# Updated Economic Impact Assessment of the Hume Coal project

Prepared for Hume Coal Pty Ltd

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# Abbreviations

| | |
|---|---|
| 2015 Guidelines | Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals |
| 2018 Technical Notes | Technical Notes supporting the Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals |
| ABS | Australian Bureau of Statistics |
| AIP | Aquifer Interference Policy |
| ASNA | Australian System of National Accounts |
| BRP | Berrima Rail Project |
| CBA | Cost benefit analysis |
| CPP | Coal preparation plant |
| DSE | Dry sheep equivalent |
| EEC | Endangered ecological communities |
| EIS | Environmental impact statement |
| FTE | Full-time equivalent |
| GDE | Groundwater dependent ecosystem |
| GDP | Gross domestic product |
| GSP | Gross state product |
| GE | General equilibrium |
| GL | Gigalitre |
| GOS | Gross operating surplus |
| GMI | Gross mixed income |
| GSP | Gross state product |
| GVA | Gross value of agricultural production |
| ha | Hectare |
| HCC | Hard coking coal |
| LEA | Local effects analysis |
| LGA | Local government area |
| LQ | Location quotient |
| ML | Megalitre |
| Mt | Million tonnes |
| Mtpa | Million tonnes per annum |
| NML | Noise management level |
| PSNL | Project-specific noise level |
| ROM | Run of mine |
| SA3 | Statistical Area Level 3 |
| SEARs | Secretary's Environmental Assessment Requirements |
| SIA | Social Impact Assessment |

# Summary

In 2016, BAEconomics was commissioned by Hume Coal Pty Ltd (Hume Coal) to prepare an economic impact assessment of the proposed Hume Coal project (the project). The project involves developing, operating and rehabilitating an underground coal mine and associated infrastructure over an estimated 23-year timeframe, including the construction of a rail spur that is the subject of a separate environmental impact statement (EIS), the Berrima Rail Project (BRP). In 2018, Hume Coal requested that BAEconomics provide an updated economic impact assessment to take into account changes in coal price forecasts, delays to the mine schedule and updated capital and operating costs. This document provides the results of the updated economic impact assessment in real 2018 dollars.

The approach to preparing the assessment is consistent with various guidelines published by the NSW Government, including the 'Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals' published in 2015 (the 2015 Guidelines) and the newly released Technical Notes supporting the Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals published in 2018 (the 2018 Technical Notes). The 2015 Guidelines require a public interest test in the form of a cost-benefit analysis (CBA) to be undertaken to assess the net benefit of the project to the NSW community, and a 'local effects analysis' (LEA) to assess the likely impacts of the project on the local economy.

While the BRP component of the project is subject to a separate EIS process, from an economic perspective, the benefits that would accrue to NSW and to the local community as a result of the project and the BRP arise jointly. That is, the project would not be developed in the absence of the BRP; conversely, the BRP would not be commissioned in the absence of the project. The CBA and LEA presented in this report therefore incorporate the combined costs of the project and the BRP component of the project, including the costs of any external effects. The net benefits to NSW and the local community identified in this report therefore arise as a result of the project, including the BRP component of the project.

Table E-1 summarises the net direct and flow-on benefits of the Hume Coal project for the State of NSW and the local economy, respectively, in terms of the contribution to value added or gross state product, disposable income, and full-time equivalent (FTE) employment. The components of these net benefits are discussed in the following sections. Benefits are presented in Net Present Value (NPV) terms using a 7 per cent real discount rate in order to represent the equivalent of receiving an up-front lump sum payment in 2018, rather than a series of future cash flows. The 'real' (as opposed to 'nominal') discount rate is exclusive of inflation. A 7 per cent real discount rate is the equivalent of a 9.7 per cent nominal rate assuming a 2.5 per cent inflation rate. The nominal rate is analogous to the rate of interest received on a bank deposit or investment, which is inclusive of inflation.

**Table E-1. Summary of net direct and flow-on benefits of the Hume Coal project**

| | Direct benefits | Flow-on benefits | Total |
|---|---|---|---|
| **NSW** | | | |
| Net value added / gross state product | $373 million | $119 million | $492 million |
| Average annual net employment | 41 FTEs | 22 FTEs | 63 FTEs |
| **Southern Highlands region** | | | |
| Net disposable income | $108 million | $54 million | $162 million |
| Average annual net employment | 27 FTEs | 24 FTEs | 51 FTEs |

## Net benefits of the project for NSW

### Direct impacts

The direct benefits of the project to NSW relative to the 'do nothing' (reference) case would amount to $373 million in net present value (NPV) terms discounted at a rate of 7 per cent real, consisting of:

- incremental royalty payments that would accrue to the NSW Government of $132 million in NPV terms;
- incremental personal and company income tax payments attributable to NSW of $62 million in NPV terms;
- incremental disposable income payments accruing to NSW residents of $156 million in NPV terms, and
- other incremental benefits accruing to NSW, comprising Medicare payments, payroll taxes, land taxes, levies and local government rate payments, that amount to $24 million in NPV terms.

Disposable income benefits have been estimated conservatively by assuming that a share of the workforce would be employed elsewhere in NSW if the project does not proceed.

The (gross) direct benefits of the project to NSW would be partially offset by externalities from greenhouse gas emissions and a small loss in agricultural value added. These costs have been estimated at around $2 million in NPV terms. The net direct benefits of the project to NSW are therefore estimated at $373 million in NPV terms.

### Flow-on impacts

In addition to the direct impacts described above, the project is expected to generate 'flow-on' benefits for NSW. Flow-on effects reflect the projected additional expenditures that arise as a result of the project. The additional demand for goods and services sets the economy in motion as businesses buy and sell goods and services from one another, and households earn and spend additional income. These linkages between businesses and households cause the total effects on the economy to exceed the initial change in demand as a result of the project.

The project would give rise to:

- incremental disposable income flow-on benefits of at least $149 million in NPV terms ($13 million per annum); and
- incremental annual average employment flow-on benefits of 22 full-time equivalent (FTE) jobs.

## Net benefits of the project for the local economy

For the purpose of assessing the impacts of a development on the local region, the 2015 Guidelines require proponents of a development to adopt a study area defined according to a Statistical Area Level 3 (SA3) geographical definition. In the case of the project, the relevant SA3 area is the Southern Highlands SA3 Region. The Southern Highlands SA3 Region is largely aligned with the Wingecarribee Shire local government area (LGA).

### Direct impacts

The direct benefits of the project for the local economy predominantly consist of the additional disposable income that accrues to the project workforce. The project would give rise to:

- incremental disposable income benefits of $108 million in NPV terms accruing to the project workforce in the Southern Highlands SA3 Region; and
- incremental payments in shire rates accruing to local government of $1 million in NPV terms.

Accounting for a loss of agricultural value added of around $2 million in NPV terms, the net benefits accruing to the local economy are estimated at $107 million.

As is the case for the CBA, disposable income benefits have been estimated conservatively by assuming that a share of the workforce would be employed elsewhere in the local economy if the project does not proceed.

## Flow-on impacts

The calculation of value added multipliers and flow-on effects for a small local region is not meaningful. The assessment of local flow-on impacts of the project has therefore been limited to income and employment.

The project would generate the following flow-on impacts in the Southern Highlands SA3 Region:

- incremental disposable income flow-on benefits of $54 million in NPV terms or $5 million per annum; and
- incremental employment flow-on benefits, accounting for agricultural impacts, of 24 FTE jobs.

The estimated flow-on effects have been calculated accounting for a small reduction in economic activity that would occur because of the displacement of agriculture as a result of the project.

## Summary LEA analysis

The following summary table presents the results from the LEA for the project, as required by the 2015 Guidelines. As discussed in this report, non-labour related expenditures have not been attributed to the local economy because there are no regional statistics on the local and imported content of goods and services, and the local ownership of capital. Hence any increase or loss of surplus in other industries cannot be attributed to a small geographical (local) area. However, given that Hume Coal would incur overall operating expenditures of $643 millions in NPV terms over the life of the project, the local economy can be expected to benefit from these expenditures.

A portion of the land that would be disturbed by the project is currently used for livestock production. The net benefits arising from the project would therefore be partially offset by a small reduction in agricultural value added in the local region. The externalities arising from greenhouse gas (GHG) emissions associated with the project are global in nature and have therefore not been attributed to the local economy. This approach is consistent with the 2015 Guidelines, which recommend a focus on externalities that create material, un-mitigated effects within the locality.

## Table E-2. Project – Summary LEA analysis

| | Project direct: Total NSW | Project direct: SA3 Region | Project net direct: SA3 Region |
|---|---|---|---|
| **Employment related** | | | |
| Operational workforce jobs (FY 2023 to FY 2042), average annual FTEs | 273 | 194 | 39 |
| Disposable income (NPV $2018 million) | $156 | $108 | $108 |
| Other, non-labour operating expenditure (NPV $2018) | $766 | N/a | N/a |
| **Externality benefit/cost** | | | |
| Scope 1 and 2 greenhouse gas emissions (NPV $2018 million) | -$0.1 | N/a | N/a |
| Loss of agricultural value added (NPV $2018 million) | -$1.7 | -$1.7 | -$1.7 |

# 1 Introduction

In 2016, BAEconomics was commissioned by Hume Coal Pty Ltd (Hume Coal) to prepare an economic impact assessment of the proposed Hume Coal project (the project). The economic assessment undertaken in 2016 forms part of an Environmental Impact Statement (EIS), which has been prepared to accompany a Development Application made for the project in accordance with Division 4.1 of Part 4 of the NSW Environmental Planning and Assessment Act, 1979 (EP&A Act). In 2018, Hume Coal requested that BAEconomics prepare an update to the economic impact assessment undertaken in 2016. This report details the results of the updated assessment.

## 1.1 Purpose and scope of the economic assessment

This economic assessment has been prepared to update the original 2016 EIS assessment using recent coal price and exchange rate forecasts as well as an updated mining schedule, operating and capital costs. This assessment has taken into account the economic components of the Secretary's Environmental Assessment Requirements (SEARs), and with reference to various guidelines published by the NSW Government, in particular the 'Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals' (2015, 'the 2015 Guidelines') and the newly released Technical Notes supporting the Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals (2018, 'the 2018 Technical Notes'). The 2015 Guidelines require a cost-benefit analysis (CBA) to be undertaken to assess the net benefit of the project to the NSW community. The 2015 Guidelines also require a 'local effects analysis' (LEA) to be undertaken to assess the likely impacts of the project on the local economy. The 2018 Technical Notes describe the approaches that should be taken to value any external effects that may arise as a result of a significant development.

The project involves developing, operating and rehabilitating an underground coking coal mine and associated infrastructure over an estimated 30-year timeframe, including the construction of a rail spur that is the subject of a separate EIS, the Berrima Rail Project (BRP). While the BRP component of the project is subject to a separate EIS process, from an economic perspective, the benefits that would accrue to NSW and to the local community as a result of the project and the BRP arise jointly. That is, the project would not be developed in the absence of the BRP; conversely, the BRP would not be commissioned in the absence of the project.

Given that their benefits and costs are inextricably linked, the CBA and LEA presented in this report therefore incorporate the combined costs of the project and the BRP component of the project, including the costs of any external effects. The net benefits to NSW and the local community identified in this report therefore arise as a result of the project, including the BRP component of the project. This approach is consistent with the approach specified in the 'NSW Government Guidelines for Economic Appraisal' (NSW Treasury 2007, p.33), which state that:

> *Project interdependencies may arise in which the costs or benefits of one project are dependent on whether or not a second project of group of projects, goes ahead. The appropriate response is to evaluate projects as a single project…*

The approach that has been applied is also fully consistent with that recommended by the European Commission (1997, pp.16-17), which similarly requires an integrated analysis for projects that are mutually dependent.

## 1.2 Structure of this report

This report is structured as follows:

- Section 2 describes the project;
- Section 3 describes the approach to undertaking the CBA and the results of the CBA;
- Section 4 describes the approach to undertaking the LEA and the results of the LEA; and
- Section 5 describes the analysis conducted to identify the 'flow-on' impacts of the project for NSW and for the local region.

Supporting documentation is presented in two appendices:

- Appendix A provides additional detail on the methodology and assumptions used in preparing the CBA and the LEA; and
- Appendix B describes the derivation of the input-output multipliers used to determine flow-on effects.

# 2 Project and regional context

This section provides an overview of the project and its regional context:

- Section 2.1 sets out the range of activities comprising the project;
- Section 2.2 describes the local region where the project would be located; and
- Section 2.3 sets out where the issues raised in the SEARs are addressed in this report.

## 2.1 Project description

This economic assessment considers all aspects of the combined Hume Coal and Berrima Rail projects. The former is outlined below while the latter is described in Appendix D to the Hume Coal EIS.

The Hume Coal project involves developing and operating an underground coal mine and associated infrastructure, with coal production commencing in FY 2023 through to FY 2042. Indicative mine and surface infrastructure plans are provided in Figure 2-1 and Figure 2-2. A full description of the project, as assessed in this report, is provided in Chapter 2 of the main EIS report. In summary, the project involves:

- Ongoing resource definition activities, along with geotechnical and engineering testing, and other low impact fieldwork to facilitate detailed design.
- Establishment of a temporary construction accommodation village.
- Development and operation of an underground coal mine, comprised of approximately five years of construction and 20 years of mining, followed by a closure and rehabilitation phase of up to five years, leading to a total project life of 30 years.
- Extraction of approximately 40 million tonnes (Mt) of run-of-mine (ROM) coal from the Wongawilli Seam. Low impact mining methods will be used, which will have negligible subsidence impacts.
- Following processing of ROM coal in the Coal Preparation Plant (CPP), production of up to 2.7 million tonnes per annum (Mtpa) of metallurgical and thermal coal for sale to international and domestic markets.
- Construction and operation of associated mine infrastructure, mostly on cleared land, including:
  - one personnel and materials drift access and one conveyor drift access from the surface to the coal seam;
  - ventilation shafts, comprising one upcast ventilation shaft and fans, and up to two downcast shafts installed over the life of the mine, depending on ventilation requirements as the mine progresses;
  - a surface infrastructure area, including administration, bathhouse, washdown and workshop facilities, fuel and lubrication storage, warehouses, laydown areas, and

other facilities. The surface infrastructure area will also comprise the CPP and ROM coal, product coal and emergency reject stockpiles;

- surface and groundwater management and treatment facilities, including storages, pipelines, pumps and associated infrastructure;
- overland conveyors;
- rail load-out facilities;
- an explosives magazine;
- ancillary facilities, including fences, access roads, car parking areas, helipad and communications infrastructure; and
- environmental management and monitoring equipment.

- Establishment of site access from Mereworth Road, and minor internal road modifications and relocation of some existing utilities.
- Coal reject emplacement underground, in the mined-out voids.
- Peak workforces of approximately 405 full-time equivalent (FTE) employees during construction and approximately 352 FTE employees and contractors during operations.
- Decommissioning of mine infrastructure and rehabilitating the area once mining is complete, so that it can support similar to current land uses.

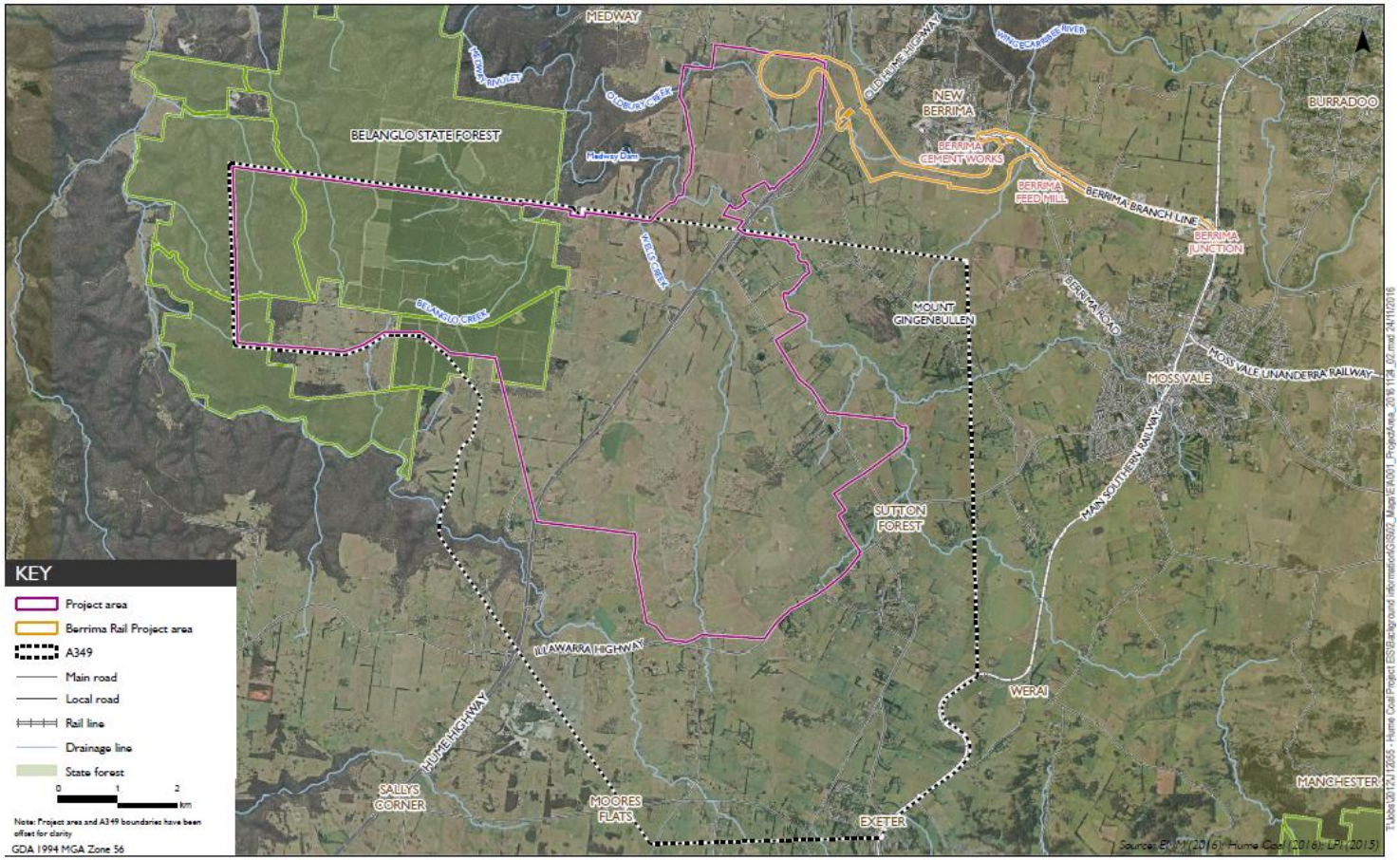
### 2.1.1 Project and surface area

The project area, shown in Figure 2-1, is approximately 5,051 hectares (ha). Surface disturbance will be mainly restricted to the surface infrastructure areas shown indicatively in Figure 2-2, although this will include some other areas above the underground mine, such as drill pads and access tracks. The project area generally comprises direct surface disturbance areas of up to approximately 117 ha, and an underground mining area of approximately 3,472 ha, where negligible subsidence impacts are anticipated.

