

Appendix N

Economic Specialist Response

Appendix N-1 Economic Specialist Response



Economic Analysis of Rix's Creek Environmental Impacts

Prepared for Big Ben Holdings Pty Ltd

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Glossary

Term	Definition
CBA	Cost benefit analysis
CO _{2-e}	CO2 equivalent units
GHG	Greenhouse Gas
Km	Kilometres
NSW	New South Wales
PM	Particulate matter
PM2.5	Particulate matter 2.5 micrometers or less in diameter
PV	Present Value
SUA	Significant Urban Area
SPCC	State Pollution Control Commission
The Project	The Rix's Creek Continuation Project
The Review	Review of the NSW Energy Savings Scheme
TSP	Total suspended particulates

1 Introduction

1.1 Background

Operated by The Bloomfield Group, Rix's Creek is an open cut coal mine which produced its first coal in 1990. The site is located five kilometres (km) northwest of Singleton in the Hunter Valley, New South Wales (NSW).

In 2015, as part of the approval process, the environmental impact of the Rix's Creek Continuation Project (the Project) was assessed. The assessment found that the Project is estimated to generate average annual greenhouse gas (GHG) emissions of 0.47 Mt CO_{2-e} per annum¹. In a cost benefit analysis of the Project conducted by KPMG (the KPMG analysis), environmental impacts were quantified based on an assumed shadow carbon price of \$AUD 9.50 per tonne, consistent with the long-term spot market price for European permits². The shadow carbon price was applied to the expected average annual emissions associated with the Project. The total incremental cost associated with the GHG emissions over the life of the Project were estimated to be \$4.5 million (in 2015 dollars) in present value (PV) terms³.

Since these estimates were developed, the production profile for the Project has been revised and a subsequent, more detailed, environmental impact assessment has been completed. Additionally, since the original KPMG analysis was completed, the NSW Government have released specific guidance regarding the approach and parameters for the quantification of environmental impacts of mining projects⁴.

1.2 Scope and purpose

To assist in understanding the potential economic implications relating to the updated environmental impacts, Big Ben Holdings Pty Limited (parent company for The Bloomfield Group and Rix's Creek Pty Limited) has commissioned KPMG to quantify the economic value of the updated environmental impacts based on guidance provided by the NSW Government. While these updated estimates are not directly comparable to the KPMG analysis, primarily due to a change in the production profile associated with the Project, they do provide insights into the potential magnitude of impacts relative to the original analysis.

The scope of the engagement, as outlined in the KPMG engagement letter dated 8th February 2017, has been agreed as follows:

- quantification of direct environmental impacts associated with the Project based on estimates of the Project's contribution to GHG and particulate matter (PM) emissions provided by Todoroski Air Sciences; and
- description of the magnitude of the environmental impacts in the context of other economic costs and benefits of the Project.

¹ Todoroski Air Services 2015, *Air Quality and Greenhouse Gas Assessment – Rix's Creek Continuation of Mining Project*, report prepared for Rix's Creek Pty Limited, March.

² Acil Allen 2014, *RET Review Modelling Results*, prepared for the RET Review Panel, August.

³ KPMG 2015, *Rix's Creek Continuation Project – Economic Assessment*, report prepared for Rix's Creek Pty Limited.

⁴ NSW Department of Planning and Environment, 2015, *Guidelines for the economic assessment of mining and coal seam gas proposals*, October

1.3 Limitations

The scope of this analyses explicitly excludes the following areas:

- quantification or consideration of any other project costs or benefits; and
- updates to findings of the cost benefit analysis for the Project conducted by KPMG in July 2015 and subsequent addendum prepared by KPMG in May 2016.

Further, the findings of the analysis outlined in this report, are not directly comparable to previous estimates of the economic costs associated with environmental impacts or broader economic analysis findings outlined in the original KPMG analysis. The primary source of deviation is attributable to the change in the planned production profile since the original economic analysis was completed in July 2015.

The economic cost of the GHG emissions and air quality impacts for the Project should be assessed relative to a clearly defined base case or counterfactual. In the original KPMG analysis, it was stated:⁵

"For the purpose of the analysis, the base case is:

- *continuation of existing operations until 2019 when the current approval expires;*
- *cessation of activity in 2019 and rehabilitation of land; and*
- *land being returned to its next best use (agriculture production)."*

A modest amount of GHG emissions and air quality impacts are likely to be associated with the gradual cessation of mining operations up to 2019 and the agriculture production assumed to occur once the land is rehabilitated.⁶ The data inputs provided to KPMG from Todoroski Air Services for the purpose of this engagement included:

- gross GHG emissions for the Project (as opposed to incremental emissions relative to the base case); and
- air quality impacts for the Project relative to the level of impacts recorded in 2012.

These data inputs made it difficult to accurately quantify the economic cost of the incremental change in GHG emissions and air quality impacts relative to the base case defined above and led to the following implicit assumptions:

- the level of GHG emissions in the base case is insignificant; and
- the level of air quality impacts in the base case, during mining operations and agricultural production, is broadly in line with the level of air quality impacts recorded by the Rix's Creek Mine in 2012.

Lastly, Todoroski Air Services provided data on air quality impacts for discrete years only. Accordingly, it is not possible to estimate the over cost of air quality impacts over the Project life given the information currently available to KPMG.

⁵ KPMG 2015, *Rix's Creek Continuation Project – Economic Assessment*, report prepared for Rix's Creek Pty Limited, P.7

⁶ DPI Victoria and the University of Melbourne, *Greenhouse gas emissions from agriculture – reduction options, 2010*, available at: http://www.greenhouse.unimelb.edu.au/pdf_files/Hamilton_Field_Day2010.pdf

1.4 Report Structure

The remainder of the Report is structured as follows:

- Section 2 outlines the estimated carbon emissions and air quality impacts associated with the Project, the approach to quantifying the value of these emissions and the economic cost of these emissions over the life of the Project; and
- Section 3: provides a conclusion and considers the implication of the environmental impacts in the context of the broader Project.
- Appendix A: provides the results of the sensitivity analysis conducted.

2 Environmental Impacts

The following section outlines the economic implications associated with carbon emissions and air quality estimates for the Project, including:

- core economic analysis assumptions adopted to quantify the impacts;
- forecast GHG emissions associated with the Project, the approach to quantifying emissions and the economic implications of the Project carbon emissions; and
- forecast air quality impacts associated with the Project, the approach to quantifying these impacts and the economic implications of the Project's air quality impacts.

2.1 Economic Analysis Assumptions

The approach to the economic analysis of carbon emissions and air quality impacts are consistent with NSW Government *Guidelines for Economic Appraisal*. Key parameters used in the economic evaluation are summarised in Table 2-1.

Table 2-1: Economic analysis assumptions

Item	Assumption	Basis for Assumption
Discount rate (real)	A 7 per cent per annum real discount rate is applied to the analysis to calculate the PV of costs	NSW Treasury
Price year	All costs are presented in 2015 Australian prices.	Consistent with the base year adopted in the calculation workbooks that accompany the NSW Government <i>Guidelines for the economic assessment of mining and coal seam gas proposals</i> .
Evaluation period	For carbon emissions, the evaluation period is for 21 years. For air quality impacts, single year analyses were undertaken for 2017, 2020, 2023, 2026 and evaluation was undertaken over the Project life (21 years)	Information provided by The Bloomfield Group and consistent with the proposed Project life.
Consumer Price Index (CPI)	2.5 per cent per annum	Average based on Sydney CPI

Source: KPMG

2.2 Carbon Emissions Impacts

Estimated Project carbon emissions...

The GHG Protocol defines direct and indirect emissions as follows:

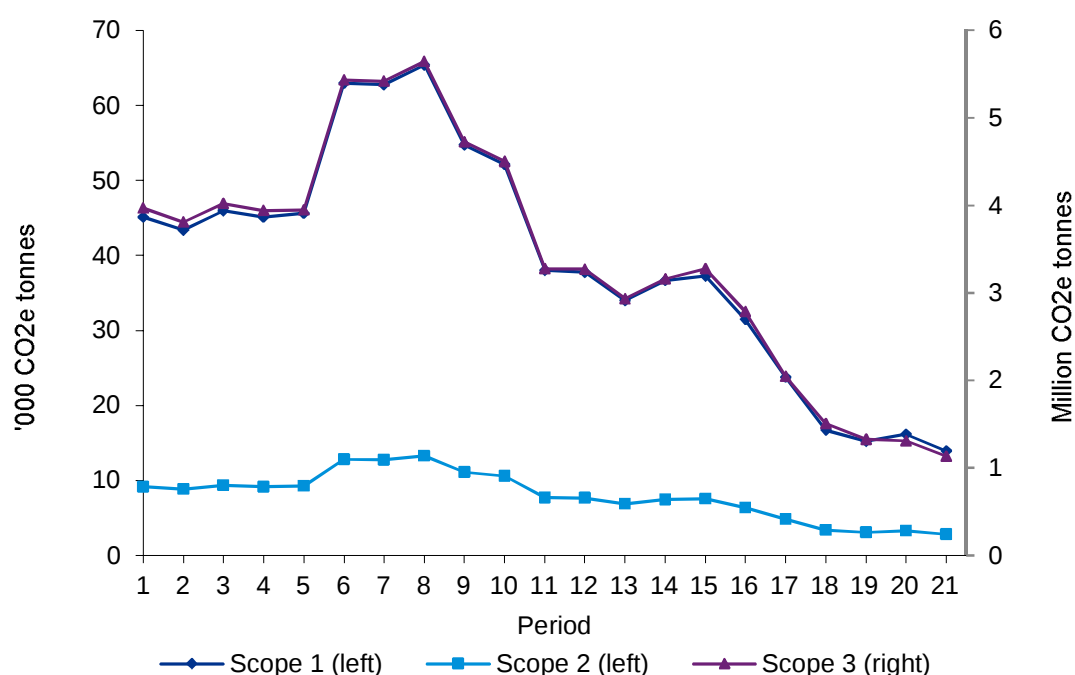
- **Direct GHG** emissions are emissions from sources that are owned or controlled by the reporting entity.
- **Indirect GHG** emissions are emissions that are a consequence of the activities of the reporting entity, but occur at sources owned or controlled by another entity.

