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# Mine Plan Justification Report

**BYLONG** COAL PROJECT
Environmental Impact Statement

Hansen Bailey
ENVIRONMENTAL CONSULTANTS

MINE ADVICE
A.B.N. 15 152 928 222

FOR
KEPCO Bylong Australia Pty Ltd on behalf of Worley Parsons Services Pty Ltd

# Bylong Coal Project
# Environmental Impact Statement Mine Plan Justification Report

MAY 2015

REPORT: WORLEY01/1

Unit 7, 17 Babilla Close
BERESFIELD, NSW 2322
TEL: (02) 4088 0600 FAX: (02) 4028 6342
E-MAIL: enquiries@mineadvice.com.au

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| **REPORT TO :** | Andrew Burleigh<br>Senior Project Manager<br>Australia East, WorleyParsons |
| **REPORT ON :** | Environmental Impact Statement Mine Plan Justification Report, Bylong Coal Project |
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| **PREPARED BY :** | Trephon Stambolie |
| **REVIEWED BY :** | Russell Frith |
| **DATE :** | 15th May 2015 |

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Trephon Stambolie
Senior Mining Engineer

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## 1.0 INTRODUCTION

The Bylong Coal Project (the Project) comprises two coal exploration authorisations (A) 287 and A342, located within the Mid-Western Regional Council (MWRC) Local Government Area (LGA), New South Wales (NSW), approximately 230km north-west of Newcastle (see **Figure 1**).


**FIGURE 1: Project locality plan**

The Project is well progressed through exploration and mine planning stages and as such is to lodge an Environmental Impact Statement (EIS) which has been prepared according to the Secretary's

Environmental Assessment Requirements (SEARs). More specifically, from a mine planning perspective, the SEARs call for "a full description of the development including the resource to be extracted along with demonstrated efficient resource recovery within relevant environmental constraints" (**Department of Planning and Environment 2014**).

The following report sets out to explain the evolution of the mine planning process and the decisions undertaken to deliver the preferred mine plan which maximises coal recovery whilst minimising the potential for adverse environmental and social impacts. The mine planning process not only takes into account the technical aspects of the relevant coal authorisations but more importantly involves consideration of environmental and social influences. These influences naturally evolve over time and therefore have required iterative mine plan changes and optimisation to balance the needs of the mining company versus the potential environmental and social implications of the planned mining operation.

## 2.0 PROJECT GEOLOGY AND RESOURCES

### 2.1 A287 and A342 Geology Summary

The Project coal resource has been independently reviewed and reported via way of systematic industry standards, i.e. Joint Ore Reserves Committee (JORC) reporting. The full sequence of Permian Illawarra Coal Measures has been recognised on site through exploration activities. In addition, the Triassic Narrabeen Group, Mesozoic Teschinite, Tertiary Basalts, and Quaternary Alluvium are also recognised in the Project area (**RungePincockMinarco (RPM) 2014**). Notably the Quaternary Alluvium, although not specifically related to coal seams, play an important role in mine planning from an environmental perspective.

The coal seams observed within A287 and A342 include the following:

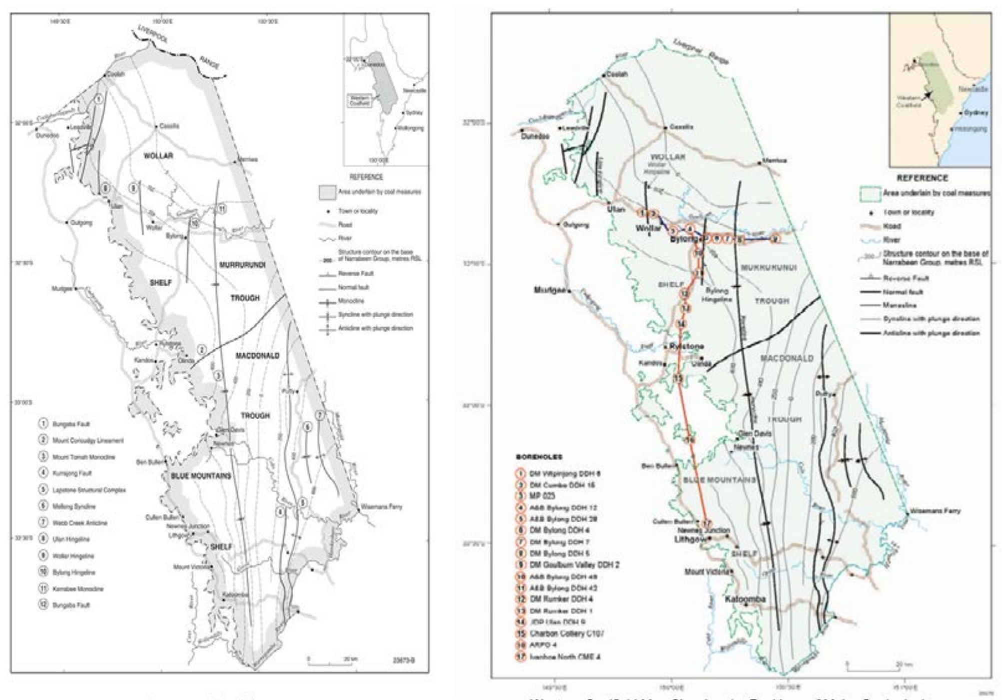
- Farmers Creek Seam – uppermost seam generally of poor quality (high ash content), highly banded and considered uneconomic at Bylong.
- State Mine Creek Seam – consists of dull, poor quality coal, thinly bedded and considered uneconomic at Bylong.
- Goulburn Seam – banded, poor quality coal and claystone, considered uneconomic at Bylong.
- Glen Davis Seam – generally thinly bedded, relatively high ash coals exhibiting some economic potential via open cut surface mining methods.
- Ulan Seam - the Ulan Seam is the major economic seam mined at the Ulan and Wilpinjong Mines located 30 km and 20 km respectively to the north-west. Between the Ulan Mine and the Bylong area the seam deteriorates and splits and the upper plies are not present at Bylong. The Ulan seam at Bylong is generally comprised of relatively thin poor quality plies. For the most part the seam is considered uneconomic, with only certain portions of the seam presenting as potentially economic with selection of specific mining methods.
- Coggan Seam – the Coggan Seam is the major economic resource of the Project due to its relatively low *in situ* ash (10% to 30% air dried basis) and thickness ranging from 2 m to 5 m. The Coggan Seam is present across the large majority of both A287 and A342 and varies in depth from just below surface to depths of 380 m. The Coggan Seam is the lowest seam in the sequence and correlates stratigraphically with the Lithgow Seam. The Coggan Seam is amenable to varied mining methods and is considered an export and domestic quality thermal coal resource. NOTE: for the purpose of this report, reference to general mine planning will be specific to the Coggan Seam for simplicity purposes.

In summary, the geology of the area relevant to mine planning consists of relatively flat seams (i.e. dips of approximately 2˚). On a regional scale, available literature suggests the immediate Bylong area is characterised by a large scale hingeline, i.e. the Bylong Hingeline (**Bayly 2012**) and varied igneous intrusions (see **Figure 2**). The major intrusion characteristic of the area is that identified as the Murrumbo Sill (**Cornubian Resources Pty Ltd 2013**), located to the east of A287. Other igneous occurrences are considered common as with the Western Coalfield and include basalt flows and dykes.

On a site-based scale, geological features identified through on-going exploration include:

- Anticline or seam roll with associated small scale faulting (equates and aligns to the Bylong Hingeline) – this structure traverses through the south-eastern portion of A287 and the northern portion of A342. From a mining perspective, the geological feature exhibits localised seam grade steepening. The monocline feature will present with the greatest hazard to underground longwall mining as this mining method favours a flat seam environment, devoid of major geological structure and seam grade changes.

- Coggan Sill - The Coggan Sill is a relatively well defined feature in the southwest of A287 (RPM 2014). This feature provides a major constraint to mining in that the majority of Coggan Seam is intruded or affected to a point whereby resultant coal quality is considered uneconomic from a mining perspective.
- Igneous intrusions and dykes – exploration to-date has identified additional potential areas of seam silling and minor dykes. These features can present as a constraint or barriers to mining and have been considered in the mine planning process whereby the mine plan and schedule has been modified or mining has been excluded from such areas.
- Minor geological faulting – extensive geological drilling, i.e. to a JORC "Measured Status", in association with creation of a site specific geological model suggests large, or full seam, displacement faulting is not common within A287 and A342. Minor faulting, i.e. less than 1 m displacements, have been identified in drill core in localised areas. Such features have been considered throughout the mine planning process and are deemed a minor constraint but will influence the mining process to some degree. No large displacement faults are currently defined in the Project area through drilling and modelling information (**RPM 2014**).



Structure of the Western Coalfield (**Yoo et el 2001**)

Western Coalfield Map Showing the Positions of Major Geological Structures and Boreholes (**Bayly 2012**)

**FIGURE 2: Advances in structure interpretation of the Western Coalfield (Yoo *et el* 2001 and Bayly 2012)**

### 2.2 A287 and A342 Resource Summary

RPM was commissioned to independently review the available geological information for the Project to prepare and document a Resources Estimate in accordance with the 2012 JORC Code. The study was based on the interpretation of 471 drill holes resulting in the culmination of an accompanying geological model. In order to estimate Resources, RPM determined points of observations from the drill holes, and defined resource polygons based on appropriate distances between points of observations (500 m, 1000 m, and 4000 m for Measured, Indicated, and Inferred Resources respectively). The Resources were identified as either Open Cut or Underground Resources based on consideration of technical and economic criteria and appropriate cut off parameters were applied (**RPM 2014**). The coal resources available for extraction, by authorisation, are shown in **Table 1**.

| **Authorisation** | **Resource Type** | **Resource Category** | | | |
|---|---|---|---|---|---|
| | | **Measured** (Mt Insitu) | **Indicated** (Mt Insitu) | **Inferred** (Mt Insitu) | **Total** (Mt Insitu) |
| **A287** | Open cut | 91.3 | 100.9 | 82.4 | 274.7 |
| | Underground | 146.9 | 136.5 | 68.2 | 351.6 |
| | *Subtotal* | *238.3* | *237.4* | *150.6* | *626.3* |
| **A342** | Open cut | 50.5 | 47.7 | 18.8 | 116.9 |
| | Underground | 4.9 | 33.7 | 92.5 | 131.1 |
| | *Subtotal* | *55.4* | *81.4* | *111.3* | *248.1* |
| **Grand Total** | | **293.6** | **318.8** | **261.9** | **874.3** |

**TABLE 1: Summary of 2014 JORC Resource Estimate (RPM 2014)**

## 3.0 GENERIC MINE PLANNING PRINCIPLES

Mining is accepted by the public at large because of the role it plays in society as a provider of minerals and metals for the public's needs and general wellbeing (**Boutilier and Thompson 2011**). A resource company's overarching objective is to optimise (i.e. maximise) extraction of the available resource, delivering the greatest economic advantage, within the allowable boundaries governed by environmental and social inputs. It is important to evaluate the role that environmental and social considerations play in decisions about mineral development, that is, that these considerations should be evaluated alongside more traditional business and economic considerations (**Eggert 2006**).

Overall objectives and considerations are represented via way of relevant NSW government departments, through which a mining development must be approved in-principle:

- Department of Trade and Investment, Resources and Energy (DT&I-RE) – a Conceptual Project Development Plan (CPDP) is required for approval in-principle, whereby the plan demonstrates to Trade & Investment- Mineral Resources, that the proposal is (**DT&I-RE 2015**):
  - Practical (i.e. uses reputable, tried and tested mining methods),
  - Feasible (i.e. is considered reasonably economic in the prevailing economic climate),
  - Optimises resource utilisation (i.e. extracts all available coal resource, avoiding sterilisation or waste, using tried and tested mining methods), and
  - Can be achieved within known environmental and mining/production constraints.

  Note: a specific emphasis is placed on maximising the resource extraction for each project application, with specific justification as to why this is not the case, thus ensuring maximum benefit to the State of NSW, through proceeds from royalties etc. Through this forum all technical mining aspects are to be considered.

- Department of Planning and Environment (DP&E) - a range of development types such as mines and manufacturing plants as well as warehousing, waste, energy, tourist, education and hospital facilities are considered to be State Significant Developments if they are over a certain size or located in a sensitive environmental setting. Through this system, all environmental and social elements of the proposed mining project are to be identified and evaluated yielding the most appropriate course of action.

Therefore the relevant mine planning undertaken for the Project has had to pro-actively consider from the outset a mix of relevant legislation, industry codes, standards (industry or corporate) and financial hurdles. Through forethought, adopting early systematic communication with relevant stakeholders and implementing associated iterative mine planning, the most acceptable mine plan has been tabled specific to the coal resources and environmental parameters specific to A287 and A342.

## 4.0 GENERIC MINE PLANNING PROCESS

Mining operations are relatively unique in that they typically extend over a number of decades (see **Figure 3**).

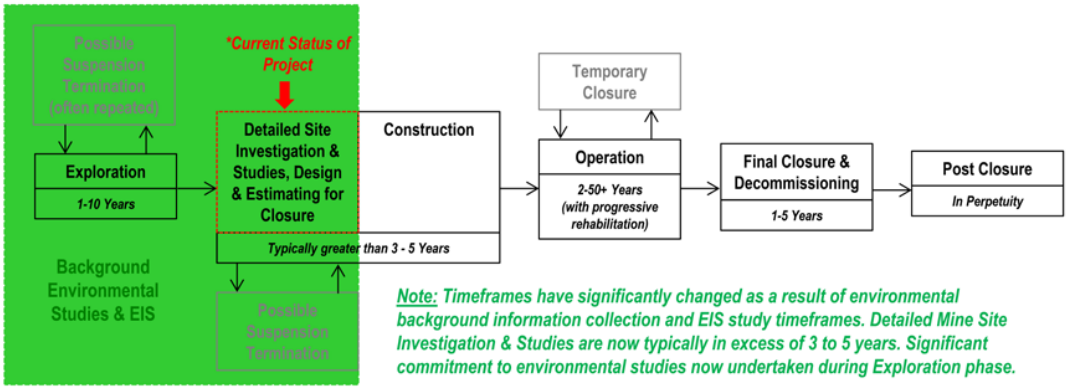



**FIGURE 3: Stages of the mine life cycle (modified, Boutilier and Thompson 2011)**

From a corporate perspective, a mining project is typically evaluated through a series of internal technical and economic studies prior to seeking planning approvals and the actual mine development (see **Figure 4**). At each stage of internal study, the Project is to satisfy specific corporate and financial objectives, whilst also understanding potential environmental and social impacts and implementing appropriate change to facilitate an environmentally pragmatic mine plan that is both economic and approvable. The general stages of corporate study of a mining project are as follows:

- Concept Study or Scoping Study – a concept study represents the transformation of a project idea into a broad investment proposition. It is intended primarily to highlight the principal investment aspects of a possible mining proposition (**Bullock 2011**).

- Pre-Feasibility Study (PFS) – a PFS is an intermediate-level exercise, normally not suitable for an investment decision. A PFS studies a range of options and has the objective of determining whether the project concept justifies a detailed analysis by feasibility study, and whether any aspects of the project are critical to its viability and necessitate in-depth investigation through functional and support studies (**Bullock 2011**). Generally a preferred case is selected to take forward to a more detailed Feasibility Study. NOTE: for the purpose of the Project, this stage of internal corporate study presented a logical point with which to table the proposed mine plan to both the DT&I (through delivery of a pre-Conceptual Project Development Plan) and DP&E (through informal presentation and discussions) prior to commitment to a greater than 12 month feasibility study and accompanying EIS. Additionally, key preliminary EIS studies were undertaken on the PFS mine plan to understand corresponding impacts. Relevant feedback, evolving legislation and preliminary EIS studies led to a review of the proposed mine plan as developed in the PFS. The concept of an "approvable mine plan" philosophy was adopted and the mine plan reworked to identify a balanced mix of mining and environmental acceptance.

- Feasibility Study – the feasibility study provides a definitive technical, environmental and commercial base for an investment decision. Feasibility studies use iterative processes to optimise all critical elements of a project (**Bullock 2011**). The subsequent EIS for the Project is based on the detail of the completed Feasibility Study.

