Maules Creek Project

Economic Analysis of Alternatives

Final Report

Prepared for

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EXECUTIVE SUMMARY

The Economic Assessment undertaken for the Maules Creek Project (the Project) undertook a benefit cost analysis (BCA) of the "with" Project scenario compared to the "without" Project scenario. Other alternatives e.g. Alternative 1 - underground mining and Alternative 2 - mining in accordance with the previously approved project (in accordance with DA85/1819), were not subject to economic evaluation in the Environmental Assessment (EA) (in the same way that they were not subject to detailed noise assessments, air quality assessments, groundwater assessments) as they were not considered to be feasible to the proponent and were not the primary subject of the EA.

However, in order to demonstrate the economic performance of these alternatives relative to the Project this report evaluates these alternatives using BCA.

The two alternative mining scenarios were identified as having the same potential categories of incremental economic benefits and costs as the Project, with the difference between the alternatives and the Project largely relating to the different magnitudes of production costs and benefits and the level of externalities.

Table ES 1 summarises production levels and net production benefits of the Alternatives relative to the Project.

Table ES1
Production Levels and Net Production Benefits of the Project and Alternatives

	Project	Alternative 1 – Underground Mining	Alternative 2 – Previously Approved Project
ROM (Mt)	242.4	28.0	202.2
Product (Mt)	215.7	25.2	180.0
Total Net Production Benefits @ 7% ($M)	$8,728	$638	$6,571
Royalties @ 7%	$1,218	$172	$953
Corporate tax @7%	$2,334	$140	$1,767
Australian Net Production Benefits @ 7% ($M)	$5,674	$445	$4,299

Alternative 1 would sterilise 88% of the coal resource that is planned to be extracted by the Project. The total net production benefits and those accruing to Australia would be substantially lower than the Project i.e. 8% to 14% of the levels of the Project. However, this alternative would have less environmental impacts than the Project or Alternative 2.

Alternative 2 would sterilise 17% of the coal resource that is planned to be extracted by the Project. The total net production benefits and those accruing to Australia would be lower than the Project i.e.75% to 78% of the levels of the Project. However, this alternative would have greater environmental impacts than the Project or Alternative 1, with the exception of greenhouse gas generation which is considered to be lower than the Project but greater than Alternative 1.

These trade-offs can be considered using a threshold value framework. The Australian net production benefits of the Project are $5,229M greater than Alternative 1. For Alternative 1 to be considered to be preferable on economic efficiency grounds, the Project would need to have Australian environmental impacts that are valued at greater than $5,229M more than the environmental impacts of Alternative 1. While it is considered that the Project would have greater environmental impacts than Alternative 1, the total Australian environmental externalities of the Project, after mitigation were estimated in the Economic Assessment of the Project at $189M. Consequently, the Project is considered to be more economically efficient than Alternative 1.

The Australian net production benefits of the Project are $1,375M greater than Alternative 2. For Alternative 2 to be considered to be preferable on economic efficiency grounds, the Project would

need to have Australian environmental impacts that are valued at greater than $1,375M more than the environmental impacts of Alternative 2. However, the Project is considered to have less environmental impacts than Alternative 2 (apart from in relation to greenhouse gas generation). Consequently, relative to Alternative 2 the Project has greater net production benefits and lower environmental impacts, and so is preferable from an economic efficiency perspective.

The Project is therefore considered to more economically efficient than either Alternative 1 or Alternative 2.

1.0 INTRODUCTION

As part of the Environmental Assessment (EA) for the Maules Creek Project (the Project) Gillespie Economics undertook a benefit cost analysis (BCA) of the "with" Project scenario compared to the "without" Project scenario.

This assessment indicated that there would be total net production benefits of the Project of an estimated $8.7B distributed between:

- The local community in the form of donations and community support programs;
- Aston Resources and its shareholders;
- The NSW Government via royalties; and
- The Commonwealth Government in the form of Company tax.

Other alternatives evaluated in Section 3.13 of the EA included:

- Underground mining; and
- The previously approved Maules Creek Project (in accordance with DA85/1819).

An underground option was found to:

- Result in resource recovery of around 8%;
- Be uneconomical; and
- Not meet the principles of Intergenerational Equity as significant quantities of non-renewable coal resources would be sterilised for future generations.

