VICKERY EXTENSION PROJECT
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX J
ECONOMIC ASSESSMENT

WHITEHAVEN COAL

AnalytEcon

VICKERY EXTENSION PROJECT

ECONOMIC ASSESSMENT

Report prepared for
Whitehaven Coal Limited

August 2018

ACN 140 021 450

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Abbreviations

ABS	Australian Bureau of Statistics
ANZSIC	Australian and New Zealand Standard Industrial Classification
ASNA	Australian System of National Accounts
CBA	Cost-benefit analysis
CHPP	Coal Handling and Preparation Plant
EIS	Environmental Impact Statement
EPA	Environment Protection Authority
FTE	Full-time equivalent
GDP	Gross domestic product
GE	General equilibrium
GHG	Greenhouse gas
GOS	Gross operating surplus
GSC	Gunnedah Shire Council
GSP	Gross state product
Ha	Hectares
LEA	Local effects analysis
LGA	Local government area
LQ	Location quotient
ML	Megalitres
Mt	Million tonnes
Mtpa	Million tonnes per annum
NPV	Net Present Value
NSC	Narrabri Shire Council
NSW	New South Wales
Project Region	Local region comprising Gunnedah LGA, Narrabri LGA, Liverpool Plains LGA and Tamworth Regional LGA
RBA	Reserve Bank of Australia
RAP	Registered Aboriginal Party
ROM	Run-of-mine
SA3 Region	Local region comprising the Tamworth - Gunnedah SA3 region
SEARs	Secretary's Environmental Assessment Requirements
SSC	Semi soft coking

SUMMARY

The approved Vickery Coal Project (herein referred to as the Approved Mine) is an approved, but yet to be constructed, project involving the development of an open cut coal mine and associated infrastructure.

Whitehaven Coal Limited (Whitehaven) is seeking a new Development Consent for the extension of open cut mining operations at the Approved Mine (herein referred to as the Vickery Extension Project [the Project]).

AnalytEcon was commissioned by Whitehaven to prepare an economic assessment of the Project. The approach to preparing the assessment is consistent with various guidelines published by the New South Wales (NSW) Government, including the 'Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals' published in 2015 (the 2015 Guidelines) and the '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. They also require a 'local effects analysis' (LEA) to be undertaken to assess the likely impacts of the Project on the local economy.

NET BENEFITS OF THE PROJECT FOR NSW

Given that approval has been obtained for the Approved Mine, but that the Approved Mine has not been developed, the net public benefits that would arise if the Project is commissioned (the 'Project Scenario') have been assessed relative to two counterfactuals:

- a no development or 'do nothing' scenario, referred to as the 'Reference Case'; and
- the development of the Approved Mine (Vickery Coal Project), as approved, referred to as the 'Approved Mine Scenario'.

Construction would begin in 2019 in both the Approved Mine Scenario and in the Project Scenario, but the Project would have a shorter mine life of 25 years compared to 30 years for the Approved Mine.

First-round impacts

The Project would deliver significant net benefits to NSW relative to both counterfactuals considered. The stand-alone net benefits of the Project relative to the Reference Case would amount to $1,208 million in net present value (NPV) terms, consisting of:

- incremental royalty payments that would accrue to the NSW Government of $671 million in NPV terms;
- incremental disposable income payments accruing to NSW residents of $271 million in NPV terms;

- incremental company income tax payments attributable to NSW of $121 million in NPV terms;
- incremental profits accruing to NSW shareholders of Whitehaven of $53 million in NPV terms; and
- other incremental benefits accruing to NSW, comprising the NSW share of personal income taxes and Medicare payments, payroll taxes, land taxes and local government rate payments, that amount to $91 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 stand-alone net benefits of the Project for NSW have been calculated taking into account the social cost of the NSW share of an increase in greenhouse gas (GHG) emissions corresponding to $0.3 million in NPV terms.

The incremental net benefits of the Project relative to the Approved Mine Scenario would amount to $499 ($500) million in NPV terms, consisting of:

- incremental royalty payments that would accrue to the NSW Government of $261 million in NPV terms;
- incremental disposable income payments accruing to NSW residents of $114 million in NPV terms;
- incremental company income tax payments attributable to NSW of $57 million in NPV terms;
- incremental profits accruing to NSW shareholders of Whitehaven of $32 million in NPV terms; as well as
- other incremental benefits accruing to NSW, comprising the NSW share of personal income taxes and Medicare payments, payroll taxes and local government rate payments, which amount to $35 million in NPV terms.

Relative to the Approved Mine, the social cost of GHG emissions would be reduced, corresponding to a difference of (-) $0.03 million in NPV terms.

Flow-on impacts

In addition to the first round effects described above, the Project is expected to generate significant '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.

On a stand-alone basis (relative to the Reference Case), the Project would give rise to:

- incremental disposable income flow-on benefits of $146 million in NPV terms ($12 million per annum); and
- incremental value added flow-on benefits of $322 million in NPV terms ($25 million per annum.

Relative to the Approved Mine Scenario, the Project would give rise to:

- incremental disposable income flow-on benefits of $61 million in NPV terms ($5 million per annum); and
- incremental value added flow-on benefits of $138 million in NPV terms ($12 million per annum.

The Project would additionally generate annual average employment flow-on benefits of 316 full-time equivalent (FTE) jobs relative to the Reference Case, and 92 FTE jobs relative to the Approved Mine Scenario.

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 to adopt a study area using a Statistical Area Level 3 (SA3) geographical definition. In the case of the Project, the relevant SA3 area is the 'Tamworth-Gunnedah' region. The Tamworth - Gunnedah SA3 region incorporates the Gunnedah, Liverpool Plains and Tamworth Regional Local Government Areas (LGAs), but excludes large parts of the Narrabri LGA where part of the Project would be located and where a significant number of Project workers are expected to reside.

The following approach has therefore been adopted in this report for the purposes of assessing the economic impacts of the Project on the local economy:

- The LEA has been prepared for the local region comprising the four LGAs of Gunnedah, Narrabri, Liverpool Plains and Tamworth Regional, referred to as the 'Project Region'.
- In order to comply with the 2015 Guidelines, the LEA has additionally been prepared for the Tamworth - Gunnedah SA3 Region, referred to as the 'SA3 Region'.

First-round impacts

The first-round benefits of the Project for the local economy predominantly consist of the additional disposable income that accrues to the Project workforce. On a stand-alone basis (relative to the Reference Case) the Project would give rise to:

- incremental disposable income benefits of $224 million in NPV terms accruing to the Project workforce in the Project Region ($200 million in the SA3 Region); and
- incremental payments in shire rates accruing to local government of $3 million in NPV terms for either definition of the local region.

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 region if the Project does not proceed.

Relative to the Approved Mine Scenario, the Project would give rise to:

- incremental disposable income benefits of $93 million in NPV terms accruing to the Project workforce in the Project Region (or $83 million in the SA3 Region); and
- a reduction in shire rates accruing to local government of -$0.2 million in NPV terms (due to the reduction in mine life from 30 to 25 years relative to the Approved Mine).

Flow-on impacts

Significant flow-on benefits are estimated to arise in the local region. On a stand-alone basis (relative to the Reference Case), the Project would generate:

- incremental disposable income flow-on benefits of $92 million in NPV terms or $8 million per annum in the Project Region ($80 million or $7 million per annum in the SA3 Region); and
- annual average employment flow-on benefits of a total of 181 FTE jobs (153 FTE jobs in the SA3 Region).

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 or the Approved Mine.

Relative to the Approved Mine Scenario, the Project would give rise to:

- incremental disposable income flow-on benefits of $39 million in NPV terms or $4 million per annum in the Project Region ($34 million or $3 million per annum in the SA3 Region); and
- employment flow-on benefits of a total of 52 FTE jobs in the Project Region (44 FTE jobs in the SA3 Region).

Impacts on agriculture

The potential economic impacts of the Project on agriculture in the local region also encompass direct and flow-on impacts. Direct impacts refer to foregone agricultural production, including as a result of a biodiversity offset, that arise over the life of the mine or in perpetuity to land and water entitlement holders. Flow-on impacts arise as a result of reduced agricultural production on the demand for downstream agricultural services and upstream value adding enterprises.

The direct agricultural impacts of the Project have been valued as the opportunity cost of foregone agricultural production. Ignoring any offsetting non-market benefits associated with the biodiversity offset, the Project is projected to result in a loss of agricultural gross margins of $17.9 million in NPV terms ($1.6 million annually). Given that the corresponding land and water entitlements were purchased on the open market by Whitehaven, these impacts do not constitute a net cost to NSW or to the local region.

The agricultural flow-on impacts represent an offset to the broader flow-on benefits of the Project to the local region. This effect is insignificant at the state level. At the level of the local region it corresponds to:

- a reduction in disposable income of $15.5 million in NPV terms ($0.7 million per annum in NPV terms); and
- a reduction in employment of 12.6 FTE jobs over the life of the Project (0.5 FTE job per annum).

Relative to the Approved Mine, the Project would give rise to agricultural flow-on impacts of a reduction in disposable income of $5.6 million in NPV terms (around $0.3 million per annum), and a reduction in employment of 4.6 FTE jobs (0.2 FTE jobs per annum).

SUMMARY LEA ANALYSIS

The following summary table presents the results from the LEA for the Project, as required by the 2015 Guidelines:

- Over the life of the mine (2020 to 2044), the Project would generate direct employment of an annual average of 364 FTE jobs, of which 255 FTEs (218 FTEs) can be attributed to the Project Region (the SA3 region). Over the entire time horizon for which the LEA has been conducted (2020 to 2048), total (direct and flow-on) local employment effects are estimated at 393 FTE jobs in the Project Region, or 335 FTE jobs in the SA3 region.
- The Project is estimated to generate $271 million in NPV terms of additional disposable income for NSW as a whole, of which $224 ($200) million in NPV terms would accrue to residents of the Project Region (the SA3 region). Total (direct and flow-on) disposable income effects are estimated at $316 million in NPV terms for the Project Region, or $280 million in NPV terms for the SA3 region.

- Total non-labour (operating and capital) expenditures for the Project amount to $6,026 million in NPV terms. 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 ownership of capital. Hence any increase or loss of surplus in other industries cannot be attributed to a small geographical (local) area.
- The social cost of the GHG emissions from the Project that can be attributed to NSW is estimated at $0.28 million in NPV terms; that cost is insignificant at a local level. With the exception of GHG emissions, the costs of mitigating any other local external effects would be borne by Whitehaven; these costs therefore do not constitute a net cost at the local level or to the State of NSW. No material, unmitigated external effects or impacts on other local industries such as tourism have been identified.

Table S-1. Project – Summary LEA analysis

	Project direct:* NSW	Project direct:* Project Region (SA3 Region)	Net effect: Project Region (SA3 Region)	Total local effects: low** SA3 Region	Total local effects: high** Project Region
Employment (FTE jobs, annual average, 2020-2044)	364	255 (218)	N/a	335	393
Disposable income (NPV $2017, millions) ***	$271	$224 ($200)	N/a	$280	$316
Other, non-labour expenditure (NPV $2017, millions) ****	$6,026	N/a	N/a	N/a	N/a
Externality benefit/cost (GHG emissions, NPV $2017 millions)	$0.28	N/a	$0	$0	$0

Notes: * Direct employment effects have been calculated over the life of the mine (2020 – 2044), see Section 2.3. ** Total effects have been calculated over the forecasting horizon applied for the LEA and CBA (2020 – 2048). Total effects refer to combined direct and flow-on effects*** Disposable income is gross wages and salaries net of taxes, superannuation and Medicare payments. **** Other, non-labour expenditure is the sum of operating and capital expenditures.

Source: AnalytEcon.

1. INTRODUCTION

The former Vickery Coal Mine and the former Canyon Coal Mine were operated by Whitehaven Coal Limited (Whitehaven) and are located approximately 25 kilometres (km) north of Gunnedah, in New South Wales (NSW). Open cut and underground mining activities were conducted at the former Vickery Coal Mine between 1986 and 1998. Open cut mining activities at the former Canyon Coal Mine ceased in 2009. The former Vickery and Canyon Coal Mines have been rehabilitated following closure.

The approved Vickery Coal Project (herein referred to as the Approved Mine) is an approved, but yet to be constructed, project involving the development of an open cut coal mine and associated infrastructure, and would facilitate a run-of-mine (ROM) coal production rate of up to approximately 4.5 million tonnes per annum (Mtpa) for a period of 30 years.

Whitehaven is seeking a new Development Consent for extension of open cut mining operations at the Approved Mine (herein referred to as the Vickery Extension Project [the Project]). This would include a physical extension to the Approved Mine footprint to gain access to additional ROM coal reserves, an increase in the footprint of waste rock emplacement areas, an increase in the approved ROM coal mining rate and construction and operation of a Project Coal Handling and Preparation Plant (CHPP), train load-out facility and rail spur. This infrastructure would be used for the handling, processing and transport of coal from the Project, as well as other Whitehaven mines.

This Economic Assessment forms part of an Environmental Impact Statement (EIS) which has been prepared to accompany a Development Application made for the Project in accordance with Part 4 of the NSW *Environmental Planning and Assessment Act, 1979*.

1.1. SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

The Secretary's Environmental Assessment Requirements (SEARs) state that the EIS for the Project must include the following socio-economic components:

> *The EIS must address the following specific issues:*
> ...
> *Social &Economic – including:*
>
> ...
> - *an assessment of the likely economic impacts of the development, paying particular attention to:*
>
> – *the significance of the resource;*

- *the economic benefits of the project for the State and region and the demand for the provision of local infrastructure and services, having regard to Gunnedah Shire Council's and Narrabri Shire Council's requirements (see Attachment 2).*

1.1.1. Significance of the resource

It is expected the NSW Government will consider the 'significance of the resource' for the Project, both to the State of NSW and the region. This includes items such as employment generation, expenditure and the payment of royalties, which are addressed in this report:

- The economic benefits to the State of NSW and the region are considered in the cost-benefit analysis (CBA) for NSW and the local effects analysis (LEA) for the local region, presented in Sections 3 and 4, respectively, as well as in Section 5, which evaluates the state and regional flow-on effects. The net economic benefits for NSW of the Project are estimated at $1,208 million in net present value (NPV) terms. For the local region, the net economic benefits are estimated at $227 million or $203 million in the Project Region or SA3 region, respectively.
- Estimates of direct and flow-on employment generation are provided in Section 3 and in Section 5. Over the life of the mine, the Project would generate an average of 344 operational jobs (364 jobs if construction jobs are included). The Project would additionally generate 316 full-time equivalent (FTE) jobs in NSW, in terms of annual average employment flow-on benefits, or 181 and 153 FTE jobs in the Project Region or SA3 region, respectively.
- Project expenditures are considered in both the CBA and LEA (Sections 3 and 4). In NPV terms, the Project is expected to require $674 million in capital expenditures, and $5,352 million in operating expenditures.
- The estimated royalties from the Project are described in Section 3. In NPV terms, the Project is expected to generate $671 million in royalty payments to NSW.

1.1.2. Local government requirements

In accordance with the SEARs for the Project, this report and the EIS also have regard to Gunnedah Shire Council's (GSC's) and Narrabri Shire Council's (NSC's) inputs to the SEARs contained in Attachment 2 to the SEARs. Table 1-1 summarises where the GSC and NSC inputs are addressed.

Table 1-1. Local government authorities' comments for the SEARs

Local Government Authority	Comment	Addressed in
Gunnedah Shire Council	Financial contributions to GSC	Section 4.3 in this report
	Population and housing impacts, including accommodation impacts	Social Impact Assessment (Appendix R).
	Workforce and training impacts, including training programs, workforce supply	Social Impact Assessment (Appendix R).
	Environmental impacts on family farms and homes in the vicinity of the mine	Agricultural Impact Statement (Appendix H), Social Impact Assessment (Appendix R), Noise and Blasting Assessment (Appendix D), Air Quality and Greenhouse Gas Assessment (Appendix E), Visual Assessment (Appendix L) and Groundwater Assessment (Appendix A).
	Cumulative impacts	Section 4 of the EIS Main Text.
Narrabri Shire Council	Likely and potential impacts on Council infrastructure, in particular Council's road network and any consequent need for upgrades or increased maintenance, as well as management and funding	Road Transport Assessment (Appendix I).
	Socio-economic impacts on Narrabri Local Government Area (LGA) in relation to employment and housing	Social Impact Assessment (Appendix R).
	Environmental impacts on neighbouring properties and Narrabri LGA, including in relation to dust	Agricultural Impact Statement (Appendix H), Social Impact Assessment (Appendix R), Noise and Blasting Assessment (Appendix D), Air Quality and Greenhouse Gas Assessment (Appendix E), Visual Assessment (Appendix L) and Groundwater Assessment (Appendix A).

1.2. APPROACH

This economic assessment has been prepared to address the economic components of the SEARs, and with reference to the guidelines published by the NSW Government: the 'Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals' (NSW Government 2015) ('the 2015 Guidelines') and the 'Technical Notes supporting the Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals' (NSW Government 2018) ('the 2018 Technical Notes').

The 2015 Guidelines require a CBA to be undertaken to assess the net benefit of the Project to the NSW community. The 2015 Guidelines also require an 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.

Some aspects of the methodologies set out in the 2015 Guidelines are problematic from a national and cost-benefit accounting perspective. The approach that has been adopted in this report is:

- to prepare the CBA in a manner that is conceptually correct, noting any differences to the methodology set out in the 2015 Guidelines and how they affect the results where they arise; and
- to prepare the LEA for a geographical definition that is considered to best capture the local impacts of the Project, as well as for the geographical definition determined by application of the 2015 Guidelines.