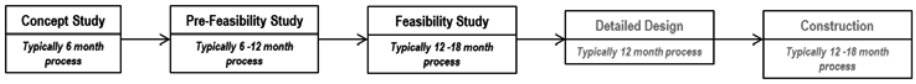



**FIGURE 4: Generic mine feasibility study stages**

A complicating factor with mine design relates to the number of years required to undertake the mining study process, over and above the requirements and timeframes attributed to an accompanying EIS (see **Figure 3** and **Figure 4**). Here, in parallel, evolving legislative requirements and perceptions attributed to environmental and social constraints complicate the selection and adoption of a fixed mine plan to take forward both on an internal corporate and external EIS perspective. In the case of the Project, continual rework and expense have been required to best align and evolve the mine plan so as to satisfy the overarching and perceived future approvals environment at each stage of the mining studies.

Following pro-active communication with the DT&I-RE, DP&E and the community at relevant stages of the mine planning process, timely modifications have been made to suit feedback and advice provided by the relevant stakeholders. Of particular note, on the completion of the PFS[1], the preferred mine plan was scrutinised not only from a corporate business case perspective but from a broader stakeholder and environmental perspective. In addition, the timing coincided with the introduction and roll out of the new Gateway Process and the introduction of the Aquifer Interference Policy (AIP). KEPCO subsequently made a responsible decision to adopt an "approvable mine plan" philosophy whereby the PFS mine plan was put through further rigour and modification. In addition to generic mine planning stages of Concept Study, PFS then Feasibility Study, KEPCO instigated another level of study (i.e. an additional Options Study) between the PFS and Feasibility Study. The inclusion of the Options Study added another 6-12 months to the mine planning process, prior to committing to a Feasibility Study and EIS.

It is important to note that the PFS mine plan included several open cut mining areas as well as extensive underground operations culminating in a 10 MTPA operation. Cross-sectional expert advice based on the PFS, i.e. preliminary noise, dust and groundwater modelling, in combination with DP&E feedback led to the retiring of significant resource and annual production capacity in order to balance economic, social and environmental benefits. For example, the PFS mine plan included 228.4 Mt of ROM resources, 67.8 Mt from open cut operations and 160.6 Mt from underground operations. Following detailed and iterative rework of the PFS mine plan, approximately 48% of the PFS open cut ROM resource and 57% of the PFS underground ROM resource have been retired in order to not only achieve the economic, social and environmental balance but to take heed of relevant stakeholder advice as observed in that time of the study process.

The additional Options Study assessed several mine plan variations with perceived reduced environmental footprint and better fit within the Bylong site specifics. The Options Study looked at the following with the view of selecting the most appropriate mine plan to take through to detailed Feasibility Study and corresponding EIS studies:

[1] The PFS mine plan included 7 open cut voids distributed across both A287 & A342 in combination with an underground longwall mine in A287 and extensive bord and pillar workings for the most part of the remaining resource across both A287 and A342. The proposed PFS mine plan exhibited an extensive footprint for the most part of both A287 and A342.

- Underground only longwall mine within A287 – from an approvals perspective, the underground only mine plan presented with challenges associated with rejects disposal on surface. In addition, within the current economic climate an underground only mine delivered a marginal economic business case.

- Iterations of two “short-term” open cut operations with accompanying “long-term” underground mine within the central portions of A287 and A342 – from an approvals perspective, the use of open cut voids presents as a useful solution to reject disposal for life of mine operations. In addition to reject solutions, use of short-term open cut mining (generally viewed as a cheaper mining method) up front within the Project life also delivered an improved economic business case and satisfies the requirement to maximise resource recovery by targeting resources unsuitable for underground extraction.

The changes adopted by KEPCO between the PFS and Option Study involved the reduction in lateral extent of proposed mining operations along with an overall reduction in mining intensity (see **Figure 5**). The refined mine plan is considered a compromised and balanced position at both maximising resource recovery and economic benefit but at the same time satisfying environmental and social considerations. The resultant Option Study mine plan then formed the basis for a detailed Feasibility Study to justify further the investment decision as well as providing detailed inputs into the EIS. Continued mine plan refinement was undertaken throughout detailed the Feasibility Study.

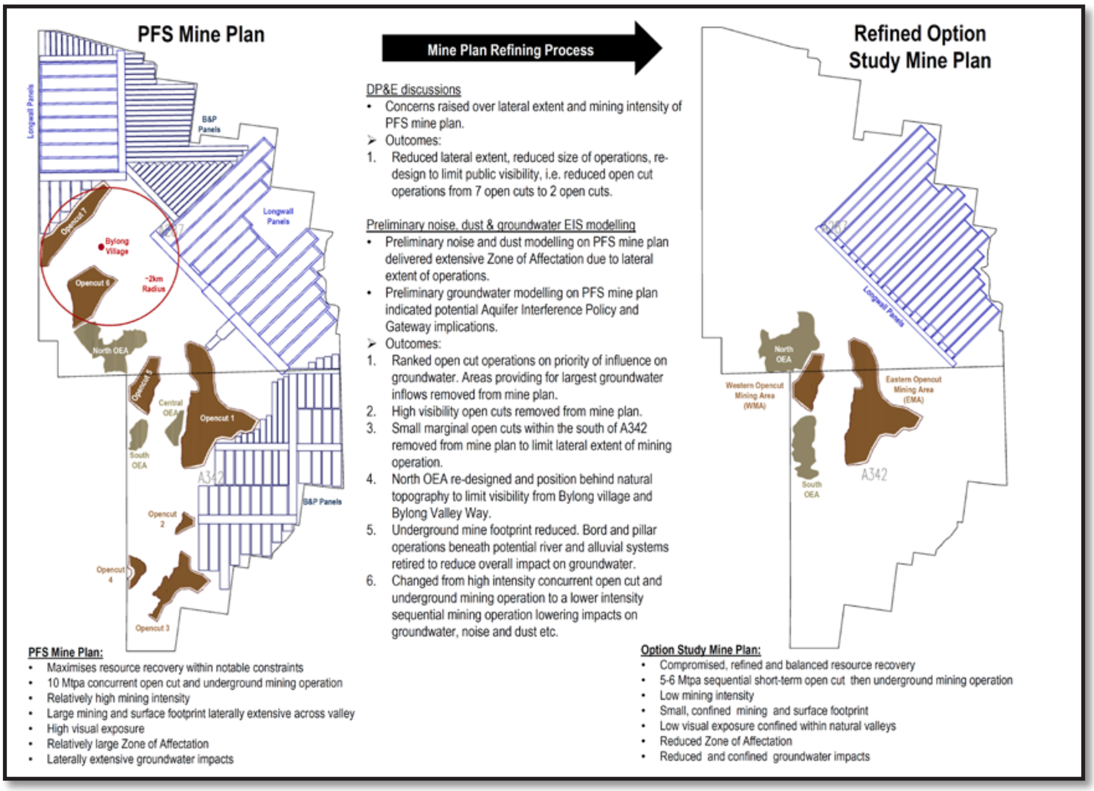



**FIGURE 5: Refined Project mine plan through stakeholder engagement and preliminary EIS studies**

## 5.0 PROJECT MINE PLANNING CONSTRAINT CONSIDERATIONS

Prior to the commencement of any mine planning it is fundamental to understand and formulate all the constraints to mining, whether technical, financial or environmental. This allows for the establishment of areas within the designated exploration authorisation that are amenable to some form of mining extraction. At the onset of the mining studies a simplified "cookie cutter" approach was set up whereby constraints to mining were identified and layer upon layer developed culminating in suitable and potential mining areas within A287 and A342. Major constraints to mining where updated and modified over time to reflect relevant studies, evolving legislation (e.g. implementation of the Gateway Process) and ongoing stakeholder influences (e.g. land ownership changes). The following constraints have been considered from the early stages of mine planning resulting in the selected mine plan:

- Authorisation boundaries – the starting point and fundamental premise of mining potential is limited by the authorisation boundaries of A287 and A342. In principle, mining could technically occur to the relevant authorisation boundary but a generic standoff distance of greater than 50m was adopted at the start of mining planning.

- Coal resource extents – the overarching principle governing mining within the Bylong area is the occurrence and quality of the Coggan Seam, i.e. the primary target seam, along with physical characteristics such as seam thickness and seam depth. Physical characteristics of the seam generally dictate the adopted mining method that is through Strip Ratio analysis either open cut potential or underground potential is determined. By and large, the Coggan Seam is considered to exist across the majority of both authorisations except for a small area of seam sub-crop along the western portion of A342 (see **Figure 6**). In reality, a range of different mining methods could be engaged to extract the primary target seam for the majority of A287 and A342.

- Coal quality - in addition to seam physical characteristics, the assessment of coal quality also plays an important role in determining economic extraction and ranking certain areas to prioritise mining. Simplistically, the assessment of coal quality can be related to the *in situ* ash (%) content. In general, coal quality of the Coggan Seam is fairly consistent across the authorisations although high ash zones exist in the north-eastern portions of A287 (see **Figure 7**). Coal quality also provides a means of ranking the deposit and assists in determining an order of priority of extraction across the resource. All other factors being equal, priority for mining is within the central portion of A287 and A342, as well as the northern portion of A287 and the south-eastern portion of A342. However, selected mining method, seam access requirements, economics and overarching environmental constraints will govern the final ranking and priority selection of mining.

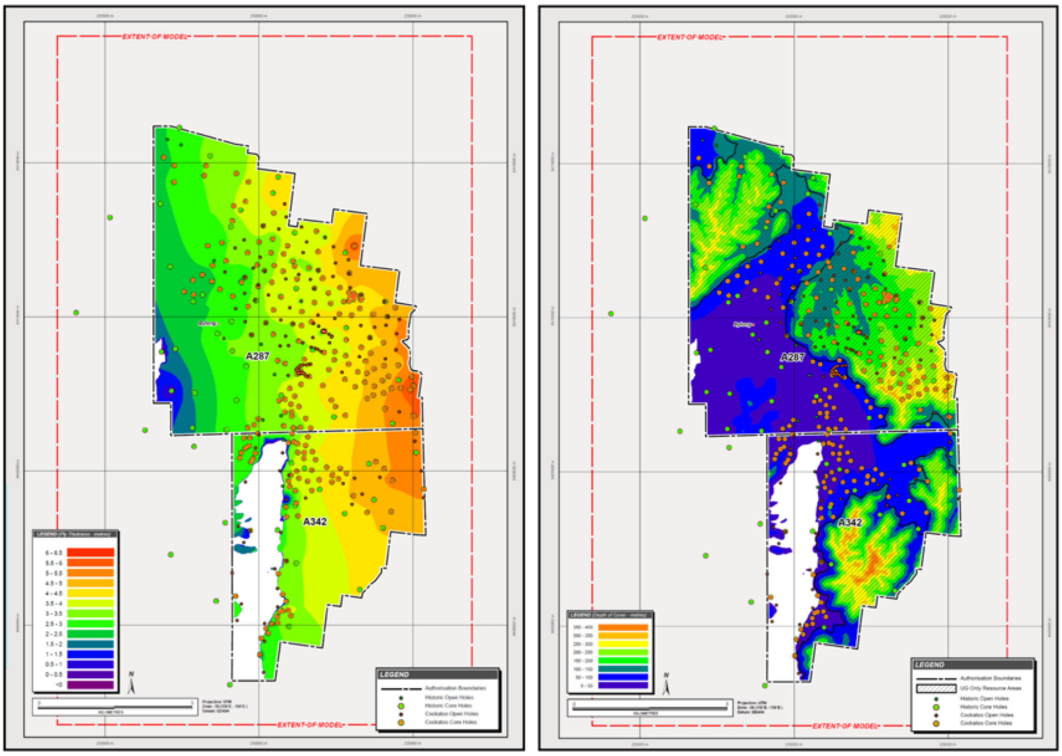



**FIGURE 6: Extent of Coggan Seam shown by seam thickness and depth of cover (RPM 2014)**

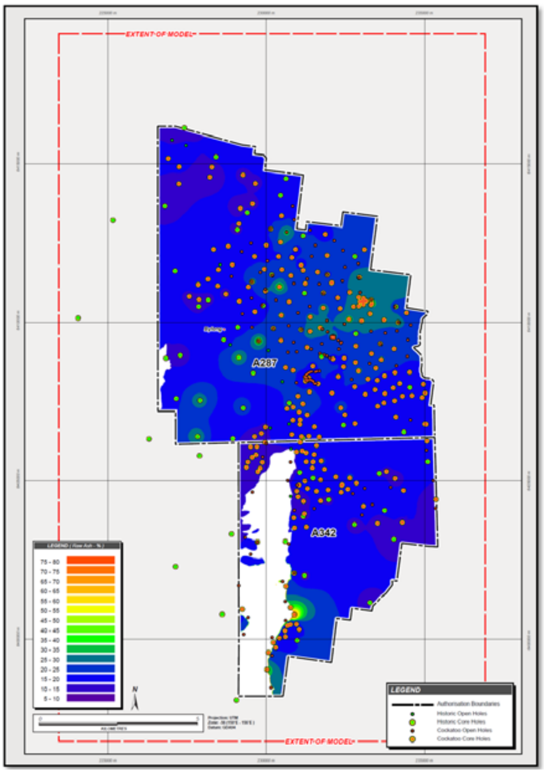



**FIGURE 7: Coggan Seam quality – Raw Ash (RPM 2014)**

From an effective resource utilisation perspective, the occurrence of reasonable quality coal across the majority of both A287 and A342 suggests extraction across the entirety of both authorisations is the starting point for mine planning, pending the subsequent inclusion of influential constraints to mining.

In addition to the existence of an available coal resource, a number of traditional mining constraints exist which preclude or restrict the decision to mine. Pro-active identification and acceptance of such constraints by KEPCO ensured that a robust, fit-for purpose mine plan was established over a number of years. The following examples of constraints and limitations to mining have been considered through the mine planning process:

- Surface infrastructure – existing infrastructure is not only important from a community perspective but may also play a vital role towards a viable mining operation. In some instances relevant surface infrastructure will preclude or inhibit mining within a particular area. Overall, Bylong is considered a fairly remote site with major infrastructure limited to the village of Bylong, Bylong Valley Way and the Sandy Hollow to Gulgong railway line. From a mine planning perspective, pre-emptive standoff distances of 2 km were adopted around the village of Bylong for open cut mining activities (this being an arbitrary reference point to be confirmed through subsequent EIS studies). In addition, both Bylong Valley Way and the Sandy Hollow to Gulgong Railway line were considered as critical infrastructure and as such, appropriate controls have been adopted to minimise impacts, i.e. no proposed open cut mining within these areas or alternatively, reasonable subsidence impacts have been considered from an engineering perspective.

- Rivers and associated alluvials (surface and groundwater) – interaction between mining and rivers/alluvials has been considered using the NSW Management of Stream/Aquifer System in Coal Mining Developments – Stream/Aquifer Guidelines (**Department of Infrastructure, Planning and Natural Resources (DIPNR) 2005**). As a starting point for mine planning and prior to commencement of associated EIS studies, the Bylong and Growee Rivers were regarded as Schedule 2 streams from a Stream/Aquifer Guideline perspective. Lee Creek, Dry Creek, Cousins Creek, Crow's Nest Creek and Wattle Creek were considered as Schedule 1 streams (**Golder Associates 2012**). Typical initial mine planning input guides included:

    - Underground mining operations should provide a minimum barrier between the 20 mm line of subsidence and the bank of Schedule 2 streams (**DIPNR 2005**). It is important to note that a 40 m barrier over and above the 20 mm line of subsidence was adopted for conservatism, as stipulated for a Schedule 3 stream. The Project underground longwall mine plan is considered to impact the upper sections of Dry Creek, but is typically outside the 20 mm line of subsidence relative to the Bylong River. Pre-cursor mine planning subsidence studies indicate that impacts on Dry Creek are manageable (**MSEC 2012**). In terms of other recognised rivers or creeks within the Project area, the Project underground longwall mine footprint falls outside the perceived systems attributed to recognised rivers or creeks, as defined in the Stream/Aquifer guidelines.