The GHG Protocol further categorizes these direct and indirect emissions into three broad scopes:

- **Scope 1:** all direct GHG emissions.
- **Scope 2:** indirect GHG emissions from consumption of purchased electricity, heat or steam.
- **Scope 3:** other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities not covered in Scope 2, outsourced activities, waste disposal, etc.⁷

Estimates of Scope 1, 2 and 3 carbon emissions for the Project were developed by Todoroski Air Services based on the most recent planned production levels. Annual emissions for the Project are illustrated in Chart 2-1 and cumulative emissions over the life of the Project are illustrated in Chart 2-2. Estimates indicate that emissions are expected to peak from year five to 10, consistent with the higher annual levels of production over the period.

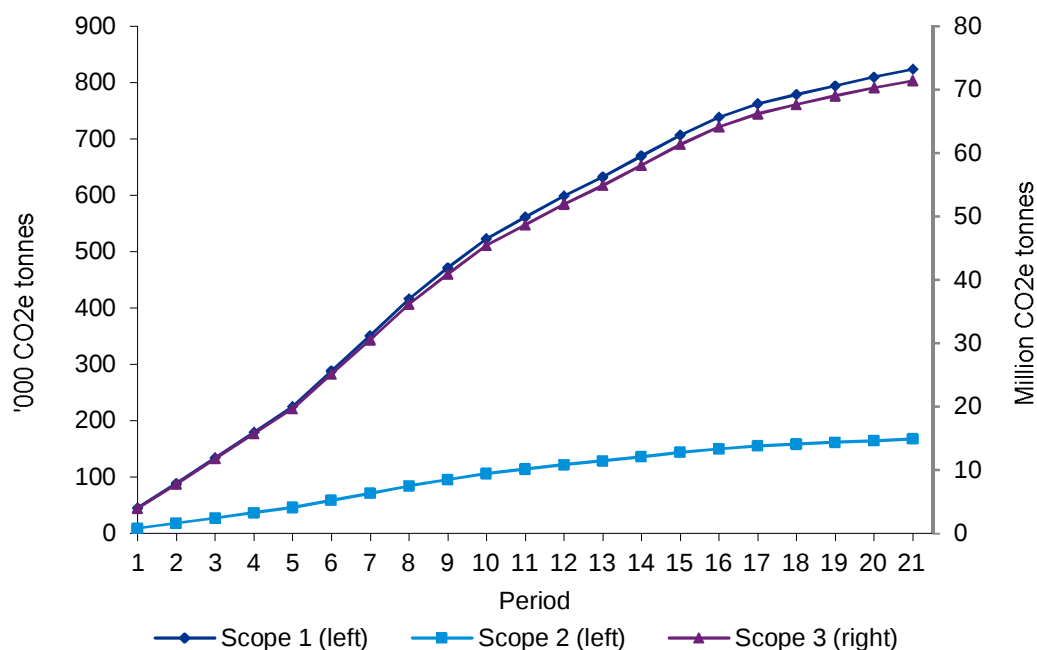
Chart 2-1: Annual carbon emission projections over the project life



Source: Information provided by Todoroski Air Sciences

⁷ Greenhouse Gas Protocol, FAQ, available at: <http://www.ghgprotocol.org/calculation-tools/faq>

Chart 2-2: Cumulative carbon emission projections over the project life



Source: Information provided by Todoroski Air Sciences

Approach to quantification of carbon emission impact...

The quantification of the economic cost of carbon emissions is typically a function of quantity and price, specifically:

$$\text{Cost of carbon emissions} = \text{units of carbon emissions} \times \text{economic cost per unit of carbon emissions}$$

There are a number of sources of information that can be used to inform the assumed economic cost per unit of carbon emissions. Consistent with NSW Government guidance and as requested by Bloomfield, four alternate assumptions were adopted in the quantification of the cost of carbon emissions. These assumptions and the basis for each are outlined in Table 2-2. It is acknowledged that Assumption 1 is the preferred approach specified by NSW Government guidance.

Table 2-2: Alternate assumptions for the economic cost per unit of carbon emissions

Assumption	Basis for Assumption
Assumption 1 Forecast European Union Emission Allowance Units price NSW Government preferred approach	- Included in the calculation workbooks that accompany the NSW Department of Planning and Environment, <i>Guidelines for the economic assessment of mining and coal seam gas proposals</i> - Noted as the most appropriate assumption by the <i>Review of the NSW Energy Savings Scheme</i>
Assumption 2 Australian Treasury Clean Energy Future Policy Scenario	- Included in the calculation workbooks that accompany the NSW Department of Planning and Environment, <i>Guidelines for the economic assessment of mining and coal seam gas proposals</i> - Noted as the a valid alternate assumption by the <i>Review of the NSW Energy Savings Scheme</i>
Assumption 3 US EPA Social Cost of Carbon	Included in the calculation workbooks that accompany the NSW Department of Planning and Environment, <i>Guidelines for the economic assessment of mining and coal seam gas proposals</i>

- Noted as a valid alternate assumption by the *Review of the NSW Energy Savings Scheme*

Assumption 4

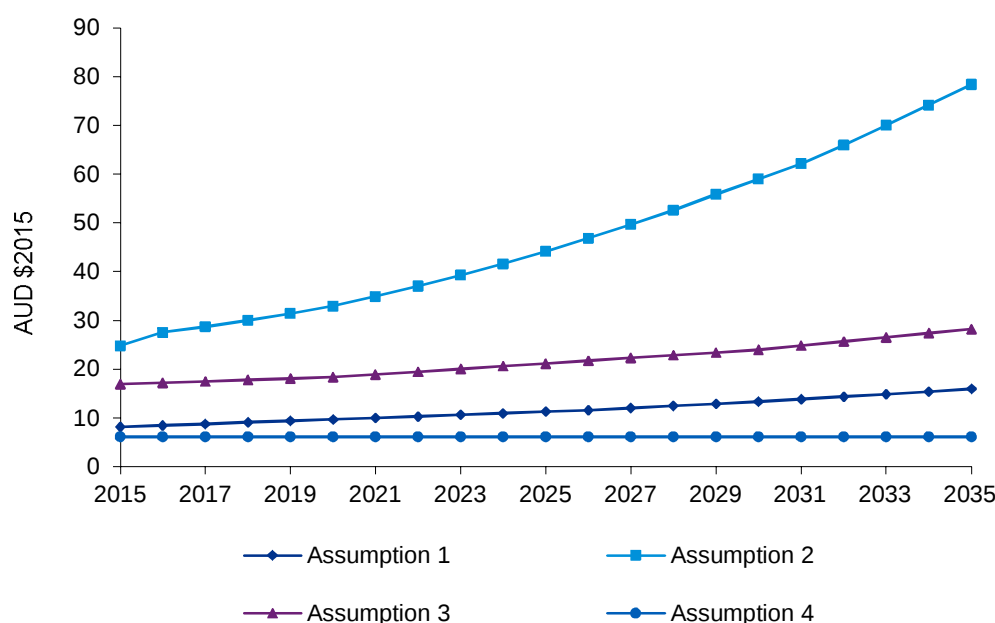
European Union
Allowance futures price
(as at July 2014)

- Adopted in a recent analysis of the Mount Owen Coal Mine submitted as part of the approvals process with NSW Government

Source: KPMG analysis

The forecast unit costs associated with each alternate assumption are illustrated in Chart 2-3. Forecasts were updated to real 2015 dollars based on the economic parameters discussed above.

Chart 2-3: Projected unit costs of carbon over project horizon (\$ real = 2015)



Source: NSW Department of Planning and the Environment, *greenhouse Gas Emissions Workbook*, *Deloitte Access Economics (2015)*, *Cost Benefit Analysis and Economic Impact Analysis of the Mount Owen Continuation Project*, and KPMG analysis.

Estimated impacts of carbon emissions...

The impact of carbon emissions over the Project life were quantified based on the four alternate assumptions outlined above. The total value of emissions, in PV terms, is summarised in Table 2-3. The analysis highlights that the economic costs of carbon emissions over the project horizon is sensitive to the estimate of the unit cost used. Specifically:

- the economic cost of Scope 1 carbon emissions over the project horizon ranges between \$3 and \$19 million dollars in real, net PV terms;
- the economic cost of Scope 2 carbon emissions over the project horizon ranges between \$1 and \$4 million dollars in real, net PV terms; and
- the economic cost of Scope 3 carbon emissions over the project horizon ranges between \$270 million and \$1.6 billion dollars in real, net PV terms.

Sensitivity analysis, based on changes in the assumed discount rate, was undertaken for Assumption 1. The findings of this analysis are outlined in Appendix A.

