



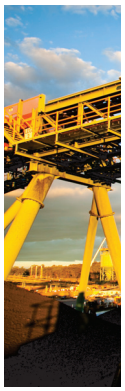

MOOLARBEN COAL COMPLEX
OC3 EXTENSION PROJECT

ENVIRONMENTAL IMPACT STATEMENT

APPENDIX K

ECONOMIC ASSESSMENT

YANCOAL
兖煤澳大利亚有限公司
MOOLARBEN COAL

AnalytEcon

MOOLARBEN COAL COMPLEX
OC3 EXTENSION PROJECT

Economic Assessment prepared for
Moolarben Coal Operations

October 2022

ACN 140 021 450

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Abbreviations

ABS	Australian Bureau of Statistics
AEP	Annual Exceedance Probability
ACCU	Australian Carbon Credit Unit
ACHA	Aboriginal Cultural Heritage Assessment
BSAL	Biophysical Strategic Agricultural Land
CBA	Cost-benefit analysis
$CO_{2\text{-}e}$	Carbon dioxide equivalent
CHPP	Coal handling and preparation plant
CEFP	Clean Energy Future Policy
EA	Economic assessment
EL	Exploration Lease
EA Guidelines	Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals (2015)
EA Technical Notes	Technical Notes supporting the Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals (2018)
EEX	European Energy Exchange
EIS	Environmental impact statement
EUA	European emission allowance
FTE	Full-time equivalent
GDP	Gross domestic product
GHG	Greenhouse gas
GRP	Gross regional product
GSP	Gross state product

GVA	Gross value of agricultural production
ha	Hectare
LEA	Local effects analysis
LGA	Local Government Area
LSC	Land and Soil Capability
LQ	Location quotient
MCO	Moolarben Coal Operations Pty Ltd
M	Metres
MCC	Moolarben Coal Complex
MGNR	Munghorn Gap Nature Reserve
Mt	Million tonnes
Mtpa	Million tonnes per annum
NPV	Net Present Value
NSW	New South Wales
PM_{10}	Particulate matter less than 10 microns
$PM_{2.5}$	Particulate matter less than 2.5 microns
RAPs	Registered Aboriginal Parties
RBA	Reserve Bank of Australia
ROM	Run of mine
SEARs	Secretary's Environmental Assessment Requirements
SA3 Region	Local region comprising the Lithgow-Mudgee Statistical Area 3
VLAMP	Voluntary Land Acquisition and Mitigation Policy

EXECUTIVE SUMMARY

The Moolarben Coal Complex (MCC) is located approximately 40 kilometres (km) north of Mudgee in the Western Coalfields of New South Wales (NSW). The MCC is operated by Moolarben Coal Operations Pty Ltd (MCO).

Mining operations at the MCC are currently approved until 31 December 2038 with a combined coal production rate of 22 million tonnes per annum (Mtpa). The MCC comprises four approved open cut mining areas (OC1 to OC4), three approved underground mining areas (UG1, UG2 and UG4) and other mining related infrastructure (including coal processing and transport facilities).

MCO has identified an opportunity to extend open cut mining operations immediately south of the approved OC3 open cut pit and develop four new open cut pits to the east and south-east of the approved OC3 mining area within MCO's existing mining tenements (the Project). The extended open cut mining operations would provide approximately 10 years of mining (from 2025 to 2034), optimise the use of the existing mining fleet, and maintain a steady rate of production of run-of-mine (ROM) coal at the MCC post-completion of mining within the approved OC3 mining area. Importantly, mining at the OC3 Extension Project (the Project) would occur within the currently approved production parameters for the MCC, within the current approval timeframe ending in December 2038, with an unchanged peak workforce, and within the bounds of the previously assessed rail movements for the MCC.

MCO is seeking a new Development Consent under the State Significant Development provisions of Part 4 of the NSW *Environmental Planning and Assessment Act 1979* for the Project.

This Economic Assessment (EA) forms part of the Environmental Impact Statement (EIS) which has been prepared to accompany the Development Application for the Project, with reference to the economic components of the Secretary's Environmental Assessment Requirements. The EA has been prepared in accordance with the NSW Government's '*Guidelines For The Economic Assessment Of Mining And Coal Seam Gas Proposals*' (NSW Government 2015, 'the EA Guidelines') and the '*Technical Notes supporting the Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals*' (NSW Government, 2018). The EA Guidelines require the following analyses to be undertaken:

- a cost-benefit analysis (CBA) to assess the incremental net benefit that the Project would deliver to the NSW community; and
- a local effects analysis (LEA) to assess the incremental net benefit that the Project would deliver to the local region.

COST-BENEFIT ANALYSIS

The EA Guidelines require that the benefits that would accrue to the NSW community if the Project is approved be measured by comparing the outcomes in a 'Project' scenario with those in a counterfactual 'base case' scenario. In the case of this Project, the approved operations at the MCC would not change, irrespective of whether the Project is either approved or rejected. In either case, MCO will continue to mine the approved resource under the same operational and approval conditions. There are then two implications for the CBA:

- First, as there are no material interactions with the MCC, the Project can be assessed on a stand-alone basis. Hence, there is no need to incorporate the costs and benefits of the MCC within a broader Project or base case scenario since these costs and benefits would broadly net out.

- Second, given that some of the existing MCC workforce would be redeployed to the Project, no additional employment- or income-related benefits have been counted in this EA. Any such state-wide or local benefits have already been considered as part of past approvals processes for the MCC.

Table ES-1 summarises the estimated incremental net benefits of the Project for NSW which are estimated at $182 million in Net Present Value (NPV) terms. Given that employment-related benefits have been excluded from the CBA, these benefits essentially derive from the extraction of additional ROM coal, which will in turn give rise to additional royalties and taxation payments to the State of NSW and local government:

- $152 million in NPV terms in royalty payments to the State of NSW;

- $26 million in NPV terms corresponding to the NSW share of company income tax; and

- around $4 million in NPV terms corresponding to the share of MCO's producer surplus that would accrue to NSW residents.

The Project would potentially give rise to some external effects that would affect third parties. However, MCO would mitigate the great majority of these, including through the purchases of the requisite water licences and of biodiversity offsets. These external effects therefore do not impose a cost on the NSW community. Similarly, the loss in the net value of agricultural production associated with the Project is an opportunity cost to MCO as the project is located on Moolarben-owned freehold land and does not impose a direct cost on the NSW community.

There would be a reduction in agricultural output if the Project is approved, which would have a contractionary flow-on effect on related upstream and downstream related industries, and

result in a small reduction in agricultural employment and income. These impacts are not considered to be material at the State or at the local level. The NSW share of the incremental greenhouse gas (GHG) emissions attributable to the Project is estimated at around $11,000 in NPV terms and constitutes a cost to the NSW community.

Table ES-1 Incremental net benefits of the Project for NSW community ($2022)

Incremental direct and indirect costs	NPV $m	Incremental direct and indirect benefits	NPV $m
External effects (GHG emissions)	< $0.1	Royalties	$152
Reduction in agricultural employment /income	< $0.1	NSW share of company income tax	$26
		Net producer surplus	$3.5
Total direct and indirect costs	< $0.1	Total direct and indirect benefits	$182
Net benefits to NSW			$182

Note: Totals may not sum precisely due to rounding.
Source: AnalytEcon.

The Project would also generate economic benefits for suppliers. MCO expects to direct an additional $658 million in NPV terms in operating expenditures to NSW suppliers, including local suppliers, between 2025 and 2038 if the Project is approved.

The results of sensitivities undertaken to establish the robustness of the net benefit estimates to the underlying assumptions suggests that the Project would generate net benefits to NSW in a broad range of circumstances.

FLOW-ON EFFECTS OF THE PROJECT

In addition to the immediate net benefits attributable to the Project, the Project would generate 'second round' or 'flow-on' effects, as the additional expenditures flow through the economy and in turn generate additional income and value added for businesses and households.

The incremental flow-on benefits of the Project for NSW have been derived using the same assumptions as those used for the CBA. Given that employment-related benefits have been excluded from the CBA, the incremental flow-on benefits of the Project relate to the additional value added (or contribution to gross state product [GSP]) generated. These are estimated at around $50 million in NPV terms, or $5 million per annum.

The incremental flow-on benefits of the Project for the local region also relate to the additional value added (or contribution to gross regional product [GRP]) generated. These are estimated at around $5.5 million in NPV terms, or $0.5 million per annum.

LOCAL EFFECTS ANALYSIS

For the purpose of undertaking the LEA, the EA Guidelines require proponents to identify a local region or study area that should match a Statistical Area Level 3 (SA3) geographic definition. In the case of the Project, the relevant SA3 area is the 'Lithgow-Mudgee' SA3 Region (the SA3 Region). The SA3 Region includes Mudgee and the Mudgee region, Lithgow and the Lithgow region and the Wollangambe – Wollemi Region. Approximately 80 per cent of the workforce of the MCC resides locally within the SA3 Region.

Table ES-2 summarises the net effects of the Project for the local region, as required by the EA Guidelines, noting that income and employment related benefits have not been considered in this EA:

- Row (1) summarises the information on non-labour related local expenditures. Over the Project operational timeframe, total operating expenditures for the Project are estimated to amount to $1,014 million in NPV terms. Assuming that, going forward, the same shares as currently of expenditures continue to be directed towards local suppliers, $97 million in NPV terms would be sourced from suppliers in the SA3 Region.

- Row (2) focuses on local government rate payments. From 2025 to 2038, MCO would pay around $23 million in NPV terms in rate payment to the Mid-Western Regional Council for the Project. These expenditures would additionally give rise to value added flow-on effects to the local region of $5.5 million in NPV terms (Column D).

- Row (3) refers to potential negative environmental or other impacts of the Project on third parties. Where such impacts are expected to occur MCO would implement mitigation measures, for instance via management and compensation measures, the purchase of water licences, and through the implementation of a biodiversity offset strategy. No net cost should therefore be attributed to the local region.

The Project would conservatively displace up to an additional 975 hectares (ha) of land that is currently leased for agricultural use. The corresponding foregone value of agricultural production is an opportunity cost for MCO, and does not represent a net cost for the local region. The corresponding reduction in agricultural production may give rise to (contractionary) flow-on effects on related local downstream and upstream industries. These effects are unlikely to be a material consideration, given that the share of gross production attributable to the Project area is 0.3 per cent of production in the local region. There may be some limited local impact on income and employment due to agricultural land being removed from production, which is estimated at around $28,000 per annum or 0.6 FTE jobs. Any flow-on effects arising from this loss of employment and income is unlikely to be a material consideration.

Table ES-2. LEA Summary ($2022, 2025 to 2038)

(A)	(B) Project direct/indirect benefits & costs: Total (NPV $ millions)	(C) Project direct/indirect benefits & costs: Local SA3 Region (NPV $ millions)	(D) Project flow-on benefits & costs: Local SA3 Region (NPV $ millions)	(E) Project total: Local SA3 Region (NPV $ millions)
(1) Other, non-labour expenditure	$1,014	$97	N/a	N/a
(2) Local government rates	$23	$23	$5.5	$28.5
(3) Externality benefit/ cost	Reduction in agricultural GVA of around $466,743	Reduction in agricultural GVA of around $466,743	~ 0 (immaterial)	Reduction in agricultural GVA of around $466,743
Agriculture	Loss of agricultural income of around $28,000 per annum or 0.6 FTE	Loss of agricultural income of around $28,000 per annum or 0.6 FTE	~ 0 (immaterial)	Loss of agricultural income of around $28,000 per annum or 0.6 FTE

Source: AnalytEcon.

1. INTRODUCTION

The Moolarben Coal Complex (MCC) is located approximately 40 kilometres (km) north of Mudgee in the Western Coalfields of New South Wales (NSW) and is operated by Moolarben Coal Operations Pty Ltd (MCO).

MCO has identified an opportunity to extend open cut mining operations within existing mining and exploration tenements and within existing approved life of the MCC (i.e., until 2038). MCO is therefore seeking a new Development Consent under the State Significant Development provisions of Part 4 of the NSW *Environmental Planning and Assessment Act 1979* for the MCC OC3 Extension Project (the Project).

1.1. PURPOSE AND SCOPE OF THE ECONOMIC ASSESSMENT

This Economic Assessment (EA) has been prepared to address the economic components of the Project Secretary's Environmental Assessment Requirements (SEARs), issued on 21 January 2022:

> *Economic – including:*
>
> - *the likely economic impacts of the development, paying particular attention to:*
>   - *the significance of the resource;*
>   - *the costs and benefits of the development identifying if it would result in a net benefit to NSW, including consideration of fluctuations in commodity markets and exchange rates, and costs of residual Scope 1 and 2 greenhouse gas emissions appropriately apportioned to NSW; and*
>   - *the demand for the provision of local infrastructure and services; and*
>   - *the need for a voluntary planning agreement; in relation to infrastructure, services, and community benefits to address residual social impacts.*

This report has also considered the general requirements of the SEARs:

> *In particular, the EIS must include:*
>
> - *a full description of the development, including:*
>
> ..
>
>   - *the likely interactions between the development and any other historical, existing, approved or proposed mining or infrastructure projects in the vicinity of the site; …*

This EA of the Project has been prepared in accordance with the 'Guidelines For The Economic Assessment Of Mining And Coal Seam Gas Proposals' (NSW Government 2015, 'the EA Guidelines') and the 'Technical Notes supporting the Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals' (NSW Government 2018, 'the EA Technical Notes'). The EA Guidelines require the following analyses to be undertaken:

- a cost-benefit analysis (CBA) to assess the net benefit that the Project will deliver to the NSW community; and
- a local effects analysis (LEA) to assess the net benefit that the Project will deliver to the local region.