There will be a construction buffer zone around the direct disturbance areas. The buffer zone will provide an area for construction vehicle and equipment movements, minor stockpiling and equipment laydown, as well as allowing for minor realignments of surface infrastructure. Ground disturbance will generally be minor and associated with temporary vehicle tracks and sediment controls as well as minor works such as backfilled trenches associated with realignment of existing services. Notwithstanding, environmental features identified in the relevant technical assessments will be marked as avoidance zones so that activities in this area do not have an environmental impact.

Product coal will be transported by rail, primarily to Port Kembla terminal for the international market, and possibly to the domestic market depending on market demand. As noted, the rail works and use are the subject of a separate EIS and SSD application for the BRP.

## Figure 2-1. Project area




Source: EMM / Hume Coal.

## Figure 2-2. Surface infrastructure areas


Source: EMM / Hume Coal.

### 2.1.2 Employment

Figure 2-3 shows projected employment for the project from the present until mine closure and rehabilitation. Over that timeframe:

- The project would work to gain government and internal approvals, and undertake detailed design work until FY2022
- Construction would begin in FY 2022 and would be completed by FY 2025, with rehabilitation activities commencing in FY 2043. At its peak in FY 2023, the annualised average construction workforce would amount to 405 FTEs.
- The operational workforce would begin ramping up in FY 2023. The annualised average operational workforce would peak in FY 2025 at 341 FTEs. Between FY 2023 and FY 2042, the operational workforce would average 274.

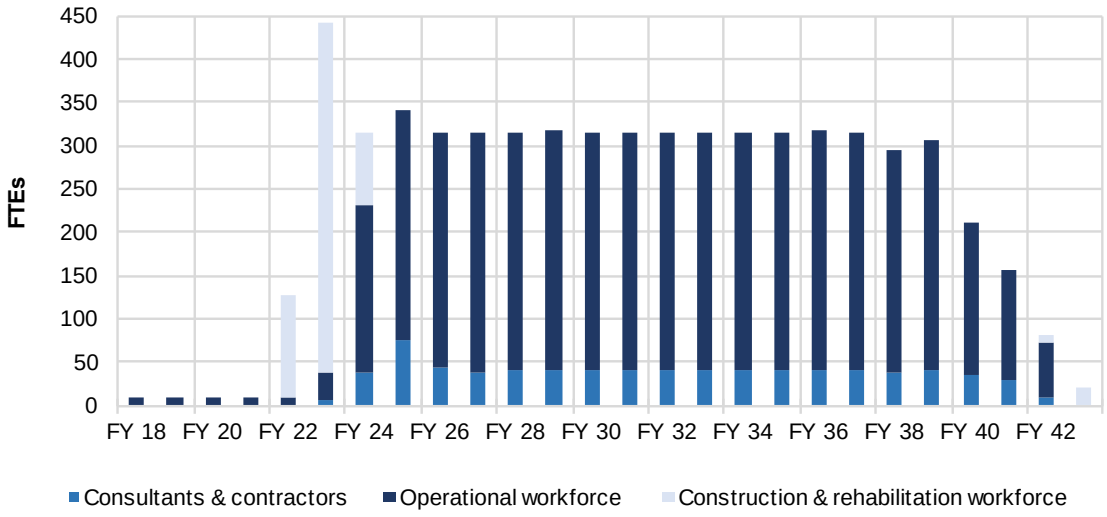



**Figure 2-3. Hume Coal project – Projected employment schedule**

Source: Hume Coal.

## 2.2 Local region

The project would be located in the Southern Highlands region of NSW and the Sydney Basin Biogeographic Region. The project area is approximately 100 km south-west of Sydney and 4.5 km west of Moss Vale town centre in the Wingecarribee LGA (Figure 2-1). The nearest area of surface disturbance will be associated with the surface infrastructure area, which will be 7.2 km north-west of Moss Vale town centre.

### 2.2.1 Local setting

The project area is in a semi-rural setting, with the wider region characterised by grazing properties, small-scale farm businesses, natural areas, forestry, scattered rural residences, villages and towns, industrial activities such as the Berrima Cement work and Berrima Feed

Mill, and some extractive industry and major transport infrastructure such as the Hume Highway.

Hume Coal propose to develop surface infrastructure on predominately cleared land owned by Hume Coal or affiliated entities, or for which there are appropriate access agreements in place with the landowner. Over half of the remainder of the project area (principally land above the underground mining area) comprises cleared land that is, and will continue to be, used for livestock grazing and small-scale farm businesses. Belanglo State Forest covers the north-western portion of the project area and contains introduced pine forest plantations, areas of native vegetation and several creeks that flow through deep sandstone gorges. Native vegetation within the project area is largely restricted to parts of Belanglo State Forest and riparian corridors along some watercourses.

The project area is traversed by several drainage lines including Oldbury Creek, Medway Rivulet, Wells Creek, Wells Creek Tributary, Belanglo Creek and Longacre Creek, all of which ultimately discharge to the Wingecarribee River, at least 5 km downstream of the project area (Figure 2-1). The Wingecarribee River's catchment forms part of the broader Warragamba Dam and Hawkesbury-Nepean catchments. Medway Dam is also adjacent to the northern portion of the project area.

Most of the central and eastern parts of the project area are characterised by very low rolling hills with occasional elevated ridge lines. However, there are steeper slopes and deep gorges in the west in Belanglo State Forest.

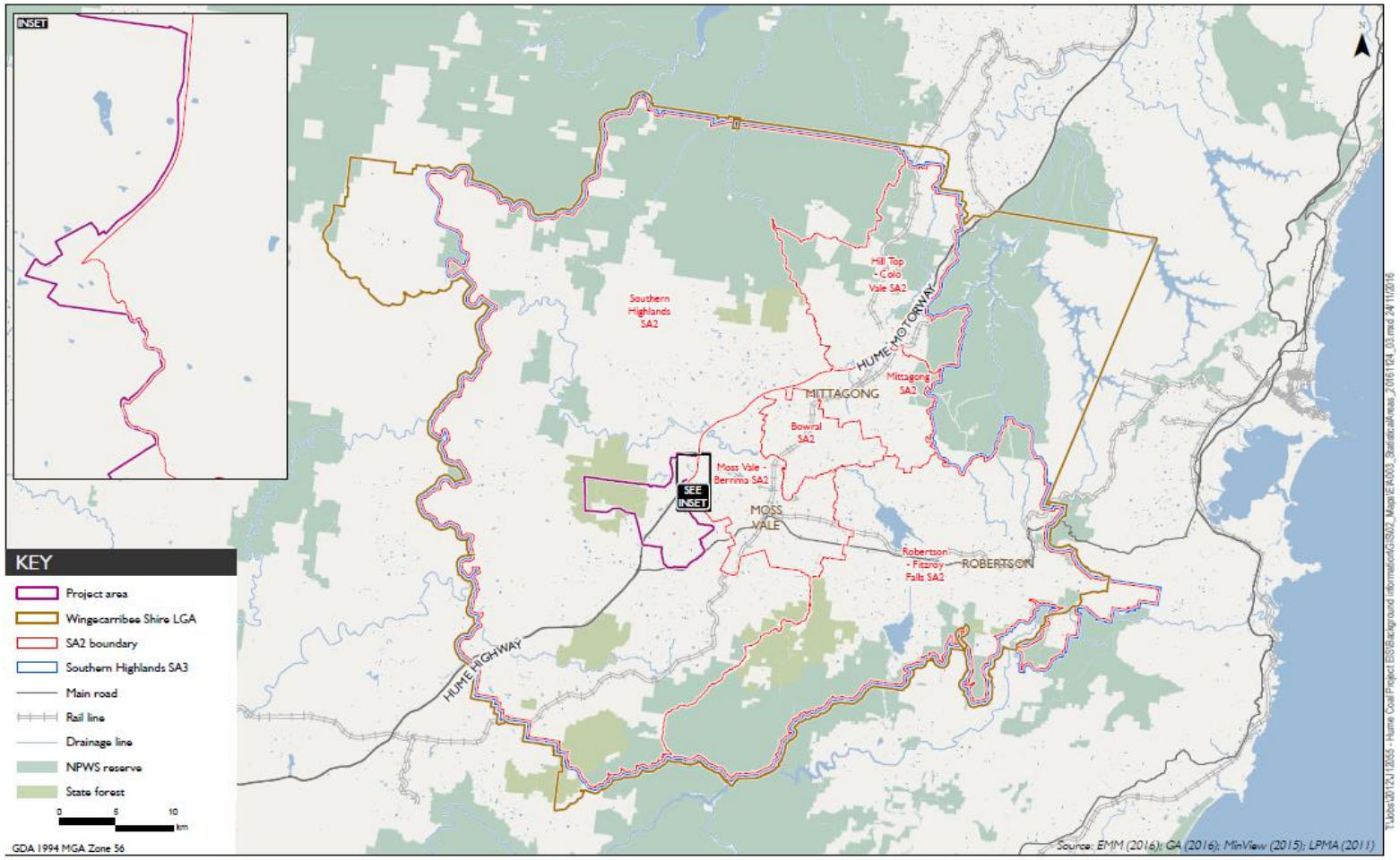
Existing built features across the project area include scattered rural residences and farm improvements such as outbuildings, dams, access tracks, fences, yards and gardens, as well as infrastructure and utilities including roads, electricity lines, communications cables and water and gas pipelines. Key roads that traverse the project area are the Hume Highway and the Golden Vale Road. The Illawarra Highway borders the south-east section of the project area.

Industrial and manufacturing facilities adjacent to the project area include the Berrima Cement Works and Berrima Feed Mill on the fringe of New Berrima. Berrima Colliery's mining lease (CCL 748) also adjoins the project area's northern boundary. Berrima Colliery is currently not operating, with production having ceased in 2013 after almost 100 years of operation. The mine is currently undergoing closure.

### 2.2.2 Study area

For the purpose of undertaking the LEA, the 2015 Guidelines require proponents to adopt a study area that should match a SA3 geographical definition. In the case of the project, the relevant SA3 area is the Southern Highlands SA3 Region (Figure 2-4). Figure 2-4 shows the Southern Highlands SA3 Region, which comprises the five Statistical Area Level 2 (SA2) areas of Southern Highlands, Hill Top, Mittagong, Bowral, Moss Vale, and Robertson Fitzroy Falls. Figure 2-4 also shows that the Southern Highlands SA3 Region largely aligns with the Wingecarribee Shire LGA.

## Figure 2-4. Project area within the context of statistical area bondaries




Source: Hume Coal / EMM.

## 2.3 Secretary's Environmental Assessment requirements

The SEARs state that the EIS for the project must address the following socio-economic components (p.3):

- *an assessment of the likely social impacts of the development; and*
- *an assessment of the likely economic impacts of the development, paying particular attention to:*
  - *the significance of the resource;*
  - *economic benefits of the project for the State and region; and*
  - *the demand for the provision of local infrastructure and services, having regard to Wingecarribee Shire Council's requirements (see Attachment 2).*

This report addresses the economic SEARs; the social impacts SEARs are addressed separately in Chapter 20 and Appendix R of the EIS.

### 2.3.1 Significance of the resource

The repealed clause 12AA of the State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (the Mining SEPP) indicates the matters that may be relevant in assessing the 'significance of the resource'. Clause 12AA of the Mining SEPP required the significance of the resource to be assessed, having regard to the economic benefits, both to the State and the region, of developing the resource. The matters taken to be relevant were:

- employment generation;
- expenditure, including capital investment; and
- the payment of royalties to the State.

The broader economic benefits to the State of NSW and the region are considered in the CBA for NSW and the LEA for the local region, presented in Sections 3 and 4. The net economic benefits of the project for NSW are estimated at $373 million in NPV terms. For the local region, net economic benefits are estimated at $107 million in NPV terms.

Estimates of project employment are provided in Section 2.1. From FY 2023 to FY 2042, the project would generate an average of 273 operational jobs, as well on average 202 construction jobs from FY 2022 to FY 2024. In terms of project expenditure, the project is expected to require around $925 million (undiscounted) in total capital expenditures, including for sustaining capital expenditures and rehabilitation, and almost $2 billion (undiscounted) in operating expenditures, including for materials and services. Estimates of royalties accruing to the State of NSW are derived as part of the results for the CBA (Section 3). The project is expected to generate around $345 million in royalty payments in real, 2018 dollars, or $132 million in NPV terms.

### 2.3.2 Local government requirements

We understand that Wingecarribee Shire Council has not communicated any requirements with respect to the SEARs, and does not intend to do so.

# 3 Cost benefit analysis of the project

This section describes the CBA that has been undertaken to derive the net benefits of the project for the State of NSW:

- Section 3.1 describes the economic framework that has been applied to prepare the CBA;
- Section 3.2 describes the approach to valuing market transactions;
- Section 3.3 sets out the approach to valuing the predicted (non-market) external effects;
- Section 3.4 describes the approach to determining the foregone value of agricultural production;
- Section 3.5 comments on other matters raised in the 2015 Guidelines;
- Section 3.6 describes the results of the CBA, in terms of the net benefits of the project for NSW; and
- Section 3.7 describes the sensitivities of the results of the CBA to changes in various assumptions.

The flow-on effects of the project are described in Section 5. Appendix A describes the accounting framework and assumptions used for the CBA.

## 3.1 Economic framework

CBA is a technique for assessing the economic merits of an initiative or course of action (such as undertaking a mining investment) from the perspective of society as a whole. A CBA compares all costs and benefits attributable to the initiative, discounted to a common point in time, to arrive at an overall assessment of whether the initiative is 'net beneficial'; that is, whether society will benefit from its implementation. A project is net beneficial if the NPV of the sum of benefits minus the sum of costs is greater than zero.

### 3.1.1 Reference case and project scenario

A CBA requires that the economic merits of a project are compared to a meaningful counterfactual. The CBA prepared for the project therefore considers the incremental (net) benefits that would arise if the project is approved, referred to as the 'project scenario', relative to the counterfactual, referred to as the 'reference case'. For the Hume Coal project, the reference case is to 'do nothing', whereby the land owned by Hume Coal and required for the project would continue to be used for agricultural purposes.

### 3.1.2 Net benefits of the project for the State of NSW

The 2015 Guidelines set out that the purpose of the CBA is to estimate the net benefits of a proposed development for the State of NSW. From an economic perspective, the extent to which a project contributes to the welfare of a country or state differs from a private benefit

calculation, which focuses on the consumer and producer surplus. The public benefit of a project is measured with reference to 'value added'. Value added is the additional value of goods and services that are newly created in an economy, and that are available for domestic consumption or for export.

Value added is a central concept in the Australian System of National Accounts (ASNA), where it is referred to as 'gross value added' to emphasise that this measure is gross of the consumption of fixed capital (that is, depreciation). Gross value added is the difference between output and intermediate inputs (the value created by production) and equals the contribution of labour and capital to the production process (ABS 2013). Subject to adjustments that need to be made to ensure that valuations are internally consistent by accounting for various taxes and subsidies, the sum of gross value added across all industries in a country or state equals gross domestic product (GDP) or gross state product (GSP), respectively.

Given the objective of the CBA to identify the net benefits accruing to the State of NSW, the economic impacts of the project have been evaluated with reference to its contribution to NSW GSP. The focus on value added as a means of measuring the contribution of the project to NSW GSP is based on an internally consistent economic framework that reflects standard public accounting rules (United Nations 2003, Lequiller and Blades 2007). In particular, this framework avoids double-counting and enables a clear line to be drawn as to the factors that constitute a public cost or a benefit, and those that do not.

As discussed in the following sections, within a value added framework, the project's contributions to GSP fall into the following broad categories:

- the additional salaries and wages paid to the NSW workforce, which comprise the additional disposable income accruing to the NSW workforce and the NSW share of personal income taxes and Medicare contributions;
- the share of the project's 'gross operating surplus' (GOS) that can be attributed to NSW, including coal royalties, the NSW share of company income taxes, and the share of the project surplus that would accrue to residents of NSW; and
- the additional payroll taxes, land taxes, shire rates and levies paid to the State of NSW and local government.

Given that outlays associated with the project are projected to continue through to 2047, the CBA and LEA have been conducted over the timeframe from FY 2018 to FY 2047. All NPVs reported here are discounted to 2018 and presented in 2018 Australian dollars.

## 3.2 Valuation of market transactions

A CBA requires a full accounting calculation whereby the direct costs and benefits of a project are compared in monetary terms, and therefore requires that costs and benefits should, as far as possible, be valued. As a general matter, a CBA relies on the 'opportunity cost' principle to value goods or services (Commonwealth 2006). In practice, the opportunity cost concept is made operational with reference to the 'willingness-to-pay' criterion. For 'conventional', market based transactions, such as the sale of coal outputs or the purchase of labour and

other inputs, the relevant valuation is determined with reference to market prices.

### 3.2.1 Incremental income benefits attributable to NSW

The compensation of employees and long-term contractors is a key component of value added, and the incremental change in wage and salary payments associated with the project represents a contribution to NSW GSP. However, only a share of incremental wage and salary payments can be attributed to NSW, namely:

- the incremental disposable incomes (gross wages and salaries, net of superannuation, taxes, and Medicare contributions) paid to the NSW workforce; and
- of the total imposts paid by the workforce, the incremental share of income taxes and Medicare contributions that would accrue to NSW.

#### *3.2.1.1 Incremental gross income*

If approved, the project would represent a source of additional employment and additional gross income paid to the workforce. However, only a share of the added income accruing to the NSW workforce is strictly 'additional'. In the absence of the project, a share of the workforce would likely be employed elsewhere in NSW at an 'alternative wage'.

The income benefits accruing to NSW have therefore been reduced by the proportion of the workforce that would have found alternative employment in NSW at an alternative wage. The proportion of the workforce assumed to find alternative employment in NSW in the absence of the project is assumed to be 80 per cent in the central case modelled for the CBA. The remaining 20 per cent may remain unemployed or leave the NSW workforce, for instance, by retiring, or by moving interstate.

