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Commercial Viability Assessment

Hawkins-Rumker

NSW Department of Planning and Environment.

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Executive Summary

Geos Mining has been commissioned by the Coal Resource Assessment, Resources & Geoscience, NSW Department of Planning & Environment, to undertake a Commercial Viability Assessment (CVA) of the Hawkins-Rumker Project (Authorisation 286). The objective of the assessment is to determine if the area contains coal resources that would support a viable mining feasibility and development project.

The Hawkins-Rumker area is located in the central-northern part of the Western Coalfield. Potentially mineable coal at Hawkins-Rumker occurs in two main horizons within the Lidsdale Coal Member, within the Illawarra Coal Measures, including the Lidsdale Upper (UDWS mining section) and Lidsdale Lower (UG mining section). The Lidsdale Coal Member is correlated to be the lateral equivalent of a section of the Ulan seam in the Ulan – Wilpinjong mining area, and Ulan seam nomenclature has been adopted at Hawkins-Rumker.

The dataset provided for evaluation was found to be valid and sufficiently comprehensive for the purposes of the CVA. Output from the NSW Department of Planning and Environment (Resources and Geoscience Group) Hawkins-Rumker resource model has been adopted for the current assessment.

Structure is assumed to be generally benign, with shallow dipping coal seams. However, some structural anomalies have been noted. We agree with the Inventory Coal report, which concludes that there is insufficient data to identify structures or structural domains with any certainty. Structural discontinuity remains a risk, particularly for longwall mining, and further drilling would be required to characterise structure in more detail.

Potentially mineable coal occurs mainly within the UDWS and UG working sections, with a small area in the central west where an extended UDWS-UCL-UC2 mining section should be targeted. The UDWS and UG Inventory Coal areas overlap within the central part of the project area, where an interburden thickness of less than 4m precludes mining both seams. We conclude that higher product yields that are likely to be achieved from mining the UDWS seam in this area, by targeting a ROM bypass product with periodic washing, outweigh the better quality product achieved from washing the UG working section. We have assumed for the purposes of the CVA that the UDWS seam is the preferred mining target in the area of resource overlap.

Mining Approach: The most appropriate mining methods for the Hawkins-Rumker project are longwall and Bord & Pillar mining, with longwall mining providing the best opportunity for a viable operation. A significant Inventory Coal tonnage of up to 165Mt for the UDWS seam and 347Mt for the UG seam has been identified after applying mining constraints. The best mining approach at Hawkins-Rumker is considered to involve the following key criteria:

- Target the UDWS seam as a priority, due to its potential to produce a partial ROM thermal coal product. Periodic washing of the UDWS seam is likely to be required after dilution;
- Initially target a central-west area of low (<17% ad) in-situ ash coal in an extended UDWS-UCL-UC2 working section, which is up to 4.1m thick. This coal is unlikely to require washing, and delays the need for capital investment in a washplant;
- Target other areas of the UDWS seam, and the UG seam after establishment of an on-site washplant;

- Use Bord & Pillar methods in areas of the UDWS and UG seam, where igneous intrusions and areas of potential structural discontinuity disallow effective longwall panel layouts.

After consideration of three mining layouts, a preferred ‘Low Ash’ mining option was selected for analysis. This option initially mines the UDWS-UCL-UC2 mining section from a Central access portal using low capex Bord & Pillar methods. This coal and some UDWS coal following is likely to produce a marketable ROM product, without washplant backup. The UDWS resource down to 1.8m thick is then mined using a conventional longwall layout, with periodic washing likely to be required to control dilution. The majority of UG seam resource down to 1.8m thick is then mined, primarily by conventional longwall methods, and fully washed. This mining scenario has been considered at three production levels, which average 2.9, 4.6 and 6.8Mtpa product for the UDWS seam and 2.9, 4.0 and 6.1Mtpa for the UG seam.

Concurrent operations are conceivable if the UG seam is accessed from a Southern Access portal. Some surface infrastructure such as stockpile areas, CHPP, workshops, offices and facilities could be shared, while significant duplication would also be necessary, but this option has not been costed. We consider that further studies are required to properly investigate and optimise surface infrastructure synergies and cost savings for this option.

Product Quality: Indicative product specifications for the UDWS, UDWS-UCL-UC2 and UG mining sections have been defined based on an average of drill hole data relevant to the target mining area. The UDWS based products conform to the Newcastle High Ash export thermal coal brand, with attractive energy, total sulphur, HGI, and slagging and fouling properties. All published impurity specifications for the Newcastle high Ash brand, including Phosphorous, Chlorine, Fluorine and trace elements Mercury and Arsenic, are well satisfied by the UDWS and UDWS-UC2 products, ROM or washed. We expect that the only quality issue to be managed for the UDWS working section is dilution.

The UG mining section washed product conforms to the Newcastle 6300 (GAR) export thermal coal brand, with attractive energy, total sulphur, HGI, and slagging and fouling properties. Published specifications for the Newcastle 6300 brand, including Calcium Oxide in ash and Boron are well satisfied by the UG washed product, but impurities Selenium and Beryllium are notably high. Average Selenium content (0.21mg/kg) is marginally higher than the Newcastle 6300 maximum specification of 0.2mg/kg (db), with a range of 1.3 – 4.0 mg/kg (db); however, we do not expect that this will present a major marketing issue.

Infrastructure: Surface infrastructure options at northwest and central west locations have been considered and costed. The options considered do not include a third portal option considered for the Low Ash mining scenario, which is assumed to be similar to the central surface infrastructure option.

Several options exist for water supply, of which Windermere Dam is the most logical and reliable, based on size and current usage. Several options also exist for the supply of power, of which the most favourable source is likely to be an upgraded substation at Endeavour Energy’s Kandos Zone Substation, which would require 36km of 66KV transmission line to the mine site.

Coal export port options include Port Newcastle, via rail links to the north to Mudgee and then east, or Port Kembla via rail links to the south via Sydney suburbs. Both involve about the same rail distance, but shipping from Port Newcastle is favoured, due to better capacity options, less rail upgrading, and the track south via Sydney would likely be subject to greater community resistance and greater risk of delays. The rail link via Mudgee is also likely to meet with significant community resistance. Either rail link would initially be via the Rylstone-Mudgee line, which is currently closed and would require significant upgrading to carry coal export tonnages.

Capital and Operating Costs:

Total initial capital expenditure within the first 6 years is estimated to range from A$450M in the Low Case model to A$507M for the High Case production rate. Additional capital costs for a CHPP of A$75 - $105M, depending on required throughput capacity, are scheduled after production starts. Sustaining capital at a rate of A$2.0 – $2.15 is assumed in addition to periodic longwall equipment replacement. Initial and sustaining capex contingencies are recommended by MEC Mining, which we have accounted for in a sensitivity analysis.

Mine operating costs are estimated to range from A$39.54 - $34.01/ROM tonne without washing, depending on production rate. An additional operating cost of A$4.90/ROM tonne for washing is assumed for all production cases. An additional operating cost of A$12/tonne (above and below rail) and A$8/tonne are estimated for rail transport and shipping costs respectively.

Commercial Viability:

A number of discounted cash flow models have been developed, which look at the UDWS and UG operations in isolation, plus a mining scenario where the UG seam operation follows on from the UDWS. The models are in real (today's) dollar terms, and assume a long term benchmark thermal coal price of US$65/tonne (FOB), and an A$/US$ exchange rate of 0.76.

The base models show a negative NPV, which essentially improve with increasing production rate. The UDWS operation improves from negative $86M at the Mid Case production rate of 4.6Mtpa, to negative $33M at 6.8Mtpa (High Case). The conceptual UG operation financial models similarly improve from negative $191M at 4Mpta product, to negative $118M at 6.1Mtpa.

We believe that coal price is the main determining factor influencing a negative NPV for all models, with capital expenditure also very significant. Essentially, annual revenue (post royalties and tax) at the long-term price of US$65/tonne, is too low to provide sufficient return on initial capital investment at the preferred discount rate of 10%.

Sensitivity analysis shows that NPV becomes positive at a range of long term coal prices from US$67/tonne to US$81/tonne for the UDWS seam, and US$69 – US$85/tonne for the UG seam, depending on production rate and whether capex contingencies are applied. NPV is significantly worsened after applying the capex contingencies recommended by MEC Mining, but even these models break-even at coal prices within the range from about US$75 – US$85/tonne. We note current benchmark thermal spot prices are around US$100/tonne, but we consider that this is due to a temporary demand/supply imbalance.

We consider that the Hawkins-Rumker project has the potential to be commercially viable at coal prices above about US$67/tonne, subject to further confirmation of capital cost estimates, or US$75/tonne if the recommended capital cost contingencies are applied. We therefore conclude that, subject to coal price, the Hawkins-Rumker area does contain coal resources that could support a viable mining feasibility and development project.

Disclaimer

While every effort has been made, within the time constraints of this assignment, to ensure the accuracy of this report, Geos Mining accepts no liability for any error or omission. Geos Mining can take no responsibility if the conclusions of this report are based on incomplete or misleading data.

Geos Mining and the authors are independent of NSW Department of Planning and Environment., and have no financial interests in NSW Department of Planning and Environment. or any associated entities. Geos Mining is being remunerated for this report on a standard fee for time basis, with no success incentives.

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Scope of Work

Geos Mining has been commissioned by the Coal Resource Assessment, Resources & Geoscience, NSW Department of Planning & Environment, to undertake a Commercial Viability Assessment (CVA) of the Hawkins-Rumker Project (Authorisation 286). The objective of the assessment is to determine if the area contains coal resources that would support a viable mining feasibility and development project. The CVA is to incorporate a conceptual mine design and assessment of process and non-process infrastructure requirements, based on geological characterisation of the deposit. A site visit was deemed unnecessary. We note that this increases the level of uncertainty with respect to mine design and capital cost estimates for surface infrastructure.

The project scope of work is as follows:

- Preliminary review of geological data provided and associated Inventory Coal report, identifying any critical issues with the provided data or associated report;
- Assess coal quality, likely product specifications, coal processing requirements, potential market utilisation, and a coal price forecast;
- Develop a conceptual mine design, assess likely hazards & constraints, outline extraction methodology and selection criteria, and develop annual production and cost schedules;
- Undertake a Range Analysis involving development of low and high case mining scenarios benchmarked to nearby coal operations;
- Develop a conceptual mine infrastructure layout & discuss alternative options, costs and issues for on and off-site infrastructure requirements;
- Conduct an indicative commercial viability analysis, involving conceptual discounted cash flow modelling, which includes capital and operating cost estimates, indicative project valuation, and a sensitivity analysis;
- Assess risks and opportunities;
- Assess potential competitive allocation criteria that should be set for development of the project(s) to maximise benefit to the State, including which of the two overlapping resources should be prioritised.

Strategic Resource Assessment & Advice (SRAA), NSW Division of Resources and Geoscience (DRG) has undertaken 3D modelling of the area using Geovia Minex modelling software and a compiled database of drilling and geological mapping. An Inventory Coal report, with relevant model output and resource estimates, has been provided for this assessment. The Lidsdale Lower Seam (UG) and Lidsdale Upper Seam (UDWS) are the main potentially viable resource targets.

We note that the Hawkins-Rumker project is at a very early stage of development, with no resources or reserves defined under the JORC Code 2012, and hence the mining and commercial viability assessment is conceptual and only provides an indicative assessment of project economics.

Investigation Approach

The investigation has been undertaken in two stages as follows:

Stage 1:

- review all provided information, including the Inventory Coal report, borehole data, seam correlation section lines, geological model and coal quality data, and report any critical issues;
- characterise the Inventory Coal with regard to a mining constraints matrix provided by MEC Mining;
- review utilisation potential, potential markets and likely future market environment trends; and
- undertake a first principals conceptual mining assessment and develop an appropriate schedule of production and mining costs (MEC Mining);
- undertake an assessment of non-process infrastructure requirements, coal transport options and costs (Wave International);

Stage 2:

- undertake a Range Analysis of low and high case mining scenarios benchmarked to nearby coal operations.

Stage 1 and 2:

- develop discounted cash flow model(s) as a basis for determining project commercial viability;
- undertake a project valuation and sensitivity analysis;
- Assess risks and opportunities.

Project Area Description

Project Location

The Hawkins-Rumker Project (Authorisation 286), which comprises approximately 830km^2, is located in the Western Coalfield of the Sydney-Gunnedah Basin, some 6-20km north of Rylstone and about 240km by road from Sydney. It is about 80km and 90km respectively from the Mt. Piper and Wallerawang Power Stations (currently closed) in the Lithgow area (Figure 1). The distance by rail from Rylstone to the ports of Port Kembla and Newcastle is about 350km and 360km respectively.

Access to the project area is via the sealed Bylong Valley Way and Lue Road from the east and Lue Road from Mudgee to the north. Unsealed roads and farm tracks have provided access to most areas for drilling.

Topography and Land Use

The project area is dominated by an elongate, northwesterly oriented plateau ranging in elevation from 700−800m (Figure 2), which rises to a higher plateau to the northeast at up to 1,150m above sea level. The southeastern side of this plateau is occupied by the Wollemi National Park, which is part of the Greater Blue Mountains World Heritage Area. The main geomorphic features of the area are Elephant Mountain, Lion Mountain, Hawkins Pinnacle and Jimmy Jimmy in the west and the Bald Mountain, which is a phonolitic plug, in the east of the Project.

The plateau is dissected in the east by valleys draining to the north into the Growee River. On the western and southwestern side, ephemeral creek systems that dissect the plateau, drain to the southwest into the alluvial flats of Breakfast Creek and Lawsons Creek and eventually northwest to join the Cudgegong River north of Mudgee.

The majority of the plateau, under which most Inventory Coal exists, is cleared or dominated by dry sclerophyll forest. Land uses include small acreage hobby farms, battery poultry and minor broader acre sheep, goat and cattle grazing. More intensive agricultural land use occurs on alluvial flats of the Growee River system in the east, where environmentally significant BSAL and alluvial groundwater supply areas are recognised.

The majority of the area identified with Inventory Coal is owned by the Crown.

Local Exploration and Mining

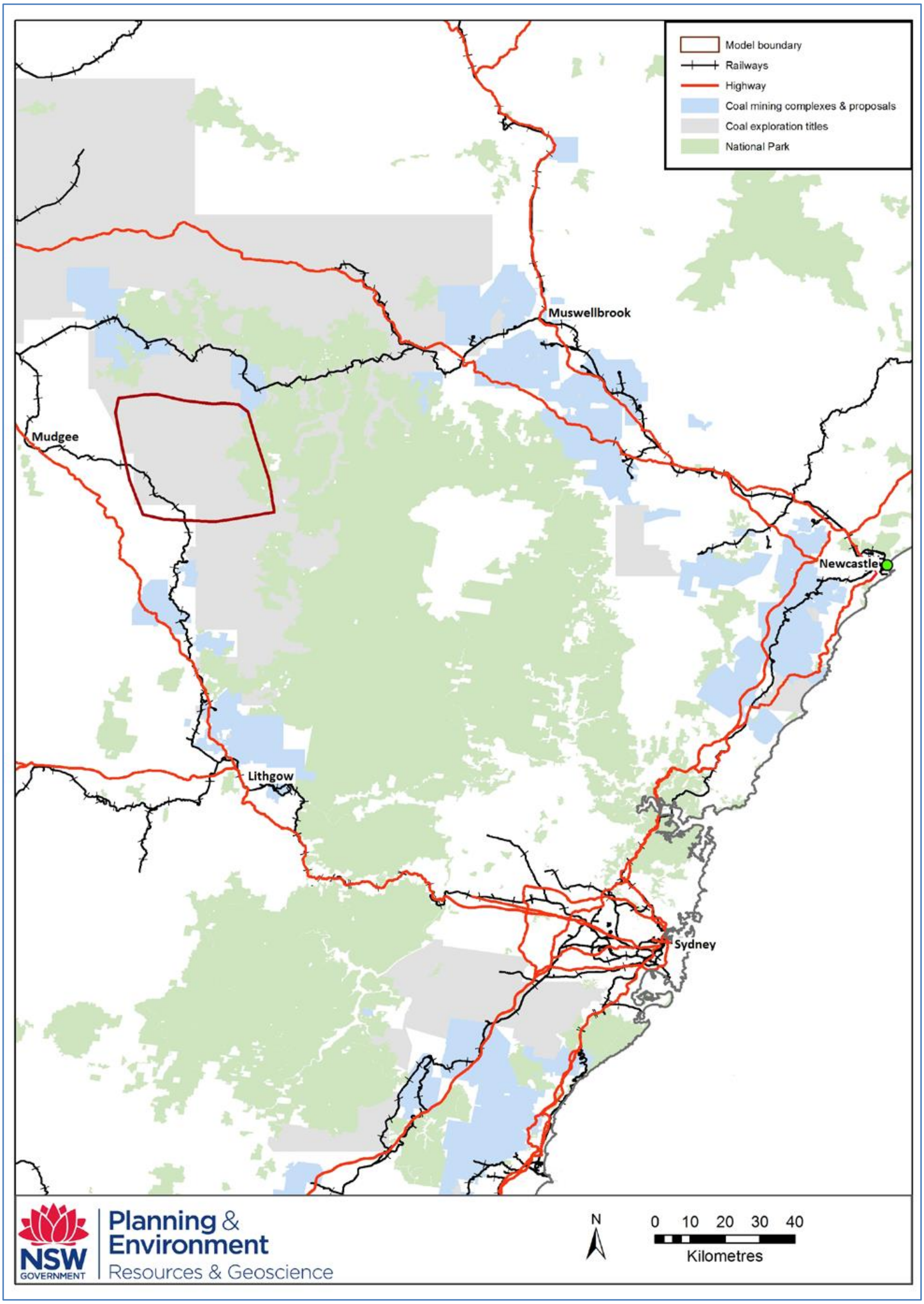
The project area covers the southern part of A286 and the northern parts of A230 and A360 in the Western Coalfield. Inventory Coal, as identified by (Bayly & Matthews, 2017), occurs mostly within A286 and A230, which are currently held by the Director General of Industry & Investment NSW on behalf of the Crown.

Authorisations 287 and 342 (held by KEPCO Bylong) bound the project to the northeast (Figure 2). The KEPCO Bylong project is currently seeking development consent, which is being considered by the Planning Assessment Commission. KEPCO Bylong proposes to extract up to 6.5 million tonnes per annum (MTPA) via open cut and underground methods over a 25 year mine life.

The now closed Charbon Colliery lies some 15km to the south of the Hawkins−Rumker project, adjacent to the township of Kandos. It has mined coal from an equivalent of the Hawkins-Rumker UG working section, using underground continuous miner methods. Three coal mining operations (Moolarben, Wilpinjong and Ulan) are situated approximately 35km north of the project, where an equivalent of the Hawkins-Rumker UDWS working section is extracted by large open cut and underground longwall methods. The Ulan and Moolarben coal mines operate longwall operations.

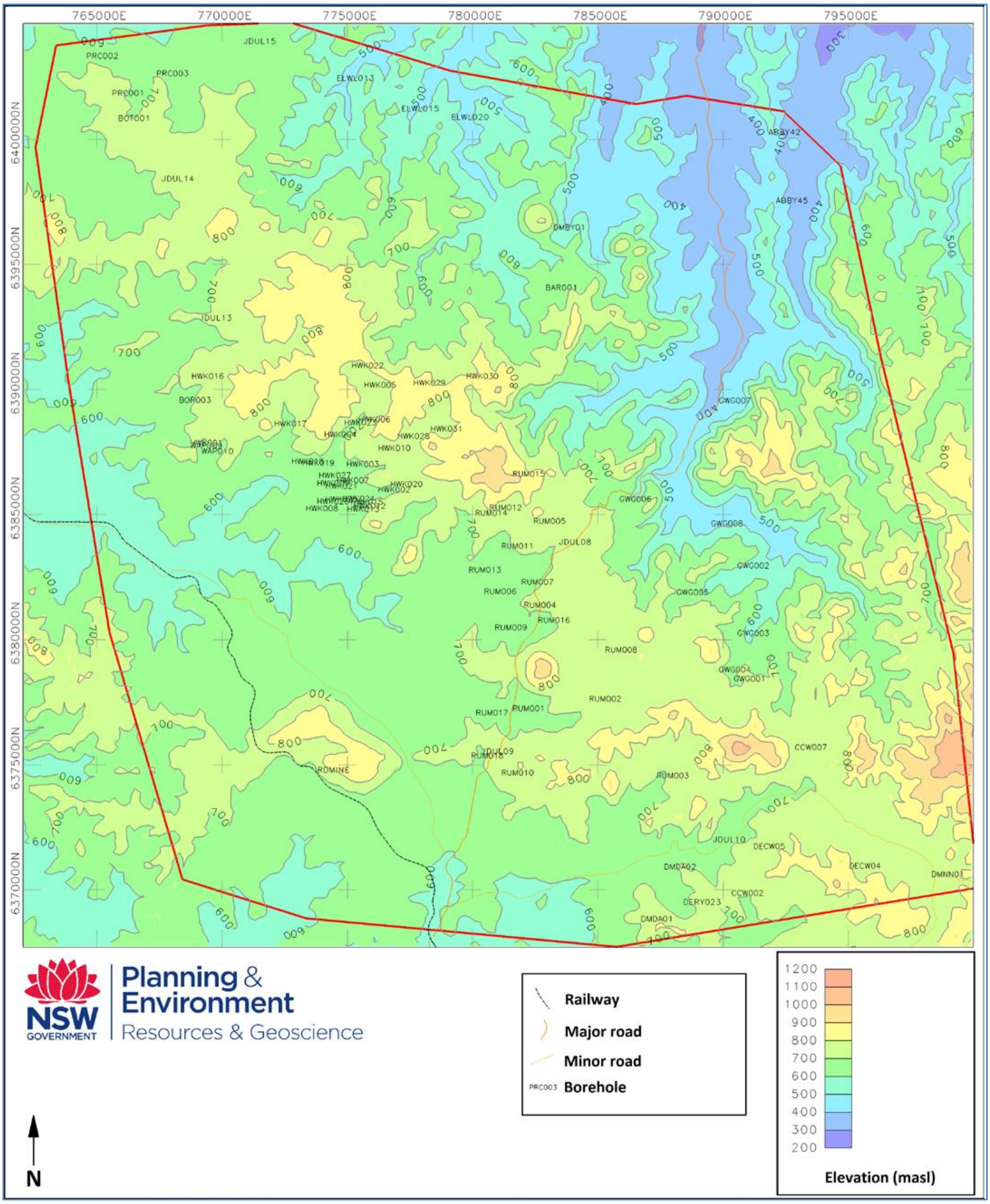
Three coal mining operations (Clarence, Springvale and Angus Place) are situated approximately 75km to the south. These mines extract coal from the Ulan, Lithgow or Katoomba seams, using underground longwall or continuous miner methods.

Figure 1: Hawkins-Rumker Coal Project Area Regional Location



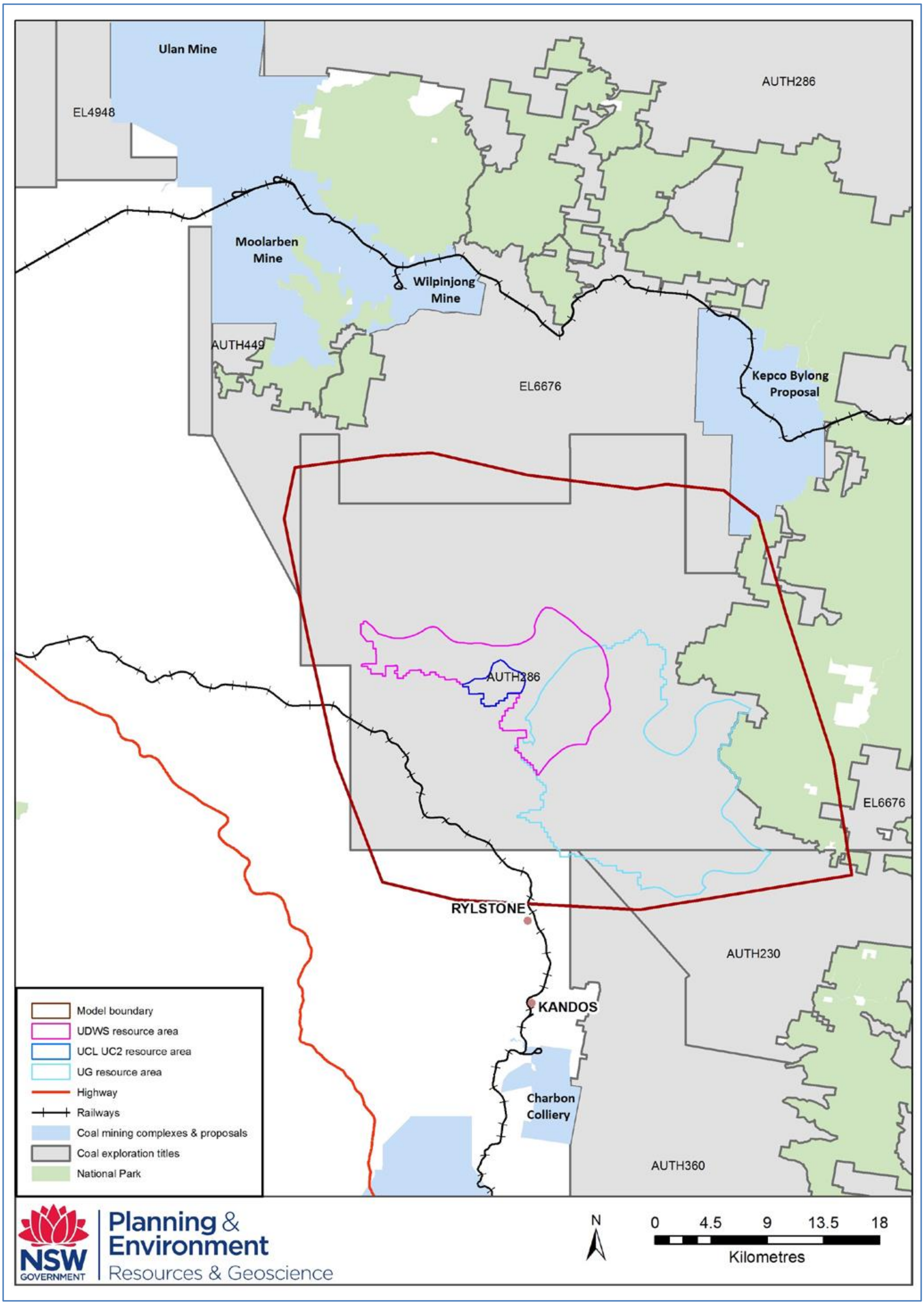
Source: (Bayly & Matthews, 2017)

Figure 2: Topography



Source: (Bayly & Matthews, 2017)

Figure 3: Surrounding Tenure and Local Infrastructure



Source: (Bayly & Matthews, 2017)

Review of Available Data

Regional Geology and Stratigraphy

The Hawkins-Rumker area occurs in the central-northern part of the Western Coalfield. Stratigraphy conforms with that described by (Yoo, et al., 2001) and (Bembrick, 1983) for the Western Coalfield (Figure 4). Hawkins-Rumker geology and stratigraphy is fully described in the NSW Planning & Environment Hawkins-Rumker Inventory Coal report (Bayly & Matthews, 2017), which need not be repeated here.

Potentially mineable coal at Hawkins-Rumker occurs at two main horizons within the Illawarra Coal Measures (Figure 5 and Figure 6), which overlies the early Permian Shoalhaven Group that unconformably overlies the early Permian Rylstone Volcanics over much of the project area.

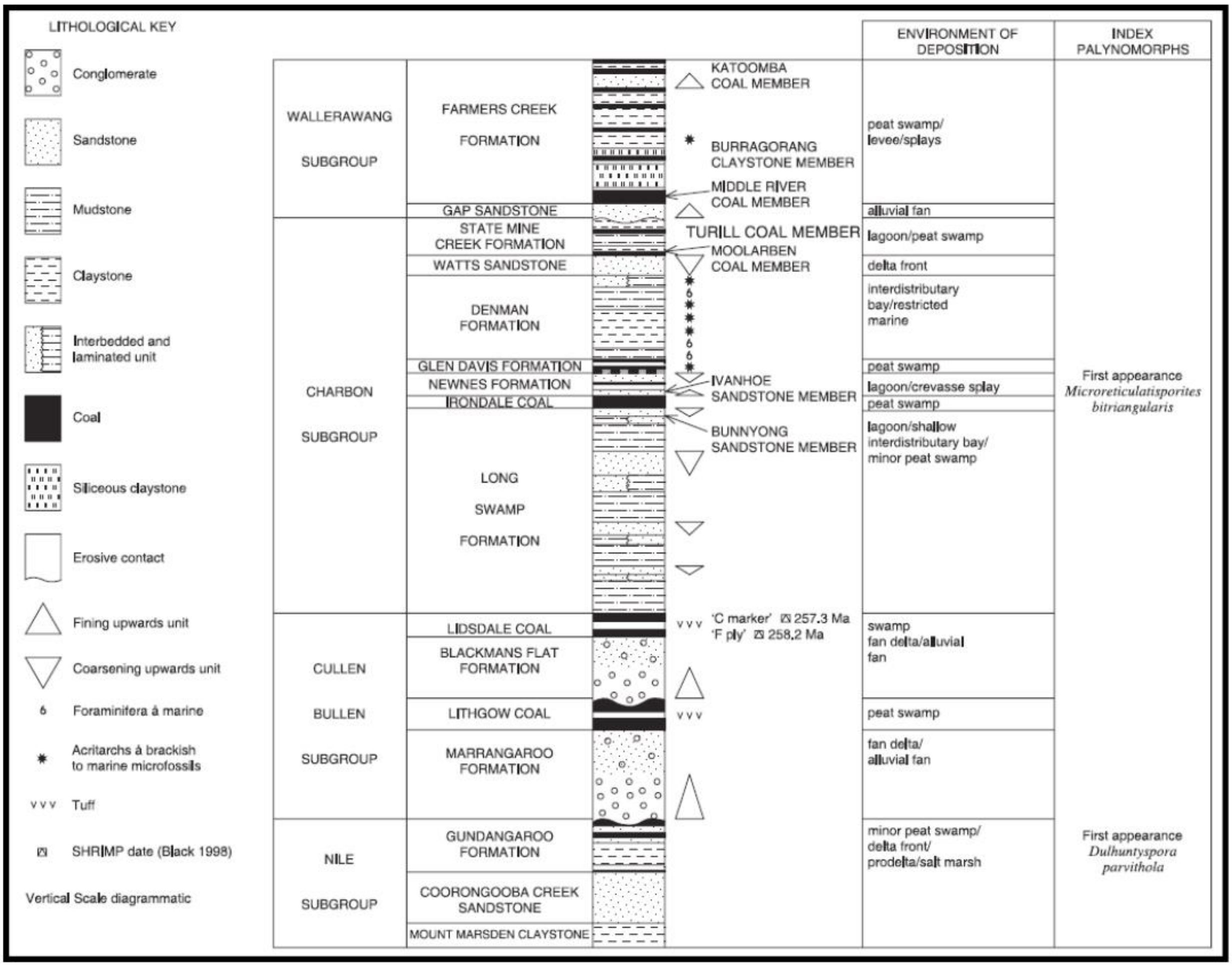
The Illawarra Coal Measures is unconformably overlain by the Triassic Narrabeen Group within the project area, which generally comprises lithic, very coarse sandstone or granule conglomerate at the base to progressively more quartzose sandstones at the top. A number of correlatable fining upward cycles are recognised. The Narrabeen Group forms the near continuous, but dissected, plateau geomorphology of the area. Cliff-forming hard sandstone sequences are a common surface feature of the area, particularly in the north. Surface geology is shown in Figure 7.

Figure 4: Western Coalfield Stratigraphy

Period		Western Coalfield – Southern Part: Group	Southern Part: Subgroup	Southern Part: Formation	Northern Part: Formation
Tertiary				Basalt	Basalt
Jurassic					Piliga Sandstone Purlawaugh Formation
Triassic		Wianamatta Group		Ashfield Shale	Nappertry Formation
Triassic		Hawkesbury Sandstone			
Triassic		Narrabeen Group	Grose Subgroup	Burralow Formation	Digby Formation
Triassic		Narrabeen Group	Grose Subgroup	Banks Wall Sandstone	Digby Formation
Triassic		Narrabeen Group	Grose Subgroup	Mt York Claystone	Digby Formation
Triassic		Narrabeen Group	Grose Subgroup	Burra-Moko Head Sandstone	Digby Formation
Triassic		Narrabeen Group		Caley Formation	Digby Formation
Permian	Late	Illawarra Coal Measures	Wallerawang Subgroup	See Figure 6	See Figure 6
Permian	Late	Illawarra Coal Measures	Charbon Subgroup	See Figure 6	See Figure 6
Permian	Late	Illawarra Coal Measures	Cullen Bullen Subgroup	See Figure 6	See Figure 6
Permian	Late	Illawarra Coal Measures	Nile Subgroup	See Figure 6	See Figure 6
Permian	Early	Shoalhaven Group		Berry Siltstone	Shoalhaven Group – Undifferentiated
Permian	Early	Shoalhaven Group		Snapper Point Formation	Shoalhaven Group – Undifferentiated

Source: Adapted from (Bayly & Matthews, 2017), and modified from (Yoo, et al., 2001).

Figure 5: Stratigraphy of the Illawarra Coal Measures



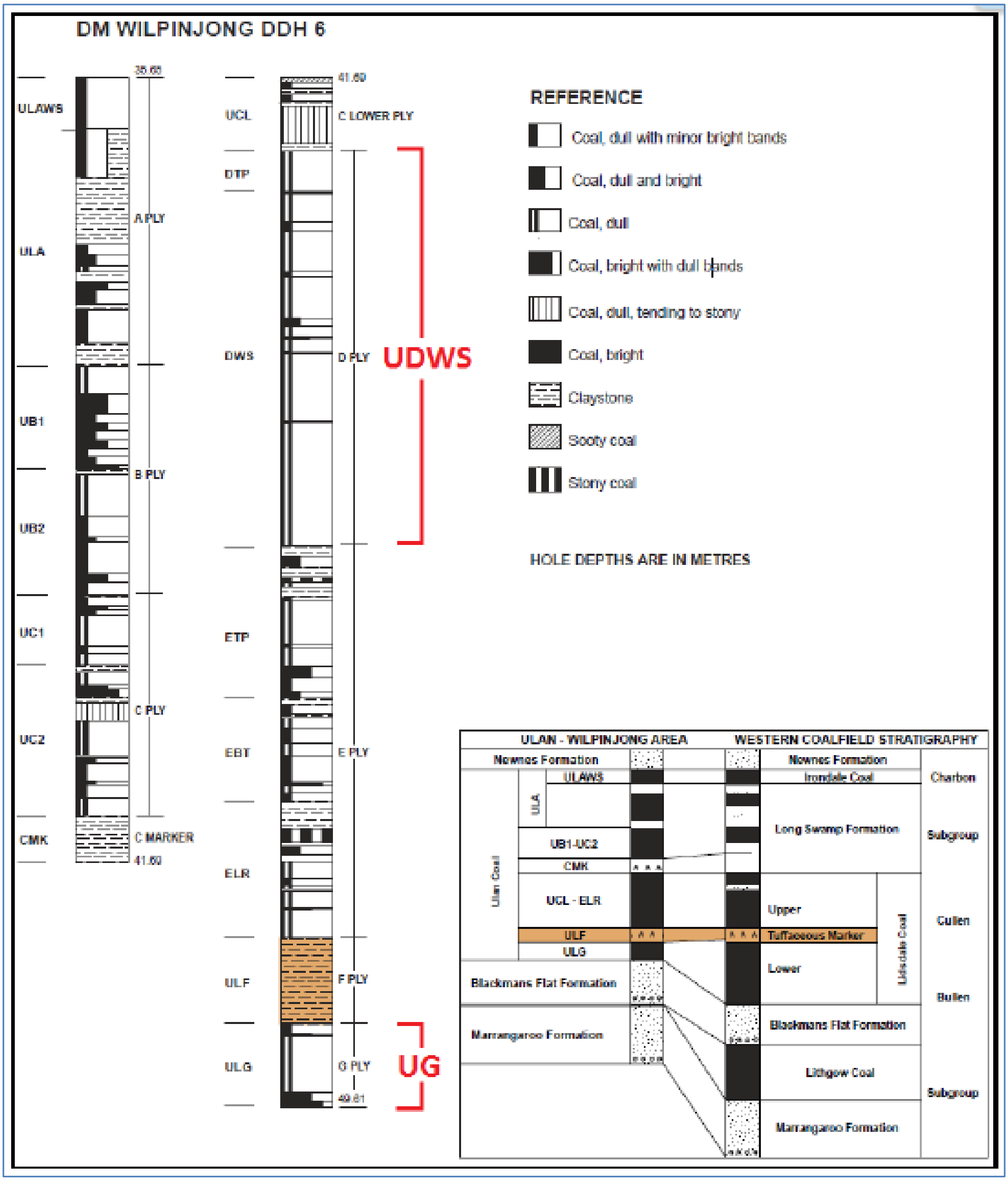
Source: (Bembrick, 1983) in (Bayly & Matthews, 2017)

The Illawarra Coal Measures (ICM) are generally flat lying, with a gentle dip of 1−2 degrees to the northeast. They outcrop in low lying areas around the periphery of the plateau, and gradually thicken in the subsurface, from 140m in the west to more than 180m in the east. The majority of this thickening trend is attributed to the Charbon Subgroup, which does not contain economic coal.

Economic coal seam thickness and quality occur only within the Lidsdale Coal horizon, which occurs at the top of the Cullen Bullen Group. Historical interpretations have identified a Lithgow seam as being economic, but a new seam correlation model derived from the Departments' latest exploration program has established that the lowermost potentially economic seam at Hawkins-Rumker is the Lidsdale Lower seam (UG) and not the Lithgow Seam (Bayly, 2012) (Bayly, 2017) (Bayly & Matthews, 2017). The Lithgow Seam is recognised within the area, but it is generally less than 1m thick.

The Lidsdale Coal Member, which ranges in geological thickness in the study area from 6.1m to 15.6m, is correlated to be the lateral equivalent of a section of the Ulan seam in the Ulan – Wilpinjong mining area (Bayly & Matthews, 2017), from the UCL to ULG plies, or everything below the CMK Marker horizon (Figure 6). The Ulan coal seam nomenclature has been adopted in the Hawkins-Rumker area. The Lidsdale Coal Member at Hawkins-Rumker consists of many coal seams, comprising predominantly dull coal with minor bright bands, which are interbedded with stony coal, carbonaceous claystone and regionally persistent tuffaceous bands. The Lidsdale Coal Member is subdivided into an Upper and Lower seam section, which are separated by a laterally persistent tuff marker bed known regionally as the F Ply.

Figure 6: Typical Lithological Log of the Lidsdale/Ulan Seam at Wilpinjong Mine



Source: (Bayly, 2017) in (Bayly & Matthews, 2017)

The Lidsdale Coal Member, which ranges in geological thickness in the study area from 6.1m to 15.6m, is correlated to be the lateral equivalent of a section of the Ulan seam in the Ulan – Wilpinjong mining area.

Other coal seams throughout the project area are not considered to be prospective. These include (from base upwards):

- The Lithgow seam within the Cullen Bullen Subgroup below Lidsdale Coal, which is generally less than 1m thick within the Hawkins-Rumker area;

- Irondale Coal, which consists of a persistent, but relatively thin (0.5–1.0m) seam comprising dull coal with minor bright bands and interbedded claystone (commonly tuffaceous);
- The overlying Newnes, Glen Davis and State Mine Creek Formations contain several thin and impersistent coal bands, which include the Moolarben Coal Member in the lowermost portion of the latter formation.

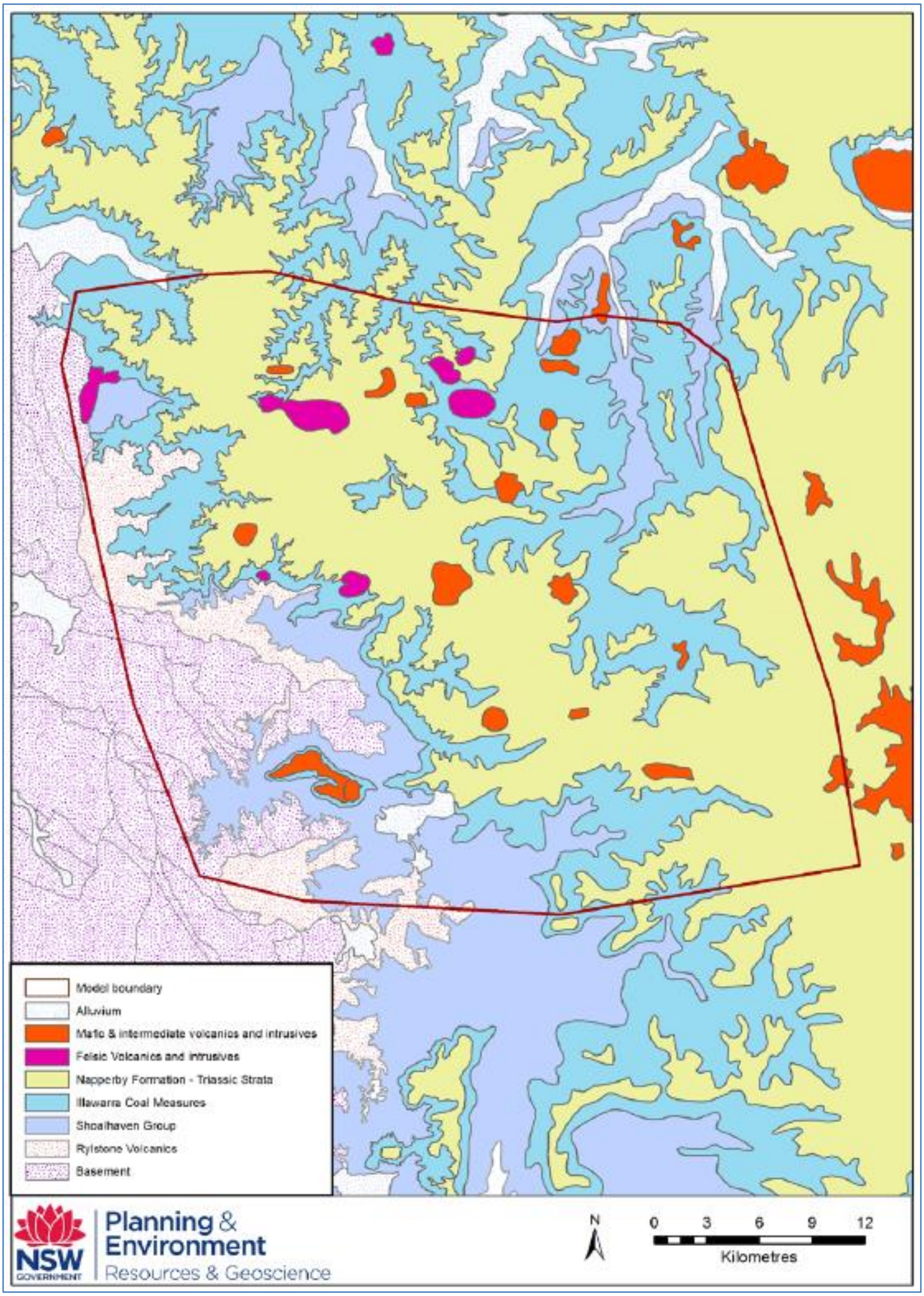
PREVIOUS EXPLORATION

The project area has been the subject of several exploration programs, which commenced with the drilling of three holes by the Joint Coal Board and Department in the mid-1970s. This was followed by further Department drilling within and adjacent to the study area, into the mid-1980s.

The Department's most recent work (Bayly & Matthews, 2017) involved a 60-hole, four-stage assessment of the project area between May 2011 and December 2016, which had the following main objectives:

- Examine the resource potential of the Lidsdale Lower seam (UG);
- Assess the thickening trend to the north and east for the Lithgow Seam;
- Investigate the potential for the thickening and improvement in quality of the UDWS section of the Ulan Seam toward the basin margin;
- Generally assess coal quality, structure, igneous intrusions and other important geological constraints;
- Determine the tonnage and extent of coal resources that could meet both domestic thermal power station feed and export thermal product either with or without beneficiation;
- Undertake preliminary gas desorption studies within one borehole where the target seam is projected to be greater than 300m (DM Rumker DDH 15).

Figure 7: Surface Geology



Source: (Bayly & Matthews, 2017)

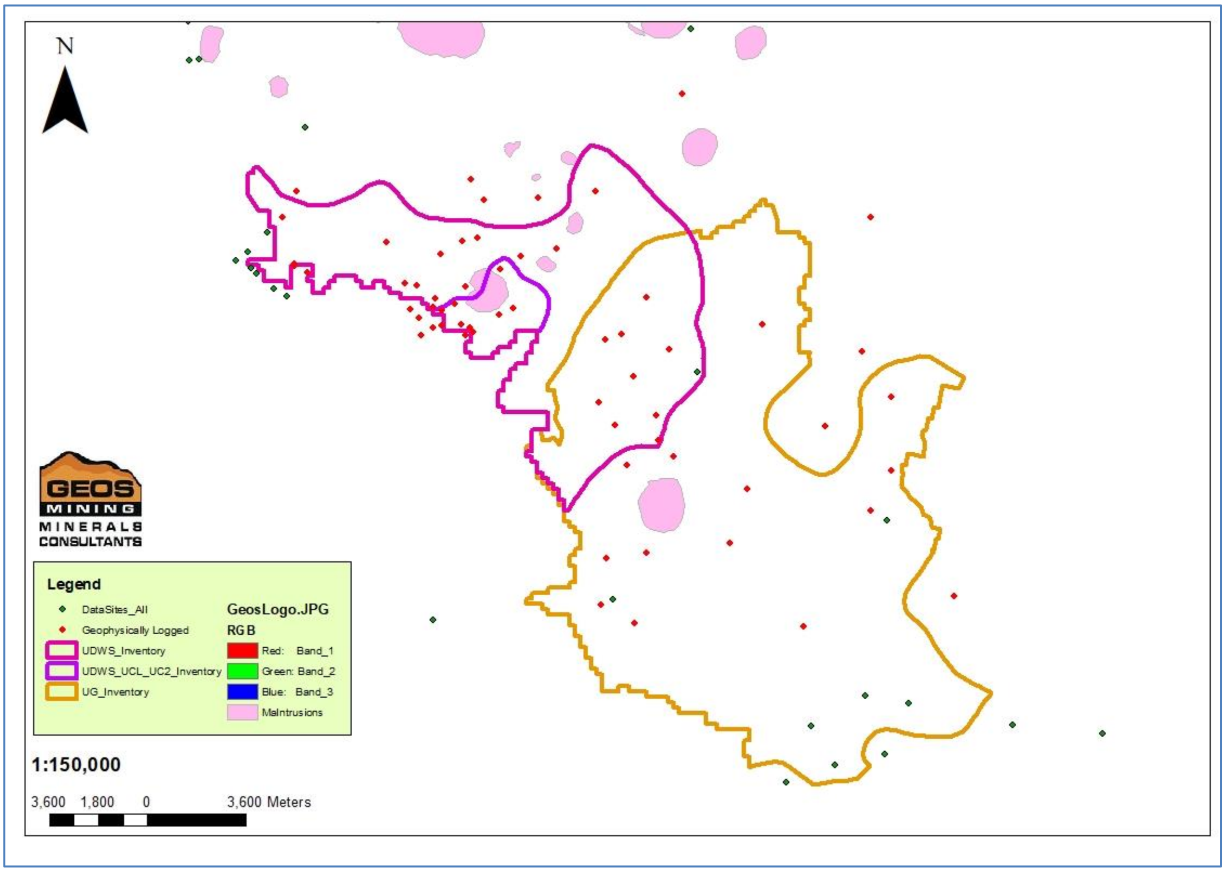
Resource Data Availability and Validation

Drill Hole Data

The New South Wales Department of Industry has provided a dataset for the Hawkins-Rumker area, which comprises 81 drill sites and 14 outcrop sites (Figure 8). Of these, 70 drill holes and 7 outcrop sites occur within or adjacent to the area being considered for mining in this report. Drill hole spacing within UDWS resource area is typically 1 – 2km, with some clustering and some areas with spacing out to 2 – 4km. Drill hole spacing for the UG resource area is more sparse at 2 – 5km, particularly in the south. While this is a good dataset for the current evaluation, considerable further drilling will be required as the project is developed to pre-feasibility and feasibly stage.

