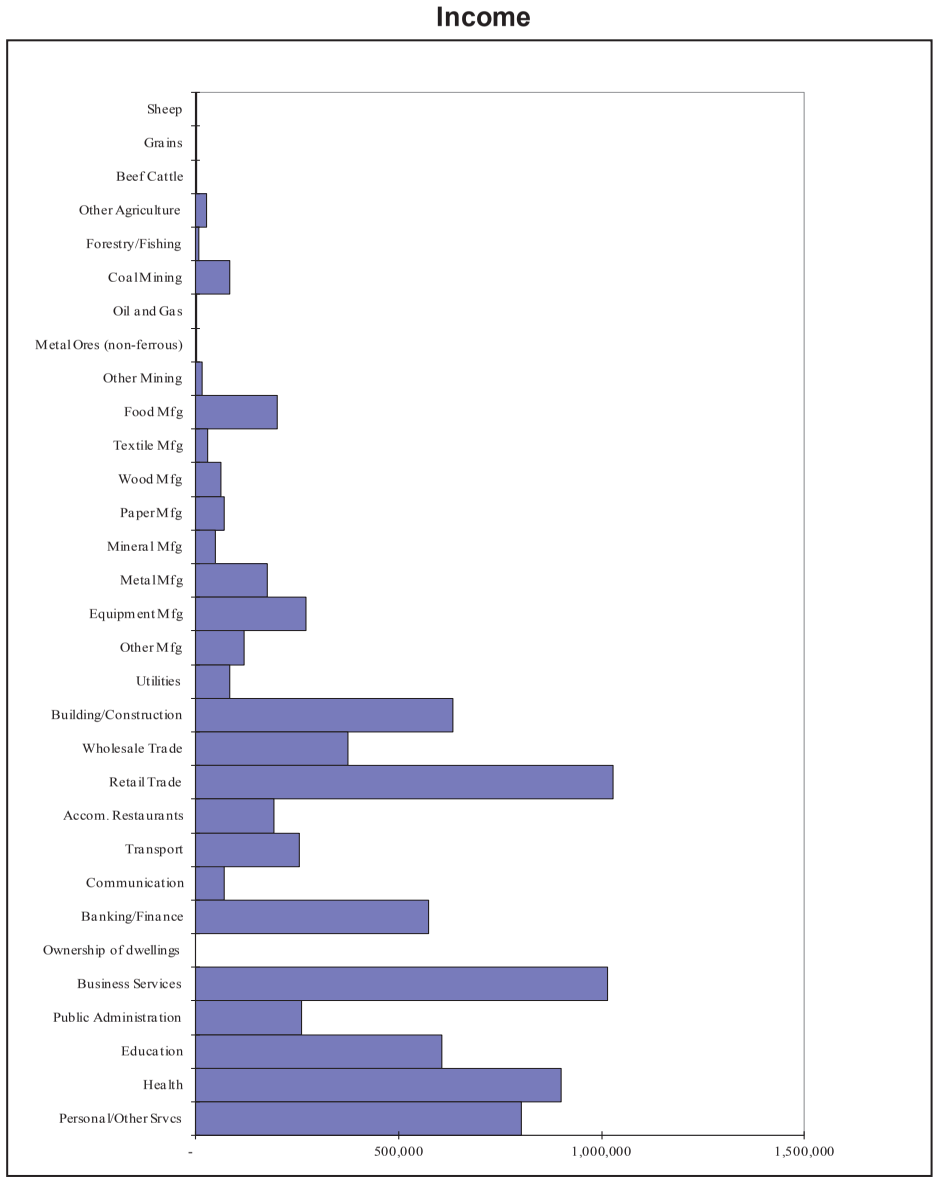


Figure 3.4 Sectoral Distribution of Gross Regional Income ($'000) and Employment (No.)