The 2015 Guidelines do not offer clear guidance on the approach to be adopted in relation to the wages paid to the workforce of a given project, and how the alternative wage should be determined. The Guidelines state that the economic benefit to workers (or 'wage premium') is the difference between the wage paid by a mining project and the minimum (reservation) wage that the workers would accept for working elsewhere in the mining sector. According to the 2015 Guidelines, an appropriate starting assumption should be that workers on a given mining project do not receive a wage premium; i.e., that workers are paid wages that are generally reflective of remuneration in the mining sector.

The following approach has been applied to estimating gross wages paid to the construction and operational workforce of the project:

- Annual average gross wages paid to the operational and construction workforce were provided by Hume Coal, on the basis of a detailed, bottom-up calculation reflecting the mix of skills and qualifications required for the project workforce over the life of the project. It is understood that the corresponding mix of wages and salaries reflects Hume Coal's estimates of the 'market rates' for the workforce composition that will be required.
- The alternative wage has been determined with reference to the average employee income applicable to the relevant geographical area. For the CBA, the alternative wage

is the average employee income for the State of NSW; for the LEA, the alternative wage is the average employee income for the Southern Highlands SA3 Region. A consistent alternative wage definition has therefore been applied for both geographical areas. The alternative wage is assumed to increase by 1 per cent per annum in real terms over the timeframe of the analysis.

In summary, the estimated wages that would be paid to the project workforce have been derived on the basis of market outcomes for similar types of skills, and do not incorporate any type of wage premium. The approach adopted here is therefore considered to be consistent with the 2015 Guidelines. The sensitivity of the CBA results to the alternative wage assumption is tested in Section 3.7.

#### 3.2.1.2 *Incremental disposable income*

The gross wages that would be paid to the project workforce and the alternative wage have been further adjusted to derive incremental disposable income. The per person disposable income was derived by taking average gross wages and deducting superannuation payments, income taxes, and Medicare payments. Aggregated across workforce numbers in the project scenario, this gives an estimate of the incremental disposable income accruing to the Hume Coal workforce.

#### 3.2.1.3 *Personal income tax and Medicare payments*

In the project scenario, the project workforce would make personal income tax and Medicare payments to the Commonwealth, a share of which can be attributed to NSW. In order to avoid overstating personal income tax and Medicare benefits, the same approach has been applied as for deriving disposable income benefits. That is, incremental tax and Medicare benefits were derived by subtracting the taxation and Medicare payments that would be made by the share of the workforce that would be employed elsewhere in the absence of the project.

### 3.2.2 Gross operating surplus attributable to NSW

One of the key components of the increase in NSW GSP attributable to the project is the share of its GOS that can be attributed to NSW. The GOS is the portion of the income derived from production that is earned by the capital factor of production (i.e. the capital invested in the mine). GOS is calculated as output valued at producer prices (gross mining revenues), net of intermediate consumption (operating expenditures), net of employee compensation, and net of taxes on production (ABS 2013). Only a portion of the incremental GOS associated with the project accrues to NSW, namely:

- the coal royalties paid by Hume Coal to the State of NSW;
- the share of company taxes paid by Hume Coal to the Commonwealth Government that accrues to NSW; and
- the share of any surplus generated by Hume Coal that accrues to NSW residents.

#### 3.2.2.1 *Royalties*

Incremental royalty payments accruing to NSW were derived by multiplying gross mining

revenues, net of allowable deductions for coal beneficiation, and net of estimated levies with the relevant underground ad valorem royalty rate of 7.2 per cent applied to the net disposal value.

Gross mining revenues were estimated by multiplying the product coal production schedules provided by Hume Coal with projected coal prices. Projected coal prices reflect contract prices forecast by the Australian Government (2018) through to 2023; these prices are assumed to remain at that level thereafter. Thermal coal contract prices in 2023 are projected at US$ 75 per tonne;[1] coking coal prices in 2023 are projected at US$ 162.9 per tonne.[2] These prices were adjusted by a price premium (discount) to reflect coal quality variations from the benchmark, and converted into Australian dollars using the Australian Government's forecast US$/AU$ exchange rate of 0.80.

The sensitivity of the results of the CBA to variations in coal price and exchange rate assumptions is considered in Section 3.7.

#### 3.2.2.2 *Company income tax payments*

Aggregate Commonwealth company income tax payments were derived by deducting operating expenditures, royalty and tax payments, and nominal depreciation from the respective gross mining revenues to derive taxable income. The inflation adjustment was made to account for the fact that depreciation is determined on the basis of nominal asset values. The company tax rate of 30 per cent was then applied to derive nominal company tax payments. Real ($2018) company tax payments were derived by adjusting for inflation, assumed to be 2.5 per cent per annum over the forecasting timeframe in line with the Reserve Bank of Australia's 2 to 3 per cent inflation target, on average, for its monetary policy. As required in the 2015 Guidelines, the share of incremental company income taxes paid as a result of the project that accrues to NSW was determined on the basis of the NSW share of the Australian population (32 per cent).

#### 3.2.2.3 *Share of GOS accruing to NSW residents*

Hume Coal's ultimate parent company, POSCO, is listed on Korean and US stock exchanges. Whilst it is possible that NSW residents own shares in POSCO (both directly, and via superannuation funds and index funds), this information is not available, and the profits attributable to residents of NSW arising from the project are not likely to be material in the scope of this CBA. For the purpose of this analysis, it has therefore been assumed that no share of project profits would accrue to NSW residents.

[1] Japanese Fiscal Year (JFY), starting April 1, 2018 JFY US dollars.

[2] 2018 calendar year US dollars.

### 3.2.3 Other taxation benefits attributable to NSW

#### *3.2.3.1 Payroll taxes*

Payroll taxes constitute a tax on labour and a contribution to NSW GSP. The 2015 Guidelines note that payroll taxes may be recognised as a benefit, provided that these taxes are shown to be additional and would not be offset by lower taxation payments elsewhere in the economy. The approach in relation to estimating incremental payroll taxes in this report therefore parallels that adopted to derive disposable income benefits accruing to NSW (Section 3.2.1). That is, the additional payroll taxes accruing to NSW have been derived by:

- estimating the payroll taxes that would be paid in the project scenario; and
- adjusting for the payroll taxes that would be paid for the share of the workforce assumed to find alternative employment in NSW at an alternative wage, to arrive at a full opportunity cost calculation.

#### *3.2.3.2 Local government rates*

Hume Coal will be required to pay local government rates in the project scenario over the operating life of the mine. Local government rates constitute a tax on land and a contribution to NSW GSP (as well as to the gross regional product). In FY 2018 Hume Coal is assumed to pay rates for coal mining activities of $93,527. In the absence of the project, the site of the proposed development would continue to be used for agricultural purposes, and corresponding rate payments of $18,422 would accrue to local authorities. These agricultural rate payments have therefore been deducted from Hume Coal's rate payments to arrive at a full opportunity cost calculation and identify the net benefit for NSW/the local region. Local government rates are projected to increase by 12.15 per cent in nominal terms in FY 2019 in accordance with Wingecarribee Shire Council's approved Special Rate Variation, and the same opportunity cost calculation (inflation-adjusted) has been applied in that year and in all subsequent years.[3]

#### *3.2.3.3 Land taxes*

Land taxes also constitute a tax on land and a contribution to NSW GSP. It has been assumed that Hume Coal would pay land taxes of around $114,000 per annum in the project scenario over the operating life of the mine. Land tax payments accrue to the State of NSW.

In the absence of the project, the site of the proposed development would continue to be used for agricultural purposes. Section 10AA of the NSW Land Tax Management Act, 1956 exempts land that is used for the dominant purpose of primary production, including for the purposes of cultivation and the maintenance of animals. No offsetting land tax payments have,

[3] Local government rate payments are projected to stay constant in real terms from FY 2020 onwards.

therefore, been incorporated.

## 3.3 Valuation of non-market (external) effects

The direct impacts of a project that are relevant for society, but for which a market value is not available need to be accounted for as part of the economic benefits and costs considered in a CBA. Such 'externalities' or 'external effects' are spillovers (positive or negative) from the production of a good or service, for example, in the form of air pollution or noise (negative spillovers).

The 2015 Guidelines specify that external effects should be assessed on a cumulative basis; that is, taking into account the effects of existing and already approved (but not yet operational) projects. Where relevant, these have been considered in the specialist studies undertaken for the project.

### 3.3.1 Overview of predicted impacts

The predicted environmental impacts of the project, including those from the associated BRP, are summarised in Table 3-1. Chapter 24 of the EIS provides a summary of the mitigation, management and monitoring measures proposed by Hume Coal. The approach to valuing the external effects is described in more detail below. The approach to estimating the value of foregone agricultural production is described in Section 0 below.

As set out in Table 3-1, the external effects associated with the project are limited. In particular, no air quality impacts (6) are expected, and traffic impacts (8) are expected to be negligible. These outcomes reflect a range of mitigation strategies incorporated in the design of the project, including:

- the design of the mining system such that there would be no damage to the water bearing zones in the sandstone, meaning inflows into the active mining area would be minimised;
- the use of 'non-caving' coal extraction methods such that surface subsidence impacts would be negligible;
- relatedly, the underground emplacement of reject material, which significantly reduces the potential for visual, dust and noise impacts, reduces the surface disturbance footprint, and eliminates the need for tailings ponds or cells on the surface;
- the use of covered rail wagons to transport product coal, reducing dust emissions from trains travelling to and from the project; and
- the use of advanced high performance locomotives that use less fuel and generate less emissions than older locomotives commonly used in Australia, as well as giving rise to less vibration and noise emissions.

**Table 3-1. Hume Coal project – Predicted external effects (including external effects attributable to BRP)**

| | Aspect | Issue | Predicted impacts |
|---|---|---|---|
| 1 | Surface water | Residual of licenses (water demand minus existing licenses) | No residual surface water licences are required. |
| | | Reduction in catchment area | Minimal reduction of approximately 94.2 ha in catchment areas:<br>▪ 0.8% of the total catchment for Medway Rivulet to its confluence with Wingecarribee River (totalling approximately 12,264ha); or<br>▪ 0.01% of the total catchment for Lake Burragorang (905,100ha). |
| 2 | Groundwater | Residual licensable groundwater take | Peak of approx. 153 ML/annum from the Sydney Basin Nepean groundwater source. |
| | | Private bores within zone of greater than 2m AIP minimal impact criteria | AIP 2012 minimal impact criteria exceeded at 94 landholder bores. |
| 3 | Visual amenity | Viewpoints in close proximity to the surface infrastructure area | Two viewpoints are predicted to experience a moderate visual impact (private residence along Medway Road and the Hume Coal Highway at its intersection with Medway road). No further mitigation is recommended. |
| 4 | Noise | Properties predicted to exceed project-specific noise levels (voluntary acquisition zone) | Number of properties is 2. |
| | | Properties predicted to exceed project specific noise levels (voluntary mitigation zone) | Number of properties is 9. |
| 5 | Ecology | Native vegetation to be removed | Clearing of 64 paddock trees (Brittle Gums and Scribble Gums) underlain by exotic pasture, resulting in an 'effective clearing area' requiring offset of 8.3ha for the mine infrastructure.<br>Clearing of 2ha of native vegetation (Broad-leaved Peppermint Narrow-leaved Peppermint grassy woodland and Snow Gum Woodland) for the BRP, requiring 0.2ha to be offset. |
| | | GDE to be impacted | No GDE to be removed.<br>No impacts are expected to ecosystems on Belanglo Creek and south of Wells Creek if periods of prolonged drought are not experienced during mining. |

| | Aspect | Issue | Predicted impacts |
|---|---|---|---|
| | | EEC vegetation to be removed | None |
| | | Threatened species directly impacted | None |
| | | Habitat of threatened species to be removed | Loss of 17 hollow bearing trees. |
| 6 | Air quality | Number of properties predicted to exceed dust criteria (acquisition zone) | Nil |
| | | Number of properties predicted to exceed dust criteria (management zone) | Nil |
| 7 | Greenhouse gas | Scope 1 and 2 emissions over the life of the project | 1.8 Mt CO2-e |
| 8 | Traffic | Level of service at assessed intersections (construction) | No or only marginal increases in wait times with no change to levels of service. |
| | | Level of service at assessed intersections (operations) | No or only marginal increases in wait times with no change to levels of service. |
| | | Predicted safety implications | No perceptible change predicted. |
| 9 | Aboriginal heritage | Aboriginal sites identified in the project area | No sites of high significance will be disturbed.<br>11 sites will be avoided and fenced.<br>20 sites will be impacted to some degree by the surface infrastructure area:<br>▪ 4 sites partially collected/fenced and avoided;<br>▪ 10 sites will be collected;<br>▪ 4 sites will be partially excavated with the remainder avoided;<br>▪ 2 sites will be subject to unmitigated impacts (subsurface sites of low significance which do not warrant further investigation or salvage).<br>An additional 8 sites will be directly impacted by the Berrima Rail Project:<br>▪ no sites of high significance;<br>▪ 2 sites of moderate significance;<br>▪ 6 sites of low significance. |

Notes: EECs refers to 'endangered ecological communities'. GDEs refers to 'groundwater dependent ecosystems. AIP refers to 'Aquifer Interference Policy'.

Source: EMM, Hume Coal.

### 3.3.2 Ground- and surface water impacts

The nature and magnitude of the potential impacts of the project on ground- and surface

water resources, as well as any wider implications for these resources, are described in detail in Appendix E of the EIS. Updated modelling has been undertaken following the EIS and is described in Hume Coal's Response to Submissions (RTS) document in Chapters 8 and 9 and in Appendix 2.

## Predicted ground- and surface water impacts

The impacts on ground- and surface water resources is predicted to be as follows:

- Minimal impacts on surface water resources are predicted as a result of the project. A temporary 0.8 per cent reduction in the catchment area of Medway Rivulet, in which the surface infrastructure area will be located, is predicted to occur as a result of project construction and operation.
- The predicted nutrient loads and concentrations in Oldbury Creek will fall within the applicable criteria.
- The water balance model demonstrates that the primary water dam has enough capacity to contain all surplus water and treatment and release of water is not required.
- Changes in flood levels and flood peak velocities as a result of the project for land not owned by Hume Coal are considered acceptable with reference to the assessment criteria.
- Groundwater inflows to the mine will occur during the period when the project causes stress on the groundwater system, which will be throughout the operational mine life and continuing for about three years after coal extraction ceases. 94 private landholder bores on 72 properties are predicted to be subject to a project impact drawdown of 2 m or more.
- With the implementation of various proposed mitigation measures, the project is not anticipated to result in a lowering of the beneficial use category of the groundwater source beyond 40 m from the activity.
- Cumulative impacts to groundwater and surface water quality are not anticipated as a result of the project.

## Mitigation and management measures

The project mine design and associated water management system has been optimised via an iterative process to minimise water extraction and groundwater inflow, conserve and reuse water, minimise evaporation losses, and minimise discharge to surface water systems. The mine design initiatives include:

- the diversion of runoff from undisturbed catchments back into the natural system to minimise unnecessary water capture;
- the first workings mining method and design of barrier pillars minimises groundwater depressurisation and drawdown, and prevents losses from surface water systems due to cracking;

- sealing of panels as mining progresses to allow the groundwater system to begin recovering immediately after a panel is sealed and provide more rapid recovery to overlying landholder bores that may be impacted;
- the use of water required for mine operations from within the void such that water from an external source is not required for the mine;
- scour protection measures downstream of the conveyor piers and box culverts so that water quality in Medway Rivulet is not impacted by erosion and sedimentation; and
- the installation of vegetated swales along the two mine access roads located outside of the water management system to result in acceptable nutrient loads and concentrations in Oldbury Creek.

Additional mitigation measures proposed in the RTS following post-EIS consultation with WaterNSW include:

- The installation of small constructed wetland areas at the ends of swales to polish surface water runoff during low-flow periods
- The protection of certain riparian zones along creeks and streams on Hume Coal owned properties

Monitoring of the extensive surface water and groundwater network will continue, and will form the basis for determining triggers and thresholds when management measures are required. Two overarching water management plans will be developed for the project, one for the construction phase and one for the operational phase.

A make good assessment was conducted during the EIS to address the project impacts on the bores that may be impacted by the project. This assessment has been expanded in the RTS. Hume Coal propose to apply a range of 'make-good' measures so that landholders have access to a reasonable quantity and quality of water that aligns to the bores' authorised use. These options include:

- compensation for additional electricity costs for pumping;
- lowering the pump intake in the bore;
- installing new headworks and piping to create a more efficient system;
- changing the pump so that it is better suited/more efficient to a decreased water level in the bore;
- deepening the bore to allow it to tap a deeper part of the aquifer;
- reconditioning the water bore to improve its hydraulic efficiency;
- drilling a new bore to a different depth or wider diameter.

Hume Coal holds the great majority of the necessary ground- and surface water licenses under the relevant water sharing plans to meet its expected licensing requirements during the project and post-mining.

The 2018 Technical Notes state that the market price of water should be considered the primary way to value the impacts on water quantity. The 2018 Technical Notes also require

proponents to take into consideration seasonal demand and supply factors, as well as the number and nature of participants in the market in determining the market price of water.

The surface water impacts of the project are limited and require Hume Coal to hold license allocations from the Medway Rivulet Zone of the Upstream Warragamba and Upper Nepean Unregulated River Water Source. Updated ground water modelling shows that Hume Coal already holds the surface water licences it requires.

The value of the surface water and groundwater licenses required by the project has therefore been assessed at Hume Coal's purchase prices and incorporated in the costings.

The costs of the various monitoring and mitigation activities, as well as those of the estimated make-good measures has been accounted for in the costings for the project.

### Other matters raised in the 2018 Technical Notes

There is no indication that the water requirements for the project would have an impact on third parties in a manner that is not already captured by market prices. As noted, the analysis of potential surface water impacts indicates that:

- the impacts on surface water resources are predicted to be minimal;
- the project would not lower the beneficial use category of the groundwater source beyond 40 m from the activity; and
- cumulative impacts to groundwater and surface water quality are not anticipated as a result of the project.

## 3.3.3 Biodiversity

Appendix H of the EIS contains the Biodiversity Assessment Report and Biodiversity Strategy for the project and Chapter 13 of the RTS responds to submissions dealing with biodiversity. Appendix 4 of the RTS provides additional information on biodiversity.

