# Appendix D

# Independent Expert Advice

# Appendix D1 - Emeritus Professor Jim Galvin (mining engineering)

**Galvin and Associates Pty Ltd**
**ABN 27 086 258 871**

2 September 2020

Mr S O'Donoghue
Director Resource Assessments
Energy, Resources and Compliance
Department of Planning, Industry & Environment
12 Darcy St
Parramatta NSW 2124

Dear Mr O'Donoghue

**Subject: Review of Mine Advice and Professor Hebblewhite's Reports re Hume Coal Project**

I refer to the following Departmental requests made through Dr Mandana Mazaheri:

1. 20 August 2020: to *provide a provide a peer-review of the Russell Frith's report number HUME22/2 dated February 2019 entitled, "Response to DPE Assessment report by Mine Advice and Dr Bruce Hebblewhite", which was included in Appendix C of Hume Coal's Submission to the Independent Planning Commissions (IPC) in March 2019.*
2. 26 August 2020: to consider in my updated advice both Dr Frith's and Professor Hebblewhite's responses to a report by myself and one by Professor Canbulat in relation to Hume Coal's response to the Independent Planning Commission Report of 27 May 2019.

These reports total some 240 pages. It is not feasible in the given timeframe to peer review all this material and having read it, I do not think that a peer review would add much value in resolving the more important outstanding issues. This is because, with some minor exceptions, they have either been dealt with in one or more of the three reports I have already prepared in this matter (GAPL, 2017, 2018, 2020) and/or no new information has been presented to change my opinion. Having said that, it appears that the Professor Hebblewhite (the Proponent's peer review) and I are in reasonably close agreement on many of the issues other than some aspects of the numerical modelling.

Therefore, this letter report is focused on expanding on the reasons for my outstanding concerns with the numerical modelling, and why I consider that it is important for these to be resolved. My previous advice (GAPL, 2018) remains current, viz:

> *The choice of LaModel as the modelling technique and of Dr Heasley to construct the models is supported. As in all numerical modelling, it is important before relying on the outputs to understand the construct of the model and its input parameters and to be satisfied that they are appropriate. Clarification is required, therefore, on the points that follow. This is not an unusual situation in numerical modelling. On this occasion, clarification is particularly important since the mining situation is complex to model;*

PO Box 1228
MANLY NSW 1655
AUSTRALIA

Mobile: +61 417 710 476

Email: J.Galvin@Galvin.net.au

*the assessment of the stability of web pillars is likely to be very sensitive to the selection of pillar strength formulations, constitutive laws and calibration factors; and the reliability of the outcomes is likely to be critical to the project assessment.*

**Why does the stability of the web pillars need to assessed to a higher level of confidence**

Provided the intra-panel pillars remain stable, web pillar stability is not essential for controlling surface subsidence to manageable levels. The relevance of web pillar stability relates primarily to the risk that their instability could present to workplace health, safety and welfare. It could potentially also impact on groundwater response to mining. These aspects are discussed further in GAPL (2018).

There is precedent in highwall mining for web pillars of the dimensions being proposed in the shallower areas of the Hume Project to yield at these depths, including in a sudden manner, and result in material being ejected from the plunges (drives) and entrapment of equipment.

Highwall mining offers benefits over underground mining is that the highwall can be continuously monitored to provide warning of instability, fluids and solids are not ejected into a confined workplace and persons have unimpeded and rapid egress options in fresh air.

On the other hand, underground mining offers benefits over highwall mining in that the overburden is likely to be stiffer and have a higher spanning capacity because it has not suffered structural damage from blasting and because it behaves as a plate rather than a quasi-cantilever (as it is confined/supported on all sides). These features can reduce the likelihood of web pillar yielding. However, underground mining does not offer the same scope to monitor for impending failure and for taking early and rapid evasive action. Further, the consequences of pillar instability for workplace safety are much higher due to risks associated with falls of ground and working within a confined space (e.g. contamination of mine atmosphere, impeded egress)

In summary, the likelihood of web pillar failure in an underground setting can be expected to be much lower than in comparable highwall mining conditions, but the consequences of failure for workplace health, safety and welfare could be very much higher. Web pillar failure does not need to be sudden or complete in an underground mining situation in order to constitute a high risk. As in pillar extraction, partial yielding can lead to increased risk of falls of ground in and around the extraction panel. This risk is not confined to the immediate vicinity of active mining but can materialise later while persons are undertaking secondary activities, such as waste and water disposal prior to the sealing of a panel.

**The concept of safety factor**

Both the construct of the numerical model and the interpretation of its outcomes have a reliance on the concept of safety factor. Safety factor is a traditional engineering approach to assessing stability by comparing capacity to demand, or strength to working stress. This can be stated for coal pillars as:

$$Pillar\ safety\ factor = \frac{pillar\ strength}{pillar\ working\ stress} = \frac{pillar\ load\ carrying\ capacity\ per\ m^2}{pillar\ load\ per\ m^2}$$

In a perfect world where the formulations for pillar strength and pillar load were known exactly and the material properties to input into these formulations were determined precisely, a safety factor of marginally greater than 1 (one) would imply a stable design outcome, while a value marginally less than 1 would imply an unstable design outcome. A safety factor of exactly one (1) therefore corresponds to a 50% probability of stability (or instability).

However, as neither material properties, coal pillar strength nor coal pillar load can be determined precisely, a range of uncertainty is associated with values of safety factor. Stable outcomes may be associated with safety factors less than 1 and unstable outcomes with safety factors greater than 1. By way of example, Figure 1 shows the distribution of safety factors associated with unstable coal pillar designs for the Australian database that underpins the derivation by Salamon et al. (1996) of the UNSW power pillar strength formula. A similar distribution is associated with the derivation of the Salamon and Munro pillar strength formula based on a South African database (Salamon & Munro, 1967). It is important to note that the process used to derive these estimations of pillar strength was based on both unstable and stable cases for situations where a high level of confidence was associated with the estimation of the pillar load component of safety factor.

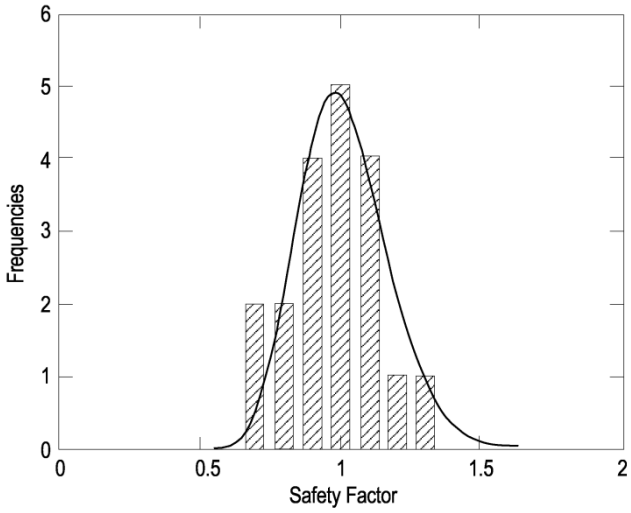


Figure 1: Histogram of frequency of failure versus safety factor constructed from the Australian database employing the UNSW power law pillar strength formulae and utilising the maximum likelihood method (after Salamon et al. (1996).

The reliability of a calculated safety factor depends on the confidence that can be placed in the estimations of both the pillar strength and the load acting on the pillar. The concept relies on the principle that the higher the uncertainty associated with these estimations and/or the higher the consequences of failure, the higher the design safety factor. This is illustrated in Figure 2 for situations where pillar load is known reasonably accurately. The figure shows that in order to achieve a given likelihood of stability, pillar design needs to be based on a higher safety factor when employing the UNSW linear strength estimation formula because a higher level of uncertainty is associated with the derivation of that formula than for the derivation of the UNSW power strength formula.

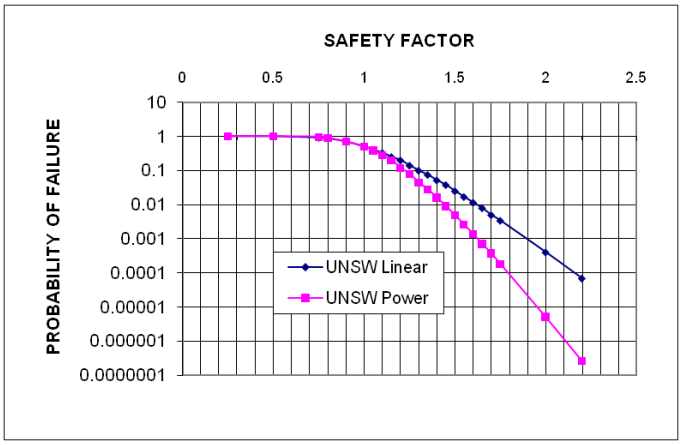


Figure 2: Safety factor versus probability of failure associated with UNSW pillar design formulae.

## Why is numerical modelling required?

In the case of the Hume Coal project, Professors Hebblewhite, Canbulat and Galvin agreed early on that numerical modelling was required to estimate the load acting on the various coal pillars making up the mine design. At the time of the meeting facilitated by Emeritus Professor Brown on 28 March 2018, the numerical model was still a work in progress, with consensus that LaModel was an appropriate code for this purpose.

## Calibration of the numerical modelling

As a matter of due diligence, the confidence that can be placed in the outcomes of a numerical model is a function of calibrating it to and/or testing it against a known behaviour or outcome. LaModel is based on simulating the overburden as a series of frictionless beams of equal elastic modulus, E, and thickness, t. For the Hume Coal Project, an attempt was made to calibrate the model based on subsidence data reported for Berrima Colliery.

The calibration process back-calculated a lamination thickness of 155 m with a rock modulus of 22.3 GPa. These values are not realistic and were recognised as such. Accordingly, they were de-rated significantly in the numerical modelling runs. The modelled overburden stiffness ranged down to about 1/20$^{th}$ of the back-analysed stiffness, with the highest modelled stiffness being only about 1/3$^{rd}$ of the back-analysed stiffness.[1]

It is because these are assumed values and not back-calculated values based on calibration to field performance that I am of the opinion that the calibration of the model is incomplete. Effectively, one could claim that the model was not calibrated. This is not to say that the assigned values may not be reasonable, but that they remain assumed values and not values derived from calibration.

[1] Hume Coal response of 11 July 2018, page 9.

**Pillar strength estimation used in the numerical modelling**

There are many coal pillar strength formulae and they produce a wide range of strength estimations. However, the reliability of four of these has been determined by developing correlations between safety factor and likelihood of success for circumstances where the load acting on the pillars is reasonably well known. Three of these correlations are quantitative, having been derived on the basis of both stable and unstable mine workings utilising the maximum likelihood statistical analysis technique. These three formulations are the Salamon and Munro power pillar strength formula (Salamon & Munro, 1967), the UNSW power pillar strength formula and the UNSW linear pillar strength formula (Salamon et al., 1996). The fourth correlation relates to the Bieniawski linear pillar strength formula (Bieniawski, 1983, 1992) and is more qualitative in nature. That correlation is shown in Table 1.

Table 1: Summary of safety factor recommendations of Bieniawski (1983), (1992) when using the Bieniawski coal pillar strength estimation formula.

| Situation | Safety Factor |
|---|---|
| Bord and pillar first workings | 1.5 |
| Pillar extraction | 2.0 |
| Main development pillars | 2.0 |
| Barrier pillars | 2.5 |
| Tailgate chain pillars | 1.3 |
| Pillars in bleeder roadways | 1.5 to 2.0 |

The Hume Coal numerical model construct and outcomes are not premised on any of the four pillar strength estimation equations for which levels of reliability have been determined. Rather, they are based on estimating pillar strength using the Bieniawski and Mark rectangular pillar strength pillar equation. This formula estimates web pillar strengths that are of the order of 17% to 43% higher than those estimated by the four pillar strength equations for which levels of reliability have been determined (see GAPL (2018)).

The Bieniawski and Mark rectangular pillar strength formula is intended to account for the additional load bearing capacity per $m^2$ that, based on mechanistic considerations, should arise when pillars of a given width are rectangular in shape. This additional load carrying capacity is attributed to the benefit of additional confinement to the pillar core in the longitudinal direction.

The Bieniawski and Mark rectangular pillar strength formula was derived by mathematically manipulating the Bieniawski formula, aided by an assumption as to how load is distributed across a pillar. Unlike the UNSW power pillar strength formula, the Bieniawski and Mark rectangular formula does not place a lower limit on pillar width-to-height ratio below which a pillar could fully fail across its width before any benefits materialise from the additional confinement in its longitudinal direction. Salamon et al. (1996) postulated that the benefit of additional confinement in the longitudinal direction only begins to materialise once pillar width-to height ratio exceeds three (3).

The (un)reliability of this postulation by Salamon et al. (1996) was accounted for in the derivation of the correlation between safety factor and likelihood of stability using the maximum likelihood statistical method based on both stable and unstable mine workings. This contrasts significantly with that of the Bieniawski and Mark rectangular formula which, as far as I am aware, has yet to be tested for reliability against both failed and stable case studies.

Until this occurs, one cannot associate a safety factor derived on the basis of this formulae with a level of reliability or confidence in the design outcomes based on it.

However, since the Bieniawski and Mark rectangular formula was founded on mathematically manipulating the Bieniawski strength estimation formula, it would be logical to expect that the level of uncertainty associated with the rectangular version of the formula must be at least as high as that associated with the parent (foundation) formula. In fact, it should be higher due to the additional assumptions associated with its derivation. Hence, I would expect that when applying the Bieniawski and Mark rectangular formula to designing bord and pillar workings, for example, stability assessment would be based on a safety factor of not less than 1.5, corresponding to discounting the predicted pillar strength by 33%. The numerical modelling assessment does not appear to make this allowance for the reliability of the Bieniawski and Mark rectangular formula.

This background accounts for the queries I raised in (GAPL, 2018). Basically, these are:

- Is the Bieniawski and Mark rectangular pillar strength formula resulting in pillar strength being significantly overestimated by the numerical model as a result of there being no limitation placed on the minimum pillar width-to-height ratio at which the beneficial effects of additional confinement in the longitudinal direction cease?
- Can the level of reliability associated with the use of Bieniawski and Mark rectangular pillar strength formula be quantified based on unstable and stable outcomes (noting that the formula needs to be evaluated against both outcomes)?
- Given that Bieniawski considered that pillar strength should be discounted by 33 % when the foundation Bieniawski formula is applied to designing first workings and by 50% when applied to designing pillar extraction workings, should similar discount factors, or their corresponding factors of safety not also be applied when defining pillar strength in the Hume Coal numerical model and assessing stability based on the modelling outcomes.

**Constitutive Law**

I have previously raised the concern that by using an elastic-perfectly plastic constitutive law to define pillar response to load, the pillars are prevented from unloading and so cannot fail (GAPL, 2018). That is, the pillars cannot spall or yield and, instead, continue to sustain peak load indefinitely. I queried how realistic is it to use an elastic-perfectly plastic constitutive law when pillar strength estimated by other mainstream pillar strength formulae is much lower and when design needs to take into account that failure can occur at safety factors less than or greater than 1. For example, if the modelling was re-run based on pillar strength defined by the UNSW power strength formula would it still be appropriate to utilise an elastic-perfectly plastic constitutive law and, if so, why?

Professor Hebblewhite has advised in his most recent review (Hebblewhite, 2020) that:

> *It is recommended that the modelling be re-run using strain-softening elements to represent the coal seam. As discussed previously, if the project was starting again, I would endorse this recommendation. However, based on the results obtained already, which clearly indicate that pillar coal has not exceeded peak strength, there is nothing to gain, and there would be no significant change to the results, even if the elements were modelled differently, as recommended.*

Professor Hebblewhite's endorsement that if the project was starting again, the models should be based on a strain-softening constitutive law addresses my concerns regarding the appropriateness of the elastic-pure plastic constitutive law on which the numerical modelling to date has been premised. However, given that the reliability of the Bieniawski and Mark rectangular pillar strength formula on which the numerical modelling has been based is apparently yet to be quantified, that this formula predicts significantly higher pillar strengths than other pillar strength estimation formulas whose reliability has been quantified, and that the safety factor being used to base decision making on appears to be much lower than that recommended by the developer of the underpinning formula, it is my opinion that it is premature to draw this conclusion. Rather, the model should be rerun using both a strain-softening constitutive law and alternative pillar strength estimation equations to evaluate the impact of these factors.