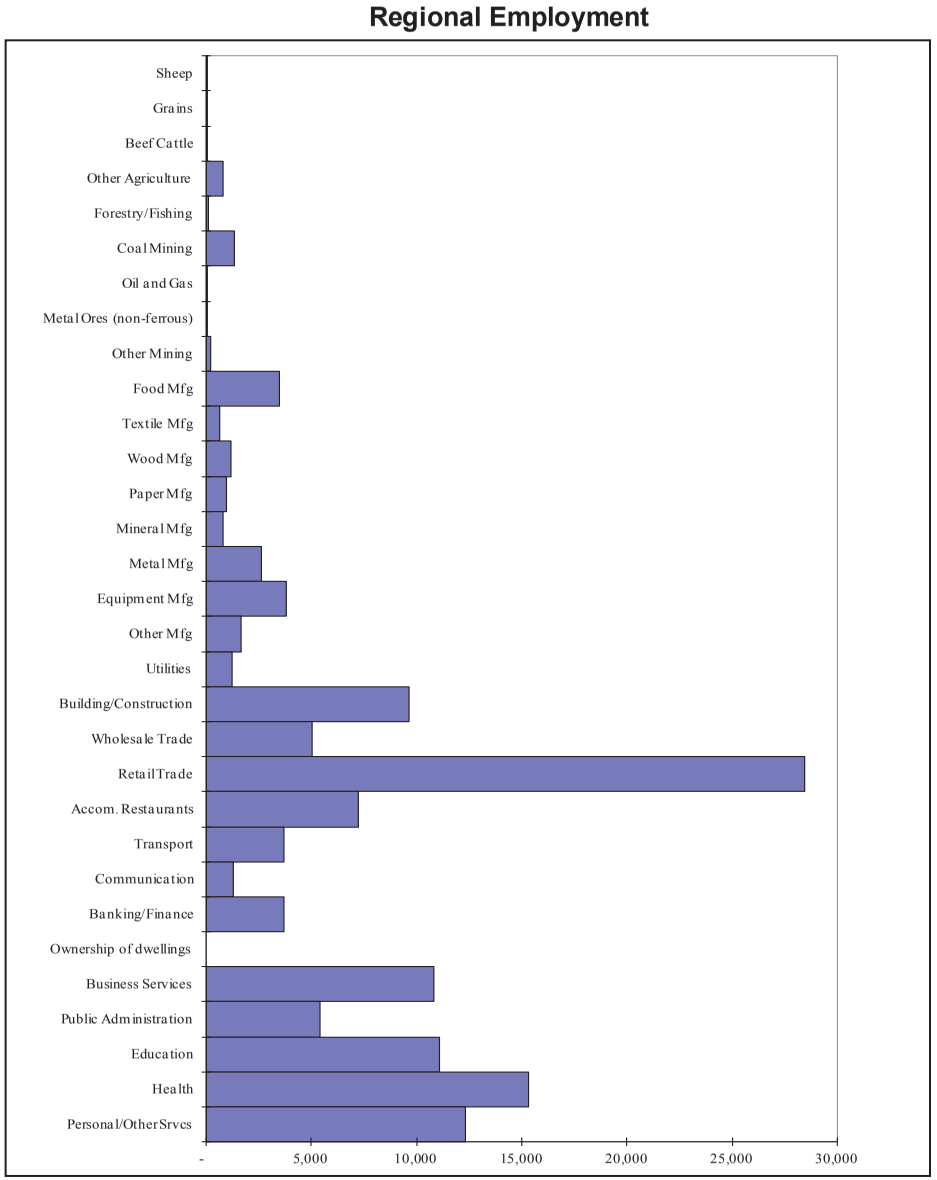
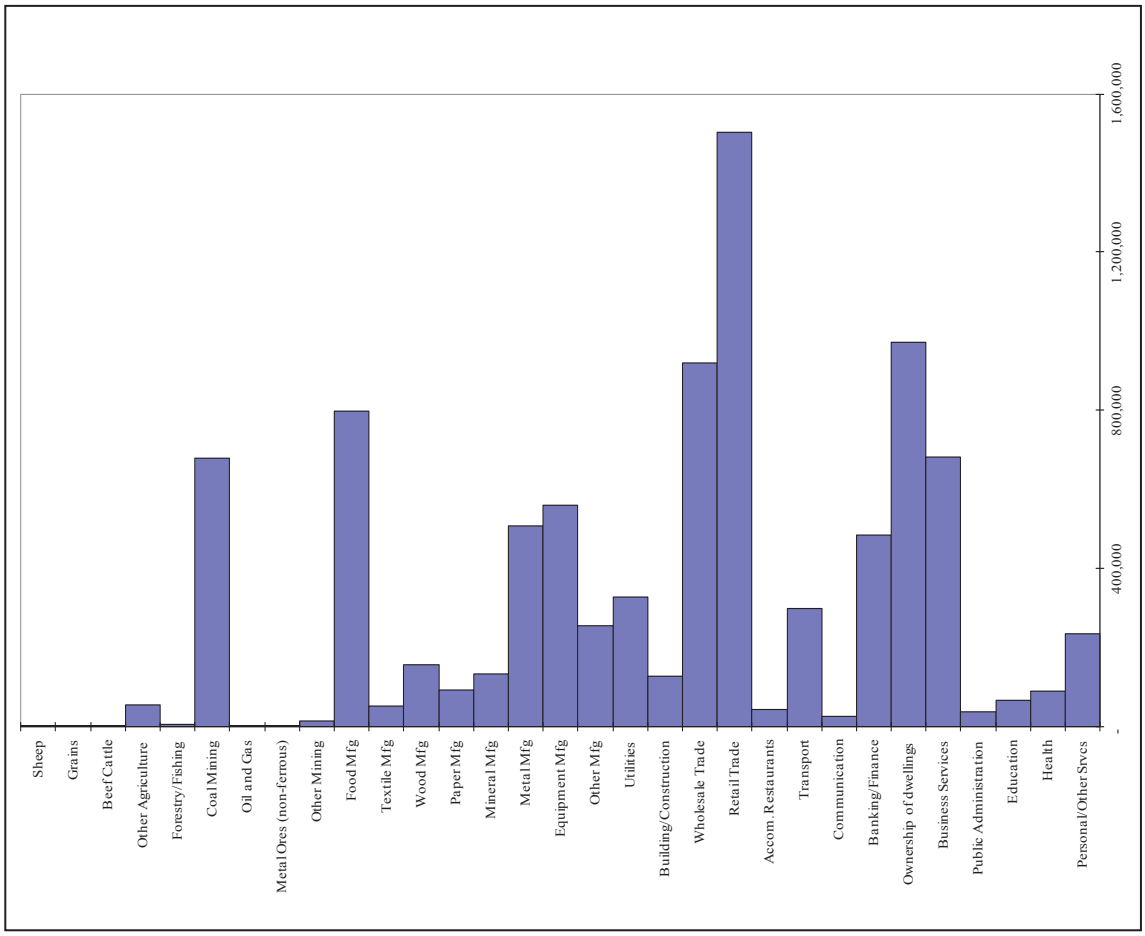