The majority of holes were partially cored within at least the Illawarra Coal Measures, which has been logged in detail. The proportion of geophysically logged holes is high throughout most of both resource areas, with the notable exception of drill holes in the extreme south of the UG resource area (Figure 8). This, combined with detailed logging of drill core, provides a sound basis for correlation of coal seams within what is a relatively variable coal seam stratigraphy.

Figure 8 Drill Hole Locations



Seam Correlation

The seam correlation model for the Hawkins-Rumker area is based on core logging at Hawkins-Rumker, and a detailed regional study (Bayly, 2012) of the stratigraphy of the lower Illawarra Coal Measures. This characterisation of the Lidsdale and Lithgow Coal Member lithotype profiles is assisted by characteristic lithologies, lithological relationships and several regional marker beds, including tuffs. Correlations between different areas of the Western Coalfield are now made with a high degree of consistency and confidence (Bayly & Matthews, 2017). Several cross-sections showing the seam correlations through the target mining area were supplied by the client. These were selectively reviewed against available English and geophysical logs, to validate the seam correlation model.

Marker beds available to provide horizon control for underground mining, include:

- the F Ply tuff and underlying carbonaceous to stony coal interval that typically defines the UG seam roof,
- Band 4 within the UG seam,
- An extensive claystone band referred to as UCLP, which typically marks the top of the UDWS mining section; and
- the widely present CMK marker bed that occurs above the UDWS working section, between the UCL and UC2 seam intervals;

Geos Mining considers that the current seam correlations are valid and consistent, although we note the seam stratigraphy is highly variable and some minor adjustments may be required as further drilling is undertaken.

Coal Quality

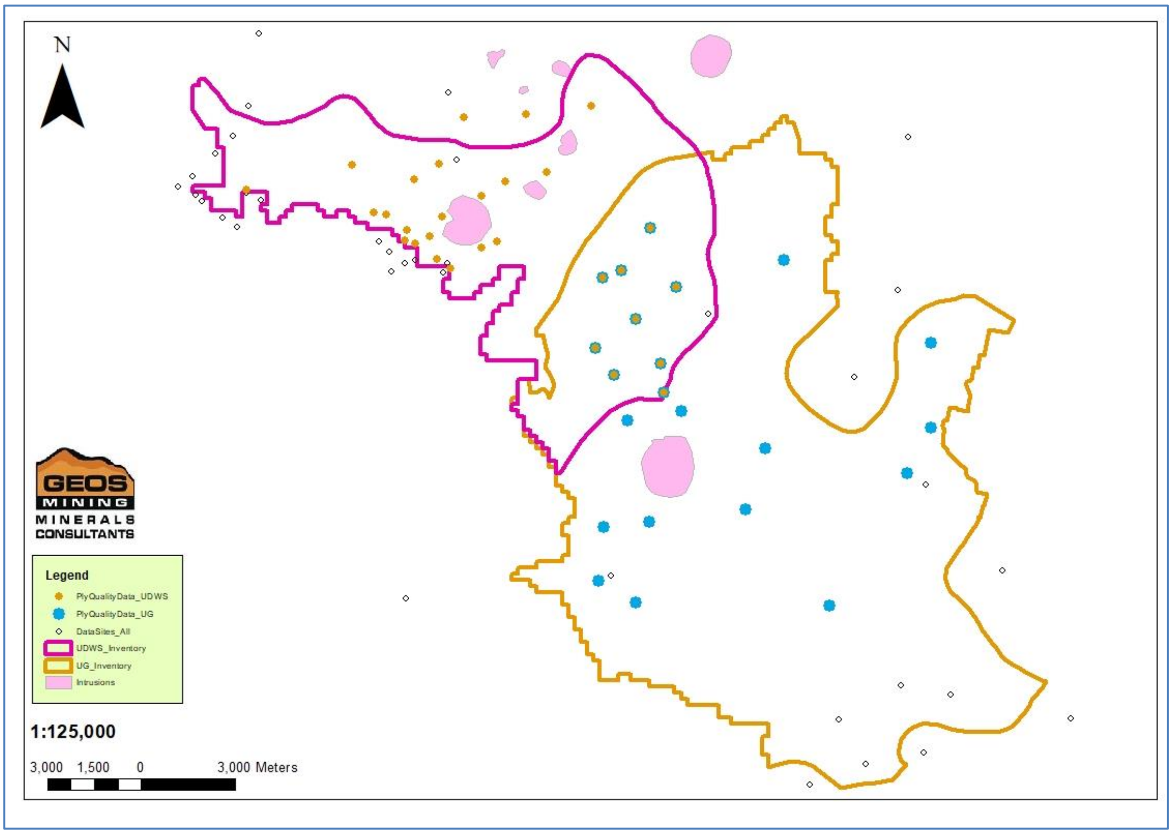
The Department has provided a coal quality data set, which includes quality data of varying type for 69 of the 81 drill holes in the area. Of these, 64 are within or adjacent to the area being considered for mining in this study, and have at least ply Rd, Ash and Inherent Moisture data. Our review has focussed on quality data available for the UDWS, and UG mining sections primarily, with consideration of an extended working section to include the UCL and UC2 coal seams in one area. We note that the UDWS, UCL and UC2 seam intervals have been considered as a source of ROM and washed product, and that the UG seam is being considered primarily as a source of washed coal.

Ply Analysis Data:

Figure 9 shows ply raw quality data coverage for the UDWS and UG seams. 43 sites have substantial raw ply proximate analysis, total sulphur and energy data, including 30 for the UDWS seam and 22 for the UG seam. This data has been used to define underground mining working sections. We note that the sampling methodology has consistently honoured coal seam ply correlations between drilling programmes. It therefore provides a sound basis for the determination of working section intervals and quality. There is typically a good correlation between the mining section depth interval and the intervals sampled for ply and composite analysis, although this is not always the case.

Spacing between ply quality sites varies from less than 1km to greater than 4km (Figure 9). While we have not undertaken a geostatistical analysis of the dataset, we expect that considerable drilling will be required to close spacing for further resource estimation. However, we consider that raw ply data coverage is adequate for the purposes of a conceptual analysis of commercial viability. We note sparse UG seam data in the south, and frequent absence of non-coal parting and roof and floor analysis results, which are required to determine diluted ROM quality.

Figure 9 Raw Ply Quality Data Coverage



Washability and Composite Analysis of the UDWS Working Section:

Analysis of Ultimates, HGI, Ash Composition, Ash Fusion Temperatures and impurities ('detailed analysis') has been undertaken on raw and/or washed composites at selected sites for the UDWS seam. Detailed analysis of raw UDWS seam composites has been undertaken at 15 sites. Figure 10 shows that this data is concentrated mostly around the central part of the UDWS Inventory Coal area.

Washability analysis of composites has been undertaken at 26 sites with broader coverage (Figure 10), of which 24 sites have detailed analysis of a F1.60 product composite. We note that several sites have Ultimates, HGI, Ash Composition, Ash Fusion Temperatures and impurities for a washed UDWS product only. Although these are not fully representative of a ROM product, they are indicative for determination of ROM (unwashed) product quality. We consider there is a reasonable coverage of UDWS mining section washability and washed composite detailed analysis data for the purposes of a conceptual commercial viability assessment. We have developed a ROM product specification for the UDWS working section (

Table 2), and the UDWS-UC2 working section (Table 3), using only raw ply and composite data, but note the washed product detailed analysis results are similar.

Washability and Composite Analysis UG Working Section:

Washability analysis of the UG seam has been undertaken at 27 sites, of which detailed analysis of a F1.60 product composite, including typically Ultimates, HGI, Ash Composition, Ash Fusion Temperatures and impurities, has been undertaken at 20 sites (Figure 11). We consider there is a reasonable coverage of UG mining section washability and washed composite detailed analysis data for the purposes of a conceptual commercial viability assessment, but we note the absence of washed product detailed analysis in the extreme south. We have developed a F1.60 product specification (Table 5) for the UDWS seam using only raw ply and composite data

Figure 10 Composite Data – UDWS Seam

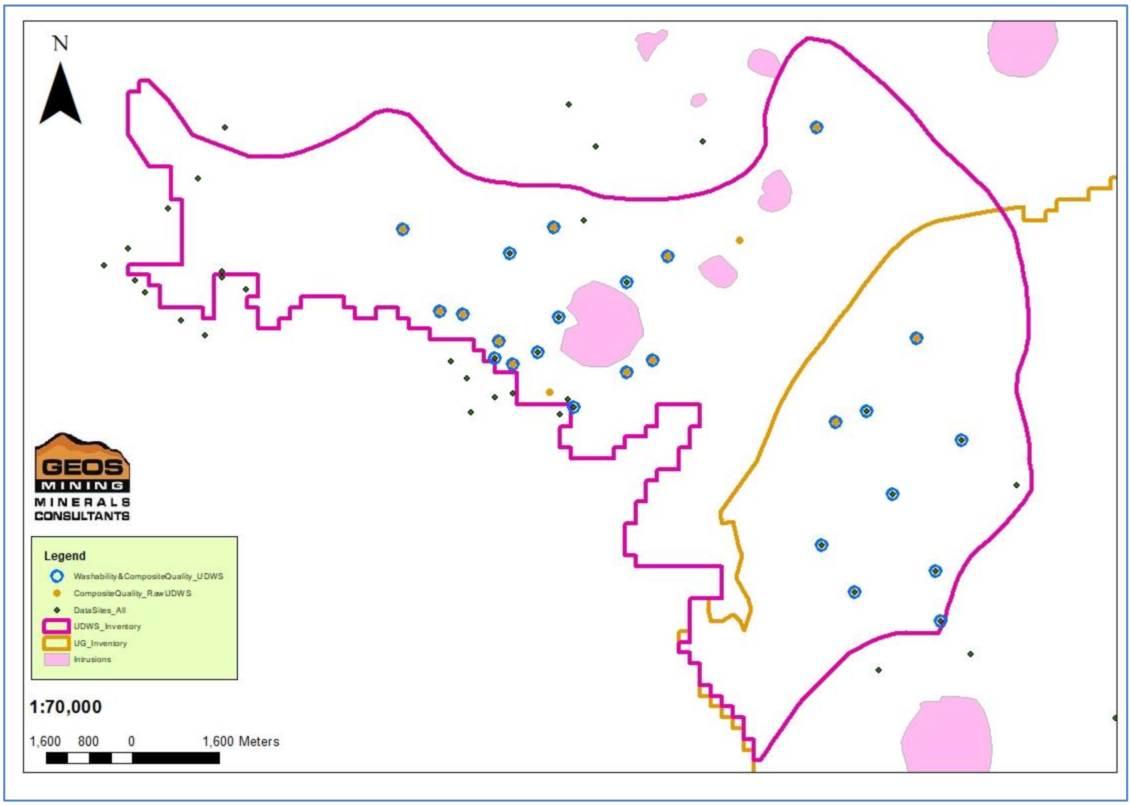
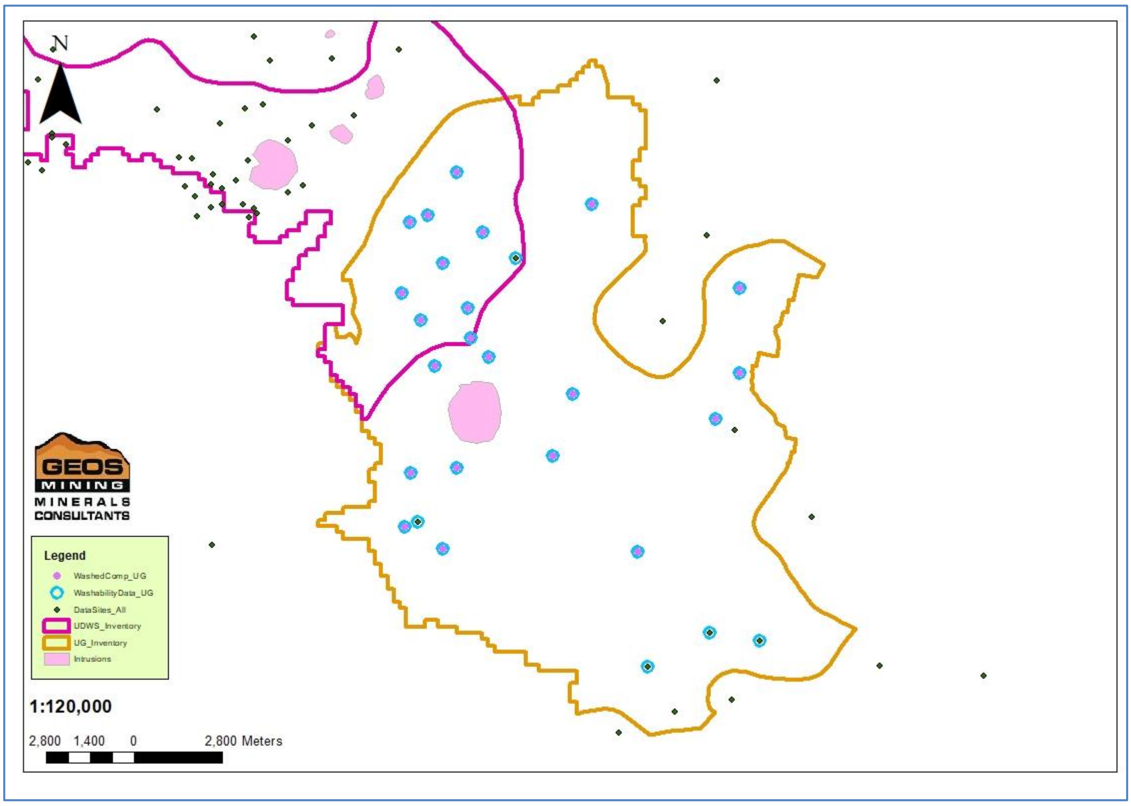


Figure 11 Washability and Composite Analysis Data - UG Seam



Geotechnical Data

No geotechnical data has yet been collected for the Hawkins-Rumker project, with the exception of Sonic Velocities that have not been calibrated. We have relied largely on an analysis of lithological types and associations forming the roof and floor of mining targets, with reference to experience gained in surrounding mines that mine a similar coal seam stratigraphy.

Resource Modelling

The drill hole data that forms the basis of the current geological model has been reviewed as above, and found to be valid for the purposes of this CVA assessment. Model output, including seam isopachs and ash and sulphur contour maps, have been spot checked against the drill hole quality data as a final check, and found to be valid.

The model has been developed by the Resources and Geoscience Group of the NSW Department of Planning and Environment, using Geovia Minex mining software. The model is based on a 200m x 200m grid mesh, including topography which was developed from 30 x 30m SRTM data. We consider that the current geological and Inventory Coal model is valid and adequate for the purposes of a CVA, and has been used in the current assessment. It has not been necessary to remodel the area.

Inventory Coal Characterisation

This section of the report focusses primarily on the UDWS and UG mining sections as potential targets for underground mining, with consideration of and extended UDWS-UC2 mining section in a small area in the central west.

Mining Section Thickness and Extent

UDWS Mining Section

The UDWS working section reaches a maximum of around 3 - 3.5m thick in the central west, where it occurs close to outcrop. The UDWS seam thins radially outwards to less than 0.5m around the periphery (Figure 13). Non-coal partings are largely and characteristically absent from the UDWS working section within the limits of potentially mineable coal.

UDWS-UC2 Mining Section

The UCL and UC2 coal seams that closely overlie the UDWS mining section are typically thin and separated from each other and the UDWS seam by the CMK and UCLP stone bands respectively (Figure 6). The UCL and UC2 seams generally do not attain a mineable thickness in themselves, but the CMK and UCLP partings are very thin or absent in a small area in the central west (Figure 12), which is coincident with the area of thickest UDWS coal. In-situ quality data, discussed in a later section, indicates that the UDWS working section in this area could be extended to include the UCL and UC2 seams and any minor partings, without compromising ROM quality. This extended UDWS-UCL-UC2 working section ranges from 3.5 to 4.2m thick in this area.

Figure 12 UDWS-UCL-UC2 Extended Working Section Thickness Postings

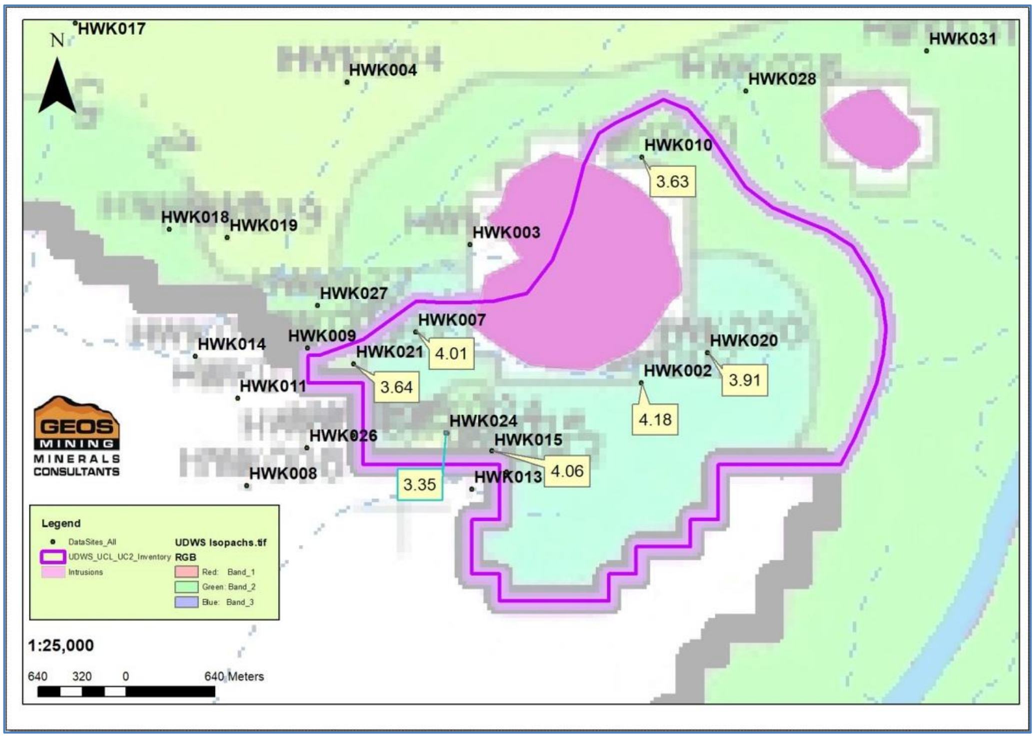
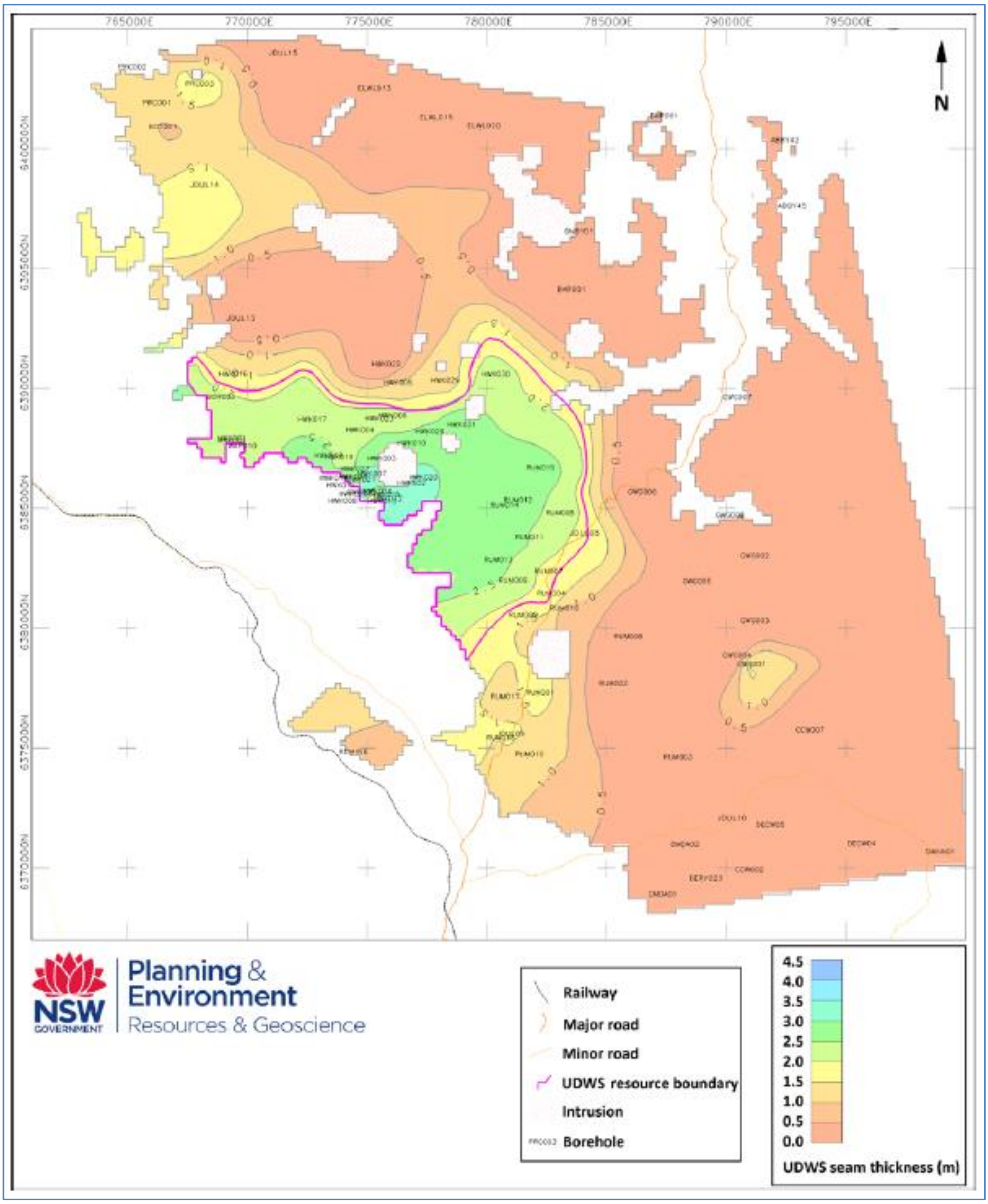


Figure 13 UDWS Mining Section Thickness

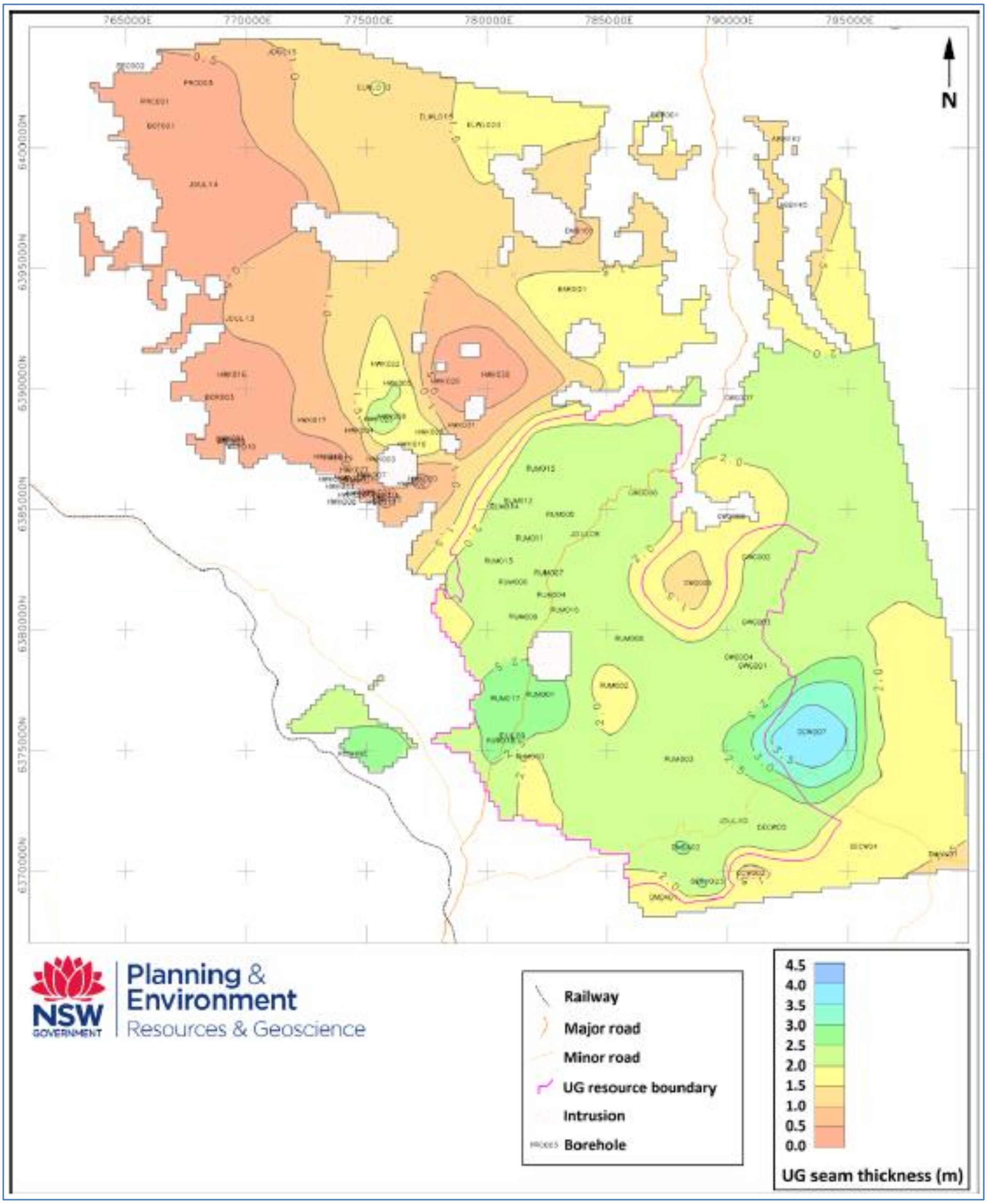


Source: (Bayly & Matthews, 2017)

UG Mining Section

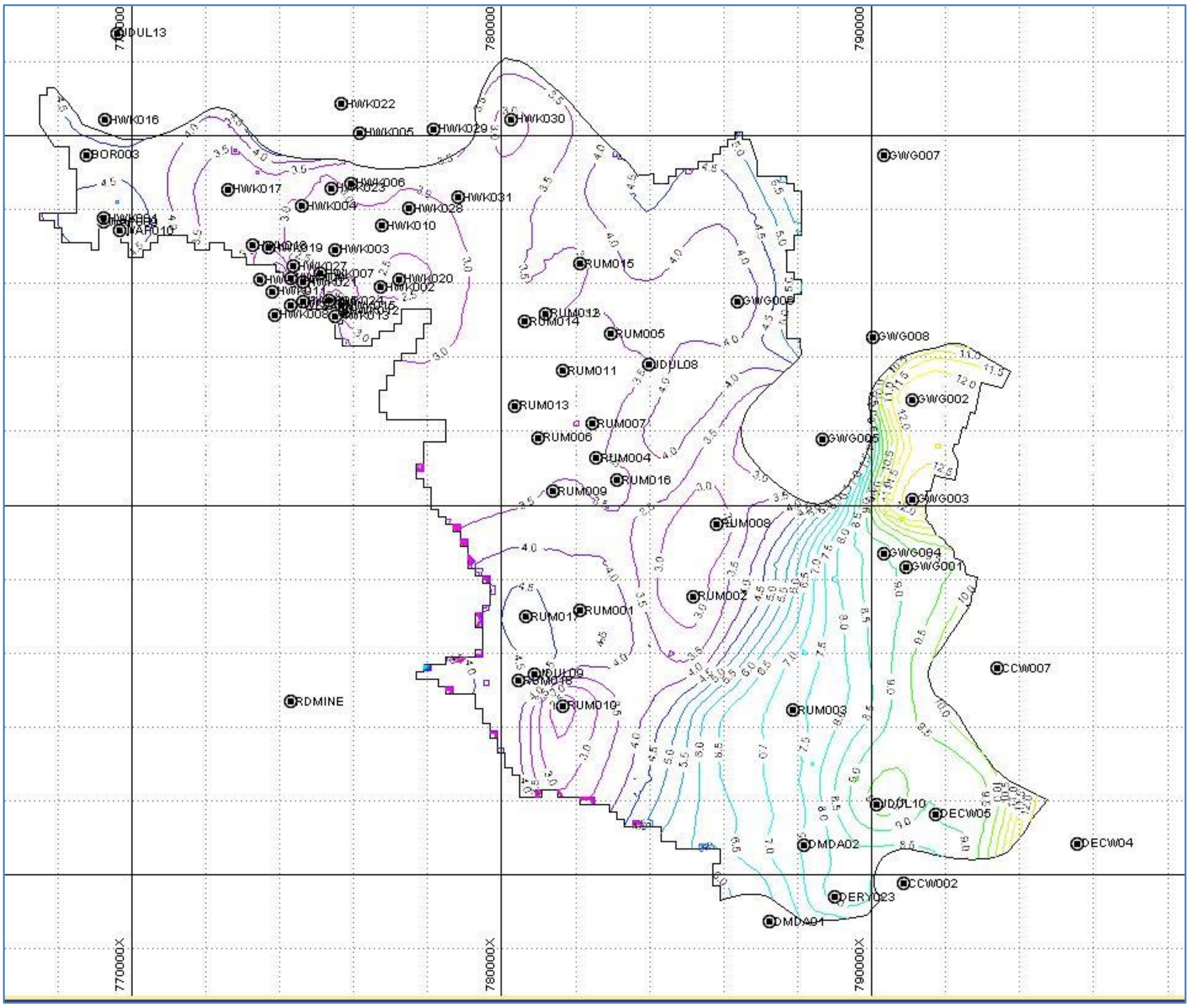
The UG mining section is generally 2.0 to 2.5m thick throughout the southern half of the Hawkins-Rumker area, with localised areas less than 2m or greater than 2.5m (Figure 14). The UG seam thins over a narrow band passing into the northern half of the area where it is generally from 0.5 – 1.5m thick. UG seam coal is not considered to be a mining target in this area, due to its thickness and close vertical proximity to the more attractive UDWS seam. The UG working section is characterised by frequent in-seam partings.

Figure 14 UG Mining Section Thickness



The UG seam occurs only a short distance below the UDWS seam in all areas. We note that the areas of potentially mineable UDWS and UG coal overlap, as discussed in a later section, and that within this area interburden thickness ranges from 3 – 4m. Interburden thickness increases to 10m in the south where mineable UG coal underlies thin, uneconomic UDWS coal (Figure 15).

Figure 15 UDWS - UG Working Section Interburden Thickness

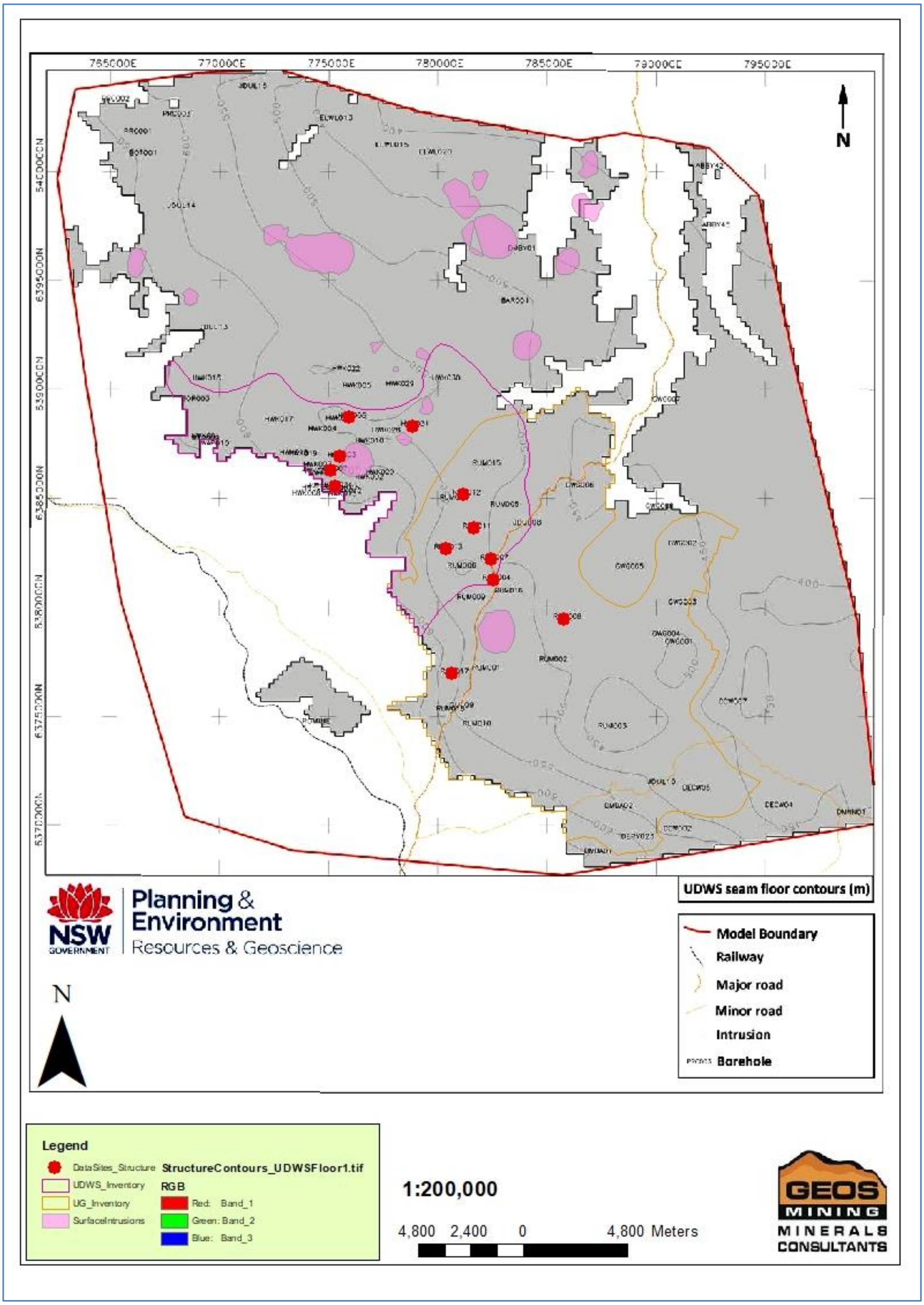


STRUCTURE

The Illawarra Coal measures generally have a gentle dip to the northeast at about 1-2 degrees, reflecting generally stable structural conditions for sediment accumulation over the Wollar Shelf (Bayly & Matthews, 2017). These authors also report localised structural disturbances observed in association with major intrusions exposed at the surface.

Drill hole data within the Hawkins-Rumker area generally confirms shallow dips of from 1 – 2 degrees, with coal seams dipping to the northeast in the northern half of the model area, but trending more to the east and southeast in the southern half (Figure 16). However, the Inventory Coal report identifies possible post Triassic displacement of about 75m (downthrown to southeast) in the vicinity of drill hole HWK003, but there is insufficient drilling definition to determine an orientation (Bayly & Matthews, 2017). It also lists holes with structural features described in drill core, which are located in Figure 16.

Figure 16 Structure Contours on UDWS Seam Floor



Source: After (Bayly & Matthews, 2017)

Structure contours on UDWS seam floor (Figure 16) indicate structural discontinuity in a general area bounded by HWK022 - HWK030 - HWK003 - HWK017. Although this may be partially due to the impact of intrusions in the vicinity of HWK022, a structure or structures with likely ENE – WSW orientation is indicated. The Inventory Coal report identifies structural features logged in HWK003, HWK006, HWK007, HWK024 and HWK031 within this area.

Another possible structural anomaly is a structural high in the vicinity of RUM003 in the south, which may impact the UG seam.

Although we agree there is generally a benign shallow dipping structure at Hawkins-Rumker, and insufficient data to identify structural domains with any certainty (Bayly & Matthews, 2017), structural discontinuity remains a risk for longwall mining. Further drilling is required to characterise structure in detail.

Overburden and Interburden Materials

The UG seam closely underlies the UDWS seam as discussed above. The UDWS and UG seams outcrop in low lying areas around the periphery of the Inventory Coal area, including extensively along the western escarpment. The UDWS seam otherwise occurs at depths ranging from less than 40m in topographically low areas, to 250-400m and locally up to 500m, beneath the Hawkins-Rumker plateau. Depth of cover generally increases down dip to the east, before reducing to less than 40m in eastern gullies.

Base Of Weathering

Depth of weathering beneath the Hawkins-Rumker plateau is generally from 10m to 30m, but increases in two localised areas to 40m and 140m respectively, in association with possible fractured zones (Bayly & Matthews, 2017). Weathered materials are largely within the Triassic Narrabeen Group, and do not impact on identified underground Inventory Coal.

Unweathered Overburden

Unweathered overburden materials may be subdivided into two groupings as follows:

- Triassic Narrabeen Group sediments, comprising up to 140m of thickly bedded lithic dominant basal conglomerates and very coarse sandstones, which become upwardly more quartzose and more commonly interbedded with finer siltstones and claystones. The Narrabeen Group typically forms erosion resistant cliff lines at the surface, possibly indicating a relatively high compressive strength;
- Mainly thinly bedded, and finer grained sediments of the Illawarra Coal Measures, comprising:
    - Predominantly interbedded siltstones, fine, medium and coarse sandstones, claystones, tuffs and coal seams of the Charbon Subgroup, which is from 99-122m thick and directly overlies the UDWS seam; and
    - Wallerawang Subgroup sediments at the top of the Illawarra Coal Measures, which comprise 18-28m of thinly bedded carbonaceous claystones, tuffs and coal (Farmers Creek Fm) over multiple fining upward medium to very coarse sandstone cycles (Gap Sandstone).

There are no geotechnical data for either the Narrabeen Group or Illawarra Coal Measures overburden materials, nor roof and floor materials of the target seams. We expect that the thinly bedded Illawarra Coal Measures sequence is likely to have medium to low strength.

UDWS Seam Roof and Floor materials:

Immediate roof materials (ie first 20cm) of the UDWS seam typically comprise claystone, carbonaceous claystone or coal (UCL seam), while the overlying materials to within 5m of the UDWS seam typically comprise a variety of thinly bedded claystones, tuff, siltstones, coal and carbonaceous or coaly claystones. Siltstones and sandstones are uncommon. There is no apparent spatial pattern in the distribution of these sediment types from our analysis of roof material types. No geotechnical data is available, but we expect that roof materials are likely to have low strength due thin bedding and high clay content.

The immediate floor (20cm) of the UDWS seam is typically formed by claystones and carbonaceous claystones, with coal or tuff common, and siltstones/ sandstones uncommon. There is no apparent spatial pattern as shown in Figure 17. UDWS floor materials are likely to have low slake durability and may present floor trafficability issues.

UG Seam Roof and Floor materials:

Immediate roof materials (ie first 20cm) of the UG seam typically comprise tuff, claystone, or carbonaceous claystone, while roof materials within 4m of the UG seam include the F Ply tuff marker bed and thinly bedded claystones, carbonaceous or coaly claystones and coal. Siltstones and sandstones are uncommon. The extensive F Ply tuff forms the immediate roof, or is within 20cm of the roof at many drill sites, but is otherwise separated from the UG seam by an interval of thinly bedded carbonaceous claystones and stony coal. Anecdotal evidence from the nearby Charbon Colliery suggests that the carbonaceous mudstone to stony coal interval immediately above the UG seam forms a more stable roof than does the F-Ply tuff (Bayly & Matthews, 2017).

The immediate floor (20cm) of the UG seam is predominantly siltstones and sandstones, but carbonaceous claystones and claystones as common, with no apparent spatial pattern (Figure 18). The predominance of siltstone and sandstone UG seam floor materials indicates floor trafficability issues may occur only locally.

Figure 17 UDWS Floor Materials

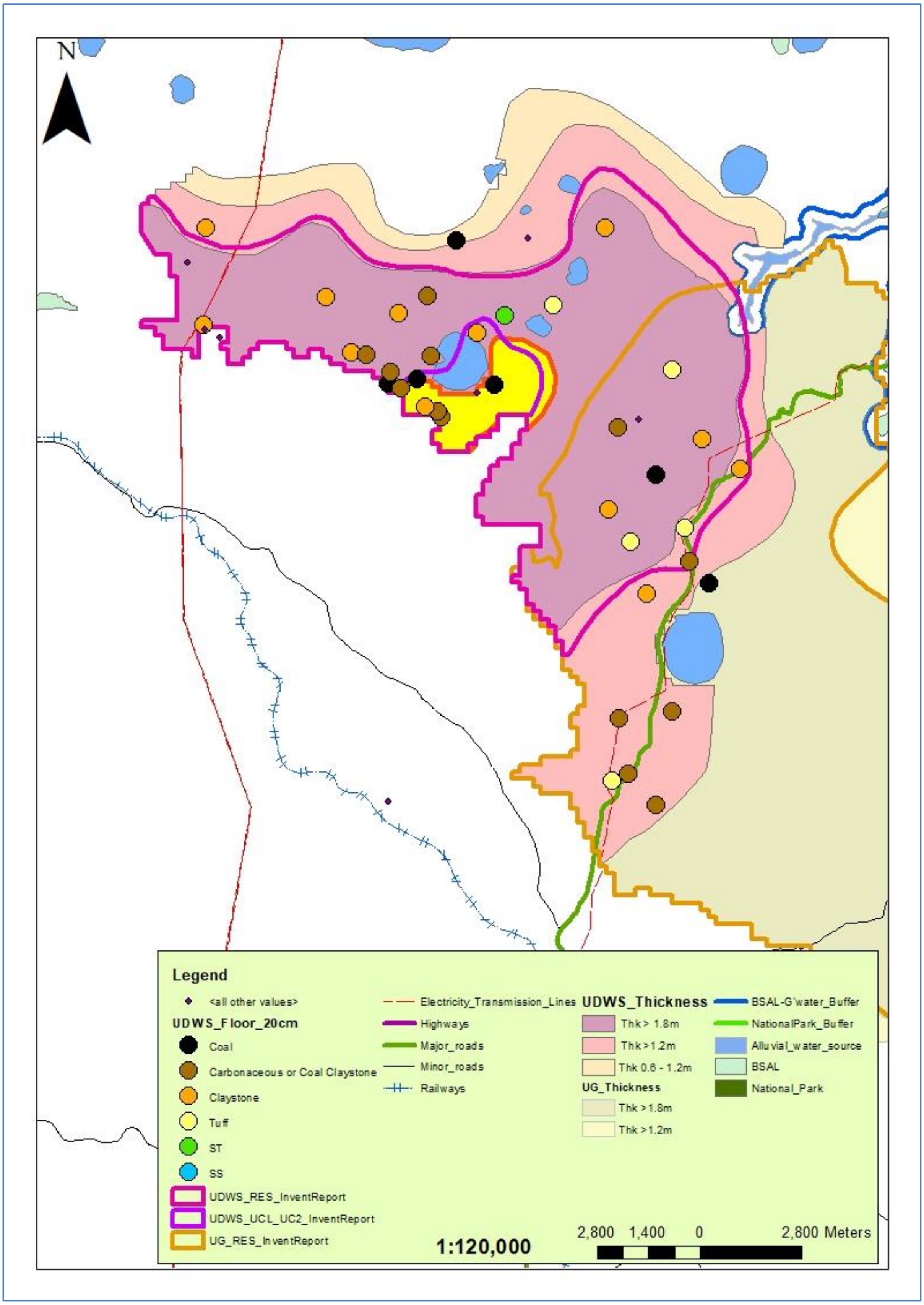
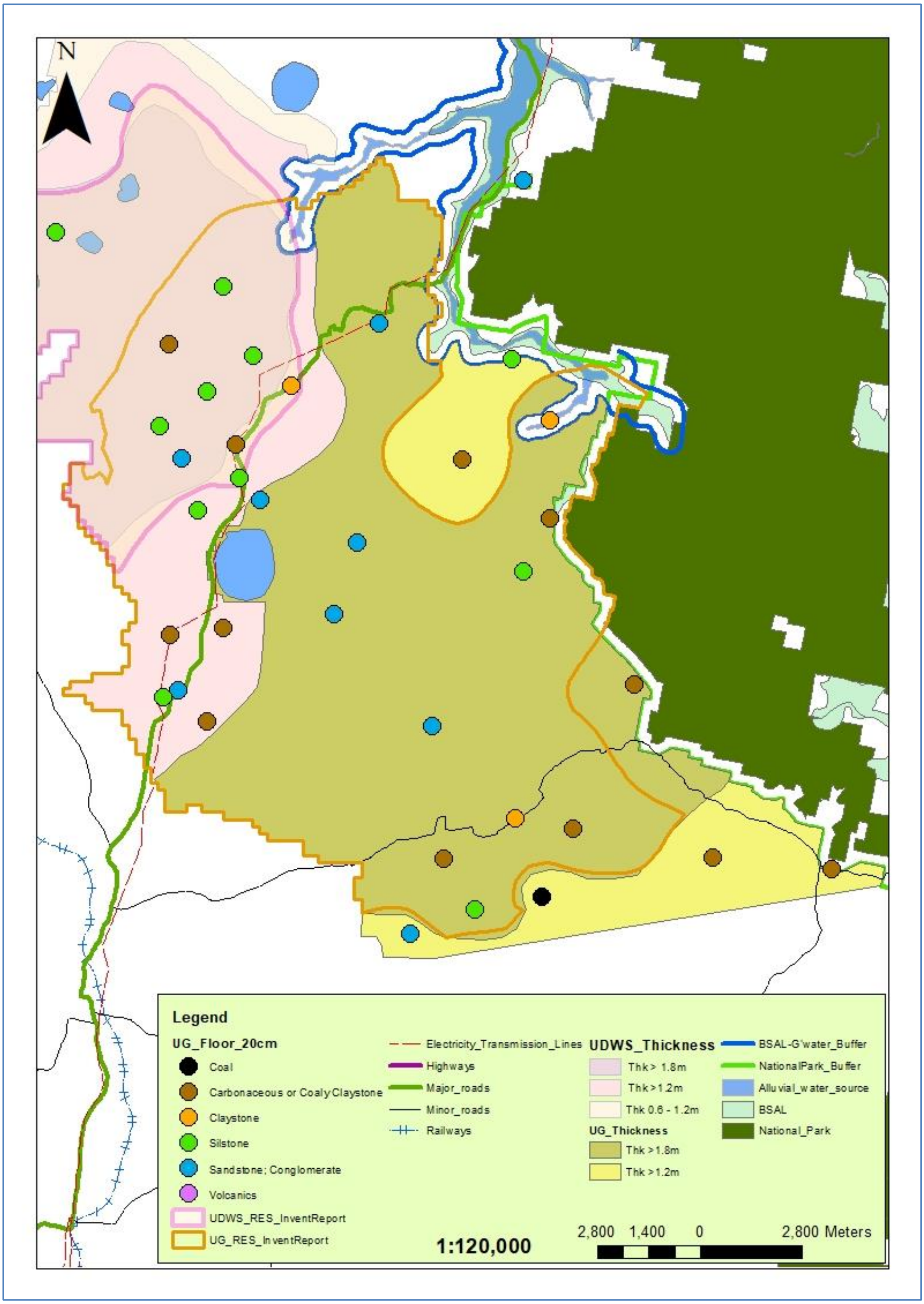


Figure 18 UG Seam Floor Materials



INTRUSIONS AND HEAT AFFECTED COAL

The Hawkins–Rumker area has been subjected to a relatively high level of igneous activity during the Mesozoic and Tertiary, including phonolitic plugs, sills, dykes, diatremes and basaltic plugs, caps and flows (Bayly & Matthews, 2017). The majority of intrusions intersected within the project area occur above the Lidsdale Coal seams of economic interest, with the majority of these within the Glen Davis Formation. However, sills and heat affected coal have been intersected at a number of sites within the UDWS or UG resource areas, as shown in Figure 19 and summarised below:

- CCW007 - Multiple thick sills within the Long Swamp Formation, with the lowest occurring about 24m above the UG seam in this area. However, the UG seam is significantly devolatilised at this site, as are the overlying UC2 and UCL thin seams, indicating another nearby intrusion or a very wide heat affected area from the intrusion intersected up to 24m above;
- RUM002 - Sill 1.65m thick, directly above UC2 seam and 6.3m above potentially mineable UG seam. UG coal is not heat affected at this site, with VM and Energy (daf) within the normal range for the UG seam. UDWS coal is not targeted in this area;
- RUM016 - Sills and heat affected coal (UC2 seam) 5.8m thick about 0.5m above the UCL/UDWS seam, and 5.4m above the UG seam mining target. UG coal is not heat affected at this site, with VM and Energy (daf) within the normal range for the UG seam. UDWS coal is not targeted in this area;
- RUM008 - Sill 2.2m thick about 28m above the UG mining target. UDWS coal is not targeted in this area;
- GWG005 - Multiple sills intersected within the Lidsdale coal sequence, including sills forming the roof and floor of the UG seam, which appears to have a reduced thickness (1.3m) at this site;
- GWG008 - Multiple sills and heat affected coal intervals within the Lidsdale Coal sequence, including the heat affected coal within the UG seam;
- HWK005 - Sill 90.8m thick occurring directly on the UC2 seam, and 0.9m above the UCL/UDWS seam, which is about 1.3m thick and significantly devolatilised at this site;
- HWK022 – Sill 57.1m thick, which occurs above and appears to have replaced the UDWS seam;
- HWK029 – Sill over 7.9m thick (hole abandoned), which occurs below the UDWS seam. The UDWS seam, and minor seams above it, are significantly devolatilised at this site.