**Concluding Remark**

The proposed mining method is amenable to utilising changes in panel and pillar dimensions as an effective engineering controls for implementing the mining method such that it safely delivers target hydrogeological and surface subsidence objectives. However, these are very likely to have negative implications for resource recovery and financial performance.

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Should you have any queries in relation to this letter report, please do not hesitate to contact me.

Yours sincerely

Emeritus Professor JM Galvin

FTSEA, HonFIEAust CPEng, FAusIMM CP(Min)

## References

Bieniawski, Z. T. (1983). *New Design Approach for Room-and-Pillar Coal Mines in the U.S.A.* Paper presented at the 5th Congr. Int. Soc. Rock Mech., Melbourne.

Bieniawski, Z. T. (1992). *A Method Revisited: Coal Pillar Strength Formula Based on Field Investigations.* Paper presented at the Workshop on Coal Pillar Mechanics and Design, Santa Fe, NM.

GAPL. (2017). *Independent Assessment, Hume Coal Project. Galvin and Associates Report No. 1716-12/1b.*

GAPL. (2018). *Supplementary Report. Independent Assessment, Hume Coal Project. Galvin and Associates Report No. 1716-12/2b.*

GAPL. (2020). *Review Relating to Hume Coal's Response to Independent Planning Commission Report on Hume Coal Project and Berrima Rail Project - Confidential. Galvin and Associates Report No. 1716-12/3a.*

Hebblewhite, B. K. (2020). *Review of Independent Review Reports by Professors Galvin and Canbulat (June/July 2020). Report No. 2008/01.1. 21 August 2020.*

Salamon, M. D. G., Galvin, J. M., Hocking, G., & Anderson, I. (1996). *Coal Pillar Strength from Back-Calculation.* Research Report No. 1/96. Sydney: Dept. Mining Engineering, University of New South Wales.

Salamon, M. D. G., & Munro, A. H. (1967). A Study of the Strength of Coal Pillars. *J. Sth. Afr. Inst. Min. Metall., 68* (2), 55-67.

# Appendix D2 - Professor Ismet Canbulat (mining engineering)

**Date:** 26 October 2020

**To:** Dr Mandana Mazaheri
Department of Planning, Industry and Environment
T 02 9995 5093
E mandana.mazaheri@planning.nsw.gov.au
4 Parramatta Square, 12 Darcy St, PARRAMATTA NSW 2150

**Report No: DPIE-HUME-2020-2**

**From:** Dr Ismet Canbulat, FIEAust, FAusIMM, RPEQ

**RE: Response to reports by Prof Hebblewhite and Mine Advice**

## 1 INTRODUCTION

As per the requests in your emails dated 20th and 26th August 2020, this short report addresses Prof Hebblewhite and Mine Advice's responses to my report dated 24th July 2020.

As Prof Hebblewhite rightly pointed out, communication failure between the various parties meant that I did not get the chance to review the responses made by Prof Hebblewhite and Mine Advice in relation to my report dated 29th October 2018. This report will attempt to address some of their comments.

As it will be appreciated, there have been several reports between myself and Hume Coal addressing and highlighting some of the issues regarding the proposed mine layout at Hume Coal. It is my opinion that the majority of those issues are being addressed and/or studied by Hume Coal to achieve a layout that is robust and safe. It is my intention to resolve those remaining issues in this report.

### 1.1 TERMS OF REFERENCE

The below terms of reference were provided by the DPIE on 20 August 2020:

- "The Department requests that you provide a peer-review of the Russell Frith's report number HUME22/2 dated February 2019 entitled, "Response to DPE Assessment report by Mine Advice and Dr Bruce Hebblewhite", which was included in Appendix C of Hume Coal's Submission to the Independent Planning Commissions (IPC) in March 2019."
- Consider the Hume Coal's response to your review.

### 1.2 INFORMATION PROVIDED

The following information has been provided by DPIE:

- Review of Independent Review Reports by Professors Galvin and Canbulat (June/July 2020). By Prof BK Hebblewhite. Dated 21st August 2020. Report No. 2008/01.1
- Responses to Various Review Reports Pertaining to the Hume Project EIS and Associated Mine Layout Design. Prepared by Dr Russell Firth on behalf of Mine Advice. Dated 22nd August 2020. Report No. HUME22/3.

- Appendix C in Submission to the Independent Planning Commission (SSD7172 and 7171), Hume Coal Project and Berrima Rail Project. By Hume Coal. Dated 6th March 2019. Report No. J12055 RP#3.

In order to ensure that this review process progresses, I have only responded to the latest reports from Prof Hebblewhite and Mine Advice in this report. However, I have been through the submission of Hume Coal to IPC, which included the responses of Prof Hebblewhite and Mine Advice to my previous report, dated 29 October 2018.

## 2 GENERAL COMMENTS ON PILLAR LOADING

As mentioned in my earlier reports and at the experts workshop, (i) I regard Prof Heasley as a leading expert in numerical modelling and (ii) LaModel is one of the most suitable modelling codes to conduct 3D analysis of the proposed mine layout at Hume Coal. My dissatisfaction with the modelling study stems from the use of perfectly elastic-plastic material properties (i.e., the constitutive model). I have hitherto explained the reasoning for my dissatisfaction with the constitutive model. However, I will attempt to explain it again under different terms.

In LaModel, a pillar is divided into a number of elements, Figure 1. In his analysis, Prof Heasley used 0.5m wide elements. In other words, a 5.5m web-pillar modelled at a depth of 160m contained 10 elements along its width, and approximately 240 elements along its length (i.e., 120m long web-pillar).

It is my understanding that the assumption to use an elastic-plastic model was made based on the use of the *average* stress acting on all those elements. The word *average* is emphasised because the distribution of vertical stress on a coal pillar is never constant, as assumed in the Hume Coal modelling study. It is a common practice for geotechnical engineers to use an average stress acting on the pillar for design purposes only when the pillars are reasonably large and the relatively higher and/or lower stresses are not a significant concern. However, in the case of Hume Coal, the web-pillars are significantly thinner than those larger-sized pillars. Therefore, the stress distributions on web-pillars need to be considered. Figure 2, Galvin, 2016 conceptually demonstrates the vertical and average pillar stress distributions on pillars for varying extraction ratios. As evident in this figure, there are zones over a pillar where the vertical stress is significantly greater than the average stress. Unfortunately, the average stress assumption in the LaModel study ignored the high stress zones, which, in turn, resulted in a decision to use elastic-plastic elements.

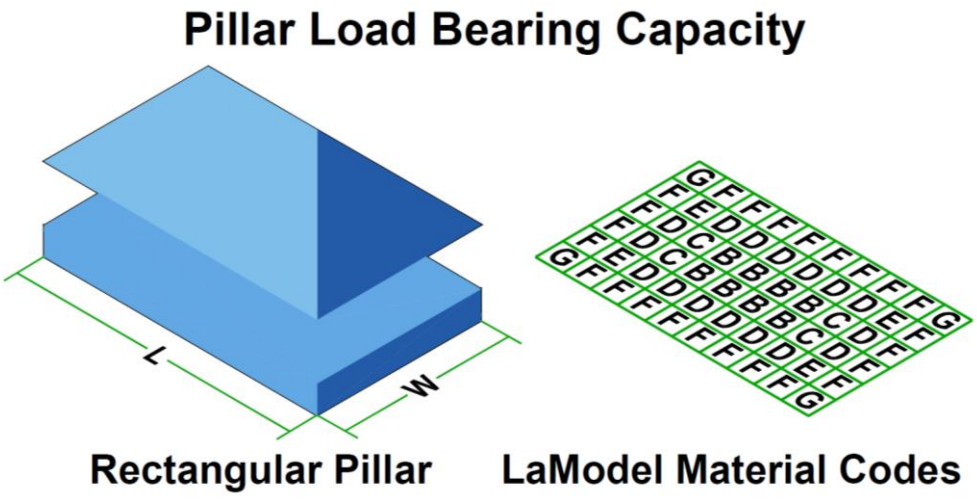


**Figure 1. Schematic of pillar load and LaModel element mapping (afetr Heasley, 2018)**

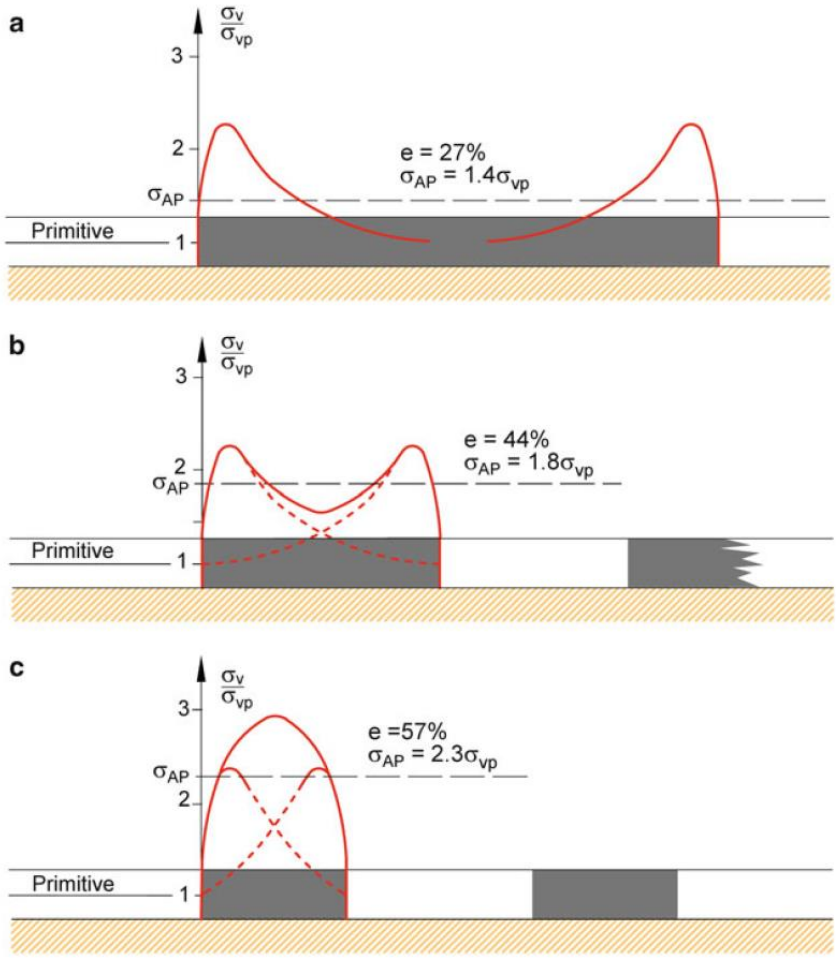


**Figure 2. Conceptualisation of the influence of distance between the flanking excavations and vertical stress magnitude and distributions in a long (strip) pillar. Three stages are shown: (a) When roadways are sufficiently far apart, associated abutment stress profiles do not overlap (b) As percentage extraction increases and pillar width is reduced, abutment stress profiles begin to overlap and result in an increase in average pillar stress (c) A further increase in percentage extraction and associated decrease in pillar width results in a change in the pillar stress profile and elevated stress (Galvin, 2016). [Where $\sigma_v$ is the pillar vertical stres, $\sigma_{vp}$ primitive stress, and $\sigma_{AP}$ is average pillar stress]**

Vertical stress distributions from Prof Heasley's study is also provided by Mine Advice in their report, dated 16th June 2018, but it is impossible to observe the pillar stresses acting on each of the corresponding elements, Figure 3. It is, however, evident in this figure that the pillar stresses vary along the length of pillars in a panel, and the maximum average stress on the web-pillars is located next to the gateroads. These results were also evident in Prof Heasley's modelling report, which demonstrated reduced factors of safety towards the outbye of the web-pillars (i.e., adjacent to gateroads). Prof Heasley explained the reasons for this behaviour, "*Firstly, not only does the outby end of the rib pillar have to support its share of the overburden above it, it also has to help support half of the overburden weight from the adjacent panel entry. Also, as the pillars are modelled in LaModel, the outby end of the web pillar has a reduced load carrying ability due to the free face and associated yield zone* [underlined by the author] *on the end of the web pillar*". Further analyses of this behaviour were provided by both Prof Heasley and Mine Advice in their reports. Nevertheless, since the pillars were modelled as elastic-plastic pillars, there was no evidence of yielding in any of the models.

The degree of precision employed in analysing this stress distribution is critical, particularly at deeper parts of Hume Coal. This is because if any elements that represent the pillar are subjected to stresses higher than the strength of that particular element, the element will fail, lose its load-carrying capability, and the remaining stress will be transferred onto neighbouring elements, which may, in turn, overstress the pillar. Depending on the pillar size, this process may continue until web-pillars reach their peak-strength and yield.

An important consideration is that once the stress acting on a web-pillar is calculated, one should also enter the strength of that particular element (i.e., not the average pillar strength). A well-established method for this is to use a failure criterion (e.g., Mohr-Coulomb or Hoek-Brown) to determine the strength of that particular element. In summary, using single, average pillar stress along the width and length of a pillar can be misleading without understanding the actual stress distributions and failure or yielding potential of each element, particularly for the web-pillars. To address this inadequacy, two methods have been employed by investigators; (i) to conduct a 3D modelling study using strain-softening elements with an appropriate failure criterion (e.g., LaModel), or (ii) to extract the pillar stresses from a 3D boundary element model (e.g., LaModel), and thereafter use a 2D model using an appropriate failure criterion.

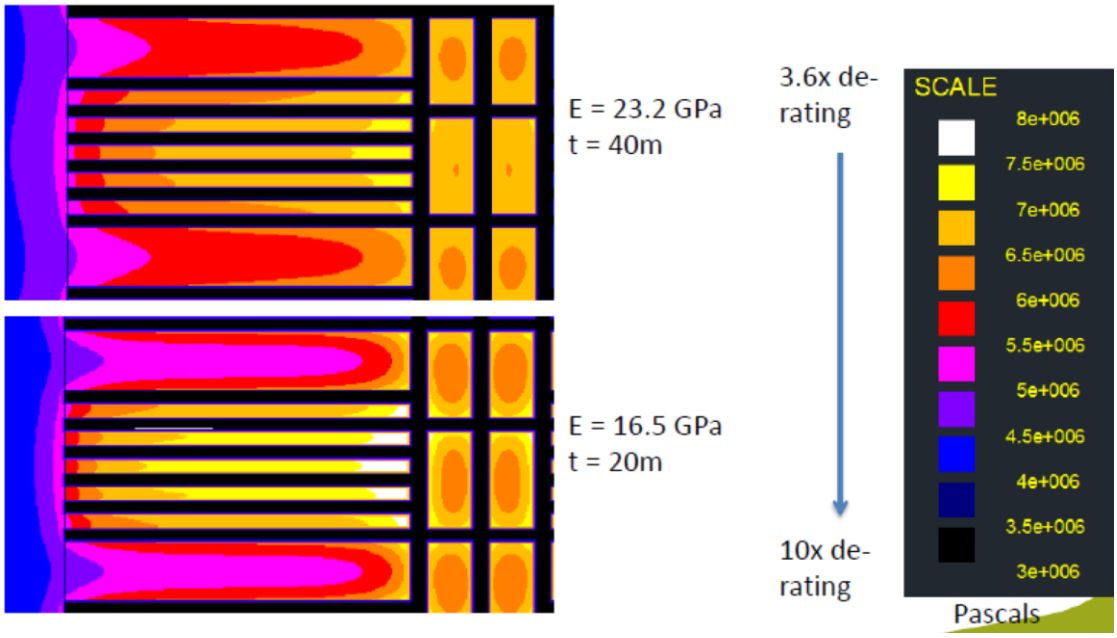


**Figure 3. Vertical stress distributions, 160 m cover depth case (after Mine Advice, 16th June 2018)**

Due to the use of elastic-plastic material properties, the current LaModel results make it impossible to determine whether elements will, or will not, fail or yield.

With the above in mind, I provide the following comments on Prof Hebblewhite's and Mine Advice reports.

## 3 RESPONSES TO PROF HEBBLEWHITE

Page 7 – point f: "*GAPL states that the RA has not listed sudden or uncontrolled web pillar failure as a threat…..However, it is agreed that there is scope in future risk assessments to include greater clarity and expansion of such threats and the consequences they could pose to both environment and safety, albeit even if ranked at a low level.*"

I agree with this statement. The current risk assessment strategy did not explicitly consider the likelihood of failure of web-pillars, which needs to be assessed in future risk assessments.

