APPENDIX R

Appendix R - Economic Impact Assessment

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ECONOMIC IMPACT ASSESSMENT OF THE TAHMOOR SOUTH PROJECT

TAHMOOR COAL PTY LTD

18 DECEMBER 2018

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General reliance restriction

This report is prepared for Tahmoor Coal Pty Ltd. The purpose of this report is to provide an economic impact assessment of the Tahmoor South 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

Tahmoor Coal Pty Ltd (Tahmoor Coal) is seeking approval under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for an extension of underground coal mining and associated activities at the Tahmoor Mine. The proposed development, the Tahmoor South Project is in the Wollondilly local government area of NSW.

Tahmoor Coal is owned by SIMEC Mining, a wholly owned subsidiary of the GFC Alliance.

The proposed development is to continue longwall mining from the Bulli seam into the Tahmoor Central Domain. The proposed development will result in an additional 48 million tonnes (Mt) of run-of-mine (ROM) coal, at an extraction rate of up to 4.0 million tonnes of ROM coal per annum.

Pre-mining activities are proposed to commence in late 2019, with longwall mining to start in the Central Domain in approximately 2022, upon completion of mining in the current Tahmoor North area. Production at Tahmoor South will continue to around 2035.

The coal will be processed at Tahmoor Mine's existing Coal Handling and Preparation Plant (CHPP), and coal clearance facilities, and then transported via the existing rail infrastructure to Port Kembla and Newcastle (from time to time) for both domestic users and international export.

This report provides an Economic Impact Assessment (EIA) for the proposed development 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. The analysis is also consistent with the *Technical Notes supporting the Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals* (the Technical Notes) published in April 2018.

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 proposed development to NSW. The LEA is based on analysis for the Wollondilly local region (as defined by the Australian Bureau of Statistics SA3 (12303) region).

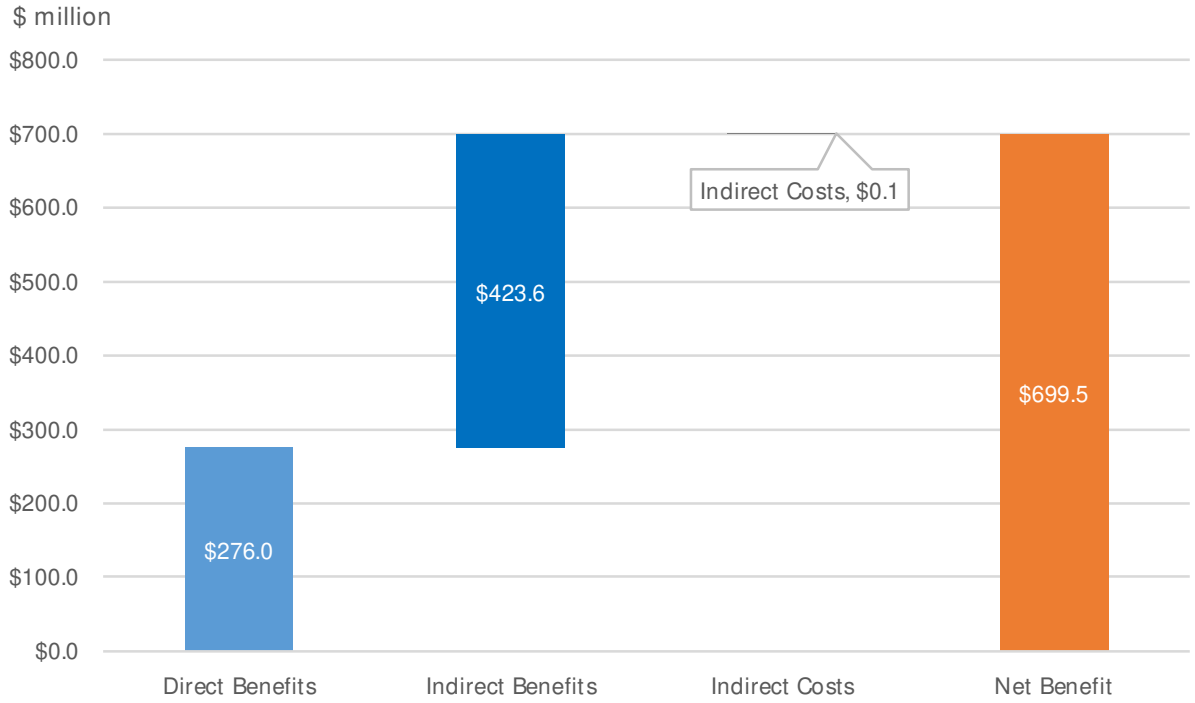
Results of the CBA

Based on the CBA methodology outlined in the Guidelines, and information provided by Tahmoor Coal, the proposed development is estimated to provide a net benefit to NSW. This net benefit is estimated to be $699.5 million in net present value (NPV)[1] terms, as shown in Figure 1. This is comprised of $276.0 million and $423.6 million in direct and indirect benefits respectively. Indirect costs of the proposed development are $0.1 million.

[1] All NPV figures reported are in real 2017 Australian dollars based on a 7 per cent real discount rate (unless otherwise stated).

These estimates are based on central case assumptions in relation to the proposed $310.8 million capital expenditure in NPV terms (both project capital and sustaining capital) and average coal prices of $169 per tonne and $84 per tonne for hard coking coal and thermal coal respectively.

Figure 1: CBA summary of the proposed development under central case assumptions (NPV*)



Source: Cadence Economics estimates based on the EIS. and information provided by Tahmoor Coal. * Net Present Value in real 2017 Australian dollars calculated over the period 2017 to 2035 using a 7 per cent real discount rate.

The ***direct benefits*** of the project are a function of the profitability of the proposed development which, in turn, depends on the prevailing coal price. The analysis shows that the combination of relatively high value of coking coal and relatively low capital, extraction and processing costs underpins the economic viability of the Tahmoor South Project. This results in the proposed development generating:

- An overall net producer surplus of $609.6 million in NPV terms, of which ***zero*** is attributed to NSW as Tahmoor Coal is assumed to be 100 per cent foreign owned;
- Total corporate taxes of $307.1 million in NPV terms for Australia, of which $98.3 million is attributed to NSW; and
- $177.7 million in other government revenue for NSW in NPV terms, the largest component of this being royalties of $149.1 million with council rates and payroll taxes contributing $7.0 million and $21.7 million respectively.

The ***indirect benefits*** of the project are related to the linkages that the proposed development has to the NSW economy through both the labour market and suppliers. The analysis shows that of the $423.6 million in estimated indirect benefits:

- Worker benefits are $212.2 million in NPV terms attributable to an average employment of 353 Full Time Equivalent (FTE) workers over the period of the proposed development, which peaks at 422 FTE over the period 2023 to 2035; and
- Supplier benefits are $211.4 in NPV terms based on NSW-based operational expenditure over the life of the development of $1047.5 million.

The incremental indirect costs of the project are $0.1 million, attributed to greenhouse gas emissions of $0.11 million. Other indirect costs, like subsidence, noise air quality and biodiversity impacts are being borne by the proponent and are included in the financial costs of the Project.

Sensitivity analysis

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 proposed development is most sensitive to the coal price assumptions underpinning the analysis. For example, assuming coal prices are 25 per cent lower than the central case assumptions, the net benefits to NSW are estimated to be $579.8 million in NPV terms (a 17.1 per cent reduction in net benefit).

The lower bound estimate of net benefits, which takes the most pessimistic assumptions around coal prices, capital expenditure, operational expenditure, worker and supplier benefits as well as indirect costs, yields an estimated net benefit to NSW of $497.7 million in NPV terms. The upper bound estimate, based on the most optimistic assumptions, is $859.1 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 relatively long timeframe of the proposed development. The NPV of the estimated net benefits to NSW range from between $533.2 million and $935.6 million under real discount rates of 10 and 4 per cent respectively.
2. Greenhouse gas emissions are only a relatively small proportion of ***indirect costs*** estimated for the proposed development at $101,893 in NPV terms. This is based on attributing the total greenhouse gas emission cost of $94.7 million back to NSW on a population basis.

Results of the LEA

The LEA considers the costs and benefits of the proposed development on residents of the Wollondilly region of NSW. The analysis shows an estimated net benefit of $132.0 million to the Wollondilly region in NPV terms. This is driven largely by:

- Benefits to local workers of $95.5 million in NPV terms based on the assumption that 45 per cent of the mines direct employees continue to be drawn from Wollondilly;
- Benefits to local suppliers of $29.5 million in NPV terms which is based on the assumption that 12.9 per cent of the inputs to production are from the region; and
- The payment of local council rates totalling $7.0 million in NPV terms.

Again, the report shows that the estimated local effects are ***robust*** under the sensitivity analysis conducted with a lower bound estimate of net benefits to the Wollondilly region of $103.4 million and upper bound estimate of $139.5 million in NPV terms.

Economy-wide modelling of the proposed development

The economic analysis in this report is augmented by an estimation of the economy-wide impacts of the proposed development on the Wollondilly region and NSW in total. This analysis is based on an application of a computable general equilibrium (CGE) model. The Cadence Economics General Equilibrium Model (CEGEM) is a large scale, dynamic, multi-region, multi-sector model of the global economy, with an explicit representation of the Wollondilly and rest of NSW economy. CEGEM is based on a substantial body of accepted microeconomic theory.

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. As a CGE model is able to analyse the impacts of the proposed development in a comprehensive, economy-wide framework that captures:

- ***Direct increases in demand*** associated with the proposed investments (short term construction activity) as well as the assumed increased expenditure attributable to continued operation of the mine.
- ***Indirect increases in demand***, or flow-on effects associated with increased economic activity relating to both the construction and operational phase of proposed development.
- ***Labour market displacement*** caused by the direct increase in demand from the proposed development 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 mine to overseas interests as well as through the redistribution of taxation and royalties.

A summary of the projected economy-wide impacts of the proposed development projected by the CGE model is shown in Figure 2 under three separate labour market response assumptions. The zero response assumption is consistent with the CBA assumptions underpinning this analysis. This is equivalent to assuming that the Wollondilly, the surrounding regions and NSW economy are operating

at full employment and, therefore, no new workers are available to service the proposed expansion. That is, workers are drawn from their existing jobs through the offer of higher wages.

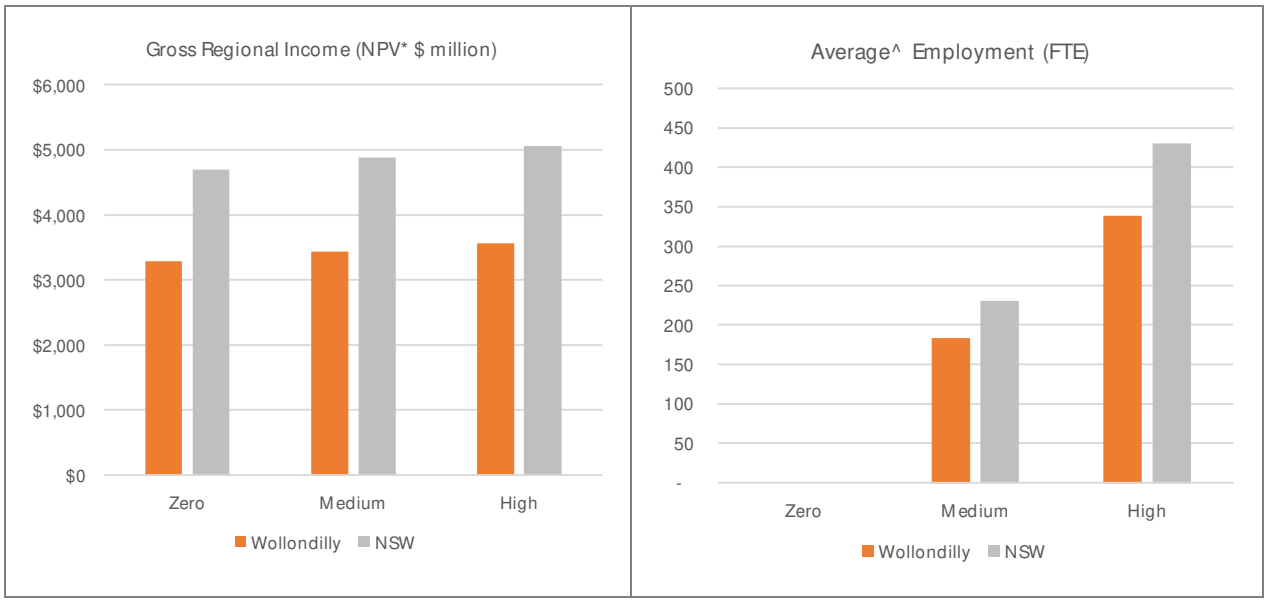
Under the other scenarios, the Wollondilly and NSW economies are operating at below capacity, as evidenced for example by higher unemployment or underemployment, and it is more realistic to assume a relatively more 'elastic' labour supply whereby potential workers are encouraged into the workforce, again through increased wages.

In terms of specifying the elasticity of labour supply, the choice of elasticities are 0.15 under 'Medium' settings and 0.3 under the 'High' scenario which is consistent with recent analysis conducted by the Commonwealth Treasury.

Under each scenario the proposed development is projected to increase gross regional income (GRI), which is a measure of economic welfare, in both the Wollondilly region and NSW broadly. In NPV terms, the projected increase in GRI in the Wollondilly region ranges from $3,288 million under the zero labour supply response to $3,561 million under the high labour response assumption. The increase in projected economic welfare is related to the projected employment which averages 339 FTE under the high labour response assumption (183 FTE under the medium assumption).

The economic benefits of the project accrue to the broader NSW economy. In NPV terms, the projected increase in GRI in NSW ranges from $4,692 million under the zero labour supply response to $5,055 million under the high labour response assumption. The associated employment effects are 430 FTE under the high labour response assumption (231 FTE under the medium assumption).

Figure 2: Projected economy-wide impacts of the proposed development by labour market response



Source: Cadence Economics estimates based information provided by Tahmoor Coal. * Net Present Value in real 2017 Australian dollars calculated over the period 2017 to 2035 using a 7 per cent real discount rate. ^ Average increase in employment over the period 2019 to 2035.

1. Introduction

Cadence Economics was commissioned by Tahmoor Coal Pty Ltd (Tahmoor Coal) to undertake an Economic Impact Assessment (EIA) of the Tahmoor South Project (the proposed development).

This Economic Impact Assessment (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.[2] In consideration of indirect costs, these have been assessed consistently with the *Technical Notes supporting the Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals* (the Technical Notes).[3]

The CBA is presented in Chapter 2 and measures the net benefits of the proposed development to the NSW community. The LEA, which focusses on the benefits accruing to the Wollondilly region is presented in Chapter 3.

In addition to the CBA and LEA, the report also contains an assessment of the economic impacts of the proposed development on the Wollondilly region of NSW based on computable general equilibrium (CGE) modelling. This modelling is presented in Chapter 4.

Description of the proposed development

Tahmoor Coal operates the Tahmoor Mine (Tahmoor) an underground coal mine located 80 km south-west of Sydney within the Southern Coalfields of New South Wales (NSW). Currently Tahmoor operates within the Northern Domain and is approved to extract up to 3 Million tonnes per annum (Mtpa). These operations in the Northern Domain are planned to end by 2022. Approval is being sought to extend operations beyond 2022 to 2035 and expand geographically into the Tahmoor Central Domain (the Tahmoor South Project), as set out in Figure 3.