1.2. ABOUT THIS REPORT

This report is structured as follows:

- Section 2 describes the MCC and the Project;
- Section 3 describes the CBA, the individual components of the CBA, the results of the CBA, and various sensitivities;
- Section 4 describes the approach for analysing flow-on effects and the estimated flow-on effects for the State of NSW and the local region;
- Section 5 describes the LEA and the local impacts of the Project; and
- Section 6 summarises the preceding discussion to show the significance of the resource.

Supporting documentation is presented in the following appendices:

- Appendix A describes the derivation of the Project's value added and contribution to gross state product (GSP); and
- Appendix B describes the derivation of input-output multipliers and their interpretation.

2. MOOLARBEN COAL COMPLEX AND PROJECT

This section describes the MCC, the Project, and the relevant regional context.

2.1. MOOLARBEN COAL COMPLEX OVERVIEW

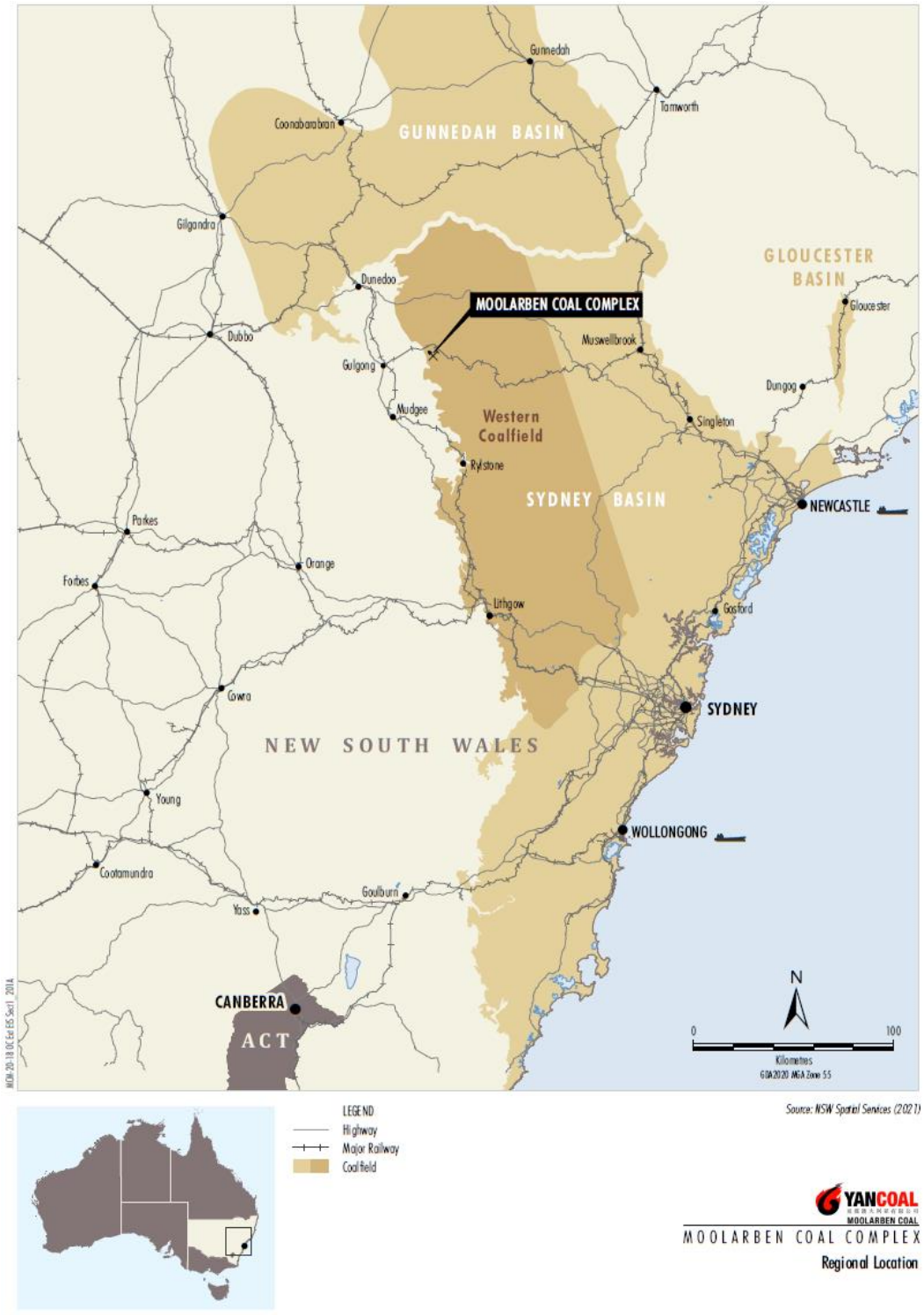
The MCC produces export quality thermal coal and is located in the western part of the Sydney Basin in the Western Coalfield of New South Wales (NSW) (Figure 2-1). The Complex comprises four approved open cut mining areas (OC1 to OC4), and three approved underground mining areas (UG1, UG2 and UG4). Run-of-mine (ROM) coal is processed at the coal handling and preparation plant (CHPP), and product coal is transferred onto a rail loadout facility for haulage by rail to market.

Mining operations at the MCC are currently approved at a combined product coal production rate of 22 million tonnes per annum (Mtpa) until 31 December 2038 in accordance with Project Approval (05_0117) (Stage 1) (as modified) and Project Approval (08_0135) (Stage 2) (as modified). The Project would not change the approved production parameters at the MCC.

2.2. THE PROJECT

The MCC is currently mining across multiple open cut mining areas. At current production rates, mining at the approved OC3 mining area will likely be completed in 2025. MCO has identified an opportunity to extend open cut mining operations immediately south of the approved OC3 open cut pit as well as develop four new open cut pits to the east and south-east of the approved OC3 mining area, within existing mining tenements (the Project). The Project would enable coal to be mined for approximately 10 years (from 2025 to 2034). Mining at the Project would occur in parallel with approved mining at OC4. The Project would maximise the use of the existing mining fleet and maintain a steady rate of production of ROM coal at the MCC after mining within the approved OC3 mining area has been completed.

Figure 2-1. Regional location of the Moolarben Coal Complex



Source: Resource Strategies.

It is anticipated that mining activities for the Project would take place until approximately 2034 (within the approved life of the MCC ending on 31 December 2038), with material rehandling and landform establishment activities planned until approximately 2038. The Project will allow approximately 40 million tonnes (Mt) of ROM coal to be recovered between 2025 and 2034 at a peak annual extraction rate of up to 9 Mt of ROM coal. If approved, it is expected the Project would include the following activities:

- the extension of open cut mining operations within mining lease 1691, exploration licence (EL) 6288, and EL 7073 to allow mining of additional coal resources;
- the extraction of up to 9 Mtpa of ROM coal with a total of approximately 40 Mt over the life of the Project;
- the extension of employment of existing open cut workforce;
- the construction and operation of ancillary infrastructure, services, plant and equipment in support of mining operations;
- the construction and operation of water management and water storage infrastructure in support of mining operations;
- the development of an integrated final landform with the approved OC3 mining area;
- ongoing exploration activities in the Project area;
- the construction of haul road creek crossings;
- quarrying and/or excavation of borrow pits within approved disturbance areas to retrieve construction materials;
- conventional open cut mining related activities such as drilling and blasting, and other associated activities; and
- rehabilitation, decommissioning and closure activities.

As noted above, the Project would allow for the employment of existing open cut workforce to be extended. The Project would *not* affect the following components of the approved MCC:

- the duration of mining at the MCC (currently approved until December 2038);
- peak product coal production, currently approved at 22 Mtpa of product coal; or
- approved rail movements for the MCC.

The Project has been designed to avoid or minimise environmental and social impacts where feasible and practicable. Thus, the Project has been designed to:

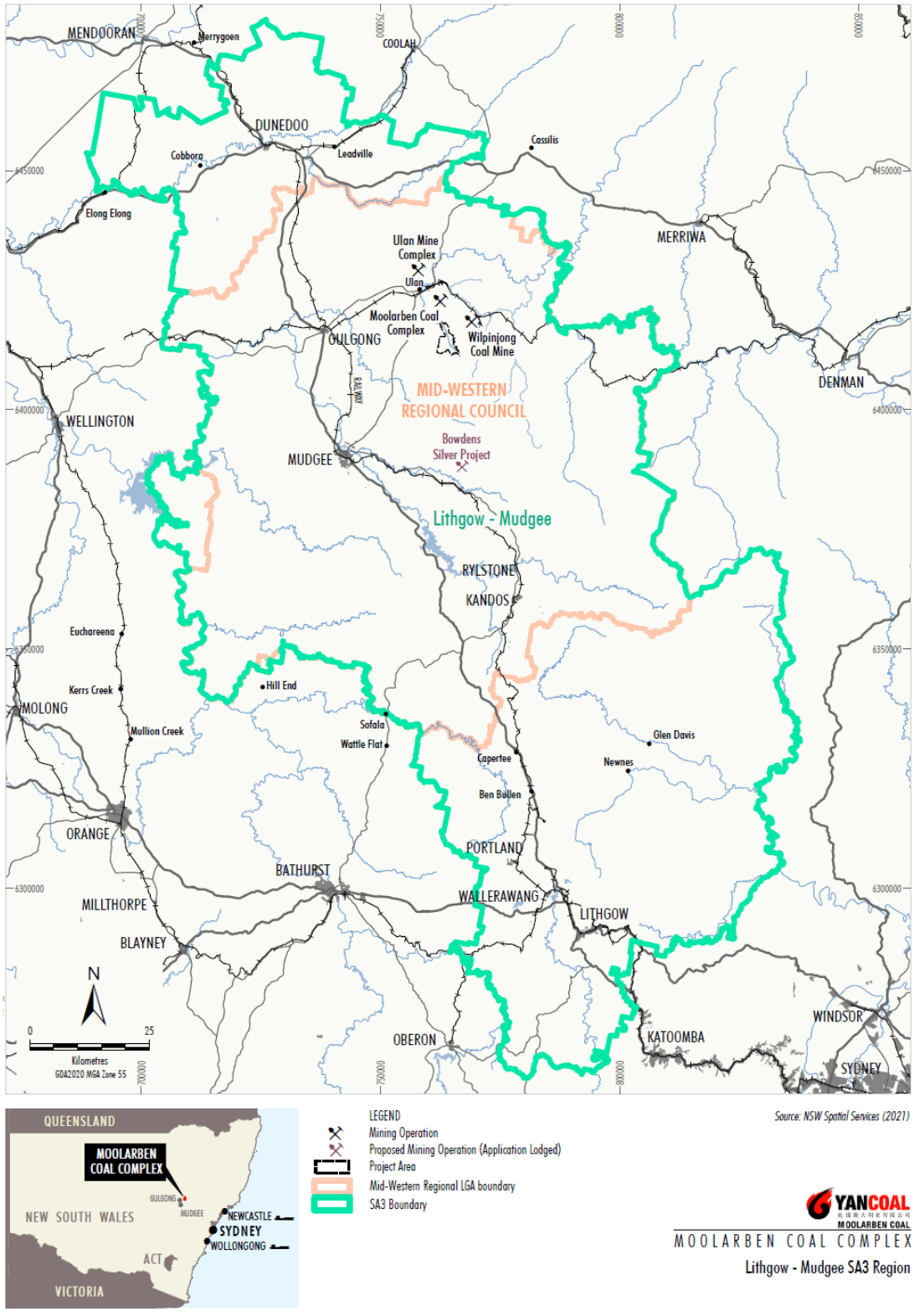
- fit within the currently approved production rates and mine life of the MCC;
- utilise the existing MCC workforce and infrastructure, including the Stage 1 coal processing and transport facilities;
- be located within existing mining and exploration tenements and on Moolarben-owned freehold land;
- improve the final landform, with no residual voids (including within the approved OC3 area), as mine voids would be progressively backfilled to create a free draining landform;
- locate the proposed open cut pits largely within valley floor areas previously cleared for low intensity agriculture;
- progress active mining away from publicly visible areas;
- avoid disturbing mapped rocky habitat features for threatened species associated with the steeper terrain adjacent to the Munghorn Gap Nature Reserve (MGNR); and
- avoid open cut mining within 200 metres (m) of Moolarben Creek and Murdering Creek.

A detailed description of the Project is provided in Section 3 in the Main Report of the EIS.

2.3. LOCAL REGION

The MCC is located within the Mid-Western Regional Local Government Area (LGA) in the Mid-West region of NSW. For the purpose of undertaking the LEA, the EA Guidelines require proponents to adopt a local study area that should match a Statistical Area Level 3 (SA3) geographic definition – that SA3 Region should contain the proposed development. In the case of the Project, the relevant SA3 area is the 'Lithgow-Mudgee' SA3 Region (the 'SA3 Region'). The Lithgow - Mudgee SA3 region (shown in Figure 2-2) incorporates Lithgow and the surrounding region, Mudgee and the surrounding region (which includes Kandos, Gulgong and Dunedoo), and the Wollangambe/Wollemi region (including Wollemi National Park).