Page 11 – second last paragraph: "*The true situation is that all such empirical formulae involve approximations and simplifications of a quite complex structural model of pillar behaviour. There is a clear error band associated with every formula used – probably at least + 10% if not greater. So the reality is that the Mark-Bieniawski strength calculations are no more or less accurate than other empirical formulae in use"*.

I concur with this statement, which emphasises the inherent uncertainty associated with coal pillar designs in calculating pillar strength and loading. Therefore, relying on one formula as the basis for the web-pillar designs may not be appropriate.

Page 12 – 2nd to 4th paragraphs: "*However, scrutiny of the results produced by Heasley confirm that in all model studies conducted, the web pillars remained with FoS values in excess of 1, meaning that their loading was below the peak strength and therefore not prone to yielding, even if an elastoplastic constitutive model had been adopted…..*

*These points are clearly noted by Heasley (p17 of his final report). It would therefore not be of any value to repeat the modelling exercise using an elastoplastic constitutive behaviour, as it would not provide any significantly different results to the present outcomes*".

*However, scrutiny of the results produced by Heasley confirm that in all model studies conducted, the web pillars remained with FoS values in excess of 1, meaning that their loading was below the peak strength and therefore not prone to yielding, even if an elastoplastic constitutive model had been adopted. This is also the case, even in the most unlikely, but extreme model analysis where a full panel of web pillars was removed to simulate a fully yielded, zero-strength set of web pillars, yet there was still no failure or loading above peak strength in any of the surrounding pillar regions".*

It is my understanding that Prof Heasley's assumption is based on average pillar stresses, which may not reflect the expected conditions. To recap, it is not known with certainty whether any section of a web-pillar, or an element of a web-pillar, is prone to stresses greater than the strength of that element. I therefore support a further modelling study with one of the approaches (or similar) I referred to above. It is also of note that for larger pillars, such as web-panel barrier pillars, Prof Heasley's assumption may be appropriate as the size of those pillars are large enough to arrest progressive stress propagation.

Page 13 – 2nd paragraph: "*Applying this to the Hume project – had the modelling been investigating conditions where web pillars were yielding/failing and potentially other regions also being stressed beyond elastic conditions, the quote would be absolutely valid and an appropriate elastoplastic model should have been used. BUT we are not in that position. The pillar coal has not been stressed beyond the elastic limit or above the pillar strength levels, and so representation of post-peak strength failure behaviour is not relevant*."

Again, we do not know if this is the case with any certainty as the stress distributions along the width of web-pillars are not provided in Prof Heasley's report. Although Mine Advice presented some of Prof Heasley's results, they also made use of average pillar stresses.

Page 15 – point c: P3 – "*It is recommended that the modelling be re-run using strain-softening elements to represent the coal seam. As discussed previously, if the project was starting again, I would endorse this recommendation. However, based on the results obtained already, which clearly indicate that pillar coal has not exceeded peak*

*strength, there is nothing to gain, and there would be no significant change to the results, even if the elements were modelled differently, as recommended*".

In my opinion, since the mine design is based on the assumption that the web-pillars will be stable during the active mining stage, it would be appropriate to conduct a further study. I therefore believe a further modelling study for Hume Coal to revisit the web-pillar dimensions will be beneficial.

Page 13 – point d: "P4 – "*The statement is made that "there is a likelihood that the web pillars may fail in the active panel(s), which can pose a risk to mine workers at the face". This statement does not define the likelihood. I would suggest that there is a likelihood under some localised conditions, but it is very low (not impossible, but very low). The statement then refers to risk to workers at the face. This statement does not acknowledge that workers will not be positioned at the face, but will be operating the mining system remotely, so there is a significant degree of protection afforded by positioning the workers well away from the active face adjacent to a web pillar."*

It is my understanding that the equipment will be operated remotely from the gateroad entries. Figure 3 indicates that the highest vertical stresses on web-pillars, and by extension, the web-pillars with the lowest factor of safety, will be located about the gateroad entries, where workers will be located. It is likely that any failure or yielding will initiate in this part of a panel.

In terms of the points put forward by Prof Hebblewhite to seek agreement, I offer the following comments:

- *It is accepted that all pillar design approaches involve approximations and will inherently contain some level of error. This includes both empirical and numerical techniques. No pillar design systems provide absolute certainty with regard to pillar stability (or otherwise).*

Agreed.

- *Making minor changes to empirical strength calculations within a regional stability modelling exercise is unlikely to result in significant changes that can be argued to be any more reliable than the current modelling approach.*

Agreed. It is however noted that depending on the purpose of the modelling study, regional stability may not change, but the local stability may, posing potential safety concerns.

- *The proposed mine layout relies on load distributions across a range of barrier pillar systems that exist both across the width of the production web panels, and along the length of the panels. As such, it is clearly a 3D load sharing concept.*

Agreed.

- *LaModel is one of, if not the only suitable, currently available numerical modelling package to geotechnically model such a geometry with any degree of reliability.*

Agreed, but the models should incorporate strain-softening elements.

- *The 3D modelling conducted has provided clear indications of load distributions in both directions, as referred to above, with regional stability demonstrated, even in the extremely unlikely event of a complete removal of web pillars from a production panel.*

Agreed.

- *Whilst the original layout design is intended to achieve stability of all pillars in the layout, including the web pillars, under normal loading conditions, it is accepted that there is a possibility of some localised web pillar failure or yielding, albeit of a very low likelihood.*

Agreed. But in my opinion, the likelihood of failure may need to be assessed further with strain-softening elements. Without that assessment, it is challenging to determine whether the likelihood of failure is low, moderate, or high.

- *The design does not rely on web pillars remaining stable indefinitely. The load-sharing across barrier pillar systems provides for situations where some localised web pillar yielding may occur, without any catastrophic outcomes.*

Agreed. However, noted that we do not know with any certainty what the failure mode and time to failure will be in the case of failure of web-pillars.

- *The mining system incorporates a high degree of flexibility, whereby, as the need arises, both web pillar widths and intra-panel pillar widths could be increased in localised conditions at the time, and/or plunges eliminated in order to provide effective control.*

Agreed.

- *Once the project proceeds to more detailed feasibility and design stages, further risk assessments will be conducted which can address geotechnical and other issues in greater detail, leading to the development of appropriate risk-based management plans in order to ensure adequate responses are in place to all perceived risk factors.*

Agreed. It is, however, noted that if the risk assessment relies on current modelling results, the outcomes may not be a true reflection of potential risks associated with web-pillars.

## 4 RESPONSES TO MINE ADVICE

Mine Advice provides further justification for their pillar design study and responds to questions raised by myself, Prof Galvin, and the Regulator in their report. I do not intend to delve into an academic argument regarding the results presented in the reports. I generally agree with the concepts and additional insights into numerical modelling results. However, I emphasise that the entire study relies on the notion of average pillar stresses, which suffers from the shortcomings previously detailed.

I offer the following comments without any relative priority or level of importance.

Page 8 – Use of the Mark-Bieniawski Pillar Strength Equation. *Whilst it may be an inconvenient truth, it is irrefutable that the empirically derived Mark-Bieniawski coal pillar strength equation is founded on a far more substantial database of coal pillar case histories than those of the UNSW PDP.*

As I commented before, the Mark-Bieniawski formula was not based on a database. It is an analytical model developed for the design of rectangular pillars by Mark and Casey in 1995. It was then assessed and applied in different mining methods using existing databases, including the highwall mining *stable* cases by Zipf and Bhatt

(2004), who also published a summary of the underlying database that relied on data provided by ground control plans in the US (it was not specified whether those cases were stable cases, but they are assumed to be).

Mine Advice attempts to justify the use of the Mark-Bieniawski formula by emphasising its wide application. However, just because a formula has been widely applied in different mining methods, does not necessarily make it better or worse, or more or less reliable (in statistical terms) than the UNSW formulae, or any other formula for that matter. While the performance of a formula can only be estimated with a proper statistical analysis of the designed cases, the *true* reliability of a formula can only be determined through a statistical analysis of the inherent variability (or the uncertainty) associated with the underlying database, which can also be used to estimate the probability of stability (or failure). Since Mine Advice also appreciates that the Mark-Bieniawski formula cannot be linked to a statistical probability of failure, its reliability cannot be judged based merely on its wide application. Having said that, I do not think the focus of our discussion is on the strength formula, but the use of average pillar stress and the constitutive model used in LaModel.

Zipf and Bhatt (2004) first *assessed* the applicability of the Mark-Bieniawski formula in highwall mining using a database of stable highwall cases. The reason I question its application to Hume Coal has been clearly explained in my previous report (Canbulat, 2018). Less than 12% of known cases in Zipf and Bhatt's highwall mining database had mining heights of 2.1m or greater. Furthermore, it is not known how many of those cases were close to the proposed 3.5m mining height in Hume Coal. Also, the maximum depth in the database was 155.2m (excluding one unknown case). The other dimensions of the proposed Hume Coal mine plan appear to be within the range of the database. I raise these concerns not to disparage the use of the Mark-Bieniawski formula, but to highlight its limitations in an ARMPS-HWM program when applied to Hume Coal, and the way in which it was utilised in the modelling study.

Whilst it is accepted that the UNSW formula has limitations, the Mark-Bieniawski formula also has limitations, especially when attempting to apply it to Hume Coal. Therefore, those limitations need to be appreciated. In this respect, I refer back to the comment made by Prof Hebblewhite "*It is accepted that all pillar design approaches involve approximations and will inherently contain some level of error. This includes both empirical and numerical techniques. No pillar design systems provide absolute certainty with regard to pillar stability (or otherwise)"*. To this end, the Mark-Bieniawski formula estimates higher pillar strengths for low w/h ratio rectangular pillars than the UNSW formulae without the appreciation of volume of pillars, i.e., it only considers the shape of pillars, not the size of pillars. In the case of the Hume Coal design, the volume of web-pillars may be an important consideration, which needs to be acknowledged.

Page 9 – Use of an Elastic-Plastic Coal Pillar Constitutive Stress-Strain Model. *None of the analyses of web pillar stability at Hume using either the Mark-Bieniawski pillar strength equations or those of the UNSW PDP, have returned web pillar SF or FoS values under full cover depth loading down to 160 m depth of < 1. Therefore, the Heasley 2018 statement can be applied with confidence, the conclusion reached being that if both elastic-plastic and strain-softening coal pillar constitutive models give the same basic modelling outcome, there is no logical reason or value in running the latter as an adjunct to the former.*

The reasoning for my critique is explained in my introductory comments in Section 2 of this report. The modelling study is based on an average pillar stress distribution, and average factor of safety, which may be an unrealistic assumption, as the vertical stresses acting on a pillar are not uniform. We don't know with any certainty whether any part or section of the web-pillars will bare stresses higher than its strength could accommodate for.

Page 9 – The Construct of the Numerical Model Was Not Made Available. *Berrima back analysis.*

I am satisfied with the back analysis of Berrima after having studied the data provided in Mine Advice report.

Page 14 – The Statement That "Web Pillars Will Fail".

I have discussed the time to failure of coal pillars in my first report (Canbulat, 2017). Another discussion on the same subject will not provide any benefit to this project. As is evident, my statement "web pillars will fail" refers to time to failure of the web-pillars, which currently cannot be determined or estimated with any certainty, particularly for the web-pillars in question.

Page 16 – Summary of Overall Mining Layout Design Analyses. *Ground Reaction Curves*

In my opinion, the Ground Reaction Curve is a useful concept, and I have no objection to use it in this case. However, while the pillars are in an elastic state, the Ground Reaction Curve only shows elastic deformations and the associated reactions. Nevertheless, the proposed graphs confirm that in an elastic state, the pillars will provide resistance to overburden movement. However, if strain-softening elements were used, the Ground Reaction Curve may have presented a completely different picture.

Page 23 – "*Both the initial layout design process conducted as part of the EIS submission and subsequent review process, have highlighted a number of concerns that need to be included within the operational management process as part of ensuring that the intent of the mine layout design is always achieved in practice. Whilst it is inappropriate to develop an actual operational management plan and process at this stage of mine development due to the need to base it on a collaborative risk assessment process, key issues can at least be listed for completeness, as follows:*"

Mine Advice goes on to list a total of five steps to manage the risks associated with the proposed layout. I concur with those proposed steps.

(a) *ensuring that web pillar compartments are not directly influenced by major geological structures such as faults and dykes, this being due to the de-stabilising influence they can have on both coal pillars and in particular, the stability of the overburden.*

(b) *mapping of mine workings to identify such structures before the commencement of forming plunges in a given area, and potentially modifying the plunge layout to accommodate the presence of anomalous geological conditions.*

(c) *developing monitoring schemes that allow actual remnant mine stability to be tracked post-mining for both environmental impact and mine safety reasons. The current base-line surveys being conducted using GPS surveys is very encouraging in this regard.*

(d) *using best practice in terms of CM guidance during plunge formation, accepting that the major control of any impact of off-line drivage on stability, is limiting the number of drives between barriers so that irrespective of any off-line drivage, maximum coal recovery within any one web pillar compartment remains unchanged.*

(e) *the general requirements of operational strata management also apply, albeit that they are more focused on the safety of the mine workings in terms of changing conditions over time, which in itself may be used as a monitoring scheme for the stability of the overburden in already mined-out areas whilst ever access is available.*

## 5 CONCLUSIONS

There has been no further modelling study conducted for the Hume Coal project. Therefore, my dissatisfaction with the current modelling of the proposed web-pillars is still present due to the reasons I explained in Section 2.

I generally concur with the points put forward by Prof Hebblewhite to seek agreement, and Mine Advice's proposed steps to manage the risks associated with the proposed layout.

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| **Report to:** | Dr Mandana Mazaheri<br>Department of Planning, Industry and Environment<br>T 02 9995 5093<br>E mandana.mazaheri@planning.nsw.gov.au<br>4 Parramatta Square, 12 Darcy St, PARRAMATTA NSW 2150 |
| **Title:** | Response to reports by Prof Hebblewhite and Mine Advice |
| **Report No:** | DPIE-HUME-2020-2 |
| **Author:** | Dr Ismet Canbulat |
| **Date:** | 26 October 2020 |
| **Signature:** |  |

***Disclaimer***

*Ismet Canbulat is employed as Professor and Head of School of Minerals and Energy Resources Engineering at The University of New South Wales (UNSW) Sydney. In accordance with policy regulations of UNSW regarding external private consulting, it is recorded that this report has been prepared by the author in his private capacity as an independent consultant, and not as an employee of UNSW. The report does not necessarily reflect the views of UNSW, and has not relied upon any resources of UNSW.*

# Appendix D3 – Andrew Tessler (economics)

BIS OXFORD ECONOMICS

# REVIEW OF 2020 ECONOMIC IMPACT ASSESSEMENT

## HUME COAL AND BERRIMA RAIL PROJECT

JULY 2020

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Oxford Economics was founded in 1981 as a commercial venture with Oxford University's business college to provide economic forecasting and modelling to UK companies and financial institutions expanding abroad. Since then, we have become one of the world's foremost independent global advisory firms, providing reports, forecasts and analytical tools on 200 countries, 100 industrial sectors and over 3,000 cities. Our best-of-class global economic and industry models and analytical tools give us an unparalleled ability to forecast external market trends and assess their economic, social and business impact.

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**July 2020**



The modelling and results presented here are based on information provided by third parties, upon which BIS Oxford Economics has relied in producing its report and forecasts in good faith. Any subsequent revision or update of those data will affect the assessments and projections shown.

To discuss the report further please contact:

**Andrew Tessler**: atessler@oxfordeconomics.com

BIS Oxford Economics

Level 8, 99 Walker St., North Sydney

Tel: +61 2 8458 4224

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# EXECUTIVE SUMMARY

Hume Coal Pty Limited ("Hume Coal") has lodged development applications for the Hume Coal Project ("the HCP"), and the associated Berrima Rail Project (BRP) which are planned to be undertaken in the NSW Southern Highlands. Collectively, these may be referred to as "the project".[1]

An Environmental Impact Statement for the project was released in March 2017. As a part of this, an Economic Impact Assessment Report ("the 2017 EIA") was prepared by BAEconomics.[2] It contained a Cost Benefit Analysis (CBA) of the project using a NSW State-wide level of analysis as well as a Local Effects Analysis (LEA) using the Southern Highlands as the basis of the analysis.