Tahmoor Coal is seeking approval for the Tahmoor South Project (the proposed development) under Part 4, Division 4.1 (State significant development) of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The proposed development is in the Wollondilly local government area (LGA) of NSW. Whilst a small portion of the Project Area extends into the Wingecarribee LGA, as shown on Figure 3, all activities associated with the proposed development for which approval is sought and as listed below are within the Wollondilly LGA.

The proposed development will utilise the existing surface infrastructure at the Tahmoor Mine surface facilities area, with some upgrades proposed to facilitate the extension. The proposed development will also incorporate the planning for rehabilitation and mine closure.

The Tahmoor South Project proposes to extend underground mining operations at Tahmoor Mine within the Project Area including the following activities:

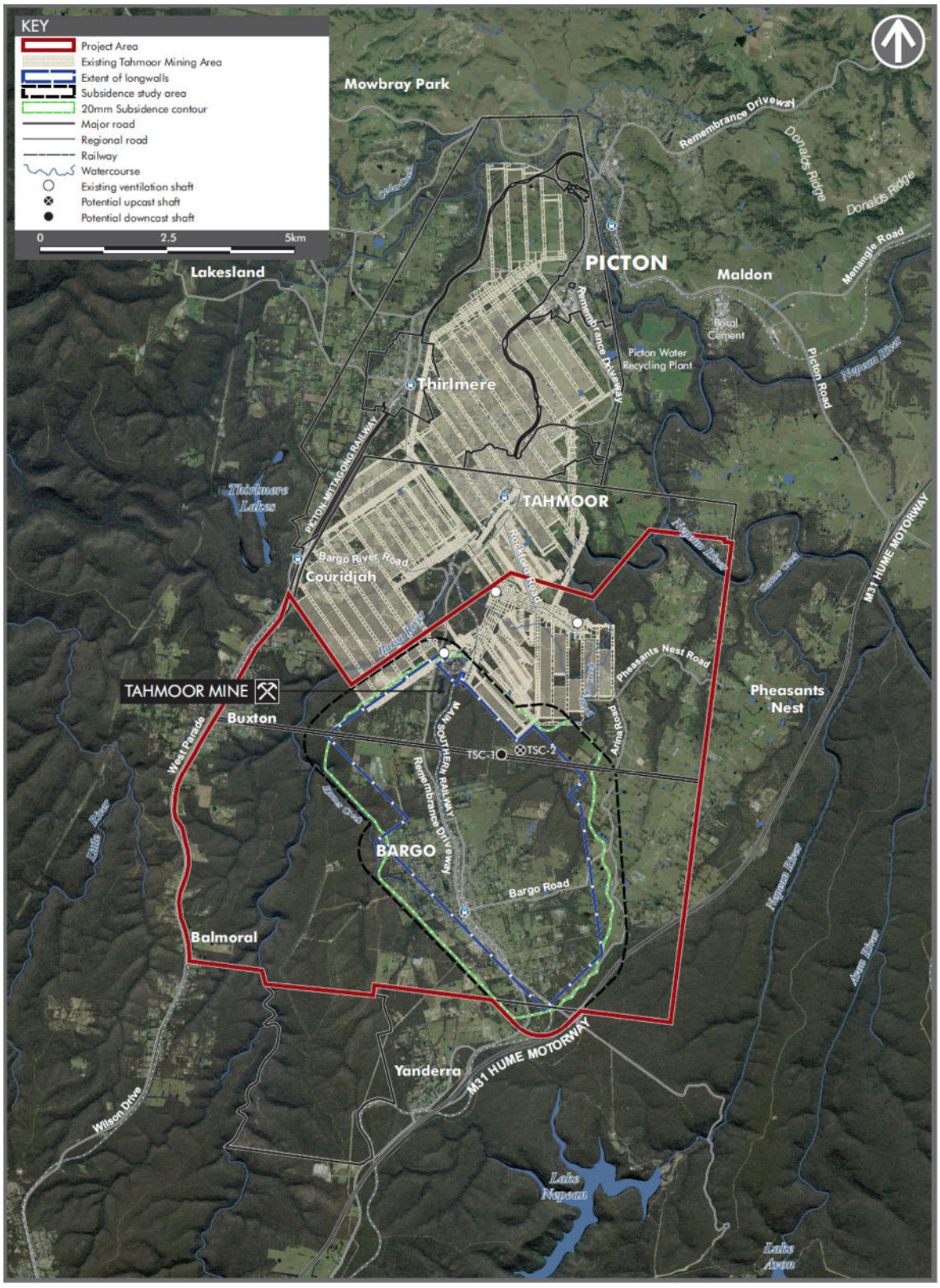
[2] New South Wales Government (2015).

[3] New South Wales Government (2018)

- undertake mine development and mine, using longwall mining methods, in the Bulli seam within CCL 747 and CCL 716, for approximately 13 years;
- extract up to 4.0 Mtpa of ROM coal from longwalls situated within the Central Domain;
- continued use of existing mine ventilation shafts and the construction of two additional mine ventilation shafts;
- process up to 4.0 Mtpa of ROM coal through the existing CHPP;
- transport product coal via rail to Port Kembla Coal Terminal for sale to domestic and international export markets, using the existing rail load out, rail loop rail infrastructure;
- continued use of ancillary infrastructure and services until 2035;
- upgrade and augment the existing surface facilities, amenities, equipment and infrastructure to accommodate the extension of mining; and
- rehabilitate the surface facilities area and associated infrastructure following the completion of mining.

The proposed mining activities and ancillary surface infrastructure associated with the proposed development are conceptually illustrated in Figure 3.

Figure 3: Project Area – Tahmoor South Project



Source: Tahmoor Coal

A summary of the key elements of the proposed development are presented in Table 1. In undiscounted terms, capital expenditure of $342.5 million is required with an additional $132.0 million of sustaining capital. The proposed development is expected to produce additional 47.8 million tonnes (Mt) of ROM output, yielding a total of approximately 38.4 Mt of saleable coal. Of this saleable coal, hard coking coal (HCC) accounts for34.8 Mt with the remainder 3.6 Mt of thermal coal.

Table 1: Summary of operations under the proposed development

	Description of operations
Run-of-Mine	47.8 Mt
Product Coal	38.4 Mt
Coking Coal	34.8 Mt
Thermal Coal	3.6 Mt
Capital Expenditure	In real 2017 Australian dollars, the total capital requirement is $256.8 million (in net present value terms using a real 7 per cent discount rate) or $342.5 million undiscounted
Sustaining Capital	In real 2017 Australian dollars, the total sustaining capital requirement is $54.0 million (in net present value terms using a real 7 per cent discount rate) or $132.0 million undiscounted
Mining Methods	Underground Longwall mining
Mining Rate	Up to, maximum annual ROM Mt of 4.0
Life of Mine	2019-2035 (on current mine schedule)
Operational Workforce	Up to 422 FTE

Source: Tahmoor Coal

The Proponent is seeking approval to extract up to a maximum rate of 4.0 Mt a year. The current mine plan includes a maximum extraction of 3.95 Mt in 2033.

2. Cost-Benefit Analysis

The Guidelines released by the NSW Government in December 2015 set out the cost-benefit analysis (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 2 provides a summary of how these net benefits are measured.

Table 2: 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: • Net producer surplus attributable to NSW • Royalties payable • Company tax attributable to NSW	Includes: • Net economic benefits to landowners • Net economics benefits to NSW employees • Net economic benefits to NSW suppliers	Includes: • Net environmental, social and transport-related costs • Net public infrastructure costs • Loss of surplus to other industries

Source: NSW Government (2015).

The direct benefits are those that accrue to the project 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:

- The EIS prepared by Tahmoor Coal as well as other data provided by Tahmoor Coal including key financial parameters of the Project not deemed to be commercial-in-confidence;
- Various social and environmental consultant reports including:
  - *Tahmoor South Project – Greenhouse Gas Assessment* undertaken by ERM
  - *Social Impact Assessment Tahmoor South Project* undertaken by AECOM
  - *Tahmoor Mine – Tahmoor South Project Longwalls 101 to 109 Subsidence Impact Assessment* undertaken by Mine Subsidence Engineering Consultants
  - *Tahmoor South Project EIS: Groundwater Assessment* undertaken by Hydro Simulations
  - *Tahmoor South EIS Flood Study* by Hydro Engineering & Consulting
  - *Tahmoor South Project Surface Water Impact Assessment* by Hydro Engineering & Consulting
  - *Agriculture Impact Statement Tahmoor Mine, Tahmoor South Project* undertaken by SLR Consulting
  - *Tahmoor South Project Biodiversity Assessment Report* undertaken by Niche Environment and Heritage
  - *Tahmoor South Project – Air Quality Impact Assessment* undertaken by ERM
  - *Tahmoor South Project Noise and Vibration Assessment* undertaken by EMM Consulting

  - *Traffic Impact Assessment for Tahmoor South Project* undertaken by Transport & Urban Planning
  - *Aboriginal Cultural Heritage Assessment Tahmoor South Project – Regulator Document* undertaken by Niche Environmental and Heritage
  - *Tahmoor South Project Historical Heritage Assessment* undertaken by Niche Environmental and Heritage
  - *Tahmoor South Project, Visual Impact Assessment* undertaken by Green Bean Design
- *Energy & Metals Consensus Forecast*, September 2018, Consensus Economics
- Various data from the Australian Bureau of Statistics (ABS) including most recent Census data
- The *Tahmoor Colliery Enterprise Agreement*.

The information underpinning this assessment therefore is a combination of publicly available information and commissioned expert studies assessing the 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.

Base case

The starting point for any CBA is the base case, or counterfactual, that considers all costs and benefits where the proposed development does not proceed.

The Tahmoor Mine currently has approved operations within the Northern Domain. As such, the economic benefits and costs associated with extraction of coal within this approved mine area have been excluded for the purposes of this assessment.

In addition, the operations within the Northern Domain are not expected to be affected by the proposed development. The current mine plan of the approved operations is expected to extract up to 3 Mtpa of ROM Coal over the period 2019 to 2022. This activity is included in the base case and is excluded from this assessment. This assessment considers only costs and benefits additional to this base case activity.

Proposed development – central case assumptions

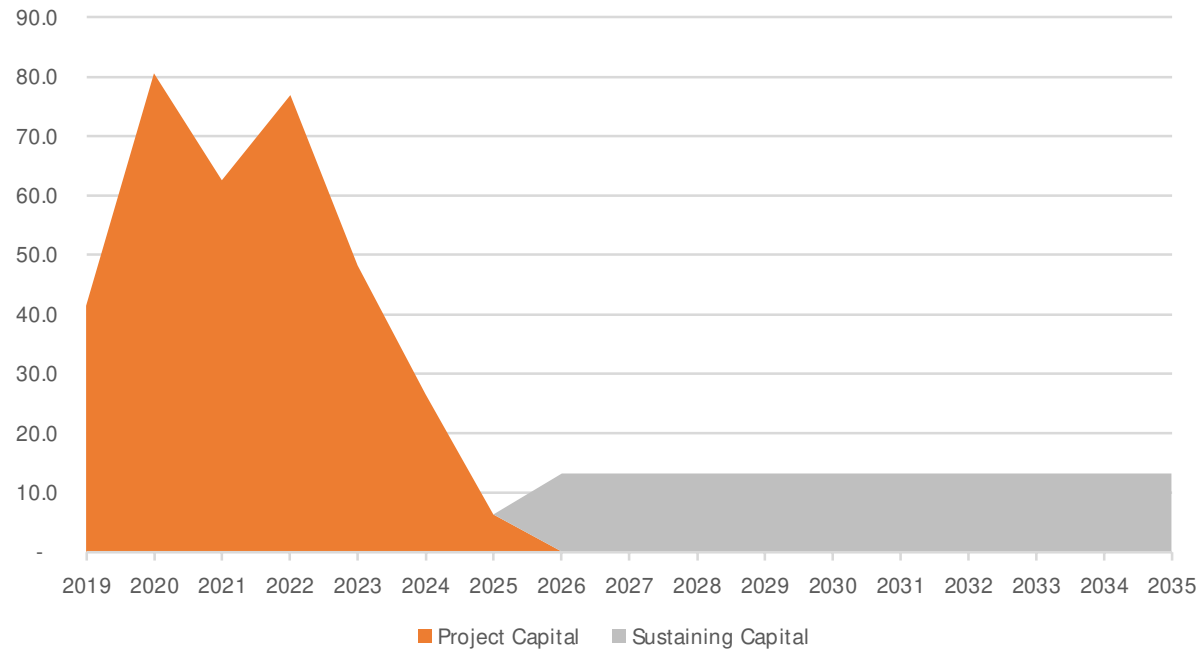
The following analysis sets out the financial assumptions underpinning the proposed development, including the capital expenditure, the output and price assumptions and the operating cost assumptions, including labour input costs and intermediate inputs. These assumptions are used to estimate the direct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

Capital costs

Tahmoor Coal provided Cadence Economics with the capital expenditure profile of the proposed development which is summarised in Figure 4. As shown, the bulk of the planned investment is to take place in 2019 and 2025, which corresponds with the large capital outlays for surface and underground infrastructure.

The underground infrastructure includes underground equipment and infrastructure including a panel recovery unit, underground conveyors, a de-watering system and ventilation. The surface infrastructure includes surface gas drainage pipelines, and ventilation shaft sites. The proposed development does not require additional investment for CHPP infrastructure and transportation, although it is noted some minor upgrades to the CHPP will be undertaken, primarily for the purposes of noise mitigation. Coal processing and washing will be undertaken using existing equipment and transport of coal to Port Kembla will use existing rail infrastructure.

Figure 4: Profile of capital expenditure under the proposed development ($ million^)



Source: Tahmoor Coal. ^ Real 2017 Australian dollars (undiscounted).

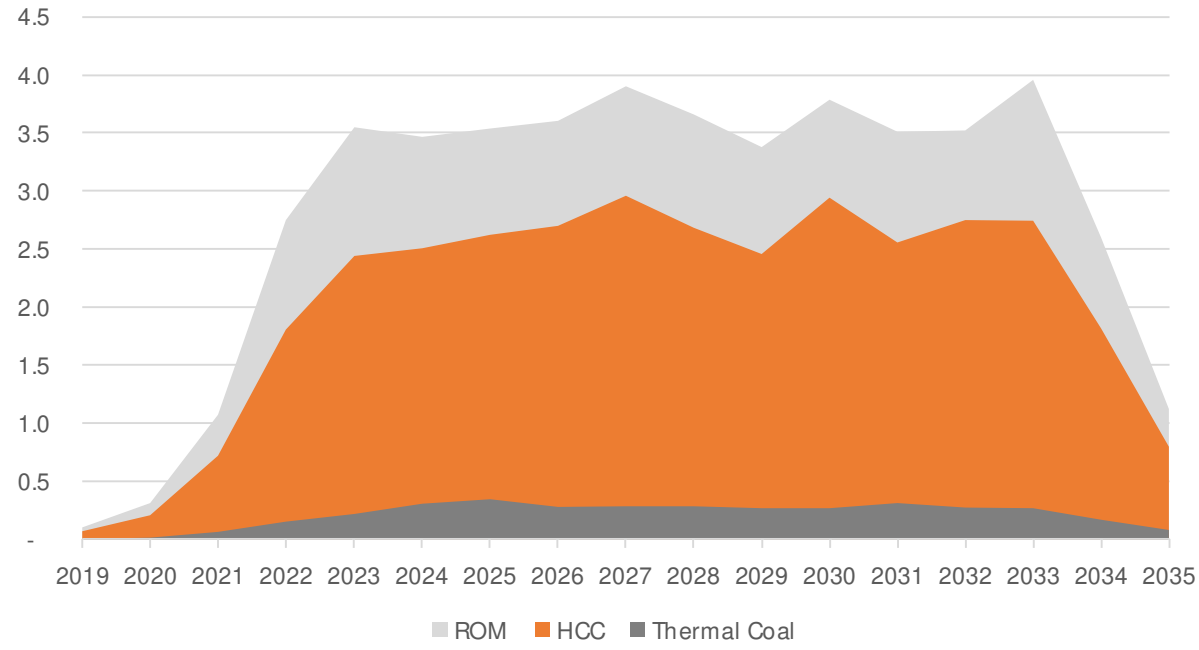
Over the period 2026 to 2035, sustaining capital expenditure is expected to be $13.2 million per year. Over the life of the proposed development, the total capital expenditure is $474.5 million in real 2017 dollars in undiscounted terms. In net present value (NPV) terms, the total real capital expenditure is $310.8 million in NPV terms in real 2017 Australian dollars (based on a 7 per cent real discount rate).[4]

[4] All NPV figures reported are in real 2017 Australian dollars based on a 7 per cent real discount rate (unless otherwise stated).

