Economic Impact Assessment

Drayton South Coal Project

Economic Impact Assessment

Prepared for

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EXECUTIVE SUMMARY

Gillespie Economics was commissioned by Hansen Bailey Environmental Consultants, on behalf of Anglo American Metallurgical Coal Pty Ltd to complete an economic impact assessment for the Drayton South Coal Project. Anglo American is seeking Project Approval under Part 3A of the *Environmental Planning & Assessment Act 1979* to facilitate the continuation of the existing Drayton Mine by the development of an open cut and highwall coal mining operation and associated infrastructure within the Drayton South area. The Project is to mine up to 7 million tonnes per annum of run-of-mine coal over a period of 27 years.

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

- the economic efficiency of the Project (i.e. consideration of economic costs and benefits including the opportunity cost of using agricultural resources); and
- the regional economic impacts of the Project (i.e. the economic activity that the Project would provide to the regional economy).

A Benefit Cost Analysis (BCA) of the Project indicated that it would have total net production benefits of $887M, with a minimum of $490M 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, that impact Australia, would need to be valued by the community at greater than the estimate of the Australian net production benefits i.e. greater than $490M. This is equivalent to each household in the study region and in NSW valuing residual environmental impacts at $24,000 and $180, 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 Aboriginal heritage, greenhouse gas emissions and surface and groundwater impacts. These impacts are estimated at $188M in total or $48M 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 $298M.

Overall, the Project is estimated to have net benefits to Australia of between $443M and $741M 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:

- Anglo American and its shareholders in the form of after tax profits;
- the Commonwealth Government in the form of any Company tax payable ($170M present value) or Minerals Resource Rent Tax from the Project, which is subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the local region;

- the NSW Government via royalties ($320M present value) 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 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 Anglo American.

Noise costs, air quality costs, agricultural production costs and road traffic impacts will occur at a local level, but have already been incorporated into the estimation of net production benefits via acquisition costs for affected properties and mitigation costs. Similarly, surface water and groundwater effects will occur at the local level, but have been incorporated into the analysis via inclusion of the costs of acquisition of Water Access Licences and HRSTS credits. Greenhouse gas costs will occur at the national and global level and will be internalised in the future through payment of the Commonwealth Government's carbon tax. The economic costs associated with the clearing of native vegetation will occur at the State level and would be counterbalanced by the Project biodiversity offsets. The cost of providing these offsets is included in the estimation of net production benefits. Visual impacts will occur at the local level and will be internalised by Anglo American through the funding of visual mitigation measures. Aboriginal heritage impacts will potentially occur to NSW households[1] as well local Aboriginal people. Anglo American will develop an Aboriginal Heritage Management Plan to minimise and manage Aboriginal heritage impacts. Other potential environmental impacts would largely occur at the local level and were found to be insignificant. Non-market benefits associated with employment provided by the Project would largely accrue at the local or State level.

The non-market costs that accrue to NSW are estimated at less than $48M. These are considerably less than the net production benefits (and potential non-market employment benefits) that directly accrue to NSW through royalties[2]. 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:

- $588M in annual direct and indirect regional output or business turnover;
- $264M in annual direct and indirect regional value added;
- $86M in annual direct and indirect household income; and
- 785 direct and indirect jobs.

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

- $930M in annual direct and indirect regional output or business turnover;
- $443M in annual direct and indirect regional value added;
- $195M in annual direct and indirect household income; and
- 2,089 direct and indirect jobs.

[1] Non-market valuation studies that have surveyed NSW households have found that they value the conservation of highly significant Aboriginal heritage (Gillespie Economics 2008, 2009a, 2009b).
[2] 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.

The Project approval would extend the life of the Drayton Mine by 27 years and extend the period of time that it provides economic activity in the regional and NSW economy. 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.
- Whether other mining developments or other opportunities in the region arise that allow employment of displaced workers.

1 INTRODUCTION

1.1 ECONOMIC ASSESSMENT

Gillespie Economics has been engaged by Hansen Bailey Environmental Consultants (Hansen Bailey) on behalf of Anglo American Metallurgical Coal Pty Ltd (Anglo American) to complete an economic impact assessment for the Drayton South Coal Project (the Project). The purpose of the assessment is to form part of an Environmental Assessment (EA) being prepared by Hansen Bailey to support an application for Project Approval under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to facilitate the continuation of the existing Drayton Mine by the development of an open cut and highwall coal mining operation and associated infrastructure within the Drayton South area.

In October 2011, Part 3A of the EP&A Act was repealed. However, the Project has been granted the benefit of transitional provisions and as a result, is a development to which Part 3A still applies.

The scope of work completed by Gillespie Economics for this assessment included addressing the Director-General's Environmental Assessment Requirements (EARs) relating to economics, issued on 3 August 2011. These indicate that an economic assessment is required as part of the EA 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
- a conclusion justifying the project, taking into consideration ..... the economic .....impacts of the project as a whole.

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

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); and
- The economic impacts of the Project (i.e. the economic activity that the Project will provide to the regional or State economy).

The DP&I's draft guideline (James and Gillespie, 2002) identifies economic efficiency as the key consideration of economic analysis. Benefit Cost Analysis (BCA) is the method used to consider the economic efficiency of proposals. The draft guideline (James and Gillespie, 2002) identifies BCA as essential to undertaking a proper economic evaluation of proposed developments that are likely to have significant environmental impacts.

The 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 from the Project.

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

- A BCA (threshold value analysis) of the Project (Section 2); and
- An economic impact assessment of the Project (Section 3).

1.2 PROJECT DESCRIPTION

Drayton Mine is managed by Anglo Coal (Drayton Management) Pty Ltd which is owned by Anglo American. Drayton Mine commenced production in 1983 and currently holds Project Approval 06_0202 (dated 1 February 2008) which expires in 2017, at which time the operation will have to close.

The Project will allow for the continuation of mining at Drayton Mine by the development of open cut and highwall mining operations within the Drayton South mining area while continuing to utilise the existing infrastructure and equipment from Drayton Mine.

The Project is located approximately 10 km north west of the village of Jerrys Plains and approximately 13 km south of the township of Muswellbrook in the Upper Hunter Valley of NSW. The Project is predominately situated within the Muswellbrook Shire Local Government Area (LGA), with the south west portion falling within the Singleton LGA. **Figure 1.1** illustrates the location of the Project. The Project is located adjacent to two thoroughbred horse studs, two power stations and several existing coal mines.

The Project will extend the life of Drayton Mine by a further 27 years, ensuring the continuity of employment for its workforce, the ongoing utilisation of its infrastructure and the orderly rehabilitation of Drayton Mine's completed mining areas.

Anglo American is seeking Project Approval under Part 3A of the EP&A Act to facilitate the extraction of coal by both open cut and highwall mining methods within Exploration Licence (EL) 5460 for a period of 27 years. The Project Application Boundary (Project Boundary) is shown on Figure 1.1.

The Project generally comprises:

- The continuation of the operations of the Drayton Mine as presently approved with minor additional mining areas within the East, North and South Pits;
- The development of an open cut and highwall mining operation extracting up to 7 Mtpa of ROM coal over a period of 27 years;
- The utilisation of the existing Drayton Mine workforce and equipment fleet (with an addition of a highwall miner and coal haulage fleet);
- The Drayton Mine fleet consists of at least a dragline, excavators, fleet of haul trucks, dozers, graders, water carts and associated supporting equipment.
- The use of the Drayton Mine existing voids for rejects and tailings disposal and water storage to allow for the optimisation of the Drayton Mine final landform;
- The utilisation of the existing Drayton Mine infrastructure including the Coal Handling and Preparation Plant (CHPP), rail loop and associated loadout infrastructure, workshops, bath houses and administration offices;
- The construction of a transport corridor between Drayton South and Drayton Mine;
- The utilisation of the Antiene Rail Spur off the Main Northern Railway to transport product coal to the Port of Newcastle for export;
- The realignment of a section of Edderton Road; and
- The installation of water management (including a licence water discharge point and pumping station adjacent to the Hunter River) and power reticulation infrastructure at Drayton South.

The conceptual layout of the Project is shown in Figure 1.2.