The previously approved Maule Creek Coal Project involves both open cut and underground mining. This option was found to:

- Sterilise significant quantities of high quality, valuable coal resources;
- Allow mining development without utilising current leading environmental and social standards;
- Limit operation flexibility;
- Utilise obsolete mining methods, equipment and technologies which would be likely to create additional environmental impacts than contemporary mining; and
- Entail a larger operational footprint than the Project.

These alternatives were not subject to economic evaluation in the EA (in the same way that they were not subject to detailed noise assessments, air quality assessments, groundwater assessments) as they were not considered to be feasible to the proponent and were not the primary subject of the EA.

However, in order to demonstrate the economic performance of these alternatives relative to the Project this reports evaluates them using BCA.

2. BENEFIT COST ANALYSIS

2.1 Introduction

BCA involves the following key steps:

- Identification of the base case or "without" alternative case;
- Identification of the "with" alternative scenario;
- Physical quantification and valuation of the alternatives incremental benefits and costs;
- Consolidation of values using discounting to account for the different timing of costs and benefits;
- Application of decision criteria;
- Sensitivity testing; and
- Consideration of non-quantified benefits and costs, where applicable.

For an alternative to be economically desirable from a community perspective, it must be more economically efficient than the base case. Technically, a development is more economically efficient than the base case, and desirable on economic grounds, if the incremental benefits to society exceed the incremental costs (James and Gillespie, 2002). Where there are a number of alternatives the alternative with the greatest net benefits is the most economically efficient.

For mining developments, the main economic benefit is the producer surplus generated by the mine[1] while the main economic costs relate to environmental, social and cultural costs.

The sub-sections below provide a BCA of the two alternatives based on financial, technical and environmental advice provided by Aston Resources and its specialist consultants. In particular, the analysis of underground mining is based on information from Minarco Mineconsult (2010) and the analysis of the currently approved mining operation is based on Kembla Coal and Coke Pty Ltd (1989).

2.2 Identification of the Base Case and Alternatives

Identification of the "base case" or "without" alternative scenario is required in order to facilitate the identification and measurement of the incremental economic benefits and costs of the alternatives.

Consistent with the economic analysis of the Project, the base case in this analysis assumes that no mining takes place at the site. In contrast, two alternatives are evaluated:

- Alternative 1 – an underground mine involving mining of up to 3.8 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal for a period of 10 years and total production of 28Mt ROM coal.

- Alternative 2 – the previously approved open cut and underground cut mining scenario (DA 85/1819) involving up to 10.1 Mtpa of ROM coal for a period of 21 years and total production in the order of 202Mt ROM coal.

[1] There may also be non use economic benefits associated with the employment provided by the mine. There has been some debate about the inclusion of these and hence for simplicity they have been omitted from the analysis. However, there is a strong case for their inclusion and all responses that have advocated their omission involve unsubstantiated hypothesis that have not been tested empirically. Whenever employment has been included in non-market valuation studies it has been found that that respondents have a significant willingness to pay.

2.3 Identification of Benefits and Costs

Relative to the base case or "without" scenario of no mining, the two alternative mining scenarios have the same potential categories of incremental economic benefits and costs as the Project, as summarised in Table 2.1. The difference between the alternatives and the Project largely relates to the different magnitudes of production costs and benefits and the level of externalities.

Table 2.1
Incremental Economic Benefits and Costs of the Alternatives

Category	Costs	Benefits
Production	Opportunity cost of water Opportunity cost of land (owned by Aston Resources) Opportunity cost of capital Capital costs associated with coal production and ancillary works Operating costs, including administration, mining, processing, transportation and rehabilitation (ex royalties) and land acquisitions Decommissioning costs	Sale value of coal Residual value of water, capital and land at the cessation of mining
Potential Externalities	Air quality impacts Greenhouse gas impacts Noise and vibration impacts Ecology impacts Groundwater impacts Traffic and transport impacts Aboriginal archaeology and cultural heritage impacts Non-Aboriginal heritage impacts Visual impacts Surface water impacts and sediment/erosion control	Economic and social benefits of employment provided by mining

It should be noted that the potential external costs, listed in Table 2.1, are only economic costs to the extent that they affect individual and community well-being through direct use of resources by individuals or non-use. If the potential impacts are mitigated to the extent where community wellbeing is insignificantly affected, then no external economic costs arise.

2.4 Quantification/Valuation of Production Benefits and Costs

In accordance with NSW *Treasury Guidelines for Economic Appraisal* (NSW Treasury, 2007), where competitive market prices are available, they have generally been used as an indicator of economic values.