Production assumptions

Tahmoor Coal provided Cadence Economics with the production figures under the proposed development which are summarised in Figure 5. Production is expected to be approximately 47.8 Mt of ROM during the period 2019 to 2035, under the current mine schedule. Longwall development is expected to take place over the period 2019 to 2021. Once the longwall panels are established, starting in around 2022, extraction rates increase substantially to average 3.3 Mt of ROM coal over the period 2022 to 2035. Under the current mine plan production is anticipated to peak in 2033 at 3.95 Mt of ROM, pending factors such as geological conditions and market factors at the time. The proposed development is largely based on the production of HCC. Over the life of the proposed development, HCC is expected to account for 34.8 Mt of the saleable coal output, with thermal coal accounting for 3.6 Mt.

Figure 5: Key production figures under the proposed development (Mt)



Source: Tahmoor Coal

Price assumptions

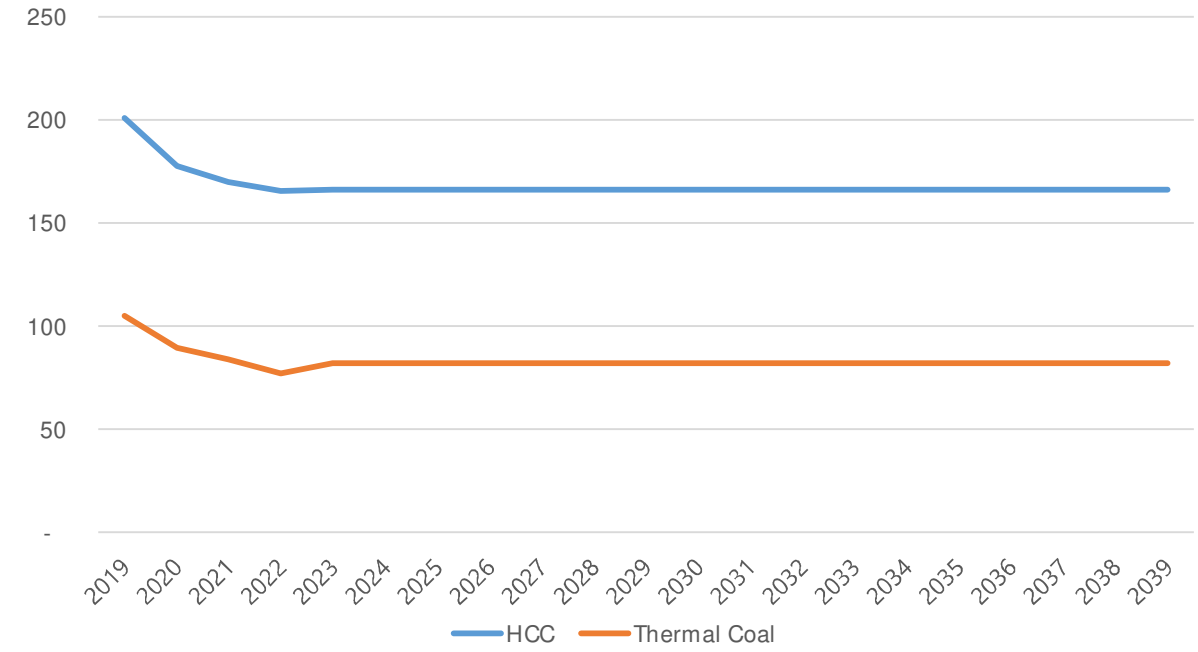
Tahmoor Coal did not provide Cadence Economics with its internal price forecasts for HCC and thermal coal (which is typical for mining companies undertaking this process). Instead, Cadence Economics have drawn on the latest price forecasts from Consensus Economics and other information in order to produce a coal price forecast for both HCC and thermal coal.

Consensus Economics (September 2018) publish a HCC price forecast in nominal US dollars out to 2027. This figure is converted to real Australian dollars using the exchange rate and inflation rate forecasts produced by the Office of the Chief Economist Department of Innovation and Science Resources and

Energy (2018).[5] Over the life of the current plan proposed development (2019 to 2035), the HCC coal price in real 2017 Australian dollars ranges from $201 per tonne in 2019 to $166 per tonne from 2022 onwards, see Figure 6.

Over the same period the average thermal price for project coal is estimated to be $84 per tonne (real 2017 Australian dollars). It is expected that thermal coal from the proposed development will sell at a discount to the reference price, given the higher ash content. The benchmark price for Australian thermal coal includes an ash content of 13.7 per cent. The project's thermal coal has a much higher ash content of 21 per cent, reducing the calorific content of the coal. Given the relatively low quality, thermal is assumed to only fetch 91.5 per cent of the benchmark price.

Figure 6: HCC and thermal coal price assumptions (real 2017 Australian dollars)



Source: Cadence Economics estimates, based on Consensus Economics forecasts

Projected revenue and project financials

Based on the production assumptions outlined in Figure 5 and the and real price assumptions in Figure 6, the proposed development is expected to generate real revenue of just over $6,080.0 million over 17 years in undiscounted real 2017 Australian dollars. This equates to $2,985.5 million real revenue in NPV terms as shown in Table 3 (this table shows selected years; full results are presented in Appendix A). In the context of this analysis, these are deemed to be ***central case assumptions***, and subject to sensitivity analysis later in this report.

[5] The exchange rate and inflation rate assumptions are outlined in Table22 in Appendix A.

Table 3: Central case assumptions – revenue projection (selected years)

	Total	2020	2025	2030	2032	2035
Production (Mt)	38.4	0.23	2.97	3.21	3.02	0.88
Hard Coking Coal	34.8	0.21	2.62	2.94	2.75	0.80
Thermal Coal	3.6	0.02	0.35	0.26	0.27	0.08
Real price^						
Hard Coking Coal		177.5	166.2	166.2	166.2	166.2
Thermal Coal		89.7	82.1	82.1	82.1	82.1
Total Revenue^ ^	6,080.0	38.6	463.9	511.0	479.6	139.3
Total Revenue (NPV*)	2,985.5					

Source: Cadence Economics estimates ^ Real 2017 Australian dollars. ^ ^ Undiscounted. * NPV in 2017 Australian dollars based on a 7 per cent real discount rate.

Based on information provided by Tahmoor Coal, the operating costs for the proposed development are summarised in Table 4. In addition to operating revenue of $2,985.5 million in NPV terms, asset sales at the end of the development's life are expected to yield $33.0 million dollars (undiscounted), $9.1 million in NPV terms. This results in total revenue from the proposed development of $2,994.6 million in NPV terms.

Operating costs are estimated to be $1,574.1 million in NPV terms. Additional costs include: biodiversity offset of $19.7 million, subsidence mitigation of $11.8 million and rehabilitation costs at $5.4 million in NPV terms.[6] This yields net revenue of $1,383.6 million in NPV terms. In terms of other costs:

- Depreciation is calculated using the straight-line method, assuming zero residual cost of capital (which is consistent with the standard Tahmoor Coal treatment);
- Royalties are based on standard NSW Government royalty rates of 7.2 per cent *ad valorem* for underground mines above 400 metres. A discount of $3.50 per ROM tonne is applied for washing as is allowed by the NSW Government;
- The estimated council rates data was provided by Tahmoor Coal; and
- Company tax payments are estimated by Cadence Economics.

Based on this data, the proposed development is estimated to generate an after-tax profit of $716.6 million in NPV terms. These are deemed to be ***central case assumptions***, and subject to sensitivity analysis later in this report.

[6] In 2036, following the mine closure, a program of rehabilitation will begin. This program will take a number of years to complete. For the purposes of this assessment it is conservatively assumed that all rehabilitation costs, $19.5 million in real 2017 Australian dollars (undiscounted) will be incurred in 2036.

Table 4: Central case assumptions – project financials (selected years, $ million^)

	Total (NPV*)	2020	2025	2030	2032	2035
Operational revenue	2,985.5	38.6	463.9	511.0	479.6	139.3
Asset Sales Revenue	9.1	-	-	-	-	-
Total Revenue	2,994.6	38.6	463.9	511.0	479.6	139.3
Operating Costs ($m)^ ^	1,574.1	18.9	248.0	268.3	252.9	73.6
Biodiversity - Offsets	19.7	-	-	-	-	-
Subsidence Mitigation	11.8	-	0.9	3.0	4.8	-
Other Mitigation costs	-	-	-	-	-	-
Rehabilitation Costs	5.4	-	-	-	-	-
Net revenue ($m)	1,383.6	19.7	214.9	239.7	221.9	65.7
Depreciation	203.7	7.5	23.6	32.2	36.6	43.2
Royalties	149.1	2.0	23.0	25.6	23.9	7.0
Council rates	7.0	0.8	0.8	0.8	0.8	0.8
Company Tax	307.1	2.9	50.2	54.4	48.2	4.5
Total Profit	716.6	6.7	117.2	126.9	112.4	10.4

Source: Cadence Economics estimates based on information provided by Tahmoor Coal. ^ Figures reported at selected years are in undiscounted 2017 Australian dollars. ^ ^ Includes intermediate inputs, labour costs and payroll taxes paid * NPV in 2017 Australian dollars based on a 7 percent real discount rate.

Direct Benefits

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

- The net producer surplus generated by the project that is attributable to NSW.
- 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.

Net producer surplus attributable to NSW

Consistent with the Guidelines, the net producer surplus of the proposed development represents the private benefit, or operating surplus, generated that is attributable to NSW.

Based on the financial information summarised in Table 4 above, and the capital costs of $310.8 million in NPV terms, the proposed development is estimated to generate an operating surplus of $916.7 million in NPV terms. Out of this surplus, $307.1 million in NPV terms is payable in the form of corporate taxes, leaving a net producer surplus of $609.6 million in NPV terms.

In this case, the net producer surplus that is attributable to NSW is assumed to be zero, as shown in Table 5. This is because Tahmoor Coal is 100 per cent owned by SIMEC Mining, part of the Gupta Family Group Alliance (GFG Alliance) with is a private foreign-owned company based in London.

Table 5: Central case - estimate of net producer surplus attributable to NSW ($ million^)

Key data	NPV*
Total revenue	2,994.6
Operating costs ($m)	1,574.1
Biodiversity - offsets	19.7
Subsidence costs	11.8
Other mitigation costs	-
Decommissioning costs	5.4
Net revenue ($m)	1,383.6
Capital costs	310.8
Royalties	149.1
Rates	7.0
Operating surplus	916.7
Company tax^ ^	307.1
Net Producer Surplus	609.6
NSW share of Project ownership	0%
Value of net producer surplus attributable to NSW	-

Source: Cadence Economics estimates based on information provided by Tahmoor Coal. ^ Real 2017 Australian dollars. ^ ^ Based on a 30 per cent company tax rate. * NPV in 2017 Australian dollars based on a 7 per cent real discount rate.

Company tax attributable to NSW

Consistent with the Guidelines, the company tax payments made to the Australian Government are levied on the profits generated under the proposed development as summarised in Table 6. A company tax rate of 30 per cent 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 based on the State's share of population which is 32 per cent.

As summarised in Table 6, it is estimated the proposed development will generate $1,023.8 million in taxable profit in NPV terms over the period 2019 to 2035 (this is an estimate of the accounting profit from which company taxes are calculated). At a company tax rate of 30 percent, the company tax estimate is $307.1 million in NPV terms, of which $98.3 million is attributable to NSW.

Table 6: Central case - company income tax attributable to NSW (selected years, $ million^)

Company tax attributable to NSW	NPV*	2020	2025	2030	2032	2035
Net revenue	1,383.6	19.7	214.9	239.7	221.9	65.7
Depreciation	203.7	7.5	23.6	32.2	36.6	43.2
Royalties	149.1	2.0	23.0	25.6	23.9	7.0
Council rates	7.0	0.8	0.8	0.8	0.8	0.8
Taxable profit	1,023.8	9.5	167.5	181.2	160.6	14.8
Company tax^ ^	307.1	2.9	50.2	54.4	48.2	4.5
NSW Share^ ^ ^	98.3	0.9	16.1	17.4	15.4	1.4

Source: Cadence Economics estimates based on information provided by Tahmoor Coal. ^ Figures reported at selected years are in undiscounted 2017 Australian dollars. ^ ^ Based on a 30 per cent company tax rate. ^ ^ ^ Based on a 32 per cent population share. * NPV in 2017 Australian dollars based on a 7 per cent real discount rate.

Payments to the State and the local Council

Under the proposed development, various payments will be made to NSW Government and the Wollondilly 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 Wollondilly Shire Council. Over the life of the proposed development, a total of $177.7 million in payments are made, in NPV terms (Table 7). This is made up of $149.1 million of royalty payments and $21.7 million in payroll tax. A further $7.0 million is paid in the form of council rates.

Table 7: Central case - total payments to State government and local Council ($ million*)

	NPV
Total operational revenue	2,985.5
Revenue for royalties (including allowable discounts)	2,919.6
Total Royalties paid	149.1
Payroll tax	21.7
Council rates	7.0
Total Payments	177.7

Source: Cadence Economics estimates based on information provided by Tahmoor Coal. * NPV in 2017 Australian dollars based on a 7 per cent real discount rate.

Summary of direct benefits to NSW

Based on the central case assumptions, revenue and cost data described above, the proposed development is estimated to generate $276.0 million in total direct benefits to NSW in NPV terms, as outlined in Table 8.

These benefits are comprised of $98.3 million in company tax attributable to NSW and $177.7 million in NPV terms paid to the State government and Wollondilly Shire Council, in the way of coal royalties, payroll tax and rates.

Table 8: Central case - summary of the direct benefits of the proposed development ($ million*)

	NPV
Net producer surplus attributable to NSW	0.0
Company income tax attributable to NSW	98.3
Payments to the NSW and local Government	177.7
Total financial benefit attributable to NSW	276.0

Source: Cadence Economics estimates based on information provided by Tahmoor Coal. * NPV in 2017 Australian dollars based on a 7 per cent real discount rate.

Indirect Benefits to NSW

Based on the Guidelines, the indirect benefits to NSW of the proposed development 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.

Benefit to workers

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

- Wages earnt 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); and
- Minus the wage difference due to skills and the disutility to work in the mining industry.