Table 2-3: Costs of carbon over the project horizon (PV, \$m real 2015)

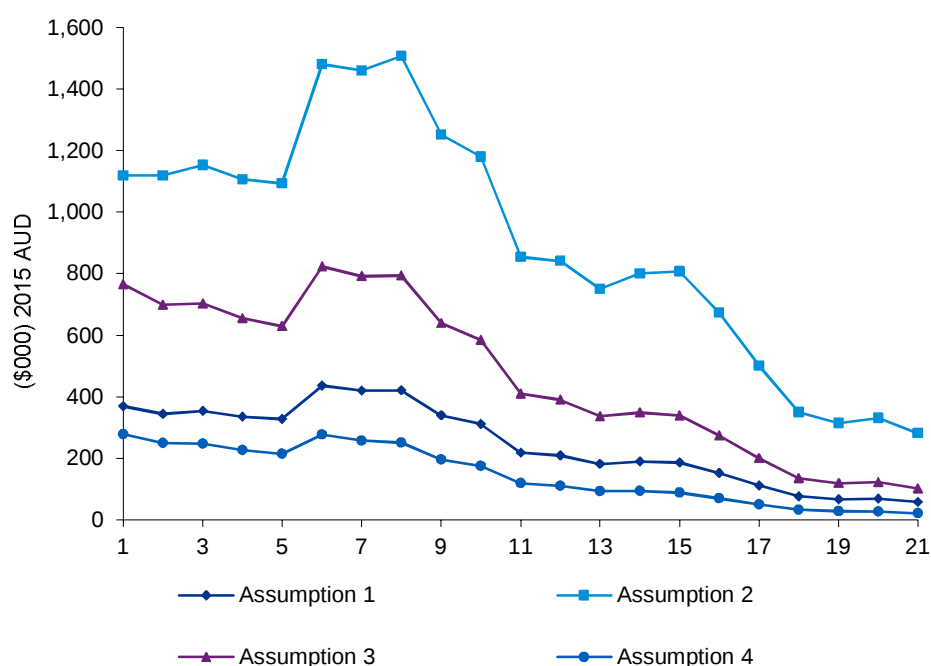
Assumption Adopted	Impact (PV, \$m real)			
	Scope 1	Scope 2	Scope 3	Total
Assumption 1 (NSW Government preferred approach)	5.2	1.1	449.2	455
Assumption 2	19.0	3.9	1,645.5	1,668
Assumption 3	9.9	2.0	855.9	868
Assumption 4	3.1	0.6	270.2	274

Source: KPMG

Economic assessments produced as part of the approval process for other mining projects have generally focussed on evaluating Scope 1 emissions only as it is not methodologically clear how the costs of other emission categories should be treated within a CBA framework.⁸ Focussing specifically on Scope 1 carbon emissions under Assumption 1, therefore, the economic costs are estimated to be \$5.2 million over the life of the Project.

The projected annual and cumulative profile of the economic cost of carbon emissions is shown in Figure 2-4 and Figure 2-5 below. Estimates indicate that emissions are expected to peak from year 7 to 10, consistent with the higher annual levels of production over this period, before easing gradually over the remainder of the project horizon.

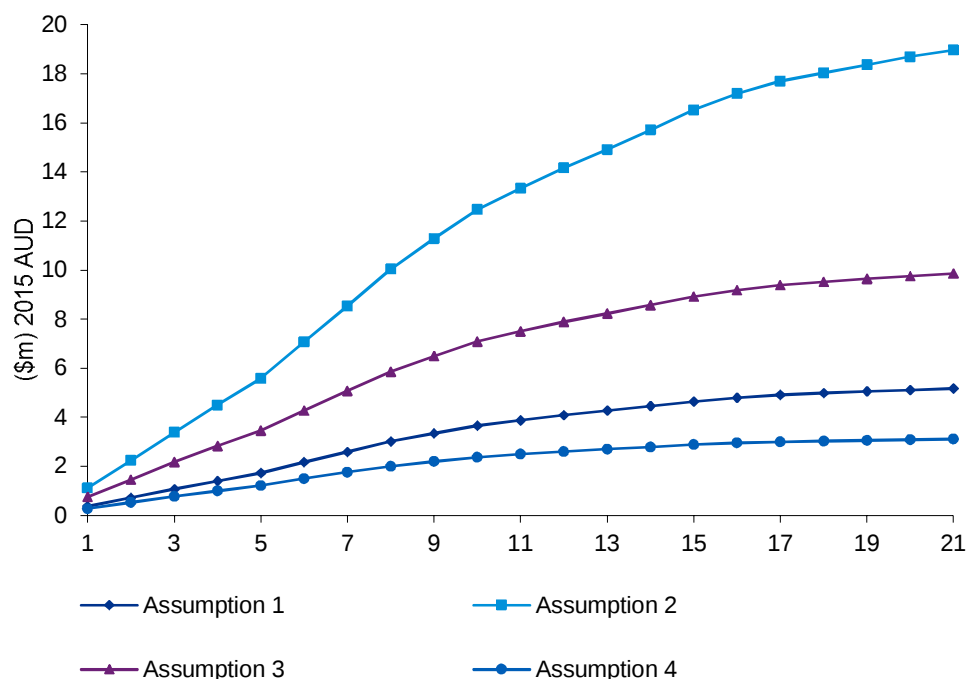
Chart 2-4: Projected annual PV costs of carbon emissions by unit cost (\$ real = 2015)



Source: Department of Planning and the Environment, Greenhouse Gas Emissions Valuation Workbook, available at: http://planspolicies.planning.nsw.gov.au/index.pl?action=view_job&job_id=7312 and KPMG analysis

⁸ Deloitte Access Economics, *Cost Benefit Analysis and Economic Impact Analysis of the Mount Owen Continuation Operations*, 2015.

Chart 2-5: Projected cumulative PV costs of carbon emissions by unit cost (\$ real = 2015)



Source: Department of Planning and the Environment, Greenhouse Gas Emissions Valuation Workbook, available at: http://planspolicies.planning.nsw.gov.au/index.pl?action=view_job&job_id=7312 and KPMG analysis

2.3 Air quality impacts

Estimated Project air quality impacts...

The incremental annual mass of particulate matter 2.5 micrometers or less in diameter (PM2.5 emissions) was estimated to measure the air quality impacts of the Project. The estimated incremental annual incremental mass of total suspended particles (TSP) associated with the Project is outlined, for selected years, in Table 2.4. These estimates were converted to PM2.5 emissions based on the results of a study by the State Pollution Control Commission (SPCC) that found that PM2.5 comprised approximately 4.7 per cent of the TSP from mine dust sources.

Table 2-4: Projected PM2.5 emissions over the project horizon

	2017	2020	2023	2026
Incremental TSP emissions (kg)	321 344	121 483	981 868	210 555
Incremental PM2.5 emissions (kg)	15 103	5 710	46 148	9 896
Incremental PM2.5 emissions (t)	15.1	5.7	46.1	9.9

Sources: Todoroski Air Sciences, Air Quality and Greenhouse Gas Assessment Rlx's Creek Continuation of Mining Report, 2015 Todoroski Air Sciences, RE: Response to Agency Submissions for Rix's Creek Continuation of Mining Project, 2015, State Pollution Control Commission (now EPA), Air Pollution from Coal Mining and Related Developments, 1983 and KPMG analysis

Approach to quantification of air quality impacts...

The Air Quality Valuation Workbook that supports the NSW Government *Guidelines for the economic assessment of mining and coal seam gas proposals* adopts the following approach to quantifying the economic cost of PM2.5 emissions:

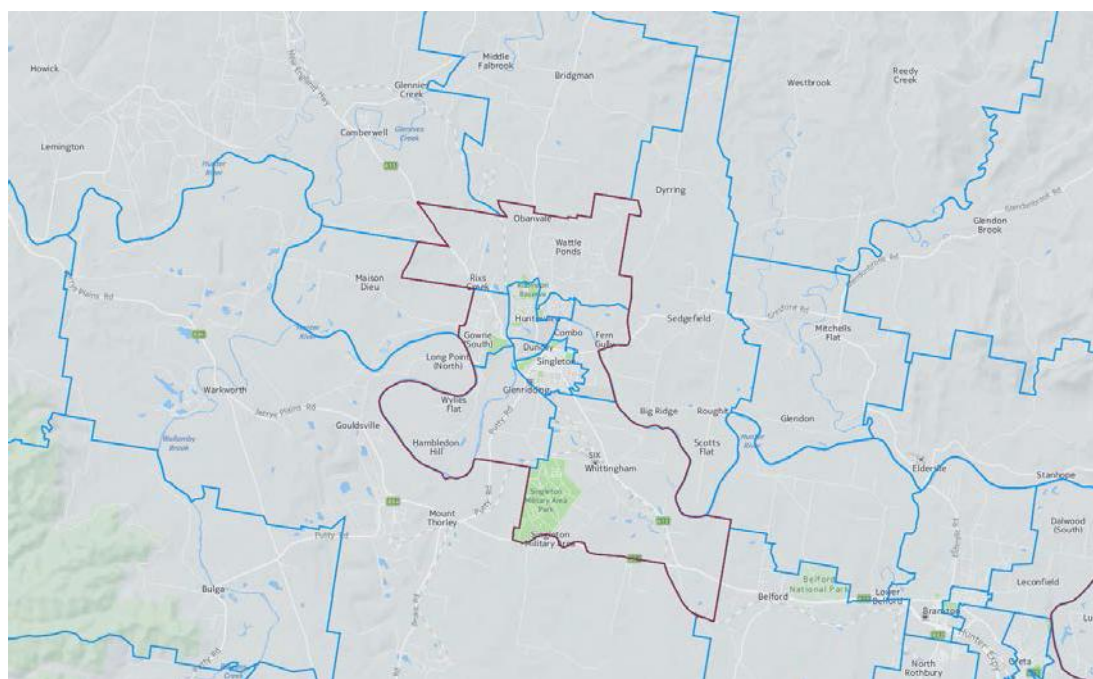
Cost of PM2.5 emissions

$$\begin{aligned} &= \text{economic cost per unit of PM2.5 emissions in geography 1} \\ &\times \text{units of PM2.5 emissions in geography 1} \\ &+ \text{economic cost per unit of PM2.5 emissions in geography 2} \\ &\times \text{units of PM2.5 emissions in geography 2 ...} \end{aligned}$$

where the economic cost per unit of emissions is a function of population density

Quantifying air quality impacts is often complicated by the fact that PM2.5 emissions can traverse geographical boundaries that have different levels of development and population density. One of key inputs required by the Air Quality Valuation Workbook is the proportion of air quality impacts that occur within neighbouring geographic catchments known as Significant Urban Areas (SUA). The Project is located within the Singleton SUA, which is bordered by pastoral and farmland that is defined by the ABS as “Not in any Significant Urban Area” (Figure 2-1).