### Predicted biodiversity impacts

Ecological field surveys completed between 2012 and 2016 have informed the selection of a non-caving mining method that has negligible surface impacts, and minor residual impacts on native vegetation, threatened species, populations, communities and their habitats. The practices adopted by Hume Coal are consistent with the requirements of the *Framework for Biodiversity Assessment: NSW Biodiversity Offsets Policy for Major Projects (OEH 2014) (FBA)* to avoid and minimise most biodiversity impacts and to propose offsets to compensate for the minor residual impacts.

The primary ecological impact from the project, including the BRP component, would be the clearing of vegetation, including native vegetation and 64 paddock trees. Other biodiversity impacts are predicted to be minor:

- the project is not predicted to result in significant impacts for any terrestrial threatened species and communities;
- no threatened aquatic species were recorded or are predicted to occur; and

- Platypus habitat was found to be absent from the project area, and the breeding population of Platypus on the Wingecarribee River will not be affected by changes to base flow as a result of the project.

The small areas to be removed are predicted to provide habitat for a number of ecosystem and species credit species. Offset calculations have been undertaken in the BioBanking Calculator to determine the number of credits required to compensate for the project's residual surface impacts and enable the project to have a net positive effect on biodiversity.

### Mitigation and management measures

Monitoring and mitigation strategies are proposed to manage potentially affected ecosystems in the event of prolonged drought.

A biodiversity offset strategy is proposed to source offset areas containing the required ecosystem and species credits and will be finalised into a biodiversity offset package within 12 months of development consent. To compensate for the clearing impacts, the project would require 159 ecosystem credits for the removal of vegetation and 'ecosystem credit species' habitat, and a total of 631 species credits for the removal of habitat and 'potential habitat'. This represents a small increase in ecosystem credits and a small decrease in species credits from the original EIS assessment, and resulted from a request from OEH to reclassify patches that were assessed to be in low condition to moderate to good condition. An assessment of an offset area which would potentially satisfy this credit requirement was undertaken as part of the biodiversity assessment, and suitable credits were found in an area of 32 ha of native vegetation.

The Total Fund Deposit, the estimated cost of managing the biobank site, has been estimated with reference to the Biodiversity Credits Pricing Spreadsheet, administered by the NSW Office of Environment and Heritage. The Total Fund Deposit estimate incorporates the costs of a range of management actions, including for bush regeneration, fencing maintenance, and signage installation, as well as other recurring costs, such as monitoring and reporting costs, council rates and targeted surveys.

### Valuation approach

The 2018 Technical Notes set out that the requirement to assess and quantify impacts that are then reflected in an offset requirement (or biodiversity credit) means that key impacts on biodiversity have a direct and quantifiable economic cost. The ecological impacts associated with the project have therefore been valued at the cost of implementing the offsets and associated initiatives, and the costs included in the CBA analysis.

## 3.3.4 Noise

Appendix I of the EIS contains the Noise and Vibration Assessment for the project and Chapter 14 of the RTS responds to submissions dealing with noise and vibration.

### Predicted noise and vibration impacts

The noise and vibration assessment of the project found the following predicted impacts:

- During adverse weather conditions and with all the feasible mitigations applied:
  - nine dwellings will experience residual noise levels between 3 to 5 dB above project-specific noise levels (PSNLs) and are entitled to voluntary mitigation upon request; and
  - two assessment locations will experience residual noise levels greater than 5 dB above PSNLs and are entitled to voluntary acquisition upon request.
- The sleep disturbance assessment concluded that the predicted internal noise levels at the assessment locations will be well below those likely to cause awakenings.
- Construction noise levels during standard construction hours will exceed the noise management level (NML) at several assessment locations across the various construction stages. The 'highly affected' noise limit of 75 dB will not be exceeded at any time. Construction noise levels from proposed out of hours' activity are predicted to satisfy the evening and night NML at all assessment locations, with mitigation in place.
- Based on the safe working distances for typical construction plant items and the location of surrounding privately owned residential properties, human response vibration criteria are unlikely to be exceeded, as is likely to be the case for cosmetic damage criteria.
- Given that underground mine construction will occur at depths of approximately 110 m under the Hume Highway, it is highly unlikely vibration levels will cause structural vibration impacts to the Hume Highway.
- All roads that will be used to access the mine site where adjacent assessment locations exist will experience zero to negligible (1-2 dB) noise level increases.

## Mitigation and management measures

Hume Coal propose a range of mitigation measures to minimise noise impacts, including:

- the construction of a noise wall alongside a portion of the rail corridor;
- the use of low noise conveyor idlers, and of underground conveyor transfers;
- the cladding of the CPP and application of 'tuneable' soft-start equipment in the CPP;
- the cladding of conveyors;
- the placement of silencers on main vent fans; and
- the selection of alternative stockpile equipment that does not require the use of dozers to minimise noise and dust.

A noise management plan will be developed for the project, which will identify noise-affected properties, outline mitigation measures, specify protocols for routine noise monitoring, establish a protocol to handle noise complaints and specify procedures for undertaking independent noise investigations.

Hume Coal will manage construction noise levels where NMLs are exceeded by generally

limiting construction activities to standard hours only. Hume Coal will also manage construction vibration, which will include preparing a construction vibration management plan. Blasting activities during construction will be designed to satisfy relevant air blast and ground vibration criteria at all surrounding privately owned assessment locations.

### Valuation

The 2018 Technical Notes require that the current and future cost of any mitigation measures, negotiated agreements or land acquisition to mitigate noise impacts should be noted and included in the proponent's operating and capital costs. Conservative estimates of the relevant property purchase costs have been allocated and included in Hume Coal's costings.

No material residual noise impacts that cannot be mitigated through the NSW *Noise Policy for Industry (2017)* and the NSW *Voluntary Land Acquisition and Mitigation Policy* are predicted. The costs of preparing the requisite management plans, associated monitoring and forecasting activities, and any equipment modifications have been incorporated in Hume Coal's capital and operating expenditure costings. These costings also include the estimated purchase costs of properties eligible for voluntary acquisition and outlays for costs for noise mitigation measures at other potentially affected properties.

## 3.3.5 Air quality

Appendix K of the EIS contains the Air Quality and Greenhouse Gas (GHG) Assessment for the project, and Chapter 15 of the RTS provides Hume Coal's response to submissions that raised issues around air quality and greenhouse gasses.

### Predicted air quality impacts

The results of the dispersion modelling conducted for the construction and operational phases of the project indicate the following predicted impacts from the project:

- project-only related particulate matter, gaseous pollutant and odour concentrations, and dust deposition rates will be well below applicable air quality impact assessment criteria and minor;
- when project incremental concentrations are combined with concentrations from neighbouring emission sources, the combined concentrations are well below applicable impact assessment criteria; and
- the analysis of cumulative impacts shows that the potential for an exceedance of applicable NSW EPA impact assessment criteria to occur as a result of the project is very low.

### Mitigation and management measures

The mitigation measures incorporated into the project design accord with industry best practice dust control standards. The range of measures that will be implemented include stockpile watering on continuous cycle to reflect the prevailing weather conditions, the shaping and orientation of stockpiles to minimise emissions of particulate matter, watering at transfer points, and the full enclosure of conveyor transfer stations.

### Valuation approach

Given that the project would not breach air quality standards, no material compliance costs are expected. The ongoing costs of air quality monitoring and compliance initiatives described above have been incorporated in Hume Coal's ongoing operating expenditures.

## 3.3.6 Visual amenity

Appendix N of the EIS contains the Visual Amenity Assessment for the project, and Chapter 18 of the RTS provides Hume Coal's response to submissions that raised issues around visual amenity

### Predicted impacts

Given existing mature vegetation in the community and the landscape/topography, the project will not have significant adverse visual impacts. While infrastructure will generally be sited so that it is shielded by existing topography and vegetation, visual amenity is expected to be affected at two viewpoints along Medway Road.

### Mitigation and management measures

Hume Coal has planted vegetation screening consisting of native vegetation species that are common to the area, in order to mitigate potential views from Medway Road and the Hume Highway. Planting has already been undertaken to maximise the time available for establishment of the trees and plants, thereby ensuring the effectiveness of the screening as early as possible. The cost of the associated fencing, trees and labour has been spent and is a sunk cost and has therefore not been included in the analysis.

Hume Coal will develop lighting protocols to ensure that any mobile lighting plant is directed away from external private receptors, lighting sources are directed to minimise potential light spill, where possible lighting will be screened from external viewers, and lighting of reflective surfaces will be avoided. Suitable colours will be chosen for the project infrastructure to minimise visual impacts.

### Valuation approach

Given that that the visual impacts of the project are expected to be minimal, no material compliance costs are expected. The ongoing costs of maintaining the vegetation screening have been incorporated in Hume Coal's ongoing operating expenditures.

### 3.3.7 Aboriginal heritage impacts

Appendix S of the EIS contains the Aboriginal Cultural Heritage Assessment for the project, and Chapter 24 of the RTS provides Hume Coal's response to submissions that raised issues around Aboriginal heritage. Appendix 3 of the RTS provides additional information on Aboriginal heritage based on additional field surveys undertaken subsequent to the EIS.

#### Predicted impacts

The project's impact on Aboriginal cultural heritage values at a landscape level will be relatively small. 219 Aboriginal heritage sites were identified in the project area, of which 28 sites will be disturbed to some degree by the surface infrastructure area, comprising:

- eight sites of moderate significance, two of which are of higher moderate significance; and
- 20 sites of low significance.

No sites of high significance will be directly affected by the project. No subsidence impacts are expected for any of the 89 sites within the underground mining footprint.

#### Mitigation and management measures

The project's surface infrastructure area has been designed to avoid the areas of highest archaeological sensitivity close to Medway Rivulet and Oldbury Creek. Mitigation measures have been identified to mitigate impacts to the Aboriginal sites identified within the surface infrastructure footprint of the project, including test excavation and artefact collection. An Aboriginal Cultural Heritage Management Plan will be developed in consultation with stakeholders to provide for the active and passive management of Aboriginal sites, ongoing monitoring requirements and site salvage procedures. A range of Aboriginal heritage management measures will apply to the remaining identified sites for the duration of the project, including:

- active protection of Aboriginal sites that are located close to the surface infrastructure area through fencing;
- passive management by avoidance of Aboriginal sites that are located within the project area, but more than 25 meters from surface infrastructure;
- the collection of all surface stone artefacts in the surface infrastructure area disturbance footprint, and archaeological excavation of four sites of moderate significance;
- the monitoring of sites that may be susceptible to subsidence for the most significant sites above the underground mining area;
- procedures that specify actions to be taken in the event that human remains or Aboriginal sites are discovered; and
- procedures for the ongoing care of salvaged Aboriginal objects within a keeping place.

### Valuation approach

Consistent with the 2018 Technical Notes, compliance with Aboriginal culture, heritage assessments and permit processes have been included in the project costings. Given the limited scope of any impacts, no material indirect costs and benefits to the NSW community, for instance on cultural tourism, are expected.

## 3.3.8 Greenhouse gas emissions

Appendix K of the EIS contains the Air Quality and Greenhouse Gas (GHG) Assessment for the project, and Chapter 15 of the RTS provides Hume Coal's response to submissions that raised issues around air quality and greenhouse gasses.

### Predicted GHG emissions

Between FY 2021 and FY 2043 the project is predicted to give rise to around 1.8 Mt $CO_2$-e in Scope 1 and 2 GHG emissions in total. It is not expected that material annual variations in emissions from those that have been forecast will occur.

### Valuation approach

The 2018 Technical Notes state that market prices should be referenced in order to value GHG emissions and refer to the forecast price of European emission allowances (EUAs) as reflected in futures prices published by the European Energy Exchange (EEX). This approach has been adopted here, as shown in Table 3-2. Table 3-2 summarises total estimated (Scope 1 and 2) GHG emissions for the project, and the valuation of these emissions at 'central', 'high' and 'low' carbon prices, as recommended in the 2018 Technical Notes:

- The central forecast relies on the prices of EUA futures, as published by EEX (2018), and which are projected to increase from € 22.13 (AU$ 35.7) in December 2019 to € 27.13 (AU$ 43.8) in December 2026. EUA futures prices are not published beyond 2026; it has therefore conservatively been assumed that prices from that year onwards will increase by 2.6 per cent in real terms to € 45.15 (AU$ 72.8) in 2047, consistent with current trends in the evolution of futures prices.
- The high price forecast relies on carbon prices derived from the Australian Treasury Clean Energy Future Policy Scenario, in accordance with the NSW Government's 'Greenhouse Gas Emissions Valuation Workbook' (Department of Planning & Environment 2018a). These prices are assumed to increase from AU$ 33.6 in 2019 to AU$ 140.0 in 2048 ($2018 prices).
- The low price forecast relies on carbon prices derived from the US EPA Social Cost of Carbon (Department of Planning & Environment 2018a). These prices are assumed to increase from AU$ 19.3 in 2019 to AU$ 40.5 in 2047 ($2018 prices).

The 2018 Technical Notes require that the economic impact of GHG emission should be estimated for NSW only. In Table 3-2, the NSW share of costs associated with increased GHG emissions has therefore been calculated with reference to NSW GSP as a percentage of world GDP, which is around 0.28 per cent. On that basis, the social costs of the GHG emissions associated with the project using futures prices for EUA futures amount to around $103,000 in

NPV terms.

**Table 3-2. Hume Coal project emissions valuation**

| Total emissions / valuation | | | |
|---|---|---|---|
| Total scope 1 & 2 emissions ($Mt CO_{2-e}$) | European Emission Allowances - Futures prices (NPV AU$ 2018 million) | Australian Treasury Clean Energy Future Policy Scenario (NPV AU$ 2018 million) | US EPA Social Cost of Carbon (NPV AU$ 2018 million) |
| 1.796 | $36 | $49 | $20 |
| **NSW share of emissions / valuation** | | | |
| Scope 1 & 2 emissions ($Mt CO_{2-e}$) | European Emission Allowances - Futures prices (NPV AU$ 2018 million) | Australian Treasury Clean Energy Future Policy Scenario (NPV AU$ 2018 million) | US EPA Social Cost of Carbon (NPV AU$ 2018 million) |
| 0.005 | $0.103 | $0.140 | $0.056 |

Notes: NSW share of emissions has been calculated with reference to relative GDP/GSP. The Australian share of world GDP as of 2017 was 0.9%, and the NSW GSP share of Australian GDP as of June 2017 is 31.4%. The AU$ / € exchange rate is 0.62.

Source: Hume Coal; World Bank 2018; EEX 2018; ABS, 2018; 5206.0 Australian National Accounts: National Income, Expenditure and Product; Table 1 & Table 26.

## 3.4 Foregone value of agricultural production

This section describes the direct agricultural impacts that are expected as a result of the project. The flow-on effects that are expected to arise from a reduction in agricultural activity are described in Section 5.

### 3.4.1 Context

The Southern Highlands SA3 Region, comprising the SA2 regions of Southern Highlands, Hill Top – Colo Vale, Mittagong, Moss Vale – Berrima, Robertson - Fitzroy Falls and Bowral, has a diverse range of agriculture dictated by rainfall, soils and amenity values. The distribution of the gross value of agricultural production (GVA, a measure of the market value of the agricultural products produced) across the Southern Highlands SA3 Region is shown in Table 3-3.

Table 3-3 highlights the relative importance of the Roberson – Fitzroy Fall region, as well as the limited level of agricultural production in the other regions making up the Southern Highlands SA3 Region, particularly in the Bowral and Hill Top – Colo Vale regions. The project's surface infrastructure is located to the northwest of Moss Vale, with most of the mine infrastructure located northwest of the Hume Highway, on land predominantly used for grazing but in proximity to the villages of Medway, Berrima and New Berrima. In this area, potential stocking rates are at the lower end of the NSW range for a high rainfall zone (defined by average annual rainfall in excess of 550mm), due to its having lower levels of rainfall and relatively poor soils.

**Table 3-3. Southern Highlands SA3 Region – Gross value of agricultural production, by SA4 region (2015-16)**

| | Crops ($ millions) | Livestock ($ millions) | Total agriculture ($ millions) | Population density (Persons/ km$^2$, June 2015) |
|---|---|---|---|---|
| Southern Highlands SA3 Region | $10.1 | $23.0 | $48.8 | 21.1 |
| Comprising: | | | | |
| Southern Highlands SA2 Region | $2.7 | $5.2 | $8.9 | 4.8 |
| Hill Top-Colo Vale SA2 Region | $0.4 | $7.7 | $8.4 | 36.0 |
| Mittagong SA2 Region | $3.1 | $0.3 | $3.3 | 126.9 |
| Bowral SA2 Region | $0.8 | $0.6 | $1.4 | 240.7 |
| Moss Vale-Berrima SA2 Region | $0.0 | $2.3 | $4.9 | 87.1 |
| Robertson-Fitzroy Falls SA2 Region | $3.1 | $6.9 | $21.8 | 7.2 |
| New South Wales | $6,897 | $4,391 | $13,086 | 9.8 |

Source: ABS, 7503.0 - Value of Agricultural Commodities Produced, Australia, 2015-16; 3218.0 Regional Population Growth, Australia; 2016-17.

### 3.4.2 Direct agricultural impacts

The agricultural impacts of the project, including those associated with the BRP, relate to the displacement of agriculture during construction of the mine and the associated rail infrastructure, the displacement of agriculture as a result of the life-of-mine infrastructure, as well as any permanent impacts on soil productivity. Subsidence is not expected to disturb agricultural activities. Some drawdowns of the water table are predicted (Table 3-1); however, under the NSW Aquifer Interference policy, 'make good' provisions will apply, and have been included in the project costings.

The displacement of agriculture during the construction and operation of the project, including as a result of the rail infrastructure, as well as any permanent productivity losses due to the disturbance of land are internal costs to Hume Coal. These foregone values are also costs from a NSW perspective, and are counted as an offset against the direct and flow-on benefits of the project on NSW GSP and the local economy. As noted, the land that would be disturbed by the project is currently used for livestock production. Cropping in the project area is for fodder production. Current stocking rates (shown in Table 3-4) are considerably higher than when the land was initially purchased by Hume Coal owing to various pasture activities that have been undertaken.