Tahmoor Coal provided Cadence Economics with information relating to the overall level of employment under the proposed development and the current *Tahmoor Colliery Enterprise Agreement (2017)*, from which Cadence Economics has estimated the average wages paid at the mine. Over the period of the proposed development, an average of 353 Full Time Equivalent (FTE) workers will be employed, which peaks at 422 FTE between 2023 and 2035 (see Table 9).

Based on analysis of the *Tahmoor Colliery Enterprise Agreement*, Cadence Economics has estimated the average wages paid for project workers. The enterprise agreement sets out the payment conditions including the base number of hours, an hourly rate and several allowances. These allowances and bonuses include:

- Shift allowances for working afternoon (15% allowance) and night shifts (25% allowance)
- ROM bonus structure that pays: $0.0044 per ROM tonne (development) and $0.01 per ROM tonne (longwall)

As a result of the analysis, the average wage for a full-time coal mining employee is currently $135,362 per annum. For the development phase of the project 2019 to 2021 the average wage is $107,472, increasing to $148,369 for the period 2022 to 2035. The increase in wages is largely a reflection of the ROM bonus and the higher extraction rates. This yields a ***total of wages paid*** to employees of $406.7 million in NPV terms.

Table 9: Central case – employee wages under the proposed development (selected years)

	NPV*	2020	2027	2028	2032	2035
Employment (FTEs)		53.7	422.0	422.0	422.0	422.0
Average wage ($ per annum^)		106,597	143,827	146,534	143,644	117,317
Total wages paid ($ million^ ^)	406.7	5.7	60.7	61.8	60.6	49.5

Source: Tahmoor Coal, *Tahmoor Colliery Enterprise Agreement (2017)* and Cadence Economics estimates. ^ Real 2017 Australian dollars. ^ ^ Figures reported at selected years are in undiscounted 2017 Australian dollars. * NPV in 2017 Australian dollars based on a 7 per cent real discount rate.

To measure the ***opportunity cost*** compared to the non-mining sector, we have compared the average wage for mining employment to the average wage paid in NSW. This implies that should the proposed development not go ahead, those who would have been employed at Tahmoor find alternative work at the average wage paid in NSW. The average wage across NSW is $67,010 per annum based on the 2016 Census data (updated to 2017 dollars).

Assuming no disutility of working in mining, this results in an estimated worker benefit of $212.2 million, in NPV terms, over the life of the proposed development. As shown in Table 10, this

calculation is the difference between the total wages paid at mining average wages less the total wages that ***would*** be paid under the average wage prevailing in NSW.

Table 10: Central case – estimated NSW worker benefit (selected years)

Employees	NPV*	2020	2027	2028	2033	2035
Average NSW wage ($ per annum^)		67,010	67,010	67,010	67,010	67,010
Mining wage ($ per annum^)		106,597	143,827	146,534	143,644	117,317
Total Wages Paid ($ million^ ^)						
- All sectors (NSW)	194.5	3.6	28.3	28.3	28.3	28.3
- Mining (Tahmoor)	406.7	5.7	60.7	61.8	60.6	49.5
Estimated worker benefit ($ million^ ^)	212.2	2.1	32.4	33.6	32.3	21.2

Source: Tahmoor Coal, ABS (Table W17) Census (2016) Occupational Total Personal Income (Weekly) by Hours Worked, NSW *Tahmoor Colliery Enterprise Agreement (2017)* and Cadence Economics estimates. ^ Real 2017 Australian dollars.. ^ ^ Figures reported at selected years are in undiscounted 2017 Australian dollars. * NPV in 2017 Australian dollars based on a 7 per cent real discount rate.

In terms of the estimated worker benefits calculated in Table 10 it is important to note that there is no disutility assumed for working in mining.

As shown, there is a significant premium incorporated in mining wages compared with the average wage paid in NSW. 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 cent 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 per cent and a dirty work allowance of 0.23 per cent that may apply to underground workers. To put this into context, First Aid Officer Allowance is 0.76 per cent per day or shift above the standard rate. In addition, the allowances set out in the Black Coal Mining Industry Award 2010 are not in the Tahmoor enterprise agreement.

Given the minor allowances for working in an underground mine, the measurement difficulties associated with measuring these disutilities and the current Tahmoor enterprise agreement we have assumed the disutility for workers under the Project case is zero for the purposes of this analysis but considered in the sensitivity analysis below.

Benefit to suppliers

Consistent with the Guidelines, the economic benefit to suppliers is estimated as a producer surplus generated from goods and services from NSW firms being provided under the proposed development. As summarised in Table 11, based on the input cost data provided by Tahmoor Coal, the proposed

development is estimated to use $1,047.5 million in intermediate inputs supplied from NSW over its life-cycle in NPV terms. Currently, 92.8 per cent of the inputs used at the Tahmoor mine are supplied from NSW-based businesses. For the purposes of this analysis, we have assumed the percentage of NSW-based supply continues under the proposed development.

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 $211.4 million in NPV terms.

Table 11: Central case – estimated supplier benefits

	NPV*
Total intermediate inputs ($ million^)	1,047.5
Gross operating surplus ratio	0.202
Total benefits to suppliers (NPV*)	211.4

Source: Cadence Economics estimates. ^ Real 2017 Australian dollars. * NPV in 2017 Australian dollars based on a 7 per cent real discount rate. * NPV in 2017 dollars based on a 7 percent real discount rate.

Summary of indirect benefits to NSW

Consistent with the Guidelines, the indirect benefits of the proposed development that accrue to workers, suppliers and land owners are summarised in Table 12. The total indirect benefits are estimated to be $423.6 million in NPV terms. The main source of these benefits is $212.2 million to workers and $211.4 million to suppliers in NPV terms. There are no anticipated benefits to land owners as a result of the proposed development.

Table 12: Summary of indirect benefits ($ million^)

Indirect benefits	NPV*
Net economic benefit to workers	212.2
Net economic benefit to suppliers	211.4
Land owner premiums (land sales made above market rates)	-
Total indirect benefit	423.6

Source: Cadence Economics estimates based on information provided by Tahmoor Coal. ^ Real 2017 Australian dollars. * NPV in 2017 Australian dollars based on a 7 per cent real discount rate. * NPV in 2017 dollars based on a 7 percent real discount rate.

Indirect Costs to NSW

Consistent with the Guidelines, a project's indirect costs are classified as the net public infrastructure costs, the estimated loss of surplus to other industries and the net environmental, social and transport-related costs.

Table 13 provides a summary of the proposed developments indirect costs. These include some costs that have been internalised by the proponent including the biodiversity and subsidence impacts and costs that have been assessed qualitatively, like visual amenity. In total indirect costs are estimated to be $42.3 million in NPV terms over the life of the proposed development, which includes $0.1 million of incremental costs that are not internalised by the proponent.

Table 13: Summary of indirect costs impacts ($ million^)

	Assessment type	Total Cost (NPV*)
Community costs		
Greenhouse gas emissions	Quantitative	0.1
Residual value of land	Quantitative	-
Loss of surplus to other industries	Quantitative	-
Net public infrastructure costs	Quantitative	-
Sub total		0.1
Proponent costs		
Biodiversity	Quantitative	19.7
Subsidence	Quantitative	11.8
Ambient noise mitigation	Quantitative	10.7
Sub total		42.2
Total indirect costs		42.3
Other costs		
Transport/ traffic impacts	Qualitative	
Visual amenity	Qualitative	
Water impact - including surface and ground water	Qualitative	
Air quality	Qualitative	
Aboriginal cultural and Historical heritage	Qualitative	

Source: Cadence Economics estimated based on information provided from Tahmoor Coal and various environmental assessments. ^ Real 2017 Australian dollars. * NPV in 2017 Australian dollars based on a 7 per cent real discount rate.

The following section provides more detail on how the environmental costs have been assessed.

Greenhouse gas emissions

The greenhouse gas assessment is outlined in the *Tahmoor South Project – Greenhouse Gas Assessment* by ERM and is used to estimate the indirect costs (for selected years), as shown in Table 14.

The greenhouse gas assessment states that the proposed development will generate almost 14.9 million tonnes of Scope 1 and tonnes of Scope 2 greenhouse gas (GHG) emissions during the operations phase of the proposed development.

To price the GHG emission we have applied the latest carbon price resulting from the most recent (June 2018) auction undertaken by the Clean Energy Regulator (CER) under the Emissions Reduction Fund (ERF).7 The results of this auction yielded an average carbon price of $13.52 tCO2-e abated (or 13.34 in 2017 prices). 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.

[7] The results of this auction are summarised at http://www.cleanenergyregulator.gov.au/ERF/Auctions-results/june-2018 which was accessed in September 2018 for this analysis.

On a global basis, the total estimated GHG cost is $94.7 million in NPV terms. To maintain consistency with the CBA methodology, this figure needs to be attributed to NSW, specifically noting that the economic impacts of climate change are a global phenomenon. It is widely acknowledged that climate change is a global issue and a global externality. Different parts of Australia and the world are predicted to experience different levels of impacts. As a result, apportioning all the costs of climate change impacts associated with the proposed development's greenhouse gas emissions overstates the cost of these impacts to NSW.

One method for doing this, which is consistent with the Guidelines, is to attribute GHG costs based on the NSW population. This results in an attributed GHG cost of $101,892 to NSW in NPV terms.

Table 14: Greenhouse gas emissions

	Total	2020	2025	2030	2035
Tonnes of GHG (Mt)					
Scope 1	13,468,487	259,412	804,712	1,505,012	756,339
Scope 2	1,463,663	9,613	108,478	116,057	34,247
Total	14,932,150	269,025	913,190	1,621,069	790,586
Price Path ($ per tonne^)		13.3	13.3	13.3	13.3
Global Impact (NPV*, $ million^ ^)	94.7	3.6	12.2	21.6	10.5
NSW (NPV*, $ million^ ^)	0.102	0.004	0.013	0.023	0.012

Source: Cadence Economics estimated based on information provided by Pacific Environment. ^ Real 2017 Australian dollars. ^ ^ Figures reported at selected years are in undiscounted 2017 Australian dollars * NPV in 2017 Australian dollars based on a 7 per cent real discount rate.

Subsidence

The development involves the construction and operation of underground mining assets and ancillary surface infrastructure. The underground operations will generate subsidence impacts to natural features and built infrastructure above and near the longwall panels. As outlined in further detail below, the subsidence attributable to the Project can impact other externalities discussed elsewhere in this report, like Aboriginal and historical heritage, surface water and groundwater.

Tahmoor Coal proposes to directly repair the built infrastructure to mitigate subsidence impacts, including repairing houses, rail lines, roads and other infrastructure.

Mine Subsidence Engineering Consultants (MSEC) have undertaken subsidence prediction and impact assessment for the proposed development.

MSEC's analysis concludes the levels of impact and damage to identified natural features and built infrastructure are manageable and can be controlled by the preparation and implementation of a Subsidence Management Plan/Extraction Plan.

To assess the impacts of the mine plan, Tahmoor Coal has estimated the costs associated with the reduced underground mining and reduced subsidence-effected area.

Table 15 provides an account of the mitigation steps proposed. Tahmoor Coal has allocated $25.7 million (undiscounted) to redress the impacts to structures like dwellings, industrial areas and utilities. A further $1.5 million has been allocated to address the impacts to rail.

Table 15: Subsidence mitigation costs

	Total ($ million^)
Structures	25.7
Rail	1.2
Total (Undiscounted)	26.9
Total (NPV*, $ million)	11.8

Source: Tahmoor Coal. ^ Real 2017 Australian dollars. * NPV in 2017 Australian dollars based on a 7 per cent real discount rate.

In total Tahmoor has allocated $26.9 million to mitigate against the cost of subsidence impacts, or $11.8 million in NPV terms. These subsidence mitigation costs are included in the operational costs. The mitigation steps are planned to start in 2024 and will operate for the remainder of the mine plan. It is expected that over 90 per cent of the mitigation will take place between 2024 and 2032.

In addition to mitigating the impacts of subsidence, Tahmoor Coal has taken avoidance measures, discussed above, reducing subsidence and the associated impacts. These avoidance measures were driven in part to pull back the longwalls in the Central Domain from the Metropolitan Special Area (MSA) and away from Dog Trap Creek. The measures reduced the planned ROM coal to be extracted by 2.2 Mt over the period 2023 to 2026. Coking coal and thermal coal output is also reduced by 1.4 Mt and 0.2 Mt respectively over the same period. In total these avoidance measures have reduced revenue by $149.0 million (in NPV terms), or 5.0 per cent of the proposed development's revenue.

Net public infrastructure costs

As discussed above the proposed development will generate subsidence that will impact on built infrastructure in the area. Tahmoor Coal has committed to mitigate against these costs, as it does for the existing operation, including those expected impacts to rail, roads, sewers, potable water telecommunications, power and gas. Because of Tahmoor Coal internalising the costs of subsidence mitigation, it is not expected that owners of public infrastructure will be required to undertake further mitigations or repairs.

As a result, we assess the impacts from net public infrastructure costs to be nil.

Groundwater

A detailed groundwater assessment (GA) has been completed by Hydro Simulations and is outlined in the *Tahmoor South Project EIS: Groundwater Assessment*. The GA concludes that the predicted average groundwater inflow to the Tahmoor South mine workings will be approximately 5 ML/day. Hydro Simulations therefore recommend that the groundwater licence allocation required to cover the predicted annual groundwater take by the Tahmoor South mine will be 2,700 megalitres (ML). Tahmoor Coal currently holds licences for 1,642 ML/a, suggesting Tahmoor will require an additional 1,058 ML/a entitlement.

The GA also assesses the potential impact to three high priority groundwater dependant ecosystems. These include O'Hares Creek and Macquarie Rivulet, which are expected to experience no drawdown impact or baseflow depletion as a result of the Project. The nearby Thirlmere Lakes is predicted to experience groundwater drawdown of less than 0.03 metres due to the operation of the Project.

The GA also outlines the impacts to bores in the region, outlining the bores that might be affected beyond a 2 metre threshold outlined in the NSW Aquifer Interference (AI) Policy. The groundwater model predicts that the Project alone will impact 30 registered bores and four unregistered bores beyond the 2 metre drawdown, with a total number of 94 bores effected when considering the cumulative mining impacts in the region. Tahmoor Coal has committed to 'make good' provisions for the impacted bores, at a cost of about $20,000 for each bore. Consistent with the Technical Notes, the cost of these mitigation steps is included in the operating costs (although an exact figure is not separately identified).

Surface water

A Surface Water Assessment (SWA) has been conducted by Hydro Engineering & Consulting (HEC), their findings are outlined in *Tahmoor South Project Surface Water Impact Assessment*. The SWA has been undertaken in four parts, including;

1. A baseline assessment – assessing the local water characteristics.
2. A Water Management System and Site Water Balance Report – assessing the impacts of the proposed development on the site. Taking into account proposed water management systems over the Project life and assessing any risks.
3. Flood Study – Assessing any effects of the Project on flooding in overlying watercourses and floodplains.
4. Surface Water Impact Assessment Report – outline the potential qualitative and quantitative impacts of the Project.

The SWA has been prepared in accordance with Division 4.1, Part 4 of the EP&A Act and incorporates the requirements of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, and includes detailed agency comments including those from NSW Environment Protection Authority, the NSW Office of Environment & Heritage and Water NSW.