    - Open cut operations should provide a barrier of 150 m between an agreed point on the highwall and a Schedule 2 stream system (**DIPNR 2005**). The recognised rivers or creeks in the immediate vicinity of the Project open cut voids are Bylong River, Lee Creek and Cousins Creek. In all instances, the planned open cut voids have been planned to fall outside the associated watercourse systems based on available information, therefore minimising any associated impacts and negating the requirement for significant watercourse diversions.

In order to quantify the associated "stream systems" further, Douglas Partners Pty Ltd were independently commissioned to map the associated alluvials related to the rivers or creeks in question. The mapped alluvial extents have been used in conjunction with relevant rivers or creeks to define the system so described in the Stream/Aquifer guidelines. The alluvial mapping has been utilised as a constraint to mining and the appropriate controls adopted in subsequent mine planning based on the abovementioned guidelines. Where possible, the philosophy adopted has been to avoid relevant and significant river/creek systems with planned mining disturbance footprints.

- Agricultural land – from the onset of mining studies the Project has adopted the view of minimising mining within prime agricultural land, especially with regards to open cut mining methods. Since KEPCO purchased the Authorisations in 2010 there have been a number of legislative changes and corresponding stance and view point with regards to agricultural land. At the commencement of mining studies up to and including the conclusion of the PFS, the only available resource from an agricultural perspective was based on the original government Class II agricultural land mapping (see **Figure 8**). This agricultural land mapping was utilised in the early stages of mine planning whereby the Project adopted a philosophy of limiting open cut mining within Class II agricultural land.

  However, over the course of the mining studies, i.e. between PFS and FS, legislation was changed with the introduction of the new Gateway Process and the AIP. This resulted in variations of the Class II agricultural mining constraint which was at the time adopted by the Project. These changes lead to subsequent mine planning iterations to best satisfy any new requirements stipulated by the new legislation.

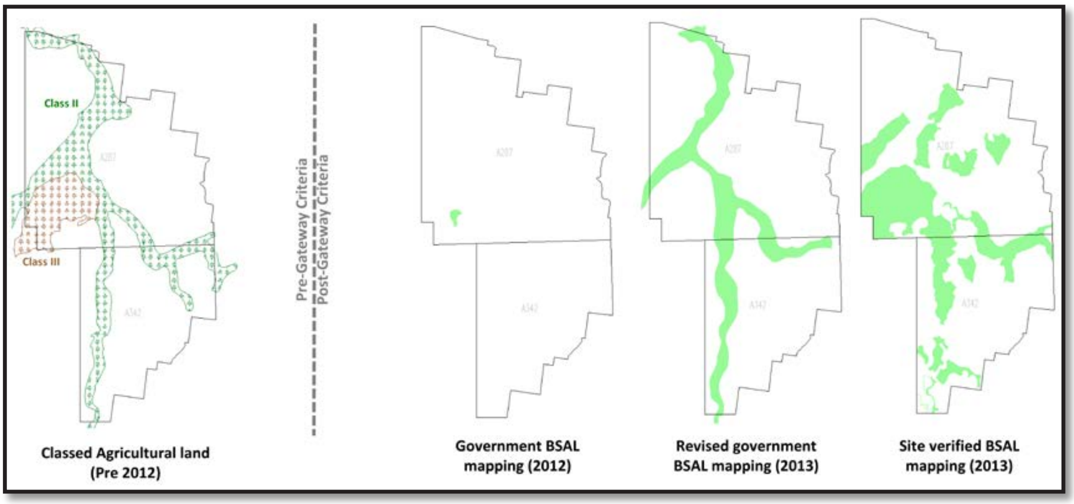



**FIGURE 8: Evolution of government BSAL mapping.**

- Gateway Process and AIP – the lengthy mine planning process was further complicated with the introduction and associated understanding of the new Gateway legislation. In addition, interim protocols were issued throughout the Project studies. Where possible, identified limitations were adopted so as to ensure the final mine plan would satisfy the Gateway process. A Gateway Certificate was subsequently granted for the Project suggesting pro-active, prudent and responsible mine planning had been systematically adopted.

The two main areas of consideration from a Gateway perspective included:

- Biophysical Strategic Agricultural Land (BSAL) – the various versions of government issued BSAL mapping changed considerably over the duration of the mining studies. Initial BSAL maps issued in March 2012 indicated limited BSAL within the Project. However, the Project maintained the more conservative historic Class II mapping as an input into mine design. Revised maps issued in September 2012 indicated BSAL areas mimicking original Class II mapping (see **Figure 8**). Detailed site specific soil sampling and mapping in accordance within the relevant *Interim Protocol for the Verification of BSAL* was undertaken to determine the current extent of BSAL across the authorisation areas. Selected mining and infrastructure footprints have been located outside identified constraints as far as possible. Following site verification mapping, small pockets of BSAL are observed within coal recovery areas and designated overburden emplacement areas (OEA). Small pockets of site verified BSAL have also been mapped within accompanying mining infrastructure footprints. OEA and infrastructure footprints have been reworked as much as possible to limit impacts to BSAL as generally these footprints are selective and engineered as opposed to coal resource occurrence which is geologically determined.

- Critical Industry Cluster (Equine) – early mine plan options did not consider the Bylong area as a specific equine area. However, with the introduction of the Gateway process, initial mapping issued in 2012 indicated the majority of the northern authorisation, A287, as an Equine Cluster. Subsequently this influenced mine planning philosophy whereby any open cut mining or major infrastructure should be sighted as far south in A287 or within A342, as possible. The later version of draft equine mapping released in October 2013 was vastly different and reduced in area including some small areas of overlap with the evolutionary mine plan developed to that point. This mapping was finalised by the NSW Government in January 2014 following KEPCO's submission of its Gateway Certificate application.

- Cliffs, escarpment type features and steep slope areas – the Bylong area is characterised by the occurrence of prominent escarpments type features bordering the lower lying valleys. At the outset of mine planning, these features have been identified as constraints to mining. Here potential open cut methods have been offset from steep slope areas and underground mine plans have taken into account the associated cliffs whereby proposed underground mining has been offset from relevant cliffs as far as possible. As a starting point, the large majority of cliffs that are considered "visible" from reasonable public vantage points have been excluded from mine plans where negative impacts could be realised.

- Biodiversity – natural vegetation is restrained mainly to the steep slope and escarpment type areas. The majority of lower lying flat areas have been worked from agricultural, industrial or residential perspectives. From the outset of deriving the preferred mine plan, open cut operations and infrastructure have targeted the predominantly cleared areas of land within the flat lying valley areas, thus limiting potential impacts on biodiversity.

- Noise and air quality – the Bylong area is characterised by relatively limited inhabitants. High level inputs into overall mine design have involved consideration of potential noise and air quality impacts on the relevant stakeholders, pending the snapshot in time during the study process and their corresponding relevance. Specific consideration has been given to the Bylong village, whereby suitable coal resource in close proximity to the village may present with adverse noise and dust impacts pending the mining method selected within the immediate vicinity of the village.

- Heritage – throughout the course of the mine studies, heritage considerations have been identified and assessed in terms of the mine plan proposed at the time. Significant heritage inputs have been assessed by specialists and actively incorporated in mine plan changes or specific management measures implemented to allow for any proposed mining.

- Public safety – due to the remote and isolated nature of the Project, the risks of public safety are somewhat reduced through relative lack in exposure. However, concentrated and well defined mining areas provide for better site control and management. Mine planning has not only been undertaken with reference to relevant coal mine legislation but will also operate under such legislation so as to address the issue of public safety. Life of mine focus on underground operations coupled with philosophies of limiting mine traffic on public roads etc, reduces expose further towards aspects attributed to public safety.

Logical and simplistic mine planning principles for the Project dictated the selection of open cut mining methods and infrastructure to areas of cleared and exposed lower lying valley flats, whereas underground mining methods are to target the deeper escarpment areas. The Bylong Valley provides natural screening with intervening topography and natural vegetation and where possible mine design has attempted to take advantage of such aspects, thus reducing the visual amenity impacts of the Project.

## 6.0 PROJECT MINE PLANNING STUDY PROCESS

### 6.1 Common Australian Coal Mining Methods

Once a coal resource has been defined as having a potential for extraction, priority then focusses on the mining method. Here two broad categories are possible:

- Open cut mining – Australian open cut methods can generally fall into two primary types, these being dragline strip mining methods or truck and excavator methods (**Aspinall** *et el* **2009**). Open cut methods target shallow seam environments that are usually cheaper and safer as compared to underground methods. Operations utilising draglines tend to be the lowest cost open cut method but are restricted to large shallow deposits and are capital intensive. Truck and excavator methods are considered more flexible but generally exhibit higher operational costs, although require less capital outlay. Truck and loader methods are suited to short-term, small-scale open cut operations.

  From a coal mining perspective, selecting between open cut and underground mining methods is typically undertaken using economic outcomes. However, technical aspects can play an equally important role when selecting open cut methods for shallow coal seam environments. Underground methods can be unfavourable at shallow depths of cover primarily due to technical and safety challenges. For example, technical aspects of underground mining such as strata stability and ventilation management may become a higher safety risk at shallow depths of cover. This example can be highlighted by specific instances governed by legislation, i.e. underground mining operations in locations where the depth of cover is less than 50 m is identified as a high risk activity (**Work Health and Safety Mines Regulation 2014**). As such, open cut mining methods are preferred for shallow coal seam environments when compared directly to underground mining methods.

- Underground mining – in deeper seam environments where open cut methods become uneconomic, i.e. the cost of overburden removal exceeds the value of coal recovered, underground mining becomes a viable alternative. In Australia, underground coal mining methods fall into two primary categories:

  1.) Bord & pillar mining – the fundamental concept of this method is that the coal seam is divided into a regular block like array, i.e. checker board arrangement. The array is created by driving systems of underground roadways leaving behind remnant coal pillars which ultimately support the overlying strata. The amount of remnant coal left behind dictates the overall ground stability in the long-term. In general, bord and pillar methods are considered to have moderate seam extraction ratios, relatively low production output, typically high operating costs although generally require low capital investments for implementation. This mining method is regarded as flexible towards changing resource characteristics and is the primary mining method for controlling mine subsidence.

  2.) Longwall mining – this method is specific to suitable resources where subsidence is not considered a significant constraint to mining. Here extensive rectangular blocks of coal, e.g. 340 m wide by 4 km long, are extracted followed by overlying strata collapse, subsequent ground consolidation and associated ground subsidence. In general, longwall methods are considered to have high extraction ratios, high production outputs, typically lower operating costs although require large capital investments for implementation. This method is generally inflexible to changing resource characteristics and requires well defined suitable coal seams for successful implementation. Longwall mining remains the principal extraction method for underground coal mines in Australia. Apart from providing much needed improvements in health and safety, profitability and return on capital are also improved (**Mitchell 2009**).

### 6.2 Project Mining Method Selection

Determination of open cut versus underground methods for the Project was based on target seam depth and economic Strip Ratio analysis. In addition, site specific terrain within A287 and A342 provides a natural input for mining method selection. Generally, the low lying valley areas with shallow coal seams present as amenable to open cut methods whereas the deeper coal seam environments beneath the escarpments are more suited to underground mining methods. The depth to the primary target Coggan Seam provides a good high level selection parameter for mining method. In general, areas of Coggan Seam resource shallower than approximately 100 m depth of cover are considered suitable for open cut. Deeper Coggan Seam resources were therefore considered from an underground perspective (see **Figure 6**, depth of cover and underground only reserve areas).

Having broadly characterised A287 and A342 into potential open cut and underground areas, individual mining areas were then ranked in terms of prioritising mining locations based on coal quality and the best economic return, i.e. targeting lower *in situ* ash areas (see **Figure 7**). Open cut methods were then sequenced and ranked based on economic Strip Ratios. Underground mining methods were prioritised by identifying suitable longwall resource areas ahead of bord and pillar areas. Longwall areas were then prioritised through appropriate margin ranking exercises identifying the best quality coal areas coupled with the greatest economic return.

Through the Project's Options Study, a number of iterations of mining method and sequencing were assessed including:

- Open cut only – this option does not effectively utilise and maximise the available coal resources within the authorisations. In consideration of an approvability perspective, the subsequently constrained resources considered available for open cut mining do not allow for a viable and economic project.
- Underground only – a likely option although found to be economically challenging. Additionally an underground only option gave rise to a potential environmental legacy attributed to coal washing and the associated reject disposal requirements.
- Combined open cut and underground, mined concurrently from the onset of the operation – this option gave rise to an increased ROM production profile early in the mine life with a significant tapering in later years attributed to the relatively short open cut mine life. This option not only required inefficient infrastructure requirements, i.e. oversized for the majority of the mine life, but was marginal from an economic perspective due to the large initial capital requirements.
- Underground then open cut – illogical sequence of mining incurs higher operating and capital cost early in the mine life compounded by the environmental challenge of reject disposal for some period of time without the availability of open cut voids.
- Open cut then underground – logical sequence of mining method maximising benefits of lower cost and simpler open cut mining method upfront in the operations. This option was identified

as the preferred case that would undergo the detailed rigour of a Feasibility Study and accompanying EIS.

## 7.0 PROJECT OPEN CUT MINING

Having identified coal resources suitable for open cut mining, appropriate and identified constraints were applied. Considerations for open cut pit boundary definitions included the analysis of the following:

- Resource characteristics including associated Strip Ratios and resource ranking.
- Rivers, creeks and associated alluvials, i.e. planned highwalls 150 m standoff from interpreted alluvial systems specific to the Bylong Valley.
- Prime agricultural land, i.e. original Class II and recent BSAL considerations.
- Infrastructure including Sandy Hollow to Gulgong Railway line and Bylong Valley Way.
- Visual aspects.
- Steep terrain.
- Approximate 2 km standoff from the Bylong village.

In general, the available Project coal resource would allow for one large open cut extending the limits of the valley. However, applied environmental pragmatism delivers the resultant potential for approximately 7 open cut mining areas and associated voids across the extents of both A287 and A342, as deduced through the PFS (see **Figure 9**). It is worth noting the highly constrained nature of the valley and the challenge to design not only suitable open cut operations but also the accompanying overburden emplacement areas and relevant infrastructure due to competing layers of environmental constraints, all with varied value and significance.

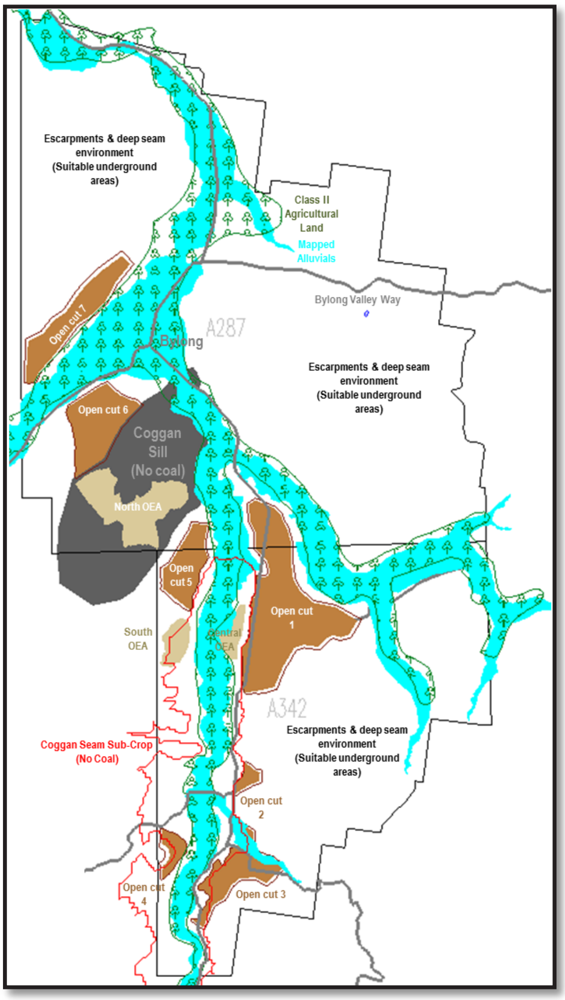



**FIGURE 9: Early studies and extent of potential open cuts with generic environmental and resource constraints**

In line with stakeholder feedback, in particular the DP&E, the lateral extent of proposed open cuts across the length of the Bylong Valley gave rise to potential social and political issues. In addition, higher emphasis was placed on visual amenity, especially in the vicinity of Bylong village and aspects from Bylong Valley Way. KEPCO's underlying goal of an approvable mine plan lead to the deliberation over the number of open cuts to be implemented as well as suitable locations. The total number of open cuts was subsequently assessed according to the following parameters:

- Strip Ratios and economics.
- Location with respect to Bylong village and Bylong Valley Way.
- Groundwater considerations from preliminary groundwater modelling.
- Distance from centralised mine infrastructure area (MIA).
- Interpretation of on-going exploration and geological modelling.
- Land ownership.

