APPENDIX Q

Economic Impact Assessment

Maules Creek Coal Project Economic Impact Assessment

Final Report

Prepared for

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EXECUTIVE SUMMARY

Aston Resources Limited (Aston Resources) purchased the Maules Creek Coal Project (the Project) in February 2010. The Project is located approximately 20 km north-east of the town of Boggabri, within the Narrabri Local Government Area (LGA). The Project is one of Australia's largest coal deposits with stated JORC resources of 610Mt and JORC reserves of 356Mt.

The Project will facilitate the development of a 21 year open cut coal mining operation and associated infrastructure, mining up to 13 Million tonnes per annum (Mtpa) of run-of-mine (ROM) coal. The scale, and potential value, of the reserve base is globally significant. On a marketable reserves basis, the Project is the seventh largest coal deposit in Australia and the fourth largest metallurgical coal deposit in Australia.

The main decision criterion for assessing the economic desirability of a project to society is its net benefit. Net benefit is the sum of the discounted benefits to society less the sum of the discounted costs. A positive net benefit indicates that it would be desirable from an economic perspective for society to allocate resources to a proposal, because the community as a whole would be better off.

In a simple framework, the benefits to society of mining relate to the net production and employment benefits, while the economic costs to society relate to any environmental impacts (externalities).

The Project is estimated to have net production benefits of $8.7Bn. The net production benefits of the Project are distributed between a range of stakeholders including Aston Resources and its shareholders in the form of net profits, the local community in the form of donations and funding of community support programs, the NSW government in the form of royalties and the Commonwealth Government in the form of company tax. The State Government also receives additional income by way of payroll tax while the Commonwealth Government would receive additional revenues in the form of income tax. In the event that the Commonwealth Government's proposed Minerals Resource Rent Tax (MRRT) is implemented, then the proportion of taxation benefits to the government is likely to be materially higher.

The main external costs from the Project relate to greenhouse gas generation, Aboriginal heritage, ecology, air quality, noise and vibration, and transport impacts. Greenhouse gas costs have been estimated at $115M. Aboriginal heritage impacts have been estimated at $188M. The externality costs associated with the clearing of native vegetation would be counterbalanced by the offset actions proposed by Aston Resources. The costs of these offset actions have been included in the estimation of net production benefits. Air quality, noise and vibration impacts have also already been incorporated into the estimation of net production benefits via acquisition costs for nearby affected properties. Transport costs have also been included in the estimation of net production costs via incorporation of the costs of upgrading Therribri Road. External benefits associated with employment provided by the Project have been estimated at $194M.

Overall the Project is estimated to have net benefits of $8,618M and hence is desirable and justified from an economic efficiency perspective.

The Project would provide a significant stimulus to the Narrabri and Gunnedah economy. This extended stimulus would arise from purchases made in the regional economy by Aston Resources and those made by employees and contractors. The annual regional economic impacts associated with the Project are estimated at up to:

- $1.9Bn in annual direct and indirect regional output or business turnover;
- $1.0Bn in annual direct and indirect regional value added;
- $54M in annual direct and indirect household income; and
- 753 direct and indirect jobs.

At the State level the Project will make up to the following contribution to the economy:

- $2.8B in annual direct and indirect output or business turnover;
- $1.6B in annual direct and indirect value added;
- $303M in annual household income; and
- 4,029 direct and indirect jobs.

The Project has sufficient reserves to produce at 13 Mtpa ROM coal for over 30 years and with necessary future approvals this is the likely outcome. If planning is restricted to a 21 year period, then the potential cessation of mining in 2032 may lead to a reduction in regional 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 cessation of the mine 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.

Given these uncertainties it is not possible to foresee the likely circumstances within which cessation of the Project would occur. It is therefore important for regional authorities and leaders to take every opportunity provided by the regional economic stimulus of the Project to strengthen and broaden the region's economic base.

1 INTRODUCTION

Aston Resources Ltd (Aston Resources) executed the sale and purchase agreement for the acquisition of the Maules Creek Coal Project (the Project) and its related mining tenements from Coal and Allied in February 2010.

The Project is located approximately 20 km north-east of the town of Boggabri, within the Narrabri Local Government Area (LGA).

The Maules Creek Coal Mine has an existing Development Consent approval (DA 85/1819) which was physically commenced in 1995 with the construction of the Development Dam. However, no open cut mining has been undertaken at the site to date. DA 85/1819 has no sunset clause and remains valid.

Aston Resources seeks to gain a contemporary Project Approval under Part 3A of the *Environmental Planning & Assessment Act 1979* (EP&A Act) to facilitate the development of surface infrastructure and open cut mining activities for the Project for a period of 21 years. The Project will replace the original DA 85/1819 with a different mine footprint and use of contemporary mining methods and practices to be implemented.

An Environmental Assessment (EA) for the Project is required to support a Project Approval Application in accordance with Part 3A of the EP&A Act. The NSW Department of Planning (DoP) Director-Generals Environmental Assessment Requirements (EARs) for the Project indicate that an economic assessment is needed as part of the EA. The EARs specifically require:

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

This economics impact assessment has been prepared to address this specific EAR.

1.1 THE PROJECT

The Project involves the development of a 21 year open cut coal mining operation and associated infrastructure.

Specifically, the Project will consist of:

- The construction and operation of an open cut mining operation extracting up to 13 Million tonnes per annum (Mtpa) Run of Mine (ROM) coal to the Templemore Seam;
- Open cut mining fleet including excavator / shovels and fleet of haul trucks, dozers, graders and water carts utilising up to 470 permanent employees;
- The construction and operation of a Coal Handling and Preparation Plant (CHPP) with a throughput capacity of 13 Mtpa ROM coal;
- The construction and operation of Tailings Drying Area;
- The construction and operation of a rail spur, rail loop, associated load out facility and connection to the Werris Creek to Mungindi Railway Line;
- The construction and operation of a Mine Access Road;
- The construction and operation of administration, workshop and related facilities;
- The construction and operation of water management infrastructure including a water pipeline, pumping station and associated infrastructure for access to water from the Namoi River;
- The installation of supporting power and communications infrastructure; and
- Construction and operation of explosive magazines and explosives storage areas.

1.2 ECONOMICS

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 stimulus that the Project will provide to the regional or State economy).

Planning NSW (James and Gillespie, 2002) *Guideline for Economic Effects and Evaluation in EIA* identifies economic efficiency as the key consideration of economic analysis. Benefit Cost Analysis (BCA) is the method used to consider the economic efficiency of proposals. The draft guideline identifies BCA as essential to undertaking a proper economic evaluation of proposed developments that are likely to have significant environmental impacts.

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

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

- A BCA of the Project; and
- An economic impact assessment of the Project.

2 BENEFIT COST ANALYSIS

2.1 INTRODUCTION

For the Project to be economically desirable from a community perspective, it must be economically efficient. Technically, a development is economically efficient and desirable on economic grounds if the benefits to society exceed the costs (James and Gillespie, 2002). For mining developments, the main economic benefit is the producer surplus generated by the mine and the employment benefits it provides, while the main economic costs relate to environmental and cultural costs. The main technique that is used to weigh up these benefits and costs is BCA.

BCA involves the following key steps:

- identification of the base case or "without" project case;
- identification of the "with" project scenario;
- physical quantification and valuation of the projects incremental benefits and costs;
- consolidation of values using discounting to account for the different timing of costs and benefits;
- application of decision criteria;
- sensitivity testing; and
- consideration of non-quantified benefits and costs, where applicable.

The sub-sections below provide a BCA of the Project based on financial, technical and environmental advice provided by Aston Resources 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 measurement of the incremental economic benefits and costs of the Project.

Under the base case, it is assumed that no mining takes place at the site. In contrast, the Project is as described above with mining up to 13 Mtpa of ROM coal for a period of 21 years.

Aston Resources' alternatives for the mining of coal are essentially limited to different scales, designs, technologies, processes, modes of transport, timing, impact mitigation measures etc. However, these alternatives could be considered to be variants of the preferred proposal rather than distinct alternatives. Consequently, this BCA focuses on the Project as described in Section 1.1 compared to the base case identified above.

2.3 IDENTIFICATION OF BENEFITS AND COSTS

Relative to the base case or "without" scenario of mining cessation, 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 cost of water Opportunity cost of land (State Forests land, agricultural land owned by Aston Resources) Opportunity cost of capital Capital costs associated with coal production and ancillary works Operating costs, including administration, mining, processing, transportation and rehabilitation (ex royalties) and land acquisitions Decommissioning costs	Sale value of coal Residual value of water, capital and land at the cessation of the Project
Potential Externalities	Air quality impacts Greenhouse gas impacts Noise and vibration impacts Ecology impacts Groundwater impacts Traffic and transport impacts Aboriginal archaeology and cultural heritage impacts Non-Aboriginal heritage impacts Visual impacts Surface water impacts and sediment/erosion control	Economic and social benefits of employment provided by the Project Value of ecological offsets

It should be noted that the potential external 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 are mitigated to the extent where community wellbeing is insignificantly affected, then no external economic costs arise.

2.4 QUANTIFICATION/VALUATION OF BENEFITS AND COSTS

In accordance with NSW *Treasury Guidelines for Economic Appraisal* (NSW Treasury, 2002), where competitive market prices are available, they have generally been used as an indicator of economic values.

2.4.1 *Production Costs and Benefits*

Production Costs

Opportunity Cost of Water

The Project will on average require between about 1,100 and 1,800 ML per year of water from the Namoi River. Aston Resources already has a high security water allocation from the Namoi River of 3,000 unit shares (effectively equal to 3,000 ML/a), which is sufficient to meet the maximum net site water demand. This water allocation has an opportunity cost which can be estimated from its market value. The Australian government has purchased general security water from the Namoi River at a price of $2,050 per ML. High security water would be valued slightly higher. For this analysis, a value of $2,300 per ML is assumed.

Opportunity Cost of Land

While Aston Resources already owns considerable land resources within and adjacent to the Project Boundary and has an Access Agreement in place for entry into the Leard State Forest, there is an opportunity cost to society of continuing to use these resources for mining instead of their next best use. This opportunity cost of land already owned by Aston Resources (or in the process of being purchased) has been estimated at $32M based on the lands estimated market value.

