

APPENDIX 7

Economic Impact Assessment





ECONOMIC IMPACT ASSESSMENT

OF THE MANGOOLA COAL CONTINUED OPERATIONS PROJECT

MANGOOLA COAL OPERATIONS PTY LTD

JUNE 2019

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General reliance restriction

This report is prepared for Mangoola Coal Operations Pty Ltd. The purpose of this report is to provide an economic impact assessment of the Mangoola Coal Continued Operations Project to NSW and to the local community. You should not use the advice for any other purpose. This report should not be used or relied upon by anyone else and we accept no duty of care to any other person or entity. Due to the uncertain nature of economic data, Cadence Economics does not warrant the completeness or accuracy of the analysis or estimates provided in this report.

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Executive summary

Mangoola Coal Mine is an open cut coal mine located approximately 20 kilometres (km) west of Muswellbrook and 10 km north of Denman in the Upper Hunter Valley of NSW. Mangoola has operated the Mangoola Coal Mine under Project Approval (PA) 06_0014 since mining commenced at the site in September 2010.

This report provides an economic impact assessment of the Mangoola Coal Continued Operations (MCCO) Project which involves the continuation of mining at Mangoola Coal Mine into a new mining area to the immediate north of the existing operations. The purpose of this assessment is to form part of an Environmental Impact Statement (EIS) being prepared by Umwelt to accompany an application for development consent under Division 4.1 and 4.7 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the MCCO Project.

Project Overview

The MCCO Project will continue operations in both the Approved Mangoola Coal Mine Disturbance Area (Approved Area) and establish operations within the MCCO Additional Mining Area to the north of Wybong Road. The MCCO Project will continue current truck and excavator extraction methods and maintain coal extraction of up to 13.5 million tonnes (Mt) run-of-mine (ROM) coal per annum.

The MCCO Project will use the existing infrastructure on the Mangoola site including mining and extraction equipment, site offices, coal handing and processing facilities and off-site infrastructure like rail. The MCCO Project will require site works in the MCCO Additional Project Area, including construction of a water management system, an overpass over Big Flat Creek and Wybong Road and off-site works including the realignment of a section of Wybong Post Office Road.

The MCCO Project will extend operations to 2030, five years beyond the current forecast mining completion of 2025. Approval of the MCCO Project would result in a net increase of approximately 52.3 Mt of ROM coal and this increase forms the basis of the economic analysis. The net increase in coal output is forecast to occur between the years 2023 and 2030 (subject to the timing of approval and commencement, with commencement of the MCCO Project subject to the timing of the granting of the required approvals. The report provides further detail of the ROM output, saleable coal output, operational and capital costs and revenue for each year for the approval and net MCCO Project case.

Mangoola markets primarily two thermal coal types, a relatively low ash thermal rated at about 5,800 kcal (per kilogram) and a high ash thermal with 4,775 kcal. Both have a higher ash content and lower kcal specifications to the reference coal specification of 6,300 kcals. Prices have been adjusted according to the calorific content and other market adjustments.

This report provides an Economic Impact Assessment (EIA) for the MCCO Project and has been undertaken to address the Secretary's Environmental Assessment Requirements (SEAR's) and follows the economic assessment framework set out in the *Guidelines for the economic assessment of mining and coal seam gas proposals* (the Guidelines) released by the New South Wales (NSW) Government in December 2015.

In addition, the Guidelines requires an estimate of the potential costs generated by the MCCO Project. These costs may include residual public infrastructure costs and environmental, social and transport-related costs.

To estimate the environmental, social and transport-related costs, the EIA uses the methods outlined in the *Technical Notes supporting the guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals*.¹

Consistent with these guidelines, the EIA includes a Cost Benefit Analysis (CBA) and a Local Effects Analysis (LEA). The CBA provides an estimate of the net benefits of the MCCO Project to NSW. The LEA is based on analysis for the Upper Hunter region (as defined by the Australian Bureau of Statistics SA3 10604 region).

Results of the CBA

Based on the CBA methodology outlined in the Guidelines, and information provided by Mangoola, the MCCO Project is estimated to provide a net benefit to NSW. This net benefit is estimated to be \$408.6 million in net present value (NPV)² terms, as shown in Figure 1. This is comprised of \$173.0 million and \$236.6 million in direct and indirect benefits respectively. The incremental indirect costs of the MCCO Project are \$1.03 million.

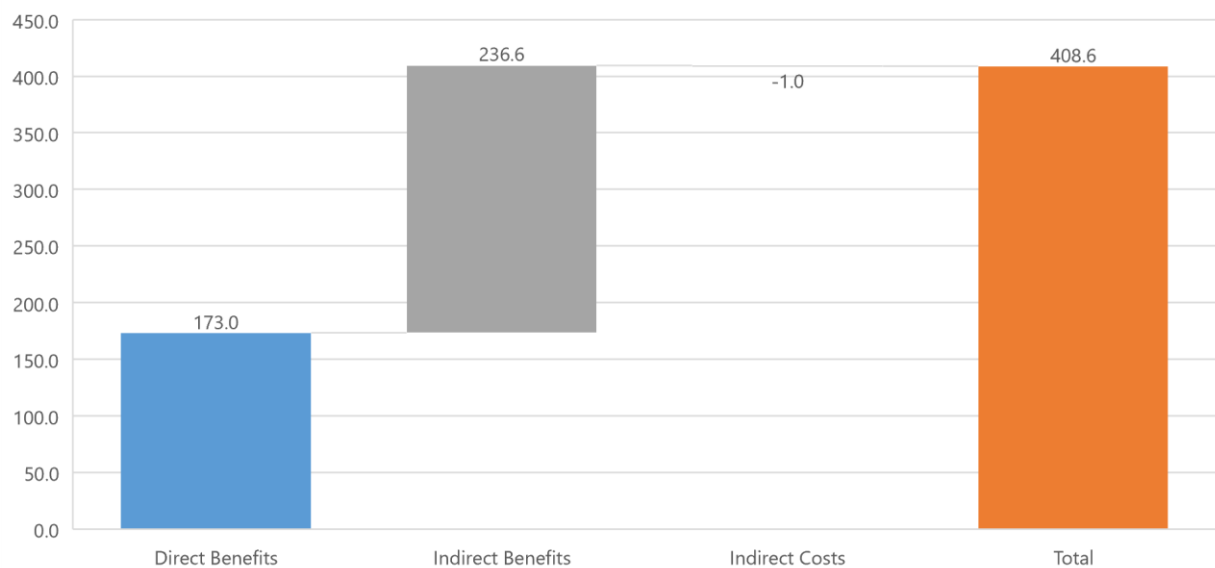
These estimates are based on central case assumptions in relation to the proposed \$171.7 million capital expenditure in NPV terms and average coal prices of \$70.2 (Australian dollars) per tonne and \$58.1 (Australian dollars) per tonne for low ash thermal and high ash thermal coal respectively. The coal price was included in the systematic sensitivity analysis outlined in the report.

The **direct benefits** of the MCCO Project are a function of its profitability which, in turn, depends on the prevailing coal price. The analysis shows that the combination of relatively low capital requirement, extraction and processing costs underpins the economic viability of the MCCO Project. As a result, the MCCO Project is predicted to generate:

- Total corporate taxes of \$135.9 million in NPV terms for Australia, of which \$43.5 million is attributed to NSW; and,
- \$129.5 million in other government revenue for NSW in NPV terms, the largest component of this being royalties of \$121.0 million with council rates and land taxes of \$2.7 million and net payroll taxes contributing \$5.9 million.

¹ Department of Planning and Environment (2018)

² All NPV figures reported are in 2018 Australian dollars based on a 7 per cent real discount rate (unless otherwise stated).

Figure 1: CBA summary of the MCCO Project under central case assumptions, (NPV*)

* Net Present Value in 2018 Australian dollars calculated over the period 2019 to 2030 using a 7 per cent real discount rate.

Source: Cadence Economics estimates based on the applicable Environmental Impact Statement findings and information provided by Mangoola.

The **indirect benefits** of the MCCO Project are related to the linkages that it will have to the NSW economy through both the labour market and suppliers. The analysis shows that of the \$236.6 million in estimated indirect benefits:

- Worker benefits are predicted to amount to \$107.6 million in NPV terms attributable to an average employment of additional 199 Full Time Equivalent (FTE) directly employed workers over the operating period of the MCCO Project, which peaks at an anticipated 303 FTE workers in 2027 (FTE in this assessment is the incremental increase of the MCCO Project over the existing Approved Mangoola Coal Mine operation and excludes contractors); and
- Supplier benefits are predicted to amount to \$129.0 million in NPV terms based on total supplier inputs over the life of the MCCO Project of \$639 million.

The **indirect costs** of the MCCO Project are related to the costs borne on the NSW community through the generation of externalities by the MCCO Project. These costs include:

- Greenhouse gas emissions costs of \$0.03 million;
- Loss of agricultural output of \$0.93 million; and,
- Travel time costs of \$0.067 million, for users of Wybong Post Office Road.

The report provides discussion of all the externalities, including those outlined above and those that are assessed qualitatively. The report also provides a discussion of the steps Mangoola is taking to reduce these externalities and the costs that are included in the costs of the MCCO Project.

Consistent with the Guidelines, systematic sensitivity analysis of the estimated net benefits is undertaken in this report. This sensitivity analysis shows that the estimated net benefits are **robust** in the sense that they remain (strongly) positive after testing all key assumptions underpinning the analysis.

In isolation, the estimated net benefit of the MCCO Project is most sensitive to the coal price assumptions underpinning the analysis, however even when assuming coal prices are 15 per cent lower than under the central case assumptions the net benefits are estimated at \$369.6 million in NPV terms.

The lower bound estimate of net benefits (or worst case), which takes the most pessimistic assumptions around coal prices, capital expenditure, operational expenditure as well as worker and supplier benefits, yields an estimated net benefit of \$350.6 million in NPV terms.

The upper bound estimate of net benefits, based on the most optimistic assumptions, is \$451.3 million in NPV terms. In isolation, assuming higher coal prices of 15 per cent, to those in the central case, the net benefits of the MCCO Project is \$448.4 million in NPV terms.

Two other points to note in the analysis are:

1. The results are relatively sensitive to the choice of discount rate chosen due to the timeframe of the MCCO Project, where many of the net benefits of the development occur beyond 2025. The NPV of the estimated net benefits range from between \$327.1 million and \$515.5 million under real discount rates of 10 and 4 per cent respectively.
2. The environmental externalities of the MCCO Project are relatively small in comparison to the direct and indirect benefits. The externalities generated by the MCCO Project are \$1.03 million from greenhouse gas apportioned to NSW, loss of agricultural output and the costs of travel times for the user of Wybong Post Office Road.

Results of the LEA

The LEA considers the costs and benefits of the MCCO Project on residents of the Upper Hunter region of NSW. The analysis shows an estimated net benefit of \$92.6 million to the region in NPV terms. This is made of:

- Benefits to local workers of \$76.8 million in NPV terms based on the assumption that 73 per cent of the mine's direct employees continue to be drawn from the Upper Hunter SA3 region;
- Benefits to local suppliers of \$14.1 million in NPV terms which is based on information from Mangoola that 9.2 per cent of the inputs to production are supplied from the region;
- The net incremental increase of local council rates totalling \$2.7 million in NPV terms; and,
- Environmental costs of \$1.0 million in NPV terms, slightly lower than the NSW cost, as greenhouse gas emission costs are allocated by resident population.

Again, the report shows that the estimated local effects are **robust** under the sensitivity analysis conducted with a lower bound estimate of net benefits of \$79.9 million and upper bound estimate of \$94.1 million in NPV terms.

Economy-wide modelling of the MCCO Project

In total the MCCO Project is projected to provide significant positive economy-wide impacts to both the Upper Hunter SA3 and to NSW. The net economic impacts of the MCCO Project are shown in Table 1. In the Upper Hunter region, the MCCO Project is projected to increase Gross Regional Product (GRP) by \$599.1 million in NPV terms. Gross Regional Income (GRI) or regional welfare, is projected to increase by \$427.8 million in NPV terms. The projected increase in GRI is significant to the relatively small Upper Hunter region. In total, the MCCO Project is projected to increase welfare for each person in the Upper Hunter by \$13,102 in NPV terms.

For NSW, the projected increase in Gross State Product (GSP) is \$686.4 million in NPV terms, Gross State Income (GSI) is projected to increase by \$744.9 million.

Table 1: Project economy-wide impacts of the Project, 2020 – 2030

Variable	Description	Upper Hunter	NSW Total
Real GRP/GSP [^]	NPV* - \$m	599.1	686.4
Real GRI/GSI [^]	NPV* - \$m	427.8	744.9
Employment	Average - FTE ^{^^}	69.7	75.2
Real Wages	Average – Per cent ^{^^}	1.31	0.007
Real GRI per person [^]	NPV* - Dollars	\$13,102	\$85

Source: Cadence Economics estimates based on information provided by Mangoola. [^] Real 2018 Australian dollars. * NPV in 2018 Australian dollars based on a 7 per cent real discount rate. ^{^^} Average over the period 2019 to 2030.

Total employment in the region is projected to increase by almost 70 FTE workers on average, lower than the average direct employment, taking into account any of the crowding out in other sectors of the economy. Across NSW, employment is projected to increase by just over 75 FTE.

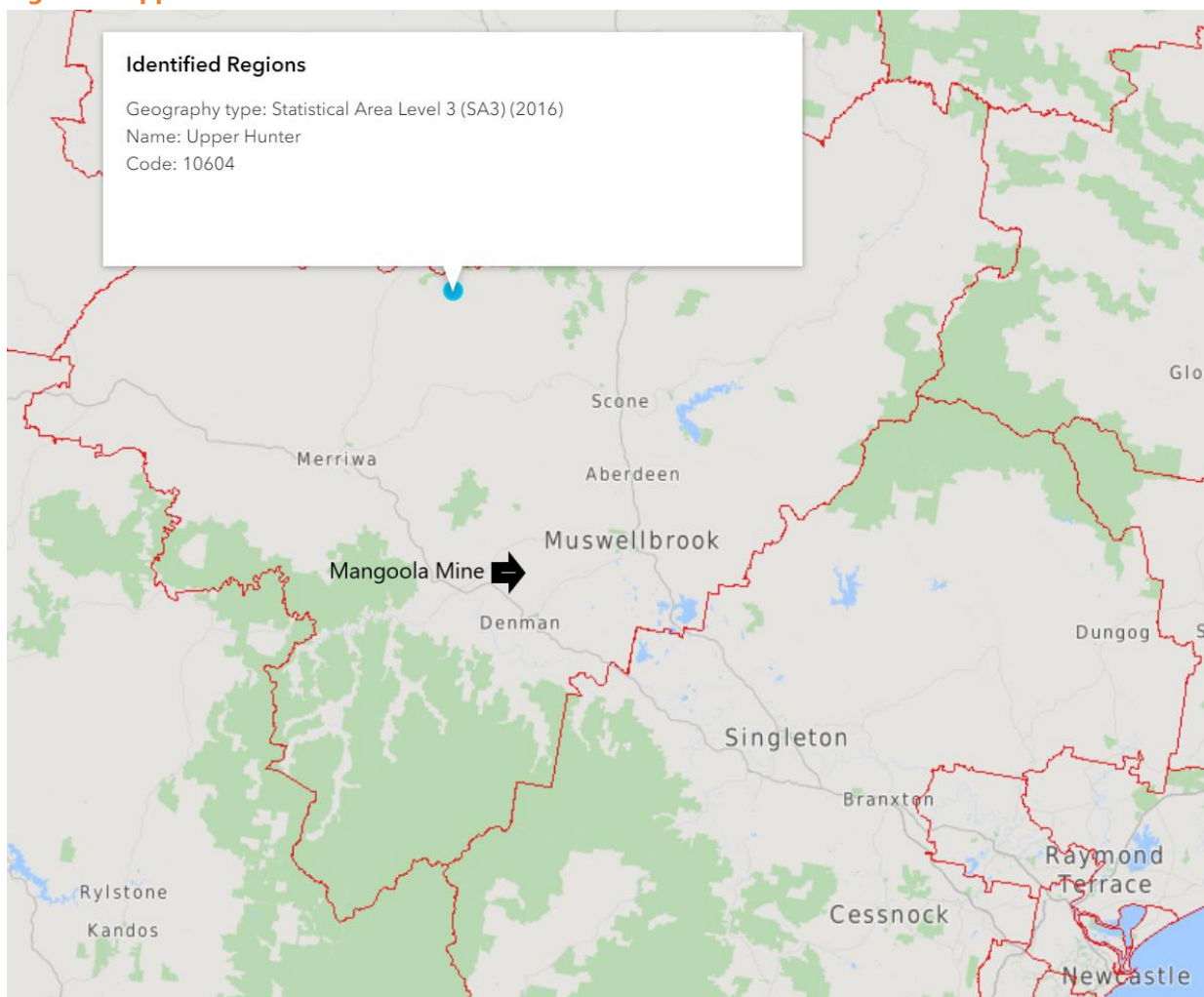
The relative size of the local region and the NSW economy-wide impacts is reflective of how each region are impacted by the MCCO Project. As outlined in Chapter 4 the CGE modelling takes into account the capital expenditure, the coal output, the migration of workers into the region and the payment of royalties from the Upper Hunter into the Rest of NSW and the repatriation of profits overseas.

1 Introduction

Cadence Economics has been engaged by Umwelt (Australia) Pty Ltd (Umwelt) on behalf of Mangoola Coal Operations Pty Limited (Mangoola) to undertake an Economic Impact Assessment (EIA) of the Mangoola Coal Continued Operations (MCCO) Project. Mangoola is a wholly-owned subsidiary of Glencore Coal Pty Limited (Glencore).