The NSW Department of Planning & Environment ("the Department") requested that BIS Oxford Economics (BISOE) undertake an independent assessment of the EIA and its component parts (the CBA and LEA).This assessment "the *Review of Economic Impact Assessment: Hume Coal and Berrima Rail Project*" or "the First Review") was competed in December 2017. It was followed in October 2018 by BISOE providing additional commentary on BAEconomics' work and the accompanying debates about the HCP ("*Further Comments on Economic Impact Assessment*" or "the Further Comments").

BAEconomics completed an updated EIA in 2018 ("the 2018 EIA") and another one in April 2020 ("the 2020 EIA"). This review ("the Second Review") is an assessment of the 2020 EIA including its revised CBA and LEA. It also includes references to other documents which have been a part of the discussions around the project including Hume Coal's *Response to the Independent Planning Committee Assessment Report,* April 2020 (the "*Response to IPC*") and Hume Coal's commissioned *Report on Comments on Updated Economic Assessment of Hume Coal Project by the Stoeckel Group Mach 2020* ("*the Stoeckel Report*").

As was the case for the 2017 CBA, on the whole, the 2020 CBA is well researched and presented. Attention has been paid to the stipulations laid down in the NSW Government (2015) *Guidelines for the economic assessment of mining and coal seam gas proposals* ("the Guidelines") in many (though not all) instances. However, as was the case in the 2017 CBA, the 2020 CBA's "broader interpretation" of the *Guidelines* overstates the case for the HCP (and indeed, is something of a misnomer as it does not appear to be consistent with the *Guidelines* as they currently stand).

With respect to the CBA's assessment of net benefits to NSW (as summarised on p. 2 of the 2020 EIA) we note the following in terms of the major assessed components of project benefits:

[1] Most of the activity in the project relates to the HCP. The BRP will essentially consist of a rail spur to service the HCP and would not occur in the absence of the HCP.

[2] BAEconomics (2017), *Economic impact assessment of the Hume Coal project, Appendix Q in* Hume Coal Project – Environmental Impact Statement – Volume 9.

- *Royalties* - The assessment of royalties and has increased substantially (by $34 million in Net Present Value (NPV) terms or 30%) since the assessment provided in the 2017 EIA. This would appear to be driven by a projected rise in the price of coking coal. Overall, the analysis seems reasonable. However, we note that royalty payments are ultimately driven by price and production assumptions and that caveats on these remain, including issues which could not have been foreseen at the time of writing of the 2020 EIA such as the COVID-19 pandemic. Other potential threats include growing geopolitical tensions and opposition to thermal coal extraction and consumption.

- *Company income tax* - Following on from this, the assessment of company income tax has also risen (by $18 million in NPV terms or 67%) since the 2017 EIA. This would be driven by the same factors as above and is subject to the same caveats, although, once again, the analysis here seems reasonable.

- *Costs* – In general, it is not possible to offer detailed commentary on the accuracy or otherwise of the cited costs as these were obtained from the commercial estimates made by Hume Coal. However one issue to investigate is whether any contingencies or optimism bias were incorporated into the analysis.

- *Benefits to workers (employment benefits)* - The assessment of the economic benefits to NSW workers has fallen considerably compared to that proposed in the 2017 EIA (by $71 million or 53%). This is apparently due to more conservative assumptions in the 2020 EIA. This illustrates the sensitivity of the assessed employment benefits to changes in the assumptions underlying the analysis.

  That said, the analysis of benefits to NSW workers remains unconvincing. It appears conceptually and mathematically inconsistent with the approach recommended in the *Guidelines* and refers to a wide variety of generic arguments rather than providing project-specific evidence. We again recommend that benefits to workers be disregarded.

- *Tax benefits* - Likewise the calculation of the associated payroll tax, personal income tax and Medicare payments which all rely on calculations of worker benefits should likewise be disregarded. However there is a reasonable case for the inclusion of land taxes and local government rates.

- *Externalities* - The information provided in the 2020 EIA provides much additional information on externalities (relative to the 2017 EIA), which is appreciated. Nonetheless, ambiguities and uncertainties remain. BAEconomics indicates that externalities are essentially incorporated within the project costings, however, it is unclear, how (or if) the assessed externalities reconcile with the NPV of $13 million in environmental mitigation costs referred to on p.28 of the 2020 EIA.

In terms of groundwater issues, it is particularly unclear how (or if) full "make good" commitments referred to in Hume Coal's *Response to IPC* are costed and indeed the amounts cited appear to represent a *lower* monetary commitment than in 2017. Given the community concerns over this issue, these matters should be clarified and the costing of externalities be made more transparent. It is highly unlikely that increased allowance for externalities alone would cause the project to record a zero NPV in economic terms. However, combined with less favourable price/demand conditions these factors could reduce project benefits materially.

- *CGE modelling* - Additional evidence on state-wide CGE modelling of project benefits (including flow on effects) is presented. While the effort is appreciated this modelling should likewise be disregarded. The presentation of an alternative welfare measure of $2.2 billion is 11 times larger than the "narrower" (i.e. Guidelines consistent) definition project benefits of some $194 million suggested below. As noted by the *Treasury Guidelines*, CGE modelling does not replace CBA and as indicated in our First Review, the Guidelines do not call for state-wide analysis of flow on effects. Citing such figures in support of the HCP could be misleading to policymakers who are not fully versed in the specifics of CGE modelling and the appropriate measure of project benefits.

- *Local Effects Analysis (LEA)* - The LEA is well researched and presented and consistent with the Guidelines. We find only minor issues regarding estimation of local vs non-local labour, externality internalisation and timelines remaining to be resolved.

Given the above, we recommend that the "narrower" measure of project benefits (as presented in the upper half of Table S-1-1, 2020 EIA, p.2) plus an allowance for land and local government taxes is a better basis for the CBA's assessment of project net benefits to NSW. On this basis, the project records a net benefit of $194 million in NPV terms. (Though we note that this is $96 million less than the "broader" definition of benefits ($290 million) also suggested by BAEconomics in the lower half of Table S-1-1.)

In other words, despite the caveats above, we find that the project records net positive benefits for NSW in NPV terms, even when benefits to workers and accompanying tax benefits are excluded. We also note that this sum is $67 million *larger* than the equivalent "narrower" definition of net benefits cited in the First Review ($127 million). This would appear to be largely driven by the revision (increase) in coking coal prices and its consequent effects on royalties and company income tax payments ($34 million and $18 million in additional benefits respectively) as well as the reduction in assessed greenhouse gas externalities ($19 million in reduced costs) associated with the approach outlined in the *Technical Notes* and the removal of levies ($5 million).

However, as indicated, there are residual issues regarding matters such as the costing and transparency of the externalities, which should be clarified by the proponent and/or BAEconomics. We suggest that the Department work with the proponent to clarify these issues. We also suggest that the Department take note of the additional risk factors which have emerged since completion of the

2020 EIA (such as COVID-19 pandemic and its effects on trade and demand and growing geopolitical and trade tensions).

As indicated, we find the LEA to be appropriate, pending the minor adjustments and clarifications referred to above.

# 1. INTRODUCTION

Hume Coal Pty Limited (Hume Coal) has lodged development applications for the Hume Coal Project (the HCP), and the associated Berrima Rail Project (BRP) which are planned to be undertaken in the NSW Southern Highlands. Collectively, these may be referred to as "the project".[3]

An Environmental Impact Statement for the project was released in March 2017. As a part of this, an Economic Impact Assessment Report ("the 2017 EIA") was prepared by BAEconomics.[4] It contained a Cost Benefit Analysis (CBA) of the project using a NSW State-wide level of analysis as well as a Local Effects Analysis (LEA) using the Southern Highlands as the basis of the analysis.

The NSW Department of Planning & Environment ("the Department") requested that BIS Oxford Economics (BISOE) undertake an independent assessment of the EIA and its component parts (the CBA and LEA).This assessment "the *Review of Economic Impact Assessment: Hume Coal and Berrima Rail Project*" or "the First Review") was competed in December 2017. It was followed in October 2018 by BISOE providing additional commentary on BAEconomics work and accompanying debates about the HCP ("*Further Comments on Economic Impact Assessment*" or "the Further Comments").

BAEconomics completed an updated EIA in 2018 (the 2018 EIA) and another one in April 2020 (the 2020 EIA).

The Department has requested that BISOE provide a review of the 2020 EIA.

The Statement of Requirements (SoR) issued by Department for the Second Review calls for the following:

- A peer-review report of the Hume Coal's responses to the Independent Planning Commission (IPC) Review Report, relating to the project's economic assessment.

- The works must involve review and verify the following documents against the SEARs, relevant government guidelines and policy:

[3] Most of the activity in the project relates to the HCP. The BRP will essentially consist of a rail spur to service the HCP and would not occur in the absence of the HCP.

[4] BAEconomics (2017), *Economic impact assessment of the Hume Coal project, Appendix Q in* Hume Coal Project – Environmental Impact Statement – Volume 9.

- *Hume Coal and Berrima Rail Project IPC Response Report* – Prepared by Hume Coal and EMM
- *Economic Impact Assessment* – Prepared by BAEconomics
- *Economic Impact Assessment Peer Review* – Prepared by The Stoeckel Group

The SoR also requests a short report to the Department responding to the above documents.

Accordingly this review ("the Second Review") is an assessment of the 2020 EIA including its revised CBA and LEA. It also includes references to other documents which have been a part of the discussions around the project including Hume Coal and EMMs *Response to the Independent Planning Committee Assessment Report,* April 2020 (the "*Response to IPC*") and Hume Coal's commissioned *Report on Comments on Updated Economic Assessment of Hume Coal Project* by the Stoeckel Group*,* March 2020 ("the *Stoeckel Report*").

As was the case for the First Review, The relevant government guidelines against which the review is conducted include the NSW Government's *Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals'* published in 2015 *("*the *Guidelines").*It is also worth noting that NSW Treasury (2017) also issues its own Guidelines informing the approach to be taken to CBA by public sector agencies (the "*Treasury Guidelines*").[5] While the *Treasury Guidelines* refer to government initiatives and indicate that these initiatives are not intended to replace agency-specific advice, they also note that they are intended to encourage a common analytical approach to CBA across NSW Government (p. 6). In this context, the Treasury Guidelines (p. 6) also refer to the *Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals* as publicly available sector specific guidelines. Accordingly, the *Treasury Guidelines* are also relevant in the context of this review.

It is also worth recalling the broader context and importance of the CBA and LEA within the development assessment process. This is outlined by the Guidelines (p.1-2) themselves:

> *Under section 78A of the [Environmental Planning and Assessment (EP&A)] Act, a development application for State Significant development must be accompanied by an Environmental Impact Statement (EIS). The Environmental Planning and Assessment Regulation 2000 requires a proponent to request any requirements for the EIS from the Secretary of the Department of Planning and Environment. These requirements are referred to as Secretary's Environmental Assessment Requirements (SEARs). To support a triple bottom line assessment, the standard SEARs require an economic assessment of the project in accordance with these guidelines.*

[5] NSW Treasury (2017), *NSW Government Guide to Cost-Benefit Analysis*, Policy and Guidelines Paper TPP 17-03.

> *The economic assessment, comprising the CBA and LEA, forms part of the EIS. The economic assessment should consider all the issues covered in the SEARs and be integrated with the conclusions of the EIS. The economic assessment should contain sufficient detail that it can be read as a stand-alone assessment. However, to avoid unnecessary duplication of highly technical or detailed information an economic assessment can summarise or cross reference information presented in other parts of the EIS.*
>
> *Section 79C of the EP&A Act states that in determining an application, the consent authority must evaluate a number of factors. Both the quantitative and qualitative findings of the CBA and the LEA are evaluated. They are considered alongside other information in relation to the individual proposal and supporting arguments.*
>
> *The economic assessment report will be reviewed as part of the full EIS and placed on public exhibition for community comment.*

The results of the review are detailed in the following chapters. Chapter 2 considers the CBA while Chapter 3 reviews the LEA.

Unless otherwise indicated all page references refer to the 2020 EIA.

# 2. REVIEW OF COST BENEFIT ANALYSIS

## 2.1 BACKGROUND

This Chapter is concerned with a review of the project's approach to CBA, as specified at the State-wide (NSW) level and contained within BAEconomics' overall 2020 EIA. Relevant points on the issues identified in the SoR are presented below.

On the whole, as was the case in the 2017 EIA, the CBA is well-researched and presented and generally attempts to adhere to the Guidelines. There remain several areas for concern, however, and these have been detailed below.

## 2.2 TREATMENT OF ROYALTIES, PRICE AND VOLUME ASSUMPTIONS

Royalties are a key component of the assessed project benefits, accounting for $148 million of the assessed $194 million in benefits assessed under the "narrower" definition of project benefits for the HCP (top half of table S-1-1, p.2 plus land and local government taxes).

Royalty calculations, in turn, are based on both price and volume assumptions and so in reviewing royalties it is necessary to test the reasonableness of these estimates. These issues are discussed below.

### 2.2.1 Price assumptions

We note that the royalties estimate is higher than the Net Present Value (NPV) of royalties of $114 million estimated in the 2017 EIA. The 2020 EIA (p.21) refers to the IPC's review of coking coal prices in particular. It referred to the IPC's point that the 2017 EIA used coking coal prices which were below those being realised at the time (*Response to IPC*, p.121). The 2020 EIA (p.23, Appendix B) cites higher coking coal prices then is the case for the 2017 EIA but also notes declines in prices to US$150-$159/tonne over the medium term to 2024, based on Department of Industry, Innovation and Science (DIIS) data. Appendix B also provides a discussion of the coking coal market and prices.

Since both the 2017 EIA and the 2020 EIA assumed the same quantity of coal production (40 Mt of saleable thermal and coking coal over the project's working lifetime with up to 3 Mtpa of saleable coal) the change in royalties would appear to be largely driven by higher estimated coal prices.

Royalty calculations are detailed on pp.23-24 and in Appendix E. The price assumptions for coking and thermal coal and AUD/USD exchange rate over the years FY 2023 – FY 2042 have been detailed in Appendix A.

There appears to be no discussion of the relative mix of thermal and coking coal to be sold on the market. However, our previous understanding was that saleable production would be 54% thermal coal and 46% coking coal.[6]

BISOE provides its own forecasts for coking coal and thermal coal for the period 2023-2042. These were last updated on 22nd June 2020. We also provide forecasts for AUD/USD exchange rates.

The average coking and thermal coal prices developed by BISOE over the period are compared to those for those provided in the 2020 EIA (Appendix A p. 4) below. In developing these prices we have applied the discounts referred to in the EIA (Appendix A, p.4) for coking (15%) and thermal (22.1%) coal respectively (although our international estimates refer to calendar years rather than the Australian financial years in the 2020 EIA).

**Fig. 1. Forecast coking and thermal coal prices and exchange rates 2023-2042**

| Estimate | Units | FY 2023 | FY 2024 | FY 2025 to FY 2042 |
|---|---|---|---|---|
| **2020 EIA forecasts** | | | | |
| Coking coal | USD/tonne | 128.2 | 132.0 | 134.5 |
| Thermal coal | USD/tonne | 60.3 | 62.5 | 64.8 |
| Exchange rate | AUD/USD | 0.78 | 0.81 | 0.81 |
| **BISOE forecasts** | | | | |
| Coking coal | USD/tonne | 104.4 | 107.1 | 132.5 |
| Thermal coal | USD/tonne | 50.3 | 52.5 | 73.9 |
| Exchange rate | AUD/USD | 0.75 | 0.78 | 0.81 |

Source: BIS Oxford Economics and BAEconomics

These figures suggest that the BISOE forecasts for thermal and coking coal for the immediate future (2023-204) are considerably lower than the coking and thermal prices (and exchange rates) adopted in the 2020 EIA. However, prices are similar for thermal coal (and higher for coking coal) in the 2024-42 period. It is the latter period which is of greatest relevance since this is the period in which the HCP is likely to be in operation and royalties generated (Appendix E). Our exchange rates are lower than those for the 202 EIA in 2023 and 2024 but identical for 2025-42.

We note that sensitivity analysis (p.79) is undertaken to examine variations in the price of coal by +20%/- 30% along with exchange rates (+30%/-20%). Under a worst case scenario (increase of exchange rates by 30%, reduction in prices by 30%) net benefits of the project to NSW would be reduced to $31 million (p.79) while all coal prices would need to fall by 65% over the life of the project to generate a zero project benefits in NPV terms.[7]

While such outcomes appear unlikely, these should be noted by the Department, particularly given that negative consequences on the revenue side

[6] BIS Oxford Economics (2018) Further Comments on the Economic Impact Assessment: Hume Coal and Berrima Rail Project

[7] Sensitivity tests (+/-25%) are also undertaken on royalty payments themselves though these have less drastic outcomes.

could interact with those on the cost side (such as higher operating or capital costs and/or higher externality costs).