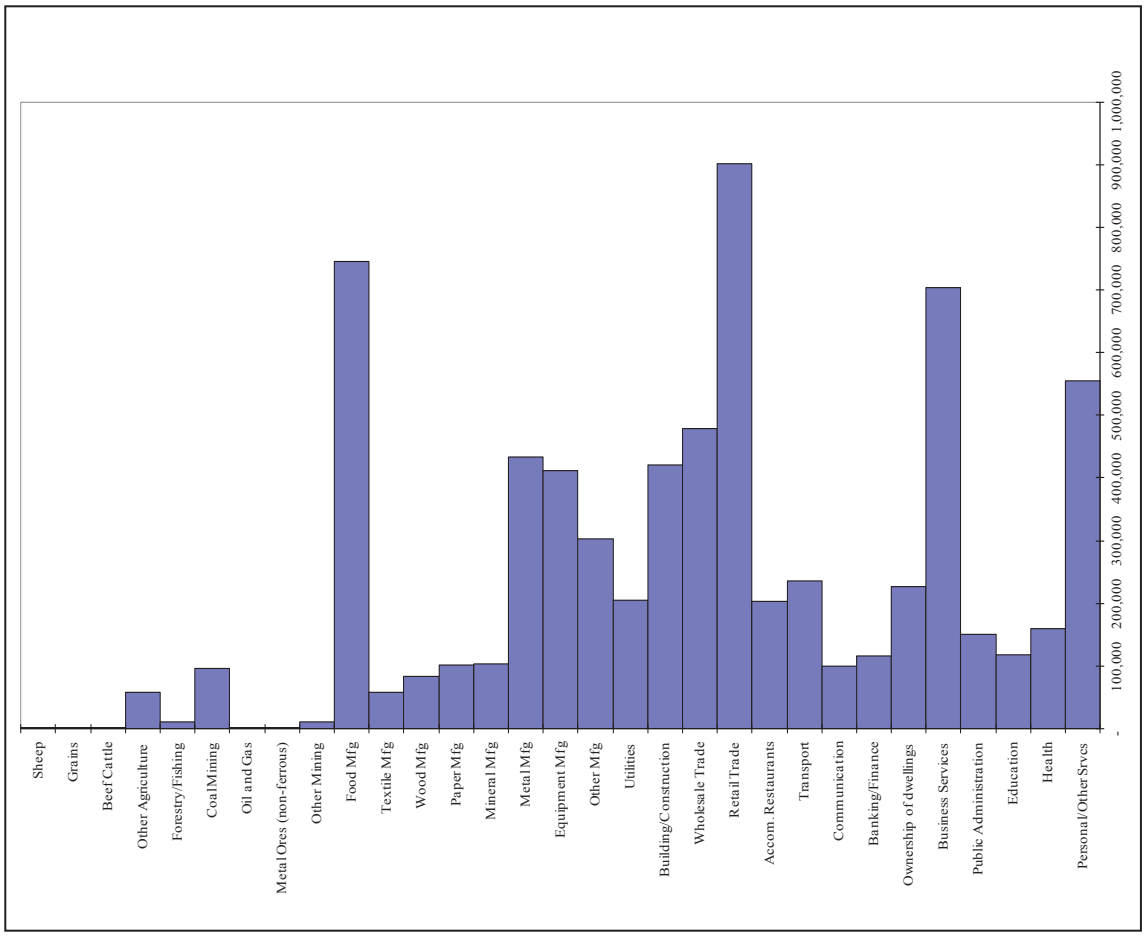