Figure 2-2. Lithgow-Mudgee SA3 Region



Source: Resource Strategies

The choice of local region defines the geographical area in which the 'local' impacts of the Project are assumed to take place (see Section 5). The SA3 region represents a suitable approximation of the local geographical area where the Project would lead to increased local economic activity, given that approximately 80 per cent of the existing workforce reside locally in the SA3 Region, predominantly in Mudgee, Gulgong, and surrounds

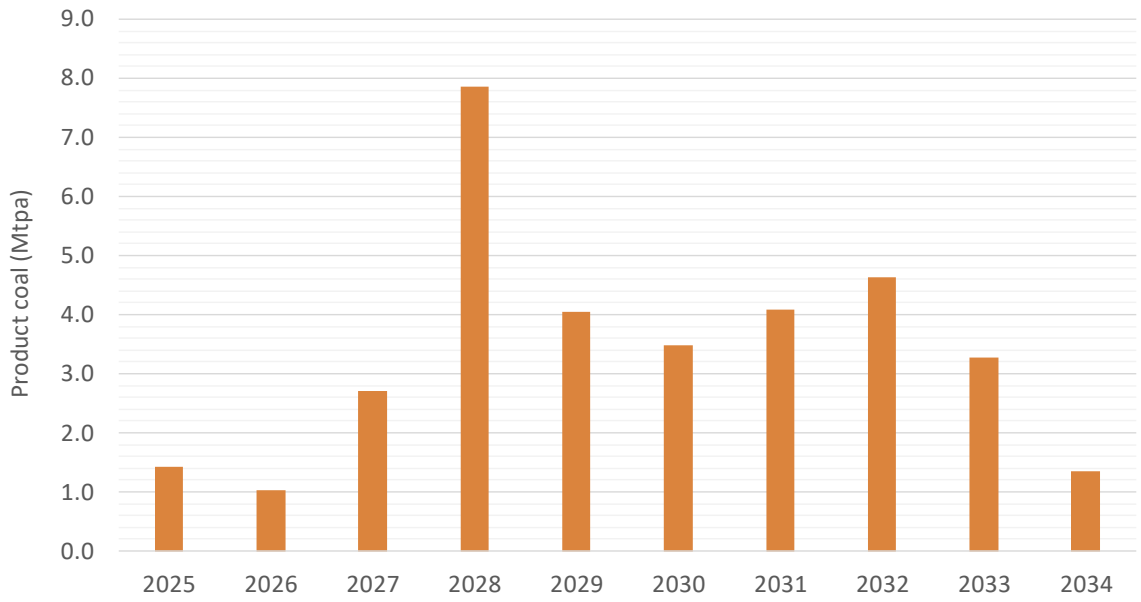
2.4. KEY ECONOMIC PARAMETERS

The following sections present key economic parameters for the MCC and the Project.

2.4.1. Product coal production

Figure 2-3 shows the incremental product coal production profiles for the Project, noting that production in the remainder of the MCC would remain unchanged. The Project would produce an annual average of 4 Mtpa of thermal coal (maximum 9 Mtpa) for a total of 39.5 Mt of product coal between 2025 and 2034.

Figure 2-3. Thermal coal production profile (2025 to 2034, Mtpa) – Project



Source: MCO.

2.4.2. Coal prices

Projected benchmark coal prices and US$/AU$ exchange rates (assumed to be at US$/A$ 0.75 over the forecasting horizon) were provided by MCO based on consensus pricing, informed by independent advice relating to forecast coal prices. These benchmark prices have been adjusted by price discounts or premiums to reflect predicted coal quality variations from the benchmark for the Project. Adjusted benchmark thermal coal prices range between approximately US$92 and US$110 per tonne in 2025 to between US$62 to $US75 per tonne in 2034.

The unadjusted benchmark Newcastle thermal coal price is forecast to be US$82 per tonne in the long term. These prices align with KPMG's *Coal Price and FX Market Forecasts June/July 2022*, which forecasts a long-term average thermal coal price of US$84/tonne (6,000 NAR). It is also noted that the coal price projections provided by MCO are significantly lower compared to current thermal coal prices.

2.4.3. Project workforce

There would be no increase in the peak workforce at the MCC as a result of the Project. During the operations of the Project (2025 to 2034), an annual average operational workforce of 170 full time equivalent (FTE) workers would be deployed at the Project.

Overall, the Project would allow for employment of the open cut workforce to be extended, but would not expand the existing peak employment at the MCC. Rather, the existing open cut workforce would be employed for the Project. Accordingly, additional worker benefits have not been included in the CBA.

2.5. OTHER RESOURCES PROJECTS IN THE REGION

The potential for interactions with other resources projects in the local region is relevant for assessing the cumulative 'external effects' associated with the Project. Where relevant, the potential cumulative environmental impacts have been considered in the specialist studies undertaken for the Project.

The Project is located in an area with extensive existing mining operations, as well as other proposed or approved industrial developments, including:

- the existing MCC;
- the Wilpinjong Coal Mine (approved), owned and operated by Wilpinjong Coal Pty Ltd, a wholly owned subsidiary of Peabody Energy Australia Pty Limited;
- the Ulan Mine Complex (approved), operated by Ulan Coal Mines Limited; and
- Bowdens Silver Project (currently under assessment), proposed by Bowdens Silver Pty Ltd.

Although their interactions with the Project are expected to be limited, there are also a number of solar and wind renewable energy projects and electricity transmission infrastructure projects in the wider region associated with the Central West Orana Renewable Energy Zone.

3. COST-BENEFIT ANALYSIS – NSW COMMUNITY

This section describes the CBA that has been prepared to evaluate the economic impacts of the Project on the NSW community.

3.1. EA GUIDELINES

Table 3-1 in the EA Guidelines contains a list of the potential costs and benefits of a proposal that may be included in the CBA. Where relevant, these are derived in the following sections. A central discount rate of 7 per cent per annum has been used to discount all costs and benefits back to a common point in time.[1] All dollar values are expressed in 2022 Australian dollars ($2022).

As set out in the EA Guidelines, a CBA examines the incremental (net) benefits that would arise if the Project is approved, referred to as the 'Project scenario', relative to a counterfactual or 'base case' scenario if the Project is not approved. For the Project, the approved operations at the MCC would not change, irrespective of whether the Project is either approved or rejected. MCO will continue to mine the approved resource for a combined product coal total of no more than 22 Mtpa. Further, as noted above, all mining will be completed within the current approval timeframe in December 2038, with an unchanged peak workforce, and within the bounds of the previously assessed rail movements for the MCC.

The central difference between the Project scenario and a base case scenario relates to an increase in coal output. If the Project is approved, the total resource would increase by approximately 40 Mt of ROM coal. Undertaking the Project (and producing the corresponding additional product coal) would require some additional operating and capital costs to be expended. Also, as noted in Section 2.4.3, some of the existing MCC workforce would be employed for the Project. But the broad operational and approval parameters of the MCC would not change.

There are then two implications for the economic analysis. First, as there are no material interactions with the MCC, the Project can be assessed on a stand-alone basis, under a conversative assumption related to the redeployment of labour between the Complex and the Project. The assumption is that the deployment of some of the MCC workforce to the project will not alter the overall output from the MCC. Hence, there is no need to incorporate the costs and benefits of the MCC within a broader Project or base case scenario since these costs and benefits would broadly net out. The assumption is conservative in that, if some additional labour were required, the net benefits to NSW would increase. The additional labour costs to MCO

[1] The sensitivity of the results to that assumption is tested in Section 3.8.

would constitute direct benefits to NSW, and there would also be flow-on benefits from added employment. Further, the reduction in net returns would be predominantly borne by external MCO shareholders.

Second, given that some of the existing open cut workforce would be employed for the Project, no additional employment- or income-related benefits have been attributed to the Project. Any such state-wide or local benefits have already been considered as part of past approvals for the MCC. Further, and while it is likely that the temporary employment of the existing open cut workforce for the Project may extend peak employment at the Complex, any such employment and associated income benefits are at this stage uncertain. Accordingly, no incremental employment- or income-related benefits attributable to the Project are considered in this EA.

In summary, the CBA presented in this EA focuses only on the net benefits that would arise if the Project is approved and that would not arise in the counterfactual base case if the Project is rejected. Given that employment-related benefits are excluded, these benefits essentially derive from the extraction of additional ROM coal, which will in turn give rise to additional royalties and taxation payments to the State of NSW and local government.

3.2. COAL ROYALTIES

The incremental coal royalty payments attributable to the Project are estimated at $152 million in NPV terms (Table 3-1). Royalties were calculated by multiplying the product coal production schedules with projected (quality-adjusted) coal prices (Section 0) and applying the ad valorem royalty rate for open cut coal mining of 8.2 per cent to the net disposal value after allowable deductions.

Table 3-1. Incremental royalty calculation – Project ($2022)

	Project (NPV $m)	Notes
Assessable revenues	$1,934	Coal production schedule multiplied with coal quality-adjusted coal prices
Allowable deductions		
Beneficiation	$71	All coal production subject to full washing cycle with an allowable deduction of $3.50 / tonne
Levies	$6	Coal Research Levy, Mines Rescue Levy, Long Service Leave Levy
Net disposal value	$1,857	Assessable revenue net of allowable deductions
Royalty payment	$152	8.2% of net disposal value for coal produced

Note: Totals may not sum precisely due to rounding.
Source: MCO, AnalytEcon analysis.

3.3. PROJECT TAX PAYMENTS

3.3.1. Company income taxes

The EA Guidelines require an estimate of the company income tax payable, of which a share corresponding to the proportion of Australia's population based in NSW should be attributed to NSW. Aggregate Commonwealth company income tax payments were derived by deducting all operating costs, royalty and tax payments, and depreciation of capital assets from gross revenues to derive taxable income, as shown in Table 3-2. The share of company income taxes attributable to NSW is estimated at $26 million in NPV terms.

Table 3-2. Incremental company income tax calculation – Project ($2022)

	Project (NPV $m)	Notes
Coal revenues	$1,934	Coal production schedule multiplied with quality-adjusted coal prices
Less:		
Operating costs	$1,130	Operating costs, including costs of mitigating externalities
Labour costs	$252	Wages & salaries, including all on-costs
Royalties	$152	NSW Royalty payments
All other taxes	$47	Payroll taxes, land taxes, shire rates, levies
Tax depreciation	$79	Depreciation of capital assets
Total assessable income	$274	Coal revenues minus all costs
Company tax	$82	30% of total assessable income
Share of company tax attributable to NSW	$26	31.4% of company tax (NSW share of Australian population)

Note: Totals may not sum precisely due to rounding.
Source: MCO; ABS 2022a; AnalytEcon analysis.

In Table 3-2, tax depreciation was calculated using the diminishing value method,[2] assuming an average effective tax life of 20 years. An inflation adjustment is necessary to account for the fact that depreciation is determined based on nominal asset values. Real ($2022) company tax payments were derived by adjusting for inflation, assumed to be 2.5 per cent per annum over

[2] The diminishing value method assumes the decline in value each year is a constant proportion of the remaining asset value and produces a progressively smaller decline in value over time. Assuming that all assets are held for a full year, the formula for the decline in value is: base value × (200% ÷ asset's effective life). (ATO, 2019).

the forecasting timeframe in line with the Reserve Bank of Australia's (RBA's) 2 to 3 per cent inflation target, on average, over the medium term for its monetary policy.[3]

3.3.2. Personal income and payroll taxes

The EA Guidelines note that a new mining project will also generate additional payroll and personal income taxes. However, as discussed in Section 3.1 no additional employment or income related benefits are expected to arise if the Project is approved, given that some of the existing MCC workforce would be redeployed to the Project. Accordingly, no incremental personal income and payroll tax benefits attributable to the Project are considered in this EA.

3.3.3. Local government rates

Local government rates are levied on individuals and businesses located within an LGA and are collected by the local council, to the benefit of the local community. The EA Guidelines do not list local government rate payments as a NSW benefit. Local government rates paid by MCO have been included as a cost for the Project but have not been included in the NSW net benefit calculation.

3.3.4. Land taxes

Land taxes are levied on the value of NSW land owned by individuals and businesses and accrue to the State of NSW, but are also not included as a NSW benefit in the EA Guidelines. Land taxes paid by MCO have been included as a cost for Project but have also not been included in the overall net benefit calculation.

3.4. NET PRODUCER SURPLUS

As set out in Table 3.5 in the EA Guidelines, the net producer surplus is the difference between the value of the output and the costs of production (Table 3-3). The net producer surplus attributable to NSW is the economic rent attributable to NSW owners of capital, which depends on the Australian share of a development's ownership. The MCC is operated by MCO on behalf of the Moolarben Joint Venture (Moolarben Coal Mines Pty Ltd [MCM] and Yancoal Moolarben Pty Ltd [YM] and a consortium of Korean power companies). MCO, MCM and YM are all owned by Yancoal Australia Limited (Yancoal), and Yancoal holds a combined ownership stake of 95 per

[3] The Governor of the RBA (2022) has recently commented that while inflation is currently considerably above target and is expected to go higher in the short term, the RBA Board is committed to ensuring that inflation returns to its target. Also, inflation expectations in Australia remain consistent with the target. For the purposes of inflation-adjusting depreciation over the timeframe of the Project, the RBA target rate has therefore been applied.

cent of the MCC. The remaining ownership share is held by a consortium of Korean power companies. Around 6 per cent of Yancoal's shareholders are based in Australia.

It has therefore been assumed that 1.8 per cent of Yancoal's net producer surplus can be attributed to NSW (calculated as: 95 per cent corresponding to Yancoal's ownership share of the MCC x 6 per cent corresponding to Yancoal's Australian shareholders x 31.4 per cent corresponding to the NSW share of the Australian population). The Project net producer surplus attributable to the Project is $197 million in NPV terms, of which 1.8 per cent or around $4 million in NPV terms accrue to NSW.