1.3. STRUCTURE OF THIS REPORT

This report is structured as follows:

- Section 2 describes the Project and the Approved Mine;
- Section 3 describes the framework applied to undertake the CBA, the net benefits of the Project for NSW, and the results of various sensitivities;
- Section 4 describes the approach to undertaking the LEA and the net benefits of the Project for the local region; and
- Section 5 sets out the approach taken to derive the flow-on effects of the Project, and the Project's State and local flow-on benefits.

Supporting documentation is presented in the following appendices:

- Appendix A describes the methodology and assumptions used for the CBA and the LEA;
- Appendix B describes the methodology for deriving the flow-on effects of the Project;
- Appendix C describes the analysis of agricultural impacts.

2. PROJECT AND REGIONAL CONTEXT

This section provides an overview of the Project and the Approved Mine and the regional context:

- Section 2.1 and Section 2.2 describe the range of activities comprising the Project and Approved Mine, respectively;
- Section 2.3 describes the key parameters of the Project, in terms of coal production, employment, as well as planned capital and operating expenditures; and
- Section 2.4 describes other existing or planned resources projects in the region.

2.1. PROJECT OVERVIEW

The Project involves mining the coal reserves associated with the Approved Mine, as well as accessing additional coal reserves within the Project area. ROM coal would be mined by open cut methods at a rate up to approximately 10 Mtpa, over a mine life of approximately 25 years.

The Project would include a physical extension to the Approved Mine footprint to gain access to additional ROM coal reserves, an increase in the footprint of waste rock emplacement areas, an increase in the approved ROM coal mining rate and construction and operation of a Project CHPP, train load-out facility and Project rail spur. This infrastructure would be used for the handling, processing and transport of coal from the Project, as well as other Whitehaven mines.

A detailed description of the Project is provided in Section 2 in the Main Report of the EIS.

2.2. APPROVED MINE OVERVIEW

The Approved Mine is an approved, but yet to be constructed, project involving the development of an open cut coal mine and associated infrastructure, and would facilitate a ROM coal production rate of up to approximately 4.5 Mtpa for a period of 30 years.

A detailed description of the Approved Mine is provided in the Main Report of the EIS.

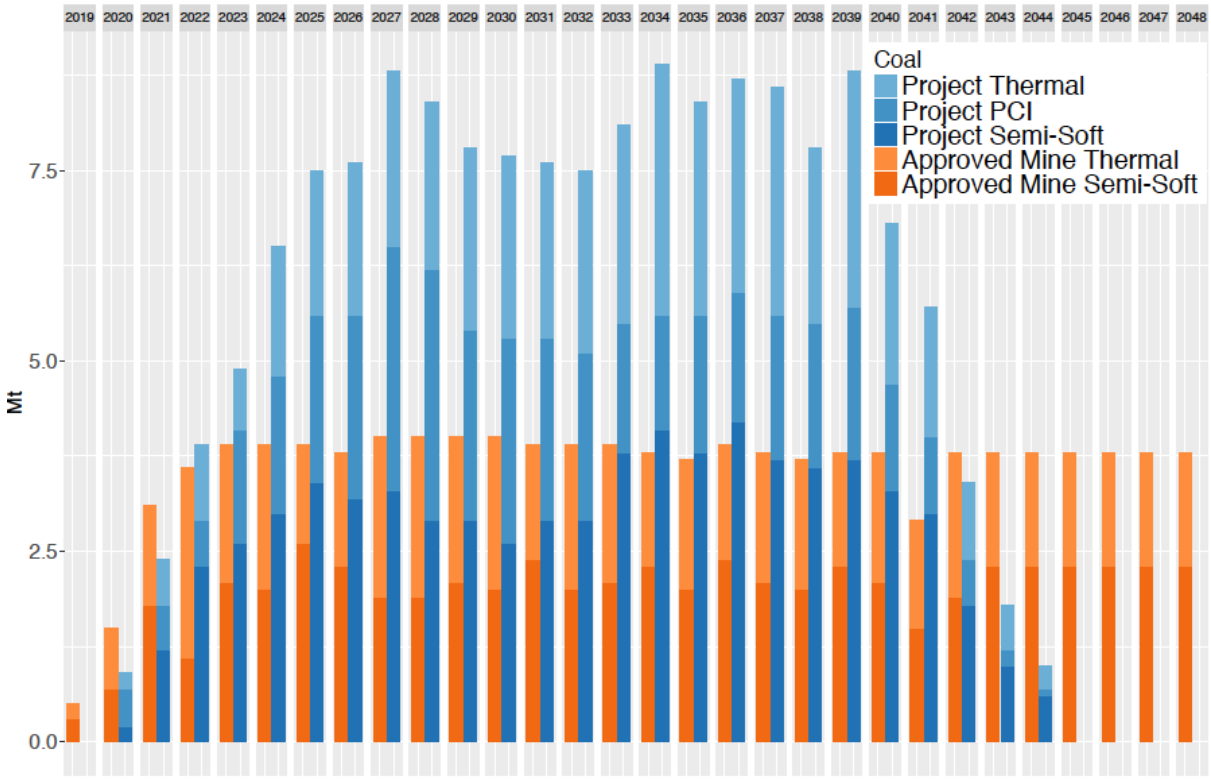
2.3. KEY PROJECT PARAMETERS

The following subsections describe the Project and Approved Mine in terms of coal production, employment, as well as operating and capital expenditure parameters.

2.3.1. Product coal production

Product coal production would consist of varying tonnages of thermal coal and semi-soft coking (SSC) coal. Figure 2-1 shows an indicative product coal production profile for the Project and the Approved Mine, respectively. For the Project, average product coal production amounts to approximately 6.4 Mtpa between 2020 and 2044. Average coal production for the Approved Mine is approximately 3.6 Mtpa between 2019 and 2048.

Figure 2-1. Production profile – Project and Approved Mine



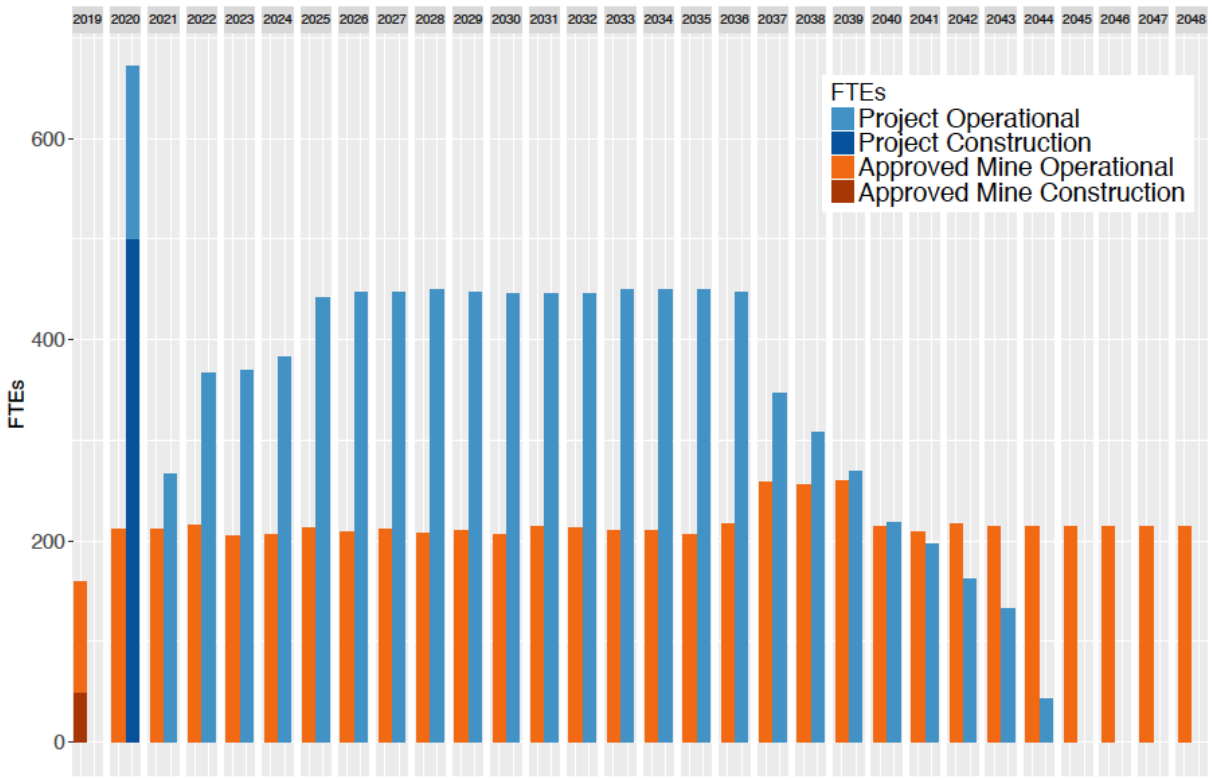
Source: Whitehaven.

It is noted that the Project would allow for the processing of coal from the Tarrawonga and Rocglen Coal Mines at a Project CHPP. However, production of this coal would also occur in the Reference Case as these mines are approved to mine coal and process their coal at the existing Whitehaven CHPP located 5 km north-west of Gunnedah. Therefore, the coal from these mines that is processed at the Project has not been considered in this assessment.

2.3.2. Employment profile

Figure 2-2 shows the projected workforce profile for the Project and the Approved Mine, respectively, based on current information and mine planning. The Project would require a peak construction workforce of up to approximately 500 FTE jobs, and a peak operational workforce of approximately 450 FTE jobs. On average, the Project would employ an operational workforce of approximately 344 FTE jobs between 2020 and 2044. The Approved Mine would require a peak construction workforce of approximately 50 FTE jobs, and employ an average operational workforce of approximately 213 FTE jobs between 2019 and 2048.

Figure 2-2. Workforce profile – Project and Approved Mine



Notes: Operational refers to the operating workforce; Construction refers to the construction workforce. While construction activities would commence in 2019, for the purposes of this assessment it has been conservatively assumed that employment (and associated benefits) would commence in 2020.

Source: Whitehaven.

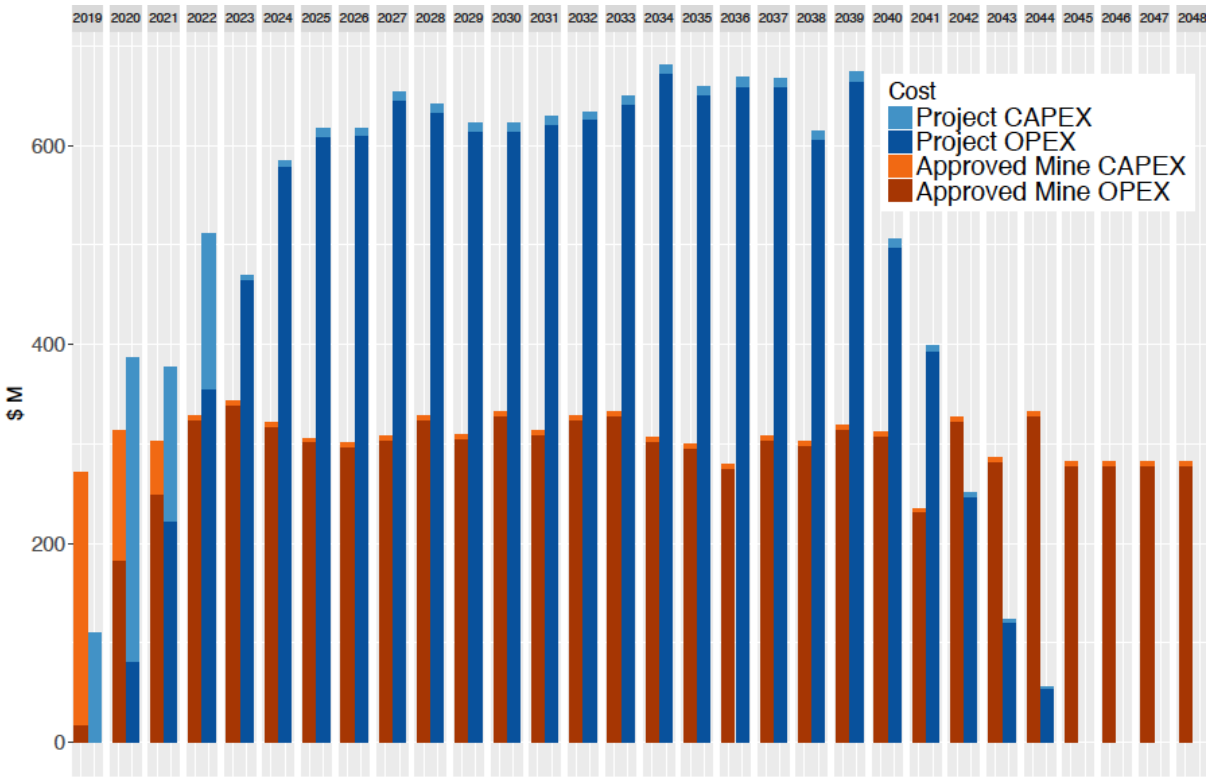
The Whitehaven CHPP is approved to operate until October 2022 under Development Consent DA 0079 2002, and employs approximately 10 personnel. In the Project Scenario, processing of Project coal at the Whitehaven CHPP would cease once the Project CHPP, train load-out and rail spur reach full operational capacity. In contrast, in the Approved Mine Scenario the operational life of the Whitehaven CHPP would be extended to 2048 (subject to separate approval).

2.3.3. Capital and operating expenditures

Figure 2-3 compares projected operating and capital expenditures for the Project and the Approved Mine, respectively. In NPV terms:

- capital expenditures for the Project over the life of the mine amount to approximately $674 million, compared to approximately $433 million for the Approved Mine; and
- operating expenditures (including rehabilitation expenditures) for the Project over the life of the mine amount to approximately $5,352 million, and approximately $3,405 million for the Approved Mine.

Figure 2-3. Capital and operating expenditure – Project and Approved Mine



Notes: CAPEX refers to capital expenditure, including sustaining capital expenditures; OPEX refers to operating expenditure, including rehabilitation expenditures.

Source: Whitehaven.

2.4. OTHER RESOURCES PROJECTS IN THE REGION

The potential for interactions between other resources projects in the region and the Project is relevant for assessing the cumulative 'external effects' associated with the Project (described in Section 3.3). Table 2-1 provides an overview of other existing and proposed projects located in the vicinity of the Project. Where relevant, the potential cumulative environmental impacts have been considered in the specialist studies undertaken for the Project; however, the timing of commencement of the currently proposed or approved projects is uncertain.

Table 2-1. Resources projects located in the vicinity of the Project Operational projects Approved/proposed projects

Project	Description	Location, distance from Project	Project life	Workforce
Rocglen Coal Mine	Open cut coal mine	Gunnedah LGA 10 km	2008 to 2020	Appr. 55 FTE jobs
Werris Creek Mine	Open cut coal mine	Liverpool Plains LGA 75 km	2005 to 2032	Appr. 70 FTE jobs
Boggabri Coal Mine	Open cut coal mine	Narrabri LGA 12 km	2012 to 2033	Appr. 600 FTE jobs
Narrabri North Coal Mine	Underground coal mine	Narrabri LGA 36 km	2011 to 2031	Appr. 330 FTE jobs
Maules Creek Coal Mine	Open cut coal mine	Narrabri LGA 25 km	2013 to 2034	Appr. 450 FTE jobs
Tarrawonga Coal Mine	Open cut coal mine	Narrabri LGA 12 km	2006 to 2029	Appr. 120 FTE jobs
Sunnyside Coal Mine	Open cut coal mine	Gunnedah LGA 20 km	2008 to 2020	Appr. 40 FTE jobs (during full production, and currently less FTE jobs)
Watermark Coal Project	Conditionally approved open cut coal mine	Gunnedah LGA 49 km	30-year mine life	Construction and operational workforce: appr. 600 FTE jobs.
Narrabri Gas Project	Proposed natural gas development	Narrabri LGA Appr. 50 km	25 years	Construction workforce: appr. 1,300 FTE jobs; operational workforce: appr. 200 FTE jobs
Orange Grove Sun Farm	Solar photovoltaic generation facility	Gunnedah LGA Appr. 26 km	In excess of 30 years	Construction workforces: appr. 80 FTE jobs; operational workforce: 3 FTE jobs
Gunnedah Solar Farm	Solar photovoltaic generation facility	Gunnedah LGA Appr. 21 km	25 years	Construction workforce: 150 jobs; operational workforce: 6 to 10 FTE jobs
Silverleaf Solar Farm	Solar photovoltaic generation facility	Narrabri LGA Appr. 59 km	Unknown	Peak construction workforce: 100 jobs

Project	Description	Location, distance from Project	Project life	Workforce
Wee Waa Solar	Solar photovoltaic generation facility	Narrabri LGA Appr. 83 km	In excess of 30 years	Construction workforces: appr. 80 FTE jobs; operational workforce: 3 FTE jobs
Narrabri South Solar Farm	Solar photovoltaic generation facility	Narrabri LGA Appr. 47 km	Appr. 30 years	Peak construction workforce: appr. 112 jobs; operational workforce: appr. 5 FTE jobs

Source: Whitehaven. Idemitsu 2017. GHD 2017. Shenhua Australia 2018. Santos 2018. EMM 2017a. EMM 2017b. pitt&sherry 2017. GHD 2018. Melotte Consulting 2017.

3. COST BENEFIT ANALYSIS

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 undertake the CBA;
- Section 3.2 describes the approach to valuing market transactions, including for deriving disposable income, royalty and taxation benefits;
- Section 3.3 sets out the approach to valuing the (non-market) external effects that are predicted to arise;
- Section 3.4 describes the results of the CBA;
- Section 3.5 comments on other matters raised in the 2015 Guidelines; and
- Section 3.6 describes the sensitivities of the results of the CBA to changes in various assumptions.
- Section 3.7 describes the major risks, unquantified and distributional impacts.