Figure 3.5 Sectoral Distribution of Regional Imports and Exports ($'000)





3.3 ECONOMIC IMPACT OF THE PROJECT

The revenue, expenditure and employment associated with the construction and operation phases of the Project would stimulate economic activity for the regional economy, as well as for the broader NSW economy, as described in this section.

3.3.1 Construction Phase

Introduction

Economic activity associated with the Project construction is estimated to 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;
- the *construction trade services sector* which includes businesses involved in site preparation services, 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
- the *other machinery and equipment manufacturing sector*.

Impact on Regional Economy

The average annual Project construction workforce is estimated to reach a peak of approximately 450 in Year 2. For Year 1 and Year 3 the average annual construction workforce is estimated at 250 and 400, respectively.

To support 450 construction workers (Year 2), reference to the input-output coefficients for the region shows that approximately $114M of capital expenditure would be required in the *other construction sector* and *construction trade services sector.* The direct and indirect regional economic impact of this level of expenditure in the regional economy is reported in Table 3.2.

Expenditure on machinery and equipment is estimated to be reach of peak of $65M in Year 3. For Years 1, 2 and 4 the estimated expenditure on machinery and equipment is $15M, $50M and $40M, respectively. WACJV advise that in the order of 25% of these machinery and equipment purchases will occur within the region. The direct and indirect regional economic impact of $16.25M expenditure in the regional economy (Year 3) is reported in Table 3.3.

Impacts

Table 3.2
Economic Impacts of the Construction Workforce on the Regional Economy (Year 2)

	Direct	Production induced	Consumption induced	Total Flow on*	TOTAL EFFECT*
OUTPUT ($'000)	114,285	79,277	44,245	123,522	237,807
Type 11A Ratio	*1.00*	*0.69*	*0.39*	*1.08*	*2.08*
VALUE ADDED ($'000)	46,436	33,043	20,612	53,655	100,091
Type 11A Ratio	*1.00*	*0.71*	*0.44*	*1.16*	*2.16*
INCOME ($'000)	35,296	26,110	15,023	41,133	76,429
Type 11A Ratio	*1.00*	*0.74*	*0.43*	*1.17*	*2.17*
EMPL. (No.)	450	352	239	591	1,041
Type 11A Ratio	*1.00*	*0.78*	*0.53*	*1.32*	*2.32*

Note: Totals may have minor discrepancies due to rounding.

Table 3.3
Economic Impacts of Construction Equipment Purchases on the Regional Economy (Year 3)

	Direct	Production induced	Consumption induced	Total Flow on*	TOTAL EFFECT*
OUTPUT ($'000)	12,923[1]	6,474	3,487	9,961	22,884
Type 11A Ratio	*1.00*	*0.50*	*0.27*	*0.77*	*1.77*
VALUE ADDED ($'000)	4,297	2,460	1,625	4,084	8,381
Type 11A Ratio	*1.00*	*0.57*	*0.38*	*0.95*	*1.95*
INCOME ($'000)	3,246	1,594	1,184	2,778	6,024
Type 11A Ratio	*1.00*	*0.49*	*0.37*	*0.86*	*1.86*
EMPL. (No.)	34	21	19	40	74
Type 11A Ratio	*1.00*	*0.61*	*0.55*	*1.16*	*2.16*

Note: Totals may have minor discrepancies due to rounding.
[1] While $16,250,000 is estimated to be spent in the local economy an adjustment has been made for some leakage of construction of machinery outside the economy based on location quotients.