Table 3-3. Incremental net producer surplus calculation – Project ($2022)

Project			
Revenues (NPV $m)		**Costs (NPV $m)**	
Gross mining revenue	$1,934	Operating costs, incl. costs of mitigation of externalities	$1,130
Residual value of land	$45	Labour costs	$252
		Capital costs	$120*
		Royalties	$152
		All taxes, incl. company taxes	$129
Total	$1,979		$1,782
Net Producer surplus			$197
NSW share of the net producer surplus			$3.5

Notes: Totals may not sum exactly due to rounding.

* For the purposes of this EA, a portion of the capital costs presented in the Capital Investment Value Report (Attachment 10 of the EIS) have been considered as operating costs.

Source: MCO, AnalytEcon.

3.5. INDIRECT BENEFITS

3.5.1. Economic benefits to existing landowners

The EA Guidelines note that existing landholders may gain an economic benefit if a project proponent purchases land to undertake economic activities. In the case of the Project, the relevant land is owned by Moolarben, and no acquisitions are proposed.

3.5.2. Economic benefits to workers

As discussed in Section 3.1, the Project would not increase the peak workforce or extend the life of the approved MCC. Accordingly, the CBA does not include any economic benefits to workers in this EA.

3.5.3. Economic benefits to suppliers

The EA Guidelines note that NSW suppliers may benefit from a mining project by achieving higher surpluses. Determining the magnitude of this benefit to suppliers poses practical difficulties, given that there are no statistics on which businesses are NSW-owned, and whether the goods and services supplied by these businesses are produced in NSW or imported from elsewhere in Australia (or from overseas). Therefore, the contributions made by NSW towards any surplus cannot be measured reliably, and have not been included in the CBA.

However, an illustrative calculation suggest that these impacts may be significant. Net of the costs of mitigating externalities, MCO would incur operating expenditures between 2025 and 2038 of around $1,014 million in NPV terms for the Project.[4] In 2022, around 65 per cent per cent of MCO's operating expenditures was directed towards NSW suppliers (Section 5.2). If that share of NSW expenditures remains the same going forward, an additional $658 million in NPV would be directed towards NSW suppliers between 2025 and 2038. If it is assumed that 10 per cent of these additional NSW expenditures represent some form of margin to wholesalers,[5] the additional surplus accruing to NSW suppliers for the Project would be around $66 million in NPV terms.

3.6. INDIRECT COSTS

3.6.1. Net environmental, social, and transport-related costs

This section reviews the predicted net environmental, social and transport-related costs of the Project (referred to as 'externalities' or 'external effects'), the residual impacts of which are summarised in Table 3-4.

[4] These expenditures can be considered incremental to those of the approved operations of the MCO, given that the Project entails additional production activities and corresponding additional costs.

[5] An illustrative estimate of 10 per cent would broadly fall into the range of plausible wholesale margins, assuming that a large business such as MCO would purchase most of its inputs from wholesalers. The most recent analysis of average wholesale margins undertaken by the RBA (2012) suggests that, as of 2007-08, wholesalers' 'cost of doing business' (CODB) was around 14 per cent of final sales prices, while the net margin was additionally around 2 per cent. The CODB consists of expenses paid to staff, landlords and freight providers, and the holding cost of inventory. In contrast, for retailers, the CODB was 26 per cent with an additional net margin of 6 per cent.

Table 3-4. External effects associated with the Project

Assessment component	Project design commitments	Summary of residual impacts	Proposed management measures
Groundwater	No open cut mining within 200 m of Moolarben Creek and Murdering Creek in accordance with the minimal impact considerations of the NSW Aquifer Interference Policy. Progressive backfilling of open cut pits allowing restoration of groundwater levels. Final landform would be free draining (i.e., no final voids, including in approved OC3 mining area).	No significant changes to the quantity or quality of water available to third party users or the environment, including in the long term. No greater than 2 m groundwater drawdown at privately-owned bores expected, consistent with the minimal impact considerations of the NSW Aquifer Interference Policy (or make good provisions would apply).	Existing MCO Water Management Plan, including Groundwater Management Plan. Extension of existing groundwater monitoring network. Groundwater modelling in accordance with the *Australian Groundwater Modelling Guidelines*. MCO would obtain sufficient water licences for the MCC incorporating the Project in accordance with relevant water sharing plans and the *Water Management Act 2000*.
Surface water and flooding	Maximise diversion of clean water as far as practically feasible. Contain and re-use mine water (to prevent downstream contamination). Control sediment runoff from disturbed areas such as waste rock emplacements or areas cleared in advance of mining. Erosion and sediment control structures would be designed, constructed and maintained in accordance with the best practice guidelines. Progressive rehabilitation throughout Project life to minimise disturbed areas.	No uncontrolled releases from the Project mine water management system and therefore no offsite water impacts for downstream users of Moolarben Creek expected. Negligible potential impacts on flows in Moolarben Creek and Goulburn River. No flooding impacts on Moolarben Creek or any private landholders downstream of the Project. No discernible deterioration in water quality. Negligible incremental contribution to any potential cumulative impacts on surface water quality, flow or availability.	Existing MCO Water Management Plan, including Surface Water Management Plan and Site Water Balance. MCO would obtain sufficient water licences for the MCC incorporating the Project in accordance with relevant water sharing plans and the *Water Management Act 2000*.

Assessment component	Project design commitments	Summary of residual impacts	Proposed management measures
	Construction of temporary flood bunds along haul roads adjacent to Moolarben and Murdering Creeks to protect infrastructure from flood events up to 1% annual exceedance probability (AEP).		
Biodiversity	The Project would be located largely within land that has been previously cleared for low intensity agriculture (i.e., grazing and dry land mapping). No disturbance of mapped rocky habitat features for threatened bat species and the Broad-headed Snake associated with the steeper terrain adjacent to the MGNR. Buffer zones between the MGNR and Project open cut mining. Commitment to progressive rehabilitation and biodiversity offsets for residual impacts. Use of directional lighting and noise attenuated equipment to minimise indirect impacts to surrounding habitat (including MGNR).	No direct impacts to the MGNR, although potential for indirect impacts. Clearance of around 624 ha of native vegetation. The Project may also cumulatively interact with the existing MCC, and other projects in the region. Negligible impacts on baseflow in the Goulburn River and Moolarben Creek. No long-term reduction in water availability for terrestrial vegetation along Moolarben Creek and associated low-lying areas, and on water-dependent assets in the MGNR.	Goulburn River National Park (including 'the Drip') is more than 11 km from the Project and would not be impacted. Determination of Project offset liability in accordance with the *NSW Biodiversity Assessment Method* under the *Biodiversity Conservation Act 2016*. Appropriate offsets required to be secured prior to commencement of mining. Existing Biodiversity Management Plan and Landscape Management Plan. Final land use to incorporate habitat enhancement measures.
Aboriginal cultural heritage	No high significance Aboriginal cultural heritages sites would be subject to direct disturbance from the Project. Management of other sites determined by archaeologist in consultation with	Potential direct disturbance of 79 known Aboriginal heritage sites, comprising: - 7 sites of moderate significance - 7 sites of low-moderate significance - 65 sites of low significance.	Consultation with RAPs undertaken in accordance with Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (DECCW, 2010).

Assessment component	Project design commitments	Summary of residual impacts	Proposed management measures
	Registered Aboriginal Parties (RAPs), as a component of Project ACHA.	11 known Aboriginal heritage sites potentially indirectly impacted by blasting.	Existing Heritage Management Plan to be updated for the Project.
Non-Aboriginal Cultural Heritage	No direct impacts to the MGNR (a national heritage item). No National, State or Local listed heritage items within the Project area.	Three potential grave sites identified within the Project area (to be exhumed prior to disturbance).	Non-Aboriginal Heritage Assessment prepared in accordance with *Heritage Act 1977* and the Burra Charter. Existing Heritage Management Plan to be updated for the Project, or a new Plan prepared.
Noise and Blasting	No increase in peak workforce at the MCC and therefore no additional workforce requirements and no increase in noise from traffic movements. No change to approved rail movements and therefore no increase in noise from rail transport.	Blast design and execution would be adjusted as required for blasts located in close proximity to sensitive locations (e.g., public infrastructure, private residence and recreational areas [when in use]) to maintain compliance with relevant vibration or air blast criteria. No additional private receivers subject to mitigation and/or land acquisition due to potential noise impacts in accordance with the: - *NSW Noise Policy for Industry* (EPA, 2017b) trigger levels; - *NSW Interim Construction Noise Guideline* (DECC, 2009) construction noise levels; and - *Voluntary Land Acquisition and Mitigation Policy* (NSW Government, 2018) noise criteria on greater than	Existing Blast Management Plan and Noise Management Plan to be updated for the Project, or a new Plan prepared. MCO would undertake additional noise and blast monitoring in Cooyal for the Project. Reduction of the proposed Maximum Instantaneous Charge for the Project near sensitive locations.

Assessment component	Project design commitments	Summary of residual impacts	Proposed management measures
		25% of land.	
Air Quality	No change in approved coal processing rates (i.e., 24 Mtpa at CHPP, including UG coal) or offsite coal transport limits (i.e., 22 Mtpa).	No exceedances of criteria for TSP, $PM_{2.5}$, PM_{10} or dust deposition predicted at any privately-owned receiver or on greater than 25 per cent of privately-owned land. No additional private receivers subject to mitigation and/or land acquisition due to potential air quality impacts in accordance with the NSW EPA assessment criteria for suspended particulate matter.	Existing Air Quality Management Plan to be updated for the Project, or a new Plan prepared. Air Quality Assessment undertaken in accordance with Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (EPA, 2022). MCO would undertake additional air quality monitoring in Cooyal for the Project.
GHG emissions	Scope 1 and 2 emissions are on an emissions intensity basis, given the low depth of cover, low gas content of the coal seam and optimised mining schedule.	The Project is expected to generate around 0.6 Mt $CO_{2\text{-}e}$ of Scope 1 and 0.2 Mt $CO_{2\text{-}e}$ of Scope 2 GHG emissions for the life of the Project. Scope 3 emissions are estimated at around 85.8 Mt $CO_{2\text{-}e}$.	Existing reasonable and feasible GHG mitigation and management measures implemented at the MCC would also be applied to the Project operations, largely through the efficient use of diesel.
Visual and landscape	The Project final landform would be integrated with the approved OC3 mining area. Project open cut voids would be progressively backfilled as mining progresses to reinstate the landform to approximate the gently undulating pre mining topography. There would be no final void in the approved OC3 final landform, as the approved final void would be backfilled	No direct views of the Project from privately-owned residences or land due to intervening ridgelines and existing vegetative screening. Negligible visual impacts of the Project at the regional, sub-regional or local level, including the Moolarben Picnic Area. The intensity, nature and degree of night-lighting for the Project would be similar to the existing impacts due to mining operations in the region.	Existing Rehabilitation Management Plan to be updated for the Project, or a new Plan developed, indicating detailed rehabilitation performance and completion criteria, and addressing all aspects of rehabilitation including mine closure, final landforms and final land use. Proposed final land uses for the Project area include agricultural land, native woodland and grassland areas, as well as

Assessment component	Project design commitments	Summary of residual impacts	Proposed management measures
	using waste rock from the Project, resulting in a free-draining landform.		targeted habitat enhancement measures (e.g., enhancement of riparian vegetation). Continued compliance with requirements of the Dark Sky Planning Guideline for the Siding Springs Observatory, including implementation of lighting infrastructure consistent with *AS 4282-2019 Control of Obtrusive Effects of Outdoor Lighting*.
Road transport / Rail traffic	No increase in peak workforce at the MCC therefore no additional workforce movements. Access to the Project area via existing MCC site access from Ulan-Wollar Road (i.e., no additional interaction with public road network). No change to Stage 1 coal transport limits (i.e., offsite train movements) as a consequence of the Project.	Assessed cumulatively (i.e., the MCC including the Project), the future operating conditions of the surrounding road network would be acceptable with no significant impacts identified on the performance, capacity, safety and efficiency of the road network. No specific additional road upgrade requirements as a result of the Project.	Continuation of road maintenance contributions for the MCC under the Ulan Road Strategy. Road Transport Assessment undertaken in accordance with *Guide to Traffic Generating Developments* (NSW Roads and Traffic Authority, 2002), Australian Standards and Austroad guidelines to demonstrate no public safety issues.
Agriculture	Final land use to include portions of agricultural land. As above, no greater than 2 m groundwater drawdown at any privately-owned bores in accordance with the minimal impact considerations of the NSW Aquifer Interference Policy.	No Biophysical Strategic Agricultural Land (BSAL) in the Project area (SVC issued by DPE). Approximately 975 ha of land currently leased for agricultural use would not be available during the Project mine life and rehabilitation.	Agricultural Impact Assessment prepared in consideration of Upper Hunter Strategic Regional Land Use Plan and Agricultural Impact Statement technical notes (DPI, 2013b). Preliminary Site Investigation in accordance with State Environmental Planning Policy (Resilience and Hazards) 2021.

3.6.1.1 GROUNDWATER

Appendix A of the EIS contains the Groundwater Assessment (AGE, 2022) for the Project. A summary of residual impacts of the Project is provided in Table 3-4.

Predicted groundwater impacts

Groundwater management and monitoring at the approved MCC is undertaken in accordance with the existing Water Management Plan.