The total and incremental wider flow-on effects of the Project, respectively, 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, Project and Approved Mine scenarios

A CBA requires that the economic merits of a project are compared to a meaningful counterfactual. There are two plausible counterfactuals to the Project being commissioned – 'doing nothing' whereby the land owned by Whitehaven and required for the Project would continue to be used for agricultural purposes; or commissioning the Approved Mine.

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' in this report, relative to two counterfactual scenarios:

- a 'do nothing' scenario, referred to as the 'Reference Case' whereby the Project is assessed on a stand-alone basis; and
- the Approved Mine, referred to as the 'Approved Mine Scenario', whereby the Project is assessed relative to the Approved Mine.

Table 3-1 describes the salient differences between the Project Scenario and the Approved Mine Scenario.

Table 3-1. Project Scenario and Approved Mine Scenario

	Project Scenario	Approved Mine Scenario
Production timeline	2020 to 2044	2019 to 2048
Product coal production (Mtpa)		
Average	6.4	3.6
Maximum	8.9	4.1
Workforce (FTE jobs)		
Average operational workforce	344	213
Peak operational workforce	450	260
Peak construction workforce	500	50

Source: Whitehaven.

3.1.2. Net benefits 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 (Australian Bureau of Statistics [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, Pearce *et al.* 2006). 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, 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 include the additional disposable income accruing to the NSW workforce and the NSW share of personal income taxes and Medicare contributions;
- the share of 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 and land taxes/shire rates paid to the State of NSW and local government.

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 of Australia 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 approach is the market price.

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 taxes, superannuation, 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 Project 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 assumed to find alternative employment in NSW at an alternative wage. The proportion of the workforce that would 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. This percentage has been applied symmetrically throughout the CBA analysis; that is:

- in the assessment of the Project Scenario relative to the Reference Case, 80 per cent of the Project workforce is assumed to take up alternative employment in NSW in the Reference Case; and
- in the assessment of the Project Scenario relative to the Approved Mine Scenario, and given that employment profiles differ in these two scenarios, 80 per cent of the Project workforce that would additionally be employed relative to the Approved Mine workforce are assumed to find employment elsewhere in NSW. Conversely, 80 per cent of the Approved Mine workforce that would additionally be employed relative to the Project workforce are assumed to find employment elsewhere in NSW.

The sensitivity of the CBA results to this assumption is tested in Section 3.6.

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 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 (where the minimum wage reflects the employment opportunity costs, skill level required and the relative disutility of an employment position).[1] The 2015 Guidelines appear to suggest (p.13) that the difference between the wage paid by a mining project and the wage paid elsewhere in the mining sector is a 'wage premium'. The 2015 Guidelines then suggest that an appropriate starting assumption should be that workers (on a given project) do not receive a wage premium, although the appropriateness of this assumption should be assessed on a case by case basis.

In the case of the Project, the following considerations are relevant:

- The Project would be located in the vicinity of a number of operational coal mines, these being the Rocglen, Werris Creek, Boggabri, Narrabri, Maules Creek, Tarrawonga and Sunnyside coal mines, as well as seven major proposed resources projects (Table 2-1). Given that the Project would need to compete with other resources projects to attract and retain skilled workers, it is unlikely that the wages paid to the Project workforce would be less than the wages paid in other local coal mining operations.[2] This suggests that it is appropriate to assume that the Project workforce would be paid wages and salaries that generally reflect the terms and conditions in the mining sector.
- Whitehaven applies a recruitment strategy that focuses on local employment and workforce diversity, including by offering apprenticeships, traineeships and scholarships to support local employment. For local people contemplating taking up employment by the Project, the alternative wage (that is, the wage which they could earn elsewhere) is therefore likely to reflect average wages (all sectors) in the region.[3]

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1 *However, as is also noted in the 2015 Guidelines, minimum wages are not readily observable. It is also difficult to determine in an objective manner any wage differences relative to the mining sector that may be due to skills differences or to the disutility of working in that sector.*

2 *The 2015 Guidelines state (P.13) "If workers are already working in the mining sector, it is not generally the case that one mine will pay significantly more than other mines for workers doing a similar job in similar conditions." By the same token, it can be argued that one mine will not pay significantly less for workers doing a similar job in similar conditions.*

3 *Given that average local wages include the wages of (higher paid) mining workers in a locality, the average local wage represents an overestimate of the wage that workers could earn outside the mining sector.*

The following approach has therefore been adopted in this report to determining gross wages paid by the Project and the alternative wage:

- Annual average gross wages paid to the Project workforce were estimated using average weekly earnings in the mining sector in Australia, as published by the ABS (2017a). The ABS does not publish statistics on average mining wages specifically in NSW.
- The approach taken to determining the alternative wage is to apply the median employee income applicable to the relevant geographical area, as determined by the most recent ABS Community Census (ABS 2016) and adjusted for the change in average weekly earnings in NSW to mid-2017 (ABS 2017a).

The sensitivity of the CBA results to the alternative wage assumption is tested in Section 3.6.

The application of the average Australian mining wage to determine remuneration for the Project (and the Approved Mine) workforce implies that the workforce would not receive a wage premium, consistent with the 2015 Guidelines. The Project (and the Approved Mine) would nonetheless generate significant positive benefits for workers (Table 3-9), given that average mining wages are higher than the median NSW employee income. That is, even assuming that the Project workforce would find alternative employment in the (counterfactual) Reference Case, the differential between average mining wages and average NSW wage and salary income is such that the workforce would benefit as a result of the Project being approved.

It is noted that the factors listed as being relevant in the 2015 Guidelines (P.14) for determining whether a project will generate net benefits for workers apply to the Project (Appendix R of the EIS):

- the local workforce would be drawn from a region with significantly lower levels of income and markedly higher levels of unemployment than the NSW average;
- all of the LGAs in the local region have greater socio-economic disadvantage when compared to the NSW average; and
- Whitehaven's local employment, training and economic development strategy would assist the local workforce in gaining new skills that would support employment prospects over the longer term.

3.2.1.2 INCREMENTAL DISPOSABLE INCOME

The gross wages assumed to 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 calculated by taking average gross wages and deducting income taxes, superannuation payments and Medicare payments. Aggregated across workforce numbers in the Project Scenario and the Approved Mine Scenario, this gives an estimate of the incremental disposable income accruing to the workforce in each scenario.

3.2.1.3 PERSONAL INCOME TAX AND MEDICARE PAYMENTS

In each of the Project Scenario and the Approved Mine Scenario, the workforce would make Commonwealth personal income tax and Medicare payments, 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 either the Project or the Approved Mine.

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 (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 and the Approved Mine, respectively, accrues to NSW, namely:

- the coal royalties paid by Whitehaven to the State of NSW;
- the share of company taxes paid by Whitehaven to the Commonwealth Government that accrues to NSW; and
- the share of any surplus generated by Whitehaven 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, with the relevant ad valorem royalty rate of 8.2 per cent for open cut mines, consistent with the 2015 Guidelines (Table 3-2).

Gross mining revenues in the two scenarios were estimated by multiplying the respective product coal production schedules provided by Whitehaven with projected coal prices. Projected coal prices are based on CRU forecasts, and consist of long-term prices per tonne (from 2026 onwards) of US$ 85 per tonne for thermal coal, and US$ 100 per tonne for SSC and pulverised coal injection (PCI) coal. The US$/AU$ exchange rate is assumed to be 0.77 in 2019 and 2020, 0.78 from 2021 to 2025, and 0.77 from 2026 onwards. The sensitivity of the results of the CBA to variations in coal price and exchange rate assumptions is tested in Section 3.6.

Table 3-2. Incremental royalty payment calculation

	Project Scenario	Approved Mine Scenario	Difference
	NPV (AU$ 2017 million)		
Gross mining revenue	$8,332	$5,099 #	$3,233
Allowable beneficiation deductions:			
- 55 per cent for product coal subject to full cycle washing at $3.50 per tonne - 45 per cent for product coal crushed and screened at $0.50 per tonne	$143	$89	$54
Net disposal value	$8,189	$5,010	$3,179
Royalty payments	$671	$411	$261

Notes: NPVs have been calculated using a 7 per cent discount rate. # Gross mining revenues exclude revenues from the sale of gravel. Totals may not sum precisely due to rounding.

Source: Whitehaven, AnalytEcon analysis.

3.2.2.2 COMPANY INCOME TAX PAYMENTS

Aggregate Commonwealth company income tax payments were derived for the Project Scenario and Approved Mine Scenario, respectively, by deducting nominal 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 applied to derive nominal company tax payments. Real ($ 2017) 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 (RBA'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), and is estimated at $121 million in NPV terms.

3.2.2.3 SHARE OF GOS ACCRUING TO NSW RESIDENTS

To the extent that they are shareholders of Whitehaven, some share of the profits generated by the Project or the Approved Mine would accrue to NSW residents.

The 2015 Guidelines refer to a 'net producer surplus' (rather than the 'GOS' concept used in the national accounts) to determine the incremental profits that should be attributed to NSW residents. The producer surplus calculation set out in the 2015 Guidelines refers to a cash profit calculation for the producer in question, consisting of the NPV of the difference between project revenues and project costs, including all operating and capital costs, as well as all tax and royalty payments. A proportion of these cash profits, corresponding to the Australian proportion of Whitehaven's ownership, multiplied by 32 per cent to approximate the NSW share of Australian ownership, has been attributed to NSW.[4] Applying the approach described in the 2015 Guidelines (as shown in Table 3-3), the incremental NSW share of cash profits attributable to the Project is $53 million in NPV terms.

Table 3-3. Incremental cash profits accruing to NSW residents

	Project Scenario	Approved Mine Scenario	Difference
	NPV (AU$ 2017 million)		
Gross mining revenues	$8,332	$5,104 #	$3,288
Net of:			
Capital expenditure (incl. residual values)	$674	$433	$241
Operating expenditure (incl. for rehabilitation, mitigation of external effects) and gross wage payments	$6,086	$3,831	$2,255
Total tax & royalty payments	$1,095	$642	$453
Aggregate cash profits	$477	$198	$279
NSW share of cash profits	$53	$22	$31

Notes: NPVs have been calculated using a 7 per cent discount rate. # Gross mining revenues *include* revenues from the sale of gravel. Totals may not sum precisely due to rounding.

Source: Whitehaven, AnalytEcon analysis.

[4] *Only a share of the NSW share of cash profits would take the form of dividend payments to shareholders. The remainder would likely be retained and reinvested, and would in turn give rise to future earnings. However, Whitehaven's dividend policy is likely to reflect outcomes for the company overall, rather than relate to specific project outcomes (for instance, for the Project or the Approved Mine). It is therefore not possible to determine the shares of Project or Approved Mine cash profits that would be paid out in dividends or retained for future earnings, respectively. Hence the NSW share of cash profits, determined consistent with the 2015 Guidelines, can be interpreted as a mix of dividend payments and future earnings.*

This calculation assumes that 100 per cent of the Project is owned by Whitehaven. Should Whitehaven seek a joint venture partner(s) for the Project, the NSW share of estimated cash profits attributable to the Project would change (increase or decrease) proportionally with the NSW share of the joint venture partner(s)' Australian ownership.

3.2.3. Other taxation benefits attributable to NSW

3.2.3.1 PAYROLL TAXES

Payroll taxes constitute a tax on production 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 mirrors that adopted to derive disposable income benefits accruing to NSW (Section 3.2.1). That is, the additional payroll taxes of $27 million accruing to NSW have been derived by:

- estimating the overall difference in payroll taxes that would be paid in either scenario; and
- adjusting for the payroll taxes that would be paid for the workforce re-employed elsewhere in NSW to arrive at a full opportunity cost calculation.

3.2.3.2 LOCAL GOVERNMENT RATES

Local government rates constitute a tax on production and a contribution to NSW GSP. Whitehaven is assumed to pay local government rates of around $400,000 per annum in each of the Project Scenario and the Approved Mine Scenario over the operating life of the mine for the Project mining area.[5] These rate payments accrue to local authorities.

In the absence of the Project or the Approved Mine, the site of the proposed development would continue to be used for agricultural purposes, and GSC and NSC would receive rate payments from agricultural businesses instead. As of 2017-18:

- NSC levies rates on farmland at a base rate of $270 per annum and an ad valorem rate of $0.0040398 on farmland (NSC 2017), corresponding to a total yield of $6.048 million. According to the ABS (2018) there were 764 farming businesses as of June 2017,[6] corresponding to around $7,916, on average, per farming business.
- GSC levies a minimum rate of $450 and an ad valorem rate of $0.004387 on farmland (GSC 2016), corresponding to a total yield of $4.820 million for 1,114 farming businesses, or around $4,327, on average, per farming business in 2016-17 (GSC 2017).

[5] *Local government rate payments have been estimated by applying the respective rates for land used for mining and for agricultural purposes. Incremental rate payment estimates have considered only the change in land use from agriculture to mining in the Project and have not considered any other lands owned by Whitehaven or future uses/ownership of this land.*

[6] *NSC does not report the number of farming businesses in Narrabri Shire, hence an estimate needs to be used.*

The exact amount of rate payments that would arise in the counterfactual is not known. For the purpose of the CBA, and given the size of the Project mining leases, it has been assumed that in the absence of the Project or the Approved Mine, there may be around 20 farming properties paying an average of $6,121 per property (the average of GSC and NSC rates per farming property), or $122,420 per annum. On that basis, the incremental rate payments of the Project are estimated at around $3.3 million in NPV terms.

3.2.3.3 LAND TAXES

Land taxes also constitute a tax on production and a contribution to NSW GSP. Whitehaven is assumed to pay land taxes of $300,000 per annum in each of the Project Scenario and the Approved Mine Scenario over the operating life of the mine. Land tax payments accrue to the State of NSW.

NSW land tax rates are based on the taxable value of the land. In the absence of the Project or the Approved Mine, the relevant land would likely be used for agricultural purposes. Section 10AA of the *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. It is therefore appropriate to include land tax payments that would accrue in the Project Scenario and the Approved Mine Scenario as a net benefit to NSW.

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, cumulative effects have been considered in the specialist studies undertaken for the Project and the Approved Mine.

3.3.1. Overview of predicted impacts

The potential environmental impacts of the Project and the Approved Mine are summarised in Table 3-4. Section 7 of the EIS provides a summary of the mitigation and management strategies and monitoring activities proposed by Whitehaven. The 2018 Technical Notes describe various valuation techniques for specific non-market effects that have been applied in this report.

Table 3-4. External effects associated with the Project and the Approved Mine

Effect	Project	Approved Mine
Surface water	No significant impacts on the Namoi River Negligible impact on surface water quality or flow in local creeks Minimal potential flood impacts The predicted requirement for importation of water from external sources to meet operational demands (and minor indirect losses due to groundwater inflow) is within the volume available from the water licenses held by Whitehaven: - Water Sharing Plan for the Upper Namoi and Lower Namoi Regulated River Water Sources 2016 allocation (shares) = 1,751.5	No significant impacts on the Namoi River Negligible impact on surface water quality or flow in local creeks Minimal potential flood impacts Whitehaven would hold the following licenses to account for potential external water demands over the life of the Project: - Water Sharing Plan for the Upper Namoi and Lower Namoi Regulated River Water Sources 2016 allocation (shares) = 1,155.5
Groundwater	Water drawdown in Maules Creek Formation groundwater system, negligible impacts on groundwater quality Negligible drawdown of Alluvial Groundwater System Drawdown of less than 2 m at all privately-owned bores The average annual requirement to be licensed to account for groundwater inflow/drawdown (and for Project borefield when required) is within the volume available from the Water Licenses held by Whitehaven: - Water Sharing Plan for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2011 allocation (shares) = 600 - Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003 allocation (shares) = 396	Water drawdown in Maules Creek Formation groundwater system, negligible impacts on groundwater quality Negligible drawdown of Alluvial Groundwater System Drawdown of less than 2 m at all privately-owned bores The average annual requirement to be licensed to account for groundwater inflow/drawdown is within the volume available from the Water Licenses held by Whitehaven: - Water Sharing Plan for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2011 allocation (shares) = 430 - Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003 allocation (shares) = 180
Biodiversity	The Project (in total) would involve the disturbance associated with the Approved Mine, as well as an additional footprint of approximately 775.8 hectares (ha). This additional area comprises of scattered remnants of native woodland/forest, semi-cleared woodland, derived native grassland, previously disturbed rehabilitation and other non-vegetation areas such as farm dams, roads, tracks and existing infrastructure. Endangered ecological communities and threatened fauna species would not be significantly impacted by the Project due to a range of impact avoidance, mitigation and offset measures.	Surface disturbance would involve the clearance of approximately 1,748 ha of predominately native vegetation, including forest, woodland, derived native grasslands and areas previously disturbed and regenerating

