

# **Dartbrook Modification 7 Economic Impact Assessment**

*Prepared for*

**Australian Pacific Coal**

*By*



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## EXECUTIVE SUMMARY

AQC Dartbrook Management Pty Limited (AQC) is the proprietor of the Dartbrook Mine, located in the Upper Hunter Valley of NSW. AQC is a wholly owned subsidiary of Australian Pacific Coal Limited. Dartbrook Mine is managed in accordance with Development Consent DA 231-7-2000 granted under the *Environmental Planning and Assessment Act 1979* (EP&A Act). DA 231-7-2000 allows for longwall mining operations to be carried out until 5 December 2022. Dartbrook Mine has been under care and maintenance since December 2006.

AQC is seeking to modify DA 231-7-2000 to facilitate further mining operations at Dartbrook Mine. This modification application will be made under Section 75W of the EP&A Act.

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

- its economic efficiency (i.e. consideration of the economic costs and benefits of the Modification); and
- its effects on the local economy.

A cost benefit analysis of the Modification indicated that it would have net production benefits to Australia of \$187M and net production benefits to NSW of \$82M. Provided the residual environmental, social and cultural impacts of the Modification that accrue to Australia are considered to be valued at less than \$187M, or those that accrue to NSW are considered to be valued at less than \$82M, the Modification 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 cost of mitigation and monitoring measures as well as the opportunity cost of land were included as direct costs to AQC. The main quantifiable environmental impacts of the Modification, which have not already been incorporated into the estimate of net production benefits, relate to the opportunity cost of Water Access Licences (WALs) and greenhouse gas (GHG) emissions. The opportunity cost of WALs are estimated at \$0.1M, while GHG impacts to Australia and NSW are estimated at \$0.2M and \$0.1M, respectively, considerably less than the estimated net production benefits of the Modification. There are also indirect benefits of the Modification to workers and suppliers.

Overall, the Modification is estimated to have net social benefits to Australia and NSW of \$236M and \$130M, respectively, and hence is desirable and justified from an Australian and NSW economic efficiency perspective.

While the main environmental, cultural and social impacts have been quantified and included in the Modification CBA, any other residual environmental, cultural or social impacts that remain unquantified would need to be valued at greater than \$236M and \$130M for the Modification to be questionable from an Australian and NSW economic efficiency perspective, respectively.

The local economy, comprises Singleton, Muswellbrook and Upper Hunter Shire LGAs. The Modification will provide the following incremental direct annual effects to the local economy:

### *Construction*

- \$9.5M in output;
- \$3.1M in value-added;

- \$3.1M in wages of which \$0.6M will accrue to the local labour force;
- 26 jobs (in addition to the existing 11 care and maintenance jobs).

#### *Operation*

- \$89M to \$95M in output;
- \$52M to \$54M in value-added
- \$11M to \$12M in wages of which \$8M to \$9M will accrue to the local labour force;
- 88 to 99 jobs (99 new mine operation jobs less 11 care and maintenance jobs in the first 5 years of operations).

The incremental expenditure by employees and non-labour expenditure that is captured by the local area will provide additional flow-on economic activity to the local economy.

## 1 INTRODUCTION

AQC Dartbrook Management Pty Limited (AQC) is the proprietor of the Dartbrook Mine, located in the Upper Hunter Valley of NSW. AQC is a wholly owned subsidiary of Australian Pacific Coal Limited. Dartbrook Mine is managed in accordance with Development Consent DA 231-7-2000 granted under the *Environmental Planning and Assessment Act 1979* (EP&A Act). DA 231-7-2000 allows for longwall mining operations to be carried out until 5 December 2022. Dartbrook Mine has been under care and maintenance since 2006.

AQC is seeking to modify DA 231-7-2000 to facilitate further mining operations at Dartbrook Mine. This modification application will be made under Section 75W of the EP&A Act.

This Economic Impact Assessment has been carried out in accordance with:

- the Department of Planning and Environment's Letter of 6 March 2018 that requires the Environmental Assessment (EA) to include a consideration of economic impacts, including an estimate of associated capital costs and job creation;
- Clause 7(1)(f) of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* which requires environmental impact statements to provide "the reasons justifying the carrying out of the development, activity or infrastructure in the manner proposed, having regard to biophysical, economic and social considerations..." Note to Clause 7 (1) (f) states that "A cost benefit analysis may be submitted or referred to in the reasons justifying the carrying out of the development, activity or infrastructure."
- Section 4.15 of the EP&A Act which requires the following two matters to be taken into consideration by the consent authority in determining a development application:
  - the public interest (taken as the collective public interest of households in NSW); and
  - the likely impacts of the development, including environmental impacts on both the natural and built environments, and social and **economic impacts in the locality**.
- the following standards, guidelines and policies:
  - NSW Government (2015) *Guideline for the economic assessment of mining and coal seam gas proposals*; and
  - NSW Treasury (2017) *NSW Government Guide to Cost-Benefit Analysis*.

To meet the above requirements two types of analysis are needed:

- a cost benefit analysis (CBA) which is the primary way that economists evaluate the net benefits of projects and policies, provide economic justification for a project and address the public interest;
- a local effects analysis (LEA) to assess the impacts of the Modification in the locality, specifically:
  - effects relating to local employment;
  - effects relating to non-labour project expenditure; and
  - environmental and social impacts on the local community.

Economic analysis tools such as CBA and LEA are not mechanised decision-making tools, but rather a means of analysis that provides useful information for decision-makers to consider alongside the performance of a project in meeting other government goals and objectives.

## **2 COST BENEFIT ANALYSIS**

### **2.1 Introduction**

CBA of the Modification involves the following key steps:

- identification of the “with” and “without” Modification scenarios;
- 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;
- consideration of non-quantified benefits and costs; and
- consideration of the distribution of costs and benefits.

What follows is a CBA of the Modification based on the production schedule proposed by AQC, and financial, technical and environmental advice provided by AQC and its specialist consultants. An explanation of CBA is provided in Attachment 1.

### **2.2 Identification of the “With” And “Without” Modification Scenarios**

Identification of the “with” or “without” Modification scenario is required in order to facilitate the identification and measurement of the incremental economic benefits and costs of the Modification.

While the existing development consent (DA 231-7-2000) allows for longwall mining operations in the Wynn, Kayuga, Mt Arthur and Piercefield coal seams to be carried out until 5 December 2022, with an approved maximum production rate of 6 Mtpa the Dartbrook Mine has been under care and maintenance since December 2006. This is expected to continue “without” the Modification with site decommissioning and rehabilitation in 2022.

In comparison to the existing development approval, the Modification would involve:

- Mining of the Kayuga seam using bord and pillar mining methods as an alternative to the approved longwall panels. Bord and pillar mining involves only first workings, which will not result in measurable subsidence. The proposed bord and pillar workings will be located within the Approved Kayuga Seam Mining Area. That is, the Modification will not increase the footprint of mining operations at Dartbrook Mine;
- The extraction of up to 10 Mt of Run of Mine (ROM) coal at an average production rate of 1 Mtpa. The maximum production rate that may be achieved in a single year is 1.5 Mtpa.
- Providing an alternate coal clearance system for transferring ROM coal to the coal handling infrastructure at the East Site. DA 231-7-2000 allows for ROM coal to be transferred from the mine workings to the East Site via the Hunter Tunnel. The Hunter Tunnel is an underground roadway that passes beneath the Hunter River and New England Highway. The conveyors in the Hunter Tunnel were removed by the previous owners of Dartbrook Mine during the care and maintenance phase. As such, AQC has developed an alternative coal clearance system for the Modification. ROM coal will be brought to the surface at the Kayuga Entry. Haul trucks will then transport ROM coal from the Kayuga Entry to a new shaft site located directly above the Hunter Tunnel. The new shaft site will include a downcast shaft for delivering ROM coal to the Hunter Tunnel. The eastern portion of the Hunter Tunnel will be reinstated to convey ROM coal from the downcast shaft to the East Site; and
- Extending the period of approval by 5 years.

## 2.3 Identification of Benefits and Costs

Relative to the base case, or without Modification scenario, the Modification may have the potential incremental economic benefits and costs shown in Table 2.1.

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 wellbeing 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.