Detailed consideration concluded that the two open cuts located within the central portion of A287 and A342 gave rise to the most balanced economic and environmental open cut mine plan. Any proposed open cuts in the immediate vicinity of Bylong village and Bylong Valley Way were considered inappropriate for further detailed studies at that point in time. The remaining number of open cuts was reduced further based on economic preference and on-going exploration. The final selection of the two central open cut locations is considered as compromised but balanced, thus satisfying both the needs of the mining company and the relevant stakeholders. The preferred two open cuts were then subjected to further technical and economic analysis via the Option Study which confirmed progression to the detailed Feasibility Study. The systematic selection of open cuts has led to the adopted open cut mine plan which forms part of the current EIS study (**see Figure 10**).

The proposed open cut operation includes the extraction of two open cuts via way of traditional truck and hydraulic excavators. The nature of the deposit which includes irregular shaped small open cuts with interbedded thin coal seams is most amenable to truck and excavator method over the dragline method. Both open cuts are commenced with a small box cut whereby there is a necessity to place overburden material other than coal outside the immediate area of mining while coal is being extracted. At such time the open cut footprints deliver sufficient working room and void space, the overburden will be placed directly in-pit as opposed to out-of-pit for the remainder of open cut mine life. This mining method specifically limits the associated disturbance footprint relative to the coal being mined.

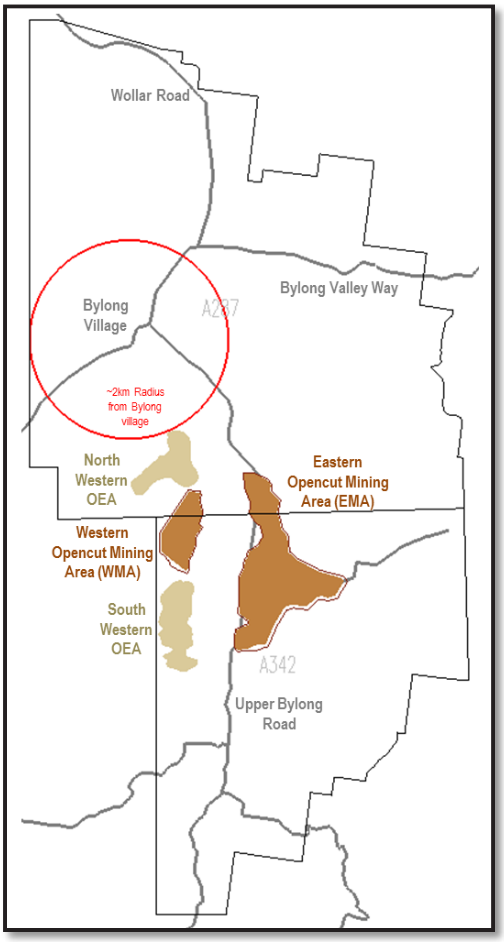



**FIGURE 10: Project open cut operations and overburden emplacement footprint**

### 7.1. Open cut Resources

The occurrence of coal seams within A287 and A342 is dictated by site specific topography (see **Figure 11**). Beneath the escarpment areas, generally all coal seams exist within the sequence. However, in the lower lying valley areas, many of the upper seams have been eroded leaving predominantly the lower lying seams, namely the Ulan and Coggan Seams. These two seams are therefore the primary target seams within the proposed open cut operations, although both the Glen Davis and Goulburn Seams occur in small quantities within the planned open cut footprints.

The Coggan Seam is up to 4 m thick in open cut areas and allows for effective high productivity open cut mining. The Coggan Seam is the primary target seam for the open cuts with inherently favourable coal quality allowing for portions of the coal to be recovered as run of mine (ROM) product coal.

The Ulan Seam is comprised of thin coal plies, is high in ash content and separated by varying interburden thicknesses. Historic mining studies of the Ulan Seam considered the seam to be uneconomic. However, by assessing alternative working sections in combination with consideration of coal preparation, selective mining horizons have been formulated to effectively extract and process large proportions of the Ulan Seam mined within the open cuts.

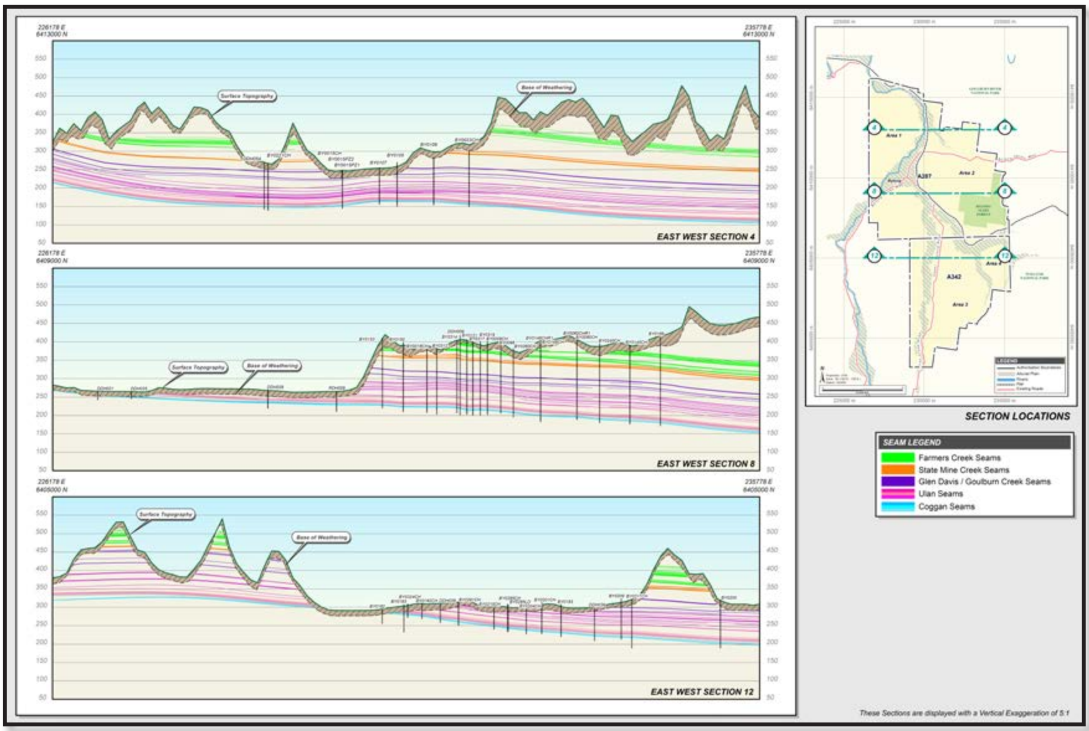



**FIGURE 11: Representative geological sections for A287 & A342 (RPM 2014)**

### 7.2. Open cut mining and schedule

Open cut mining starts at the outset of operations and has a scheduled mine life in the order of 8 years. In view of the sequential mine development of open cut followed by underground mining, with the underground mine the mainstay of the operation, the target production profile has been based on the anticipated capacity of the underground mine. The corresponding coal handling and preparation plant (CHPP) capacity is approximately 6 million tonnes per annum (MTPA) with the option of bypassing the washing process depending on coal quality. Production, equipment selection and scheduling for the open cut has therefore been based on the subsequent underground and related infrastructure capacities.

Overarching open cut design principles included: compliance with statutory requirements; minimising environmental impacts; maximising return on investment for the overall Project; optimising coal resource recovery within current constraints while minimising the sterilisation of future potential coal resources; applying conventional, efficient and cost effective mining methods; targeted selective mining of the multi-seam deposit to deliver lower cost by-pass ROM coal product where possible and a simplified marketing strategy with limited thermal coal products. Generically, coal plies considered economic for mining have *in-situ* ash contents of less than 50% and thickness greater than 0.25 m. Coal plies are not generally aggregated into a mining horizon with parting thicknesses greater than 0.30 m.

Practical open cut mining rate is determined by available in pit working room for the equipment fleet, i.e. size and number of equipment that are selected versus the space available within the mine. Working room was established using scheduling block layback to replicate the working face for open cut operations. Scheduling block layback at any point in time is the angle measured between the pit floor and a line drawn from the excavation toe on pit floor to the excavation crest on topography. Pit width and depth determine the overall working room that is available at any point in the sequence for a given excavation face layback. Deeper and wider pits provide the opportunity to increase layback angle while maintaining total working room area. Therefore specific resource conditions at Bylong, i.e. depth of seam and shape of open cut pit directly influence the rate at which coal can be mined at Bylong. Typically, the maximum rate of mining within the proposed open cuts matches the proposed underground production rate.

The Western Mining Area (WMA) is a small open cut with overall dimensions of approximately 1,600 m x 700 m. With an operating face layback of 16°, an annual waste removal rate of 4.5 million bank cubic metres (MBCM) can be practically achieved that will result in a coal uncovered rate of about 1 MTPA ROM coal. This is considered the highest practical rate of mining that can be achieved from this open cut. It will take approximately 6 years with mining rate ramp up associated with box-cut development to mine the 22 MBCM of waste and 6.8 Mt of ROM coal in this mining area.

The Eastern Mining Area (EMA) has a larger footprint with a length north to south of approximately 3,500 m, a width ranging from 500 m to 2,000 m containing approximately 133 MBCM of waste and 26 Mt of ROM coal. With an operating face layback of 22°, this pit can be operated with an annual waste removal rate of up to 30 MBCM.

A number of development sequence strategies within the two nominated open cut mining limits have been assessed supporting a practical mining rate of 5 to 6 MTPA ROM coal. Concurrent EMA and WMA development is preferred as shallow low cost coal can be developed early in the schedule and mining rate ramped up to the maximum practical coal processing rate of approximately 6 MTPA ROM coal. This mining rate results in an open cut mine life of 7-8 years to mine approximately 33 Mt of ROM coal. This is preferable from an economic perspective, compared to a longer open cut mine life and lower mining rate.

The deposit characteristics of the EMA dictate a preferred mining sequence commencing with a box-cut development in the low Strip Ratio northern end of the open cut with final pit development advancing in a north to south direction progressively moving into the higher Strip Ratio areas.

The deposit characteristics of the WMA dictate a preferred mining sequence commencing with a box-cut development in the low Strip Ratio northern end of the pit. The layback in the advancing face is established on east-west oriented benches that then advance to the higher Strip Ratio southern blocks of the pit.

The coal quality of both the Ulan and Coggan Seams is such that inherent ash contents do not always facilitate a ROM coal product suitable for the envisaged export market. For the most part there is a necessity for coal processing to target specific ash contents suitable for the export market. Coal processing will give rise to a range of products delivered to specific yields. Corresponding marketing studies have been undertaken so as to select the most economically viable product based on available coal markets and price premiums versus product tonnes realised. A 16% ash product has been selected as the most optimum product for the Coggan Seam being mined. Approximately half of the open cut Coggan Seam ROM coal will require processing whereas the reminder is considered as suitable by-pass product. The Ulan Seam is of inferior quality as compared to the Coggan Seam. A 22% ash product has been selected as the most optimum product for the Ulan Seam being mined. The majority of the Ulan Seam will require processing to meet the required specifications of an export market, or domestic market if applicable.

### 7.3. Overburden Emplacement Areas

The three forms of overburden emplacement options considered for the Project include the following (**Parsons Brinkerhoff, RungePincockMinarco, QCC (PB, RPM, QCC) 2014**):

1.) In-pit emplacement - overburden waste is placed back within the mining void and includes all waste placed in the void up to the natural surface level. A major objective of mine design is to maximise in-pit emplacement, thereby minimising external emplacement requirements for environmental reasons, i.e. reduced noise and dust implications thus reducing Zone of Affectation (ZOA). In-pit emplacement also reduces truck haul distances, truck numbers and therefore mining costs and associated impacts. It also assists in returning the land surface near to its original state.

2.) Ex-pit emplacement - ex-pit emplacements result from placement of waste on the natural surface, usually in close proximity to the mining voids created. This type of emplacement is typically a more expensive option and has a higher degree of negative environmental footprint as compared to in-pit emplacement.

3.) On-pit emplacement - occurs on top of the in-pit emplacement. Any additional surcharge above original natural surface level is defined as on-pit emplacement. This occurs within the bounds of the open cut excavation. Generally, on-pit emplacement would be closer to the mine than ex-pit emplacement, resulting in lower haulage cost. On-pit has positive implications for rehabilitation and final land use. Increasing the use of on-pit emplacement will decrease the amount of land that is disturbed by mining. The extent of on-pit emplacement is limited by the final allowable height to which waste material may be placed. This is governed by technical inputs such as geotechnical parameters of the waste material, i.e. slope stability parameters, or environmental inputs such as visual amenity of the final landforms.

In open cut mining the optimisation of overburden waste transport distances to emplacement areas is a key driver of project value. Practicality and indicative costs associated with developing waste emplacements associated with each mining sequence has been assessed. Simplistically, short haul distances and in-pit emplacement is preferred to reduce overall disturbance footprint and cost. The Project is highly constrained in terms of available space for emplacement areas and considerable effort and design has been employed to reduce environmental impacts on BSAL and relevant alluvial systems. Ex-pit emplacements have targeted natural topography so as to limit change in visual amenity of the existing landscape but in addition natural topography provides an advantage of natural screening to major public vantage points.

The disposal of waste from open cut mining will require various combinations of ex-pit, in-pit and on-pit emplacement. The need for ex-pit emplacement is required due to the initial box-cut development of both the WMA and EMA. The initial years of open cut mining requires two ex-pit OEAs, namely the North West OEA (NWOEA) and the South West OEA (SWOEA) (see **Figure 10**). When sufficient in-pit volume is available the adopted strategy is for in-pit and on-pit emplacement. Due to the numerous constraints observed for open cut mining operations waste emplacement, space is therefore at a premium. The considerations for selecting waste emplacement location and strategy include:

- surface emplacement constraints associated with environmental requirements
- topographical constraints associated with narrow valleys and steep topography
- surface emplacement constraints associated with infrastructure placement
- surface emplacement constraints along the rivers and creeks and alluvial plains
- reject tonnages from the CHPP to be accommodated in the waste emplacements
- surface emplacement constraints associated with public visibility and interaction
- non sterilisation of future coal resources
- desire to minimise haulage distance and elevation
- requirement to dispose waste effectively in view of swell factors arising from the disturbance of ground during the mining process
- meeting approval benchmarks of final rehabilitated landform slopes not exceeding 10˚.

Once the final OEA design had been achieved through balanced assessment of all available inputs, site validation mapping of BSAL was identified as a potential conflict. An iterative study was then undertaken to assess modified localities of the proposed OEA positions, i.e. shifting localities further away from the designated open cut mining areas outside of mapped BSAL or raising the elevations of the proposed OEAs so as to reduce overall footprints further.

The overall locality of ex-pit OEAs within the Project area is heavily dictated by the prominent escarpments bounding the valley. These natural barriers dictate areas within which overburden material is to be placed. As the proposed open cut mining areas are within the south of A287 and largely located within A342, repositioning any additional overburden areas, other than those already proposed, outside mapped BSAL footprints would require overburden to be hauled excessive distances north in the vicinity of the Bylong village and Bylong Valley Way within A287, or south to the south-western portions of A347. The latter option was explored whereby OEA designs were considered for the entire length of the escarpment edge, along the western boundary of A342. In addition to increased truck paths and increased mine operating costs, an environmental liability was realised as natural drainage from these relevant escarpments would be impeded and difficult to divert for perpetuity. Avenues of alternate OEA locations were explored without viable alternatives. The small quantities of BSAL to be impacted by the proposed design will be minimised further through the recovery of soil resources from the BSAL and use of these resources within rehabilitation activities.