The SWA uses baseline monitoring data to identify and assess potential impacts. In the case of the Project subsidence is the main contributor to these potential impacts. As outlined in the assessment those watercourses that are directly above the longwall panels are exposed to a greater subsidence impact. The maximum predicted reduction in total flow is relatively small in terms of mean daily flow but represents a significant percentage (54.5%) of the average estimated baseflow at Dog Trap Creek and a small to moderate percentage at the Bargo River (4.1%) and Tea Tree Hollow (3.4%). It is expected that reduction in baseflow would be most noticeable during periods of low flow which would normally be dominated by baseflow.

Regarding the impacts to Thirlmere Lakes the SWA concludes that the water levels would decrease by between 0.01 m and 0.06 m and that the level of change is very small compared to the natural variability

in the downstream catchment conditions. This conclusion is drawn from detailed inflow and outflow water modelling of Thirlmere Lakes.

The SWA also assesses the potential impact to the Metropolitan Special Area (MSA) drinking water catchment. The report notes that the Project will involve mining adjacent but not beneath the MSA and the main channel of Cow Creek is located approximately 1 km from the Project longwalls. Subsidence analysis concludes that, at this distance the maximum predicted subsidence, upsidence and valley closure are less than 20 mm. The SWA states that the potential for localised impacts on Cow Creek such as fracturing and surface water flow diversion are extremely low. The SWA concludes that it is extremely unlikely that there could be any identifiable water quality impacts to flow in Cow Creek because longwall mining is sufficiently remote from the creek that the potential for fracturing is extremely low.

HEC also conducted a flood study for the Project, the findings are outlined in *Tahmoor South EIS Flood Study.* The assessment of flooding identified that minor localised increases in flooding are predicted for Dog Trap Creek (upstream) and Teatree Hollow (upstream). Flooding is unlikely to be increased in the Bargo Township as a result of the proposed development, with the exception of minor localised flooding at Dymond Road and Wattle Street. This flooding extent would not impact surrounding residential developments.

Tahmoor Coal is taking several steps to reduce its surface water impacts. As discussed in the subsidence section above Tahmoor Coal has reduced the extent of the proposed longwall panels to reduce the potential impacts on the Metropolitan Special Area (MSA) and Dog Trap Creek.

Drainage enhancement works, including provision of additional drainage culverts or pipes under Remembrance Drive near Caloola Road, are proposed to reduce the impacts associated with the predicted increased flood inundation in this location to minimise potential impacts to urbanised areas in the Bargo township in this area.

Loss of surplus to other industries

The Project is not expected to reduce the output in other sectors of the economy operating in the area, and as a result the Project will generate nil loss of surplus to other industries. In general, losses in other sector may arise when resources used in the operation of the Project could be used in other sectors, such as land or water rights.

A detailed agriculture impact statement has been prepared by SLR Consulting that consider these impacts. The *Agriculture Impact Statement Tahmoor Mine, Tahmoor South Project* (AIS) provides a description of the potential impacts to agriculture. The report considers local climate, hydrology, soil types land use history and water resources. The assessment also includes discussion and analysis of the potential impacts posed by other externalities generated by the Project including noise, air quality, traffic, weed management and biosecurity.

The AIS outlines there are some parcels of land that will be either temporarily or permanently lost to agriculture output. Notably however, there is no land which has been, or is currently used for agriculture, that will be impacted by surface disturbance associated with the proposed development. Approximately

6 hectares of land will be temporarily lost due to surface disturbance for the additional infrastructure required, including the two ventilation fans. SLR Consulting concludes none of this land is currently used or has been used for agricultural production and is either mine disturbed or comprises shallow soils with low inherent fertility. In addition, there is a further 42.5 hectares that will be permanently removed from potential agricultural production as a result of the expansion of the Reject Emplacement Area. Again, SLR Consulting concludes that while the land and soil capability class will be reduced in this area, the land is not being used for agriculture, and that this reduction in land and soil capability class is considered a negligible impact on agricultural enterprises, agricultural employment and related industries in the region.

The AIS also considers the potential impacts from water and water rights. SLR Consulting concludes that surface water flows will have a negligible impact on agricultural enterprises within the region and downstream water quality will not be impacted.

The AIS also considers the Project's groundwater implications and the potential impact to agriculture output, where groundwater entitlements will be purchased from productive agriculture users. Tahmoor Coal advises that these groundwater entitlements exist and will not result in reduced water allocation for agriculture and as a result it is not expected that groundwater will impact agriculture output.

Biodiversity offsets

A biodiversity assessment has been undertaken by Niche Environment and Heritage (*Tahmoor South Project Biodiversity Assessment Report).* The assessment identified several offset requirements for both vegetation communities and species that will be impacted by the Project. The obligation to mitigation against these potential impacts arise under NSW and Commonwealth laws. This economic assessment measures the costs required to meet these obligations. Tahmoor Coal has advised that these obligations will be met through undertaking a combination of:

1. establishing Biodiversity Stewardship Agreement sites on land owned by Tahmoor;
2. purchasing credits; and/or
3. Payment in the NSW Biodiversity Conservation Fund.

In total the proposed development requires 44,063 biodiversity credits, as outlined in

Table 16. Developing Tahmoor-owned parcels of land will generate an estimated 231,778 credits and the remaining 7,840 will be purchased through the NSW BioBanking system.

For example, of the 2,246 total credits required to mitigate against the impacts to HN556, 399 credits will be generated through the current land holding and 1,847 will be purchased through the BioBanking system. Some of the species-related offset requirements, like the Koala and the Large-footed Myotis will be met wholly by generating credits at the land currently owned by Tahmoor Coal.

Table 16: Biodiversity credit requirement and cost

Credit Requirement	Credits Generated	Credits Required	Credits required for purchase
HN556 - Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum	399	2,246	1,847
HN564 - Red Bloodwood - Grey Gum	247	287	40
Persoonia bargoensis	1,747	7,700	5,953
Grevillea parviflora subsp. parviflora	226,831	32,536	0
Large-footed Myotis	425	163	0
Koala	2,129	1,131	0
Total	231,778	44,063	7,840

Source: Niche Environment and Heritage.

In total Tahmoor will spend $32.7 million (undiscounted), on the biodiversity offset strategy, as outlined in Table 17. Of this, $3.3 million will be spent to establish the four parcels of land owned by the company as biodiversity offset sites and $29.4 million in credits. Establishing these parcels will involve reporting on site condition, site survey, assessment and inspection. An additional $23.3 million for ecosystem credits and $13.7 million for species credits will be spent purchasing credits through the NSW BioBanking system.

Table 17: Biodiversity credit requirement and cost

Credit Requirement	Credits required	Credit cost^	Total cost ($ million)
Ecosystem credits			
HN556	1,847	11,000	20.3
HN564	40	5,000	0.2
Sub total			20.5
Species credits			
Persoonia bargoensis	5,953	1,500	8.9
Sub total			8.9
Total Credits			29.4
Biodiversity reports and site establishment			3.3
Total (Undiscounted)			32.7
Total – NPV* ($ million^)			19.7

Source: Niche Environment and Heritage. ^ Real 2017 Australian dollars. * NPV in 2017 Australian dollars based on a 7 per cent real discount rate.

The Biodiversity report also specifies that the Project credit requirements and the credits generated will be phased over seven years in two separate phases. Tahmoor Coal advises that the first stage will take place in 2021 and the second stage in 2028. The biodiversity offset strategy will cost $14.3 million in 2021 and $18.4 million in 2028, or $19.6 million in NPV terms.

In addition to the biodiversity offset strategy Tahmoor Coal is also taking a number of avoidance and mitigation steps to reduce the Project's impacts. These measures include the diversion of a planned power line through a population of Epacris purpurascens var. purpurascens was removed from the

Project and the REA was redesigned to minimise the potential impacts on a number of species Persoonia bargoensis and Grevillea parviflora subsp. parviflora, and was moved away from Tea Tree Hollow Creek and the population of Pomaderris brunnea.

The cost of meeting the biodiversity requirements are included in the Direct Costs.

Air quality

The Air Quality Assessment (AQA) has been undertaken by ERM, and the findings are outlined in the *Tahmoor South Project – Air Quality Impact Assessment* report. The AQA includes a discussion of the Project's particulate matter output of less than 10 micrometres in diameter (PM_{10}) and less than 2.5 micrometres in diameter ($PM_{2.5}$).

The assessment also outlines the emissions of Total Suspended Particulates (TSP), odour and other gas pollutants like Nitrogen Dioxide (NO_2), Carbon Monoxide (CO) and Hydrocarbons (HC). The assessment sets out the local conditions including meteorology, climatic conditions and existing air quality.

The assessment is informed by a number of monitoring stations located in the region and uses The Air Pollution Model (TAPM) and dispersion modelling to predict the Project's air quality impacts. In addition, the report measures these findings against the relevant EPA assessment criteria. In addition, ERM has incorporated into the air quality modelling the mitigation steps taken by Tahmoor Coal to reduce the Project's air quality impacts.

These mitigation steps include

- Unsealed Roads: watering with a water truck daily and applying a chemical dust suppressant once a month (or more is required).
- Sealed Roads: operators to avoid overloading to minimise spillage, minimise haulage distances, cover loads (where required).
- Exposed areas: Watering with a water truck daily, if dusty conditions are detected which require watering, personnel to contact CHPP Control Room to nofity water truck. Areas not needed are sealed and/ or re-vegetated.
- Stockpiles (ROM, product and topsoil) to be watered using automated water sprays triggered by wind speed monitoring. Regular visual inspection, revegetation of topsoil (on a risk based approach) and reduced vehicle traffic and speed around stockpiles until dust controls are implemented.

A Full list of the mitigation steps are outlined in the AQA. Consistent with the Technical Notes, the cost of these mitigation steps is included in the operating and capital costs (although an exact figure is not separately identified).

The AQA concludes that the Project alone does contribute to $PM_{2.5}$ emissions, although it is unlikely to be any project-related exceedances of the 24-hour or annual average $PM_{2.5}$ levels compared to the EPA assessment criteria.

Regarding PM_{10}, no receptors are predicted to experience exceedances of annual average PM_{10} against the relevant EPA assessment criteria. The AQA does note that, one private receptor (R10) is predicted to experience maximum 24-hour average PM_{10} concentrations above 50 $\mu g/m^3$, due to the Project's operations alone. This exceedance is predicted to occur on only one day during the year. However, with the incorporation of the TARPs and other dust management practices, these exceedances would be well managed.

In addition, the potential NO_2, CO and HC impacts from flaring are all well below their respective EPA criterion. Results from the odorous emission assessment predict no exceedances of the relevant EPA criterion at the nearest sensitive receivers. However, there may be peak periods where higher concentrations may be detected at the close receptors.

The potential impacts are qualitatively acknowledged in this economic assessment.

Ambient noise

The Noise Impact Assessment (NIA) has been undertaken by EMM Consulting, *Tahmoor South Project Noise and vibration impact assessment*, in accordance with a number of NSW Government Guidelines including the EPA's *Industrial Noise Policy* and *Noise Policy for Industry* and the *Voluntary Land Acquisition and Mitigation Policy For State Significant Mining Petroleum and Extractive Industry Developments*.

To assess the impacts of the proposed development the NIA takes the following steps:

1. Measure and determine existing background and ambient noise levels.
2. Measure and predict noise levels produced by Tahmoor Mine, having regard to meteorological effects such as from wind and temperature inversion.
3. Determine project-specific noise levels (PSNL) from intrusive and amenity noise criteria.
4. Compare the measured and/or predicted noise levels from the site with the PSNL.
5. Where the PSNL are exceeded, assess feasible and reasonable noise mitigation strategies.
6. Determine achievable noise limits for the site. Describe the noise reduction measures to be implemented and their proposed timing.

The economic assessment of the noise impacts takes into account the measures taken and the costs incurred by the proponent to reduce noise impacts to the community, in addition, we qualitatively assess the residual noise impacts.

The NIA outlines that the proposed development will contribute to noise on-site, from the CHPP and dozers and off-site from rail loading activity, compressors and reject haul trucks. The mitigation steps for each of these sources are addressed in the NIA, including the mitigation decision-making matrix used to reduce noise impacts.

Tahmoor Coal is taking a number of steps to reduce the noise impact on local residents. Over the period financial year 2020 to 2023 Tahmoor has allocated $12.8 million (undiscounted) for noise mitigation works, these include noise improvement works, purchases and noise agreements. Consistent with the Technical Notes, the cost of these mitigation steps is included in the capital costs (with an exact figure separately identified).

The NIA outlines specifically a number of anticipated feasible and reasonable mitigation options that a will be completed within three years of physical commencement of the Tahmoor South Project. These include;

- At-source measured like the purchase of new, quieter haul trucks, improved feed chute into rail wagons
- Control measures like barrier around the coal stockpile
- Mitigation at the receptor, including two residence on Charlies Point Road.

The NIA concludes that the mitigated Tahmoor South Project will result in improved noise emissions compared to existing operations at all but the two residences. Mine noise at other receptors, for example the Anglican Church and school are predicted to achieve the relevant internal amenity noise levels.

The costs incurred by the Tahmoor Coal to reduce noise emissions and to mitigate those properties impacted is included in the capital expenditure outlined above.

Transport

The Project is expected to generate additional traffic as a result of employee and truck movements from the mine site. The *Traffic Impact Assessment for Tahmoor South Project* (TIA) prepared by Transport & Urban Planning outlines the Project's traffic impact. The TIA analysis was conducted on a previous mine specification that included significantly higher employment levels. For example, under the current mine plan assumptions, it is expected the Project will employ 422 workers in 2027, where the assumed employment levels for the TIA is 462. As a result the traffic impacts set out below can be considered a high-side estimate.

The TIA models the traffic impacts, including movements and wait times for 2020 and 2027. The TIA outlines the potential impacts during the weekday morning peak 7.45am – 8.45am and the evening peak 3.30pm to 4.30pm.

The TIA models the Project's traffic impacts on two junctions alone Remembrance Driveway:

1. Tahmoor Mine access road,
2. Avon Dam Road Rail Bridge to the south of the town of Bargo.

The Project also includes an upgrade to Tahmoor Mine access road and Remembrance Driveway to improve road safety, in particular with regards to rear end collisions.

The TIA concludes that the Tahmoor Mines access road will maintain satisfactory to good operation in terms of level of service and vehicle delay, for both morning and evening peak times and for the two representative years modelled. For example, in 2020, morning peaks times the average delay in seconds increases from the existing 0.9 seconds to 1.2 seconds, an increase of 0.3 seconds. Similar increases are reported for 2020 evening peak times and for 2027.

At the Avon Dam Rail Bridge intersection, it will experience minimal impact in 2020. In 2027 the TIA concludes that in the morning peak this intersection will experience good to satisfactory operation, but will have reduced capacity in the afternoon peak hour, due to increases in background traffic. For example, in 2027 afternoon peak hour delays increase from 19.6 seconds in the base case to 21.8 seconds with the Project, an increase of 2.2 seconds.

The TIA analysis indicates relatively minor increases in wait times, and any increase in wait time cause by the Project is unlikely to have a material impact on residential and commercial road users. As a result, the traffic impacts are qualitatively assessed and are likely to be negligible.

Aboriginal Cultural Heritage

Niche Environmental and Heritage has undertaken an Aboriginal Cultural Heritage Assessment for the Project. The assessment, as outlined in *Aboriginal Cultural Heritage Assessment Tahmoor South Project – Regulator Document*, has been undertaken in accordance with the relevant guidelines, in consultation with several Aboriginal groups and individuals and included a detailed survey of the Subject Area.

As outlined in the assessment there are 41 Aboriginal heritage sites (comprising 40 physical sites and one Aboriginal dreaming story) identified within the broader Project Area. Of these, 31 are located within the Subsidence Study Area. Most of the sites in the Project Area (34 of 40) have low scientific significance. Two sites were assessed as having moderate scientific significance and a further four of high scientific significance, see Table 18.