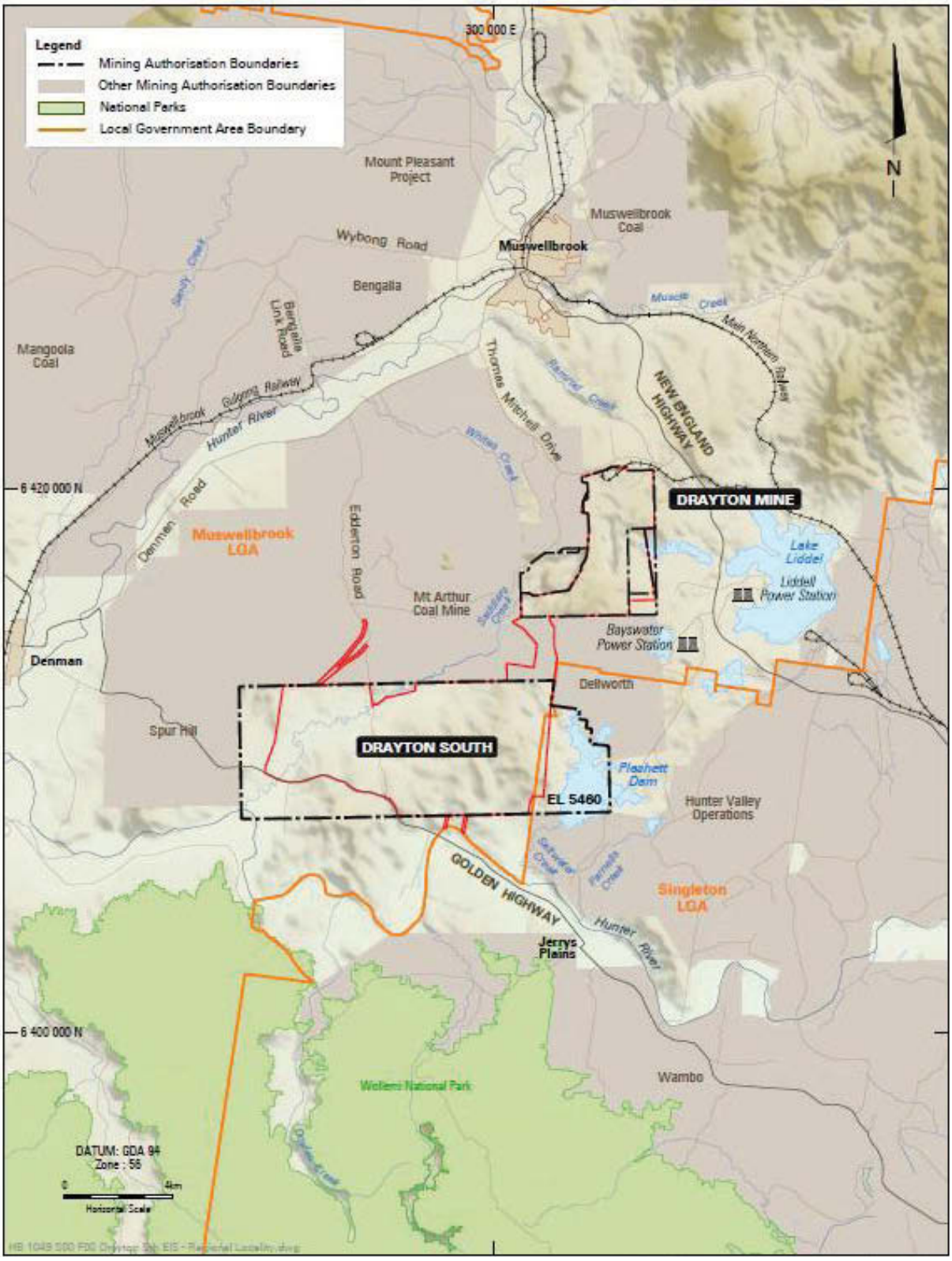

Figure 1.1 Regional Locality

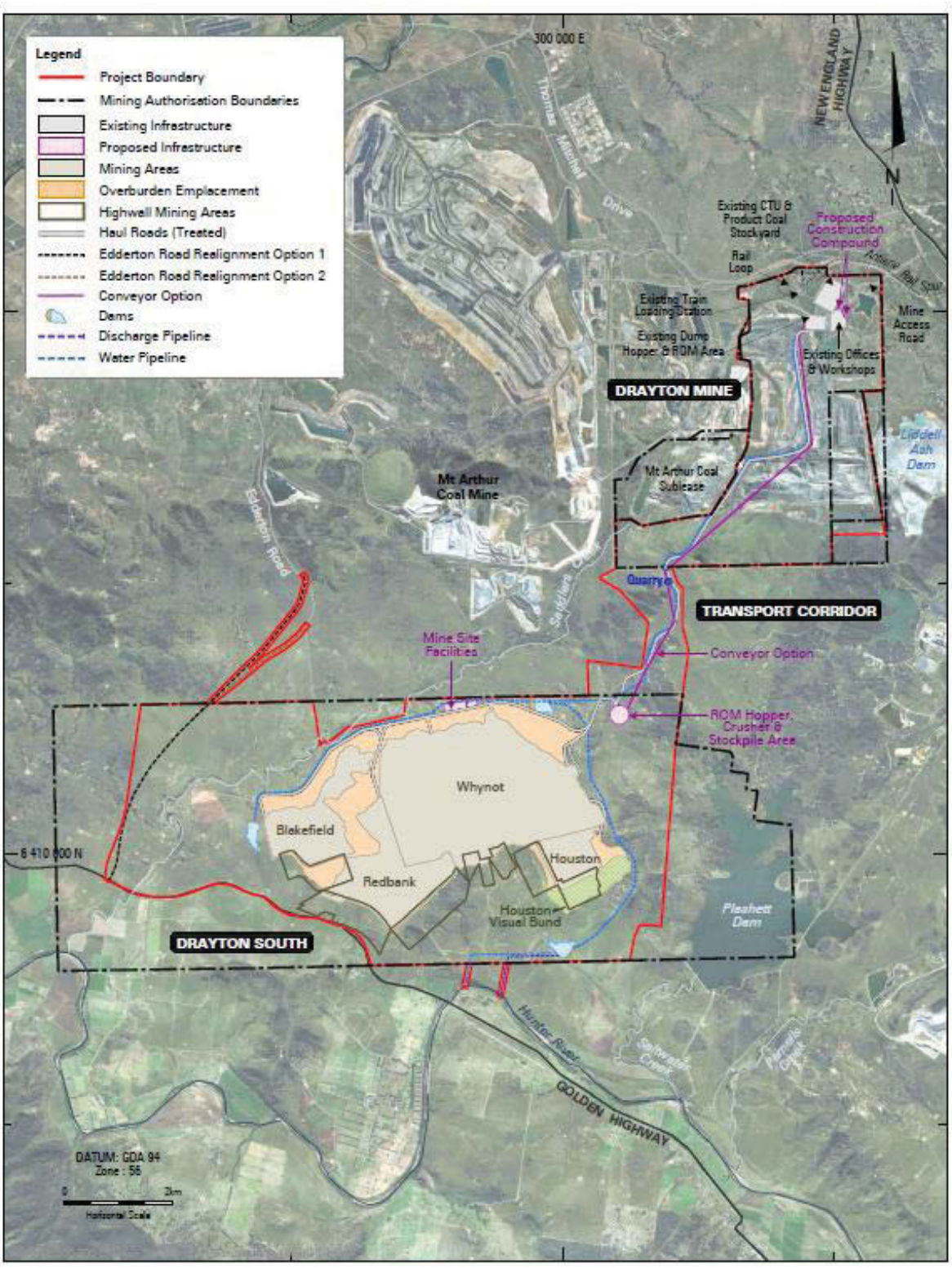

Figure 1.2 Conceptual Project Layout

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 relate to any environmental, social and cultural costs.

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, this 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;
- identification of the Project and its implications;
- identification and valuation of the incremental benefits and costs;
- consolidation of value estimates using discounting to account for temporal differences;
- application of decision criteria;
- sensitivity testing; and
- consideration of non-quantified benefits and costs.

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

2.2 IDENTIFICATION OF THE BASE CASE AND PROJECT

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

Under the base case, coal mining at the Drayton Mine would cease in 2017 with associated rehabilitation and site decommissioning following this.

In contrast, the Project is as described in Section 1.2 with mining up to 7 Mtpa of ROM coal for a period of 27 years.

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

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

The Project assessed in the EA and evaluated in the BCA is considered by Anglo American 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 Anglo American 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 - Incremental Economic Benefits and Costs of the Project

Category	Costs	Benefits
Production	Opportunity costs of capital Opportunity cost of land Capital costs of development Operating costs of mine including mitigation measures Rehabilitation and decommissioning costs at end of the Project life	Avoided decommissioning and rehabilitation in 2017 Value of coal production Residual value of capital and land at end of Project life
Potential environmental, social and cultural impacts	Ecology impacts Aboriginal heritage Historic heritage impacts Agricultural production Surface and groundwater impacts Visual amenity impacts Air quality impacts Noise and blasting Greenhouse gas and energy impacts Traffic impacts	Any non-market benefits of employment Value of ecological offsets

It should be noted that the potential environmental, social and cultural costs, listed in Table 2.1, are only economic costs to the extent that they affect individual and community well-being through direct use of resources by individuals or non-use. If the potential impacts do not occur or are mitigated to the extent where community wellbeing is insignificantly affected, then no environmental, social or cultural 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 29 years. Where competitive market prices are available, they have generally been used as an indicator of economic values. Environmental, cultural and social values have been estimated, where possible, using market data and benefit transfer. The threshold value method has also been used to interpret environmental, cultural and social impacts.

2.4.1 *Production Costs and Benefits*[3]

Production Costs

Opportunity Cost of Land and Capital

Currently all of the land required for the Project is owned by Anglo American (with the exception of a parcel of land required for the proposed relocation of Edderton Road). There is an opportunity cost associated with using this land for coal production instead of its next best use e.g. rural production. An indication of the opportunity cost of the land can be gained from its market value, estimated at $6M. This opportunity cost is assumed to occur in 2017.

The Project will also use a range of capital equipment and infrastructure from the Drayton Mine. There is an opportunity cost associated with using this equipment and infrastructure for the Project instead of using it in its next best use. An indication of the opportunity cost of the capital equipment and infrastructure can be gained from its market value, estimated at $54M. This opportunity cost is assumed to occur in 2017.

Capital Cost of the Project

Capital costs of the Project are associated with a range of plant and infrastructure development. These incremental capital costs over the life of the mine (including contingencies) are estimated at $485M. These capital costs include an allowance for acquisition of land for the Edderton Road relocation, properties adversely affected by noise/dust/vibration and ecological offsets. Capital costs are included in the economic analysis in the years that that they are expected to occur.

Annual Operating Costs of the Project

The operating costs of the Project include those associated with overburden stripping, mining, processing, rail and port charges, rehabilitation, marketing and general administration. Average operating costs (excluding depreciation and royalties) are estimated at approximately $278M per annum for the 27 year period.

While royalties are a cost to Anglo American, they are part of the overall producer surplus benefit of the mining activity that is redistributed by government. Royalties are therefore not included in the calculation of the resource costs of operating the Project. Nevertheless, it should be noted that the Project would generate total royalties in the order of $859M ($320M present value).

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

Rehabilitation and Decommissioning Costs

At the cessation of the Project, rehabilitation and decommissioning costs are estimated at $32M.