**Table 2.1**  
**Potential Incremental Economic Benefits and Costs of the Modification**

| Category      | Costs                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Benefits                                                                                                                                                                                                                                                                    |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Production    | <ul style="list-style-type: none"> <li>• Opportunity cost of land</li> <li>• Opportunity cost of capital</li> <li>• Development costs</li> <li>• Operating costs, including administration, mining, ore processing, transportation, mitigation measures and offsets (but excluding royalties)</li> <li>• Decommissioning costs at cessation of the Modification</li> </ul>                                                                                                                                                                       | <ul style="list-style-type: none"> <li>• Avoided care and maintenance costs</li> <li>• Avoided decommissioning and rehabilitation costs in 2022</li> <li>• Sale value of coal</li> <li>• Residual value of capital and land at the cessation of the Modification</li> </ul> |
| Externalities | <ul style="list-style-type: none"> <li>• Greenhouse gas generation</li> <li>• Operational noise impacts</li> <li>• Road transport impacts</li> <li>• Air quality impacts</li> <li>• Groundwater impacts</li> <li>• Surface water impacts</li> <li>• Subsidence impacts</li> <li>• Biodiversity impacts</li> <li>• Aboriginal heritage impacts</li> <li>• Historic heritage impacts</li> <li>• Visual impacts</li> <li>• Agriculture impacts</li> <li>• Net public infrastructure costs</li> <li>• Loss of surplus to other industries</li> </ul> | <ul style="list-style-type: none"> <li>• Wage benefits to employment</li> <li>• Economic benefits to existing landholders</li> <li>• Economic benefits to suppliers</li> </ul>                                                                                              |

Framed in another but equivalent way the potential incremental costs and benefits of the Modification are as per Table 2.2



**Table 2.2**  
**Alternative Frame of Potential Economic Benefits and Costs of the Modification**

| <b>Costs</b>                                                    | <b>Benefits</b>                                                                                                                                                   |
|-----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Direct costs</b>                                             | <b>Direct benefits</b>                                                                                                                                            |
| Nil                                                             | Net production benefits <ul style="list-style-type: none"> <li>• <i>Royalties</i></li> <li>• <i>Company tax</i></li> <li>• <i>Net producer surplus</i></li> </ul> |
| <b>Indirect costs</b>                                           | <b>Indirect benefits</b>                                                                                                                                          |
| Net environmental, social, cultural and transport related costs | Wage benefits to employment                                                                                                                                       |
| Net public infrastructure costs                                 | Economic benefits to existing landholders                                                                                                                         |
| Loss of surplus to other industries                             | Economic benefits to suppliers                                                                                                                                    |

## 2.4 Quantification/Valuation of Benefits and Costs

Consistent with NSW Government (2015) and NSW Treasury (2017), the CBA was undertaken in 2018 real values, with discounting at 7 percent (%) and sensitivity testing at 4% and 10%.

The analysis period is 10 years, coinciding with the proposed life of the Modification. Any impacts that occur after this period are included in the final year of the analysis as a terminal value.

Where competitive market prices are available, they have generally been used as an indicator of economic values. Environmental, cultural and social impacts have initially been left unquantified and interpreted using the threshold value method.<sup>1</sup>

An attempt has also been made to estimate environmental, cultural and social impacts using market data and benefit transfer<sup>2</sup> and incorporate them into an estimate of the net social benefit of the Modification. This estimated net social benefit of the Modification provides another threshold value that any residual or non-quantified economic costs would need to exceed to make the Modification questionable from an economic efficiency perspective.

### 2.6.1 Production Costs and Benefits<sup>3</sup>

#### **Economic Costs**

##### *Opportunity Cost of Land and Capital*

Under the base case, the Dartbrook Mine would be decommissioned in 2022 and residual land and capital value would be realised.

With the Modification the Mine life would be extended to 2027 and hence there would be an opportunity cost of continuing to use the land and capital equipment at Dartbrook Mine. This opportunity cost is estimated at \$25M for land and \$10M for capital equipment.

<sup>1</sup>The threshold value method uses the value of quantified net production benefits as the amount that unquantified environmental, social and cultural costs would need to exceed to make a project questionable from an economic efficiency perspective.

<sup>2</sup>Benefit transfer refers to transferring economic values that have been determined for other study sites.

<sup>3</sup>All values reported in this section are undiscounted unless specified.

### *Capital Cost of the Modification*

The Modification would require additional capital expenditure primarily associated with altering the coal clearance system for transferring ROM coal to the coal handling infrastructure at the East Site. This cost is estimated at \$15M.

### *Annual Operating Costs of the Modification*

Incremental operating costs are associated with mining and handling to 2027. Incremental operating costs include coal mining using bord and pillar method, handling, rail and port costs. The incremental operating costs of the Modification (excluding royalties) are in the order of \$65M per annum.

While royalties are a cost to AQC they are part of the overall net production benefit of the mining activity that is redistributed by government. Royalties are therefore not included in the calculation of the resource costs of operating the Modification. Nevertheless, it should be noted that the Modification would generate total royalties in the order of \$38M present value, at 7% discount rate (\$56M in total).

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.

### *Decommissioning and Rehabilitation Costs*

With the Modification decommissioning and rehabilitation of the surface infrastructure would occur in 2027 at an estimated cost of \$9M.

## **Economic Benefits**

### *Avoided Costs of Care and Maintenance*

Without the Modification the Dartbrook Mine will continue in Care and Maintenance until 2022 at an estimated annual cost of \$5.5M. With the Modification these costs are avoided, as they form part of operating costs associated with mining and handling the coal.

### *Avoided Decommissioning and Rehabilitation Costs*

Without the Modification, in 2022 the existing consent will expire and the Dartbrook Mine would be decommissioned and rehabilitated, at an estimated cost of \$9M. With the Modification these costs in 2022 are not incurred.

### *Revenues*

Incremental revenues associated with the expected production profile are estimated at approximately \$95M per annum (on average) over the nine year operational phase. This is based on an assumed realised coal price of United States Dollar (USD) 73/t and an Australian Dollar (AUD)/USD exchange rate of 0.77. There is obviously considerable uncertainty around future coal prices in USD and the AUD/USD exchange rate and hence the value of incremental revenue has been subjected to sensitivity analysis (Section 2.7).

### *Residual Value at End of the Evaluation Period*

At the end of the Modification, the land and capital equipment required for the Modification would have some residual value that could be realised by sale. This is estimated at \$25M for land and \$10M for capital equipment.

## **2.6.2 External Costs and Benefits**

### **Greenhouse Gases**

Scope 1 and 2 greenhouse gas (GHG) emissions may occur through fugitive emissions, electricity use and fuel combustion. The potential GHG emissions associated with the Modification were estimated based on previously reported GHG emissions at 369,000 t CO<sub>2</sub>-e/year. Over the 10 year duration of the Modification, the total GHG emissions are estimated at 3.69 Mt CO<sub>2</sub>-e.

To place an economic value on CO<sub>2</sub>-e emissions, a shadow price of CO<sub>2</sub>-e is required. Three shadow prices were initially used, the Forecast European Union Emission Allowance Units price, the Australian Treasury Clean Energy Future Policy Scenario and the US Environmental Protection Agency (EPA) Social Cost of Carbon. However, these represent the global damage cost of carbon (i.e. the cost of carbon emissions to the population of the whole world).

Consistent with the Guidelines (NSW Government 2015), the focus of this CBA of mining projects is on costs and benefits to the population of NSW. In the absence of any studies that have focused on the social damage cost of carbon emissions to NSW residents, some means of apportioning global damage costs borne by Australians is required. For the purpose of the Economic Impact Assessment, this has been undertaken using Australia's share of the global population (around 0.3%) and NSW's share of the Australian population (32%).

On this basis, the present value of the cost of greenhouse gas emissions from the Modification to Australia and NSW is estimated at between \$0.1M and \$0.4M, and less than \$0.1M (present value), respectively.

### **Operational Noise**

Noise modelling was undertaken to assess the potential acoustic impacts of all operational activities proposed by the Modification, including the use of existing and approved infrastructure. The modelling predicts that the Modification will comply with the intrusive noise criteria under the Development Consent (DA 231-7-2000) at all private residence, except for five residences in Aberdeen. These five residences are predicted to experience exceedances of 1 dBA during the night period only. The VLAMP states that exceedances of 0-2 dBA are not discernible to the average listener, and therefore do not give rise to any acquisition or mitigation requirements.

The Modification is predicted to comply with the criteria for construction noise, sleep disturbance and road traffic noise.

Consequently, there are no material economic impacts for inclusion in the analysis.

### **Road Transport**

The Modification will provide approximately 26 jobs (in addition to the existing 11 care and maintenance jobs) during the short-term construction phase. Traffic movements associated with the incremental construction workforce will be negligible compared to background traffic volumes.

The operational workforce for the Modification is expected to be approximately 99 personnel, 88 to 99 more than employed under the base case. This is within the approved operational workforce of 292 personnel. Dartbrook Mine personnel will primarily access the site via the New England Highway and Western Access Road. Traffic movements associated with the incremental operational personnel will be negligible compared to the background traffic volumes on the New England Highway. The Western Access Road is a private road owned by AQC and is primarily used for access to Dartbrook Mine. Therefore, the numbers of vehicles utilising the New England Highway / Western Access Road intersection will be relatively low, and the performance of the intersection is expected to be good. Hence, no economic effects have been identified in the CBA with respect to road transport movements.