The purpose of the EIA is to form part of an Environmental Impact Statement (EIS) being prepared by Umwelt to accompany an application for development consent under Division 4.1 and 4.7 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the MCCO Project. The EIS is to be prepared in accordance with the Secretary's Environmental Assessment Requirements (SEARs) for State Significant Development (SSD) 8642.

Figure 2: Upper Hunter SA3



Source: Australian Bureau of Statistics, MapData Services, stat.abs.gov.au/itt/r.jsp?ABSMAPS

1.1 Description of the MCCO Project

Mangoola Coal Mine is an open cut coal mine located approximately 20 kilometres (km) west of Muswellbrook and 10 km north of Denman in the Upper Hunter Valley of NSW, see Figure 3. Mangoola Coal Operations Pty Limited (Mangoola) has operated the Mangoola Coal Mine in accordance with Project Approval (PA) 06_0014 since mining commenced at the site in September 2010.

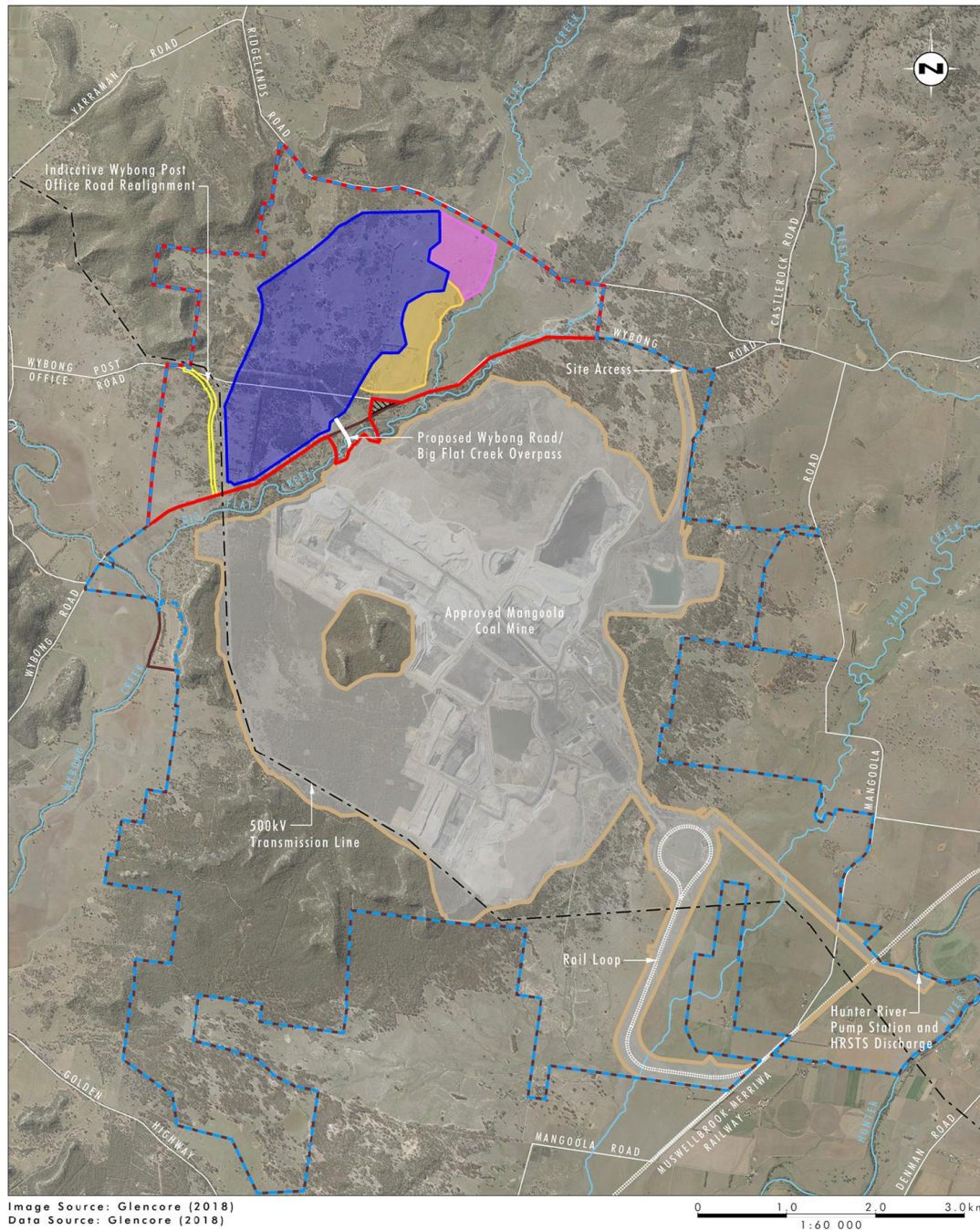
The Mangoola Coal Continued Operations Project (MCCO Project) will allow for the continuation of mining at Mangoola into a new mining area to the immediate north of the existing operations. The area where the continuation of mining will occur is termed here the MCCO Additional Project Area. The MCCO Project involves the mining of an additional 52 Mt of ROM coal and will utilise the existing infrastructure and equipment at Mangoola Coal Mine, and will extend the life of the existing operation providing for ongoing employment opportunities for the Mangoola workforce.

The MCCO Project generally comprises:

- open cut mining peaking at up to the same rate as that currently approved (13.5 Million tonnes per annum (Mtpa) of run of mine (ROM) coal) using truck and excavator mining methods;
- continued operations within the existing Mangoola Coal Mine;
- mining operations in a new mining area located north of the existing Mangoola Coal Mine, Wybong Road, south of Ridgeland Road and east of the 500 kV Electricity Transmission Line (ETL);
- construction of a haul road overpass over Big Flat Creek and Wybong Road to provide access from the existing mine to the proposed Additional Mining Area;
- establishment of an out-of-pit overburden emplacement area;
- distribution of overburden between the proposed Additional Mining Area and the existing mine in order to optimise the final landform design of the integrated operation;
- realignment of a portion of Wybong Post Office Road;
- the use of all existing or approved infrastructure and equipment for the Mangoola Coal Mine with some minor additions to the existing mobile equipment fleet;
- construction of a water management system to manage sediment laden water runoff, divert clean water catchment, provide flood protection from Big Flat Creek and provide for reticulation of mine water. The water management system will be connected to that of the existing mine;
- continued ability to discharge excess water in accordance with the Hunter River Salinity Trading Scheme (HRSTS);
- establishment of a final landform in line with current design standards at Mangoola Coal Mine including use of natural landform design principles consistent with the existing site;
- rehabilitation of the proposed Additional Mining Area using the same revegetation techniques as at the existing mine;
- a likely construction workforce of approximately 145 persons. No change to the existing approved operational workforce; and
- continued use of the mine access for the existing operational mine and access to/from Wybong Road, Wybong Post Office Road and Ridgeland Road to the MCCO Project Area for construction, emergency services, ongoing operational environmental monitoring and property maintenance.

Figure 3: Proposed Conceptual Mangoola Coal Continued Operations Project

umwelt

**Legend**

- MCCO Project Area
- Approved Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Proposed Additional Mining Area
- MCCO Proposed Employment Area
- MCCO Proposed Topsoil Stockpile Area
- Indicative Wybong Post Office Road Realignment
- Crown Land (TSR) Excluded from MCCO Project Area

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Source: Umwelt

FIGURE 1.2**Proposed Conceptual Mangoola Coal
Continued Operations Project**

1.2 Purpose of the Report

In preparing this economic impact assessment, the SEAR's issued for the MCCO Project (SSD 8642) on 15 February 2019 (replacing a previous version of the SEARs issued on 22 August 2017) have been addressed within this report. The key matters raised by the Secretary for consideration in the EIA are outlined in Table 2 along with a reference to where the requirements are addressed.

Table 2: The Secretary's Environmental Assessment Requirements - Economic

Requirement	Addressed
A detailed assessment of the likely economic impacts of the development, in accordance with the <i>Guidelines for the economic assessment of mining and coal seam gas proposals 2015</i> , paying particular attention to:	As outlined below this economic impact assessment has been prepared in accordance with the Guidelines and the Technical Notes.
The costs and benefits of the project; identifying whether the development as a whole would represent a net benefit to NSW, including consideration of fluctuation in commodity markets and exchange rates; and	The costs and benefits are addressed in Chapter 2 and 3. Including a detailed assessment of the direct and indirect benefits and indirect costs to NSW (see section 2.7) and the local area (3.2). A detailed sensitivity analysis is outlined in sections 2.8 for the CBA and 3.3 for the local effects analysis.
The demand for the provision of local infrastructure and services.	See section 2.6.1 the cost benefit analysis and the local effects analysis includes the costs associated Voluntary Planning Agreement between the project proponent and the local council (see section 2.4.3).

As required by the SEAR's this EIA is based on a cost benefit analysis (CBA) and local effects analysis (LEA) prepared under the framework established in the *Guidelines for the economic assessment of mining and coal seam gas proposals* (the Guidelines) released by the New South Wales (NSW) Government in December 2015.³ The CBA requires an assessment of the net benefits that accrue to the proponent, government, workers and suppliers of the MCCO Project.

In addition, the Guidelines require an estimate of the potential costs generated by the MCCO Project. These costs may include residual public infrastructure costs and environmental, social and transport-related costs. To estimate the environmental, social and transport-related costs, we have incorporated into our analysis the *Technical Notes supporting the guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals*.⁴

The CBA is presented in Chapter 2 and measures the net benefits of the MCCO Project to the NSW community. The LEA, which focusses on the benefits accruing to the region (the Upper Hunter Statistical Area, as defined by the Australian Bureau of Statistics), is presented in Chapter 3. In addition to the CBA and LEA, the report also contains an assessment of the economic impacts of the MCCO Project on the region based on computable general equilibrium (CGE) modelling. This modelling is presented in Chapter 4.

³ New South Wales Government (2015).

⁴ Department of Planning and Environment (2018)

The EIA has been subject to independent peer review by Emeritus Professor Jeff Bennett. Review comments and feedback have been addressed in this assessment. In summary, the peer review concluded that this assessment provides “a sound basis on which planning decisions can be made regarding the MCCO Project”. The peer review letter is included as Appendix C.

2 Cost-Benefit Analysis

The Guidelines released by the NSW Government in December 2015 set out the CBA framework to measure the net benefits to the NSW community. This approach has been adopted in the economic analysis outlined in this report. Table 3 provides a summary of how these net benefits are measured.

Table 3: Cost Benefit Analysis framework as defined in the Guidelines

Direct Benefits	Indirect Benefits	Indirect Costs
The net benefits that accrue to NSW from the direct operations of the proposed mine	The net benefits that are generated for parties that economically interact with the proposed mine	Social costs generated by the proposed mine, borne by the NSW community
Includes:	Includes:	Includes:
<ul style="list-style-type: none"> • Net producer surplus attributable to NSW • Royalties payable • Company tax attributable to NSW 	<ul style="list-style-type: none"> • Net economic benefits to landowners • Net economics benefits to NSW employees • Net economic benefits to NSW suppliers 	<ul style="list-style-type: none"> • Net environmental, social and transport-related costs • Net public infrastructure costs • Loss of surplus to other industries

Source: NSW Government (2015).

The framework set out in the Guidelines provides a cost benefit analysis framework to assess the net benefits to several beneficiaries.

The direct benefits are those that accrue to the proponent and payments made to government. The indirect benefits are those that accrue to economic agents that engage with the project proponent. These include employees, suppliers and land owners. The indirect costs are the costs borne by the community of NSW, through environmental and social impacts or public infrastructure costs.

The data inputs for the analysis presented in this report are derived primarily from:

- Financial and other information provided by Mangoola, which includes the MCCO Project physicals, ROM, coal, saleable coal by type and relative quality, costs and employment
- Assessment findings arising from other EIS studies prepared by Umwelt and various environmental technical consultants including the:
 - Greenhouse Gas and Energy Assessment (GHGEA) undertaken by Umwelt in the *Greenhouse Gas and Energy Assessment Mangoola Coal continued Operations Project (2019)*;
 - Agricultural Impact Statement (AIS) undertaken by Umwelt, as outlined in *Mangoola Continued Operations Project, Agricultural Impact Statement (2019)*;
 - Air Quality Impact Assessment (AQIA), by Jacobs, *Mangoola Coal Continued Operations Project, Air Quality Impact Assessment (2019)*
 - Aboriginal Cultural Heritage Assessment (ACHA) by Australian Cultural Heritage Management in the *Mangoola Coal Continued Operations Project Aboriginal Cultural Assessment (2019)*
 - Aboriginal Archaeology Impact Assessment (AAIA), by OzArk EHM, *Aboriginal Archaeology Impact Assessment Mangoola Coal Continued Operations Project, (2019)*

- Historical Heritage Assessment (HHA), by Umwelt outlined in *Mangoola Coal Continued Operations Project Historical Heritage Assessment Report* (2019)
- Noise Impact Assessment (NIA), by Global Acoustics, *Mangoola Continued Operations Project Noise Impact Assessment* (2019).
- Traffic and Transport Impact Assessment (TTIA), by GHD, *Mangoola Coal continued Operations Project traffic and Transport Report* (2019).
- Social Impact Assessment (SIA) by Umwelt outlined in *Mangoola Coal Continued Operations Project Social Impact Assessment Report* (2019)
- Biodiversity Assessment Report (BAR) by Umwelt outlined in *Mangoola Coal Continued Operations Project Biodiversity Assessment Report* (2019)
- Groundwater Impact Assessment (GWIA) by AGE outlined in *Mangoola Coal Continued Operations Project Groundwater Impact Assessment Report* (2019)
- Surface Water Impact Assessment (SWIA) by HEC outlined in *Mangoola Coal Continued Operations Project Surface Water Assessment Report* (2019)
- Visual Impact Assessment as outlined in the EIS
- *Energy & Metals Consensus Forecast*, March 2019, Consensus Economics
- *Resources and Energy Quarterly* (June 2018), Office of Chief Economics, Department of Industry, innovation and Science
- Various data from the Australian Bureau of Statistics (ABS) including most recent Census data

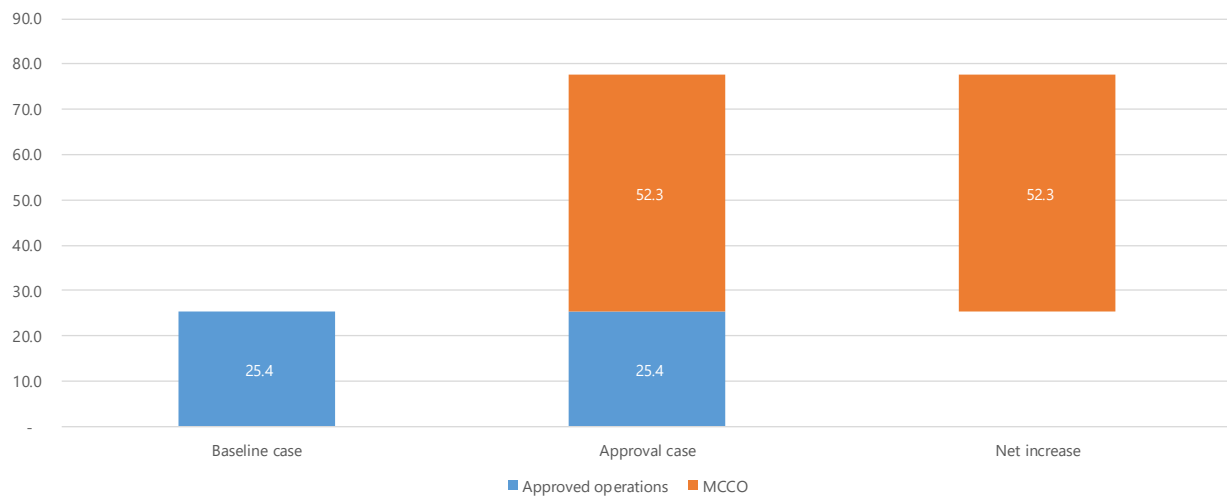
The information underpinning this assessment therefore is a combination of publicly available information and commissioned expert studies assessing the MCCO Project financials and environmental impacts. Cadence Economics has not verified the information in the studies provided as they have been prepared by relevant experts in the field. Where there is uncertainty around key assumptions, such as the coal price, sensitivity analysis has been conducted to test the robustness of the assessment to these key inputs.

A major emphasis of the Guidelines is on transparency of assumptions made. The remainder of this section describes in detail the assumptions underpinning the CBA.

2.1 Approved operations, MCCO Project and net output

To evaluate the net benefits of the MCCO Project, the economic analysis needs to consider the counterfactual or baseline operations. In this case the counterfactual is the existing operations of the currently approved Mangoola Coal Mine in the absence of any new approval. This baseline activity will generate potential costs and benefits and should be excluded from the analysis. Mangoola has provided Cadence Economics with financial and other relevant MCCO Project information for two modelling scenarios. summarised in Figure 4.

As shown on Figure 4 the baseline ROM coal output of 25.4Mt is the estimated remaining coal that is currently approved to be mined under the existing project approval and during the assessment period relating to this EIA. Should the MCCO Project not be approved this coal would likely be exhausted by 2025. Should the MCCO Project be approved this coal would likely be exhausted in 2026, due to the integration of the mining schedule with the MCCO Project Additional Mining Area.

Figure 4: The MCCO Project, Baseline and Approval case, total ROM coal output (Mt)

Source: Mangoola

2.2 MCCO – central case assumptions

The following analysis sets out the financial assumptions underpinning the MCCO Project, including the capital expenditure, the output and price assumptions and the operating cost assumptions, including labour input costs and intermediate inputs. These assumptions are used to estimate the direct and indirect benefits to NSW, and also form the basis of the LEA presented later in the report.