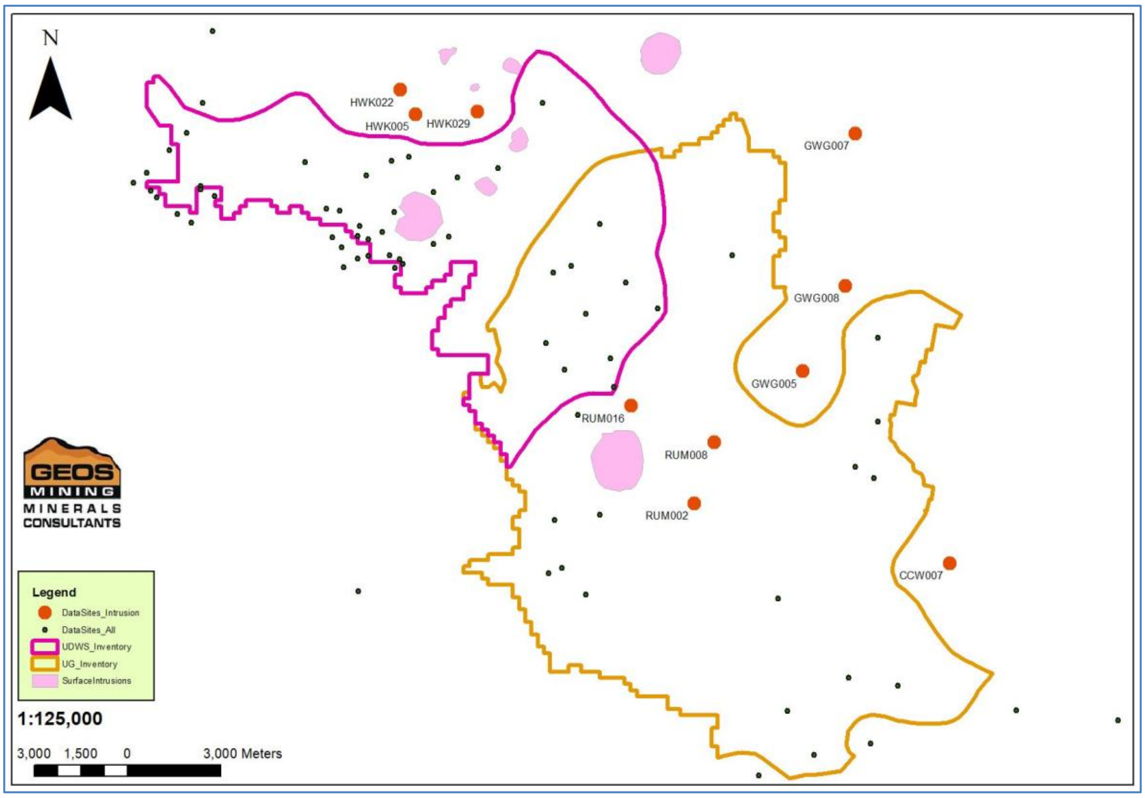
Many drill holes located at from 200 - 500m of major intrusions mapped at the surface, have shown no evidence of structural disturbance, associated intrusions or heat affected coal (Bayly & Matthews, 2017). This includes drill holes in the vicinity of a swarm of intrusions intersecting the surface in the northern half of the UDWS Inventory Coal area that trend approximately NE-SW (Figure 19). This suggests the impact on Inventory Coal is confined to within a close proximity of these features.

However, there is evidence of intrusions and heat affected coal in HWK022, HWK005 and HWK029, which are up to 1.9km from the nearest intrusions mapped at the surface. We note that while heat affected coal at sites HWK005 and HWK029 is significantly devolatilised, with VM (daf) at 13-15% well below the normal range for UDWS coal (30-35% VM daf), the energy content (daf) of the UDWS seam at HWK005 is within the normal range for the UDWS seam, and is only slightly reduced at HWK029. This suggests coal in this area may be suitable for sale if blended with coal from other areas.

Sills intersected within the UG seam Inventory Coal area within the southern half of the project, are all a considerable distance from intrusions mapped at the surface. We note that, with the exception of CCW007, drill sites with intrusions occur approximately along a NE-SW line from the Bald Mountain phonolite, and may be structurally related. While there is no heat affected UG seam coal at RUM016, RUM008 or RUM002, partial seam replacement and heat affected coal are recorded at GWG005 and GWG008.

Further exploration is required to more accurately define the influence of intrusions on Hawkins-Rumker coal resources.

Figure 19 Evidence of Intrusions Affecting Inventory Coal



Seam Quality and Utilisation

UDWS Mining Section Quality

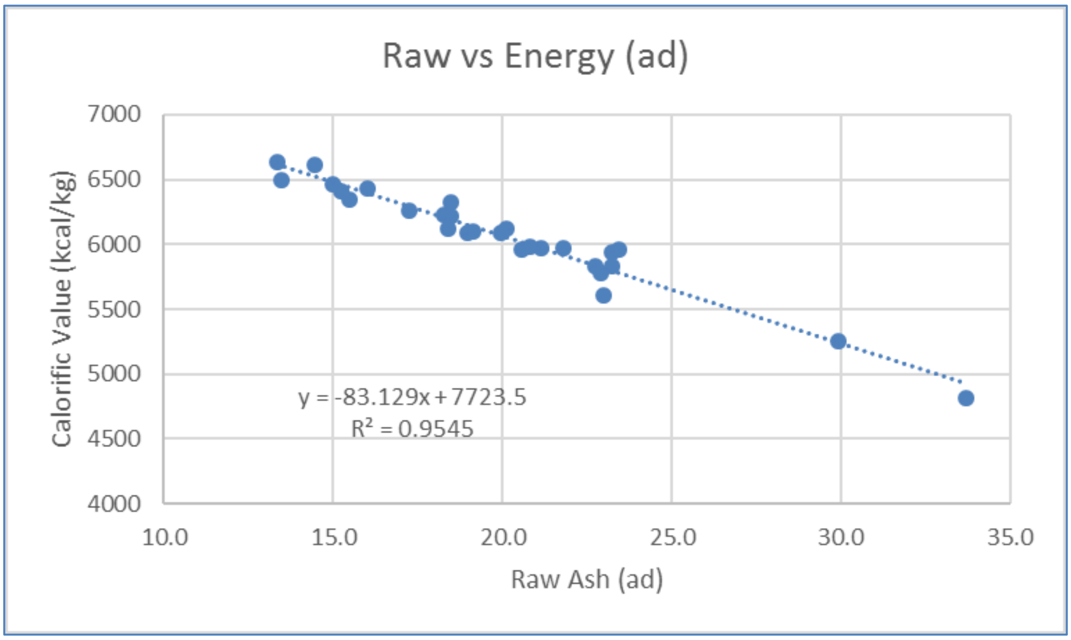
In-Situ Quality

The UDWS mining section comprises high volatile bituminous coal (ASTM, 2005), with generally – medium to high in-situ ash (less than 25%) and low sulphur content (less than 0.5%). A summary of in-situ UDWS coal quality from mostly ply data is shown in Table 1, with F1.60 yield, ash and ash reduction data. Sites with heat affected coal, as described above, have been excluded from this table.

In-situ ash trends within the UDWS target mining area reflect seam thickness, whereby the thickest coal generally has the lowest in-situ ash. Isolated areas of greater than 25% (ad) in-situ ash occur in the north and northeast, bordering the area being considered for mining in this study, while in-situ ash ranges from 20 – 25% (ad) within a significant central portion of UDWS mining target. In all areas, total sulphur (ad) is less than 0.5%, ranging from 0.29% - 0.47% (ad) with no significant spatial trend. Volatile matter generally ranges from 21.0 – 28.9% (ad), or from 30.2 – 34.7% on a dry ash free basis. This excludes two heat affected UDWS intersections at HWK005 and HWK029, where localised devolatilisation from intrusions has reduced volatile matter content to 14.9 and 12.9 % respectively, on a daf basis.

Specific energy is strongly related to raw ash, as shown in Figure 20, and we have used the resulting regression equation in the financial model to estimate energy from ash for revenue calculations.

Figure 20 Ash vs Energy Relationship; UDWS Seam



UDWS Dilution

The mining concept developed for the UDWS seam in this report estimates on average 100mm dilution in the floor and 50mm dilution in the roof. This equates to from 4.4 – 8.3% dilution depending on seam thickness, with an average of 5.5%. There are only a few analyses of immediate roof and floor, and we have used average quality of non-coal materials greater than 65% ash to provide an estimate of typical dilution (roof + floor) quality, as shown in

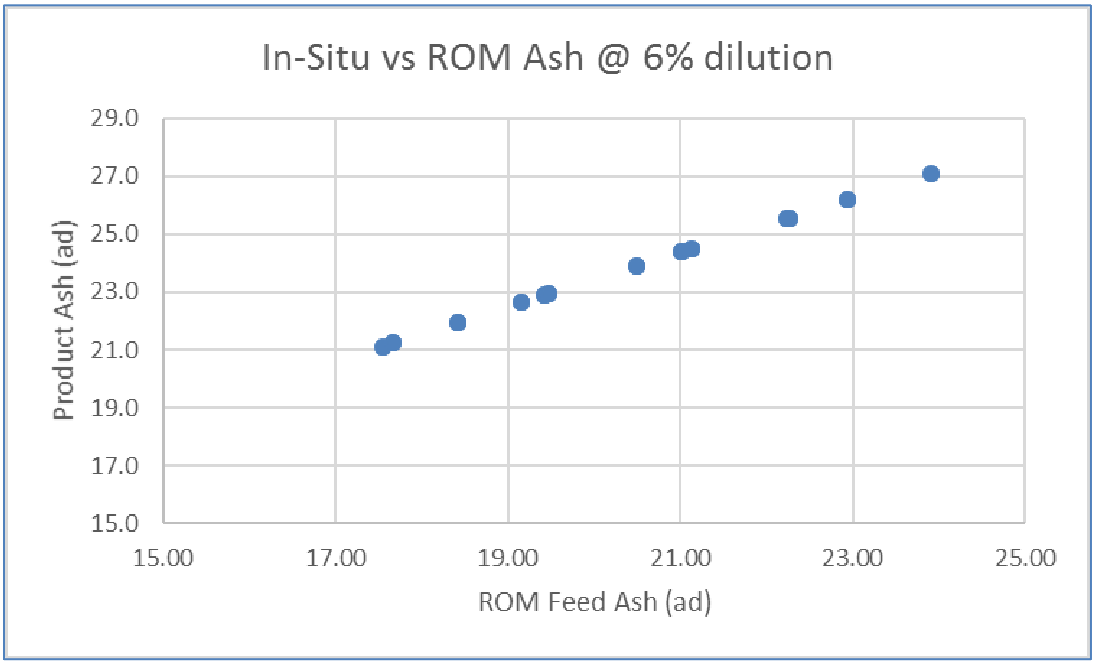
Table 2.

If it assumed that a product ash content of above 23% (ad) will attract penalties (refer Section **Utilisation Potential**), then the maximum in-situ ash that would support a ROM (unwashed) product less than 23%, is estimated to be about 19% (ad) (Figure 21). This assumes 6% average dilution, with an average dilution ash of 80% ash (ad). There is a significant area where UDWS in-situ ash is greater than 19%, which suggests that separation of dilution materials will be required in these areas. There are also areas with in-situ ash greater than 23% ash.

Table 1 Ply Data Summary, UDWS Working Section

		Ply Weighted Average (ad)									Washed F1.60		
BOREID	**Thickness**	**IM %**	**Ash %**	**VM %**	**FC %**	**TS %**	**CV MJ/kg**	**CV kcal/kg**	**CV (daf) MJ/kg**	**CV (daf) kcal/kg**	**Ash %**	**Yield %**	**Ash Reduction (%ad)**
HWK001	2.06	4.4	33.7	21.7	40.2	0.44	20.2	4819	30.4	7258	24.5	63.3	9.2
HWK002	3.3	4.8	15.0	27.9	52.3	0.42	27.0	6459	31.8	7594	12.0	87.7	3
HWK003	2.93	5.6	23.0	25.1	46.3	0.29	23.5	5605	30.4	7263	17.7	79.1	5.3
HWK004	2.29	4.2	22.9	24.6	48.3	0.30	24.2	5780	31.4	7494	20.2	87.7	2.7
HWK007	3.4	5.5	15.2	26.6	52.7	0.37	26.8	6411	31.7	7562	14.2	95.2	1
HWK009	2.94	4.1	29.9	21.0	44.9	0.40	22.0	5254	31.4	7491	20.1	60.4	9.8
HWK010	2.66	6.3	15.5	27.5	50.8	0.35	26.5	6342	31.4	7498	13.4	91.8	2.1
HWK012	3.4	6.3	13.5	27.8	52.4	0.39	27.2	6493	31.4	7502	12.6	97.8	0.9
HWK017	2.41	3.5	23.2	22.9	50.4	0.29	24.9	5939	32.4	7736	21.5	92.0	1.7
HWK018	2.78	5.5	19.0	23.6	52.0	0.36	25.5	6092	31.5	7516	17.0	93.3	2
HWK019	2.26	3.3	21.8	24.4	50.5	0.36	25.0	5971	31.9	7627	17.8	85.7	4
HWK020	3.24	3.8	13.3	28.9	54.0	0.47	27.8	6637	32.1	7658	11.8	96.7	1.5
HWK021	2.96	4.3	16.0	25.1	54.6	0.33	26.9	6427	32.0	7653	15.3	98.1	0.7
HWK023	2.4	3.9	22.7	25.5	47.9	0.29	24.4	5829	31.6	7545	19.3	85.3	3.4
HWK024	2.9	4.1	14.4	27.9	53.6	0.38	27.7	6610	32.3	7725	13.5	97.6	0.9
HWK027	2.53	3.4	18.5	24.8	53.3	0.35	26.5	6328	32.5	7761	17.5	97.6	1
HWK028	2.72	3.6	20.1	25.5	50.8	0.31	25.6	6122	32.1	7660	17.8	89.7	2.3
HWK030	2.24	2.6	23.4	22.9	51.1	0.35	24.9	5958	32.6	7788	18.8	79.3	4.6
HWK031	2.94	4.8	17.2	27.3	50.7	0.37	26.2	6261	31.7	7566	15.7	91.9	1.5
JDUL08	1.85	3.6	25.9										
RUM004	1.81	4.0	23.2	22.3	50.6	0.31	24.4	5830	31.8	7587	21.5	79.5	1.7
RUM005	2.36	4.1	18.3	26.0	51.6	0.37	26.1	6227	31.9	7617	16.8	94.6	1.5
RUM006	2.4	3.6	21.1	24.2	51.1	0.35	25.0	5970	31.7	7569	19.1	91.7	2
RUM007	1.9	4.4	20.0	24.3	51.3	0.36	25.5	6091	31.9	7609	18.4	94.9	1.6
RUM011	2.52	5.4	19.1	24.7	50.8	0.39	25.5	6100	31.6	7541	17.8	95.3	1.3
RUM012	2.78	5.5	18.4	25.1	50.9	0.34	25.6	6124	31.4	7506	16.9	95.8	1.5
RUM013	2.61	5.4	20.8	24.4	49.4	0.36	25.0	5981	31.6	7555	19.5	93.9	1.3
RUM014	2.89	5.3	20.5	26.1	48.1	0.34	25.0	5964	31.4	7507	18.7	92.8	1.8
RUM015	2.78	5.1	18.5	26.2	50.3	0.41	26.0	6219	31.9	7627	16.8	96.6	1.7
Average		**4.6**	**19.7**	**24.7**	**49.3**	**0.35**	**24.9**	**5948**	**30.93**	**7387**	**16.6**	**87.7**	
Minimum		**2.6**	**13.3**	**21.0**	**40.2**	**0.29**	**20.2**	**4819**	**30.4**	**7258**	**11.8**	**60.4**	
Maximum		**6.3**	**33.7**	**28.9**	**54.6**	**0.47**	**27.8**	**6637**	**32.6**	**7788**	**24.5**	**98.1**	

Figure 21 In-situ vs ROM Ash at 6% Dilution

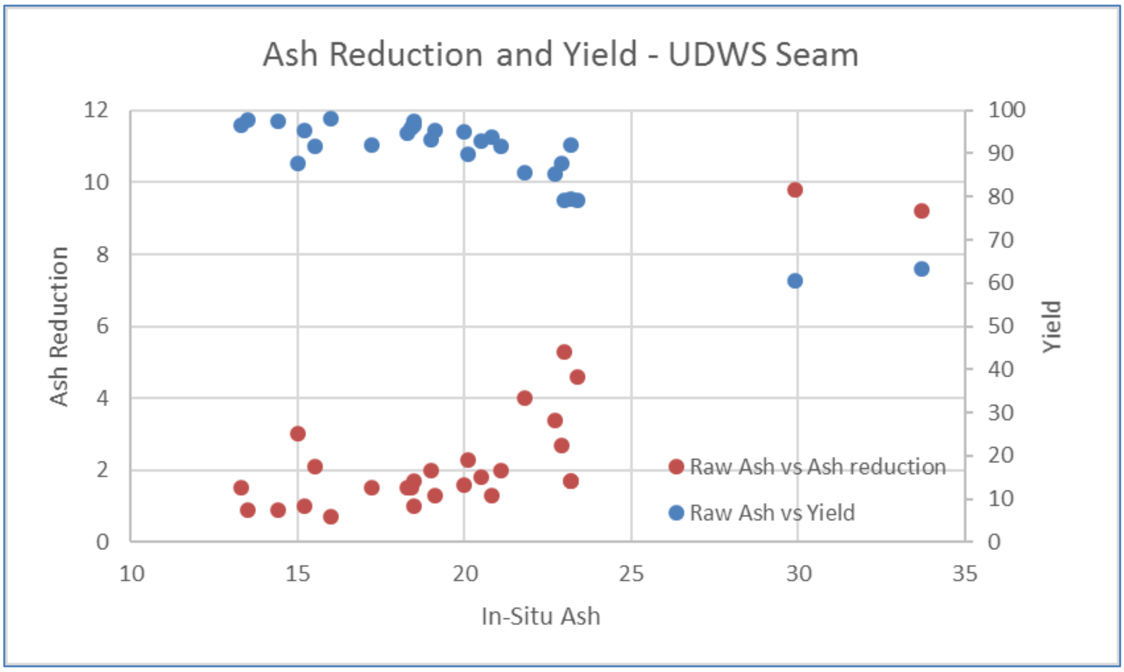


UDWS WASHABILITY:

Notably, and unlike the UG mining section, there are no, or very minor, non-coal partings within the UDWS mining section. Ash content therefore comprises mainly disseminated ash. Washability results indicate that the most ash/yield efficient cut-point is about F1.60SG, but that there is a high proportion of near gravity material (Bayly & Matthews, 2017). Table 1 and Figure 22 show that ash is generally only reduced by 0.7 – 2% at F1.60SG, when in-situ ash (undiluted) is less than about 24% (ad). This is at yields typically greater than 80%, averaging 92%, but yield is significantly compromised if a greater ash reduction is targeted. The reduction in ash by washing at F1.60 will likely increase significantly for a diluted UDWS ROM feed, while yield will reduce slightly.

We are in agreement with the Inventory Coal report, which concludes that a ROM product should be targeted for the UDWS working section. However, we consider that washing will be required in some areas, due to likely dilution impacts, if typical product ash penalties are to be avoided. We expect that wet rather than dry processing technologies will be required to separate dilution materials at Hawkins-Rumker, as is the case at the Ulan mine.

Figure 22 Cut-point F1.60 Ash Reduction and Yield – UDWS Seam



UDWS Product Specification

An indicative product specification is presented in

Table 2, based on an average of drill hole data relevant to the target mining area, and an assumed product total moisture of 8%. We note that the target mining area considered in this report, excludes resource areas with greater than 25% in-situ ash.

There has been no direct measure of UDWS ROM Moisture, but evidence from the adjacent Ulan mine indicates that a Total Moisture of 6-7% (ar) is normally achieved, with occasional increases to 10-11% due to periodic groundwater impacts (T McNally, pers.comm.).

We consider that a diluted UDWS ROM product is on average within the Newcastle 5500 GAR export thermal specification (refer Section **Utilisation Potential**), although washing will be periodically required to assist dilution management and avoid ash penalties.

Extended UDWS-UC2 Mining Section

Quality information is available from 7 drill sites within the area of the UDWS-UC2 mining section, of which 6 sites have ply by ply in-situ quality and 4 sites have detailed composite analysis results (ash composition, impurities and ash fusion temperatures). Two of the six sites with ply data, do not have full analysis of minor non-coal partings. We have estimated proximate, total sulphur and energy for these plies from other non-coal analysis results. One site (HWK024) was not sampled to the full extended height, and has not been used to determine mining section raw quality. Ultimate analysis results are mostly in error, and have not been used

A product specification for the UDWS-UC2 working section is shown in Table 3. The UDWS-UC2 mining section identified has very low in-situ ash and sulphur, and is likely to yield a low ash, high energy ROM product even after dilution. We note slagging and fouling indices are slightly higher for the UCL and UC2 seams, compared to the UDWS, for 3 of the 4 sites, but are still very low. The overall slagging and fouling propensity is indicated to be very low for the UDWS-UC2 mining section at all sites.

Table 2 Indicative Product Quality Specification, UDWS Working Section ROM Product

Hawkins-Rumker Project
Indicative Product Specification **UDWS Seam ROM Product**

February, 2018		ROM (GAR)	In-Situ				Range (ad)		Dilution
			GAR	AD	Dry	DAF	Min	Max	(ad)
Dilution %		6.0%							
Dilution Ash		80							
Proximate Analysis (%)	**Moisture**	8.0	8.0	4.6			2.6	6.3	2
	Ash	21.8	18.2	18.9	19.8		13.3	25.9	80
	Volatile Matter	23.5	24.2	25.0	26.2	32.6	22.3	28.9	13
	Fixed Carbon	46.8	49.6	51.6	54.1	67.4	46.3	54.6	8
Total Sulphur (%)		0.33	0.34	0.35	0.36	0.45	0.29	0.47	0.20
Chlorine (%)				0.011			0.010	0.020	
Fluorine (mg/kg)				58			26	120	
Calorific Value	**kcal/kg**	5528	5811	6010	6168	7387	5605	6637	
	MJ/kg	23.13	24.33	25.16	25.82	30.93	23.46	27.78	
Ultimate Analysis (%)	**Carbon**		63.5	65.6	68.6	82.7			
	Hydrogen		3.7	3.8	3.9	4.8			
	Nitrogen		1.6	1.6	1.7	2.1			
	Sulphur		0.31	0.33	0.34	0.41			
	Oxygen		6.8	7.0	7.4	8.9			
Ash Composition (average % in ash; dry basis)									
			SiO_2	76.69		**Mn_3O_4**	0.04		
			Al_2O_3	15.97		**SO_3**	0.90		
			Fe_2O_3	2.28		**P_2O_6**	0.11		
			CaO	1.52		**BaO**	0.03		
			MgO	0.65		**SrO**	0.04		
			Na_2O	0.10		**V_2O_5**	0.002		
			K_2O	0.49		**ZnO**	0.01		
			TiO_2	0.71		**Total**	99.55		
				Average			**Min**	**Max**	
Base / Acid Ratio				0.056			0.008	0.139	
Slagging Factor				0.026			0.003	0.070	
Silica %				94.5			87.1	99.4	
Fouling Index				0.0025			0.0000	0.0097	
(Fe_2O_3+CaO) % Of Total				3.8%			0.3%	9.0%	
HGI (only a few results available)				51			48	55	
Ash Fusion Temperatures (Degrees Celsius; Reducing)									
	Deformation			1508			1390	1560	
	Spherical			1523			1410	1560	
	Hemispherical			1535			1430	1560	
	Flow			1545			1480	1560	

Table 3 Indicative Product Quality Specification, UDWS-UC2 Working Section ROM Product

Hawkins-Rumker Project Indicative Product Specification		**UDWS-UC2 Working Section ROM Product**							
February, 2018		**ROM**		**In-Situ**			**In-Situ**		**Dilution**
		GAR	**GAR**	**AD**	**Dry**	**DAF**	**Min**	**Max**	**ad**
Dilution %		6.0%							
Dilution Ash		80							
Proximate Analysis (%)	**Moisture**	8	8	4.6			3.4	6.4	2
	Ash	18.8	15.1	15.6	16.4		13.7	17.5	80
	Volatile Matter	26.2	27.0	28.0	29.3	35.0	25.9	29.2	13
	Fixed Carbon	47.0	49.9	51.9	54.3	65.0	51.1	52.6	8
Total Sulphur (%)		0.39	0.40	0.42	0.44	0.52	0.39	0.48	0.2
Chlorine (%)				0.010			0.008	0.020	
Fluorine (mg/kg)				56			26	73	
Calorific Value	**kcal/kg**	5824	6125	6336	6347	7387	6287	6451	
	MJ/kg	24.4	25.6	26.5	26.6	30.9	26.3	27.0	
Ultimate Analysis (%)	**Carbon**								
	Hydrogen								
	Nitrogen								
	Sulphur								
	Oxygen								
Ash Composition (average % in ash; dry basis)									
			SiO_2	71.32		**Mn_3O_4**	0.07		
			Al_2O_3	21.48		**SO_3**	0.33		
			Fe_2O_3	3.42		**P_2O_6**	0.26		
			CaO	0.46		**BaO**	0.08		
			MgO	0.46		**SrO**	0.06		
			Na_2O	0.06		**V_2O_5**	0.008		
			K_2O	0.56		**ZnO**	0.01		
			TiO_2	0.92		**Total**	99.51		
				Average			**Min**	**Max**	
Base / Acid Ratio				0.054			0.013	0.086	
Slagging Factor				0.027			0.005	0.050	
Silica %				94.2			90.4	99.0	
Fouling Index				0.0030			0.0008	0.0054	
(Fe_2O_3+CaO) % Of Total				3.9%			0.6%	6.5%	
HGI				51			50	52	
Ash Fusion Temperatures (Degrees Celsius; Reducing)									
	Deformation			1515			1452	1560	
	Spherical			1548			1518	1560	
	Hemispherical			1553			1542	1560	
	Flow			1555			1550	1560	

UG Mining Section Quality

UG Seam In-Situ Quality

The UG mining section comprises high volatile bituminous coal (ASTM, 2005), with generally moderate - high in-situ ash (16 - 36%) within the area being targeted for mining. A summary of in-situ UDWS coal quality from mostly ply data is shown in Table 4, with F1.60 yield, ash and ash reduction data. Sites with heat affected coal have been excluded from this table. Total in-situ sulphur is mostly less than 0.5% (ad), but increases to 0.5 – 0.55% in the southern half of the target area (Figure 23).

UG seam raw ash is less than 20% (ad) in a central axis running NE-SW through the centre of the mining target, but increases to in excess of 30% in the NW along the margin of potentially mineable coal (Bayly & Matthews, 2017). We note the northwestern area of high ash has not been considered for mining area in preference to the UDWS seam, which closely overlies it.

UG seam Volatile Matter is generally higher than for the UDWS seam, ranging from 35.5 – 40.2% on a dry ash free basis. This excludes two heat affected UG intersections at GWG008 and CCW007, where localised de-volatilisation has occurred from intrusions.

UG seam energy is also relatively higher than for the UDWS seam, for a given ash content, and is again strongly related to ash, as shown in Figure 24. We have used the resulting regression equation in the financial model to estimate energy from ash for revenue calculations.

Figure 23: In-situ Total Sulphur, UG Working Section

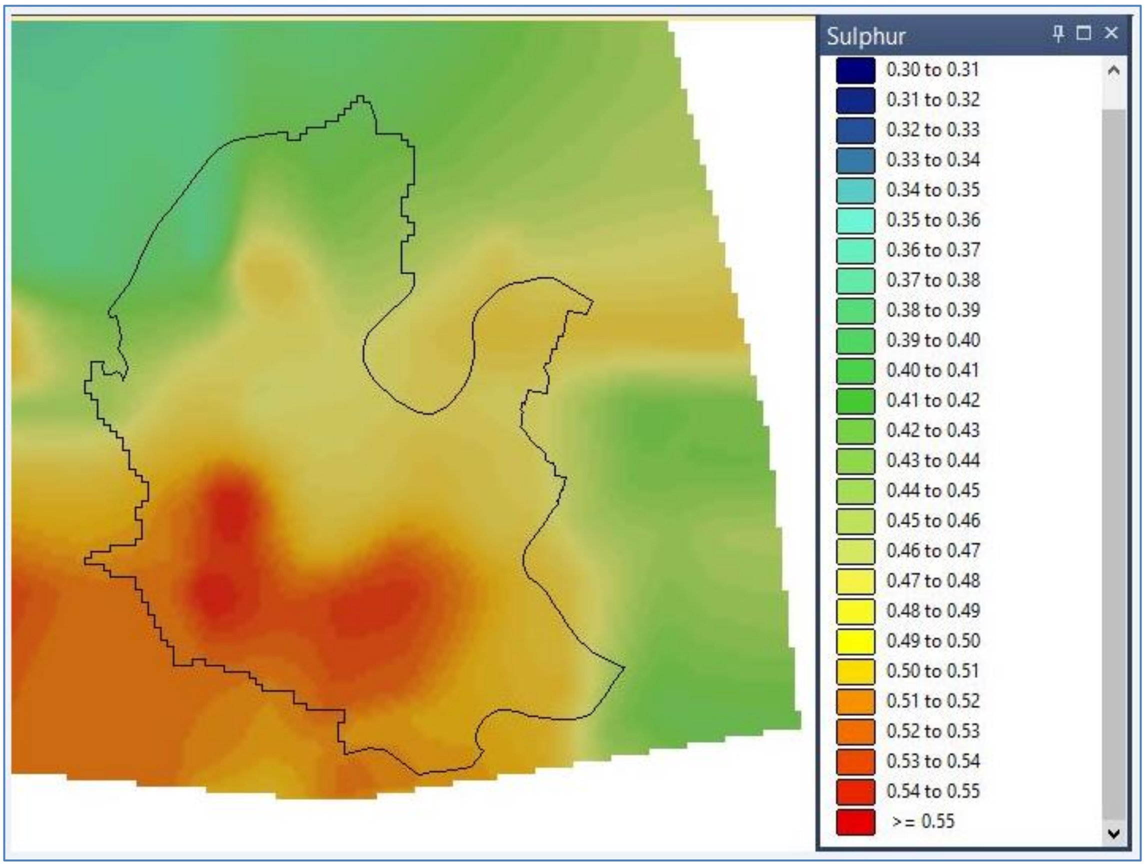
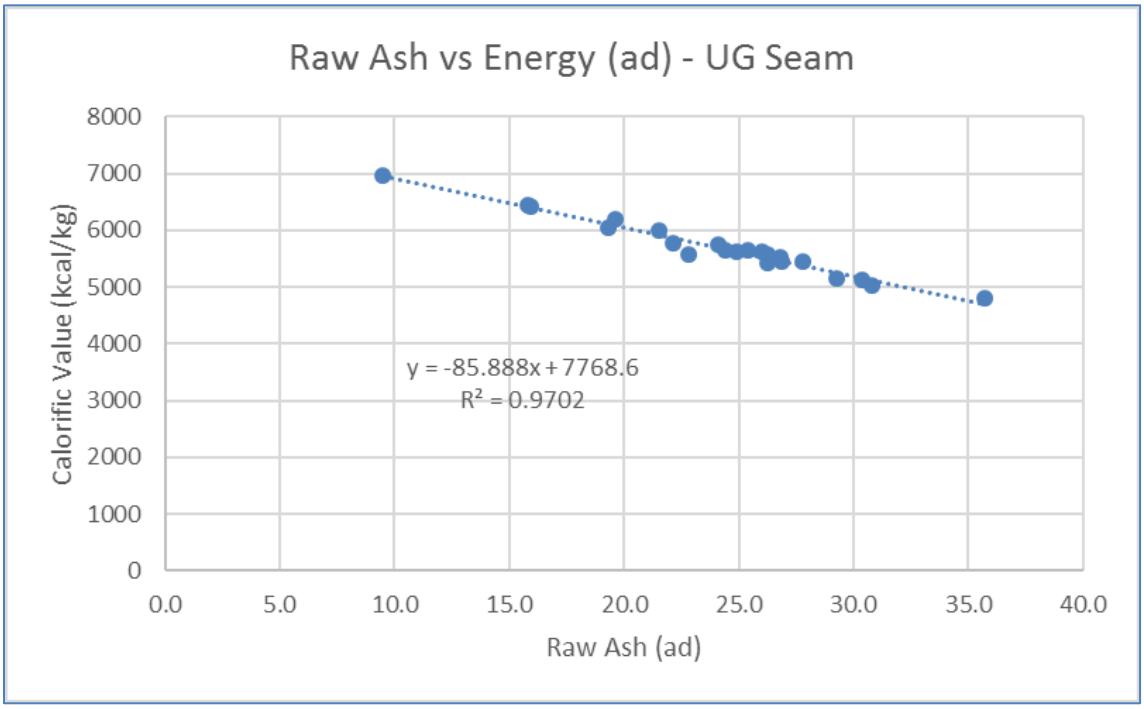


Figure 24 Ash vs Energy Relationship, UG Working Section



UG Seam Dilution

The mining concept developed for the UG seam in this report estimates on average 100mm dilution in the floor and 50mm dilution in the roof. This equates to from 5.3 – 8.0% dilution depending on seam thickness, with an average of 6.4%.

We have not estimated a diluted ROM feed quality for the UG seam because it is likely to be washed and we have assumed that dilution materials are likely to behave similarly to in-seam partings. The main impact of dilution will therefore be on yield, which we accounted for in the valuation model by applying a plant efficiency factor of 0.95.

Table 4 Ply Data Summary, UG Working Section

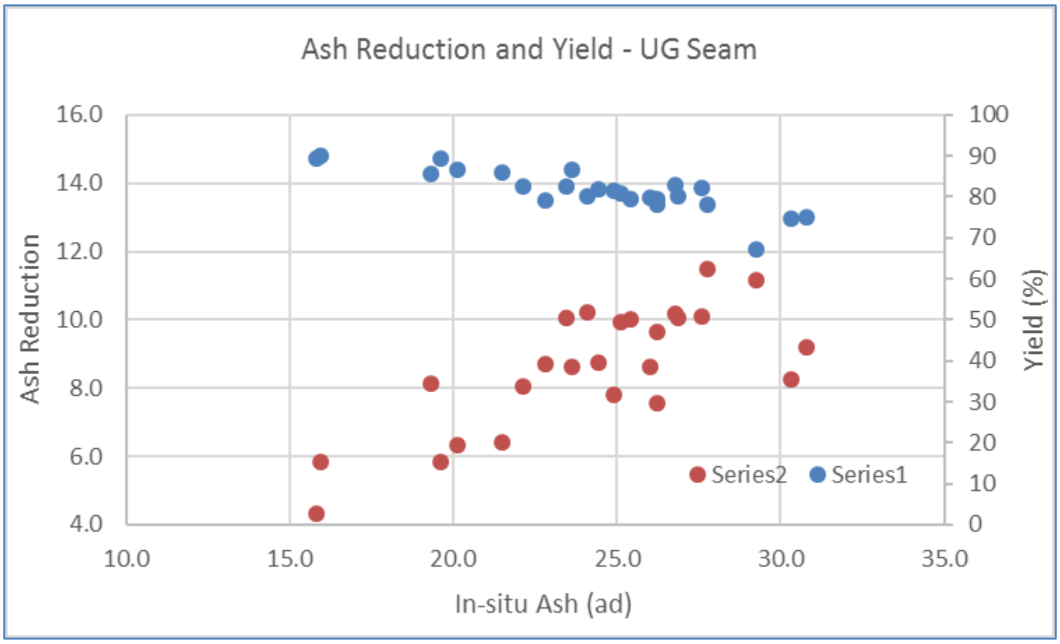
		Ply Weighted Average (ad)									Washed F1.60		
BOREID	**Thickness**	**IM %**	**Ash %**	**VM %**	**FC %**	**TS %**	**CV MJ/kg**	**CV kcal/kg**	**CV (daf) MJ/kg**	**CV (daf) kcal/kg**	**Ash %**	**Yield %**	**Ash Reduction (%ad)**
DECW05	2.28	3.5	25.1								81	15.2	9.9
DMDA02	2.51	3.2	23.5								82.7	13.4	10.1
GWG002	2.03	3.4	19.6	27.6	49.5	0.56	26.0	6199	31.0	7410	89.5	13.8	5.8
GWG003	2.21	3.8	22.8	27.9	45.6	0.57	23.4	5580	28.8	6876	79.3	14.1	8.7
GWG004	2.16	3.9	22.1	26.9	47.0	0.51	24.2	5771	29.6	7082	82.7	14.1	8.0
GWG006	2.35	4.2	24.9	26.3	44.6	0.43	23.5	5624	30.4	7265	81.5	17.1	7.8
JDUL08	2.10	2.6	27.6								82.3	17.5	10.1
JDUL09	2.73	3.1	23.6								86.8	15	8.6
JDUL10	2.34	3.8	20.1								86.5	13.8	6.3
RUM001	2.76	4.0	21.5	28.0	46.5	0.71	25.2	6006	32.0	7651	86.1	15.1	6.4
RUM002	1.88	4.3	19.3	29.7	46.7	0.56	25.3	6052	30.0	7165	85.5	11.2	8.1
RUM003	2.43	4.9	15.8	28.4	50.9	0.66	27.0	6440	31.6	7539	89.3	11.5	4.3
RUM004	2.28	3.9	26.0	28.4	41.7	0.47	23.6	5628	30.9	7387	79.7	17.4	8.6
RUM005	2.44	3.3	26.8	28.0	41.9	0.51	23.1	5516	29.4	7022	82.8	16.6	10.2
RUM006	2.35	3.3	26.9	26.9	43.0	0.51	22.8	5451	28.8	6868	80.3	16.8	10.1
RUM007	2.46	3.7	24.4	27.9	44.0	0.50	23.7	5657	29.5	7058	81.8	15.7	8.7
RUM008	2.29	4.0	9.5	32.6	53.9	0.66	29.1	6958	32.2	7688	93.3	5.9	3.6
RUM009	2.42	3.6	27.8	28.4	40.2	0.50	22.8	5450	29.7	7088	78.1	16.3	11.5
RUM010	1.97	4.1	16.0	29.5	50.5	0.63	26.8	6411	30.3	7244	90.2	10.1	5.9
RUM011	2.22	4.2	26.2	25.5	44.1	0.50	22.7	5421	29.4	7014	78.1	18.7	7.5
RUM012	2.12	4.4	30.8	24.3	40.5	0.44	21.1	5031	29.0	6934	75.1	21.6	9.2
RUM013	2.48	4.3	29.2	25.6	40.9	0.59	21.5	5146	29.3	7000	67.2	18.1	11.1
RUM014	2.11	4.5	30.3	24.0	41.1	0.49	21.5	5131	29.8	7110	74.8	22.1	8.2
RUM015	2.31	3.7	35.7	23.0	37.6	0.34	20.1	4811	31.3	7488			
RUM016	2.45	4.1	26.2	28.4	41.2	0.49	23.3	5562	29.7	7086	79.4	16.6	9.6
RUM017	2.82	3.4	25.4	27.0	44.2	0.80	23.7	5660	31.8	7587	79.4	15.4	10.0
RUM018	2.65	2.8	24.1	28.7	44.4	0.54	24.1	5754	31.7	7581	80.2	13.9	10.2
Average		**3.8**	**24.1**	**27.4**	**44.5**	**0.54**	**23.84**	**5694**	**30.29**	**7234**	**82.1**	**15.3**	**8.4**
Minimum		**2.6**	**9.5**	**23.0**	**37.6**	**0.34**	**20.14**	**4811**	**28.75**	**6868**	**67.2**	**5.9**	**3.6**
Maximum		**4.9**	**35.7**	**32.6**	**53.9**	**0.80**	**29.13**	**6958**	**32.19**	**7688**	**93.3**	**22.1**	**11.5**

UG SEAM WASHABILITY:

The UG mining section is characterised by many non-coal partings, unlike the UDWS mining section. The ash values presented in Table 4 therefore include a significant proportion of ash from partings. Washability results confirm that significant ash reductions are achievable by washing the UG seam, with the most ash/yield efficient cut-point at about F1.60SG, as determined for undiluted coal (Bayly & Matthews, 2017). Ash reductions of about 4 – 12% (ad) are indicated (Figure 25 and Table 4). This is achieved at yields typically greater than 75% across the whole range of in-situ ash from 15 – 31% (ad), averaging 82% yield.

We are in agreement with the Inventory Coal report, which concluded that the UG seam would significantly benefit from washing. Further specialist assessment of the washability data is required to determine an appropriate design of a Coal Handling and Processing Plant (CHPP), however, experience from the adjacent Charbon Mine indicates that a 14 – 18% ash (ad) export thermal product can be produced using conventional methods. At this mine ROM coal was passed initially through a crusher, with crushed material then passed over a screen to separate the coarse material, which is returned to the crusher. Feed from the screens was then passed through a series of dense-medium cyclone and spiral washing circuits.

Figure 25 Cut-Point F1.60 Ash Reduction and Yield - UG Seam



UG PRODUCT SPECIFICATION

An indicative product specification is presented in Table 5, based on an average of all available drill hole data relevant to the targeted mining area, and an assumed product total moisture of 7%. As there has been no direct measure of UG Product Moisture, we have assumed an average total moisture content of 7%, based on evidence from adjacent mines in the area and the lower inherent moisture of UG coal.

We consider that washed UG working section product quality, is on average within the Newcastle 6300 GAR export thermal specification (refer Section **Utilisation Potential**). We note that average UG product energy is at the high end of the energy range (GAR) for the Newcastle 6300 brand, and will therefore attract price premium for energy.

Table 5 Indicative Product Quality Specification, UG Working Section Washed Product

Hawkins-Rumker Project							
Indicative Product Specification			**UG Working Section F1.60 Product (undiluted)**				
February, 2018			**In-Situ**			**Range (ad)**	
		GAR	**AD**	**Dry**	**DAF**	**Min**	**Max**
Proximate Analysis (%)	**Moisture**	7	3.6			3.1	4.9
	Ash	15.3	15.8	16.4		10.1	22.0
	Volatile Matter	28.8	29.7	35.3	42.2	26.3	33.1
	Fixed Carbon	48.2	50.9	72.4		46.9	54.8
Total Sulphur (%)		0.45	0.47	0.9		0.36	0.55
Chlorine (%)			0.01			0.01	0.01
Fluorine (mg/kg)			47			30	140
Calorific Value	**kcal/kg**	6305	6517	6348	7387	5940	6996
	MJ/kg	26.4	27.29	26.58	30.93	24.87	29.29
Ultimate Analysis (%)	**Carbon**	66.16	68.4	70.9	82.48		
	Hydrogen	4.15	4.3	4.4	5.17		
	Nitrogen	1.26	1.3	1.7	1.96		
	Sulphur	0.32	0.33	0.50	0.58		
	Oxygen	28.1	25.7	22.5	9.82		
Ash Composition (average % in ash; dry basis)							
		SiO_2	81.20		**Mn_3O_4**	0.03	
		Al_2O_3	14.56		**SO_3**	0.10	
		Fe_2O_3	1.87		**P_2O_6**	0.14	
		CaO	0.22		**BaO**	0.04	
		MgO	0.21		**SrO**	0.06	
		Na_2O	0.07		**V_2O_5**	0.021	
		K_2O	0.53		**ZnO**	0.02	
		TiO_2	0.68		**Total**	99.73	
			Average			**Minimum**	**Maximum**
Base / Acid Ratio			0.029			0.000	0.082
Slagging Factor			0.039			0.0052	0.351
Silica %			0.0026			0.0002	0.0159
Fouling Index			97.2			91.1	99.0
(Fe_2O_3+CaO) % Of Total			2.1%			0.8%	6.4%
HGI			47			43	49
Ash Fusion Temperatures (Degrees Celsius; Reducing)							
	Deformation		1487			1270	1560
	Spherical		1544			1470	1560
	Hemispherical		1549			1490	1560
	Flow		1554			1530	1560

TRACE ELEMENTS

Trace element data is summarised in Table 6 for the UDWS and UG working sections from an analysis made in the Inventory Coal report (Bayly & Matthews, 2017). We note that with the exception of Selenium (Se) and Beryllium (Be), all working section products are competitive in the international market with respect to impurities. However, Selenium for the UG working section is relatively high and on average marginally higher than the maximum specification for the Newcastle 6300 (GAR) brand. Beryllium is also higher than Australian and international averages, but we are not aware of any general market constraints for Beryllium.

Table 6 Trace Element Data Summary

Working Section	Basis	As	B	Be	Cd	Cr	F	Hg	Mo	Pb	Se	Zn
UDWS (mg/kg)	**Mean**	**0.34**	**18**	**1.6**	**0.05**	**4.3**	**55.7**	**0.02**	**0.90**	**5.44**	**0.89**	**11.01**
	Min	0.2	12	1	0.03	3.6	26	0.01	0.6	4.7	0.7	8.8
	Max	0.6	27	3.8	0.06	4.9	74	0.02	1.2	5.9	1	14.3
UG (mg/kg)	**Mean**	**0.33**	**19.20**	**2.89**	**0.05**	**6.57**	**19.33**	**0.01**	**1.10**	**6.27**	**2.12**	**22.66**
	Min	0.3	17	2.7	0.05	5	35	0.01	0.8	4.8	1.3	20.2
	Max	0.4	22	3.1	0.06	8.6	49	0.02	1.4	7.6	**4**	26.2
Australian export average (mg/kg)		0.93	21	0.82	0.09	9	98	0.02	0.85	5.8	0.47	14
Chinese export average (mg/kg)		1.4	55	1.2	0.06	7	100	0.07	0.95	11	1.5	14
International export average (mg/kg)		3.4	62	0.91	0.08	12	95	0.07	1.1	7	1.4	12
Newcastle High Ash Brand Max Spec.		80					200	0.6				
Newcastle 6300 Brand Max Spec.			60								2.0	

Source: (Bayly & Matthews, 2017) and Global Coal (https://www.globalcoal.com/scota/specifications.cfm)

Utilisation Potential and Market Analysis

Utilisation Potential

Hawkins-Rumker coal quality is suited to the thermal coal market, including export thermal and potentially domestic supply. The main market is likely to be for the generation of electricity in coal fired power stations. The UDWS and UDWS-UC2 products are likely to be marketed with reference to the Newcastle High Ash (NHA) brand (5500 kcal/kg NAR), while the washed UG working section product has higher energy and lower ash, and is likely to be marketed with reference to the Newcastle 6000 (kcal/kg NAR) brand. Typical specifications for these brands are summarised in Table 7.

We consider that the UDWS and UDWS-UC2 ROM products, and UDWS and UG washed products will be attractive in their respective export thermal coal markets, due to relative high energy for a given ash content, and low sulphur.

Table 7 Newcastle Thermal Coal Specifications

Specification	Basis	Newcastle 6300			Newcastle High Ash (5500)		
		Typical	Penalties		Typical	Penalties	
			Minimum	Maximum		Minimum	Maximum
Energy (NCV)	kcal/kg GAR	6,300	6100	6500	5500	5300	5700
Total Moisture	%AR	10.0	-	15.0	10.0	-	15.0
Ash	%AD	13.0	-	16.0	17 - 23	-	23.0
Volatile Matter	%AD	31.0	27.0	35.0	-	23.0	32.0
Total Sulphur	%AD	0.70	-	0.75	0.65	-	1.0
Calcium Oxide in Ash	%DB		-	7.0	-	-	-
Hardgrove Grindability Index (HGI)	-	-	45	70	-	45	70
Initial Deformation Temperature (Reducing)	oC	-	-	-	-	1200	-
Chlorine	% DB	-	-	-	-	-	0.3
Fluorine	mg/kg DB	-	-	-	-	-	200
Selenium	mg/kg DB			**2.0**			
Boron	mg/kg DB	60					
Phosphorous	% DB	-	-	-	-	-	0.15
Mercury	mg/kg DB	-	-	-	-	-	0.6
Arsenic	mg/kg DB	-	-	-	-	-	80

Sources: (S&P Global, Platts, 2017) and Global Coal (https://www.globalcoal.com/scota/specifications.cfm)

There is very little phosphorous data for the UDWS and UDWS-UC2 mining sections, but the available data is all less than 0.005% (db) and much less than the NHA brand maximum specification. Chlorine and Fluorine are also well within NHA tolerances for the UDWS and UDWS-UC2 mining sections.