### **Air Quality**

Potential air quality impacts may occur at nearby residences as a result of dust generation at the Modification from activities such as coal handling, emissions from stockpiles and haul roads. The assessment of potential air quality impacts for the Modification indicates that it is predicted to comply with all air quality criteria for the "Modification only" scenario. However, when the cumulative impacts are taken into account, the Modification will result in exceedances of the following criteria at some private residences:

- Cumulative annual average  $PM_{2.5}$  - this criteria of  $8 \mu g/m^3$  may be exceeded at three residences. However, the contribution of the Modification is minor ( $0.4$  to  $0.7 \mu g/m^3$ ); and
- Cumulative 24h average  $PM_{10}$  - 15 residences may experience an additional day where the cumulative 24hr average  $PM_{10}$  criterion of  $50 \mu g/m^3$  is exceeded. It should be noted that on this worst case day, the background concentration is  $48.7 \mu g/m^3$  (due to a fire in the locality). If this day is disregarded, due to the influence of natural events, there are no predicted exceedances of the 24hr average  $PM_{10}$  criterion at these 15 residences. One other residence is predicted to experience two additional days exceeding the criterion; however, this residence is currently within the zone of management for Mount Pleasant Mine.

The predicted exceedances do not give rise to any acquisition liabilities under the Voluntary Land Acquisition and Mitigation Policy (VLAMP). Air quality impacts will be managed through the implementation of best practice dust controls including:

- Use of water sprays on coal stockpiles, conveyor transfers and unsealed roads;
- Covering of haul truck loads;
- Use of street sweeper on sealed roads; and
- Enclosure of coal handling infrastructure.

Consequently, in economic terms the residual impacts after management are not likely to be material.

### **Groundwater**

Groundwater monitoring data indicates that the Hunter Tunnel typically receives approximately 156 ML/year of inflows. This component of the groundwater inflow is primarily sourced from the Hunter River alluvial aquifer, which is the subject of the Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009. AQC hold sufficient Water Access Licences (WALs) to account for the taking of water from the Hunter River alluvial aquifer. The magnitude of inflow to the Hunter Tunnel is not affected by the Modification. With or without the Modification this inflow will occur and AQC will be required to continue to hold sufficient WALs. Consequently, there are no incremental impacts of the Modification with respect to alluvial groundwater.

The Modification is predicted to result in less than 10 ML/year of seepage into the proposed Kayuga Seam mine workings. This represents the taking of water from the Permian aquifer, which is the subject of the Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources 2009. AQC holds sufficient WALs to account for the taking of water from the Permian aquifer. There is an opportunity cost associated with holding these WALs which is assumed to be \$800 per ML, based on market trades in similar deep groundwater aquifers in NSW.<sup>4</sup>

### ***Surface Water***

Mine water and sediment laden runoff will be reused wherever possible to satisfy operational water demands. The Modification is expected to require approximately 0.5 ML/day, predominantly for dust suppression. There is a large volume of water stored in the Wynn Seam goaf that can be used to satisfy this requirement. Accordingly, the Modification is not expected to require water from external sources (e.g. the Hunter River).

If inflows to the mine water balance exceed the operational water requirement, the excess water can either be stored in the Wynn Seam goaf or passively released from site (using the Evaporation Ponds). The Modification is not expected to result in any discharges from the site. Consequently, there are no material economic impacts for inclusion in the CBA.

### ***Subsidence***

The proposed bord and pillar mine workings will be designed to minimise subsidence to levels that are imperceptible for all practical purposes. Consequently, there will be no material surface infrastructure or other impacts for inclusion in the CBA.

### ***Biodiversity***

The additional surface infrastructure proposed by the Modification will be located within an area of agricultural grassland. The Modification may result in disturbance to approximately 2.28 ha of exotic grassland. The Modification will not involve any clearing of native vegetation and therefore does not require a biodiversity offset strategy. Consequently, there are no material economic impacts for inclusion in the CBA.

### ***Aboriginal Heritage***

There are no Aboriginal sites located within the Infrastructure Study Area. Therefore, the construction of surface infrastructure will not result in any impacts to Aboriginal sites and there are no material economic impacts for inclusion in the CBA.

### ***Historical Heritage***

There are no Historic heritage sites that will be impacted by the Modification and hence no material economic impacts for inclusion in the CBA.

### ***Visual Impacts***

The new shaft site for the Modification will be located a short distance to the west of the New England Highway. The new shaft site will be constructed on land owned by AQC, and there are no private residences in the vicinity. The New England Highway is the only public area from which the new shaft

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<sup>4</sup> No market trade information was available for the *North Coast Fractured and Porous Rock Groundwater Sources*.

site may be visible. The infrastructure will be partially shielded by tree screens established along the New England Highway; however, limited views will be available. Given that motorists will be travelling along the New England Highway at high speeds (up to 100 km/h), views of the new shaft site will be very limited in duration. Furthermore, proposed shaft and ROM coal bin will be enclosed within a green colourbond shed, similar to many agricultural structures in the region (such as the dairy shed 500m west). Therefore, the visual effect (i.e. contrast with the surrounding landscape) will be low and there are no material economic impacts for inclusion in the CBA.

### ***Agriculture***

The new shaft site will be located within the Garoka Dairy, which is operated by a licensee of AQC. The land that will be disturbed for construction of the shaft site (approximately 2.28 ha) will not be available for agricultural purposes during the period of the operation of the downcast shaft. This is negligible compared to the total operational area of Garoka Dairy (approximately 350 ha) and the overall output of the dairy will not be affected. Consequently, there are no material economic impacts for inclusion in the CBA.

### ***Net Public Infrastructure Impacts***

All additional infrastructure requirements for the Modification relate directly to the mining operation and will be funded by AQC. Private roads will be used to haul coal to the rail loadout and provide employees access to the mine from arterial roads. Potential impacts of the Modification on infrastructure include the use of utilities. This will be paid for by user fees which are included in the Modification operating costs. Consequently, no net infrastructure costs to government are envisaged as a result of the Modification.

### ***Loss of Surplus to Other Industries***

No loss of surplus to other industries will occur as a result of the Modification, apart from a loss of producer surplus to AQC from the use of its land for mining purposes rather than for alternative uses such as agricultural production. This economic cost has already been discussed above and included in the CBA under opportunity cost of land.

### ***Market Benefits to Workers***

Employment at Dartbrook under the base case (care and maintenance) is estimated at 11 people until 2022. With the Modification there will be an initial construction workforce of 26, followed by an operational workforce of 99. Focusing on operational workforce, there will be an initial incremental increase in workforce at the site of 88. Post 2021 there will be an incremental operational workforce of 99.

In standard CBA, the wages associated with employment are considered an economic cost of production with this cost included in the calculation of net production benefits (producer surplus). Where labour resources used in a project would otherwise be employed at a lower wage or would be unemployed, a shadow price of labour is included in the estimation of producer surplus rather than the actual wage (Boardman et al. 2005). The shadow price of labour is lower than the actual wage and has the effect of increasing the magnitude of the producer surplus benefit of a project.

Estimation of this economic value of employment from the Modification requires a number of assumptions such as what proportion of the Modification workforce that would otherwise be unemployed or underemployed, the duration of time that this would occur and the opportunity cost of labour in an unemployed or underemployed state (i.e. the reservation wage rate).

Some indication of the potential magnitude of these benefits can be gained by making a number of assumptions. Following the approach of Streeting and Hamilton (1991), if it were assumed that 50% of the initial incremental direct operational workforce of the Modification<sup>5</sup> (44 out of a total of 88 incremental jobs) would otherwise be unemployed for three years and that the reservation wage for these people was \$47,500<sup>6</sup> compared to a mining wage of \$120,000<sup>7</sup>, then the market employment benefit in terms of income would be \$7.8M present value, at a 7% discount rate. Values at alternate discount rates and percentages of unemployed are provided in Table 2.3.

**Table 2.3**  
**Potential Economic Benefits to Workers Under Alternative Assumptions (\$M)**

|                             | Discount Rate |             |             |
|-----------------------------|---------------|-------------|-------------|
| % Unemployed for 3 years    | 4%            | 7%          | 10%         |
| 50%                         | 8.5           | 7.8         | 7.2         |
| 25%                         | 4.2           | 3.9         | 3.6         |
| 75%                         | 12.7          | 11.7        | 10.8        |
| <b>Wage premium benefit</b> | <b>34.2</b>   | <b>29.0</b> | <b>24.8</b> |

If alternatively, the economic benefit to workers is taken as the difference between the average wage in the region<sup>8</sup> \$68,953 (ABS 2016) and the wage in the Modification (i.e. \$120,000 pa) over the life of the Modification, then the potential economic benefit to workers would be \$29.0M, present value at 7% discount rate. These calculations exclude any consideration of search and retraining costs, scarring, stigma and physical and mental health effects of unemployment (Haveman and Weimer 2015). The more conservative approach has been included in the results.