Table 18: Aboriginal Heritage – sites with Moderate – High Significance

Site	Description	Significance rating	Impact
Dogtrap Creek (52-2-1524	Shelter with art	Moderate	Potential subsidence with partial loss of value
Dogtrap Creek (52-2-1527)	Shelter with art	Moderate	As above
Dogtrap Creek (52-2-1523),	Shelter with art	High	As above
Dogtrap Creek (52-2-1525)	Shelter with art	High	As above
Dogtrap Creek (52-2-1528)	Shelter with art	High	As above
Dogtrap Creek (52-2-1529)	Open camp site	High	As above

Source: Niche Environment and Heritage

Of the sites identified in the Project Area, one is within an area proposed to be disturbed by the project for the construction of surface infrastructure (the proposed ventilation fan site TSC2). This site has been assessed as being of low scientific significance. The sites of moderate to high scientific significance rating have potential to be impacted through subsidence from the longwalls located below the sites, or in close proximity to the sites. None of these sites will be impacted by disturbance for surface infrastructure.

Niche has recommended the development of a Heritage Management Plan to set in place the mitigation and management measures outlined in their Aboriginal Cultural Heritage Assessment. Niche outlines a number of steps that should be included in the Heritage Management Plan, including a communications

protocol between Tahmoor and the Registered Aboriginal Parties, a subsidence monitoring program and a Trigger and Action Response Plan specific to each of the site monitored.

The potential impacts with partial loss to Aboriginal heritage are qualitatively acknowledged in this economic assessment.

Historical Heritage

Niche Environmental and Heritage has undertaken a Historical Heritage Assessment (HHA) for the Project. This assessment, outlined in *Tahmoor South Project Historical Heritage Assessment,* has been undertaken in accordance with the relevant guidelines as outlined in the *NSW Heritage Manual 1996* and included:

- background research
- heritage register searches
- visual inspections of heritage items likely to be affected by the Project
- a preliminary significance assessment
- an impact assessment using mine subsidence data and
- recommendations for managing impacts from the proposed development.

The HHA identified 23 sites within the Subsidence Study Area. These items include "early roads, a mid-to-late nineteenth century homestead, sandstone culverts, a cemetery, numerous timber cottages constructed during the early twentieth century, a railway station, railway bridges and various public buildings including a pub, post office, commercial buildings and a surgery." The majority of these sites are of local significance. One site, the Wirrimbirra Sanctuary is listed on the NSW State Heritage Register, and is of State significance for its historical heritage value, research potential, rarity and associative values.

As outlined in the HHA, Wirrimbirra Sanctuary was created in the 1960s to preserve 'Bargo Brush' and promote the use and propagation of Australian native plants. The sanctuary comprises over 200 acres of preserved native bushland, a hut, a well, two rangers' cottages, an office, a bookshop, amenities and a nursery.

The HHA considers both the potential construction and subsidence impacts of the Project, on the historical heritage items identified with the Subsidence Study Area. No impacts are predicted as a result of the construction of surface infrastructure. The study concludes that the potential impacts on historical heritage predominantly relate to indirect impacts from subsidence. Notwithstanding, the Project is expected to have a minimal impact on the historical heritage in the region, with a low to extremely low likelihood of impacts to heritage items if left untreated.The HHA also includes several recommendations to manage and mitigate the impacts of subsidence on heritage items, these recommendations include:

- preparing a Heritage Management Plans (HMPs) for locally significant heritage items in consultation with land owners and Wollondilly Shire Council; and
- the preparation of a Site-Specific Statement of Heritage Impact report for Wirrimbirra Sanctuary in consultation with land owners and the NSW Heritage Council.

The potential impacts are qualitatively acknowledged in this economic assessment.

Visual amenity

Mining projects may impact the visual amenity to the surrounding community by changing the visual character of the surrounding landscape. A detailed visual impact assessment (VIA) has been undertaken to determine the likely visual significance of the proposed development on the people travelling through or living and working in the area surrounding the proposed development area. The *Tahmoor South Project, Visual Impact Assessment* was undertaken by Green Bean Design was undertaken to:

- assess the existing visual character of the proposed development
- determine the extent and nature of the potential visual significance of the proposed development on the surrounding areas, and
- identify measures to mitigate and minimise any potential visual impacts.

The VIA was based on desktop study, fieldwork and photography, assessment of visual significance and exploring mitigation measures. The VIA notes that the Project is similar in nature to the existing mining activities located within the Project Area. In addition, due to the tree cover and undulating landform the capability of the landscape to absorb the key components of the Project is considered to be high, reducing the potential magnitude of visual significance.

The VIA concludes the Project alone is considered to have a negligible visual effect and significance. Even where the Project is operating in conjunction with other existing or proposed developments, it is considered to have a very limited potential to increase the significance of cumulative visual impact.

The VIA also notes that there may be some temporary impacts from construction activities, although, views towards construction activities will be largely restricted by existing tree cover.

Finally, the VIA report proposes a number of mitigation measures to minimise the level of residual visual impacts. These includes,

- dark-toned structure to minimise reflection and visual contrast
- reduce the use of large flood lighting
- landscape mitigation, including tree cover

Residual value of land

In the absence of additional approvals, and as a result of the mining activities currently located on the site of the proposed development, it is unlikely that further approvals will impact the residual value of land. As such, we have assessed the residual value of land to be zero.

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 proposed development compared against the baseline scenario where the proposed development does not occur. The results are summarised in Table 19.

Based on the CBA methodology outlined in the Guidelines, and information provided by Tahmoor Coal, the proposed development is estimated to provide a net benefit to NSW. This net benefit is estimated to be $699.5 million in net present value (NPV) terms. This is comprised of $276.0 million and $423.6 million in direct and indirect benefits respectively. The incremental indirect costs of the project are $0.1 million. Other indirect costs, like subsidence and biodiversity impacts are being borne by the proponent and are included in the financial costs of the Project.

Table 19: Central case - estimated net benefits of the proposed development ($ 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	177.7		
3. Company income tax apportioned to NSW	98.3		
Total direct benefits	**276.0**	**Total direct costs**	**-**
Indirect benefits		**Indirect costs**	
1. Net economic benefit to landholders	0.0	1. Air quality	-
2. Net economic benefit to NSW workers	212.2	2. Greenhouse gas emissions	0.1
3. Net economic benefit to NSW suppliers	211.4	3. Visual amenity	-
		4. Transport impact	-
		5. Net public infrastructure cost	-
		6. Surface water impact	-
		8. Residual value of land	-
		7. Biodiversity impact^ ^	19.6
		8. Noise impact^ ^	10.7
		9. Loss of surplus to other industries	-
		10. Water	-
		11. Aboriginal cultural and Historical heritage	-
		12 Subsidence^ ^	11.8
Total indirect benefits	**423.6**	**Indirect Costs**	**42.3**
Total Project economic benefit	**699.6**	**Incremental Indirect Cost**	**0.1**
NPV of project - ($m)	**699.5**		

Source: Cadence Economics estimated based on information from various sources. ^ Real 2017 Australian dollars. * NPV in 2017 Australian dollars based on a 7 per cent real discount rate. ^ ^ Incorporated into operating costs.

These estimates are based on central case assumptions in relation to the proposed $310.8 capital expenditure and coal prices outlined in Figure 6.

The ***direct benefits*** of the project are a function of the profitability of the proposed development which, in turn, depends on the prevailing coal price. The analysis shows that the combination of relatively high value of coking coal and relatively low capital requirement underpins the economic viability of the proposed development. This results in:

- An overall net producer surplus of $609.6 million in NPV, of which ***zero*** is attributed to NSW as Tahmoor Coal is assumed to be 100 per cent foreign owned;

- Total corporate taxes of $307.1 million in NPV terms for Australia, of which $98.3 million is attributed to NSW; and
- $177.7 million in other government revenue for NSW in NPV terms, the largest component of this being royalties of $149.1 million with council rates and payroll taxes contributing $7.0 million and $21.7 million respectively.

The ***indirect benefits*** of the project are related to the linkages that the proposed development has to the NSW economy through both the labour market and suppliers. The analysis shows that of the $306.8 million in estimated indirect benefits:

- Worker benefits are $212.2 million in NPV terms attributable to an average employment of 353 Full Time Equivalent (FTE) workers over the period of the proposed development, which peaks in 2023 and 2035 at 422 FTE; and
- Supplier benefits are $211.4 in NPV terms, based on NSW-based procurement for the proposed development of $1,047.5 million.

The proposed development is expected to generate modest incremental indirect costs on the NSW community of $0.1 million.

Net Benefits – Sensitivity analysis

Consistent with the Guidelines, this section outlines a summary of the systematic sensitivity analysis undertaken for the proposed development. 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 25 per cent is used. 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 25 per cent over the central case assumptions for the life of the proposed development
    - Lower price assumptions, where coal prices are decreased under the central case assumptions by 25 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
- Higher environmental costs (increased by 10 per cent)
- Discount rate sensitivity, using a 4% and a 10% real discount rate (see Appendix B).

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

- ***'Worst-case' scenario***, the coal price is reduced by 25 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.
- ***'Best case' scenario***, the coal price is increased by 25 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.

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 25 per cent reduction in coal prices can either be interpreted as:

- A 25 per cent reduction in the prevailing international coal price (denominated in US dollars with no change to the exchange rate); or
- A 25 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.

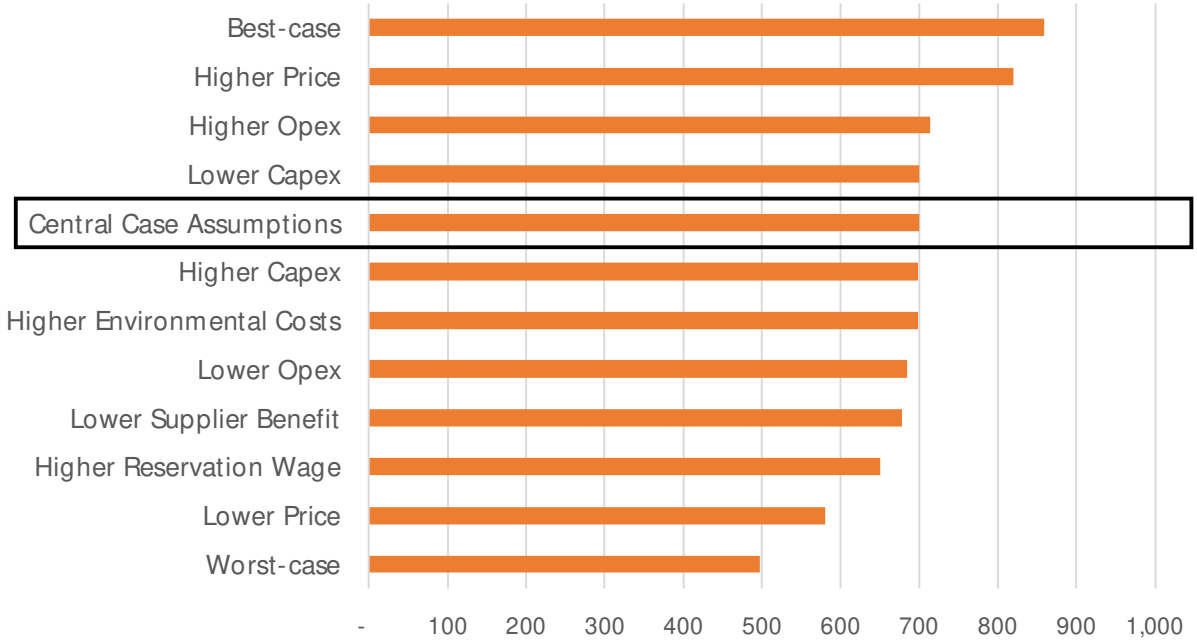
Results of sensitivity analysis

The results of the systematic sensitivity analysis are summarised in Figure 7. 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 proposed development is most sensitive to the coal price assumptions underpinning the analysis, but even assuming coal prices are 25 per cent lower than under the central case assumptions the net benefits are estimated to be $579.8 million in NPV terms.

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, environmental impacts and supplier benefits, yields an estimated net benefit of $497.7 million in NPV terms. The upper bound, or best-case, estimate, based on the most optimistic assumptions, is $859.1 million in NPV terms.

Figure 7: Systematic sensitivity analysis of the CBA to key assumptions (NPV*, $ million^)



Source: Cadence Economics estimated based on information from various sources. ^ Real 2017 Australian dollars. * NPV in 2017 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 high value coal extracted under the proposed development, the relatively low capital costs required to extract the resource due to the ongoing use of existing infrastructure associated with the current operations at Tahmoor by the proposed development, and the relatively low level of indirect costs (externalities) attributable to NSW.

It can also be inferred from the sensitivity analysis how large the non-quantified negative externalities would need to be before the proposed development 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 $497.7 million in NPV terms before the proposed development would return a net negative return to NSW.

Given the relatively long time frame of the proposed development (2019 to 2035) the net benefits are particularly sensitive to the discount rate used for the analysis. Under central case assumptions the proposed development is expected to generate $699.5 million of net benefit using a 7 per cent discount rate. Using a 4 per cent discount rate increases the net benefit to $935.6 million; conversely a 10 per cent discount decreases the net benefit to $533.2 million.

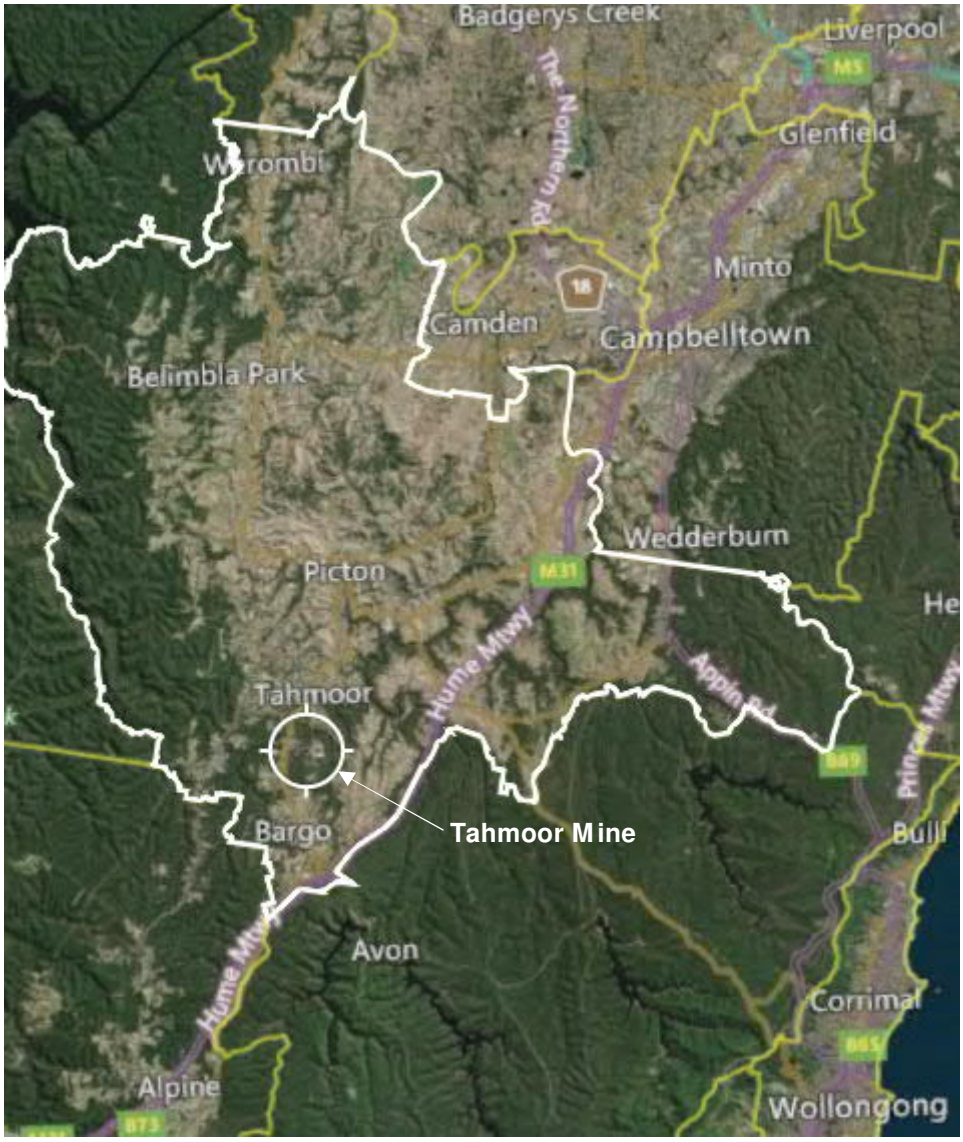
3. Local Effects Analysis

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 this Project the Wollondilly SA3 area is used for the LEA.