The final elevation of proposed OEAs was engineered whereby the volume of emplacement was maximised through height increase, thereby limiting lateral disturbance footprints (NOTE: a conflict in design develops with increased height as visual impacts enter the design fray). The narrow and irregular shape of the WMA and EMA is a major factor in the resultant geometry and overall height achieved for the on-pit emplacement areas. In order to satisfy requirements of final slopes being less than 10°, the maximum height of relevant OEAs is constrained by geometry. This then dictates additional waste volume to be sourced via ex-pit emplacement areas.

In terms of the north western and south western OEAs, the highly constrained available emplacement areas currently positioned alongside escarpments are designed at maximum acceptable slope geometries. There is limited potential to increased current OEA heights further to offset other potential environmental conflicts.

External geotechnical specialists Pells Sullivan Meynink (PSM) were engaged to provide initial site specific guidelines and input into OEA design. In general, operational (i.e. temporary) waste dumps will likely be formed at the rill angle of the waste materials, anticipated to be between 35° to 37°. The resultant Factors of Safety being above a mine design accepted 1.2. In light of long-term final landforms, "it is understood that environmental constraints restrict the final in-pit dump faces to 16° and the ex-pit faces to 10°, therefore final dump stability is not considered to be a major issue" (**PSM 2014**).

Scheduling and timing of ex-pit OEA use is dictated by proximity to the planned open cut mining operations. As such, the NWOEA is the logical starting point for overburden emplacement as the locality is closest to initial mining operations. Subsequent to the completion of the NWOEA there is a progression to the SWOEA. Here, truck paths and haulage distances are minimised at all times.

Once the final OEA designs had been established and subjected to EIS noise and dust modelling the selected OEA schedule and operations delivered potential noise impacts on the Bylong village during adverse weather conditions. As such, several iterations of haulage schedules and truck paths were undertaken to deliver an optimal scenario so as to minimise and limit noise impacts on the Bylong village and surrounds. During adverse weather conditions, operations conducted on the NWOEA were observed to have adverse noise impacts on the Bylong village. Overburden haulage schedules were therefore iteratively modified in close consultation with noise specialists to deliver and acceptable OEA plan. During adverse weather conditions, overburden materials are generally redirected to the SWOEA therefore increasing the distance of operations from the Bylong village and reducing noise impacts. (Night adverse conditions provide for greatest potential of impact, however at a reduced operational rate some level of activity is considered acceptable on the NWOEA during adverse day time conditions). This delivered a necessity for an additional haul truck due to the increased haul distances, resulting in an additional capital and operating cost expenses to the Project. In addition to these operational modifications, consideration was given to full sound attenuation on all relevant equipment and infrastructure so as to collectively reduce noise impacts on the Bylong village. This resulted in additional capital expense to the Project.

### 7.4 Final voids and rehabilitation

No final open cut voids have been contemplated as part of the Project final landform design. All open cut voids are backfilled with suitable waste overburden or coal reject materials. Reject material will be capped with a suitable thickness of inert overburden waste. This requirement was deliberated and agreed between various stakeholders during early Project development discussions and is consistent with current best practice NSW state environmental approval expectations for open cut coal mining operations.

Progressive rehabilitation will be an integral part of mine operations. OEAs are planned, and are to be managed and controlled to achieve close to the final landform during initial placement, therefore minimising rehandle of waste along the outer, final slopes. Rehabilitation will occur as soon as mine related areas are completed or no longer required for ensuing mine life. The general sequence of OEA rehabilitation will be as follows:

- removal of topsoil from areas to be disturbed
- placement of waste in OEA
- shape surface to design levels including the installation of drainage controls
- placement of topsoil on shaped OEA
- revegetation of the OEA with appropriate seeding and planting
- maintenance, monitoring and management of completed OEA

The final landform at the completion of the Project will consist generally of rehabilitated in-pit and ex-pit OEAs to a height of up to approximately 50 m above the original natural surface. The final rehabilitated landform slopes will generally be less than 10°.

## 8.0 PROJECT UNDERGROUND MINING

In general, open cut mining methods are considered a safer, lower operating cost and simpler form of mining as compared to underground methods. However, as the depth of target seam increases, there becomes a transition point whereby underground mining methods begin to take preference over open cut mining methods. The main drivers in a transition to underground mining methods are based on two main components. Firstly, as the target seam depth increases there is a resultant increase in Stripping Ratio, i.e. waste removed relative to the coal extracted. With deep open cut mines the cost of waste removal, coal processing and handling eventually exceeds the revenue attributed to the extracted coal, resulting in open cut mining methods being cost neutral. Additionally, in order to extract coal seams at greater depths via open cut methods much greater disturbance footprints result with knock-on environmental impacts. Therefore, depending on site specifics, there is a logical and natural transition to underground mining realising improved economics and reduced environmental impacts attributed to large and deep open cut mining operations. Conversely, in shallow seam environments technical limitations, safety aspects and economics generally rule in favour of open cut mining over underground mining.

### 8.1 Underground constraints analysis

Over and above constraints associated with open cut mining, a fundamental aspect of underground mine planning is the impacts associated with surface subsidence. As a starting point in underground mine planning, external subsidence specialists Mine Subsidence Engineering Consultants (MSEC) were engaged to review the Project and formulate a constraints plan taking into account site specific elements in association with current industry and approval requirements. Here, preliminary subsidence profiles were generated for a range of mine plan layouts and potential impacts compared with similar mines, past and present, to understand potential approval risk. The output of the constraints study in combination with resource characteristics, i.e. coal quality, was then utilised to rank and prioritise specific areas and select appropriate underground mine plans.

The preliminary MSEC study identified four main areas (Area 1, 2, 3 and 4) conducive to underground longwall mining (see **Figure 12**). Specific areas of A287 and A342 were highlighted by likely planning approval conditions including: minimal constraints, manageable constraints, possible restrictions on mining and almost certain restrictions on mining (**MSEC 2012**). Of particular importance, a notable subsidence constraint specific to the Project is that of characteristic cliffs and escarpment type feature common to the authorisations and surrounding area. From a mine planning perspective, the perceived “significance” of cliffs is of importance. As a starting point, any “visible” and immediately accessible cliffs from public vantage points were considered as almost certain constraints on mining. Appropriate mine layouts and designs were correspondingly adopted to take account for particular cliff lines. Relevant mine design aspects included offsetting proposed longwall panels from identified risk areas or designing stable first working development roadways beneath such areas.

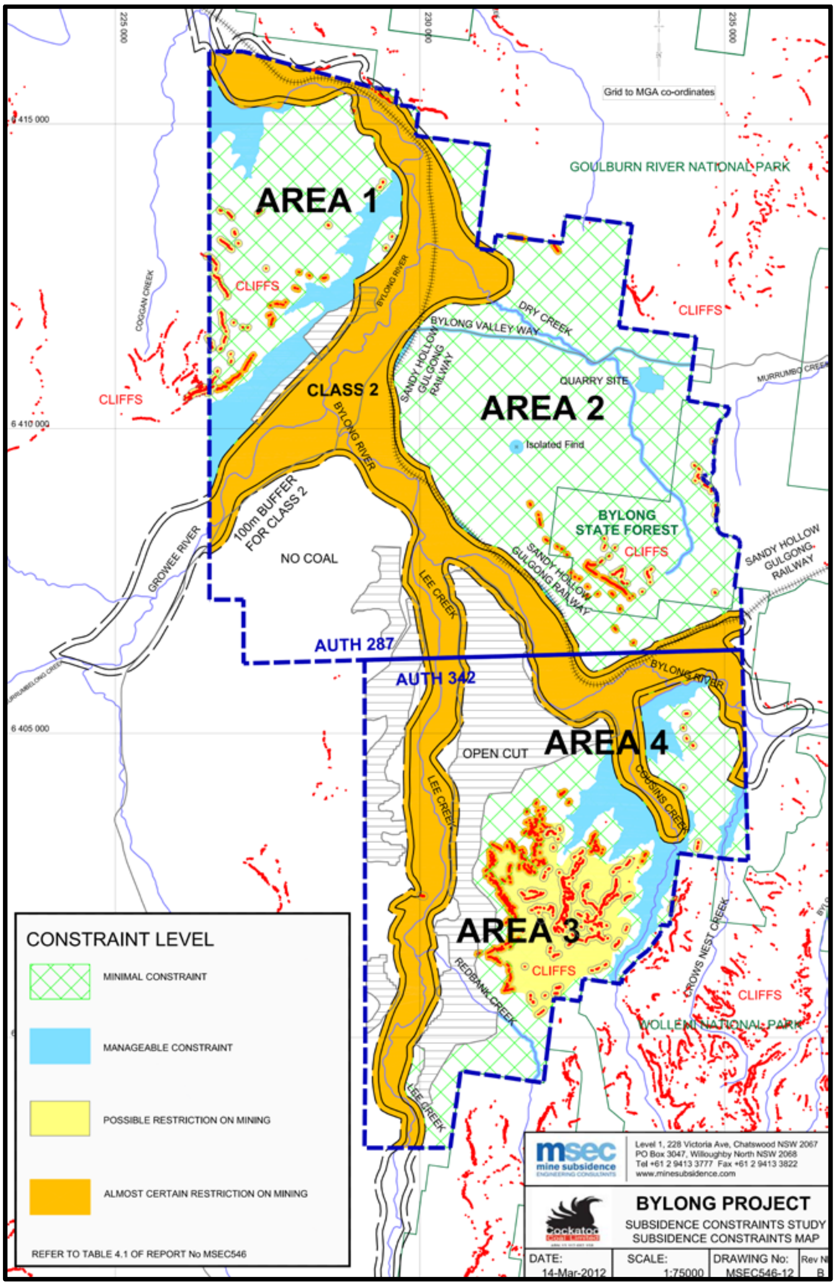



**FIGURE 12: Bylong subsidence constraints study map (MSEC 2012)**

Once areas of the Project had been identified as suitable for underground mining from an environmental constraints perspective, iterative mine layout dimension analyses were undertaken to interpret likely subsidence impacts. Here different void dimensions were modelled within Project specific conditions to predict likely impacts associated with a particular mine layout. As longwall mining delivers the greatest extraction and highest productivity, the mining method formed the basis for commencing subsequent iterative studies. Had resultant findings indicated adverse impacts attributed to longwall mining methods, i.e. adverse subsidence impacts, then alternative bord and pillar mining methods would have been studied.

In general, optimal and economically efficient longwall mines exhibit wider and longer panel dimensions to offset the development costs attributed to this method. Iterative subsidence studies were conducted for a range of longwall dimensions so as to determine the reference point for which mine design and layout arrangement could be underpinned.

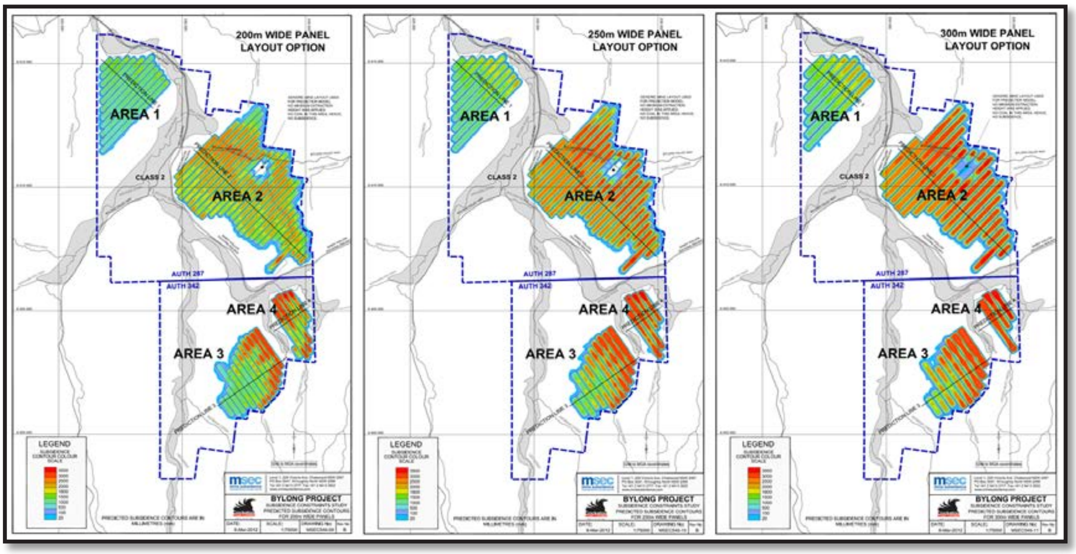



**FIGURE 13: Precursor mine planning predicted subsidence for different conceptual longwall dimensions (MSEC 2012)**

Of the potential four underground areas assessed for longwall suitability, initial studies indicated that Area 3 (see **Figure 12**) presented with the greatest potential constraints from an environmental perspective due to the cliffs attributed to Tal Tal Mountain in the south of A342. Modified mine layouts, i.e. reduced longwall panel widths, are a potential control when considering mining within Area 3. On the other hand, Areas 1, 2 and 4 were identified as suitable for longwall mining depending on suitability from a resource perspective. Area 2 presented as the most suitable area when considering a proposed longwall operation and therefore provided a platform to commence further underground mining studies.

General findings of initial subsidence studies indicated (**MSEC 2012**):

- Subsidence reaches a maximum limit with increasing panel width in valley floors
- Subsidence increases with increasing panel width along ridgelines

### 8.2 Underground resource prioritisation

Underground mining requires relatively thick coal seams for practical operation, as thin coal seams become practically impossible to access and mine based on current day mining techniques. In general, the majority of the coal seams present within the Project are thin in nature negating the use of underground mining methods. The Ulan Seam has been ruled out as an underground option due to the seam's thin and highly bedded nature with no suitable and practical mining horizon having been identified at this stage. At the time of this report, the Coggan Seam is identified as the only practical and economically viable option for underground mining within the Project's authorisations.

Having characterised suitable areas for longwall mining through preliminary constraints analysis, selection and prioritisation of underground mining areas was then based on maximising resource extraction and recovery as well as targeting higher ranked areas in terms of profit margin and coal quality. Prioritisation included assessing Areas 1, 2, 3 and 4 (see **Figure 14**).

Due to the high capital investment required for the establishment of longwall mines, large areas of resource are generally required whereby longwall mining can be maintained for many years so as to satisfy the required payback period. As longwall mining is an inflexible method and longwall equipment is designed and built specific to certain resource characteristics, it is important that identified areas of resource not only maintain longevity for payback of capital invested but satisfy longwall design particular to specific resource characteristics. In terms of the main defining resource characteristics, namely seam thickness and coal quality (see **Figure 6** and **Figure 7**), Areas 2, 3 and 4 exhibit thick Coggan Seam environments with reasonable coal qualities. In light of subsidence constraints identified for Area 3, naturally Area 2 presents as a logical and significant area of resource for proposed longwall mining. High level margin ranking analysis, undertaken as part of the Options Study, indicate that Area 2 is for the most part the most economically and practically viable locality of the Project from a longwall perspective (see **Figure 14**).