Approximately 1,066ha of Leard State Forest would be disturbed by the Project. While this land has historically been selectively logged, and would not have valuable timber resource for a further 20 to 30 years it contributes to sustainable yield forecasts for the region and hence there is an opportunity cost to society from using this land for open cut coal mining rather than timber production. This can be estimated from its contribution to sustainable yield and associated producer surplus value from timber production. Data was not readily available to estimate this value and so a rural land value of $2,000/ha was assumed. This gives an opportunity cost of $2M.

Opportunity Cost of Capital

There has been little onsite development to date and no capital equipment invested in. The opportunity cost of capital onsite is therefore considered to be zero.

Capital Cost of the Project

Capital costs of the Project are associated with the development of site infrastructure and land acquisitions as well as upgrade to Therribri Road. These costs are estimated at approximately $489M over a three year period.

In addition to the direct capital costs associated with the construction of the Project, there will be significant capital upgrades required on local and State infrastructure. The approval of the Project is likely to trigger significant upgrades to the Gunnedah rail network. These are likely to include upgrading the line to 30 tonne axle load compliance and potential duplication of some or all of the track over the Liverpool Ranges. The approval of the Project will also increase the likelihood of the early commencement of the Port Waratah Coal Services Terminal 4 expansion project. The share of these capital costs attributable to this Project are assumed to be incorporated into transport user charges already included in the operating costs above.

Annual Operating Costs of the Project

Operating costs for the Project are those associated with mining, coal treatment and transport of product coal to the Port of Newcastle. Average operating costs are estimated at approximately $574M per annum for the 21 year period. While royalties are a cost to Aston Resources, 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 the Project. Nevertheless, it should be noted that the Project would generate total royalties in the order of $2.8Bn over its 21 year life.

Decommissioning Costs

While the available coal reserves would enable mining to extend beyond 21 years, for the purpose of this analysis and to be consistent with the proposed planning period, it is assumed that the site is decommissioned and rehabilitated at the end of the end of a 21 year period at a cost of $164M.

Production Benefits

Sale Value of Coal

Open cut mining is assumed to ramp up to 13 Mtpa ROM coal by Year 8 and operate near this level until Year 21. Both demand and supply for coal influences current and projected prices.

Projected prices for the Project product coal were provided by Aston Resources and averaged US$96/tonne for thermal coal, US$135/tonne for semi-soft coking coal and US$129/tonne for PCI coal. Based on these assumptions and an average exchange rate of 0.76 average annual revenue from the Project is estimated at $1.6Bn.

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 21 year period, land and water assets owned at the commencement of the Project and those subsequently purchased are estimated to have a residual value of $54M and $6.9M, respectively. Capital equipment is provided indirectly via contractors and hence no residual value of capital at the end of the 21 year period is assumed.

2.4.2 ***External Costs and Benefits***

Noise and Blasting - noise and blasting onsite has the potential to impact on sensitive receptors such as nearby residences and buildings. These impacts can potentially be valued using the property value method, where the change in property value as a result of the noise is estimated. Nine properties with three residences were identified as likely to experience noise impacts above the relevant criteria. Two of these properties have the right to acquisition on written request to a neighbouring coal mining operation. It is expected that the owners of the additional properties impacted above the Department of Environment, Climate Change and Waters (DECCW) guidelines will be granted the opportunity to sell their properties to Aston Resources. Instead of incorporating the partial property value impact on these properties, conservatively, the full cost of acquiring these properties has been incorporated into the capital costs of Project. Further to this, a number of residences are predicted to be receive moderate noise levels and will be entitled to mitigation. The cost of this mitigation is included in the capital costs of the Project.

Air quality – air quality impacts that reduce the enjoyment associated with a property can potentially also be valued using the property valuation method. One private property has been identified as being adversely impacted by cumulative annual average PM10 concentrations and levels of PM_{10} 24 hour concentration above the DECCW criteria, as a result of the Project alone. The full cost of acquiring this affected property has been included in the capital costs of the Project.

Greenhouse gases – the Project is predicted to generate in the order of 376,000 tonnes per annum of scope 1, scope 2 and scope 3 greenhouse gas emissions associated with mining and transport of product coal by rail to the Port[1] of Newcastle. 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. There is great uncertainty around the social cost of carbon with a wide range of estimated damage costs reported in the literature. An alternative method to trying to estimate the damage costs of carbon dioxide is to examine the price of carbon credits. Again, however, there is a wide range of permit prices. For this analysis, a shadow price of

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

carbon of AUS$30/t CO_2-e was used, with sensitivity testing from AUS$8/t CO_2-e to AUS$40/t CO_2-e (refer to Appendix 1).

Ecology – approximately 1,665 ha of forest and woodland and a further 513 ha of native grassland and crop land (including 458 ha of White Box Yellow Box-Blakely's Red Gum Grassy Woodland and 87 ha of Derived Native Grassland, which are both listed as a Critically Endangered Ecological Community under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)) is proposed to be disturbed as a result of the Project. This will remove habitat for a range of threatened fauna species. These areas may have non-use values to the community that could potentially be estimated using non-market valuation methods such as choice modelling or contingent valuation.

The flora and fauna impacts will be internalised by Aston Resources' proposal to purchase lands as an offset. The proposed offset lands are approximately 6,288 ha in size and contain an estimated 2,200 ha of high quality Box Gum Woodland and 1,900 ha of Derived Native Grassland (both CEEC) in addition to 1,052 ha of Ironbark Woodland and Forest and Box Gum Shrubby Woodland.

With the implementation of the above ecological offset proposal it is considered that the potential impacts of the Project on terrestrial fauna and flora would largely be offset and hence no significant economic cost would arise that would warrant inclusion in the BCA. The capital and operating cost of this offset have also been incorporated into the capital and operating costs of the Project. The capital cost of acquiring land for the offset reflects, among other things, the foregone agricultural production to society.

Aboriginal heritage – There are approximately 38 Aboriginal heritage sites that will be disturbed by the Project. These include items such as isolated artefacts, artefact scatters, scarred trees and grinding stones. Of these, six sites that will be disturbed are of high archaeological significance and eight are of moderated archaeological significance.

Any impacts on Aboriginal heritage sites may impact the well-being of the Aboriginal community. However, monetisation of these impacts is problematic and so these impacts are best left to consideration as part of the preparation of the Aboriginal Heritage Management Plan. It should be noted that the Brigalow and Nandewar Conservation agreement set aside significant areas of land for use by Aboriginal people and the protection of Aboriginal archaeology.

Impacts on highly significant Aboriginal heritage sites have also been shown to affect the well-being of the broader community (Gillespie Economic 2009b). Gillespie Economics (2009b) used choice modelling to estimate the economic value the community of NSW held highly significant Aboriginal sites. Applying implicit prices from this study to the six highly significant Aboriginal heritage sites affected by the Project gives an externality cost of $188M.

Groundwater – The depressurised zone (as indicated by the 1 m drawdown contour at the end of mining in Year 21) extends between 5 km and 7 km from the Project open cut pit. In the order of 27 registered bores are located within the zone of influence. However, the majority of the bores within the zone of influence are located on land owned by Aston or other neighbouring mining companies. No registered irrigation bores constructed in the Namoi Valley alluvial aquifer are present within the zone of influence. Impact on productive usage of existing bores is therefore likely to be negligible.

Based on geochemical assessment conducted by RGS (2010) which assessed the overburden and potential reject materials, it is considered unlikely that leachate generated from these materials will adversely impact upon regional groundwater quality. Impacts are therefore likely to be negligible.

Traffic and transport – a traffic impact assessment of the Project did not identify any significant traffic impact from the Project. As part of the Project, Aston Resources proposed to upgrade the Therribri Road from its intersection with Manilla Road to the proposed Mine Access Road. The costs of this upgrade are included in the capital costs of the Project.

Non - Aboriginal cultural heritage – the Project will not impact on any significant non-Aboriginal Cultural Heritage sites and hence no externality costs have been included in the BCA. There will, however, be some ongoing management required for the Velyama Homestead items (on Aston owned land) such as preparing a management plan surveying, fencing off and ongoing monitoring of the condition these structures. The cost of this management is included in the operating costs for the Project.

Visual impacts – the Project is visible from a number of viewpoints mainly to the north of the Project Boundary. However, there are not expected to be any significant visual impacts experienced to any receiver surrounding the Project Boundary. Consequently no externality costs have been included in the BCA.

Surface water impacts – the Project may potentially have a range of impacts in relation to the existing surface water conditions, including:

- Use of high security water;
- Modification in catchment yields of the Namoi River;
- Contamination of natural systems with dirty water;
- Impact on flooding; and
- Overspilling of the final void.

The use of high security water has already been incorporated into the analysis by including its opportunity cost in the estimation of production costs, above.

The maximum catchment area draining to the mine water management system is approximately 1,590 ha, which represents about 25% of the catchment area of Back Creek and only about 2.1% of the total Maules Creek catchment area. The loss of catchment from the Namoi River is negligible.

Water pumped from the Open Cut Pit is likely to be of reasonable quality. However, due to the possible presence of PAF material and the recycling of water on site, it is unlikely that water stored in the mine water management system will be suitable for release off site without treatment. The water will therefore be retained onsite.

The proposed limit of disturbance is outside the 100 year ARI flood extent for Back Creek hence the Project will have no adverse impact on flood levels or flood behaviour along Back Creek for events up to the 100 year ARI event.

The flood study for the Boggabri Coal Rail Spur (WRM, 2009) found that the proposed rail bridge crossing would have an insignificant impact on flood levels (maximum of 0.03m) and no measurable impact on flood extents for all floods investigated.

Simulation of the water balance for the Final Void indicates that the water level will take several hundred years to reach an equilibrium level. The long term equilibrium level is more than 100 m below the overflow level of the Final Void. Simulation of water quality in the Final Void indicates that salinity will gradually increase over time. Due to the low salinity of leachate and surface runoff, salinity will increase at a very slow rate. The rising salinity level in the Final Void will have no adverse impact on surface water or groundwater because the Final Void will never spill and groundwater will flow into, rather than out of, the Final Void.

Social and economic value of employment –the Project would generate up to 470 direct jobs (398 on average) during the operational period of 21 years. Historically employment benefits of projects has tended to be omitted from benefit cost analysis on the implicit assumption that labour resources used in a project would otherwise be employed elsewhere. Where this is not the case and labour resources would otherwise be unemployed for some period of time, 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 people's willingness to pay to avoid the trauma created by unemployment. These are non-market values.