The Wollondilly region

As shown in Figure 8, the Wollondilly region is located to the south west of Campbelltown and Sydney and to the west of Wollongong.

Figure 8: Wollondilly SA3



Source: http://nationalmap.gov.au/

The Tahmoor Mine is located in the southern part of the SA3, adjacent to the Bargo and Tahmoor communities. In addition, Tahmoor is located within the Southern Coal Fields that has a long history of coal extraction, processing and exports and includes mines like South32's Dendrobium Mine and Illawarra Coal's Cordeaux Colliery.

Regional characteristics

Table 20 outlines the education and employment characteristics of persons who reside within the Wollondilly SA3 region. Workers in the region are concentrated within the construction, health care and retail trade sectors. Construction is a particularly important sector, with 15.3 per cent of workers, compared to 8.8 per cent and 8.9 per cent for NSW and Australian workers.

Mining employment accounts for a relatively small share of employment for Wollondilly-based employees, with 1.9 per cent of workers.

The region's work force also has a relatively high proportion of workers with a Certificate III and IV attainment. Workers with Certificate III and IV account for 27.9 per cent of the region's workers, compared to 17.1 per cent for NSW and 18.1 per cent nation-wide. This may be a result of the high share of construction, health care and manufacturing workers in the region.

Table 20: Education and employment characteristics

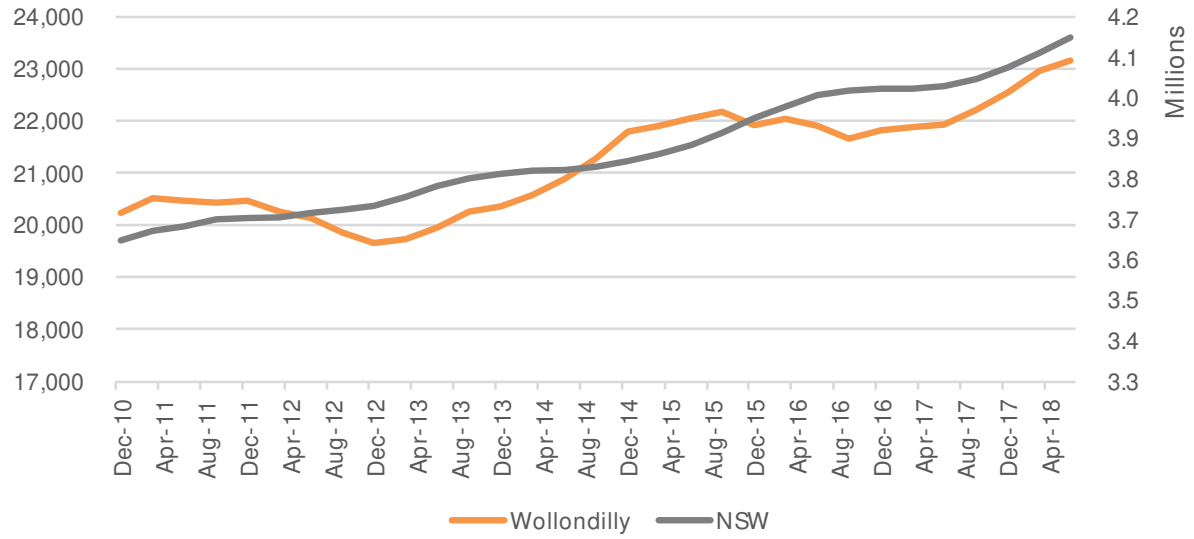
	Wollondilly	New South Wales	Australia
Level of highest educational attainment	%	%	%
Advanced Diploma and above	25.0	37.3	35.6
Certificate III and IV	27.9	17.1	18.1
Year 10 to 12	36.6	34.8	36.1
Other	10.5	10.9	10.2
Occupation	%	%	%
Technicians and Trades Workers	12.6	13.7	13.2
Machinery Operators and Drivers	15.6	24.4	22.9
Labourers	18.9	12.8	13.6
Professionals	10.7	10.8	11.2
Community and Personal Service Workers	14.5	14.1	13.8
Clerical and Administrative Workers	8.6	9.4	9.6
Managers	9.4	6.0	6.2
Sales Workers	9.6	8.8	9.4
Industry of employment, top responses	%	%	%
Construction	15.3	8.8	8.9
Health Care and Social Assistance	10.6	13.1	13.2
Retail Trade	10.0	10.1	10.3
Education and Training	9.5	8.8	9.1
Manufacturing	8.6	6.1	6.7
Mining	1.9	1.0	1.7

Source: 2016 Census General Community Profile, Wollondilly SA3, New South Wales and Australia, Australian Bureau of Statistics cat. no. 2001.0

Employment outcomes

Figure 9 shows total employment in the Wollondilly SA3 region and the NSW economy. Employment in the region peaked in June 2018 at just over 23,100 workers. The number of workers has steadily increased from about 21,640 in September 2016 an increase of approximately 880 workers or 4.0 per cent in a 15-month period.

Figure 9: Employment, Wollondilly SA3 and New South Wales

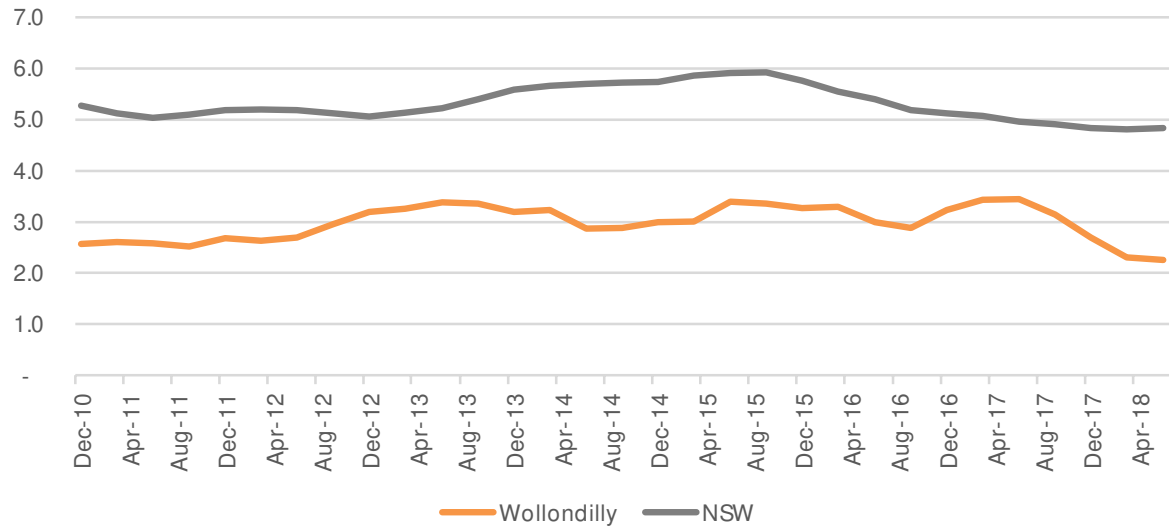


Source: Department of Jobs and Small Business, *SA2 Data tables – Small Area Labour Markets – December quarter 2017* Department of Employment (March 2018)

As a result of the increase in regional employment, the unemployment rate in Wollondilly has decreased at a similar rate, and, unemployment in the region remains relatively low compared to the state-wide rates.

As shown in Figure 10, unemployment in the region is currently 2.3 per cent compared to 4.8 per cent in NSW.

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



Source: Department of Jobs and Small Business, *SA2 Data tables – Small Area Labour Markets – December quarter 2017* Department of Employment (March 2018)

Local Effects Analysis

The LEA accounts for the economic benefits to the Wollondilly region only. It does not include any economic benefits that may accrue to the major regional centres that are located adjacent, including the Illawarra region and Sydney.

Given the nature of coal operations and export port located in Port Kembla, many of the inputs may be supplied from the broader Illawarra. In addition, analysis from the Social Impact Assessment indicates over the life of the proposed development a small proportion of the inputs will be supplied from the Wollondilly region and just below half of the employees are sourced from the region. As a result, this project may generate economic benefits to these regions; for example those workers who reside in Wollongong (currently 30 per cent of the Tahmoor workforce), other parts of Sydney and regional communities to the south and the west of the proposed development.

Underpinning the LEA are the assumptions that:

- No net producer surplus accrues to the region.
- No company income tax accrues to the Wollondilly SA3 region.
- Based on information from the Social Impact Statement, 45 per cent of the workforce requirement of the proposed development and 12.9 per cent of intermediate inputs will be supplied from the SA3 region.
    - As a result of these assumptions, it is expected the proposed development will generate indirect benefits to local suppliers and employees of $29.5 million and $95.5 million respectively in NPV terms over the baseline case, as outlined in Table 21.
- The incremental indirect costs associated with the proposed development is $674.9, which is the global greenhouse gas costs apportioned to the local area.

Based on these assumptions, the proposed development is estimated to confer a net benefit on the Wollondilly SA3 region of $132.0 million in NPV terms.

Table 21: Estimated Local Effects Analysis of the proposed development ($ 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	7.0		
3. Company tax	0.0		
Total direct benefits	7.0	**Total direct costs**	**-**
Indirect benefits		**Indirect costs**	
1. Net economic benefit to landholders	0.0	1. Air quality	0.0
2. Net economic benefit to local workers	95.5	2. Greenhouse gas emissions	0.0
3. Net economic benefit to local suppliers	29.5	3. Visual amenity	0.0
		4. Transport impact	0.0
		5. Net public infrastructure cost	0.0
		6. Surface water impact	0.0
		8. Residual value of land	0.0
		7. Biodiversity impact^ ^	19.7
		8. Noise impact^ ^	10.7
		9. Loss of surplus to other industries	0.0
		10. Water	0.0
		11. Aboriginal cultural and Historical heritage	0.0
		12 Subsidence^ ^	11.8
Total indirect benefits	**125.0**	**Indirect Costs**	**42.2**
Total Project economic benefit	**132.0**	**Incremental Indirect Cost**	**0.0**
NPV of project - ($m)	**132.0**		**0.0**

Source: Cadence Economics estimated based on information from various sources. ^ Real 2017 Australian dollars. * NPV in 2017 Australian dollars based on a 7 per cent real discount rate. ^ ^ Incorporated in operational costs.

Sensitivity analysis

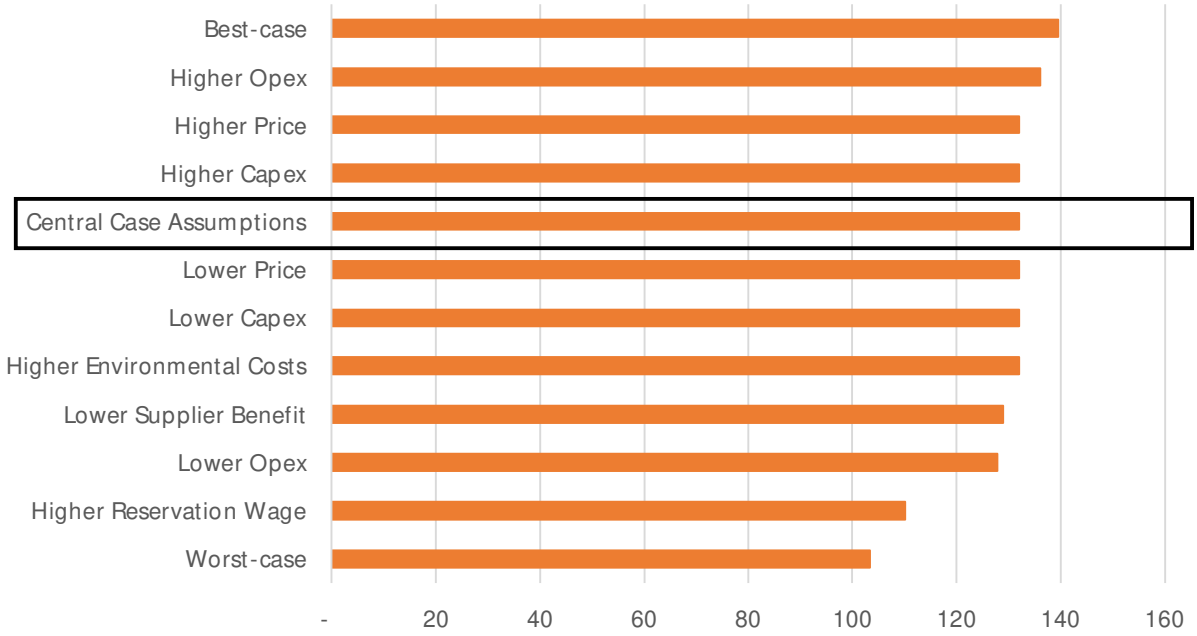
As outlined above the LEA relies on a number of modelling assumptions. Consistent with the Guidelines, provides a summary of the systematic sensitivity analysis undertaken for the proposed development. The sensitivity analysis tests the same assumptions outlined in the CBA.

The regional benefits of the proposed development are driven by 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 $103.4 million in NPV terms. The upper bound, or best-case, estimate, based on the most optimistic assumptions, is $139.5 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 2017 Australian dollars. * NPV in 2017 Australian dollars based on a 7 per cent real discount rate.

Given the relatively long time-frame of the proposed development (2019 to 2035) the net benefits are sensitive to the discount rate used for the analysis. Under the Central case assumptions the proposed development is expected to generate $132.0 million of net benefit using a 7 per cent discount rate. Using a 4 per cent discount rate increases the net benefit to $177.0 million; conversely a 10 per cent discount decreases the net benefit to $100.4 million.

4. CGE modelling framework

The economy-wide impacts of the proposed development has been undertaken using a computable general equilibrium (CGE) model of the regional and NSW economy.

The ultimate 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 standard of those residing within the Wollondilly SA3 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.[8] 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 mine to overseas interests (in this case, Tahmoor Coal which is owned by SIMEC Mining) as well as through the redistribution of taxation and royalties.

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 Wollondilly SA3 and the NSW economy. CEGEM is based on a substantial body of accepted microeconomic theory.