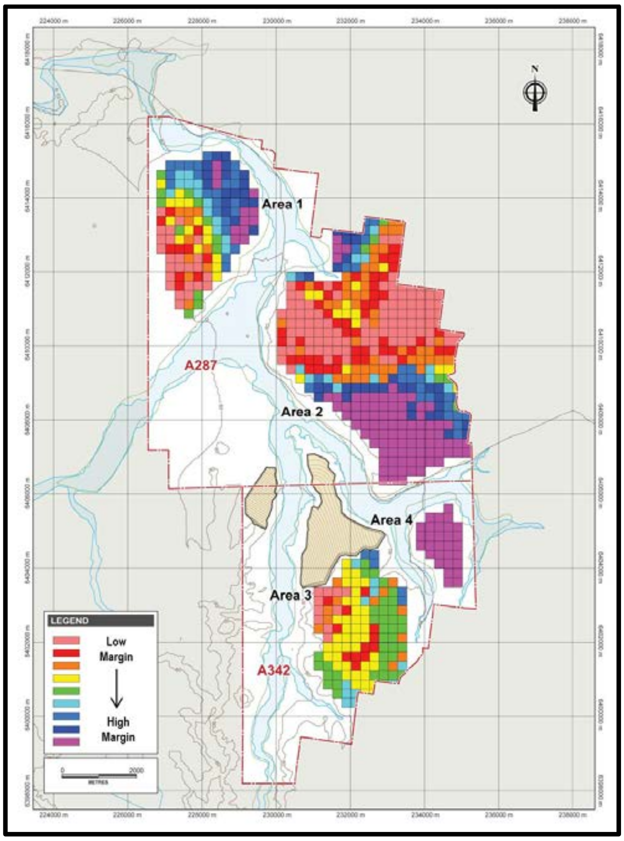



**FIGURE 14: Indicative margin ranking from Options Study (Parsons Brinkerhoff, RungePincockMinarco, QCC (PB, RPM, QCC) 2013)**

### 8.3 Underground mine design

Having identified Area 2 as the primary location for a potential longwall mine the most optimal mine layout was then selected from a resource recovery and productivity perspective. The main aspects used in selection of the final underground mine layout included consideration of the following:

- Authorisation boundary – the irregular nature of the relevant authorisation boundary complicates the maximising of resource recovery when implementing rectangular longwall panel's oblique to the boundary. Iterative panel width studies have been undertaken whereby the selected panel widths assist in achieving the highest resource recovery ratios adjoining the irregular shaped authorisation boundary.

- Cliffs – numerous cliffs exist within A287 and A342 as well as extensively beyond the authorisation boundaries. The perceived significance of relevant cliffs has been utilised as a factor in deciding whether or not to influence the overall underground mine plan. The perceived significance of cliffs is difficult to quantify at the outset of a project and will vary over the life of the project. Significance will vary depending on information gathered over the life of the project and EIS studies. The construed site specific database of cliff parameters will ultimately govern the resultant perceived significance. During formulation of the proposed Project underground mine plan, visible cliffs from Bylong village, Bylong Valley Way and Upper Bylong Road were referenced as significant and a starting point for mine design. The longwall mine plan has been offset at an angle of draw of 35˚ from these visible cliffs. Specific visible cliffs and any other cliff have subsequently been reviewed as part of the EIS process to quantify actual significance. Here further mine plan changes or appropriate management measures are to be recommended and implemented.

- Alluvials – longwall panels have been designed and sufficiently offset so as to limit potential subsidence impacts within the suggested 40 m offset of the Bylong River system, as outlined in the NSW Stream/Aquifer guidelines. Indicative angles of draw of 26.5˚ were utilised as initial mine planning offset parameters. Modelled predicted subsidence boundaries are confirmed as part of the EIS studies and any necessary mine plan changes are implemented so as to limit the impact on the adjoining Bylong River alluvials.

- Maximising resource tonnes – where possible the selected mine plan was set out so as to maximise the available resource therefore satisfying CPDP requirements. This process is complicated by the inherent fixed nature of longwall mine layouts versus the irregular shape of incumbent resource boundary specific to the Project inputs. As part of the Feasibility Study specialist consultants RPM undertook mine layout optimisation studies to select the most efficient mine plan layout within the identified mining area. These studies included assessment of maximising resource recovery, maximising productivity, reducing longwall to development ratios, minimising cost, controlling risk and meeting environmental requirements. Findings suggested longwall panel widths of 304 m in the southern portion of the longwall layout and 344 m in northern portion of the longwall layout best satisfied the salient abovementioned points.

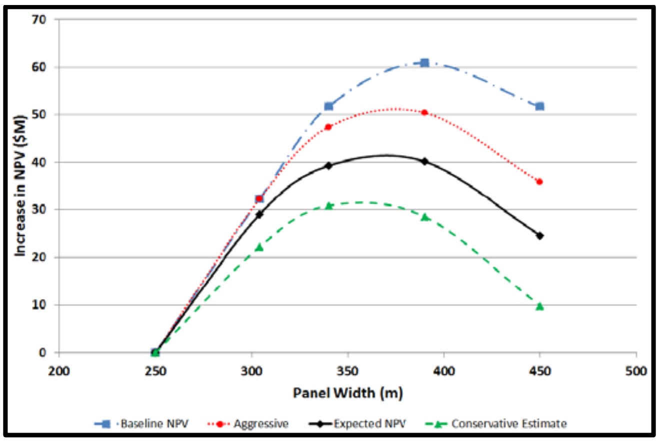



**FIGURE 15: Risk weighted economics used in selecting longwall panel width (McMillan 2014)**

- Coal quality – the longwall mine layout and associated schedule were developed so as to extract the higher quality coal early in the mine life optimising the Project economics. Area 2 is split into two distinct coal quality zones. The southern portion of Area 2 exhibiting the best quality and thickest coal seam available for extraction.

- Underground access requirements and locality relative to surface infrastructure – access to underground areas via drifts is a capital intensive aspect of longwall mining. Consideration has been given to the most effective location to access the seam in relation to the locality of the best quality coal, the resultant mine plan, depth of cover and position relative to the surface infrastructure. Preferred underground access is located at the base of the escarpment in the south west of Area 2. This area corresponds to a lower depth of cover as well as a favourable coal quality starting point for mining.

  Ventilation studies suggest one single ventilation shaft is required for life of mine. In line with mine access, the locality of the ventilation shaft takes advantage of topography relative to the mine plan to ensure limiting depth requirements of the shaft along with reduced overall underground mine surface infrastructure footprint.

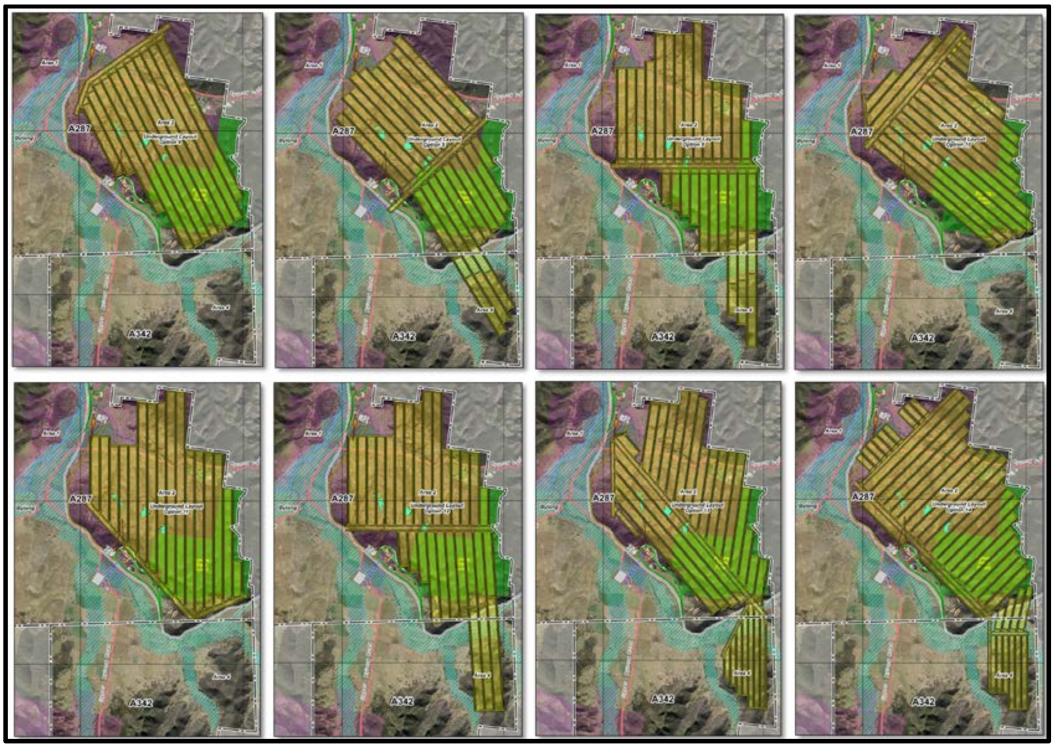



**FIGURE 16: Examples of underground mine layouts considered in Options Study (PB, RPM, QCC 2013)**

A number of preferred underground mine layouts have been considered for Area 2 as part of the mining studies to date (see **Figure 16**). The selected longwall layout utilises a simplified mine plan consisting of one set of main headings with associated gateroads and longwall panels set out perpendicular to the main headings. Due to the nature of the coal quality, the mine layout has been divided into two sections consisting of a series of northern longwalls and a series of southern longwalls. In terms of schedule, the southern longwalls are to be extracted first to take advantage of superior coal quality; with the remaining northern longwall panels extracted after the completion of the southern panels (see **Figure 17**).

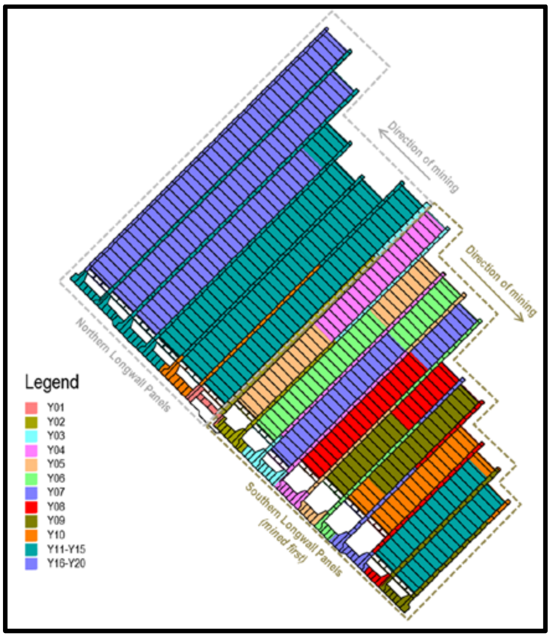



**FIGURE 17: Proposed underground mine plan and schedule (period is underground specific)**

Underground access is via two decline drifts, i.e. one coal clearance drift and one person and materials drift. These drifts have been positioned relative to surface infrastructure as well as the start of the southern longwall panels. The start of drifts on surface has been located at the base of the escarpment so as to take advantage of the shallowest depth to the Coggan Seam (see **Figure 18**). This limits the expense and complexity of constructing such drifts.

In terms of underground mine ventilation, the two decline drifts will be utilised as conventional air intakes to the mine. In order to facilitate a ventilation system and provide for mine return, i.e. exhaust air, an upcast shaft is required with accompanying ventilation fans fitted at surface. As with the decline drifts, strategic positioning of the ventilation shaft on the lower side of the escarpment has facilitated for ease of construction, reduced cost and limiting extent of the overall mine infrastructure footprint.

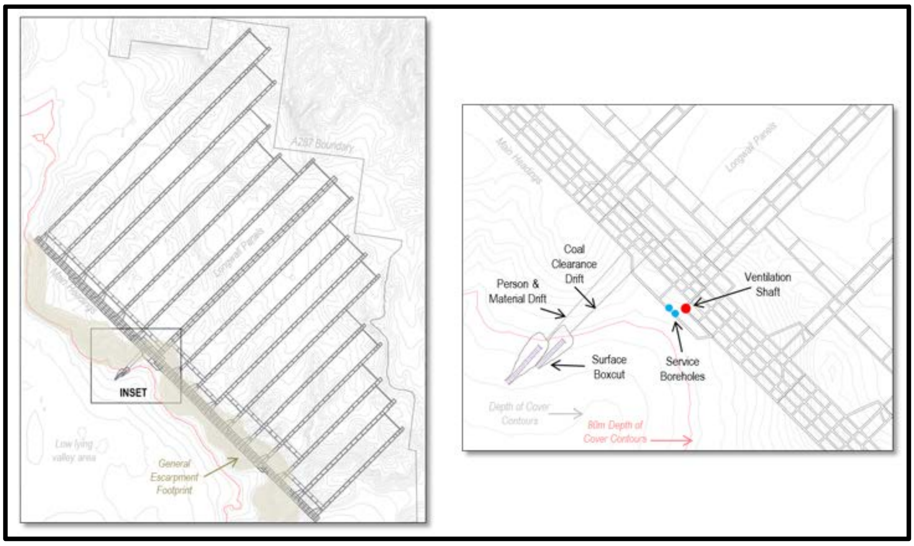



**FIGURE 18: Boxcut, drift, service boreholes and ventilation shaft relative to escarpment**

The underground operation is to utilise conventional longwall equipment including shearer for cutting coal, accompanying hydraulic roof supports and associated coal clearance systems. In line with the proposed production profile, the longwall operation will generally require two supporting continuous miner units for development of the mine. Due to the initial increased development pressures associated with the commencement of a longwall mine, three continuous miner units will be required in the initial years of underground operations.

The resource characteristics present within the selected underground mining area are amenable to a high capacity longwall operation. These favourable conditions include: low seam gas environment, relatively shallow depth of cover and favourable seam roof and floor conditions. From an Australian benchmarking perspective, the postulated production profile is realistic in terms of a new mining operation with favourable mining conditions (see **Figure 19**). The average forecast ROM coal production for the longwall operation is approximately 5.3 MTPA.

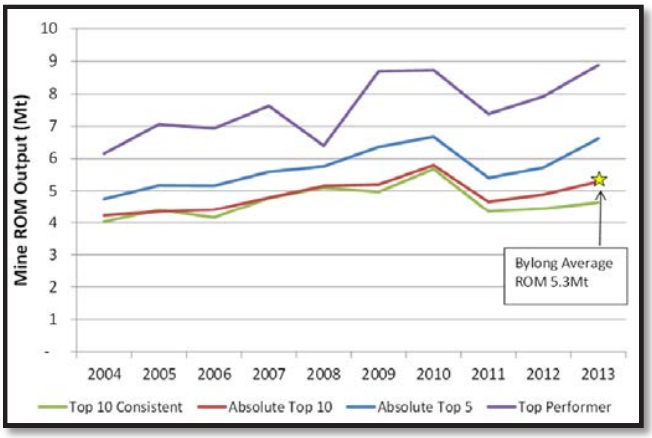



**FIGURE 19: Australian longwall benchmark performance (PB, RPM, QCC 2014)**

The coal quality of the Coggan Seam within the underground mine is such that inherent ash contents do not facilitate a ROM coal product suitable for the envisaged export market. There is a necessity for coal processing so as to target specific ash contents suitable for the export market. Coal processing will give rise to a range of products delivered to specific yields. Corresponding marketing studies have been undertaken so as to select the most economically viable product based on available coal markets and price premiums versus product tonnes realised. A 16% ash product has been selected as the most optimum product from the underground operations. Average yields of approximately 67% can be expected with maximum yields greater than 80% expected in the southern longwall panels.