Opportunity Cost of Water

Both alternatives are assumed to have the same water requirements as the Project. Since Aston Resources already has a high security water allocation from the Namoi River of 3,000 unit shares (effectively equal to 3,000 million litres (ML) per annum, which is sufficient to meet the maximum net site water demand, the opportunity cost of this water entitlement has been included in the analysis at its market value i.e. $2,300 per ML.

Opportunity Cost of Land

Any land used by mining has an opportunity cost regardless of whether it is already owned by Aston Resources. Alternative 1 would have considerably less land requirement than open cut options. For this analysis, the opportunity cost of these land requirements have been estimated at $8M. Land requirements for Alternative 2 have been assumed to be similar to the Project.

Opportunity Cost of Capital

There has been little onsite development to date and no capital equipment invested in. The opportunity cost of capital equipment onsite is therefore considered to be zero for both alternatives.

Capital Cost of the Alternatives

The capital costs of Alternative 1 are estimated at $605.7M (Minarco 2010) and are assumed to occur over a three year period. The capital costs of Alternative 2 were assumed to be similar to the Project.

Annual Operating Costs of Alternatives

Operating costs for the alternatives are those associated with mining, coal treatment and transport of product coal to the Port of Newcastle. While royalties are a cost to Aston Resources, they are part of the overall producer surplus benefit of the mining activity that is redistributed by government. Royalties are therefore not included in the calculation of the resource costs of the Project. Operating costs are directly associated with levels of production. Assumed production profiles under each alternative are identified below.

Table 2.2
Production Profile of Alternatives (thousand tonnes of Product Coal)

Year	Alternative 1 – Underground Mining	Alternative 2 – Previously Approved Project
2010	-	
2011	-	
2012	249	3,382
2013	1,863	5,607
2014	2,649	9,000
2015	2,990	9,000
2016	3,505	9,000
2017	3,508	9,000
2018	3,465	9,000
2019	2,697	9,000
2020	2,952	9,000
2021	1,358	9,000
2022	-	9,000
2023	-	9,000
2024	-	9,000
2025	-	9,000
2026	-	9,000
2027	-	9,000
2028	-	9,000
2029	-	9,000
2030	-	9,000
2031	-	9,000
2032	-	9,000
Total	**25,237**	**179,989**

Unit operating costs (net of royalties) for Alternative 1 are as reported in Minarco (2010). Unit operating costs (net of royalties) for Alternative 2 are conservatively assumed to be similar to the Project.

Decommissioning Costs

At the end of the mine life under Alternatives 1 and 2 it is assumed that the site would be decommissioned and rehabilitated. For Alternative 1 these costs are assumed to be $20M. The decommissioning costs for Alternative 2 are assumed to be the same as those for the Project.

Sale Value of Coal

This analysis assumed the same product coal splits and prices as the Project. Projected prices averaged US$96/tonne for thermal coal, US$135/tonne for semi-soft coking coal and US$129/tonne for PCI coal. An average exchange rate of 0.76 average was assumed.

There is obviously considerable uncertainty around future coal prices and hence assumed coal prices have been subjected to sensitivity testing (see Section 2.6).

Residual Value at End of the Evaluation Period

At the end of the 23 year evaluation period (2 years of start up and 21 years of production), water assets owned at the commencement of the Alternatives are assumed to have a residual value of $6.9M. Land assets are assumed to have a residual value of $8M for Alternative 1 and $54M for Alternative 2. For both alternatives, capital equipment is assumed to be provided indirectly via contractors and hence no residual value of capital at the end of the 21 year period is assumed.

2.5 Net Production Benefits

A comparison of production levels and the net production benefits of the Alternatives relative to the Project is provided in Table 2.3.

Table 2.3
Production Levels and Net Production Benefits of the Project and Alternatives

	Project	Alternative 1 – Underground Mining	Alternative 2 – Previously Approved Project
Total ROM Coal (Mt)	242.4	28.0	202.2
Total Product Coal (Mt)	215.7	25.2	180.0
Maximum Annual ROM Coal (Mt)	13.0	3.8	10.1
Maximum Annual Product Coal (Mt)	11.6	3.5	9.0
Total Net Production Benefits @ 7% ($M)	$8,728	$638	$6,571
Royalties @ 7%	$1,218	$172	$953
Corporate tax @7%	$2,334	$140	$1,767
Australian Net Production Benefits @ 7% ($M)	$5,674	$445	$4,299

Alternative 1 would sterilise 88% of the coal resource that is planned to be extracted by the Project. The total net production benefits and those accruing to Australia would be substantially lower than the Project i.e. 8% to 14% of the levels of the Project.