Phosphorous in the UG seam washed product ranges from 0.004 – 0.022% in coal (db), although again there is not much data available. Chlorine and Fluorine are also well within likely market tolerance for the Newcastle 6300 (GAR) brand. However, we note as above that the trace element Selenium is relatively high (Table 6) and on average marginally higher than the Newcastle 6300 maximum specification. We do not expect that this will present a major marketing issue for UG seam coal.

Ash characteristics of all working sections appear very favourable for utilisation as a thermal coal, based on typical indices (Coal Technology, 2017). The ratio of base to acid ash constituents is consistently very low, which in combination with low total sulphur indicates a very low slagging propensity. Similarly, low base to acid ratio in combination with low NaO_2 indicates a very low fouling propensity. The average base to acid ratio of ash constituents and total sulphur, are slightly higher for the UG seam washed product, compared to a UDWS ROM product, but low slagging and fouling propensities are still indicated.

Other favourable indices indicating low slagging and/or fouling propensity for all targeted working sections (refer Product Specification Tables) include (Coal Technology, 2017):

- High ash fusion temperatures (spherical, reducing), where temperatures above 1350 degrees Celsius are recommended;
- High proportion of silica in ash, where greater than 72% is recommended; and
- Low FeO_2+CaO in ash, where less than 10% indicates low slagging propensity.

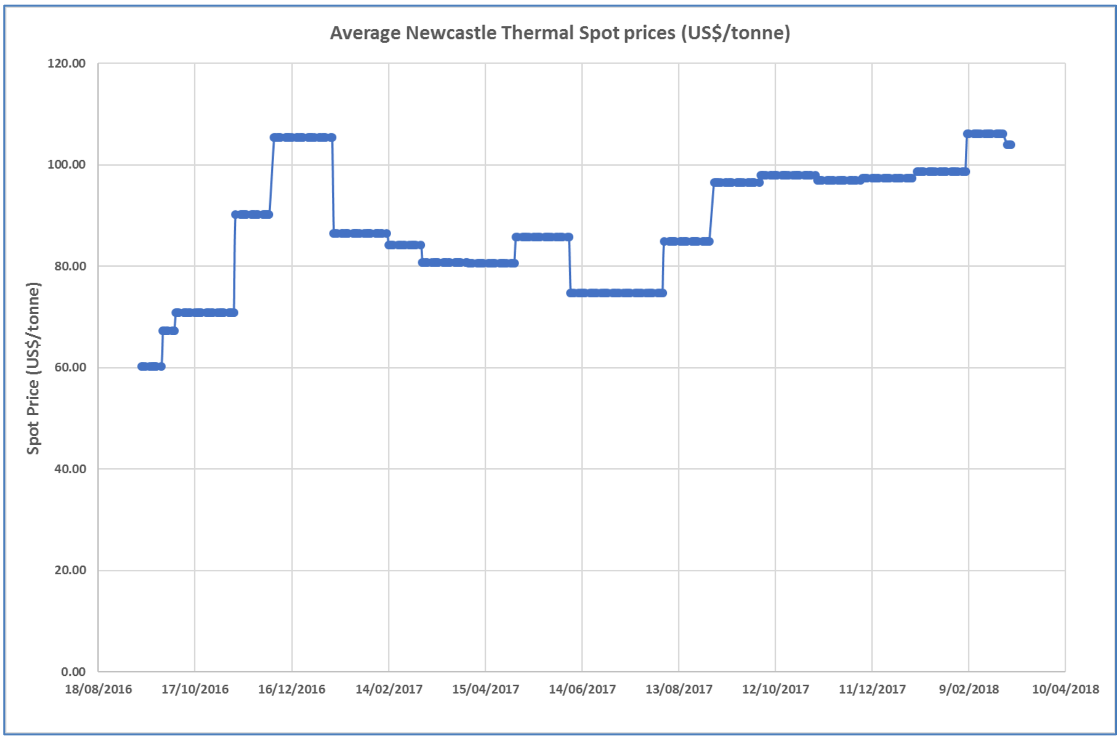
Hardgrove Grindability Index (HGI) is within Newcastle specification tolerances (Table 7) for all working sections.

Market Assessment

The export thermal coal market has strengthened in the last 12 months as shown by the average Newcastle spot price trend in Figure 26. The relatively high thermal prices have been driven by strong world demand, including consumer restocking of inventories after Australian supply disruptions in late 2016 and early 2017. However, prices are expected to ease through 2018 and early 2019, as supply rebounds and demand moderates (BREE, 2017d).

The latest IEA World Energy Outlook (IEA, 2017) released in November 2017 predicts that average international growth in demand for coal for energy use over their forecast period to 2040 will level off, despite global growth, and that seaborne coal trade does not grow. However, coal trade is expected to vary significantly between regions and by coal type. For example in the IEA's New Policies Scenario coal demand is expected to decline in advanced economies such as the European Union, Japan, and Korea, which presumably will seek to reduce their dependence on coal, and China is expected to gradually join this sector as it completes restructuring of its coal industry and reliance on coal for energy. However, IEA expect that this decline in demand for coal will be matched by increased demand for coal into developing countries such as India and price sensitive countries in South East Asia (IEA, 2017), who are likely to prefer coal to more expensive sources of energy.

Figure 26 Average Newcastle Thermal Spot Prices



Source: SNL data

Another significant factor contributing to coal demand trends is the improving efficiency of coal fired power station technologies, such as Supercritical and Ultra-Supercritical systems that operate at higher temperatures and pressures (IEA, 2017). We expect that these technologies and the push for cleaner burning coal and reduced carbon emissions, is likely to favour better quality coals. Although India has significant domestic supplies of coal, they are generally of poorer quality.

There is therefore expected to be an increased demand for better quality thermal coals over the long term, due to a move to supercritical and ultra-supercritical power generation technologies. Australian producers with high energy and low ash coal will tend to take share from local/overseas producers of lower quality coal, as developed and developing countries look to reduce air pollution, particularly during their winter months (BREE, 2017d). The IEA 2017 New Policies Scenario outlook predicts Australian coal exports to rise by 18% over the period to 2040, the largest increase of any net exporting country. The proportion of thermal coal in this Australian exports prediction stays at about 50%.

On the supply side of the equation, Australian production of thermal coal has the potential to increase significantly with the expansion of Hunter Valley mines such as Narrabri and Moolarben, and later Mangoola and Ravensworth (BREE, 2017d), and Queensland mines such as Rolleston and Callide. We note that of the 34 coal mining projects listed by the Australian Government as potentially starting before the end of 2023, 27 projects with a total annual production of 313Mtpa involve predominantly thermal coal. Of these 6 projects totalling 146Mtpa, occur in either the Galilee or North Surat Basins.

We therefore consider that, despite increased demand for Australian thermal coal, potentially increasing supplies from Columbia, Russia and Australia may shift the thermal coal market into oversupply, which would lead to thermal coal price reductions.

We have not considered the possibility of the Hawkins-Rumker project supplying the domestic thermal coal market, but note that construction of a new technology Power Station in the vicinity would reduce transport costs significantly, and is worth considering.

Coal Seam Gas

The deepest borehole (DM Rumker DDH 14) was subject to gas desorption testing. Total gas content on a dry, ash-free basis ranged from 0.07 – 0.21 m^3/t, which is low compared to coalfields other than the Western Coalfield in NSW (Bayly & Matthews, 2017). Gas composition at DDH 14 is predominantly nitrogen (78.7% average), with low carbon dioxide content (11.7% average) and lower methane content (2.4% average). We have assumed that coal seam gas will not be an issue of concern at Hawkins-Rumker.

Inventory Coal Estimates

Inventory Coal estimates made by NSW Planning & Environment, Resources and Geoscience department (Bayly & Matthews, 2017) are presented directly form that report in Table 8.

Table 8 Inventory Coal Estimates

Seam	Seam thickness (m)	ROM (Mt)	Product (Mt)	Apparent relative density (g/cm^3)	Moisture (%)	Ash (%)	Fixed carbon (%)	Volatile matter (%)	Sulphur (%)	Specific energy (ad kcal/kg)	Yield (% @FS 1.6)	Ash (% @FS 1.6)
UC2	0.51	3.6	2.9	1.36	5.1	17.4	46.7	30.8	0.47	6,140	79.7	10.4
UCL	0.24	1.7	1.3	1.51	3.6	29.4	46.5	27.7	0.39	5,957	74.0	10.0
UDWS	2.42	285.8	255.0	1.42	4.4	21.2	50.2	24.5	0.37	5,996	89.2	17.9
UG	2.24	624.3	513.6	1.43	3.7	23.0	49.9	26.8	0.57	6,233	82.3	14.5

Mining and Infrastructure Assessment

Geos Mining has commissioned MEC Mining to undertake a mining assessment of the Hawkins-Rumker project. The results of MEC's assessment are presented in Appendix 1 in the form of two Memoranda from MEC Mining to Geos Mining (MEC Mining, 2018). The first describes the mining assessment and a first principals Base Case mining scenario. The second memo describes the results of a Range Analysis undertaken at a variety of production rates in comparison with data made available from the nearby Ulan Mine. We note the Range Analysis resulted in the Base Case mining scenario in Memo 1 becoming a Low Case mining scenario in Memo 2. These assessments are summarised in following sections of this report.

Geos Mining has also commissioned Wave International to undertake an assessment of on and off site non-process (NPI) surface infrastructure requirements and costs for the Hawkins-Rumker project. The results of Wave International's assessment are presented in Appendix 2, and are summarised in Section **Surface and Coal Transport Infrastructure** below.

Information from Neighbouring Mines

The Ulan (east) and Ulan West underground mines successfully mine the UDWS working section in a geologically similar area to the northwest of Hawkins-Rumker (Figure 3). The Ulan West mine, which has relatively good roof and floor conditions, washes about 10% of its ROM feed, while the Ulan East underground washes about 30% of its ROM feed, due to relatively poor floor conditions and more dilution (T McNally, pers.comm.). The UDWS roof is relatively uniform, but floor dilution is a significant issue at the Ulan East underground mine, which is controlled by careful mining horizon control and the availability of washplant facilities as backup.

The ROM product from the Ulan mine averages approximately 8% total moisture, but this may vary up to 10-11% when there is groundwater inflow.

We were unable to contact personnel from the now closed Charbon Colliery, which has mined the UG working section. Anecdotal evidence from the Inventory Coal report (Bayly & Matthews, 2017) indicates that the persistent band between the UG seam and F ply at Charbon Colliery, is a more stable roof than the tuffaceous F ply (pers. comm. retired mine personnel, Charbon Colliery).

The Moolarben Mine, to the immediate North of the project area, operates with both opencut and underground mines. The longwall operates with ~310m wide panels in an equivalent of the UDWS seam, with a maximum extraction height of 3.5m.

MEC discussions with the Ulan mine Technical Services Manager (T McNally) are summarised below. We thank Mr McNally for providing this and other information used in this report.

The Longwall operates 5 days per week, with 13 operating and 2 maintenance 5.5hr shifts. This results in typically about 65 cutting hours per week for a 7 man operation. Longwall moves typically occur within an 8 week period, including ramp down and ramp up. Spare equipment, excluding roof supports, means they can pre-install. Longwall retreat rates range from 1.25m to 2.0m per operational hour (mpoh), with a mid-point at 1.6mpoh. Ground stresses (roof variability) and water management are the most significant issues for the longwall operation. Long panels, which range from 5.6 to 7.5km are ventilated to minimise pressure at 3,000Pa.

The development operation at Ulan West uses continuous haulage, with very good advance rates of 8 to 9 mpoh typically achieved. Advance rates at Ulan East, which reflect poorer mining conditions, are typically 3.5 to 5mpoh, which is still relatively good, reducing to 1 to 1.5mpoh in more difficult areas. Floor conditions, which are impacted by a seam split line in western areas of this mine, are the main issue at Ulan East. In particular floor conditions degenerate in areas of Carbonaceous Mudstone, which typically require concreting. Rib conditions are generally good, with low levels of structural disturbance. Faults are typically normal, with less than 2m throws and sometimes localised stress impacts.

Surface Constraints

Surface constraints to underground mining in the area include:

- The Wollemi National Park, which borders the eastern side of the mainly the UG seam resource, is a protected area that is part of the Greater Blue Mountains World Heritage Area.;
- Low lying alluvial flats of the middle and upper Growee River system, which extend into both target coal resource areas from the east, contain the following environmentally significant areas (Figure 28 and Figure 29):
    - Biophysical Strategic Land Use (BSAL) areas; and
    - Registered Alluvial Groundwater source areas.
- The Bylong Valley road, and associated power lines, which pass through the centre of the Hawkins-Rumker area (Figure 3), coincidentally along the boundary between the UDWS and UG coal resource areas;
- Electricity transmission lines that pass north-south to the east of the Project area, and beneath the extreme northwestern part of the UDWS (Figure 3). The UDWS seam in this area is relatively high ash, and has not been targeted for mining in this study. All other surface infrastructure occurs outside of the area proposed for underground mining in this study;
- Cliff lines formed by erosion resistant units of the Triassic Narrabeen Formation, which are a characteristic feature of the area.

It has been assumed that surface subsidence from longwall mining may compromise the Wollemi National Park, BSAL and Alluvial Groundwater areas. We have assumed that subsidence impacts may extend to the surface at a rule of thumb angle of draw of 26.5^{o} from the target seam roof, as proposed by the NSW Guidelines for managing mining subsidence (Workplace Health and Safety, 2017). After consideration of the depth to the UDWS and UG seam roof in the vicinity of surface features requiring protection, we have defined a 300m buffer around the Wollemi National Park, BSAL and Alluvial Groundwater areas (Figure 28 and Figure 29) that ensures no impact from surface subsidence from longwall panel extraction.

Longwall panel layouts have also been designed to avoid the Bylong Valley road, and associated power lines, and thus minimise subsidence impacts on this infrastructure.

Cliff lines formed by erosion resistant units of the Triassic Narrabeen Formation occur mainly in the northern part of the project area. We consider that the proposed longwall layouts, which are confined to central and southern areas in either the UDWS or UG seams, will not impact these features.

Resource Constraints

MEC Mining has developed a matrix to assist in the characterisation of coal deposits, which contains resource factors that may influence mining method and base production rates (MEC Mining, 2018). It is used to ultimately rank resource characteristics according to the level of geological knowledge and their influence on development and longwall base rates. The matrix is discussed in MEC Mining memo 1 in Appendix 1.

The following constraints have been applied, either as spatial constraints (eg seam thickness) or as influences on mining method or production rates.

Seam Thickness and Depth

Depth of burial provides a constraint to underground longwall mining where the seam roof is near surface. Longwall panels have been constrained to depths greater than 40m from surface to the seam roof, as determined from the existing geological model. We note this eliminates a significant area of coal for both seams from potential reserves, in areas bordering outcrop line, due to the dissected nature of the topography. Bord & Pillar mining is not constrained in this way. Depth of burial does not otherwise provide a constraint to underground mining of either seam at Hawkins-Rumker, with depths to coal typically less than 300m.

Seam thickness constraint isolines at 1.8, 1.2 and 0.6m were determined from the existing model for both the UDWS (Figure 28) and UG (Figure 29), as applicable, and supplied to MEC mining engineers. These relate to mining method constraints, as summarised in Table 9.

Table 9 Seam Thickness Mining Constraints Summary

Mining Method	Seam Thickness Minimum	Seam Thickness Maximum
Development	1.8	4.0
Bord & Pillar	1.8	4.0
Longwall – Conventional Roof Support	1.8	8.0
Longwall – Low Profile Roof Support	1.2	1.8
Low Profile (Plow) Longwall	0.6	2.3

Interburden Thickness

The UDWS and UG seam Inventory Resource areas, as defined by (Bayly & Matthews, 2017), overlap as shown in Figure 27. There is also additional resource overlap if the minimum thickness criteria of potentially mineable coal is extended to 1.2m or 0.6m, as shown in this figure.

Interburden thickness in this area (Figure 15) is from 3 – 4m thick in the main area of overlapping UDWS and UG seam. This constrains mining to only one of these seams in this area, due to potentially hazardous stress interactions between mine workings in such close proximity.

UDWS and UG seam Overlap

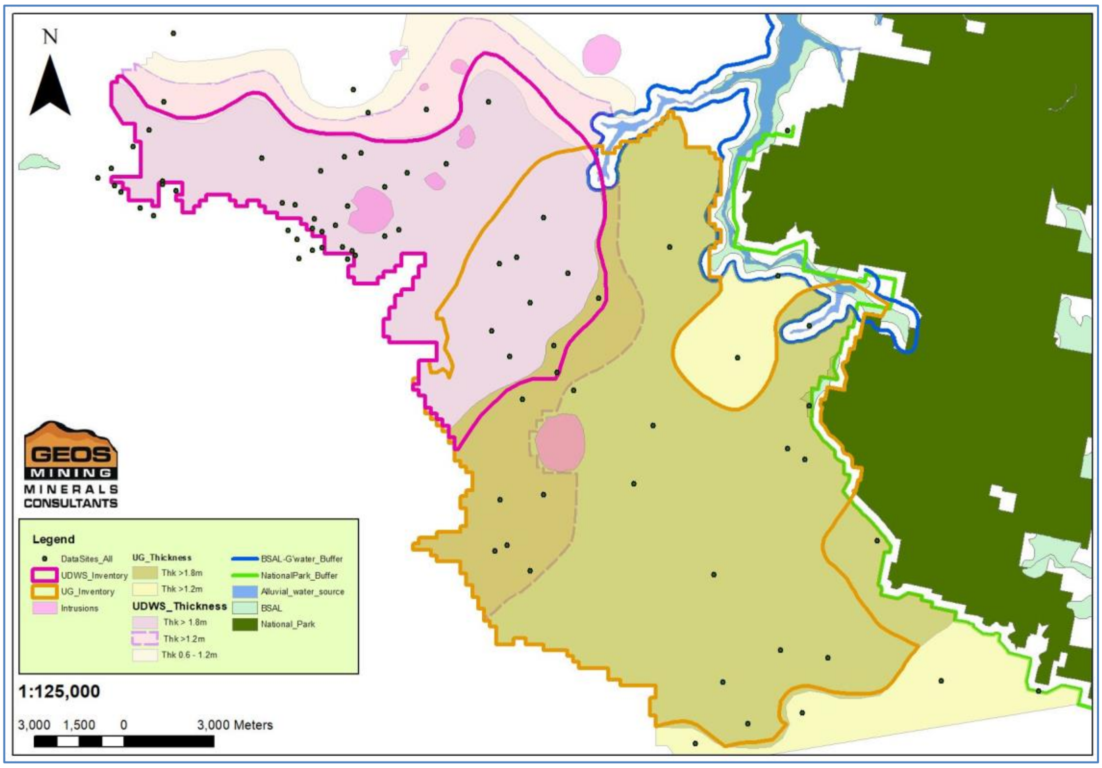
Consequently, a decision has been made regarding which seam is preferred in the area of resource overlap. The major characteristics of each in within the resource overlap area are summarised in Table 10. We consider that the quality of both seams, after dilution, requires that washing will be necessary periodically for the UDWS seam, and all of the time for the UG seam. We conclude that the higher product yields that are likely to be achieved from mining the UDWS seam in this area, targeting a ROM bypass product with periodic washing, indicate the UDWS seam should be the preferred mining target, despite probably better product quality from the UG seam.

However, the UG seam is preferred in the area where the UDWS seam thins to less than 1.8m thick, due to likely higher productivity and better product quality in this area. It overlies a UG seam that is 2.0 – 3.0m thick in this area, with washed yield mainly greater than 80%.

Table 10 Seam Characteristics in the area of Resource Overlap

Seam Characteristic	UDWS	UG
Seam thickness	2 – 2.7m	2 – 2.5m
Raw ash	15 – 25% ad	25 – 35% ad
Washing	ROM Bypass Possible, with washplant backup required	Requires washing
Yield @ 1.6	Mainly >85% (SW area <80%)	Mainly < 80%
Product ash washed	mainly 16-20% ash (ad)	17 – 25% ash (ad)

Figure 27 Area of UDWS and UG Seam Overlap



STRUCTURE

The shallow dipping and relatively structurally benign nature of coal seams at Hawkins-Rumker, lead us to assume structure will not be a significant constraint to longwall mining. Drilling to date shows no clear indications of definable structures, and we have therefore assumed structure will not constrain longwall mining layouts.

However, Section **Structure** discusses the possibility of an ENE – WSW trending structure with significant throw in the northeast of the UDWS resource area, and a structural anomaly around RUM003 in the central part of the UG resource area. There is as yet insufficient drilling data to define these anomalies, and further investigation of these areas is required. As is always the case with longwall mining, structural disturbances are a significant risk.

Heat Affected Coal

Section **Intrusions and Heat Affected Coal** summarises current knowledge of intrusion impacts on coal inventory within the Hawkins-Rumker area.

Intrusions exposed at the surface have been mapped (Bayly & Matthews, 2017), as shown in the constraint maps below. Heat affected coal has been identified in drill core in the north of the UDWS inventory area, and east and southeast of the UG inventory area, as indicated by reduced volatile matter on a dry ash free basis.

We have adopted the heat affected coal exclusion areas as defined in the Inventory report (Bayly & Matthews, 2017), but note that energy is affected less than volatile matter, and volatile matter within the exclusion areas may not be reduced to unmarketable levels. We consider that further investigations are more likely to reduce, rather than increase, the area of uneconomic, heat affected coal.

Coal Quality

We initially excluded areas of the UDWS seam with in-situ ash greater than 25% (Figure 28), assuming this coal would be difficult to market. We note that this may not be the case if there is a washplant facility, and these areas provide some upside opportunity.

Given the impacts of dilution on ROM product quality (refer Section **UDWS Dilution),** we conservatively defined a 17% (ad) in-situ ash area for the UDWS (Figure 28), and extended UDWS-UCL-UC2 working sections, within which mining may occur without a washplant. If it is assumed that the UDWS seam is periodically washed, then no other in-situ ash constraints need be applied.

The UG seam is assumed to be fully washed, and so no coal quality constraints other than for heat affected coal, need be applied.

Roof and Floor Materials

Section **Overburden and Interburden Materials** discusses the nature and distribution of roof and floor materials for the UDWS and UG seams.

We consider that roof lithologies do not present issues that may preclude mining in any area. Similarly floor lithologies, although problematic for most areas of the UDWS seam and some areas of the UG seam, will not preclude mining.

Coal Seam Gas

No coal seam gas constraints need be applied, as discussed in Section **Coal Seam Gas**.

Incendive Temperature Potential

There are no recorded instances of conglomerate, sandstone or siliceous material within the UDWS or UG working sections that may provide a source of ignition. There are, however, several instances of sandstone, conglomerate or volcanics at the UG seam floor That may provide a source of ignition, but no spatial constraints need be applied.

Groundwater Constraints

There is no data available on groundwater occurrence within the project area, or any regional connectivity, and no groundwater constraints have been applied.

Figure 28: UDWS Seam Mining Constraints Summary

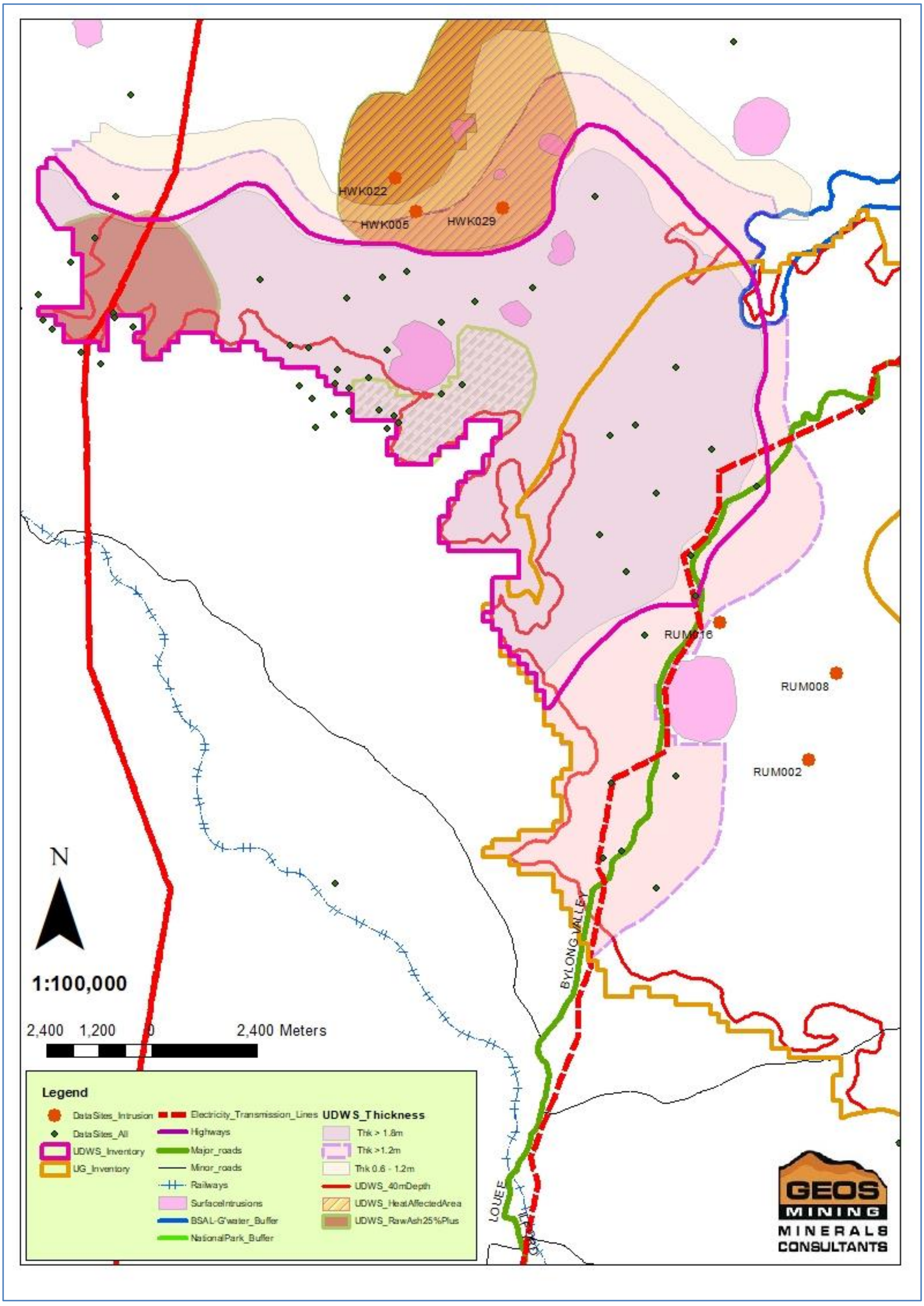
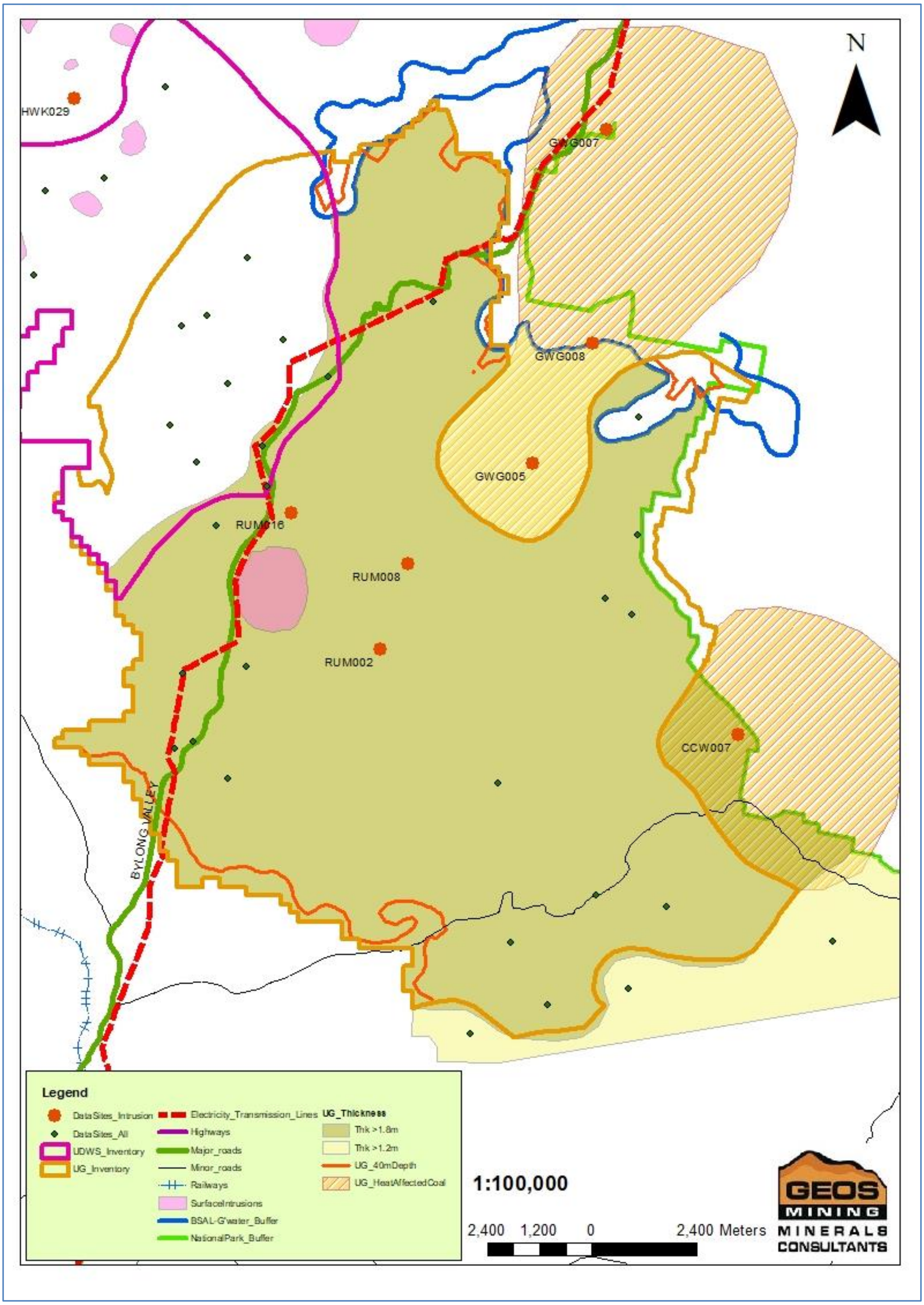


Figure 29 UG Seam Mining Constraints Summary



Proposed Mining Approach and Methods

The mining assessment undertaken by MEC Mining is presented in Appendix 1 in the form of two Memoranda. The first of these describes the general mining assessment and a first principals Base Case mining scenario, while the second presents the results of a Range Analysis of potential production rates. MEC have given us permission to summarise key components and outcomes from their assessment in the following sections, which have been provided for their review.

The most appropriate mining methods for the Hawkins-Rumker project are longwall and Bord & Pillar mining, with longwall mining providing the best opportunity for a viable operation. The project is unlikely to be viable without a viable longwall operation, while secondary Bord & Pillar mining as discussed below is likely to provide upside opportunities.

Several mine design options were considered after applying appropriate surface and sub-surface mining constraints. The constraints considered to be of primary importance include:

- provision of a minimum 40m of overburden to facilitate expected abutment stresses. Detailed geotechnical engineering and modelling is recommended to validate mine design and orientations;
- Interburden thickness less than 5m thick in the central area of resource overlap, such that only one seam can be mined in this area. The UDWS seam is the preferred mining target in this area for reasons discussed in Section **UDWS and UG seam Overlap;**
- Seam thickness greater than 1.8m. We note that consideration of longwall mining in areas with coal less than 1.8m thick is unwarranted at this stage, due to discontinuous and insufficient coal resources less than 1.8m thick. Extraction of this coal using thin seam longwall mining or other methods remains an upside opportunity;
- In-situ ash for the UDWS seam less than 17% (no washing required) and exclusion where greater than 25%; and
- Intrusion and heat affected coal exclusion areas.

The best mining approach at Hawkins-Rumker is considered to involve the following key criteria:

- Target the UDWS seam as a priority, due to it's potential to produce a partial ROM thermal coal product, including in the area of UDWS/UG seam overlap. We note that periodic washing of the UDWS seam is likely to be required after dilution;
- Initially target a central-west area of low (<17% ad) in-situ ash coal in an extended UDWS-UCL-UC2 working section, which is about 4m thick. This coal is unlikely to require washing, and delays the need for capital investment in a washplant;
- Target other areas of the UDWS seam, and the UG seam after establishment of an on-site washplant;
- Use Bord & Pillar methods in areas of the UDWS and UG seam, where igneous intrusions and potentially areas of structural discontinuity disallow effective longwall panel layouts.

Three potential layouts were initially considered, involving Northwest, Central and Southern access portals. The Northwest access option was eventually eliminated because the portal was too remote from the UG seam resource and accessed UDWS coal in an area of poor quality and structural uncertainty. The remaining mining layout options include:

1. A Low ash UDWS option that initially mines the UDWS-UCL-UC2 mining section from a Central access portal using low capex Bord & Pillar methods. We note that the Bord & Pillar design is not constrained by the minimum 40m overburden requirement. The remaining UDWS resource down to 1.8m thick is then mined using a conventional longwall layout (Figure 30), after which the UG seam resource is mined using the longwall layout shown in Figure 31; and
2. A centralised mining option accessing both seams from a Southern access point (Figure 31). The UDWS seam is generally to the north, and the UG seam is to the south of headings that follow the Bylong Valley road and associated Power lines. This option does not allow mining of low ash UDWS coal at start up, and would therefore require up front capital expenditure for a washplant. Either seam can be mined from the Southern access portal without affecting the other, and therefore concurrent mining operations are conceivable in this option. The Southern Access design includes conventional and thin seam plow longwall layouts in the extreme north of the UDWS resource. However, the low ash UDWS-UCL-UC2 mining section cannot be mined first in this option, and is unlikely to be fully extracted.

In concept, either option would require multiple portals and subsequent shaft sink to provide adequate ventilation in the mains developments. Basic washing of the UDWS ROM feed is expected to be required periodically in either scenario, when in-situ ash plus dilution approach 23% ash (ad). Longwall mining of the northern UDWS domain, as shown in the Option 2 layout (Figure 31), has not been considered for the Low Ash mining option due to poorer coal quality and structural uncertainty in this area.

MEC Mining's preferred mining scenario involves the UDWS Low Ash Option (refer Appendix 1; Memo 1), as it satisfies all the preferred mining approach criteria described above. The same mining scenario is assumed in the range Analysis described in Appendix 1; Memo 2. General mine design parameters are as follows:

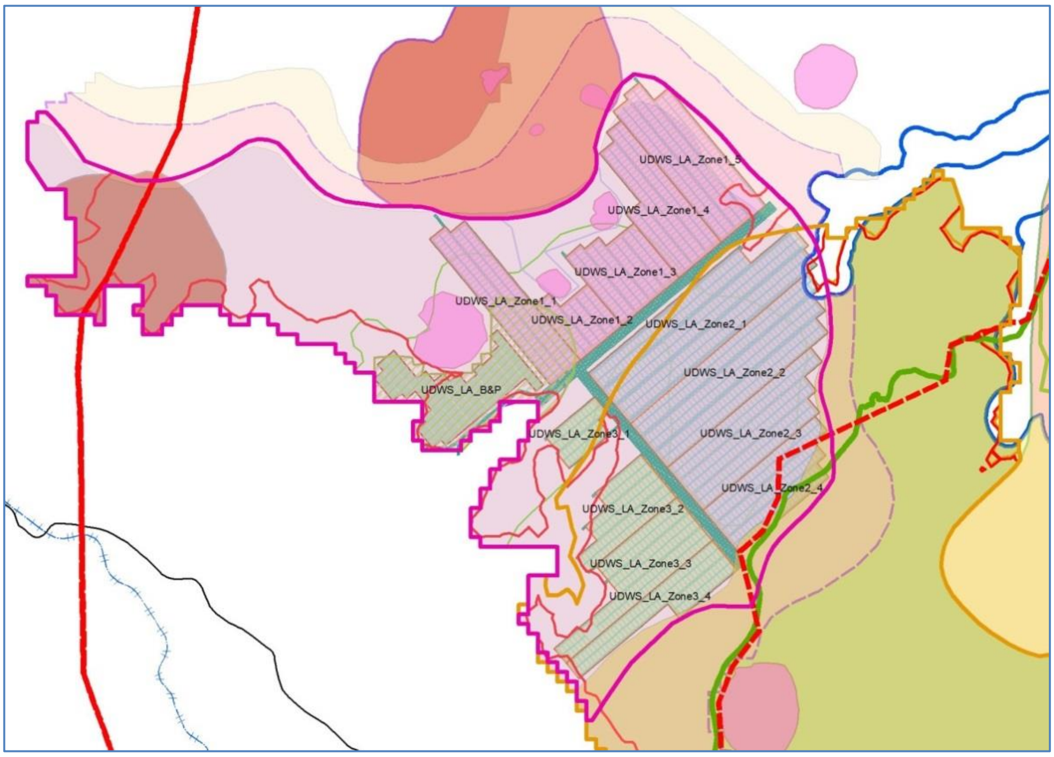
- Longwall width – 350m;
- Seven heading mains;
- Two heading gateroads <4km in length, three headings >4km;
- Development dimensions 5.2m x 2.8m; and
- Bord and pillar have 9 headings and are assumed to extract pillars to give an overall recovery of 43% (20% with no extraction).

Concurrent Operations

Conceptually an opportunity exists for concurrent operations with production from both the UDWS and UG Seams occurring simultaneously. Whilst each mine would initially operate in separate mining domains and use separate access portals, some surface infrastructure such as stockpile areas, CHPP, workshops, offices and facilities could be shared. In this scenario, the UDWS Seam would be accessed from the Central access portal and the UG Seam from the Southern access portal.

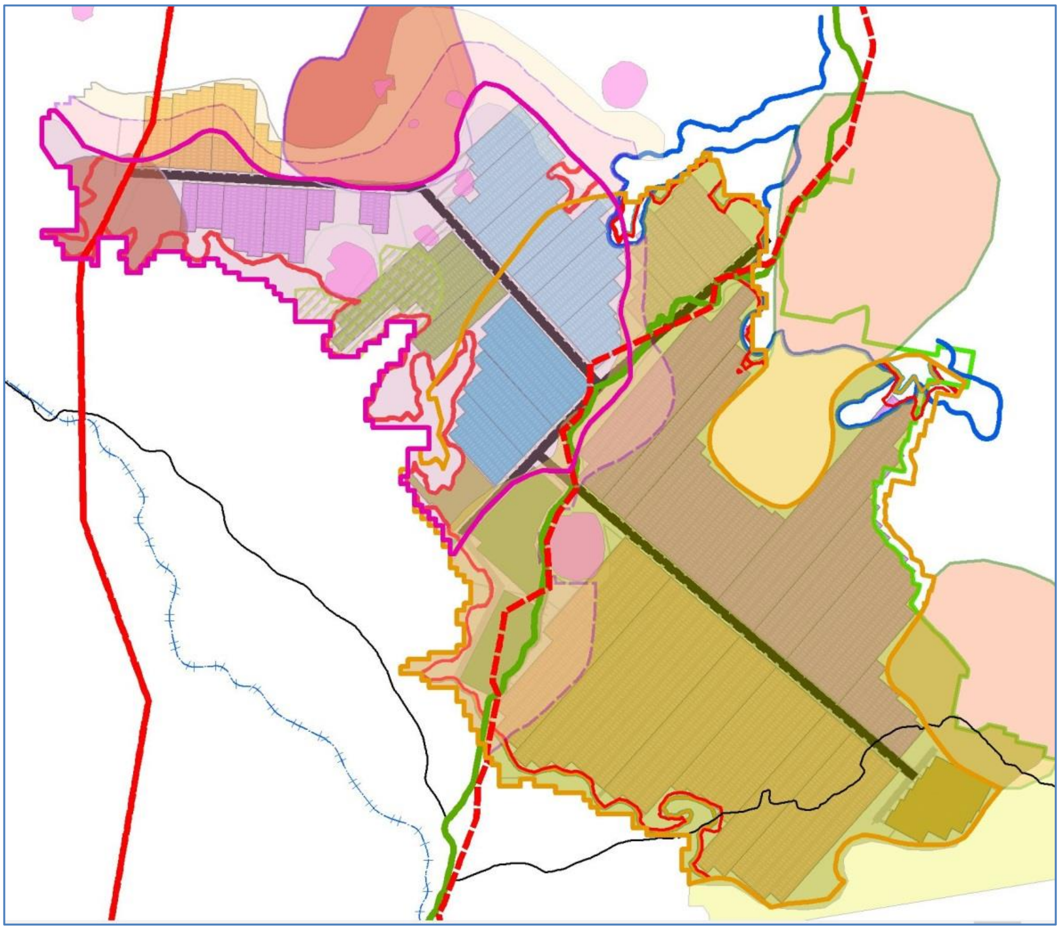
Further studies are required to investigate and optimise surface infrastructure synergies and cost savings for this option. We note that significant duplication of equipment will be required for concurrent operations.

Figure 30 UDWS Seam Low Ash Mine Design with Central Access



Note: Refer Figure 28 for mining constraints description

Figure 31 Southern Access Option, with Northern Plow



Note: Refer Figure 28 and Figure 29 for mining constraints description

Coal Processing Assumptions

It has been assumed that all UG coal will be washed, due to its relatively high in-situ ash, good washability characteristics and potential to produce a low ash high energy thermal coal. We expect conventional wet processing methods will be used, utilising a combination of dense-medium cyclones and fines spirals, as has been used at the adjacent Charbon Mine (now closed).

An unwashed ROM product from the UDWS seam has been targeted as a priority, due to this seam's relatively low in-situ ash and poor washability characteristics. However, we expect dilution will be an issue for maintaining a marketable thermal product from the UDWS seam, as is periodically the case at the nearby Ulan mine.

The high clay content of typical roof and floor dilution materials (for both seams), as described in Section **Overburden and Interburden Materials,** suggests that dilution separation is unlikely to be achieved by dry processing methods. Conventional wet processing methods (washing) are therefore expected to be necessary to control dilution. We have assumed that periodic washing of the UDWS seam will be required to maintain product quality below 23% ash(ad), above which market penalties typically apply.

Average theoretical yields and product qualities have been estimated as described below, and we have assumed a CHPP plant efficiency factor of 95% in addition to theoretical yields.

Recoverable Tonnage and Quality Estimates

Recoverable Coal Estimates

Recoverable coal estimates are summarised from Appendix 1 for three layout options, as follows:

1. UDWS Low Ash Option: Total ROM tonnes 140.3Mt; Product tonnes 136.15Mt
2. UDWS Southern Access: Total ROM tonnes 165.4Mt; Product tonnes 160.4Mt.
3. UG Southern Access: Total ROM tonnes 347.4Mt; Product tonnes 291.9Mt

The UDWS Southern Access estimate includes UDWS coal in the northwest, which is higher ash and possibly faulted, but does not include a Plow longwall option. MEC considers the incremental opportunity to mine the UDWS seam down to 0.6m thickness in the extreme north using a plow longwall, amounts to only 15.5Mt additional product, which is not expected to meet investment hurdles at this time.

Dilution

The mining concept developed by MEC, estimates on average 100mm dilution in the floor and 50mm dilution in the roof (MEC Mining, 2018) for the longwall operations. This equates to 4 – 8.5% dilution for the UDWS seam, depending on seam thickness, with an average of 5.6%.

We have assumed an average of 6% dilution for periods of longwall mining, and 2% for initial development. Dilution materials are assumed to average 80% ash and 0.2% total sulphur, based on an analysis of non-coal sample analyses. The impact of dilution on washed UG seam product quality is expected to be much less than for unwashed UDWS coal, and is assumed to be accounted for by the 95% washplant efficiency factor.

Product Quality Estimation

MEC Mining has provided Geos Mining with mine design layouts for the three mining options, from which Geos Mining has defined mining area polygons that best represent quality variability (Figure 30 and Figure 31). Average estimates of in-situ ash and total sulphur, F1.60 theoretical yield, and F1.60 product ash and total sulphur have been determined for each polygon areas, as relevant, from the Department of Planning & Environment geological model grids for these parameters.

MEC have used this information to estimate annual ROM and washed product qualities and yield for each year of production. The ROM product quality estimates include 6% average dilution, assuming a dilution ash and total sulphur of 80% and 0.2% (ad) respectively. Consideration of dilution impacts on washed product are assumed to be negligible and largely accounted for by applying a 95% plant efficiency factor.

Production Rates and Schedules

The MEC Mining assessment presented in Appendix 1 (Memo 2) describes three production rate scenarios, based on the preferred mining scenario described in Section **Proposed Mining Approach and Methods**. We note the first principals assessment in Memo 1 takes a conservative position, due to the early stage of knowledge regarding mining conditions at Hawkins-Rumker. The Range Analysis described in Memo 2 assumes mining conditions are better known and takes greater account of production rates achieved at the nearby Ulan mine, which has similar geology to Hawkins-Rumker.

Results from MEC Mining's assessment are summarised in Table 11.

Table 11: Summary of Production Rate Scenarios

Characteristic	Characteristic	Low Case	Mid Case	Max Case
Mineability indices, and associated longwall retreat rates	Green	54% @ 0.74mpoh	78% @ 1.5mpoh	90% @ 2.0mpoh
	Amber	32% @ 0.59mpoh	22% @ 1.2mpoh	10% @ 1.6mpoh
	Red	14% @ 0.49mpoh	1% @ 0.93mpoh	1% @ 1.25mpoh
UDWS Seam	Mine Life (production years)	45	29	20
	Avg Development (Mtpa)	0.280	0.45	0.72
	Avg Longwall (Mtpa)	2.89	4.76	7.49
	Total ROM (Mtpa)	3.17	5.21	8.21
	% Bypass	Avg 81%; 35 - 100%	Avg 85%; 35 - 100%	Avg 82%; 35 - 100%
	Avg Total Product (Mtpa)	2.9	4.6	6.8
UG Seam	Mine Life	91	54	44
	Avg Development (Mtpa)	0.28	0.41	0.62
	Avg Longwall (Mtpa)	3.19	4.54	6.71
	Total ROM (Mtpa)	3.48	4.95	7.33
	% Bypass	0	0	0
	Avg Total Product (Mtpa)	2.89	4.04	6.15

Bord & Pillar mining within the UDWS-UCL-UC2 mining section is scheduled at the start of all mining scenarios as contractor units. Contract mining reduces the initial project capital for equipment. Production rates over this period are assumed to average about 1.6Mtpa over about 3.5 years, which are not accounted for in the Table 11 average development rates.

Production schedules for the Low, Mid and High Case options are shown in Figures 7 to 12 in Appendix 1, Memo 2.

Surface and Coal Transport Infrastructure

Geos Mining has commissioned Wave International to undertake an assessment of on and off site non-process infrastructure (NPI) requirements and costs for the Hawkins-Rumker project. The results of Wave International's assessment are presented in a report, which is reproduced in Appendix 2. Wave International have given us permission to summarise the key components and outcomes from their assessment in the following sections, which have been provided for their review.

On-Site Infrastructure

Two location options for the underground portal and hence NPI surface infrastructure have been considered. The locations are (Figure 32):

- Option 1 at the north-western end of the identified deposit; and
- Option 2 – a more central location on the western side of the project.

These two locations have been used to scope and estimate the NPI surface infrastructure to support the underground mining activities, Coal Handling and Processing Plant (CHPP) and the off-site infrastructure required to support a coal mine. The options considered do not include a third portal option considered by MEC Mining, which is located approximately 5.6km to the NNW of Wave International's Option 2. We have assumed in the financial model that surface infrastructure costs at the Option 3 portal, will be similar to Wave International's Option 2.