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.

In total, the construction workforce of the Project during the peak construction year (Year 2) would contribute in the order of up to:

- $237M in annual direct and indirect output;
- $100M in annual direct and indirect value added;
- $76M in annual direct and indirect household income; and
- 1,041 direct and indirect jobs.

Proportionally less impact would be felt in Year 1 and Year 3 of the construction phase of the Project as indicated in the summary table below.

Table 3.4
Summary of Economic Impacts of Construction on the Regional Economy

	Direct and Indirect Output ($000)	Annual Direct and Indirect Value Added ($000)	Annual Direct and Indirect Household Income ($000)	Direct and Indirect Jobs (No.)
Year 1	132,132	55,614	42,466	579
Year 2	237,807	100,091	76,429	1,041
Year 3	211,412	88,982	67,946	926

In total, the construction equipment purchases of the Project during the peak year of expenditure (Year 3) would contribute in the order of up to:

- $23M in annual direct and indirect output;
- $8M in annual direct and indirect value added;
- $6M in annual direct and indirect household income; and
- 74 direct and indirect jobs.

Proportionally less impact would be felt in Year 1, Year 2 and Year 4 from equipment purchases as indicated in the summary table below.

Table 3.5
Summary of Economic Impacts of Construction Equipment Purchases on the Regional Economy

	Direct and Indirect Output ($000)	Annual Direct and Indirect Value Added ($000)	Annual Direct and Indirect Household Income ($000)	Direct and Indirect Jobs (No.)
Year 1	5,281	1,934	1,390	17
Year 2	17,603	6,447	4,634	57
Year 3	22,884	8,381	6,024	74
Year 4	14,082	5,158	3,707	46

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 workforce of the Project range from 2.08 for output up to 2.32 for employment. The Type 11A ratio multipliers for the equipment expenditure in the region range from 1.77 for output up to 2.16 for employment.

Main Sectors Affected

The input-output analysis indicates that flow-on impacts from the construction 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, accommodation/cafes/restaurant, health services and legal, accounting, marketing and business management services.

The input-output analysis indicates that impacts from the equipment purchases are most likely to directly impact the agriculture, mining and construction machinery, lifting and material handling equipment manufacturing sector and the other machinery and equipment manufacturing sector. The sectors most impacted by output, value-added, income and employment flow-ons are likely to be iron and steel manufacturing, wholesale and retail trade, other business services, scientific research, technical and computer services, other property services, accommodation/cafes/restaurant, health services and legal, accounting, marketing and business management services.

Impact on the NSW Economy

When the impact of $114M of expenditure in the *other construction* sector and *construction trade services* sector is assessed for the NSW economy (Table 3.6), the impacts are greater because of the larger inter-sectoral linkages and hence multipliers of a larger economy.

The impact of machinery and equipment purchases on the NSW economy are also greater than for the regional economy (Table 3.7) as the NSW economy is able to capture more of the machinery and equipment purchases (75%) and the larger economy has greater inter-sectoral linkages and hence multipliers.

Impacts

Table 3.6
Economic Impacts of the Construction Workforce on the NSW Economy (Year 2)

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	114,285	103,259	133,989	237,248	351,533
Type 11A Ratio	*1.00*	*0.90*	*1.17*	*2.08*	*3.08*
VALUE ADDED ($'000)	46,436	44,447	68,248	112,695	159,131
Type 11A Ratio	1.00	0.96	1.47	2.43	3.43
INCOME ($'000)	39,462	37,010	39,056	76,066	115,528
Type 11A Ratio	1.00	0.94	0.99	1.93	2.93
EMPL. (No.)	450	432	521	953	1,403
Type 11A Ratio	1.00	0.96	1.16	2.12	3.12

Note: Totals may have minor discrepancies due to rounding.

Table 3.7
Economic Impacts of Construction Equipment Purchases on the NSW Economy (Year 3)

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	42,761	32,897	37,930	70,827	113,588
Type 11A Ratio	*1.00*	*0.77*	*0.89*	*1.66*	*2.66*
VALUE ADDED ($'000)	14,833	13,487	19,320	32,807	47,640
Type 11A Ratio	*1.00*	*0.91*	*1.30*	*2.21*	*3.21*
INCOME ($'000)	12,197	9,450	11,056	20,507	32,704
Type 11A Ratio	*1.00*	*0.78*	*0.91*	*1.68*	*2.68*
EMPL. (No.)	120	110	152	262	382
Type 11A Ratio	*1.00*	*0.91*	*1.27*	*2.18*	*3.18*

Note: Totals may have minor discrepancies due to rounding.
[1] While $48,750,000 is estimated to be spent in the NSW economy an adjustment has been made for some leakage of construction of machinery outside the economy based on location quotients.