More recently, it has 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). Gillespie Economics (2008) estimated the value the community hold for the 23 years that the Metropolitan Colliery provides 320 jobs, at $756M (present value). Gillespie Economics (2009a) estimated the value the community hold for the 30 years that the Bulli Seam Operations provides 1,170 jobs, at $870M (present value). Gillespie Economics (2009b) estimated the value the community hold for 10 years (after 2021) that the Warkworth Mine provides 975 jobs, at $286M (present value).

The Project will provide an average of 416 direct jobs for a period of 21 years. Using the more conservative Bulli Seam Operation employment value gives an estimated $207M for the employment benefits of the Project. This value has been included in the BCA. Sensitivity testing includes omission of the variable.

2.5 CONSOLIDATION OF VALUE ESTIMATES

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

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

COSTS ($M)		BENEFITS ($M)	
Production			
Opportunity cost of water	$6	Revenue	$14,336
Opportunity cost of land	$29	Residual value of water assets	$1
Opportunity cost of capital	$0	Residual value of land	$11
Capital costs, including land acquisition	$416	Residual value of capital	$0
Operating costs	$5,134	**Total Production Benefits**	**$14,349**
Decommissioning costs	$35	**Net Production Benefits**	**$8,728**
Total Production Costs	**$5,620**		
Potential Externalities			
Air quality	Acquisition costs included in capital costs and opportunity costs of land	Social and economic values of employment	$194
Greenhouse gases	$115		
Noise and vibration	Acquisition and mitigation costs included in capital costs		
Ecology	Some loss of values but offset. Cost of offset included in capital costs and operating costs		
Groundwater	Negligible impacts		
Traffic and transport	Negligible impacts. Costs of Therribri Road upgrade included in capital costs		
Aboriginal heritage	$188		
Non-Aboriginal heritage	Negligible impacts. Costs of management included in operating costs		
Visual impacts	Negligible impacts		
Surface water	Negligible impacts		
TOTAL QUANTIFIED	**$5,924**	**TOTAL QUANTIFIED**	**$14,542**
NET QUANTIFIED BENEFITS		**$8,618**	

*Columns may not total due to rounding.

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. Table 2.3 indicates that the Project will have net production benefits of $8,728M.

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

- The local community in the form of donations and community support programs;
- Aston Resources and its shareholders;

- The NSW Government via royalties; and
- The Commonwealth Government in the form of Company tax.

The NSW Government receives additional benefits in the form of payroll tax and local councils also benefit through rates and development contributions.

The main external costs from the Project relate to greenhouse gas generation, Aboriginal heritage, ecology, air quality, noise and vibration, and transport impacts. Greenhouse gas costs have been estimated at $115M. Aboriginal heritage impacts have been estimated at $188M. The externality costs associated with the clearing of native vegetation would be counterbalanced by the offset actions proposed by Aston Resources. The costs of these offset actions have been included in the estimation of net production benefits. Air quality, noise and vibration impacts have also already been incorporated into the estimation of net production benefits via acquisition costs for nearby affected properties. Transport costs have also been included in the estimation of net production costs via incorporation of the costs of upgrading Therribri Road. External benefits associated with employment provided by the Project have been estimated at $194M.

Overall the Project is estimated to have net benefits of $8,618M and hence is desirable and justified from an economic efficiency perspective.

2.6 SENSITIVITY ANALYSIS

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

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

- Opportunity cost of water;
- Opportunity cost of land;
- Capital costs;
- Operating costs;
- Decommissioning costs;
- Revenues;
- Residual value of water, capital and land;
- Greenhouse costs;
- Aboriginal heritage costs; and
- Employment benefits.

What this analysis indicated (refer to Appendix 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 greenhouse gas costs had little impact on the economic desirability of the Project.

The results were most sensitive to increases in operating costs and decreases in the sale value of coal.

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, 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 impact of up to 13 Mtpa of ROM coal production associated with the Project.

The economy on which the impact is measured can range from a township to the entire nation (Powell *et al.,* 1985). In selecting the appropriate economy, regard needs to be had to capturing the local expenditure and employment associated with the Project, but not making the economy so large that the impact of the Project becomes trivial (Powell and Chalmers, 1995). The workforce is likely to predominantly reside in either the townships of Gunnedah, Narrabri or Boggabri. Consequently, for this study, the economic impacts of the Project have been estimated for the Australian Bureau of Statistics (ABS) Statistical Local Areas (SLA) of Narrabri and Gunnedah.

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 (Narrabri SLA and Gunnedah SLA) was developed using the Generation of Input-Output Tables (GRIT) procedure (Appendix 3) with 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	35,880	6	22,442	1	48	1,440	59,818	2,239	75,566	273,793	411,416
Mining	0	1,366	408	4,542	80	75	6,472	9	414	39,497	46,391
Manuf.	18,864	521	33,443	358	7,526	19,964	80,677	13,561	14,582	252,514	361,334
Utilities	2,466	233	4,773	35,397	447	7,841	51,156	5,122	474	24,237	80,988
Building	1,176	219	599	919	18,524	6,158	27,596	0	63,881	17,943	109,419
Services	35,693	2,975	45,703	2,314	9,353	138,231	234,269	144,288	216,795	340,979	936,331
TOTAL	94,079	5,321	107,369	43,531	35,979	173,709	459,987	165,218	371,711	948,963	1,945,879
Household wages	87,711	6,599	48,813	5,236	25,714	294,091	468,164	0	0	0	468,164
OVA	110,176	27,920	47,614	17,119	12,784	193,010	408,623	25,985	13,143	1,706	449,457
Imports	119,450	6,551	157,538	15,103	34,943	275,521	609,105	279,748	70,615	67,275	1,026,744
TOTAL	411,416	46,391	361,334	80,988	109,419	936,331	1,945,879	470,952	455,469	1,017,944	3,890,243
Employment	2,288	105	728	88	440	5,868	9,517				

Note: Totals may have minor discrepancies due to rounding.

Gross regional product (GRP) for the regional economy is estimated at $917M, comprising $468M to households as wages and salaries (including payments to self employed persons and employers) and $449M in OVA.

A total of 9,517 people were working in the region during 2005/2006.

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 sector is of greater relative importance to the regional economy than it is to the NSW economy, while the services sectors and building sectors are of less relative importance than they are to the NSW economy. Mining, manufacturing and utilities sectors in the region are of similar relative importance as they are to NSW.

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

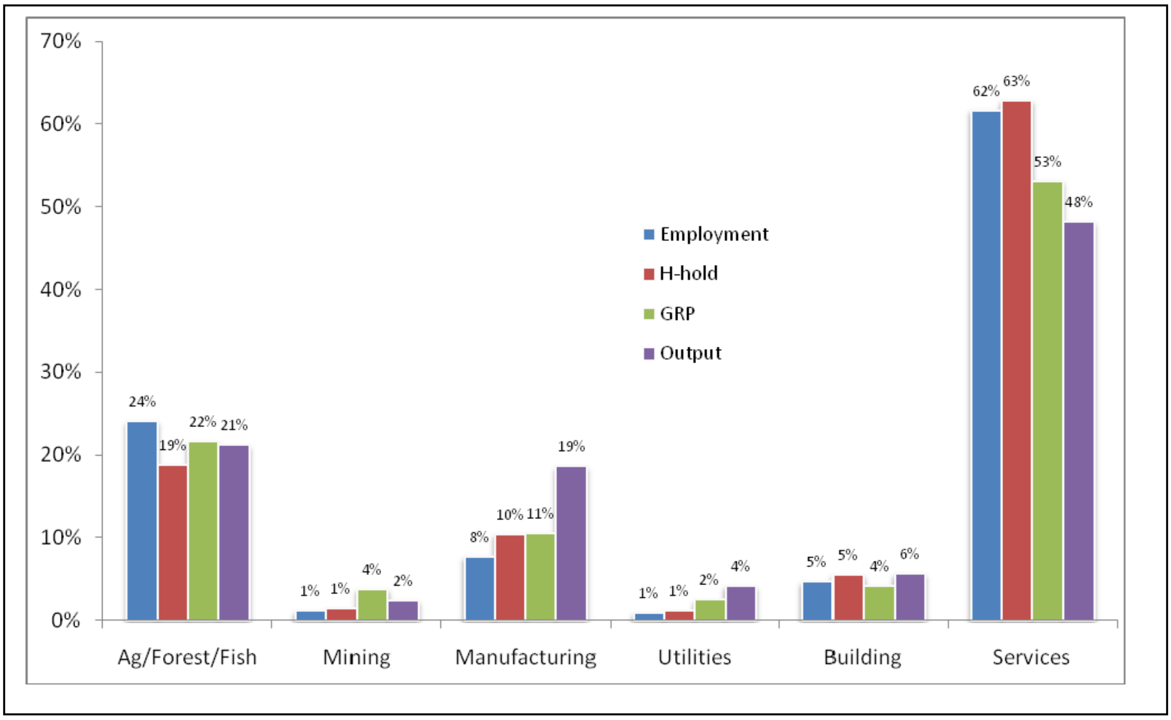
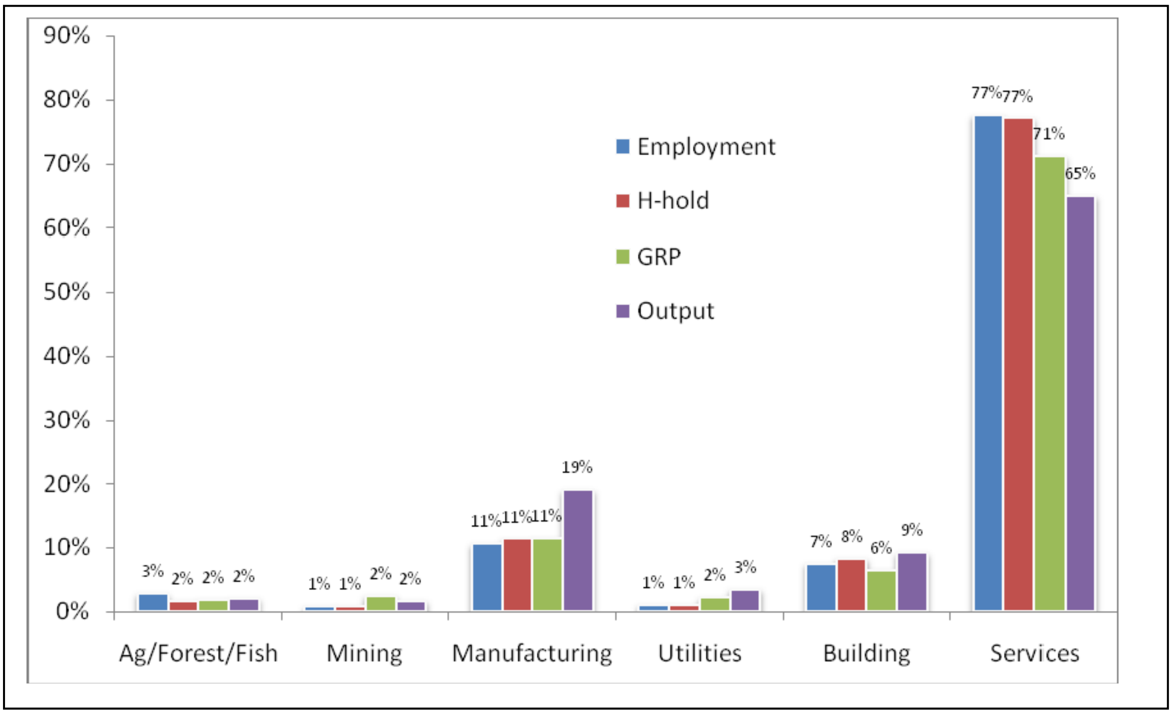