The on-site non-process infrastructure needed to access and support the underground mining and coal handling and processing plant (CHPP) for either Option is expected to consist of the following main elements:

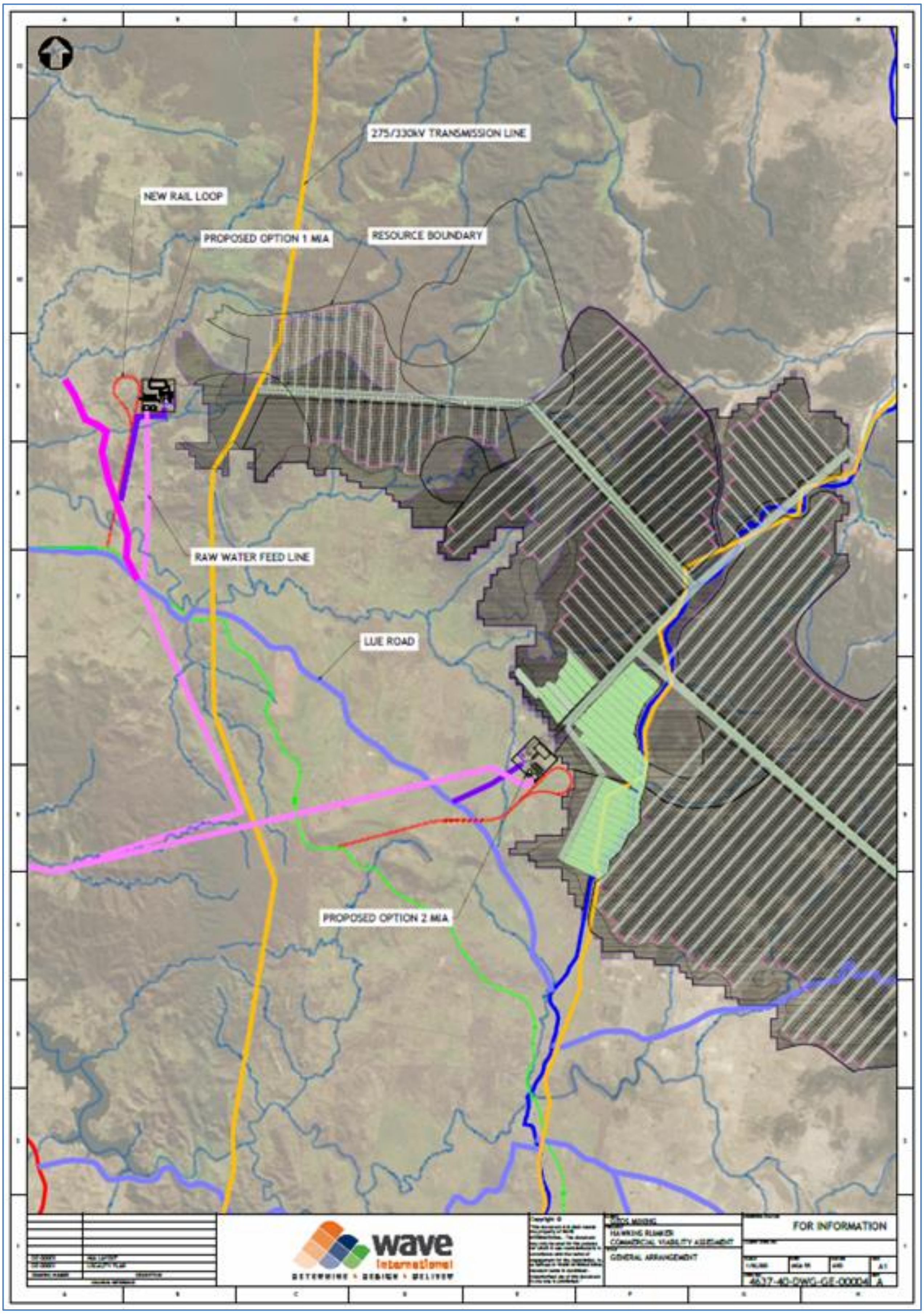
- Site access roads, earthworks, hardstands and parking;
- Underground mine vehicle parking;
- NPI area drainage and sedimentation dam;
- Security Facility and fencing;
- Administration building / Bath House;
- Vehicle workshop, wash down area, store, stone dust shed, and laydowns;
- Fuel and lube facility;
- NPI area water services;
- NPI area Sewage system;
- NPI area Compressed Air System; and
- NPI area Power and Communications Reticulation.

Off Site Infrastructure

Off-site infrastructure requirements include:

- Option 1 (North western location):
    - Approximately 4.5km of upgraded existing unsealed roads from Lue Road to a new 3km long on-site access road;
    - Upgrading the existing intersection at Lue Road;
    - Construction of a 6.7km long rail spur and balloon loop from the existing Rylstone-Mudgee rail line;
    - Upgrade of Endeavour Energy's Kandos Zone Substation and construction of approximately 36km of 66kV overhead power line; and
    - On the assumption that the site water supply can be obtained from Windermere Dam, construction of a pump station and approximately 17km of water pipeline to an on-site raw water dam. This assumes that there is sufficient power supply at the Windermere dam wall location.

Figure 32 Surface Infrastructure Locations



- Option 2. (A central west location):
    - Approximately 2.2km of upgrading to existing unsealed roads from Lue Road to a new 1.2km on-site access road;
    - Upgrading the existing intersection at Lue Road;
    - Construction of an 8km long rail spur and balloon loop from the Rylstone-Mudgee rail line;
    - Upgrade of Endeavour Energy's Kandos Zone Substation and construction of approximately 20km of 66kV overhead power line; and
    - On the assumption that the site water supply can be obtained from Windermere Dam, construction of a pump station and approximately 20km of water pipeline to an on-site raw water dam. This assumes that there is sufficient power supply at the Windermere dam wall location.

Coal export port options available to service the Hawkins-Rumker project include Port Newcastle via rail links to the north and then east, or Port Kembla via rail links to the south. Wave International's recommendation is that the three loading facilities at Newcastle are likely to provide the best option for coal export, due to:

- Capacity is more likely to be available;
- A larger proportion of the below rail solution to Newcastle is already used by a large number of mines, and is likely to require less upgrading; and
- The track south to Port Kembla passes through Sydney, and would therefore be subject to community resistance, more expensive upgrades and greater risk of delays due to competition with passenger traffic.

The rail link to Port Newcastle comprises approximately 350km of line via Mudgee, Muswellbrook, Singleton, Maitland and Port Newcastle. The rail link south to Port Kembla is almost equidistant, comprising approximately 360km of line via Lithgow, Katoomba, Sydney, Sutherland, Wollongong and then Port Kembla. Either rail link would initially be via the Rylstone-Mudgee line, which is currently closed and unsuitable for coal transport. It will require significant upgrading to carry coal export tonnages. Wave International have not estimated a specific capital allowance for upgrading this line, but have included an allowance in the below rail operating cost estimates below for upgrading the line to Mudgee. We note that there is also likely to be significant resistance to coal transport on the existing rail line via Mudgee, and future studies may need to consider alternate options to Newcastle.

The site water demand has been estimated as 1400ML/a. This is made up of 1.51ML/day for underground operations, 2.22ML/day for coal washing at 200L/t and the remainder for wash down, fire and potable water usage on site. Of four potential options available for mine water supply, Wave International considers that Windermere Dam is the most logical and reliable supply based on size and current usage. Supply from this source will be subject to negotiations with Water NSW and if approved a licence to take agreement. Water NSW has not been approached to ascertain the likelihood of water supply being drawn from this source.

The site power demand has been estimated to be in the order of 25MW. This is made up of underground demand of 10 to 15MW and up to 10MW for the CHPP and pit top infrastructure. The Hawkins-Rumker project occurs on the boundary of Essential Energy and Endeavour Energy distribution zones. Based on very preliminary investigations, Wave International considers the most favourable source of power is likely to be an existing substation at Endeavour Energy's Kandos Zone Substation, which would require 36km of 66KV transmission line to the mine site. The Kandos substation will need to be upgraded by the addition of a feeder circuit.

Non-Process Capital Cost Estimates

Direct capital cost estimates, which include preliminary scoping and studies to feasibility stage, plus a +35% contingency factor, are estimated as follows:

- Option 1 (NW location) - A$215M, which includes approximately:
  - A$42.6M for non-process site infrastructure;
  - A$2.5M for external road upgrades;
  - A$40M for a rail spur and balloon loop (excluding land acquisitions); and
  - A$48.3M for Water and Power Supply.
- Option 2 – (Central location) A$228M, which includes approximately:
  - A$41.4M for non-process site infrastructure;
  - A$0.05M for external road upgrades (existing roads are of sufficient width and condition);
  - A$68.5M for a rail spur and balloon loop (excluding land acquisitions); and
  - A$31.3M for Water and Power Supply.

Non-Process Operating Cost Estimates

Typical operating costs for the four potential coal export ports are summarised below, based on Wave International's experience of short and long term coal supply contracts:

- Newcastle:
  - Newcastle Coal Infrastructure Group - $6 - $7 per tonne;
  - Newcastle Port Waratah Coal Services, including:
    - Carrington - $3 - $4 per tonne;
    - Kooragang Island: - $5 - $6 per tonne;
- Port Kembla - $5 - $6 per tonne.

The port loading rates above assume capacity is available at the terminals without triggering capital expansions. They do not include potential terminal operating costs and harbour costs, which can amount to another $2 per tonne.

Indicative **below rail** access charges for haulage to these export terminals are estimated to be:

- Newcastle rail link: $7-$8 per tonne;
- Port Kembla rail link: $9-$10 per tonne.

Indicative **above rail** access charges to these locations are estimated to be:

- Newcastle rail link: $4-$5 per tonne
- Port Kembla rail link: $5-$6 per tonne

These indicative costs have been estimated without direct or indirect discussions with the track owners or other customers. The below rail cost estimates include an allowance of $2.00 per tonne if the coal is railed south and $1.00 per tonne if taken north, to account for capacity upgrades that are likely to be required.

Mining Cost Estimates

Mine Operating Costs

Operating costs associated with the proposed underground mine have been derived by MEC Mining (Appendix 1) from a database of recent similar studies and cost drivers. The average operating cost estimates summarised in Table 12 apply to both the UDWS and UG seam operations and are un-escalated. They include labour costs.

Table 12: Unit Operating Cost Estimates, Hawkins-Rumker

Operating Costs ($/ROMt)	Low Case	Mid Case	Max Case
Development: All	12.58	12.58	12.58
Conveyors	2.39	1.77	1.47
Longwall	9.46	6.43	5.43
Outbye	7.50	7.50	7.30
Localised Requirements	4.46	4.17	4.08
Tech Services	1.17	1.17	1.17
Surface and Administration	1.99	1.99	1.99
CHPP (>23% ROM Ash only)	4.90	4.90	4.90
Total (excluding CHPP)	**39.54**	**35.60**	**34.01**
Total	**44.44**	**40.51**	**38.92**

Capital Costs

MEC Mining, in conjunction with Wave International have estimated capital costs and a capital cost schedule (refer Appendix 1 and 2), based on:

- MEC Mining Project Capital Drivers;
- MEC Mining Capital Cost Database; and
- Wave International Estimates for on and off-site non-process infrastructure, as summarised above.

The capital cost estimates were initially estimated for the Low Case mining scenario (Base Case Appendix 1, Memo 1) from a first principals listing of infrastructure and equipment requirements. Capital costs include three components:

- Initial development capital, which is scheduled in the first 6 years. This includes:
  - Capitalised development, which includes access portals, drifts, mains development and gateroads to the initial bord & pillar or longwall production area.
  - Equipment purchase; and
  - Facilities, which include surface infrastructure requirements such as workshops, rail loadout facilities and site development. Initial facilities does not include capital costs for a washplant, as the timing of this expenditure varies;

  - MEC have applied a contingency factor of 35% to account for the early stage of project knowledge and conceptual nature of the estimation. We have applied this contingency provision as part of the sensitivity analysis in Section **Sensitivity Analysis**;
- Washplant capital is accounted for separately, because for the preferred mining scenario (UDWS seam mined first), a CHPP is only required as a backup to manage dilution as the longwall advances into higher ash UDWS coal. The timing of this expenditure varies as shown in Table 13. CHPP cost estimates assume a 700tph, 1,000tph and 2x750tph systems for the Low , Mid and High Case scenarios respectively. This equates to an annual ROM throughput capacity of approximately 4.9Mtpa, 6.9Mtpa and 10.4Mtpa for a 24/7 operation (50 weeks per year) at industry standard 83% utilisation. We note a CHPP would be required from start-up if the UG seam is mined first; and
- On-going sustaining capital, which includes:
  - a variable $/ROM tonne cost of A$2 - $2.15/ROM tonne;
  - a periodic cost of A$129M (A$150M, including contingency) for longwall equipment replacement every 60,000m of longwall advance; and
  - MEC have recommended a sustaining capital contingency provision of A$5/ROM tonne to account for unexpected capital replacement requirements. We have applied this contingency provision as part of the sensitivity analysis in Section **Sensitivity Analysis.**

Table 13: Development Capital Cost Summary (MEC)

Capital Costs ($M)	Low Case	Mid Case	Max Case
Surface Equipment	2.293	2.293	2.293
Underground Equipment	165.134	171.389	190.152
Other Equipment	0.967	0.967	0.967
Capitalised Development	123.575	123.575	126.575
Facilities	158.249	165.627	187.762
Initial Capital Sub-Total	**450.218**	**466.852**	**507.750**
Initial Capex Contingency (35%)	157.5	163.398	177.712
Recommended Initial Capital	**607.795**	**630.249**	**685.462**
CHPP	75.0 (700tph plant; Production year 11-12)	82.5 (1,000tph plant; Production year 9-10)	105.0 (2x750tph plant; Production year 6-7)
Total Development Capital ($M)	**682.80**	**712.75**	**790.46**
Sustaining Capital ($/ROM tonne)	**2.15**	**2.15**	**2.0**
Longwall replacement @ 60,000 advance m cycles	**129M**	**129M**	**129M**
Sustaining Capex Contingency ($/ROM tonne)	**$5**	**$5**	**$5**

Commercial Viability Assessment

Methodology

The objective has been to determine if the proposed Hawkins-Rumker project area contains coal resources that would support a viable Greenfields development project. The assessment has been undertaken at a conceptual level.

Inventory Coal, comprising mainly the UDWS and UG working sections, has been characterised and quantified in terms of an underground longwall plus Bord & Pillar mining operation. Surface infrastructure and transport options have been considered. Commercial viability has been assessed using conceptual discounted cash flow models of production, product quality, operating costs, capital costs and likely revenue, for the preferred mining scenario described in Section **Proposed Mining Approach and Methods**. Models have been developed for Low, Mid and High Case production scenarios, as described in Section **Production Rates and Schedules** and Table 11.

The preferred mining scenario involves mining the UDWS seam first from the Central Access portal, due to it's potential to produce coal initially without a washplant. Mining the UG seam follows from the same portal access, with full washing. However, to assess the relative viability of mining the UDWS and UG working sections, we have developed conceptual Mid and High Case financial models that assume that only the UG seam is mined. These models assume that UG seam production and mining costs are brought forward to Year 7 and initial development capital includes a CHPP. Mining the UG seam first would occur from the Southern access portal, but we have assumed that the capitalised development costs are similar to the Central Access portal.

Assumptions

General Assumptions

The models assume the project is at a project development stage in year 1, with all exploration licences and approvals in place. For the purposes of the CVA, we have assumed a total of 6 years for feasibility studies, mine design, surface infrastructure development and underground development to the first mining area. We note that considerably more time is likely to be required, given the current level of project knowledge and typical approvals timing, and that this contributes negatively to project risk.

The following assumptions have been made for all models:

- The cash flow models are in real (todays dollar) terms, with unescalated operating and capital costs derived from MEC Mining estimates and revenue based on coal prices adjusted to real terms assuming an inflation rate of 1.8% (RBA December 31st 2017 trimmed mean);
- Product energy is estimated from product ash on a gross as received (GAR) basis, assuming a as received total moisture of 8% for the UDWS seam and 7% for the UG seam;
- A CHPP plant efficiency factor of 0.95 is assumed in addition to theoretical yield determined from the geological model;

- Long term benchmark thermal coal (6300 GAR) price of US$64.97 (real), based on the Consensus Economics March 2018 forecast mean. See below for further discussion of revenue assumptions;
- A consistent A$/US$ exchange rate of 0.76;
- Coal royalties estimated at 7.0% of pre-tax revenue, less standard deductions equivalent to A$3.00/product tonne for the partially washed UDWS coal and A$4.50 for the fully washed UG coal;
- Capital depreciation at 10% per annum;
- Company tax rate of 30%;
- NPV discount rate range of 9.0, 10.0% and 11.0%, as discussed below.

We have assumed that initial production from the UDWS seam, including UDWS-UCL-UC2 Bord & Pillar mining and the first few UDWS longwall panels, will not require washing. Subsequent UDWS production will require periodic washing to control dilution. The proportion of UDWS seam bypass is adjusted in the financial models on an annual basis, to maintain product ash below 23% ash. The UG seam is fully washed.

Capital Expenditure

We have assumed zero contingency for the capital cost estimates to establish a base position for the commercial viability assessment. The Capex contingencies that have been recommended by MEC Mining to account for the conceptual nature of the analysis, which include 35% of initial development capital and $5.0/ROM tonne sustaining capital, have been applied as part of the sensitivity analysis below.

Revenue

Revenue is estimated on the basis of the March 2018 Consensus Economics forecast for the benchmark Newcastle 6300 kcal/kg (GAR) thermal coal brand (Consensus Economics, 2018b), which is in nominal US$ terms. A long term benchmark price of US$64.97/tonne has been assumed, which is equivalent to about A$85.50/tonne at the assumed life of mine A$/US$ exchange rate of 0.76. The impact of higher and lower long term prices and exchange rates are considered as part of a sensitivity analysis.

We note the UG seam is likely to be marketed with reference to the Newcastle 6300 brand, due to low product ash and high energy, while the higher ash UDWS seam is likely to be marketed with reference to the Newcastle High Ash brand (refer Section **Market Assessment**), which has an energy rating of about 5500 kcal/kg (GAR). However, all revenue has been estimated with reference to the Newcastle 6300 kcal/kg (GAR) benchmark price, with price adjustments for energy and ash following the S&P Global Platts guideline (S&P Global, Platts, 2017), such that:

- Price is adjusted upwards or downwards in direct proportion to benchmark energy, such that UDWS product is typically discounted by about 0.93 and UG product has a premium of up to 1.1 times the benchmark price; and
- An ash penalty of US$1.00/tonne is applied per 1.0% ash over the maximum ash limit for each brand. The ash limits are 16% and 23% for the 6300 (UG product) and 5500 (UDWS product) brands respectively (Table 7). We note ash penalties were not required in any of the models.

Other potential price adjustments, such as for Sulphur and Moisture, have not been necessary for Hawkins-Rumker coals. We note that the UDWS and UG products may attract market premiums for low sulphur, attractive fouling and slagging indices and low impurities, but determination of these are beyond the scope of this report.

Discount Rate

The Net Present Value (NPV) of projected net revenue from a mining project is calculated at a discount rate that is chosen to reflect the level of project risk. The higher the project risk, the higher the discount rate. Future income is essentially discounted at the chosen rate, to deduct a proportion of project income that may be regarded by the investor as reasonable given project risk. Hawkins-Rumker project risk is considered to be relatively high, due to the early stage of project knowledge and conceptual nature of the cash flow projections.

We have assessed the Hawkins-Rumker project at a range of discount rates from 9.0% to 11.0%, with a preferred discount rate of 10%. This has been determined using a Weighted Average Cost of Capital (WACC) analysis (Table 14), which considers current economic factors. A project risk premium of 1.0 – 2.0% was applied in this analysis, to account for risks associated with underground mining and the conceptual stage of the project.

Table 14: Weighted Average Cost of Capital Analysis, Hawkins-Rumker

Hawkins-Rumker Weighted Average Cost of Capital Estimate. March 2018

		Low	High	SOURCE:	
Cost of equity (CAPM)					
Risk free rate of return	R_f	2.80%	2.80%	Australian 10 year Bond March 2018	
Equity market risk premium	MRP (R_m-F	6.00%	6.50%	KPMG July 2017 Australian Survey	
Ungeared beta estimate	β	1.25	1.25	Industry typical	
Asset beta estimate	β_a	2.13	2.13	Industry typical	
CAPM based cost of equity	R_e	**15.550%**	**16.613%**		
Cost of debt					
Cost of debt	R_d	**6.80%**	**6.80%**	assumes 4.0% credit risk premium + risk free rate	
Capital structure					
Debt / (Debt+Equity)	D/(E+D)	50.00%	50.00%	HR Assumption	50%
Equity / (Debt+Equity)	E/(E+D)	50.00%	50.00%		
WACC					
Local corporate tax rate	t_c	30.00%	30.00%	Australian corporate tax rate	
Post tax cost of equity	E/V * R_e	7.78%	8.31%		
Post tax cost of debt	D/V*R_d*(1-	2.38%	2.38%		
WACC (post-tax, nominal)	R_n	**10.16%**	**10.69%**		
Inflation estimate		1.80%	1.80%	RBA trimmed mean, Dec 2017	
WACC (post-tax, real)	R_r	**8.21%**	**8.73%**		
Project risk discount		1.00%	2.00%	Underground coal mining + HR project specific risk	
Discount Rate		9.21%	10.73%		

Commercial Viability Assessment

Financial model characteristics and NPV results for the Low, Mid and High production rate cases are presented in Table 15 for the UDWS seam only, and in Table 16 for the UG seam only. NPV is negative in all cases, based on the assumptions described above. NPV results are presented in Table 17 for the mining scenario where UDWS seam mining is followed by the UG seam.

We note that mine life at the Low Case production scenario is 51 years for the UDWS seam, and about 91 years for the UG seam. Production rates at these Low Case levels are considered inappropriate for the size and likely geological characteristics of the Hawkins-Rumker resource. This case has not been considered for the UG seam. Production rates at the Mid and High Case levels are more comparable with nearby mines and provide more promising NPV results for both seams.

Table 15 Summary of UDWS Seam Financial Models

UDWS Seam Only	Characteristic	Low Case	Mid Case	High Case
Production	Mine Life (includes 6 years development)	51	35	26
	ROM Rate (Mtpa)	Avg 3.1; 1.6-3.6	Avg 4.8; 1.6-5.7	Avg 7.2; 1.6-9.6
	Bypass %	Avg 81%; 35 - 100%	Avg 85%; 35 - 100%	Avg 82%; 35 - 100%
	Theoretical Yields (geological model)	Avg 91%; 82-96%	Avg 91%; 82-97%	Avg 91%; 82-97%
	Product (Mtpa)	Avg 2.9; 1.6 -3.5	Avg 4.6; 1.6 -5.6	Avg 6.8; 1.6 - 9.1
Operating Costs	OpCost ($/ROM tonne FOR)	Avg $40.5; $39.5-42.7	Avg $36.4; $35.6 - 38.8	Avg $34.9; $34 - 37.2
	OpCost ($/Product tonne FOB)	Avg $62.80	Avg $58.43	Avg $63.34
Capital Costs	Initial Development Capex (excludes contingency & CHPP)	A$450.2M	A$466.9M	A$507.8M
	CHPP Capex	A$75.0M (Production year 11-12)	A$82.5M (Production year 9-10)	A$105.0M (Production year 6-7)
	Sustaining Capex ($/ROM tonne; no contingency)	Avg A$3.68	Avg A$3.73	Avg A$3.70
	Sustaining Capex ($/Product tonne; no contingency)	Avg A$3.85	Avg A$3.93	Avg A$3.89
Revenue	Revenue/Product tonne (A$M real)	Avg A$80.0; $79-87/t	Avg A$80.4; $79-87/t	Avg A$80.6; $79-87/t
	Post Tax & Royalties Revenue (A$Mpa real)	Avg $17.8M; -$101 - 44	Avg $40.7M; -$68 - 75	Avg $65.2M; -$24 - 129
NPV (UDWS seam only)	@ 10% discount rate	**-$163.31 M**	**-$85.95 M**	**-$32.57 M**

We believe that coal price is the main determining factor influencing a negative NPV for all models. Production is modelled to start in Year 7 or 8 (hypothetically 2024 or 2025), by which time the Consensus Economics March 2018 long term price forecast of US$64.97/tonne real (US$76.29/tonne nominal) applies.

Essentially annual post royalty and tax revenue at this price is typically positive, but too low to provide sufficient return on initial investment at the preferred discount rate of 10%. For example, the net revenue after royalties and tax for the UDWS seam, which ranges from $17.8M to $65.2M (Table 15), is equivalent to a margin of about $6.10/product tonne for the Low Case, $8.80 for the Mid Case and $9.60/product tonne for the High Case. That for the UG seam is slightly lower at about $8.00/product tonne for the Mid Case and $8.80 for the High Case, due largely to lower product yield. We have considered NPV sensitivity to coal price and other factors below.

We note that there are significant periods when the UG seam washed product is 8.5 – 13.5% ash (ad), which is well under the 16% ash penalty limit. While washing has a positive impact on product energy and price, bypassing the UG seam coal would increase production rates. We have not modelled this opportunity, but identify it as potential upside.

Table 16 Summary of UG Seam Financial Models

UG Seam Only	Characteristic	Low Case	Mid Case	High Case
Production	Mine life (includes 7 years development)	91	61	51
	ROM Production Rate(Mtpa)	Not modelled	Avg 4.9; 3.7-5.8	Avg 7.5; 2.7 - 9.7
	Bypass %		0	0
	Theoretical Yields (geological model)		Avg 85%; 72 - 85%	Avg 91%; 80-90%
	Production Rates (Mtpa)		Avg 4.0; 2.8 - 4.8	Avg 6.1; 2.1 - 7.5
Operating Costs	OpCost ($/ROM tonne FOR)		Avg $40.5; no range	Avg $38.2; no range
	OpCost ($/Product tonne FOB)		Avg $70.06	Avg $68.14
Capital Costs	Initial Development Capex (excludes contingency)		A$541.9M	A$612.8M
	Sustaining Capex ($/ROM tonne; no contingency)		Avg A$3.11	Avg A$3.25
	Sustaining Capex ($/Product tonne; no contingency)		Avg A$3.84	Avg A$4.00
Revenue	Revenue/Product tonne (A$M real)		Avg A$90.10; $84-95/t	Avg A$89.89; $85-95/t
	Post Tax & Royalties Revenue (A$Mpa real)		Avg $32.0M; -$95 - 77	Avg $54.3M; -$74 - 118
NPV (UG seam only)	@ 10% discount rate		**- $190.99**	**- $117.86**

Table 17: NPV Result for UDWS followed by UG Seam

UDWS followed by UG seam	Characteristic	Low Case	Mid Case	High Case
Production	Mine life (includes 7 years development)	142	89	70
NPV (UDWS followed by UG seam)	@ 10% discount rate	**- $163.06**	**- $77.25**	**+ $3.13M**

Sensitivity Analysis

NPV is sensitive to coal price, exchange rate, initial capital costs and discount rate. Table 18 illustrates NPV sensitivity to coal price, exchange rate and capital expenditure.

Hawkins-Rumker capital costs are necessarily high, relative to revenue generated, due to the greenfield nature of the project, requirement for upgrading local rail infrastructure, and likely long period required for completion of feasibility studies and mine development. The level of uncertainty around required capital expenditure is also high, due to the early stage of project knowledge. A significant contingency factor has therefore been recommended by MEC Mining, which includes a 35% initial development capex contingency and an additional sustaining capital contingency of $5/ROM tonne. Sensitivity to this additional capital expenditure at a 10% discount rate, is shown in Table 18 for the Mid and High Case UDWS and UG mining scenarios. Applying these contingencies to reflect the early stage of the Hawkins-Rumker commercial viability assessment, deducts from $180M - $270M off the NPV, depending on the Case. The UG seam requirement for CHPP construction during the development phase, reduces NPV by about $30M.

Table 18: Capex and Coal Price Sensitivity

NPV $M at 10% discount rate	Coal Price					Exchange Rate	
	Base Position	-10%	+10%	+20%	+30%	0.70	0.80
Benchmark (US$/t real)	$65	$58.50	$71.50	$78.00	$84.50		
UDWS Mid Case	-$86M	-$199M	$24M	$134M	$243M	$9M	-$142M
UDWS Mid Case + Capex Contingencies	-267M	-$397M	-$155M	-$45M	$65M	-$171M	-$325M
UDWS High Case	-$33M	-$182M	$116M	$264M	$412M	$94M	-$107M
UDWS High Case + Capex Contingencies	-$257M	-$412M	-$108M	$40M	$188M	-$130M	-$333M
UG Mid Case	-$191M	-$331M	-65M	$56M	$175M	-$83M	-$256M
UG Mid Case + Capex Contingencies	-$403M	-$567M	-$272M	-$147M	-$27M	-$291M	-$482M
UG High Case	-$104M	-$294M	$81M	$261M	$441M	$54M	-$197M
UG High Case + Capex Contingencies	-$373M	-$599M	-$187M	-$4M	$177M	-$213M	-$473M

The impact of coal price is significant. Table 18 shows that NPV becomes positive within a long term benchmark coal price range of from US$66 - US$81/tonne for the UDWS model (Figure 33), and US$68 – US$85/tonne for the UG seam (Figure 34, depending on production rate and Capex contingency. This assumes an A$/US$ exchange rate of 0.76. The Newcastle 6300 (GAR) spot price is currently at about US$100/tonne, and although we consider that this reflects a temporary demand/supply imbalance, future prices within the range from US$66 to US$85/tonne are conceivable. We note that on one hand there is a general expectation that future thermal coal prices will reduce from current levels, due to expectations of reduced average world demand and growing preference for other means of power generation. However, it is also expected that demand for good quality Australian thermal coals may remain steady or increase, due a growing preference for new power station technologies to minimise CO2 emissions, particularly in developing South East Asian countries (refer Section **Market Assessment**) where there is expected to be an increase in energy demand.

Figure 33: NPV vs Coal Price, UDWS Seam

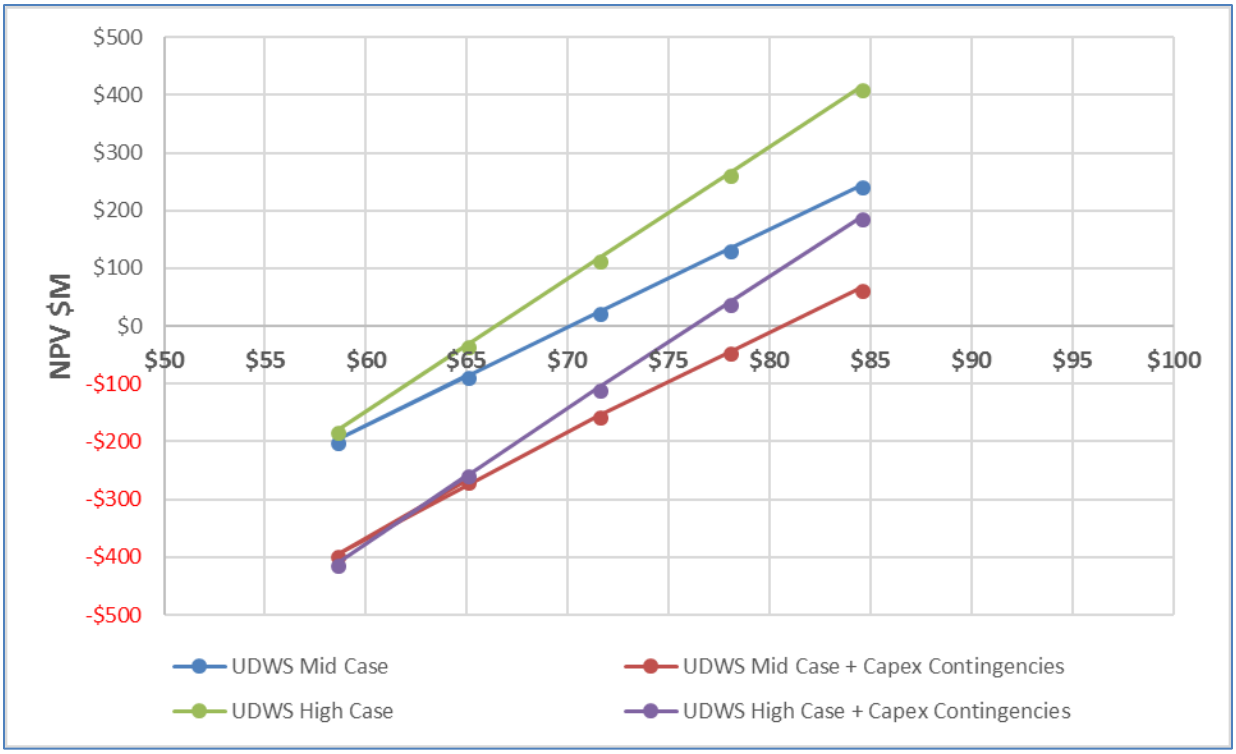
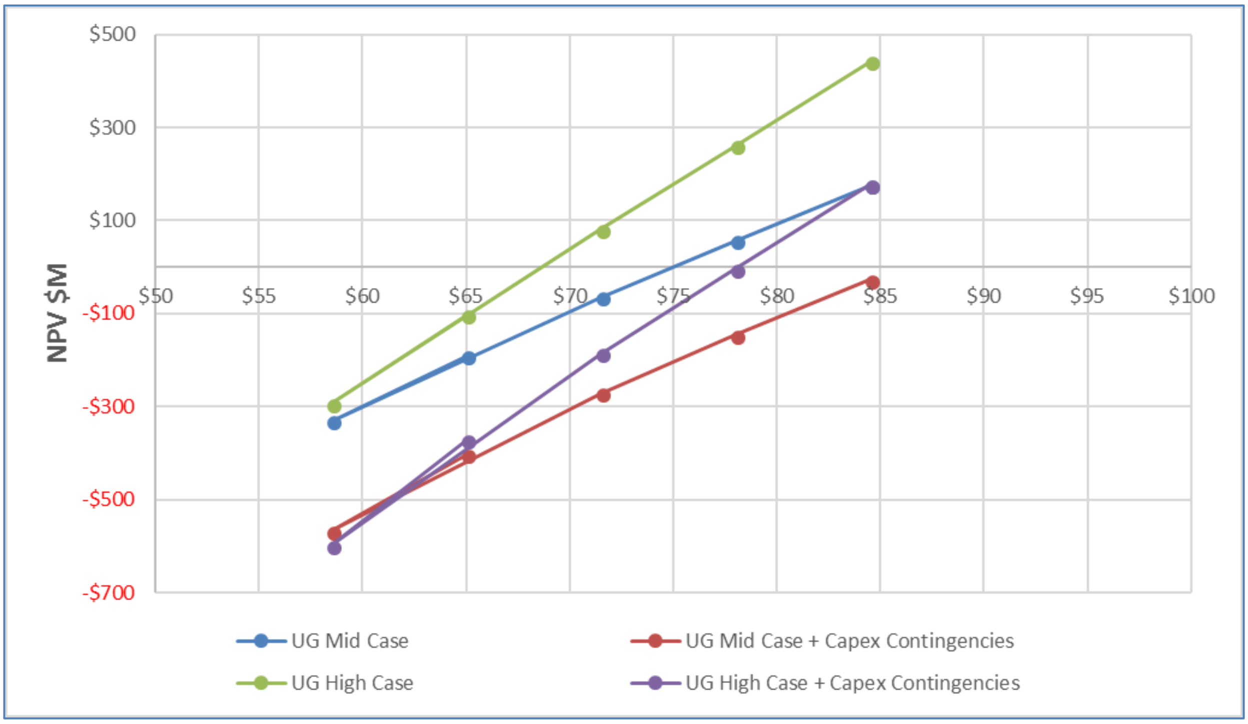


Figure 34: NPV vs Coal Price, UG Seam



The impact of discount rate for the Mid Case mining scenario is shown in Table 19. We consider that discount rates below 10% do not reflect the high level of risk associated with a conceptual stage greenfield development.

Table 19: Discount Rate Sensitivity

Discount Rate	Mid Case UDWS seam	Mid Case UG Seam	Mid Case – Both Seams
NPV Period (Years)	35	50	89
11%	-$103M	-$203M	-$97M
10%	-$86M	-$191M	-$77M
9%	-$64M	-$174m	-$50M
8%	-$36M	-$149M	-$15M

Conclusions and Recommendations

Resource Characterisation: The dataset provided for evaluation was found to be valid and sufficiently comprehensive for the purposes of the commercial viability assessment (CVA). Output from the NSW Department of Planning and Environment (Resources and Geoscience Group) Hawkins-Rumker resource model was validated and adopted for the current assessment.

Structure is assumed to be generally benign, with shallow dipping coal seams. However, some structural anomalies have been noted. We agree with the Inventory Resource report, which concludes that there is insufficient data to identify structures or structural domains with any certainty. Structural discontinuity remains a risk, particularly for longwall mining, and further drilling would be required to characterise structure in more detail.

Potentially mineable coal occurs mainly within the UDWS and UG working sections, with a small area in the central west where an extended UDWS-UCL-UC2 mining section should be targeted. The UDWS and UG Inventory Coal areas overlap within the central part of the project area, where an interburden thickness of less than 4m precludes mining both seams. We conclude that higher product yields that are likely to be achieved from mining the UDWS seam in this area, by targeting a ROM bypass product with periodic washing, outweigh the better quality product achieved from washing the UG working section. We have assumed for the purposes of the CVA that the UDWS seam is the preferred mining target in the area of resource overlap.

Mining Approach: The most appropriate mining methods for the Hawkins-Rumker project are longwall and Bord & Pillar mining, with longwall mining providing the best opportunity for a viable operation. A significant Inventory Coal tonnage of up to 165Mt for the UDWS seam and 347Mt for the UG seam has been identified after applying mining constraints. The best mining approach at Hawkins-Rumker is considered to involve the following key criteria:

- Target the UDWS seam as a priority, due to its potential to produce a partial ROM thermal coal product. Periodic washing of the UDWS seam is likely to be required after dilution;
- Initially target a central-west area of low (<17% ad) in-situ ash coal in an extended UDWS-UCL-UC2 working section, which is up to 4.1m thick. This coal is unlikely to require washing, and delays the need for capital investment in a washplant;
- Target other areas of the UDWS seam, and the UG seam after establishment of an on-site washplant;
- Use Bord & Pillar methods in areas of the UDWS and UG seam, where igneous intrusions and areas of potential structural discontinuity disallow effective longwall panel layouts.

After consideration of three mining layouts, a preferred ‘Low Ash’ mining option was selected for analysis. This option initially mines the UDWS-UCL-UC2 mining section from a Central access portal using low capex Bord & Pillar methods. This coal and some UDWS coal following is likely to produce a marketable ROM product. The UDWS resource down to 1.8m thick is then mined using a conventional longwall layout, with periodic washing probably required to control dilution. The majority of UG seam resource down to 1.8m thick is then mined, primarily by conventional longwall methods, with all coal fully washed. This mining scenario has been considered at three production levels, which average about 2.9, 4.6 and 6.8Mtpa product for the UDWS seam and 2.9, 4.0 and 6.1Mtpa for the UG seam.

Concurrent operations are conceivable if the UG seam is accessed from a Southern Access portal. Some surface infrastructure such as stockpile areas, CHPP, workshops, offices and facilities could be shared, while significant duplication would also be necessary. but this option has not been costed. We consider that further studies are required to properly investigate and optimise surface infrastructure synergies and cost savings for this option.

Product Quality: Indicative product specifications for the UDWS, UDWS-UCL-UC2 and UG mining sections have been defined based on an average of drill hole data relevant to the target mining area. The UDWS based products conform to the Newcastle High Ash export thermal coal brand, with attractive energy, total sulphur, HGI, and slagging and fouling properties. All published impurity specifications for the Newcastle high Ash brand, including Phosphorous, Chlorine, Fluorine and trace elements Mercury and Arsenic, are well satisfied by the UDWS and UDWS-UC2 products, ROM or washed. We expect that the only quality issue to be managed for the UDWS working section is dilution.

The UG mining section washed product conforms to the Newcastle 6300 (GAR) export thermal coal brand, with attractive energy, total sulphur, HGI, and slagging and fouling properties. Published specifications for the Newcastle 6300 brand, including Calcium Oxide in ash and Boron are well satisfied by the UG washed product, but impurities Selenium and Beryllium are notably high. Average Selenium content (0.21mg/kg) is marginally higher than the Newcastle 6300 maximum specification of 0.2mg/kg (db), with a range of 1.3 – 4.0 mg/kg (db), however, we do not expect that this will present a major marketing issue.

Infrastructure: Surface infrastructure options in extreme northwest and central west locations have been considered and costed. The options considered do not include a third portal option considered for the Low Ash mining scenario, which is assumed to be similar to the central surface infrastructure option.

Several options exist for water supply, of which Windermere Dam is the most logical and reliable, based on size and current usage. Several options also exist for the supply of power, of which the most favourable source is likely to be an upgraded substation at Endeavour Energy's Kandos Zone Substation, which would require 36km of 66KV transmission line to the mine site.

Coal export port options include Port Newcastle, via rail links to the north to Mudgee and then east, or Port Kembla via rail links to the south via Sydney suburbs. Both involve about the same rail distance, but shipping from Port Newcastle is favoured, due to better capacity options, less rail upgrading, and the track south via Sydney would likely be subject to greater community resistance and greater risk of delays. The rail link via Mudgee is also likely to meet with significant community resistance. Either rail link would initially be via the Rylstone-Mudgee line, which is currently closed and would require significant upgrading to carry coal export tonnages.

Capital and Operating Costs:

Total initial capital expenditure within the first 6 years is estimated to range from A$450M in the Low Case model to A$507M for the High Case production rate. Additional capital costs for a CHPP of A$75 - $105M, depending on required throughput capacity, are scheduled after production starts. Sustaining capital at a rate of A$2.0 – $2.15 is assumed in addition to periodic longwall equipment replacement. Initial and sustaining capex contingencies are recommended by MEC Mining, which we have accounted for in a sensitivity analysis.

Mine operating costs are estimated to range from A$39.54 - $34.01/ROM tonne without washing, depending on production rate. An additional operating cost of A$4.90/ROM tonne for washing is assumed for all production cases. An additional operating cost of A$12/tonne (above and below rail) and A$8/tonne are estimated for rail transport and shipping costs respectively.

Commercial Viability:

A number of discounted cash flow models have been developed, which look at the UDWS and UG operations in isolation, plus a mining scenario where the UG seam operation follows on from the UDWS. The models are in real (todays) dollar terms, and assume a long term benchmark thermal coal price of US$65/tonne (FOB) and an A$/US$ exchange rate of 0.76.

The base models show a negative NPV, which essentially improve with increasing production rate. The UDWS operation improves from negative $86M at the Mid Case production rate of 4.6Mtpa, to negative $33M at 6.8Mtpa (High Case). A conceptual UG operation model similarly improves from negative $191M at 4Mpta product, to negative $118M at 6.1Mtpa.

We believe that coal price is the main determining factor influencing a negative NPV for all models, with capital expenditure also very significant. Essentially annual revenue (post royalties and tax) at the long-term price of US$65/tonne, is too low to provide sufficient return on initial capital investment at the preferred discount rate of 10%.

Sensitivity analysis shows that NPV becomes positive at a range of long term coal prices from US$67/tonne to US$81/tonne for the UDWS seam, and US$69 – US$85/tonne for the UG seam, depending on production rate and whether capex contingencies are applied. NPV is significantly worsened after applying the capex contingencies recommended by MEC Mining, but even these models break-even at coal prices within the range from about US$75 – US$85/tonne. We note current benchmark thermal spot prices are around US$100/tonne, but we consider that this is due to a temporary demand/supply imbalance.

We consider that the Hawkins-Rumker project has the potential to be commercially viable at coal prices above about US$67/tonne, subject to further confirmation of capital cost estimates, or US$75/tonne if the recommended capital cost contingencies are applied. We therefore conclude that, subject to coal price, the Hawkins-Rumker area does contain coal resources that could support a viable mining feasibility and development project.

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Appendix 1 – MEC Mining Assessment

Memo 1: First Principals MEC Mining Assessment

6th March 2018

Mr Tom Bradbury,

Geos Mining.

Suite 301/68 Alfred St.

Milsons Point,

NSW 2061

Re: Hawkins Rumker Commercial Viability Assessment.

Dear Tom,

MEC Mining (MEC) would like to thank Geos Mining for the opportunity to contribute to the commercial viability assessment (CVA) of the Hawkins Rumker deposit in New South Wales. MEC have undertaken the following scope of work:

- Created value driver tree model;
- Mineability assessment;
- Underground mine design options;
- Mine extraction and scheduling of preferred option;
- Operating cost estimates; and
- Capital cost estimate.

Key Findings

The Hawkins Rumker deposit comprises two target seams for potential thermal product, the UDWS Seam and the UG Seam. MEC have undertaken an underground mining assessment to support the CVA being undertaken by Geos Mining.

Key findings include:

- The UDWS Seam contains up to 181Mt of ROM coal;
  - Including the preferred "Low Ash Option" with 140Mt;
- The UG Seam contains up to 347Mt of ROM coal;
  - Assumed to require preparation.
- An extensive mine life, at a potential mining rate of 2.2Mt to 4.7Mt ROM per year (typically 3.6Mt per year);

- Product at a potential rate of 1.7Mt to 3.8Mt per year;
- LOM FOR costs of A$44.44/ROM tonne (including washing);
- Initial project capital cost estimate A$596.5M with a pre-concept accuracy of ±35%

Risks and Mitigations

Limited groundwater and geomechanical engineering data exists for the Hawkins Rumker deposit. **Mitigation - The acquisition of data, testing and modelling in future studies is recommended.**

Underground access location has yet to be firmly decided. **Mitigation – undertake a trade-off study.**

Although there is generally a benign shallow dipping structure at Hawkins-Rumker, some possible structural discontinuity has been identified and structure remains a risk. The project doesn't yet have sufficient drill spacing in these areas to clearly define structure. **Mitigation – Exploration capital A$33M to Feasibility stage.**

Longwall subsidence is likely to affect to surface topography. **Mitigation - undertake modelling to investigate the magnitude.**

Opportunities

The concurrent operation of the UDWS and UG Seams is technically feasible. It is envisaged that the UDWS would commence from the central access area and the UG Seam from the southern access area. Both operations could benefit from some surface infrastructure synergies however, the underground production areas would be initially segregated. It is assumed that a high degree of duplication will exist in terms of capital expenditure for equipment and underground infrastructure. Further studies are recommended to investigate and evaluate this opportunity.

The irregular nature of the deposit and presence of intrusives lend itself to the highly flexible bord and pillar method in domains where longwall mining is precluded. There are potential bord and pillar domains that may become opportunistic if access, ventilation and schedule permit.

Scope and Deliverables

MEC have created pre-concept level mining assessments in the form of integrated spreadsheets. Due to the size and proprietary nature of the spreadsheets MEC has summarized the key outputs in a single workbook. This memo serves to provide some high level description of the process steps and key findings of the assessments.

It is noted that MEC Mining did not have scope to undertake a site visit as part of this CVA. Future site visits are recommended to identify any further practicalities, project constraints or opportunities.

Mining Assessment Process

MEC have developed a robust assessment process to determine the key parameters that are likely to influence the production rates of underground mining processes. As shown in Figure A1-35, the inputs and outputs provide a logical and transparent sequence of events.

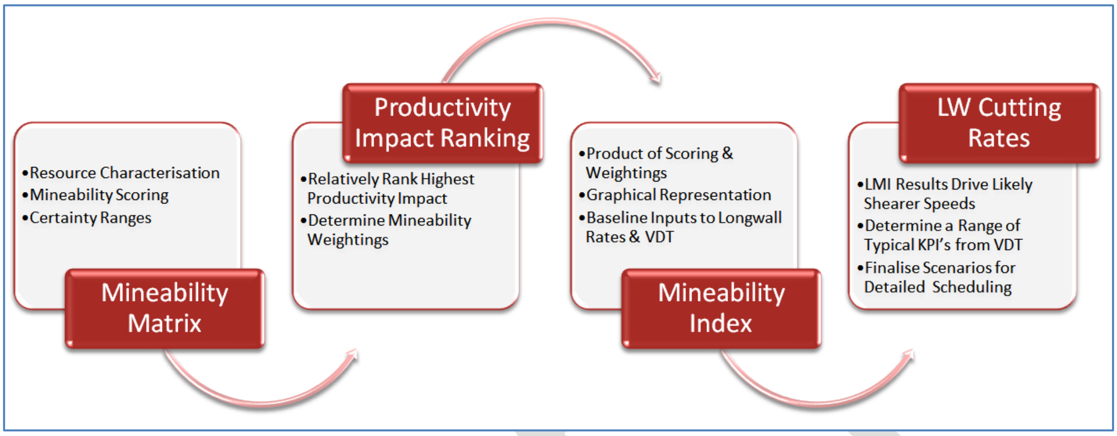

Figure A1-35 - MEC Mineability Assessment Process

Value Driver Tree Model

The value driver tree model determines and number of parameters for inputs to the mine design process. The key outputs are:

- Longwall width;
- Base rates;
- Basis of costs; and
- Key performance indicators (KPIs) for production

Mineability Assessment

Mining parameters that are likely to affect production base rates have been identified, characterised, ranked in terms of their influence on production assumptions (Table 1 Order), and how well known or understood (aka explored / tested) the parameter influence on production rates is (Table 1 ranking). Green rankings are reasonably well known, Amber are moderate, and Red are not well known. Each characteristic is also ranked against all other characteristics in terms of its importance, and assigned a weighting. The resulting weighting table is then multiplied by the ranking data to produce a Mineability Index for each parameter and the deposit as a whole (Table 2). Green, amber and red rankings for each parameter provide an indication of expected variability across the deposit. Essentially, the rankings applied to the Hawkins Rumker deposit reflect the level of geological influence and the factors that are likely to reduce development and longwall base rates.