Based on the above approach, expenditure in the *other construction* sector and *construction trade services* sector during the peak construction year of the Project (Year 2) would result in impacts on the NSW economy of up to:

- $351M in annual direct and indirect output;
- $159M in annual direct and indirect regional value added;
- $115M in annual direct and indirect household income; and
- 1,403 direct and indirect jobs.

Proportionally less impact would be felt in Year 1 and Year 3 of the construction phase of the Project as indicated in the summary table below.

Table 3.8
Summary of Economic Impacts of Construction on the NSW Economy

	Direct and Indirect Output ($000)	Annual Direct and Indirect Value Added ($000)	Annual Direct and Indirect Household Income ($000)	Direct and Indirect Jobs (No.)
Year 1	195,322	88,418	64,191	780
Year 2	351,533	159,131	115,528	1,403
Year 3	312,516	141,469	102,705	1,247

The impact of the peak year of equipment purchases (Year 3) on the NSW economy would be up to:

- $114M in annual direct and indirect output;
- $48M in annual direct and indirect value added;
- $33M in annual direct and indirect household income; and
- 382 direct and indirect jobs.

Proportionally less impact would be felt in Year 1, Year 2 and Year 4 from equipment purchases as indicated in the summary table below.

Table 3.9
Summary of Economic Impacts of Construction Equipment Purchases on the NSW Economy

	Direct and Indirect Output ($000)	Annual Direct and Indirect Value Added ($000)	Annual Direct and Indirect Household Income ($000)	Direct and Indirect Jobs (No.)
Year 1	26,213	10,994	7,547	88
Year 2	87,376	36,646	25,157	294
Year 3	113,588	47,640	32,704	382
Year 4	69,900	29,317	20,126	235

3.3.2 Operation Phase

Impact on the Regional Economy

Introduction

For the analysis of the Project, a Project sector was inserted into the regional input-output table[15] reflecting peak production levels for the Project. The revenue, expenditure and employment data for this new sector was obtained from financial information provided by WACJV. For this new sector:

- the estimated gross annual revenue of the Project was allocated to the o*utput* row;
- the estimated wage bill of employees residing in the region was allocated to the *household wages* row with any remainder allocated to *imports*;
- non-wage local expenditure was initially allocated across the relevant *intermediate sectors* in the economy, *imports* and *other value-added* based on advice from WACJV;
- allocation was then further made between *intermediate sectors* in the local economy and *imports* based on regional location quotients;
- purchase prices for expenditure in the each sector in the region were adjusted to basic values and margins and taxes were 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 in the Project that resides in the region was allocated to the *employment* row.

Impacts

The total and disaggregated annual impacts of the average operation of the Project on the regional economy in terms of output, value-added, income and employment (in 2011 dollars) are shown in Table 3.10.

Table 3.10
Annual Regional Economic Impacts of the Project

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	489,099	90,404	45,418	135,822	624,920
Type 11A Ratio	*1.00*	*0.19*	*0.09*	*0.28*	*1.28*
VALUE-ADDED ($'000)	323,669	35,948	21,159	57,107	380,776
Type 11A Ratio	*1.00*	*0.11*	*0.07*	*0.18*	*1.18*
INCOME ($'000)	40,153	22,881	15,422	38,303	78,456
Type 11A Ratio	*1.00*	*0.57*	*0.38*	*0.95*	*1.95*
EMPLOYMENT (No.)	300	259	245	505	805
Type 11A Ratio	*1.00*	*0.87*	*0.82*	*1.68*	*2.68*

Note: Totals may have minor discrepancies due to rounding.
Employees are located in direct employment while the estimated 30 contractors are located in production-induced flow-on employment.

Again regional economic impacts are separated out between production-induced effects and consumption-induced effects. Production-induced effects occur in a near-proportional way within a region. Where workers commute from outside the region some of the consumption-induced flow-on effects leak from the region. Where workers are already located in the region i.e. unemployed or

[15] Inflated to 2011

employed, some of the consumption-induced flow-ons in the region may already be occurring through expenditure of their current wage or unemployment benefits.