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

Production Benefits

Avoided Rehabilitation and Decommissioning Costs

Under the base case, or "without" Project scenario, decommissioning and rehabilitation costs of approximately $32M would be incurred in 2017. With the Project these occur in 2040. The avoided costs in 2017 are a benefit of the Project.

Value of Coal

Total ROM coal production is estimated at over 118 Mt with peak production at 7 Mtpa ROM. Product coal is thermal coal for export.

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

Projected prices for the Project product thermal coal were provided by Anglo American and averaged AUD$118/tonne. There is obviously considerable uncertainty around future coal prices and hence assumed coal prices have been subjected to sensitivity testing (see Section 2.6).

Residual Value at End of the Evaluation Period

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

2.4.2 *Environmental, Social and Cultural Costs and Benefits*

Greenhouse Gases

The Project is predicted to generate in the order of 8.4 Mt of direct carbon dioxide equivalent (CO_2-e) emissions associated with mining (Scope 1 emissions) over the lifetime of the Project. Approximately 2.2 Mt of indirect (Scope 2) CO_2-e emissions associated with on-site electricity consumption and 0.9 Mt of indirect (Scope 3) CO_2-e emissions associated with the transport of product coal to Newcastle and on-site diesel and electricity use would also be generated over the lifetime of the Project. The economic analysis has included these emissions as a potential environmental cost of the Project.

In addition, the Project would result in the loss of carbon sequestration benefits from the clearing of vegetation (approximately 1,928 hectares [ha]). It is considered that the loss of carbon sequestration benefits associated with the clearance of this vegetation would be offset by proposed onsite and offsite offsets.

To place an economic value on CO_2-e emissions, a shadow price of CO_2-e is required that reflects its global social costs. The global social cost of CO_2-e is the present value of additional economic damages now and in the future caused by an additional tonne of CO_2-e emissions. There is great uncertainty around the global social cost of CO_2-e with a wide range of estimated damage costs reported in the literature. An alternative method to trying to estimate the global damage costs of CO_2-e is to examine the price of CO_2-e credits/taxes. Again, however, there is a wide range of prices. For this analysis, a shadow price 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).

This represents the global social cost of carbon. In the absence of any studies that have focused on the social damage cost of carbon emissions to Australia, some means of apportioning global damage costs to Australian damage costs is required. For the purpose of the economic assessment this has

been undertaken using Australia's share of global GDP (around 1%). An alternative approach would be Australia's share of world population which is considerably less than 1%.

Agricultural Production and Horse Health

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

A separate assessment of the potential impact of the Project on horse health found that the minor increase in dust levels should not result in any additional health or production problems for the horses on these studs. It was also not expected that noise levels predicted to be generated by the Project will have any impact on the equine population on surrounding horse studs. The ground vibration and overpressure from blasting arising from the Project is expected to be intermittent and minimal across the Coolmore and Darley properties and is very unlikely to have any adverse effects on equine health.

Operational Noise

The existing Drayton Mine contributes to the existing noise environment at nearby private rural residences.

Noise levels associated with the construction phase of the Drayton South Project are expected to be acceptable at all potentially affected residences during the day. Proposed construction activities during the night have the potential to exceed relevant operational noise criteria and hence a detailed Construction Noise Management Plan is proposed for all work outside normal construction hours.

During Project operation there are 12 residences and 5 properties (impacted >25%) predicted as being in the Project noise management zone, where marginal to moderate exceedances of applicable noise criteria are predicted. These properties are currently within a noise management zone for the existing Drayton Mine Operations and as such there will be a continuation of the requirements to apply management and mitigation measures at these properties for the Project. No properties fall within an acquisition zone for noise impacts. Further no properties to the south of the Drayton South area will be impacted above the applicable intrusive noise criteria for the Project.

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

Blasting Overpressure and Vibration

Blasting at the Project has the potential to cause structural damage or human discomfort at properties surrounding the Project. The acoustic impact assessment concluded that blasting associated with the Project is predicted to produce ground vibration and overpressure levels well below the relevant amenity criteria at all privately owned residences and structures with the exception of Arrowfield where it is predicted that the relevant criteria would be exceeded if the Maximum Instantaneous Charge of the blast is above 500 kg. With the implementation of mitigation measures when blasting close to Arrowfield (ie. limit blast sizes to meet criteria) all criteria would be able to met for the Project. However, Arrowfield is also predicted to experience exceedance with regard to air quality and as such will likely fall within an acquisition zone for this reason.

An allowance for acquisition of this property has been incorporated into the capital costs of the Project.

Air Quality

One property is predicted to experience exceedances of the cumulative annual average criterion for PM10 and TSP. It is also predicted to experience exceedances of the 24 hr average PM10 for the Project alone.

The impacts on this property can potentially be valued using the property value method, where the change in property value as a result of the air quality impacts is estimated. It is expected that the owners of the property would be granted the opportunity to be acquired via conditions of the Development Consent. Instead of incorporating the partial property value impact on these properties, conservatively, the full cost of acquiring the affected property has been incorporated into the capital costs associated with the Project[4].

Two other properties are only predicted to experience minor exceedances of the 24hr average PM10 for the Project alone for less than 5 days of the year and as such it is proposed that predicted impacts at these locations would be avoided by real time monitoring and modification of Redbank operations under certain meteorological conditions.

Four other mine-owned residences are also predicted to be adversely affected above relevant criterion. Again the impact on these properties would potentially be valued using the property value method, where the change in property value as a result of the air quality impacts is estimated. Instead of incorporating the partial property value impact on these properties, conservatively, the full opportunity cost of owning these properties has been incorporated in the costs of the Project[5].

Surface Water

During mining, the Project would capture 570 ML pa of runoff from the site catchment that would otherwise make its way into the Hunter River (or associated catchments). Post mining 353 ML pa is estimated to be captured by the final void lake. In addition, two general security water access licences totalling 198 units from the Hunter River would be required during the Project life. The opportunity cost of this quantity of water over the 27 year Project life has been included in the BCA using an estimated market value of water of $2,000/ML.

The Project will also require 50 credits under the Hunter River Salinity Trading Scheme (HRSTS). To allow controlled discharge of mine affected water. The market value of these 50 credits is also included in the analysis.

Groundwater

Groundwater drawdown as a result of the Project is predicted to be restricted to the immediate vicinity surrounding the mining areas and is not predicted to extend into the Hunter River alluvial aquifer. No private registered bores are located within the predicted zone of influence, however, the Project is estimated to result in a reduction of 73 ML/yr from Saddlers Creek and ultimately Hunter River. The opportunity cost of this quantity of water has been included in the BCA using an estimated market value of water of $2,000/ML.

Flora and Fauna

The additional surface disturbance associated with the Project would involve the clearance of approximately 1,928 ha of vegetation comprising remnant and regenerating forest and woodland and

[4] 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.

[5] See footnote 4.

extensive areas of open grassland with scattered trees. This clearing includes 181 ha of NSW and Commonwealth listed Box-Gum Woodland and 279 ha of other NSW listed threatened ecological communities.

A range of measures to avoid, mitigate and offset impacts on biodiversity are proposed including:

- Restoration of Saddlers Creek;
- Conservation of available onsite areas of remnant vegetation;
- Rehabilitation of all disturbed onsite areas to woodland communities; and
- Acquisition of an offsite property containing suitable remnant open forest and woodland habitats. This property will be secured permanently for conservation and managed under a site-specific management plan to improve and maintain the conservation values of the land.

Land opportunity costs and operational expenditure associated with the biodiversity offset areas have been included in the capital and operating costs of the Project. To the extent that the community values for impacted vegetation are counterbalanced by the proposed offset strategy no significant further economic cost would arise that would warrant inclusion in the BCA.

Road Transport

The traffic impact assessment did not identify any significant impacts that will result from the Project. The Project includes the realignment of the southern portion of Edderton Road and these costs are included in the capital costs of the Project.

Aboriginal Heritage

The Project has the potential to impact Aboriginal heritage sites in Project land disturbance areas. The Aboriginal archaeology assessment identified 175 sites that will be impacted by the Project including three of high significance, 16 of moderate significance and 156 of low significance.

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

Impacts on highly significant Aboriginal heritage sites have also been shown using choice modelling to affect the well-being of the broader community (Gillespie Economics 2008, 2009a, 2009b). Three sites of high significance would be affected by the Project. Using benefit transfer from Gillespie Economics (2008, 2009a, 2009b) these impacts are estimated at between $16M and $100M, with average impacts across studies of $45M.

Non-Aboriginal Heritage

Two items of non-Aboriginal heritage were identified within the Project disturbance boundary and will be directly impacted by the Project. Both of these items were identified as being of low significance at a local level and therefore no significant economic effects would arise with respect to non-Aboriginal heritage that would warrant inclusion in the BCA.

Visual Impacts

Visual impacts from the Project may potentially occur to the south of the Project with sensitive receptors including the village of Jerrys Plains, the Golden Highway, Coolmore Stud and Arrowfield Estate, as well as some isolated rural residences.

However, mine planning has been modified to keep operational areas from views to the most sensitive locations. In addition, a bund will be constructed to screen views to the Houston mining area along an

open gully line. There will be short-term visual impacts during the 16 month construction of this bund and associated rehabilitation.

Visual intrusion to surrounding landholders can potentially impact their property value[6]. However, any high levels of visual intrusion are only likely to be short term in nature and longer term visual impacts have been assessed as moderate to low. The costs of mitigation measures have been included in the capital costs of the Project. However, it is recognised that to the extent that any significant residual visual impacts occur, after mitigation, costs of the Project included in the BCA will be understated.

Geochemistry

The Geochemical impact assessment did not identify any significant impacts that will result from the Project. Overburden and most coal reject materials are expected to have very low oxidisable sulfur content, significant excess Acid Neutralising Capacity, and be classified as Non-Acid Forming.

Social Impacts

The social impact assessment did not identify any significant impacts that will result from the Project. This is largely due to the fact that the Project is a continuation of the existing Drayton Mine utilising the existing workforce and much of the existing infrastructure.