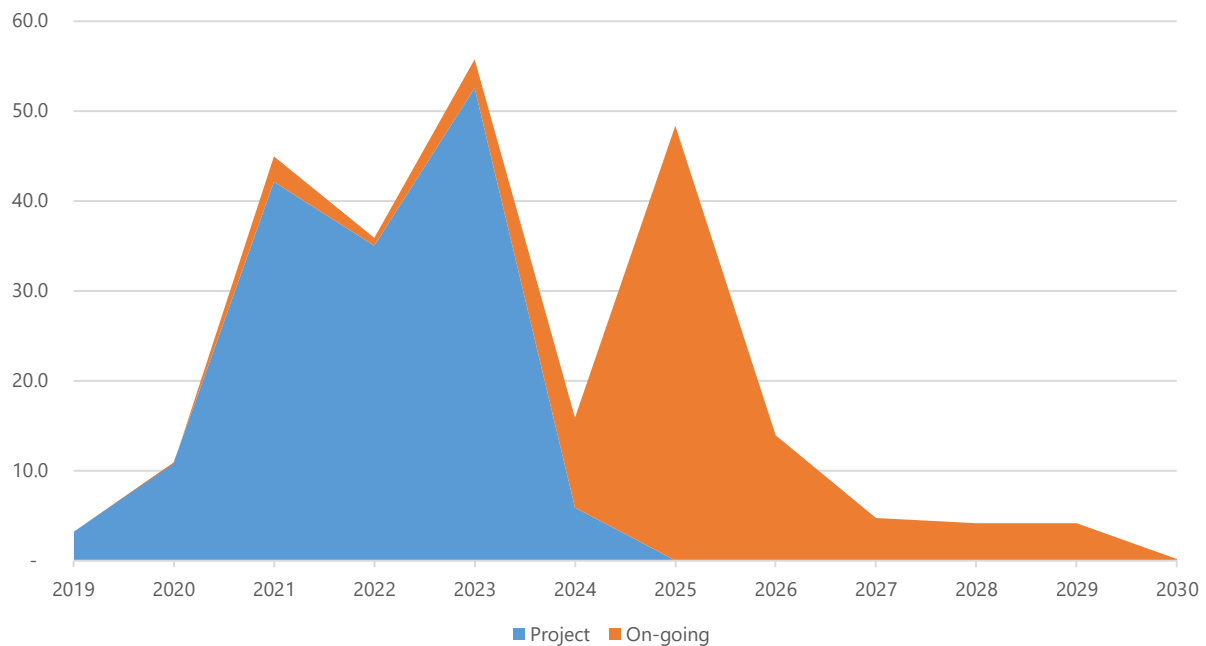
2.2.1 Capital costs

Mangoola provided Cadence Economics with the capital expenditure profile of both the Baseline and Approval case. In net terms, the MCCO Project will generate \$171.7 million (in NPV terms) of capital expenditure over the period 2019 to 2030, or \$241.8 million undiscounted. Figure 5, provides a summary of capital expenditure, categorised into project capital and on-going capital.

The MCCO Project requires additional Project capital of \$115.0 million (in NPV terms) which includes funds for the major works required to develop the MCCO Additional Project Area. The MCCO Project major works include:

- the realignment of a portion of Wybong Post Office road;
- the overpass of Wybong Road and Big Flat Creek to enable direct connectivity to existing operations;
- the relocation of 11kV power lines;
- construction of a water management system to manage sediment laden water runoff, divert clean water catchment, provide flood protection from Big Flat Creek and provide for reticulation of mine water.

The MCCO Project will also have on-going capital expenditure of \$56.7 million (in NPV terms) to maintain operations.

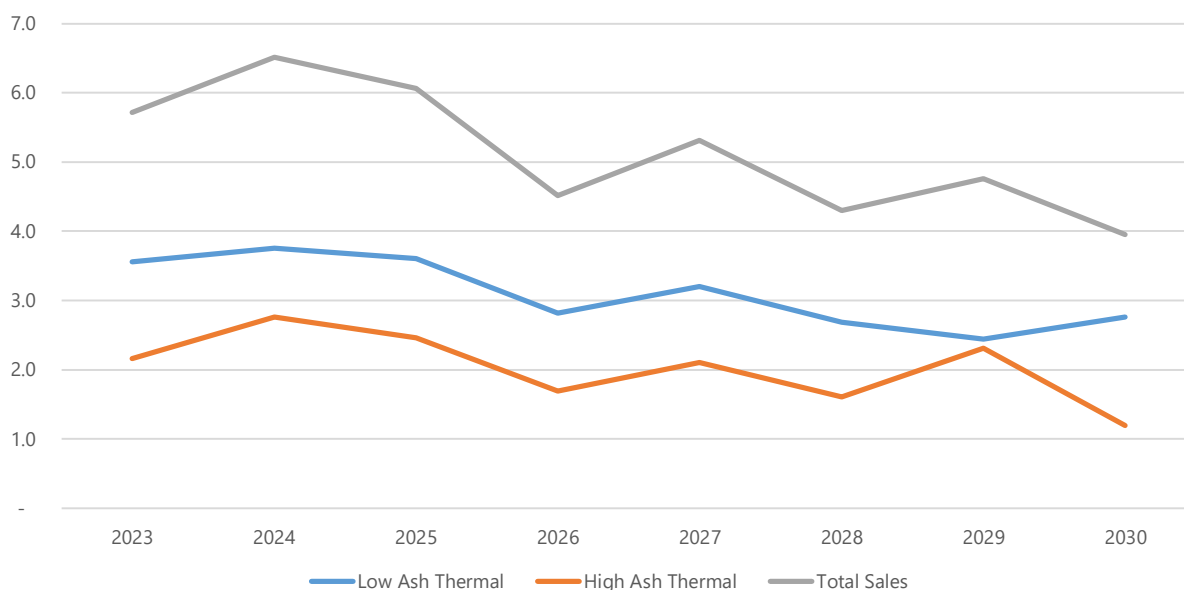
Figure 5: MCCO Project - Capital expenditure, Project and On-going (2018 dollars)

Source: Data provided by Mangoola

2.2.2 Production assumptions

In net terms the MCCO Project will generate 52.3 Mt of additional ROM coal, based on information provided by Mangoola the output is predicted to generate a total of 41.1 Mt of saleable coal. Most of the additional sales, 24.8 Mt is of low ash thermal coal, where the remaining, 16.3 Mt is of high ash thermal coal.

Figure 6 outlines the level of additional saleable coal output predicted for each year of the MCCO Project, 2023 to 2030. As outlined above the Mangoola mine will continue to mine up to 13.5 Mtpa of ROM coal. The production in the figure below, is the year-on-year output from the MCCO Project minus the Baseline approval.

Figure 6: Key production figures under the MCCO Project (Mt)

Source: Data provided by Mangoola

Table 30 in Appendix A has a detailed description of the Baseline case and the Approval case, providing more detail of the year-on-year ROM coal output, low ash thermal and high ash thermal.

2.2.3 Price assumptions

Mangoola did not provide Cadence Economics with its internal price forecasts for high ash thermal coal and low ash thermal coal (due to the commercial sensitivity of this information). Mangoola did provide a year-on-year estimate of coal quality, as measured by ash content and calorific content. The relative coal quality was used along with information from Consensus Economics and the Office to Chief Economist to estimate the coal price assumptions.

Consensus Economics (March 2019) publish a thermal price forecast in nominal US dollars out to 2028. The nominal US dollar thermal coal price forecast is converted to real 2018 Australian dollars. The conversion is completed using the exchange rate and inflation rate forecasts from *Resources and Energy Quarterly* (June 2018) produced by the Office of the Chief Economist Department of Innovation and Science Resources and Energy. The *Resources and Energy Quarterly* (June 2018) publication forecasts exchange rates and inflation out to 2023. Beyond 2023, we assume both exchange rates and inflation remains at the 2023 Department of Industry forecast.

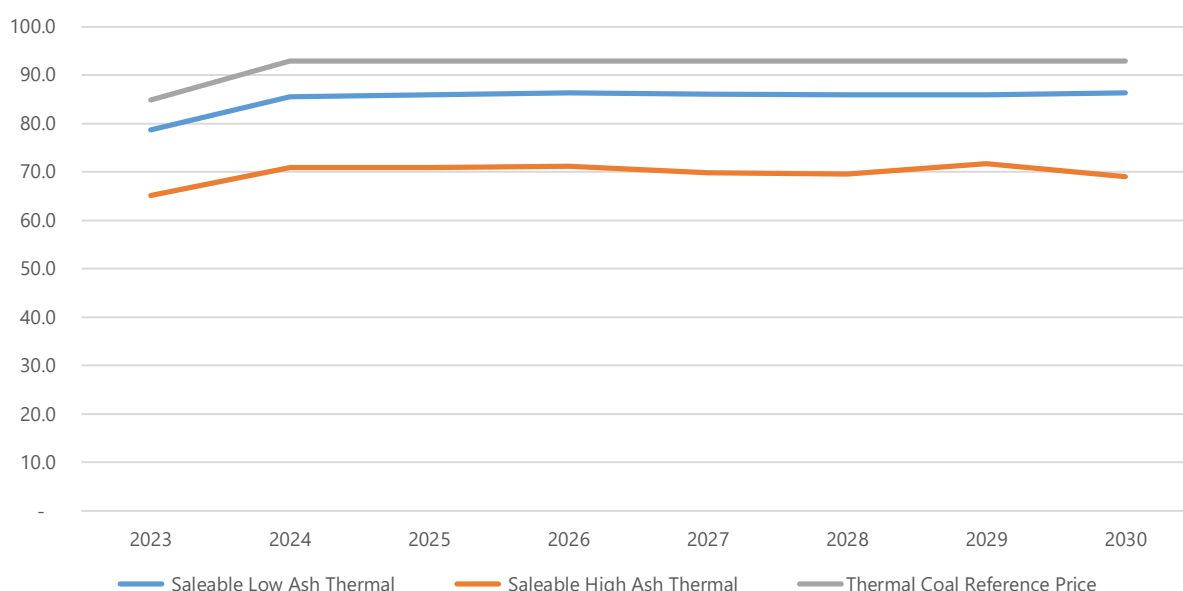
Over the life of the MCCO Project, the modelling assumes an exchange rate of \$0.79 US dollars per Australian dollar and an inflation rate of 2.4 per cent.

The reference price assumptions are based on two sales assumptions, including a calorific content of 6,300 kilocalories (kcal), gross as received (GAR), free-on-board (FOB) Newcastle and an additional market-based reduction for high ash coal of 21%.

Regarding the calorific content, the coal extracted and processed at Mangoola is of a relatively high ash content and low calorific content. Mangoola markets two classes of coal, a low ash and a high ash thermal coal. Both have a lower calorific content to the thermal coal reference price, and as a result the revenue price assumptions are reduced in proportion to the lower calorific content, as outlined in in Figure 7. In summary:

- The Thermal coal reference price, ranges from AUD \$84.9 per tonne in 2023 and \$92.9 over the period 2024 to 2030.
- The Mangoola saleable low ash thermal coal has an average calorific content of 5,800 kcal, the average FOB sales price of this coal is AUD \$70.2 per tonne, or 24% below the reference price.
- The Mangoola saleable high ash thermal coal, the average FOB sales price of this coal is AUD \$58.1 per tonne, or 37% below the reference price.

Figure 7: Thermal Coal Consensus Reference, Mangoola output prices, real 2018 Australian dollars



Source: Cadence Economics estimates

It is assumed that all coal produced by Mangoola is sold at the FOB price of \$70.2 per tonne (low ash) and \$58.1 per tonne (high ash). For the Baseline or Approval case, the assumption is that all coal is sold at the same equivalent FOB price regardless of whether the sale is domestic supply or export. Thus not impacting the net benefits of the MCCO Project.

2.3 Projected revenue and MCCO Project financials

Based on the production assumptions outlined in Figure 6 and the real price assumptions in Figure 7, the MCCO Project is expected to generate real revenue of just over \$2,688.9 million over the eight years in undiscounted 2018 Australian dollars. This equates to \$1,558.8 million real revenue in NPV terms based on a 7 per cent real discount rate as shown in Table 4. In the context of this analysis, these are deemed to be MCCO Project **central case assumptions**, and subject to sensitivity analysis.

Table 4: Central case assumptions – coal production, real prices[^] and total revenue

	Total	2023	2024	2026	2030
Production (Mt)					
Low ash thermal		3.6	3.8	2.8	2.8
High ash thermal		2.2	2.8	1.7	1.2
Real price (2018 Australian dollars)					
Low ash thermal		64.9	70.6	71.2	71.3
High ash thermal		54.2	59.1	59.3	57.6
Total Sales Revenue	2,688.9	348.1	427.9	301.2	265.2
Total Sales Revenue - NPV	1,558.8				

Source: Cadence Economics estimates [^] Real prices in 2018 Australian dollars. * NPV in 2018 Australian dollars based on a 7 per cent real discount rate.

Based on information provided by Mangoola, the operating costs of the MCCO Project are summarised in Table 5. Total costs are, \$1,170.3 in NPV terms, which includes operating costs of \$994.7 million in NPV terms. These operating costs include the cost of extraction, processing and transportation of coal. In addition, the operating costs include the anticipated property acquisition costs of mitigating against the potential social impacts and noise costs of the MCCO Project. These costs are included in the costs as they are subject to commercial negotiation and are confidential.

In terms of other costs:

- Depreciation is calculated using the straight line method, assuming ten year asset life (which is consistent with the Mangoola treatment).
- Royalties are based on standard NSW Government royalty rates of 8.2 per cent *ad valorem* for open cut mines. A discount of \$3.50 per ROM tonne is applied for washing as is allowed by the NSW Government.
- The other costs including council rates and offset costs as provided by Mangoola.

The MCCO Project has several identified costs where approval will delay costs, resulting in a reduction of costs in NPV terms. For example, decommissioning and closure costs are \$8.8 million lower under the Approval case to the Baseline case, as these costs are delayed. This is because the decommissioning costs that would be incurred in 2026 and 2027 under the Baseline case are delayed to 2031 and 2032. This is also the case with other shut-down costs, which are \$1.8 million lower.

Based on this data, the MCCO Project is estimated to generate \$419.7 million in profit in NPV terms. These are deemed to be the MCCO Project **central case assumptions**, and subject to sensitivity analysis. Table 31, in Appendix A also provides an account of all the revenue and costs of the MCCO Project.

Table 5: Central case assumptions – project financials (\$ million[^])

	NPV	Total	2023	2024	2026	2030
Total Sales	1,558.8	2,688.9	348.1	427.9	301.2	265.2
Asset Sales Revenue	31.2	70.3				70.3
Total Revenue	1,590.0	2,759.2	348.1	427.9	301.2	335.4
Operating costs	944.7	1,653.5	209.5	232.7	188.4	183.9
Decommissioning and closure costs	-8.8	7.7			-36.4	-
Rehabilitation	12.8	24.7	0.1	0.5	5.1	4.9
Other shut-down costs	-1.8	3.0	-1.7	-1.8	-6.2	8.4
Depreciation	95.5	171.6	15.0	16.6	22.9	24.2
Royalties	121.0	208.7	26.9	33.2	23.4	20.6
Biodiversity Offsets	1.7	2.4	2.2	-	-	-
Council Rates	2.8	5.5	-	-	1.1	1.1
Other Government payments/ incl. VPA	2.5	4.8	-	-	1.0	1.0
Total Costs	1,170.3	2,081.8	252.1	281.2	199.3	244.1
Profit	419.7	677.4	96.0	146.7	102.0	91.4

Source: Cadence Economics estimates based on information provided by Mangoola. [^] Real 2018 Australian dollars. ^{^^} Includes intermediate inputs and labour costs, * NPV in 2018 Australian dollars based on a 7 percent real discount rate.

2.4 Direct Benefits

Based on the Guidelines, the direct benefits to NSW of the MCCO Project are derived from three sources:

- The net producer surplus generated by the MCCO Project that is attributable to NSW (estimated using cash outlays and revenues).
- The share of company tax payments that are attributable to NSW.
- Other tax payments such as royalties and payroll tax that are paid to the NSW and local government.

Each of these direct benefits are dealt with below.

2.4.1 Net producer surplus attributable to NSW

Consistent with the Guidelines, the net producer surplus of the MCCO Project represent the private benefit, or operating surplus, generated that is attributable to NSW.

Based on the financial information outlined above, the MCCO Project is estimated to generate an operating surplus of \$343.6 million in NPV terms (estimated using cash earnings and cost). Out of this surplus, \$135.9 million in NPV terms is payable in the form of corporate taxes, leaving a net producer surplus of \$207.7 million in NPV terms.

In this case, the net producer surplus that is attributable to NSW is assumed to be zero, see Table 6. This is because Mangoola is 100 per cent owned by Glencore Coal Pty Ltd which is a subsidiary of Glencore PLC, which is a foreign company (listed on the London, Hong Kong and South African exchanges). While it is possible that NSW residents have some ownership of these shares, it is not possible to ascertain the level of this ownership (which is, in all likelihood, relatively small).

Table 6: Central case - estimate of net producer surplus attributable to NSW (\$ million[^])

Key data	NPV*
Total cash revenue	1,590.0
Total cash costs	1,246.4
Operating surplus	343.6
Company tax ^{^^}	135.9
Net Producer Surplus	207.7
NSW share of Project ownership	0%
Value of net producer surplus attributable to NSW	-

Source: Cadence Economics estimates based on information provided by Mangoola. [^] Real 2018 Australian dollars. ^{^^} Based on a 30 per cent company tax rate. * NPV in 2018 Australian dollars based on a 7 per cent real discount rate.