Moreover, while a number of uncertainties are discussed in Appendix B (including the impact of Chinese government import restrictions) the sizable impact of COVID-19 and growing geopolitical tensions may produce even larger impacts on demand for coal. If so, coal prices in the short to medium term could be lower than anticipated. Another risk is falling demand (and prices) for coal exports due to environmental concerns (although this is more likely to affect thermal coal then coking coal). While the coal price analysis undertaken in the 2020 EIA is probably as robust as could be expected at present, these issues should be kept in mind in the assessment of royalty benefits.

### 2.2.2 Production volumes

The question of the mine's production volumes is ultimately linked to project viability. If the mine is unable to produce the volumes projected then royalties and project benefits will be lower than forecast. The project will use a pine feather mining method aimed at minimising subsidence impacts on the area. The 2020 EIA (p.7, p. 24, Appendix E) indicates that the HCP involves construction and operation of a mine employing the pine feather technique in the Berrima area. Two years are allocated to construction, 19 years to mining and two years to rehabilitation giving a total project life of 23 years. The 2020 EIA (p.7, p.24) indicates that the HCP will produce 50Mt of Run of Mine (ROM) coal over its lifetime, with saleable output being 40Mt of coking coal and thermal coal.

The pine feather method to be used in the HCP is untested in Australia. Past debates about the HCP have raised concerns about the safety, viability and resource recovery rates of the pine-feather method in respect of the project.

Accordingly, we have previously been asked by the Department to investigate the issue of volume risk and the circumstances under which the HCP might reach an economic breakeven point. We undertook this work in our Further Comments. In doing so we had access to information provided by the Department's Division of Resources and Geosciences (DRG). Among the points that the DRG argued was that a pine feather method might have a lower rate of extraction than a longwall mine. The DRG assumed a peak extraction rate of 2.6 Mtpa for the HCP (Further Comments, p.9) in contrast to the 3 Mtpa estimated by the proponent. In our Further Comments analysis (undertaken in October 2018) we indicated that, based on the data provided by the DRG and other available data at the time, the breakeven point of the project might be reached at 222,000tpa although the *financial* breakeven point might come at levels well above this figure (Further Comments, pp.7-10).

We do not have any updated data on this issue from the Department and have not repeated this exercise for this review. However we note that the safety concerns related to the pine feather method (and the impact that this might have on resource recovery) were raised by the IPC. Hume Coal details its answers in the *Response to IPC* (pp..28-32). We note that the *Response to IPC* (pp.28-32, Appendix A) refers to an independent review of the pine feather method by Russell Howarth and Associates ("the *Howarth Review*") .

As indicated in the *Response to IPC* and the *Howarth Review* (completed in January 2020), the proposed mining method is found to be safe and technically feasible with the layout of the mine maximising resource recovery. While the *Howarth Review* does not appear to explicitly endorse the HCP's production forecasts, this may address some of the concerns aired by the Department in previous years.

However, there remain some risks which may impact on production and ultimately royalties.

First, as discussed below, it is not clear if any contingencies have been allowed for in the base project costings – and these might be relevant if mining operations prove more complex than originally anticipated. If there are (still) concerns about project operating cost blowouts this may be an issue worth investigating in more detail.

Second, although approximately half of the HCP's output is coking coal, another potential production-related risk in the long run is the growing environmental concern about thermal coal and/or the mining of coal under any circumstances. Likewise, as noted above, geopolitical and trade tensions may also affect demand (and thereby production). As noted above, similar factors could also impact on price.

Third, apart from this, of course, there is the short to medium term impact of the COVID-19 pandemic on coal demand and production, though this could not have been foreseen at the time of writing of the 2020 EIA.

We note that no production-specific sensitivity tests have been undertaken in the 2020 EIA, though these are not specifically required by the *Guidelines* and some of the pricing sensitivity tests which are required could be seen as covering similar issues.

Accordingly, while we have no specific reason to doubt the production volumes suggested in the 2020 EIA, these issues should be noted by the Department.

### 2.2.3 Royalties

Details of the calculation of royalties are provided on pp.23-24 of the 2020 EIA. These appear consistent with the *Guidelines* (p.10) and the increase in royalties since the 2017 EIA appears to be driven by higher forecast coking coal prices. The calculation of project royalty benefits therefore appears reasonable.

As indicated the main risks to these royalties appear to lie with developments in the global coal market (which could affect coal prices and/or demand and production). The Department may also wish to confirm that it is satisfied that the findings of the *Howarth Report* have resolved its remaining questions about the use of the pine feather method for the HCP.

## 2.3 PRODUCER SURPLUS AND TREATMENT OF COSTS

The 2020 EIA (pp.27-28) estimates a Net Producer Surplus of $66 million. With some caveats, discussed below, the approach seems broadly consistent with that recommended by the *Guidelines* in that it allows for the assessment of Net Producer Surplus after deducting costs and tax and attributing a portion of the

Net Producer Surplus to NSW. As Hume Coal's parent company, POSCO is listed on Korean and US stock exchanges no (known) profits are attributable to residents of NSW. Accordingly, the Net Producer Surplus attributable to NSW is deemed to be zero (p.28).

However, it is worth recalling the *Guidelines'* stipulation on the assessment of Net Producer Surplus. On the benefits side the *Guidelines* state that producer surplus is to include:

- Gross mining revenue
- Residual value of land at the end of the evaluation period
- Residual value of capital at end of the evaluation period

On the costs side, the *Guidelines* state these include:

- Operating costs
- Capital costs
- Decommissioning costs
- Environmental mitigation costs
- Transport management costs
- Purchase costs for land
- Local contributions
- All taxes (Federal, State and local)

The 2020 EIA presents this information (p.28) and there is more transparency about the data provided then was the case for the 2017 EIA. This is welcome.

In general, it is not possible to offer detailed commentary on the accuracy or otherwise of the cited costs as these were obtained from the commercial estimates made by Hume Coal. However, while sensitivity tests are undertaken (pp.78-80) there is no allowance for sensitivity around environmental costs or net public infrastructure costs as required in the *Guidelines*, p.18 (though the latter are deemed to be zero in any event, see p.73). A zero costing for net public infrastructure could be questioned given that there may be some use of public roads by mine-related traffic (though we likewise note that changes in levels of service to traffic are estimated to be negligible, see p.47).

More fundamentally it is not clear that there is any allowance for project contingencies. "Optimism bias" (i.e. underestimating costs in particular) may be a generic issue with major projects. The *Treasury Guidelines* (p.49) indicate that a contingency allowance should be built into the project budget. (Sensitivity tests are then generally applied to this cost base inclusive of contingencies.)

While some of these issues may be deemed an academic with respect to Net Producer Surplus (as it is zero from a NSW point of view) they are relevant because the assessment of profits (and thereby company tax) is contingent upon the estimation of costs and revenues and it is important to ensure correct costing of environmental externalities. These issues are discussed below. .

### 2.4 COMPANY INCOME TAX

The derivation of company income tax is reported on p. 25 of the 2020 EIA and it is assessed as $45 million. The additional transparency about the calculation of company income tax (as compared to the 2017 EIA) is noted and welcome.

Company income tax is obviously related to assessment of revenues and costs discussed above. Accordingly, the validity of the estimate is likewise dependent on the issues discussed above.

While we have indicated some issues the Department may wish to investigate (such as price/demand risks on the revenue side and the issue of contingencies and externalities (see below) on the cost side) if the project costs and revenues are accepted "as is" then the derivation of company income tax appears straightforward.

Accordingly, these caveats aside, the estimate of company income tax in the 2020 EIA appears reasonable.

## 2.5 BENEFITS TO WORKERS (EMPLOYMENT BENEFITS)

We note that the 2020 EIA (pp.29-39, Appendix C) has gone to considerable effort in making a renewed case for benefits. The effort that BAEconomics has gone to in researching and making its arguments is substantial and this is noted and appreciated. However, it is not clear that this addresses the central issues of concern to the *Guidelines;* namely that proponents demonstrate how a specific project (as opposed to an industry) will generate benefits to its workers.

The 2020 EIA points to a number of issues in respect of employment benefits, some of which were also referred to in the 2017 EIA. Many of these arguments are complex and inter-related. However many of them are also generic in nature and/or would seem to be distractions (to some extent) from the requirements which proponents must meet in order to make a case for employment benefits.

Moreover the key issue from the point of view of the CBA is how the 2020 EIA calculates the wage premium and whether the evidence base for this is credible, given the stipulations of the *Guidelines*. Accordingly, we have addressed some of the key issues below, while also briefly noting some of the 2020 EIA's arguments separately in the "other issues" section below..

### *2.5.1* Sources of labour

The 2020 EIA offers commentary on the source of labour for the proposed project (p.33-34; Appendix C, pp.24-27). In essence, this argument suggests that much of the workforce might be drawn from sectors other than the mining industry itself and therefore should support an argument for a wage premium (which is wholly based on productivity differences). The 2020 EIA also refers to BISOE's commentary indicating that employers prefer experienced employees and that it might be expected that project workers be drawn chiefly from the mining and rail sectors rather than from a workforce unfamiliar with the mining sector.

It is worth recalling the context of these references in the First Review. BISOE did not state that labour mobility across sectors does not occur. (And indeed the *Guidelines* discussion of wage premiums allows for precisely such mobility.). Rather, we indicated in the First Review (p.8) that it was difficult to justify the apparent assumption in the 2017 EIA (and labour benefits calculations) that the entire project workforce (excluding unemployed labour)

was drawn from sectors outside of the mining or rail sector. This assumption would appear to have had the effect of increasing the size of estimated wage premium in the 2017 EIA.

We note that no *specific* evidence is presented in the 2020 EIA for the HCP's source of workers. The 2020 EIA indicates that no such reliable information about the origin of the workforce for a new business or project exists (p.33). This point is discussed further below. However, in the absence of other information relating specifically to the HCP, it is reasonable to expect that the proponent would preference experienced workers and indeed those with mining and rail sector backgrounds.

The generic evidence that is presented by the 2020 EIA (p.34), referring to the ABS*' Participation Job Search and Mobility, Australia* (Cat. No. 6226.0) survey indicates that, of those employees who:

- had been employed in the mining sector for at least a year; and
- had changed employer in the past year

on average (over a five year period) 46% had changed jobs from another employer in the mining industry.

In other words, nearly half of current mining employees who had recently taken on new jobs had previously worked in the mining sector. While no corresponding sectoral breakdown is provided (which might indicate the source industry of other employees in the mining sector) this again suggests that the largest single source of employment in mining is the mining sector itself.

Indeed, the 2020 EIA (p.37) appears to have taken this into account in calculating a revised wage premium, by assuming 49% of employees were recruited from the mining sector, with 51% recruited from other industries. Those from the mining sector were assumed to receive no wage premium – with the calculations being based solely on those assumed to be drawn to mining from other sectors.[8]

We note that the employment benefit estimate in the 2020 EIA ($63 million) (p.2) is considerably lower than that presented in the 2017 EIA ($134 million) (2017 EIA, p.40) despite the estimated operational FTE employee numbers being roughly the same (266 FTEs (2020 EIA) to 275 FTEs (2017 EIA)). The difference equates to $71 million – a reduction of 53% relative to the original total. We presume that a part of this may be because the revised calculations only apply the estimated wage premium to those deemed to be recruited from other industries rather than assuming that all are from other industries (or are unemployed).[9]

The substantial reduction in the estimate of the wage premium is material to the project NPV. It points to the sensitivity of such calculations to wage premium assumptions and of the importance of presenting solidly grounded (and project

[8] We also note that under the 2020 EIA calculations, no wage premium was calculated for the "newly employed" including unemployed workers.

[9] Even after this substantial reduction, the methodology and assumptions behind even this revised calculation raises other concerns, as discussed below.

specific) evidence for such assumptions. These issues are addressed further below.

### *2.5.2* Generic arguments vs specific evidence

Parallel to the discussion of the sources of labour for the mining industry, the 2020 EIA points to the differences in labour productivity between mining and other industries. The essential contention appears to be that:

- labour productivity in the mining industry is higher than that in other industries:
- labour productivity is a long term driver of wages;
- there is no good evidence for compensating wage differentials, such as those assumed by the *Guidelines*; and
- since much of the labour for the mining sector is drawn from other sectors of the economy, the difference in wages between the mining sector and other industries must reflect a difference in productivity and this should be the basis for a wage premium benefit.

A parallel argument is that the *Guidelines* themselves are incorrect in their treatment of wage premiums (2020 EIA, p.31-32, Appendix C). We address such arguments in our discussion of external critiques and internal evidence below. We note here, however, that while critiques are important in a healthy debate on economic issues, proponents need to address the *Guidelines* as they are, not as they may wish them to be.

In a generic sense, the link between wages and productivity in the long run is indeed important. Likewise, the 2020 EIA points to the higher wages and labour productivity of the mining industry relative to other industries (Appendix C p.17, p.21).. However, to indicate that the *Guidelines* are therefore incorrect because, in the first instance, they assume a zero wage premium (and require evidence from proponents that project-specific wages are not due to more physically demanding work, tougher working conditions, relocation costs etc.) does not follow.

The *Guidelines* (p.13) actually note differences in (reservation) wages between the mining industry and other industries, stating:

> *The economic benefit to workers is the difference between the wage paid in the mining project and the minimum (reservation) wage that the workers would accept for working elsewhere in the mining sector (Chart 3.8). The minimum wage reflects the employment opportunity costs, skill level required and the relative disutility of an employment position*

and pointing out in a footnote that:

> *the reservation wage is the minimum wage a worker has to be paid to work in a particular industry. In view of the hours of work and working conditions, there is a reasonable possibility that workers' reservation wages in mining are higher than in other industries, and take into account hours of work and working conditions.*

In other words, the *Guidelines* already note that the mining industry has higher (reservation) wages relative to other industries. The basis for estimating the

economic benefit to workers required by the *Guidelines* is not comparison to other industries but to the minimum wage that workers would accept for working elsewhere within the mining sector. So, on this basis, the question for workers "transferring in" to the mining sector is how they might gain additional skills and know-how relative to other mining projects. This has implications for the calculation of the wage premium, discussed below.[10]

Accordingly, pointing to wage differentials between industries alone (Appendix C p. 17) does not appear to advance the argument substantively.

Of course, as indicated, BAEconomics' argument appears to be that when workers transfer from other industries to the mining industry this represents a productivity boost (rather than compensation for harder working conditions or relocation). They argue that it is this which is reflected in wages and should be the basis for a wage premium. However, apart from the fact that this is not the basis suggested by the *Guidelines* (and leaving aside arguments that the *Guidelines* are "incorrect" to set out this approach) no project specific evidence is provided in this respect.

This leads to a second (and related) point: that the arguments advanced by BAEconomics are *generic*. They point to broad trends within the economy such as long term drivers of wages across entire industries and assessed labour productivity differentials between those industries. However, the issues the *Guidelines* refer to in their discussion of the wage premium (pp.13-14) are *specific*: namely the evidence that a particular project (in this case the HCP) will confer specific benefits to workers.

In this context it is again worth reiterating what the *Guidelines* (pp.13-14) say in referring to wage premium assessments:

> *Although a zero wage premium is a useful starting assumption, the appropriateness of this assumption must be assessed on a case by case basis. This is because benefits to workers can be one of the major economic benefits from a project. If a proponent considers that a project will generate positive benefits for workers, the economic assessment should clearly explain the reasons for this conclusion and present evidence in support of the valuation that has been adopted.*
>
> *A broad range of factors may be relevant to the question of whether a project will generate net benefits for workers. In general, the net benefit to workers is more likely to exist if workers will be drawn from a population with persistently high unemployment or experiencing other forms of social and economic disadvantage. Workers are also more likely to realise net economic benefits if they will develop new skills by working on a project, such that they become more employable in the long term, especially if the skills are relevant to jobs in other industries or locations. Workers may also receive a net economic benefit if a*

[10] Note that the *Guidelines* (p.13) go on to acknowledge the difficulties in observing reservation wages in practice. However, this does not really alter the point, as the stipulations on pp.13-14 for proving a wage premium then go on to refer to a zero wage premium and refer to the need for proponents to supply evidence that the project in question has provided benefits to workers, as noted below.