Alternative 2 would sterilise 17% of the coal resource that is planned to be extracted by the Project.. The total net production benefits and those accruing to Australia would be lower than the Project i.e. 75% to 78% of the levels of the Project.

2.6 Sensitivity Analysis

This results presented in Table 2.3 are based on a range of assumptions around which there is some level of uncertainty. Uncertainty in a BCA can be dealt with through changing the values of critical variables in the analysis (James and Gillespie, 2002) to determine the effect on the NPV.

In this analysis, the BCA result for Alternative 1 and Alternative 2 were tested for 20% changes to the following variables at a 4%, 7% and 10% discount rate:

- Opportunity cost of water;
- Opportunity cost of land;
- Capital costs;
- Operating costs;
- Decommissioning costs;
- Revenues; and
- Residual value of water, capital and land.

What this analysis indicated is that the results of the BCA are not sensitive to reasonable changes in assumptions regarding any of these variables (refer to Attachment 1).

The results were most sensitive to increases in operating costs and decreases in the sale value of coal.

2.7 External Costs and Benefits

A detailed assessment of the environmental externalities of the alternatives is beyond the scope of this report. However, a simple consideration is sufficient to shed light on the relative net community benefits of the Alternatives.

As identified in Table 2.4, Alternative 1 would have less environmental impacts than the Project or Alternative 2. Alternative 2 would greater environmental impacts than the Project or Alternative 1, with the exception of greenhouse gas generation which is considered to be lower than the Project but greater than Alternative 1.

Table 2.4
Environmental Impacts of Alternatives Relative to the Project and Each Other

	Alternative 1 – Underground Mining	Alternative 2 – Previously Approved Project
Air quality impacts	Lower	Higher
Greenhouse gases	Lower	Lower
Noise and vibration	Lower	Higher
Ecology	Lower	Higher
Groundwater	Lower	Higher
Traffic and transport	Lower	Higher
Aboriginal heritage	Lower	Higher
Non-Aboriginal heritage	Lower	Higher
Visual impacts	Lower	Higher
Surface water	Lower	Higher

Notes:
Lower = lower than Project
Lower = lower than Project and the other Alternative
Higher = higher than the Project
Higher = higher than the Project and the other Alternative

2.8 Threshold Value Analysis

The estimated net production benefits that accrue to Australia[2] can be used as a threshold value or reference value against which the relative value of the residual environmental impacts of the Project and its alternatives may be assessed. The threshold value indicates the price that the community must value the residual environmental impacts (be willing to pay) to justify in economic efficiency terms the no further development option. Similarly, the differences in net production benefits between alternatives provides a reference value that incremental environmental impacts between Alternatives would need to be to justify one alternative over another.

The Australian net production benefits of the Project are $5,229M greater than Alternative 1. For Alternative 1 to be considered to be preferable on economic efficiency grounds, the Project would need to have Australian environmental impacts that are valued at greater than $5,229M more than the environmental impacts of Alternative 1. While the Project would have greater environmental impacts than Alternative 1, the total Australian environmental externalities of the Project, after mitigation were estimated in the Economic Assessment of the Project at $189M. Consequently, the Project is considered to be more economically efficient than Alternative 1.

The Australian net production benefits of the Project are $1,375M greater than Alternative 2. For Alternative 2 to be considered to be preferable on economic efficiency grounds, the Project would need to have Australian environmental impacts that are valued at greater than $1,375M more than the environmental impacts of Alternative 2. However, as identified in Table 2.4 the Project is considered to have less environmental impacts than Alternative 2 (apart from in relation to greenhouse gas generation). Consequently, relative to Alternative 2 the Project has greater net production benefits and lower environmental impacts, and so is preferable from an economic efficiency perspective.

[2] Traditional and continuing practice in BCA is to undertake the analysis from a national perspective. This is based on pragmatic grounds as well as the view that projects should be assessed from the view point of the nation which undertakes the projects, incurs the costs, receives the benefits and is responsible for decision-making.

3. CONCLUSION

The two alternative mining scenarios assessed in this report, Alternative 1 – underground mining and Alternative 2 - mining in accordance with the previously approved project, were identified as having the same potential categories of incremental economic benefits and costs as the Project with the difference between the alternatives and the Project largely relating to the different magnitudes of production costs and benefits and the level of externalities.