**Table 3-4. Current livestock enterprises on the properties in the project area**

| Property | Land (ha) | Cattle * | Sheep * | DSE ** | DSE/ha |
|---|---|---|---|---|---|

| Property | Land (ha) | Cattle * | Sheep * | DSE ** | DSE/ha |
|---|---|---|---|---|---|
| Mereworth | 500 | 1,500 | N/a | 11,250 | 22.5 |
| Evandale | 580 | 1,000 | 8,000 | 15,500 | 26.7 |
| Stonnington | 120 | 400 | N/a | 3,000 | 25.0 |
| Eastern properties | 80 | 250 | N/a | 1,875 | 23.4 |
| Other freehold*** | 26 | 26 | N/a | 195 | 7.5 |

Notes: * Estimates as per Princess Pastoral Farm Management Plan (2015). ** Calculated using the assumption that cattle correspond to 7.5 Dry Sheep Equivalents (DSE). *** Land that will be disturbed by the project on other properties.

Source: Hume Coal.

### 3.4.3 Foregone value added of agricultural production

To estimate the foregone value of agricultural production from these properties (the net value added to the state economy), gross margins per hectare for typical livestock enterprises were taken from budgets compiled by the NSW Department of Primary Industry (2016). Gross margins are calculated as sales revenues less operating costs for representative livestock production systems. The systems selected are conservative, being amongst the highest returning per Dry Sheep Equivalent (DSE):

- the fattening of weaner calves at $48 per DSE; and
- Merinos ewes 20 micron at $36 per DSE.

The gross margins (or value per hectare, per annum) for the relevant properties and for farm properties applying 'typical' farm management practices are shown in Table 3-5. Gross margins on Hume Coal managed properties are significantly higher than would be the case for typical properties in the region. As a result, the foregone agricultural value added is also higher.

The NPV of gross margins is an approximate indicator of the foregone value of agricultural production that is analogous to the concept of value added in national and state accounts. Agricultural gross margins refer to revenues less variable costs but exclude capital costs and a return to owner-operator labour, and hence overstate the opportunity cost of the project. The degree to which opportunity costs are overestimated increases with the length of time considered, hence the estimates of foregone production values are conservative. This overestimation may be offset to some degree because the restoration of full agricultural productivity may not occur within the two-year rehabilitation period. However, these costs are not expected to be material, as the majority of the rehabilitation takes place at the end of the mine life. At an annual discount rate of 7 per cent, these costs are heavily discounted.

**Table 3-5. Agricultural gross margins, $ per hectare (A$ 2018)**

| | Hume Coal farm management | | | Typical farm management | | |
|---|---|---|---|---|---|---|
| Property | DSE/ha | $/DSE | $/ha/year | DSE/ha | $/DSE * | $/ha/year |
| Mereworth | 19.6 | 46 | 900 | 9 | 46 | 414 |

| Property | Hume Coal farm management | | | Typical farm management | | |
|---|---|---|---|---|---|---|
| | DSE/ha | $/DSE | $/ha/year | DSE/ha | $/DSE * | $/ha/year |
| Evandale | 17.8 | 43 | 774 | 9 | 43 | 391 |
| Stonington | 16.9 | 48 | 810 | 9 | 48 | 432 |
| Eastern properties | 14.8 | 48 | 711 | 9 | 48 | 432 |
| Other freehold ** | 9 | 48 | 432 | 9 | 48 | 432 |

Notes: * $/DSE is influenced by the percentage of sheep and cattle on the property. ** Land that will be disturbed by the project on other properties.

Source: Hume Coal / BAEconomics analysis.

The estimated foregone value added of agriculture production – the land removed from production multiplied by the corresponding gross margins – is shown in Table 3-6. The foregone value added of agriculture is estimated at $1.7 million in NPV terms.

**Table 3-6. Foregone agricultural value added (NPV A$ 2018)**

| Project phase | Hectares | Foregone value added |
|---|---|---|
| Construction phase | 279 | $529,000 |
| Operational phase | 135 | $1,178,000 |
| In perpetuity (post operational phase) | 3 | $15,000 |
| Total | 417 | $1,722,000 |

Notes: NPVs calculated using an annual discount rate of 7 per cent.

Source: BAEconomics analysis.

### 3.4.4 Foregone income and employment

Income in the form of wages and salaries derived from agriculture is a component of agricultural value added; it can therefore be expected that there may be some limited local impacts on income and employment due to agricultural land being removed from production. According to the ABS 2015-16 input output requirements table (ABS 2018), employee compensation makes up about 15 per cent of the value added by agriculture. The foregone income for NSW and for the Southern Highlands SA3 Region, assuming that farm labour is sourced locally, would then be approximately $260,000 in NPV terms.[4] Converting this estimate of foregone agricultural income to an annual amortised value over the life of the project corresponds to approximately $22,000 per annum. At an average regional wage of about $47,000, this represents a loss of FTE jobs of less than 0.5 per annum.

[4] As shown in Figure 2-4, Wingecarribee LGA largely aligns with the Southern Highlands SA3 Region.

## 3.5 Other matters raised in the 2015 guidelines

This section addresses other requirements discussed in the 2015 Guidelines.

### 3.5.1 Change in economic surplus in other NSW industries

The 2015 Guidelines specify that the CBA should incorporate changes in economic surplus arising in other NSW industries. For example, local suppliers may achieve higher surpluses as a result of a mining project, while there may be a loss of economic surplus in other industries.

This requirement poses practical difficulties, given that, at the local and state level, there are limited statistics on:

- the imported content of goods and services; or
- the stock of capital and the ownership of that capital.

Expenditures (for instance, as a result of purchasing equipment, materials and services) are relevant for determining the net benefits of a project for the State of NSW only so far as they can be apportioned to the value added by other NSW industries. For example, a business supplying local materials and labour, but using equipment constructed interstate or overseas, only adds local value from wages and the surplus or profits made from the supply of the materials in question. The balance of the expenditure flows to wages and to profits to those who manufactured the equipment. In addition, a change in surplus (or profits) in an industry is relevant for determining the net benefits of a project for NSW only so far as it accrues to residents of NSW that own or have a share in the capital invested. If a local business supplying materials to a development is owned by an interstate or overseas corporation, then no profits would flow locally or to the State of NSW, and the only component of expenditure that benefited the State of NSW would be any incremental wages paid to NSW residents and any incremental taxes paid in NSW.

The limitations described above imply that the change in economic surplus in particular NSW industries arising from the project cannot be measured with any precision, and we have not attempted to do so in this report. However, overall, the impacts of the project on other NSW industries are likely to be positive:

- Hume Coal would incur overall operating expenditures (net of labour costs) of $766 million in NPV terms ($1,949 million in total). If it is assumed, for illustrative purposes, that 10 per cent of these expenditures represents additional margins to NSW suppliers, the additional surplus accruing to suppliers would be $76 million in NPV terms ($195 million in total).
- The analysis of flow-on impacts for the State of NSW in Section 5 indicates that the project would generate additional value added in other industries of $119 million in NPV terms.

### 3.5.2 Economic benefit to existing landholders

The 2015 Guidelines note that a mining proponent may purchase or lease land from an existing landholder(s) at a price which may exceed the opportunity cost of the land. This is more likely

to occur when a mining proponent pays a premium above market prices for land acquisitions or leases. The corresponding surplus is an economic benefit that accrues to existing landholders and should be attributed to NSW.

Any future acquisitions, such as properties provided with voluntary acquisition rights as a result of the planning approval process, may include a slight premium to market value. However, the resulting net benefit accruing to landholders is insignificant relative to the overall net benefit to NSW generated by the project, and these premia often include a component of compensation to account for the costs of relocation. Therefore, the economic benefits accruing to local landholders have not been estimated. The approach adopted in this report is therefore conservative.

### 3.5.3 Net public infrastructure costs

Any net public infrastructure costs (the difference between the cost of the infrastructure to the public and any contributions made by the proponent) need to be included in the CBA. No public infrastructure costs are expected to be incurred for the project.

## 3.6 Net benefits of the project for NSW

The net economic benefit of the project for NSW is estimated at $373 million in NPV terms (Table 3-7). Key components include:

- royalty payments, which are estimated at $132 million in NPV terms (31 per cent of net benefits);
- net employment benefits in terms of the additional disposable income accruing to NSW residents and the NSW shares of personal and company income taxes, corresponding to:
  - $156 million in terms of net disposable income benefits;
  - $30 million in terms of the NSW share of personal income taxes; and
  - $32 million in terms of the NSW share of company income taxes; and
- incremental payroll taxes, shire rates and various levies, as well as the NSW share of Medicare payments amounting to around $24 million in NPV terms.

As discussed in Section 3.2, a number of adjustments have been made so that employment related benefits are estimated conservatively by accounting for re-employed workers, by including only incremental disposable income and incremental tax receipts and attributing the share of income taxes and Medicare contributions that would accrue to NSW. Net disposable income benefits have also been adjusted to account for the foregone income from reduced agricultural activities.

The net costs arising from external effects relate to the social cost of GHG emissions ($0.1 million in NPV terms) and the foregone value of agricultural production ($2 million in NPV terms). The remaining external effects would be internalised by Hume Coal and are accounted for in the cost-benefit calculation. These are the costs of measures to mitigate against environmental impacts, including groundwater, visual amenity, noise, and Aboriginal heritage

impacts, as well as a range of operating and capital costs to mitigate against potential external effects.

**Table 3-7. Incremental (economic) benefits of the project for NSW (NPV A$ 2018)**

| Costs | NPV (A$ m real 2018) | Benefits | NPV (A$ m real 2018) |
|---|---|---|---|
| **Production related** | | **Production related** | |
| | | Employment benefits: | |
| | | Disposable income | $156 |
| | | NSW share of personal income taxes | $30 |
| | | NSW share of Medicare payments | $2 |
| | | Share of Hume Coal gross operating surplus accruing to NSW: | |
| | | Royalties | $132 |
| | | NSW share of company income taxes | $32 |
| | | Taxes on production and imports: | |
| | | Payroll taxes | $16 |
| | | Shire rates | $1 |
| | | Land taxes | $2 |
| | | Levies | $5 |
| **Total production related** | | **Total production related** | $375 |
| Externalities (costs) | | Externalities (offsets) | |
| Loss of agricultural value added | $2 | Loss of agricultural value added | N/a |
| GHG emissions | $0.1 | GHG emissions | $0 |
| **Total externalities** | $2 | **Total externalities** | $0 |
| **Net economic benefits** | | | $373 |

Notes: NPVs have been derived using an annual discount rate of 7 per cent. Totals may not sum precisely due to rounding. Detailed calculations to derive production-related benefits that can be attributed to NSW are set out in Appendix A.

Source: BAEconomics analysis.

## 3.7 Sensitivity analysis

The 2015 Guidelines require a proponent to undertake sensitivity analyses of a range of variables as part of the CBA. The following sections consider variations in key parameters to assess the sensitivity of the net benefits generated by the project.

### 3.7.1 Variations in the discount rate

Discounting future cash flows using a compounding discount formula is undertaken in order to determine the equivalent present-day lump sum value of an investment or project. In accordance with the 2015 Guidelines, a real discount rate of 7 per cent per annum has been assumed for the analysis, and the sensitivity of the results of the CBA has been tested by applying a discount rate of 4 per cent and 10 per cent, respectively (Table 3-8). Reducing the discount rate to 4 per cent implies net benefits to NSW of around $410 million, while increasing the discount rate to 10 per cent implies net benefits to NSW of around $220 million.

At an inflation rate of 2.5 per cent per annum, a real discount rate of 7 per cent is equivalent to a nominal discount rate of 9.7 per cent per annum. The nominal discount rate is the rate that most lay people would equate with an interest rate or rate of return on an investment.

**Table 3-8. Net benefit to NSW – Discount rate sensitivity**

| Discount rate assumption | Incremental benefits of the project for NSW (NPV A$ m 2018) |
|---|---|
| 7 per cent real (9.7% nominal) | $373 |
| 4 per cent real (6.6% nominal) | $540 |
| 10 per cent real (12.8% nominal) | $265 |

Source: BAEconomics analysis.

### 3.7.2 Variations in coal prices and exchange rates

Most of the project's coal production would be exported and is priced in US dollars. The results of the CBA incorporate coal price forecasts sourced from the Australian Government (2018) and assume that the price for export benchmark thermal coal and coking coal would remain at US$ 75 per tonne and US$ $163 per tonne from 2024 onwards. The benchmark prices have then been adjusted according to relevant coal quality parameters, to reflect the likely price premia/discounts that would be applied to the benchmark. The US$/AU$ exchange rate is assumed to remain at 0.80 over the life of the mine.

Different combinations of coal prices and US$/A$ exchange rates will affect corporate income tax payments and royalty payments to NSW.

Table 3-9 shows the net benefits accruing to NSW as a function of various combinations of coal prices and exchange rates:

- for the coal price sensitivity, product (thermal and HCC) coal prices have been varied by +20 per cent and –40 per cent over the life of the mine, respectively; and

- for the exchange rate sensitivity, the US$/AU$ exchange rate has also been varied by +25 per cent and –25 per cent, respectively, over the life of the mine.

Table 3-9 shows that in the 'worst case' scenario modelled of a combination of a low coal price and a high exchange rate, the net benefits to NSW of the project would be $226 million in NPV terms. We note that such a low coal price and high exchange rate combination is unlikely, given that the Australian dollar is a 'commodity currency' that tends to appreciate and depreciate in line with the price of Australia's key exports – iron ore and coal (Cayen et al. 2010). In addition, the -40 per cent coal price sensitivity case is very conservative in that it would imply that coal prices remain for the life of the project almost 50 per cent below the average realised price for Australian exports over the past ten years. It follows that even under adverse assumptions the project is highly likely to be of net benefit to NSW.

**Table 3-9. Net benefit to NSW – Coal price and exchange rate sensitivity (NPV A$ m 2018)**

| Coal price assumptions / Exchange rates (US$/A$) | Thermal/coking coal price (after quality penalties) (US$ per tonne) | | |
|---|---|---|---|
| | $45.24/$97.76 | $75.4/$162.94 | $90.48/$195.28 |
| $0.60 | $286 | $436 | $511 |
| $0.80 | $248 | $373 | $451 |
| $1.00 | $226 | $335 | $390 |

Notes: NPVs have been derived using an annual discount rate of 7 per cent.
Source: BAEconomics analysis.

The 2015 Guidelines require proponents, where practicable, to undertake a sensitivity analysis of how much output prices would need to fall for a project to have a zero NPV, and to report on whether such a scenario is either likely or unlikely. Coal prices would need to fall by more than 60 per cent below central case levels and stay at that level over the life of the mine before the estimated NPV of the project to NSW would fall to zero (excluding disposable income benefits). This would represent a sustained long-term fall in price of well over 70% for coking coal (in Australian dollar terms) compared to today's benchmark price (as at 2 October 2018) of US$213 per tonne and exchange rate of 0.72. Such a scenario is highly unlikely.

### 3.7.3 Variations in employment assumptions (NSW)

As discussed in Section 3.2, only a share of employment benefits can be considered to be additional for the purposes of the net benefit calculation. Two key assumptions were adopted to estimate the additional employment benefits attributable to the project, namely:

- the proportion of the project workforce that would move to the project from alternative employment in NSW was assumed to be 80 per cent; and
- the alternative wage that the project workforce would earn in alternative employment was assumed to be the NSW median employee income.

Table 3-10 explores the implications of varying these assumptions. It can be seen that:

- the net disposable income benefits generated by the project increase, the smaller the share of the workforce that is assumed to move from alternative employment in NSW; and
- the net disposable income benefits generated by the project increase, the lower the alternative wage earned by the workforce.

**Table 3-10. Net benefits to NSW and net employment benefits – Variations in employment assumptions**

| | Net benefits to NSW (NPV A$2018 m) | Net employment benefits (disposable income) (NPV A$2018 m) |
|---|---|---|
| **Variations in the share of the Hume Coal workforce re-employed from elsewhere in NSW** | | |
| 70 per cent | $386 | $167 |
| 80 per cent (central case assumption) | $373 | $156 |
| 90 per cent | $360 | $144 |
| **Variations in the NSW alternative wage** | | |
| $42,126 (20 per cent decrease) | $391 | $170 |
| $52,658 (central case assumption) | $373 | $156 |
| $63,190 (20 per cent increase) | $355 | $141 |

Notes: NPVs have been derived using an annual discount rate of 7 per cent.
Source: BAEconomics analysis.

### 3.7.4 Variations in royalty payments

The 2015 Guidelines require an assessment of the royalties derived from the project if mining revenues are 25 per cent lower or higher than in the central case. Table 3-11 shows that an increase (decrease) in mining revenues by 25 per cent would result in project royalties of around $165 million and $98 million, respectively.

**Table 3-11. Net benefits to NSW and net royalty receipts – Variations in mining revenues**

| | Net benefits to NSW (NPV A$2018 m) | Net royalty receipts (NPV A$2018 m) |
|---|---|---|
| 25 per cent increase in mining revenues | $451 | $165 |
| Central case mining revenues | $373 | $132 |
| 25 per cent decrease in mining revenues | $295 | $98 |

Notes: NPVs have been derived using an annual discount rate of 7 per cent.
Source: BAEconomics analysis.

### 3.7.5 Variations in company income tax payments

The 2015 Guidelines require an assessment of a variation in company income tax by +/- 50 per cent. Table 3-12 summarises the results of the analysis.

**Table 3-12. NSW share of company income tax payments – Sensitivity**

| | Net company income tax payments (NPV A$2018 m) |
|---|---|
| 50 per cent increase in company income tax | $48 |
| Central case company income tax | $32 |
| 50 per cent decrease in company income tax | $16 |

Notes: NPVs have been derived using an annual discount rate of 7 per cent.
Source: BAEconomics analysis.

### 3.7.6 Major risks, unquantified and distributional impacts

The 2015 Guidelines require a discussion of major risks, as well as unquantified and distributional impacts relevant to the CBA. All resources projects are exposed to the risk of a major and sustained downturn in the price of the underlying commodity, in this case, coal prices. Beyond generic risks of this nature, we are not aware of major risks or potential impacts that have not been quantified in the CBA described in the preceding sections.

# 4 Local effects analysis

This section describes the economic impacts of the project on the local region, consistent with the requirements of the 2015 Guidelines:

- Section 4.1 describes the economic framework that has been applied to estimate the net benefits of the project that can be attributed to the local region; and
- Section 4.2 sets out the results of the LEA, in terms of the net benefits that would accrue to the local region.

The flow-on effects of the project on the local region are discussed in Section 5.

## 4.1 Economic framework

The same framework adopted for the CBA (Section 3.1) has been adopted for the LEA.