### ***Economic Benefits to Existing Landholders***

Payments by the proponent for the purchase of land, that exceed the opportunity cost of the land, are an economic benefit to the landholder. However, no additional land needs to be purchased for the Modification and hence no additional benefits accrue to landholders. While historic land purchase costs may have been in excess of opportunity costs these can be considered "sunk" and do not vary with or without the Modification.

### ***Economic Benefits to Suppliers***

The focus of CBA is generally on primary costs and benefits i.e. first round impacts. Secondary net benefits that accrue to firms that sell to or buy from a project are ignored. This is because in a competitive market, all resources are assumed to be fully employed, and so increases in the production of goods and services required as inputs to the project will withdraw labour and raw materials from other industries. The additional net benefits (surpluses) to suppliers to the Modification will be offset by decreases in net benefits in other industries and so there is no net secondary benefit to the economy as a whole.

<sup>5</sup> All jobs sourced from NSW.

<sup>6</sup> As estimated by the unemployment benefits plus income tax payable on a mining wage, following the reservation wage rate approach used by Streeting and Hamilton (1991).

<sup>7</sup> Based on National IO Table 2014-15 and ABS census data.

<sup>8</sup> ABS does not publish data on average wages by industry sector and therefore it is not possible to estimate the average wage of those not in the mining or quarrying industry.

However, where the economy is not at full employment some benefits to suppliers may accrue. It is estimated that the Modification will result in average annual additional non-labour operating costs of \$50M. Based on ratios for the Coal Mining Sector in the National Input-Output table and NSW Input-Output table, 85% and 66% of non-labour coal mining expenditure is captured within the National and NSW economies, respectively. Assuming a ratio of producer surplus to output of 20%<sup>9</sup> for industries supplying non-labour inputs, the indirect economic benefits to Australian and NSW suppliers would be in the order of \$52M and \$41M present value at 7% discount rate, respectively.

## **2.8 CONSOLIDATION OF VALUE ESTIMATES**

### **2.8.1 National Results**

The present value of costs and benefits, using a 7% discount rate, is provided in Table 2.4. 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 Modification is estimated to have total net production benefits of \$187M (present value at 7% discount rate). AQC is estimated to be 90% Australian owned. Hence, the components of the net production benefits that accrue to Australia are royalties, company tax (assuming a 30% company tax rate) and 90% of the residual net production benefits. On this basis, the net production benefits that accrue to Australia are estimated at \$176M (present value at 7% discount rate).

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 Modification, after mitigation, may be assessed. This threshold value is the opportunity cost to society of not proceeding with the Modification. The threshold value indicates the price that the community must value any residual environmental impacts of the Modification (be willing to pay) to justify in economic efficiency terms the no development option.

For the Modification to be questionable from an economic efficiency perspective, all incremental residual environmental impacts from the Modification, that impact Australia<sup>10</sup>, would need to be valued by the community at greater than the estimate of the Australian net production benefits i.e. greater than \$176M. This is equivalent to each household in the Region (i.e. Singleton, Muswellbrook and Upper Hunter LGAs) valuing residual environmental impacts at \$8,455. The equivalent figure for NSW and Australian households is \$58 and \$19, respectively.

Instead of leaving the analysis as a threshold value exercise, an attempt has been made to qualitatively consider and where possible quantify the main environmental, cultural and social impacts. From Section 2.4 it is evident that the main potential impacts of the Modification are internalised into the production costs of the Modification through mitigation measures, ownership of land and water allocations. Other costs not already included in the production costs of the Modification are associated with opportunity cost of WALs, greenhouse gas costs, minor cumulative air quality exceedances and visual impacts, although from Table 2.4 it is evident that these impacts to Australia are small or immaterial, considerably less than the estimated net production benefits of the Modification to Australia. There may also be wage benefits to employment and benefits to suppliers.

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<sup>9</sup> For all intermediate sectors in the NSW economy the ratio of gross operating surplus to output is 21%.

<sup>10</sup> 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.



Overall, the Modification is estimated to have net social benefits to Australia of \$236M and hence is desirable and justified from an economic efficiency perspective.

While the major environmental, cultural and social impacts have been quantified and included in the Modification CBA, any other residual environmental, cultural or social impacts that remain unquantified would need to be valued at greater than \$236M for the Modification to be questionable from an Australian economic efficiency perspective.

**Table 3.4**  
**CBA Results of the Modification (Present Values at 7% Discount Rate) - Australia**

|                                       | <b>COSTS</b>                                                      | <b>\$M*</b>                                                                         | <b>BENEFITS</b>                                          | <b>\$M*</b>  |
|---------------------------------------|-------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------------------------------------------|--------------|
| <b>Production<sup>1</sup></b>         | Opportunity cost of land                                          | \$18                                                                                | Avoided costs of care and maintenance                    | \$23         |
|                                       | Opportunity cost of capital                                       | \$7                                                                                 | Avoided decommissioning and rehabilitation costs in 2022 | \$6          |
|                                       | Capital cost                                                      | \$14                                                                                | Revenue                                                  | \$577        |
|                                       | Operating costs (ex royalties)                                    | \$394                                                                               | Residual value of land                                   | \$13         |
|                                       | Additional decommissioning costs at cessation of the Modification | \$5                                                                                 | Residual value of capital                                | \$5          |
|                                       | <b>Production Sub-total</b>                                       | <b>\$438</b>                                                                        | -                                                        | <b>\$624</b> |
|                                       | <b>Total Net Production Benefits</b>                              |                                                                                     | -                                                        | <b>\$187</b> |
|                                       | <b>Australian Net Production Benefits</b>                         |                                                                                     |                                                          | <b>\$176</b> |
| <b>Australian Externalities</b>       | Greenhouse gas emissions                                          | \$0.3                                                                               | Wage benefits to employment                              | \$8          |
|                                       | Operational noise                                                 | No material impact*                                                                 | Economic benefits to existing landholders                | \$0          |
|                                       | Road transport                                                    | No material impact*                                                                 | Economic benefits to suppliers                           | \$52         |
|                                       | Air quality                                                       | Minor cumulative exceedences                                                        |                                                          |              |
|                                       | Groundwater                                                       | \$0.01                                                                              | -                                                        | -            |
|                                       | Surface water                                                     | No material impact*                                                                 | -                                                        | -            |
|                                       | Subsidence                                                        | No material impact*                                                                 | -                                                        | -            |
|                                       | Biodiversity                                                      | No material impact*                                                                 | -                                                        | -            |
|                                       | Aboriginal heritage                                               | No material impact*                                                                 |                                                          |              |
|                                       | Historic heritage                                                 | No material impact*                                                                 | -                                                        | -            |
|                                       | Visual                                                            | Limited views of shaft site from motorists on New England Highway                   | -                                                        | -            |
|                                       | Agriculture                                                       | Disturbance of 2.28 ha of Dairy Farm owned by AQP - no impact on farm profitability | -                                                        | -            |
|                                       | Net public infrastructure costs                                   | No material impact*                                                                 |                                                          |              |
|                                       | Loss of surplus to other industries                               | No material impact*                                                                 |                                                          |              |
|                                       | <b>Externalities sub-total</b>                                    | <b>\$0.3</b>                                                                        | -                                                        | <b>\$60</b>  |
| <b>AUSTRALIAN NET SOCIAL BENEFITS</b> |                                                                   |                                                                                     |                                                          | <b>\$236</b> |

<sup>1</sup> Production costs and benefits in accordance with data provided by AQC.

\* From an aggregate economic efficiency perspective

\*\* Totals may have minor discrepancies due to rounding.

### **2.8.2 New South Wales Costs and Benefits**

The NSW Government (2015) guidelines have a particular focus on the costs and benefits to NSW. Table 2.5 identifies the costs and benefits to NSW. Impacts that have a national dimension are apportioned to NSW, as follows:

- 32% of the estimated company tax generated from the Modification is attributed to NSW based on NSW's share of the Australian population (NSW Guidelines 2015);
- 32% of the residual net producer surplus to Australia i.e. net production benefits minus company tax minus royalties, is attributed to NSW based on NSW's share of the Australian population;
- 100% of potential wages benefits are attributable to NSW based on an assumption that all incremental employment will be filled by NSW residents;
- 78% of benefits to suppliers is attributed to NSW, based on input-output analysis of the Coal Mining sector for Australia and NSW. This shows that 85% of non-labour inputs for the Australian Coal Mining sector are sourced from Australia and that 66% of the non-labour inputs for the NSW Coal Mining sector are sourced from NSW. NSW's share of the Australian benefits to suppliers is 66%/85% i.e. 78%;
- 32% of Australian greenhouse gas impacts are attributed to NSW based on NSW's share of the Australian population; and
- all other potential environmental, social and cultural impacts would accrue to NSW households. However, in accordance with Government policy and regulation these impacts are largely mitigated, compensated or offset by the proponent.