Effect	Project	Approved Mine
Noise	One privately owned property would be in the Noise Affectation Zone (greater than 40 A-weighted decibels [dB{A}]) (and a second dwelling on this property is predicted to be in the Noise Management Zone) Three additional privately owned dwellings (on two properties) would be in the Noise Management Zone (36 to 37 dB[A]) (considered negligible exceedances) No exceedance of relevant rail noise criteria. Negligible increase in road traffic noise (compared to background traffic) No exceedance of relevant vibration criteria	One privately owned properties (not currently owned by Whitehaven) would be in the Noise Affectation Zone (greater than 40 dB[A]) No other privately owned properties would be in the Noise Management Zone (35 to 40 dB[A])
Air quality	No exceedance of relevant dust and total suspended particulate project-only or cumulative criteria No exceedance of annual average particulate matter less than 10 microns (PM_{10}) or 2.5 microns ($PM_{2.5}$) project-only or cumulative criteria No exceedance of the 24 hour PM_{10} and $PM_{2.5}$ criteria	No exceedances of relevant dust and total suspended particulate project-only or cumulative criteria No exceedance of annual average PM_{10} project-only or cumulative criteria A small number of additional exceedances of the 24 hour PM_{10} criterion on a limited number of days
Greenhouse gas emissions	Scope 1 emissions of 3.2 million tonnes of carbon dioxide equivalent (Mt CO_2-e) over the life of the project. Scope 2 emissions of 0.9 Mt CO_2-e over the life of the Project.	Scope 1 emissions of 4.1 Mt CO_2-e over the life of the project. Scope 2 emissions of 0.7 Mt CO_2-e over the life of the Approved Mine
Agricultural land impacts	2,541 hectares for mining and 1,102 hectares for offsets = 3,643 hectares of agricultural land lost in perpetuity	1,462 hectares for mining and 440 hectares for offsets = 1,902 hectares of agricultural land lost in perpetuity
Aboriginal heritage	The Project (in total) would involve the disturbance associated with the Approved Mine, as well as direct disturbance of an additional 21 known Aboriginal heritage sites and three sites previously identified for the Approved Mine (not scheduled for disturbance), which have been reassessed as being impacted by the Project Limited indirect impacts on known Aboriginal heritage sites One site that was previously assessed as being partially impacted by the Approved Mine has since been reassessed as not being impacted by the Project	Direct disturbance of 24 known Aboriginal heritage sites and partial disturbance of eight sites Limited indirect impacts on open artefact scatters and isolated artefacts
Historic heritage	Photographic archiving of a cottage to be directly disturbed	No direct disturbance of heritage items

Effect	Project	Approved Mine
	Potential indirect impacts on The Rampadells, Broadwater Homestead Complex and Kurrumbede Homestead Complex would be managed	Potential for indirect impacts would be low
Road transport	No significant impacts on performance, capacity, efficiency and safety of the road network. Whitehaven would fund necessary road upgrades and requirements	No significant impacts on performance, capacity, efficiency and safety of the road network. Whitehaven would fund necessary road upgrades
Visual effects	Moderate/high, declining to low and very low visual impacts with progressive rehabilitation on some dwellings, localities/roads in the vicinity of the Project	Moderate, declining to low and very low visual impacts with progressive rehabilitation on some dwellings, localities/roads in the vicinity of the Project
	Prominent visual impacts on some aspects of Blue Vale Road	Prominent visual impacts on some aspects of Blue Vale Road
	Potential for some night light spillage	Potential for some night light spillage

Source: Refer to Section 4 of the Main Report of the EIS.

3.3.2. Ground- and surface water

The nature and magnitude of the potential impacts of the Project and Approved Mine on ground- and surface water resources, as well as any wider implications for these resources, are described in detail in Appendix A and Appendix B of the EIS.

PREDICTED GROUND- AND SURFACE WATER IMPACTS

Table 3-5 shows the estimated ground- and surface water licensing requirements for the Project and the Approved Mine, respectively, as well as the estimated market values of these licences. Whitehaven holds the necessary ground- and surface water licenses to meet the Project requirements.

MITIGATION AND MANAGEMENT MEASURES

Whitehaven proposes to develop a Water Management Plan, including a ground- and surface water monitoring plan, for the Project. No privately-owned bores are predicted to experience drawdown greater than 2 metres (m) (Appendix A of the EIS). Notwithstanding, in the event that groundwater monitoring shows a greater than 2 m drawdown at a privately-owned bore that is attributable to the Project, 'make good' provisions for the affected groundwater user would be implemented. Such measures may include deepening the affected groundwater bore, the construction of an alternative bore, and/or the provision of an alternative water supply of appropriate quality and quantity. Further, to prevent surface water impacts, a Project Water Management System would be used to capture on-site run-off from disturbed/mine-affected areas (for reuse on-site).

Table 3-5. Estimated ground- and surface water licensing requirements for the Project and Approved Mine

Water sharing plans	Mining operations (licenses held)		Post mining (predicted licensing requirements)		Assumed license value (per ML)
	Project	Approved Mine	Project	Approved Mine	
Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003 allocation	396 ML	180 ML	9 ML	98 ML	$3,000
Water Sharing Plan for the Upper Namoi and Lower Namoi Regulated River Water Sources 2016 allocation	1,751.5 ML	1,155.5 ML	27 ML	N/a	$2,750
Water Sharing Plan for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2011 allocation	600 ML	430 ML	<500 ML	≤ 430 ML	$800
Total ground- and surface water licensing requirements	2,747.5 ML	1,765.5 ML	536 ML	528 ML	

Notes: Assumes 1 share = 1 ML

Source: Whitehaven.

VALUATION APPROACH

The 2018 Technical Notes state that the market price of water should be considered the primary way to value the impacts on water quantity. As noted, Whitehaven currently holds the required licence allocations under the relevant water sharing plans to meet its expected licensing requirements during the Project and post-mining.

The incremental effects of the Project's ground- and surface water resources have therefore been valued using the estimated prices of these licences, as shown in Table 3-5. The value of the required license allocations during mining operations has been incorporated as an opportunity cost to Whitehaven in Year 1 of operation of the Project and the Approved Mine, respectively, and as a residual value at the end of operations of the respective projects. The value of the licence allocations post mining have been incorporated as an opportunity cost in the final year of mining operations, assuming that these licenses will need to be held over an infinite timeframe thereafter.

The assumed valuations for the license allocations reflect Whitehaven's estimates, and were confirmed with reference to external sources. According to the NSW Department of Primary Industries (NSW DPI, 2017):

- Between 2004-05 and 2015-16, aquifer entitlements for the Upper Namoi and Lower Namoi deep groundwater sources, respectively, traded at similar prices; generally in the $2,000 per ML range. Some 2015 trades in the Upper Namoi groundwater aquifer were priced in the $3,000 to $3,500 per ML range. Whitehaven's opportunity cost of holding groundwater licenses has therefore conservatively been estimated at $3,000 per ML.
- General Security entitlements in the Namoi River are traded relatively frequently, generally commanding a price between $1,500 and $2,000 per ML, while Supplementary entitlements are traded at lower prices. Whitehaven's estimate of the opportunity cost of holding surface water licenses of $2,750 per ML is therefore conservative.

Information published by the NSW Department of Industry (2018) on recent trades for the Gunnedah–Oxley Basin Murray Darling Basin (MDB) groundwater source suggests that as of September 2014, these shares were traded at a price of $800 or $801 per ML. The minimum bid price per unit share for groundwater available from the Gunnedah-Oxley Basin MDB Groundwater Source in 2018 under the 2017 controlled allocation order is reported at $650 per ML. We note that the first auction in May 2013 produced a wide range of prices, with some as high as $2,200 per unit share; however, at that time, it is understood the market for these shares was immature, effectively leading to a blind auction, and prices are considered to have stabilised since then. An allocation value of $800 per ML is considered appropriate for the opportunity cost of holding the required MDB groundwater licenses.

OTHER MATTERS RAISED IN THE 2018 TECHNICAL NOTES

The 2018 Technical Notes note that market prices may be affected by seasonal demand and supply factors, as well as the number and nature of participants in the market. For the Upper Namoi and Lower Namoi ground- and surface water resources, the time series data shown in NSW DPI (2017) suggests that prices have been relatively stable over time, and there is no evidence of seasonal volatility.

To date, only three auctions have taken place for allocations from the Gunnedah–Oxley Basin Murray Darling Basin (MDB) groundwater source, so that there is not sufficient information to gauge whether seasonal factors play a material role in determining prices.

There is also no indication that the water requirements for the Project and Approved Mine, respectively, would impact third parties in a manner that is not already captured by market prices. The analysis of potential surface water impacts indicates that (Appendices B and C of the EIS):

- there would be no significant impacts on the Namoi River (flows and quality);
- the impacts on surface water quality or flow in local creeks would be negligible; and
- potential flood impacts are minimal.

Furthermore, the analysis of potential groundwater impacts indicates that (Appendix A of the EIS):

- there would be negligible impacts on groundwater quality;
- the drawdown of the Alluvial Groundwater system would be minimal; and
- drawdowns at privately-owned bores would be less than 2 m.

3.3.3. Biodiversity

Appendix F of the EIS contains the Biodiversity Assessment Report and Biodiversity Strategy for the Project.

PREDICTED BIODIVERSITY IMPACTS

The surface disturbance footprint for the Approved Mine is approximately 2,242 hectares (including 1,748 hectares of native vegetation); the Project would result in an additional 775.8 hectares of surface disturbance (3,017.8 hectares in total). Given that the Project would be located on former mining and agricultural (grazing) land, the impacts on biodiversity are predicted to be relatively minor. In particular, with the avoidance, mitigation, management and offsetting strategies for the Project the Project would not have a significant negative impact on threatened species, ecological communities or Matters of National Environmental Significance at a local or regional scale.

MITIGATION AND MANAGEMENT MEASURES

Whitehaven proposes to mitigate and manage biodiversity impacts for the Approved Mine and the Project by implementing a Biodiversity Management Plan, Biodiversity Offset Strategy and Rehabilitation Management Plan.

A range of measures are proposed to minimise impacts before, during, and following mining operations:

- activities designed to preserve existing habitats, such as riparian restoration or enhancement, vegetation and soil protection, conserving and reusing topsoil, and weed and feral animal controls;
- operational measures, such as vehicle speed controls and, where practicable, measures to limit night-lighting impacts;
- planning initiatives, such as designing and constructing the Project rail spur in a manner that avoids biodiversity impacts as far as possible, and avoiding clearance of Weeping Myall Woodland during construction of the Blue Vale Road realignment;
- the rehabilitation of post-mining landforms; and
- implementation of the biodiversity offset strategy.

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. For both the Approved Mine and the Project, a Biodiversity Offset Strategy that is consistent with Commonwealth and State Government policies has been developed to mitigate and offset potentially significant biodiversity impacts. While the offset costs will not be known until the biodiversity offset conditions are set by the NSW Government and the biodiversity offset package has been finalised for the Project, conservative establishment and ongoing management costs for the offset strategy have been allocated and included in Whitehaven's costings for each scenario.[7]

Other management and mitigation initiatives proposed by Whitehaven, such as planned habitat protections, the development of and compliance with requisite plans, operational and planning measures, and the ongoing process of rehabilitating mined land forms would be undertaken by Whitehaven employees in the normal course of operations, and are therefore accounted for as part of Whitehaven's ongoing wage and operational costs.

3.3.4. Noise

Appendix D of the EIS contains the Noise and Blasting Assessment for the Project.

[7] *As finalisation of the offset strategy (to the satisfaction of the Commonwealth and State governments) may require purchasing parcels of land, these specific outlays are to be considered to be commercial-in-confidence.*

PREDICTED NOISE AND BLASTING IMPACTS

Noise levels from the Project are predicted to results in "negligible" (1-2 dB) exceedances of operational noise criteria (as defined in the NSW *Voluntary Land Acquisition and Mitigation Policy*) at three privately-owned receivers during adverse meteorological conditions. "Significant" (>5 dB) exceedances of the evening and night-time operational noise criteria are predicted at one privately-owned receiver (located at property 127) during adverse meteorological conditions. A second receiver on property 127 is predicted to experience "moderate" (3-5 dB) exceedances of the operational noise criteria during adverse meteorological conditions. There are no predicted exceedances of sleep disturbance, road or rail noise impact criteria, and no privately-owned residences would be considered 'noise affected' or 'highly noise affected' by rail spur construction activities undertaken during standard hours.

No exceedances of vibration and airblast criteria are predicted to occur at any privately-owned receivers, or at cultural heritage sites in the vicinity of the Project.

For the Approved Mine "significant" exceedance of criteria are predicted at a receiver located at property 127 and "moderate" exceedances are predicted at two receivers on property 127. Exceedances at receivers at two other properties are now owned by Whitehaven.

MITIGATION AND MANAGEMENT MEASURES

In either of the Project Scenario or the Approved Mine Scenario, property 127 would be located within the Noise Affectation Zone, and the property owners may request that the property be acquired by Whitehaven. As such, any costs associated with noise impacts relating to this property would be internalised by Whitehaven.

Whitehaven proposes to mitigate and manage potential noise impacts by preparing a Noise Management Plan and a Blast Management Plan. Other planned measures to minimise noise impacts include:

- pro-active monitoring activities, such as regular noise monitoring at representative locations to confirm compliance with noise trigger levels, and real-time noise and meteorological monitoring and forecasting to inform operational activities; and
- 'at source' noise mitigation measures to reduce noise levels from typical operational activities, such as the treatment of plant and the orientation of haul roads.

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 Whitehaven's costings for each scenario.[8]

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 Whitehaven's capital and operating expenditure costings. These costs would be incurred by Whitehaven in the normal course of operations.

3.3.5. Air quality

Appendix E of the EIS contains the Air Quality and Greenhouse Gas (GHG) Assessment for the Project.

PREDICTED AIR QUALITY IMPACTS

For the Project, no exceedances of Environmental Protection Agency (EPA) criteria are predicted at any privately-owned receivers for 24-hour average PM_{10} or $PM_{2.5}$ concentrations, or for annual average PM_{10}, $PM_{2.5}$ or TSP concentrations or dust deposition levels. No receivers are predicted to require acquisition or mitigation in accordance with the NSW *Voluntary Land Acquisition and Mitigation Policy*.

For the Approved Mine, one privately-owned property (127) is predicted to experience cumulative 24 hour average PM_{10} concentrations above the EPA assessment criterion, and exceedance were also predicted at two other properties now owned by Whitehaven.

MITIGATION AND MANAGEMENT MEASURES

In either of the Project Scenario or the Approved Mine Scenario, Whitehaven proposes to manage and mitigate potential air quality impacts by preparing an Air Quality Management Plan, and by undertaking real-time air quality and meteorological monitoring and forecasting.

[8] *Pending completion of negotiations around noise agreements and or purchase costs, these outlays are considered to be commercial-in-confidence.*

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 Whitehaven's ongoing operating expenditures. These costs would be incurred by Whitehaven in the normal course of operations.

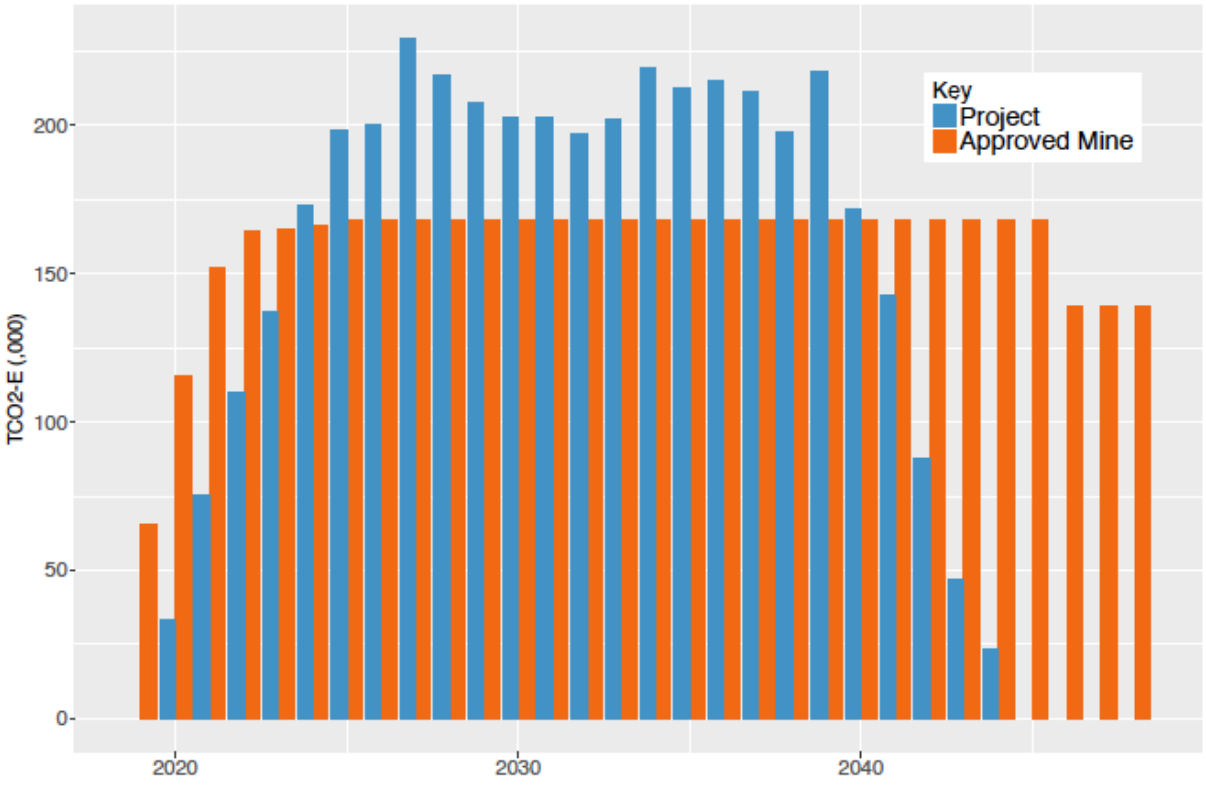
3.3.6. Greenhouse gas emissions

Appendix E of the EIS contains the Air Quality and Greenhouse Gas Assessment for the Project and the Approved Mine, respectively.