> *proponent intends to pay its workers more than necessary to attract the necessary skills or number of workers. If this is the case, they should clearly explain why this intention is credible and how compliance with this intention might be verified and enforced.*

Also noting in an accompanying footnote:

> *a time-inconsistency problem can arise in such circumstances, such that even if a proponent intends, in good faith, to pay above market wages to its workers, the incentives will be for it to stop doing so once construction starts or once the project is operational.*

In other words, labour that learns new skills, boosting employability and/or which attracts a higher wage would be reflective of a gain to the productive efficiency of the economy. To the incremental extent that this is true (relative to base case skills /wages elsewhere in the mining sector) a case for benefits could be considered within a CBA.

The next step is for proponents to demonstrate that this will indeed be the case in respect of the project in question. As indicated, the evidence needs to be credible and provide an indication of how compliance (with higher wages for example) will be "verified and enforced" even in spite of incentives not to do so over time.

However, as indicated, while BAEconomics presents much generic evidence in terms of wages, productivity and labour mobility across industries it is not clear that this case has been made in the 2020 EIA. In order to make such a case, it would need to be demonstrated, for example, that the HCP is paying workers more than necessary for their additional skills or to attract them to the project.

### 2.5.3 Calculation of the wage premium

These issues are relevant when considering the actual approach the 2020 EIA has adopted in calculating the wage premium for currently employed workers, as detailed in the 2020 EIA (pp.37-38).

In essence the approach is to:

- Estimate project gross wages using a calculation reflecting the skill mix required for the project over its lifetime. The mix of wages and salaries reflects Hume Coal's estimates of the "market rates" for the workforce composition that will be required.
- Estimate project annual average disposable income (gross income net of superannuation, Medicare and personal income tax), i.e. $95,115.
- Estimate average disposable income for non-mining industries NSW in 2020 ($50,848)
- Take the difference between the two ($44,268).
- Derive the wage premium based on this and apply it to the 51% of workers (or 136 workers) who are assumed to be recruited from other NSW industries (i.e. outside the mining industry).

- This produces an increased disposable income per annum of $6 million which is then spread across the project lifetime to produce a NPV of $63 million.

In other words the assertion would appear to be that:

- workers coming to the HCP from other industries are on the average NSW wage; and
- the differences between this wage and wages in the mining industry (and the HCP in particular) are due purely to skills (and higher productivity) with the other factors mentioned in the *Guidelines* playing no part.

As noted above, no allowance is made for "newly employed" (including unemployed) labour in these calculations and the estimated NPV of employment benefits is less than half that in the 2017 EIA.

We note that the calculation dismisses rather than deals with the requirements of the *Guidelines* (pp.13-14) outlined above in respect of comparisons of HCP wages to wages within the rest of the mining sector (rather than to other industries).

However even if this is disregarded, the calculations give rise to a number of questions.

First, and perhaps most fundamentally, the reference to Hume Coal's use of "market rates" to calculate its wages bill is of interest. If it is Hume Coal's intention that market rates are to be paid to the various occupations which will be employed in the HCP, then it is not clear why any wage differential (or a wage premium) would arise in the first instance. For example, if an accountant coming from the utilities industry now works at the HCP would that person be paid more than in their previous job ? If so how much more and why ? Given the reference to the use of market rates in Hume Coal's calculations, it is not clear that this is the case[11].

The reference to market rates is also problematic given the *Guidelines*' (p.14) stipulations that proponents demonstrate that they intend to pay "above market wages" to attract labour, explain why this is credible and how it would be enforced.

Second, even aside from this point, we note comparison is made to the wages of the average occupational mix across NSW ($50,848) not of the occupational mix required by the HCP itself. Yet even if this approach is accepted, the best basis for comparison would appear to be with the specific type of labour required by the project, not the generic NSW wage.[12]

[11] An interesting conceptual point is also to consider the converse. Would an accountant who *leaves* the mining industry and works in the utilities industry, receive a markedly lower wage ? Would this be due to skills or other issues (e.g. location, work conditions) ? Should a CBA for a utilities project include a "negative wage premium" to reflect the reduced wage (if any) ?

[12] Of course in defence of a generic average wage (as opposed to an occupational matching) approach it could be argued that some might change occupations *and* industries – e.g. a school teacher who became an accountant in the mining sector and then received higher wages. However even if this was the case, it would still

The fact, as indicated in the 2020 EIA (p.37) that Hume Coal has undertaken "a detailed bottom up calculation reflecting the mix of skills and qualifications required for the workforce over the life of the project" and a "corresponding mix of wages and salaries" suggests that Hume Coal:

a) does indeed have a reasonable expectation about what occupations it is likely to require for the HCP; and
b) what wages it would be willing to pay workers.

Indeed calculating the wage bill is exactly what one would expect in project planning and cost estimation. If so, then the information would exist to compare the project's disposable wage estimate per worker (i.e. $95,115) to the average NSW wages paid to the same mix of occupations required for the project.

This would produce a better comparison then one which simply drew on the NSW average wage. If this was done and it was determined:

- there was a differential between the two wage rates; and
- it could be explained that this was, for example, due to the need to attract certain skills (rather than due to the hardship or relocation costs referred to in the *Guidelines*)

then a better case for wage premiums could be made.

However, as indicated, if the intention is simply to pay market rates, then it is not clear that such a differential would exist or be material.

Third, we assume the detailed calculations have been withheld for reasons of confidentiality. However, the description provided suggests that the *entire* HCP workforce wages and salaries have been included in the estimated workforce wage bill. This would therefore appear to include the portion of the workforce which is more likely to come from the mining sector itself. So it is possible that the HCP *occupational mix* may also include the wages of those who are literally "at the coal face" and who may be more likely to:

a) transfer in from the mining industry itself; and
b) receive the highest wages.

If this is the case, then the calculation could potentially exaggerate the wage differential because the (potentially higher) salaries of those who are already in the mining sector (and/or experienced) are in the HCP average wage mix which is being compared to those who "transfer in" based on the average NSW wage rate. [13]

need to be shown that wage differentials were not due to the factors mentioned in the Guidelines but due to other factors such as the specific skills and expertise required by the project. Moreover this effect would seem modest at best. We note Appendix C (pp. 25-26) uses recent ABS labour mobility survey data to suggest that on average 27% of those employed in the mining industry had changed occupations in the previous year. However, it is not clear if those who did so were already within the mining industry itself. If so, then using the approach outlined in the 2020 EIA, they would be excluded from the analysis.

[13] For example, note that in the occupational mix presented in Appendix C Table C1 (pp.24-25) that "Drillers, Miners and Shot Firers" comprise 18% of the mining workforce but are not present in the other industries listed. Presumably this group might include some of those literally at the coal face and paid some of the highest wages. Since the numbers of this occupation seem largely confined to mining and are not present in the other potential

Fourth, the magnitude of the wage differential per worker is large ($44,268). It is, in fact, nearly double that of the average disposable NSW wage in on-mining industries ($50,848). In other words, the wages of workers coming to the project are assumed to be nearly double their previous wages.

A wage increase per worker of this magnitude is difficult to sustain in practical terms. It implies that workers could nearly double their salary simply by obtaining a mining job and that this is purely due to the fact that their productivity will be nearly twice that of their previous employment (rather than reflecting compensation for difficult work, relocation, etc.). If this were to be the case it would seem to suggest that there is an immense incentive for workers to take on mining jobs and indeed that they would do so enthusiastically at any opportunity. It is not clear that this is the case. It seems more likely that the calculation is an artefact of the issues described above and does not represent a credible wage premium.

Given the above issues, we again reiterate that we find no good basis for the calculation of a wage premium for the HCP. We suggest that it be excluded in the assessment of project benefits. We note that the 2020 EIA's "narrower" definition of project benefits (items described in the in the top half of Table S-1-1, p.2) also excludes this calculation.

#### 2.5.4 Unemployed (and "newly employed") labour

We note the 2017 EIA argued that 20% of workers in the project would be "newly employed" (i.e. just entering the workforce, unemployed or inactive for other reasons, or people moving to NSW from interstate/overseas). The 2020 EIA also notes this and the BISOE critiques of this assumption before going on to refer to the mining sector's employment of apprentices and indigenous people (p.35). The *Stoeckl Report* also implicitly defends this assumption although no new empirical evidence is presented (*Stoeckel Report* pp.7-11).

However, no evidence of the HCP's willingness or commitment to the employment of the unemployed (or other "newly employed" groups) for the project in question is explicitly provided.[14]

Given the sudden surge in unemployment due to the COVID-19 pandemic, there will likely be much higher unemployment for a period then was the case when the 2020 EIA was written. However, the unusual "forced" nature of this recession (an enforced lockdown of economic activity followed by a loosening of restrictions which is now gathering pace) makes it difficult to predict how long this will last. The key point however is that the *Guidelines* (p.14) indicate that a case may be made for employment benefits when the workforce is drawn from a population with "persistently high unemployment" and the potential for the

source industries indicated in this table, the effect could be to push up the overall HCP wage bill relative to the State average. The same is true for mining engineers (2% of the mining workforce).

[14] There is a reference (p.36) to Hume Coal's commitment to hire "inexperienced workers" in the local area but these are to be people who already have experience in related fields rather than the unemployed.

project in question to alleviate it. No such evidence is presented in respect of the project in question.[15]

In practical terms this is of no direct material consequence to the calculation of a wage premium since, as noted above, the calculation of the wage premium in the 2020 EIA excludes such "newly employed" labour.

However, we note that benefits to the newly employed are included in the estimation of payroll tax benefits below. As indicated below, since there is no firm evidence for the employment of such people in the HCP, the basis for such an inclusion is not strong.

#### 2.5.5 Suggested approach

We suggest that a better approach then making generic arguments or disputing the approach laid down by the *Guidelines*, would be for the proponent to adhere to the references in the *Guidelines* (p.13) to assess wage premiums on a "case by case" basis, backed up by evidence.

As indicated in the calculations above, labour force costings are a part of the costings for the project. Other project costings are referred to in the discussion of project operations and producer surplus considerations above. Some evidence worth bringing forward to justify a wage premium. might, for example, include the following:

- Is there any evidence that Hume Coal intends to hire unemployed labour for this project ? Does such evidence exist in terms of written commitments for example ? What are the numbers of unemployed labour that Hume Coal is committed to hiring ?

- What kinds of workers is Hume Coal seeking to hire for the project ? What experience levels are required/preferred ? Is there any indication of a preference from which sectors or occupations these will be drawn ?

- What kinds of salary levels are committed to for the various roles in the mine ? How do these compare to the (independently verified) average market rates for such occupations elsewhere in the mining sector ? Or the other sectors from which employees are to be drawn? How do these add up to the total wages bill calculated for the operation ?

- Can evidence be supplied that any potential difference in wages is due to the types of skills required for this particular project (as opposed to projects or occupations elsewhere in the mining (or other) sectors ? To

[15] Data for May 2020 records a NSW unemployment rate of 6.4% while that for the Southern Highlands and Shoalhaven was 4.9% (ABS *Labour Force, Australia May Detailed - Electronic Delivery, May 2020 C*at. No. 6291.0.55.001) The *AusIMM Professional Workforce Survey 2018* https://www.ausimmbulletin.com/feature/ausimm-professional-workforce-survey-2018/ , which remains the most recent data source for mining professionals employment status, indicates that unemployment for mining professionals in NSW and the ACT was 0%.

what extent are any wage differentials due to the conditions and nature of the work (e.g. harsher conditions) and/or location of the work ?

In the absence of strong arguments backed up by such data, consistent with the requirements of the *Guidelines*, we see no compelling reason for the inclusion of benefits to workers in the CBA.

#### 2.5.6 Other issues

We note that a number of other issues were raised in the course of the 2020 EIA's discussion of benefits to workers. While these are not directly consequential to the discussions above, we have provided a brief discussion of these below.

- *The purpose of CBA as described in the Guidelines* – The 2020 EIA (pp.31-32) notes BISOE's past reference to the *Treasury Guidelines* referring to employment as an opportunity cost. However it questions if this should be true for the HCP, stating that "the CBA described in the Guidelines does not correspond to a conventional cost-benefit calculation". It goes on to state that:

  > *in the case of a mining project, the direct (construction and operational) costs are borne by the proponent and are not relevant from the perspective of the NSW community unless the activity imposes some opportunity cost on the NSW community.*

  However, there is no material distinction between conventional CBA and the approach set out in the Guidelines. A project like the HCP will indeed impose opportunity costs on NSW. It will call on capital and labour which cannot be used elsewhere in the NSW economy. This clearly constitutes an opportunity cost regardless of the fact that Hume Coal is a private entity.

  More broadly CBA deals with the costs imposed by an initiative to society as well as the resulting benefits. It does not matter whether the costs or benefits are incurred (or enjoyed) by the public or private sector. Consistent with this, the role and scope of CBA is clearly set out in the *Guidelines* (pp.1-4, p.9). These clearly indicate that the scope of the analysis is the NSW community and that opportunity costs include the land, labour and capital used for the project (*Guidelines* p.4).

- *Treatment of labour surplus* – The 2020 EIA indicates that NSW Treasury allows for a labour surplus as a project benefit. It also suggests that the *Guidelines* contradict the *Treasury Guidelines* in this respect (2020 EIA, p.19,30,32, 37).

  The *Treasury Guidelines* (p.13) state the following:

  > *Labour surplus is the difference between a worker's actual wages and what they are willing to accept (their reservation wage). If an initiative increased hourly wage rates, the incremental increase would be a benefit. However, if an*

> *initiative increased employment, this would only be a benefit if the labour resources were previously unemployed or underemployed. That is, if employment is simply displaced, then it would not be a benefit.*

We also that that the *Treasury Guidelines* define labour as an opportunity cost within a CBA, with the opportunity cost being measured by the reservation wage (*Treasury Guidelines* p.56).

There appears to be no contradiction between the *Guidelines* and the *Treasury Guidelines*. The *Treasury Guidelines* refer to reservation wages and recognise labour is fundamentally an opportunity cost but allow for a labour surplus under specific circumstances. The *Guidelines* (pp.13-14) also refer to reservation wages, but note that in practice estimation of a reservation wage is difficult. They set out how a wage premium might be calculated for specific mining projects in practical terms, noting that in making such an assessment issues such as the impact of tougher conditions, more physically demanding work, relocation costs etc. must be taken into account.

Accordingly, they indicate that it cannot be asserted that a wage premium (or labour surplus) exists simply because workers earn more from working in the mining sector. They seek evidence that workers are earning more for a given project then they would elsewhere in the mining sector because of the specific skills associated with that project (which would be one reflection of the true gain in productivity). We note this project specific focus is also similar to the reference in the *Treasury Guidelines* to "an initiative" raising hourly wage rates. In other words, the focus is on a specific action or development rather than generic wage differences between industries.

Ultimately the intention behind both the *Guidelines* and the *Treasury Guidelines* is to measure the true incremental gain in productivity. More productive labour constitutes a net benefit to society. Labour which is simply paid more to compensate for more physically demanding work, tougher conditions or for relocation costs is not necessarily more productive.

- *Shadow price of labour* – The 2020 EIA (pp.35-36) notes the references to the shadow price of labour in the First Review. It refers to the *Treasury Guidelines* (pp.61-62) which indicate that shadow prices are not commonly used in Australia due to the measurement complexities involved and recommend against their use.

  This point is noted and the 2020 EIA is correct in its reference to *Treasury Guidelines*. However, the *Treasury Guidelines* do not dispute the existence of shadow prices – rather they do not recommend using them due to the complexities involved. The issue is somewhat academic as no substantive evidence is presented that unemployed labour will be employed for the HCP and no allowance for unemployed labour is made in the calculation of wage premiums.

### 2.6 TREATMENT OF NON-COMPANY TAXES

We note that the 2020 EIA includes the following taxes in its assessed benefits:

- Payroll tax
- Personal income tax
- NSW share of Medicare payments
- Land tax
- Local government rates

The *Guidelines* (p.10) refer to employment-related taxes in the following passage:

> *Note that a new mine will also pay other taxes, such as payroll tax and personal income tax. The majority of these taxes will have been generated without the project, as people would have been employed elsewhere. Hence these should be included in costs. To the extent that a proponent can demonstrate that other taxes are genuinely additional and will not be offset by lower tax payments elsewhere in the economy, they may be recognised, provided that the impact of these taxes on the overall NPV of the project is reported.*

The treatment of these taxes is detailed on pp. 26-27 and pp. 38-39 of the 2020 EIA.