On this basis, the costs and the benefits of the Modification to NSW are summarised in Table 2.5. The estimated Net Social Benefits of the Modification to NSW are \$130M, present value at 7% discount rate. Consequently, as well as resulting in net benefits to Australia, the Modification would also result in net benefits to NSW.

Any unquantified residual impacts of the Modification to NSW after mitigation, offsetting and compensation would need to be valued at greater than \$130M, present value for the Modification to be questionable from a NSW economic efficiency perspective.

**Table 2.5**

**NSW Cost Benefit Analysis Results of the Modification (Present Values at 7% discount rate)**

| <b>COSTS</b>                        | <b>NPV</b>                                                                          | <b>BENEFITS</b>                      | <b>NPV</b>   |
|-------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------|--------------|
| <b>Direct costs</b>                 |                                                                                     | <b>Net direct benefits</b>           |              |
|                                     |                                                                                     | Net producer surplus                 | \$30         |
|                                     |                                                                                     | Royalties                            | \$38         |
|                                     |                                                                                     | Company tax                          | \$14         |
| <b>Total direct costs</b>           | -                                                                                   | <b>Total direct benefits</b>         | <b>\$82</b>  |
| <b>Indirect costs</b>               |                                                                                     | <b>Indirect benefits</b>             |              |
| Greenhouse gas emissions            | \$0.1                                                                               | Net economic benefits to workers     | \$8          |
| Operational noise                   | No material impact*                                                                 | Net economic benefits to landholders | \$0          |
| Road transport                      | No material impact*                                                                 | Net economic benefits to suppliers   | \$41         |
| Air quality                         | Minor cumulative exceedences                                                        |                                      |              |
| Groundwater                         | \$0.1                                                                               |                                      |              |
| Surface water                       | No material impact*                                                                 |                                      |              |
| Subsidence                          | No material impact*                                                                 |                                      |              |
| Biodiversity                        | No material impact*                                                                 |                                      |              |
| Aboriginal heritage                 | No material impact*                                                                 |                                      |              |
| Historic heritage                   | No material impact*                                                                 |                                      |              |
| Visual impacts                      | Limited views of shaft site from motorists on New England Highway                   |                                      |              |
| Agriculture                         | Disturbance of 2.28 ha of Dairy Farm owned by AQP - no impact on farm profitability |                                      |              |
| Net public infrastructure costs     | No material impact*                                                                 |                                      |              |
| Loss of surplus to other industries | No material impact*                                                                 |                                      |              |
| <b>Total indirect costs</b>         | <b>\$0.1</b>                                                                        | <b>Total indirect benefits</b>       | <b>\$49</b>  |
| <b>Total costs</b>                  | <b>\$0.1</b>                                                                        | <b>Total benefits</b>                | <b>\$131</b> |
|                                     |                                                                                     | <b>NSW Net social benefits</b>       | <b>\$130</b> |

\* "No material impact" does not mean that there will be no impacts but impacts are not likely to amount to more than 5% of the quantified net production benefits of the Modification.

## 2.9 Distribution of NSW Costs and Benefits

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

The costs and benefits of the Modification to NSW are potentially distributed among a range of stakeholders as identified in Table 2.6.

**Table 2.6**  
**Incidence of NSW Costs and Benefits**

| BENEFITS AND COSTS                                      | INCIDENCE OF COSTS AND BENEFITS                                                     | MAGNITUDE OF IMPACT (\$M)                                                   |
|---------------------------------------------------------|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| <b><i>Share of Net Production Benefits</i></b>          |                                                                                     |                                                                             |
| Net producer surplus                                    | AQC and its NSW shareholders                                                        | \$30                                                                        |
| Royalties                                               | NSW Government and NSW households                                                   | \$38                                                                        |
| Company tax                                             | NSW Government and NSW households                                                   | \$14                                                                        |
| <b><i>Additional benefits</i></b>                       |                                                                                     |                                                                             |
| Wage benefits to employment                             | Some of the local and NSW labour force                                              | \$8                                                                         |
| Economic benefits to existing landholders               | Local landholders who sell land required for the Modification including buffer land | \$0                                                                         |
| Economic benefits to suppliers                          | Regional and State suppliers of inputs to production                                | \$41                                                                        |
| <b><i>Environmental, social and cultural costs*</i></b> |                                                                                     |                                                                             |
| Greenhouse gas impacts                                  | Local and NSW households                                                            | \$0.1                                                                       |
| Operational noise                                       | Adjoining landholders                                                               | No material impact                                                          |
| Road transport                                          | Local residents                                                                     | No material impact                                                          |
| Air quality                                             | Adjoining landholders                                                               | Minor cumulative exceedances                                                |
| Groundwater                                             | AQC                                                                                 | Required to hold WALs \$0.01                                                |
| Surface water                                           | AQC                                                                                 | No additional WALs required                                                 |
| Subsidence                                              | AQC and adjoining landholders                                                       | No material impact                                                          |
| Biodiversity                                            | Local and NSW households                                                            | No material impacts                                                         |
| Aboriginal heritage                                     | Aboriginal people and other local and NSW households                                | No material impact                                                          |
| Historic heritage                                       | Local and NSW households                                                            | No material impact                                                          |
| Visual amenity                                          | Motorists on the New England Highway                                                | Limited views of shaft site from New England Highway                        |
| Agriculture                                             | AQC                                                                                 | Disturbance of 2.28 ha of AQC owned dairy farm - no impact on profitability |
| Net public infrastructure costs                         | NSW Government and NSW households                                                   | No material impact                                                          |
| Loss of surplus to other industries                     | Not applicable                                                                      | No material impact                                                          |

\* NSW regulations require many impacts to be borne by the proponent via mitigation, offset and compensation. Where these measures perfectly mitigate, offset or compensate then no residual impacts occur and all impacts are borne by the proponent. This table identifies who bears residual impacts where mitigation, offset and compensation is imperfect.

## 2.10 Risk and Sensitivity Analysis

The main areas of environmental risks associated with mining projects relate to:

- the financial viability of a project from unexpected downturns in prices and any consequent environmental impacts from premature cessation of operations;
- ecological risk associated with whether the biodiversity offsets will adequately compensate for the direct ecological impacts; and
- other environmental, social and cultural impact estimations and required mitigation measures.

The NSW Department of Planning and Environment has previously identified that the financial viability of projects is a risk assumed by the project owners. Nevertheless, it should be noted that it is highly unlikely that AQC would invest in the Modification if it were not financially viable. However, any risk that the Modification may commence and then cease operation for financial reasons leaving unmet rehabilitation liabilities is mitigated by the fact that AQC is required to pay a rehabilitation security deposit to the Division of Resources and Geosciences (DRG) as the holder of a mining authority under the *Mining Act 1992*. This security deposit is held by DRG to ensure that the legal obligations in relation to rehabilitation and safety of the site can be met following mine closure. If rehabilitation obligations are not met to the satisfaction of the Minister, then the security funds would be used by DRG to meet the relevant requirements.

The provision of biodiversity offsets can be associated with a number risks. However, no biodiversity values will be impacted by the Modification and no risks with regard to biodiversity and offsets arise.

There is some risk associated with the estimation of environmental, social and cultural impacts of the Modification and the level of mitigation measures proposed. However, it should be noted that impacts have generally been assessed based on the maximum annual levels of production and hence are likely to be overstated. Ongoing monitoring will ensure that appropriate mitigation measures are implemented as required.

The net present value of the Modification to NSW (presented in Table 2.5) is based on a range of assumptions around which there is some level of uncertainty. Uncertainty in a CBA 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<sup>11</sup>.

In this sensitivity analysis, the CBA results for NSW were tested for changes to the following variables at a 4%, 7% and 10% discount rate:

- opportunity cost of land;
- opportunity cost of capital;
- operating costs;
- capital costs;
- decommissioning and rehabilitation costs;
- revenue;
- residual value of land;
- residual value of capital;
- greenhouse gas costs;
- groundwater costs;
- benefits to workers; and
- benefits to suppliers.