Non-market 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 directly employ on average approximately 463 people for 27 years. Applying the more conservative Bulli Seam Operation employment value to the estimated incremental direct employment[7] gives an estimated $298M for the non-market 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 underground mining operation in another region of NSW. Consequently, sensitivity testing that excludes this value has also been undertaken.

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6 And potentially consumer surplus.

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

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 $887M. Assuming 100% foreign ownership, $490M of these net production benefits would accrue 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. This threshold value is the opportunity cost to society of not proceeding with the Project. The threshold value indicates the price that the community must value 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[8], would need to be valued by the community at greater than the estimate of the Australian net production benefits i.e. greater than $490M. This is equivalent to each household in the study region valuing residual environmental impacts at $24,000. The equivalent figure for NSW households is $180.

Instead of leaving the analysis as a threshold value exercise, an attempt has been made to quantify the residual environmental impacts of the Project. From Table 2.2 these impacts to Australia are estimated at $48M, considerably less than the estimated net production benefits of the Project to Australia.

Overall, the Project is estimated to have net benefits to Australia of between $443M and $741M, and hence is desirable and justified from an economic efficiency perspective.

The present value of the incremental costs and benefits of the Project, using a 7% discount rate are provided in Table 2.2.

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

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

	Costs		Benefits	
	Description	**Value ($M)**	**Description**	**Value ($M)**
Production	Opportunity cost of land and water	$4	Avoided decommissioning costs	$21
	Opportunity cost of capital	$36	Value of coal	$4,046
	Additional capital costs	$391	Residual value of land	$0
	Operating costs excluding royalties	$2,745	Residual value of capital	$0
	Decommissioning and rehabilitation costs	$4		
	Production Sub-total	**$3,180**	**Sub-total**	**$4,067**
	Net Production Benefits			**$887 ($490)**
Non-market Impacts	Greenhouse gas impacts	$142 ($2)	Social values of employment	$298
	Agricultural impacts	Included in opportunity cost of land and water and capital costs (land acquisitions)		
	Noise impacts	Minimal. Cost of noise mitigation measures for properties in the noise management zone are included in capital costs.		
	Blasting	Minimal.		
	Air quality impacts	Full cost of property acquisition and opportunity cost of mine owned land included in capital costs		
	Surface water	$1		
	Groundwater	$0		
	Flora and fauna	Some loss of values but offset. Cost of biodiversity offset included in capital costs		
	Road transport impacts	Minimal. Cost of Edderton Rd relocation included in capital costs		
	Aboriginal heritage	$45		
	Historic heritage impacts	Minimal		
	Visual impacts	Minimal. Costs of mitigation included in capital costs		
	Geochemistry impacts	Minimal		
	Social impacts	Minimal		
	Non-market impacts sub-total	**$188 ($48)**		**$298**
NET BENEFITS – including employment benefits				**$997 ($741)**
NET BENEFITS – excluding employment benefits				**$699 ($443)**

Note: totals may have minor discrepencies due to rounding.

When impacts accrue globally, the numbers in brackets relates to the level of impact estimated to accrue to Australia

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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 shown in Table 2.3 is potentially distributed amongst a range of stakeholders including:

- Anglo American and its shareholders in the form of any after tax profits;
- the Commonwealth Government in the form of any Company tax payable ($170M present value) or Minerals Resource Rent Tax from the Project, which is subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the local region;
- the NSW Government via royalties ($320M present value) 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 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 Anglo American.

Noise costs, air quality costs, agricultural production costs and road traffic impacts will occur at a local level, but have already been incorporated into the estimation of net production benefits via acquisition costs for affected properties and mitigation costs. Similarly, surface water and groundwater effects will occur at the local level, but have been incorporated into the analysis via inclusion of the costs of acquisition of Water Access Licences and HRSTS credits. Greenhouse gas costs will occur at the national and global level and will be internalised in the future through payment of the Commonwealth Government's carbon tax. The economic costs associated with the clearing of native vegetation will occur at the State level and would be counterbalanced by the Project biodiversity offsets. The cost of providing these offsets is included in the estimation of net production benefits. Visual impacts will occur at the local level and will be internalised by Anglo American through the funding of visual mitigation measures. Aboriginal heritage impacts will potentially occur to NSW households[9] as well local Aboriginal people. Anglo American will develop an Aboriginal Heritage Management Plan to minimise and manage Aboriginal heritage impacts. Other potential environmental impacts would largely occur at the local level and were found to be insignificant. Non-market benefits associated with employment provided by the Project would largely accrue at the local or State level[10].

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

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

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

Value		Distribution			
		Local	State	National	Global
Net Production Benefits					
Net production benefits to Anglo American	$387M	✓	✓	✓	✓
Net production benefits to Commonwealth Government – Company tax	$170M	✓	✓	✓	-
Net production benefits to NSW Government – Royalties	$320M	✓	✓	-	-
Total	***$887M***				
Non-market Costs and Benefits					
Non-market benefit of employment	$298M	✓	✓	-	-
Total	***$298M***				
Costs					
Greenhouse gas emissions rest of the world[1]	$140M	-	-	-	✓
Greenhouse gas emissions Australia[1]	$2M	✓	✓	✓	
Agricultural production	Included in opportunity cost of land and water and capital costs (land acquisitions)	✓	-	-	-
Operational noise	Minimal. Cost of noise mitigation measures for properties in the noise management zone are included in capital costs.	✓	-	-	-
Blasting	Minimal	✓	-	-	-
Air quality	Full cost of property acquisition and opportunity cost of mine owned land included in capital costs	✓	-	-	-
Surface water	$1	✓	-	-	-
Groundwater	$0	✓	-	-	-
Flora and fauna	Some loss of values but offset. Cost of biodiversity offset included in capital costs	✓	✓	-	-
Road transport	Minimal. Cost of Edderton Rd relocation included in capital costs	✓	-	-	-
Aboriginal heritage	$45	✓	✓	-	-
Non-Aboriginal heritage	Negligible	✓	-	-	-
Visual	Minimal. Costs of mitigation included in capital costs	✓	-	-	-
Total	***$188M***				
Net Benefits	**$997M**				

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.

The non-market costs that accrue to NSW are estimated at less than $48M. These are considerably less than the net production benefits (and potential non-market employment benefits) that directly accrue to NSW through royalties[11]. Consequently, as well as resulting in net benefits to Australia the Project would result in net benefits to NSW.

[11] 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.

2.6 DOWNSTREAM COSTS AND BENEFITS OF GREENHOUSE GAS EMISSIONS

A persistent issue that has arisen in community consultation concerns potential greenhouse gas emissions from the use of the coal that is exported through the Port of Newcastle. However, these impacts are not considered relevant to a BCA of the Project, which is defined as the mining of coal and delivery to the Port of Newcastle.

Also, 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 willingness to pay of the community 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 to a consideration of this next stage of the production process, not just the greenhouse gas costs.

Where these different production processes occur in NSW or Australia they are subject to separate approval and decision-making requirements. Where they occur overseas they are not subject to the NSW development approval process. Decisions by the NSW Government 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, and with NSW containing around 1% of total recoverable coal reserves in the world there are significant coal supply source substitution possibilities.

2.7 SENSITIVITY ANALYSIS

This 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 20% changes to the following variables at a 4%, 7% and 10% discount rate:

- Opportunity costs of land;
- Opportunity costs of capital equipment;
- Capital costs;
- Operating costs;
- Decommissioning costs;

- Revenues;
- Residual value of capital and land; and
- Greenhouse costs;
- Aboriginal heritage impacts;
- Surface and groundwater impacts; and
- Non-market employment impacts.

What this analysis indicates (refer to Attachment 2) is that the results of the BCA are not sensitive to reasonable changes in assumptions regarding any of these variables. In particular, significant increases in the values used for external impacts such as Aboriginal heritage impacts, greenhouse gas costs or surface water and groundwater had little impact on the economic desirability of the Project.

The results were most sensitive to any potential decreases in the sale value of coal. Although a significant and sustained reduction in coal price (48%) would be required to make the Project inefficient.

3 ECONOMIC IMPACT ASSESSMENT

3.1 INPUT-OUTPUT TABLE AND ECONOMIC STRUCTURE OF THE REGION

Economic impact assessment is primarily concerned with the effect of an impacting agent on an economy in terms of a number of specific indicators of economic activity, such as gross regional output, value-added, income and employment.

These indicators can be defined as follows:

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

An impacting agent may be an existing activity within an economy or may be a change to a local economy (Powell *et al.,* 1985; Jensen and West, 1986). This assessment is concerned with the economic impact of average annual production of the Project i.e. 5.1 Mtpa ROM coal production, between 2018 and 2036.

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

A range of methods can be used to examine the economic impacts of an activity on an economy including economic base theory, Keynesian multipliers, econometric models, mathematical programming models and input-output models (Powell *et al.,* 1985). This study uses input-output analysis.

Input-output analysis essentially involves two steps:

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

A 2005-06 input-output table of the regional economy (Upper Hunter SLA, Muswellbrook SLA and Singleton SLA) was developed using the Generation of Input-Output Tables (GRIT) procedure (Attachment 3) using a 2005-06 input-output table of the NSW economy (developed by Monash University) as the parent table. The 109 sector input-output table of the regional economy was aggregated to 30 sectors and 6 sectors for the purpose of describing the economies.

A highly aggregated 2005-06 input-output table for the regional economy is provided in Table 3.1. The rows of the table 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). The corresponding column shows the sources of inputs to produce that gross regional output. These include purchases of intermediate inputs from

other industries, the use of labour (household income), the returns to capital or other value-added (OVA - which includes gross operating surplus and depreciation and net indirect taxes and subsidies) and goods and services imported from outside the region. The number of people employed in each industry is also indicated in the final row.