Figure 2-1: Singleton Significant Urban Area (SUA)



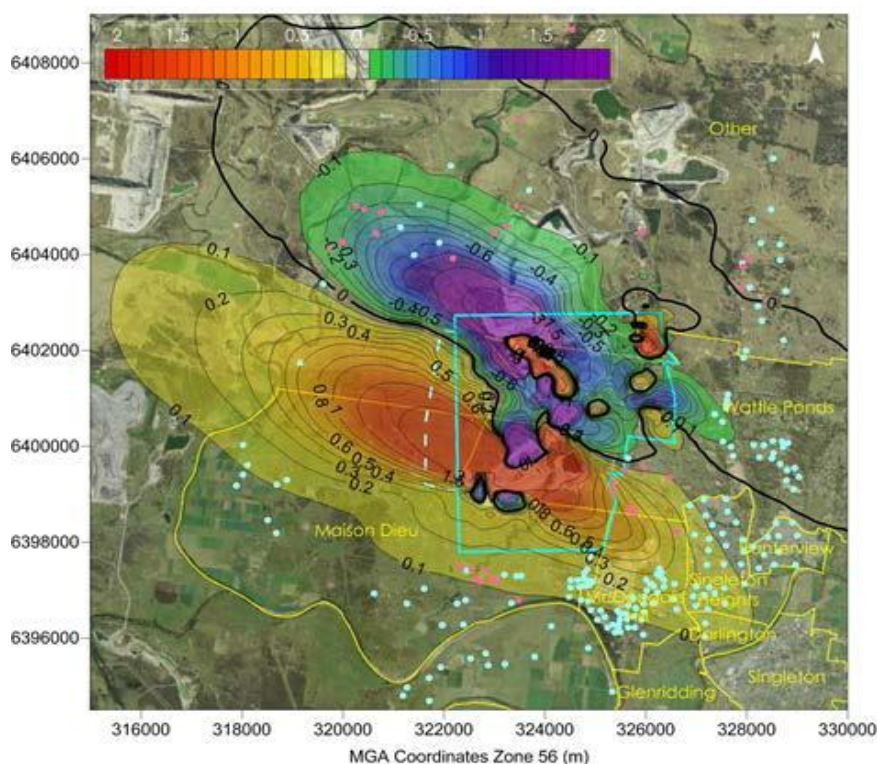
Notes: The border of the Singleton SUA is highlighted in red. The borders of NSW suburbs are highlighted in blue.

Source: ABS, Australian Statistical Geography Standard (ASGS): Volume 3 - Non ABS Structures, July 2016, 2016

The proportion of air quality impacts that occur within a given geographic catchment is a function of both the concentration of emissions and the physical area or volume of the impact zone. Analysis of detailed maps of the impact zones and concentration of PM2.5 emissions from the Project produced by Todoroski Air Sciences indicated that on average, over the Project’s life, close to 20 per cent of the incremental air quality impacts are likely to occur outside the Project site and within the Singleton SUA.⁹ Air quality impacts are expected to reach a peak close to 2023 (Figure 2-3) and be located within the Singleton SUA in large part to the south east of the Project site in suburbs such as Singleton Heights (Figure 2-2).

⁹ Please note that Maison Dieu or the area to the north-west of Wattle Ponds is not located in the Singleton SUA as defined by the ABS.

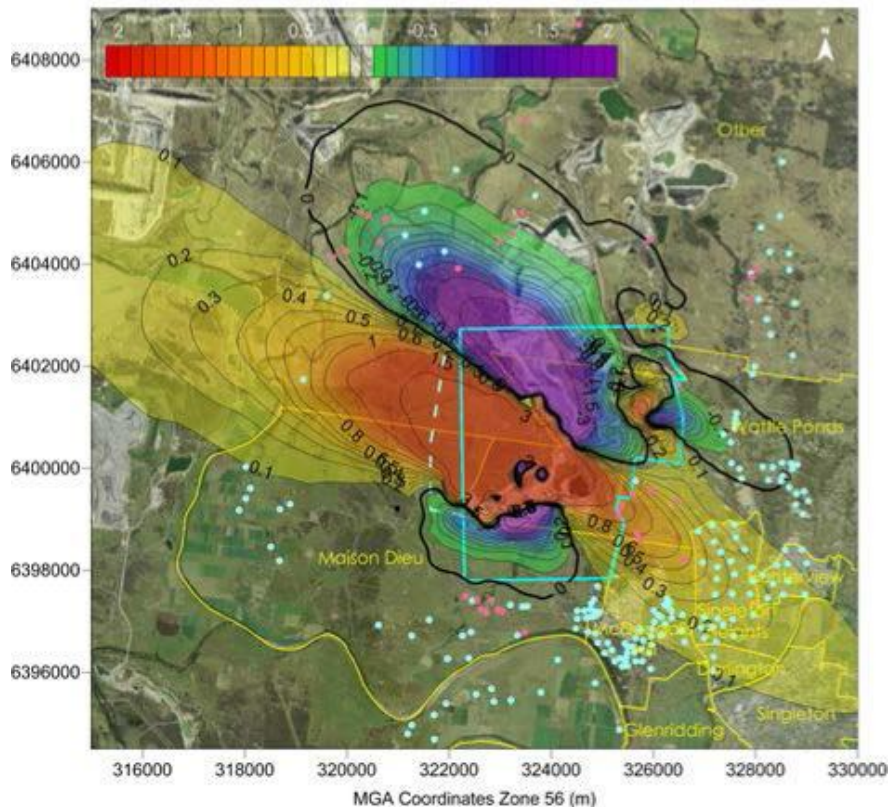
Figure 2-2: Impact zone and concentration of PM 2.5 emissions from the Project, 2017



Notes: The vertical and horizontal axis display spatial coordinates. The light blue line designates the Project site. The scale indicates the concentration of PM2.5 emissions.

Source: Information provided by Todoroski Air Sciences

Figure 2-3: Impact zone and concentration of PM 2.5 emissions from the Project, 2023



Notes: The vertical and horizontal axis display spatial coordinates. The light blue line designates the Project site. The scale indicates the concentration of PM2.5 emissions.

Source: Information provided by Todoroski Air Sciences

The analysis assumed a cost per tonne of PM2.5 emissions of \$39,000, consistent with default values provided by the Workbook (Table 2-6).

Table 2-5: Key inputs into the calculation of the economic costs of projected PM2.5 emissions

	Impact distribution (%)	Cost per tonne (\$)
Singleton	20	39 000
Not in any Significant Urban Area	80	0

Sources: Department of Planning and the Environment, Air Quality Valuation Workbook, KPMG

Estimated cost of air quality impacts...

The total estimated cost of air quality impacts, in real, net PV terms, is summarised in Table 2-7. The economic cost of air quality is estimated to range between \$0.03 and \$0.21 million for the years analysed.

Table 2-6: Costs of air quality impacts over project horizon (PV, \$m real 2015)

Timeframe	Impact (PV, \$m real)
2017	0.10
2020	0.03
2023	0.21
2026	0.04

Source: KPMG analysis based on Department of Planning and the Environment, Air Quality Valuation Workbook and assumptions provided by Todoroski Air Sciences

3 Conclusions

Analysis of carbon emissions and air quality impacts outlined in this report found the following:

- The cost of carbon emissions over the life of the Project are estimated to be \$5.2 million for Scope 1 emissions and \$1.1 million for Scope 2 in PV terms based on the preferred quantification metric.
- The cost of Scope 3 carbon emissions are estimated to be significant, \$449 million based on the preferred quantification metric, however, this type of emission is not typically considered in economic analysis of mining projects.
- The annual cost of air quality impacts over the life of the Project are estimated to range between \$0.03 and \$0.21 million for the years analysed.

Given the implicit assumption that carbon emissions in the base case are insignificant, the estimates of the economic cost of the incremental carbon emissions over the project life could be viewed as an upper bound. While not directly comparable, it may be useful to consider these impacts in the context of the broader economic analysis for the Project that was finalised in 2015. The findings of the original KPMG analysis are summarised in Table 3-1.