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<sup>11</sup> Quantitative risk analysis could also potentially be undertaken. However, this requires information on the probability distributions for input variables in the analysis. This information is not available and so the sensitivity testing is limited to uncertainty analysis.

Results are reported in Tables 2.7. What this analysis indicates is that CBA is most sensitive to changes in revenue (reflecting production levels, the value of coal in USD and the USD/ AUD exchange rate) and to a lesser extent operating costs. This is because changes in revenue directly impact royalties which is the main component of net production benefits to NSW and net producer surplus. Changes in revenue also impact company tax estimates, only a component of which accrues to NSW. Changes in operating costs impact net producer surplus, company tax and net economic benefits to suppliers.

The sensitivity analysis indicated that the CBA results are not sensitive to changes in capital costs, or environmental costs that have not already been internalised into production costs, such as greenhouse gas. Since mitigation, offset and compensation costs are a small component of the capital and operating costs of the Modification, it is unlikely that large changes in these cost levels would have any significant impact on the CBA results. Benefits to suppliers is a significant benefit of the Modification and so changes do significantly impact the results.

Under all scenarios examined, the Modification has net social benefits to NSW.

**Table 2.7**  
**NSW CBA Sensitivity Testing (Present Value \$M)**

|                                                        | <b>4% Discount Rate</b> | <b>7% Discount Rate</b> | <b>10% Discount Rate</b> |
|--------------------------------------------------------|-------------------------|-------------------------|--------------------------|
| <b>CENTRAL ANALYSIS</b>                                | <b>\$153</b>            | <b>\$130</b>            | <b>\$112</b>             |
| <b>INCREASE</b>                                        |                         |                         |                          |
| Opportunity cost of land - 20%                         | \$152                   | \$129                   | \$111                    |
| Opportunity cost of capital - 20%                      | \$153                   | \$130                   | \$112                    |
| Operating costs - 20%                                  | \$138                   | \$117                   | \$101                    |
| Capital costs - 20%                                    | \$152                   | \$130                   | \$111                    |
| Decommissioning and rehabilitation costs - 20%         | \$153                   | \$130                   | \$112                    |
| Avoided costs of care and maintenance - 20%            | \$154                   | \$131                   | \$113                    |
| Avoided decommissioning and rehabilitation costs - 20% | \$154                   | \$131                   | \$112                    |
| Revenue - 30%                                          | \$223                   | \$190                   | \$163                    |
| Residual value of land - 20%                           | \$154                   | \$131                   | \$113                    |
| Residual value of capital - 20%                        | \$154                   | \$131                   | \$112                    |
| Greenhouse gas costs - 20%                             | \$153                   | \$130                   | \$112                    |
| Groundwater costs - 20%                                | \$153                   | \$130                   | \$112                    |
| Benefit to suppliers - 20%                             | \$163                   | \$139                   | \$119                    |
| Benefits to workers - 20%                              | \$155                   | \$132                   | \$113                    |

|                                                        | <b>4% Discount Rate</b> | <b>7% Discount Rate</b> | <b>10% Discount Rate</b> |
|--------------------------------------------------------|-------------------------|-------------------------|--------------------------|
| <b>DECREASE</b>                                        |                         |                         |                          |
| Opportunity cost of land - 20%                         | \$155                   | \$131                   | \$113                    |
| Opportunity cost of capital - 20%                      | \$154                   | \$131                   | \$112                    |
| Operating costs - 20%                                  | \$169                   | \$143                   | \$123                    |
| Capital costs - 20%                                    | \$154                   | \$131                   | \$113                    |
| Decommissioning and rehabilitation costs - 20%         | \$154                   | \$131                   | \$112                    |
| Avoided costs of care and maintenance                  | \$152                   | \$130                   | \$111                    |
| Avoided decommissioning and rehabilitation costs - 20% | \$153                   | \$130                   | \$112                    |
| Revenue - 30%                                          | \$83                    | \$71                    | \$61                     |
| Residual value of land - 20%                           | \$152                   | \$130                   | \$111                    |
| Residual value of capital - 20%                        | \$153                   | \$130                   | \$112                    |
| Greenhouse gas costs - 20%                             | \$153                   | \$130                   | \$112                    |
| Groundwater costs - 20%                                | \$153                   | \$130                   | \$112                    |
| Benefit to suppliers - 20%                             | \$144                   | \$122                   | \$105                    |
| Benefits to workers - 20%                              | \$152                   | \$129                   | \$111                    |

### 3 LOCAL EFFECTS ANALYSIS

#### 3.1 Introduction

The CBA in Section 4 is concerned with whether the incremental benefits of the Modification exceed the incremental costs and therefore whether the community would, in aggregate, be better off 'with' the Modification compared to 'without' it. This section examines local effects.

The Local Area is defined as the LGAs of Singleton, Muswellbrook and Upper Hunter, within which the Modification is located.

#### 3.2 Direct Effects Related to Employment Of Existing Residents Only

The Modification will provide:

- a construction workforce of up to 26 during the single year of construction (in addition to the existing 11 care and maintenance jobs - 55% of which reside in the local area), with 20% (5) of the additional construction workforce assumed to already reside in the local area and the rest commuting into the local area; and
- an operational workforce of 99 per year over the 9 year operational life of the Modification, comprising 69 employees and 30 contractors. The incremental jobs during the first four years of operation is 88 and the incremental jobs for the remaining 5 years of operation is 99. Eighty percent of the incremental jobs during the first four years of operation (70) are assumed to already reside in the local area with the remainder commuting from outside the local area. In the remaining 5 years of operation the incremental employment comprises the 11 care and maintenance workers whose jobs would otherwise have ceased (of which 55% reside in the local area) and 88 additional jobs (80% of which reside in the local area) i.e. 76 local jobs.

Assuming that future incremental employees that already reside in the local area are already employed and that job vacancies created by these people filling the incremental jobs during construction and mining positions remain unfilled (i.e. no job chain effects), the incremental disposable wages accruing to the region is \$169,813 during the single year of construction and between \$2.3M and \$2.5M during the operations phase. This is equivalent to 2 direct full time equivalent (FTE) jobs during the single year of construction and between 26 and 28 direct FTE mining jobs during operations. This is a minimum estimate as it assumes full employment in the region and hence the jobs from which people come to fill the mining jobs remain vacant.

**Table 3.1**  
**Analysis of Net Income Increase and FTE Job Increase Assuming No Job Backfilling**

|                                                             | Construction | Operations  |             |
|-------------------------------------------------------------|--------------|-------------|-------------|
|                                                             | Year 1       | Year 2-5    | Year 6-10   |
| a) Direct incremental employment                            | 26           | 88          | 99          |
| Number that already reside in the region                    | 5            | 70          | 76          |
| b) Average net income in mining                             | \$87,653     | \$87,653    | \$87,653    |
| c) Average net income in other industries*                  | \$54,997     | \$54,997    | \$54,997    |
| d) Average increase in net income per job (b-c)             | \$32,656     | \$32,656    | \$32,656    |
| e) Increase in net income per year due to direct employment | \$169,813    | \$2,299,013 | \$2,496,584 |
| f) FTE (e/b)                                                | 2            | 26          | 28          |



\*This information is not available from the ABS and hence average income across all sectors is used.

### **3.3 Direct Effects Related to Non-Labour Expenditure**

The total annual non-labour expenditure (operating costs of the Modification after subtraction of wages to employees) is on average \$50M, per annum.

However, not all of this expenditure will accrue to the local area. From the location quotient analysis and allocation of margins and taxes undertaken by Gillespie Economics, approximately 41% i.e. \$21M pa of non-labour expenditure is estimated to accrue to the local area. The producer surplus to local suppliers associated with this level of spending is estimated at \$25M present value at 7% discount rate.

### **3.4 Regional Economic Impact Assessment**

Standard Regional Economic Impact Assessment is not restricted to a focus on the existing labour force in the local area and does not assume an absence of job chain effects. The presence of job chain effects in a region, means that to the extent that jobs from which people come to fill the mining jobs are themselves filled and their jobs are also filled until the lowest paid jobs are filled by people from unemployment, new labour force participants, then new wages in the region will approximate the total incremental wages associated with the mining project. Refer to Attachment 2.

In this framework, the Modification will provide the following incremental direct effects to the local economy:

#### **Construction**

- \$9.5M in output;
- \$3.1M in value-added;
- \$3.1M in wages of which \$0.6M will accrue to the local labour force;
- 26 jobs (in addition to the existing 11 care and maintenance jobs).

#### **Operation**

- \$89M to \$95M in output;
- \$52M to \$54M in value-added
- \$11M to \$12M in wages of which \$8M to \$9M will accrue to the local labour force;
- 88 to 99 jobs (99 new mine operation jobs less 11 care and maintenance jobs in the first 5 years of operations).