PREDICTED GHG EMISSIONS

The Project and the Approved Mine will give rise to Scope 1 and 2 greenhouse gas emissions, as shown in Figure 3-1. It is not expected that material annual variations in emissions from those that have been forecast will occur. Ongoing monitoring and management of GHG emissions and energy consumption at the Project would occur through Whitehaven's participation in the Commonwealth Government's *National Greenhouse and Energy Report System*.

Figure 3-1. Scope 1 and 2 emissions (t CO2-e) – Project and Approved Mine



Source: Ramboll 2018; PAEHolmes 2012.

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 3-6. Table 3-6 summarises total estimated (Scope 1 and 2) GHG emissions for the Project and Approved Mine, respectively, 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 AU$ 24.6 in 2019 to AU$ 27.6 in 2026. EUA futures prices are not published beyond 2026; it has therefore conservatively been assumed that prices from that year onwards will increase by 1.9 per cent in real terms to AU$ 41.9 in 2048, 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$ 32.6 in 2019 to AU$ 141.1 in 2048 ($2017 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$18.7 in 2019 to AU$ $39.8 in 2048 ($2017 prices).

The 2018 Technical Notes require that the economic impact of GHG emission should be estimated for NSW only. In Table 3-6, 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 0.54 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 $0.28 million in NPV terms, compared to $0.31 million in NPV terms for the Approved Mine.

Table 3-6. Project and Approved Mine emissions valuation (NPV AU$ 2017 million)

		Valuation		
	Total scope 1 & 2 emissions (Mt CO_{2-e})	European Emission Allowances - Futures prices (NPV AU$ 2017 million)	Australian Treasury Clean Energy Future Policy Scenario (NPV AU$ 2017 million)	US EPA Social Cost of Carbon (NPV AU$ 2017 million)
Approved Mine	4.8	$57	$121	$48
Project	4.1	$52	$109	$44
Incr. Project	-0.6	-$5	-$12	-$4
NSW share of emissions				
Approved Mine	0.026	$0.31	$0.65	$0.26
Project	0.022	$0.28	$0.59	$0.24
Incr. Project	-0.003	-$0.03	-$0.07	-$0.02

Notes: NSW share of emissions has been calculated with reference to relative GDP/GSP. The Australian share of world GDP as of 2017 was 1.64%, and the NSW GSP share of Australian GDP as of June 2017 is 33.0%.

Source: Whitehaven; World Bank 2018; ABS 2018.

3.3.7. Agriculture

Appendix H of the EIS contains the Agricultural Impact Statement.

PREDICTED AGRICULTURAL IMPACTS

Table 3-7 shows the predicted agricultural impacts for the Project and the Approved Mine. It is estimated that the Project (Approved Mine) would impact on 2,541 hectares (1,462 hectares) in perpetuity. In addition, the proposed biodiversity offset areas are estimated to impact on 1,102 hectares of land that could potentially be used for agriculture (e.g. existing grassland rather than woodland) for the Project and 440 hectares for the Approved Mine.

Table 3-7. Resource loss assumptions – Physical units

Impact	Project		Approved Mine	
	2020-2044	In perpetuity	2019-2048	In perpetuity
Land disturbance Class 2 (ha)	202	148	127	100
Land disturbance Class 3 (ha)	806	696	595	350
Land disturbance Class 4 (ha)	1,875	1,697	1,520	1,012
Total agricultural land disturbance	2,883	2,541	2,242	1,462
Biodiversity offset land Class 4 (ha)	1,102	1,102	440	440
Water entitlements (ML)	2,747.5	36 (Alluvium and Namoi River)	1,765.5	528

Source: Whitehaven.

VALUATION APPROACH

The 2015 Guidelines require the foregone value of the existing land use to be estimated. The Project and the Approved Mine are located on Whitehaven-owned land consisting of previously cleared agricultural areas and rehabilitated open cut workings used for dryland cropping and cattle grazing. The value of the output foregone on the Project site therefore relates to agricultural output. The valuation of the agricultural impacts of the Project is set out in detail in Appendix C.

The potential economic impacts on agriculture of the Project fall into two categories:

- the direct impacts in terms of foregone agricultural production, either over the life of the mine or in perpetuity, to land and water entitlement holders in the State or local region; and
- flow-on impacts, in terms of the effects of reduced agricultural production on the demand for downstream agricultural services and upstream value adding enterprises in the State or local region. The agricultural flow-on impacts of the Project are derived in Section 5.3.1.

The valuation of the direct agricultural impacts of the Project and the Approved Mine, respectively, incorporates recent land data, and gross revenue and margin assumptions. The valuation refers to the foregone agricultural production from land that would be established as a biodiversity offset, as well as from land directly disturbed for mining and infrastructure purposes. While there would be some offsetting non-market environmental benefits associated with the biodiversity offsets, these have not been calculated.

Table 3-8 summarises the results of the analysis (Appendix C). The Project is estimated to lead to:

- a reduction in agricultural gross values (revenues) by $33.0 million in NPV terms or $3.1 million annually; and
- a reduction in agricultural gross margins by $17.9 million in NPV terms or $1.6 million annually.

Table 3-8. Estimated foregone returns to agriculture for the Project and the Approved Mine

	Project		Approved Mine	
	Gross value	Gross margin	Gross value	Gross margin
	Cumulative (NPV AU$ 2017 million)			
Land disturbance	$15.3	$9.5	$10.9	$4.3
Water use	$14.5	$5.7	$9.0	$6.2
Biodiversity offset	$3.3	$2.7	$1.3	$1.0
Total	$33.0	$17.9	$21.1	$11.5
	Annual (NPV $ million)			
Land disturbance	$1.4	$0.9	$0.9	$0.4
Water use	$1.4	$0.5	$0.8	$0.6
Biodiversity offset	$0.3	$0.2	$0.1	$0.1
Total	$3.1	$1.6	$1.8	$1.1

Notes: Gross value refers to gross revenues. Gross margin is the gross revenue from an enterprise less the variable costs incurred in achieving it, but differs from profit because it does not include fixed or overhead costs such as depreciation, interest payments, rates and permanent labour. Totals may not sum precisely due to rounding.

Source: AnalytEcon analysis.

Whitehaven currently owns (or has entered into commercial agreements) for the land and water entitlements expected to be required for the Project.

The land and water entitlements in question were purchased at market prices by Whitehaven. In either of the Project Scenario or the Approved Mine Scenario, Whitehaven would undertake mining activities and forgo profits from agriculture.

The foregone profits from agriculture represent an opportunity cost to Whitehaven. As is also noted in the 2015 Guidelines, land prices can be assumed to reflect the present value of future earnings or other uses. For the purpose of accounting for the opportunity cost of agricultural production, we have therefore deducted the estimated NPV of lost agricultural production, as measured by enterprise gross margins, as a cost from Whitehaven's revenues in the Project Scenario and the Approved Mine Scenario, respectively. Given that enterprise gross margins do not include capital and related costs, this represents an overestimate of opportunity costs and is therefore conservative. Furthermore, given that Whitehaven would have purchased these properties at fair market prices in the past, NSW landowners have been compensated, so that there is no net cost to NSW.

3.3.8. Aboriginal cultural heritage

Section G of the EIS describes the Aboriginal cultural heritage values that would be affected by the Approved Mine and the Project, respectively, and the consultations with Aboriginal people undertaken by Whitehaven.

PREDICTED ABORIGINAL CULTURAL HERITAGE IMPACTS

The Aboriginal Cultural Heritage Assessment for the Approved Mine identified 24 Aboriginal heritage sites of low or low-moderate significance that would be directly impacted and 8 sites that would be partially impacted. Potential indirect impacts from blasting vibrations were predicted to be manageable at a grinding groove site in the vicinity of the Approved Mine, such that no damage would occur.

An additional 21 Aboriginal heritage sites of low- or low-moderate significance would be disturbed as a result of the Project, as well as three Aboriginal heritage sites previously identified for the Approved Mine (not predicted to be impacted) which have been reassessed as being impacted by the Project. No indirect impacts on a grinding groove site in the vicinity of the Project are expected.

One site that was previously assessed as being partially impacted by the Approved Mine has since been reassessed as not being impacted by the Project.

MITIGATION AND MANAGEMENT MEASURES

In either of the Project Scenario or the Approved Mine Scenario Whitehaven proposes preparing a Heritage Management Plan in consultation with the Registered Aboriginal Parties (RAPs) to manage and mitigate the predicted impacts. Whitehaven would maintain a record of Aboriginal heritage sites, and engage in ongoing consultations with RAPs and other relevant Aboriginal community groups or members. Whitehaven would provide opportunities for Aboriginal community members to access known Aboriginal sites on Whitehaven-owned land where practical (e.g. where safety permits).

Where it would not be practical to avoid known Aboriginal heritage sites, sites would be subject to baseline recording prior to any disturbance and artefacts would be salvaged in consultation with the RAPs.

Whitehaven additionally proposes:

- developing a protocol for the management of any previously unidentified Aboriginal cultural heritage sites;
- providing training to all on-site personnel and contractors regarding known Aboriginal cultural heritage sites; and
- undertaking ongoing monitoring of blast vibration at the grinding groove site.

VALUATION APPROACH

The costs of managing and mitigating the potential impacts on Aboriginal heritage sites have been accounted for as part of Whitehaven's operating expenditures. These costs encompass the activities of Whitehaven personnel, as well as occasional smaller outlays that may be required to compensate RAPs during the salvage activities, employing an archaeologist to undertake salvage, or hiring suitable small machinery to undertake particular tasks.

3.3.9. Historical heritage

Appendix K of the EIS contains the Historic Heritage Assessment.

PREDICTED HISTORICAL HERITAGE IMPACTS

The Project would directly disturb a cottage of local heritage significance. Indirect impacts to other local heritage sites (e.g. the Kurrumbede Homestead Complex) as a result of noise, dust, blasting, vibration and visual would be managed such that heritage values would be maintained. The Approved Mine would not directly impact on any sites of local heritage significance, and potential indirect impacts are predicted to be negligible.

MITIGATION AND MANAGEMENT MEASURES

Whitehaven proposes preparing a photographic archival recording prior to any site disturbance, and the implementation of a Heritage Management Plan. Items identified during the surveys may be of interest to local collectors, and these objects would be offered to the Boggabri Historical Society and the Gunnedah Museum. Specifically in relation to the Kurrumbede Homestead Complex, Whitehaven proposes the following management and mitigation measures:

- the inspection of the homestead by a structural engineer to confirm blast vibration limits;
- vibration monitoring and structural inspections of the homestead complex; and

- management measures specific to the Kurrumbede Homestead as part of the Heritage Management Plan.

VALUATION APPROACH

The costs of managing and mitigating the predicted historical heritage impacts from the Project and the Approved Mine have been included in the costings for the Project Scenario and the Approved Mine Scenario. In addition to the monitoring activities undertaken by Whitehaven personnel, these costs would include employing an archaeologist or other qualified person to assist with the preparation of the Heritage Management Plan, and to undertake a photographic archival recordings, and employing an engineer to assess blasting limits for the Homestead.

3.3.10. Visual amenity

Appendix L of the EIS describes the Visual Assessment for the Project and the Approved Mine.

PREDICTED VISUAL AMENITY IMPACTS

The visual amenity impacts of the Project are predicted to vary by location:

- There are no privately-owned dwellings in the local setting (i.e. < 1 km away from the Project Mining area). A low level of potential visual impact would be expected for rural residences in the vicinity of the rail spur during operations.
- Dwellings in the sub regional setting (i.e. 1 to 5 km away from the Project Mining area) are expected to have moderate to high levels of visual impact due to Project landforms. Following progressive and final rehabilitation, levels of visual impact would reduce to low or very low.
- Dwellings in the regional setting (i.e. > 5 km away from the Project Mining area) are expected to have low levels of visual impact, given their distance from the Project. Following progressive and final rehabilitation, levels of visual impact would reduce to very low.
- Users of public roads in the vicinity of the Project are expected to experience a low to moderate level of visual impact due to Project landforms and mine infrastructure. Following progressive and final rehabilitation, levels of visual impact would reduce to low or very low.
- The cumulative visual impacts as a result of the Project and the Rocglen Coal Mine are considered to be low to moderate and confined to viewpoints to the south and south-east of the Project. These impacts would reduce to low once final rehabilitation has been completed.

- There would be an increase in potential night-lighting impacts from Project mining equipment, infrastructure and trains on the Project rail spur, which would be minimised as far as possible.

For the Approved Mine:

- Dwellings in the regional setting are expected to experience a low level of visual impact.
- Those dwellings in a sub-regional settings are predicted to experience visual impacts from very low to high. Following progressive and final rehabilitation, these visual impact would reduce to low or very low.
- Users of public roads in the vicinity of the Approved Mine are predicted to have a very low to low level of visual impact.
- There would be an increase in night lighting impacts associated with Project mining equipment, infrastructure and vehicle headlights due to vehicles using the Whitehaven haul route at night.
- Overall, the cumulative visual impacts as a result of the Approved Mine and the Rocglen Coal Mine are considered to be low to moderate and confined to viewpoints to the south of the Project.

MITIGATION AND MANAGEMENT MEASURES

Whitehaven proposes undertaking progressive rehabilitation of the Project landforms in the course of mining operations, such that any remaining visual impacts would be low. Other proposed initiatives to manage and mitigate visual impacts include:

- installing vegetative screens or bunds along sections of the Blue Vale Road realignment where road traffic would be exposed to prominent views of active mine operations;
- implementing measures to reduce potential impacts from night-lighting (including sky glow); and
- in the event that the visual impact of the Project at particular dwellings is found to be high, putting in place reasonable and feasible visual mitigation measures in consultation with the owner to minimise the visibility of the Project from the dwelling.

VALUATION APPROACH

The costs of managing and mitigating the predicted visual impacts from the Project and the Approved Mine, respectively, have been included in the costings for each scenario. In addition to rehabilitation costs (accounted for in the operational costings) and the monitoring and management activities that would be undertaken by Whitehaven personnel (whose wages and salaries are already accounted for), $100,000 for any additional outlays has been included in the respective mine costings.

3.4. NET BENEFITS OF THE PROJECT FOR NSW

Table 3-9 summarises the estimated net economic benefits of the Project for NSW. The net economic benefits of the Project have been calculated incrementally:

- relative to the ('do nothing') Reference Case; and
- relative to the net benefits to NSW that would arise in the Approved Mine Scenario.

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, including only incremental disposable income and attributing the share of income taxes and Medicare contributions that would accrue to NSW.

Table 3-9 shows that the Project would deliver significant additional net benefits relative to the Reference Case and the Approved Mine Scenario. The net benefits to NSW amount to:

- $1,208 million in NPV terms, if the Project is considered relative to the Reference Case; and
- $499 million in NPV terms, if the Project is considered relative to the Approved Mine.

Royalty payments constitute a significant share of the net benefits accruing to NSW, and are estimated at:

- $671 million in NPV terms (56 per cent of net benefits), if the Project is considered relative to the Reference Case; and
- $261 million in NPV terms (52 per cent of net benefits), if the Project is considered relative to the Approved Mine.

Net employment benefits in terms of the additional disposable income accruing to NSW residents, the NSW shares of company income taxes, and the NSW share of cash project profits constitute other important components to the overall net benefit in each of the cases considered. Relative to the Reference Case (relative to the Approved Mine Scenario), the Project would give rise to:

- $271 million ($114 million) in terms of net disposable income benefits;
- $121 million ($57 million) in terms of the NSW share of company income taxes; and
- $53 million ($32 million) in terms of the NSW share of cash profits attributable to the Project.

In contrast, the net costs arising from external effects are very small and relate to the social cost of GHG emissions that can be attributed to NSW. The remaining external effects are internalised by Whitehaven and are accounted for in the cost-benefit calculation.

These are the costs of surface and groundwater licenses, property acquisition upon request rights, a range of operating and capital costs to mitigate against dust, noise and visual amenity effects, the cost of establishing and maintaining environmental offsets, and the opportunity costs of foregone agricultural production.

Table 3-9. Net benefits of the Project for NSW (NPV AU$ 2017 million)

Costs	NPV (A$ 2017 millions)	Benefits	NPV (A$ 2017 millions)
Project (relative to Reference Case)			
Production related		**Production related**	
		Employment benefits (disposable income)	$271
		NSW share of personal income taxes	$54
		NSW share of Medicare payments	$3
		Share of gross operating surplus accruing to NSW:	
		Royalties	$671
		NSW share of company income taxes	$121
		NSW share of cash profits	$53
		Taxes on production and imports:	
		Payroll taxes	$27
		Land taxes	$3.4
		Shire rates	$3.3
Total production related	$0	Total production related	$1,208
Externalities		**Offsets**	
GHG emissions	$0.28		
Total externalities	$0.28	Total externalities	$0
Net economic benefits	**$1,208**		
Project (relative to Approved Mine)			
Production related		**Production related**	
		Employment benefits (disposable income)	$114
		NSW share of personal income taxes	$23

Costs	NPV (A$ 2017 millions)	Benefits	NPV (A$ 2017 millions)
		NSW share of Medicare payments	$1
		Share of gross operating surplus accruing to NSW:	
		Royalties	$261
		NSW share of company income taxes	$57
		NSW share of cash profits	$32
		Taxes on production and imports:	
		Payroll taxes	$11
		Land taxes *	-$0.3
		Shire rates *	-$0.2
Total production related	$0	Total production related	$499
Externalities		**Offsets**	
GHG emissions	-$0.03		
Total externalities	-$0.03	Total externalities	$0
Net economic benefits	**$499**		

Notes: NPVs have been derived using a discount rate of 7 per cent. Totals may not sum precisely due to rounding. * Negative incremental land tax/shire rate payments reflect the shorter mine life of the Project relative to the Approved Mine.

Source: AnalytEcon analysis.

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 such as tourism.