The open cut mine plan for the Project has been designed in accordance with the minimal impact considerations of the NSW Aquifer Interference Policy, including no open cut mining within 200 m of Moolarben Creek and Murdering Creek. Project open cut pits would be progressively backfilled allowing restoration of groundwater levels.

The analysis of potential groundwater impacts (AGE, 2022) found that the Project would not result in significant changes to the quantity or quality of water available to third party users or the environment, including in the long term. The groundwater modelling showed:

- minimal drawdown in the Moolarben Creek alluvium or downstream Goulburn River alluvium; and
- negligible changes to baseflow in Moolarben Creek or the Goulburn River.

The Project's contribution to cumulative drawdowns is limited by the extensive unsaturated areas in the vicinity of the Project, and any predicted drawdowns are largely contained to the immediate vicinity of the Project. The recovery of the groundwater table within the backfilled open cut pits is predicted to occur relatively quickly following the cessation of mining. The flow of water through the backfilled open cuts is not anticipated to impact downstream water quality. No privately-owned bores are predicted to experience a drawdown greater than 2 m.

Valuation

The EA Technical Notes state that the economic impacts on water resources should primarily be measured with reference to the market price of the relevant water resource(s), or water-related costs borne by third parties. As noted above, the predicted groundwater impacts of the Project are generally small or negligible, and no impacts on third party boreholes are anticipated. Any remaining impacts therefore relate to water licence requirements.

As is the case for the MCC, the Project will be required to hold licences to account for licensable take. The Project does not rely on external licensed water supplies to meet operational demands, with water that is captured on-site reused, consistent with best practice water management.

Water licensing requirements would largely be associated with groundwater inflow to the open cut (AGE, 2022). MCO would preferentially use surplus licences already held for the MCC to meet the Project's water demand. If additional licences are required, these would preferentially be sourced from other Yancoal operations and other mining operations (e.g., the Ulan Coal Mine and/or Wilpinjong Coal Mine), where available.

Notwithstanding these considerations, an allowance has been made for purchase of water licences based on the peak licensable take (AGE, 2022). It has been conservatively assumed that:

- licences corresponding to 70 ML from the Upper Goulburn River Water Source and 181 ML from the Sydney Basin-North Coast Groundwater Source would be acquired in 2023; and
- these licences would continue to be used for the MCC at the end of the life of the Project, noting that the Project does not involve any final voids and as such there would be no ongoing pit inflows following cessation of mining.

With the exception of two trades in August 2018 and in May 2019, all reported trades for allocations from the Upper Goulburn River Water Source have transacted at $150 per ML from 2019 onwards. For this EA it has therefore been assumed a price of $150 per ML for a projected total cost of purchasing the Project groundwater licences of $22,500. Trades in the Sydney Basin-North Coast Groundwater Source have averaged approximately $1,000 per ML, for a projected total cost of purchasing of $181,000

3.6.1.2 SURFACE WATER AND FLOODING

Appendix B of the EIS contains the Surface Water and Flood Impact Assessment (WRM, 2022) for the Project. A summary of residual impacts of the Project is provided in Table 3-4.

Predicted surface water impacts

Surface water management and monitoring at the approved MCC is undertaken in accordance with the existing Surface Water Management Plan. The water management system for the Project has been designed to comply with accepted best practice principles for mine site water management. It is based on the water management strategy for the Project: maximising the diversion of clean water runoff around disturbance areas, containing and re-using mine water, and controlling sediment runoff from disturbed areas.

The analysis of potential surface water impacts (WRM, 2022) concluded that any effects would be minimal:

- the loss of catchment flows in Moolarben Creek and Goulburn River would be indiscernible and the potential impacts on flows negligible;
- there would be no loss of catchment post-mining;
- the probability of uncontrolled spills of mine-affected water is minimal (i.e., less than 1 per cent) and would have no measurable impact on receiving water quality;
- environmental risks from disturbed area runoff are expected to be low;
- no flooding impacts on Moolarben Creek or any private landholders downstream of the Project are expected;
- no discernible deterioration in water quality in Moolarben Creek or the Goulburn River are predicted; and
- the Project's incremental contribution to any potential cumulative impacts on surface water quality, flow or availability are expected to be negligible.

Valuation

The water balance modelling undertaken as part of the Surface Water and Flood Impact Assessment indicates that external water demands associated with the Project would be met by water entitlements already held by MCO (WRM, 2022). There is no indication that the water requirements for the Project would impact third parties. No additional surface water-related costs would therefore be incurred by the Project, and none have been included in the CBA.

3.6.1.3 BIODIVERSITY

Appendix C of the EIS contains the Biodiversity Development Assessment Report (Niche, 2022a) for the Project. A summary of residual impacts of the Project is provided in Table 3-4.

Predicted biodiversity impacts

The new Project mining areas are largely contiguous with the existing approved and operating OC3 mining area, and would use existing transport and processing infrastructure, thus minimising additional disturbance areas. The Project has also been designed to minimise biodiversity impacts, as far as practicable (Niche, 2022a).

The Project would result in the clearance of around 624 ha of native vegetation, including Derived Native Grassland (394 ha), remnant woodland/forest (210 ha), regenerating woodland/ forest (19 ha), scattered trees (2 ha), and planted natives (0.1 ha). The Project may also cumulatively interact with the existing MCC, the Ulan Mine Complex, the Wilpinjong Coal Mine, the Bowdens Silver Project, and solar and wind renewable projects in the region. Potential

indirect impacts to the adjacent MGNR may include accidental damage of adjacent habitat and reduced habitat viability due to increased edge effects, noise and blasting, light spill, dust, and invasion of non-native species.

The potential impacts of the Project on baseflow in the Goulburn River and Moolarben Creek are predicted to be negligible (Section 3.6.1.1). The Project would not result in a long-term reduction in water availability for terrestrial vegetation along Moolarben Creek and associated low-lying areas and is unlikely to impact on water-dependent assets in the MGNR.

Valuation

The EA Technical Notes set out the requirement to assess and quantify impacts that are then reflected in a biodiversity offset requirement. The biodiversity impacts associated with the Project have been valued using MCO's estimated cost to implement the Biodiversity Offset Strategy for the Project (e.g., the establishment of a land-based biodiversity offset and/or the purchase of credits). MCO has estimated that the total cost of implementing the Biodiversity Offset Strategy for the Project would be around $150 million. All other costs associated with mitigation, management, and monitoring measures for biodiversity have been internalised and are included in the Project's costings.

3.6.1.4 ABORIGINAL HERITAGE

Appendix F of the EIS contains the ACHA (Niche, 2022b) for the Project. The ACHA was prepared in consultation with the RAPs for the Project. A summary of residual impacts of the Project is provided in Table 3-4.

Predicted Aboriginal heritage impacts

Niche (2022b) concluded that the Project would not cause a loss of heritage resources that could be viewed as being very rare or unique. The Project may result in the direct disturbance of 79 known Aboriginal heritage sites, comprising seven sites assessed as being of moderate significance, seven sites assessed as being of low-moderate significance, and 65 sites assessed as being of low significance. 11 known Aboriginal heritage sites may potentially be indirectly impacted by blasting from the Project. The Project would not result in any significant cumulative impact on Aboriginal heritage in the region.

The ACHA outlines ongoing mitigation, consultation, and management measures for the Aboriginal heritage items for the Project determined in consultation with the RAPs. MCO would review and update the existing Heritage Management Plan for the Project, or a new Plan would be prepared, and would implement the recommended ACHA mitigation measures for the Project in consultation with relevant stakeholders. MCO would also adjust blast designs to minimise potential vibration damage to sensitive sites, where required.

Valuation

Consistent with the EA Technical Notes, the costs of compliance with the recommendations in the ACHA, the ongoing application of the Heritage Management Plan and all related processes have been internalised and are included in the Project costings.

3.6.1.5 NON-ABORIGINAL CULTURAL HERITAGE

Appendix G of the EIS contains the Non-Aboriginal Heritage Assessment (Niche, 2022c) for the Project. A summary of residual impacts as a result of the Project is provided in Table 3-4.

Predicted non-Aboriginal cultural heritage impacts

Three sites of local significance (potential grave sites) were identified within the Project area; these would be exhumed prior to disturbance in accordance with a section 140 excavation permit under the NSW Heritage Act 1977 (prior to Project determination), or in accordance with the Project Development Consent (Niche, 2022c). There are no listed State, National or Local heritage items and/or places within the Project area. No significant impacts to historic heritage in the region are expected when the Project is considered cumulatively with the existing MCC and other projects in the region.

Valuation

Consistent with the EA Guidelines, the costs associated with mitigation, consultation, management, and monitoring measures for non-Aboriginal heritage have been internalised and are incorporated in the Project costings.

3.6.1.6 NOISE

Appendix H of the EIS contains the Noise and Blasting Impact Assessment (SLR, 2022) for the Project. A summary of residual impacts of the Project is provided in Table 3-4.

Predicted noise impacts

The Project would generate additional noise emissions during the mining, handling and transport of waste rock and ROM coal. SLR (2022) expect that Project noise emissions could be managed to comply with noise criteria at all private residences, including when considered cumulatively with other sources:

- blast design and execution would be adjusted as required for blasts located in close proximity to sensitive locations (e.g., public infrastructure, private residences, and recreational areas [when in use]) to maintain compliance with relevant vibration or air blast criteria;

- construction noise from the Project is expected to be indistinguishable compared to operational noise from the MCC at the nearest privately-owned receivers;
- the low-frequency noise assessment indicated that any of the receivers surrounding the Project would be unlikely to be exposed to dominant low-frequency noise;
- the predicted noise levels of the Project at all privately-owned receivers would comply with amenity noise criteria/the Project Noise Trigger Levels;
- the predicted noise impacts of the Project and the approved MCC would comply with both the relevant intrusive and amenity criteria, and the criteria set out in the Stage 1 and 2 Project Approvals;
- no receivers are predicted to experience exceedances of sleep disturbance criteria; and
- no acquisition or mitigation upon request is predicted to be required for the Project to manage noise emissions.

The assessment indicated that cumulative noise levels from the concurrent operation of the MCC (including the Project), Ulan Mine Complex and Wilpinjong Coal Mine would be minimal and would not result in exceedances at any privately-owned receivers in the vicinity of the Project. Further, no increase in traffic noise impacts associated with the Project are expected. Rail noise impacts would not change under the Project.

Valuation

No material residual noise impacts that cannot be mitigated through the *Noise Policy for Industry* and the NSW *Voluntary Land Acquisition and Mitigation Policy* (VLAMP) are predicted. The costs of preparing/updating the requisite management plans, associated monitoring and forecasting activities, and any equipment modifications have been incorporated in MCO's capital and operating expenditure costings. They include the installation of a new real-time noise monitor in Cooyal and the associated ongoing maintenance through 2038.

3.6.1.7 AIR QUALITY

Appendix I of the EIS contains the Air Quality Impact Assessment (TAS, 2022) for the Project. A summary of residual impacts of the Project is provided in Table 3-4.

Predicted air quality impacts

The Project would generate additional dust emissions during the mining, handling and transport of waste rock and ROM coal. TAS (2022) predict that dust emissions could be managed to comply with air quality criteria at all private residences, including when considered cumulatively

with other sources. Potential dust emissions associated with construction and operational activities would be appropriately managed using best practice dust control measures predictive and reactive measures. No exceedances of criteria for TSP, $PM_{2.5}$, PM_{10} or dust deposition are predicted at any privately-owned receiver or on greater than 25 per cent of privately-owned land. No acquisition or mitigation upon request is predicted to be required for the Project to manage dust emissions.

Valuation

The costs of ongoing air quality management and mitigation measures have been included as part of MCO's capital and operational costs for the Project. These costs include the installation of a new Tapered Element Oscillating Mass Balance (TEOM) in Cooyal and the associated ongoing maintenance through 2038.

3.6.1.8 GREENHOUSE GAS EMISSIONS

Appendix J of the EIS contains the GHG Assessment (MCO, 2022) for the Project. A summary of residual impacts of the Project is provided in Table 3-4.

Predicted GHG emissions impacts

The Project is expected to generate around 0.6 Mt $CO_{2\text{-}e}$ of Scope 1 and 0.2 Mt $CO_{2\text{-}e}$ of Scope 2 GHG emissions. On an emissions intensity basis, Scope 1 and 2 emissions are low, given the low depth of cover, low gas content of the coal seam and optimised mining schedule. Scope 3 emissions are estimated at around 85.8 Mt $CO_{2\text{-}e}$.[6]

Valuation

The costs associated with various mitigation measures to minimise the overall generation of GHG from the Project have been incorporated in MCO's costings.

The EA Technical Notes state that only Scope 1 and 2 emissions should be valued, that market prices should be used for the valuation, and that the value of the externality should be limited to the impact on NSW only. Given that, at the time of writing the EA Technical Notes, there was considered to be "*no identified carbon price in Australia*", the application of the forecast price of European emission allowances, as reflected in futures prices published by the European Energy Exchange was suggested.

The average market price of $17.35 per tonne of $CO_{2\text{-}e}$ has been applied in this EA, which was achieved at the most recent auction of Australian Carbon Credit Units (ACCUs), held by the Clean

[6] Scope 3 emissions are associated with the end of use of the product coal (i.e., for energy production overseas). MCO has existing sales agreements with customers who are signatories of the Paris Agreement or have domestic policies consistent with the Paris Agreement (MCO, 2022).