**Table 3.2 Regional Economic Impacts of the Modification**

|                                                | Base   |            |           | Modification |            |           | Increment    |            |           |
|------------------------------------------------|--------|------------|-----------|--------------|------------|-----------|--------------|------------|-----------|
|                                                |        | Operations |           | Construction | Operations |           | Construction | Operations |           |
| <i>Economic Indicator</i>                      | Year 1 | Year 2-5   | Year 6-10 | Year 1       | Year 2-5   | Year 6-10 | Year 1       | Year 2-5   | Year 6-10 |
| Output                                         | \$5.5  | \$5.5      | \$0.0     | \$15.0       | \$94.8     | \$94.8    | \$9.5        | \$89.3     | \$94.8    |
| Value-added                                    | \$1.3  | \$1.3      | \$0.0     | \$4.4        | \$53.7     | \$53.7    | \$3.1        | \$52.4     | \$53.7    |
| Income                                         |        |            |           |              |            |           |              |            |           |
| <i>Gross generated in region</i>               | \$1.3  | \$1.3      | \$0.0     | \$4.4        | \$11.9     | \$11.9    | \$3.1        | \$10.6     | \$11.9    |
| <i>Gross paid to labour residing in region</i> | \$0.7  | \$0.7      | \$0.0     | \$1.4        | \$9.2      | \$9.2     | \$0.6        | \$8.4      | \$9.2     |
| Employment                                     |        |            |           |              |            |           | -            | -          | -         |
| <i>Gross employment in region</i>              | 11     | 11         | 0         | 37           | 99         | 99        | 26           | 88         | 99        |
| <i>Labour residing in region</i>               | 6      | 6          | 0         | 11           | 76         | 76        | 5            | 70         | 76        |

### **3.4 Second Round and Flow-On Effects**

The incremental expenditure by employees and non-labour expenditure that is captured by the local area provides flow-on economic activity to the local economy, which can be estimated in terms of economic activity indicators of output, value-added, income and employment. No specific input-output or computable general equilibrium modelling has been undertaken for this Modification.

A recent study by Lawrence Consulting (2018) for the NSW Minerals Council confirms the existence of substantial flow-on effects from mining operations in the Hunter region but does not report multipliers.

### **3.5 Effects on Other Industries**

#### ***3.5.1 Regional Economic Impacts of Displaced Agriculture***

The Modification will result in a small reduction in the area of land available for dairy farming on AQC owned land. However, this represents a negligible proportion of the total operational area of the Garoka Dairy and hence is not expected to have any measurable impact of the farms profitability.

#### ***3.5.2 Other Wage Impacts***

In the short-run, increased regional demand for labour as a result of the Modification (relative to the “without Project” scenario) could potentially result in some increased pressure on wages in other sectors of the economy. The magnitude and duration of this upward wages pressure would depend on the level of demand for labour, the availability of labour resources in the region and the availability and mobility of labour from outside the region. However, given the scale of the Modification and the availability of labour inside and outside the region, wage impacts are not likely to be significant. Where upward pressure on regional wages occurs, it represents an economic transfer between employers and owners of skills and would in turn attract skilled labour to the region leading to future downward pressure on wages.

#### ***3.5.3 Housing Impacts***

The Modification is not expected to result in any substantial in-migration of workers and their families and consequently the impact on housing prices is expected to be negligible.

### 3.7 Environmental and Social Impacts on the Local Community (Externalities)

The distribution of costs and benefits of the Modification are summarised in Table 2.6. The main potential effects on the local community (excluding to AQC) relate to minor cumulative exceedance of air quality and low visual amenity impacts from passing traffic on the New England Highway.

### 3.8 Summary Of Local Effects

A summary of local effects of the Project is provided in Table 3.3.

**Table 3.3**  
**Summary of Effects on the Local Community (Excluding AQC)**

|                                                                          | Year 1                                     | Year 2-5                                             | Year 6-10 |
|--------------------------------------------------------------------------|--------------------------------------------|------------------------------------------------------|-----------|
| <b>Net Annual Income to Existing Local Labour - No Job Chain Effects</b> | \$0.2                                      | \$2.3                                                | \$2.5     |
| <b>Direct Annual Regional Economic Impacts</b>                           |                                            |                                                      |           |
| Output (\$M)                                                             | \$9.5                                      | \$89.3                                               | \$94.8    |
| Value-added (\$M)                                                        | \$3.1                                      | \$52.4                                               | \$53.7    |
| Gross Income (\$M)                                                       |                                            |                                                      |           |
| <i>Gross generated in region</i>                                         | \$3.1                                      | \$10.6                                               | \$11.9    |
| <i>Gross paid to labour residing in region</i>                           | \$0.6                                      | \$8.4                                                | \$9.2     |
| Incremental employment (No.)                                             |                                            |                                                      |           |
| <i>Employment in region</i>                                              | 26                                         | 88                                                   | 99        |
| <i>Labour residing in region</i>                                         | 5                                          | 70                                                   | 76        |
| Second round and flow-on effects                                         | Refer to Section 3.4                       |                                                      |           |
| Contraction in other sectors                                             | No material impact                         |                                                      |           |
| Displaced activities                                                     | Not applicable                             |                                                      |           |
| Wage rise impacts                                                        | No material impact                         |                                                      |           |
| Housing impacts                                                          | No material impact                         |                                                      |           |
| <b>Externality impacts</b>                                               | <b>Incidence of Impacts</b>                | <b>Magnitude of Impact (\$M present value)</b>       |           |
| <b>Benefits</b>                                                          |                                            |                                                      |           |
| Economic benefits to local suppliers                                     | Regional suppliers of inputs to production | \$25                                                 |           |
| <b>Environmental, social and cultural costs*</b>                         |                                            |                                                      |           |
| Air quality                                                              | Adjoining landholders                      | Minor cumulative exceedances                         |           |
| Visual amenity                                                           | Motorists on the New England Highway       | Limited views of shaft site from New England Highway |           |

## 4 CONCLUSION

A CBA of the Modification indicated that it would have net production benefits to Australia of \$187M and net production benefits to NSW of \$82M, present value. Provided the residual environmental, social and cultural impacts of the Modification that accrue to Australia are considered to be valued at less than \$187M, or those that accrue to NSW are considered to be valued at less than \$82M, the Modification 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 exercise was undertaken to quantify them. The cost of mitigation and monitoring measures as well as the opportunity cost of land were included as direct costs to AQC. The main quantifiable environmental impacts of the Modification, which have not already been incorporated into the estimate of net production benefits, relate to the opportunity cost of WALs and GHG emissions. The opportunity cost of WALs are estimated at \$0.1M, GHG impacts to Australia and NSW are estimated at \$0.2M and \$0.1M, respectively, considerably less than the estimated net production benefits of the Modification. There are also indirect benefits of the Modification to workers and suppliers.

Overall, the Modification is estimated to have net social benefits to Australia and NSW of \$236M and \$130M, respectively, and hence is desirable and justified from an Australian and NSW economic efficiency perspective.

While the main environmental, cultural and social impacts have been quantified and included in the Modification CBA, any other residual environmental, cultural or social impacts that remain unquantified would need to be valued at greater than \$236M and \$130M for the Modification to be questionable from an Australian and NSW economic efficiency perspective, respectively.

The local economy comprises Singleton, Muswellbrook and Upper Hunter Shire LGAs. The Modification will provide the following direct effects to the local economy:

### *Construction*

- \$9.5M in output;
- \$3.1M in value-added;
- \$3.1M in wages of which \$0.6M will accrue to the local labour force;
- 26 jobs (in addition to the existing 11 care and maintenance jobs).

### *Operation*

- \$89M to \$95M in output;
- \$52M to \$54M in value-added
- \$11M to \$12M in wages of which \$8M to \$9M will accrue to the local labour force;
- 88 to 99 jobs (99 new mine operation jobs less 11 care and maintenance jobs in the first 5 years of operations).

The incremental expenditure by employees and non-labour expenditure that is captured by the local area will provide additional flow-on economic activity to the local economy.

## 5 REFERENCES

Boardman, A., Greenberg, D., Vining, A., Weimer, D. (2001) *Cost-Benefit Analysis: Concepts and Practice*, Prentice Hall, USA.

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## ATTACHMENT 1 - COST BENEFIT ANALYSIS

### Introduction to CBA

Cost Benefit Analysis (CBA) has its theoretical underpinnings in neoclassical welfare economics. Applications in New South Wales (NSW) are guided by these theoretical foundations as well as the NSW Treasury (2017). CBA applications within the NSW environmental assessment framework are further guided by the NSW Government (2015) *Guidelines for the economic assessment of mining and coal seam gas projects*.