Alternative 1 would sterilise 88% of the coal resource that is planned to be extracted by the Project. The total net production benefits and those accruing to Australia would be substantially lower than the Project i.e. 8% to 14% of the levels of the Project. However, this alternative would have less environmental impacts than the Project or Alternative 2.

Alternative 2 would sterilise 17% of the coal resource that is planned to be extracted by the Project. The total net production benefits and those accruing to Australia would be lower than the Project i.e.75% to 78% of the levels of the Project. However, this alternative would have greater environmental impacts than the Project or Alternative 1, with the exception of greenhouse gas generation which is considered to be lower than the Project but greater than Alternative 1.

These trade-offs can be considered using a threshold value framework. The Australian net production benefits of the Project are $5,229M greater than Alternative 1. For Alternative 1 to be considered to be preferable on economic efficiency grounds, the Project would need to have Australian environmental impacts that are valued at greater than $5,229M more than the environmental impacts of Alternative 1. While it is considered that the Project would have greater environmental impacts than Alternative 1, the total Australian environmental externalities of the Project, after mitigation, were estimated in the Economic Assessment of the Project at $189M. Consequently, the Project is considered to be more economically efficient than Alternative 1.

The Australian net production benefits of the Project are $1,375M greater than Alternative 2. For Alternative 2 to be considered to be preferable on economic efficiency grounds, the Project would need to have Australian environmental impacts that are valued at greater than $1,375M more than the environmental impacts of Alternative 2. However, the Project is considered to have less environmental impacts than Alternative 2 (apart from in relation to greenhouse gas generation). Consequently, relative to Alternative 2 the Project has greater net production benefits and lower environmental impacts, and so is preferable from an economic efficiency perspective.

The Project is therefore considered to more economically efficient than either Alternative 1 or Alternative 2.

4. REFERENCES

James, D. and Gillespie, R. (2002) *Guidelines for Economic Effects and Evaluation in EIA*. Prepared for NSW Department of Urban Affairs and Planning.

Kembla Coal and Coke Pty Ltd (1989) *Maules Creek Coal Project Environmental Impact Statement*

Minarco Mineconsult (2010) *Mauls Creek Coal Deposit: Conceptual Underground Study*

NSW Treasury (2007) *Treasury Guidelines for Economic Appraisal*.
Website: www.treasury.nsw.gov.au
Date Accessed: 1 October 2011.

ATTACHMENT 1 – SENSITIVITY ANALYSIS

Table A1.1 – Alternative 1 Australian Net Production Benefits Sensitivity Analysis

	4%	7%	10%
CORE ANALYSIS	$600	$445	$327
INCREASE 20%			
Opportunity cost of water	$599	$445	$327
Opportunity cost of land	$600	$445	$327
Capital costs	$534	$383	$269
Operating costs	$425	$304	$212
Decommissioning costs	$599	$444	$327
Revenue	$963	$740	$569
Residual value of water, capital and land	$601	$446	$328
DECREASE 20%			
Opportunity cost of water	$601	$446	$328
Opportunity cost of land	$600	$446	$328
Capital costs	$666	$508	$386
Operating costs	$775	$587	$443
Decommissioning costs	$601	$447	$328
Revenue	$237	$151	$86
Residual value of water, capital and land	$599	$445	$327

Table A1.2 – Alternative 2 Australian Net Production Benefits Sensitivity Analysis

	4%	7%	10%
CORE ANALYSIS	$5,914	$4,299	$3,225
INCREASE 20%			
Opportunity cost of water	$5,914	$4,298	$3,225
Opportunity cost of land	$5,912	$4,296	$3,223
Capital costs	$5,871	$4,258	$3,187
Operating costs	$5,068	$3,696	$2,781
Decommissioning costs	$5,906	$4,295	$3,223
Revenue	$8,042	$5,841	$4,381
Residual value of water, capital and land	$5,917	$4,300	$3,226
DECREASE 20%			
Opportunity cost of water	$5,915	$4,299	$3,226
Opportunity cost of land	$5,917	$4,301	$3,228
Capital costs	$5,958	$4,339	$3,263
Operating costs	$6,761	$4,902	$3,669
Decommissioning costs	$5,922	$4,303	$3,227
Revenue	$3,787	$2,757	$2,069
Residual value of water, capital and land	$5,911	$4,297	$3,224