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

	Ag, forestry, fishing	Mining	Manuf.	Utilities	Building	Services	TOTAL	Household Expenditure	OFD	Exports	Total
Ag, forestry, fishing	22,617	82	49,848	6	152	2,895	**75,600**	6,577	72,535	189,590	**344,301**
Mining	39	106,136	4,149	57,239	995	821	**169,379**	319	-91,080	2,789,060	**2,867,678**
Manuf.	4,043	50,938	118,889	3,498	24,771	54,895	**257,035**	40,670	136,100	631,731	**1,065,536**
Utilities	2,594	18,850	12,695	445,448	2,372	16,664	**498,623**	15,949	11,510	409,114	**935,196**
Building	1,966	18,390	1,434	10,206	69,203	26,313	**127,512**	0	263,601	18,373	**409,485**
Services	26,080	105,969	117,869	18,672	37,342	306,685	**612,618**	400,447	479,356	665,726	**2,158,147**
TOTAL	**57,339**	**300,365**	**304,885**	**535,069**	**134,835**	**408,274**	**1,740,767**	**463,961**	**872,022**	**4,703,593**	**7,780,342**
Household Income	99,848	391,132	192,406	68,063	110,962	831,996	**1,694,408**	0	0	0	**1,694,408**
OVA	69,422	1,767,288	123,983	162,029	37,217	255,815	**2,415,754**	79,626	30,833	8,454	**2,534,668**
Imports	117,691	408,892	444,263	170,035	126,471	662,061	**1,929,414**	899,544	165,661	333,455	**3,328,073**
TOTAL	**344,301**	**2,867,678**	**1,065,536**	**935,196**	**409,485**	**2,158,147**	**7,780,342**	**1,443,131**	**1,068,515**	**5,045,502**	**15,337,491**
Employment	2,317	5,435	2,286	861	1,383	12,648	**24,930**				

Gross regional product (GRP) for the regional economy is estimated at $4,229M, comprising $1,694M to households as wages and salaries (including payments to self employed persons and employers) and $2,535M in OVA.

The employment total working in the region was 24,930 people.

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

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

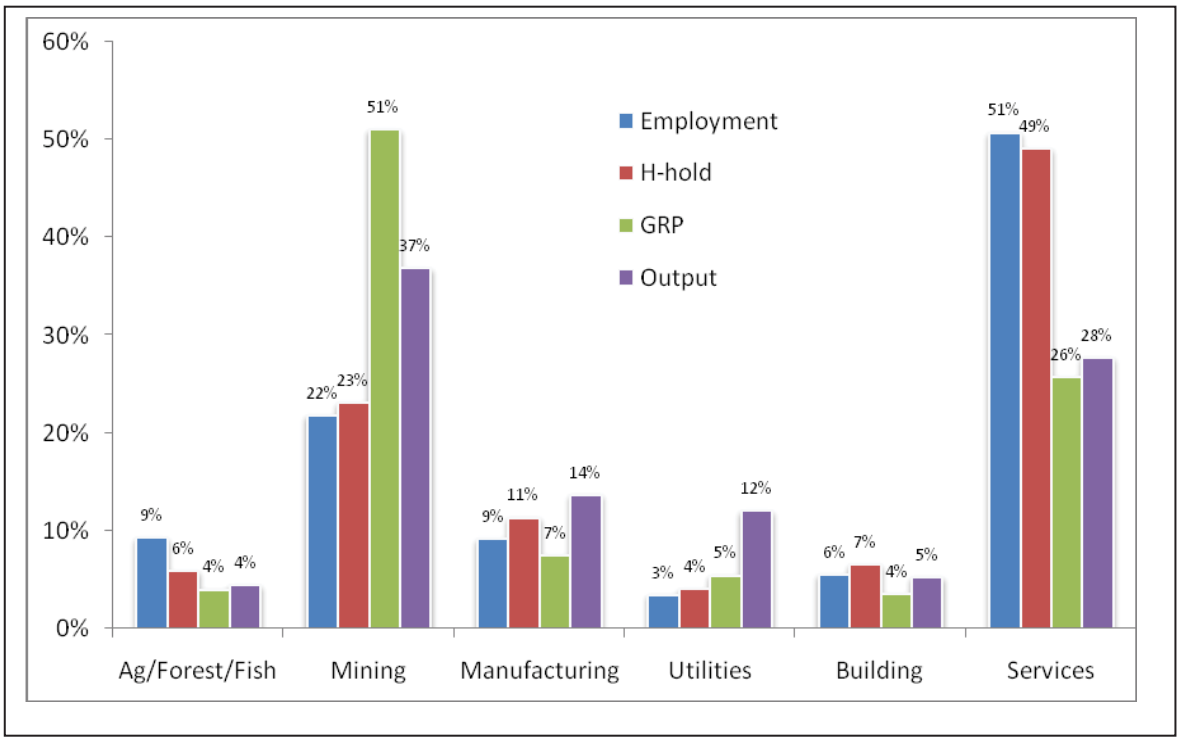
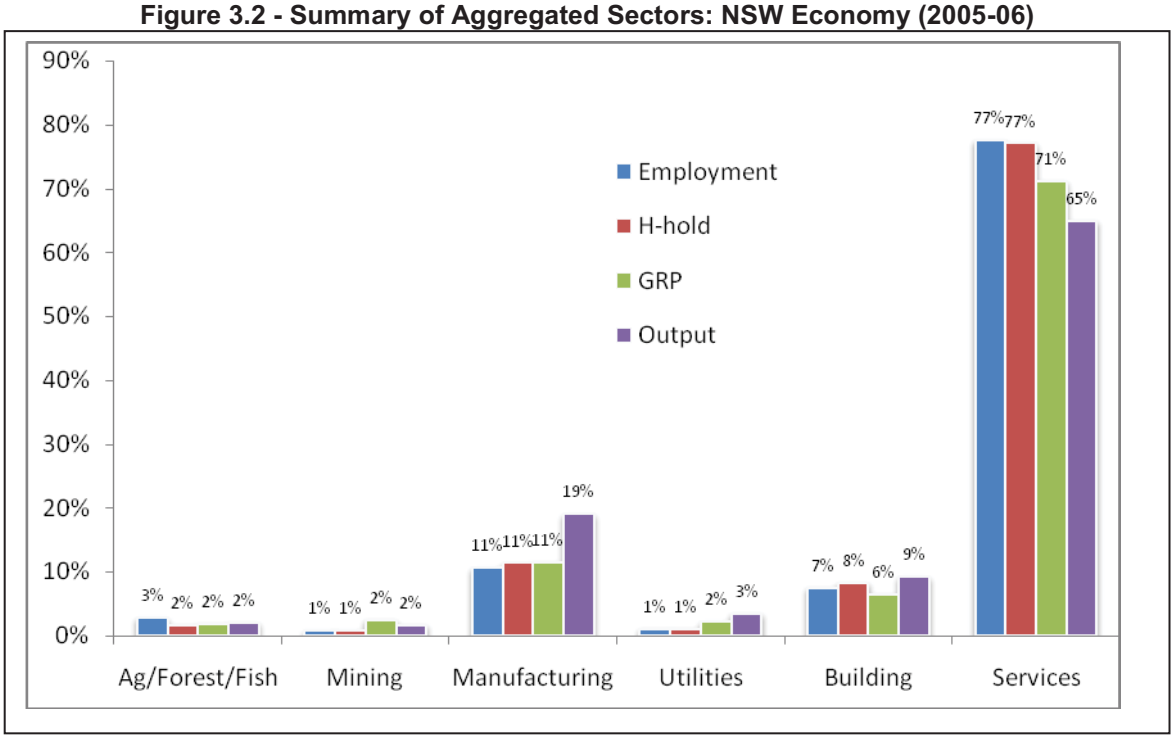


Figure 3.2 - Summary of Aggregated Sectors: NSW Economy (2005-06)

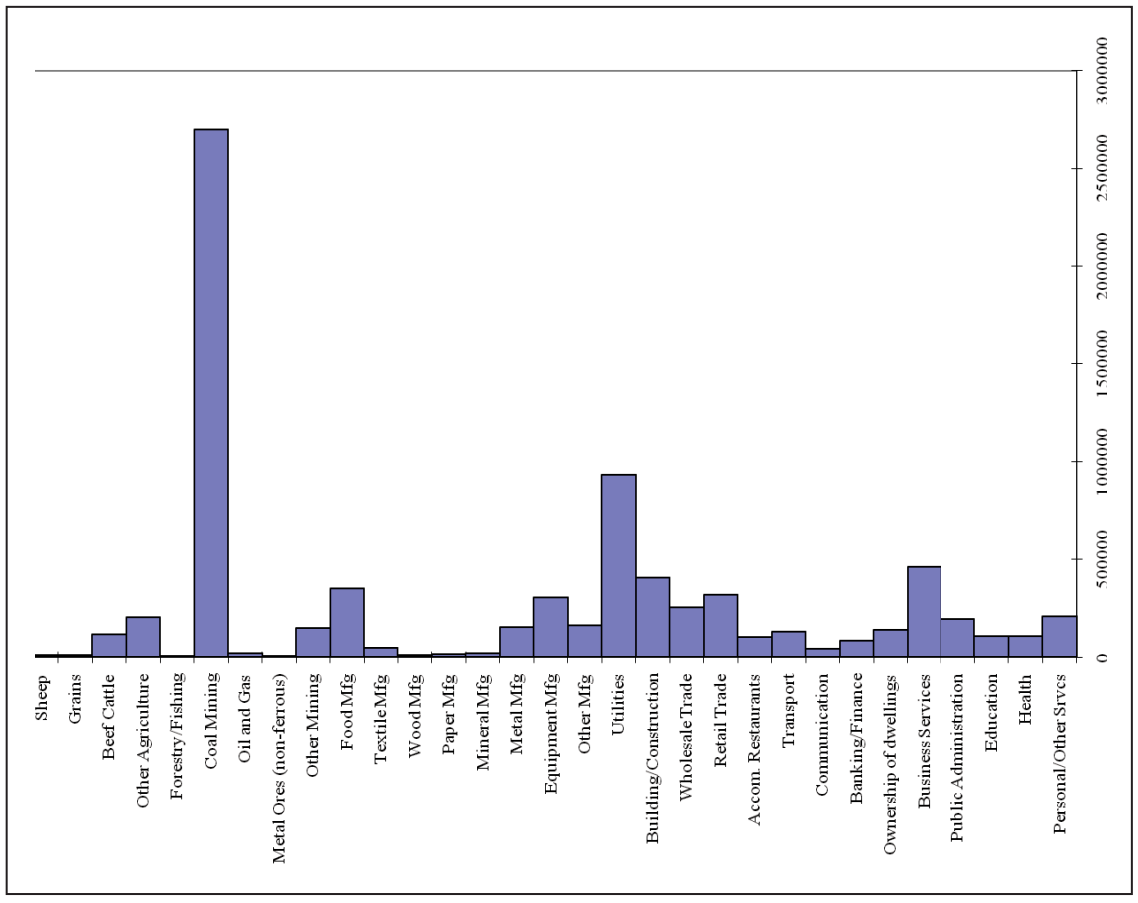


Figures 3.3 to 3.5 provide a more expansive sectoral distribution of gross regional output, employment, household income, value-added, exports and imports, and can be used to provide some more detail in the description of the economic structure of the economy.