### 4.1.1 Incremental income benefits attributable to the local region

As is the case for the CBA, a number of adjustments have been made to ensure that employment and income benefits derived in the LEA are estimated conservatively. For the purpose of estimating the local income benefits only the incremental disposable income (gross wages and salaries net of taxes, superannuation and Medicare contributions) accruing to the local workforce has been included in the LEA.

Attributing income benefits to the local region furthermore requires assumptions to be made about the share of the workforce expected to reside in the Southern Highlands SA3 Region. The assumptions made in this report are consistent with those developed in the Social Impact Assessment (SIA) for the project (Appendix R, EIS).

The SIA assumes that 90 per cent of construction personnel will temporarily relocate to the local region, so that only 10 per cent of the workforce would be recruited locally. Where the operational workforce is concerned, Hume Coal will require all workers, including those involved in the mine closure, to live within a 45-minute travel time radius from the project for health and safety reasons. The 45-minute travel catchment (the 'workforce catchment area') includes most of the Wingecarribee LGA, as well as the following localities in adjoining LGAs:

- Douglas Park, Picton, Thirlmere, Tahmoor and Wilton (Wollondilly LGA);
- Carrington Falls (Kiama LGA);
- Kangaroo Valley (Shoalhaven LGA); and
- Goulburn and Marulan (Goulburn Mulwaree LGA).

The SIA considers two local recruitment scenarios, whereby 70 per cent and 50 per cent, respectively, of the project workforce would be recruited from within the workforce catchment area. Conversely, 30 per cent and 50 per cent, respectively, of the project workforce would relocate from elsewhere to the workforce catchment area. Taking the average of these two scenarios implies that 60 per cent of the project workforce would be

recruited from the (45-minute drive) workforce catchment area, and 40 per cent would relocate to the workforce catchment area.

Looking first at the 60 per cent of the operational workforce that would be recruited from the workforce catchment area, an assessment of the respective populations suggests that the population in the Southern Highlands SA3 Region accounts for at least 51 per cent of the population in the workforce catchment area. 31 per cent (60 per cent × 51 per cent) of the operational workforce is then assumed to be already based in the Southern Highlands SA3 Region. Looking next at the 40 per cent of the operational workforce that is expected to relocate to the workforce catchment area, the population distribution derived in the SIA predicts that 86 per cent of those relocating to the workforce catchment area would move to the Wingecarribee LGA, or equivalently, to the Southern Highlands SA3 Region.[5] 34 per cent (40 per cent × 86 per cent) of this share of the operational workforce would therefore be based in the Southern Highlands SA3 Region.

Overall, 65 per cent of the operational workforce has been attributed to the Southern Highlands SA3 Region for the purposes of preparing the LEA. 65 per cent is the sum total of the 31 per cent of the workforce that are estimated to already reside in the SA3 Region, plus the 34 per cent of the workforce that is expected to relocate there. The local income benefits have been derived on that basis.

We note that Hume Coal consider the estimates of the share of workers that would reside in the local region to be conservative, given that:

- there is an existing skills base in heavy manufacturing that would be directly transferrable in the Southern Highlands SA3 Region, and that may be attracted to the project workforce; and
- training programs provided by Hume Coal are expected to increase the potential to recruit local workers.

Overall, Hume Coal estimate that, given the reasonably large pool of suitable local workers, about 70 per cent of all workers may be sourced locally over the life of the project.

As is the case for the CBA, we have furthermore assumed that, in the absence of the project, a share of the workforce would be employed elsewhere in the local region. The disposable income benefits attributable to the local region have therefore been reduced by the proportion of the workforce assumed to find alternative employment in the local region at an alternative wage. As noted in Section 3.2, for the purposes of the CBA, 80 per cent of the workforce is assumed to find alternative employment in NSW in the absence of the project. This percentage has also been applied to the respective shares of the workforce assumed to reside in the local region; that is, 52 per cent (65 per cent × 80 per cent) of the project

[5] As shown in Figure 2-4, Wingecarribee LGA largely aligns with the Southern Highlands SA3 Region.

workforce is assumed to find alternative employment in the local region in the reference case.

The 2015 Guidelines set out that, for the LEA, the alterative wage should be determined as the average level of income in the local area. The alternative wage has therefore been assumed to be the average employee income in the Southern Highlands SA3 Region, determined to be $47,306 in 2018 dollars.

### 4.1.2 Other net benefits attributable to the local region

In addition to the incremental income benefits discussed above, net rate payments accruing to Wingecarribee Shire LGA also represent direct benefit to the local region. As discussed in Section 3.2, it has been assumed that Hume Coal would pay local government rates for mining activities in the project scenario over the operating life of the mine. These rate payments have been reduced by the rates that Hume Coal or another land owner would pay in the reference case (i.e., if agricultural production were to continue).

### 4.1.3 Other matters raised in the 2015 guidelines

Various other requirements of the 2015 Guidelines are discussed in the following sections.

#### *4.1.3.1 Non-labour project expenditure*

The 2015 Guidelines require a proponent to quantify (non-labour) construction and operating expenditures and to attribute that expenditure to the relevant local region. As set out in Section 3.5, meeting this requirement is not possible in practice. A key difficulty is that there are no data about the local content of any goods and services that Hume Coal may purchase, or about the ownership of the corresponding suppliers. For instance, and while it would, in principle, be possible to match mining expenditures to certain local postcodes (corresponding to a supplier's address), such an attribution would not be meaningful since a local postcode only indicates that a supplier has a local presence, not that the supplier is locally owned or what share of value added would accrue to the local region.

It is therefore not possible to provide a reliable estimate about the extent to which the projected operating expenditures would benefit the Southern Highlands SA3 Region, and these benefits have not been quantified in this report. However, as noted in Section 3.5, Hume Coal would incur operating expenditures of approximately $766 million in NPV terms for the project. A share of these expenditures, for instance, for transport, repair and maintenance services, various consumables, and food and accommodation services would be expected to benefit the local region.

#### *4.1.3.2 Effects on other local sectors*

The 2015 Guidelines require a qualitative discussion of the effects of a project on other local industries, including whether a project would displace specific land uses, affect tourism, or whether short run market adjustments, for instance in housing markets, might be expected.

##### Local housing market

The potential impacts of the project on the local housing market are discussed in the SIA (Appendix R, EIS). Overall, no significant adverse impacts are predicted:

- The construction workforce for the project (including for the BRP) would be housed in a purpose-built construction accommodation village (CAV), and would therefore not add to the demand for local housing.
- Given current availability and the forecast supply of new housing in the region, the operational workforce would also not significantly impact the local housing market. It is probable that there will be adequate capacity to cater for relocated workers and their families, so that mitigation measures would likely not be needed.

## Local tourism

Over the four years from 2014 to 2017, Wingecarribee LGA recorded on average 1.6 million visitors (including overnight and day-trip visitors), or around 1.7 per cent of the NSW total in 2017 (Austrade/Tourism Research Australia 2017). According to the ABS 2016 Census, of the employed people in Wingecarribee LGA, 3.0 per cent worked in cafes and restaurants. Other major industries of employment included aged care residential services (2.9 per cent), secondary education (2.7 per cent), hospitals (2.7 per cent) and primary education (2.3 per cent).

Table 4-1 below provides an overview of the number of tourism establishments and rooms, as well as associated accommodation revenues in Wingecarribee LGA, including the Bowral, Mittagong, Moss Vale – Berrima and Southern Highlands SA2 regions as of June 2016.[6] There were three tourist accommodation establishments in the Southern Highlands SA2 region (where the mine would be located), or 15 per cent of all establishments in Wingecarribee LGA. As of the quarter ending June 2016, revenues from tourist accommodation in the Southern Highlands SA2 region accounted for 3 per cent of total for the Wingecarribee LGA.

[6] As shown in Figure 2-4, Wingecarribee LGA largely aligns with the Southern Highlands SA3 Region.

**Table 4-1. Tourism establishments, rooms and accommodation revenues (June 2016)**

| | No. of establishments (June 2016) | Percentage WCB LGA | No. of rooms (June 2015) | Percentage WCB LGA | Revenues from accommodation (Quarter ending June 2016) | Percentage WCB LGA |
|---|---|---|---|---|---|---|
| Bowral SA2 Region | 8 | 40% | 293 | 45% | $2.1 | 51% |
| Mittagong SA2 Region | 5 | 25% | 151 | 23% | $1.0 | 25% |
| Moss Vale – Berrima SA2 Region | 4 | 20% | 114 | 18% | $0.9 | 22% |
| Southern Highlands SA2 Region | 3 | 15% | 87 | 13% | $0.1 | 3% |
| Total Wingecarribee LGA | 20 | 100% | 645 | 100% | $4.2 | 100% |
| Total Capital Country | 63 | | 2,118 | | $12.4 | |
| New South Wales | 1,424 | | 75,235 | | $801.4 | |

Notes: WCB refers to Wingecarribee LGA. Capital Country additionally includes Goulburn, Yass and the Yass Region, Young and the Young Region, and Queanbeyan, Queanbeyan – East, the Queanbeyan Region, and Queanbeyan West - Jerrabomberra

Source: ABS, 86350DO002_201415 Tourist Accommodation, New South Wales, 2015-16.

Table 4-1 suggests that the Southern Highlands SA2 region where the mine would be located accounts for a relatively small share of tourism establishments, and, in particular, a very small share of revenues from tourism accommodation in the Wingecarribee LGA. These high-level indicators suggest that negative impacts on tourism of the project would be limited. In addition, the project is an underground mine, so that any visual impacts would be limited. While some surface infrastructure would be required to support the project, the visual impact assessment of the project found that there are unlikely to be significant impacts on the character and amenity of the area.

### 4.1.4 Critical mass analysis of agricultural impacts

The NSW Guidelines for Agricultural Impact Statements (NSW Government 2012) require that if a project reduces the proportion of agricultural enterprises within a locality or region by more than 5 per cent, a 'critical mass threshold' analysis is required. The potential reduction in livestock production as a result of the project would be less than 5 per cent of total cattle production in the Southern Highlands region, and hence falls below the threshold for conducting a critical mass analysis.

## 4.2 Net benefits of the project for the local region

The 2015 Guidelines specify that the LEA should translate the effects estimated at the State level to the local level. For the local region, the net benefits of the project are expected to amount to $107 million in NPV terms, corresponding to (Table 4-2):

- additional disposable income of $108 million that would accrue to residents of the SA3 Region and $1 million in NPV terms in additional shire rate payments; and
- a small offset in terms of loss of agricultural value added of $1.7 million.

The estimated net benefits of $107 million account for the expected forgone value of agricultural production, the estimated foregone income from reduced agricultural activities, as well as reduced local government rate payments from agricultural activities. The externalities arising from GHG emissions associated with the project are global in nature and have therefore not been attributed to the local economy. This approach is consistent with the 2015 Guidelines, which recommend a focus on externalities that create material, un-mitigated effects within the locality.

**Table 4-2. Net benefits of the project, Southern Highlands SA3 Region (NPV A$ 2018)**

| Costs | NPV (A$ m real 2018) | Benefits | NPV (A$ m real 2018) |
|---|---|---|---|
| Production related | | Production related | |
| | | Employment benefits: | |
| | | Disposable income | $105 |
| | | Taxes on production and imports: | |
| | | Shire rates | $1 |
| Total production related | | Total production related | $109 |
| Externalities (costs) | | Externalities (offsets) | |
| Loss of agricultural value added | $1.7 | Loss of agricultural value added | N/a |
| Total externalities | $1.7 | Total externalities | $0 |
| Net economic benefits | | | $107 |

Notes: NPVs have been calculated using an annual discount rate of 7 per cent. Totals may not sum precisely due to rounding.

Source: BAEconomics analysis.

# 5 Flow-on benefits of the project

This section describes the analysis that has been undertaken to derive the secondary or flow-on benefits of the project for the State of NSW and for the local region. Section 5 is structured as follows:

- Section 5.1 sets out the approach taken to determine flow-on benefits;
- Sections 5.2 and 5.3 comment on the interpretation of input-output multipliers, and the limitations of input-output analysis, respectively;
- Section 5.4 describes the estimated flow-on benefits for NSW, accounting for agricultural impacts; and
- Section 5.5 describes the estimated flow-on benefits for the Southern Highlands SA3 Region, including in terms of agricultural employment impacts.

The detailed methodology used for deriving the input-output multipliers is described in Appendix B.

## 5.1 Economic framework

Flow-on effects refer to the adjustments in the economy that follow from initial changes in the level of demand for goods, services and labour arising from a significant development (such as the project). The economic framework described in the following has been applied to estimate these flow-on effects for the NSW and the local economy.

### 5.1.1 Choice of input-output analysis

There are a number of methods that can be used for calculating the flow-on effects for resources projects. They all face a singular issue in that the relative importance of a project increases when moving from a national to a state, and then to a regional perspective. At the same time, the degree of difficulty in estimating flow-on effects increases when moving from the national to the state and the regional level. For the most part, this reflects a general lack of information about the specific composition and source of intermediate inputs used by an industry, as well as about trade at a state and regional level. In addition, there may also be local rigidities in employment, capital assets and other fixed resources that are not consistent with the assumptions that underpin methodologies for measuring flow-on effects.

The methodology used here relies on input-output analysis to derive various multipliers. The primary reasons for selecting this methodology are the simplicity and clarity with which the underlying assumptions can be set out and appropriate caveats made. Further, when compared to more complex methods such a general equilibrium (GE) analysis:

- The gross value of the project is small in relation to the Australian and NSW economies. Unlike an input-output analysis, a GE analysis takes into account the price impacts of a project on inputs and outputs. However, given the relatively small size of the project (relative to the NSW economy), material price impacts would not be

expected and the difference between the results of a GE and an input-output analysis should also be small.

- Given the lack of information about industry structure and trade at a regional and state level, there is no reason to think that one method would be materially more accurate than another. Both GE and input-output analysis depend critically on accurately modelling flows of production and expenditure.

### 5.1.2 Adjusting regional/state industry composition and trade

Regional impact analysis depends, in large part, on adjusting the flows of production and expenditure, as represented by national input-output tables, to represent a state or local economy.[7] However, industries at a local or state level have differing compositions of inputs and outputs than is the case for the national average; the same difficulty arises for specific projects within a local region. Hence, a consistent set of ancillary information that is specific to national, state and regional economies is required to apportion national aggregates. The most commonly used information for this purpose (which is also recommended by the ABS) is industry employment.

The 2016 ABS Census contains information about employment by industry and at the LGA level. This employment information can be used to calculate location quotients (LQs) to adjust national industry structure and trade flow data to derive the corresponding state and regional aggregates. Employment based LQs are ratios that indicate the percentage of people employed in a particular industry at a state or regional level, relative to the percentage of people employed in that industry in the national economy. Employment based LQs are then used to proportionally adjust the contribution of an industry to the use of intermediate inputs in a state or region. The consequent shortfall in intermediate inputs is made up by increasing 'imports' from outside the state or region across all industries.

The use of employment LQs has a critical limitation. Input-output tables do not explicitly account for fixed capital, human or physical, although the returns to these assets are implicitly reflected in wages and operating surpluses (profits). As the impact analysis becomes more granular, the geographic location of these assets becomes increasingly important. A local region may simply not have the fixed capital needed to cost-effectively produce the input required by a local industry. The input will be then be 'imported' from other regions, states, or from overseas.

[7] Input-output tables capture the flows of intermediate inputs between producers and form the basis for deriving multipliers. These tables are generally prepared at a national level; national input-output multipliers are essentially derived from a weighted average of enterprises at the national level. Thus the Australian input-output tables reflect a snapshot in time of the entire Australian economy and the inter-relationships between producers, households, governments, and the outside world. However, while the ABS publishes national input-output tables, similar information about the relationships between economic agents within a region and flows into and out of a region ('imports' and 'exports') is not available.

## 5.2 Interpretation of input-output multipliers

A change in demand sets the economy in motion as the productive sectors buy and sell goods and services from one another and households earn additional incomes, which gives rise to further flow-on effects (Coughlin et al. 1991). These relationships cause the total effects on the regional and state economy to exceed the initial change in demand.

Economic flow-on impacts can be measured in terms of income, value added and employment, which in turn gives rise to income, value added and employment multipliers.[8] In the case of the project:

- the income multiplier refers to the percentage change in total income arising per dollar change in the wages and salaries paid by Hume Coal;
- the employment multiplier corresponds to the change in total employment (in numbers of FTEs) arising per additional person employed by Hume Coal; and
- the value added multiplier refers to the percentage change in total value added arising per dollar change in the value added created by Hume Coal.

Multipliers are classified into 'types'. Type I multipliers refer only to flow-on effects in the production sectors, while Type II multipliers incorporate subsequent impacts on households. In the case of the project:

- Type IA multipliers refer to the 'initial' and 'first-round' effects arising from an increase in demand from the project. The initial effect refers to the additional output from the project. The first-round effect captures the immediate subsequent impacts on income, employment or value added from all industries whose output is required to produce the additional output from the project.
- Type IB multipliers refer to the initial and 'production induced' effects, which encompass first-round effects and additionally 'industrial support' effects. Industrial support effects capture subsequently induced effects that occur after the first-round effects (since the initial output effect from project will induce additional output in other industries, which will in turn lead to further rounds of effects and so on).
- Type IIA multipliers incorporate the effects of the initial increase in output from the project on households and refer to the sum of production induced and consumption induced effects. Consumption induced effects capture the fact that, as a result of the

[8] It is also possible to calculate output multipliers, as representing the amount of additional output induced by the need for other industries to produce the output to meet the demand for an extra dollar of output from a project. However, the value of total business activity implied by output multipliers is larger than the market value of the goods and services that are produced, because some of the re-spending is used for the purchase of intermediate goods and services. Because of the implied double-counting, some commentators consider output multipliers to be misleading, and we do not report them here.

additional output from the project and subsequent production induced effects in other industries, wage and salary earners will earn extra income which they spend on goods and services produced by all industries in the state or region.

## 5.3 Limitations of input-output analysis

The principal advantage of the impact multiplier method is the simplicity with which levels of mining investment, employment and output can be translated into measures of changes in regional income and employment. However, the accounting conventions that form the basis of input-output models and hence how multipliers are derived impose a number of restrictive assumptions. Some of these assumptions pertain to input-output analysis generally while others relate to the use and interpretation of input-output analysis at a regional or state, as opposed to a national level. The key assumptions are set out below.