Figure 3.2
Summary of Aggregated Sectors: NSW Economy (2005-06)

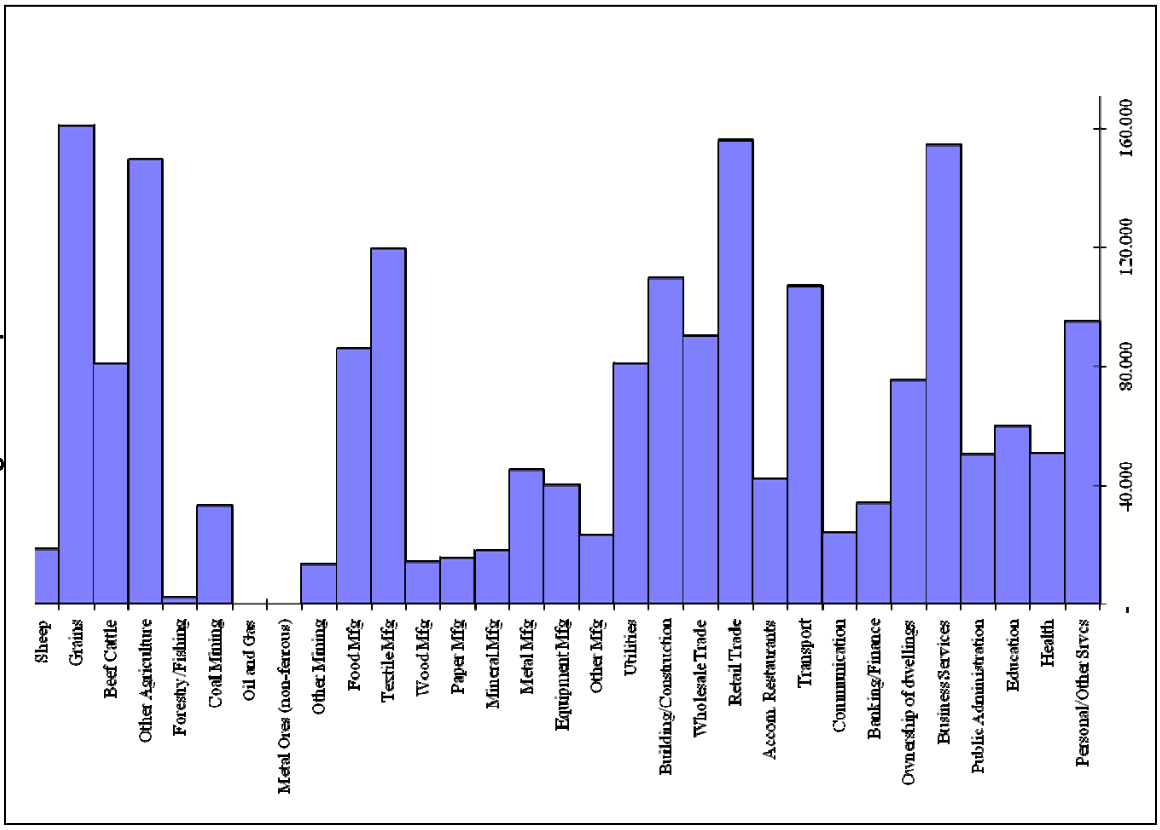


Figures 3.3 to 3.5 provide a more expansive sectoral distribution of gross regional output, employment, household income, value-added, exports and imports, and can be used to provide some more detail in the description of the structure of the economy.

From these figures it is evident that in terms of gross regional output and value-added grains and other agriculture sector, business services and retail trade are the most significant sectors. The retail trade sector is the most significant sector in terms of regional employment while the retail trade sector and business services sector are the most significant sectors in terms of income. Imports and exports are spread across many sectors with major contributors being the grains and other agriculture sectors, food and textile manufacturing, retail trade and business services.

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

Gross Regional Output



Gross Value-Added

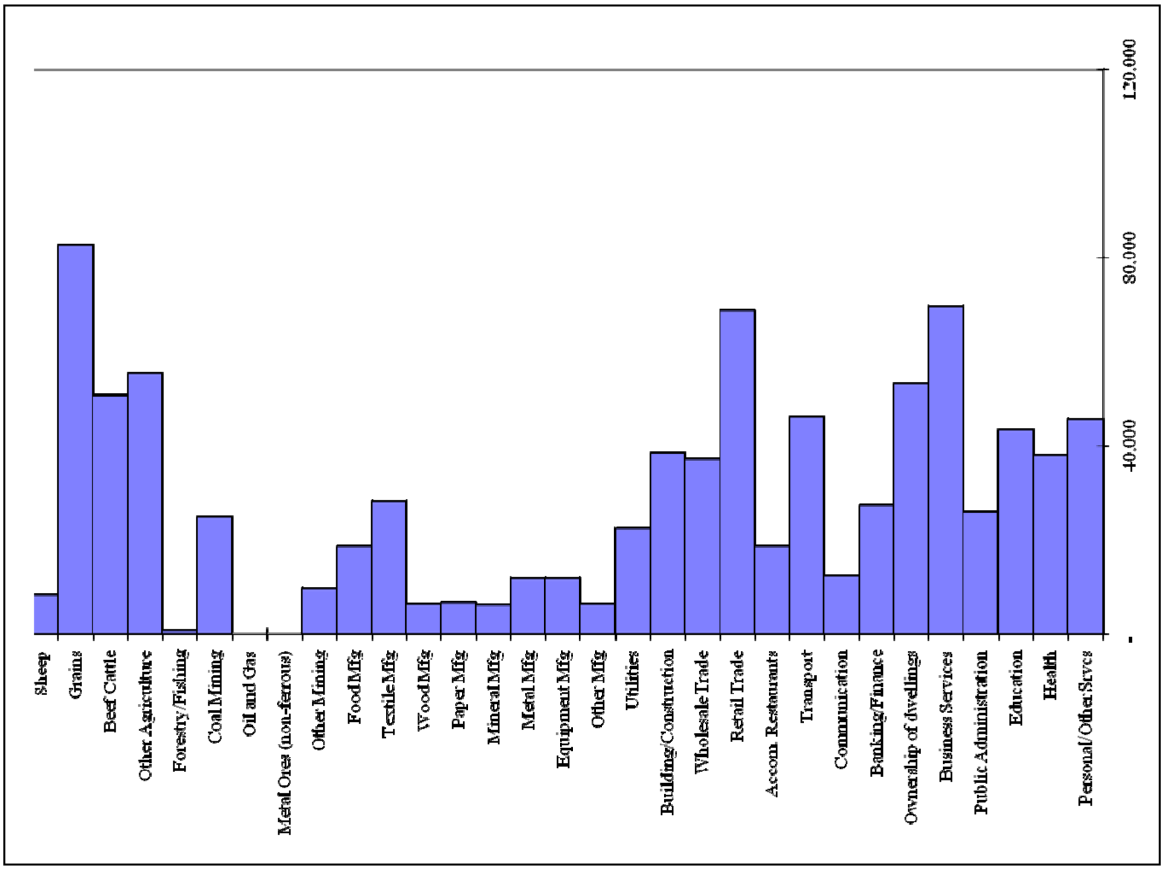
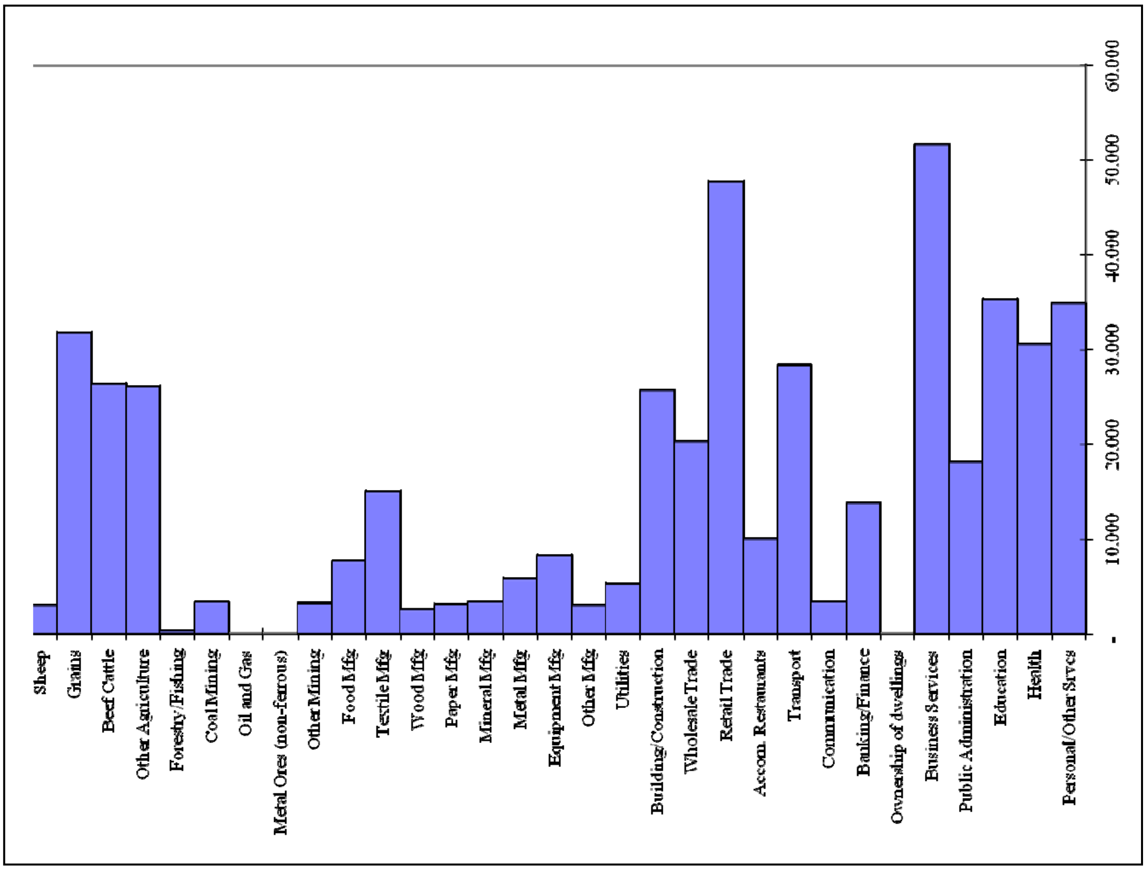


Figure 3.4 Sectoral Distribution of Gross Regional Income ($'000) and Employment (No.)