Order	Mineability Matrix	Mineability Ranking: Sum to 10 1 = Unknown 10 = Well Known		
Order	Parameter	Green	Amber	Red
1	Seam Dip	6.00	3.00	1.00
2	Seam Thickness	7.00	2.00	1.00
3	Floor Condition	5.00	3.00	2.00
4	Fault Exposure	4.00	4.00	2.00
5	Ground Water	5.00	4.00	1.00
6	Seam Continuity (Dykes & Sills)	4.00	4.00	2.00
7	Roof Condition	4.00	4.00	2.00
8	Seam Quality	4.00	4.00	2.00
9	Field Stress	5.00	4.00	1.00
10	Seam Strength	6.00	3.00	1.00
11	Ventilation / Spon Com	6.00	4.00	1.00
12	Seam Gas(s)	6.00	3.00	1.00

Table A1-20 - Mineability Matrix and Ranking

The key outputs, shown in Table 2 and Figure A1B-44 are used to derate the base rate (from VDT) to take account of the level of knowledge (uncertainty) and expected variability within the deposit.

The "traffic light" system has two primary functions:

1. To indicate the level of knowledge / uncertainty across each of the mineability parameters; and
2. To drive the low, mid and high production rates for the mining schedule.

In the case of Hawkins Rumker, the assessment produces the following bottom line indices, which are used to influence the longwall shearer cutting speeds from maingate to tailgate and vice versa:

- Green – 54%;
- Amber – 32%; and
- Red – 14%.

Mineability Index	Green	Amber	Red
Seam Dip	1.25	0.62	0.21
Seam Thickness	1.03	0.29	0.15
Floor Condition	0.64	0.38	0.25
Fault Exposure	0.26	0.26	0.13
Ground Water	0.34	0.27	0.07
Seam Continuity (Dykes & Sills)	0.33	0.33	0.16
Roof Condition	0.32	0.32	0.16
Seam Quality	0.32	0.32	0.16
Field Stress	0.16	0.13	0.03
Seam Strength	0.26	0.13	0.04
Ventilation / Spon Com	0.18	0.12	0.03
Seam Gas(s)	0.14	0.07	0.02
Mineability Index	**54%**	**32%**	**14%**

Table A1-2 - Mineability Indices

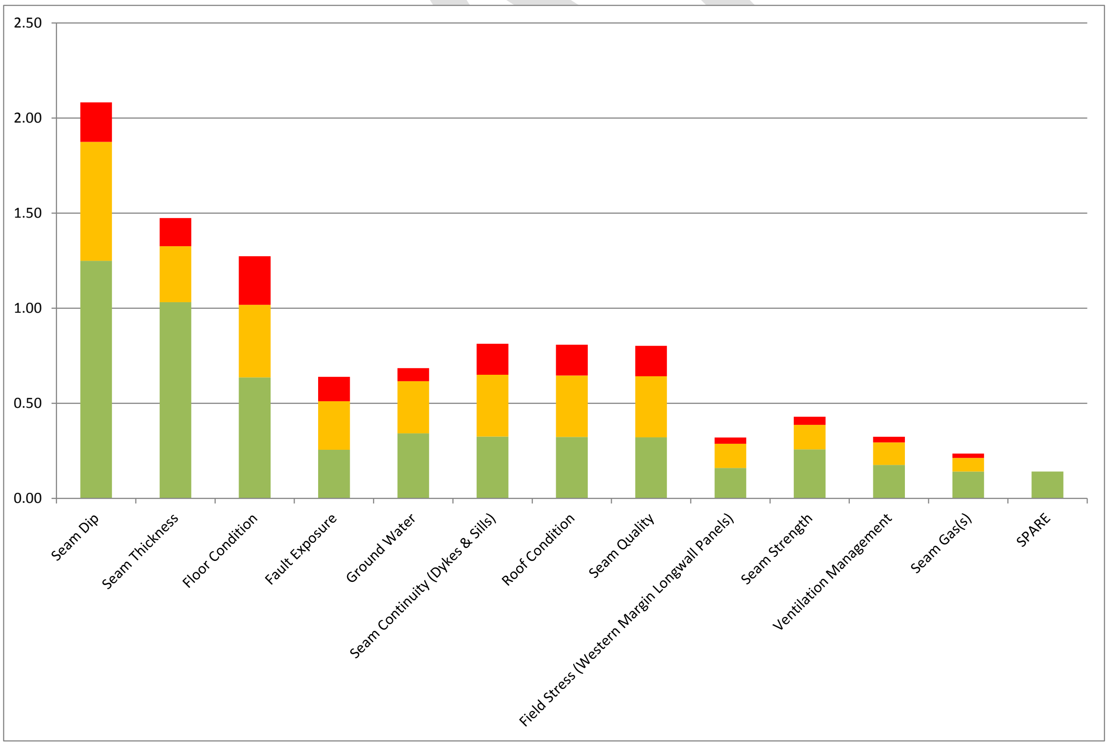

Figure A1-36 - Longwall Mineability Assessment Parameters

Access Options

In consideration of the likely underground mine layouts three access options have been evaluated. However, there has been no site visit as part of this study and hence the underground access points should be evaluated in further detail. Access points considered include:

- Option 1 (Wave International) – considered a north-western entry to the UDWS Seam;
- Option 2 (Wave International) – the most southerly access into the UDWS Seam; and
- **Option 3 Base Case (MEC Mining) – considers access to the low ash area of the UDWS Seam.**
- Option 4 Upside option – considers concurrent UDWS and UG Seam operations. This strategy utilises both central and southern access points.

In concept, the underground access would comprise multiple portals and subsequent shaft sink to provide adequate ventilation in the mains developments.

Mine Design Options

Several mine design options were considered using a number of surface and sub-surface constraints as outlined in the Geos Mining Report.

One of the primary constraints for the longwall design was the provision of a minimum 40m of Permian to facilitate the expected abutment stresses. Detailed geotechnical engineering and modelling is recommended to validate mine design and orientations.

Of the options considered, two preferred cases provide viable opportunities for the deposit:

- Low ash start up on the UDWS Seam using a central access point, Figure A1-37; and
- A central mining domain, in the UDWS Seam, using a Southern access point. This design may include a mining domain that uses longwall plow operations with seam thickness between 0.6m and 1.8m.

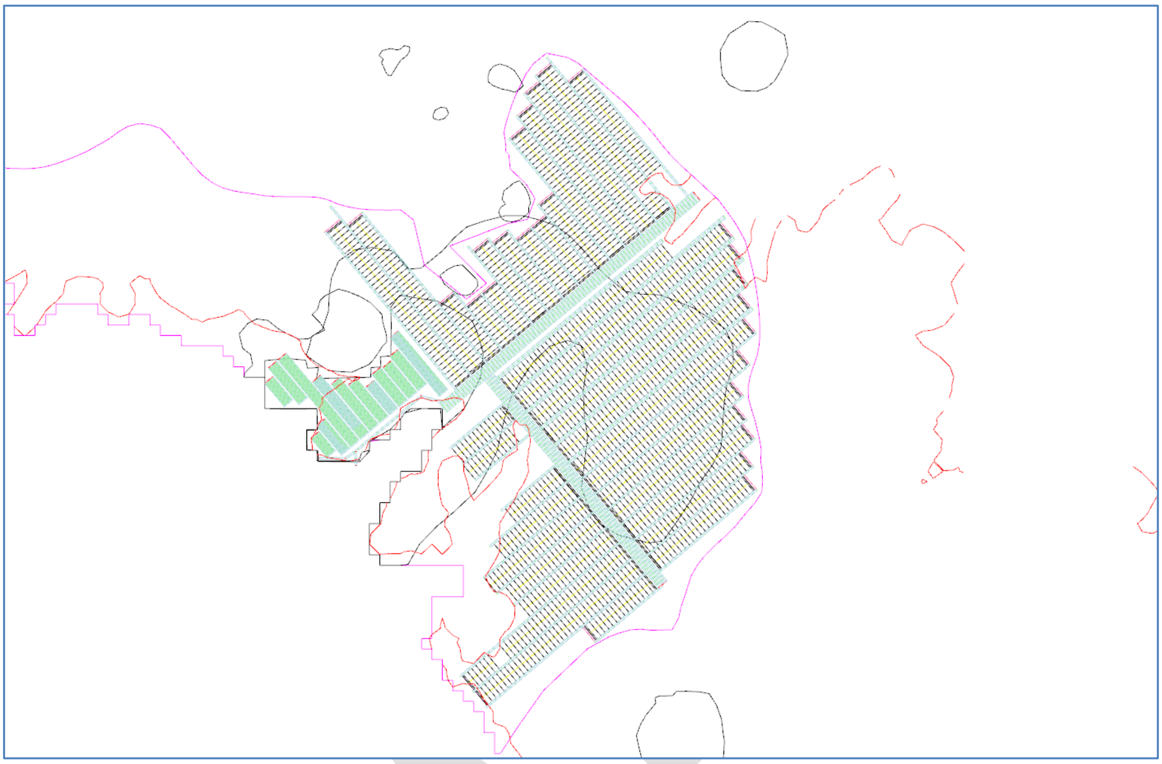

Figure A1-37 - UDWS Seam Low Ash Mine Design with Central Access

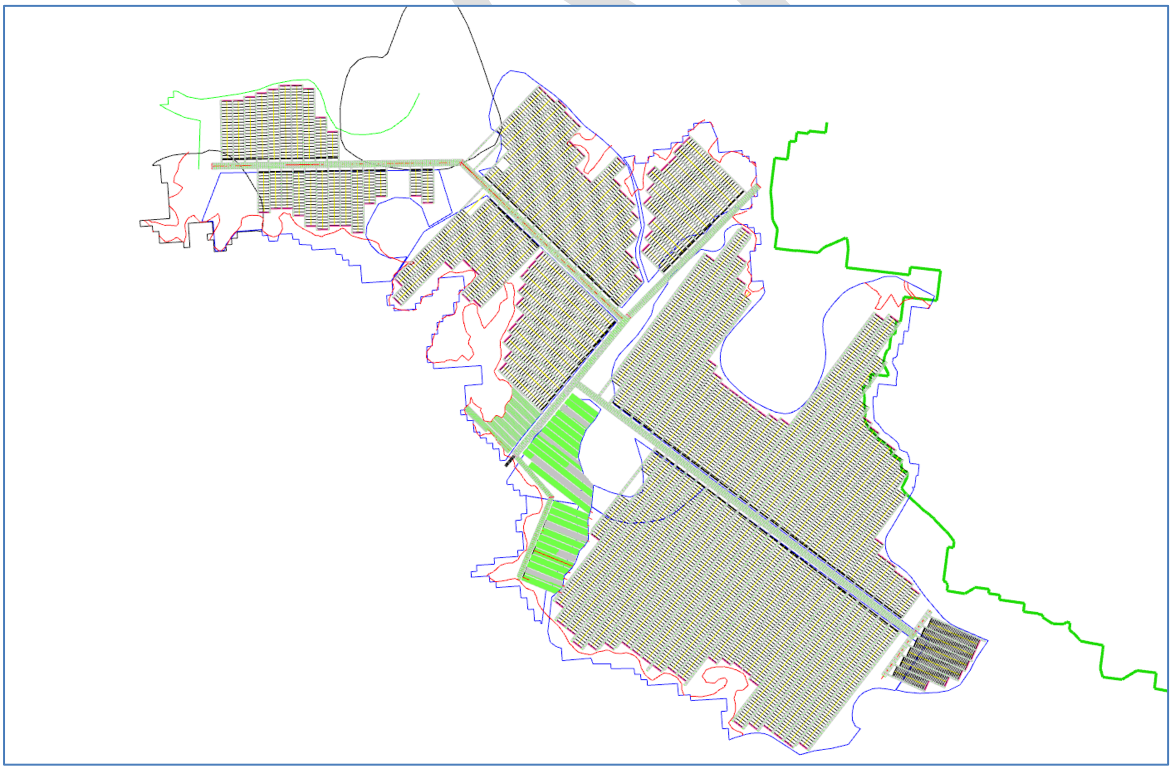

Figure A1-38 - Hawkins Rumker Case 4 with Longwall Plow with Southern Access

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General Mine Design Features

The value driver tree provides the basic mine design parameters:

- Longwall width – 350m;
- Seven heading mains;
- Two heading gateroads <4km in length, three headings >4km;
- Development dimensions 5.2m x 2.8m; and
- Bord and pillar have 9 headings and are assumed to extract pillars to give an overall recovery of 43% (20% with no extraction).

Recoverable Tonnage Estimates

Each seam has been delineated into specific mining domains to enable localised scheduling variances. The UDWS Seam also contains an opportunity to extend reserves using a longwall plow to recover reserves down to 0.6m in the North only. However, the incremental opportunity amounts to 15.5Mt product which is not expected to meet investment hurdles at this time.

The MEC Mining base case combines the UDWS Low Ash Option, plus the UG Seam portion of the Southern access option, with UG mining assumed to follow UDWS mining. Effective yields were obtained from Geos Mining for the two preferred mining options.

UDWS Seam	DV Metres	DV Tonnes	LW Metres	LW Tonnes	Total Tonnes	Total Product	Effective Yield	Method
Domain	(m)	(ROMt)	(m)	(ROMt)	(ROMt)	(Prodt)	(%)	
1.10	163,038	3,658,251	18,100	21,760,725	25,418,976	24,656,407	97%	Conventional LW
1.20	206,883	4,210,311	42,630	61,409,408	65,619,718	63,651,127	97%	Conventional LW
1.30	195,980	4,277,562	40,635	51,635,509	55,913,071	54,235,678	97%	Conventional LW
1.40	64,709	1,418,986	11,530	14,522,445	15,941,431	15,463,189	97%	Conventional LW
1.50	93,846	2,415,274	19,080	13,606,110	16,021,384	15,540,742	97%	Plow System
1.55	83,800	2,549,870	0	0	2,549,870	2,473,374	97%	Bord & Pillar
Sub Total No Plow	**714,410**	**16,114,981**	**112,895**	**149,328,086**	**165,443,067**	**160,479,775**		
Sub Total With Plow	**808,256**	**18,530,254**	**131,975**	**162,934,196**	**181,464,451**	**176,020,517**		

Table A1-21 - UDWS Mining Domains

UG Seam	DV Metres	DV Tonnes	LW Metres	LW Tonnes	Total Tonnes	Total Product	Effective Yield	Method
Domain	(m)	(ROMt)	(m)	(ROMt)	(ROMt)	(Prodt)	(%)	
1.60	253,529	5,958,934	62,940	68,069,610	74,028,544	63,473,395	86%	Conventional LW
1.70	236,209	5,322,339	55,750	65,664,585	70,986,924	58,371,008	82%	Conventional LW
1.80	295,644	6,862,864	80,690	89,687,514	96,550,378	84,055,294	87%	Conventional LW
1.90	249,314	5,859,865	61,200	66,187,800	72,047,665	60,404,763	84%	Conventional LW
2.00	119,849	2,746,046	18,510	21,263,498	24,009,544	17,716,278	74%	Conventional LW
2.10	245,000	6,590,425			6,590,425	5,221,917	79%	Bord & Pillar
2.20	122,400	3,279,672			3,279,672	2,683,507	82%	Bord & Pillar
Sub Total UG Seam	**1,521,943**	**36,620,144**	**279,090**	**310,873,007**	**347,493,151**	**291,926,162**		

Table A1-22 - UG Seam Mining Domains (Base Case)

UDWS Seam - Low Ash	DV Metres	DV Tonnes	LW Metres	LW Tonnes	Total Tonnes	Total Product	Effective Yield	Method
Domain	(m)	(ROMt)	(m)	(ROMt)	(ROMt)	(Prodt)	(%)	
3.0	127,500	5,455,135			5,455,135	5,291,481	97%	Bord & Pillar
3.1	215,531	4,811,542	34,009	41,304,234	46,115,776	41,566,234	90%	Conventional LW
3.2	191,937	4,239,496	45,791	56,945,397	61,184,893	57,528,060	94%	Conventional LW
3.3	120,396	2,630,576	19,754	24,975,125	27,605,701	24,524,343	89%	Conventional LW
Sub Total UDWS Seam Low Ash	**655,363**	**17,136,749**	**99,554**	**123,224,755**	**140,361,504**	**128,910,118**		

Table A1-23 - UDWS Low Ash Option Mining Domains (Base Case)

Coal Quality Estimation

MEC Mining has provided Geos Mining with mine design outlines for the three mining options, from which Geos Mining has defined mining area polygons for ROM and/or product quality estimates from the geological model. MEC Mining also reviewed the potential for dilution as it appears the immediate roof and floor materials are variable in strength and nature. MEC therefore assumes a nominal 50mm of roof dilution and 100mm of floor dilution.

The low ash mine layout in Figure A1-39 shows the coal quality domains for estimation. Please refer to Geo Mining report for further details.

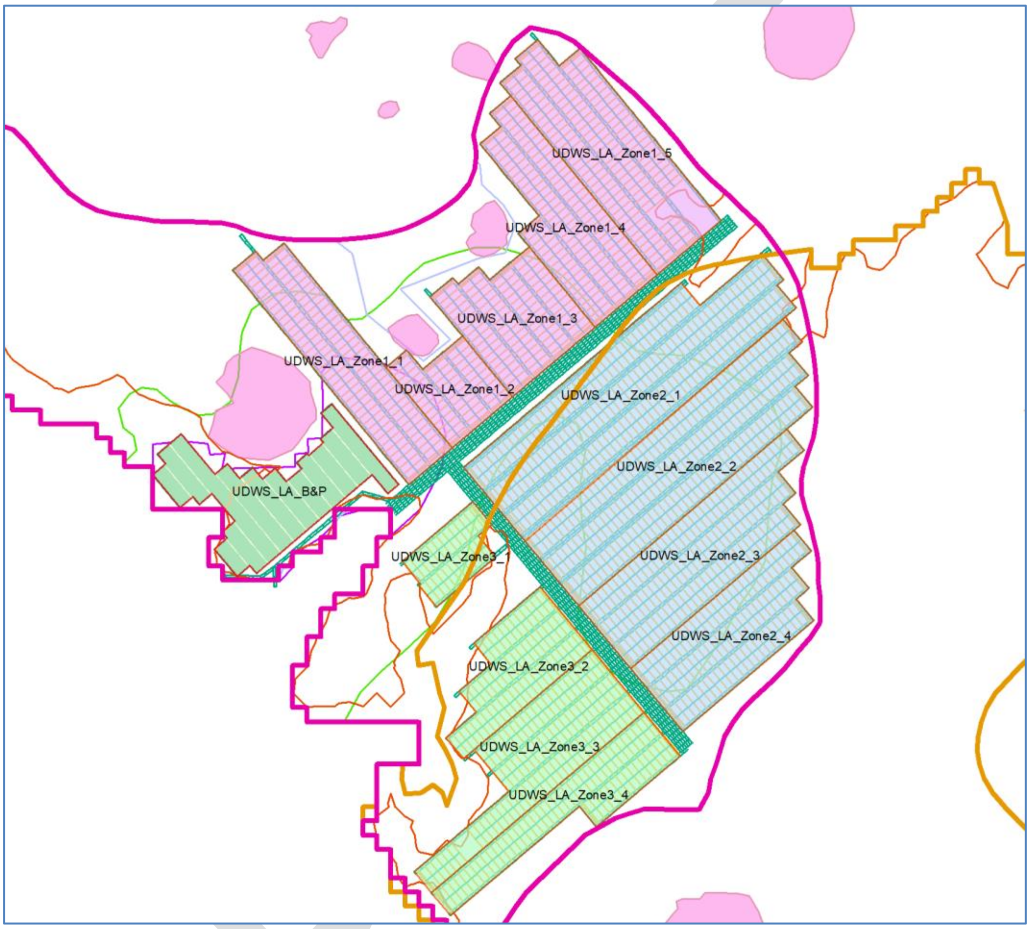

Figure A1-39 - UDWS Mine Plan with Coal Quality Domains

Mine Scheduling – Base Case

MEC has determined a “first principles” base rate and operating time approach from the mineability assessments. These are shown in Table A1B-28, and Table A1-25. The UG Seam demonstrates a more favourable geological roof and floor conditions and this is reflected in the slightly improved Mineability index and rate uplift see Figure A1-41.

The longwall is assumed to operate for 73 hours per week as a base production time. This is considered conservative given the nature of the study and knowledge of the deposit.

Developments are considered as contractor units (lower capital) and assume 90 hours per week and are scheduled at a rate of 0.22m longwall metres per development metre.

The resultant UDWS Seam schedule for the base case is shown in Figure A1B-47.

Time Usage Model (Hours & Rates)				
Production Time	73	m/Wk	m/Day	m/Mth
Base Rate: Low	0.49	35	5.9	154
Base Rate: Mid	0.59	43	7.1	185
Base Rate: High	0.74	54	9.0	233

Table A1-24 - UDWS Seam Longwall Production Assumptions

Time Usage Model (Hours & Rates)				
Production Time	73	m/Wk	m/Day	m/Mth
Base Rate: Low	0.54	39	6.5	169
Base Rate: Mid	0.79	57	9.5	248
Base Rate: High	0.81	59	9.9	256

Table A1-25 - UG Seam Longwall Production Assumptions

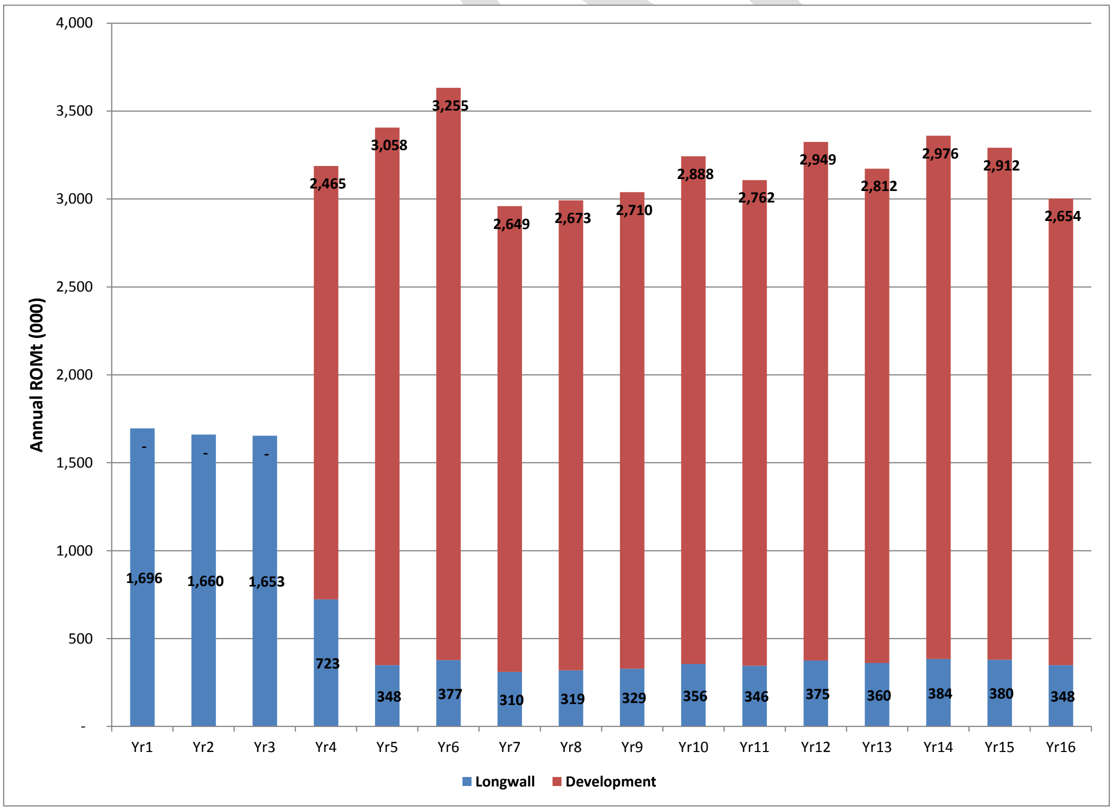

Figure A1-40 - UDWS Seam Base Case Production Schedule

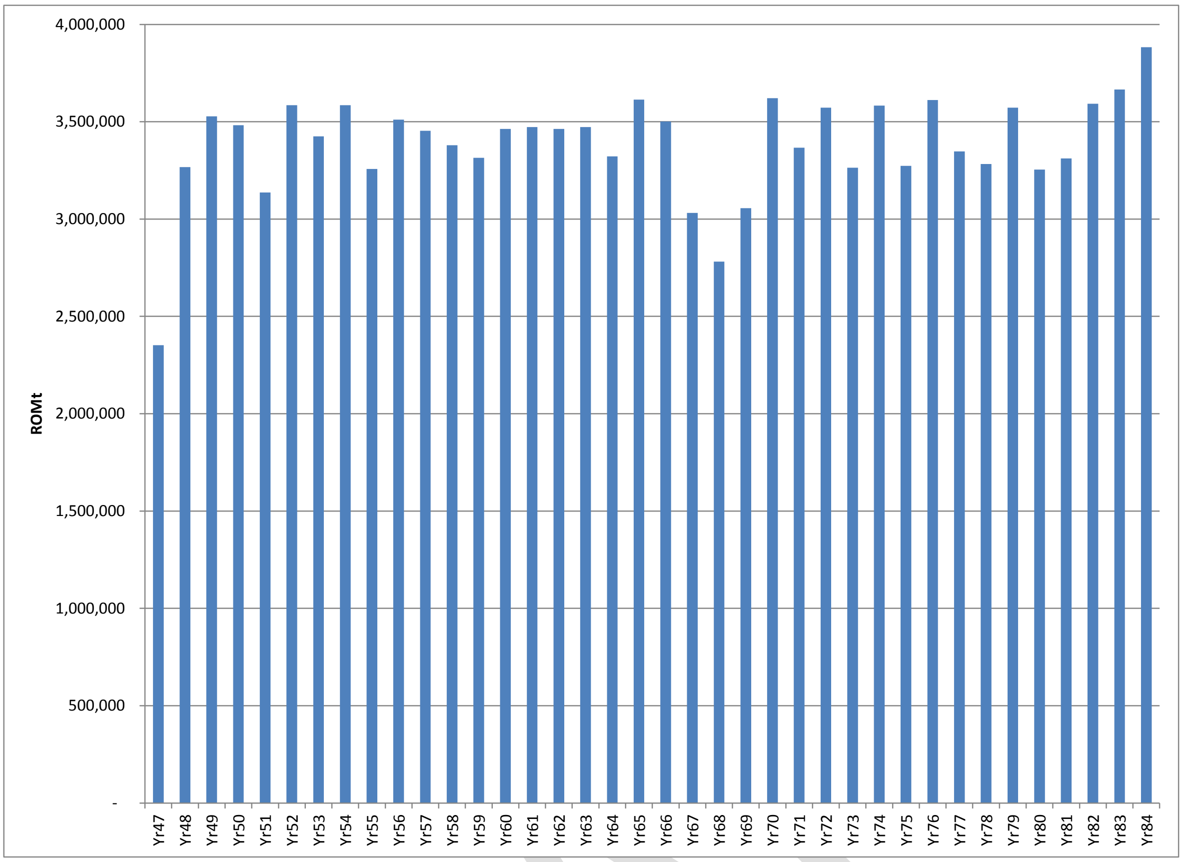

Figure A1-41 - UG Seam Production - Post UDWS Seam

Concurrent Operations

An opportunity exists for concurrent operations with production from both the UDWS (circa 3.5mtpa ROM) and UG Seams (3mtpa to 3.5mtpa ROM). Whilst the undergrounds would initially operate in separate mining domains, the surface infrastructure has potential synergies with workshops, offices and facilities being shared.

Further studies are required to optimise the synergies and reduce capital expenditure for equipment effectiveness. It is however expected that significant duplication of equipment and hence, capital will be required.

Operating Costs Free on Rail (FOR)

Underground operating costs have been derived from recent similar studies and a database of cost drivers. Costs are presented as A$/ROMt, including labour and are un-escalated. The costs are summarised in Table A1B-31.

Operating Costs (Inc. Labour)	Unit Costs (A$/ROMt)
Development: ($/Metre)	4,500
Conveyors	2.39
Longwall	9.46
Outbye	7.50
Localised Requirements	4.46
Tech Services	1.17
Surface and Administration	1.99
CHPP (UG Seam Only)	4.90
Total (No CHPP)	**40.64**

Table A1-26 - Underground Operation Cost Assumptions

Capital Estimation

Capital cost estimates are based around two sources;

- MEC Mining standard Project Capital Drivers;
- MEC Mining Capital Cost Database; and
- Wave International Estimates.

Cost estimates are un-escalated and are presented in Table A1B-34 with +35% level of accuracy contingency.

Description	**A$**
Equip-Surface	2,293,000
Equip-Underground	165,134,690
Equip-Other	967,420
Development	123,575,000
Facilities	233,248,844
Contingency	35%
Initial Capital Total	**607,795,589**

Table A1-27 - Initial Project Capital Estimate (Un-Escalated)

The "Development" estimate is inclusive of $94M capitalised development which is inclusive of central access portals, drifts, mains development and gateroads to the initial longwall panel. No capital estimate for the southern access.

The "Equip-Underground" estimate includes the costs of the longwall equipment (A$129M exc. contingency) to maintain continuity with the initial bord and pillar operation.

The "Facilities" estimate excludes the costs of a Coal Handling Preparation Plant (CHPP) of approximately $75M for a 700tph system. The CHPP is expected to be required as the mine plan extracts LW108 panel. The current schedule has the CHPP being required in years 8 and 9 of production with the capital scheduled as "Ongoing Capital".

The initial capital estimate schedule is shown in Figure A1-42.

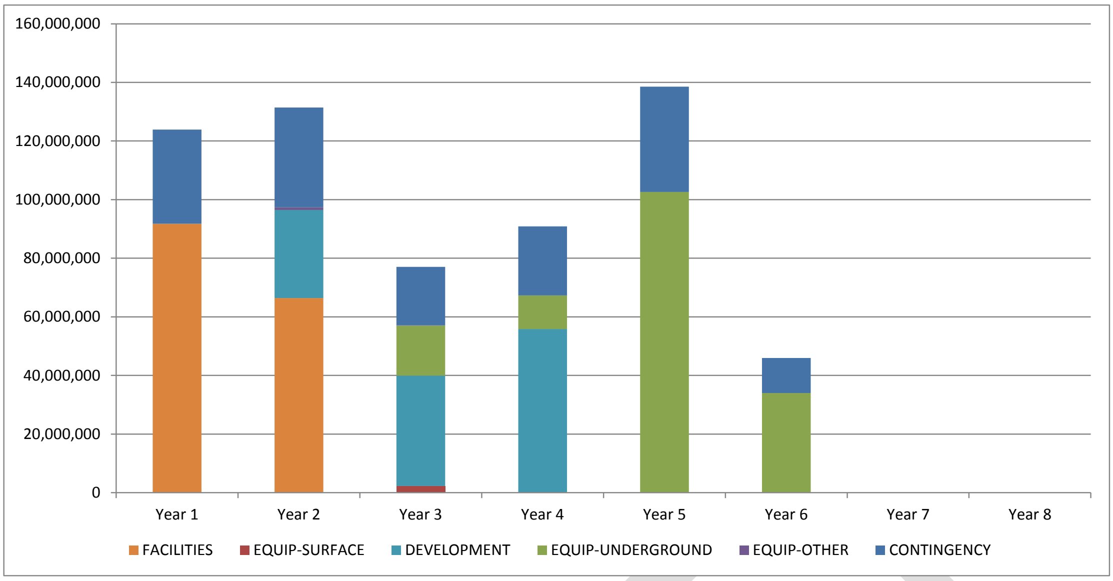

Figure A1-42 - Capital Estimate Schedule

MEC Mining would like to thank Geos Mining for the opportunity to undertake this Commercial Viability Assessment.

Should you have any questions then please do not hesitate to contact.

Regards

Geoff Watson
Study Lead MEC Mining

MEMO 2: RANGE ANALYSIS

20th April 2018

Mr. Tom Bradbury,

Geos Mining.

Suite 301/68 Alfred St.

Milsons Point,

NSW 2061

Re: Range Analysis Hawkins Rumker Commercial Viability Assessment.

Dear Tom,

MEC Mining (MEC) would like to thank Geos Mining for the opportunity to include a longwall Range Analysis (the analysis) with the commercial viability assessment (CVA) of the Hawkins Rumker deposit in New South Wales. MEC have undertaken the following scope of work:

- Discussions with the regional underground mining operations Technical Services Manager 28/03/2018;
- Revised the mineability assessments for the UDWS and UG Seams to reflect a wide range of conditions;
- Determined three incremental ranges of production, costs and capital; and
- Scheduled the production costs and capital outputs for financial evaluation by Geos Mining.

This analysis has focused on the sensitivity of longwall productivity and as such the bord and pillar extraction remains as per the original MEC memo. Also note that coal development requirements are assumed to maintain longwall continuity. Further studies are recommended to support this.

MEC has specifically excluded the following areas from this range analysis which should form part of ongoing studies;

- Resource ranging;
- Concurrent operations;
- Bord and Pillar mining domains; and
- Capital contingency ranging.

Executive Summary

A high level range analysis for coal production, operating and capital cost has been undertaken for the Hawkins Rumker deposit. The analysis has determined the following key outputs:

Range Analysis		Low	Mid	Max
ROMt	Mtpa	2.5 - 3.6	4.0 - 5.8	5.3 - 9.5
Prodt	Mtpa	2.0 - 3.3	3.7 - 5.5	4.6 - 8.9
OPEX	A$/ROMt	44.44	40.51	38.92
CAPEX	A$M	608	630	685

Figure A1B-43 - Summary Findings from Range Analysis

The analysis data associated with the low case relates directly to the previously supplied MEC Memo dated 6th March 2018.

The key outputs show the variability in the expected mining conditions across each of the cases, noting the relative consistency of production in the low case versus the volatility of the max case. This may be attributed to the spreadsheet scheduling methodology, which is considered appropriate for a conceptual range analysis, and further refinement is recommended using proprietary and specialist applications.

The variability and accuracy in OPEX and CAPEX estimates should also be refined and validated using budget estimates with work breakdown structure (WBS).

MEC have determined a range of cases (scenarios) that align to a low, mid and max philosophy. Benchmarking has been used to compare similar operations to Hawkins Rumker.

- **Low** – In the original MEC memo (6/03/2018) a case was presented (Mid) which was determined from a first principles basis which included assumptions that the mining conditions are not well known and that factors which affect production derated potential production capacity. During the range analysis, a "minimum" case was investigated which was found to fundamentally eliminate any economic mining of the deposit. The minimum case was therefore eliminated from further evaluation. In discussions with Geos Mining it was agreed to align the original mid case as the new low case;
- **Mid** – mining conditions are assumed to be moderately well known and production rates are improved to reflect the improved mineability. MEC have also referenced the MEC longwall database and the data indicates a minimum 2.5m cut height required for higher tonnes (all mines which achieved >4mtpa average at least 2.5m cut height). This is typically 75% of Ulan Rates; and
- **Max** – mining conditions are assumed to be well known, and average production rates are at the maximum considered conceivable for Hawkins Rumker. These are at the highest rates being achieved at Ulan mine, and are expected to "book-end" the prospectivity of a single longwall operating in the Hawkins Rumker mining domains.

Mineability Assessment - Overview

Mining parameters that are likely to affect the production base rates have been previously identified, characterised, ranked and weighted. During the analysis, the individual mining parameters have been modified to reflect a "level of confidence" in the mineability conditions that will drive production rates.

The "traffic light" system has two primary functions:

3. To indicate the level of knowledge / uncertainty across each of the mineability parameters. Green areas are where we have some knowledge whilst amber / red areas are lower certainty; and
4. To drive the low, mid and high production rates for the mining schedule.

Mineability Assessment – Low Case

In the low case of Hawkins Rumker, the assessment produces the following indices and longwall rates, metres per operating hour (mpoh):

- Green – 54% and 0.74mpoh;
- Amber – 32% and 0.59mpoh; and
- Red – 14% and 0.49mpoh.

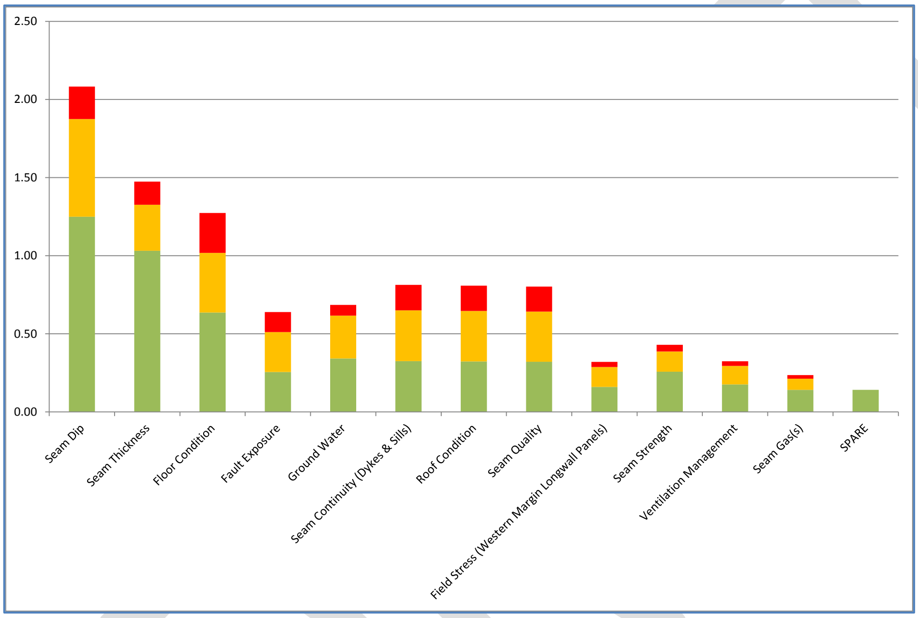

Figure A1B-44 - Longwall Mineability Assessment Parameters Low Case

Mineability Assessment – Mid Case

In the mid case of Hawkins Rumker, the assessment produces the following indices and longwall rates;

- Green – 78% and 1.5mpoh;
- Amber – 22% and 1.2mpoh; and
- Red – 1% and 0.93mpoh.

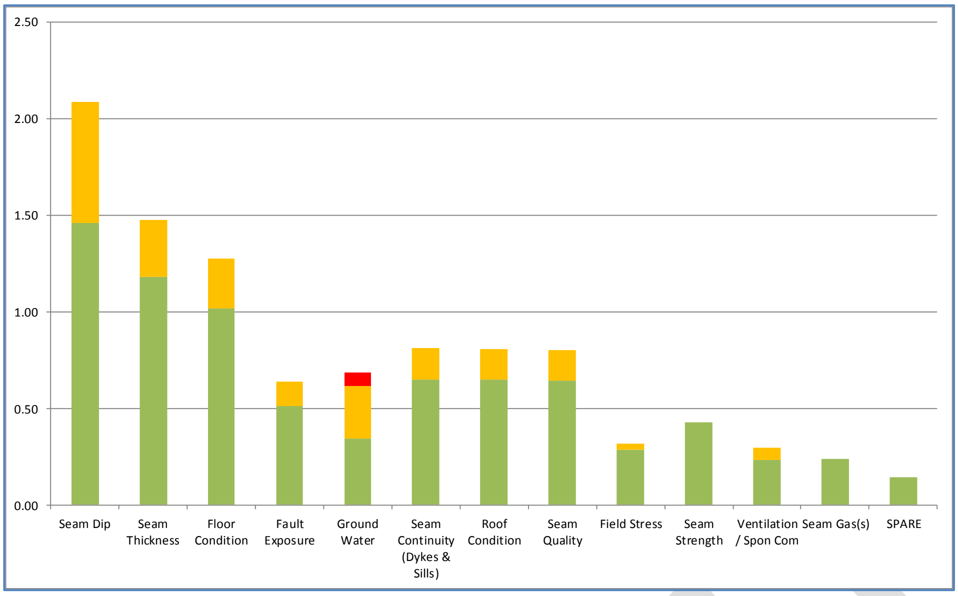

Figure A1B-45 - Longwall Mineability Assessment Parameters Mid Case

Mineability Assessment – Max Case

In the max case of Hawkins Rumker, the assessment produces the following indices and longwall rates;

- Green – 90% and 2.0mpoh;
- Amber – 10% and 1.6mpoh; and
- Red – 1% and 1.25mpoh.

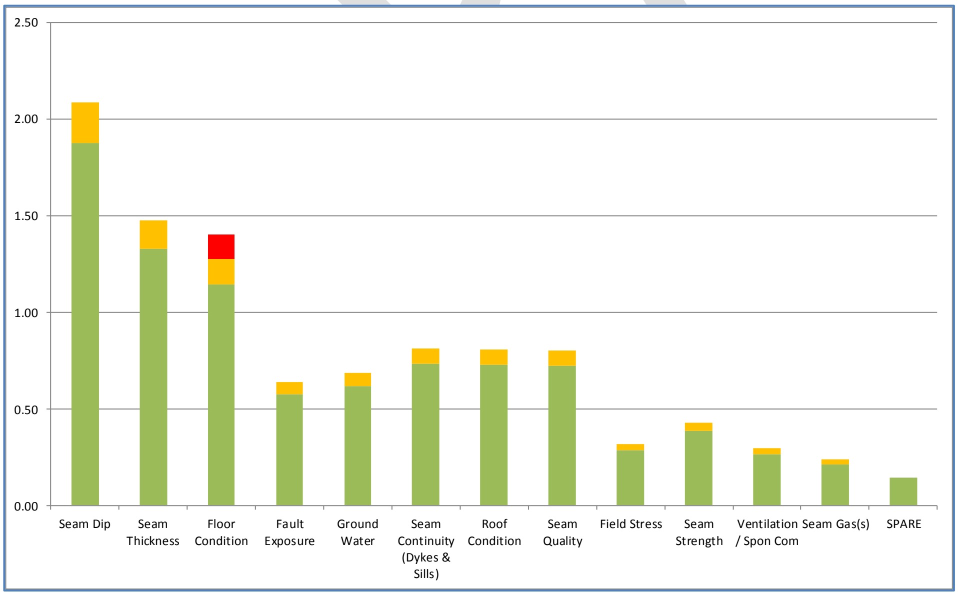

Figure A1B-46 - Longwall Mineability Assessment Parameters Max Case

Mine Scheduling – Low Case

MEC has determined a "first principles" base rate and operating time approach from the mineability assessments.

Time Usage Model (Hours & Rates)				
Production Time	73	m/Wk	m/Day	m/Mth
Base Rate: Low	0.49	35	5.9	154
Base Rate: Mid	0.59	43	7.1	185
Base Rate: High	0.74	54	9.0	233

Table A1B-28 - UDWS Seam Longwall Production Assumptions Low Case

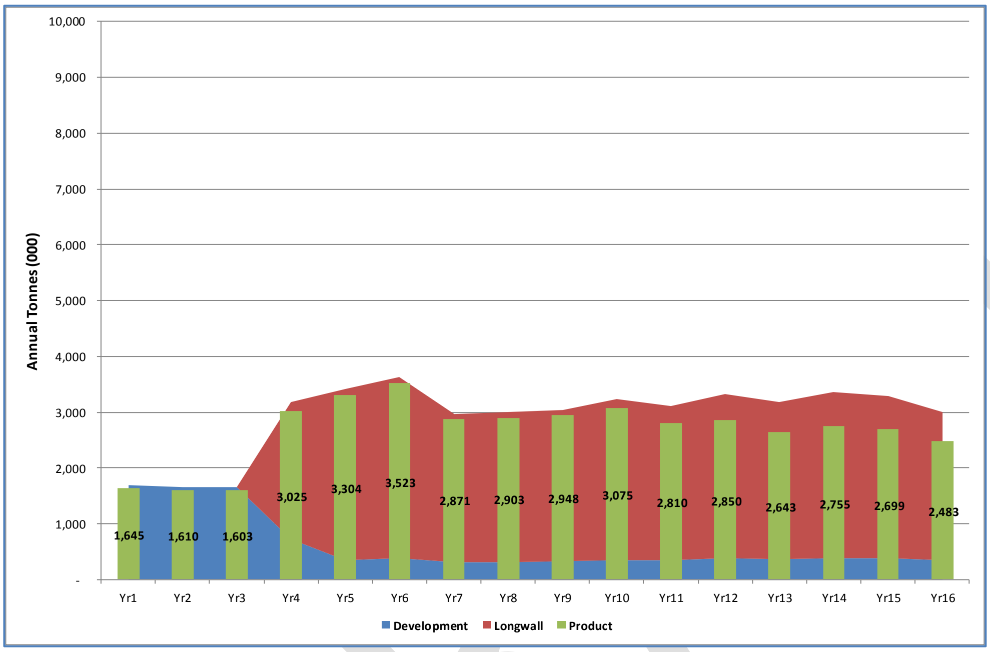

Figure A1B-47 - UDWS Seam Production Schedule Low Case

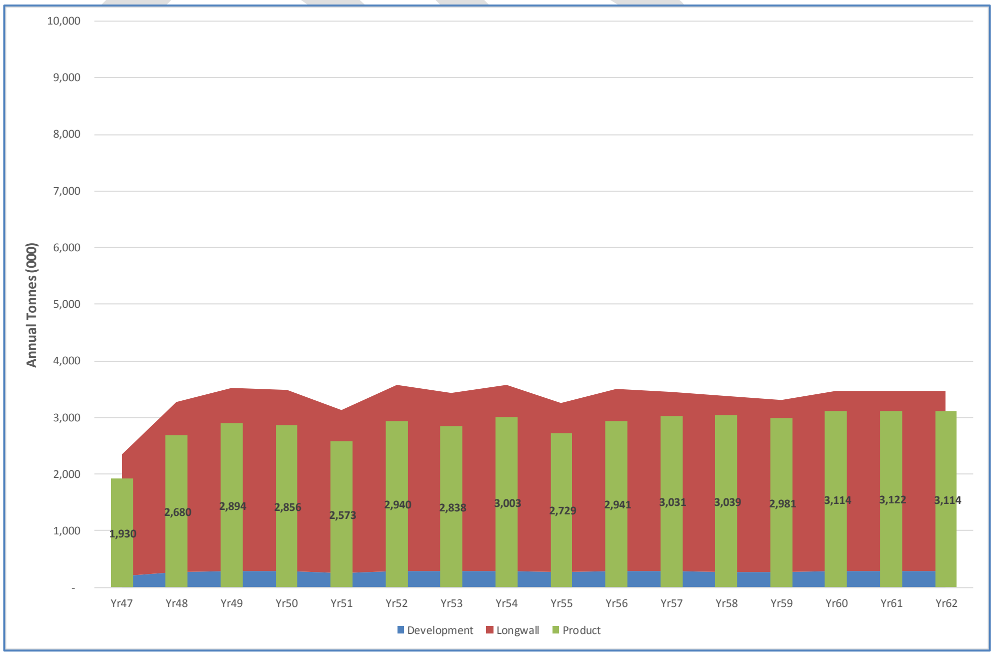

Figure A1B-48 - UG Seam Production Schedule Low Case

Mine Scheduling – Mid Case

The mid case strategy is based on an assumed 75% of the Ulan rates as discussed with the Technical Services Manager at a regional coal mining operation. The rates are derived from a review of the low case mineability assessment as shown in Figure A1B-44. Also note that the production time has actually reduced from 73 to 65 hrs per week based on the discussions.