### 5.3.1 Key assumptions

#### Fixed capital stocks

The National Accounts, on which input-output analysis is based, do not explicitly account for fixed capital stocks. This is an issue with input-output analysis generally as fixed capital has a significant impact on how an industry adjusts over time. A corollary to this is that input-output analysis is static in the sense that it takes no account of the time required for the composition of inputs and outputs of production to shift to a changed level in output. Industries that require large amounts of fixed capital and labour adjust slowly, particularly when they are near full employment or when the supply of skilled labour is tight. These dynamics are hard to predict, but the implication over the short- to medium-term is that input-output effects will be overstated to varying degrees across industries.

The fixed nature of the capital stock is a critical issue in local impact assessments. In moving from the national to a state or local level, the location of fixed assets becomes increasingly important in establishing the goods and services that are supplied locally and those which are imported. Moreover, there is no information as to whether fixed assets are owned locally or whether the owners are located outside the region or state. As a consequence, determining the valued added by local industry becomes increasingly problematic.

#### Supply constraints

Relatedly, when the initial impact considered is an increase in production, the assumption of fixed production patterns requires that there is a sufficient endowment of resources that is either available in (or able to migrate to) a local region to meet the increase in demand for inputs whose supply is fixed. These inputs include resources such as land and water, as well as labour with adequate skills.

#### Homogenous and fixed production patterns

The input coefficients that measure inter-industry flows between sectors are ‘fixed’ in input-output models; at any level of output, an industry’s relative pattern of purchases from other sectors is unchanged. These assumptions are likely to be inconsistent with production patterns in the local economy, since the local economy may not have on offer the range of inputs

required for a given industry. Therefore, the impact of the change in output on the local economy will differ from that implied by a national multiplier.

#### Fixed prices

Input-output analysis assumes that prices in the economy in question are held constant, so that the additional material and labour inputs are available at existing prices and wage rates. In reality, prices of inputs may change with substantive changes in their demand. To the extent that there is an impact on prices, imputed output effects will be overstated. However, this is only a problem in input-output analysis for projects of a sufficient scale to materially shift the demand for production inputs and the total supply of industry output.

### 5.3.2 Implications for the LEA

Many of the above assumptions can lead to an overstatement of the impacts of a project; the resulting regional impact estimates should therefore be interpreted as an upper bound of the likely effects (Bess and Ambargis 2011, Coughlin et al. 1991).

Furthermore, and while, from a theoretical perspective, the total (Type IIA) multiplier is the appropriate choice for calculating flow-on effects (since this measure takes into account the full adjustment of the economy to a change in economic activity), total multipliers are calculated in a manner that compounds any measurement errors and breaches in the assumptions that underpin the analysis. For example, total multipliers are calculated as a progression of first, second and successive round effects, with each embodying any errors in earlier effects. From this perspective, a more conservative approach is to rely only on multipliers that capture only first-round effects (Type IA multipliers).

As noted above, there are additionally specific issues that arise in deriving local value added multipliers. Value added includes profits that are distributed on the basis of ownership of capital assets, which becomes increasingly uncertain as the analysis becomes more granular.[9] The calculation of value added multipliers at a local level is therefore not meaningful.

## 5.4 Flow-on effects of the project for NSW

The following sections describe the results of the analysis of flow-on impacts of the project for the State of NSW. The detailed multipliers are shown in Appendix B.

[9] For instance, there is no way of knowing from generally available public information whether a productive asset (say, a factory) that is located in the Southern Highlands SA3 Region is owned by persons living in that region, or in NSW, or elsewhere. It then becomes very difficult to attribute the value added generated by the factory on a regional and even state basis.

### 5.4.1 Agricultural flow-on effects for NSW

The results of the CBA described in Section 3 show that the project would generate direct net benefits for NSW in terms of an increase in GSP of $373 million in NPV terms (including accounting for a small change in value added in offsetting agricultural impacts). The increase in NSW GSP would give rise to corresponding flow-on effects; again, the offsetting foregone value of agricultural production needs to be taken into account.

The opportunity costs of foregone agricultural production on downstream and upstream industries are related to the level of agricultural output, as measured by the gross value of agricultural production. Using the Type 1A value added multiplier for NSW agriculture of 1.47 (Appendix B), the flow-on effects corresponding to the foregone value added of agricultural production would be of the order of $0.8 million in NPV terms. The estimated flow-on effects arising from the change in income and employment are estimated at:

- $0.1 million in NPV terms for foregone agricultural income; and
- 0.5 FTE jobs per annum for foregone agricultural employment.

### 5.4.2 Combined flow-on effects for NSW

Table 5-1 shows the estimated flow-on effects for the project for NSW, taking into account the offsetting agricultural (value added, income and employment) impacts. The assumptions made for the input-output analysis are consistent with those made in the CBA. The calculation of flow-on benefits focuses on changes in disposable income, and have been adjusted to account for the expectation that a share of workers would be employed elsewhere in the absence of the project. The multipliers that were used are reported in Appendix B.

Table 5-1 indicates that the flow-on benefits in terms of additional income, employment and value added generated by the project for NSW amount to:

- $149 million in NPV terms in terms of additional disposable income, or $13 million in NPV terms annually;
- on average, an additional 22 FTE jobs per annum; and
- additional value added of $119 million in NPV terms, or $10 million in NPV terms per annum.

**Table 5-1. Initial flow-on effects (Type IA) for the project – NSW (NPV A$ 2018)**

| | Total | Annual |
|---|---|---|
| Disposable income ($ millions) | $149 | $13 |
| Employment (Annual average FTE jobs) | N/a | 22 |
| Value added ($ millions) | $119 | $10 |

Notes: NPVs have been derived using an annual discount rate of 7 per cent.
Source: BAEconomics analysis.

In Table 5-1, the flow-on benefits attributable to the additional disposable income generated by the project are greater than the flow-on benefits attributable to the value added from the project. Disposable income is a component of value added, so that the value added flow-on effects should, by definition, also be greater than the income flow-on effects. However, the relative scale of the income and value added multipliers are proportional to the relative contribution of labour, capital and taxes to value added, as derived from the National Accounts. The ratio of income to value added for the mining sector as a whole is about one to five, or 20 per cent, whereas for the project the ratio is about one to two, or 50 per cent. With these differences in scale the application of an income and value added multiplier of 1.41 and 1.47, respectively, generate an income flow-on effect that is greater than the value added flow-on effect.

## 5.5 Flow-on effects of the project for the Southern Highlands SA3 Region

The flow-on effects of the project for the local region consist of the positive flow-on effects generated by the project, but also a small offsetting impact arising from a reduction in agricultural activities. As noted in Section 5.3, the calculation of value added multipliers for a small local area is not meaningful. To determine the local flow-on impacts of the project on the local economy, we have therefore focused on income and employment. Agricultural flow-on impacts

As noted in Section 3.4, we have assumed that all agricultural labour is sourced locally, so that the absolute impacts in terms of income and employment are the same as those estimated for NSW. Applying Type 1A multipliers for Wingecarribee Shire LGA (Appendix B), the local flow-on effects arising from land removed from agricultural production are approximated as:

- $0.2 million for the flow-on arising from foregone agricultural income; and
- 0.2 FTE jobs for the flow-on effects corresponding to foregone agricultural employment.

### 5.5.1 Combined flow-on benefits on the local region

Table 5-2 shows the estimated flow-on effects from the project for the Southern Highlands SA3 Region. The employment flow-on effects take into account the small reduction in flow-on impacts that is attributable to the displacement of agriculture by the project:

- the flow-on benefits in terms of additional disposable income generated by the project are estimated at $54 million ($5 million annually) in NPV terms; and
- the employment flow-on effects are estimated at an annual average of 24 FTE jobs.

## Table 5-2. Initial flow-on effects (Type IA) for the project – Southern Highlands SA3 Region (NPV A$ m 2018)

| | Total | Annual |
|---|---|---|
| Disposable income ($ millions) | $54 | $5 |
| Employment (Annual average FTE jobs) | N/a | 24 |

Notes: NPVs have been derived using an annual discount rate of 7 per cent.
Source: BAEconomics analysis.

# Appendix A Cost-benefit analysis

## A.1 CBA accounting framework

The accounting and definitional conventions set out in the following reflect the framework used in the Australian System of National Accounts (ASNA), as set out in Australian Bureau of Statistics (ABS 2013). These conventions have been applied to derive the net benefits accruing to NSW.

Formally, GSP at market prices derived using the income approach (GSP(I)) measures the sum of income flows accruing to the factors of production, plus taxes less subsidies on production and imports (ABS 2013):

$$\begin{aligned}&\text{GSP(I)=Compensation of employees}\\&+ Gross\ operating\ surplus\\&+ Gross\ mixed\ income\\&+(-)\ Taxes\ (subsidies)\ on\ production\ and\ imports\end{aligned}$$

In the ASNA accounting framework:

- 'compensation of employees' refers to the remuneration of labour in the form of wages, salaries, and employers' social contributions;
- gross operating surplus (GOS) refers to the share of income from production that can be attributed to capital inputs for incorporated businesses;[10]
- gross mixed income (GMI) is a similar concept as GOS, and refers to the share of income from production that can be attributed to unincorporated businesses (for instance, self-employed people) and therefore also includes a labour component; and
- taxes (subsidies) on production include taxes on products, such as goods and services tax (GST), and other taxes (subsidies) on production, such as payroll taxes or subsidies, land taxes, council rates, and taxes on pollution.

Only a portion of the incremental GOS associated with the project accrues to NSW, namely:

- the coal royalties paid by Hume Coal to NSW; and
- the share of company taxes paid by Hume Coal to the Commonwealth Government that accrues to NSW.

[10] Hence the contribution of capital to value added in NSW depends on the extent to which capital is owned by the residents of NSW.

Some share of the company taxes paid by Hume Coal to the Commonwealth Government can be deemed to benefit the residents of NSW. As for personal income taxes, there is no direct relationship between any company tax paid by Hume Coal to the Commonwealth and the resulting benefits accruing to residents of NSW. The share of company taxes paid by Hume Coal that accrues to NSW has therefore also been determined on the basis of share of population.

## A.2 Labour market assumptions

This annex describes the available empirical information about labour market outcomes that has informed the re-employment assumptions made about the project workforce.

### A.2.1 Literature review

#### Newly employed persons

There is relatively little empirical information about the origin of workers who are newly employed. According to the ABS 'Job Search Experience' survey (ABS 2014a), as of July 2013 and for Australia as a whole, 14 per cent of employed persons (1,668,700 out of 11,599,600) had started their job in the previous 12 months. Of these 14 per cent, 10 per cent (163,300) stated that this was the first job ever held, while 33 per cent (550,400) indicated that they had been out of work prior to starting a job. The share of persons transferring from occasional work, part-time work or full-time work elsewhere is not known.

#### Outcomes following involuntary redundancy

The most recent study of labour market outcomes following a retrenchment was published by the ABS in 2014 (ABS 2014b). That analysis found (Table A-1):

- Of those retrenched in the 12 months to February 2013, 50 per cent were employed at the end of that period, while 29 per cent were unemployed and 22 per cent were not in the labour force.
- Among those employed, many had changed at least one aspect of the work they had previously done: 27 per cent had changed industry; 19 per cent had changed occupation; 33 per cent had changed their hours of work; and 17 per cent had a change of employment type. Those changing their industry, occupation, hours of work or employment type may have changed several of these aspects.

**Table A-1. Persons retrenched during the previous 12 months, labour force status in the reference week of the survey**

| | Feb-00 | Feb-06 | Feb-13 |
|---|---|---|---|
| Labour force status in reference week of survey | | | |
| Employed | 46.4 | 54 | 49.5 |
| Changed industry (a) | 24.4 | 28.8 | 26.8 |

| | Feb-00 | Feb-06 | Feb-13 |
|---|---|---|---|
| Changed occupation (a) | 18.5 | 20.9 | 19 |
| Changed employment type (a) | n/a | 21.5 | 17.1 |
| Changed usual hours worked (a) | n/a | 38.6 | 33.1 |
| Unemployed | 29.9 | 28.7 | 28.9 |
| Not in the labour force | 23.7 | 17.3 | 21.6 |
| Total | 100 | 100 | 100 |

Notes: n/a Not collected in the 2000 Labour Mobility Survey. (a) Categories are not mutually exclusive. Retrenchments are defined as instances where persons ceased a job because they were either: laid off, the employer went out of business; and self-employed and the business closed down for economic reasons.

Source: ABS, 2014. 6105.0 - Australian Labour Market Statistics, Retrenchments (Feature Article), July.

A 2012 RBA analysis indicates that re-employment outcomes differ depending on whether workers separate from their jobs involuntarily (for instance, as a result of being made redundant) or voluntarily (for instance, to look for better employment opportunities). More than 75 per cent of people who leave their jobs voluntarily tend to find new employment in the same year. In contrast, of those employees experiencing an involuntary separation during the year to February 2012:

- 35 per cent were re-employed within the year;
- 43 per cent remained unemployed at the end of the year; and
- 23 per cent left the labour force altogether.

### Duration of unemployment

ABS (2014a) research provides information about the experiences of unemployed persons in seeking work and the duration of unemployment:

- 79 per cent of persons unemployed in July 2013 had been unemployed for less than one year. The percentage of unemployed persons who had been unemployed for one year or more increased by 1.2 percentage points between 2012 and 2013 (19.6 per cent and 20.8 per cent respectively). The proportion of unemployed persons who were unemployed for two years or more was 10 per cent in 2013.
- The median duration of current period of unemployment as at July 2013 was 17 weeks compared to 14 weeks from 2010 to 2012.

## A.3 Labour market assumptions

The CBA described in Section 3 and the LEA described in Section 4 consider the incremental benefits of the project accruing to NSW and the Southern Highlands SA3 Region. If the project is commissioned, employment would increase relative to the reference case between FY 2022 and FY 2043. A share of the workforce is assumed to be additional (that is, drawn from job starters or from the unemployment pool), while the remainder is assumed to be redeployed from existing positions in NSW. The central (re-) employment assumption used in this report is

that 80 per cent of additionally employed persons transfer from an alternative job in NSW.

For the purpose of the LEA, this assumption was modified by the share of employees assumed to reside in the Southern Highlands SA3 Region (Table A-2). As for the CBA, 80 per cent of additional workers are assumed to transfer from alternative jobs. Additionally, the targeted mix of local versus non-local (rest of NSW) employees was preserved, so that of the additional workers in the power station, 40 per cent are assumed to live in the Southern Highlands SA3 Region.

**Table A-2. Workforce (re-) employment assumptions**

| Analysis | Relevant geographical area | Percentage of workers redeployed | Percentage of workers from the relevant geographical area | Combined re-employment assumption |
|---|---|---|---|---|
| CBA | NSW | 80 | 100 | 80 |
| LEA | Southern Highlands SA3 Region | 80 | 65 | 52 |

Source: BAEconomics.

### Alternative wage

The approach that has been taken to determining the alternative wage is to apply the average employment income applicable to the relevant geographical area (Table A-3). In the CBA/LEA it has been assumed that the alternative wage would increase by 1 per cent in real terms per annum.

**Table A-3. Alternative wage assumptions – Average employee income**

| Analysis | Relevant geographical area | $ 2016 | $ 2018 |
|---|---|---|---|
| CBA | NSW | $49,256 | $52,658 |
| LEA | Southern Highlands SA3 Region | $44,250 | $47,306 |

Notes: $2016 incomes were converted to $2018 using the NSW wage price index.

Source: ABS, 2018. Estimates of Personal Income for Small Areas, 2011-16, 6524.0, Table 3 Estimates of Personal Income, Employee Income, 2011-16, Wage Price index, 6345.0, Table 8b. Ordinary Hourly Rates of Pay Excluding Bonuses, All Sectors, NSW.

## A.3.1 Other assumptions

Table A-3 summarises other assumptions used to derive the net benefits to NSW.

Long-term thermal and coking coal price forecasts were derived from thermal and coking coal contract price forecasts through to 2023 (Australian Government 2018), and assuming a central thermal coal forecast of US$ 75 per tonne (2018 US dollars) and a central coking coal price forecast of US$ 162.9 per tonne (2018 US dollars) for all years thereafter.

### Table A-3. Other CBA assumptions

| Assumption | Numerical value | Sensitivity | Source |
|---|---|---|---|
| Thermal coal price forecast (Japanese Fiscal Year (JFY); FOB Australia basis; Steaming coal with a calorific value of 6700 kcal/kg gross air dried; 2018 JFY US dollars; | US$ 75 per tonne | - 40 per cent / + 20 per cent | Australian Government 2018; Hume Coal. |
| Coking coal price forecast (FOB Australian basis; contract price assessment for high-quality hard coking coal; 2018 calendar year US dollars) | US$ 162.9 per tonne | - 40 per cent / + 20 per cent | Australian Government 2018; Hume Coal. |
| Exchange rates (US$ / AU$) | $0.80 | $0.60 to $1.00 | Australian Government 2018; Hume Coal. |
| Inflation * | 2.5 per cent | N/a | BAEconomics |
| Real wage indexation | 1 per cent | N/a | BAEconomics |

Note: * An inflation assumption is required for the company tax calculation.
Source: Australian Government 2018.

# Appendix B Analysis of flow-on effects

## B.1 Derivation of multipliers

This annex describes the methods used to calculate the flow- on effects of changes in the level of mining investment and production in NSW and the Mid and Upper Hunter region.

A number of practical difficulties arise in estimating regional or state-wide input-output multipliers for the purpose of conducting a regional impact analysis. Regardless of the approach that is adopted, regional impact analysis depends on national account statistics that, in Australia, are derived for the economy as a whole. The difficulty that then arises in assessing regional economic impacts is the inability to accurately account for the flow of goods and resources within and between regions.

The collection of regional employment statistics now provides a consistent and transparent method of deriving regional economic impacts at a reasonably granular level. The approach we have adopted here therefore makes use of 2016 census figures at an SA3 level and the most recent national accounts figures compiled by the ABS for 2015-16, as set out below.

### B.1.1 Concordance of the national accounts with census employment data

The Australian National Accounts input-output tables set out the flows of industry inputs (columns) and outputs (rows) for 114 industry classifications. The ABS census records employment an aggregated level with 19 industry classifications. The concordance between the census and the accounts is set out in Table B-1.