In terms of payroll tax, this is assumed to increase as a result of the incremental wage difference from the employment of both people from other industries and of "newly employed" workers. However, as indicated above, we do not believe the case for an incremental wage differential in the case of the HCP is strong. Likewise there is no compelling evidence to indicate the HCP will hire substantial numbers of "newly employed people" or that it will alleviate "persistently high unemployment" in the area.

Accordingly, there is no good case for the inclusion of payroll tax in the CBA and this should be excluded from the assessed project benefits.

The same reasoning applies to the assessment of personal income tax and Medicare payments, as these also rely on assumptions of a wage differential for the HCP for which strong evidence, consistent with the *Guidelines,* is lacking. Accordingly, these should also be excluded from the assessed project benefits.

As per our First Review, we agree that a case may be made for the inclusion of land tax and local government rates in the CBA but note that the material effect of these is small (a total of $2 million).

We also note that the "levies" item (which totalled $5 million in the 2017 EIA) has been removed from the analysis.

### 2.7 ENVIRONMENTAL AND SOCIAL EXTERNALITIES

The 2020 EIA (pp.4-73) refers to a variety of environmental and social externalities, including:

- Greenhouse Gas Emissions
- Biodiversity Impact

- Ambient noise impact
- Subsidence
- Air Quality
- Groundwater
- Loss of surplus to other industries
- Residual value of land
- Visual Amenity
- Traffic and Transport
- Aboriginal Heritage
- Historic heritage
- Surface water

We note that, externalities have been the subject of extensive debate in the past with respect to the HCP. Many of these issues involved go beyond pure economic analysis and have been the product of specialist analysis in areas such as hydrology, geology, air quality and cultural issues.

Debates relating to these issues were the concern of the IPC and were also detailed in the *Response to IPC*. The Department may therefore wish to reach its own determination as to whether Hume Coal's responses to the technical issues raised – detailed in the *Response to IPC*- have been adequate.

Total externalities (presumably equal to "environmental mitigation costs") are cited as $13 million in NPV terms in the 2020 EIA (p.28). Additional information on externalities is provided in Table 3-5 (predicted externality costs) and Table 3-6 (externality costs incurred to date) of the 2020 EIA. This is welcome. However, as discussed below, it remains unclear as to how (or if) the various items in these two tables combine to add to the $13 million (in NPV terms) allocated to environmental mitigation costs.

Based on our experience, the most material issue relating to the HCP – and the one provoking the most intense debate - relates to groundwater usage. Table 3-6 (pp. 49-50) lists groundwater costs as totalling some $7.2 million to date and we estimate that future make good provisions detailed in Table 3-5 (pp.44-48) equate to $3.5 million in NPV terms (though see further comments below). If so then groundwater costs account for $10.6 million (rounded) of the assessed externality costs. Accordingly we have mainly confined our comments in this review to the issue of groundwater costs, with providing some broader comments on the externality estimates below.

We previously provided extensive comments on groundwater issues in the First Review and in our Further Comments. The *Response to the IPC* (pp.33-59) noted that the Department and Hume Coal remained some distance apart on issues relating to groundwater usage. It noted (*Response to IPC*, p.34) the IPCs three recommendations in respect of groundwater, namely:

- the completion of a revised groundwater model;
- the engagement of an independent consultant (or a small technical group) to resolve remaining differences of opinion; and
- that the Department give close attention to the practical adequacy of make good provisions during the final assessment process with an independent consultant appointed if necessary.

The *Response to the IPC* sets out Hume Coal's response to these issues. This includes a details of the appointment of an independent consultant into groundwater modelling (Dr Lloyd Townley) and the findings of his report. (We note that the *Response to the IPC* (p.39) stated that the Department declined to jointly engage an independent consultant.)

In essence, the *Response to IPC* indicates that Dr Townley found Hume Coal's groundwater modelling to be appropriate.

The *Response to IPC* (p.59) also indicates that make good provisions have been revised and refined. The make good strategy is also discussed in Appendix B of the *Response to IPC*.

These issues are relevant since, as indicated in the Further Comments, it was not completely clear how the precise costing of the make good provisions, in particular, dealt with some of the concerns which have been raised relating to the willingness and or ability of Hume Coal to "make good".

That said, it remains unclear precisely how, or if, these costings have been revised in light of the *Response to IPC* discussions and initiatives. The 2020 EIA's discussion of groundwater impacts (pp. 55-57) refers to the make good provisions, along with references to $300,000 per annum for monitoring and make good provisions (based, in part, on the 2018 EIA). This amount is also referred on Table 3-5. However, the link between these costing assumptions and the issues and revised approaches discussed in the *Response to IPC* remains uncertain.

The First Review (pp.30-32) included data from BAEconomics on externality costs. This indicated $4.4 million in make good provisions (in NPV terms). The only other groundwater related externality listed at that time included the cost of purchasing water licenses ($4.8 million in NPV terms). This equated to a total groundwater cost allocation of $9.2 in NPV terms. Total externalities reported at that time equated to $10.8 million in NPV terms (as against $13 million in "environmental mitigation costs " reported in the 2020 EIA (p.28) and the $16.7 million in externality costs we estimate below, based on Tables 3-5 and 3-6).[16]

It is unclear if the allocated $300,000 in annual make good provisions reconciles to the $4.4 million in NPV terms reported in the First Review. We note that $300,000 spread over 25 years (consistent with the timeframe for the project cashflow calculations in Appendix E) and discounted at 7% equates to $3.5 million on an NPV basis (i.e. *lower* than the amount estimated in 2017). Other groundwater-related items listed in Table 3-6 such as groundwater monitoring ($2.8m) are defined separately to make good provisions (and did not appear in the data to us provided for the First Review), while the $4.4 million allocated to groundwater licenses is similar to the $4.8 million estimated (NPV terms) in the First Review.

As indicated, in total, past and future cost allocations to groundwater costs in the 2020 EIA appear to equate to $10.6 in NPV terms (as against $9.2 million

[16] As indicated below it is unclear if the rehabilitation expenses item of $3 million reported on p.28 also includes some externality allowances. If so the relevant externality allowance figure for the 2020 EIA should be $16 million which would be closer to our estimated $16.7 million in costs based on our analysis of Tables 3-5 and 3-6.

in the 2017 EIA). The higher 2020 total appears to be due to the groundwater monitoring cost item. However, the allocation for make good provisions in particular appears *lower* than in the 2017 EIA (though again this is not made transparent).

The figure below provides a summary of the above discussions.

**Fig. 2. Estimated groundwater and other externalities 2017 and 2020 EIA**

| Item | 2017 EIA estimate ($ million, NPV) | 2020 EIA estimate ($ million, NPV) |
|---|---|---|
| Groundwater – Make good provisions | 4.4 | 3.5* |
| Groundwater – License purchases | 4.8 | 4.4 |
| Groundwater - monitoring | - | 2.8 |
| ***Groundwater - subtotal*** | ***9.2*** | ***10.6*** |
| Other externalities | 1.6 | 6.1 |
| **Total externalities**** | **10.8** | **16.7** |

Source: BIS Oxford Economics estimates
*$3,5 million estimate based on $300,000 per annum allocation over 25 years, discounted at 7%.
** BISOE estimates for the 2020 EIA are based on data in 2020 EIA Table 3-5 and 3-6 including the provision in Table 3-5 of $380,000 per annum for all externalities which has been spread over 25 years at a 7% real discount rate. As noted, only $13 million is presented as environmental mitigation costs in the 2020 EIA (p.28).

In short, despite the additional information provided in the 2020 EIA, it remains unclear if the groundwater provisions costings are adequate to address previous concerns or how they reconcile with the make good initiatives suggested in the *Response to IPC*. Indeed, despite the initiatives proposed in the *Response to IPC*, and the controversy over this particular issue, the make good provisions appear to be *lower* than was the case in the 2017 EIA.

At the same time, any groundwater externalities would need to be very sizable to make a material difference to project viability. The Further Comments provided details as to the amount of local agricultural land which would be required to be rendered unusable (due to the drawdown of water supplies) in order for the project to record a zero NPV (i.e. reach an economic breakeven point). The analysis at that time suggested that between 6,100 ha and 23,000 ha of land would need to be forgone to produce a zero project NPV. This compared to a project area of 5,051 ha (though some properties affected by groundwater drawdowns would lie outside these boundaries while others within it would not be affected).

We have not repeated these calculations for the Second Review. However based on the above it would be highly unlikely that groundwater externalities would cause the HCP to record a zero NPV.

Nonetheless, we as noted in our Further Comments, if such depletion incurs a greater economic cost than forecast in the EIA, this would obviously *reduce* the economic case for the mine. Moreover, the above analysis does not appear to explicitly take into account the broader issues (and potential costs) noted by past submissions such as that of WaterNSW and others relating to the impacts of reduced water quantity across the Sydney catchment area in circumstances such as water take exceeding allocations and/or in periods of extended drought.

It could be the case that additional water externalities act in combination with reduced coal take and/or lower prices scenarios discussed above. If this is the case then the economic case for the HCP could become more marginal.

In addition, to the issues discussed in terms of water resources there are also some broader points which should be noted in terms of externalities, some of which are related to the matters raised above.

- *Other externalities* - As indicated we have not generally commented on other externalities (though see notes on greenhouse gases and net public infrastructure costs). It is also possible that the Department may wish to satisfy itself as to the technical adequacy of the *Response to IPC*. This might also have cost implications.

- *Clarity and magnitude of costings* - While the information provided in Tables 3-5 and 3-6 of the 2020 EIA is welcome it is unclear how the various externalities listed in these tables combine to produce the assessed environmental remediation measures of $13 million in NPV terms (or indeed if they reconcile to this sum). We estimate that the sum of the costs incurred to date in Table 3-6 equates to $12.3 million, while the NPV of the $380,000 per annum allocated to "all external effects" listed in Table 3-5 (detailing predicted costs) equates to $4.4 million (over 25 years at a 7% discount rate)[17]. The sum of these equates to a NPV of $16.7 million. It is possible that the relevant comparison should be to the sum of environmental mitigation measures and rehabilitation expenses ($3 million) or $16 million but this is nowhere made clear.

  Given the importance of externalities in the debates over the HCP in the past (and the questions raised by the IPC) the clarity of the costings, calculations and assumptions provided and their linkage to the *Response to the IPC* proposals and initiatives should be reviewed. As indicated, these considerations also affect the issue of groundwater costs as the precise combination of costs to produce a total groundwater cost estimate remains somewhat murky. Total make good provision costs, in particular, over the life of the HCP also remain unclear. It is not obvious how the issues raised by the various parties - and the *Response to IPC* - are realised within this costing, particularly as the make good allocation appears lower ($3.5 million ?) than that adopted in the 2017 EIA ($4.4 million).

- *Net public infrastructure costs* - As noted previously, no serious consideration appears to be given to net public infrastructure costs. These may be more than negligible if there is substantial use of public roads during the course of the project.

- *Greenhouse gas emissions* – We note that the assessed cost of greenhouse gas emissions is some $19 million lower than the assessment provided in the 2017 EIA. The assessment provided on

[17] We presume that this includes the $300,000 per annum allocated to groundwater make good provisions.

> pp. 64-66 of the 2020 EIA reflects the new guidance provided by the Department's *Technical Notes supporting the Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals*, April 2018 ("the *Technical Notes*") .This confines the impacts of greenhouse gas emissions to NSW rather than using a global basis for the analysis. This has the practical effect of reducing the size of the externality substantially, relative to the 2017 EIA. However, as indicated, this appears consistent with the stipulations of the *Technical Notes*.

- *Sensitivity tests*- No sensitivity tests have been undertaken in respect of environmental externalities (or net public infrastructure costs below). This is at odds with the stipulations of the *Guidelines* (p.18). We also note that the *Guidelines* (p.19) refer to the need to discuss the risk that environmental mitigation measures may not be fully effective as a part of the CBA. While Hume Coal has provided extensive evidence and arguments about the robustness of its mitigation measures in its *Response to IPC* and elsewhere, it might be useful to provide a summary of these risks in the CBA as indicated by the *Guidelines*.

In short, while it seems unlikely that externalities in themselves could cause a zero project NPV, there is a need for the proponent to clarify some of the outstanding cost issues realised above.

### 2.8 NOTE ON NET BENEFITS TO NSW AND CGE MODELLING

The 2020 EIA (pp.18-19) makes a number of statements with respect to issues such as:

- jurisdictional standing and the allocation of taxes to NSW;
- the treatment of taxes as a revenue, expense or transfer; and
- the use of a broader national accounts perspective to help resolve ambiguities over taxes.

While this discussion is interesting, it is not clear that it drives the analysis any further. While references to the Australian System of National Accounts (ASNA) are made at various points in discussions of taxes in the 2020 EIA, in many cases the issue is largely moot. The basic approach to the treatment of such taxes is outlined in the *Guidelines* and in practical terms their inclusion in some cases stands or falls on other aspects of the analysis such as whether employment benefits are included (or not) as discussed below.

A suggestion is also made that BISOE misinterpreted the 2017 EIA's discussion of GSP and economic welfare, as this was motivated by an interest in using the ASNA for guidance.

However, the 2017 EIA (p.19) and the 2020 EIA (p.19) state that:

> *Given that the objective of the CBA is to identify the net benefits accruing to the State of New South Wales, the economic impacts of the project can therefore be evaluated with reference to its contribution to NSW GSP.*

Although the 2020 EIA goes on to state that:

> *Second, as noted in BAEconomics' response in October 2017, it is clear that GDP or GSP are not direct measures of economic and social 'welfare' but measure the production of goods and services.*

It also goes on to state that:

> *However, production is an important dimension of welfare because it enables greater consumption, and because strong GDP/GSP growth generally goes hand in hand with declining unemployment (Lequiller and Derek 2007). In fact, the 'benefits' identified in the 2015 Guidelines are also components of GSP, and the criteria established by the NSW Government can therefore be viewed as supporting GSP and GSP growth.*

While the acknowledgement that GSP/GDP is not a measure of welfare is welcome, the other references in the 2020 EIA to GSP/GDP again seem to create unnecessary confusion.

Put simply (and indeed as acknowledged by the 2020 EIA itself, p.37) GDP/GSP are measures of *economic activity* not *economic welfare*. The two are distinct. The need to measure net economic (or social) welfare is why approaches to CBA emphasise the use of producer and consumer surplus as well as externalities rather than GSP or GDP. This is the approach to CBA outlined in the *Guidelines* and *Treasury Guidelines* as well as by analysts such as Dobes et. al. and Abelson who point to the clear differences between GSP/GDP and economic welfare[18].

There may be some overlap between economic welfare and GSP in areas such as producer surplus (which is similar to Gross Operating Surplus). However the distinction between the two is clear and they should not be confused.

In this context we also note the 2020 EIA's use of CGE modelling commissioned through Cadence Economics (pp. 81-84) to produce NSW flow-on effects measured through changes to GSP and Gross State Income (GSI). References are also made to Gross State Income (GSI) as a measure of welfare.

While we appreciate the time and effort involved in undertaking such work, the rationale behind the use of a CGE model to measure benefits when these are already measured by a CBA is unclear. While allowing for flow-on (or multiplier) effects at the local level, the Guidelines do not appear to allow for such benefits at the State level.

Moreover, the *Treasury Guidelines* (Appendix 8 p.63, pp. 65-66) note several caveats about the use of CGE modelling and multiplier effects (and even more so for input-output modelling). The *Treasury Guidelines* make clear that CGE is not a CBA and should not be used in its place. They note (*Treasury Guidelines* p.66), with emphasis in the original, that:

> *CGE modelling is best used for assessing the macroeconomic impacts of a portfolio of projects/programs of significant size or a large body of*

[18] See for example Dobes et. al. (2016) Social Cost-Benefit Analysis in Australia and New Zealand; Abelson, P. "Evaluating Major Events and Avoiding the Mercantilist Fallacy", *Economic Papers* 30 (1) March 2011

> *reforms (e.g. competition policy reforms in the 1990s).* ***CGE models are of limited use for microeconomic project/program appraisal, selection and ranking on the basis of social welfare****.*
> *Macroeconomic parameters in CGE models may not always be directly applicable to individual programs or projects.*

The 2020 EIA itself notes that measures such as GSI do not capture non-market effects and that the CGE modelling should not be considered to replace CBA. The use of CGE modelling is referred to as "another lens" through which project benefits can be measured (2020 EIA p.83). However given the *Treasury Guidelines* comments above and the requirements of the *Guidelines* for a CBA approach, it is not clear why it has been applied to the project in question. We note that the *Stoeckel Report* also questions whether CGE modelling is justified for a relatively small scale project such as the HCP (*Stoeckel Report* pp.11-12).