2.4.2 Company tax attributable to NSW

Consistent with the Guidelines, the company tax payments made to the Australian Government are levied on the profits generated for the MCCO Project as summarised in Table 7. A company tax rate of 30% is used to estimate the tax payments made to the Australian Government under the assumption that all the profit generated by the mine is subject to company tax in Australia (for example, ignoring financing costs).

Consistent with the Guidelines, company tax is attributable to NSW is based on the State's share of the national population, which is 32 per cent.

As summarised in Table 7, it is estimated the MCCO Project will generate \$419.7 million in total profit in NPV terms over the period 2019 to 2030. At a company tax rate of 30 percent, the company tax estimate is \$135.9 million in NPV terms, of which \$43.5 million is attributable to NSW.

Table 7: Central case - company income tax attributable to NSW (\$ million[^])

Company tax attributable to NSW	NPV*
Total profit	419.7
Company tax ^{^^}	135.9
NSW Share ^{^^^}	43.5

Source: Cadence Economics estimates based on information provided by Mangoola. [^] Real 2018 Australian dollars. ^{^^} Based on a 30 per cent company tax rate. ^{^^^} Based on a 32 per cent population share. * NPV in 2018 Australian dollars based on a 7 per cent real discount rate.

2.4.3 Payments to the State and the local Council

Under the MCCO Project, various payments will be made to the NSW Government and the Muswellbrook Shire Council to extract and process coal in the State.

These are made up of three types of payments: coal mining royalties and payroll tax paid to the NSW Government and council rates paid to the Muswellbrook Shire Council. The following factors have been taken into account:

- Royalties are based on standard NSW Government royalty rates of 8.2 per cent *ad valorem* for open cut mines. A discount of \$3.50 per ROM tonne is applied for washing as is allowed by the NSW Government.

- The payroll taxes are based on the net increase in payroll taxes above the baseline or no-approval case.
- The council rates are estimated as the net increase in payments from the current agriculture use.

Over the life of the MCCO Project, a total of \$129.5 million in payments are made, in NPV terms, see Table 8. This is made up of \$121.0 million of royalty payments and \$5.9 million in net payroll tax. A further \$2.7 million is paid in the form of council rates.

Table 8: Central case - total payments to State government and local Council (\$ million[^])

Corporations tax paid to NSW	NPV*
Coal sales revenue	1,558.8
Revenue for royalties (including allowable discounts)	1,475.1
Total Royalties paid	121.0
Payroll tax	5.9
Net council rates and land tax	2.7
Total Payments	129.5

Source: Cadence Economics estimates based on information provided by Mangoola. [^] Real 2018 Australian dollars. * NPV in 2018 Australian dollars based on a 7 per cent real discount rate.

Referencing the existing voluntary planning agreement (VPA) with Muswellbrook Shire Council, the Project will also generate further VPA payments of \$2.5 million in NPV terms. These payments are made by Mangoola to the Muswellbrook Shire Council to manage and mitigate against potential costs to Council-maintained infrastructure like roads. As a result, the VPA is excluded from the benefits analysis above.

2.4.4 Summary of direct benefits to NSW

Based on the central case assumptions, revenue and cost data described above, the MCCO Project is estimated to generate \$173.0 million in total direct Benefits to NSW in NPV terms, as outlined in Table 9.

These benefits are comprised of \$43.5 million in company tax attributable to NSW and \$129.5 million in NPV terms paid to the State government and Muswellbrook Shire Council, in the form of coal royalties, payroll tax, council rates and land taxes.

Table 9: Central case - summary of the direct benefits of the Project (\$ million[^])

Net financial benefit	NPV*
Net producer surplus attributable to NSW	-
Company income tax attributable to NSW	43.5
Payments to the NSW and local Government	129.5
Total financial benefit attributable to NSW	173.0

Source: Cadence Economics estimates based on information provided by Mangoola. [^] Real 2018 Australian dollars. * NPV in 2018 Australian dollars based on a 7 per cent real discount rate.

2.5 Indirect Benefits to NSW

Based on the Guidelines, the indirect benefits to NSW of the MCCO Project are derived from three sources:

- The net economic benefit to workers in NSW.
- The net economic benefit to suppliers in NSW.
- Any land owner premiums attributable to the project.

2.5.1 Benefit to workers

Consistent with the Guidelines, a key factor in determining the benefit to NSW-based workers are defined as the:

- Wages earned in the mine.
- Minus the opportunity cost of labour for working in the mining sector, that is compared to working in non-mining sectors (or being unemployed).
- Minus the wage difference due to skills and the disutility to work in the mining industry.

Mangoola provided Cadence Economics with the Full-time equivalent employment under both the Baseline and Approval case, as well as the average wages paid per employee. Over the period of the MCCO Project, 2023 to 2030, an average of 199 FTE additional workers will be employed, for the MCCO Project which peaks at 303 FTE additional workers in 2027 (Table 10). The table includes the average wages paid and the **total of wages paid** to employees is estimated at \$166.1 million in NPV terms.

Table 10: Central case – total wages paid to those employed under the MCCO Project

Employees	NPV*	2022	2024	2027	2030
Employment (FTEs)**		135.9	188.3	303.3	136.7
Average wage (\$ per annum^)		180,342	189,680	192,293	195,842
Total wages paid (\$ million^)	166.1	24.5	35.7	58.3	26.8

Source: Mangoola, ^ Real 2018 Australian dollars. * NPV in 2018 Australian dollars based on a 7 per cent real discount rate.

** FTE in this assessment is the incremental increase of the MCCO Project over the existing Approved Mangoola Coal Mine operation and excludes contractors

Mangoola has advised that 99.7 per cent of current employees are located in NSW, we have assumed the MCCO Project employs NSW residents in the same proportion as the current operations.

To measure the **opportunity cost** compared to the non-mining sector, the wages earned by NSW-based Mangoola workers was compared to the average wage paid on average in NSW. This implies that should the approval not go ahead, those who would have been employed by Mangoola would find alternative work at the average wage paid in NSW. The average wage across NSW is \$66,401 per annum based on the 2016 Census data (updated to 2018 dollars).

Assuming no disutility of working in mining, this results in an estimated worker benefit of \$107.6 million, in NPV terms, over the life of the MCCO Project, as shown in Table 11.

Table 11: Central case – estimated worker benefit – NSW-based MCCO Project workers

Employees	NPV*	2022	2024	2027	2030
Average wage (\$ per annum^)	-	66,401	66,401	66,401	66,401
Mining wage (\$ per annum^)	-	180,342	189,680	192,293	195,842
Total wages based on average wage (\$ million^)	58.0	9.0	12.5	20.1	9.0
Total mining wages paid (\$ million^)	165.6	24.4	35.6	58.1	26.7
Estimated worker benefit (\$ million^)	107.6	15.4	23.1	38.1	17.6

Source: Mangoola, ABS Census (2016) Occupational Total Personal Income (Weekly) by Hours Worked, and Cadence Economics estimates. ^ Real 2018 Australian dollars. * NPV in 2018 Australian dollars based on a 7 per cent real discount rate.

As shown above, there is a significant premium incorporated in mining wages compared with the average wage paid in NSW and the local region. There are a number of likely reasons for this premium that might be explained by relative skill and productivity levels. In relation to the latter, mining employees are more productive than workers in other industries as they operate with higher levels of capital (for example, based on capital stock figures produced by the ABS, miners work with over 10 times the amount of capital than average employees across Australia).

Any metrics around the disutility of working in mining are very difficult to ascertain in both an absolute (mining specific) or relative (compared with other industries) way. One source of information considered in this analysis was any documented 'hardship' allowances recognised in mining awards. However, these allowances appear to be relatively minor. For example, the Black Coal Mining Industry Award 2010 does provide for the payment of an Underground allowance (Electrical/Mechanical) of 0.23% per day or shift (above the standard rate/reimbursement) to an adult employee who works underground on any shift. In addition, there is a Confined space allowance of 0.08% and a Dirty work allowance of 0.23%, that may apply to underground workers. To put this into context, First Aid Officer Allowance is 0.76% per day or shift above the standard rate.

In addition, a further consideration is whether workers would experience more or less disutility being employed by Mangoola compared with any alternate employment. In this context, as the assumption is made that any worker employed in the MCCO Project would find alternative employment if the project did not go ahead it is the relative disutility of mine work versus non-mine work that is a key consideration. Given the minor allowances for working in coal mines and the measurement difficulties associated with measuring these disutilities generally, we have assumed the disutility for workers under the MCCO Project case is zero. This implies, effectively, that those workers employed by the MCCO Project experience no additional disutility from working in the mine compared with any alternative employment they would have secured in the absence of the project.

In addition, we have conservatively assumed that MCCO Project workers can find alternative employment, and will not experience periods of unemployment, lowering the reservation wage.

2.5.2 Benefit to suppliers

Consistent with the Guidelines, the economic benefit to suppliers is estimated as a producer surplus generated from goods and services provided from NSW firms to the MCCO Project. As summarised in Table 12, based on the input cost data provided by Mangoola, the MCCO Project is estimated to require \$757.2 million (in NPV terms) in intermediate inputs over its life-cycle in NPV terms. These are the costs

to suppliers only and does not include any labour costs or costs of land or dwelling acquisition or remediation. Mangoola has advised that currently, almost 84.4 per cent of the inputs to the mine are sourced from NSW-based suppliers, or \$639.1 million (in NPV terms) over the life of the MCCO Project.

The estimated economic benefit to suppliers (producer surplus) is based on the Cadence Economics Regional Input-Output Model (CERIOM). This model was customised to generate a NSW-specific Input-Output table so as to not include benefits generated in other Australian states.

The producer surplus estimates are based on Type I multipliers which limit the benefit to direct value added generated by NSW suppliers. This methodology does not account for second round, nor induced consumption effects that are captured within the CGE modelling. Using this relatively conservative technique, the total supplier benefits are estimated to be \$129.0 million in NPV terms.

Table 12: Central case – estimated supplier benefits

Indirect benefits –suppliers	NPV*
Total intermediate inputs (\$ million^)	757.2
Share from NSW (per cent)	84.4
Total intermediate inputs (\$ million^)	639.1
Gross operating surplus ratio	0.202
Total benefits to suppliers (NPV*)	129.0

Source: Cadence Economics estimates based on information provided by Mangoola. ^ Real 2018 Australian dollars. * NPV in 2018 Australian dollars based on a 7 per cent real discount rate.

2.5.3 Summary of indirect benefits to NSW

Consistent with the Guidelines, the indirect benefits of the MCCO Project that are predicted to accrue to workers, suppliers and land owners are summarised in Table 13. The total indirect benefits are estimated to be \$236.6 million in NPV terms. The main source of these benefits is the \$129.0 million in benefits to suppliers and \$107.6 million in benefits to employees in NPV terms. There are no anticipated benefits to land owners as a result of the MCCO Project.

Table 13: Summary of indirect benefits (\$ million^)

Indirect benefits	NPV*
Net economic benefit to workers	107.6
Net economic benefit to suppliers	129.0
Land owner premiums (land sales made above market rates)	N/A
Total indirect benefit	236.6

Source: Cadence Economics estimates based on information provided by Mangoola. ^ Real 2018 Australian dollars. * NPV in 2018 Australian dollars based on a 7 per cent real discount rate.

2.6 Indirect Costs to NSW

Consistent with the Guidelines, the indirect costs of the MCCO Project are classified as:

- Net public infrastructure costs,
- Estimated loss of surplus to other industries,
- Net environmental, social and transport-related costs,
- Net environmental costs.

2.6.1 Net public infrastructure costs

Based on information provided by Mangoola, there are no anticipated impacts to any off-site infrastructure, except for those accounted for in the form of the continued VPA (to be agreed with Muswellbrook Shire Council). As outlined above there are a number of infrastructure upgrades required to develop the MCCO Additional Project Area, including the realignment of Wybong Post Office road and the overpass of Wybong Road and Big Flat Creek to enable direct connectivity to existing operations.

In addition, 11kV electricity transmission lines will require realignment or termination and in-ground Telstra lines will require realignment or termination, as they are within the MCCO Additional Project Area. These measures are funded by Mangoola and are currently included in the capital costs, there are no additional or residual public infrastructure costs anticipated as a result of approval of the MCCO Project.

2.6.2 Loss of surplus to other industries

To assess the potential losses to agriculture from soil disturbance and the reduction in land available, an Agricultural Impact Statement (AIS) was prepared by Umwelt. The AIS includes an assessment of the direct losses to agriculture land use within the MCCO Additional Project Area and the proposed biodiversity areas.

The AIS outlines that, a majority of the MCCO Additional Project Area is currently suited for low intensity agricultural production, namely beef cattle grazing. In the Hunter region, weaner production is most common, while vealer production is supported in the more productive grazing sites.⁵

Within the MCCO Additional Project Area, the AIS states, that agriculture will be permanently lost to this area. Within the biodiversity offset area, again, land will be permanently lost to agriculture use.

In total, the AIS estimates that there is a permanent loss of land to agricultural output, as a result of the MCCO Project, see Table 14. Based on the current production levels on each of the sites, this is a loss of 560 breeders.

Table 14: Agricultural output loss attributable to the MCCO Project

	Breeders	Sales unit per breeder	Head of output
MCCO Additional Project Area	350	1.0	350
Biodiversity Offset Sites			-
<i>Mangoola offset area</i>	150	1.0	150
<i>Wybong Heights</i>	60	1.0	60
Total	560		560

Source: Umwelt, *Mangoola Coal Continued Operations Project, Agricultural Impact Statement* (2019).

Based on the assumption of one sales unit per breeder, that the loss of these breeders will result in a reduction of 560 head of output per year.

⁵ NSW Department of Primary Industries (2006)

Meat & Livestock Australia sales data indicates that the sales price of a small vealer, a useful proxy for weaners, is \$2.97 per live weight kilo, or \$534.8 per head, assuming an average of 180 live weight kilos per head, see Table 15.

Table 15: Price of unit of output

Stock	Per live weight kilo [^] (dollars*)	Per head ^{^^} , (dollars*)
0-200 kg Vealer heifer	2.72	489.9
0-200 kg Vealer steer	3.22	579.8
Average sales price	2.97	534.8

Source: Umwelt, Mangoola Coal Continued Operations Project, Agricultural Impact Statement (2019).

[^] Meat & Livestock Australia (2019), average sales price July 2016 to 2019 for vealer steers and heifers in Singleton 0-200 kg

^{^^} 180 live weight kilos per head average sales weight.

* Real 2018 Australian dollars

In total the annual loss sales of veal output, as a result of the MCCO Project, is \$0.30 million, see Table 16. The total loss of gross operating surplus is \$0.09 million based on a gross operating surplus ratio of 0.31

Table 16: Agricultural output loss attributable to the MCCO Project

Stock	Loss per annum
Annual production unit loss (Head of veal)	560
Average sales price (dollars)	534.8
Annual agricultural revenue loss (\$ million)	\$0.30
Gross operating surplus ratio*	0.31
Annual gross operating surplus loss (\$ million)	\$0.09

Source: Cadence Economics estimates, based on Umwelt, Mangoola Coal Continued Operations Project, Agricultural Impact Statement (2019).

[^] Real 2018 Australian dollars.

* Gross operating surplus ratio for Sheep, grains beef and dairy cattle.

The estimated economic loss of gross operating surplus is based on the Cadence Economics Regional Input-Output Model (CERIOM). This model was customised to generate a NSW-specific Input-Output table so as to not include losses generated in other Australian states.

For the purposes of this economic assessment the permanent losses were estimated over the period 2023 to 2060, 30 years beyond the end of the MCCO Project. Over this period, the total loss of agriculture gross operating surplus, attributable to the MCCO Project is \$0.93 million in NPV terms.

2.6.3 Net environmental, social and transport-related costs

Table 17 provides a summary of the environmental impacts predicted by the technical assessments undertaken for the MCCO Project with the sections following providing details with regard to the relevant considerations in this EIA.

Table 17: Summary of environmental and social impacts, NSW

Environmental costs	Assessment type	Discussion
Greenhouse gas emissions	Quantitative	Based on scope 1 and 2 greenhouse gas emissions generated by the MCCO Project.
Air quality	Qualitative	The MCCO Project will impact air quality within the region. However, the predicted impacts are within the relevant criteria as outlined in the Voluntary Land Acquisition and Mitigation Policy (VLAMP) (DPE 2018). The air quality impacts of the MCCO Project are considered qualitatively.
Transport/ traffic impacts	Quantitative	The MCCO Project will result in minor quantities of additional traffic during the construction phase. Traffic impacts are outlined in section 2.6.8.
Residual value of land	Qualitative	The MCCO Project Additional Project Area is primarily currently used for agriculture. The costs associated with the use of the MCCO Additional Project Area (including disturbance of soil) and the offset areas is included in the loss of agricultural output.
Ambient noise impact	Quantitative	The MCCO Project does generate requirements to either purchase properties or undertake mitigation measures at sensitive receptors in accordance with the Noise Policy for Industry (NPI) criteria and requirements of the VLAMP. These costs are included in the costs of the MCCO Project and are not individually identifiable as they are subject to commercial negotiation and are confidential.
Biodiversity impact	Quantitative	The MCCO Project does impact biodiversity values, and as a result creates a requirement to generate/acquire biodiversity offset credits. Mangoola will generate these credits in a variety of ways including generating its own offset areas, rehabilitation and purchasing (and retiring) credits.
Non-Aboriginal heritage	Quantitative	Nil impacts generating costs
Visual amenity	Qualitative	No visual impacts from residences are predicted with views available from public roads. Mangoola will undertake mitigation steps to reduce the impact of visual amenity on road users, these are included in the MCCO Project costs.
Water impact – surface water and groundwater	Quantitative	Water impacts are minor, Mangoola will incur some costs mitigating predicted impacts to two privately owned bores which are provided for in the costs. All required water licence allocations are already held by Mangoola.
Aboriginal cultural heritage	Qualitative	Some Aboriginal heritage sites have been identified within the MCCO Additional Project Area that will be impacted, these sites are of low to moderate-low scientific significance. The mine design includes several mitigation and management steps, these are included in the operating and capital costs of the mine. There are also specific mitigation measures proposed to address cultural heritage impacts more broadly. These are included in the operating costs.
Other social impacts	Quantitative	The SIA as completed for the MCCO Project has identified a number of social impacts that require mitigation. Mangoola has committed to mitigation measures in this regard these costs are included in the costs of the MCCO Project.