**Table B1. Industry concordance between the industries in the National Accounts and industry level employment data in the 2016 census**

| 2016 ABS census | ABS National Accounts industry codes | |
|---|---|---|
| Aggregate Industry | Starting from | Ending with |
| Agriculture, forestry and fishing | 101 | 501 |
| Mining | 601 | 1001 |
| Manufacturing | 1101 | 2502 |
| Electricity, gas, water and waste services | 2601 | 2901 |
| Construction | 3001 | 3201 |
| Wholesale trade | 3301 | 3301 |
| Retail trade | 3901 | 3901 |
| Accommodation and food services | 4401 | 4501 |
| Transport, postal and warehousing | 4601 | 5201 |
| Information media and telecommunications | 5401 | 6001 |
| Financial and insurance services | 6201 | 6401 |
| Rental, hiring and real estate services | 6601 | 6702 |

| | | |
|---|---|---|
| Professional, scientific and technical Services | 6901 | 7001 |
| Administrative and support services | 7210 | 7310 |
| Public administration and safety | 7501 | 7701 |
| Education and training | 8010 | 8210 |
| Health care and social assistance | 8401 | 8601 |
| Arts and recreation services | 8901 | 9201 |
| Other services | 9401 | 9502 |

Source: 5209.0.55.001 - Australian National Accounts: Input-Output Tables, 2015-16. 2016 ABS census.

To construct the flows of industry inputs and outputs at the same level of the census, the rows and columns are summed. For example, there are seven industries classified as being part of the broader agriculture classification. Summing the seven rows aggregates the outputs of agriculture as a whole into each of the 114 industries. Summing the resulting new rows across the seven individual agricultural industries give the total input requirements for agriculture as a whole from each the 114 regions. The final result is a balanced flow table with 19 industry classifications.

The balancing items include rows and columns that are important for the regional impact analysis:

- there are rows for wages and salaries, imports and value added, respectively; and
- there are columns for household consumption, as well as for other final demands.

### B.1.2 Requirements matrix and first-round (Type IA) output multipliers

The initial requirement for an extra dollar's worth of output of a given industry is called the initial output effect. It equals one in total for all industries, since an additional dollar's worth of output from any industry will require the initial one dollar's worth of output from that industry plus any induced extra output. The first-round effect is the amount of output required from all industries of the economy to produce the initial output effect.

First-round effects can be measured by deriving the 'direct requirements matrix'. In this matrix, the coefficients in a given industry's column show the amount of extra output required from each industry to produce an extra dollar's worth of output from that industry. The requirements matrix has been constructed from the Australian input-output (flows) table by standardising the inputs into each industry to produce one unit of output in each industry. This is achieved by dividing each row of the table by the total output on an industry-by-industry basis.

The first-round impact multiplier is then the sum of the standardised inputs for a given industry. For example, each element of the column for agriculture is divided by total agricultural output and then summed to obtain the total input requirement for one addition unit of output. The initial multiplier can be interpreted as the direct costs of an additional unit of production at current prices. Given these inputs are supplied domestically, the costs are other industry outputs and therefore contribute to total economic output. The sum of the

initial output effect (which equals one) and the first-round effect is the Type IA output multiplier. This is simply the total first-round contribution of a project to the economy. For a project that is small when compared to the size of the industry, the first-round and Type IA impact multipliers are valid given the requirements are representative of those used in the project.

### B.1.3 Simple output or Type IB multiplier

The simple Type IB multiplier takes into account the inputs required for the increased agricultural output (for example) that must also be produced, which requires the expansion of these industries and those that support them. These may be seen as series of flow-on effects that continue until the overall industry flows are again balanced.

Calculation of the simple multipliers requires solving a matrix equation. Let $A$ be the 19 by 19 matrix of industry requirements (as discussed above), $x$ a vector of inputs used in each of the industries and $y$ a vector of net outputs from the economy. Net output can be standardised to 1 for each industry, giving rise to the simple linear input-output equation:

$$Ax - x = 1$$

Solving for the overall input requirement to one additional unit of output from each industry:

$$x = (I - A)^{-1}$$

where I is an identity matrix with ones along the main diagonal and zeros elsewhere, and the superscript -1 denotes the matrix inverse. Summing the columns of $(1 - A)^{-1}$ gives the simple multipliers. For example, summing the agricultural column gives the total inputs from all industries needed to sustain the production of one additional unit of net agricultural output at the national level.

The simple multiplier represents a shift in the composition of industry output, as well as the total level of industry output assuming constant prices. This may be reasonably valid for a small increase in, for example agricultural, output. However, for large change like what has occurred in the Australian mining industry, output prices for most industries will adjust in an offsetting manner. That is, the relative prices for the outputs that are used more extensively in mining will rise, while prices for those that are less extensively use will fall. The implication is that the simple multiplier will, for a given increase in mining output, overstate the flow-on effects in industries where relative prices rise and understate flow-on effects where relative prices fall.

For a project that is small relative to the size of industry the price effects will be small and the bias in the simple multiplier may be ignored. However, the composition of flow effects will vary if the input requirements for the project differ from those of the industry. A comparison can lead to useful caveats regarding the simply multiplier effects on other industries.

### B.1.4 The total or Type IIA output multiplier

The total multiplier takes into account the relationship between wages and household demand, that is, the increase (decline) in household demand that results from a rise (fall) in

household income. This is derived by adding the wages row and the household expenditure column to the A matrix from the requirements table. Let the expanded matrix be denoted $B$. The total multipliers are analogous to the simple multiplier and given by the column sums of the matrix $\left(I - B\right)^{-1}$.

The key issue with the total multiplier is that wage rates and output price changes will tend to offset the effect. In a limiting case, an increase in wage rates will result in an increase in output prices and leave total output and real household expenditure unchanged. However, if the project is small relative to the size of the economy the effects on household income and wages can be ignored.

### B.1.5 Employment, income and value added multipliers

First-round, simple and total employment, income and value add multipliers can be calculated in much the same way as the output multipliers. The caveat noted for wage rates and employment in the previous section applies.

#### Employment multipliers

To calculate employment multipliers requires information about employment by industry that is provided in the ABS National Accounts (Table 20). For each industry, the FTE level of employment is divided by total industry output. This creates a vector of employment requirements per unit of output (denoted $h$) that can be used to convert the physical input requirements per additional unit of industry output into requirements for labour. The sum of these labour requirements constitute the employment multipliers, written in matrix notation as:

- Type IA: $hA$;
- Type IB: $h\left(I - A\right)^{-1}$; and
- Type IIA: $h\left(I - B\right)^{-1}$.

These multipliers give the FTEs of employment needed to support an additional unit of output. These multipliers can be adjusted to Type IA, Type IIA multipliers by expressing the multiplier as the total employment needed per person directly employed on the project. This is done by dividing each of the multipliers above by the number of workers required per unit of output. They are not the number of jobs created as this will be impacted by the number of part-time work that are converted to full-time workers or vice versa.

#### Income multipliers

The calculation of the income multiplier is done in the same way. The wage and salary requirement per unit are given in the requirements table. Designating these as a vector $w$ the income multipliers written in matrix notation are:

- Type IA: $wA$;
- Type IB: $w\left(I - A\right)^{-1}$; and

- Type IIA: $w\left(I - B\right)^{-1}$.

These multipliers can be adjusted to Type IA, Type IIA multipliers by expressing the multiplier as the total income per dollar of salaries and wages expended directly on the project. This done by dividing each of the multipliers above by the salaries and wages required per unit of output.

### Value added multipliers

Value added is the value of industry output less the costs of inputs, whether produced domestically or imported (the contribution to regional GDP). This can again be calculated, as a vector, $v$, from the requirements table as value added per unit of industry output. The multipliers are then calculated in an identical way to employment and income:

- Type IA: ;
- Type IB: ; and
- Type IIA: .

These multipliers can be adjusted to Type1A, Type 2a multipliers by expressing the multiplier as the total income per dollar of value added by the project. This done by dividing each of the multipliers above by the valued added per unit of output.

## B.1.6 Regional impacts

It is not possible to maintain the level of consistency that exists in national input output tables at a regional level. Comprehensive data on industry composition, household consumption and the flow of goods and services to and from regions is not available.

A standard approach that can be reproduced across different regional definitions in a consistent manner is to use employment by industry data to form what are known as location quotients (LQs). LQs are used to translate economy-wide input-output relationships into regional relationships. For instance, while coal mining only accounts for a small share of employment at a national level, employment in coal mining in the Mid and Upper Hunter region is very significant. Hence national input-output tables need to be adjusted to better reflect the characteristics of the local economy.

### Locational quotients

A raw LQ is simply the percentage of FTE employment in a given industry and region, divided by the percentage of FTE employment in a given industry at the national level. This may be written for the $i^{th}$ industry and the $j^{th}$ region as:

The LQ has a natural interpretation for an industry within a region:

- if the LQ is less than one, the goods and services from that industry will tend to be imported into the region to meet demand; while

- if the LQ is greater than one, the goods and services from that industry will tend to be exported into the region to meet demand elsewhere.

Given that goods and services and labour requirements are the same in all regions, the relationship will tend to be proportional so long as the actual size of the labour force does not represent a constraint. These are standard assumptions in an input output analysis. However, at the regional level, the violation of these assumptions can often be more apparent. For example, specialised good or services demanded for a project may simply not be produced domestically and may have to imported, with a consequent reduction in regional flow-on effects. However, this can be addressed within the context of the requirements table if project information on where purchases are made is available.

Total employment may not be a constraint for a large region, such as a state. However, while a large proportion of people may be employed in an industry in a small region, the overall workforce in that industry may not be sufficient to meet labour requirements. While this may in part be offset by migration, it can simply be more efficient to import goods and services into the region.

It is recommended practice (Bess and Ambargis 2011) to adjust the raw LQs in small regions by the following formula:

LQs consist of the ratio of an industry's share of regional earnings to the industry's share of national earnings. This adjustment has the effect of holding constant or reducing regional flow-on effects. The basic idea is that industries in the region are not likely to produce all of the intermediate inputs required to produce the change in final demand. In these cases, local industries must purchase intermediate goods and services from producers outside the region, thereby creating leakages from the local economy.

### Regional multipliers

Given LQ is a vector of location quotients, the regionally adjusted Type IA and Type IB input multipliers are calculated by multiplying the industry requirements by the quotients. The output multipliers are the column sums of:

- Type IA: $LQ' A$;
- Type IB: ; and
- Type IIA: .

Where × denotes element-by-element multiplication of each column of $A$ by $LQ$.

The income, employment and value add multipliers are calculated in the same manner as the national multipliers.

## B.1.7 Adjusted mining and agricultural industry expenditures

The LQ adjusts for locally sourced intermediate inputs. Therefore, the expenditure column of the input-output matrix, which includes wages, gross operating surplus, taxes and imports needs to be rebalanced to sum to total industry output. The balancing item is imports. The

adjusted State and regional mine and agricultural expenditure are shown in Table B-2.

**Table B-2. NSW and Southern Highlands LQ adjusted mine and agricultural expenditures**

| | NSW | | SA3 Region | |
|---|---|---|---|---|
| **Expenditure** | **Mining** | **Agriculture** | **Mining** | **Agriculture** |
| Agriculture, forestry and fishing | 0.1% | 14.2% | 0.0% | 0.2% |
| Mining | 4.6% | 0.2% | 0.1% | 0.0% |
| Manufacturing | 3.8% | 5.6% | 0.0% | 0.1% |
| Electricity, gas, water and waste services | 1.9% | 2.1% | 0.0% | 0.0% |
| Construction | 5.8% | 3.7% | 0.1% | 0.0% |
| Wholesale trade | 2.0% | 3.7% | 0.0% | 0.0% |
| Retail trade | 0.6% | 0.9% | 0.0% | 0.0% |
| Accommodation and food services | 0.5% | 0.3% | 0.0% | 0.0% |
| Transport, postal and warehousing | 2.6% | 3.3% | 0.0% | 0.0% |
| Information media and telecommunications | 0.2% | 0.2% | 0.0% | 0.0% |
| Financial and insurance services | 4.3% | 5.2% | 0.0% | 0.0% |
| Rental, hiring and real estate services | 2.0% | 1.4% | 0.0% | 0.0% |
| Professional, scientific and technical Services | 4.4% | 2.9% | 0.0% | 0.0% |
| Administrative and support services | 0.7% | 1.1% | 0.0% | 0.0% |
| Public administration and safety | 0.8% | 0.1% | 0.0% | 0.0% |
| Education and training | 0.1% | 0.0% | 0.0% | 0.0% |
| Health care and social assistance | 0.0% | 0.0% | 0.0% | 0.0% |
| Arts and recreation services | 0.1% | 0.0% | 0.0% | 0.0% |
| Other services | 1.7% | 0.8% | 0.0% | 0.0% |
| Total domestic inputs | 36.2% | 45.7% | 36.9% | 52.5% |

## B.2 Estimates of multipliers

### B.2.1 Mining

The multipliers reported in the following were derived from national level multipliers in accord with guidelines provided by the ABS (n.d.). State and regional multipliers were derived using employment LQs to translate economy-wide input-output relationships into regional relationships. Table B-3 shows the NSW mining multipliers derived from the 2015-16 National Accounts tables for:

- gross output (production);

- income;
- employment (FTE equivalent); and
- value added (contribution to GDP).

**Table B-3. NSW input-output multipliers (mining)**

| Multiplier | NSW | | |
|---|---|---|---|
| | Type IA | Type IB | Type IIA |
| Income | 1.96 | 3.00 | 2.67 |
| Employment | 1.54 | 3.76 | 4.01 |
| Value added | 1.32 | 2.57 | 3.21 |

Source: ABS, 2016. 5209.0.55.001 - Australian National Accounts: Input-Output Tables, 2015-16; 6291.0.55.003 - Labour Force, Detailed, Quarterly, August.

Table B-4 shows the corresponding multipliers for the Southern Highlands SA3 Region.

**Table B-4. Southern Highlands SA3 Region input-output multipliers (mining)**

| Multiplier | Southern Highlands SA3 Region | | |
|---|---|---|---|
| | Type IA | Type IB | Type IIA |
| Income | 1.50 | 2.89 | 3.79 |
| Employment | 1.91 | 3.61 | 5.59 |

Source: ABS, 2016. 5209.0.55.001 - Australian National Accounts: Input-Output Tables, 2015-16; ABS, 2016 Census.

### B.2.2 Agriculture

Table B-5 shows the NSW agriculture multipliers; Table B-6 shows these multipliers for the Southern Highlands SA3 Region.

**Table B-5. NSW input-output multipliers (agriculture)**

| Multiplier | NSW | | |
|---|---|---|---|
| | Type IA | Type IB | Type IIA |
| Income | 1.41 | 3.82 | 5.27 |
| Employment | 1.91 | 2.75 | 3.29 |
| Value added | 1.47 | 2.57 | 3.55 |

Source: ABS, 2018. 5209.0.55.001 - Australian National Accounts: Input-Output Tables, 2015-16; ABS 2016 Census; ABS 6291.0.55.003 - Labour Force, Detailed, Quarterly, August.

**Table B-6. Southern Highlands SA3 Region input-output multipliers (agriculture)**

| Multiplier | Southern Highlands SA3 Region | | |
|---|---|---|---|
| | Type IA | Type IB | Type IIA |
| Income | 1.87 | 3.68 | 4.95 |

| Multiplier | Southern Highlands SA3 Region | | |
|---|---|---|---|
| | Type IA | Type IB | Type IIA |
| Employment | 1.42 | 2.73 | 3.31 |

Source: ABS, 2018. 5209.0.55.001 - Australian National Accounts: Input-Output Tables, 2015-16; ABS 2016 Census; ABS 6291.0.55.003 - Labour Force, Detailed, Quarterly, August.

# References


Austrade/Tourism Research Australia, 2017. Local Government Area Profiles, 2017; at: https://www.tra.gov.au/Regional/Local-Government-Area-Profiles/local-government-area-profiles; accessed on 26 September 2018.

Australian Burau of Statistics, 2018. 5209.0.55.001 - Australian National Accounts: Input-Output Tables, 2015-16.

_____ 2014a. 6222.0 - Job Search Experience, Australia, July 2013; 5 February.

_____ 2014b. 6105.0 - Australian Labour Market Statistics, Retrenchments (Feature Article), July.

_____ 2013, Australian System of National Accounts, Concepts, Sources and Methods, Catalogue No. 5216.0.

_____ n.d., Information Paper, Australian National Accounts, Introduction to Input-Output Multipliers, Catalogue No. 5246.0.

Australian Government, Office of the Chief Economist, 2018. Resources and Energy Quarterly, March.

Bess, Rebecca, and Zoë O. Ambargis 2011, Input-Output Models for Impact Analysis: Suggestions for Practitioners Using RIMS II Multipliers; in: 50th Southern Regional Science Association Conference, New Orleans, Louisiana.

Cayen, Jean-Philippe, Donald Coletti, Rene Lalonde and Philipp Maier 2010. 'What Drives Exchange Rates? New Evidence from a Panel of U.S. Dollar Bilateral Exchange Rates,' Working Papers 10-5, Bank of Canada.

Commonwealth of Australia 2006, Handbook of Cost-Benefit Analysis, January.

Coughlin, Cletus, and Thomas B. Mandelbaum 1991, A consumer's guide to regional economic multipliers, Federal Reserve Bank of St. Louis Review, January/February, 73(1).

European Commission (1997), Guide to Cost-Benefit Analysis of Major Projects: In the context of EC Regional Policy, 1997 edition; at: http://ec.europa.eu/regional_policy/sources/docgener/guides/cost/pdf/3_full_en.pdf; accessed 12 October, 2016.

EEX, 2018, at: https://www.eex.com/en/market-data/environmental-markets/derivatives-market/european-emission-allowances-futures#!/2018/09/21; accessed 24 September 2018.

Lequiller, François, and Derek Blades, 2007. Understanding national accounts. OECD Publishing.

NSW Department of Planning and Environment, 2018. Technical Notes supporting the Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals, April.

NSW Government 2015, Guidelines for the economic assessment of mining and coal seam gas proposals, December.

NSW Department of Primary Industry 2016, Livestock gross margin budgets', at: http://www.dpi.nsw.gov.au/content/agriculture/farm-business/budgets/livestock; accessed on 18 September 2016.

NSW Treasury 2007, NSW Government Guidelines for Economic Appraisal, July.

Office of Chief Economist (March 2018).

Planning NSW 2002, Guideline for economic effects and evaluation in EIA, November.

Reserve Bank of Australia, 2012. Bulletin – December Quarter 2012, Labour Market Turnover and Mobility.

United Nations, 2003. National Accounts: A Practical Introduction, Studies in Methods Series F, No.85, Handbook of National Accounting. New York.

World Bank, 2018. Data catalogue, at: http://data.worldbank.org/data-catalog/GDP-PPP-based-table; accessed on 24 September 2018.