Table 3-1: Previous economic evaluation results (PV @ 7% \$ million 2015)

Evaluation Results (\$m, PV @ 7 per cent)

Incremental costs	
Capital expenditure	110.5
Operating and maintenance expenditure	705.4
Environmental externalities	4.5
Opportunity cost of land use	0.2
Total Incremental Costs	820.6
Incremental Benefits	
Revenue	997.5
Wage premium	104.3
Residual value of land	0.4
Total Incremental Benefits	1,072.2
Summary Results	
NPV (\$ million)	251.6
BCR	1.3

NOTE: Totals may not sum due to rounding.

Source: KPMG, Rix's Creek Continuation Project – Economic Assessment, 2015

The original KPMG analysis undertaken in July 2015 found that total environmental externalities were \$4.5 million over the life of the Project, or 0.5 per cent of total incremental costs of the project. The updated carbon emission impacts are higher than the previous estimates, particularly when estimates of air quality impact are also considered. For example, the Scope 1 carbon emissions using the preferred metric (Assumption 1) and air quality impacts result in total environmental externalities of approximately \$6.5 million over the project life. Despite this, while not directly comparable, the updated environmental externalities still represent a small proportion of the total incremental cost of the Project.

Appendix A: Sensitivity Analysis

Sensitivity analysis was undertaken to highlight the impact of changes in the assumed discount rate on the economic value of the carbon emissions.

For the carbon emissions, the analysis focuses on the preferred assumption (Assumption 1) for the unit cost of carbon emissions. The results of the sensitivity analysis are summarised in Appendix Table A1.

Appendix Table A 1: Costs of carbon over the project horizon for Assumption 1 (PV, \$m real 2015)

Discount rate	Impact for Assumption 1 (PV, \$m real)			
	Scope 1	Scope 2	Scope 3	Total
4 per cent	6	1	557	564
7 per cent	5	1	449	455
10 per cent	4	1	372	377

Source: KPMG



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Appendix N-2 Economic Specialist Peer Review



Advisory

Level 38 Tower Three
300 Barangaroo Avenue
Sydney NSW 2000

P O Box H67 Australia Square
Sydney NSW 1213
Australia

ABN: 51 194 660 183
Telephone: +61 2 9335 7000
Facsimile: +61 2 9335 7001
DX: 1056 Sydney
www.kpmg.com.au

Attention: Garry Bailey
General Manager of Mining Development
Big Ben Holdings Pty Ltd
PO Box 4
East Maitland NSW 2323

Our ref KPMG Response Letter_Bloomfield CIE
Review_070217

Contact Elizabeth Clark - 02 9455 9161

21 February 2013

Dear Garry

Peer Review of Rix's Creek Extension Economic Assessment

Thank you for providing KPMG with the opportunity to respond to the findings of a peer review of the Economic Analysis of the Rix's Creek Extension Project. Specifically, we note that the review focuses on two documents, namely:

- KPMG 2015, *Rix's Creek Continuation Project – Economic Assessment*, report prepared for Rix's Creek Pty Limited, July (referred hereafter as 'the KPMG Report').
- KPMG 2016, *Rix's Creek Continuation Project – Economic Assessment*, addendum report prepared for Rix's Creek Pty Limited, April (referred hereafter as 'the KPMG Addendum Report').

The attachment to this letter outlines the responses to each key point raised in the CIE review. This letter and the attachment should be read in conjunction with the CIE review, the KPMG Report and the KPMG Addendum Report.

Yours sincerely

Peter Ball
Partner

ATTACHEMENT A

This attachment outlines responses to the CIE review as requested by The Bloomfield Group.

1. Alternative scenarios

CIE Review Finding

KPMG Response

While the EIS present a single option (the Project), from the perspective of the NSW community, it is possible that there are alternative options that have not been presented here that may deliver greater net benefits to the community.

The scope of the KPMG analysis was to consider the incremental impact of the Project relative to a 'do nothing' base case (refer to page 13 of the KPMG Report). KPMG acknowledges that there may be alternate options that may deliver benefits to the community, however, these options do not form part of the scope for analysis.

2. Future production profile

CIE Review Finding

KPMG Response

While there is uncertainty regarding how the future production profile from the mine will be affected by changes in the international market, it is expected that there will be a sustained demand for the product over the timeframe for the project.

The future production profile assumed in the analysis is based on information provided by The Bloomfield Group (refer to page 39 of the KPMG Report). Due diligence regarding the certainty of the levels of demand to support the production profile were not undertaken by KPMG and were beyond the scope of the analysis (refer to page 13 of the KPMG Report). However, it is noted that, at the time of the analysis, The Bloomfield Group indicated that they had existing supply contracts with Japan.

3. Future coal price assumption adopted in the analysis

CIE Review Finding

KPMG Response

It is not clear what price assumptions are used beyond 2025. It is also not clear what exchange rate assumptions have been used and whether separate prices have been assumed for export thermal and coking coal.

There is a lack of clarity regarding the future coal prices assumed in KPMG's analysis. Further information should be sought regarding these assumptions.

The economic appraisal was undertaken as at July 2014 with all results reported in 2014 Australian dollars. The analysis relied on coal price forecasts published by the World Bank (in July 2014). These prices were converted to real Australian dollars based on assumed CPI (3 per cent) and the US dollar exchange rate at the time of the analysis (AU\$1 = US\$0.85). As outlined in the KPMG Addendum Report, the analysis assumed a long term average price of slightly below \$100 per tonne (Australian dollars). As the analysis extends beyond the forecast years, the forecast price for 2020 was adopted as the assumed price for the remaining analysis years. The assumed coal prices are outlined in the table below and were applied to the production profile estimated by Bloomfield. KPMG note that no separate estimates of thermal and coking coal production were available at the time of the analysis.

Table 1: Assumed coal price forecasts (\$AUD)

	2014	2015	2016	2017	2018	2019	2020 onwards
Coal price (\$/tonne)	93.06	95.25	96.15	97.05	97.95	98.72	99.49

Source: World Bank (2014) and KPMG analysis

4. Estimates of Royalty Payments

CIE Review Finding

Based on alternate estimates of future coal prices it is reasonable to assume conservative estimates for royalties in the range of \$101 million to \$130 million.

KPMG Response

As noted in the KPMG Addendum Report, Royalties and taxes are typically excluded from an economic appraisal as they represent a transfer from one party to another. In the case of the analysis of the Rix's Creek Continuation Project, royalties and company tax represent a cost to Bloomfield Collieries and an equivalent benefit to government. Accordingly, inclusion of royalties and company tax has no net impact on the overall analysis result.

It is noted in the KPMG Addendum Report that the inclusion of royalties and taxes impacts the distribution of costs and benefits. However, distributional impacts were not the focus of the KPMG analysis.

As noted in the KPMG Addendum Report, DRE have developed estimates of coal royalties based on an assumed price of A\$80 per tonne for export thermal cost. For coking coal, DRE have assumed a short term price of A\$100 and a medium to long term price of A\$120 per tonne. Based on production of 25 million tonnes per annum (Mtpa) of saleable coal mined from 2016 to 2038, the typical annual royalty is estimated to be \$9 million. Over the life of the Project, DRE estimated total royalties to be A\$240 million or A\$130 million in present value terms (based on a discount rate of 7 per cent) to NSW.

As noted in the KPMG Addendum Report, KPMG have developed similar estimates of coal royalties, although as noted above these are not included in the economic appraisal results. Specifically, the expected royalties relating to the project are estimated to be approximately \$9 million per annum or \$215 million over the life of the project (\$133 million in present value terms). These estimates are based on the current share of allowable deductions (4.56 per cent as estimated based on the March 2016 Royalty Statement, the coal prices assumed in the KPMG analysis (equivalent to a long term average of slightly below \$100 per tonne) and the current Ad Valorem rate of 8.2 per cent.

Estimates of royalties developed by CIE (June 2016) under "...conservative estimates of future coal price forecasts..." would be "...in the range of \$100-130 million in present value terms". CIE note in their review that the driver of variation in royalty estimates are likely to be the result of differences in coal price assumptions.

5. Wage premium benefits

CIE Review Finding	KPMG Response
For the purposes of the CBA, it is reasonable to assume that the benefit attributable to the wage premium is between \$150,000 to \$300,000 in present value terms.	The report includes quantification of the economic benefit to workers associated with the Rix's Creek Continuation Project. Inclusion of this benefit is consistent with the recently finalised NSW Government <i>Guidelines for Economic Assessment of Mining and Coal Seam Gas Proposals</i> (see Table 3.1 in the guidelines)¹. The rationale for inclusion of the wage premium is recognition of the economic benefits associated with continued operation of the Rix's Creek Project for the local community. Importantly, as outlined Section 3 of the report, the number of unemployed persons in the Hunter Valley region has increased significantly over the last two years and average individual taxable income is significantly lower in the region relative to the state average.

6. Environmental externalities

CIE Review Finding	KPMG Response
Chart 2.6 – Potential Environmental Externalities Chart 2.7 – KPMG conclusions regarding expected unmitigated environmental impacts	The CIE review presents an extract from the KPMG Report that summarises the environmental externalities associated with project and attributes this information to KPMG. It is important to note that this citation within the Review is incorrect and KPMG did not undertake environmental assessment of the Project. The information presented in Chart 2.6 and Chart 2.7 of the Review is attributable to the broader Environmental Impact Statement (EIS) prepared by AECOM or the individual specialist reports commissioned by the Bloomfield Group to support the preparation of the EIS.