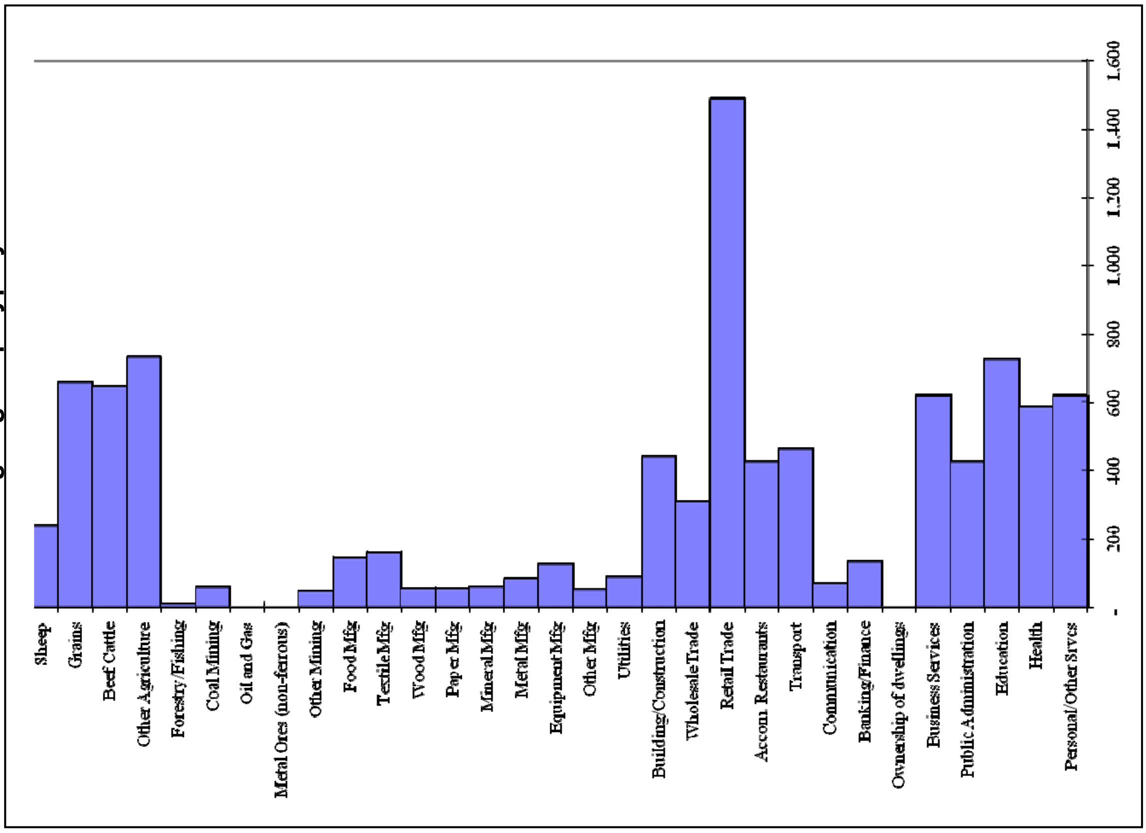
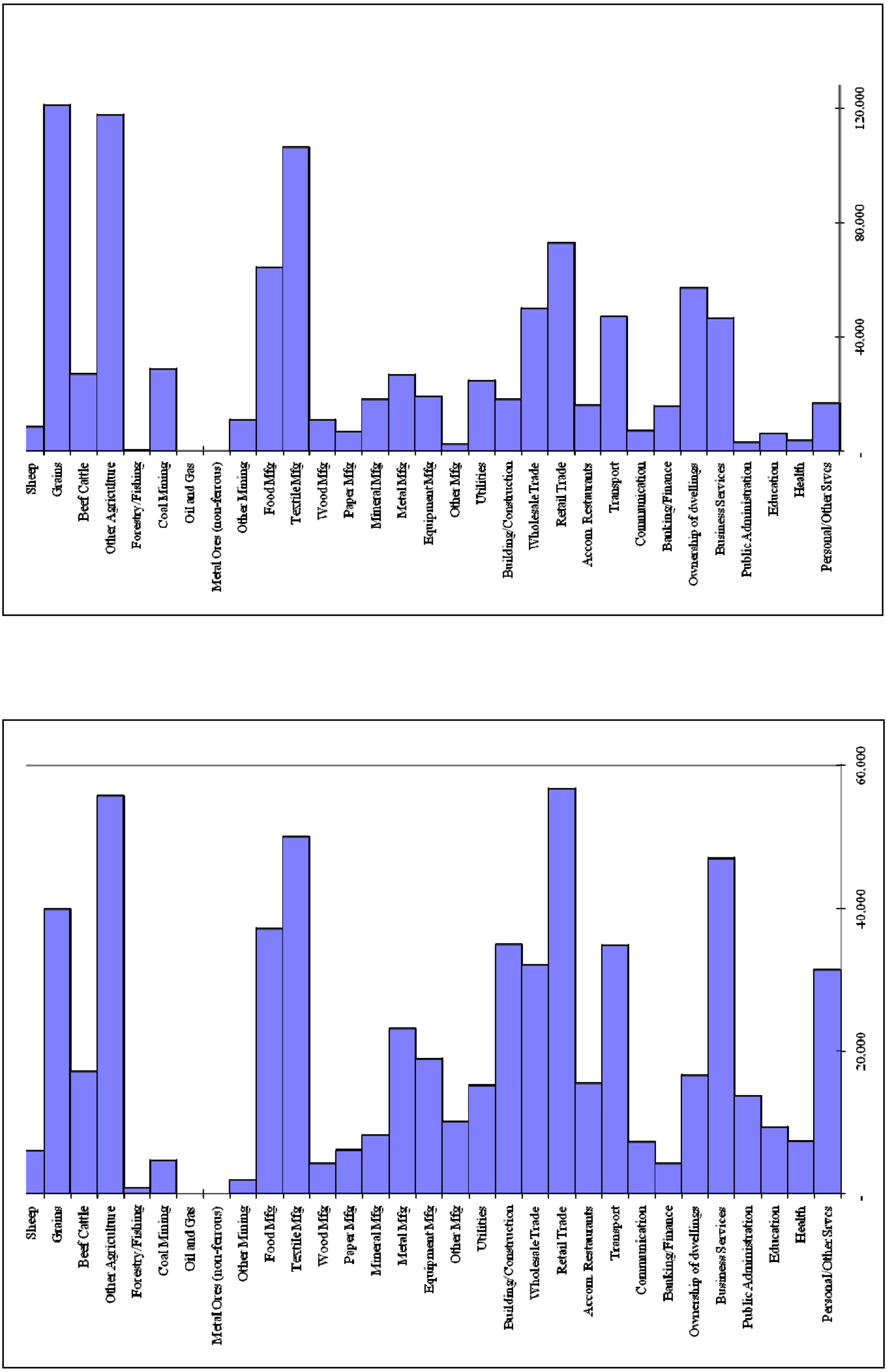


Figure 3.5 Sectoral Distribution of Imports and Exports ($'000)



3.2 REGIONAL ECONOMIC IMPACT OF THE PROJECT

3.2.1 *Introduction*

For the analysis of the Project, a new Maules Creek Coal Mine sector was inserted into the regional input-output table[2] reflecting peak production levels of 13 Mtpa of ROM coal for the Project. The revenue, expenditure and employment data for this new sector was obtained from financial information provided by Aston Resources. For this new sector:

- the estimated gross annual revenue was allocated to the *Output* row;
- the estimated wage bill of the direct employment residing in the region (100%) was allocated to the *household wages* row;
- 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 regional location quotients;
- purchase prices for expenditure in 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;
- employment assumed to reside in the region (100%) was allocated to the *employment* row; and
- adjustment was then made to the estimated income and employment impacts to include contractor payment effects as direct effects rather than production induced flow-ons.

3.2.2 *Impacts of the Project on the Regional Economy*

The total and disaggregated annual impacts of the Project on the regional economy in terms of output, value-added, income and employment (in 2010 dollars) are shown in Table 3.2.

Table 3.2
Annual Regional Economic Impacts of the Project

	Direct Effect	Production Induced	Consump. Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	1,698,963	176,325	23,827	200,152	1,899,115
Type 11A Ratio	*1.00*	*0.10*	*0.01*	*0.12*	*1.12*
VALUE ADDED ($'000)	897,963	112,324	11,450	123,774	1,021,738
Type 11A Ratio	*1.00*	*0.13*	*0.01*	*0.14*	*1.14*
INCOME ($'000)	31,858	14,157	7,553	21,709	53,568
Type 11A Ratio	*1.00*	*0.44*	*0.24*	*0.68*	*1.68*
EMPL. (No.)	398	206	149	355	753
Type 11A Ratio	*1.00*	*0.52*	*0.37*	*0.89*	*1.89*

In total, the Project is estimated to make up to the following contribution to the regional economy:

- $1,899M in annual direct and indirect regional output or business turnover;
- $1,022M in annual direct and indirect regional value added;
- $54M in annual household income; and
- 753 direct and indirect jobs.

[2] Inflated to 2010

3.2.3 *Multipliers*

The adjusted Type 11A ratio multipliers for the Project range from 1.12 for value-added up to 1.89 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 value-added reflecting the relatively high direct value-added for the Project compared to that in flow-on sectors. The low output ratio multiplier largely reflects the high direct output value of the Project compared to those sectors that experience flow-on effects from the Project.