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

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

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



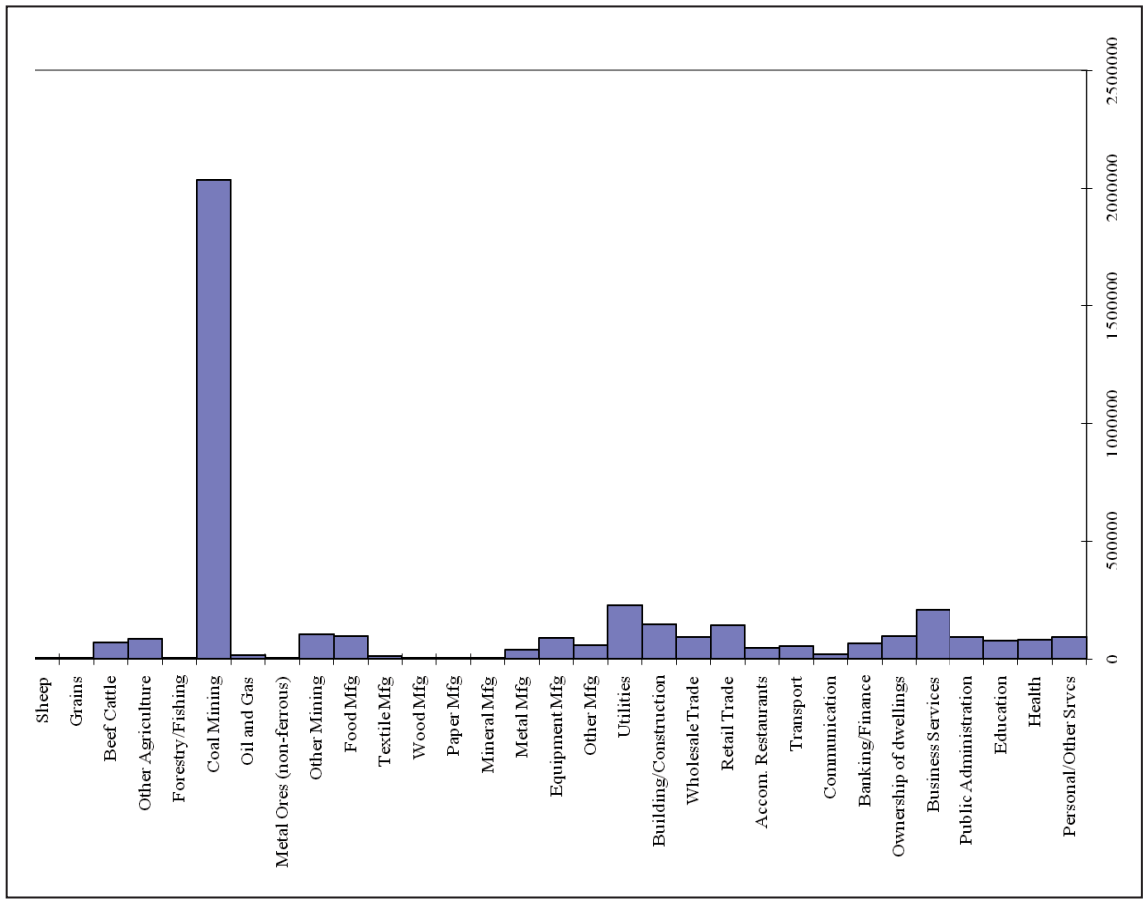


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Figure 3.4 Sectoral Distribution of Gross Regional Income ($'000) and Employment (No.)