The Project is estimated to make the up to the following contribution to the regional economy (Table 3.10):

- $625M in annual direct and indirect regional output or business turnover;
- $381M in annual direct and indirect regional value-added;
- $79M in annual direct and indirect household income; and
- 805 direct and indirect jobs.

Multipliers

Type 11A ratio multipliers for the Project range from 1.28 for output up to 2.68 for employment.

Capital intensive industries tend to have a high level of linkages 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 relatively high ratio multipliers for employment. A lower ratio multiplier for income (compared to employment) also generally occurs 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 value-added, reflecting the relatively high direct value-added for the Project compared to that in flow-on sectors. The low output ratio multiplier largely reflects the high direct output value of the Project compared to the sectors that experience flow-on effects from the Project.

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, mining and construction machinery, lifting and material handling equipment manufacturing sector;*
- *Scientific research, technical and computer services*
- *wholesale trade sector;*
- *retail trade sector;*
- *other property services sector;*
- *electricity supply sector;*
- *accommodation, cafes and restaurants sector;*
- *health sector; and*
- *education 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 operation (Table 3.11).

Table 3.11
Sectoral Distribution of Total Regional Employment Impacts of the Project

Sector	Average Direct Effects	Production Induced	Consumption Induced	Total
Primary production	0	0	2	3
Mining	300	30	0	331
Manufacturing	0	87	18	105
Utilities	0	7	2	9
Wholesale/Retail	0	42	55	96
Accommodation, cafes, restaurants	0	6	37	43
Building/Construction	0	6	2	8
Transport	0	8	6	14
Services	0	74	123	196
Total	**300**	**259**	**245**	**805**

Note: Totals may have minor discrepancies due to rounding.

Table 3.11 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, wholesale/retail, services* and *mining* sectors, while consumption induced flow-on employment would be mainly in the *services, wholesale/retail trade and accommodation/cafes/restaurants* sectors (Table 3.11).

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 increase in economic activity. However, because of the inter-linkages between sectors, many indirect businesses would also benefit.

Impact on the NSW Economy

Introduction

The State economic impacts of the Project operation were assessed in the same manner as for estimation of the regional impacts. A new Project sector was inserted into a NSW input-output table in the same manner described in Section 3.3.2. The primary difference from the Project sector identified for the regional economy was that all employment was assumed to reside in NSW and a greater level of expenditure would therefore be captured by the NSW economy compared to the regional economy.

Impacts

The total and disaggregated average annual impacts of the Project on the NSW economy in terms of output, value-added, income and employment (in 2011 dollars) are shown in Table 3.12.

Table 3.12
Annual State Economic Impacts of the Project

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	489,099	232,380	178,737	411,117	900,215
Type 11A Ratio	*1.00*	*0.48*	*0.37*	*0.84*	*1.84*
VALUE-ADDED ($'000)	317,879	97,791	91,040	188,831	506,710
Type 11A Ratio	*1.00*	*0.31*	*0.29*	*0.59*	*1.59*
INCOME ($'000)	40,153	61,858	52,100	113,957	154,110
Type 11A Ratio	*1.00*	*1.54*	*1.30*	*2.84*	*3.84*
EMPLOYMENT (No.)	300	715	695	1,411	1,711
Type 11A Ratio	*1.00*	*2.39*	*2.32*	*4.70*	*5.70*

Note: Totals may have minor discrepancies due to rounding.

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

- $900M in annual direct and indirect output;
- $507M in annual direct and indirect regional value added;
- $154M in annual direct and indirect household income; and
- 1,711 direct and indirect jobs.

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

3.4 PROJECT CESSATION

The establishment and operation of the Project would stimulate demand in the regional and NSW economy leading to increased business turnover in a range of sectors and increased employment opportunities. Conversely, cessation of the mining operations would result in a contraction in regional 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 would depend on whether the workers and their families affected would leave the region. If it is assumed that some or all of the workers remain in the region, then the impacts of Project cessation would not be as severe compared to a greater proportion of employees leaving the region. 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 given in Table 3.10. However, if displaced workers and their families leave the region then impacts would be greater and begin to approximate the total effects in Table 3.10.

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 region compared to elsewhere, the

likely loss or gain from homeowners selling, and the extent of "attachment" to the locality (Economic and Planning Impact Consultants, 1989).

To the extent that alternative development opportunities arise in the regional economy, the regional economic impacts associated with Project 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 a region's capacity to expand its factors of productions by attracting investment and labour from outside the region (Bureau of Industry Economics, 1994). This in turn can depend on a region's natural endowments.