This requirement poses practical difficulties. Neither the Project nor the Approved Mine are currently operational, so that there are no existing expenditure patterns that could be analysed.

More generally, it is difficult to measure a change in surplus arising in other NSW industries, because, 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 materials. The balance of the expenditure flows to wages and to profits to those who manufactured the machinery. 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 the wages paid to NSW residents and any taxes paid in NSW.[9]

These limitations imply that the change in economic surplus in particular NSW industries arising from the Project or the Approved Mine, respectively, cannot be measured with any precision. However, overall, the impacts of the Project or the Approved Mine, respectively, on other NSW industries are likely to be positive:

- In the Project Scenario and the Approved Mine Scenario, Whitehaven would incur overall operating expenditures (net of labour costs) of $5,352 million and $3,405 million in NPV terms, respectively. 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 $535 million and $340 million in NPV terms in the Project Scenario and the Approved Mine Scenario, respectively.[10]
- The analysis of flow-on impacts for the State of NSW in Section 5 indicates that the Project and the Approved Mine would generate additional value added in other industries of $322 million and $184 million in NPV terms, respectively.

[9] *At a national level, these types of issues are handled through the national accounts whereby the balance of payments accounts for capital flows and GDP accounts for the compositions of domestic and imported production or consumption.*

[10] *Given that the value added multiplier for the Project Region is 1.27 (Appendix B), assuming that 10 per cent of local expenditures translate into margins earned by local suppliers is likely to be a conservatively low assumption.*

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. The corresponding surplus is an economic benefit that accrues to existing landholders and should be attributed to NSW. Whitehaven may acquire property in each of the Approved Mine and the Project Scenarios. Given the relatively unique nature of property, it is difficult to quantify the surplus relevant to the opportunity cost of the land. Any resulting net benefit accruing to landholders is also likely to be insignificant relative to the overall net benefit to NSW generated in each scenario. For these reasons, the economic benefits accruing to local landholders have conservatively not been estimated.

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. The Project and Approved Mine would require some road realignments and upgrades to be undertaken, which would be funded by Whitehaven. No public infrastructure costs would therefore be incurred in the Project Scenario or the Approved Mine Scenario, respectively.

3.6. 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.

3.6.1. Variations in the discount rate

In accordance with the 2015 Guidelines, a 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 3-10). Reducing the discount rate to 4 per cent implies that the Project would deliver net benefits to NSW of $1,725 million, while increasing the discount rate to 10 per cent implies net benefits to NSW of around $876 million.

Table 3-10. Net benefit to NSW – Discount rate sensitivity (NPV AU$ 2017 million)

Discount rate assumption (Per cent)	Project (relative to Reference Case, $ millions)	Project (relative to Approved Mine, $ millions)
7	$1,208	$499
4	$1,725	$683
10	$876	$369

Source: AnalytEcon analysis.

3.6.2. Variations in coal prices and exchange rates

The Project's coal production would be exported overseas, and is priced in US dollars. As noted in Section 3.2.1.1, the results of the CBA rely on long-term trend estimates of US$ 85 per tonne and US$ 100 per tonne for thermal and SSC/PCI coal, respectively, and on a long-term US$/AU$ exchange rate of $0.77.

Table 3-11 shows the net benefits accruing to NSW for each of the cases considered as a function of various combinations of coal prices and exchange rates:

- The coal price sensitivity simultaneously varies all product coal prices by -30 per cent and +10 per cent over the entire Project forecasting horizon (corresponding to a thermal coal price of $59.50 per tonne and $93.50 per tonne, respectively, from 2026 onwards) to account for greater downside than upside coal price risk.
- The US$/AU$ exchange rate sensitivity over the entire Project forecasting horizon by -20 per cent and +20 per cent (corresponding to a US$/AU$ exchange rate of $0.62 and $0.92 in 2020, respectively).

The sensitivities shown in Table 3-11 illustrate the implications for the net benefits accruing to NSW for different combinations of coal prices and exchange rates, whereby higher (+10 per cent) and lower (-30 per cent) coal prices are combined with higher (+20 per cent) and lower (-20 per cent) exchange rates, respectively. For instance, Table 3-11 shows that in the 'worst case' scenario modelled of a combination of a low coal price and a high AU$/US$ exchange rate, the net benefits to NSW of the Project would be $368 million in NPV terms. It is noted 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).

Table 3-11. Net benefit to NSW – Coal price and exchange rate sensitivity (NPV AU$ 2017 million)

	2026 benchmark coal prices		
Exchange rate (US$/A$)	**-30%**	**Central assumption (2026 onwards)**	**+10%**
	US$ 59.50 per tonne	**US$ 85.00 per tonne**	**US$ 93.50 per tonne**
Project (relative to Reference Case, AU$ 2017 million)			
-20% (0.62 US$/AU$)	$956	$1,713	$1,965
Central assumption (2026 onwards): 0.77 US$/AU$	$603	$1,208	$1,410
+20% (0.92 US$/A$)	$368	$872	$1,040
Project (relative to Approved Mine, AU$ 2017 million)			
-20% (0.62 US$/AU$)	$402	$696	$794
Central assumption (2020 onwards): 0.77 US$/AU$	$265	$499	$579
+20% (0.92 US$/A$)	$174	$370	$435

Notes: NPVs have been derived using a discount rate of 7 per cent.
Source: AnalytEcon 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. An assessment of the implications of a significant and sustained fall in output prices shows that if all product coal prices are simultaneously reduced by 60 per cent over the entire CBA forecasting horizon (corresponding to a US$ 34 thermal coal price in 2026), the NPV of the net Project benefits accruing to NSW would be zero.

3.6.3. Variations in employment assumptions

As discussed in Section 3.2.1, 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:

- the proportion of the Project workforce that would find alternative employment in NSW in the event that the Project does not proceed was assumed to be 80 per cent; and

- the alternative wage that the Project workforce would earn in the event that the Project does not proceed was assumed to be the average NSW wage and salary income.

Table 3-12 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 would find alternative employment in NSW in the absence of the Project; similarly,
- the net disposable income benefits generated by the Project increase, the lower the alternative wage earned by the workforce in the Reference Case.

Table 3-12. Net employment benefits and net benefits to NSW – Variations in employment assumptions (NPV AU$ 2017 million)

Variation in re-employment assumptions	Share of workers re-employed in NSW		
	Central assumption		
	70%	80%	90%
Project (relative to Reference Case)			
Net disposable income benefits	$288	$271	$253
Net benefits to NSW	$1,228	$1,208	$1,188
Project (relative to Approved Mine)			
Net disposable income benefits	$121	$114	$107
Net benefits to NSW	$508	$499	$492
Variation in alternative wage assumptions (+/- 20 per cent)	**Alternative wage**		
	Central assumption		
	$39,678	**$49,598**	**$59,517**
Project (relative to Reference Case)			
Net disposable income benefits	$293	$271	$249
Net benefits to NSW	$1,237	$1,208	$1,180
Project (relative to Approved Mine)			
Net disposable income benefits	$122	$114	$105
Net benefits to NSW	$511	$499	$489

Notes: NPVs have been derived using a discount rate of 7 per cent.
Source: AnalytEcon analysis.

The CBA results presented in Table 3-9 separately show the employment benefit components of NSW net benefits. Table 3-13 reproduces these results, excluding net employment-related benefits (disposable income and the NSW share of personal income taxes and Medicare payments). Table 3-13 shows that even if employment benefits are set aside, the net benefits for NSW of the Project would be substantial.

Table 3-13. Net benefits of the Project for NSW – Excluding employment-related benefits (NPV AU$ 2017 million)

Costs	NPV (AU$ 2017 million)	Benefits	NPV (AU$ 2017 million)
Project (relative to Reference Case)			
Production related		**Production related**	
		Share of gross operating surplus accruing to NSW:	
		Royalties	$671
		NSW share of company income taxes	$121
		NSW share of cash profits	$53
		Taxes on production and imports:	
		Payroll taxes	$27
		Land taxes	$3.4
		Shire rates	$3.3
Total production related	$0	Total production related	$881
Externalities		**Offsets**	
GHG emissions	$0.28		
Total externalities	$0.28	Total externalities	$0
Net economic benefits	**$880**		
Project (relative to Approved Mine)			
Production related		**Production related**	
		Share of gross operating surplus accruing to NSW:	
		Royalties	$261
		NSW share of company income taxes	$57

Costs	NPV (AU$ 2017 million)	Benefits	NPV (AU$ 2017 million)
		NSW share of cash profits	$32
		Taxes on production and imports:	
		Payroll taxes	$11
		Land taxes *	-$0.3
		Shire rates *	-$0.2
Total production related	$0	Total production related	$360
Externalities		**Offsets**	
GHG emissions	-$0.03		
Total externalities	-$0.03	Total externalities	$0
Net economic benefits	**$360**		

Notes: NPVs have been derived using a discount rate of 7 per cent. * Negative incremental land tax/shire rate payments reflect the shorter mine life of the Project relative to the Approved Mine. Totals may not sum precisely due to rounding.

Source: AnalytEcon analysis.

3.6.4. Variations in royalty payments

The 2015 Guidelines require an assessment of the royalties derived from project as a result of mining revenue that are 25 per cent lower or higher than in the central case. Table 3-14 shows that a decrease (increase) in mining revenues by 25 per cent would result in Project royalties of around $501 million ($842 million).

Table 3-14. Net royalty receipts and net benefits to NSW – Variations in mining revenues (NPV AU$ 2017 million)

	Variations in mining revenues ($ million)		
	- 25 per cent	Central case	+25 per cent
Project (relative to Reference Case)			
Royalties ($ millions)	$501	$671	$842
Net benefits to NSW ($ millions)	$704	$1,208	$1,713
Project (relative to Approved Mine)			
Royalties ($ millions)	$195	$261	$327
Net benefits to NSW ($ millions)	$305	$499	$696

Notes: NPVs have been derived using a discount rate of 7 per cent.
Source: AnalytEcon analysis.

3.6.5. Variations in company income tax payments

The 2015 Guidelines require an assessment of a variation in company income tax by +/- 50 per cent. Table 3-15 summarises the results of the analysis.

Table 3-15. NSW share of company income tax payments – Sensitivity (NPV AU$ 2017 million)

Company income tax	Project (relative to Reference Case, $ millions)	Project (relative to Approved Mine, $ millions)
Central case	$121	$57
50 per cent increase	$182	$85
50 per cent decrease	$61	$28

Notes: NPVs have been derived using a discount rate of 7 per cent.
Source: AnalytEcon analysis.

3.7. 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 geographical study area used for the LEA;
- Section 4.2 describes the economic framework that has been applied to estimate the net benefits of the Project that can be attributed to the local region;
- Section 4.3 sets out the results of the LEA, in terms of the net benefits that would accrue to the local region; and
- Section 4.4 comments on a number of other requirements for the LEA set out in the 2015 Guidelines.

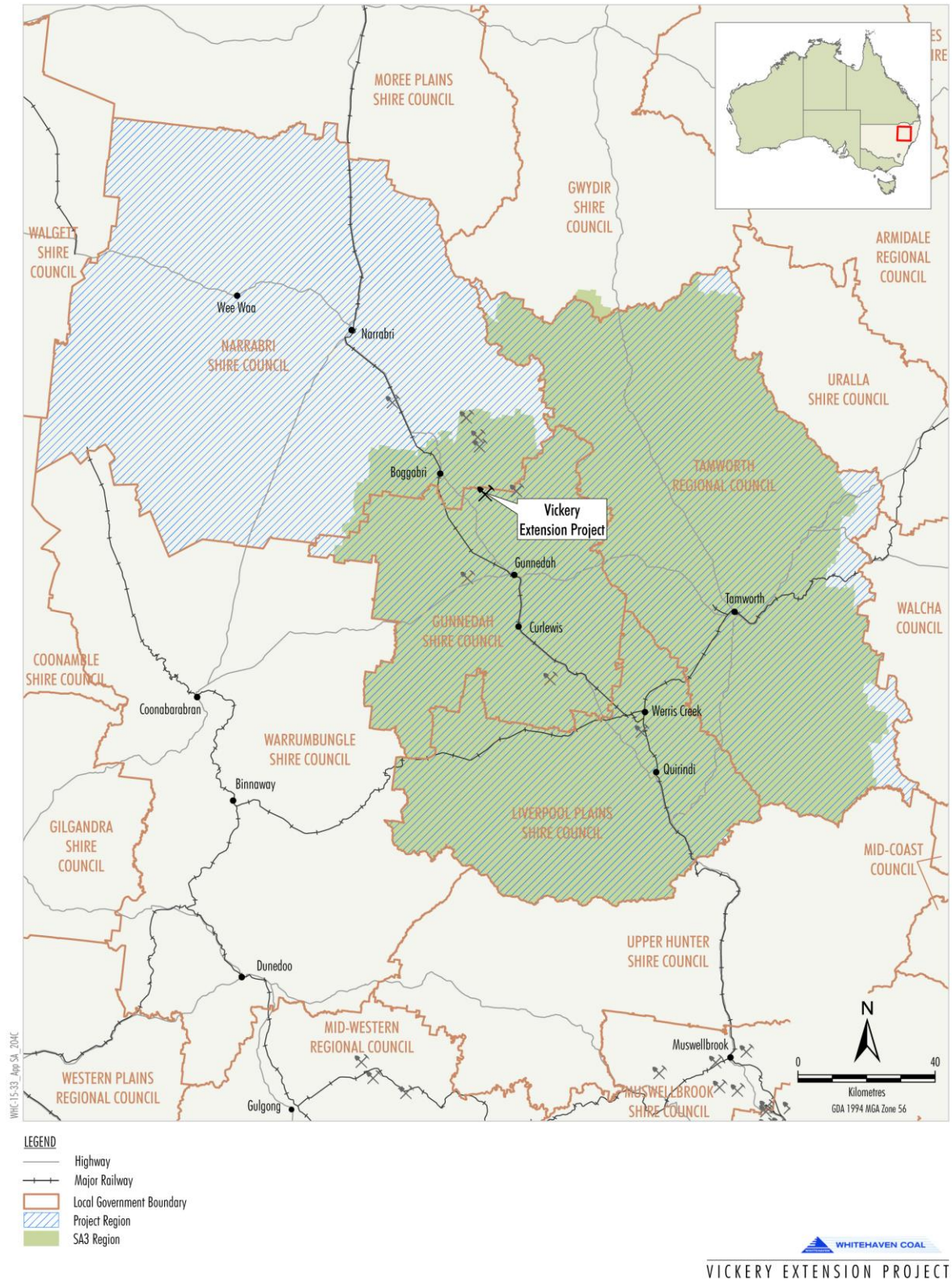
The flow-on effects of the Project on the local region are derived in Section 5.

4.1. LEA STUDY AREA

For the purpose of preparing the LEA, the 2015 Guidelines require proponents of a development to adopt a study area defined according to a Statistical Area Level 3 (SA3) geographical definition, whereby the relevant SA3 region should contain the proposed development. In the case of the Project, the relevant SA3 area is the 'Tamworth-Gunnedah' region. As shown in the green shaded area in Figure 4-1, The Tamworth - Gunnedah SA3 region incorporates the Quirindi region (Liverpool Plains LGA), Tamworth and the Tamworth region (Tamworth Regional LGA), Gunnedah and the Gunnedah region (Gunnedah LGA), as well as Boggabri (located in Narrabri LGA). However, the Tamworth – Gunnedah SA3 region excludes Narrabri and Wee Waa, and most of Narrabri LGA. A study area based on the Tamworth – Gunnedah SA3 region would therefore only partially capture the likely economic impacts of the Project, given that:

- the Project is located in both Narrabri and Gunnedah LGAs; and
- Whitehaven has a general policy of recruiting its workforce locally (Section 4.2.1), so that a significant share of the workforce can be expected to be drawn from or reside in the Narrabri LGA (as well as other areas).

Figure 4-1. Tamworth - Gunnedah SA3 Region and Project Region



Source: Whitehaven.

A more meaningful assessment of the localised impacts of the Project can be prepared by considering a study area comprising, at a minimum, the LGAs of Narrabri and Gunnedah within which the Project would be located and where Whitehaven would seek to recruit a significant share of the workforce. In addition, given Whitehaven's experience to date, some share of the workforce is likely to reside in Liverpool Plains LGA, as well as in Tamworth Regional LGA, which is also an important regional centre for a range of commercial and public services. Liverpool Plains LGA and Tamworth Regional LGA also form part of the Tamworth – Gunnedah SA3 region.

The following approach has therefore been adopted in this report for the purposes of assessing the localised economic impacts of the Project:

- the LEA has been prepared for the region comprising the four LGAs of Gunnedah, Narrabri, Liverpool Plains and Tamworth Regional, referred to in this report as the 'Project Region' (the blue shaded area in Figure 4-1); and
- in order to comply with the 2015 Guidelines, the LEA has additionally been prepared for the Tamworth - Gunnedah SA3 Region, referred to as the 'SA3 Region' in this report (the green shaded area in Figure 4-1).

Where the reported effects are the same, the Project Region and the SA3 Region are referred to jointly as the 'local region' or the 'local economy' in this report.

4.2. ECONOMIC FRAMEWORK

The same framework adopted for the CBA (Section 3) has been adopted for the LEA. Appendix A describes the assumptions used for the LEA. Consistent with the CBA, the LEA considers the incremental (net) benefits that would arise if the Project is approved relative to two counterfactual scenarios:

- the 'Reference Case' whereby the Project is assessed on a stand-alone basis; and
- the Approved Mine, whereby the Project is assessed relative to the Approved Mine.