CBA is concerned with a single objective of the *Environmental Planning and Assessment Act, 1979* (EP&A Act) and governments i.e. economic efficiency. It provides a comparison of the present value of aggregate benefits to society, as a result of a project, policy or program, with the present value of the aggregate costs. These costs and benefits are defined and valued based on the microeconomic underpinnings of CBA. In particular, it is the values held by individuals in the society that are relevant, including both financial and non-financial values. Provided the present value of aggregate benefits to society exceed the present value of aggregate costs (i.e. a net present value of greater than zero), the project is considered to improve the well-being of society and hence is desirable from an economic efficiency perspective.

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

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

### Definition of Society

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

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

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

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

CBAs of mining projects are therefore often undertaken from a global perspective i.e. including all the costs and benefits of a project, no matter who they accrue to, and then truncated to assess whether there are net benefits to Australia. A consideration of the distribution of costs and benefits can then be undertaken to identify the benefits and costs that accrue to NSW and other regions.

However, a project is considered to improve the well-being of society if it results in net benefits to the nation, even if it results in net costs to the local area.

### **Definition of the Project Scope**

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

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

### **Net Production Benefits**

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

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

Net production benefits can be estimated based on market data on the projected financial<sup>12</sup> value of coal less the capital and operating costs of projects, including opportunity costs of capital and land already in the ownership of mining companies. This is normally commercial in confidence data provided by the proponent. Production costs and benefits over time are discounted to a present value.

### **Environmental, Social and Cultural Impacts**

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

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

These environmental, social and cultural impacts generally fall into three categories, those which:

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<sup>12</sup> In limited cases the financial value may not reflect the economic value and therefore it is necessary to determine a shadow price for the coal.



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

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

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

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

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

### **Consideration of Net Social Benefits**

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

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

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

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

Any other residual environmental, cultural or social costs that remain unquantified in the analysis<sup>13</sup> can also be considered using the threshold value approach. The costs of these unquantified environmental, cultural and social impacts would need to be valued by society at greater than the quantified net social benefit of a project to make it questionable from an economic efficiency perspective.

## REFERENCES

Boardman, A., Greenberg, D., Vining, A. and Weimer, D. (2001) *Cost-Benefit Analysis: Concepts and Practice*, Prentice Hall, USA.

NSW Government (2015) *Guidelines for the economic assessment mining and coal seam gas proposals*.

NSW Treasury (2017) *NSW Government Guide to Cost-Benefit Analysis*, [www.treasury.nsw.gov.au](http://www.treasury.nsw.gov.au).

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<sup>13</sup> Including potential impacts that were unknown at the time of the preparation of the relevant assessment document or arise during the Environmental Impact Assessment process due to differences in technical opinions.

## ATTACHMENT 2 – COMPARISON OF INPUT-OUTPUT ANALYSIS AND THE LEA METHOD

IO analysis begins with identification of the direct gross regional economic activity footprint of a project for the region. If a project provides 100 jobs at the mine site then all these jobs are counted in IO analysis as a direct effect i.e. direct employment in the region, because the jobs are located in the region. All income paid to employment is also included as it is generated in the economy and IO tables are based on place of work. However, in assessment of the impacts of a project on the regional economy only the income of employees living in the region are counted as direct income effects since it is only wages expenditure of those living in the region that flows through the regional economy. In IO analysis, if 40% of a projects jobs are filled by people who already reside in the region then the **total** wages of these people is counted as a direct regional income effect of the project. Similarly, if 40% of the new jobs are taken by people who migrate into the region this is also counted as direct income for the region, as it is income that will accrue to people living in the region even though they are new residents. In impact assessment using IO analysis, the income of those residing outside the region is excluded as most of their income will be taken home after shift and spent where they live or elsewhere.

These direct employment and income effects for the region are those **associated** with the project i.e. the gross footprint, rather than specifically an assessment of **incremental** effects. This is partly because assessment of incremental effects becomes highly contentious and difficult. However, as will be shown below, these gross direct effects associated with a project can also be a reasonable approximation of incremental effects when "job chain" effects are considered.

However, first is a comparison between how IO analysis treats direct employment and income effects (as explained above) and that in the NSW (2015) guideline.

The guideline splits labour into those ordinarily resident in the region and those not ordinarily resident in the locality. For those ordinarily resident in the region the guideline suggests calculation of incremental income as the difference between a mining (including quarrying) income and the average level of income in other industries in the region. Incremental direct employment is then calculated by dividing this incremental income by the average wage in mining.

The guideline ignores workers who migrate into the region to work. However, using the rationale of the guideline, workers who migrate into the region to take jobs in a project provide a greater level of incremental income and spending in the region than those to take jobs in a project and who already reside in the region. The entire wage of those migrating into the region is additive to regional income in comparison to wage increments for those already residing in the region.

Table 1 provides an example of incremental wages using the guideline method and when income from those migrating into the region is counted. If only the incremental wages of those who already reside in the region are counted the incremental impact is \$1.4M in annual wages. However, if the incremental wages to the region from those who migrate into the region are included, this increases to \$5.4M.

**Table 1 - Incremental Income when Immigrating Workforce is Included**

| Categories of Workers       | Direct Empl | Current Wages @\$65k | New Wages @\$100k | Incremental New Wages for Workers | Incremental New Wages to the Region |
|-----------------------------|-------------|----------------------|-------------------|-----------------------------------|-------------------------------------|
| Already Live in Region      | 40          | 2,600,000            | 4,000,000         | 1,400,000                         | 1,400,000                           |
| Migrate into Region to Live | 40          | 2,600,000            | 4,000,000         | 1,400,000                         | 4,000,000                           |
| Commute from outside        | 20          | 1,300,000            | 2,000,000         | 700,000                           | 0                                   |
| <b>Total Direct Empl</b>    | <b>100</b>  | <b>6,500,000</b>     | <b>10,000,000</b> | <b>3,500,000</b>                  | <b>5,400,000</b>                    |

Even for those already living in the region who are already employed, the incremental income estimated using the guideline will substantially understate additional regional income effects. This is because new jobs in a region create a chain of job opportunities (referred to in the literature as the "job chain" - see Persky et al, 2004 What are jobs worth?, Employment Research Vol. 11 , p. 3).

An already employed person in the region moving into a mining (including quarrying) job, creates a job vacancy, which can be filled by those in the region (already employed, unemployed or attracted into the labour force) or by in-migration. Where this job is filled by those already employed in the region this in turn creates another vacancy etc. Following the entire chain through, the cumulative increase in wages to a region would approach the wages of the total direct mining jobs. It would only be discounted if the chain ends with employment of those from local residents in the unemployment pool (who are receiving an allowance and hence already are spending income in the region), if jobs remain unfilled or if jobs are filled by a commuter workforce. The latter is less likely for lower paying jobs down the job chain. In periods of higher unemployment rates, jobs along the job chain remaining unfilled is unlikely. If the chain ends with in-migrating employment or employment of those in the region that are new to the workforce then the incremental wages is equal to the total wages of the new jobs.

Table 2 demonstrates the "job chain" effect in relation to 40 new mining jobs filled by already employed local workers. It shows that the total annual wages of the new mining jobs is \$4M. Under the job chain approach where all jobs are backfilled including ultimately by 40 local residents from the unemployment pool the incremental wages to the region are \$3.5M. If some of these jobs filled from the unemployment pool are ultimately filled by in-migration the difference between the incremental wages to the region and the total annual mining jobs wages will lessen.

The guideline does not take account of the "job chain" effect and essentially assumes that the previous jobs of "job movers" in the region remain vacant for the life of the Project.

Incorporation of consideration of the "job chain" effect means that the direct incremental income to a region approximates that assumed in IO analysis (i.e. the gross footprint of economic activity estimated using IO analysis is also an indicator of the net effect).

**Table 2 - Demonstration of the Job Chain Effect for 40 Jobs Filled by Locals Who are Already Employed in the Region**

|                                                                                       | Total wages | Increment Wages Gain to Region |
|---------------------------------------------------------------------------------------|-------------|--------------------------------|
| 1. New mining wage for 40 workers @\$100k                                             | \$4,000,000 | \$1,400,000 (1-2)              |
| 2. Current Wages for 40 workers @\$65k                                                | \$2,600,000 | \$1,000,000 (2-3)              |
| 3. Wage of people filling above 40 positions @\$40k                                   | \$1,600,000 | \$800,000 (3-4)                |
| 4. Wage of people filling above 40 positions @\$20k                                   | \$800,000   | \$ 255,664 (4-5)               |
| 5. Wages of the unemployed filling above 40 positions (Newstart - single no children) | \$544,336   |                                |
| <b>T</b>                                                                              |             | <b>\$3,455,664</b>             |