The region is a prospective location with a range of coal resources. New mining resource developments in the region would help broaden the region's economic base and buffer against impacts of the cessation of individual projects. The region is also increasingly a growing part of the Greater Sydney region.

Ultimately, the significance of the economic impacts of cessation of the Project will depend on 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 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 the region, it is not possible to foresee the likely circumstances within which Project cessation would occur. It is therefore important for regional authorities and leaders to take every advantage of the regional economic activity and skills and expertise that the Project would maintain for the region.

4 CONCLUSION

A BCA of the Project indicated that it would have net production benefits to Australia of $346M. Provided the residual environmental, social and cultural impacts of the Project that accrue to Australia are considered to be valued at less than $346M, 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 forestry, agriculture and greenhouse gas emissions. These impacts are estimated at $56M globally or $1M 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 $186M. Overall, the Project is estimated to have net benefits to Australia of between $346M and $531M 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:

- WACJV in the form of any after tax profits;
- the Commonwealth Government in the form of any Company tax payable ($139M, 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 Central Coast region;
- the NSW Government via royalties (estimated at $661M in total or $207M present value at 7% discount rate) which are subsequently used to fund provision of government infrastructure and services across the State, including the local region; and
- the local community in the form of any 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 WACJV.

The non-market costs that accrue to NSW are estimated at $1M. 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:

- $625M in annual direct and indirect regional output or business turnover;
- $381M in annual direct and indirect regional value-added;
- $79M in annual direct and indirect household income; and
- 805 direct and indirect jobs.

For the NSW economy, the operation of the Project is estimated to make up to the following contributions:

- $900M in annual direct and indirect output;
- $507M in annual direct and indirect regional value added;
- $154M in annual direct and indirect household income; and
- 1,711 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 (CO_2-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 CO_2-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 (CO_2) 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$0.55/t CO_2 (in 1995 US$), the median was US$3.82/t CO_2, the mean US$25.34/t CO_2 and the 95th percentile US$95.37/t CO_2. 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 CO_2 emissions exceed US$14/t CO_2 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 CO_2).

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 CO_2 is to examine the price of carbon credits. This is relevant because emitters can essentially emit CO_2 resulting in climate change damage costs or may purchase credits that offset their CO_2 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 CO_2. The average price was €22/t CO_2 in the second half of 2008 and €13/t CO_2 in the first half of 2009. In March 2012, the permit price reduced to under €10 /t CO_2.

In 2008, spot prices in the Chicago Climate Exchange were in the order of US$3.95/t CO_2. 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 CO_2.

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, a range for the social cost of greenhouse gas emissions from AUD$8/t CO_2-e to AUD$40/t CO_2-e was used in the sensitivity analysis described in Section 2.6 of this report, with a conservatively high central value of AUD$30/t CO_2-e.

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ATTACHMENT 2 – BCA SENSITIVITY TESTING

Table 2-1
Benefit Cost Analysis Sensitivity Testing, Australian Net Present Value ($Millions)

	4% Discount Rate	7% Discount Rate	10% Discount Rate
CENTRAL ANALYSIS	$857	$531	$352
INCREASE 20%			
Opportunity cost of land	$855	$530	$351
Capital costs	$797	$484	$313
Operating costs	$702	$431	$284
Coal value	$1,206	$750	$495
Forestry impacts	$857	$531	$352
Agriculture impacts	$856	$531	$352
Employment benefits	$895	$569	$388
GREENHOUSE COSTS @ $40/TONNE (T)	$856	$531	$352

	4% Discount Rate	7% Discount Rate	10% Discount Rate
DECREASE 20%			
Opportunity cost of land	$858	$533	$353
Capital costs	$916	$579	$391
Operating costs	$1,011	$632	$420
Coal value	$507	$313	$209
Forestry impacts	$857	$531	$352
Agriculture impacts	$857	$531	$352
Employment benefits	$818	$494	$316
GREENHOUSE COSTS @ $8/T	$857	$532	$352

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.

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

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

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

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 GRIT SYSTEM FOR GENERATING 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 GC-1 (Powell and Chalmers, 1995).

Table 4-1
The GRIT Method

Phase	Step	Action
PHASE I		ADJUSTMENTS TO NATIONAL TABLE
	1	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.
	8	Insertion of aggregated superior data.
PHASE IV		DERIVATION OF PROTOTYPE TRANSACTIONS TABLES
	9	Derivation of transactions values.
	10	Adjustments to complete the prototype tables.
	11	Derivation of inverses and multipliers for prototype tables.
PHASE V		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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