Energy Regulator in April 2022.[7] ACCUs can be considered to represent a reliable market price for the cost of abating carbon emissions in Australia, and to represent a reasonable indication of future demand and supply trends. ACCUs represent an offset for one tonne of $CO_{2\text{-}e}$ emissions that are stored or avoided by landowners and entities from other industry sectors in Australia. Kyoto-compliant ACCUs are purchased by the Australian Government to meet Australia's climate change commitments, by industrial facilities that are covered by the Safeguard Mechanism, and by 'voluntary' purchasers – state and local governments or corporate buyers who have made voluntary emissions reductions pledges.

The projected year-on-year Scope 1 and 2 emissions from the Project have therefore been multiplied by the projected ACCU prices, assuming that these prices will continue to increase by 3.2 per cent per annum in line with historic trends since ACCUs were first auctioned in April 2015, to derive a total global GHG cost of $10.4 million in NPV terms. Given that the economic impact of GHG emission should be estimated for NSW only, GHG emissions costs have been attributed on the basis of the share of the NSW population of the world population, which results in incremental GHG emissions costs of $0.011 million to NSW.[8] Variations to the carbon price and apportionment method have been considered in the sensitivity analysis below (refer to Section 3.8).

3.6.1.9 ROAD TRANSPORT

Appendix O of the EIS contains the Road Transport Assessment (TTPP, 2022) for the Project. A summary of residual impacts of the Project is provided in Table 3-4.

Predicted road transport impacts

The Project would not increase peak employment at the MCC or increase the currently approved mine life. The Project would not involve any direct interaction with the public road network, as it does not involve any new site access points or road closures when compared to the existing MCC.

The Road Transport Assessment concluded that the existing road network can satisfactorily accommodate the forecast traffic demands resulting from the Project without any specific additional road upgrade requirements. When considered cumulatively with background growth and impacts from other developments in the region:

[7] https://www.cleanenergyregulator.gov.au/ERF/auctions-results/april-2022; accessed 20 September 2022.
[8] As of December 2021, the NSW population was around 8.1 million, compared to the world population of around 7.8 billion. (ABS, 2022a; World Bank, 2022).

- there would be minimal changes to the levels of service on the key access roads in the vicinity of the Project;
- there were no specific concerns with the safety of the key routes and access roads used by mine-related traffic;
- the increase in vehicles using the level crossing from the MCC (including the Project) during peak hour would be negligible; and
- there would be no additional travel time delays resulting from the Project.

Valuation

MCO contributes to the maintenance of the local road network via the existing Ulan Road Strategy, and this would continue to be the case for the Project. Given that the transport impacts associated with the Project are expected to be minimal and that no mitigation measures are needed, no additional transport-related costs have been included in the CBA.

3.6.1.10 VISUAL AND LANDSCAPE CHARACTER

A Visual and Landscape Assessment has been prepared for the Project and is presented in Appendix N.

Predicted visual and landscape impacts

The assessment of potential cumulative visual impacts considered the combined effects of the Project with the effects of the existing MCC, the Ulan Mine Complex and Wilpinjong Coal Mine. As the Project is an extension of existing mining operations within a valley surrounded by elevated areas within the MGNR, as well as other intervening topographical features in the wider landscape, the Project would not incrementally increase cumulative visual impacts at sensitive receivers.

While the existing MCC mining operations may be visible from viewpoints to the west, the Project would progressively move further to the south and south-east down the Moolarben Valley:

- there would be negligible visual impacts for all viewpoints in the regional setting and at the sub-regional setting for the duration of Project operations;
- at the local level, the Project would have a negligible impact on the Moolarben Picnic Area; and

- there are no private residences, landholdings, and publicly accessible roads within the local setting of the Project area, noting that Moolarben Road is already closed for public access within the Project area.

The intensity, nature, and degree of night-lighting for the Project would be similar to the existing night-lighting at the approved MCC, as well as other surrounding mining operations. Further, it is not expected that there would be any direct views of Project lighting sources from public roads and residential areas.

Valuation

Given that the incremental visual impacts associated with the Project are expected to be negligible and that no mitigation measures are needed, no additional costs have been included in the CBA.

3.6.2. Net public infrastructure costs

No public infrastructure costs are expected to be incurred for the Project, and none have therefore been included in the CBA.

3.6.3. Loss of surplus to other industries

The EA Guidelines specify that the CBA should incorporate changes in economic surplus arising in other NSW industries such as the agricultural, forestry, tourism, or equine industries. Negative impacts on other industries are likely to be limited, as:

- The Project is an extension of an existing mining operation, which gives rise to less surface disturbance and other noise, visual and dust impacts than is the case for a new mine. The Project would make use of much of the existing MCC surface infrastructure.
- Visual impacts associated with the Project would remain largely unchanged compared to those of the existing approved MCC.
- The Air Quality Assessment (TAS, 2022) concluded that the Project would not cause adverse air quality impacts.
- Noise contributions from the Project would generally be less than the EPA's noise criteria. No additional exceedances of the Project noise trigger levels are predicted.
- No specific measures or upgrades to the existing road network would be required, and the Project would not impact significantly on the capacity, safety or efficiency of the current road network (TTPP, 2022).

3.6.4. Agricultural impacts

Appendix L of the EIS contains the Agricultural Impact Assessment (2rog, 2022) for the Project. A summary of residual impacts of the Project is provided in Table 3-4.

3.6.4.1 PREDICTED AGRICULTURAL IMPACTS

The Project is located in the Central Tablelands Region of NSW, which comprises an area of approximately 3.1 million ha. Agriculture is a key industry for the Region and contributes approximately 4.2 per cent of NSW's annual value of agricultural production, with 1.4 million ha under agricultural production (2rog, 2022).

All freehold land associated with the Project is owned by MCO. MCO currently licenses some areas of Moolarben-owned land within the Project area and to the west of the approved OC3 mining area for ongoing low-intensity agricultural use, including for cattle and sheep grazing, and opportunistic fodder cropping. A number of agricultural enterprises are also located on private landholdings in the vicinity of the Project. Proximate private agricultural activities largely consist of grazing and dryland cropping.

At the time of reporting, approximately 975 ha of land that is currently leased for agricultural use would not be available during the Project mine life and rehabilitation. Agricultural production on this land would no longer occur during the life of the Project, but a portion of the Project area would be returned to land suitable for agricultural production following rehabilitation.

A Soils and Land Impact Assessment has been prepared for the Project by Mine Soils (2022). There is no NSW Government-mapped BSAL land within the Project area. Most of the previously cleared areas in the Project indicative surface disturbance extent are mapped as Land and Soil Capability (LSC) Class 5 and 6 (moderate to low capability), which transitions to LSC Class 7 and 8 (very low capability to extremely low) on the steeper slopes adjacent to the MGNR. There are also scattered small patches of LSC Class 3 and 4 (moderate to high capability) land in areas with remnant vegetation.

3.6.4.2 VALUATION

The agricultural impacts of the Project relate to the temporary displacement of agriculture over the Project life. These impacts refer to:

- The foregone *gross* value of agricultural production (GVA). The GVA refers to the foregone revenues from the sale of primary agricultural products due to the disruption of agricultural land use.

- The foregone *net* value of agricultural production. This is the foregone gross revenue less the costs of production due to the disruption of agricultural land use.

The GVA includes the net returns to land and other capital assets as well as the costs of labour and intermediate inputs. A reduction in GVA will have a direct impact on employment, which, to some extent, will be offset by redeployment. The reduced demand for inputs from upstream domestic industries and loss of throughput to downstream domestic industries can have flow-on effects on the state and local economy, in terms of reduced employment and a reduction in value generated by these industries.

The direct agricultural impacts of the Project relate to the foregone net value of agricultural production and represent an opportunity cost for MCO. That is, while the Project generates significant value added as a result of coal mining activities, that value added has an opportunity cost (to MCO) in the form of the value lost due to the removal of agricultural activities.

2rog (2022) has conservatively estimated the annual loss in GVA as a result of the Project to be $466,743 per annum (2015-16 figures). This figure compares with the GVA from agricultural activities in the local region (the Lithgow - Mudgee SA3 Region) of around $136.4 million in the same year. As a proportion of the GVA from agricultural activities in the local region, the foregone Project GVA amounts to 0.3 per cent, so that any impacts on related upstream and downstream industries is unlikely to be a material consideration.

Income in the form of wages and salaries derived from agriculture is a component of agricultural value added. It can be expected that there may be some limited local impacts on income and employment due to agricultural land being removed from production. The incremental employment impact of the Project has been approximated with reference to the most recent (2019-20) ABS requirements table (ABS, 2022b). Compensation of employee's accounts for around 6 per cent of the gross value of GVA for the sheep, grains, beef and dairy cattle sector, or around $28,000 per annum (i.e., 6 per cent of the foregone Project GVA of $466,743). Given the median total income (excluding Government pensions and allowances) in the SA3 Region in 2019 of $47,379 (ABS, 2022c), the direct loss of agricultural employment is estimated at around 0.6 FTE jobs per annum.

It is noted that any agricultural land associated with any land-based Project biodiversity offset area would be permanently displaced. The foregone value of agricultural production from the biodiversity offset area has not, however, been estimated as the Biodiversity Offset Strategy for the Project is not required to be finalised and its location is yet to be determined. This is inherent in the process for satisfying offset liability under the NSW *Biodiversity Conservation Act 2016*, which allows an offset liability to be satisfied via land-based offsets, purchasing credits to 3rd parties and/or payment into a biodiversity conservation fund. This foregone agricultural

production is not expected to be significant as the biodiversity offset area site would be selected for its biodiversity values and is therefore expected to have marginal agricultural value. Also, the offsets would not be required if the State of NSW did not consider the value of biodiversity benefits to the wider community to be greater than the foregone value of agricultural production.

Notwithstanding the above, the costs of establishing offsets have been included as part of the CBA (Section 3.6.1.3). As is noted in the EA Guidelines, land prices can be assumed to reflect the present value of future earnings or other uses, and therefore it is considered that any foregone net returns by MCO from agricultural production associated with the Project biodiversity offset areas has been considered in the CBA.

3.7. INCREMENTAL NET BENEFITS OF THE PROJECT FOR THE NSW COMMUNITY

This section summarises the results of the CBA. The net benefits derived in the previous subsections have been allocated to the NSW community consistent with the EA Guidelines. Table 3-5 summarises the estimated net benefits of the Project for NSW. The NPV of the net benefits of the Project accruing to NSW are estimated at $182 million in NPV terms, consisting of:

- royalties of around $152 million in NPV terms;
- the NSW share of company income tax of around $26 million in NPV terms; and
- the NSW share of the net producer surplus of around $ 4 million in NPV terms.

Table 3-5. Incremental net benefits for the NSW community – Project ($2022)

Incremental direct and indirect costs	NPV $m	Incremental direct and indirect benefits	NPV $m
External effects that have not been internalised by MCO (GHG emissions)	<$0.1	Royalties	$152
		NSW share of company income tax	$26
		NSW share of the net producer surplus	$3.5
Total direct and indirect costs	<$0.1	Total direct and indirect benefits	$182
Net benefits to NSW			$182

Note: Totals may not sum precisely due to rounding.
Source: AnalytEcon.

The Project would potentially give rise to external effects that would impact third parties. However, MCO would mitigate the great majority of these, including through the purchase of the requisite water licences, and the purchase of biodiversity offsets. These external effects therefore do not impose a cost on the NSW community. Similarly, the loss in the net value of agricultural production associated with the Project is an opportunity cost to MCO as the Project is located on MCO-owned freehold land and does not impose a direct cost on the NSW community.

The reduction in agricultural activity and GVA as a result of the Project may potentially affect related upstream and downstream industries, but is considered to be too small to be material. There may, however, be a small reduction in agricultural employment and income, expected to be around $28,000 per annum or 0.6 FTE jobs. The NSW share of the incremental GHG emissions attributable to the Project is estimated at around $11,000 in NPV terms and constitutes a cost to the NSW community.

3.8. SENSITIVITY ANALYSIS

The EA Guidelines require a proponent to undertake sensitivity analyses of a range of variables as part of the CBA in order to test the robustness of the results to changes in the underlying assumptions.

3.8.1. Variations in the discount rate

The sensitivity of the results of the CBA to changes in the central discount rate of 7 per cent has been tested by applying a discount rate of 4 per cent and 10 per cent, respectively (Table 3-6).

Table 3-6. Incremental net benefit to NSW – Discount rate sensitivity ($2022)

Discount rate assumption	Net benefits for NSW (NPV $m)
7 per cent	$182
4 per cent	$223
10 per cent	$149

Source: AnalytEcon.

3.8.2. Variations in coal prices and exchange rates

The Project's coal production will be exported and priced in US dollars. Different combinations of coal prices and US$/A$ exchange rates will affect revenues, and therefore royalty and income

tax payments. Table 3-7 shows the net benefits accruing to NSW as a function of various combinations of coal prices and exchange rates:

- for the coal price sensitivity, product prices have been varied by +10 per cent and –20 per cent, respectively; and
- for the exchange rate sensitivity, the US$/AU$ exchange rate has also been varied by +10 per cent and –20 per cent, respectively.

Table 3-7 shows that in the 'worst case' scenario of a combination of a low coal price and a low (US$/AU$) exchange rate (implying that the value of the US$ is low relative to the AU$), sustained through all years of product coal production from 2025 through to 2034, the net benefits to NSW would amount to $66 million in NPV terms.