4.2.1. Incremental income benefits attributable to the local region

Figure 2-2 shows the projected workforce profile for the Project. Whitehaven has developed a recruitment strategy with a focus on local employment and workforce diversity, including by offering apprenticeships, traineeships and scholarships to support local employment and increase local skills levels. As of May 2013, 58 per cent of Whitehaven employees across its established operations in the local region lived in the Narrabri, Liverpool Plains or Gunnedah LGAs, and a further 15 per cent lived in Tamworth Regional LGA (Whitehaven 2015).

Given Whitehaven's experience with other mining operations in the region and the company's focus on generating local employment opportunities:

- the Project Region is assumed to encompass 70 per cent of the workforce by place of residence; and
- given that it excludes most of Narrabri LGA, including the towns of Narrabri and Boggabri, the SA3 Region is assumed to encompass 60 per cent of the workforce by place of residence.

As is the case for the CBA, a number of adjustments have been made to ensure that employment and income benefits 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.

It has furthermore been assumed that in the absence of the Project, a share of the workforce would be employed elsewhere in the Project Region or the SA3 Region. The disposable income benefits 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 3.2.1.1, 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 then been applied to the respective shares of the workforce assumed to reside in the local region. Where the assessment of the Project on a stand-alone basis is concerned:

- 56 per cent (70 per cent × 80 per cent) of the Project workforce is assumed to find alternative employment in the Project Region in the Reference Case counterfactual; and
- 48 per cent (60 per cent × 80 per cent) of the Project workforce is assumed to find alternative employment in the SA3 Region in the Reference Case counterfactual.

The same approach has been applied to account for alternative employment opportunities in the assessment of the Project relative to the Approved Mine. As is apparent from Figure 2-2, the employment profiles differ in these two scenarios so that employment is greater in the Project Scenario than in the Approved Mine Scenario from 2020 until 2040, and the reverse holds in 2019 and from 2041 to 2048.

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 weighted-average median employee income of Project Region and the SA3 Region, determined to be $44,659 and $44,944, respectively, in 2017 dollars.

4.2.2. Other net benefits attributable to the local region

A number of incremental benefits accruing to NSW were identified for the purposes of undertaking the CBA, including a share of the Project's GOS and other taxation benefits (Section 3.2). Of these net benefits, only rate payments accruing to local authorities can be attributed directly to the local region. Consistent with the CBA, the LEA assumes that local government rate payments of $400,000 per annum would accrue to the local region in each of the Project Scenario and the Approved Mine Scenario over the operating life of the mine, net of an estimated $122,430 per annum in rate revenues from farmland that would be paid in the Reference Case.

4.3. 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. Table 4-1 and Table 4-2 show the net benefits of the Project for the Project Region and the SA3 Region, respectively.

Table 4-1 and Table 4-2 show that the benefits accruing to the Project Region would be greater than for the SA3 Region, reflecting the expectation that a larger percentage of the workforce is expected to live in the Project Region:

- For the Project Region, the stand-alone benefits of the Project are expected to amount to $224 million in NPV terms in additional disposable income and $3 million in NPV terms in additional shire rate payments (Table 4-1). Relative to the Approved Mine, the Project would deliver disposable income benefits of $93 million in NPV terms, but generate a smaller shire rate contribution (-$0.2 million in NPV terms), reflecting the shorter mine life of the Project.
- For the SA3 Region, the stand-alone benefits of the Project are expected to amount to $200 million in NPV terms in incremental disposable income and $3 million in NPV terms in additional shire rate payments (Table 4-2). Relative to the Approved Mine, the Project would deliver incremental disposable income benefits of $83 million in NPV terms, and a reduction in shire rate payments (-$0.2 million in NPV terms).

As discussed in Section 3.3.7, Whitehaven has purchased land and water entitlements at market prices, so that land- and water holders have been compensated. There is therefore no net cost from agricultural external effects to the local region.

Table 4-1. Net benefits of the Project for the Project Region (NPV AU$ 2017 million)

Costs	NPV (AU$ 2017 million)	Benefits	NPV (AU$ 2017 million)
Project (relative to Reference Case)			
Production related		**Production related**	
		Employment benefits (disposable income)	$224
		Taxes on production and imports:	
		Shire rates	$3.3
Total production related	$0	Total production related	$227
Externalities		**Offsets**	
Foregone land use	$0		
Total externalities	$0	Total externalities	$0
Net economic benefits	**$227**		
Incremental Project (relative to Approved Mine)			
Production related		**Production related**	
		Employment benefits (disposable income)	$93
		Taxes on production and imports:	
		Shire rates	-$0.2
Total production related	$0	Total production related	$93
Externalities		**Offsets**	
Foregone land use	$0		$0
Total externalities	$0	Total externalities	$0
Net economic benefits	**$93**		

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

Source: AnalytEcon analysis.

Table 4-2. Net benefits of the Project for the SA3 Region (NPV AU$ 2017 million)

Costs	NPV (AU$ 2017 million)	Benefits	NPV (AU$ 2017 million)
Project (relative to Reference Case)			
Production related		**Production related**	
		Employment benefits (disposable income)	$200
		Taxes on production and imports:	
		Shire rates	$3.3
Total production related	$0	Total production related	$203
Externalities		**Offsets**	
Foregone land use	$0		
Total externalities	$0	Total externalities	$0
Net economic benefits	**$203**		
Incremental Project (relative to Approved Mine)			
Production related		**Production related**	
		Employment benefits (disposable income)	$83
		Taxes on production and imports:	
		Shire rates	-$0.2
Total production related	$0	Total production related	$83
Externalities		**Offsets**	
Foregone land use	$0		$0
Total externalities	$0	Total externalities	$0
Net economic benefits	**$83**		

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

Source: AnalytEcon analysis.

4.4. OTHER MATTERS RAISED IN THE 2015 GUIDELINES

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

4.4.1. Non-labour project expenditure

The 2015 Guidelines require a proponent to quantify (non-labour) construction and operating expenditures and to attribute these expenditures to the relevant local region. As set out in Section 3.5.1, meeting this requirement is practically not possible. A key difficulty is that there are no data about the local content of any goods and services that Whitehaven 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 additionally noted that the Approved Mine has not commenced operations, and the Project is at a proposal stage, so that expenditure patterns have not yet been established.

While it is therefore not possible to make a reliable statement about the extent to which the projected operating expenditures would benefit the Project Region or the SA3 Region, respectively, Whitehaven would incur operating expenditures of $5,352 million in NPV terms for the Project. A share of these expenditures, for instance, for construction services and supplies, transport support services, professional, scientific and technical services, repair and maintenance services, and food and accommodation services would be expected to benefit the local region. The analysis of the flow-on impacts of the Project on the local region (Section 5.3) also indicates that the Project would generate net (disposable) income benefits of $92 million in NPV terms and annual average employment benefits of 181 FTE jobs in the Project Region, or net income benefits of $80 million in NPV terms and annual average employment benefits of 153 FTE jobs in the SA3 Region.

4.4.2. Effects on other local industries

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.

4.4.2.1 AGRICULTURE

The Project Mining area would be located on cleared agricultural land that is currently used for grazing, while the Project rail spur is predominately located on land used for cropping. As discussed in Section 3.3.7 and Appendix C, at the local level the potential economic impacts on agriculture of the Project fall into two categories:

- the direct impacts in terms of foregone agricultural production, either over the life of the mine or in perpetuity, to land and water entitlement holders in the local region; and
- the flow-on impacts, in terms of the effects of reduced agricultural production on the demand for downstream agricultural services and upstream value adding enterprises in local region.

Where the direct (foregone production) impacts are concerned, these impacts have been internalised by Whitehaven, and have been accounted for in the CBA. However, the agricultural flow-on impacts represent an offset to the flow-on benefits of the Project to the local region. These (negative) offsets have therefore been accounted for in the estimated regional flow-on effects in Section 5.3.

4.4.2.2 TOURISM

As illustrated in Figure 4-1, the Project would be located on the border of Narrabri and Gunnedah LGAs. The surrounds of the Project are considered to be of low- to moderate scenic quality (Urbis 2012). The landscape has been heavily modified over time, although the Vickery State Forest and the Namoi River add some scenic quality. There are also a number of other coal mines in the region, of which the Rocglen Coal Mine, the Boggabri Coal Mine, and the Tarrawonga Coal Mine are located within a 12 km radius of the Project.

As of 2016 community census, employment in accommodation and food services – an indication of the importance of tourism – lay between 6 and 7 per cent in all LGAs in the Project Region except Liverpool Plains LGA, where it was around 5 per cent (ABS 2016). Table 4-3 lists a number of indicators that relate to the importance of tourism in Narrabri and Gunnedah LGAs. Relative to the New England North West region and NSW, and as of 2015, Narrabri LGA and Gunnedah LGA accounted for a small share in terms of the number of (hotel, motel and serviced apartment) establishments with more than 15 rooms, the number of occupied room nights, and revenues from accommodation. Tamworth Regional LGA plays a far greater role in terms of tourism offerings and accommodation. Overall, therefore, the relatively limited role of tourism accommodation in Narrabri and Gunnedah LGAs suggests that any impacts of the Project on tourism would be limited. Beyond the Narrabri and Gunnedah LGAs, the Project is not expected to adversely impact tourism.

This includes consideration of the findings of the Visual Assessment (Appendix L of the EIS), which describes measure to minimise potential lighting impacts of the Project including to the Siding Springs Observatory (located approximately 115 km to the south-west of the Project).

Table 4-3. Tourism indicators (2015)

	No. establishments with 15 rooms or more	Per cent New England NW (NSW)	Occupied room nights ('000s)	Per cent New England NW (NSW)	Accom. revenues ($ million)	Per cent New England NW (NSW)
Narrabri LGA	8	8.4% (0.6%)	45	9.1% (0.2%)	$5.3	8.6% (0.2%)
Gunnedah LGA	6	6.3% (0.4%)	27	5.5% (0.1%)	$2.6	4.2% (0.1%)
Tamworth Regional LGA	26	27.4% (1.8%)	166	33.5% (0.9%)	$24.2	39.2% (0.7%)
New England North West	95		495		$61.8	
NSW	1,424		18,573		$3,499	

Notes: Destination NSW does not publish tourism data relating to Liverpool Plains LGA.

Source: Destination NSW; http://www.destinationnsw.com.au/tourism/facts-and-figures; accessed on 21 February 2017.

5. FLOW-ON BENEFITS

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 describes the approach taken to determine flow-on benefits, and the limitations of input-output analysis; and
- Section 5.2 sets out the estimated flow-on benefits for NSW; and
- Section 5.3 sets out the estimated flow-on benefits for the Project Region and the SA3 Region, respectively.

Consistent with the CBA, the analysis of flow-on benefits has considered the Approved Mine so that the incremental flow-on impacts of the Project relative to the Approved Mine can be quantified. 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 local economy.

5.1.1. Choice of input-output analysis

A number of methods can be used for calculating flow-on effects from resource 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 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 in this report 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 as general equilibrium (GE) analysis:

- The gross value of the Project is small in relation to the NSW economy. 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, material price impacts would not be expected and the difference between the results of a GE and an input-output analysis should therefore be small.
- Given that detailed information about industry structure and trade at a regional and state level is not available, 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 regional economy. However, industries at a regional 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 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, ABS 1995) is industry employment.

ABS employment data by industry and at the LGA level can then 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/regional level, relative to the percentage of people employed in that industry in the economy as a whole. 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 fixed assets can become increasingly important. A region may simply not have the fixed assets needed to cost-effectively produce the input required by a local industry and as a consequence they will be 'imported' from other regions and states in Australia, or from overseas.

5.1.3. 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.

Regional economic impacts can be measured in terms of income, value added and employment, which in turn gives rise to income, value added and employment multipliers. 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 Whitehaven;
- the employment multiplier corresponds to the change in total employment (in numbers of FTE jobs) arising per additional person employed by Whitehaven; and
- the value added multiplier refers to the percentage change in total value added arising per dollar change in the value added created by Whitehaven.

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, say:

- 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 the 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 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.

5.1.4. 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 analysis generally while others relate to the use and interpretation of input-output analysis at a regional/state, as opposed to a national level. The key assumptions are set out below.

5.1.4.1 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 regional impact assessments. In moving from the national to a state or regional 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, it becomes increasingly difficult to determine the value added by local industry.

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 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 inputs into production and the total supply of industry output.

5.1.4.2 IMPLICATIONS FOR THE ASSESSMENT OF FLOW-ON EFFECTS

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) at each level.

Furthermore, and while theoretically 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 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. The calculation of value added at a regional level is therefore not meaningful.

5.2. FLOW-ON EFFECTS OF THE PROJECT FOR NSW

Table 5-1 shows the estimated flow-on effects for the Project for NSW. 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 projects. 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:

- $146 million in NPV terms in terms of additional disposable income, or $12 million in NPV terms annually;
- annual average employment flow-on benefits of 316 FTE jobs; and
- additional value added of $322 million in NPV terms, or $25 million per annum.

Relative to the Approved Mine, the Project would generate an additional disposable income of $61 in NPV terms ($5 million annually), 92 FTE jobs, and additional value added of $138 million in NPV terms ($12 million per annum).

Table 5-1. Initial flow-on effects (Type IA) for the Project – NSW (NPV AU$ 2017 million)

	Total	Annual
Project (relative to Reference Case)		
Disposable income ($ millions)	$146	$12
Employment (FTE jobs)	N/a	316
Value added ($ millions)	$322	$25
Incremental Project (relative to Approved Mine)		
Disposable income ($ millions)	$61	$5
Employment (FTE jobs)	N/a	92
Value added ($ millions)	$138	$12

Notes: NPVs have been derived using a discount rate of 7 per cent.
Source: AnalytEcon analysis.

5.3. FLOW-ON EFFECTS OF THE PROJECT FOR THE LOCAL 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 negative flow-on impact arising from a reduction in agricultural activities.

5.3.1. Agricultural flow-on impacts

The agricultural flow-on impacts represent an offset to the flow-on benefits of the Project to NSW and the local region. At a state level, this offset is small, which is typical for a conversion of land from extensive to much more intensive land use. However, the offset is more material at the local level, as shown in Table 5-2 for the Project Region and the SA3 Region.[11]

The potential change in regional agricultural value is not expected to cause significant losses to related services. As such, agricultural production values in the region are not expected to drop below critical mass thresholds.

Table 5-2. Regional agricultural flow on effects (Project Region and SA3 Region)

Type of flow-on effect	Project	Approved Mine	Difference
		Cumulative	
Employment (FTE jobs)	12.6	8.0	4.6
Disposable income* (NPV AU$ 2017 million)	$15.5	$9.9	$5.6
		Annual	
Employment (FTE jobs)	0.5	0.3	0.2
Disposable Income* (NPV AU$ 2017 million)	$0.7	$0.4	$0.3

Notes: * The disposable income calculation assumes that disposable income is 60 per cent of gross income, which is equivalent to that assumed for non-mine workers in the CBA.

Source: AnalytEcon analysis.

5.3.2. Net flow-on benefits of the Project

For the reasons discussed in Section 5.1.4.2, there are specific issues that arise in deriving value added multipliers for small geographic areas. Value added includes profits that are distributed on the basis of the ownership of capital assets, which becomes increasingly uncertain as the analysis becomes more granular. The calculation of value added at a local level is therefore not meaningful.

In addition, as discussed in Section 5.3.1, the positive flow-on effects of the Project on the local region would be offset by a small reduction in flow-on impacts that is attributable to the displacement of agriculture by the Project or the Approved Mine.

[11] *As discussed in Section 4, the LEA has been undertaken for two local regions, the 'Project Region' encompassing the LGAs of Gunnedah, Narrabri, Liverpool Plains and Tamworth Regional, and the SA3 Region encompassing the Tamworth – Gunnedah SA3 statistical region.*

This is a reflection of the effects of reduced agricultural production on the demand for downstream agricultural services and upstream value adding enterprises in the local region. This offset effect has been taken into account in the calculation of flow-on impacts on the local region.

Table 5-3 and Table 5-4 show the estimated flow-on effects from the Project for the Project Region and the SA3 Region, respectively.

- For the Project Region, the total flow-on benefits in terms of additional income and employment generated by the Project are $92 million ($8 million annually) in disposable income in NPV terms, and an annual average of 181 FTE jobs. Relative to the Approved Mine, the Project would generate an additional $39 million ($4 million annually) in disposable income in NPV terms, and 52 FTE jobs.
- For the SA3 Region, the total flow-on benefits in terms of additional income and employment generated by the Project are $80 million ($7 million annually) in disposable income in NPV terms, and an annual average of 153 FTE jobs. Relative to the Approved Mine, the Project would generate an additional $34 million ($3 million annually) in disposable income in NPV terms, and 44 FTE jobs.

Table 5-3. Initial flow-on effects (Type IA) for the Project – Project Region (NPV AU$ 2017 million)

	Total	Annual
Project (relative to Reference Case)		
Disposable income ($ millions)	$92	$8
Employment (FTE jobs)	N/a	181
Incremental Project (relative to Approved Mine)		
Disposable income ($ millions)	$39	$4
Employment (FTE jobs)	N/a	52

Notes: The calculation of flow-on effects takes into account the effects of reduced agricultural production as a result of the Project.

Source: AnalytEcon analysis.

Table 5-4. Initial flow-on effects (Type IA) for the Project - SA3 Region (NPV AU$ 2017 million)

	Total	Annual
Stand-alone Project (relative to Reference Case)		
Disposable income ($ millions)	$80	$7
Employment (FTE jobs)	N/a	153
Incremental Project (relative to Approved Mine)		
Disposable income ($ millions)	$34	$3
Employment (FTE jobs)	N/a	44

Notes: The calculation of flow-on effects takes into account the effects of reduced agricultural production as a result of the Project.