7. Air pollution - particulate matter emissions

CIE Review Finding	KPMG Response
Given concerns raised by agencies, we would anticipate that additional modelling is required to clarify issues. Further, the impacts on properties needs to be quantified and monetised. This would include properties where acquisition rights exist and these rights have not been exercised.	Estimates of particulate matter (air quality) emissions were not available at the time of the analysis. KPMG notes, however, that selected estimates of air quality have now been developed and quantified in economic terms in a separate analysis. These estimates are not directly comparable to the CBA, largely due to changes in the production profile, and are, therefore, not included in the CBA. However, these estimates provide an indication of the magnitude of the air quality impacts.

¹ NSW Department of Planning and Environment 2015, *Guidelines for the economic assessment of mining and coal seam gas proposals*, December.

8. Greenhouse gas emissions

CIE Review Finding

Further information is required to test the estimates of greenhouse gas emissions for inclusion in the CBA. KPMG should also provide estimates using alternative carbon prices including the Commonwealth Government's previous carbon tax price and the US EPA estimates of the social cost of carbon based on the economic damages associated with a small increase in carbon dioxide emissions.

KPMG Response

Quantification of the environmental externalities (as outlined in the KPMG Report) was based on the information available at that time. As noted in the KPMG Report, quantification of air quality impacts is based on the following two assumptions:

"The Project is estimated to generate annual greenhouse gas (GHG) emissions of 0.047Mt CO₂-e per annum..."²

"The value of GHG emissions assumed for the analysis is equivalent to the shadow carbon price modelled for the Independent Expert Panel reviewing the (RET) scheme. The shadow carbon price is based on the long-term spot market price for European permits and is approximately \$9.50 per tonne of carbon, escalating at 3 per cent in real terms"³

The value of emissions is the product of volume and price, that is:

$$\text{Annual value of air quality impacts} = \text{Annual emission volume} \times \text{Index carbon price}$$

It is recognised that the carbon price is subject to variation based on a variety of factors, however, the assumption adopted at the time of the analysis was consistent with advice received from the Commonwealth Department of Environment. If there has been subsequent analysis of emissions, these would not be reflected in the economic analysis.

Following a request from Bloomfield, KPMG conducted an indicative sensitivity analysis of the impact of change in the carbon price assumption. The findings of this analysis are reproduced in Table 2 for reference and additional sensitivities added to reflect carbon prices similar in magnitude to the Social Cost of Carbon estimates developed by the US EPA.

While not directly comparable, subsequent estimates of carbon emissions have been developed for a revised production schedule for the Project. The economic costs associated with these emissions have been quantified as part of a separate analysis.

² Todoroski Air Sciences 2015, *Air Quality and Greenhouse Gas Assessment – Rix's Creek Continuation of Mining Project*, draft report prepared for Rix's Creek Pty Limited, March

³ Acil Allen 2014, *RET Review Modelling Results*, prepared for the RET Review Panel, August



Table 2: Indicative sensitivity analysis results, carbon price assumption

Carbon Price Assumption (\$/tonne)		Benefits (\$m)	Externalities (\$m)	Other Costs (\$m)	Total Costs (\$m)	NPV (\$m)	BCR
\$4.75	50 per cent decrease	1,072.2	2.3	816.0	818.3	253.9	1.31
\$9.50	Assumed price based on RET scheme	1,072.2	4.5	816.0	820.6	251.6	1.31
\$14.25	50 per cent increase	1,072.2	6.8	816.0	822.9	249.4	1.30
\$19.00	100 per cent increase	1,072.2	9.1	816.0	825.1	247.1	1.30
\$28.50	200 per cent increase	1,072.2	13.6	816.0	829.7	242.6	1.29
\$57.00	500 per cent increase	1,072.2	27.2	816.0	843.3	228.9	1.27
\$104.50	1000 per cent increase	1,072.2	49.9	816.0	866.0	206.2	1.24
\$199.50	2000 per cent increase	1,072.2	95.3	816.0	911.4	160.8	1.18

Source: KPMG analysis

9. CGE analysis assumptions and findings

Client Review Finding

KPMG Response

Based on information provided and externally sourced information the results presented appear to significantly overstate the regional and state level of impact

As outlined in Section 2.6 of the report, comparative static Computable General Equilibrium (CGE) modelling was used to estimate the economic impact of the proposed Rix's Creek continuation. Input-output (IO) tables published by the ABS for 2007-08 underpin the CGE model and provide details on the upstream and downstream linkages of sectors. Key assumptions adopted in CGE modelling were consistent with widely accepted values based on empirical studies and qualitative assessments of cost and sale structures in sectors.

Review of the CGE analysis results reported in the KPMG Report has found that one of the charts was incorrectly labelled. Accordingly, the results of the analysis are presented in the following table for clarity and completeness.

Table 3: Economic impact of the Project (\$, 2013-14)

Impact Measure	Direct Impacts	Total Impacts
Regional Impacts (Hunter Valley)		
Gross State Product (\$m)	70.2	104.0
Employment (FTE)	126	375
State Impacts (NSW)		
Gross State Product (\$m)	70.2	164.9
Employment (FTE)	169	291

Source: KPMG analysis based on information provided by Rix's Creek Pty Limited

Appendix N-3 Economic Impact of Environmental Impacts

Rix's Creek Continuation Project – Economic Assessment

Addendum to report prepared for
Rix's Creek Pty. Limited

3 May 2016

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Disclaimer and limitations

Inherent limitations

This Addendum Report has been prepared as outlined in the Background and Scope and Purpose Sections. This Addendum Report provides further clarification regarding selected components of KPMG's Final Report *Rix's Creek Continuation Project – Economic Assessment* dated 9 July 2015 (**Final Report**). This Addendum Report does not contain KPMG's conclusive findings (which are only contained in the Final Report), and therefore this Addendum Report must be read in conjunction with the Final Report.

The services provided in connection with this engagement comprise an advisory engagement, which is not subject to assurance or other standards issued by the Australian Auditing and Assurance Standards Board and, consequently no opinions or conclusions intended to convey assurance have been expressed.

No warranty of completeness, accuracy or reliability is given in relation to the statements and representations made by, and the information and documentation provided by, Big Ben Holdings Pty Limited (parent company of The Bloomfield Group including Rix's Creek Pty. Limited), its management and personnel, its other consultants and stakeholders, consulted as part of the process.

KPMG have indicated within this Addendum Report and the Final Report the sources of the information provided. We have not sought to independently verify those sources unless otherwise noted within the Addendum Report and / or the Final Report.

KPMG is under no obligation in any circumstance to update this Addendum Report and / or the Final Report, in either oral or written form, for events occurring after either the Addendum Report or the Final Report have been issued in final form.

The findings in this Addendum Report have been formed on the above basis.

Third party reliance

This Addendum Report is solely for the purpose set out in the Scope and Background and Purpose Sections and for Big Ben Holdings Pty Limited's information, and is not to be used for any other purpose or distributed to any other party without KPMG's prior written consent.

This Addendum Report has been prepared at the request of Big Ben Holdings Pty Limited in accordance with the terms of KPMG's Engagement Letter dated 8 April 2014, as subsequently varied on 15 April 2016. Other than our responsibility to the Big Ben Holdings Pty Limited, neither KPMG nor any member or employee of KPMG undertakes responsibility arising in any way from reliance placed by a third party on this report. Any reliance placed is that party's sole responsibility.

Distribution

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Document Purpose and Limitations

Background and Scope

Big Ben Holdings Pty Limited (ultimate holding company of The Bloomfield Group and Rix's Creek Pty Limited), engaged KPMG in April 2014 to prepare an economic impact assessment of the Rix's Creek Continuation Project as a part of a broader EIS. Specifically, the scope of services includes:

- CBA of the Project including:
 - assessment of the direct economic benefits of the development;
 - identification of any adverse impacts of the development; and
 - detailed assessment of the costs and benefits of the development as a whole, and
 - whether it would result in a net benefit for the NSW community.
- Regional economic impact assessment to estimate the indirect economic benefits of the Project for the local (Hunter Valley region) and state (NSW) economies.

The KPMG report *Rix's Creek Continuation Project – Economic Assessment* ('the report' or 'the KPMG report') was issued on 9 July 2015. This document forms an addendum to the report.

Purpose

This addendum report provides further information on selected components included in the KPMG report. Specifically, this addendum seeks to respond to questions and points of clarification regarding the KPMG report and should, under all circumstances, be read in conjunction with the report.

Limitations

This addendum does not seek to re-estimate the economic implications associated with the Rix's Creek Project or replace or update the KPMG report issued on 9 July 2015. The content of this addendum does not seek to provide a comprehensive representation of the economic implications of the Rix's Creek Project. For that reason, this addendum should be read in conjunction with and refers to the KPMG report issued on 9 July 2015.

Response to Questions and Clarifications

The following table provides further information relating to the analysis of the economic implications of Rix's Creek Extension Project. The questions and clarification relating to the report were grouped into five key areas, namely:

- coal price assumptions;
- royalties and taxes;
- net producer surplus;
- cost of mitigating environmental and social impacts; and
- labour premiums.

The complete findings of the analysis are documented in the KPMG report issued on 9 July 2015.