3.2.4 *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:

- Scientific research, technical and computer services sector;
- Electricity supply sector;
- Wholesale trade sector;
- Retail trade sector;
- Road transport sector;
- Accommodation, cafes and restaurants sector; and
- Legal, accounting, marketing and business management services sector.

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

Table 3.3
Sectoral Distribution of Total Regional Employment Impacts

Sector	Average Direct Effects	Production induced	Consumption-induced	Total
Ag/forestry/fishing	0	0	3	3
Mining	398	4	0	402
Manufacturing	0	6	5	11
Utilities	0	13	2	14
Wholesale/Retail	0	38	38	76
Accommodation, cafes, restaurants	0	7	22	29
Building/Construction	0	10	1	11
Transport	0	23	6	28
Services	0	105	73	178
Total	**398**	**206**	**149**	**753**

Note: Totals may have minor discrepancies due to rounding.

Table 3.3 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 will occur mainly in the wholesale/retail, transport and services sectors while consumption induced flow-on employment will be mainly in wholesale/retail, accommodation/cafes/restaurants and services sectors.

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

3.2.5 *Cumulative Impacts*

The Project is located in the Gunnedah Basin. The Gunnedah Basin contains 13% of the estimated recoverable coal reserves in NSW but currently only accounts for 2% of coal production (NSW DPI 2009). There is therefore considerable scope for additional coal mining activity.

Boggabri Coal are seeking approval to extend and expand the current mining operation for a 21-year period. Tarrawonga is also looking to expand production in the future and there is another potential project, the Goonbri Coal Project to the southeast of Maules Creek. These three potential operations are all within the vicinity of the Leard State Forest. Other coal mining projects are possible.

All potential coal mining projects will stimulate demand for inputs to production and the goods and services required by employees. To the extent that these inputs to production and goods and services can be supplied by existing or future local business the stimulus will be captured by the local economy. Where this does not occur, the demand generated by the projects will result in economic stimulus leaking to surrounding or other regions and towns. Where the demand for labour results in migration into the region the stimulus to the regional economy will be greater but this will also increase demand for housing and community infrastructure.

3.3 STATE ECONOMIC IMPACTS OF THE PROJECT

3.3.1 *Introduction*

The State economic impacts of the Project were assessed in the same manner as for estimation of the regional impacts. A new Maules Creek Coal Mine sector was inserted into a 2005-06 NSW input-output table[3] in the same manner described in Section 3.2.1.

3.3.2 *Impacts of the Project on NSW*

The total and disaggregated annual impacts of the Project on the NSW economy in terms of output, value-added, income and employment (in 2010 dollars) are shown in Table 3.4.

Table 3.4
Annual State Economic Impacts of the Project

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	1,698,963	764,489	351,251	1,115,739	2,814,702
Type 11A Ratio	*1.00*	*0.45*	*0.21*	*0.66*	*1.66*
VALUE ADDED ($'000)	1,026,693	352,002	178,912	530,914	1,557,607
Type 11A Ratio	*1.00*	*0.34*	*0.17*	*0.52*	*1.52*
INCOME ($'000)	31,858	168,612	102,386	270,997	302,855
Type 11A Ratio	*1.00*	*5.29*	*3.21*	*8.51*	*9.51*
EMPL. (No.)	398	2,168	1,463	3,631	4,029
Type 11A Ratio	*1.00*	*5.45*	*3.68*	*9.12*	*10.12*

[3] Inflated to 2010.

In total, the Project is estimated to make the following contribution to the NSW economy:

- $2,815M in annual direct and indirect output or business turnover;
- $1,558M in annual direct and indirect value added;
- $303M in annual household income; and
- 4,029 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.

3.4 PROJECT CESSATION

The Project will stimulate demand in the regional and NSW economy 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 3.2. However, if displaced workers and their families leave the region then impacts would be greater and begin to approximate the total effects in Table 3.2.

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 its capacity to expand its factors of productions 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 Gunnedah Basin is highly prospective and is known to contain other considerable coal resources (DPI, 2008).

It is therefore likely that over time, new mining developments will occur offering potential to strengthen and broaden the economic base of the region and hence buffer against impacts of the cessation of individual activities. Conversely, if the Project is not approved, this may discourage other miners from investing in exploration in the region due to a perceived uncertainty as to whether they could be successful in gaining approvals to mine.

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.

Given these uncertainties it is not possible to foresee the likely circumstances within which cessation of the Project would occur. It is therefore important for regional authorities and leaders to take every opportunity provided by the regional economic stimulus of the Project to strengthen and broaden the region's economic base.

Notwithstanding this, reserve estimates indicate that the mine life can be extended beyond 2032, subject to obtaining necessary approvals. The issue of mine cessation may therefore not occur for many years.

4 CONCLUSION

A BCA identified a range of potential economic costs and benefits of the Project. The net production benefits of the Project were estimated at $8,728M. The main external costs from the Project relate to greenhouse gas generation, Aboriginal heritage, ecology, air quality, noise and vibration, and transport impacts. Greenhouse gas costs have been estimated at $115M. Aboriginal heritage impacts have been estimated at $188M. The externality costs associated with the clearing of native vegetation would be counterbalanced by the offset actions proposed by Aston Resources. The costs of these offset actions have been included in the estimation of net production benefits. Air quality, noise and vibration impacts have also already been incorporated into the estimation of net production benefits via acquisition costs for nearby affected properties. Transport costs have also been included in the estimation of net production costs via incorporation of the costs of upgrading Therribri Road. External benefits associated with employment provided by the Project have been estimated at $194M.

Overall the Project is estimated to have net benefits of $8,618M and hence is desirable and justified from an economic efficiency perspective.

A regional economic impact analysis, using input-output analysis, estimated that in total, the Project will contribute up to the following to the regional economy:

- $1,899M in annual direct and indirect regional output or business turnover;
- $1,022M in annual direct and indirect regional value added;
- $54M in annual household income; and
- 753 direct and indirect jobs.

At the State level the Project will make up to the following contribution to the economy:

- $2,815M in annual direct and indirect output or business turnover;
- $1,558M in annual direct and indirect value added;
- $303M in annual household income; and
- 4,029 direct and indirect jobs.

This stimulus would be felt across a range of sectors in the economy including the coal mining sector, wholesale trade sector, retail trade sector, technical services sector, road transport sector, electricity supply sector and hotels, cafes and restaurants sector.

Approval is being sought for the Project for a period of 21 years, although it is recognised that there are further coal resources within Aston Resources mining tenements beyond this period. On cessation of mining the economic stimulus provided by the Project will largely cease. The significance of these Project cessation impacts will depend on:

- The degree to which any displaced workers and their families remain within the region;
- The economic structure and trends in the regional economy at the time; and
- Whether other mining developments or other opportunities in the region arise that allow employment of displaced workers.

Nevertheless, given the uncertainties about the circumstances within which Project cessation will occur, it is important for regional authorities and leaders to take every advantage from the stimulation to regional economic activity and skills and expertise that the Project brings to the region, to strengthen and broaden the region's economic base.

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Appendix 1 – Valuing Greenhouse Gas Emissions

To place an economic value on 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 US$85/t CO_2-e 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;
- 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 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$0.55/t CO_2-e (in 1995 US$), the median was US$3.82/t CO_2-e, the mean US$25.34/t CO_2-e and the 95^{th} percentile US$95.37/t CO_2-e. 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 carbon dioxide emissions exceed US$14/t CO_2-e 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 (/tC) (US$8/t CO_2-e).

An alternative method to trying to estimate the damage costs of carbon dioxide is to examine the price of carbon credits. This is relevant because emitters can essentially emit CO_2-e resulting in climate change damage costs or may purchase credits that offset their CO_2-e 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 2008, the price of carbon credits under the European Union Emissions Trading Scheme were around Pounds (£) 24/t CO_2, the equivalent of about US$38/t CO_2 while spot prices in the Chicago Climate Exchange were in the order of US$3.95/t CO_2.

As of July 2008 the spot price under the NSW Government Greenhouse Gas Reduction Scheme was AUS$7.25 t CO_2-e. Prices under the Commonwealth Governments Greenhouse Friendly Voluntary Scheme were AUS$8.30 t CO_2-e and Australian Emissions Trading Unit (in advance of the Australian Governments Emissions Trading Scheme) was priced at AUS$21 t CO_2-e (Next Generation Energy Solutions pers. comms. 24 July 2008).

A National Emissions Trading Scheme is foreshadowed in Australia by 2010. While the ultimate design and hence liabilities under the scheme are still a work in progress, the National Emissions Trading Taskforce cited a carbon permit price of around AUS$35 t CO_2-e.

The Carbon Pollution Reduction Scheme: Australia's Low Pollution Future White Paper (Australian Government,2008) cited a carbon permit price of AUS$23/t CO_2-e in 2010 and AUS$35/t CO_2-e in 2020 (in 2005) dollars for a 5% reduction in carbon pollution below 2000 levels by 2020.

Given the above information and the great uncertainty around damage cost estimates, a range for the social cost of greenhouse gas emissions from AUS$8/ t CO_2-e to AUS$40/ t CO_2-e was used in the sensitivity analysis in Section 2.6, with a conservatively high central value of AUS$30/ t CO_2-e.

Appendix 2 – Sensitivity Testing (NPV A$M)

INCREASE 20%	4%	7%	10%
Opportunity cost of water	$12,016	$8,617	$6,377
Opportunity cost of land	$12,011	$8,612	$6,372
Capital costs	$11,928	$8,535	$6,300
Operating costs	$10,575	$7,591	$5,622
Decommissioning costs	$12,004	$8,611	$6,374
Revenue	$15,997	$11,485	$8,514
Residual value of water, capital and land	$12,022	$8,621	$6,379
Greenhouse costs @$40/t	$11,966	$8,580	$6,348
Aboriginal heritage costs	$11,978	$8,580	$6,341
Employment benefits	$12,057	$8,657	$6,416
DECREASE 20%			
Opportunity cost of water	$12,018	$8,619	$6,379
Opportunity cost of land	$12,023	$8,624	$6,384
Capital costs	$12,106	$8,701	$6,456
Operating costs	$13,460	$9,645	$7,134
Decommissioning costs	$12,030	$8,625	$6,382
Revenue	$8,037	$5,751	$4,242
Residual value of water, capital and land	$12,012	$8,616	$6,377
Greenhouse costs @$8/t	$12,130	$8,703	$6,444
Aboriginal heritage costs	$12,056	$8,656	$6,415
Employment benefits	$11,977	$8,579	$6,340
No employment benefits	$11,818	$8,424	$6,190

Appendix 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 non-ferrous metals and building and construction sectors. 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. It also means that the method should be used by an analyst who is familiar with the economy being modelled, or at least someone with that familiarity should be consulted.