Source: AnalytEcon analysis.

APPENDIX A COST BENEFIT ANALYSIS AND LOCAL EFFECTS ANALYSIS

A.1. 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):

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

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;[12]
- 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.

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

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.

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

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
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 2014b.

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.2.2. Redeployment assumptions

The CBA described in Section 3 and the LEA described in Section 4 considers the incremental benefits and costs of the Project and the Approved Mine, respectively:

- the additional benefits and costs accruing to NSW and the local economy if the Approved Mine is commissioned, relative to a 'do nothing' scenario (the Reference Case);
- the additional benefits and costs accruing to NSW and the local economy if the Project is commissioned, relative to the Approved Mine being commission; and
- the additional benefits and costs accruing to NSW and the local economy if the Project is commissioned, relative to the Reference Case.

Each of these three cases requires assumptions to be made about the number of employed people in the counterfactual.

If the Project is commissioned, employment would increase relative to the Approved Mine Scenario between 2020 and 2040. In 2019 and from 2041 to 2048, employment in the Project Scenario would be less than in the Approved Mine Scenario. For the Project Scenario, it has therefore been assumed that:

- a share of the additional workforce is redeployed from elsewhere in NSW and/or from the Project Region or the SA3 Region; and
- by the same token, a share of the workforce that would be unemployed between 2041 and 2048 (relative to the Approved Mine Scenario) would also be redeployed. That is, of the workers that would be made redundant in the Project Scenario relative to the Approved Mine Scenario from 2041, a share would find alternative employment in NSW and/or in the Project Region or the SA3 Region, while the remainder would either remain unemployed, take early retirement or otherwise leave the NSW workforce (for instance, by moving interstate).

The same logic is applied when considering the Project on a stand-alone basis. If the Project is commissioned, employment would increase relative to the Reference Case between 2020 and 2044. 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 redeployed from existing positions.

If the Approved Mine is commissioned, employment would increase relative to the Reference Case between 2019 and 2048. However, not all of this employment would be additional, in the sense that they would consist of either job starters or previously unemployed workers. The majority of the workforce would be expected to move to the mine from alternative employment; i.e. these workers would be redeployed from elsewhere in NSW and/or from the Project Region or the SA3 Region, respectively.

The limited empirical evidence suggests that 22 to 23 per cent of persons leave the labour force altogether following a redundancy, and 29 per cent of persons remain unemployed in the 12 months following a redundancy. On that basis, the central (symmetric) employment/ re-employment assumption used in this report is that 80 per cent of additionally employed persons transfer from an alternative job in NSW and 80 per cent of persons made redundant also transfer to an alternative job in NSW.

For the purpose of the LEA, this assumption was modified by the share of employees in the Project Region and the SA3 Region, respectively (Table A-2). As for the CBA, 80 per cent of additional workers are assumed to transfer from alternative jobs, and 80 per cent of workers who are made redundant are assumed to transfer to alternative jobs.

Additionally, the targeted mix of local versus non-local (rest of NSW) employees was preserved, so that of the additional workers in both the Project Scenario and the Approved Mine Scenario, 70 per cent are assumed to live in the Project Region. Given that the SA3 Region excludes Narrabri and much of Narrabri LGA, the assumption was made that 60 per cent of the workforce would live in the SA3 Region.

Table A-2. Workforce employment/re-employment assumptions

Analysis	Relevant geographical area	Percentage of workers redeployed	Percentage of workers from the relevant geographical area	Combined employment/re-employment assumption
CBA	NSW	80	100	80
LEA	Project Region	80	70	56
LEA	SA3 Region	80	60	48

Source: AnalytEcon analysis.

A.2.3. Wages assumptions

As of May 2017, average adult full time weekly earnings in the mining sector (Australia) were $2,595.3, corresponding to annual earnings of $134,956. Construction wages were assumed to be $200,000 per annum.

A.2.4. Alternative wage

The alternative wage has been estimated using the median employee income applicable to the relevant geographical area (Table A-3). For the Project Region, median income has been calculated as the (population) weighted-average for the four LGAs making up the region.

Table A-3. Alternative wage assumptions

	Median employee income ($)		
Year	NSW	Project Region	SA3 Region
2015, AU$ 2015	$47,500	$42,770	$43,043
AU$ 2017	$49,598	$44,659	$44,944

Source: ABS 2016 Census Community Profiles; 6302.0 Average Weekly Earnings, New South Wales.

A.2.5. Other assumptions

Table A-4 summarises other assumptions used to derive the net benefits to NSW. Coal price and exchange rate forecasts were provided by Whitehaven on the basis of CRU forecasts. Inflation is assumed to be 2.5 per cent per annum, in line with the RBA's inflation target. Real wage indexation is assumed to be 1 per cent per annum.

Table A-4. Coal price and exchange rate assumptions ($2017)

Assumption	2019	2020	2021	2022	2023	2024	2025	Thereafter
Benchmark thermal coal price (US$ per tonne)	$84	$84	$83	$83	$85	$85	$85	$85
PCI coal price (US$ per tonne)	$113	$113	$107	$107	$106	$105	$104	$100
Semi-soft coking coal price (US$ per tonne)	$113	$113	$107	$107	$106	$105	$104	$100
Exchange rates (US$ / AU$)	0.77	0.77	0.78	0.78	0.78	0.78	0.78	0.77

Source: Whitehaven, AnalytEcon.

APPENDIX B ANALYSIS OF FLOW-ON EFFECTS

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 local economy. The input-output multipliers that were derived for the Project Region we also used for the SA3 Region, as the numerical differences were not large enough to be material.

B.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 input output tables are for the year 2014-15 which were released in June 2017. The ABS census records employment an aggregated level with 19 industry classifications. The employment data was drawn from the most recent, 2016, census The concordance between the census and the accounts is set out in Table B-1.

Table B-1. Industry concordance between the industries in the National Accounts and industry level employment data in the 2016 census

2016 ABS census Aggregate Industry	ABS National Accounts industry codes	
	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

2016 ABS census Aggregate Industry	ABS National Accounts industry codes	
	Starting from	Ending with
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, 2013-14. ABS 2011 Census of Population and Housing.

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.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 additional 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.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 $(I - A)^{-1}$ 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.4. 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 $(I - B)^{-1}$.

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.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.

B.5.1. Employment multipliers

To calculate employment multipliers requires information about employment by industry that is provided in the ABS National Accounts (Table B-1). 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: $h(I - A)$; and
- Type IIA: $h(I - B)$.

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 workers who are converted to full-time workers or vice versa.

B.5.2. 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: $w(I - A)$; and
- Type IIA: $w(I - B)$.

These multipliers can be adjusted to Type1A, Type 2a multipliers by expressing the multiplier as the total income per dollar of salaries and wages expended directly on the project. This is done by dividing each of the multipliers above by the salaries and wages required per unit of output.

B.5.3. 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: vA;
- Type IB: $V(I - A)$; and
- Type IIA: $v(I - B)$.

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.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. Hence national input-output tables need to be adjusted to better reflect the characteristics of the local economy (Table B-2).

Table B-2. Australian, NSW and local region FTE employment by industry as a percentage of total employment

Industry	Australia	NSW	SA3 Region/ Project region
Agriculture, forestry and fishing	2.6	2.3	11.2
Mining	1.7	1.0	3.7
Manufacturing	6.7	6.1	6.5
Electricity, gas, water and waste services	1.1	1.0	1.0
Construction	8.9	8.8	7.4
Wholesale trade	3.0	3.2	2.9
Retail trade	10.3	10.1	10.6
Accommodation and food services	7.2	7.4	6.9
Transport, postal and warehousing	4.9	4.9	5.0
Information media and telecommunications	1.8	2.3	0.9
Financial and insurance services	3.8	5.2	1.7
Rental, hiring and real estate services	1.8	1.9	1.3
Professional, scientific and technical Services	7.6	8.5	3.8
Administrative and support services	3.6	3.6	3.1

Industry	Australia	NSW	SA3 Region/ Project region
Public administration and safety	7.0	6.3	5.9
Education and training	9.1	8.8	8.8
Health care and social assistance	13.2	13.1	14.0
Arts and recreation services	1.7	1.6	0.9
Other services	3.9	3.9	4.4
Total	100.0%	100.0%	100.0%

B.6.1. 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:

$$LQ_{i,j} = \frac{employment_{i,j}}{\frac{\sum_i employment_{i,j}}{\sum_j employment_{i,j}}}{\sum_i \sum_j employment_{i,j}}$$

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:

$$LQ_{i,j} = \begin{cases} LQ_{i,j} & if \quad LQ_{i,j} < 1 \\ 1 & if \quad LQ_{i,j} >= 1 \end{cases}$$

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.

B.6.2. Regional multipliers

If 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 the matrix:

$$(I - LQ \times A)^{-1}$$

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.6.3. Adjusted mining 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 Australian and the adjusted State and regional mine expenditure are shown in Table B-3.

Table B-3. Australian, NSW, Project Region and SA3 Region – LQ-adjusted mine expenditures

Industry	Australia	NSW	SA3 Region/ Project Region
Agriculture, forestry and fishing	0.2%	0.2%	0.2%
Mining	7.7%	4.4%	7.7%
Manufacturing	4.5%	4.1%	4.4%
Electricity, gas, water and waste services	1.5%	1.3%	1.4%
Construction	6.0%	5.9%	4.9%
Wholesale trade	2.0%	2.0%	1.9%
Retail trade	0.6%	0.6%	0.6%
Accommodation and food services	0.7%	0.7%	0.6%
Transport, postal and warehousing	2.4%	2.4%	2.4%
Information media and telecommunications	0.2%	0.2%	0.1%
Financial and insurance services	3.6%	3.6%	1.6%
Rental, hiring and real estate services	1.7%	1.7%	1.2%
Professional, scientific and technical Services	4.5%	4.5%	2.3%
Administrative and support services	0.6%	0.6%	0.8%
Public administration and safety	0.7%	0.6%	0.6%
Education and training	0.1%	0.1%	0.1%
Health care and social assistance	0.0%	0.0%	0.0%
Arts and recreation services	0.1%	0.1%	0.0%
Other services	1.8%	1.8%	1.8%
Totals domestic inputs	38.8%	32.9%	32.4%
Total inputs	51.1%	51.1%	51.1%
Wages and salaries	14.6%	14.5%	14.5%
Gross operating Surplus	39.3%	39.3%	39.3%
Taxes less subsidies	1.0%	1.1%	1.1%
Imports	6.4%	11.5%	12.0%
Total	100.0%	100.0%	100.0%

B.7. ESTIMATES OF MULTIPLIERS

The multipliers reported in the following were derived from national level multipliers in accord with guidelines provided by the ABS (1995). State and regional multipliers were derived using employment LQs to translate economy-wide input-output relationships into regional relationships. Table B-4 shows national multipliers derived from the 2014-15 National Accounts tables for:

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

Table B-4. National input-output multipliers

Multiplier	Type IA: Direct + Type IA effects	Type IB: Direct + Type IA + industry support effects	Type IIA: Direct + Type IA + industry support + consumption induced effects
Output	1.39	1.71	2.86
Income	1.59	3.11	5.10
Employment	2.09	4.09	6.75
Value Added	1.33	2.61	3.29

Source: AnalytEcon analysis.

Table B-5 shows these multipliers for NSW and for the Project Region (the SA3 Region).

Table B-5. NSW, Project Region and SA3 Region regional input-output multipliers

	NSW			Project Region / SA3 Region		
Multiplier	IA	IB	IIA	IA	IB	IIA
Income	1.54	2.98	3.05	1.48	2.77	3.55
Employment	2.04	3.90	6.32	1.91	3.51	5.38
Value Added	1.29	2.52	5.83	1.27	2.42	2.88

Source: AnalytEcon analysis.

The Type 1A multipliers for agriculture to estimate the flow impacts of foregone agriculture for the Project Region and the SA3 Region were calculated in an identical manner, and are reported in Appendix C.

APPENDIX C ANALYSIS OF AGRICULTURAL IMPACTS

The potential economic impacts of the Project on agriculture fall into two categories:

- direct impacts in terms of foregone agricultural production, either over the life of the mine or in perpetuity, to land and water entitlement holders in the State or local region; and
- flow-on impacts, in terms of the effects of reduced agricultural production on the demand for downstream agricultural services and upstream value adding enterprises in the State or local region.

C.1. ASSUMPTIONS

The methodology set out by Gillespie (2012) for estimating the net present value (NPV) of foregone agricultural revenue for the Approved Mine is appropriate and has been applied to the Project. However, some of the underlying assumptions used by Gillespie (2012) have been changed where:

- the gross revenue and gross margin assumptions per hectare were updated by the NSW Department of Primary Industry or were not explicit stated and sourced;[13] and
- gross revenue and margin assumptions were based on current land use for grazing but the land has been classified as able to be cultivated.

The key physical and financial assumptions are set out in Table C-1 and Table C-2, which show changes to resource availability and gross margins per hectare (ha), respectively.

Table C-1. Resource loss assumptions – Physical units

Impact	Project		Approved Mine	
	2018-2042	In perpetuity	2018-2048	In perpetuity
Land disturbance Class 2 (ha)	202	148	127	100
Land disturbance Class 3 (ha)	806	696	595	350
Land disturbance Class 4 (ha)	1,875	1,697	1,520	1,012
Total agricultural land disturbance	2,883	2,541	2,242	1,462
Biodiversity offset land Class 4 (ha)	1,102	1,102	440	440

[13] *Gross margin is the gross revenue from an enterprise less the variable costs incurred in achieving it, but differs from profits because it does not include fixed or overhead costs such as depreciation, interest payments, rates and permanent labour.*

Impact	Project		Approved Mine	
	2018-2042	In perpetuity	2018-2048	In perpetuity
Water entitlements (ML)	2,747.5	36 (Alluvium and Namoi River)	1,765.5	528

Source: Whitehaven 2017.

Table C-2. Resource loss assumptions – Gross revenue and gross margin per hectare ($2017)

Type	Gross revenue per hectare	Gross margin per hectare
Land Class 2	$1,793	$449
Land Class 3	$449	$355
Land Class 4	$207	$167
Irrigated cotton	$4,637	$1,580
Dryland Cotton	$1,793	$449

Source: NSW Department of Primary Industries 2017.

The following remaining assumptions have been made:

- Class 2 land is suitable for dryland cropping based on a budget for dry land cotton;
- Class 3 land is suitable for grazing on improved pasture with fodder based on a budget of growing out steers of 240 kilograms to 460 kilograms;
- Class 4 land is suitable for grazing on native pasture based on an inland weaner budget; and
- irrigated cotton is the highest valued water use and requires seven megalitres per hectare (in relation to the value of water entitlements to agriculture).

C.2. DIRECT AGRICULTURAL IMPACTS

In the context of the CBA, the direct impacts of foregone agricultural production due to land disturbance, a reduction in available surface water and groundwater entitlements and the biodiversity offset are relevant. There would be some offsetting non-market benefits associated with the biodiversity offset, but these have not been calculated.

The financial calculations for land and water are the sum of foregone revenues over the life of the Project, plus the revenues lost in perpetuity after the mine is closed.

The value of water entitlements was imputed as the difference between irrigated cotton and dryland cotton revenues per hectare divided by the water use per hectare. The results are shown in Table C-3. In summary, the Project is projected to increase the loss of:

- agricultural gross values (or revenues) by $33.0 million in NPV terms, or $3.1 million annually; and
- agricultural gross margins by $17.9 million in NPV terms, or $1.6 million annually.

The land and water entitlements in question were purchased on the open market by Whitehaven. These impacts have therefore been fully internalised as opportunity costs that have been accounted for in the CBA.

Table C-3. Foregone returns to agriculture for Project and the Approved Mine (AU$ 2017 million)

	Project		Approved Mine	
	Gross value	Gross margin	Gross value	Gross margin
	NPV $ million			
Land disturbance	$15.3	$9.5	$10.9	$4.3
Water use	$14.5	$5.7	$9.0	$6.2
Biodiversity offset	$3.3	$2.7	$1.3	$1.0
Total	$33.0	$17.9	$21.1	$11.5
	Annual (NPV $ million)			
Land disturbance	$1.4	$0.9	$0.9	$0.4
Water use	$1.4	$0.5	$0.8	$0.6
Biodiversity offset	$0.3	$0.2	$0.1	$0.1
Total	$3.1	$1.6	$1.8	$1.1

Source: AnalytEcon analysis.

C.3. AGRICULTURAL FLOW-ON IMPACTS

The agricultural flow-on impacts are an offset to the flow-on benefits of the Project to NSW and the local region. At a state level, this offset is small, which is typical for a conversion of land from extensive to much more intensive land use, but it may be material at the level of the local region.

Calculating the flow-on impacts on a comparable basis with mining requires the regional Type IA employment and income multipliers for agriculture. These multipliers are the same for the Project Region and the SA3 Region:

- the Type IA employment multiplier is 1.38; and
- the Type IA income multiplier is 1.78.

The flow-on impacts of the Project and the Approved Mine are summarised in Table C-4.

Table C-4. Regional agricultural flow on effects (Project Region and SA3 Region)

Type of flow-on effect	Project	Approved Mine	Difference
		Cumulative	
Employment (FTE jobs)	12.6	8.0	4.6
Disposable income* (NPV AU$ 2017 million)	$15.5	$9.9	$5.6
		Annual	
Employment (FTE jobs)	0.5	0.3	0.2
Disposable Income* (NPV AU$ 2017 million)	$0.7	$0.4	$0.3

Notes: * The disposable income calculation assumes that disposable income is 60 per cent of gross income, which is equivalent to that assumed for non-mine workers in the CBA.

Source: AnalytEcon analysis.

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