## 9.0 PROJECT RESERVE ESTIMATE

RPM was commissioned to independently evaluate the selected mining operation from a JORC Reserve perspective. The conversion from reported JORC Resources to JORC Reserves has taken into account summation of available coal within the proposed mine plan including modifying factor assumptions (examples of modifying factors include coal loss and dilution during mining and influences associated with geological structure etc). A summary of the JORC Reserves for the Project are summarised shown in **Table 2** and **Table 3**.

| | | Proved | | | | | | Probable | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Seam | ROM Coal (Mt) | Ash (%ad) | Specific Energy (MJ/kg gar) | Fixed Carbon (% ad) | Volatile Matter (%ad) | Total Sulphur (%ad) | ROM Coal (Mt) | Ash (%ad) | Specific Energy (MJ/kg gar) | Fixed Carbon (% ad) | Volatile Matter (% ad) | Total Sulphur (% ad) |
| OC | Glen Davis | 0.1 | 47 | 16.8 | 24 | 18 | 0.3 | 1.3 | 39 | 16.8 | 30 | 22 | 0.3 |
| | Ulan | 13.1 | 37 | 16.0 | 33 | 21 | 0.3 | 1.1 | 40 | 21.2 | 30 | 20 | 0.3 |
| | Coggan | 16.8 | 17 | 23.0 | 45 | 28 | 0.4 | 0.1 | 19 | 23.0 | 44 | 27 | 0.5 |
| | Subtotal | 30.2 | 26 | 19.8 | 40 | 25 | 0.4 | 2.5 | 39 | 19.0 | 30 | 21 | 0.3 |
| UG (Area 2) | Coggan | 62.2 | 27 | 22.6 | 43 | 26 | 0.4 | 24.7 | 27 | 22.5 | 43 | 26 | 0.4 |
| Combined OC & UG | TOTAL | **92.4** | **26.7** | **21.7** | **42** | **26** | **0.4** | **27.2** | **28** | **22.2** | **42** | **25** | **0.4** |

**TABLE 2: Project coal reserves (RPM 2014)**

| | | Proved | | | Probable | | |
|---|---|---|---|---|---|---|---|
| Mining Method | Seam | Product Coal (Mt) | Ash (% ad) | Specific Energy (kcal/kg gar) | Product Coal (Mt) | Ash (% ad) | Specific Energy (kcal/kg gar) |
| OC | Glen Davis | 0.1 | 22.0 | 22.4 | 0.8 | 22.0 | 22.4 |
| | Ulan | 8.1 | 22.0 | 22.4 | 0.7 | 22.0 | 22.4 |
| | Coggan | 16.0 | 16.0 | 23.9 | 0.1 | 16.0 | 23.9 |
| | Subtotal | 24.1 | 18.0 | 23.4 | 1.6 | 21.6 | 22.5 |
| UG Area 2 | Coggan | 40.5 | 15.7 | 24.6 | 15.4 | 15.8 | 24.6 |
| Combined OC & UG | TOTAL | **64.6** | **16.6** | **24.2** | **17.0** | **16.3** | **24.4** |

**TABLE 3: Project marketable coal reserves (RPM 2014)**

In terms of reconciliation between Project coal resources versus coal reserves within the Authorisation's, there is approximately 141.8 Mt of total measured open cut coal resource and 151.9 Mt of total measured underground resource available for extraction by the selected mining method. Through layers of constraints analysis and implemented concessions adopted by KEPCO, resultant mutual considerations between the available resource characteristics, practical mining aspects and environmental impacts deliver the following:

- 32.7 Mt of open cut coal reserves with 25.7 Mt considered as marketable open cut product coal reserves, i.e. 5.0 Mt lost through processing (**RPM 2014**)
- 86.9 Mt of underground coal reserves with 55.9 Mt considered as marketable underground product coal reserves, i.e. 31.0 Mt lost through processing (**RPM 2014**). There is approximately 4.7 Mt of Inferred resource within the proposed underground mine plan as a direct result of borehole spacing. As such, these resources cannot be reported as a reserve, hence yielding small changes in total tonnages when compared to the Project descriptions.

From a resource utilisation perspective approximately one quarter of available coal resource has been converted to reserve in terms of the Project mine plan. In the interest of maximising resource utilisation, every effort has been made to maximise coal extraction from a corporate perspective (Note: this is inherent in any mining project when considering maximising return on investment). However, through responsible mine planning as well as taking into account foreseeable and concessionary constraints, a large proportion of coal resource has been excluded from the mine plan at this stage. The remaining coal resource is still considered available for extraction, subject to future approvals. Future mining will be dependent on empirical learnings, further relevant studies, advances in mining technology coupled with an appropriate economic climate. These considerations provide the facility for increased resource utilisation in the future and therefore ensure further economic benefit is realised from the state's coal into the future.

By and large, the percentage of reserve mined for the Project compared to available resource highlights concessions implemented and adopted by KEPCO throughout the entire Feasibility Study and accompanying EIS process since purchase of A287 and A342 in 2010.

| **Estimate Entity** | **JORC Status** | **Open cut (Mt)** | **Underground (Mt)** | **Total (Mt)** |
|---|---|---|---|---|
| | **Typical available resource within A287 & A342** | | | |
| **JORC Resource Summary** | Measured | 141.8 | 151.8 | 293.6 |
| | Indicated | 148.6 | 170.2 | 318.8 |
| | Inferred | 101.2 | 160.7 | 261.9 |
| | Total | 391.6 | 482.7 | 874.3 |
| | **Typical Project mineable ROM tonnes** | | | |
| **JORC Reserve Summary** | Proved | 30.2 | 62.2 | 92.4 |
| | Probable | 2.5 | 24.7 | 27.2 |
| | Total (Proved & Probable) | 32.7 | 86.9 | 119.6 |
| | | | | |
| **Project Summary** | Project EIS | 32.8 | 91.5* | 124.3 |
| **Note: Project EIS and reserve value differ due to occurrence of minor Inferred Resource in the UG.* | | | | |
| | | | | |
| **Estimate of retired resource in the interest of social and environmental considerations** | | | | |
| **Estimate of mined or retired resource at this stage in study** | | **%** | **%** | **%** |
| Percentage of resource proposed to be mined by mining method | | 8.4 | 19.0 | 14.2 |
| Percentage of resource retired by mining method | | 91.6 | 81.0 | 85.8 |

**TABLE 4: Summary of coal resources, reserves, Project ROM and assessment of resource utilisation**

## 10.0 PROJECT ON-SITE INFRASTRUCTURE PLANNING CONSIDERATIONS

### 10.1 Generic mine infrastructure

The Project requires the typical supporting infrastructure for such a mining operation. The quality of targeted coal warrants coal processing facilities to satisfy conditions for the proposed export market. As a result, the Project requires significant infrastructure in both a Coal Handling and Preparation Plant (CHPP) and rail loop for coal transportation. The rail loop is to connect to the existing Sandy Hollow to Gulgong Railway Line (managed by Australian Rail Track Corporation (ARTC)) which passes through the two authorisations.

Relevant Mine Infrastructure Areas (MIA's), access roads, power lines, dams and haul roads are also required to support the operation. Other smaller ancillary and supporting infrastructure requirements will also be required as part of the operation, for example: sedimentation dams; diversion drains; temporary short term demountable buildings etc.

Specific to the location of the Project is the requirement for a Workforce Accommodation Facility (WAF) which will support construction activities.

As discussed in previous sections, the starting point for infrastructure design has been based on traditional tried and tested mining constraints pertinent to both A287 and A342. Subsequent infrastructure planning has been undertaken as best as possible to adapt to recently (and ongoing) implementation of new Gateway criteria and understanding of such criteria. The main traditional constraints to both mine layout and infrastructure design are (see **Figure 20**):

- Existing regional infrastructure, e.g. Bylong village, Bylong Valley Way and the existing ARTC rail line
- Original Class II agricultural land and more recent BSAL mapping
- Rivers, stream and creeks along with any associated alluvials
- Preliminary flood modelling extents (i.e. Q50, Q100 & Q1000)
- Steep topography (i.e. escarpments and cliffs)
- Sensitive environmental and heritage receptors
- Areas of suitable coal extraction (i.e. to avoid coal sterilisation, infrastructure has been sighted in areas with limited coal extraction potential)

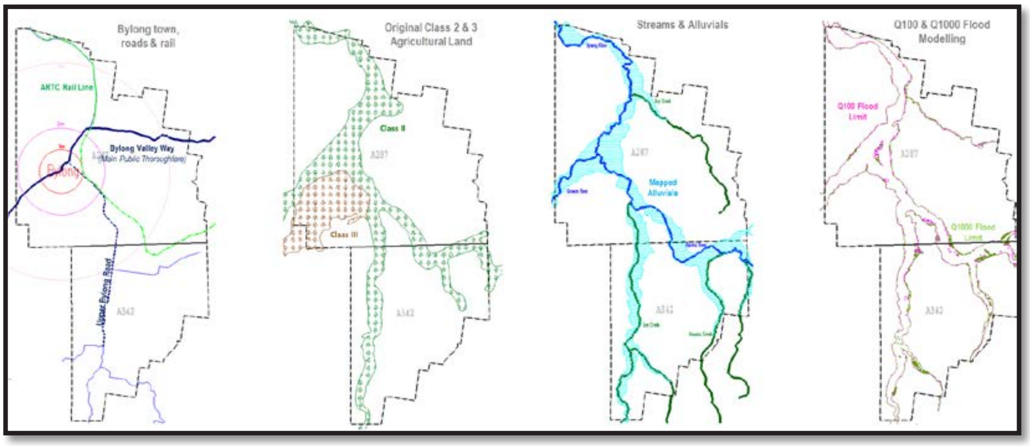



**FIGURE 20: Simplified traditional constraints inputs for infrastructure location determination**

The foundation for major infrastructure site selection, namely the CHPP, has been based on close proximity to both the rail loop location and preferred mining areas, thus minimising disturbance footprints and associated coal clearance distances. A number of alternative rail loop locations have been considered and designed throughout the duration of the Project life (see **Figure 21**). The final infrastructure locations ultimately satisfy both environmental and mining requirements as best as possible. The selected mine plan (i.e. two open cuts and a longwall operation) is centred within both authorisations and as a result the infrastructure associated with servicing the mine and coal processing and clearance would logically be sited within the central portion of both authorisations, as close to the mining operation as possible. Due to the number of Project constraints, the philosophy of minimising the overall disturbance footprint directed design decisions to place the CHPP within the rail loop. For purposes of design justification, the rail loop and CHPP were therefore considered as a single entity in terms of selecting the most appropriate location.

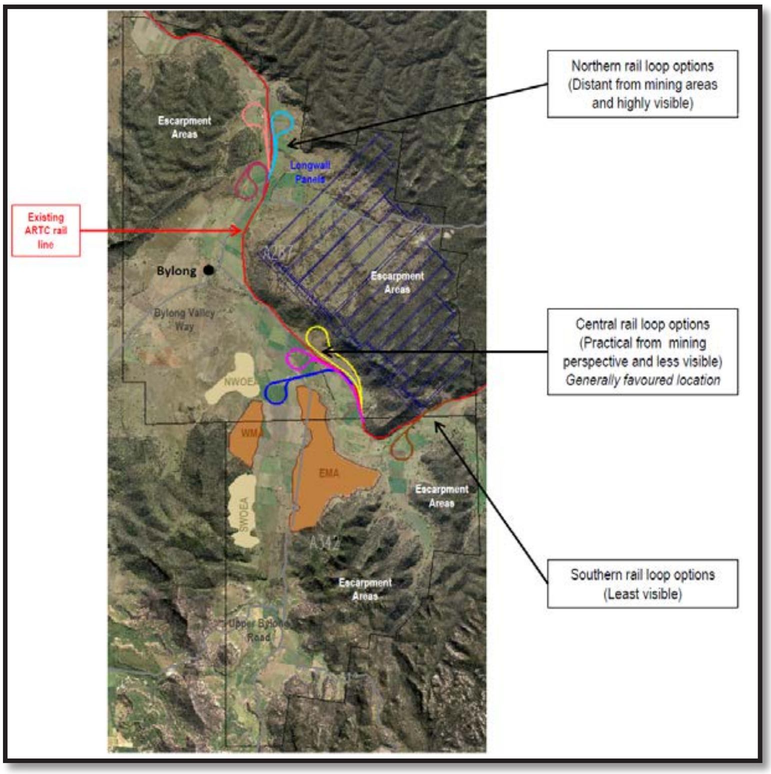



**FIGURE 21: Alternate rail loop options assessed during relevant studies**

The major considerations for selecting the final infrastructure locations were based on the following:

- Topography – the topography within the Project area is constraining in that potential locations for infrastructure, specifically the rail loop, are limited to the flat valley areas. Extensive escarpment features and steep slopes are not conducive to rail construction and therefore exclude a large number of potential infrastructure development areas. As such, there are limited specific locations within the Project that are amenable and appropriate for relevant mine infrastructure development. It is important to note that the existing ARTC rail line takes advantage of the flat ground at the base of steep slopes. Additionally, the ARTC rail line runs along the edge of the Bylong River and associated alluvials and flood boundaries. As such, due to topography constraints, any mine related rail infrastructure sites will invariably cross the Bylong River or associated alluvials and flood boundary. Extensive investigation was undertaken to identify areas that are of suitable topography but outside the Bylong River system.

- Visual – the topography within the Authorisations offers natural screening and provides an advantage in terms of limiting visual aspects of infrastructure if the appropriate location is selected. Northern infrastructure options within A287 are highly visual from both Bylong village and Bylong Valley Way. Specific concerns relate to Gateway considerations of Equine CIC and tourism aspects of Bylong Valley Way. Therefore due consideration has been given to selecting infrastructure as far south within A287 or A342, where possible.

- Noise and dust – as with visual aspects, positioning of infrastructure in terms of noise and dust is considered better suited within the southern portions of the Bylong Valley. Here the naturally occurring steep slopes that bound the valley provide a natural barrier therefore controlling the zone of affectation. Later iterations of mine planning included noise modelling of specific scenarios so as to determine optimal mine operations and infrastructure design. Major modifications undertaken during this process included re-scheduling of overburden emplacement from the NWOEA to the SWOEA during adverse weather conditions. Additionally, selection of suitable sound attenuation on specific equipment and infrastructure has been implemented at significant operating and capital cost to the Project to assist in reducing noise impacts within the Project area.

- Surface water and groundwater – construction of rail facilities and large infrastructure projects tend to favour relatively flat topography. In terms of the Project the valley flats provide suitable locations for such infrastructure. However, placement of rail loop infrastructure within or across the valley flats introduces inherent issues related to constructing large embankments across water courses and associated alluvials and therefore introducing the potential for latent impacts to such water systems. The preferred rail loop location has been engineered and sighted separate to relevant river systems or associated flood plains. The site selected is deemed to have the least and limited direct impact on major surface water systems, specifically the Bylong River (see **Figure 22**). The earth embankment required for the overland conveyor across the Bylong River floodplain was amended as part of the EIS to minimise potential adverse impacts to the natural flood regime.

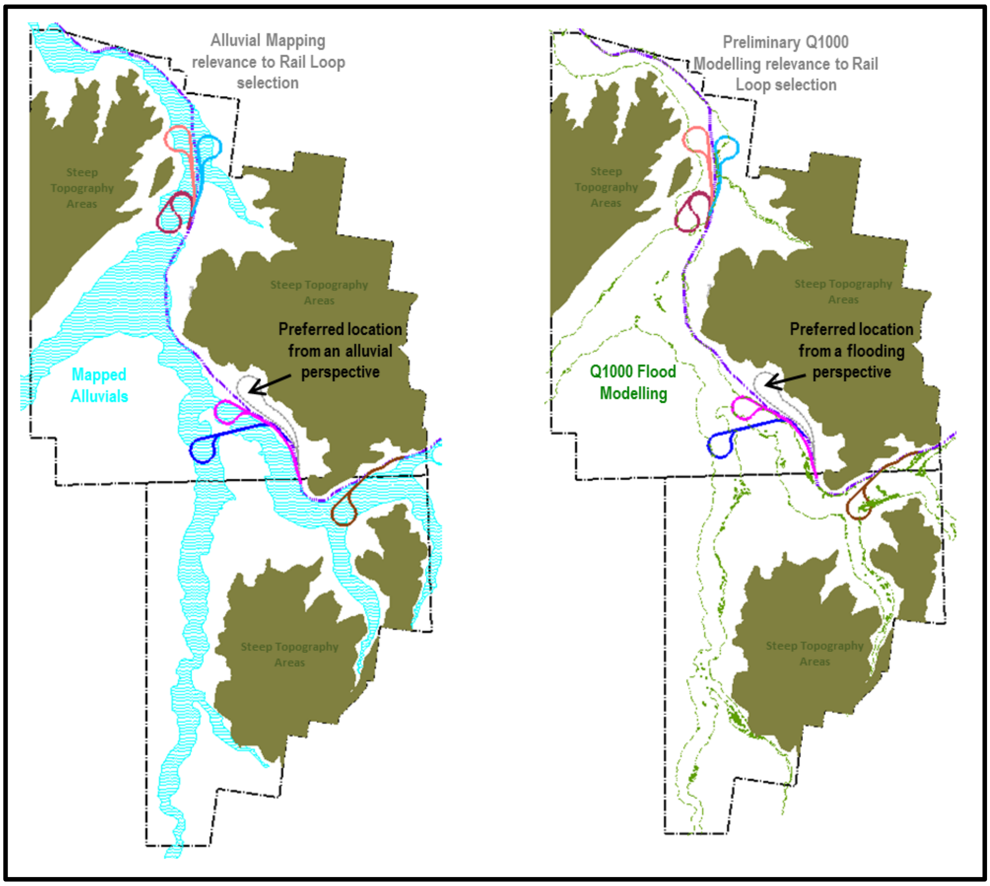



**FIGURE 22: Alternate rail loop options assessed against alluvial and flood extents**

- Agricultural land – consideration of productive agricultural land has been undertaken in terms of infrastructure location selection. In principle, original Class II agricultural land in combination with mapped alluvials provided for the starting point for site selection. Incidentally the selected location of rail loop and CHPP minimises impacts to BSAL.