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). That 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 A-1" (Powell and Chalmers, 1995).

Table A-1
The GRIT Method

Phase	Step	Action
PHASE 1		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)

Allocation of Land and Water Resources Between Agriculture and Mining

Final Report

Prepared for

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1.0 INTRODUCTION

There appear to be a range of interrelated issues associated with coal mining and the use of agricultural land and water, including:

- The impact of exploration on landowners;
- The area of land subject to exploration and potential mining and the impact on agricultural land;
- That agricultural lands are important to NSW;
- That high quality farming land is finite;
- The competition between mines and agriculture for land and water resources;
- The potential (unintended) externality impacts of mining on water resources e.g. drawdown of groundwater;
- The importance of agricultural land for food security;
- The importance of agriculture to rural economies.

Many of these issues can be addressed through discussion of economic principles and simple empirical analysis in relation to NSW and the case study region of Gunnedah and Narrabri Statistical Local Areas (SLAs).

2.0 UNDERLYING ISSUES WITH COAL MINING AND USE OF AGRICULTURAL LAND AND WATER CONCERNS

2.1 Agricultural Lands are Important to New South Wales

Agricultural lands are important to NSW. They cover approximately 81% of NSW (65M hectares) (ANRA 1997) and directly provide employment for 76,261 people or 2.7% of total employment in NSW (ABS 2006)[1]. Payment to agriculture, forestry and fishing employees in 2008-09 was $1,842M and value-added was $7,205M. Gross operating surplus and gross mixed income from agriculture, forestry and fishing was $4,974M (ABS 5220.0).

However, other land uses are also important to NSW. The area used for mining is a small fraction of the area of NSW (i.e. likely to be less than 0.1% of the total NSW land area) and mining directly employs 19,026 or 0.7% of total employment in NSW (ABS 2006). Payment to mining employees in 2008-09 was $3,058M and value-added was $9,995M. Gross operating surplus and gross mixed income from mining was $9,128M (ABS 5220.0)

Hence, using considerably less land area, mining actually is a more significant sector than agriculture in terms of payments to employees, value-added and gross operating surplus and mixed income.

Nevertheless, no policy implication should be drawn from the relative magnitudes of existing sectors. What is relevant in a policy context is whether moving from one land use to another is economically efficient or not. That is, do the economic benefits to the community from changing land uses exceed the costs to the community. This is discussed in Section 3.0.

2.2 Agricultural Lands Support Economic Growth in Regional Areas

Agricultural lands have historically supported the economies of regional areas. However, regional economies are facing a number of trends including:

- Loss of significant industries such as Abattoirs and timber mills from many rural areas;
- Increased mechanisation of agriculture and aggregation of properties resulting in loss of employment opportunities in this industry;

[1] This is based on the ABS sector of Agriculture, forestry and fishing.

- Declining commodity prices[2];
- The preference of Australians for coastal living, particularly for retirement; and
- The preference of many of today's fastest growing industries for locating in large cities (Collits 2001).

The result is that there has been declining population growth in 47 out of 96 rural SLAs that are located in non-coastal statistical subdivisions (excluding Hunter SD) (ABS 3218.0). There has also been a decline in the population of smaller towns even in regions that have been growing.

Trends in agriculture are leading to improved productivity but reduced stimulus in regional areas as demand for factor inputs such as labour decline. The prosperity of rural areas reliant on agriculture has also been in decline.

It is the increased or new spending in regions that contributes to economic stimulus and growth. One potential source of new spending is mining projects that utilise the resource endowments of a region. Studies (e.g. Gillespie Economics 2003; Gillespie Economics 2007) have shown that mining projects provide significant new economic stimulus to regional and rural economies through direct expenditures on inputs to production as well as the expenditure of employees. This latter stimulus is enhanced by the high wages paid in the mining sector.

Mining projects can also broaden the economic base of regions, thereby insulating the economy from external shocks such as droughts and downturns in agricultural commodity prices (Collits 2001).

2.3 There is a Conflict between Prime Agricultural Land and Other Land Uses that Threatens Food Production

In Queensland, cropping land covers an area of 46,800 km^2 while surface disturbance caused by all mines in the last 50 years covered an area of 107 km^2, 0.23% of cropping lands.

No similar information is available for NSW, however, it is expected that the situation would be similar.

The threat to cropping land from mining would therefore appear to be minimal at a macro level. Nevertheless, the desirability of proposals that impact this land should be addressed at a micro level through a consideration of costs and benefits including the costs to society of impacting high value, agricultural land.

[2] Over the past two decades the prices of nearly all the major agricultural commodities declined in real terms (Greenfield, undated).

2.4 Water Supplies Should Also be Protected

Like land, water can also be considered a scarce resource that faces competing demands. Consequently, the government has established a framework to facilitate its allocation between competing uses.

The *NSW Water Management Act 2000* (WM Act) vests ownership of water in the Crown; water access and use is now only permissible with possession of a water access licence (except in the case of harvestable rights, native title rights and some stock and domestic rights). Water Sharing Plans that are prepared under the WM Act set the rules by which water is shared between all users, including the environment, in each water management area in NSW. These plans also set rules for water trading, that is, the buying and selling of water licences and also annual water allocations (Montoya 2010).

The aim of water trading is to facilitate the re-allocation of water from sectors with low added value to sectors with a higher added value (Savenije and van der Zaag 2001). Like the situation with land, the price of water performs the function of rationing the scarce supply of water among competing uses. Consistent with any asset class, and with all other external factors being equal, users that value water the most will be willing to pay the most for water entitlements.

3.0 ECONOMIC EFFICIENCY OF THE PROPOSALS THAT IMPACT PRIME AGRICULTURAL LAND

3.1 Economic Efficiency

From an economic perspective, the aim is to use scarce resources, such as capital, labour, land and water, to maximise economic welfare or community fulfilment. This is referred to as economic efficiency and refers to a situation where production costs are as low as possible (technical or productive efficiency), and consumers want the combination of goods and services that is being produced (allocative efficiency).

Economic efficiency can be achieved for market goods, where there are no externalities, through competitive markets. In this situation the price mechanism (interaction of supply and demand) functions to allocate resources in a manner that maximises the net benefits to society as a whole.

Agricultural land and water (where property rights have been established) are market goods. In an efficient market, resources will be re-allocated to their most productive use for society. The exception is where a change in land use or water use may result in market failure through the occurence of externalities. In these circumnstances markets will not allocate resources to maximise economic welfare. Government intervention may therefore be required to determine how resources should be allocated.

In these situations any Government intervention should be guided by a consideration of the costs and benefits of the intervention. The method that economists use to do this is benefit cost analysis (BCA). The essence of BCA is:

- the estimation of the extent to which a community is made better off by a resource reallocation;
- the estimation of the extent to which the community is made worse off by a resource reallocation; and
- a comparison of these two figures.

If the benefits of the intervention are greater than the costs of the intervention then it provides net benefits to the community and is economically efficient.

3.2 Economic Efficiency of Proposals that Impact Prime Agricultural Land

Mining proposals are already subject to a requirement to obtain government approval through the environmental assessment (EA) process. This includes a consideration of economic efficiency.

In a simple BCA framework, the potential costs and benefits of of a mining project that impacts prime agricultural land may be as follows:

Table 1 – Potential Costs and Benefits of a Mining Proposal that Impacts Prime Agricultural Land

	COSTS	**BENEFITS**
Net Production Benefits	**Production**	
	Opportunity costs of land and capital	Value of mineral resource
	Capital and operating costs (including impact mitigation and rehabilitation)	Residual value of land and capital
Net Externalities	**Externalities**	
	Residual environmental impacts after impact mitigitation	Non use employment benefits of mining *

*these benefits have been estimated using choice modelling in Gillespie Economics 2008, Gillespie Economics 2009a and Gillespie Economics 2009b.

Where the proposal impacts prime agricultural land there is an opportunity cost to society of using the land for mining instead of agriculture. The magnitude of this opportunity cost is reflected in the market value of the land, since the market value of the land reflects, among other things, the discounted future net income that can be earned from the property and income reflects how much the community values the outputs of agricultural production.

The utlimate outcome of any benefit cost analysis of a proposal is an empirical issue. But estimating the value of the opportunity cost of prime agricultural land is an integral component of the analysis.

The existing EA framework is considered to be the most appropriate mechanism for addressing individual projects that may impact prime agricultural land, with the impact on prime agricultural land being one of many potential costs and benefits to be included in the assessment.

4.0 CASE STUDY – MAULES CREEK PROJECT

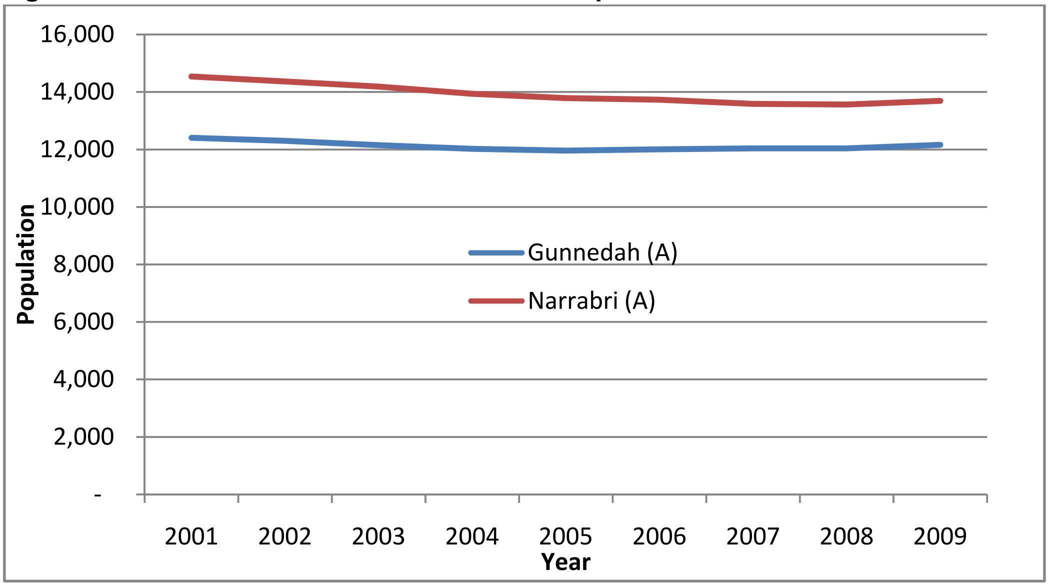
4.1 Introduction

The Maules Creek Coal Project (the Project) is located approximately 20 km north-east of the town of Boggabri, within the Narrabri Local Government Area (LGA). The Project comprises the development of site infrastructure and the mining of up to 13 million tonnes per annum (Mtpa) run-of-mine (ROM) coal over at least a 21-year period, using open-cut mining methods.