Source: Based on information provided in the EIS and various technical reports.

2.6.4 Greenhouse gas emissions

Consistent with Australia's international obligations under the United Nations Framework Convention on Climate Change the level of greenhouse gas (GHG) emissions attributable to the MCCO Project is measured by the:

1. Scope 1 emissions, representing the direct GHG emissions from the MCCO Project from, for example, the use of diesel in plant and equipment and fugitive emissions; and
2. Scope 2 emissions, representing the indirect emissions from the MCCO Project purchases of inputs, generally associated with the purchase of electricity.

The GHGEA of the MCCO Project was undertaken by Umwelt Australia, their findings are outlined in *Greenhouse Gas and Energy Assessment, Mangoola Coal Continued Operations Project* (2019).

Umwelt estimates that the MCCO Project will generate a total of 3.7 Mt CO₂e of scope 1 and scope 2 emissions, see Table 18.

To price the GHG emission we have applied the latest carbon price resulting from the most recent (December 2018) auction undertaken by the Clean Energy Regulator (CER) under the Emissions Reduction Fund (ERF).⁶ The results of this auction yielded an average carbon price of \$13.71 (updated to financial year 2018 prices) per tonne of CO₂e abated. While this is an average figure, it represents a useful proxy to the marginal cost of abatement under Australia's current emission abatement policy represented by the ERF.

The externalities arising from GHG emissions associated with the MCCO Project are derived by taking the year-on-year emissions and multiplying these figures by the \$13.71 carbon price under the ERF over the life of the MCCO Project.

The impact of GHG emissions are global in nature, as a result, apportioning the whole costs of CO₂e associated with the MCCO Project overstates the cost to NSW. To estimate the impacts on NSW, it is appropriate to apportion a component of the total global costs to NSW. The approach adopted is to apportion the global GHG costs estimated to NSW using the ratio of NSW population to global population.

On a global basis, the total estimated GHG cost is \$29.1 million in NPV terms, see Table 18. Attributing the GHG costs based on the NSW population, consistent with the Guidelines, results in an attributed GHG cost of \$0.03 million to NSW in NPV terms.

The use of comparatively lower cost domestic offsets in Australia and internationally where eligible, could also be considered.

⁶ The results of this auction are summarised at <http://www.cleanenergyregulator.gov.au/ERF/Auctions-results/december-2018> which was accessed in May 2019 for this analysis.

Table 18: Greenhouse gas emissions attributable to the MCCO Project

	NPV*	Total	2022	2024	2026	2030
ROM Coal Output Mt	-	52.3	7.2	8.4	5.8	4.9
<i>Tonnes of GHG (Mt)</i>						
<i>Scope 1</i>	-	3.3	0.4	0.5	0.4	0.3
<i>Scope 2</i>	-	0.4	0.1	0.1	0.0	0.0
<i>Total</i>	-	3.7	0.5	0.6	0.4	0.3
Price Path (\$ per tonne^)	-	-	13.7	13.7	13.7	13.7
Global Impact (\$ million^)	29.1	50.1	6.8	8.0	5.5	4.7
NSW (\$ million^)	0.03	0.05	0.01	0.01	0.01	0.01

Source: Cadence Economics estimates based on Umwelt, *Greenhouse Gas and Energy Assessment, Mangoola Coal Continued Operations Project* (October 2018).

^ Real 2018 Australian dollars.

* NPV in 2018 Australian dollars based on a 7 per cent real discount rate.

2.6.5 Air quality

The MCCO Project has the potential to impact air quality to the surrounding region from dust from general mining activities, fume from blasting and the emissions of substances from machinery exhausts.

To assess these potential impacts, Jacobs has undertaken an AQIA for the Project, the findings of their analysis is outlined in *Mangoola Coal Continued Operations Project, Air Quality Impact Assessment* (2019).

Regarding PM₁₀ the AQIA assessed the impacts for both the predicted 24-hour impacts and the annual impacts. The AQIA concludes the MCCO Project will not contribute to an annual exceedance of the PM₁₀ criteria, and as a result will not cause adverse air quality impacts with respect to annual average PM₁₀. On a 24-hour basis, one property (property ID 83) will experience some concentration higher than the cumulative criteria.

ID 83 is predicted to exceed relevant noise acquisition criteria as outlined in the VLAMP due to the MCCO Project and therefore costs to acquire this property are allowed for in the costs of the MCCO Project (see section 2.6.10).

Regarding PM_{2.5} the AQIA assessed the impacts for both the predicted 24-hour impacts and the annual impacts. The AQIA concludes the MCCO Project will not contribute to an annual exceedance of the PM_{2.5} criteria, and the results demonstrate compliance with the VLAMP criterion for annual averages. On a 24-hour basis, property ID 83 may experience some exceedances in PM_{2.5} levels, although notes that MCCO Project is not the primary cause.

In addition, the AQIA concludes:

- Regarding TSP and deposited dust - there are no predicted exceedances at private dust sensitive locations.
- Post Blast Fume NO₂ – will not exceed the criteria at any off-site sensitive receptor location and there are no adverse impacts with respect to post blast fume

- Diesel exhausts emissions (associated with off-road vehicles and equipment) – are not expected to result in any adverse air quality impacts, based on model predictions which show compliance with air quality criteria.

Based on the analysis of the AQIA, the air quality impacts of the MCCO Project are considered qualitatively.

2.6.6 Residual value of land

The residual value of land captures any of the benefits associated with an alternate use of the land. That is, where the Project is not approved, the earmarked land used by the MCCO Project may be used for an alternate benefit-purpose. Any benefits generated by the alternate use, are a cost to the Project.

The MCCO Project would continue to use much of the surface infrastructure that is currently used by the approved Mangoola Coal Mine operations. As result of the current approved use, it is unlikely that further approvals would significantly impact land use of surface infrastructure.

As outlined above, the MCCO Additional Project Area and the offset areas are suitable for agricultural use and are currently used for those purposes. The residual value of the land, is a function of the agricultural returns estimated above, as a result the residual value of the land is included in the loss of gross operating surplus attributable to the MCCO Project.

2.6.7 Biodiversity and ecological impacts

A Biodiversity Assessment Report (BAR) has been completed by Umwelt, the findings from the analysis are outlined in *Mangoola Coal Continued Operations Project Biodiversity Assessment Report (2019)*.

The BAR does not consider any impacts to the Approved Project Area, as they are subject to previous approval.

The BAR considers Mangoola's existing Biodiversity and Offset Management Plan (BOMP) and the continued application to the MCCO Project, to mitigate adverse biodiversity impacts during the construction and operations. The BOMP includes several measures to mitigate against the potential direct and indirect biodiversity impacts of the MCCO Project.

The BAR concludes the development of the MCCO Project will result in biodiversity impacts that are unavoidable. These impacts will require a number of biodiversity off-set credits to compensate for the unavoidable loss of ecology values. Table 19, provides a summary of the ecosystem and species off-set credits required to compensate the ecological loss of the MCCO Project. In total, development of the MCCO Project will require 43,966 credits, which includes, 17,718 ecosystem credits and 26,248 species credits.

Table 19: Biodiversity credit requirements

Name	Credits Required
Ecosystem Credits	
HU812 Forest Red Gum grassy open forest on floodplains of the lower Hunter	1,874
HU816 Spotted Gum - Narrow-leaved Ironbark shrub	369
HU817 Narrow-leaved Ironbark - Bull Oak - Grey Box shrub	13,457
HU821 Blakely's red Gum - Narrow-leaved Ironbark	253
HU906 Bull Oak grassy woodland of the central Hunter Valley	1,597
HU945 Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley	168
Ecosystem subtotal	17,718
Species Credits	
Flora	
<i>Prasophyllum petilum</i> (Tarengo leek orchid)	8,983
<i>Diuris tricolor</i> (Pine donkey orchid)	17,238
Fauna	
Large-eared pied bat	27
Southern myotis	20
Species subtotal	26,268
Total Biodiversity off-set credits	43,986

Source: Biodiversity Assessment Report (Umwelt, 2019e).

To meet these off-set requirements, the BAR Proposes a biodiversity offset strategy to compensate the ecological losses from the MCCO Project, these include:

- In-perpetuity conservation using the retirement of biodiversity credits through the establishment of the proposed Mangoola and Wybong Heights Offset sites
- Credits from other existing offset sites operated by Glencore
- Restoration of up to approximately 500 hectares of ecological mine rehabilitation, and
- Payment into the Biodiversity Conservation Fund for the small number of remaining credits.

Over the life of the MCCO Project, the biodiversity off-set strategy will cost \$1.7 million in NPV terms, as outlined in Table 20. This includes \$2.2 million in 2023 for purchasing credits into the Biodiversity Conservation Fund and additional managements costs and \$0.2 million in 2025 for on-going management costs.

Table 20: Biodiversity off-set cost of the MCCO Project

	NPV*	Total	2023	2025
NSW (\$ million^)	1.7	2.4	2.2	0.2

Source: Umwelt. ^ Real 2018 Australian dollars. * NPV in 2018 Australian dollars based on a 7 per cent real discount rate.

2.6.8 Transport/traffic impacts

The MCCO Project may generate a traffic impact where Project-related traffic imposes increased wait-times or travel times of other road and rail users. Wait-times may be generated by increased traffic at

intersections causing a reduction in performance. Travel times may be impacted through changes to road and rail alignment.

GHD has undertaken a Traffic and Transport Impact Assessment (TTIA) for the MCCO Project, the findings of the analysis is outlined in the report *Mangoola Coal continued Operations Project traffic and Transport Report* (2019).

The scope of MCCO Project-related impacts assessed in the TTIA is limited to the construction phase activity and the time-delay impacts from the realignment of a portion of Wybong Post Office Road. Regarding the operational phase, TTIA concludes that, operational traffic volumes are not expected to change from those previously assessed and approved as there is no proposed increase to either the currently approved maximum extraction rates or operational workforce.

The TTIA also outlines several management and mitigation steps to reduce the potential traffic-related impacts of the MCCO Project, these include a Construction Traffic Management Plan.

Regarding the construction phase related traffic impacts the TTIA concludes that all intersections considered will maintain a good Level of Service. To reach this conclusion the TTIA modelled the relative impacts of the construction build activity against a no-build scenario. The impacts on average delays are relatively minor and not discernible to road users.

The realignment of a portion of Wybong Post Office Road does contribute to an increase in travel times for road users. The economic costs of the increased travel times are summarised in Table 21. The TTIA states that the realignment will extend the trip distances by 1.6km and increase travel times by up to 55 seconds for the 34 cars that use the road each day. Over a year the realignment will increase travel times for all road users (conservatively assuming they all travel to/from Muswellbrook) by a total of 190 hours, at a cost of \$38.20 per hour, and generate an annual total cost of travel time of \$7,238.

The realignment is expected to be completed in 2022 and will be operational for the life of the MCCO Project and beyond. For the purposes of the economic assessment we have estimated the delay from 2022 to 2050. Over this period of 28 years, it is expected that the MCCO Project will generate \$0.067 million of travel time costs.

Table 21: Wybong Post Office Road, travel time impacts

	Unit	Travel time cost
Travel time increase	Seconds	55
Vehicle movements	No.	34
Travel time delay per year ^{^^}	Hours	190
Cost of increased travel time	Dollars [^] per hour	38.2
Annual cost of increased travel time (2022 to 2050)	Dollars [^]	7,238
Cost of increased travel time (NPV* \$ million)	Dollars [^]	0.067

Source: Cadence Economics estimated based on information provided in the Transport and Traffic Impact Assessment and the *Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives*, March 2016, Transport for NSW.

[^] Real 2018 Australian dollars.

^{^^} Assuming 365 days per year

* NPV in 2018 Australian dollars based on a 7 per cent real discount rate.

2.6.9 Visual amenity

Umwelt has undertaken a Visual Assessment (VA) and the conclusion of their analysis is outlined in the EIS. The VA includes an assessment of both the visual impacts and the lighting impacts of the MCCO Project. The potential visual and lighting impacts were assessed for private residences in the area and for another ten representative public viewing localities, including roads.

The VA concludes that there are no predicted views of the proposed mining operations or infrastructure from any private residences. The VA concludes that there are some visual impacts at the public viewing locations assessed. Views from public roads will be intermittent and generally short term in nature.

Regarding the lighting impacts, the VA concludes that there will be no direct impact on private residences. In addition, indirect impacts or glow will be minimal due to the lack of fixed lighting within the MCCO Additional Project Area, viewing distances and screening effects of intervening topography and vegetation. Mangoola have committed to some mitigation measures to reduce the potential impacts to public road users.

To minimise the visual impacts the MCCO Project includes a number of design features, including progressive rehabilitation and shaping of final landform is expected to reduce visual impacts. Additional measures to reduce visual impacts include;

- Planting tree screens to reduce availability of direct views;
- Progressive rehabilitation to reduce the duration of visible soil exposure; and,
- Ongoing management of mobile lighting including the procedures for the appropriate placement of lighting.

The costs of progressive rehabilitation, shaping of the final landform and the other measures outlined above are included in the operating costs of the MCCO Project and are not individually identifiable.

2.6.10 Ambient noise impact

Global Acoustics has undertaken a Noise Impact Assessment (NIA) for the Project. Their findings are outlined in the report, *Mangoola Continued Operations Project Noise Impact Assessment* (Global Acoustics, 2019). The NIA concludes that the MCCO Project will generate noise impacts that will be dealt with through land acquisition or mitigation steps utilising the criteria and principles contained within the VLAMP (DPE 2018), plus some additional controls to be applied by Mangoola.

A number of noise controls and management strategies were incorporated into the noise impact assessment modelling and identifies the steps Mangoola will implement to reduce noise impacts. The NIA outlines the residual noise impacts of the MCCO Project, taking into account the management and mitigation steps.

Regarding operational noise the NIA concludes that seven private residences that are impacted above the Noise Policy for Industry (NPfI) criteria, are subject to acquisition under the VLAMP⁷ method. A further 19 receptors are entitled to mitigation rights based on the residual noise impact levels being considered marginal. Mangoola has provided the cost of property acquisition and mitigation, and these costs are included in the costs outlined in Table 5. These costs are sensitive, and as a result are not individually identifiable.

The construction noise assessment has been undertaken for both, non-enhancing weather conditions and strongly enhancing weather conditions. Under non-enhancing weather conditions construction noise should be well below the 'noise effected' criteria. Under enhancing conditions, three receptors are assessed to receive impacts that are classified as between 'noise effected' and 'highly noise effected.'

Regarding the off-site noise impacts the NIA concludes no additional impact from rail noise. Similarly, the NIA concludes, no additional road noise impact during the operational phase and the construction phase.

2.6.11 Surface Water and groundwater impacts

The water impacts of the MCCO Project are anticipated to be relatively minor and managed within Mangoola's existing water licence allocations. The groundwater assessment concludes that there are two privately owned bores that are predicted to be impacted by the MCCO Project. The cost of rehabilitating this bore is included in the costs of the mine. These costs have not been individually identified as they are confidential.

With regard to water take by the MCCO Project, as a result of groundwater drawdown into the mining areas and surface water catchment areas intercepted by mining, Mangoola already holds sufficient water access licences for all water take associated with the MCCO Project. The water take licensing system in NSW has been designed to provide for sustainable environmental flows and thereby minimises the cumulative impacts of water take by all water users.

2.6.12 Aboriginal Cultural Heritage

Australian Cultural Heritage Management has undertaken an Aboriginal Cultural Heritage Assessment (ACHA) report for the MCCO Project. The findings of their analysis is outlined in the *Mangoola Coal Continued Operations Project Aboriginal Cultural Assessment* (2019). This included the Aboriginal Archaeology Impact Assessment (AAIA), by OzArk.

The ACHA concludes that the natural landscape has been altered as a result of a long history of agriculture. Combined with the historical disconnection of people, means that the MCCO Additional Project Area has relatively low cultural significance, compared to other places in the region. Specifically, the majority of Aboriginal sites identified in the AAIA have been assessed as having low scientific significance as a result

⁷ *Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments* (VLAMP) (NSW Government, 2018)

of the long-running previous disturbance within the disturbance footprint. Of the 26 identified sites, 24 are of low scientific significance, one is of low-moderate and one is of moderate significance.

The ACHA outlines several design elements incorporated into the design of the MCCO Project to avoid, minimise and manage potential impacts to Aboriginal cultural heritage. This includes:

- The continued use and review of the Aboriginal Cultural Heritage Management Plan (ACHMP)
- Survey, collection and analysis of the 26 Aboriginal sites to be impacted
- Repatriation of artefacts from the MCCO Project Area
- Care and control measures regarding Aboriginal objects
- Management of any previously unknown cultural heritage items

In addition, Mangoola will undertake a program of intergenerational equity, which include a number of cultural awareness and education programs, employment opportunities and land management. Mangoola estimates the cost of this program will be \$150,000, these costs are included in the operating costs.

Any loss of scientific value from these sites are qualitatively acknowledged in the economic assessment.