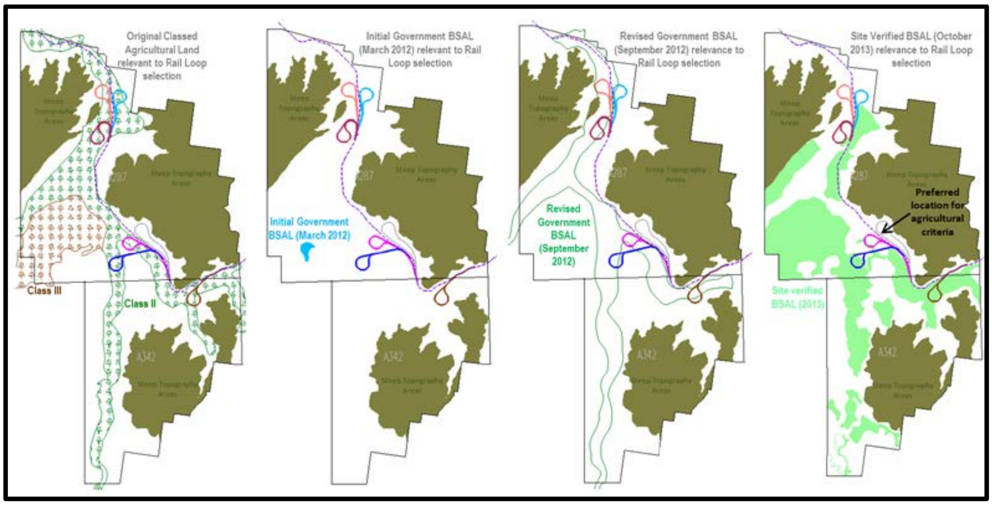



**FIGURE 23: Alternate rail loop options assessed against agricultural lands**

- Visual - the village of Bylong and the main public thoroughfare (i.e. Bylong Valley Way) are located within the northern portion of A287. Logically, infrastructure suits a site south of these areas to minimise visual impacts along with potential noise and dust impacts. Visual impacts are considered most relevant in terms of Equine CIC's and tourism aspects. Initial mine designs as part of the PFS located infrastructure as far south within A342 in an attempt to mitigate these amenity issues. However, the selected site presented with notable surface water impacts on the Bylong River and agricultural land disturbance including site specific faming method issues. The current location within the southern part of A287 provides for a well screened location utilising natural topography but also limits impacts to surface water and priority agricultural lands.

### 10.2 Worker Accommodation Facility (WAF)

The Project locality provides for a unique circumstance in that there is a requirement for a WAF. The MWRC is specific in its requirements for such facilities as outlined in the Development Control Plan (DCP). The salient points relative to siting and design of a WAF as per the DCP requirements are as follows (**Mid-Western Regional Council 2013**):

*If the development relates to a mine, the accommodation must be within 5 km of the relevant mining lease.*

As mentioned, the available real estate within the Project is highly constrained and is prioritised on mining and relevant operations infrastructure. A number of potential WAF locations have been considered within the Project authorisations. Locating the WAF within A342 is limited due to conflicts with proposed mining operations and zone of affectation. Therefore the logical location is within northern parts of A287 as this satisfies the requirement to be within 5 km of the proposed relevant mining lease. The selected location balances the need to limit the impact on Bylong village, be close enough to regional access roads but be positioned so as to limit any adverse visual impacts. The latter may be complimented by way of visual screening methods. Specific design requirements as highlighted by the DCP have been incorporated as part of the detailed Feasibility Study but will be confirmed as part of the requirements delivered in the approval process and implemented during subsequent tender process for WAF construction.

## 11.0 PROJECT MINE PLAN

The Project mine plan includes relatively short-term open cut operations, comprising two open cut voids, followed by a longer-term life of mine underground longwall operation. The preferred project mine plan is shown in **Figure 24**.

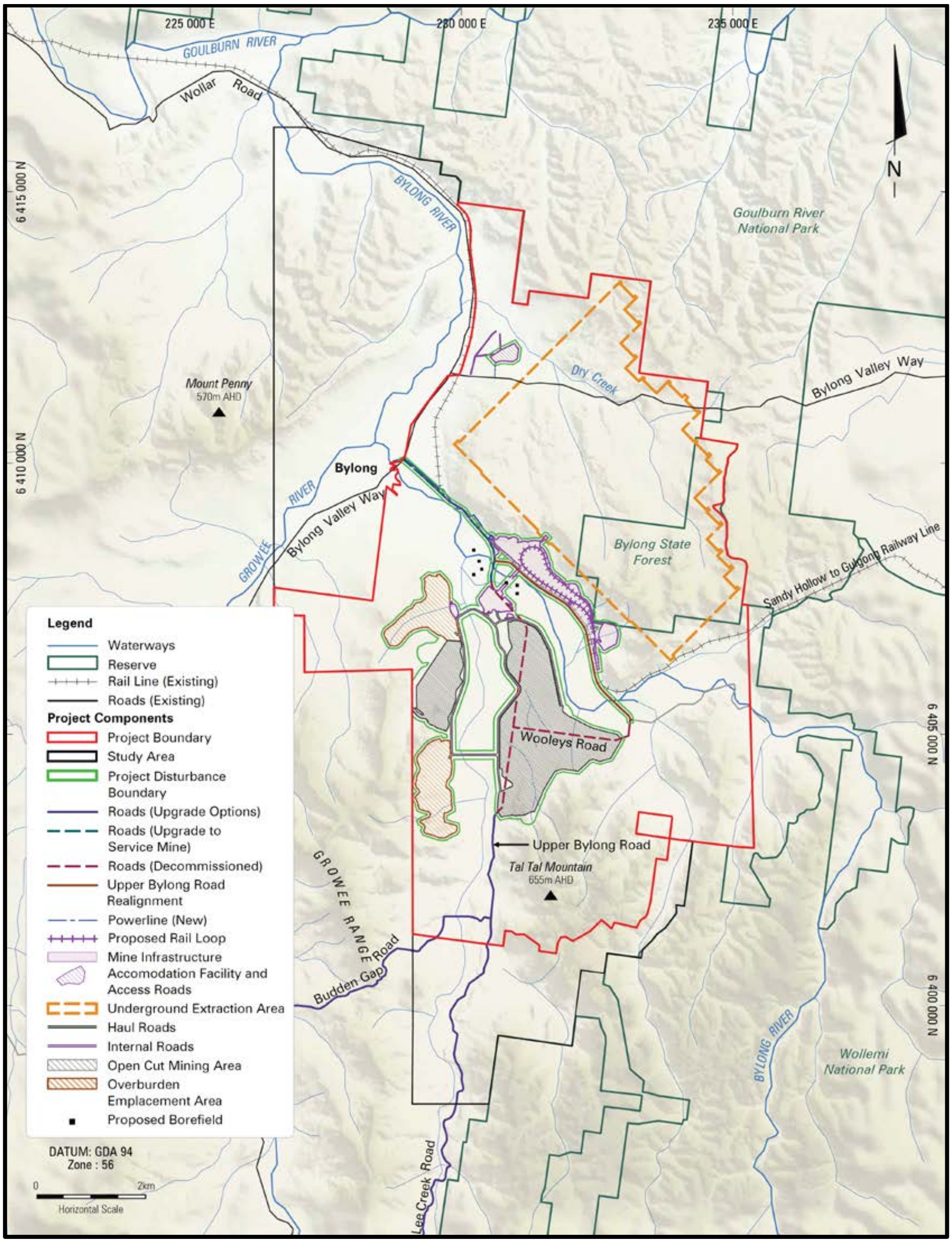



**FIGURE 24: Project mine plan and infrastructure**

The open cut operation is summarised as the following:

- 24 hours per day, 7 days per week operation. Provides for the most optimum operations tailored within the allowable environmental and social inputs. Proposed rosters and operational times are typically of the coal mining industry.
- Temporary MIA designed specifically to address the relatively short term nature of the open cut mining operations.
- Traditional truck and hydraulic excavator operations working overburden and coal. The operations are to be assisted by way of typical Front End Loaders (FEL), dozers, water trucks and utility type vehicles. The class and size of equipment has been selected to match the coal deposit along with optimal mining rates to ensure efficient resource recovery, within the allowable environmental constraints. Mining methods and equipment should allow for appropriate levels of safety expectations through tried and tested mining equipment and process as well as underpinned via relevant legislation.
- The open cut method attempts to extract and process any coal of practical quality and thickness that is within the open cut disturbance footprints. Here, the full extent of the primary target Coggan Seam is mined, in addition to selected portions of Ulan, Glen Davis and Goulburn Seam coal plies. Two main coal products are envisaged from the open cut:
  - 16% ash product (predominantly from the Coggan Seam)
  - 22% ash product (predominantly from the Ulan Seam)
- The open cut voids are to be backfilled utilising the haul back method. Here, in combination with coal preparation reject disposal, no final voids are envisaged for the planned open cut operations.
- The disturbance footprints will be progressively rehabbed culminating in appropriately engineered final emplacement landforms with slopes of less than 10°.

The underground mine is summarised as follows:

- 24 hours per day, 7 days per week operation. Provides for the most optimum operations tailored within the allowable environmental and social inputs. Proposed rosters and operational times are typically of the coal mining industry.
- Permanent MIA designed specifically to satisfy the long term, life of mine underground operation.
- Traditional longwall operations including development support utilising industry standard continuous miners. Mining methods and equipment should allow for appropriate levels of safety expectations through tried and tested mining equipment and process as well as underpinned via relevant legislation.
- The longwall method will attempt to extract the full Coggan Seam thickness, within the allowable technical specifications of the equipment hereby ensuring the most efficient utilisation and extraction of the Coggan Seam resource.

The ROM coal will be beneficiated through use of traditional coal handling and preparation plant and transported to the Port of Newcastle for export (or appropriate domestic market), via way of a purpose built rail load out  and rail loop facility.

## 12.0 PROJECT OFFSETS

The Biodiversity Offset Strategy (BOS) entails the acquisition of properties for permanent conservation of flora and fauna species and their habitat, including species predicted to be impacted by the Project. The BOS for the Project targets Box Gum Woodland and Derived Native Grassland and other habitats for the various threatened flora and fauna known to occur within the Study Area. KEPCO has devised a BOS that includes "direct" biodiversity offsets. The two main areas proposed for conservation as biodiversity offsets for the Project include:

- Onsite Offset Areas
- Offsite Offset Areas

The onsite offset areas are of particular importance relative to mine planning in that areas designated as part of the BOS should be devoid of coal reserve or exhibit limited potential for future extraction of coal. Hereby, any conflict between BOS and future mining activities are limited.

The selected onsite offset areas typically occupy the escarpment type areas along the borders of both A287 and A342. These areas inherently limit the potential for open cut or major infrastructure disturbance areas. By and large, the majority of selected properties onsite are outside identified open cut areas. Certain variants of underground mining are considered a possibility and would be subjected to future technical studies pending technological advances and economics of relevant areas.

## 13.0 CONCLUSIONS

Since the purchase of A287 and A342, KEPCO has embarked on a robust exploration program so as to increase technical confidence of the proposed mining operation as well as strengthening a sound economic case for extraction. The relevant mining studies have been undertaken by a vast range of external specialist consultants providing for a thorough and cross-sectional involvement from a range of experience and expertise. Staged and systematic study phases have been undertaken through industry standard Concept, Pre-Feasibility and Feasibility studies, resulting in the preferred mine plan and supporting infrastructure. The mine plan has evolved and has been refined over a number of years following valuable input and learnings from key stakeholders and regulators.

In the interest of environmental and social considerations dictating the operation, these considerations have been evaluated alongside the more traditional business and economic aspects. The Project mine plan not only attempts to satisfy KEPCO's internal corporate requirements but has embarked on pre-emptive environmental planning and assessments, regulator engagement along with relevant mine plan modifications so as to put forward the most optimised, balanced and environmentally pragmatic operation that is fit for purpose to the site specifics of this Project. The process of formulating an appropriate mine plan has been complicated by change in legislation coupled with adjustment in perception and sentiment towards mining. As such, precedence and practice of relevant operations within the Western Coalfields and NSW have been considered but additional mine plan modifications have been pro-actively implemented on views of today as well as on perceived perceptions of newly implemented legislation. Overall, the Project attempts to provide a well-balanced concessionary operation that is accepted by the public at large and therefore satisfying the role it plays in society as a provider of a resource for the public's needs and general wellbeing (**Boutilier and Thompson 2011**).

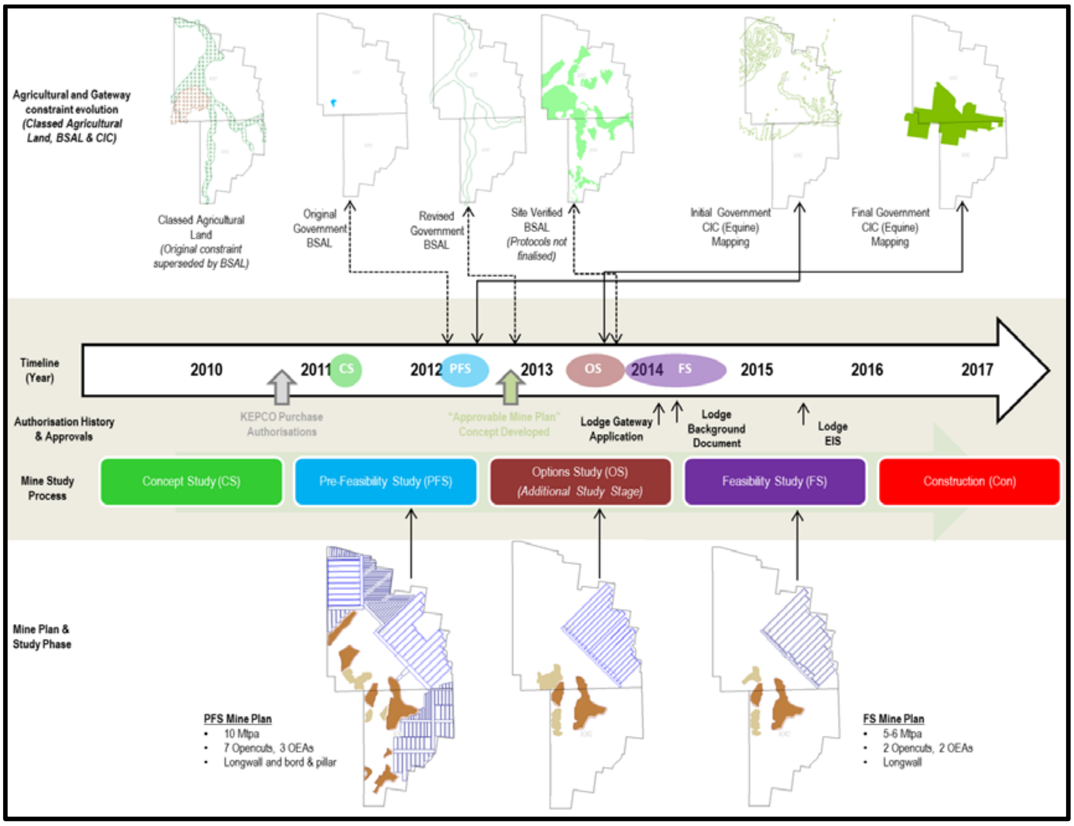



**FIGURE 25: Summary of mine plan evolution**

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