4.2 Population

While Gunnedah and Narrabri in are adjoining SLAs they are located in different Statistical Sub-Divisions of the Northern Statistical Division (SD). Narrabri is located in the North Central Plain SSD while Gunnedah is located in the Northern Slopes (ex Tamworth SSD). Both these SSDs have been experiencing population decline despite the overall Northern SD experiencing population growth since 2005 (ABS 3218.0). Both Narrabri and Gunnedah SLAs have also been experiencing population decline. Nevertheless, there has been a slight increase in population in the last couple of years at both the SSD and SLA levels (ABS 3218.0). Population projections vary, but the Namoi Region State of the Environment Report (Namoi CMA 2009) projects continued decline in population in both Gunnedah and Narrabri SLAs down to 10,530 and 11,900 respectively by 2032.

Figure 1 – Gunnedah SLA and Narrabri SLA Population Trends



4.3 Existing Agricultural and Mining Production

The Gunnedah and Narrabri SLAs have a combined land area of 1.2M ha, of which 68% is agricultural land. 5.6% of this agricultural land is irrigated with annual irrigation volumes of around 323,173ML. The total value of agricultural production is estimated at $386M with employment of 2,006 (ABS 2010a, ABS 2010b).

Extractive industries in Gunnedah and Narrabri are less than 1% of the land area (Edge Land Planning 2007; Edge Land Planning 2009). Despite being a small fraction of the footprint of agriculture saleable coal output in 2007/08 is estimated to have a value of around $400M [3] which is greater than all agricultural production.

[3] Assuming a market coal price of $100/t.

Table 2 – Existing Agricultural Land Use and Value of Production in Gunnedah and Narrabri SLAs

	Units	Gunnedah SLA	Narrabri SLA	Total
Area				
Land area	ha '000	499	1,303	1,802
Area of agricultural land	ha '000	434	791	1,225
Irrigation				
Area irrigated	ha '000	18	51	69
Irrigation volume applied	ML	62,907	260,266	323,173
Other agricultural uses	ML	2,068	4,355	6,423
Total water use	ML	64,974	264,621	329,595
Area irrigated as proportion of agricultural land	%	4.1	6.4	5.6
Value				
Gross value of crops	$m	95	215	310
Gross value of livestock slaughterings	$m	29	41	71
Gross value of livestock products	$m	1	4	5
Total gross value of agricultural production	**$m**	**126**	**261**	**386**
Agriculture employment	No.	778	1,228	2,006
Coal Mining				
Coal Saleable Production (2007/2008)	MT			4.03
Gross value of coal production	$m			403
Mining employment	No.			375

Source: ABS 2010a, ABS 2010b, NSW DPI (2009).

4.4 Values and Regional Economic Impacts of Maules Creek Project and the Agricultural Land and Water Inputs

The Maules Creek Project has a land footprint of approximately 3,550 ha. A total of 60% of this land area is class 5 agricultural land, which is predominantly part of the Leard State Forest. The agricultural suitability of land within the Project Boundary is given in Table 3. Currently agricultural land uses of the subject land outside of the Leard State Forest include beef grazing and some dryland wheat. Assuming that the NSW DPI (2010a, 2010b) farm budget for dryland wheat (winter crop) and grain sorghum (summer crop) applies to Class 1 and Class 2 land and the NSW DPI (2010c) farm budget beef cattle (grow out steers 240kg - 420kg) applies to the Class 3 and Class 4 land, the potential total value of agricultural production from the agricultural land within the Project Boundary is $1.5M pa.[4]

[4] This is a rough estimate based on general agricultural information rather than site specific information. It should also be noted that the prices assumed in the DPI gross margin budgets were correct at the time but world market prices are volatile making estimates of future pricing difficult.

Table 3 – Agricultural Land Suitability and Potential Production Values of Land Impacted by the Project

Land Class	Ha	%	Assumed use	Output /ha	GM/ha	Total output	Total GM
Class 1	191	5%	Dryland wheat	$1,458	$621	$278,542	$118,616
Class 2	147	4%	Dryland wheat	$1,458	$621	$213,646	$90,980
Class 3	514	14%	Grazing	$889	$204	$457,113	$104,995
Class 4	583	16%	Grazing	$889	$205	$518,032	$119,570
Class 5	2,116	60%	Na				
Total	**3,550**	**100%**				**$1,467,332**	**$434,161**

As well as using the agricultural lands identified in Table 3, Aston Resources holds a water allocation licence of 3,000 units (equivalent to 3,000 ML at 100% allocation) of water from the Namoi River that is proposed for the Project that could have otherwise been used for irrigated cotton production. Historic cotton production using this quantity of water is summarised in Table 4 with values based on NSW DPI (2010d) farm budget for irrigated cotton.

Table 4 – Agricultural Production Values Associated with 3000ML of Water Allocated to Irrigated Cotton

Yr	Water used ML	Area irrigated (ha)	Bales	Bales /ha	Seed (t)/ha	Value of cotton output @ $500/bale	Value of seed output @ $150/t	Total Value of output	Total GM
2005	3000	350	3700	11	3.96	$1,850,000	$207,900	$2,057,900	$1,271,450
2006	3000	400	3900	10	3.60	$1,950,000	$216,000	$2,166,000	$1,267,200
2007	3000	370	3900	11	3.96	$1,950,000	$219,780	$2,169,780	$1,338,390
2008	3000	310	3900	13	4.68	$1,950,000	$217,620	$2,167,620	$1,471,050
2009	3000	360	3900	11	3.96	$1,950,000	$213,840	$2,163,840	$1,354,920
Average	**3000**	**358**	**3860**	**11**	**4.03**	**$1,930,000**	**$215,028**	**$2,145,028**	**$1,340,602**

The regional flow-on effects of the above levels of annual production from the agricultural lands and 3000ML of water allocated to irrigated cotton were estimated from the sectors in the Gunnedah/Narrabri regional input-output table within which production is located i.e. cotton growing is included in the *other agriculture sector*, wheat production is included in *grains sector* and beef enterprises in the *beef sector.*

The following table summarises the annual regional economic impacts associated with the use of Class 1 to Class 4 agricultural land impacted by the mine for agriculture instead of mining and the use of the 3000ML of water for cotton production instead of mining and the Project.

Table 5 – Regional Economic Impacts of the Project and Displaced Agriculture

	Water	Agriculture Land	Project
Annual water usage (ML)	3,000		3,000
Area (ha)	358	1,434*	3,550
Production type	Cotton	Dryland Wheat and Beef Cattle Grazing	Coal
Production (t) or bales (b))	3860 b	See budget information	13 Mtpa
Direct output value	$2.1M	$1.5M	$1.7B
Direct income	$0.4M	$0.4M	$32M
Direct Employment	12	9	398
Direct and indirect output value	$3.1M	$2.1M	$1.9B
Direct and indirect income	$0.7M	$0.6M	$54M
Direct and indirect employment	16	12	753

*Class 1 to 4 agricultural land

The Project is estimated to provide considerable stimulus to the regional economy of Gunnedah and Narrabri SLAs that is far in excess of the regional economic impacts of using the impacted Class 1 to Class 4 land for agriculture or using the water for cotton production.

The direct annual output of the Project at 13 Mtpa of ROM production (10.8 Mtpa of product coal) is estimated at $1.7B. This is over four times the annual value of all agriculture production in both the Gunnedah and Narrabri SLAs in 2006 and 450 times the agricultural production from the land and water entitlements consumed by the Project. Employment provided by the Project is estimated at 27 times that provided by continued agricultural use of the land and water.

This stimulus provided by the Project will continue for approximately 21 years should the approval being sought be granted. However, there are additional coal resources available that could lead to the extension of mining activity further into the future.

4.4 Economic Efficiency of Using Land and Water Resources for Coal Mining Instead of Agriculture

A BCA included estimation of the present value of production costs and benefits of the Project over a 21-year period. The present value of net production benefits of the Project are estimated at $8.7B, including an allowance for the opportunity costs of the agricultural land and water entitlements. In contrast, the present value of future agricultural use of the land, in perpetuity, is estimated at $5.8M and the present value of future agricultural use of the water, in perpetuity, is estimated at $19.2M. The water entitlement itself is estimated to have a present value $6.9M based on the Australian government's purchase of water from the Namoi River.

The net production benefits of the Project are therefore 344 times those of continued and perpetual agricultural production and use of water. Excluding consideration of externalities the Project is considered to be significantly more efficient than continued agricultural production.

Table 6 – Net Production Benefits of Different Land Uses ($M)

	Cotton	Agriculture (Wheat and Beef)	Project
Annual net production benefits	$1.3	$0.4	$969
Net Present Value	$19.2	$6.2	$8,728

*Discounting is at 7% with the Project limited to a life of 21 years and assumption of no production from the land post mining. Agricultural production is assumed to be in perpetuity.

There are a number of potential negative externalities associated with the Project valued at in the order of $303M. Positive employment externalities of the Project are estimated at $194M. Including all externalities the Project is estimated to have net benefits to society of $8.6B which is significantly more efficient than continued agricultural production.

5.0 CONCLUSION

In the case study area:

- The population of Gunnedah SLA and Narrabri SLA are declining and expected to continue to decline.
- Extractive industries comprise less than 1% of the land area while agriculture comprise 68% of the land area;
- The output value of existing coal production is greater than all agricultural production in the region;
- The annual output value of the Maules Creek Project is over four times the annual output value of all agriculture production in the region;
- Direct and indirect employment provided by the Project is 27 times that provided by continued agricultural use of the land and water;
- The net production benefits of the Project are 344 times those of continued agricultural production and use of water;
- Incorporating the value of externality impacts, the Project is estimated to have net benefits of $8.6B.

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