Table 3-7. Incremental net benefit to NSW – Coal price and exchange rate sensitivity (NPV $2022 m)

	Coal price assumptions		
Exchange rates (US$/A$)	**All coal prices: (–)20%**	**Central coal price assumptions**	**All coal prices: +10%**
Central US$/A$ exchange rate	$112	$182	$216
All US$/A$ exchange rates: +10%	$143	$220	$259
All US$/A$ exchange rates: (-) 20%	$66	$124	$153

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

The EA 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. The analysis suggests that all coal prices over the life of the Project would need to be reduced by 48 per cent relative to the assessed consensus pricing to result in a net benefit to NSW of $0.[9]

3.8.3. Variations in royalty payments

The EA Guidelines require an assessment of the royalties derived from the Project if mining revenues are 25 per cent lower or higher than in the central case (Table 3-8).

[9] It is noted, however, that the CBA model is a mechanical calculation that does not, for instance, allow for changes in operating patterns or investment as a result of low coal prices.

Table 3-8. Incremental net benefits to NSW and royalties – Mining revenues sensitivity ($2022)

	Net benefits to NSW (NPV $m)	Net royalty receipts (NPV $m)
Central case mining revenues	$182	$152
+25% mining revenues	$269	$192
(-) 25% mining revenues	$95	$113

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

3.8.4. Variations in company income tax payments

The EA Guidelines require an assessment of a variation in company income tax by +/- 50 per cent (Table 3-9).

Table 3-9. Incremental net benefits to NSW and NSW share of company income tax payments – Income tax sensitivity (NPV $2022)

	Net benefits to NSW (NPV $m)	Net company income tax payments (NPV $m)
Central case company income tax	$26	$182
+50% increase company income tax	$39	$196
(-) 50% decrease company income tax	$13	$169

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

3.8.5. Variations in MCO's Australian ownership share

As noted in Section 3.4, the NSW ownership share of the MCC is estimated to be 1.8 per cent. Variations in the Australian ownership share would affect the portion of the Project's incremental producer surplus that can be attributed to NSW. To test the implications of this variation, the Australian ownership share (i.e., 6 per cent of Yancoal shareholders) has been varied by +/- 50 per cent, as shown in Table 3-10.

Table 3-10. Incremental net benefits to NSW and producer surplus – Australian ownership share sensitivity ($2022)

	Net benefits to NSW (NPV $m)	Net producer surplus (NPV $m)
Central case Australian ownership share	$182	$3.5
+50% increase Australian ownership share	$183	$5.3
(-) 50% decrease Australian ownership share	$180	$1.8

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

3.8.6. Variation in the price of carbon and allocation of costs

Table 3-11 summarises total estimated (Scope 1 and 2) GHG emissions for the Project and the valuation of these emissions at 'low', 'medium' and 'high' carbon prices, as recommended in the EA Guidelines, and using different approaches to allocate the cost of carbon emissions to NSW.

The low price forecast relies on the price of ACCUs, as derived in Section 3.6.1.8. The medium price forecast relies on carbon prices derived from the Australian Treasury Clean Energy Future Policy (CEFP) scenario, in accordance with the NSW Government's 'Greenhouse Gas Emissions Valuation Workbook' (NSW Government, 2018a). These prices are assumed to increase from $49 t CO2-e in 2024 to A$108 t CO2-e in 2038 ($2022). The high price forecast relies on the prices of EUA futures, as published by EEX (2022), which increases from around AU$119 per tonne of $CO_{2\text{-}e}$ (t $CO_{2\text{-}e}$) in December 2024 to around AU$ 175 t $CO_{2\text{-}e}$ in December 2031. EUA futures prices are not published beyond 2031; it has therefore conservatively been assumed that prices from that year onwards will increase by 5.9 per cent in real terms, consistent with recent trends. Table 3-11 also provides a comparison of the resulting net benefits of the Project for NSW associated with each of the emissions valuations.

Table 3-11. Carbon price sensitivity ($2022)

	Low price forecast: ACCUs (NPV $2022 m)	Medium price forecast: CEFP scenario (NPV $2022 m)	High price forecast: EUA futures (NPV $2022 m)
All externality costs allocated to the Project			
Project	$10	$32	$76
NSW net benefits	$171	$150	$106

	Low price forecast: ACCUs (NPV $2022 m)	Medium price forecast: CEFP scenario (NPV $2022 m)	High price forecast: EUA futures (NPV $2022 m)
Externality costs allocated on the basis of NSW share of Australian population			
Project	$3	$10	$24
NSW net benefits	$178	$172	$158
Externality costs allocated on the basis of NSW share of global population			
Project	$0.01	$0.03	$0.07
NSW net benefits	$182	$182	$182

Notes: As of December 2021, the NSW share of the Australian population was 31.4 per cent. As of 2021, the NSW share of the world population was 0.1 per cent. The €/AU$ exchange rate was assumed at 1.5.

Sources: World Bank, 2022; EEX, 2022; ABS, 2022a.

3.9. DISTRIBUTIONAL IMPACTS

The EA Guidelines recommend commenting on the distributional impacts of a proposal:

- As described in previous sections of this report, the Project would deliver significant net benefits to the NSW community as a whole, estimated at $182 million in NPV terms. Of these, $152 million in NPV terms in royalties will flow directly to the NSW Government for disbursement to benefit the wider NSW commodity.
- The assessments of the likely external effects associated with the Project suggest that the great majority of any impacts on third parties will be mitigated, and the corresponding costs borne by MCO. In particular, there are predicted to be no material ground- or surface water, air, noise, blasting, visual, or heritage impacts. MCO would mitigate any loss of biodiversity via an approved biodiversity offset strategy. While there will be a small reduction in agricultural land available for farming if the Project is approved, the corresponding impacts on upstream and downstream industries and agricultural employment are not considered material.
- Given the operating costs that would be incurred over the life of the Project, local and NSW suppliers can be expected to benefit from additional sales. As set out in Section 3.5.3, MCO expects to expend around $1,014 million in NPV terms in operating costs over the life of the Project, of which around $658 million in NPV terms would be directed to NSW suppliers.

4. FLOW-ON EFFECTS OF THE PROJECT FOR THE NSW COMMUNITY

This section describes the incremental 'second-round' or 'flow-on' effects that the Project would generate for the NSW and the local community. The choice of approach for deriving these flow-on effects, the necessary caveats, and the derivation of multipliers is detailed in Appendix B.

4.1. APPROACH

Second-round or 'flow-on' effects refer to the adjustments in the economy that follow on from the initial changes in the demand for goods, services and labour arising from a significant development such as the Project. Such a change in demand for a range of inputs sets the economy in motion as the productive sectors buy and sell goods and services from one another, and households earn additional incomes. These relationships cause the total effects on the regional or state economy to exceed the initial change in demand so that an entire state or region benefits from the increased economic activity that arises from a significant investment.

In this EA, input-output analysis has been used to derive the flow-on effects of the Project for the NSW economy. Economic flow-on effects can be measured in terms of the effects on income, employment and value added multipliers. In the case of the Project, as discussed in Section 3.1, no incremental employment- or income-related benefits attributable to the Project are considered. The determination of flow-on effects has therefore been limited to those arising from the incremental value added (or contribution to gross state product [GSP]) generated by the Project.[10]

Multipliers are classified into 'types'. 'Type IA' multipliers refer to the 'initial' and 'first-round' effects arising from an increase in demand generated by a proposal. Type IB and Type IIA multipliers capture subsequent impacts on all industries whose output is required to produce the additional output from the Project, and on households. These subsequent multipliers are calculated in a manner that compounds any measurement errors and breaches in the assumptions that underpin the analysis. A more conservative approach to calculate flow-on effects is therefore to rely only on multipliers that capture only first-round effects (Type IA multipliers), and this is the approach adopted in this EA.

[10] 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 (Appendix A). Subject to some adjustments, the sum of gross value added across all industries in a country or state equals GDP or GSP, respectively.

4.2. VALUE ADDED FLOW-ON BENEFITS FOR NSW

The assumptions made for the input-output analysis are consistent with those made in the CBA; that is, the flow-on effects arise from the incremental value added generated by the Project. The estimated value added of the Project is $209 million in NPV terms, as derived in Appendix A.[11] Using a mining value added multiplier for NSW of 1.24, this estimate translates into:

- a net change in NSW GSP of $50 million in NPV terms; or
- an annual change in NSW GSP of around $5 million over the life of the Project.

4.3. VALUE ADDED FLOW-ON BENEFITS FOR THE LOCAL REGION

The flow-on effects of the Project for the local region consist of the positive incremental flow-on effects generated by the Project. There is also a small impact arising from a reduction in agricultural activities, but this is considered to be immaterial and has not been estimated.

4.3.1. Mining flow-on effects

There are some specific issues that arise in deriving value added multipliers at a local level. 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. However, in the case of the Project, the value added component of benefits that accrues at the local (SA3 Region) level only consists of incremental LGA rate payment which can unambiguously be attributed to the local region. Hence, the estimated incremental value added of the Project at the local level of $23 million in NPV terms (Section 3.3) and a mining value added multiplier for the Lithgow - Mudgee SA3 Region of 1.21 translates to:

- a net change in GRP of $5.5 million in NPV terms; or
- an annual change in GRP of around $0.5 million over the life of the Project.

4.3.2. Agricultural flow-on effects

The loss of agricultural output may result in a reduced demand for inputs from local upstream domestic industries and a loss of throughput to local downstream domestic industries. The flow-on impacts of foregone agricultural production on downstream and upstream industries are related to the level of agricultural output, as measured by the GVA (Section 3.6.4). In the case

[11] The NSW value added calculation for the Project differs from the net benefit calculation set out in the EA Guidelines since land taxes and local government rates are included in value added.

of the Project, the GVA associated with the Project is estimated at around 0.3 per cent of the GVA for the Lithgow - Mudgee SA3 Region and is unlikely to be material consideration.

As also discussed in Section 3.6.4, there would be a small loss of agricultural income and employment, estimated at around $28,000 per annum or 0.6 FTE jobs. Any flow-on effects arising from this loss of employment and income are also likely to be immaterial.

5. LOCAL EFFECTS ANALYSIS

This section describes the LEA that has been prepared for the Project. The LEA is intended to complement the CBA by translating the effects estimated at the state level into local impacts. For the reasons set out in Section 2.3, the LEA has been prepared for the Lithgow - Mudgee SA3 Region.

5.1. LOCAL EMPLOYMENT AND INCOME EFFECTS

According to the EA Guidelines, estimating the employment and income effects accruing to the local workforce requires an estimate of the local workforce and the additional income attributable to the local workforce because of the Project. As discussed in Section 3.1, no additional employment- or income-related benefits are expected to arise if the Project is approved and/or any such benefits are at this stage uncertain. The LEA has therefore not considered local employment and income effects.

5.2. EFFECTS RELATED TO NON-LABOUR PROJECT EXPENDITURE

MCO has analysed its 2022 open cut operating expenditures by postcodes; those costs are assumed to be reasonably representative of the expenditures that would be incurred for the Project. The expenditure information by postcode was mapped to locations in NSW and in the SA3 Region using the appropriate ABS correspondence (ABS, 2012).[12]

It is noted that postcodes provided represent the locations of head offices of companies, and that some of these companies have a permanent local presence in the region (for example mining support service companies with head offices in Sydney or Brisbane, which also have local offices in Mudgee that provide support for the Moolarben Coal Complex). Accordingly, the analysis of expenditure in the local regional may be conservatively low.

Of MCO's 2022 expenditures, around 65 per cent were directed to suppliers located in NSW, and around 10 per cent to suppliers located in the local region. On that basis, it is possible to estimate the share of local and NSW expenditures for the Project. Assuming that these shares will broadly remain the same going forward, of the $1,014 million in NPV terms of operating expenditures forecast for the Project, around $658 million in NPV terms would be expended in NSW, and $97 million in NPV terms in the Lithgow - Mudgee SA3 Region.

[12] The postcodes that are located in the SA3 Region (99 per cent of the area or greater) are: 2790, 2844, 2845, 2846, 2847, 2848, 2849, 2850, and 2852.

5.3. OTHER NET BENEFITS ATTRIBUTABLE TO THE LOCAL REGION

In addition to the incremental income benefits discussed above, net rate payments accruing to the Mid-Western Regional Council represent a direct benefit to the local region. MCO estimates that it would pay $23 million in NPV terms for the Project to Mid-Western Regional Council over the life of the Project (Section 3.3).

MCO also makes financial and in-kind contributions to non-government and community organisations in the region. MCO's financial contributions (in the form of sponsorships and donations) in FY2021 were $138,000 in the Mid-Western Regional LGA through its Community Support Program. Similar contributions would be continued during the Project life. Further, MCO would continue to contribute financially to the implementation of the Ulan Road Strategy in accordance with Stage 1 and Stage 2 Project Approvals (05_0117 and 08_0135).

5.4. EFFECTS ON OTHER LOCAL INDUSTRIES

The EA Guidelines require a qualitative discussion of the effects of a proposal 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.

As discussed in Section 3.6.3, negative impacts on other industries are likely to be limited, given that the Project is an extension of an existing mining operation, which gives rise to fewer surface disturbance and other noise, visual and dust impacts than would be expected for a new mine, and would make use of much of the existing surface infrastructure. The Project would not materially add to the visual impacts of the existing MCC, and no additional acquisition or mitigation due to air quality or noise impacts are expected to arise as a result of the Project.