The model projects change in macroeconomic aggregates such real gross state product (real GSP) which is an output measure of the NSW economy, 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), 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.

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

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) shows 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 particular 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.

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 a 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.

That noted, real GSI does not capture some non-market effects that can impact on the living standards of NSW resident. These could include 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 that no proposed development investment or coal output. Set against this scenario is the policy scenario (or the Project case) under consideration.

Overview of scenarios

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

- Capital expenditure of $310.8 million (as outlined in Figure 4); and
- Coal revenue of $2,985.5 million (as outlined in Table 3).

In addition we have also factored into our scenarios the benefits that flow from the proposed development outside of the Wollondilly 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 company tax to the Australian Government. We have assumed these royalty payments accrue to the Rest of NSW.

The central consideration across the scenarios relates to the responsiveness of the NSW labour market to the increase in expenditure (the labour supply response[9]), to test the responsiveness we have incorporated into out modelling three labour market assumptions.

Conceptually, if the NSW economy is operating at full employment and, therefore, no new workers were available to service the increase in expenditure (demand) associated either with the construction of the proposed development or the associated increase in coal output, the project would not create a single additional job. That is, workers would be drawn from their existing jobs via the new project offering higher wages. Similarly, if a new project required very specific highly trained and skilled workers and there were none readily available, the project would not create a single additional job. We replicate this type of world by applying assuming a 'inelastic' – or Zero -labour supply elasticity.

On the other hand, in a world where the economy is operating at below capacity, as evidenced for example by higher unemployment and slower growth, it is more realistic to assume a relatively more 'elastic' labour supply whereby potential workers are encouraged into the workforce, again through increased wages. In terms of specifying the elasticity of labour supply, we follow the lead of the Australian Treasury and use a labour supply elasticity assumption of 0.15 under 'Medium' settings, which indicates a relatively 'inelastic' response from workers. This means workers are slow to respond to changes in wages because (it is assumed that) the economy is close to full employment or the project under consideration requires highly skilled workers.

[9] In economic jargon, the assumed labour supply elasticity.

To further test the results to the responsiveness of the NSW labour market, under the 'High' scenario, a labour supply elasticity of 0.3 is assumed, which is relatively more 'elastic' and means that workers respond more readily to marginal changes in the wage rate.

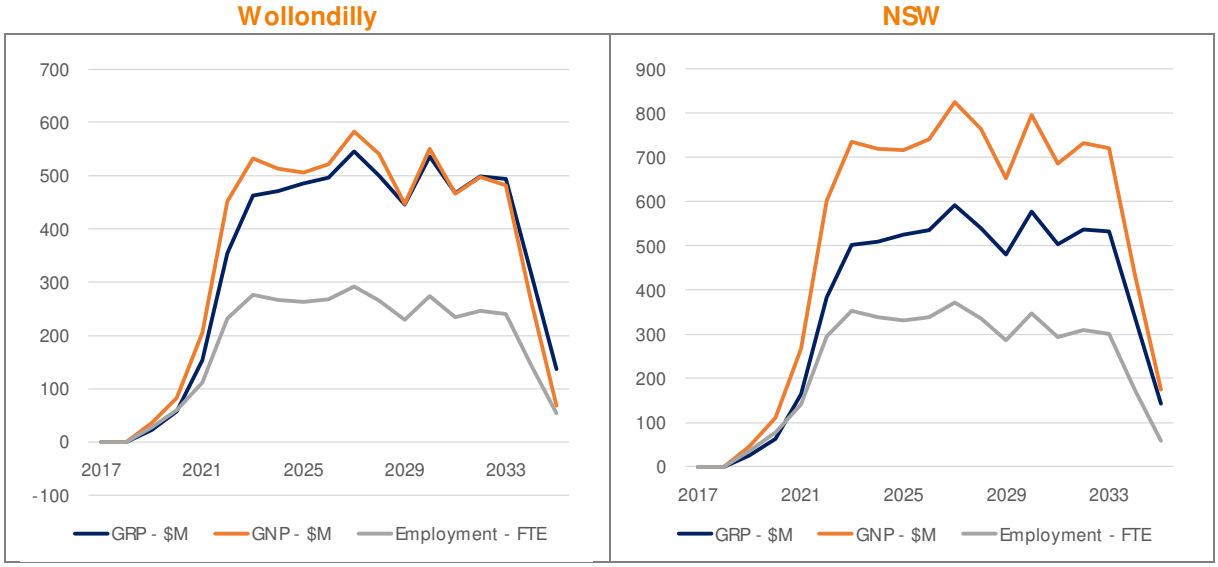
Economy-wide modelling of the proposed development

Given the number of possible scenarios under consideration, this section focusses on annual impacts of the medium labour supply scenario that is based on the proposed development using a labour supply elasticity of 0.15.

A summary of the key macroeconomic variables projected under the core scenario is shown in Figure 12. The results are reported as deviations from the reference case and represent the change in a particular variable as a result of investing in and operating under the proposed development assumptions. The results for the Wollondilly region are outlined on the left hand side of the figure and NSW on the right (NSW includes Wollondilly).

The annual results from the CGE model generally move in-line with the proposed development capital expenditure and production activity. Real GRP for the Wollondilly region is projected to peak at $546 million higher than the reference case in 2027, coinciding with peak coal output from the proposed development. This increase in real GDP is a function of the higher levels of activity within the region associated with output at the mine and the flow-on benefits of purchasing inputs to operate the mine. Real GRI is also projected to peak in 2027 at $582 million, the increase in GRI is driven by the twin factors of higher wages for local workers and the repatriation of profits out of the region to the foreign owners of the mine and wage earners, the company tax outflows and the royalty payments to the Rest of NSW.

Figure 12: Projected economy-wide impacts of the proposed development



Source: Cadence Economics estimates based and information provided by Tahmoor Coal.

Employment in the region is expected to peak at 292 FTE. These results are driven by the direct employment within the region, the flow-on impacts from local inputs and any of the crowding out of employment in other sectors.

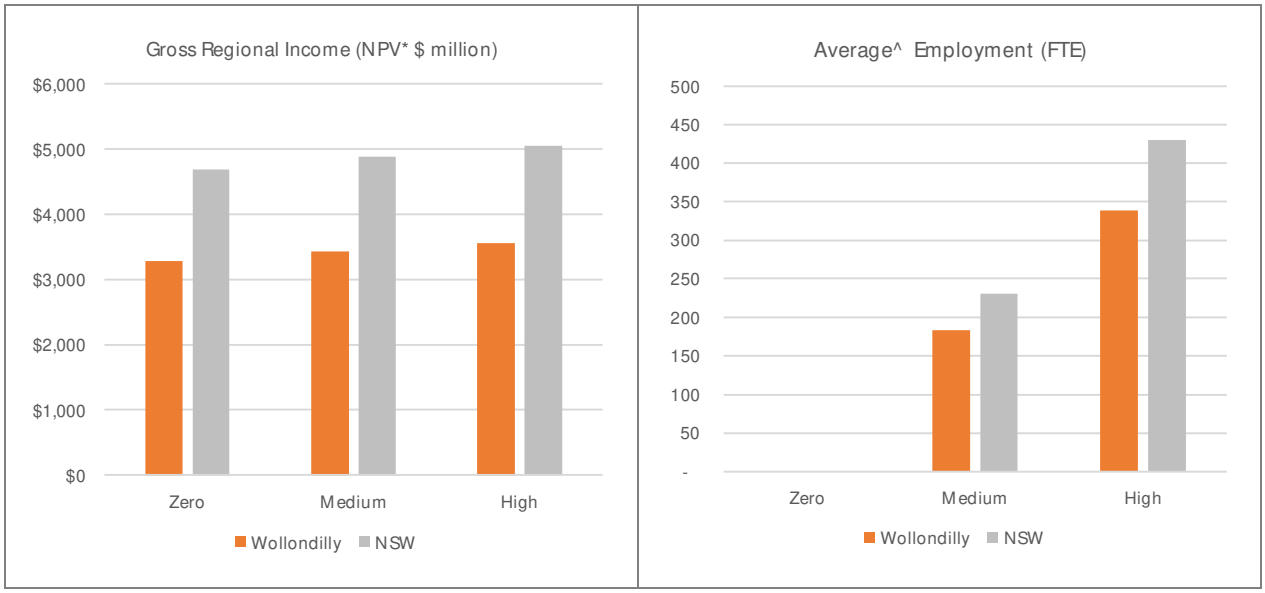
Moving to the state-wide results, real GSP for NSW is projected to peak at $591 million higher than the reference case in 2027, coinciding with peak coal output from the proposed development. In the same year real GSI will peak at $824 million and employment of 372 FTE.

Overall summary

A summary of the projected economy-wide impacts of the proposed development generated by the CGE model are summarised in Figure 13 under three separate labour market response assumptions.

Under each scenario the proposed development is projected to increase gross regional income (GRI), which is a measure of economic welfare, in both the Wollondilly region and NSW broadly. In NPV terms, the projected increase in GRI in the Wollondilly region ranges from $3,288 million under the zero labour supply response to $3,561 million under the high labour response assumption. The increase in projected economic welfare is related to the projected employment which averages 339 FTE under the high labour response assumption (183 FTE under the medium assumption).

Figure 13: Projected economy-wide impacts of the proposed development by labour market response



Source: Cadence Economics estimates based on information provided by Tahmoor Coal. * Net Present Value in Real 2017 Australian dollars calculated over the period 2017 to 2035 using a 7 per cent real discount rate. ^ Average increase in employment over the period 2019 to 2039.

The economic benefits of the project accrue to the broader NSW economy. In NPV terms, the projected increase in GRI in NSW ranges from $4,692 million under the zero labour supply response to $5,055 million under the high labour response assumption. The associated employment effects are 339 FTE under the high labour response assumption (183 FTE under the medium assumption).

The zero response assumption is consistent with the CBA and LEA assumptions underpinning this analysis. This is equivalent to assuming that the Wollondilly region and NSW economy are operating at full employment and, therefore, no new workers are available to service the proposed expansion. That is, workers are drawn from their existing jobs through the offer of higher wages.

Under the other scenarios, the Wollondilly region and NSW economies are operating at below capacity, as evidenced for example by higher unemployment or underemployment, and it is more realistic to assume a relatively more 'elastic' labour supply whereby potential workers are encouraged into the workforce, again through increased wages.

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APPENDIX A: FULL-YEAR INPUTS

Table 22: Central case assumptions – revenue projection (all years)

Year	Production (Mt)	HCC (Mt)	Thermal Coal (Mt)	Inflation rate (%)	Exchange rate (USD per AUD)	HCC Price^	Thermal Coal Price^	Total Revenue^
2019	0.07	0.07	0.00	2.4	0.78	200.8	104.7	13.8
2020	0.23	0.21	0.02	2.4	0.79	177.5	89.7	38.6
2021	0.78	0.73	0.06	2.4	0.79	169.7	83.9	128.0
2022	1.95	1.80	0.15	2.4	0.79	165.5	77.1	310.0
2023	2.66	2.44	0.22	2.4	0.79	166.2	82.1	423.9
2024	2.81	2.50	0.30	2.4	0.79	166.2	82.1	441.2
2025	2.97	2.62	0.35	2.4	0.79	166.2	82.1	463.9
2026	2.97	2.70	0.28	2.4	0.79	166.2	82.1	471.0
2027	3.25	2.96	0.29	2.4	0.79	166.2	82.1	515.6
2028	2.98	2.69	0.29	2.4	0.79	166.2	82.1	470.2
2029	2.72	2.45	0.26	2.4	0.79	166.2	82.1	429.0
2030	3.21	2.94	0.26	2.4	0.79	166.2	82.1	511.0
2031	2.87	2.56	0.31	2.4	0.79	166.2	82.1	450.2
2032	3.02	2.75	0.27	2.4	0.79	166.2	82.1	479.6
2033	3.02	2.75	0.27	2.4	0.79	166.2	82.1	478.4
2034	1.99	1.82	0.17	2.4	0.79	166.2	82.1	316.3
2035	0.88	0.80	0.08	2.4	0.79	166.2	82.1	139.3
Total^ ^	38.36	34.78	3.58					6,080.0
NPV*								2,985.5

Source: Cadence Economics estimates ^ Real 2017 Australian dollars. * NPV in 2017 Australian dollars based on a 7 per cent real discount rate. ^ ^ Undiscounted.

APPENDIX B: SENSITIVITY ANALYSIS – CBA AND LEA

Table 23: Sensitivity analysis of the net benefits of the proposed development (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	276.0	396.2	156.3	260.9	291.1	275.8	276.3	276.0	276.0	275.7	170.7	381.7	367.7	211.2
1. Net producer surplus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2. Royalties, payroll tax and Council rates	177.7	231.5	124.0	177.7	177.7	177.7	177.7	177.7	177.7	177.7	124.0	231.5	236.6	136.1
3. Company income tax apportioned	98.3	164.8	32.3	83.2	113.4	98.0	98.5	98.3	98.3	98.0	46.7	150.2	131.0	75.1
Indirect Benefits	423.6	423.6	423.6	453.1	394.1	423.6	423.6	375.0	402.5	423.4	327.1	477.5	568.0	322.1
1. Net economic benefit to existing landholders	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2. Net economic benefit to Local workers	212.2	212.2	212.2	212.2	212.2	212.2	212.2	163.6	212.2	212.2	163.6	212.2	285.9	160.7
3. Net economic benefit to Local suppliers	211.4	211.4	211.4	240.9	181.9	211.4	211.4	211.4	190.3	211.2	163.5	265.2	282.1	161.4
Indirect (Environmental costs)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Net Benefits	**699.5**	**819.8**	**579.8**	**713.9**	**685.2**	**699.3**	**699.8**	**650.9**	**678.4**	**699.0**	**497.7**	**859.1**	**935.6**	**533.2**

Source: Cadence Economics estimated based on information from various sources. * Estimated as the benefits of the Project case less the Baseline case. ** NPV in 2017 dollars based on a 7 percent real discount rate.

Table 24: Sensitivity analysis of the net regional benefits of the proposed development (NPV*, $ million)**

	Central Case	Higher Price	Lower Price	Higher Opex	Lower Opex	Higher Capex	Lower Capex	Higher Reservation	Lower Supplier	Higher Environ.	Worst-case	Best-case	Central Case	Central Case

								Wage	Benefit	Costs			(4%)	(10%)
Direct Benefits	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	9.0	5.6
1. Net producer surplus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2. Royalties, payroll tax and Council rates	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	9.0	5.6
3. Company income tax apportioned	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Indirect Benefits	125.0	125.0	125.0	129.1	120.9	125.0	125.0	103.1	122.0	125.0	96.4	132.5	168.0	94.8
1. Net economic benefit to existing landholders	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2. Net economic benefit to Local workers	95.5	95.5	95.5	95.5	95.5	95.5	95.5	73.6	95.5	95.5	73.6	95.5	128.7	72.3
3. Net economic benefit to Local suppliers	29.5	29.5	29.5	33.6	25.4	29.5	29.5	29.5	26.5	29.5	22.8	37.0	39.3	22.5
Indirect (Environmental 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	0.0	0.0
Net Benefits	**132.0**	**132.0**	**132.0**	**136.1**	**127.9**	**132.0**	**132.0**	**110.1**	**129.0**	**132.0**	**103.4**	**139.5**	**177.0**	**100.4**

Source: Cadence Economics estimated based on information from various sources. * Estimated as the benefits of the Project case less the Baseline case. ** NPV in 2017 dollars based on a 7 percent real discount rate.