Production Time	65	m/Wk	m/Day	m/Mth
Base Rate: Low	0.93	60	10.0	260
Base Rate: Mid	1.20	77	12.9	335
Base Rate: High	1.50	97	16.1	419

Table A1B-29 - UDWS Seam Longwall Production Assumptions Mid Case

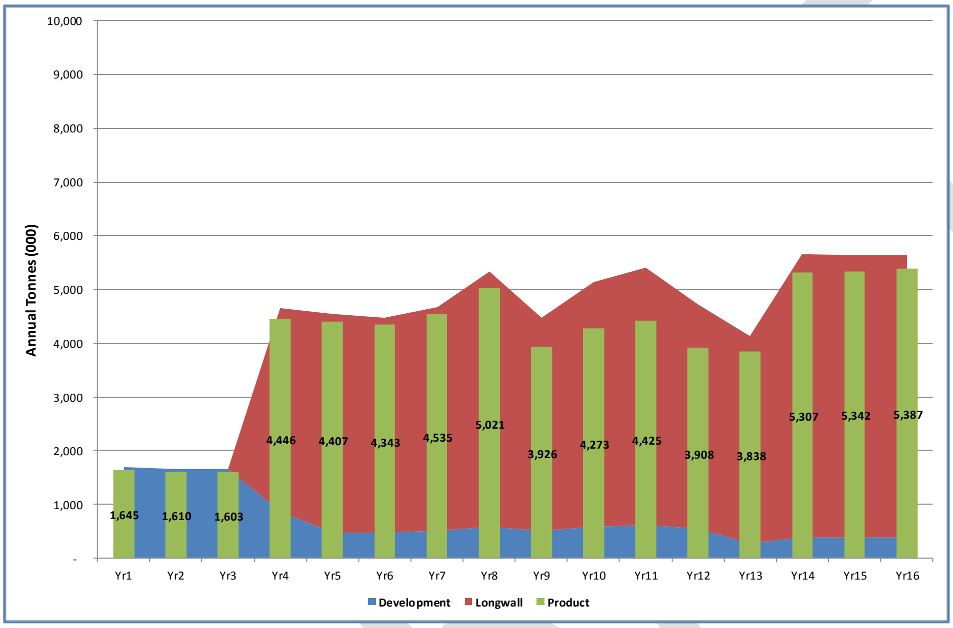

Figure A1B-49 - UDWS Seam Production Schedule Mid Case

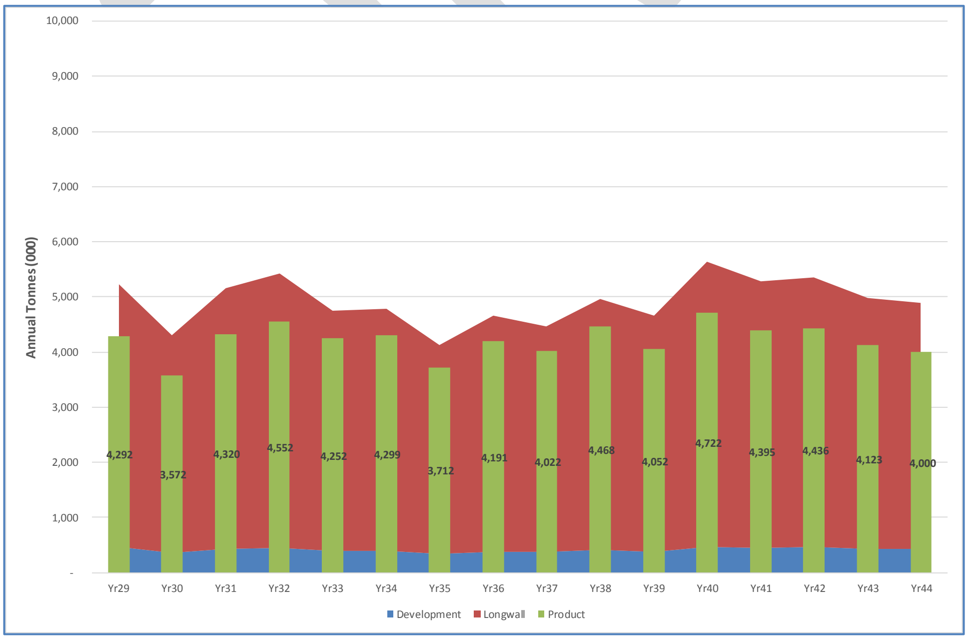

Figure A1B-50 - UG Seam Production Schedule Mid Case

Mine Scheduling – Max Case

The max case strategy assumes 100% of the Ulan mine rates, as discussed with the Technical Services Manager. The production time has assumed to be achievable at 76 hours per week.

Production Time	76	m/Wk	m/Day	m/Mth
Base Rate: Low	1.25	94	15.7	409
Base Rate: Mid	1.60	121	20.2	524
Base Rate: High	2.00	151	25.2	655

Table A1B-30 - UDWS Seam Longwall Production Assumptions Max Case

As a cautionary comment, these production rates are only achieved with a significant increase in development performance. The data indicates that around 6 Continuous Miner units would be required and this places additional load on the UG services including ventilation systems and contract development labour. As an additional comment, the MAX production profile is considered at the very limits of Australian longwall benchmarking data for similar cut heights.

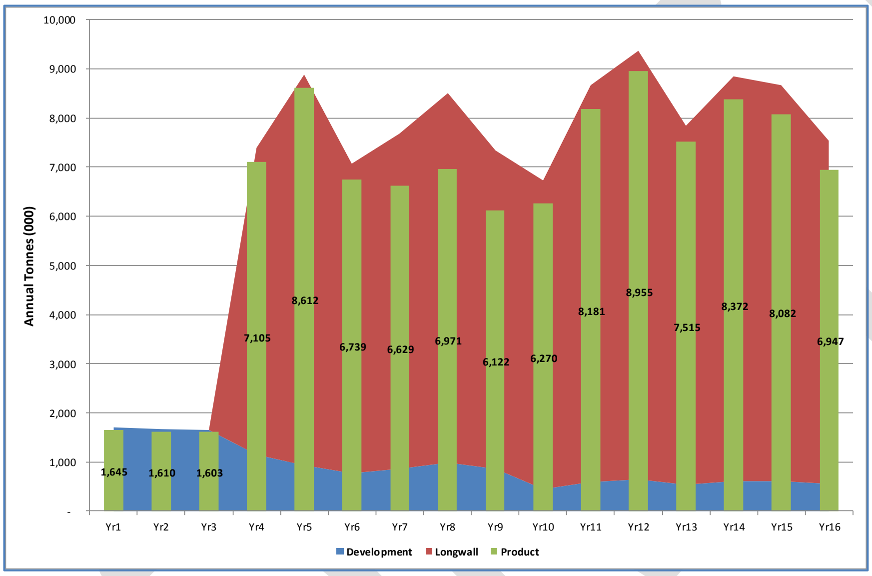

Figure A1B-51 - UDWS Seam Production Schedule Max Case

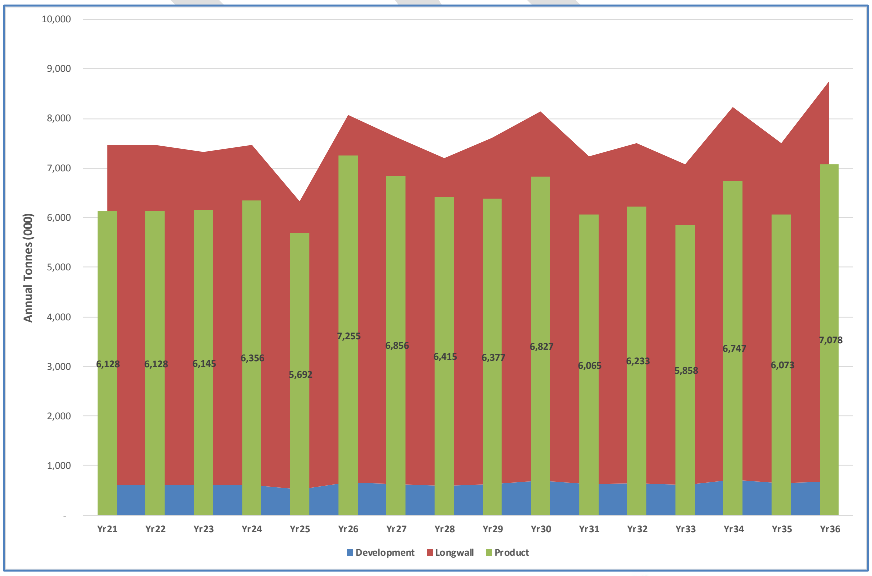

Figure A1B-52 - UG Seam Production Schedule Max Case

Benchmarking Data

Observation of the available data in the benchmarking database (to circa 2016) indicates the "most likely" longwall output for the range of cut heights is up to ~6Mt (ROM) with a headline rate of ~4Mt (ROM) for cut heights <2.5m. Ulan and Kestrel Mines are shown as similar longwall configurations and mining conditions.

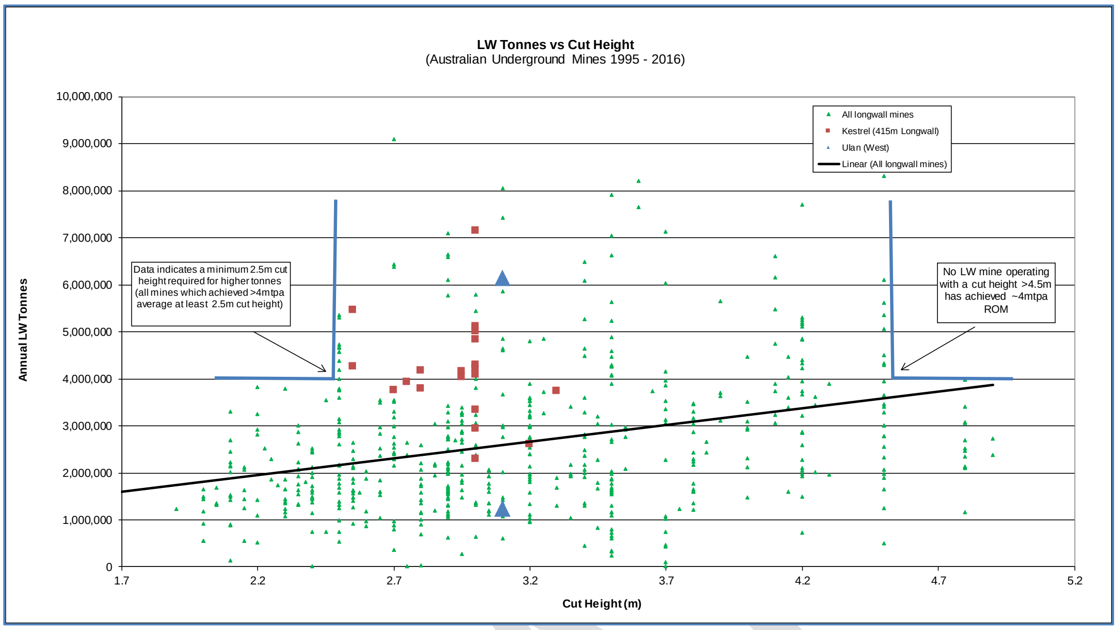

Figure A1B-53 - Longwall Benchmarking Data to 2016

Operating Costs Free on Rail (FOR) – Low Case

Underground operating costs have been derived from recent similar studies and a database of cost drivers. Costs are presented as a total of fixed and variable, A$/ROMt, including labour and are un-escalated. The costs are summarised in Table A1B-31.

Operating Costs (Inc. Labour)	Unit Costs (A$/ROMt)
Development: ($/Metre)	4,500
Conveyors	2.39
Longwall	9.46
Outbye	7.50
Localised Requirements	4.46
Tech Services	1.17
Surface and Administration	1.99
CHPP (UG Seam Only)	4.90
Total (with CHPP)	**44.44**
Total (No CHPP)	**39.54**

Table A1B-31 - Underground Operation FOR Cost Assumptions Low Case

Operating Costs Free on Rail (FOR) – Mid Case

As a result of the higher production rates, a combination of lower costs for conveyors, longwall and localised requirements has been assumed. Detailed cost analysis is recommended for ongoing evaluation.

Operating Costs (Inc. Labour)	Unit Costs (A$/ROMt)
Development: ($/Metre)	4,500
Conveyors	1.77
Longwall	6.43
Outbye	7.50
Localised Requirements	4.17
Tech Services	1.17
Surface and Administration	1.99
CHPP (UG Seam Only)	4.90
Total (with CHPP)	**40.51**
Total (No CHPP)	**35.60**

Table A1B-32 - Underground Operation FOR Cost Assumptions Mid Case

Operating Costs Free on Rail (FOR) – Max Case

As a result of the higher production rates, a combination of lower costs for conveyors, longwall, outbye and localised requirements has been assumed. Detailed cost analysis is recommended for ongoing evaluation.

Operating Costs (Inc. Labour)	Unit Costs (A$/ROMt)
Development: ($/Metre)	4,500
Conveyors	1.47
Longwall	5.43
Outbye	7.30
Localised Requirements	4.08
Tech Services	1.17
Surface and Administration	1.99
CHPP (UG Seam Only)	4.90
Total (with CHPP)	**38.92**
Total (No CHPP)	**34.01**

Table A1B-33 - Underground Operation FOR Cost Assumptions Max Case

Capital Estimation

MEC have included a range of CAPEX estimates which intend to reflect the elevated capacities of the production profiles. MEC was not given the scope to obtain budget estimates and therefore recommend this as an ongoing project requirement. **Capital estimates are provided as indicative only.**

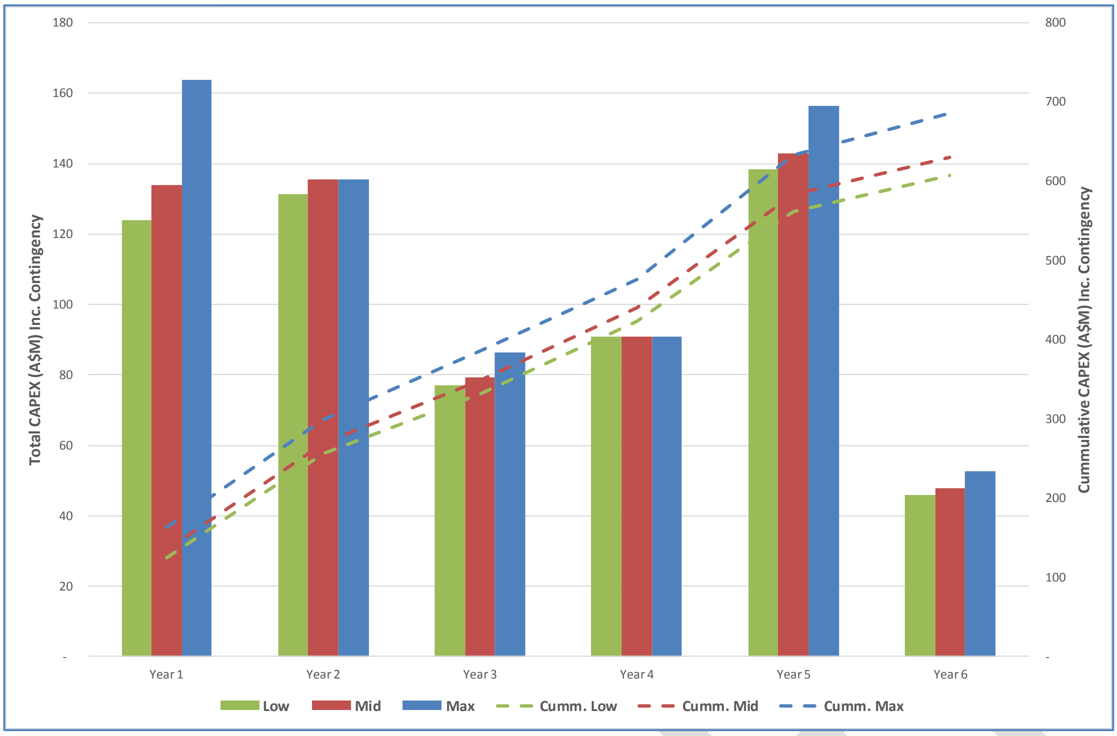

Figure A1B-54 - MEC CAPEX Ranging Estimate (No Budget Estimates)

Capital Estimation – Low Case

Capital cost estimates are based around three sources;

- MEC Mining Project Capital Drivers
- MEC Mining Capital Cost Database; and
- Wave International Estimates.

Cost estimates are un-escalated and are presented in Table A1B-34 with +35% level of accuracy contingency.

Description	A$
Equip-Surface	2,293,000
Equip-Underground	165,134,690
Equip-Other	967,420
Development	123,575,000
Facilities	158,248,844
Sub Total	**450,218,955**
Contingency (35%)	157,576,634
Initial Capital Total	**607,795,589**

Table A1B-34 - Initial Project Capital Estimate (Un-Escalated) Low Case

The “Development” estimate is inclusive of $94M capitalised development which is inclusive of central access portals, drifts, mains development and gateroads to the initial longwall panel. No capital estimate for the southern access.

The “Equip-Underground” estimate includes the costs of the longwall equipment (A$129M exc. contingency) to maintain continuity with the initial bord and pillar operation.

The "Facilities" estimate excludes the costs of a Coal Handling Preparation Plant (CHPP) of approximately $75M for a 700tph system. The CHPP is expected to be required as the mine plan extracts LW108 panel.

Sustaining Capital is assumed to comprise a A$2.15/ROMt provision in addition to a Contingency provision which will total ~$5/ROMt excluding major capital expenditures such as longwall equipment replacements at 60,000m cycles.

Capital Estimation – Mid Case

With the increased annual capacity required for power, water, ventilation, coal clearance, outbye activities and CHPP, MEC have assumed typically 10% increases in these areas. MEC have also assumed the CHPP will require a throughput capacity of 1,000tph with a sustaining CAPEX of A$82.5M.

Sustaining Capital is assumed to comprise a A$2.15/ROMt provision in addition to a Contingency provision which will total ~$5/ROMt excluding major capital expenditures such as longwall equipment replacements at 60,000m cycles.

Description	A$
Equip-Surface	2,293,000
Equip-Underground	171,389,135
Equip-Other	967,420
Development	126,575,000
Facilities	165,627,189
Sub Total	**466,851,744**
Contingency (35%)	163,398,110
Initial Capital Total	**630,249,854**

Table A1B-35 - Initial Project Capital Estimate (Un-Escalated) Mid Case

Capital Estimation – Max Case

The max case capacity CAPEX requirements (similar to the mid case) have typically increased by 40% from the low case estimate. In addition, the CHPP is assumed as a 2 x 750tph configuration with a sustaining CAPEX of A$105M. Additional sustaining capital is assumed to comprise a A$2.00/ROMt provision in addition to a Contingency provision which will total ~$5/ROMt excluding major capital expenditures such as longwall equipment replacements at 60,000m cycles.

Description	A$
Equip-Surface	2,293,000
Equip-Underground	190,152,468
Equip-Other	967,420
Development	126,575,000
Facilities	187,762,224
Sub Total	**507,750,112**
Contingency (35%)	177,712,539
Initial Capital Total	**685,462,652**

Table A1B-36 - Initial Project Capital Estimate (Un-Escalated) Max Case

MEC Mining would like to thank Geos Mining for the opportunity to undertake this Range Analysis for the Hawkins Rumker Commercial Viability Assessment.

Should you have any questions then please do not hesitate to contact.

Regards

Geoff Watson
Study Lead MEC Mining.

Appendix 2 – Wave International Infrastructure Assessment

wave international

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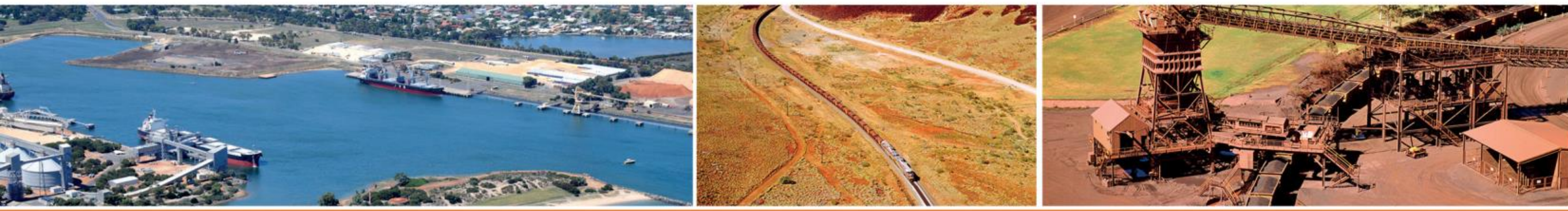

NSW Planning and Environment
Resources and Geoscience

Hawkins-Rumker Coal Project

Commercial Viability Assessment
On and Off site non-process infrastructure

engineering asset management project delivery

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DOCUMENT BRIEF

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PROJECT	Hawkins-Rumker Coal Project Commercial Viability Assessment
DOC TITLE	Hawkins-Rumker Coal Project Commercial Viability Assessment
DOC NUMBER	4637-20-RPT-GE-00001
CLIENT	Geos Mining
CLIENT CONTACT	Tom Bradbury
CLIENT ADDRESS	

DOCUMENT STATUS

REV	DATE	DESCRIPTION	BY	REV	APP
A	01/03/18	FIRST DRAFT FOR REVIEW	PDY	RJH	RJH
B	12/03/2018	REVISED REPORT	PDY	RJH	RJH

DISCLAIMER

wave international
DETERMINE • DESIGN • DELIVER

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Glossary

AC	Asphaltic concrete
AHD	Australian height datum
ARI	Average recurrence interval

AS	Australian Standard
AS/NZS	Australian and New Zealand Standard
BCA	Building Code of Australia
CASA	Civil Aviation Safety Authority Australia
CBR	California bearing ratio
CCTV	Closed-circuit television
CHPP	Coal handling and preparation plant
GPS	Global positioning system
HDPE	High density polyethylene
HV	High voltage
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardization
LAN	Local area network
LPG	Liquid petroleum gas
LV	Low voltage
MCC	Motor control centre
MGA	Map Grid of Australia
MIA	Mine Industrial Area
NSW	New South Wales, Australia
PLC	Programmable logic controller
PTO	Power take-off
PVC	Polyvinyl chloride
Q100	1 in 100year ARI peak flow as defined by the Australian Rainfall and Runoff publication (Institute of Engineers, Australia)
R&G	NSW Government Planning and Environment Resources and Geosciences
RMU	Ring main unit
SAE	Society of Automotive Engineers
SMDD	Standard maximum dry density
SWL	Safe working load
STP	Sewage treatment plant
UPS	Uninterruptible power supply
VoIP	Voice over internet protocol
WAN	Wide area network
WTP	Water treatment plant
XLPE	Cross linked polyethylene
4WD	Four-wheel drive

1 EXECUTIVE SUMMARY

In accordance with the NSW Government Planning and Environment Resources and Geosciences Brief, the following is a summary of the Commercial Viability Assessment work for on and off site non-process (NPI) infrastructure undertaken by Wave International as part of the GEOS Mining Mineral Consultants Study Team.

1.1 OPTIONS OVERVIEW

Two optional locations for the underground portal and hence NPI surface infrastructure have been considered in this NPI study. The locations are – Option 1 at the north-western end of the identified deposit and Option 2 – a more central location on the western side of the overall identified deposit. These two locations have been used to scope and estimate the NPI surface infrastructure to support the underground mining activities and Coal Handling and Processing Plant (CHPP) and the off-site infrastructure required to support a coal mine.

1.2 ON-SITE NON-PROCESS INFRASTRUCTURE

The on-site non-process infrastructure needed to access and support the underground mining and coal handling and processing plant (CHPP) for either Option is expected to consist of the following elements:

- Site Access Road,
- Site roads, earthworks, hardstands and parking,
- Underground mine vehicle parking,
- NPI area drainage and sedimentation dam,
- Security Facility and fencing,
- Administration building / Bath House,
- Vehicle workshop, store, stone dust shed, laydowns,
- Vehicle wash down facilities,
- Fuel and lube facility,
- NPI area water services,
- NPI area Sewage system,
- NPI area Compressed Air System, and
- NPI area Power and Communications Reticulation.

1.3 OFF-SITE INFRASTRUCTURE

For each of the two Options, the off-site infrastructure requirements are:

- Option 1. With the portal and NPI infrastructure located at the north western end of the identified deposit, the off-site infrastructure requirements are:

    - Approximately 4.5km of upgrading to existing unsealed roads from Lue Road to a new approximately 3km long on-site access road including upgrading the existing intersection at Lue Road,
    - Construction of an approximately 6.7km long rail spur and balloon loop,
    - Upgrade of Endeavour Energy's Kandos Zone Substation and construction of approximately 36km of 66kV overhead power line, and
    - On the assumption that the site water supply can be obtained from Windermere Dam, construction of a pump station and approximately 17km of water pipeline to an on-site raw water dam. This also assumes that a sufficient power supply is also available at the Windermere dam wall location.
- Option 2. With the portal and NPI infrastructure located at a central point on the western side of the identified deposit, the off-site infrastructure requirements are:
    - Approximately 2.2km of upgrading to existing unsealed roads from Lue Road to a new approximately 1.2km long on-site access road including upgrading the existing intersection at Lue Road,
    - Construction of an approximately 8km long rail spur and balloon loop,
    - Upgrade of Endeavour Energy's Kandos Zone Substation and construction of approximately 20km of 66kV overhead power line, and
    - On the assumption that the site water supply can be obtained from Windermere Dam, construction of a pump station and approximately 20km of water pipeline to an on-site raw water dam. This also assumes that a sufficient power supply is also available at the Windermere dam wall location.

1.4 CAPITAL COST ESTIMATES

The estimated +/-35% direct capital cost estimates for each of the two Options are:

- Option 1 - $133,143,000, and
- Option 2 - $141,223,000.

When contractor's preliminaries, scope growth, risk allowance, PFS and FS study costs, design and delivery management costs are included, the total estimated capital costs for each Option are:

- Option 1 - $214,995,945, and
- Option 2 - $228,075,145.

2 Scope

The purpose of these works undertaken by Wave international, as part of a team including GEOS Mining and MEC Engineering, are to determine if the Hawkins Rumker Coal Project area contains the coal resources that would support a viable exploration and mine development project and provide sufficient detail and costing of the non-process infrastructure (NPI) to support the financial viability assessment of the Project. Wave International scope is to identify, prepare sketches and high-level capital cost estimates for the on and off site NPI infrastructure associated with an underground mine including off site road upgrading, rail line extension and upgrading, water supply and power supply.

For the purposes of scale, Wave have assumed the NPI will be required to support a 4MTpa Run of Mine (ROM) operation with all coal requiring washing. It has also been assumed that the CHPP will include belt filter presses and hence no tailings facility will be required.

The site location is shown in Figure 2.1 Locality Plan.

2.1 NPI BATTERY LIMITS

2.1.1 UNDERGROUND PIT TOP FACILITIES

At this early stage of the concept design and costing, two approximate locations for these NPI facilities have only been determined. Accordingly, the costs associated with the access road, rail, power and site water supply have only been costed to those two locations. Additional work to finally determine a final location will need to be undertaken prior to proceeding to the next level of design.

The entry to the portal, the portal (including de watering), vent shafts and fans and underground facilities and the materials handling and washing (CHPP) infrastructure from the portal to the train loadout are not included in this NPI Report.

Only the fire, raw and potable water reticulation to the NPI pit top facilities and a common point for the CHPP has been costed in this NPI Report. Supply to underground facilities is not included in this NPI Report.

The battery limit for the power supply is from the substation within the pit top facility and reticulation throughout the various facilities within the pit top. Power supply to the CHPP substation and underground substation are excluded from this NPI Report.

The concept location of the pit top facilities and portal for Option 1 are shown in Figure 2.1 on the next page. The access and service locations (Water, power and rail) for Option 2 are shown on Figure 6.1.

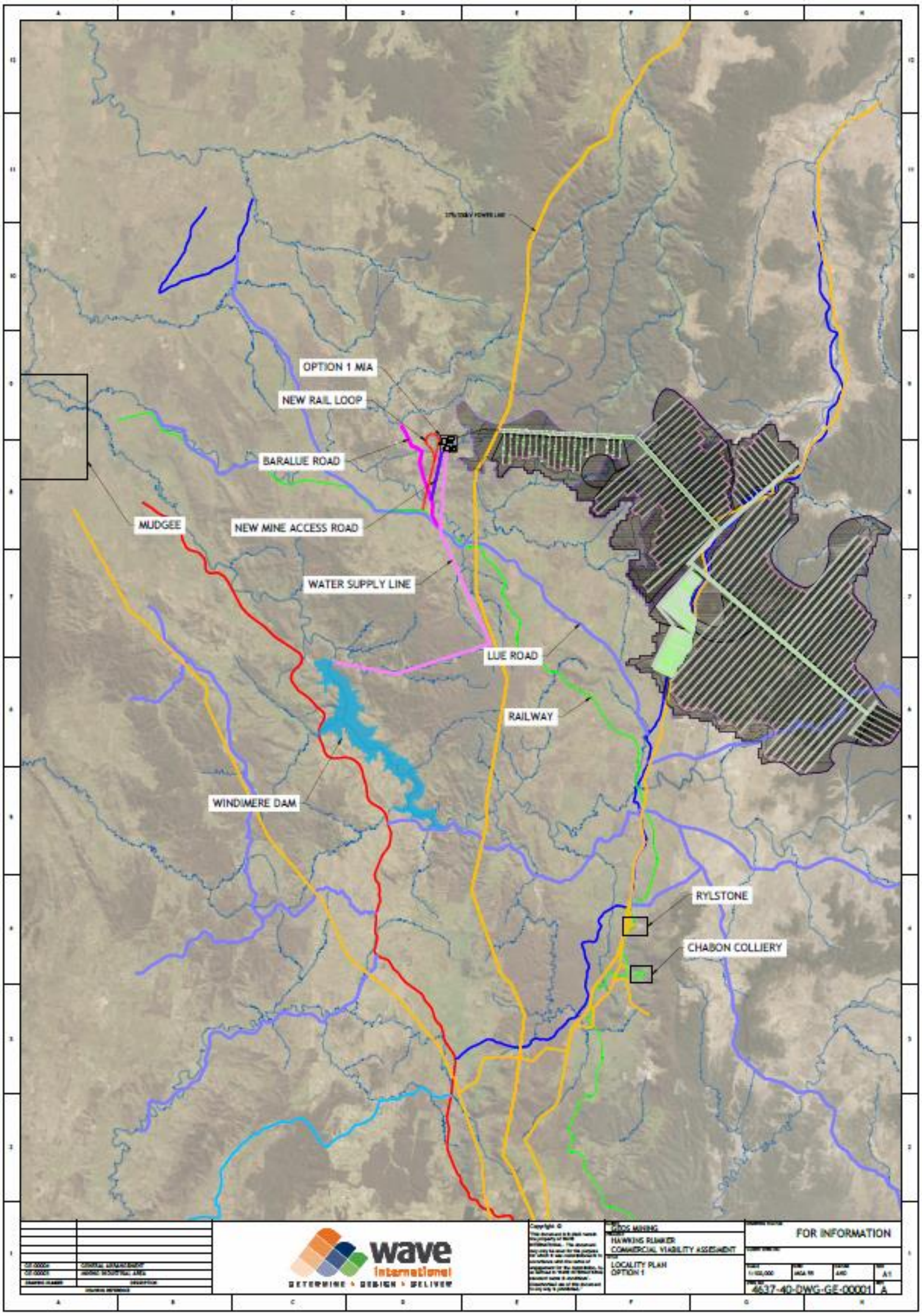

Figure A3-2.1 - Locality Plan

2.1.2 Road Access

On the assumption that no upgrading of Lue Road either to the north or south of Lue will be required, the battery limits applying to the investigation and costing of road access to the Option 1 NPI area location are:

- Off-site Roads - Lue Cemetery Road and Lue Road intersection to the Pit Top Facilities, generally following existing Lue Cemetery Road, a short section of Cox Street and Baralue Road between Lue Road and the proposed mine access road, and
- On site – a mine access road from Baralue Road to the pit top facilities and surface pit top roads.

For Option 2, the same assumption regarding upgrading of Lue Road applies and the battery limits are:

- Off-site Roads – Breakfast Creek Road and Lue Road intersection to the pit top facilities.

2.1.3 Rail

The battery limits applying to the investigation and costing of the rail line construction and upgrading for the proposed project are:

- On and off-site rail from site to port facilities at either Newcastle or Port Kembla.

2.1.4 Water Supply

The battery limits applying to the investigation and costing of a water supply for the proposed project are:

- Identification of local potential sources of water supply and recommendation of a possible supply.

2.1.5 Power Supply

The battery limits applying to the investigation and costing of a power supply for the proposed project are:

- Identification of a most likely site demand connection point and site substation and pit top distribution.

2.2 METHODOLOGY

The methodology involved a desktop assessment of the proposed facilities required to support the mining operation. A high-level concept design of the NPI Infrastructure, based on similar sized operations, has been developed and Capex estimate (targeted accuracy ±35%) was then developed to address each of the identified facilities. The rates for the various items included in the CAPEX have been derived from cost estimates prepared for other similar coal mine development projects in the Hunter Valley Region.

3 On-site infrastructure

Access to the underground operation is proposed in either the north west corner or at the approximate centroid of the mapped deposits as indicated on the included Figures. For either location, the on-site non-process infrastructure needed to access and support the underground mining and coal handling and processing plant (CHPP) is expected to consist of the items listed in the following section.

Figure 3.1 below shows an indicative pit top layout of typical infrastructure associated with an underground coal mine including a Coal Handling and Processing Plant (CHPP), load out facility and indicative rail spur and balloon loop.

3.1 INFRASTRUCTURE REQUIREMENTS

3.1.1 SITE ACCESS ROAD

Option 1 access to the new facilities will be via approximately 2.2km of existing roads including the existing Lue Cemetery Road and a new intersection at Lue Road, a short section of Cox Street and Baralue Road between Lue Road and the new mine access road and 4.0km of new mine access road from Baralue Road to the pit top facilities.

Option 2 access to the new facilities will be via approximately 2.a new mine access road from Lue Road to the pit top facilities.

3.1.2 PIT TOP SURFACE FACILITIES

The pit top surface facilities include the following:

- administration and bath house facilities
- vehicle workshop and store
- vehicle wash facilities
- site-wide services incorporating the supply and reticulation of raw water, fire water, potable water (trucked in) and compressed air; the harvesting of rainwater; and the collection and treatment of dirty water and sewage
- electrical systems within the pit top incorporating power supply, lighting, communications and controls
- sewage treatment plant (STP)
- light vehicle access roads
- light vehicle car parks for staff/visitors and mine operations vehicles
- sedimentation dam
- stone dust storage shed
- compressed air system

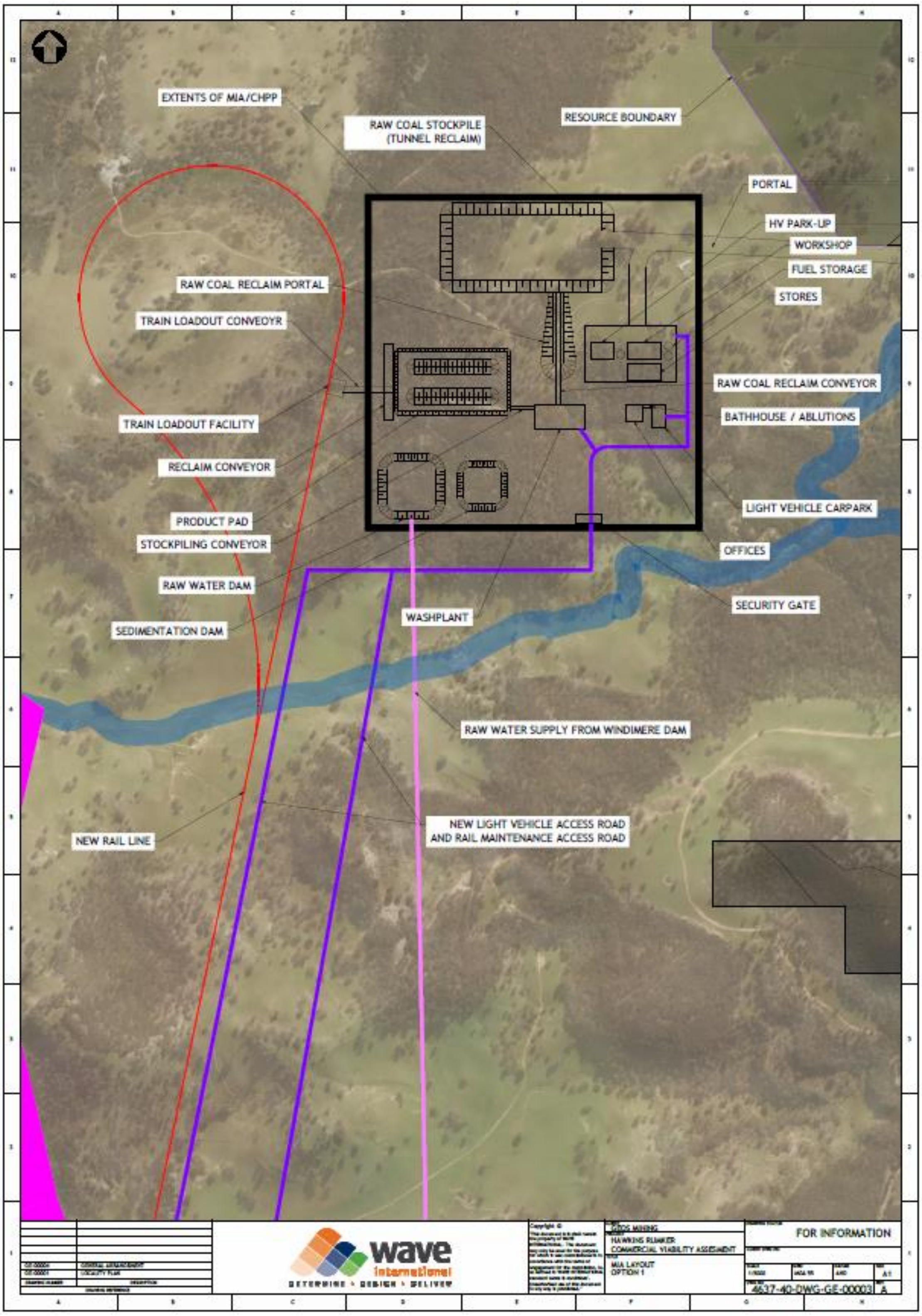

Figure A3-3.1 - MIA layout

- emergency evacuation pad
- security facility
- security fencing
- personnel walkways (covered)
- laydown areas
- general store area
- loading ramp
- emergency vehicle car parks and equipment storage
- fuel and lube storage and reticulation
- ballast bins
- tyre store and fitting area

3.2 SIZING PARAMETERS

The pit top facilities have been based on the following parameters for a 4 Mtpa run-of-mine (ROM) operation (where relevant):

- Operating regime: 24 hours per day, 7 days a week.
- Personnel numbers (total personnel numbers based on a similar sized underground operation)
  - 175 – operators (in two shifts on a four-panel roster)
  - 60 – staff
  - Allowance for 30 contractors per day
- Design vehicle:
  - B-double haul truck has been used as the design vehicle to model vehicle movements and turning circles within the surface facilities.
  - Eimco ED10 Loader-ED705 for sizing of wash facilities and mine vehicle parking

4 Layout considerations

The following general considerations were made in the concept layout of the overall pit top facilities:

- safety must be considered in all aspects of the design, particularly the separation of heavy vehicles, light vehicles and pedestrians
  - pedestrian/heavy vehicle interaction should be avoided
  - heavy/light vehicle interaction should be avoided
  - pedestrian/light vehicle interaction should be avoided where practical
- disabled access must be provided as required in accordance with the Building Code of Australia (BCA)
- sustainability should be considered where possible
- the MIA should be designed with a general philosophy of future expansion in mind
- interaction between all staff (including contractors) should be encouraged through the centralisation of personnel workspaces and facilities (crib, ablutions, etc) where possible
- one-way mine vehicle circulation within the MIA is preferred
- mine vehicle intersections within the hardstand area should be at 90 degrees where practical
- turning circles for the design vehicle (Eimco ED10 Loader-ED705) were used
- mine vehicle traffic should be directed through the heavy vehicle wash down facility prior to entering the heavy vehicle workshop. A wash down facility bypass option should also be available
- the mine vehicle workshop should be oriented such that any coal dust from the coal stockpile does not enter the workshop
- the lube storage area should be located in the vicinity of the mine vehicle workshop to maximise product flows
- services should be run in common trenches where possible
- the administration and bath house facility should be oriented for energy efficiency reasons
- site access shall be controlled via a security facility
- light vehicle car parking should be provided in the vicinity of the administration and bath house facility.
- vehicle, equipment and personnel access for construction, operation, maintenance and repair activities should be considered. This includes access to the hardstand for the delivery of oversized items.
- equipment standardisation should be employed.
- bulk earthworks volumes should be minimised.
- Overall layout to minimise drainage requirements.

5 General design parameters

5.1 LEGISLATION, STANDARDS AND GUIDELINES

The requirements of the following documents shall apply:

- The NSW Occupational Health and Safety Act and Regulation (2000 and 2001).
- The NSW Coal Mine Health and Safety Act and Regulation (2002 and 2006).
- The NSW Electrical Safety Act and Regulation
- The Building Code of Australia (BCA).
- The current relevant Australian, British or American standards and codes in that order of precedence.

5.2 SURVEY

No detail survey has been undertaken for the site. Design plans and drawings have been based on information provided by R&G. Detail survey of all infrastructure areas will need to be undertaken prior to any subsequent design phases.

5.3 GEOTECHNICAL

No geotechnical information was available at the time of this assessment. Geotechnical investigations will need to be undertaken prior to any subsequent design phases.

5.4 ASSUMPTIONS FOR CONCEPT DESIGN / COSTING

It has been assumed that the areas proposed for NPI are relatively flat and of reasonable quality materials to enable building thereon.

Materials preferred for use as engineered fill such as ripped or crushed rock are available from initial underground mining works and will be acceptable for use as engineered fill. Select materials are available within short distance hauls for road pavements, hardstands and rail construction.

5.5 WIND DESIGN

The design wind loads for buildings and structures will be in accordance with AS 1170.2.

5.6 EARTHQUAKE DESIGN

The design earthquake loads for buildings and structures will be in accordance AS 1170.4.

6 Project requirements: Pit Top facilities

6.1 CIVIL WORKS

6.1.1 EARTHWORKS, LAY DOWN/HARDSTANDS

REQUIREMENTS

Typical design requirements will be:

- The surface facilities shall be located above the 1 in 100year ARI flood level of any nearby river, creek or waterway.
- Where practical future expansion has been considered in the layout of the pit top facilities
- The size of the hardstand area shall allow adequate provision for the safe operational movements of all vehicles accessing the surface facilities:
  - Simulated vehicle paths of a typical B-double (design vehicle) will need to be used during detail design to provide adequate turning circles within the mine surface facilities
  - Eimco ED10 Loader-ED705 for sizing of wash facilities and mine vehicle parking
- Finished grades shall be 1% preferred minimum and 4% preferred maximum. Where preferred grades cannot be achieved, 0.5% absolute minimum and 6% absolute maximum finished grades shall be permitted:
  - All hardstand surfaces (pavements and sub-grades) shall be free draining.
- Pavement areas for the surface facilities hardstand have been split into the following categories:
  - Light vehicle pavement sealed
  - Light vehicle pavement unsealed:
  - Water storage and sewage treatment plant:
  - Building pad (under concrete):
  - Building pad (general):
  - Pit vehicle pavement (design vehicle – EIMCO-ED10 loader)
  - Emergency evacuation pad pavement:
  - Landscaping:

6.1.2 OFF-SITE ROADS

FUNCTION

Off-site roads will provide for all road transport between the existing sealed Lue Road and the pit top facilities They will be designed to meet NSW Roads and Traffic Authority standards and requirements and local roads to the Mid-West Regional Council standards and Regulations.

REQUIREMENTS

Typical design requirements will be:

- 2 x 3.5m sealed lanes with 1.0m unsealed shoulders,
- Maximum grade 8%,
- 40km/hr design speed,
- Roadway line marking and guideposts,
- Lue Road intersection upgraded to NSW RTA standards including a protected right turn lane and a left turn slip lane,
- Design vehicle - 25m B-double.

6.1.3 ON-SITE ROADS

FUNCTION

On-site access roads will provide light vehicle access to, from and throughout the surface facilities.

REQUIREMENTS

Typical design requirements will be:

- Maximum grade 8%.
- 40 km/hr design speed.
- 2 x 3.5 m wide sealed lanes with 1.0 m unsealed shoulders. Fill batters shall be 4H:1V to remove the need for guardrail along the top of the batter.
- Roadway delineated with centreline, edge lines and guideposts.
- Light vehicle pavements will be constructed with imported sub-base and base-course material.
- Intersections and curves designed for 19 m semi-trailers turning without crossing the centreline. Long, wide loads including 25 m B-doubles shall be allowed to cross the centreline while turning.
- Unloading/loading bays shall be provided for all delivery/removal vehicles such that these operations can be performed without the obstruction of normal traffic flow.

6.1.4 LIGHT VEHICLE PARKING

FUNCTION

Light vehicle parking areas will provide temporary parking for surface facilities staff, visitors and contractors. Separate mine operations vehicle car park to be provided within the hardstand area.

REQUIREMENTS

Typical design requirements will be:

- 260-car (nominal) staff/visitor car park:
  - This car park will include designated disabled and emergency vehicle car parks.

- This car park is sized to cater for mine shutdown periods.

- Car park and aisle dimensions are as follows:
  - All car parks other than for disabled: 5.4 m long x 2.8 m wide bays, 7.4 m wide aisles. Note: these dimensions are generally more conservative than those tabled in AS/NZS 2890.1 - Parking facilities - Off-street car parking.
- All car parks shall include line markings, signage and stormwater drainage. Landscaping shall also be provided in the staff/visitor car park.

6.1.5 UNDERGROUND MINE VEHICLE PARKING

FUNCTION

Vehicle parking areas will provide a safe area for the temporary parking of a portion of the underground mine vehicle fleet.

REQUIREMENTS

Typical design requirements will be:

- Hardstand area pre and post servicing parking for six underground mine vehicles sized at 4.5m wide x 8m long. (covered)
- Hardstand area for driftrunner vehicles
  - driftrunner vehicles vehicle car park: 6 m long x 3 m wide bays (covered)
- Safe pedestrian access to the parking area.
- Each parking area shall incorporate roll-away protection. Earthen mounds shall be used instead of 'spoon drains' for this purpose.

6.1.6 DRAINAGE

FUNCTION

Drainage infrastructure will direct runoff from the surface facilities to a sedimentation dam via an open drain and will provide the nominated levels of flood immunity. Dirty water from both the workshop and wash facilities will first pass via the dedicated oil separator adjacent to the wash facilities.

REQUIREMENTS

Typical design requirements will be:

- Overland flowpaths will be designed to convey up to the 1 in 100year ARI storm event to prevent the inundation of infrastructure.
- Culvert structures will be designed to convey the peak flow for the 1 in 20year ARI time of concentration event.
- Minor drainage from the surface facilities pad (e.g. pipe drainage under berms) will be designed for the 1 in 5year ARI time of concentration event and to avoid concentrated flow and scour of adjacent roads/pads.

- Edge of formation will be 1.0 m (minimum) above surrounding natural surface for the full extent of any flood plain area or table drains are to be provided with sufficient depth to allow for drainage of pavement.
- Longitudinal grades for table drains will be 0.5% preferred minimum and 4% preferred maximum with rock protection required for steeper grades or locations with flow velocities exceeding 2 m/s (in the 1 in 5year ARI event).
- Table drains will have a minimum of 150 mm freeboard above the estimated maximum 1 in 5year ARI peak flow depth.

6.1.7 SEDIMENTATION DAM

FUNCTION

The sedimentation dam will hold all of the dirty water and water runoff collected within the pit top facilities.

REQUIREMENTS

Typical design requirements will be:

- Sedimentation dam sized for a minimum 1 in 20year ARI time of concentration event (subject to land availability and environmental authority), with 3H:1V side slopes maximum. Construction will need to be in accordance with any site permit conditions.
- Spillway from the sedimentation dam sized for peak flow from a 1 in 100year ARI storm event.
- Overflow from the sedimentation dam will need to be in accordance with site permit conditions. No allowance for other than the sedimentation dam has been included in these works.

6.2 SECURITY AND FENCING

FUNCTION

The security facilities will incorporate an office for security personnel, a training/examination room, a drug test room, and toilets. It will also include boom gates for in and outward flow of traffic. Fencing will be provided up to the boom gates and extend to prevent personnel access to the surface facilities other than through turnstiles at the administration building.

REQUIREMENTS

Typical design requirements will be:

- Prefabricated, two building modules consisting of 12 m long x 3 m wide units laid side-by-side including a covered veranda all round:
  - Approximately 80 m^2 overall allowed for.
  - Mono-sloped roofing with ceilings at a clear height of 2.7 m.
- Security office with a clear view of all approaching vehicles entering and leaving the site, including waiting/examination and testing areas and sign-in system.
- Ablution facilities one male and one female.