2.6.13 Historical heritage

Umwelt has completed a Historical Heritage Assessment (HHA) of the Project, the findings of their analysis is outlined in *Mangoola Coal Continued Operations Project Historical Heritage Assessment Report* (2019). The HHA concludes that the items identified within the MCCO Additional Project Area do not meet the criteria for heritage significance at the local or state level and don't have any research potential. Further, mining in the MCCO Additional Project Area will not result in any adverse impacts to the historical heritage of the disturbed area or the wider area.

The HHA also considered the potential indirect impacts of blasting and views, to sites located within the region. The report concludes the MCCO Project will not impact these sites. Finally, the HHA concludes that there are no further requirements for investigation or assessment with regards to historical heritage. Where, in the unlikely event that unexpected historical heritage is discovered, they should be managed in accordance with the appropriate protocols.

As a result of the conclusions in the HHA, the economic impacts of the MCCO Project on historical heritage is nil.

2.7 Net Benefits Analysis results

Consistent with the Guidelines, the CBA is based on comparing the net direct and indirect benefits and subtracting the indirect costs of the MCCO Project compared against the baseline scenario where the MCCO Project does not occur. The results are summarised in Table 22.

Based on the CBA methodology outlined in the Guidelines, and information provided by Mangoola, the MCCO Project is estimated to provide a net benefit to NSW. This net benefit is estimated to be

\$408.6 million in net present value (NPV)⁸ terms. This is comprised of \$173.0 million and \$236.6 million in direct and indirect benefits respectively. The incremental indirect costs of the MCCO Project are estimated to be \$1.03 million.

Table 22: Central case - estimated net benefits of the MCCO Project (\$ million[^])

Benefits	NPV*	Costs	NPV*
Direct benefits		Direct costs	
1. Net producer surplus attributed to NSW	0.0		
2. Royalties, payroll tax and Council rates	129.5		
3. Company income tax apportioned to NSW	43.5		
Total direct benefits	173.0	Total direct costs	-
Indirect benefits	0	Indirect costs	
1. Net economic benefit to landholders	0.0	1. Air quality ^{^^^}	-
2. Net economic benefit to NSW workers	107.6	2. Greenhouse gas emissions	0.031
3. Net economic benefit to NSW suppliers	129.0	3. Visual amenity ^{^^^}	-
		4. Transport impact	0.067
		5. Net public infrastructure cost	2.46
		6. Surface water impact ^{^^}	-
		8. Residual value of land	-
		7. Biodiversity impact	1.69
		8. Noise impact ^{^^}	-
		9. Loss of surplus to other industries	0.93
		10. Groundwater	-
		11. Aboriginal cultural and Historical heritage ^{^^^}	-
		12. Social Costs ^{^^^}	-
Total indirect benefits	236.6	Indirect Costs	5.18
Total Project economic benefit	409.6	Incremental Indirect Cost	1.03
NPV of project - (\$m)	408.6		

Source: Cadence Economics estimated based on information from various sources. ^ Real 2018 Australian dollars. * NPV in 2018 Australian dollars based on a 7 per cent real discount rate. ^^ Included in the operating costs, excluded on the basis that they are confidential. ^^^ Costs are included in the operating costs of the Project and not individually identifiable

The **direct benefits** of the MCCO Project are a function of its profitability which, in turn, depends on the prevailing coal price. The analysis shows that the combination of relatively low capital requirement, extraction and processing costs underpins the economic viability of the MCCO Project. As a result, the MCCO Project is predicted to generate:

- Total corporate taxes of \$135.9 million in NPV terms for Australia, of which \$43.5 million is attributed to NSW; and

⁸ All NPV figures reported are in 2018 Australian dollars based on a 7 per cent real discount rate (unless otherwise stated).

- \$129.5 million in other government revenue for NSW in NPV terms, the largest component of this being royalties of \$121.0 million with net council rates and land taxes of \$2.7 million and payroll taxes contributing \$5.9 million.

The **indirect benefits** of the MCCO Project are related to the linkages that it will have to the NSW economy through both the labour market and suppliers. The analysis shows that of the \$236.9 million in estimated indirect benefits:

- Worker benefits are predicted to amount to \$107.6 million in NPV terms attributable to an average employment of 199 additional Full Time Equivalent (FTE) directly employed NSW-based workers over the period 2023 to 2030 of the MCCO Project; and
- Supplier benefits are predicted to amount to \$129.0 in NPV terms based on total NSW-based supplier inputs over the life of the MCCO Project of \$639 million.

The MCCO Project is expected to result in minor incremental indirect costs, of \$1.03 million, on the NSW community through greenhouse gas emissions, loss of agriculture output and travel time costs for the users of Wybong Post Office Road.

2.8 Net Benefits – Sensitivity analysis

Consistent with the Guidelines, this section outlines a summary of the systematic sensitivity analysis undertaken for the MCCO Project. The sensitivity analysis considers all key areas of the CBA, particularly coal prices, key costs (both capital expenditure and operating costs) as well as worker benefits. Where there are considered to be higher levels of uncertainty with the figures, a range of plus/minus is used in the sensitivity analysis. In areas where the figures are deemed more certain, a range of plus/minus 10 per cent is used. The sensitivity analysis is comprised of the following:

- Revenue sensitivity
 - Higher price assumptions, where coal prices are increased by 15 per cent over the central case assumptions for the life of the MCCO Project
 - Lower price assumptions, where coal prices are decreased under the central case assumptions by 15 per cent
- Cost-base sensitivity
 - Higher operational expenditure (increased by 10 per cent over the central case)
 - Lower operational expenditure (decreased by 10 per cent under the central case)
 - Higher capital expenditure (increased by 10 per cent over the central case)
 - Lower capital expenditure (decreased by 10 per cent under the central case)
- Worker and Supplier assumptions
 - Increased disutility of mining wage premium by 25 per cent on central case assumptions
 - Reduced supplier benefits of 10 per cent from central case assumptions
- Environmental impact costs, increased by 10 per cent over the central case
- Discount rate sensitivity, using a 4% and a 10% real discount rate (see Appendix A).

In addition, upper and lower bound estimates are undertaken which assume:

- **'Worst-case' scenario**, the coal price is reduced by 15 per cent, operational and capital expenditure are increased by 10 per cent, the disutility of the mining wage premium is set to 25 per cent and supplier benefits are lowered by 10 per cent compared with central case assumptions. Environmental costs are increased by 10 per cent over the central case.
- **'Best case' scenario**, the coal price is increased by 15 per cent, operational and capital expenditure are decreased by 10 per cent, the disutility of the mining wage premium is set to zero and supplier benefits are increased by 10 per cent compared with central case assumptions. Environmental costs are decreased by 10 per cent over the central case.

Consistent with the Guidelines, the revenue sensitivity undertaken considers the impact of higher or lower prices on the results of the CBA denominated in Australian dollars. There are two main factors effecting the price assumptions. First is the US dollar price of coal prevailing in international markets. Second is the exchange rate between the Australian and US dollar. A decrease in the price of coal can either reflect a reduction in world prices or an appreciation of the Australian dollar relative to the US dollar. As such, a 15 per cent reduction in coal prices can either be interpreted as:

- A 15 per cent reduction in the prevailing international coal price (denominated in US dollars with no change to the exchange rate); or
- A 15 per cent appreciation in the Australian dollar relative to the US dollar (with the prevailing international price of coal unchanged); or
- Some combination of both.

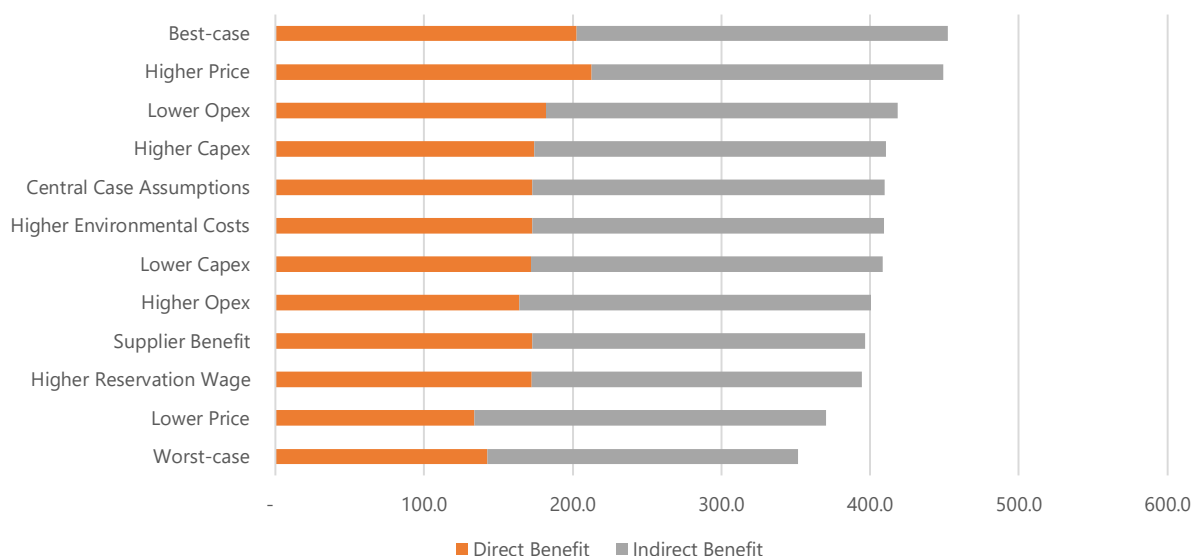
2.8.1 Results of sensitivity analysis

The results of the systematic sensitivity analysis are summarised in Figure 8. This sensitivity analysis shows that the estimated net benefits are robust in the sense that they remain (strongly) positive after testing all key assumptions underpinning the analysis.

In isolation, the estimated net benefit of the MCCO Project is most sensitive to the coal price assumptions underpinning the analysis, but even assuming coal prices are 15 per cent lower than under the central case assumptions the net benefits are estimated at \$369.6 million in NPV terms.

The lower bound estimate of net benefits, which takes the most pessimistic assumptions around coal prices, capital expenditure, operational expenditure as well as worker and supplier benefits, yields an estimated net benefit of \$350.6 million in NPV terms.

The upper bound estimate of net benefits, based on the most optimistic assumptions, is \$451.3 million in NPV terms. In isolation, assuming higher coal prices of 15 per cent, to those in the central case, the net benefits of the MCCO Project is \$448.4 million in NPV terms.

Figure 8: Systematic sensitivity analysis of the CBA to key assumptions (NPV*, \$ million[^])

Source: Cadence Economics estimated based on information from various sources. [^] Real 2018 Australian dollars. * NPV in 2018 Australian dollars based on a 7 per cent real discount rate.

The robustness of the results to the sensitivity analysis is a reflection of the relatively low operating costs, the relatively low capital costs required to extract the resource and the relatively low level of indirect costs (externalities) attributable to NSW.

It can also be inferred from the sensitivity analysis how large the qualitatively assessed negative externalities would need to be before the MCCO Project is no longer a net benefit to the NSW community. Using the most conservative estimate, the worst-case assumptions, these externalities would need to be \$350.6 million in NPV terms before the MCCO Project would return a net negative return to NSW. Although, as outlined in section 2.6.3, the qualitative assessment is limited to Aboriginal cultural heritage and visual impacts and as a result the qualitatively assessment negative impacts are likely to be small.

As a result of the incremental benefits accruing after 2023, the net benefits are sensitive to the discount rate used for the analysis. Under the Central case assumptions, the MCCO Project is expected to generate \$408.6 million of net benefit using a 7% discount rate. Using a 4% discount rate increases the net benefit to \$515.5 million, conversely a 10% discount decreases the net benefit to \$327.1 million.

Appendix B provides a detailed account of the direct and indirect benefits and the indirect costs for each of the sensitivities conducted. The analysis shows that the net benefits of the MCCO Project remain robust under various assumptions. In addition, if conservatively the indirect benefits were all set to zero, that is suppliers were assumed to gain no benefit and workers reservation wages are equal to those earned in the MCCO Project, the net benefits to NSW would remain positive.

3 Local Effects Analysis

Consistent with the Guidelines, the local effects analysis (LEA) uses a similar framework to the CBA presented in the previous section, but is focussed on the net economic impacts to the local community. The Guidelines refer to the local area as being consistent with the relevant Statistical Area (SA3) as defined by the Australia Bureau of Statistics. In the case of the MCCO Project the location used for the LEA is the Upper Hunter SA3.

3.1 The Upper Hunter region

The Upper Hunter region is located to the north west of the Newcastle, Singleton and Cessnock. The SA3 local area includes the regional centres of Muswellbrook and smaller towns like Denman and Aberdeen. Mangoola Coal Mine is located approximately 20 kilometres (km) west of Muswellbrook and 10 km north of Denman, in the south-central part of the SA3 region. The Upper Hunter region has a long history of coal mining, located less than 5km from Muswellbrook, these include:

- Bengalla,
- Muswellbrook Coal,
- Mount Arthur Coal Mine, the Hunter Valley's largest coal mine
- Mount Pleasant (recently commenced operations)

In addition, the Upper Hunter region is the location of both the Bayswater and Liddell Power Stations.

3.1.1 Regional characteristics

The region is heavily reliant on the coal mining sector, of the residents in the region almost 16 per cent work within the coal mining sector, as outlined in Table 23, compared to 0.6 per cent in NSW and 0.4 per cent Australia-wide.

As a result, a high proportion of workers in the region are in occupations that are typically found within both the coal mining sector and industries that supply that sector. Technicians and trades workers make up 18.5 per cent of the Upper Hunter labour force compared to 12.7 per cent in NSW and machinery operators and drivers account for 15.5 per cent of the regional economy compared to 6.1 per cent state-wide.

These occupation outcomes are also reflected in the educational outcomes within the region. 21.9 per cent of residents report certificate level III and IV as their highest educational attainment, compared to 14.8 per cent in NSW.

Table 23: Education and employment characteristics

	Upper Hunter	New South Wales	Australia
Level of highest educational attainment	%	%	%
Advanced Diploma and above	15.6	32.3	30.9
Certificate III and IV	21.9	14.8	15.7
Year 10 to 12	32.9	30.1	31.4
Other	26.9	19.6	19.2
Occupation	%	%	%
Technicians and Trades Workers	18.5	12.7	13.5
Machinery Operators and Drivers	15.5	6.1	6.3
Labourers	14.4	8.8	9.5
Professionals	12.9	13.5	13
Community and Personal Service Workers	11.4	23.6	22.2
Clerical and Administrative Workers	9.8	13.8	13.6
Managers	8.4	10.4	10.8
Sales Workers	7.5	9.2	9.4
Industry of employment, top responses	%	%	%
Coal Mining	15.8	0.6	0.4
Horse Farming	4.4	0	0
Beef Cattle Farming (Specialised)	4.4	0.4	0.4
Supermarket and Grocery Stores	2.6	2.2	2.4
Local Government Administration	2.4	1.3	1.3

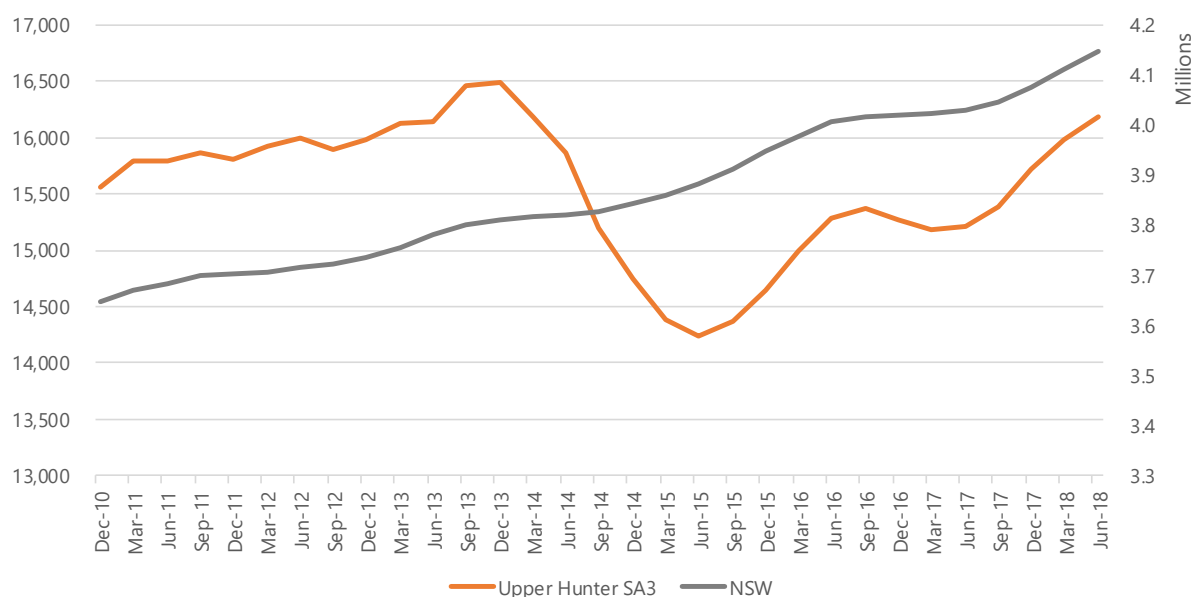
Source: 2016 Census QuickStats, Australian Bureau of Statistics

3.1.2 Employment outcomes

Employment outcomes in the Upper Hunter region are highly variable, in part impacted by coal mining activity. Figure 9 shows total employment for Upper Hunter SA3 and the NSW residents, covering the period December 2010 to June 2018 (the most recent data). Employment for residents of the region peaked in December 2013 at 16,484.