Table 1: Response to questions and clarifications

Analysis component	Description
Coal price assumptions	The economic appraisal was undertaken as at July 2014 with all results reported in 2014 Australian dollars. The analysis relied on coal price forecasts published by the World Bank, <i>Commodity Market Outlook, July 2014</i>.¹ These prices were converted to real Australian dollars based on the exchange rate and the consumer price index (CPI) at the time of the analysis. The analysis assumes a long term average price of slightly below \$100 per tonne (Australian dollars). It is recognised that, given the long term nature of the project, there will be variation in coal prices. However, the assumed price adopted in the 2014 KPMG analysis is broadly consistent with price assumptions adopted by the NSW Department of Industry (Division of Resource and Energy "DRE") in the review of the Rix's Creek Environmental Impact Statement (dated December 2015), specifically: • \$80 per tonne in the short term for export thermal coal; • \$75 to \$100 per tonne in the medium to long term for export thermal coal; • \$100 per tonne in the short term for export coking coal; and • \$120 per tonne in the medium to long term for export semi soft coking coal. In considering the impact of changes in coal prices in the short to medium term, changes in the costs of the project should also be considered. Recent consultation with Bloomfield Collieries suggests that, since the completion of the economic analysis in 2014, there have been a number of changes that have potentially reduced the costs associated with the Rix's Creek Extension Project. The changes are primarily associated with purchase of Integra Open Cut and include: • Acquisition of the rail loop that is expected to result in cost savings of approximately \$4.5 million per annum. These cost savings are expected to result from savings in rail loop access charges (previously paid to the owner of the rail loop) net of expected rail loop operational expenses.

¹ World Bank Group 2014, *Commodity Markets Outlook*, July 2014.

Analysis component	Description
	- Excess mobile mining machinery purchased through the Integra acquisition will be used to refresh the Rix's Creek fleet and provide savings in forecast mobile fleet replacement capital expenditure of approximately \$85.6 million over the first 16 years of the Rix's Creek extension. - Excess mobile mining machinery will also realise savings on repairs and maintenance, with newer machinery replacing older and less efficient machines. - Excess components and inventory purchased through the Integra acquisition will reduce repairs and maintenance costs by \$6.5 million over the first 2 years. - The operation of Rix's Creek and Rix's Creek North will utilise predominantly the existing management personnel. The effect of this will be a reallocation of management salaries overheads from Rix's Creek to Rix's Creek North. This is expected to result in a saving of 30 per cent of management overheads or \$2.8 million per annum².
Royalties and taxes	Royalties and taxes are typically excluded from an economic appraisal as they represent a transfer from one party to another. In the case of the analysis of the Rix's Creek Continuation Project, royalties and company tax represent a cost to Bloomfield Collieries and an equivalent benefit to government. Accordingly, inclusion of royalties and company tax has no net impact on the overall analysis result. It is noted that the inclusion of royalties and taxes impacts the distribution of costs and benefits. However, distributional impacts were not the focus of the KPMG analysis. There are a number of potential tax revenue streams that would be generated as a result of the Rix's Creek Continuation Project, namely: - royalties; - payroll taxes; - income tax paid by employees associated with their wage and salary income; and - company tax payable by Bloomfield Collieries. It is important to note that Bloomfield Collieries is an Australian owned entity and accordingly, profits and associated tax payments accrue within Australia. Royalties DRE have developed estimates of coal royalties based on an assumed price of A\$80 per tonne for export thermal cost. For coking coal, DRE have assumed a short term price of A\$100 and a medium to long term price of A\$120 per tonne. Based on production of 25 million tonnes per annum (Mtpa) of product coal mined from 2016 to 2038, the typical annual royalty is estimated to be \$9 million. Over the life of the Project, DRE estimated total royalties to be A\$240 million or A\$130 million in present value terms (based on a discount rate of 7 per cent) to NSW.

² Based on information provided by Bloomfield Collieries.

Analysis component	Description
	The DRE estimates of royalties are slightly higher than estimates if the assumed price adopted in the KPMG analysis is assumed. Specifically, the expected royalties relating to the project are estimated to be approximately \$9 million per annum or \$215 million over the life of the project (\$133 million in present value terms). These estimates are based on the current share of allowable deductions, the coal prices assumed in the KPMG analysis and the current Ad Valorem rate of 8.2 per cent. Payroll taxes Payroll tax is applied to wages that exceed the payroll tax threshold (\$750,000 in 2015-16). The current rate of payroll tax is 5.45 per cent. Over the life of the Project, average annual labour costs are estimated to be approximately \$17 million. Payroll tax associated with this would be approximately \$900,000 per annum. It is recognised that payroll tax income may be generated without the Project, with workers employed in another part of the entity. However, it is expected that a proportion of this tax revenue is incremental to the extent that workers earn a wage premium under the Project. Personal income tax Personal income tax is paid by individuals based on their annual taxable income. Based on the average annual labour cost (\$17 million) and an average annual labour force of 125 persons, average annual personal income tax contribution by employees of the Rix's Creek Project is estimated to be almost \$4.8 million (in 2016 dollars). The share of this tax revenue attributable to NSW can be estimated based on the state share of population (32 per cent). Accordingly, the NSW personal income tax contribution associated with the project is estimated to be approximately \$1.5 million per annum. Company tax The current company tax rate in Australia is 30 per cent. Based on the average annual revenue and costs associated with the Rix's Creek Project, the estimated company tax payable is approximately \$10 million per annum. The company tax income attributable to NSW is estimated to be just over \$3 million per annum over the life of the Project.
Net producer surplus	Net producer surplus is equivalent to the revenue from operations less the costs of the project. While not specified in the analysis as a benefit, producer surplus is effectively included in the analysis. The economic analysis considers full project revenue and full project costs associated with the Rix's Creek Continuation Project. The difference between these two analysis components, the producer surplus, forms part of the analysis results.
Cost of mitigating environmental and social impacts	The costs of mitigation activities undertaken by Bloomfield Collieries is included in the costs associated with operating the Rix's Creek Continuation Project. Specifically, these costs include: • environmental monitoring; • waste management; • rehabilitation costs; • licenses; • other environmental related activities; and

Analysis component	Description
	equipment replacement.
Labour Premiums	The report includes quantification of the economic benefit to workers associated with the Rix's Creek Continuation Project. Inclusion of this benefit is consistent with the recently finalised NSW Government <i>Guidelines for Economic Assessment of Mining and Coal Seam Gas Proposals</i> (see Table 3.1 in the guidelines).³ The rationale for inclusion of the wage premium is recognition of the economic benefits associated with continued operation of the Rix's Creek Project for the local community. Importantly, as outlined Section 3 of the report, the number of unemployed persons in the Hunter Valley region has increased significantly over the last two years and average individual taxable income is significantly lower in the region relative to the state average. The potential for labour premiums is increasingly compelling as some excess labour capacity emerges in the resources sector. Cessation of operations at Rix's Creek would likely result in employees seeking alternate employment. These employees may face difficulty in obtaining alternate employment at their current wage levels given the lower commodity price environment. Social impact analysis relating the Rix's Creek expansion assessed the areas of resilience and risk in the local community. The analysis identified that the "...lack of economic diversity in the Hunter region and dominance of mining industry employment and associated occupations..." potentially made the region "...vulnerable to changes in mining activity...".
External costs	As outlined in Table 4.1 of the report, environmental externalities are identified as a potential cost associated with the Rix's Creek Continuation Project. The report draws on various third party publications pertaining to the specific development to highlight the potential environmental externalities, including impacts on: - air quality; - ecology (vegetation); - noise; - soils and geology; - surface water; - groundwater; and - heritage. The third-party environmental impact reports generally concluded that the environmental impacts were manageable and appropriate mitigation measures were established. An assessment of air quality impacts quantified the air quality impacts although noted that these would likely be ameliorated. Despite this amelioration, these air quality impacts were quantified and included in the economic costs. The unit price of Greenhouse Gas (GHG) emissions adopted at the time of the analysis (2014) was based on advice from the Department of Environment (Commonwealth) and was based on the Renewable Energy Target (RET)

³ NSW Department of Planning and Environment 2015, *Guidelines for the economic assessment of mining and coal seam gas proposals*, December.

Analysis component	Description
	Review undertaken in the months leading up to the date of the analysis. It is recognised that there is some speculation regarding an appropriate assumption for the valuation of GHG emissions and sensitivity analysis would demonstrate the impact of variation in this assumption on analysis findings. However, the total value of environmental externalities represents less than one per cent of total project costs (refer to Table 4.7), and accordingly, changes in the assumed unit price is unlikely to have a material impact on the analysis findings.
Residual value of land and agriculture production	The residual value of land was estimated based on the total land area (185 hectares) included in the extension of Rix's Creek and an average land value of \$10,000 per hectare (as described on Page 42 of the report). The average land value assumption was adopted based on information provided by Bloomfield Collieries on recent sales of equivalent land in the area. The value of agriculture production foregone was estimated based on an assessment of the productive potential of the site prepared by Neil Nelson Agvice P/L. The assessment found that the site had a carrying capacity of between \$20,000 to \$30,000 per annum. If the site was managed intensively, the annual capacity may be as high as \$45,000 per annum.⁴
Economic impact assessment	As outlined in Section 2.6 of the report, comparative static Computable General Equilibrium (CGE) modelling was used to estimate the economic impact of the proposed Rix's Creek continuation. Input-output (IO) tables published by the Australian Bureau of Statistics (ABS) for 2007-08 underpin the CGE model and provide details on the upstream and downstream linkages of sectors. Key assumptions adopted in CGE modelling were consistent with widely accepted values within empirical studies and qualitative assessments of cost and sale structures across sectors. Further information on the CGE modelling approach is contained in Attachment A.

⁴ Neil Nelson Agvice P/L 2015, *Rix's Creek Continuation of Mining Project: Agricultural Impact Statement*, report prepared for Rix's Creek Pty Limited, August 2015.

Attachment A: Modelling Approach

This attachment discusses and presents the economic modelling approach used to estimate the potential economic impact of the Rix's Creek Extension Project.