- IT/communication rooms as required.
- Vinyl flooring in all areas of the building.
- Air conditioning in all areas except the ablutions.
- Fire escape doors in accordance with the BCA. Additional personnel access doors as required.
- A roof fall arrest system.
- Connection of potable water, fire water, sewerage, electrical and communications cabling to a battery limit determined during detail design.
- An uninterruptible power supply (UPS).
- Lighting, power outlets, signage, a drinking fountain, vending machines and firefighting equipment as required.

6.3 ADMINISTRATION AND BATH HOUSE FACILITIES

FUNCTION

The administration and bath house facilities will incorporate offices, bath house, lunch room, reports and assembly area, reception, boardroom, first-aid room, conference room, rehabilitation area, lamp room.

REQUIREMENTS

Typical design requirements will be:

- Prefabricated, multiple building modules consisting of 12 m long x 3 m wide units laid side-by-side. Walkways between building modules shall be covered:
  - Approximately 2,550 m^2 overall allowed for.
  - Mono-sloped roofing with ceilings at a clear height of 2.7 m.
- Reception area including reception desk, waiting area and sign-in system.
- Office area including at least 20 workstations and 30 offices
- Office area ablution facilities with a male to female ratio of 1:1
- Ancillary office areas such as meeting rooms, store rooms, print rooms, compactus and
- IT/communication rooms as required.
- Separate male and female bath house amenities with a male to female ratio of 4:1 (assumed to be consistent with underground mine operations for the purposes of this study). Male and female bath house areas shall include:
  - Clean side and dirty side full height lockers for all operations and maintenance personnel (205 people total) based on 175 operations staff and allowance for 30 contractors, it’s assumed that staff working in the administration facilities do not require lockers.
  - Showers (communal in the male bath house, individual in the female bath house):

- The number of showers will be based on 60 people using the bath house at a time, with the understanding that maintenance shifts typically begin 30 minutes before operations shifts.
- The staff to shower ratio shall be approximately 3:1.
- Solar water heating system with gas backup
- Muster room adjacent to the crib room and in the vicinity of the bath house.
- A crib room including kitchen area intended for use by office and maintenance personnel only.
- A first aid room with ramp access in accordance with the First Aid in NSW coal mines guideline for the management of acute workplace injury and illness (MDG 1016). The room shall include a disabled toilet, sink and shower, cupboard, bench, first aid cabinet and a single examination bed.
- A training room with kitchenette.
- Vinyl flooring in all areas of the building.
- Air conditioning in all areas except the bath house. The bath house shall be ventilated.
- Fire escape doors in accordance with the BCA. Additional personnel access doors as required.
- A roof fall arrest system.
- Connection of potable water, fire water, sewerage, electrical and communications cabling to a battery limit determined during detail design.
- An uninterruptible power supply (UPS).
- Lighting, power outlets, signage, drinking fountains, vending machines and firefighting equipment as required.
- The main fire indicator panel for the surface facilities.

6.4 VEHICLE WORKSHOP AND STORE FACILITY

FUNCTION

The vehicle workshop will provide a suitably sized and equipped area for the maintenance and servicing of the vehicle fleet.

The workshop store will provide an indoor area for workshop consumable and tool storage, assembly tasks and general work bench activities.

REQUIREMENTS

Typical design requirements will be:

- 12 m x 18 m designated for the workshop area.
- 12 m x 12 m area designated for service bays (this area includes a 6 m x 12 m maintenance pit area).
- 12 m x 18 m designated for the store area (including a 4 m x 3.5 m store office area).
- High pallet racking, low racking (mesh decks), general work benches and clean assembly area.

6.5 STONE DUST SHED

FUNCTION

The stone dust shed would be used to store stone dust.

REQUIREMENTS

Typical design requirements will be:

- An open, braced frame steel structure with metal cladding to roof. The structure would be approximately 18 m long x 9 m wide x 3.5 m high (to underside of rafters).
- A reinforced concrete slab with 1% nominal floor grade.

6.6 EXTERNAL LAY DOWN/HARDSTAND AREAS

FUNCTION

The external lay down/hardstand compound will provide an external space for items that cannot be stored inside the workshop store (including hazardous goods but excluding explosives). It will also contain the designated waste management area.

REQUIREMENTS

Typical design requirements will be:

- A hardstand area of approximately 15,000 m2:
    - This area shall be designed to handle stored equipment and forklift loads.
- An earthed hazardous goods store comprising one approved storage container, to be earthed.
- A designated waste management area.

6.7 VEHICLE WASH DOWN FACILITIES

FUNCTION

The vehicle wash will:

- Enable the effective removal of residual material from underground mine and light vehicles.
- Collect dirty water runoff from the wash bay for discharge into the local silt trap for oil separation and recycling.

6.8 FUEL AND LUBE FACILITY

6.8.1 GENERAL

Diesel and waste oil will be stored in self bunded tanks, all other lubricants and fluids will be stored in intermediate bulk containers (IBC's) or similar.

IBC's will be stored within a self-bunded container complete with pumping system or a concrete slab and will bunded facility to reticulate fluids to the workshop.

IBC's will be replaced or refilled when required.

- Typical Tank storage capacities have been allowed as follows:
  - Diesel 40,000 L (nominal)
  - Waste oil 4,000 L (nominal)
- Intermediate bulk container storage as follows:
  - SAE 15W-40 1,000 L (nominal)
  - ISO 68 2,000 L (nominal)
  - Coolant 1,000 L (nominal)
  - Waste Coolant 1,000 L (nominal).

These assumptions will require confirmation during any future stages of design.

6.8.2 Fuel System

FUNCTION

A proprietary fuel system (Transtank or equivalent) will receive, store and dispense diesel to underground mine and light vehicles. Diesel dispensing will be immediately adjacent to the diesel tank.

REQUIREMENTS

Typical design requirements will be:

- A compacted hardstand area with buried impermeable layer draining to local sumps.
- A Transtank or approved equivalent diesel tank farm incorporating:
  - Delivery area suitable for receiving B-double tankers:
    - Fuel delivery shall be achieved via the delivery tanker PTO pump.
    - The delivery area shall be arranged to suit tankers unloading on the lefthand side of the vehicle only.
  - 40 kL diesel storage (nominal):
    - Tanks shall be fitted with desiccant breathers.
- Control panels located at the delivery and dispensing areas. These panels will have the capacity to control all operational aspects of the fuel system:
  - Provision for integration with a fuel management system (FMS) shall be made.
- Lighting, earthing, equipment grounding and communication conduits as required.
- Compressed air system if required for system control purposes.

6.9 SITE-WIDE SERVICES

Site-wide services include:

- The reticulation of raw water, fire water, potable water and compressed air.
- The harvesting of rainwater.
- The collection and treatment of dirty water and sewage.

Pipes associated with these systems will be grouped in common service trenches where possible. Electrical and communications cabling shall also utilise these trenches where possible. The functions and requirements of these systems are outlined in the following sections.

6.9.1 RAW WATER SYSTEM

FUNCTION

The raw water system will reliably convey the stored raw water to service points throughout the surface facilities at the required flow and pressure. The raw water system includes the following subsystems:

- Raw water conveyance from a mine water dam to the clean water dam (fed from incoming supply line) via a filtration system.
- Raw water conveyance from the clean water dam to the raw water storage tanks and throughout the mine surface facilities.
- Raw water conveyance from the portal void (surface) to the main dam.
- Raw water conveyance from the portal sump (underground) to the main dam.

REQUIREMENTS

Typical design requirements will be:

- Two (2) 390 kL (nominal) raw water tanks located at the surface facilities, sized to accommodate the AS 2419 fire water storage requirements and one (1) day supply of the calculated raw water system requirements:
  - Each tank shall store the full volume of fire water and 50% of the calculated volume of raw water (calculated raw water volume includes 20% contingency).
  - Pump suction points on the tanks shall be arranged to physically prevent the raw water reticulation pump drawing from the stored volume of fire water.
  - The supply of raw water to these tanks is provided by the raw water system, supplied from the clean water dam or direct from the external raw water supply pipeline.
- A pump station comprising an open, braced frame steel structure with metal cladding to roof. This structure shall be located adjacent to the raw water tanks and is approximately 11 m long x 6.5 m wide x 3.5 m high (to underside of rafters):
  - The raw water and fire water system pumps shall be housed under this structure.
- A reinforced concrete slab with 1% nominal floor grade.

- A raw water reticulation system comprising:
  - A suitably sized pump assembly configured with duty and standby pumps.
  - A network of buried, high density polyethylene (HDPE) pipes.
- Connection of electrical and communications cabling to the battery limit located outside the pit top facilities pump station boundary.

6.9.2 FIRE WATER SYSTEM

FUNCTION

The fire water system will reliably convey the stored fire water to service points throughout the surface facilities at the required flow and pressure.

REQUIREMENTS

Typical design requirements will be:

- A fire water reticulation system comprising:
  - An electric fire pump and a diesel fire pump in accordance with the relevant Australian Standards.
  - This pump assembly shall be housed within a pump station adjacent to the raw water tanks.
- A network of buried, HDPE pipes passing the fire service points located throughout the surface facilities with an isolation valve at each facility serving as the system battery limit. Any aboveground pipes shall be galvanised steel.
- Fire hydrants and fire hose reels positioned throughout the surface facilities in accordance with statutory requirements, Australian Standards and the NSW Mining Act:
  - External fire hose reels shall be contained in cabinets.
- Connection of electrical and communications cabling to the battery limit located outside the pit top facilities pump station boundary.
- Bollards shall be provided to protect fire equipment in the hardstand area or in other areas where vehicle impact is possible.

6.9.3 POTABLE WATER SYSTEM

FUNCTION

The potable water system will receive (from delivery trucks), store and reticulate safe, clean water meeting the requirements of the Australian Drinking Water Guidelines.

REQUIREMENTS

Typical design requirements will be:

- A delivery system located in the vicinity of the potable water tanks. This system shall include:
  - A delivery coupling suitably sized for connection to the delivery truck unloading hose.
  - A suitably sized back-up pump for use in the event of on-board pump failure.

- Two (2) 82 kL (nominal) potable water storage tanks, sized to hold the equivalent of seven (7) days of nominal consumption.
- A potable water reticulation system comprising:
  - A suitably sized pump assembly configured with duty and standby pumps housed within a pump station adjacent to the potable water tanks.
  - A network of buried, HDPE pipes
- Connection of electrical and communications cabling to the battery limit located outside the potable water pump station boundary.

6.9.4 Dirty Water System

FUNCTION

The dirty water system will collect and treat dirty water prior to discharge into the sedimentation dam. Dirty water will be collected from the vehicle workshop and store, vehicle car park, vehicle wash facility, fuel and lube facility, waste management area and air compressor station and pump.

REQUIREMENTS

Typical design requirements will be:

- Spoon drains, bunds and pits shall be used to collect dirty water:
  - All pits shall be fitted with a strainer to prevent material back-up and blockages.
- Dirty water shall drain to a proprietary, pit-style oil separator via a network of underground pipes:
  - The oil separator shall remove at least 95% of hydrocarbons prior to discharge.
  - The device shall have provision for vacuum truck removal of collected wastes in accordance with the manufacturer's recommendations.
  - The pipes shall pass the boundary of the surface facilities listed above with an isolation valve at each facility serving as the system battery limit:
- Hydrocarbon-free dirty water will discharge to the sedimentation dam via additional pipe work.

6.9.5 Sewerage System

FUNCTION

The sewerage system will collect raw sewage within the store, treat the sewage at the sewage treatment plant (STP) and produce outputs in accordance with the legislation and requirements of the authorities having jurisdiction over this application. The system will also provide environmental protection against contamination in the event of STP malfunction.

REQUIREMENTS

Typical design requirements will be:

- Sewage will be delivered via gravity sewer mains to the STP where possible. Pits and pumps shall be used where a gravity system is not viable:
  - Gravity sewer mains shall consist of buried polyvinyl chloride (PVC) pipes to the boundary of each surface facilities building with ablutions facilities.
- A vendor-supplied STP shall be sized to process 25 kL/day of raw sewage with peak flow conditions of 400 L/min for 20 minutes:
  - The vendor shall supply all equipment required by the STP downstream of the sewerage piping network battery limit including the treated water discharge at the effluent disposal area.
- Discharge from the STP shall produce effluent that is not suitable for human contact reuse (i.e. vehicle wash and irrigation).

6.9.6 ABOVE GROUND COMPRESSED AIR SYSTEM

FUNCTION

The above ground compressed air system will produce and reticulate compressed air to the vehicle workshop, and fuel and lube facility.

REQUIREMENTS

Typical design requirements will be:

- An air compressor station, located adjacent to the vehicle workshop, consisting of:
  - A roofed, bunded concrete slab
  - Air compressors, dryers, filters and receivers as required by the design.
- Compressed air outlets and reels located throughout the vehicle workshop
- Pressure regulators and isolation valves at each of the nominated area/facility boundaries (refer function section above) and at each individual outlet point where applicable
- Water traps at all low points

6.10 EMERGENCY EVACUATION PAD

FUNCTION

The emergency evacuation pad will provide a site for helicopter landing and takeoff manoeuvres.

REQUIREMENTS

Typical design requirements will be:

- An emergency evacuation pad constructed in accordance with Civil Aviation Safety Authority Australia (CASA) – Guidelines for the Establishment and Use of Helicopter Landing Sites (HLS) – CAAP 92-2(1) – January 1996 and located in the vicinity of the surface facilities.

6.11 ELECTRICAL SERVICES

On site electrical services will encompass the following systems:

- power
- lighting
- earthing
- controls
- communications.

Cables associated with these systems will be grouped in common service trenches where possible. Segregation will be provided between high voltage, low voltage, extra low voltage and communication cables.

6.11.1 POWER SYSTEM

FUNCTION

The on-site power system will supply electrical loads within the underground mine and pit top facilities.

REQUIREMENTS

Typical design requirements will be:

- Incoming 11kV supply via underground cable in heavy duty conduit from 66/11kV substation for MIA, TLO and CHPP.
- 11 kV underground cable in heavy duty conduit:
  - ring main to substations throughout the surface facilities
  - 11 kV distribution system cables buried along shared corridors to the kiosk substations.
- Substation for CHPP (included in CHPP design and costing),
- Substation for underground supply,
- Kiosk substations for power distribution within the surface facilities, serving the following areas:
  - fan building (anticipated up to two locations for these at a maximum distance of 18km of overhead transmission line from main substation)
  - office and workshop area
  - compressor area
  - main dam area
- MCCs and distribution boards as required throughout the surface facilities
- MCC and distribution boards designed with a minimum of 30% physical and electrical spare capacity
- Grading rings around building and structure perimeters to satisfy step and touch potential requirements
- Lightning protection measures for buildings and structures in accordance with AS/NZ1768

- Buried cables to be installed as an AS 3000 Category A wiring system in heavy duty underground conduits and trafficable cable pits
- Above ground cables within industrial buildings installed in galvanised cable ladders segregated in accordance with the requirements of AS 3000
- UPS power supply to support communications equipment where required
- Electrical equipment and wiring suitable for the hazardous environments expected on site.
- IT system earthing arrangement on underground power distribution in accordance with IEC 60364

6.11.2 Lighting System

FUNCTION

The lighting system will provide area and task lighting to the surface facilities.

REQUIREMENTS

Typical design requirements will be:

- Illumination levels in accordance with the relevant Australian or international standards or where no standard exists to accepted mining industry levels.
- 240 V external lighting
  - 1 kW high pressure sodium or LED floodlights mounted 12 m high
  - 400 W metal halide or LED lights mounted 8 m high
  - Road lighting in accordance with AS1158
- 240 V internal and task specific lighting
  - general lighting in accordance with AS1680
  - emergency evacuation lighting in accordance with AS2293
  - High efficiency fluorescent luminaires or LED lighting

6.11.3 Controls System

FUNCTION

The controls system will provide:

- Fire detection
- Security
- PLC controls.
- Power demand monitoring

REQUIREMENTS

Typical design requirements will be:

- Fire detection system to AS1670 incorporating:
  - master fire indicator panel and local fire indicator panels
  - smoke and thermal detectors in general facilities:
  - aspirating smoke detection systems in IT/communications rooms
  - NOVEC1230 suppression release systems in IT/communications rooms
  - a flame detection system at fuel and lube facilities
  - mimic screens
  - warning systems comprising:
    - speakers in office environment buildings
    - horn speakers and strobe lights in high noise environments
- Security system incorporating:
  - reed switches on all external doors and windows
  - passive infrared detectors in rooms with high security requirements
  - CCTV
- PLC control system
  - programmable logic controllers (PLCs) in MCCs
  - instrumentation and wiring required to operate:
    - gas monitoring
    - fuel and lube facility
    - site-wide services
    - vehicle washdown facility
    - vent fans
    - external lighting
  - PLC & SCADA coding
  - Connection to site wide controls network
  - Monitoring power demand for the site

6.11.4 Communications System

FUNCTION

The communications system will provide site-wide and external connections via fibre or copper cables and radio links.

Surface facility systems will include:

- local/wide area network (LAN/WAN)
- voice over internet protocol (VoIP)
- Mobile radio (Trunked and Microwave)
- Personal Emergency Device (PED) system

REQUIREMENTS

Typical design requirements will be:

- Service provider off-site connection:
  - off-site services are accessed via a fibre connection from the MIA.
- Communications backbone incorporating:
  - fibre optic cables reticulated in communications conduits and cable pits (separate to those used for electrical cables) along routes throughout the pit top facilities and via galvanised cable ladders in buildings
  - fibre patch panels
  - racks (air-conditioned as required), switches and routers
- LAN/WAN and VoIP system comprising:
- Mobile radio systems
- PED (specialised underground mine communication and emergency communication systems).

7 Off-Site infrastructure

7.1 EXTERNAL SITE ACCESS

FUNCTION

For either of the two Optional locations of the NPI facilities, to provide access to these pit top facilities, a sealed connection road between the existing sealed Lue Road and the site access road will be required.

For Option 1, north west portal location, the external access will be via the existing Lue Cemetery access Road, Cox Street and Baralue Road. These works will include upgrading the existing intersection of the Lue Cemetery access road with Lue Road to NSW RTA standards, construction to a sealed standard the section of the Lue Cemetery road between Lue Road and Cox Street, installation of a level crossing to RailCorp or ARTC requirements, and construction to a sealed standard, a short section of Cox Street and Baralue Road between Lue Road and the proposed mine access road as shown on Figure 6.1.

For Option 2, central portal location, the external access will be via the existing Breakfast Creek Road. These works will include upgrading the existing intersection of Breakfast Cree Road with Lue Road to NSW RTA standards and construction to a sealed standard the section of Breakfast Creek Road and the proposed mine access road as shown on Figure 6.1.

It must be noted that at this early stage of the project development the final location of the new NPI pit top facilities may change. For the purposes of the assessment, we have considered two possible locations for the NPI facilities based on the proposed mine plans and portal locations. The cost estimates are based on providing all external services to either of these two locations.

Based on photographic evidence obtained from Google Earth, the existing sealed Lue road appears to be of sufficient width and in good condition and hence no allowed has been made for any upgrading of Lue Road from either Mudgee or Rylstone to the proposed site access at Lue. NSW RTA will need to be consulted to confirm that there are no other upgrades to Lue Road required prior to further stages of Project assessment being undertaken.

REQUIREMENTS

Typical design requirements will be:

- 2 x 3.5m sealed lanes with 1.0m unsealed shoulders,
- Maximum grade 8%,
- 60km/hr design speed,
- Roadway line marking and guideposts,
- Lue Road intersection upgraded to NSW RTA standards including a protected right turn lane and a left turn slip lane,
- Design vehicle - 25m B-double.

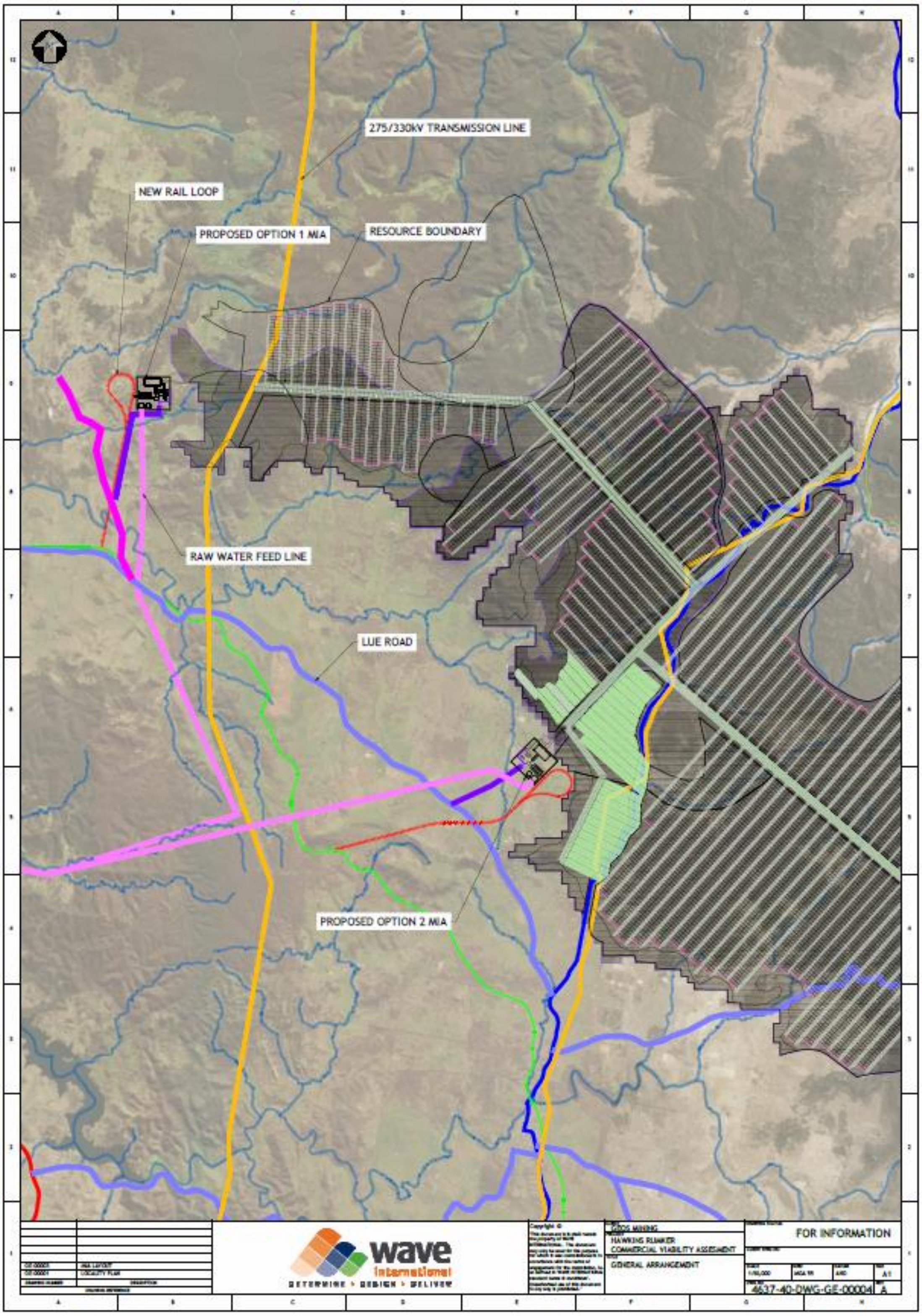

Figure A3-7.1 - General Arrangement

7.2 RAIL LINE AND BALLOON LOOP

FUNCTION

To convey the product coal from the proposed pit top facilities a new turnout off the Rylstone to Mudgee rail line and for Option 1 an approximately 8km long rail spur and balloon loop will be required to be constructed. For Option 2 the length is approximately 13.7km.

The location of the proposed rail is shown on Figure 3. The existing rail line between Rylstone and Mudgee is currently closed and not electrified. As this line is not currently electrified, no allowance for electrification of any new work is proposed. In addition to the new spur and loop, upgrading of the existing line between the new connection and Mudgee is expected to be required. Upgrading costs associated with the existing rail line are covered in the Access Costs included in the operational cost estimates. No negotiations have been held with the rail owner ARTC to determine any upgrades required and no allowance for capital costs for upgrading has been included in the capital cost estimates. We have allowed a higher rate to apply to the expected access agreement cost in the operating estimate costs to allow for potential upgrading to Mudgee. (Refer to Section 8 – Operating Costs).

Costs associated with planning approvals and the like and land acquisitions for the rail corridor are not included in the capital cost estimates.

REQUIREMENTS

Typical design requirements will be:

- Design to ARTC Code of Practice and Heavy Haul Guidelines,
- Diesel power locomotives,
- Track design speed – spur line 60km/hr, loop 25km/hr,
- Train length 1540m.

7.3 WATER SUPPLY

The site water demand has been estimated as 1400ML/a. This is made up of 1.51ML/day for underground operations, 2.22ML/day for coal washing at 200L/t and the remainder for wash down, fire and potable water usage on site. There are a number of potential sources of supply for this demand within a reasonable distance of the site and are their location is shown on Figure 2.1. These sources are:

- Windamere Dam. This dam is located on the Cudgegong River, 30km upstream from Mudgee and 19km south-west of Rylstone. It is managed by NSW State Water. The dam has a storage capacity of 368,120 megalitres (ML) which is more than half the size of Sydney Harbour. The maximum water depth is 58 metres and at 100% capacity the dam wall holds back **368,120 megalitres** of water at 552 metres AHD. The surface area of Lake Windamere is 2,030 hectares and its catchment area is 1,070 square kilometres.

- Rylstone Dam is a water supply dam located on Cudgegong River. It is managed by the Mid-West Regional Council. The capacity of the reservoir at full supply level is 3038ML and the reservoir storage surface area is 0.78 square miles. It is used predominantly for the town water supply for Mudgee, Gulgong, Rylstone, Kandos, Charbon and Clandulla.
- Dunns Swamp. This 2000ML capacity body of water is approximately 14m deep and is located east of Rylstone. It was built in 1930 on the Cudgegong River downstream of Never Never Creek and Ganguddy Creek to supply water to the Kandos Cement Work. It is now part of the Wollemi National Park and predominantly used for recreation.
- Reedy Creek Dam. This 220ML capacity dam is located on Reedy Creek, west of the former Charbon Colliery and was constructed to supply water to the colliery operations. The colliery is no longer in operation.

Based on size and current usage of the above listed potential water sources, it is considered that the most logical and reliable supply for the proposed mine would be from Windermere Dam. Supply from this source will be subject to negotiations with Water NSW and if approved a licence to take agreement. Water NSW have not been approached to ascertain the likelihood of water supply being drawn from this source. To enable a water supply capital cost to be estimated, it has been assumed that the site demand will be supplied from Windermere Dam.

The capital cost to supply water to the mine includes an estimate for the construction of pump station and power connection at Windermere Dam spillway and a 315mm diameter HDPE above ground pipeline to each of the optional NPI areas on site. The pipeline length is approximately 22.7km for Option 1 and approximately 18.7km for Option 2. The cost estimates exclude any allowance to provide access or power supply to the spillway area as it is assumed that this already exists. We have also excluded any costs associated with obtaining supply approvals, environmental approvals and the like and the acquisition costs of the pipeline easement.

REQUIREMENTS

Typical design requirements will be:

- Supply a site demand of 4ML/day.

7.4 POWER SUPPLY

The site power demand has been estimated to be in the order of 25MW. This is made up of underground demand of 10 to 15MW and up to 10MW for the CHPP and pit top infrastructure.

A 66KV transmission line owned by Trans Grid (330kV) traverses the deposit and is identified in Figure 3.

This site is on the boundary for Essential Energy and Endeavour Energy distribution zones.

The Essential Energy closest supply point is Mudgee. The power line would be approximately 33km and run adjacent to Lue road. Current reports from Essential Energy indicate that there are active limitations on supply reliability for Mudgee Zone Substation.

The two possible locations for supply from within the Endeavour Energy network are from Bylong Zone Substation and Kandos Zone Substation. While the Bylong Zone substation is the same via direct path, the terrain, final route and environmental considerations will make the cost higher than feeding from the Kandos Zone Substation. For Option 1 the supply length is approximately 36km and for Option 2 approximately 20km.

Based on very preliminary investigation in substation locations, the power supply for the site will need to be sourced from an existing substation at Endeavour Energy's Kandos Zone Substation and 36km of 66KV transmission line to the site substation. The existing substation will need to be upgraded by the addition of feeder circuit in the Kandos Substation.

The indicative alignment of the 66kV transmission line will travel generally adjacent to Lue road to Kandos.

REQUIREMENTS

Typical design requirements will be:

- Supply a site demand of 25MW,
- Reliability will require N-1 transformer substation arrangement for underground operation. To minimise cost it is anticipated that two off skid mounted substations will be used that will be interconnected in a ring topology.
- Reticulation into site will be 66kV using concrete or steel poles
- Reticulation around site will be at 11kV due to underground operation
- Transmission line will have OPGW (Optical Fibre Ground Wire) to enable communications connection to the regional communications network

8 Construction cost estimate

The cost estimate for the on and off site NPI infrastructure for this CVA has been developed based on recent and past standard civil contractor rates typically used for estimating the cost of civil works for similar projects in the Hunter Valley. Detailed construction cost estimates of the NPI infrastructure for both Options 1 and 2, with targeted accuracy of ±35%, are provided in Appendix A and summarised in Table 7-1 and Table 7-2.

The cost estimates exclude:

- Owner costs and costs associated with local authority and environmental planning approvals,
- Any land acquisition costs associated with the rail line, access road, power transmission line and water pipeline.

Table A3-8-1 CAPEX Option 1

Item	Description	Cost
1	Site Access Road	$3,200,000
2	Site roads, earthworks, hardstands and parking	$11,230,000
3	Underground mine vehicle parking	$700,000
4	NPI area drainage and sedimentation dam	$525,000
5	Security Facility and fencing	$150,000
6	Administration building / Bath House	$7,860,000
7	Vehicle workshop, store, stone dust shed, laydowns	$4,220,000
8	Vehicle wash down facilities	$1,000,000
9	Fuel and lube facility	$500,000
10	NPI Area water services	$1,260,000
11	NPI area Sewage system	$743,000
12	NPI area Compressed Air System	$400,000
13	NPI area Power and Comms Reticulation	$10,800,000
14	External Roads	$2,470,000
15	Rail	$40,000,000
16	Water Supply	$5,855,000
17	Power Supply	$42,500,000
	Total for direct cost items	**$133,143,000**
18	Contractor overhead and margin (20%)	$26,628,600
19	Scope growth (5%)	$6,657,150
20	Risk allowance / contingency (20%)	$26,628,600
21	Pre-feasibility and feasibility design (1.5%)	$1,997,145
22	Detailed design (6%)	$7,988,580
23	Procurement and construction management (9%)	$11,982,870
	Total capital cost (+/-35%)	**$214,995,945**

The Capital Cost of Option 2 is as shown in Table *7-2* below.

Table A3-8-2 CAPEX Option 2

Item	Description	Cost
1	Site Access Road	$2,000,000
2	Site roads, earthworks, hardstands and parking	$11,230,000
3	Underground mine vehicle parking	$700,000
4	NPI area drainage and sedimentation dam	$525,000
5	Security Facility and fencing	$150,000
6	Administration building / Bath House	$7,860,000
7	Vehicle workshop, store, stone dust shed, laydowns	$4,220,000
8	Vehicle wash down facilities	$1,000,000
9	Fuel and lube facility	$500,000
10	Site wide water services	$1,260,000
11	NPI area Sewage system	$743,000
12	NPI area Compressed Air System	$400,000
13	NPI area Power and Comms Reticulation	$10,800,000
14	External Roads	$50,000
15	Rail	$68,500,000
16	Water Supply	$4,785,000
17	Power Supply	$26,500,000
	Total for direct cost items	**$141,223,000**
18	Contractor overhead and margin (20%)	$28,244,600
19	Scope growth (5%)	$7,061,150
20	Risk allowance / contingency (20%)	$28,244,600
21	Pre-feasibility and feasibility design (1.5%)	$2,118,345
22	Detailed design (6%)	$8,473,380
23	Procurement and construction management (9%)	$12,710,070
	Total capital cost (+/-35%)	**$228,075,145**

9 Operating Cost Estimates

To provide input into the project financial evaluation, the following operational areas have been considered and operational cost estimates developed.

9.1 ROAD LEVIES

For the purposes of this assessment it has been assumed that as there is no long term heavy haulage on the existing road network, there will be no ongoing transport levies applied to the mine operations.

9.2 RAIL HAULAGE AND PORT COSTS

For the purposes of this assessment it has been assumed that as there is no operational cost differential for coal haulage for either of the two optional portal locations.

9.2.1 PORT

There are four potential ports available to ship the product coal through. These and the indicative cost per tonne are:

- Newcastle – Newcastle Coal Infrastructure Group - $6 - $7 per tonne,
- Newcastle – Port Waratah Coal Services:
  - Carrington - $3 - $4 per tonne,
  - Kooragang Island: - $5 - $6 per tonne.
- Port Kembla - $5 - $6 per tonne.

ASSUMPTIONS

The above indicative costs are generated without direct or indirect discussions with the terminal owners and/or operators and/or terminal customers. There rates are generated from experience of negotiating capacity on behalf of coal mining companies for short term and long-term capacity. At both regulated and unregulated ports the rates charged for short term capacity (by transferring customers or the terminal itself) may differ significantly to those offered to long term customers.

The rates above assume capacity is available at the terminals without triggering capital expansions. They are the rates for the terminal handling charges (fixed and variable) and do not include terminal operating costs and harbour costs. These can amount to another $2 per tonne.

It must be noted that whatever port is chosen, they will not grant access unless below rail capacity is concurrently secured.

9.2.2 BELOW RAIL (ACCESS)

The indicative below rail access charges for haulage to the available terminals are:

- Newcastle Terminals (approx. 350km) via Mudgee, Muswellbrook, Singleton, Maitland - $7-$8 per tonne,

- Port Kembla (approx. 360km) via Lithgow, Katoomba, Southerland and Wollongong - $9-$10 per tonne.

ASSUMPTIONS

The above indicative costs are generated without direct or indirect discussions with the track owners or other customers. There rates are generated are based on experience in negotiating capacity on behalf of coal mining companies for short term and long-term capacity. Short term capacity (by transferring customers or the track owner itself) may differ significantly to those offered to long term customers.

The rates above assume capacity is available on the track without triggering capital expansions. As this is unlikely, any future studies will require discussions to need to be had with track owners to determine upgrade requirements. As this required investment could significantly increase the cost of access and hence the rates shown above, we have included an allowance of $2.00 per tonne if the coal is railed south and $1.00 per tonne if taken north in the above rates.

9.2.3 Above Rail (Haulage)

The estimated cost of above rail haulage costs to the various terminals are:

- Newcastle Terminals (approx. 350km) via Mudgee, Muswellbrook, Singleton, Maitland - $4-$5 per tonne,
- Port Kembla (approx. 360km) via Lithgow, Katoomba, Southerland and Wollongong - $5-$6 per tonne.

ASSUMPTIONS

The above indicative costs are generated without direct or indirect discussions with the haulage service providers or other customers. There rates are generated from experience of holding competitive tender processes and negotiating haulage contracts on behalf of coal mining companies for short term and long-term services. Short term services (by transferring customers or use of ad hoc capacity in existing rolling stock) may differ significantly to those offered to long term customers.

The pricing above assumes dedicated rolling stock for this service. A single train set is most efficient at multiples of approx. 4 million tons per annum (Mtpa). It is difficult to accurately estimate the cost of haulage through Sydney as delays due to passenger train movements are common. The operators generally apply loading due cater for additional dwell on the passenger network.

9.2.4 Recommendations

In order to provide accurate port, rail and haulage cost information and finalise the on-mine-site rail infrastructure solution it is most important to resolve the preferred port solution as this will dictate the negotiation for rail access and the cost of haulage.

In our opinion, it is more likely that either PWCS or NCIG in Newcastle will have available port capacity. Our reasoning is as follows:

- Recent expansions have occurred at these terminals and although the likelihood is high that these expansions are fully contracted, there may be some excess un-contracted capacity available,
- The Newcastle terminals have a significantly more customers and are of larger capacity than Port Kembla. This would facilitate a higher chance of negotiating for capacity from an existing customer,

- Because the Newcastle terminals are of much larger capacity and have a lot more equipment, this equipment would have some redundancy and could therefore be upgraded to facilitate more capacity at a lower capital cost if required,
- The below rail solution to Newcastle is likely to require a lower degree of upgrades to that of the track to Port Kembla. The Newcastle track is utilised by a number of heavy haul mining operations so upgrades would be easier to plan and implement and the costs may be socialised across these other customers.
- The track to Port Kembla passes directly through the Sydney metropolitan passenger network so upgrades (and capacity) would be more expensive and disruptive if required. There is also a general political movement to remove non-passenger freight (as far as possible) from these rail lines. In addition, the rail solution for trains passing through Sydney down to Port Kembla would be at greater risk of delays and extended dwell and this would be priced into the service offering.

9.2.5 Future Steps

Should this Project advance further than this CVA, it is suggested that the following actions be included in any further project assessment:

- Make formal contact with the port owners / operators and identify the opportunity to contract for capacity and obtain indicative access costs,
- Progress the indicative access proposal process with the below rail owners (ARTC) and obtain indicative access cost,
- Progress informal enquiries to the above rail operators and obtain indicative access cost, and
- Request advice from all three port proponents if they are aware or are interested in facilitating a capacity transfer from an existing customer.

9.3 WATER SUPPLY

Based on the assumption that an adequate and reliable water supply of 1400ML/a can be obtained from Windermere Dam, the annual supply costs based on Water NSW 2017-2018 charges for bulk raw water would be at least somewhere in the order of $700 per ML and a fixed availability connection charge of approximately $30,000 per annum. For the purposes of estimating the annual operational costs for the mine it is recommended that a water charge of $1000 per ML be applied to the site demand plus the annual connection charge.

9.4 POWER SUPPLY

There are two tariffs available from Endeavour Energy to power the site.

- Default tariff
- Individually calculated ST TOU demand tariff

The indicative (2018/2019) Default Tariff cost are:

Tariff Type	Fixed ($/day)	Single and TOU Consumption (c/kWh)				Demand ($/kVA/mth)	
	Daily	Non-TOU	Peak	Shoulder	Off-peak	High Season	Low Season
ST TOU Demand	51.19		2.80	2.27	1.04	6.96	6.04

This equates to approximately 3.44c/kWh or $3,839,904 / month.

ASSUMPTIONS

The above indicative costs are generated without direct or indirect discussions with the utility suppliers. The rates are generated based on the following assumptions:

- Mine operation and processing will be continuous (24/7)
- Month is 31 days
- Average demand is 15,000kWh (based on 25MW installed capacity at 0.6 diversity)
- Peak demand is based on 25,000kWh
- Peak is 7 hrs duration
- Shoulder is 8 hours duration
- Off peak is 9 hours duration
- 66kV power line has been handed back to the TNSP to Operate and Maintain up to boundary of mine lease

9.4.1 Future Steps

Should this Project advance further than this CVA, it is suggested that the following actions be included in any further project assessment:

- Make formal contact with Endeavour Energy and Essential Energy to identify the opportunity to access their network for capacity and obtain indicative access costs,
- Progress the indicative connection application process with one of the Transmission Network Service Providers (TNSP) and obtain access cost,
- Investigate options to locate the MIA and CHPP closer to Kandos to substantially reduce the cost of the transmission line.

APPENDIX A

Capital Cost Estimates

Hawkins - Rumker Coal Project					
NPI Capital Cost Estimate Option 1 – Direct Costs					
Item	**Description**	**Unit**	**Quantity**	**Rate**	**Cost**
1	**Site Access Road**				
1.1	7.2m wide sealed access road, 450 thick pavement	lm	4000	$800	$3,200,000
2	**Site Roads, general earthworks, hardstands and car parking**				

2.1	7m wide unsealed site roads 450mm thick pavements	lm	3000	$800	$2,400,000
2.2	General earthworks	m2	250000	$20	$5,000,000
2.3	Hardstand areas (Workshop and stores area), 600mm pavement	m2	15000	$200	$3,000,000
2.4	Unsealed LV car parking, 450mm pavement	m2	2000	$115	$230,000
2.5	Sealed car parking	m2	5000	$120	$600,000
3	**Underground mine vehicle parking**				
3.1	Unsealed HV parking, 600mm thick	m2	3500	$200	$700,000
4	**NPI area Drainage and sedimentation dam**				
4.1	Infrastructure area drainage, open channels and minor pipeworks	lm	5000	$70	$350,000
4.2	Sedimentation dam	m3	2500	$50	$125,000
4.3	Pumps and pontoon	Item	1	$50,000	$50,000
5	**Security facility and fencing**				
5.1	Security building and gates	Item	1	$100,000	$100,000
5.2	Fencing	lm	500	$100	$50,000
6	**Administration Building, bathhouse and walkways**				
6.1	Administration building (prefabricated units) including fitout	m2	1800	$2,300	$4,140,000
6.2	Bathhouse building including fitout	m2	2000	$1,800	$3,600,000
6.3	Covered Walkways	lm	300	$400	$120,000
7	**HV Workshop, covered and open stores and stone dust shed**				
7.1	HV Workshop including lube storage area and NPI area facilities compressor	m2	600	$3,750	$2,250,000
7.2	Covered stores building	m2	900	$1,500	$1,350,000
7.3	Outdoor stores area (fencing included in 5.2), 450mm pavement	m2	2500	$200	$500,000
7.4	Stone dust shed	Item	1	$120,000	$120,000
8	**Vehicle wash facilities**				
8.1	U/G mining equipment wash facility	Item	1	$700,000	$700,000
8.2	LV wash facility (proprietary item)	Item	1	$300,000	$300,000
9	**Fuel and Lube Facility**				
9.1	Self bunded, fuel and lube facility	Item	1	$500,000	$500,000

10	**NPI Area water services**				
10.1	Raw water	lm	3000	$130	$390,000
10.2	Fire water tanks and pumps	Item	1	$50,000	$50,000
10.3	Fire water reticulation	lm	3000	$150	$450,000
10.4	Potable water tanks	Item	1	$25,000	$25,000
10.5	Potable water reticulation	lm	$3,000	$110	$330,000
10.6	Dirty water (collection and treatment prior to discharge to NPI area drainage)	Item	1	$15,000	$15,000
11	**NPI Area Sewage System**				
11.1	Sewage reticulation pipework and pits	lm	300	$310	$93,000
11.2	Sewage treatment Plant	Item	1	$350,000	$350,000
11.3	Effluent disposal area	m2	1000	$300	$300,000
12	**NPI Area Compressed air**				
12.1	Compressor and shed	Item	1	$200,000	$200,000
12.2	NPI Area compressed air piped reticulation	lm	500	$400	$200,000
13	**NPI Area Power reticulation, lighting and communications**				
13.1	Power reticulation (HV OH)	lm	18000	$415	$7,470,000
13.2	Power reticulation (HV buried)	lm	1500	$1,600	$2,400,000
13.3	Lighting	Item	1	$300,000	$300,000
13.4	Communications	Item	1	$630,000	$630,000
14	**External roads**				
14.1	Lue Road Intersection upgrade	Item	1	$50,000	$50,000
14.2	Access Road (Lue Road to site access Road) 7.2m wide sealed access, 450mm pavement	lm	2200	$1,100	$2,420,000
15	**Rail**				
15.1	Rail spur and balloon loop (non-electrified and local control)	lm	8,000	$5,000	$40,000,000
16	**Water Supply**				
16.1	Pump station (1400ML per annum)	Item	1	$45,000	$45,000
16.2	Pipeline DN315 PN16	lm	22,700	$200	$4,540,000
16.3	Site storage tanks	kL	2000	$200	$400,000
16.4	Site storage Dam	m3	12000	$50	$600,000
17	**Power Supply - Option 1 NW**				
17.1	Offtake substation upgrade works	Item	1	$500,000	$500,000

17.2	Power line 66kV option 1 NW	lm	36000	$1,000	$36,000,000
17.3	Site substation	Item	2	$3,000,000	$6,000,000
	TOTAL				$133,143,000

Hawkins - Rumker Coal Project					
NPI Capital Cost Estimate Option 2 – Direct Costs					
Item	**Description**	**Unit**	**Quantity**	**Rate**	**Cost**
1	**Site Access Road**				
1.1	7.2m wide sealed access road, 450 thick pavement	lm	2500	$800	$2,000,000
2	**Site Roads, general earthworks, hardstands and carparking**				
2.1	7m wide unsealed site roads 450mm thick pavements	lm	3000	$800	$2,400,000
2.2	General earthworks	m2	250000	$20	$5,000,000
2.3	Hardstand areas (Workshop and stores area), 600mm pavement	m2	15000	$200	$3,000,000
2.4	Unsealed LV carparking, 450mm pavement	m2	2000	$115	$230,000
2.5	Sealed carparking	m2	5000	$120	$600,000
3	**Underground mine vehicle parking**				
3.1	Unsealed HV parking, 600mm thick	m2	3500	$200	$700,000
4	**NPI area Drainage and sedimentation dam**				
4.1	Infrastructure area drainage, open channels and minor pipeworks	lm	5000	$70	$350,000
4.2	Sedimentation dam	m3	2500	$50	$125,000
4.3	Pumps and pontoon	Item	1	$50,000	$50,000
5	**Security facility and fencing**				
5.1	Security building and gates	Item	1	$100,000	$100,000
5.2	Fencing	lm	500	$100	$50,000
6	**Administration Building, bathhouse and walkways**				
6.1	Administration building (prefabricated units) including fitout	m2	1800	$2,300	$4,140,000
6.2	Bathhouse building including fitout	m2	2000	$1,800	$3,600,000
6.3	Covered Walkways	lm	300	$400	$120,000

7	**HV Workshop, covered and open stores and stone dust shed**				
7.1	HV Workshop including lube storage area and NPI area facilities compressor	m2	600	$3,750	$2,250,000
7.2	Covered stores building	m2	900	$1,500	$1,350,000
7.3	Outdoor stores area (fencing included in 5.2), 450mm pavement	m2	2500	$200	$500,000
7.4	Stone dust shed	Item	1	$120,000	$120,000
8	**Vehicle wash facilities**				
8.1	U/G mining equipment wash facility	Item	1	$700,000	$700,000
8.2	LV wash facility (proprietary item)	Item	1	$300,000	$300,000
9	**Fuel and Lube Facility**				
9.1	Self bunded, fuel and lube facility	Item	1	$500,000	$500,000
10	**NPI Area water services**				
10.1	Raw water	lm	3000	$130	$390,000
10.2	Fire water tanks and pumps	Item	1	$50,000	$50,000
10.3	Fire water reticulation	lm	3000	$150	$450,000
10.4	Potable water tanks	Item	1	$25,000	$25,000
10.5	Potable water reticulation	lm	$3,000	$110	$330,000
10.6	Dirty water (collection and treatment prior to discharge to NPI area drainage)	Item	1	$15,000	$15,000
11	**NPI Area Sewage System**				
11.1	Sewage reticulation pipework and pits	lm	300	$310	$93,000
11.2	Sewage treatment Plant	Item	1	350000	$350,000
11.3	Effluent disposal area	m2	1000	$300	$300,000
12	**NPI Area Compressed air**				
12.1	Compressor and shed	Item	1	$200,000	$200,000
12.2	NPI Area compressed air piped reticulation	lm	500	$400	$200,000
13	**NPI Area Power reticulation, lighting and communications**				
13.1	Power reticulation (HV OH)	lm	18000	415	$7,470,000
13.2	Power reticulation (HV buried)	lm	1500	1600	$2,400,000
13.3	Lighting	Item	1	300000	$300,000
13.4	Communications	Item	1	630000	$630,000
14	**External roads**				

14.1	Lue Road Intersection upgrade	Item	1	$50,000	$50,000
14.2	Access Road (Lue Road to site access Road) 7.2m wide sealed access, 450mm pavement	lm	0	$1,100	$0
15	**Rail**				
15.1	Rail spur and balloon loop (non-electrified and local control)	lm	13,700	$5,000	$68,500,000
16	**Water Supply**				
16.1	Pump station (1400ML per annum)	Item	1	$45,000	$45,000
16.2	Pipeline DN315 PN16	lm	18700	$200	$3,740,000
16.3	Site storage tanks	kL	2000	$200	$400,000
16.4	Site storage Dam	m3	12000	$50	$600,000
18	**Power Supply - Option 2 Central**				
18.1	Offtake substation upgrade works	Item	1	500000	$500,000
18.2	Power line 66kV option 1 NW	lm	20000	1000	$20,000,000
18.3	Site substation	Item	2	3000000	$6,000,000
	TOTAL				$141,223,000