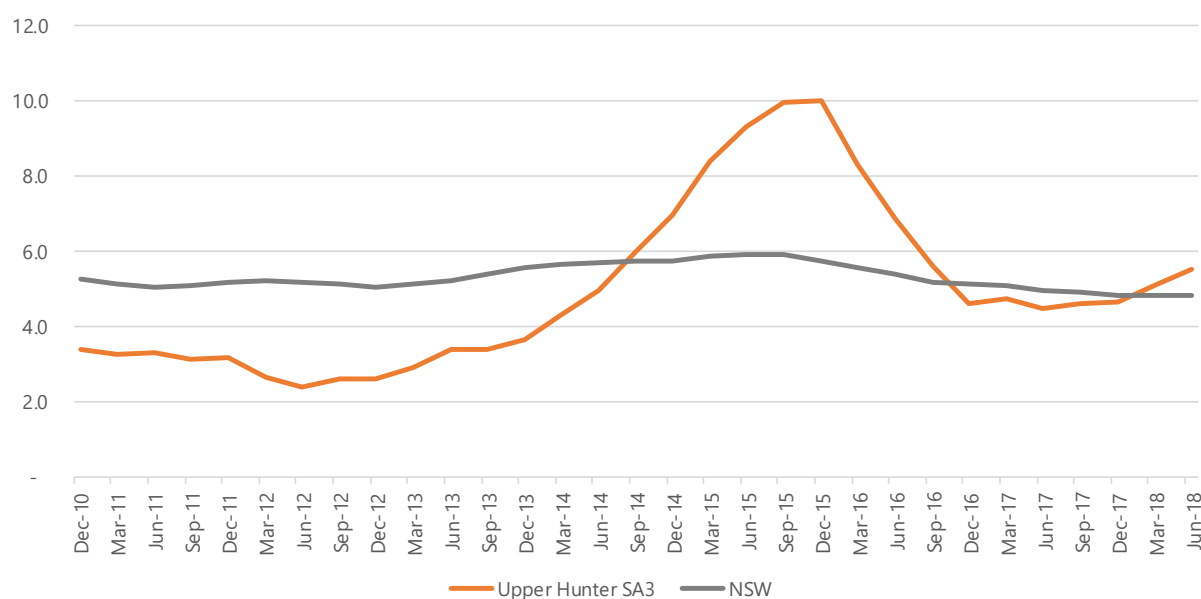
The 18 months after this peak was characterised as a challenging one for the coal mining sector, facing relatively low coal prices and a strong Australian Dollar, thus impacting profitability. Some operators suspended coal operations or reduced output impacting on regional employment outcomes. Employment for residents of the region, by June 2015, fell to 14,232, a reduction of 2,252 or 13.7 per cent.

In more recent times as conditions in the mining sector have improved, employment in the region has steadily increased. Over the period, June 2015 to June 2018 employment in the Upper Hunter increased by 1,954, or 13.7 per cent.

Figure 9: Employment, Upper Hunter SA3 and New South Wales

Source: SA2 Data tables – Small Area Labour Markets – June quarter 2018 Department of Employment (September 2018)

As shown in Figure 10, unemployment in the region has followed the broad trends as those outlined above. Unemployment in the region was as low as 2.4 per cent in June 2012, although as a result of the coal industry conditions, the unemployment rate rose to 10.0 per cent by December 2015. Recently though employment conditions have improved, and the unemployment rate has declined to around the state-wide average.

Figure 10: Unemployment rate (per cent), Upper Hunter SA3 and New South Wales

Source: SA2 Data tables – Small Area Labour Markets – June quarter 2018 Department of Employment (September 2018)

3.2 Local Effects Analysis

The LEA accounts for the economic benefits to the Upper Hunter region only. It does not include any economic benefits that may accrue to the major regional centres that are located adjacent, including Maitland and Newcastle or the broader Hunter region.

Given the nature of coal operations and export ports located in Newcastle, many of the inputs may be supplied from the broader Hunter region. In addition, Mangoola has advised that for the currently approved operations 9.0 per cent of the supplier inputs are sourced from Upper Hunter based businesses and 73 per cent of workers live in the Upper Hunter SA3.

Underpinning the LEA are the assumptions that:

- No net producer surplus accrues to the region.
- No company income tax accrues to the Upper Hunter SA3 region.
- The LEA benefits does not include any of the Resources for Regions payments made by the NSW Government to those regions that contribute royalties.
- Based on information supplied by Mangoola, we have assumed for the purposes of the MCCO Project that 73 per cent of the workforce requirement of the MCCO Project and 9.0 per cent of intermediate inputs will be supplied from the SA3 region.
- The average wage in the Upper Hunter SA3 is \$69,812 per annum, 5.1 per cent higher than the NSW-wide average of \$66,401.

Indirect costs associated with the MCCO Project are minor, including, greenhouse gas transport impact costs and the loss of agricultural output, in total the incremental indirect costs to the Upper Hunter SA3 is estimated to be \$1.0 million in NPV terms over the life of the MCCO Project, see Table 24.

Table 24: Summary of environmental and social impacts, Upper Hunter

Environmental costs	Assessment type	Discussion of the regional impacts
Greenhouse gas emissions	Quantitative	Based on scope 1 and 2 greenhouse gas emissions generated by the MCCO Project, the indirect costs of greenhouse gas emission are apportioned to the region as a share of the Upper Hunter and NSW population.
Air quality	Qualitative	The MCCO Project will impact air quality within the region. However, the predicted impacts are within the relevant criteria as outlined in the Voluntary Land Acquisition and Mitigation Policy (VLAMP) (DPE 2018). The air quality impacts of the MCCO Project are considered qualitatively.
Transport/ traffic impacts	Quantitative	The MCCO Project will result in minor quantities of additional traffic during the construction phase. The traffic impacts generated, see section 2.6.8 are included in the incremental indirect costs of the MCCO Project.
Residual value of land	Qualitative	The MCCO Project Additional Project Area is primarily currently used for agriculture. The costs associated with the use of the MCCO Additional Project Area (including the disturbance of soil) and the offset areas is included in the loss of agricultural output.
Ambient noise impact	Quantitative	The MCCO Project does generate requirements to either purchase properties or undertake mitigation measures at sensitive receptors in accordance with the Noise Policy for Industry (NPfI) criteria and requirements of the VLAMP. These costs are included in the costs of the MCCO Project and are not individually identifiable as they are subject to commercial negotiation and are confidential.
Biodiversity impact	Quantitative	The MCCO Project does impact biodiversity values, and as a result creates a requirement to generate/acquire biodiversity offset credits. Mangoola will generate these credits in a variety of ways including generating its own offset areas, rehabilitation and purchasing (and retiring) credits. The incremental cost of the biodiversity impact are included in the indirect costs of the MCCO Project to the Upper Hunter SA3.
Non-Aboriginal heritage	Quantitative	Nil impacts generating costs
Visual amenity	Qualitative	No visual impacts from residences are predicted with views available from public roads. Mangoola will undertake mitigation steps to reduce the impact of visual amenity on road users, these are included in the MCCO Project costs.
Water impact – surface water and groundwater	Quantitative	Water impacts are minor, Mangoola will incur some costs mitigating predicted impacts to two privately owned bores which are provided for in the costs. All required water licence allocations are already held by Mangoola.
Aboriginal cultural heritage	Qualitative	Some Aboriginal heritage sites have been identified within the MCCO Additional Project Area that will be impacted, these sites are of low to moderate-low scientific significance. Mitigation and management steps are included in the operating costs.
Other social impacts	Quantitative	The SIA as completed for the MCCO Project has identified a number of social impacts that require mitigation. Mangoola has committed to mitigation measures in this regard these costs are included in the costs of the MCCO Project.

Source: Based on information provided in the EIS and various technical reports.

As a result of these assumptions, it is expected the MCCO Project will generate indirect benefits to local suppliers and employees of \$14.1 million and \$76.8 million respectively in NPV terms over the baseline case, as outlined in Table 25.

Based on these assumptions, the MCCO Project is estimated to confer a net benefit on the Upper Hunter SA3 region of \$92.6 million in NPV terms.

Table 25: Estimated Local Effects Analysis of the MCCO Project (\$ million[^])

Benefits	NPV*	Costs	NPV*
Direct benefits		Direct costs	
1. Net producer surplus attributed to NSW			
2. Royalties, payroll tax and Council rates	\$2.7		
3. Company tax			
Total direct benefits	\$2.7	Total direct costs	-
Indirect benefits		Indirect costs	
1. Net economic benefit to landholders		1. Air quality ^{^^}	-
2. Net economic benefit to NSW workers	76.8	2. Greenhouse gas emissions	0.00
3. Net economic benefit to NSW suppliers	14.1	3. Visual amenity ^{^^}	-
		4. Transport impact	0.07
		5. Net public infrastructure cost	2.46
		6. Surface water impact ^{^^}	-
		8. Residual value of land	-
		7. Biodiversity impact	1.69
		8. Noise impact ^{^^}	-
		9. Loss of surplus to other industries	0.93
		10. Groundwater	-
		11. Aboriginal cultural and Historical heritage ^{^^}	-
		12 Social ^{^^}	-
Total indirect benefits	90.9	Indirect Costs	5.15
Total Project economic benefit	93.6	Incremental Indirect Cost	1.00
NPV of project - (\$m)	92.6		

Source: Cadence Economics estimated based on information from various sources. [^] Real 2018 Australian dollars. * NPV in 2018 Australian dollars based on a 7 per cent real discount rate.

3.3 Sensitivity analysis

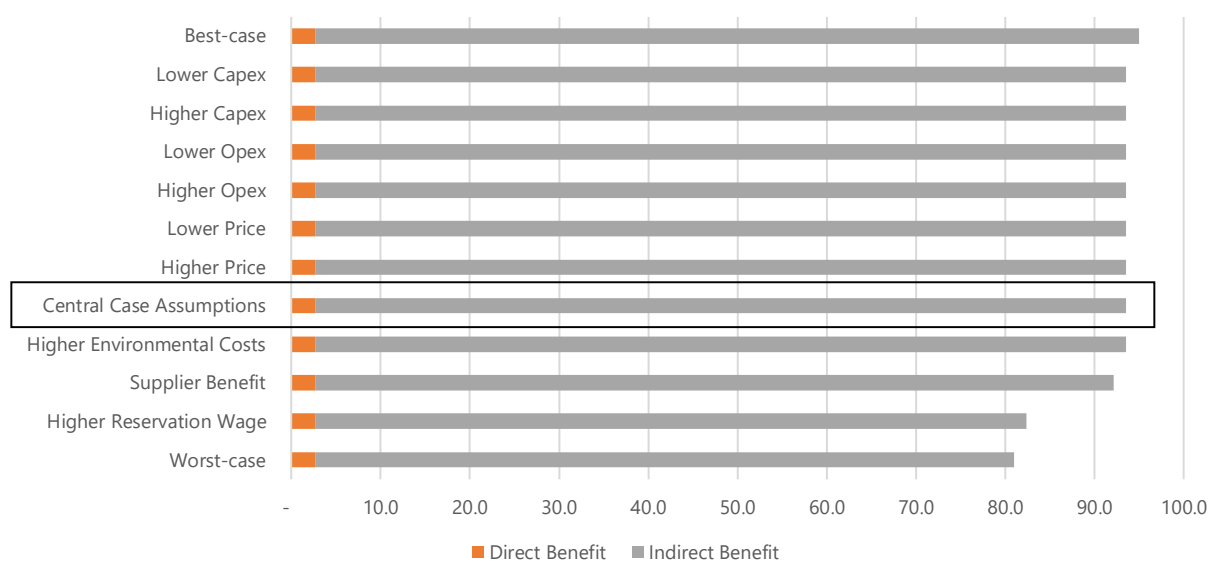
As outlined above the LEA relies on a number of modelling assumptions. Consistent with the Guidelines, Figure 11 provides a summary of the systematic sensitivity analysis undertaken for the MCCO Project. The sensitivity analysis tests the same assumptions outlined in the CBA.

The main drivers for the regional impact are the supplier and employee benefits. Those sensitivities that change the supplier benefits through lower operational costs, lower supplier benefit or employee benefit have the greatest impact on the regional net benefit.

The results of the systematic sensitivity analysis are summarised in Figure 11. This sensitivity analysis shows that the estimated net benefits are **robust** in the sense that they remain (strongly) positive after testing all key assumptions underpinning the analysis. Full detail of the sensitivity analysis is presented in Appendix B.

The lower bound, or worst-case, estimate of net benefits, which takes the most pessimistic assumptions around coal prices, capital expenditure, operational expenditure as well as worker and supplier benefits, yields an estimated net benefit of \$79.9 million in NPV terms. The upper bound, or best-case, estimate based on the most optimistic assumptions, is \$94.1 million in NPV terms.

Figure 11: Systematic sensitivity analysis of the LEA to key assumptions (NPV*, \$ million[^])



Source: Cadence Economics estimated based on information from various sources. ^ Real 2018 Australian dollars. * NPV in 2018 Australian dollars based on a 7 per cent real discount rate.

4 CGE modelling

The economy-wide impacts of the proposed development have been undertaken using a CGE model of the regional and NSW economy.

The aim of an economic impact study based on applied CGE modelling is to estimate the net benefit of the proposed development on economic activity and the living standards of those residing within the Upper Hunter SA3, the same region used for the LEA analysis, and in NSW.

CGE modelling is the preferred technique to assess the impacts of large projects as they are based on a more detailed representation of the economy, including the complex interactions between different sectors of the economy.⁹ As a CGE model is able to analyse the impacts of the proposed development in a comprehensive, economy-wide framework meaning the modelling captures:

- **Direct increases in demand** associated with the proposed development (short term construction activity) as well as the assumed increases output attributable to increased coal production.
- **Indirect increases in demand**, or flow-on effects associated with increased economic activity relating to both the construction phase of development and additional coal production.
- **Labour market displacement** caused by the direct increase in demand from a project of this nature (and the associated investment) on other sectors of the economy bidding up wages and 'crowding out' other sectors of the economy.
- **Revenue leakage** associated with the expropriation of profits from the Project to overseas interests (in this case, Glencore).

4.1 About Cadence Economics' CGE model

The estimates are based on the Cadence Economics General Equilibrium Model (CEGEM). CEGEM is a large scale, dynamic, multi-region, multi-sector model of the global economy, with an explicit representation of the Upper Hunter SA3 and the NSW economy. CEGEM is based on a substantial body of accepted microeconomic theory.

The model projects change in macroeconomic aggregates such as real gross state product (real GSP) which is an output measure of the NSW economy and real gross state income (real GSI) which is a welfare measure for NSW residents. At a regional level the model projects change in real gross regional product (real GRP) and real gross regional income (real GRI). The model also projects state-wide and regional employment, export volumes, investment and private consumption. At the sectoral level, detailed results such as output, exports, imports and employment are also produced. A brief description of the model is presented in Box 1.

⁹ See for example the Policy & Guidelines Paper produced by the NSW Treasury (2009).

Box 1: An overview of CEGEM

CEGEM is a multi-commodity, multi-region, dynamic model of the world economy. Like all economic models, CEGEM is based on a range of assumptions, parameters and data that constitute an approximation to the working structure of an economy. Its construction has drawn on the key features of other economic models such as the global economic framework underpinning models, such as GTAP and GTEM, with state and regional modelling frameworks such as Monash-MMRF and TERM.

Labour, capital, land and a natural resource comprise the four factors of production. On a year-by-year basis, capital and labour are mobile between sectors, while land is mobile across agriculture. The natural resource is specific to mining and is not mobile. A representative household in each region owns all factors of production. This representative household receives all factor payments, tax revenue and interregional transfers. The household also determines the allocation of income between household consumption, government consumption and savings.

Capital in each region of the model accumulates by investment less depreciation in each period. Capital is mobile internationally in CEGEM where global investment equals global savings. Global savings are made available to invest across regions. Rates of return can differ to reflect region specific differences in risk premiums.

The model assumes labour markets operate in a model where employment and wages adjust in each year so that, for example, in the case of an increase in the demand for labour, the real wage rate increases in proportion to the increase in employment from its base case forecast level.

CEGEM determines regional supplies and demands of commodities through optimising behaviour of agents in perfectly competitive markets using constant returns to scale technologies. Under these assumptions, prices are set to cover costs and firms earn zero pure profits, with all returns paid to primary factors. This implies that changes in output prices are determined by changes in input prices of materials and primary factors.

In terms of specifying the elasticity of labour supply, Cadence follow the lead of the Australian Treasury and use a labour supply elasticity assumption of 0.15, which indicates a relatively 'inelastic' response from workers.

Importantly, in terms of interpreting the results as well as for consistency with the CBA analysis, real GSI represents the preferable welfare measure to the commonly reported change in real GSP (a measure of production). As a measure of income, Pant et al (2000) show how the change in real GSI is a good approximation to the **equivalent variation** welfare measure in global CGE models such as CEGEM. This measure is widely used by practitioners and can also be decomposed into various components to assist in the analysis of results. Real GSI is computationally more convenient than (say) an equivalent variation, and a more familiar concept to explain to decision makers (Layman, 2004).

As noted by Pant et al (2000), in considering welfare results in global CGE such as CEGEM, the main components are the change in: output (measured by real GSP), terms of trade and payments to foreigners. Of relevance in the discussion around estimating the net benefits of the proposed development are the terms of trade effects. These can be closely linked to changes in labour market conditions because any increase in real wages as a result of higher levels of coal exports will result in an improvement in the terms of trade and, hence, welfare.

That noted, real GSI does not capture some non-market effects that can impact on the living standards of NSW residents. These could include impacts such as the noise impacts for residents or pollution as considered in the detailed CBA above.