As set out in Section 3.6.4.2, the foregone net value of agricultural production represents an opportunity cost for MCO. The expected reduced demand for agricultural inputs from upstream industries and loss of agricultural throughput to downstream industries is unlikely to be material. As set out in Section 3.6.4, there would be a small direct effect on agricultural income and employment that is estimated at around $28,000 per annum or around 0.6 FTEs per annum.

5.5. NET BENEFITS OF THE PROJECT FOR THE LOCAL REGION

Table 5-1 summarises the net effects of the Project for the SA3 Region over the operational life of the Project, as derived in the previous sections of the LEA, in the format recommended in Table 4.5 in the EA Guidelines.

As noted, no employment- or income-related local effects have been included in the LEA. The direct local benefits attributable to the Project are therefore also the net local benefits (since it is not necessary to account for movements of workers or relative differences in incomes). Table 5-1 therefore reports the total direct and indirect benefits and costs attributable to the Project and to the local region, respectively, the flow-on effects attributable to the local region, and the combined total impacts on the local region.

Row (1) summarises the information on non-labour related local expenditures. Over the Project operational timeframe, total operating expenditures for the Project are estimated to amount to $1,014 million in NPV terms. Assuming that, going forward, the same shares as currently of operating expenditures continue to be directed towards local suppliers, $97 million in NPV terms would be sourced from suppliers in the SA3 Region.

Row (2) focuses on local government rate payments. From 2025 to 2038, MCO would pay around $23 million in NPV terms in rate payment to the Mid-Western Regional Council. As noted in Section 4.3, these expenditures would additionally give rise to value added flow-on effects to the local region of $5.5 million in NPV terms (Column D).

Row (3) refers to potential negative environmental or other impacts of the Project on third parties. Where such impacts are expected to occur, MCO would mitigate these, for instance via the implementation of management and compensation measures, the purchase of the requisite water licences, and through the implementation of a biodiversity offset strategy. No net cost should therefore be attributed to the local region.

The Project would conservatively displace up to an additional 975 ha of agricultural land during mining and rehabilitation. The corresponding foregone value of agricultural production represents an opportunity cost for MCO, and therefore does not represent a net cost for the local region. As noted in Section 3.6.4, the incremental reduction in agricultural production would give rise to small (contractionary) flow-on effects on related downstream and upstream industries, but also a small loss in agricultural income and employment. Neither of these effects are expected to be material.

Table 5-1. LEA Summary ($2022, 2025 to 2038)

(A)	(B) Project direct/indirect benefits & costs: Total (NPV $ millions)	(C) Project direct/indirect benefits & costs: Local SA3 Region (NPV $ millions)	(D) Project flow-on benefits & costs: Local SA3 Region (NPV $ millions)	(E) Project total: Local SA3 Region (NPV $ millions)
(1) Other, non-labour expenditure	$1,014	$97	N/a	N/a
(2) Local government rates	$23	$23	$5.5	$28.5
(3) Externality benefit/ cost	Reduction in agricultural GVA of around $466,743	Reduction in agricultural GVA of around $466,743	~ 0 (immaterial)	Reduction in agricultural GVA of around $466,743
Agriculture	Loss of agricultural income of around $28,000 per annum or 0.6 FTE	Loss of agricultural income of around $28,000 per annum or 0.6 FTE	~ 0 (immaterial)	Loss of agricultural income of around $28,000 per annum or 0.6 FTE

Source: AnalytEcon.

6. SIGNIFICANCE OF THE RESOURCE

The net benefits that are attributable to the Project as described in this EA indicate the significance of the resource, in terms of the generation of taxation revenues including royalties, and the share of the producer surplus attributable to NSW.

The incremental economic benefits of the Project for NSW are estimated at around $182 million in NPV terms, consisting of:

- $152 million in NPV terms of incremental royalty payments;
- incremental company income tax payments attributable to NSW of around $26 million in NPV terms; and
- an incremental net producer surplus of around $4 million in NPV terms that is attributable to NSW shareholders of MCO.

If approved, the Project would give rise to capital expenditures of around $120 million in NPV terms. The Project would additionally account for operating expenditures of $1,014 million in NPV terms. On current trends, around $658 million in NPV terms of those operating expenditures would be expected to be directed at NSW suppliers.

Overall, the additional value added (or contribution to GSP) generated by the Project is estimated at $209 million in NPV terms, which would generate wider value added economic flow-on effects for the State of NSW of an estimated $50 million in NPV terms.

The Project would deliver significant net benefits to the local region. For the Lithgow - Mudgee SA3 Region, where almost 80 per cent of the current operational workforce live, these incremental benefits are estimated at additional expenditures directed at local suppliers of $97 million in NPV terms over the life of the Project.

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APPENDIX A. PROJECT VALUE ADDED

A.1. Value added and gross state product

From an economic perspective, the extent to which a commercial development contributes to the welfare of a country or state differs from a private benefit calculation, which focuses on profits. 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, where it is referred to as 'gross value added' to emphasise that this measure is gross of the consumption of fixed capital (that is, depreciation). Gross value added is the difference between output and intermediate inputs (the value created by production) and equals the contribution of labour and capital to the production process (ABS 2013). Subject to adjustments that need to be made to ensure that valuations are internally consistent by accounting for various taxes and subsidies, the sum of gross value added across all industries in a country or state equals gross domestic product (GDP) or gross state product (GSP), respectively.

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):

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

Where:

- The gross operating surplus (GOS) is a measure of the surplus accruing to the owners of incorporated enterprises, and is the difference between gross output, on the one hand, and intermediate consumption, the compensation of employees and long-term contractors, and taxes less subsidies on production and imports. GOS is calculated before deducting the consumption of fixed capital (depreciation), dividends, interest, royalties and land rent, and direct taxes payable.

- 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 is not relevant here.

- Taxes (subsidies) on production include taxes on products, such as GST and import duties, and other taxes (subsidies) on production, such as payroll taxes or subsidies, land taxes, stamp duties and taxes on pollution.

Given that additional income and employment-related benefits arising from the Project have not been considered in this EA, the change in GSP as a result of the Project being approved therefore captures the incremental benefits accruing to NSW from:

- the share of the Project's GOS that can be attributed to NSW: coal royalty payments to NSW, the share of Commonwealth income taxes that can be attributed to NSW, and the share of the project surplus that can be attributed to NSW residents; and

- the additional land taxes and local government rates paid to NSW and to local government.

A.2. Incremental value added

Table A-1 shows the estimated incremental contribution of the Project to NSW GSP. It is noted that this estimate is higher than the identified net benefit to NSW (Table 3-5) since the EA Guidelines do not provide for the inclusion of land taxes or local government rates.

Table A-1. Value added – Project ($2022)

Components of value added	Project (NPV $ millions)
NSW share of Project GOS:	
Producer surplus	$4
Royalties	$152
Company tax	$26
Other taxes on production less subsidies on production:	
Land taxes	$4
Local government rates	$23
Externalities:	
GHG emissions	< $0.1
Net change in GSP	$209

APPENDIX B. DERIVATION OF FLOW-ON EFFECTS

This appendix describes the interpretation of input-output multipliers, the limitations of input-output analysis, and the methods used to calculate the flow-on effects of changes in the level of mining investment and production in NSW and the local SA3 Region.

B.1. Input-output multipliers

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. 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:

- Type IA multipliers refer to the 'initial' and 'first-round' effects arising from an increase in demand from a proposal. 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 proposal.

- 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 a proposal 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 a proposal 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 a proposal 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.

B.2. 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 several restrictive assumptions. Some of these assumptions pertain to input-output analysis generally while others

relate to the use and interpretation of input-output analysis at a regional or state, as opposed to a national level.

The key assumptions used for the input-output analysis of flow-on effects are summarised in the following. Many of these assumptions can lead to an overstatement of the impacts of a proposal (Bess and Ambargis 2011, Coughlin et al. 1991). The implication is that the resulting regional impact estimates should be interpreted as an upper bound of the likely effects.

B.2.1. Fixed capital stocks

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

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

B.2.2. Supply constraints

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

B.2.3. 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.

B.2.4. Fixed prices

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

B.3. Derivation of multipliers

The following describes the various steps required to derive state and local input-output multipliers.

B.3.1. 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 2016-17 which were released in July 2019. The ABS census records employment at an aggregated level with 19 industry classifications. The employment data was drawn from the most recent, 2021, census. The ABS census records employment an aggregated level with 19 industry classifications. The concordance between the census and the accounts is set out in Table B-1.

Table B-1. Industry concordance between the industries in the National Accounts and industry level employment data in the 2021 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

Aggregate Industry	ABS National Accounts industry codes	
	Starting from	Ending with
Retail trade	3901	3901
Accommodation and food services	4401	4501
Transport, postal and warehousing	4601	5201
Information media and telecommunications	5401	6001
Financial and insurance services	6201	6401
Rental, hiring and real estate services	6601	6702
Professional, scientific and technical Services	6901	7001
Administrative and support services	7210	7310
Public administration and safety	7501	7701
Education and training	8010	8210
Health care and social assistance	8401	8601
Arts and recreation services	8901	9201
Other services	9401	9502

Source: 5209.0.55.001 - Australian National Accounts: Input-Output Tables, 2019-20. 2021 ABS Census.

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

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

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

B.3.2. Requirements matrix and first-round (Type IA) output multipliers

The initial requirement for an extra dollar's worth of output of a given industry is called the initial output effect. It equals one in total for all industries since an additional dollar's worth of output from any industry will require the initial one dollar's worth of output from that industry

plus any induced extra output. The first-round effect is the amount of output required from all industries of the economy to produce the initial output effect.

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

The first-round impact multiplier is then the sum of the standardised inputs for a given industry. For example, each element of the column for agriculture is divided by total agricultural output and then summed to obtain the total input requirement for one addition unit of output. The initial multiplier can be interpreted as the direct costs of an additional unit of production at current prices. Given these inputs are supplied domestically, the costs are other industry outputs and therefore contribute to total economic output. The sum of the initial output effect (which equals one) and the first-round effect is the Type IA output multiplier. This is simply the total first-round contribution of a project to the economy. For a project that is small when compared to the size of the industry, the first-round and Type IA impact multipliers are valid given the requirements are representative of those used in the project.

B.3.3. Simple output or Type IB multiplier

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

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

$$Ax - x = 1$$

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

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

where I is an identity matrix with ones along the main diagonal and zeros elsewhere, and the superscript -1 denotes the matrix inverse.

Summing the columns of $(1 - A)^{-1}$ gives the simple multipliers. For example, summing the agricultural column gives the total inputs from all industries needed to sustain the production of one additional unit of net agricultural output at the national level.

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

For a project that is small relative to the size of industry the price effects will be small and the bias in the simple multiplier may be ignored. However, the composition of flow effects will vary if the input requirements for the project differ from those of the industry.

B.3.4. The total or Type IIA output multiplier

The total multiplier takes into account the relationship between wages and household demand, that is, the increase (decline) in household demand that results from a rise (fall) in household income. This is derived by adding the wages row and the household expenditure column to the A matrix from the requirements table. Let the expanded matrix be denoted B. The total multipliers are analogous to the simple multiplier and given by the column sums of the matrix $(I - B)^{-1}$.

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.3.5. 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.3.6. Employment multipliers

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

Type IA: hA;
Type IB: $h(I - A)^{-1}$
Type IIA: $h(I - B)^{-1}$

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

B.3.7. 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: $w(I - A)^{-1}$
Type IIA: $w(I - B)^{-1}$

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

B.3.8. Value added multipliers

Value added is the value of industry output less the costs of inputs, whether produced domestically or imported. 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: $v(I - A)^{-1}$

Type IIA: $v(I - B)^{-1}$

These multipliers can be adjusted to Type 1A, 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.4. 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.

B.4.1. Location quotients

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). Employment based LQs are ratios that indicate the percentage of people employed in a particular industry at a state or regional level, relative to the percentage of people employed in that industry in the national economy. Employment based LQs are then used to proportionally adjust the contribution of an industry to the use of intermediate inputs in a state or region. The consequent shortfall in intermediate inputs is made up by increasing 'imports' from outside the state or region across all industries.

LQs are used to translate economy-wide input-output relationships into state or regional relationships. Hence the national input-output tables need to be adjusted to better reflect the characteristics of the local economy.

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

B.4.2. Adjusting regional/state industry composition and trade

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 ith industry and the jth region as:

$$LQ_{i,j} = \frac{\dfrac{\text{employment}_{i,j}}{\sum_i \text{employment}_{i,j}}}{\dfrac{\sum_j \text{employment}_{i,j}}{\sum_i \sum_j \text{employment}_{i,j}}}$$

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:

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

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.4.3. Regional multipliers

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

Type IA: $LQ' \; A$;
Type IB: $\left(I - LQ' \; A\right)^{-1}$
Type IIA: $\left(I - LQ' \; B\right)^{-1}$

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.4.4. Mining multipliers

Table B-2 shows NSW multipliers derived from the 2019-20 National Accounts tables and employment data for:

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

Table B-2. NSW input-output multipliers - Mining

Multiplier	Type IA	Type IB	Type II
Income	1.96	3.76	5.82
Employment	1.59	3.09	4.14
Value Added	1.24	2.43	2.87

Source: AnalytEcon.

Table B-3 shows the corresponding multipliers for the SA3 Region.

Table B-3. Lithgow - Mudgee SA3 Region input-output multipliers – Mining

Multiplier	Type IA	Type IB	Type II
Income	1.81	3.42	5.12
Employment	1.50	2.87	3.77
Value Added	1.21	2.36	2.72

Source: AnalytEcon.