To estimate the economic impact of the Rix's Creek Extension Project in the Hunter Valley and NSW, this study employed a comparative static (CGE) model, described further below.

A1: Modelling economic impacts

To model the economic impacts beyond those that directly relate to the Rix's Creek Extension Project (as outlined in section 4), it is necessary to employ a modelling technique that makes use of information about the linkages of the sector within the broader economic context. The starting point for modelling these linkages is the input-output table published by the ABS.

Input-output table data provides detailed information on the upstream and downstream linkages of each industry in the economy. Upstream linkages refer to the sources of inputs to the industry in question. These linkages may be in the form of the use of intermediate inputs produced by other domestic industries, imported intermediate inputs, labour and other factors of production. For example, the mine would use inputs such as equipment, and construction and transport services. Downstream refers to linkages to those economic agents that purchase the industry's output. Downstream linkages include sales to other industries that use the output of the Rix Creek Extension Project as an intermediate input to their own production process, including sales to foreign companies.

An input-output table is a useful tool as a snapshot of the economic flows within the economy at the time the data was collected. An input-output table can be used to provide simplified estimates of the sensitivity of the economy (measured by employment, value added or turnover) to small changes (termed 'shocks') within industries. An example of such a shock might be a one per cent increase in the production of coal for export. This might lead to a similar increase in the use of inputs required to produce the additional output including fuels, labour, transport services etc. This type of analysis can be used at the industry-wide level to estimate input-output multipliers – that is, the total economy-wide impact on employment or output resulting from a change in one industry, taking into account the change in demand for the outputs of other industries.

However, an input-output table in itself is not an economic model that can explain how the economy may react to changes such as to demand or prices. A major limitation of the use of input-output multipliers when used to conduct impact analysis is that the relationship between industry inputs and outputs (the coefficients) are fixed, implying that industry structures remain unchanged by the shock to the industry (for example, a change in demand or prices).

Effectively, input-output multipliers are based on the assumption of unlimited resources. For example extending the example above, it assumes the one per cent increase in the use of transport services or labour can be accommodated through utilising what would otherwise have been an idle resource.

In reality, the scarcity of inputs (e.g. skilled labour, fuels etc.) mean that these inputs are affected by and respond to prices (e.g. wages, fuel prices). The higher prices, due to the increased demand for transport services, will at the margin reduce demand by some other users. Therefore, the result will be that these price impacts will then have an impact on activity levels, which feed back into price effects and so on.

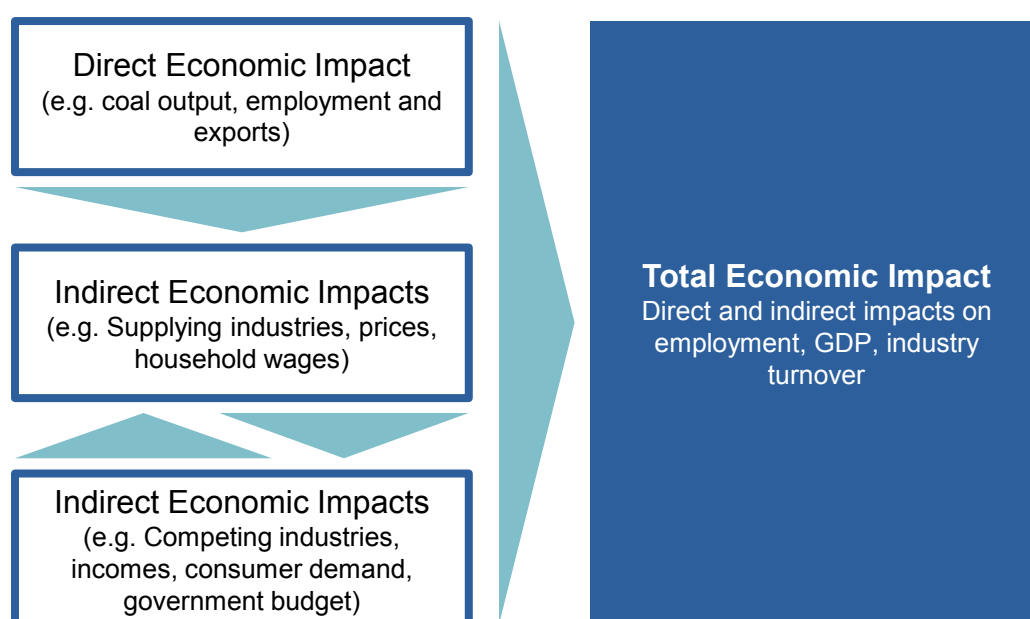
In input-output analysis, where all adjustments relate only to the quantities produced, this type of feedback response is assumed not to occur. Consequently, using an input-output model can result in an overstatement of the impacts of a change in one sector on the broader economy. For these reasons, while the ABS previously published input-output multipliers, it has ceased publishing these estimates.

A CGE model is based on an input-output table database, but is extended to make more sophisticated economic assumptions. In particular, CGE models have additional features that make them better suited for economic impact assessments, including:

- recognising resource constraints and responses of businesses, workers through adjusting prices/wages;
- capturing employment/capital (and other factor inputs) substitution for example, by responding to higher wages by increasing the use of capital; and
- capturing a much wider set of economic impacts such as behavioural responses to price changes of consumers, investors, foreigners etc.

By introducing these additional economic assumptions, we are able to model beyond the first round impact of an event or policy. This added sophistication means that a CGE model allows for feedback responses by producers, consumers, investors and foreigners. These flow-on effects mean that the results are less likely to be overstated, particularly over the medium to long term.

Figure A1: Direct and first and second order impacts in a CGE model



A2: The MMRF Model

The CGE model used for the analysis is the Monash Multi-Regional Forecasting (MMRF) developed by the Centre of Policy Studies, Monash University. The MMRF model is a multi-regional, dynamic CGE model.⁵ Depending on the application, it can separately distinguish up to eight Australian regions (six States and two Territories) and up to 144 commodities/industries. The model recognises:

- domestic producers classified by industry and domestic region;
- investors similarly classified;
- up to eight region-specific household sectors;
- an aggregate foreign purchaser of the domestic economy's exports;
- flows of greenhouse gas emissions and energy usage by fuel and user; and
- up to eight state and territory governments and the Commonwealth government.

⁵ P. Adams, J. Dixon, J. Giesecke and M. Horridge (December 2010). MMRF: Monash Multi-Regional

Forecasting Model: A Dynamic Multi-Regional Model of the Australian Economy. General Paper No. G-223, Centre of Policy Studies, Monash University.

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The database shows the following for each state economy:

the flow of industry outputs to other industries, final demands by households, Government, investment, and exports; and

- the cost structures of industries in terms of intermediate inputs of commodities supplied by domestic industries and by imports plus the primary factors of production, labour, capital and agricultural land, other costs to production and commodity taxes and subsidies.

The model accounts for taxes and subsidies associated with all transactions and also includes margin services for all the transactions. The margin services included are to represent the costs associated with transferring products from the producer (or the port of entry in the case of imports) to final consumers and other users.

The MMRF model is able to provide analysis of how a change in one sector – such as the Rix’s Creek Extension Project – ultimately flows through to other sectors across the economy in the longer term, after labour and capital has adjusted across the economy. For example, additional mining operations and export sales would flow-on to increased demand for transport services. Stronger demand would raise average prices. In the short-term, this would lead to reduced demand for transport services by other sectors. However, in the longer term, the model captures the impact of the higher incomes flowing from increased exports and employment, thus boosting activity across the economy. The comparison of the current state with the long run state after the shock is described as a comparative static analysis.

A3: Model closure

Essentially, the comparative static analysis calculates what the economy would look like if all markets were in equilibrium (a condition known as general equilibrium), that is, once all consumer, businesses, foreigners, workers and other economic agents have adjusted their behaviour in response to the new activity. This demand involves adjustment such that demand again equals supply in all product markets and for the labour, capital and other factor input markets. In this way, it is considered a long run model because these factors are slow to adjust to full equilibrium.

The general equilibrium framework imposes accounting for all additional resources needed in the economy. This means that additional assumptions are required to close the model. Key assumptions underlying the analysis are as follows:

- The labour market is assumed to be consistent with an exogenous level of national unemployment below which inflation rises. That is, in the long-run, the underlying national labour supply is not influenced by the investment project, but is primarily determined by demographic factors and technological change. The assumption on interstate migration is that unemployment in each State or Territory is exogenous, as is the inter-regional wage differentials so that population will instantly migrate between regions to take up employment opportunities.
- It is assumed that the additional output from the Rix’s Creek Extension Project Creek Extension Project is in response to additional international demand for coal exports. That is, the output does not “crowd-out” any existing coal production exports.

The model produces annual impacts from an annual shock (additional coal output and exports) and, for ease of interpretation, these have been presented in 2013-14 dollars. There is, however, no time dimension to the model; it is simply a comparison of two equilibrium states of the same economy.

A4: Hunter Valley Impacts

The NSW results from MMRF are then disaggregated across regions to provide an indication of the likely impacts in the Hunter Valley region. This uses an approach that distinguishes between industries influenced by broader economic activity (tradeable) and industries that largely service the local economy (non-tradeable). The results for tradeable industries are estimated using a top-down disaggregation across the state, while the results for non-tradeable industries are estimated in response to the resulting additional activity in industry activity across the Hunter Valley region.



Address

17 Warabrook Boulevard
Warabrook, NSW 2304
Australia

Telephone +61 2 4911 4900

Facsimile +61 2 4911 4999

Email newcastle@aecom.com