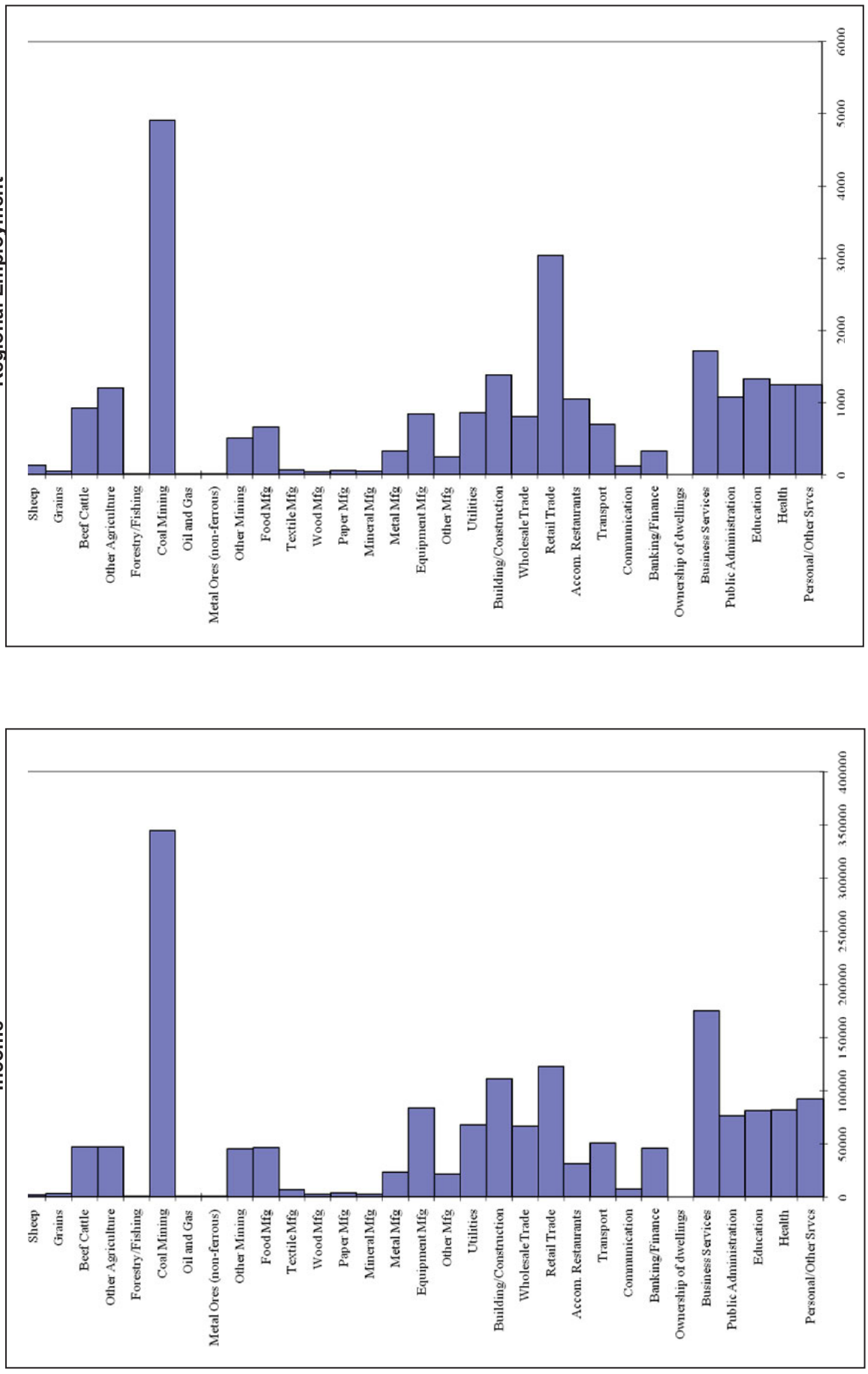
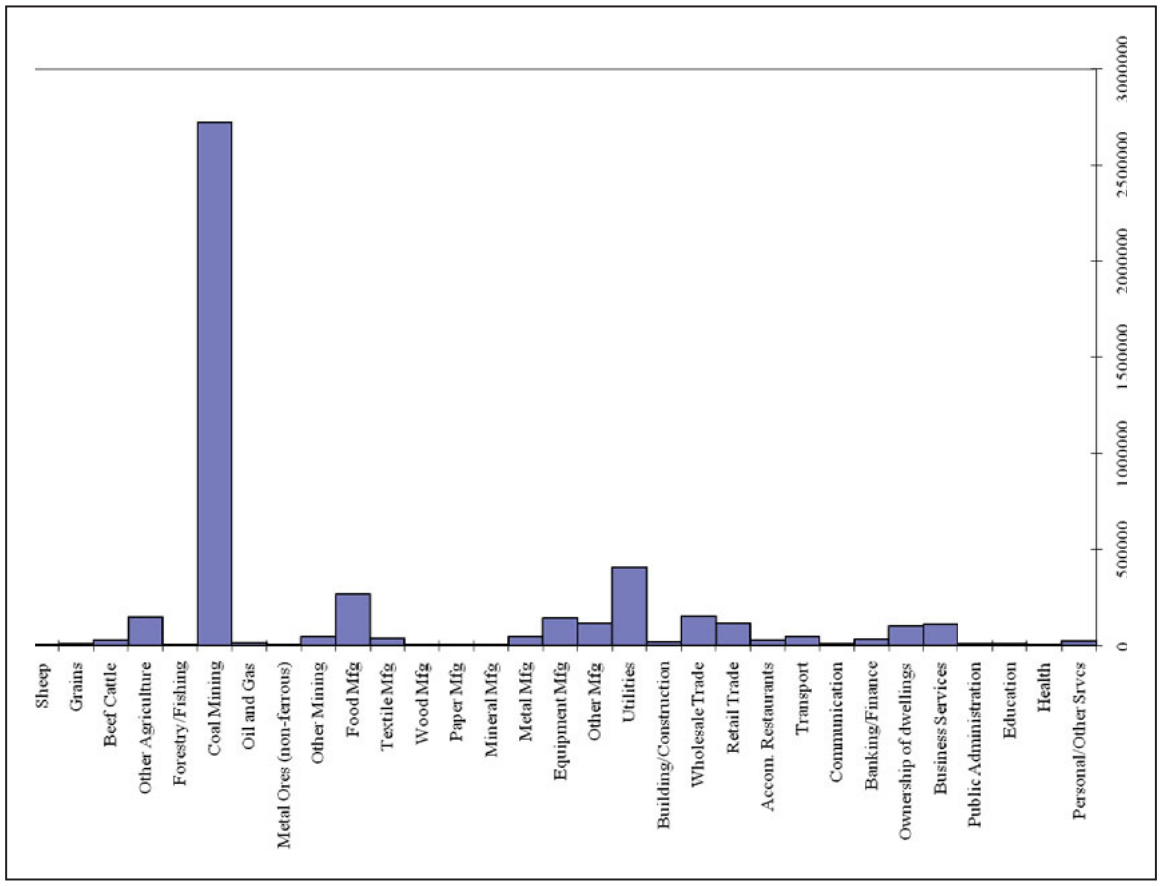
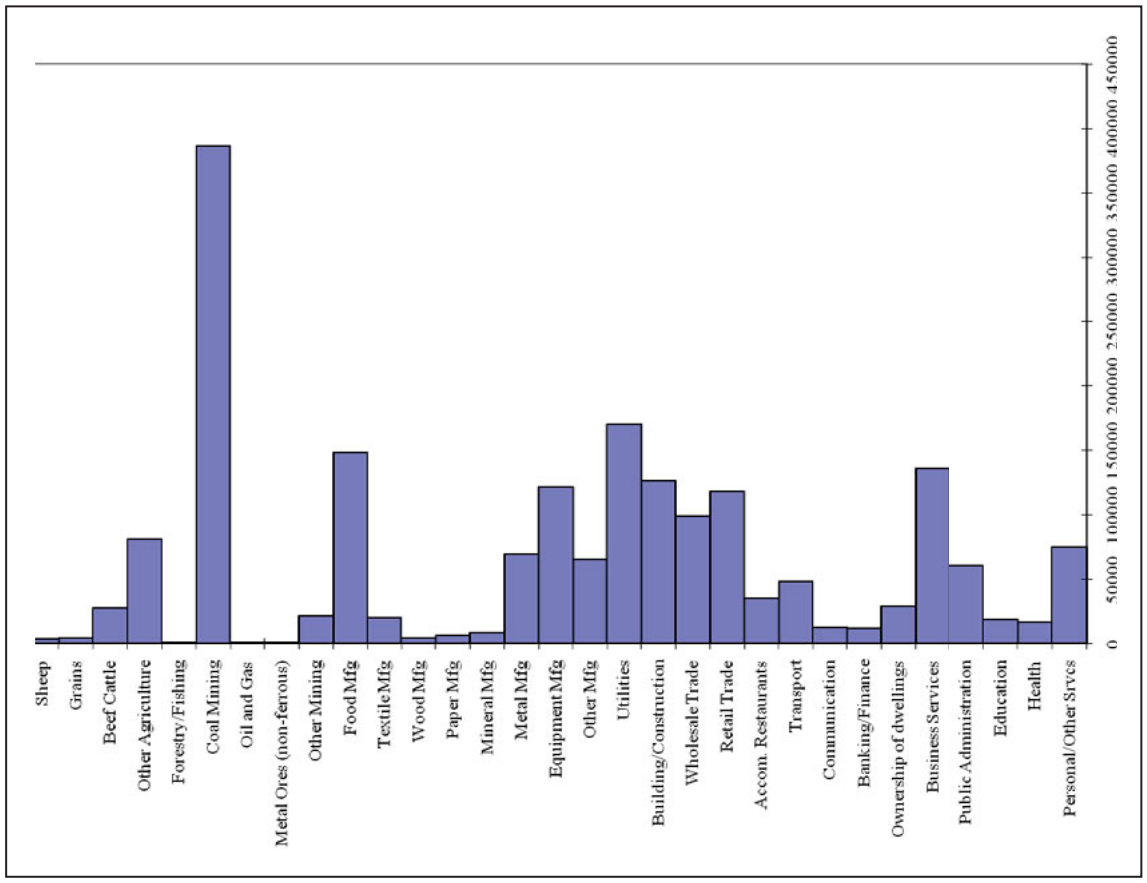


Figure 3.5 Sectoral Distribution of Imports and Exports ($'000)





3.2 REGIONAL ECONOMIC IMPACT OF THE PROJECT

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

3.2.1 *Construction Phase*

Introduction

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

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

Impact on Regional Economy

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

The construction phase is scheduled to commence in Quarter Four, 2013 and continue for a period of 29 months. Construction activities will be facilitated by a workforce of up to 369 employees and contractors at peak construction (month 11). The average annual construction workforce required for Drayton South is 126. Based on the input-output coefficients of the *other construction sector* and *trade services sector* in the Hunter Valley region transactions table (indexed to 2011) in the order of $41M of the capital costs in each year of *construction would need to be spent on the other construction sector and construction* trade services sector within the region to result in a workforce of 126 people. The direct and indirect regional economic impact of this level of expenditure in the regional economy is reported in Table 3.2.

Impacts

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

	Direct	Production induced	Consumption induced	Total Flow on	Total
OUTPUT ($'000)	41,100	18,321	8,410	26,732	67,831
Type 11A Ratio	*1.00*	*0.45*	*0.21*	*0.65*	*1.65*
VALUE ADDED ($'000)	16,082	7,330	3,910	11,240	27,322
Type 11A Ratio	*1.00*	*0.46*	*0.24*	*0.70*	*1.70*
INCOME ($'000)	11,909	5,477	3,235	8,712	20,620
Type 11A Ratio	1.00	0.46	0.27	*0.73*	*1.73*
EMPL. (No.)	126	60	48	108	234
Type 11A Ratio	1.00	0.48	0.38	0.86	*1.86*

*Direct employment of 126 represents average annual construction employment. It is assumed that these people reside in the region. Where they do not, a proportion of the consumption-induced flow-on impacts will leak from the region.

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

Production-induced effects occur in a near-proportional way within a region, whereas the consumption-induced flow-on effects only occur in a proportional way if workers and their families are located in the region or migrate into the region. Where workers commute from outside the region some of the consumption-induced flow-on effects leak from the region. Where workers are already located in the region i.e. unemployed or employed, some of the consumption-induced flow-ons in the region may already be occurring through expenditure of their current wage or unemployment benefits.

In total, the construction phase of the Project would contribute in the order of up to:

- $68M in annual direct and indirect output;
- $27M in annual direct and indirect regional value added;
- $21M in annual direct and indirect household income; and
- 234 direct and indirect jobs.

These particular impacts on the regional economy are likely to be felt for a period of in the order of 29 months.

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 4). Type 11A ratio multipliers summarise the total impact on all industries in an economy in relation to the initial own sector effect e.g. total income effect from an initial income effect and total employment effect from an initial employment effect, etc.

The Type 11A ratio multipliers for the construction phase of the Project range from 1.65 for output up to 1.86 for employment.

Main Sectors Affected

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

Examination of the estimated direct and flow-on employment impacts (Table 3.3) gives an indication of which sectors employment opportunities would be generated in.

Table 3.3 - Distribution of Average Direct and Flow-on Employment by Industry Sector in the Regional Economy from Construction of the Project

Sector	Average Direct Effects	Production induced	Consumption-induced	Total
Primary	0	0	1	1
Mining	0	1	0	1
Manufacturing	0	9	2	10
Utilities	0	1	1	1
Wholesale/Retail	0	8	13	21
Accommodation,cafes, restaurants	0	1	7	8
Building/Construction	126	24	0	150
Transport	0	2	2	4
Services	0	16	22	38
Total	**126**	**60**	**48**	**234**

Note: Totals may have minor discrepancies due to rounding.

Direct employment impacts would generate demand for employment in the *other construction sector* and *construction trade services sector*. Production-induced employment impacts would mainly generate demand for employment in the:

- *other construction sector and construction trade services sector*;
- *services sectors* (predominantly other property services, legal, accounting and business management sector, scientific research, technical and computer services and other business services);
- *manufacturing sectors* (predominantly cement lime and concrete slurry manufacturing, iron and steel manufacturing, structural metal products manufacturing and fabricated metal products manufacturing); and
- *wholesale and retail trade sectors*.

Consumption-induced employment flow-ons would mainly generate demand in the:

- *services sectors (education, health, community services, sport, gambling and recreation services and personal services);*
- *wholesale and retail trade sectors; and the*
- *accommodation, cafes and restaurants sector.*

Impact on the NSW Economy

When the impact of $41M of expenditure in the *other construction sector* and *construction trade services sector* is assessed for the NSW economy, the impacts are greater because of the larger inter-sectoral linkages and hence multipliers for the larger economy.