CEGEM is a recursive dynamic model that solves year-on-year over a specified timeframe. The model is used to project the relationship between variables under different scenarios over a predefined period. A typical scenario is comprised of a reference case projection (or the Base case scenario) that forms the basis of the analysis. In this instance, the reference case assumes no proposed development investment or coal output from the MCCO Project. Set against this scenario is the policy scenario (or the MCCO Project case) under consideration.

4.1.1 Overview of scenarios

All scenarios outlined in the modelling below use the central case assumptions:

- Capital expenditure of \$171.7 million; and
- Coal output of \$1,558.8 million.

Cadence have also factored into our scenarios the benefits that flow from the proposed development outside of the Upper Hunter region and the NSW economy. This includes, the repatriation of profits out of the region to foreign shareholders, along with wages and the payments out of the region for royalties to the NSW Government and corporations tax to the Australian Government. Cadence have conservatively assumed these royalty payments accrue to the rest of NSW.

In addition, Cadence have factored into our scenarios the level of migration of workers from the rest of NSW into the Upper Hunter SA3. As outlined above, 73 per cent of the workers at the Mangoola Mine reside in the Upper Hunter SA3, where the remainder are sourced from the Rest of NSW. This represents a migration into the region, increasing the labour supply in the Upper Hunter and reducing the labour supply in the Rest of NSW.

4.2 Economy-wide modelling of the proposed development

The key macroeconomic variables projected under the core scenario is shown in Table 26. In the Upper Hunter region, the Project is projected to increase GRP by \$599.1 million in NPV terms. GRI or regional welfare, is projected to increase by \$427.8 million in NPV terms. The projected increase in GRI is significant to the relatively small Upper Hunter region. In total, the Project is projected to increase welfare for each person in the Upper Hunter by \$13,102 in NPV terms.

For NSW, the projected increase in GSP is \$686.4 million in NPV terms. GSI is projected to increase by \$744.9 million.

Table 26: Project economy-wide impacts of the Project, 2020 – 2030

Variable	Description	Upper Hunter	NSW Total
Real GRP/GSP [^]	NPV* - \$m	599.1	686.4
Real GRI/GSI [^]	NPV* - \$m	427.8	744.9
Employment	Average - FTE ^{^^}	69.7	75.2
Real Wages	Average – Per cent ^{^^}	1.31	0.007
Real GRI per person [^]	NPV* - Dollars	\$13,102	\$85

Source: Cadence Economics estimates based on information provided by Mangoola. [^] Real 2018 Australian dollars. * NPV in 2018 Australian dollars based on a 7 per cent real discount rate. ^{^^} Average over the period 2019 to 2030.

Total employment in the region is projected to increase by almost 70 FTE workers on average, lower than the average direct employment, taking into account any of the crowding out in other sectors of the economy. Across NSW, employment is projected to increase by just over 75 FTE.

The analysis above outlines the impacts of the Project over the whole time scale of the proposed development. The Project includes several phases, these include a capital intensive phase, from 2019 to 2022 and an operating-intensive phase from 2023 to 2030. Table 27, provide an account of the economy-wide impacts during each of these phases, for indicative years, for the Upper Hunter region.

The relative impacts do shift during each phase of the MCCO Project. During the capital-intensive phase welfare, as measured by real GRI, in the region is similar in relative size with the GRP. As we move into the operational phases of the MCCO Project, the welfare measure falls in relative size to GRP, showing the impacts of the repatriation of income to other regions.

Table 27: MCCO Project economy-wide impacts to the Upper Hunter SA3, 2020 – 2030

Variable	Description	Capital Intensive 2021	Peak output 2024	Mid-range output 2026	Final year 2030
Real GRP	Deviation (%)	0.34	3.98	3.12	2.54
	\$million (real 2018)	11.2	141.3	116.5	104.6
Real GRI	Deviation (%)	0.33	1.92	1.03	0.49
	\$million (real 2018)	12.4	80.9	46.2	25.2
Employment	Deviation (%)	0.084	0.538	0.512	0.365
	FTE	13.9	91.7	89.2	66.4
Real wages	Deviation (%)	0.560	2.168	1.481	1.082
Real GRI per Capita	Dollars (real 2018)	389.3	2,495.3	1,410.4	758.6

Source: Cadence Economics estimates based on information provided by Mangoola. [^] Real 2018 Australian dollars. * NPV in 2018 Australian dollars based on a 7 per cent real discount rate.

Table 28 outlines the economy-wide impacts to NSW during each phase of the Project.

Table 28: MCCO Project economy-wide impacts to NSW, 2020 – 2030

Variable	Description	Capital Intensive 2021	Peak output 2024	Mid-range output 2026	Final year 2030
Real GRP	Deviation (%)	0.00	0.02	0.02	0.01
	\$million (real 2018)	12.5	163.8	133.0	120.9
Real GRI	Deviation (%)	0.00	0.02	0.01	0.01
	\$million (real 2018)	19.8	159.7	101.3	72.9
Employment	Deviation (%)	0.001	0.001	0.001	0.001
	FTE	24.7	91.9	93.2	67.2
Real wages	Deviation (%)	0.004	0.009	0.007	0.005
Real GRI per Capita	Dollars (real 2018)	2.4	18.5	11.5	7.9

Source: Cadence Economics estimates based on information provided by Mangoola. ^ Real 2018 Australian dollars. * NPV in 2018 Australian dollars based on a 7 per cent real discount rate.

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APPENDIX A: PROJECT INFORMATION – MORE DETAIL

Table 29: Capital expenditure, MCCO Project (NPV* and Undiscounted, \$ million)**

		Undiscounted	NPV	2022	2023	2024	2025	2026	2027	2028	2029	2030
Net MCCO												
Project	\$M	149.6	115.0	35.0	52.5	5.9	-	-	-	-	-	-
On-going	\$M	92.2	56.7	0.9	3.2	9.9	48.4	13.9	4.7	4.2	4.1	0.2
Total		241.8	171.7	35.9	55.8	15.9	48.4	13.9	4.7	4.2	4.1	0.2

Source: Mangoola, Cadence Economics estimated based on information from various sources. * Estimated as the benefits of the Project case less the Baseline case. ** NPV in 2018 dollars based on a 7 percent real discount rate.

Table 30: ROM and Saleable coal output, MCCO Project (Mt – Millions of Tonnes)

		Total	2023	2024	2025	2026	2027	2028	2029	2030
Net MCCO										
Low Ash Thermal	Mt	24.8	3.6	3.8	3.6	2.8	3.2	2.7	2.4	2.8
High Ash Thermal	Mt	16.3	2.2	2.8	2.5	1.7	2.1	1.6	2.3	1.2
Total	Mt	41.1	5.7	6.5	6.1	4.5	5.3	4.3	4.8	3.9
ROM	Mt	52.3	7.2	8.4	7.6	5.8	6.8	5.6	6.1	4.9

Source: Mangoola, Cadence Economics estimated based on information from various sources. * Estimated as the benefits of the Project case less the Baseline case. ** NPV in 2018 dollars based on a 7 percent real discount rate.

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Table 31: Central case assumptions – Total revenue, total costs and Profit

	NPV	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Total Sales	1558.8	0.0	348.1	427.9	400.6	301.2	350.4	283.8	311.8	265.2	0.0	0.0
Asset Sales Revenue	31.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	70.3	0.0	0.0
Operating costs	944.7	0.0	209.5	232.7	189.0	188.4	228.4	200.4	221.1	183.9	0.0	0.0
Decommissioning and closure costs	-8.8	0.0	0.0	0.0	0.0	-36.4	-37.1	0.0	0.0	0.0	40.2	41.0
Rehabilitation	12.8	0.0	0.1	0.5	-0.5	5.1	6.1	4.2	4.3	4.9	0.0	0.0
Other shut-down costs	-1.8	-3.0	-1.7	-1.8	-2.0	-6.2	1.1	0.8	0.0	8.4	6.8	0.6
Depreciation	95.5	0.0	15.0	16.6	21.5	22.9	23.4	23.8	24.2	24.2	0.0	0.0
Royalties	121.0	0.0	26.9	33.2	31.1	23.4	27.2	22.0	24.2	20.6	0.0	0.0
Biodiversity Offsets	1.7	0.0	2.2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Mitigation Costs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Council Rates	2.8	0.0	0.0	0.0	0.0	1.1	1.1	1.1	1.1	1.1	0.0	0.0
Other Government payments/ VPA	2.5	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0
Other Costs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Costs	1170.3	-3.0	252.1	281.2	239.2	199.3	251.1	253.3	275.9	244.1	47.0	41.5
Profit	419.7	3.0	96.0	146.7	161.4	102.0	99.2	30.4	35.9	91.4	-47.0	-41.5

Source: Mangoola, Cadence Economics estimated based on information from various sources. * Estimated as the benefits of the Project case less the Baseline case. ** NPV in 2018 dollars based on a 7 percent real discount rate.

APPENDIX B: SENSITIVITY ANALYSIS – CBA AND LEA

Table 32: Sensitivity analysis of the net benefits of the MCCO Project (NPV*, \$ million)**

	Central Case	Higher Price	Lower Price	Higher Opex	Lower Opex	Higher Capex	Lower Capex	Higher Reservation Wage	Lower Supplier Benefit	Higher Environ. Costs	Worst-case	Best-case	Central Case (4%)	Central Case (10%)
Direct Benefits	173.0	212.8	134.0	164.0	182.1	174.1	172.0	172.2	173.0	173.0	142.5	202.8	216.8	139.5
1. Net producer surplus	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. Royalties, payroll tax and Council rates	129.5	148.7	110.4	129.5	129.5	129.5	129.5	128.7	129.5	129.5	109.6	148.7	162.8	104.1
3. Company income tax apportioned	43.5	64.1	23.6	34.5	52.5	44.5	42.5	43.5	43.5	43.5	32.9	54.0	54.0	35.4
Indirect Benefits	236.6	236.6	236.6	236.6	236.6	236.6	236.6	222.1	223.7	236.6	209.2	249.5	300.4	188.3
1. Net economic benefit to existing landholders	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. Net economic benefit to Local workers	107.6	107.6	107.6	107.6	107.6	107.6	107.6	93.1	107.6	107.6	93.1	107.6	138.3	84.6
3. Net economic benefit to Local suppliers	129.0	129.0	129.0	129.0	129.0	129.0	129.0	129.0	116.1	129.0	116.1	141.9	162.1	103.7
Indirect (Environmental costs)	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.13	1.13	0.93	1.68	0.69
Net Benefits	408.6	448.4	369.6	399.5	417.6	409.6	407.6	393.3	395.7	408.5	350.6	451.3	515.5	327.1

Source: Cadence Economics estimated based on information from various sources. * Estimated as the benefits of the Project case less the Baseline case. ** NPV in 2018 dollars based on a 7 percent real discount rate.

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Table 33: Sensitivity analysis of the net regional benefits of the MCCO Project (NPV*, \$ million)**

	Central Case	Higher Price	Lower Price	Higher Opex	Lower Opex	Higher Capex	Lower Capex	Higher Reservation Wage	Lower Supplier Benefit	Higher Environ. Costs	Worst-case	Best-case	Central Case (4%)	Central Case (10%)
Direct Benefits	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	3.6	2.1
1. Net producer surplus	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. Royalties, payroll tax and Council rates	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	3.6	2.1
3. Company income tax apportioned	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indirect Benefits	90.9	90.9	90.9	90.9	90.9	90.9	90.9	79.7	89.5	90.9	78.3	92.3	116.4	71.7
1. Net economic benefit to existing landholders	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. Net economic benefit to Local workers	76.8	76.8	76.8	76.8	76.8	76.8	76.8	65.6	76.8	76.8	65.6	76.8	98.8	60.4
3. Net economic benefit to Local suppliers	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1	12.7	14.1	12.7	15.5	17.7	11.3
Indirect (Environmental costs)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.1	0.9	1.6	0.7
Net Benefits	92.6	92.6	92.6	92.6	92.6	92.6	92.6	81.4	91.2	92.5	79.9	94.1	118.4	73.1

Source: Cadence Economics estimated based on information from various sources. * Estimated as the benefits of the Project case less the Baseline case. ** NPV in 2018 dollars based on a 7 percent real discount rate.

APPENDIX C: PEER REVIEW REPORT



ENVIRONMENTAL & RESOURCE ECONOMICS

Umwelt (Australia) Pty Ltd
75 York St
Teralba, NSW 2284

Attn: Daniel Sullivan

Dear Mr Sullivan,

I have now completed my peer review of the 'Economic Impact Assessment of the Mangoola Coal Continued Operations Project' (EIA) conducted by Cadence Economics. The report to which I refer is dated June 2019. In this letter I will set out my credentials for conducting the review, the approach I took, my broad findings and a set of conclusions.

Credentials

I have over 40 years experience as an applied economist, working primarily in the resources, environmental and agricultural sectors. I am Emeritus Professor at the Australian National University, a Fellow of the Academy of Social Sciences in Australia and a Distinguished Fellow of the Australasian Agricultural and Resource Economics Society. I currently serve as a member of the NSW Biodiversity Conservation Advisory Panel and the Food Standards Australia and New Zealand Socio-Economic Advisory Board. I have previously served as a part-time member of the NSW Planning Advisory Commission.

Approach

Since agreeing to perform the review in late 2017, I have had the opportunity to review two drafts of material prepared for the EIA. This allowed for an iterative process to be developed between myself and Cadence Economics. Written and oral feedback was provided to Cadence Economics on the drafts. This ensured that any points of contention in the analysis could be discussed and satisfactory solutions developed.

Findings

The EIA has been conducted to be consistent with the framework set out by the NSW Government's 'Guidelines for the economic assessment of mining and coal seam gas proposals' of 2015 (hereafter referred to as The Guidelines). As such, it has involved a cost benefit analysis (CBA) and a local effects analysis (LEA).

The CBA applies a definition of 'the margin' that is appropriate to the context. Care is taken to ensure that the changes resulting from the project are assessed relative to the termination of the existing mine. Furthermore, the principle of 'standing' in the analysis is applied to a NSW-wide assessment, as is specified by The Guidelines. This means that any benefits generated by the mine to those who reside outside of NSW are excluded. The implications of this approach are significant because it means that increased returns to shareholders resulting from the mine are not included in the net benefit estimates because the mine is owned by a foreign entity (Glencore Coal Pty Ltd).

Only the royalty payments made to the Government of NSW (and hence to the residents of the state) and the proportion of company tax receipts that relate to the population of NSW relative to the population of Australia are counted as benefits. Similarly, the external costs of greenhouse gas emissions from the mining operation are apportioned so that only costs to NSW residents are included in the CBA.

The treatment of risk in the CBA is worth noting. Projecting future outcomes in any CBA presents the analyst with challenges. This is particularly the case where prices are involved. In the case of coal mining, the price received in the future is unknown and problematic to predict with accuracy. The Cadence analysis adopts a two stage process to address this task. First, the specific quality characteristics of the coal to be mined are noted and differences in prices for the different grades are estimated. Second, a sensitivity analysis is performed that takes into account possible variations in future prices across the different grades. The sensitivity analysis demonstrates the variation in the overall net present value of the proposed project given price fluctuations. The advantage of this approach is that a ‘worst case scenario’ can be considered, under which prices received (and hence benefits enjoyed) are at their lowest levels. From this, policy analysts can assess if project approval exposes the state to an unacceptable risk.

The treatment of external costs (beyond those relating to greenhouse gas emissions already noted) is also an area of analysis that is sometimes contentious in CBA. The Cadence approach is to rely on regulations applying to the proposed mine that require actions to be taken that mitigate external (environmental) costs such as those caused by noise, dust and biodiversity loss. Hence, the external costs are ‘internalised’ to the mine’s establishment and operating costs. The assumption made is that the regulations ensure a perfect avoidance or ‘offsetting’ of any damage caused. Measures include the acquisition of impacted properties and the purchase of biodiversity offsets. While the assumption of perfection is likely to be inadequate, the residual of any damage is unlikely to be material to the outcome of the CBA.

The estimation of ‘indirect benefits’ conducted in the EIA is consistent with The Guidelines. While it is my professional opinion that The Guidelines are incorrect in attributing a proportion of the costs associated with the employment of labour and material in a project as ‘indirect benefits’ of a project, Cadence Economics has conducted an analysis of those ‘indirect benefits’ that complies with the requirements of The Guidelines and is hence providing information for policy makers that is consistent with the existing expectations of NSW policy makers and their advisers. At least the analysis of ‘indirect benefits’ provides a good indication of the impacts of the increased spending that will result from the project. This is also the case for the Local Effects Analysis which makes more specific forecasts of likely employment effects. Furthermore, the Computable General Equilibrium (CGE) modelling conducted to estimate wider economic effects of the project substantiates these findings and is conducted appropriately.

Conclusions

The Cadence Economics analysis provides sound evidence on which to judge the economic impacts of the Mangoola Coal Continued Operations Project. The CBA (comprising the direct benefits assessment and the indirect costs assessment) shows that even under the most pessimistic

assumptions regarding the key model parameters, the proposed project will provide a positive net present value to the people of NSW. In other words, the CBA shows that the proposed continuation of mining at Mangoola will generate a net improvement in the well-being of the people of the state. This conclusion is drawn without reference to the analysis of the 'indirect benefits'. Following the approach taken by The Guidelines, and followed in the EIA, the inclusion of the 'indirect benefits' enhances this conclusion. The EIA also demonstrates through the LEA and CGE modelling that the proposed project will have significant and positive economic impacts on the local region and the wider NSW economy.

I am confident in recommending the EIA conducted by Cadence Economics as a sound basis on which planning decisions can be made regarding the Mangoola Coal Continued Operations Project proposal.

Yours sincerely



Emeritus Professor Jeff Bennett, Principal
20 June 2019