The inclusion of State-level flow-on effects risks confusing (and exaggerating) the assessment of the project's net benefits to NSW which are appropriately modelled via the CBA. The presentation of State-level results could be particularly confusing (or potentially misleading) for those who are not well versed in the technical distinctions between CBA and CGE analysis.

This is especially so, given that the NPV of the project GSI (cited as $2.2 billion, EIA p.83) is over 11 times higher than the "narrower" definition of projects net benefits to NSW of $194 million.[19] The difference is clearly material. Citing the GSI figure could produce confusion about the assessed benefits of the project, when the stipulations of the *Guidelines* and *Treasury Guidelines* in this respect are very clear.

Accordingly, we suggest that the State-wide CGE modelling results be disregarded in the Department's deliberations on the economic benefits of the HCP.

### 2.9 NOTE ON EXTERNAL CRITIQUES VS INTERNAL EVIDENCE

We note that at several points the 2020 EIA and the *Stoeckel Report* critique the *Guidelines* and *Treasury Guidelines*, and appear to question their approach to various issues. These include arguments that:

- The *Guidelines* are incorrect in their wage premium assumption that higher wages in the mining industry reflect compensation for the harder working conditions, relocation costs etc associated with working in that industry (pp.30-32).
- The *Guidelines* are incorrect to exclude interstate labour migration from project benefits (*Stoeckel Report* pp.7-11).
- The current discount rate of real discount rate of 7% used for project assessment "now looks ridiculous" and should be revisited by NSW Treasury (*Stoeckel Report* p. 5-6).

As indicated above, healthy constructive criticism is a part of economic debates. However there is a risk of confusing external critiques (which

[19] Based on the results in the top half of Table S-1-1,p.2 plus land tax and council rates and equating to $194 million

challenge the stipulations of the *Guidelines*) with internal evidence (which seeks to present arguments, evidence and calculations within those stipulations).

As indicated in the *Guidelines* (p.1) their purpose is to assist proponents with providing the necessary information to meet some of the requirements of Section 79C of *the Environmental Planning and Assessment Act 1979* (EP&A Act). This imposes an obligation on proponents. If proponents were free to choose which approaches and calculations they wished to apply and which stipulations they wished to follow (and which to ignore) then there might be little point to the *Guidelines* themselves in the first instance.[20]

Whether or not the *Guidelines* should adopt a different approach to some of the issues outlined above is an interesting issue. However, as indicated, in some cases the arguments appear to debate the stipulations of the *Guidelines* along with a suggestion that they should be changed. Moreover, we are also conscious of the parameters of our review. Our review must, of necessity, match a proponent's arguments against the stipulations of the *Guidelines* as they are - not as they might wish them to be.

While these issues fall somewhat outside the immediate scope of our review, if proponents believe that the Guidelines are incorrect in their approach then we would suggest that they provide alternative calculations in a separate section (in accordance with allowance provided in the *Guidelines,* p.6). We would also suggest that if they feel the *Guidelines* should be amended, they discuss the matter separately with the Department (and/or NSW Treasury).[21]

### 2.10 NOTE ON THE STOECKEL REPORT

As indicated above we were also requested by the Department to examine the *Stoeckel Report* as a part of the Second Review. We note that the *Stoeckel Report* is referred to in the *Response to IPC* (pp.112-120) where it is indicated that the IPC requested a peer review of the EIA in the light of BISOE's concerns and recommendations in the First Review (Recommendation R20). The *Response to IPC* indicates that the *Stoeckel Report* found that the concerns and recommendations in the First Review had been adequately met by the 2018 EIA.

In the main, the *Stoeckel Report* appears to describe what the *Guidelines*, BAEconomics and BISOE have already stated in previous analysis. There appears to be no new presentation of data specific to the HCP, although some generic arguments are made. We have noted these arguments and provided a brief response below.

[20] We note that the *Guidelines* (p.6) *do* allow for the presentation of alternative methodologies and assumptions. However, "these alternative results should be clearly presented as supplementary to the main results" with a "detailed justification" as to why such alternative parameters should be considered. Moreover, we note that this paragraph also refers to the *Guidelines* as setting out the "minimum standards" for an economic assessment.

[21] We note that the *Stoeckel Report* (p.6) does indeed suggest taking the matter of real discount rates up with NSW Government. However, regardless of the merits of this, it would have implications for all project evaluation in NSW (acknowledged by the *Stoeckel Report* itself) as distinct from the specific issues relating to the HCP. In other words, it is an external critique and does not constitute internal evidence.

As indicated, we note that the *Stoeckel Report* is based on the 2018 EIA rather than the 2020 EIA and therefore some of its assessments do not appear to take into account the differences between the two.

- *Interstate labour migration* – As indicated above, the *Stoeckel Report* (pp.7-11) suggests that interstate labour migration should be allowed for in the assessment of benefits to workers, as these add to the NSW labour pool. While interesting, this clearly contradicts the *Guidelines'* specifications (p.14). In essence, this might be seen as a challenge to the *Guidelines*' notion of "the population of standing" as restricted to existing NSW residents. If so, this is a matter which might be best taken up with the Department rather than in the context of a specific project, where the *Guidelines* clearly lay down how benefits are to be assessed. More fundamentally, no evidence is presented that interstate migration will form a material part of the HCP workforce.

- *Estimated benefits to labour* – The 2018 EIA NPV estimates of employment benefit ($156 million) income tax benefits ($30 million) and Medicare benefits ($2 million) are seen as reasonable by the *Stoeckel Report*, based on the discussions on pp.7-11, which support BAEconomics approach and a cited lack of evidence about labour markets. We note that this approach has itself now been revised in the 2020 EIA to produce much lower labour benefits figures. However in any event, we do not find the revised approach in the 2020 EIA consistent with the Guidelines, and recommend against the inclusion of any benefits to labour based on the evidence presented, as discussed above.

- *Discount rate* – As indicated the *Stoeckel Report* critiques the current discount rate of real discount rate of 7% used for project assessment in the Guidelines (and elsewhere in NSW). As the *Stoeckel Report* itself acknowledges this is a broader issue which affects all project assessment across NSW and over which there is a lively debate. However, as the *Stoeckel Report* also acknowledges, this is an issue to be taken up with the NSW Government. Accordingly, it is not one which can be addressed within the scope of an individual CBA of the HCP.

- *Status of the Guidelines* – The *Stoeckel Report* (p.5) notes that the Guidelines are not legal requirements but are guidelines .There is no contention that the Guidelines are, in themselves, a legal document. However as indicated above, the *Guidelines* exist to assist proponents with providing the necessary information to meet some of the requirements of Section 79C of *the Environmental Planning and Assessment Act 1979* (EP&A Act). This, in turn, imposes an obligation on proponents in terms of ensuring that they meet the requirements set out by the *Guidelines*.

The *Stoeckel Report* (p.12) suggests that the 2018 EIA addresses the concerns of BISOE and the IPC and a BAEconomics estimate of $373 million in net benefits to NSW, presented in the 2018 EIA, is justified.

We note that it is the 2020 EIA and not the 2018 EIA which is the subject of our current review. Further, some of the benefits cited by the *Stoeckel Report* as "reasonable and justifiable" (p.12) such as benefits to labour have been downwardly revised by the 2020 EIA.

While the 2018 EIA was not the subject of the Second Review, based on our above analysis of the 2020 EIA, we do not concur that the concerns and recommendations we noted in the First Review of the 2017 EIA have been fully addressed in the 2020 EIA. We have set out our concerns and recommendations with the current EIA in respect of our discussions of the CBA and LEA in this review.

Given the above, while we appreciate the contribution made by the *Stoeckel Report* to economic debate, we do not find that it adds materially to the issues discussed above.

### 2.11 CONCLUSION

As was the case for the 2017 CBA, on the whole, the 2020 CBA is well researched and presented. Considerable research has been undertaken and care has been taken to adhere to the *Guidelines* in many instances. However as was the case in the 2017 CBA, the 2020 CBA's "broader interpretation" of the *Guidelines* overstates the case for the HCP (and indeed, is something of a misnomer as it does not appear to be consistent with the *Guidelines* as they currently stand).

With respect to the assessment of net benefits to NSW (as summarised on p. 2 of the 2020 EIA) We note the following in terms of the major assessed components of project benefits:

- *Royalties* - The assessment of royalties and has increased substantially (by $34 million or 30%) since the assessment provided in the 2017 EIA. This would appear to be driven by an assumed rise in the price of coking coal. Overall the analysis seems reasonable However, we note that royalty payments are ultimately driven by price and production assumptions and that caveats on these remain, including issues which could not have been foreseen at the time of writing of the 2020 EIA such as the COVID-19 pandemic. Other potential threats include growing geopolitical tensions and opposition to thermal coal extraction and consumption.

- *Costs* – In general, it is not possible to offer detailed commentary on the accuracy or otherwise of the cited costs as these were obtained from the commercial estimates made by Hume Coal. However one issue to investigate is whether any contingencies or optimism bias were incorporated into the analysis.

- *Company income tax* - Following on from this the assessment of company income tax has also risen (by $18 million or 67%). This would be driven by the same factors as above and is subject to the same caveats, although once again the analysis here seems reasonable.

- *Benefits to workers ( employment benefits)* - The assessment of the economic benefits to NSW workers has fallen considerably compared to that proposed in the 2017 EIA (by $71 million or 53%). This is apparently due to more conservative assumptions in the 2020 EIA. This illustrates the sensitivity of the assessed employment benefits to changes in the assumptions underlying the analysis.

  That said, the analysis of benefits to NSW workers remains unconvincing. It appears conceptually and mathematically inconsistent with the approach recommended in the *Guidelines* and refers to a wide variety of generic arguments rather than providing project-specific evidence. We again recommend that benefits to workers be disregarded.

- *Tax benefits* - Likewise the calculation of the associated payroll tax, personal income tax and Medicare payments which all rely on calculations of worker benefits should likewise be disregarded. However there is a reasonable case for the inclusion of land taxes and local government rates.

- *Externalities* - The information provided in the 2020 EIA provides much additional information on externalities (relative to the 2017 EIA), which is appreciated. Nonetheless, ambiguities and uncertainties remain. BAEconomics indicates that externalities are essentially incorporated within the project costings, however, it is unclear, how (or if) the assessed externalities reconcile with the NPV of $13 million in environmental mitigation costs referred to on p.28 of the EIA.

  In terms of groundwater issues, it is particularly unclear how (or if) full ”make good” commitments referred to in Hume Coal’s *Response to IPC* are costed and indeed the amounts cited appear to represent a lower monetary commitment than in the 2017 EIA. Given the community concerns over this issue, these matters should be clarified and the costing of externalities be made more transparent. It is highly unlikely that increased allowance for externalities alone would cause the project to record a zero NPV in economic terms. However, combined with less favourable price/demand conditions these factors could reduce project benefits materially.

- *CGE modelling* - Additional evidence on state-wide CGE modelling of project benefits (including flow on effects) is presented. While the effort is appreciated this modelling should likewise be disregarded. The presentation of an alternative welfare measure of $2.2 billion is 11 times larger than the “narrower” (i.e. *Guidelines* consistent) definition project benefits of some $194 million suggested below. As noted by the *Treasury Guidelines*, CGE modelling does not replace CBA and as indicated in our First Review, the Guidelines do not call for state-wide analysis of flow on effects. Citing such figures in support of the HCP could be misleading to policymakers who are not fully versed in the specifics of CGE modelling and the appropriate measure of project benefits.

- *Local Effects Analysis (LEA)* - The LEA is well researched and presented and consistent with the Guidelines. We find only minor issues regarding estimation of local vs non-local labour, externality internalisation and timelines remaining to be resolved.

Given the above, we recommend that the "narrower" measure of project benefits (as presented in the upper half of Table S-1-1, 2020 EIA, p.2) plus an allowance for land and local government taxes is a better basis for the CBA's assessment of project net benefits to NSW. On this basis, the project records a net benefit of $194 million in NPV terms. (Though we note that this is $96 million less than the "broader" definition of benefits ($290 million) also suggested by BAEconomics in the lower half of Table S-1-1.)

This would appear to be largely driven by the revision (increase) in coking coal prices and its consequent effects on royalties and company income tax payments ($34 million and $18 million in additional benefits respectively) as well as the reduction in assessed greenhouse gas externalities ($19 million in reduced costs) associated with the approach outlined in the *Technical Notes* and the removal of levies ($5 million).

However, as indicated, there are residual issues regarding matters such as the costing and transparency of the externalities, which should be clarified by the proponent and/or BAEconomics. We suggest that the Department work with the proponent to clarify these issues. We also suggest that the Department take note of the additional risk factors which have emerged since completion of the 2020 EIA (such as the COVID-19 pandemic and its effects on trade and demand and growing geopolitical and trade tensions).

# 3. REVIEW OF LOCAL EFFECTS ANALYSIS

The Guidelines call for a discussion of a number of key elements affecting the local area as a part of a LEA. These include:

- Effects relating to local employment;
- Second round/flow-on effects;
- Effects related to non-labour project expenditure;
- Effects on other local industries; and
- Environmental and social impacts on the local community

We examined the content and modelling presented in the LEA and find that it is generally well researched, reasonable and consistent with the Guidelines. It generally addresses the above key elements well and is a marked improvement on the LEA presented in the 2017 EIA. Accordingly we have limited our comments on the 2020 LEA to the following three points

- *Employment assumptions* – The two scenarios modelled on pp. 86-87 of the EIA both assume 70% of operational employment would be from outside the Southern Highlands SA3 Region and 30% would be local. Its not quite clear how these proportions were arrived at, although a reference is made to the Social Impact Assessment (SIA) and to a 45 minute maximum travel time to the project (2020 EIA p.86). While the detailed modelling is appreciated, greater clarity around the derivation of these proportions could be provided.

- *Externalities* – The Guidelines indicate that the LEA start with the externalities investigated in the CBA and then identify those which are material and unmitigated within the local area. The discussion of the CBA indicates that virtually externalities are mitigated. The LEA lists externalities (pp.94-95; p.102) and also indicates that they are virtually all mitigated apart from some minor agricultural losses. In practice mitigation would mean that the externalities are internalised. However as indicated the estimation of externalities in the 2020 EIA remains murky and it is not clear if all externalities have indeed been mitigated. While this is chiefly a matter for the CBA, it affects the LEA too. If externalities have not been fully mitigated then they would exceed the $0.1 million currently allocated (only) to agricultural losses in the LEA.

- *Timeline* – The Guidelines (p.24) refer to the need to present an indicative timeline of when costs and benefits might be incurred. This appears to be absent from the LEA.

BIS OXFORD ECONOMICS


**Sydney**
Level 8
99 Walker Street
North Sydney
NSW 2060
Australia
**Tel:** +61 (0)2 8458 4200

**Melbourne**
Level 40
Railto South Tower
525 Collins Street
Melbourne
VIC 3000
Australia
**Tel:** +61 (0)3 8679 7300

**Global headquarters**
Oxford Economics Ltd
Abbey House
121 St Aldates
Oxford, OX1 1HB
UK
**Tel:** +44 (0)1865 268900

**London**
**Tel:** +44 (0)20 7803 1400

**Belfast**
**Tel: + 44 (0)2892 635400**

**Frankfurt**
**Tel:** +49 69 95 925 280

**Paris**
**Tel:** +33 (0)1 78 91 50 52

**Milan**
**Tel:** +39 02 9406 1054

**Paarl**
**Tel:** +27(0)21 863-6200

**New York**
**Tel:** +1 (646) 786 1879

**Philadelphia**
**Tel:** +1 (610) 995 9600

**Boston**
**Tel:** +1 (617) 206 6112

**Chicago**
**Tel:** +1 (773) 372-5762

**Los Angeles**
**Tel:** +1 (424) 238-4331

**Florida**
**Tel:** +1 (954) 916 5373

**Toronto**
**Tel:** +1 (905) 361 6573

**Mexico City**
**Tel:** +52 (55) 52503252

**Singapore**
**Tel:** +65 6850 0110

**Hong Kong**
**Tel:** +852 3103 1096

**Tokyo**
**Tel:** +81 3 6870 7175

**Dubai**
**Tel:** +971 56 396 7998

**Email:**
info@bisoxfordeconomic.com.au
mailbox@oxfordeconomics.com

**Website:**
www.bis.com.au
www.oxfordeconomics.com