Impacts

Table 3.4 - Regional Economic Impacts of Construction of the Project on the NSW Economy

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	41,100	37,612	44,322	81,934	123,034
Type 11A Ratio	1.00	0.92	1.08	1.99	2.99
VALUE ADDED ($'000)	16,082	16,221	22,576	38,797	54,878
Type 11A Ratio	1.00	1.01	1.40	2.41	3.41
INCOME ($'000)	11,909	13,388	12,919	26,307	38,216
Type 11A Ratio	1.00	1.12	1.09	2.21	3.21
EMPL. (No.)	128	160	178	338	466
Type 11A Ratio	1.00	1.25	1.39	2.64	3.64

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

- $123M in annual direct and indirect output;
- $55M in annual direct and indirect regional value added;
- $38M in annual direct and indirect household income; and
- 466 direct and indirect jobs.

These particular impacts on the NSW economy are only likely to be felt for a period of in the order of 29 months.

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

3.2.2 *Operation Phase*

Introduction

For the analysis of the Project, a new Drayton South sector was inserted into the regional input-output table reflecting average annual production levels of 5.1 Mtpa ROM between 2018 and 2036. The revenue and expenditure data for this new sector was obtained from financial information provided by Anglo American for the Drayton South Project. For this new sector:

- the estimated gross annual revenue was allocated to the *Output* row;
- the estimated wage bill of those residing in the region was allocated to the *household wages* row with any remainder allocated to *imports*;

- non-wage expenditure was initially allocated across the relevant *intermediate sectors* in the economy, *imports* and *other value-added*;
- allocation was then made between *intermediate sectors* in the local economy and *imports* based on advice from Anglo American and regional location quotients;
- purchase prices for expenditure in the each sector in the region were adjusted to basic values and margins and taxes and allocated to appropriate sectors using relationships in the National Input-Output Tables;
- the difference between total revenue and total costs was allocated to the *other value-added* row*;* and
- direct employment by Project that resides in the region was allocated to the *employment* row.

Impacts on the Regional Economy

Economic Activity

The total and disaggregated annual impacts of the Project on the regional economy (in 2011 dollars) are shown in Table 3.5.

Table 3.5 - Regional Economic Impacts of the Project

	Direct Effect	Production Induced	Consump. Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	459,324	93,162	35,068	128,230	587,554
Type 11A Ratio	*1.00*	*0.20*	*0.08*	*0.28*	*1.28*
VALUE ADDED ($'000)	209,686	37,600	16,310	53,910	263,597
Type 11A Ratio	*1.00*	*0.18*	*0.08*	*0.26*	*1.26*
INCOME ($'000)	48,175	24,298	13,515	37,813	85,988
Type 11A Ratio	*1.00*	*0.50*	*0.28*	*0.79*	*1.79*
EMPL. (No.)	343	241	201	442	785
Type 11A Ratio	*1.00*	*0.70*	*0.59*	*1.29*	*2.29*

*Direct employment of 346 represents average annual employees residing in the region. Contractors are located in production-induced flow-ons.

The Project is estimated to make the following total annual contribution to the regional economy for up to 27 years:

- $588M in annual direct and indirect regional output or business turnover;
- $264M in annual direct and indirect regional value added;
- $86M in annual direct and indirect household income; and
- 785 direct and indirect jobs.

Multipliers

The Type 11A ratio multipliers for the Project range from 1.26 for value-added up to 2.27 for employment.

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

have a relatively low ratio multiplier for output and value-added reflecting the relatively high direct output and value-added compared to that in flow-on sectors.

Main Sectors Affected

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

- Services to mining sector;
- Agricultural and mining machinery manufacturing sector;
- Retail trade sector;
- Wholesale trade sector;
- Scientific research, technical and computer services sector; and
- Electricity supply sector.

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

Table 3.6 - Sectoral Distribution of Total Regional Employment Impacts of the Project

Sector	Average Direct Effects	Production induced	Consumption-induced	Total
Primary	0	0	5	5
Mining	343	53	0	396
Manufacturing	0	77	7	84
Utilities	0	13	3	16
Wholesale/Retail	0	46	56	102
Accommodation, cafes, restaurants	0	2	31	33
Building/Construction	0	4	1	5
Transport	0	15	6	22
Services	0	30	92	122
Total	**343**	**351**	**201**	**785**

Note: Totals may have minor discrepancies due to rounding.

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

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

Impact on the NSW Economy

Introduction

The NSW economic impacts of the Project were assessed by inserting a new Project sector into a 2011 NSW input-output table in the same manner described in Section 3.2.1. The primary difference

from the sector identified for the regional economy was that all direct employment was assumed to reside in NSW and a greater level of expenditure was captured by NSW economy compared to the regional economy.

Economic Activity

The total and disaggregated annual impacts of the Project on the NSW economy (in 2011 dollars) are shown in Table 3.7.

Table 3.7 - NSW Economic Impacts of the Project

	Direct Effect	*Production Induced*	*Consump. Induced*	*Total Flow-on*	*TOTAL EFFECT*
OUTPUT ($'000)	459,324	244,209	226,270	470,479	929,803
Type 11A Ratio	*1.00*	*0.53*	*0.49*	*1.02*	*2.02*
VALUE ADDED ($'000)	224,764	102,547	115,252	217,799	442,563
Type 11A Ratio	*1.00*	*0.46*	*0.51*	*0.97*	*1.97*
INCOME ($'000)	65,101	64,038	65,955	129,993	195,094
Type 11A Ratio	*1.00*	*0.98*	*1.01*	*2.00*	*3.00*
EMPL. (No.)	463	718	908	1,626	2,089
Type 11A Ratio	*1.00*	*1.55*	*1.96*	*3.51*	*4.51*

The Project is estimated to make up to the following total contribution to the NSW economy for 27 years:

- $930M in annual direct and indirect regional output or business turnover;
- $443M in annual direct and indirect regional value added;
- $195M in annual direct and indirect household income; and
- 2,089 direct and indirect jobs.

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

3.3 MINE CESSATION

As outlined in Sections 3.2 and 3.3, the Project will continue to stimulate demand in the regional and NSW economy, for up to 27 years, leading to increased business turnover in a range of sectors and increased employment opportunities. Conversely, the cessation of the mining operations in the future would result in a contraction in regional 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 level 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 in Table 3.5. However, if displaced workers and their families leave the region then impacts would be greater and begin to approximate the total effects in Table 3.5.

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

To the extent that alternative development opportunities arise in the regional economy, the regional economic impacts associated with mining closure that arise through reduced production and employment expenditure can be substantially ameliorated and absorbed by the growth of the region. One key factor in the growth potential of a region is a region's capacity to expand its factors of production by attracting investment and labour from outside the region (BIE, 1994). This in turn can depend on a region's natural endowments. In this respect, the Hunter region is highly prospective with considerable coal resources (NSW DPI, 2009).

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

Ultimately, the significance of the economic impacts of cessation of the Project would depend on the economic structure and trends in 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.

4 CONCLUSION

A BCA of the Project indicated that it would have net production benefits to Australia of a minimum of $490M. Provided the residual environmental, social and cultural impacts of the Project that accrue to Australia are considered to be valued at less than $490M 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 Aboriginal heritage, greenhouse gas emissions and surface water and groundwater impacts. These impacts are estimated at $188M in total or $48M 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 $298M. Overall, the Project is estimated to have net benefits to Australia of between $443M and $741M 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:

- Anglo American and its shareholders in the form of any after tax profits;
- the Commonwealth Government in the form of any Company tax payable ($170M present value) or Minerals Resource Rent Tax from the Project, which is subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the local region;
- the NSW Government via royalties ($320M present value) 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 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 Anglo American.

The non-market costs that accrue to NSW are estimated at less than $48M. 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:

- $588M in annual direct and indirect regional output or business turnover;
- $264M in annual direct and indirect regional value added;
- $86M in annual direct and indirect household income; and
- 785 direct and indirect jobs.

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

- $930M in annual direct and indirect regional output or business turnover;
- $443M in annual direct and indirect regional value added;
- $195M in annual direct and indirect household income; and
- 2,089 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.
- 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 B-1
Benefit Cost Analysis Sensitivity Testing, Project Australian Net Present Value ($Millions)

	4% Discount Rate	7% Discount Rate	10% Discount Rate
CENTRAL ANALYSIS	$1,030	$741	$567
INCREASE 20%			
Opportunity cost of land	$1,030	$741	$567
Opportunity cost of capital equipment	$1,028	$739	$565
Capital costs	$1,005	$718	$546
Operating costs	$789	$577	$450
Decommissioning and rehabilitation costs	$1,031	$742	$568
Coal value	$1,454	$1,029	$771
Residual value of land and capital equipment	$1,030	$741	$567
Surface and groundwater	$1,030	$741	$567
Aboriginal heritage	$1,021	$732	$559
Employment benefits	$1,092	$801	$625
GREENHOUSE COSTS @ $40/TONNE (T)	$1,030	$741	$567

	4% Discount Rate	7% Discount Rate	10% Discount Rate
DECREASE 20%			
Opportunity cost of land	$1,034	$745	$570
Opportunity cost of capital equipment	$1,033	$743	$569
Capital costs	$1,056	$765	$589
Operating costs	$1,272	$906	$684
Decommissioning and rehabilitation costs	$1,029	$740	$566
Coal value	$606	$454	$363
Residual value of land and capital equipment	$1,030	$741	$567
Surface and groundwater	$1,031	$741	$567
Aboriginal heritage	$1,040	$750	$576
Employment benefits	$969	$682	$509
GREENHOUSE COSTS @ $8/T	$1,031	$742	$567

ATTACHMENT 3 – 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 3-1
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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ATTACHMENT 4 – 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.

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

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

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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