Ulan Highwall Project

P Ferguson[1]

HIGHWALL MINING – DECISION TO MINE

Ulan had completed operations in the first Open Cut area due to high stripping ratios and the presence of geological features which destroyed a significant portion of the coal in the upper part of the seam. The pit had been abandoned in 1994 and operations had moved to a new location to the north west.

It was timely to investigate the possibility of recovering more of the coal seam via the use of secondary extraction methods as it could be demonstrated that it would not be viable to continue with either conventional Open Cut or Underground methods. Previous mine plans had centred around the backfilling of final voids with plant rejects and tailings, effectively precluding any further coaling in the region.

In early 1995 a review of Open Cut mining plans was undertaken. As a part of this review, two regions of coal, the old pit and a section of the new resource were identified as sites for remnant coal extraction. These areas would be available with only minimal additional preparation work.

The Ulan seam is a 10m thick seam (see Fig. 1), however the first 6m has a weight average insitu Ash of 36%. There is a limited market for this type of coal. Even after washing at 66% yield the product Ash is still approximately 22%. The Open Cut mines the Ulan seam in two passes. The first 6m bench is used for Domestic Supply Coal, while the lower 4m produces a good quality export coal. The underground mines only the lower ply of the Ulan seam - which has an insitu Ash of around 12%. As a significant proportion of the upper bench coal in the old Open Cut pit had been destroyed, Highwall Mining would only be used to access the D Section. (U/G Working Section). In other high ratio remnant areas Highwall Mining could not be justified to produce the high Ash product.

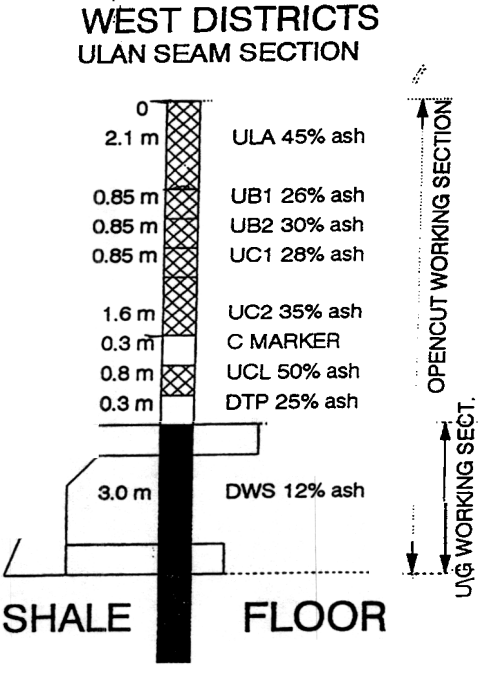


Fig. 1 – Seam sections

[1] Ulan Coal Mines Ltd, Mudgee

The geotechnical design at Ulan was such that pillars should be long term stable. To this end, if it could later be determined that more of the coal seam could be extracted via Highwall Mining - the areas would allow this to occur.

With potential locations in mind it was then time to investigate the usefulness of this coal to the mine plan. Highwall mining was attractive to the Ulan Joint Venture because of a variety of key reasons:-

1. Increase Resource Recovery

2. Additional Source of Coal

3. Blending Synergies

4. Strategic benefits

Resource recovery is a key issue at Ulan and at the time of the investigation into Highwall Mining, Ulan was also preparing its application for a significant lease extension.

It was therefore important to be demonstrating an ability to utilise reasonably new technology to recover coal from remnant regions of the existing lease, while requesting extensions.

The Ulan mine is a Joint Venture project between Exxon Coal & Minerals Australia (36%), Mitsubishi Development (49%) and the State Superannuation Board of NSW (SASTC) (15%). Although Exxon also manages Lemington Coal Mine, near Singleton in the Hunter Valley (100%) - the two mines produce quite different coal types. To that end, production at Ulan is limited to an Open Cut and an Underground mine. Ulan is a 5Mtpa coal producer, with approximately 4.2Mtpa of export sales (Forecast 98). As a single mine operator, production exposure is centred on the performance of the companies underground mine. Highwall mining was then seen as an advantage to the company as it became the "Claytons", sister mine. With a project keen to expand, the benefit of another source of supply became an important concept in maintaining a program to support supply at existing levels.

With another potential source of supply coal came another source of quality. In recent years the underground has progressed through several panels of poorer quality (higher sulphur) coal. While the underground does not have the flexibility to move from area to area (from a pure quality perspective) - the Highwall operation does allow this flexibility. It was possible to develop a mine plan which would have the Highwall System working in a complimentary area to that of the Underground. The overall effect being to minimise the need for washing of coal types for blending. This, then has a marked effect on production costs.

Finally, from a strategic perspective, the Highwall System also offered some key advantages. With the mine looking at opportunities to expand production, the Highwall System offered a low cost means of ramping up production levels and helping to build markets prior to any project capitalisation - such as another longwall operation.

The initial success of the Highwall Mining operation at Ulan (forecast 1Mtpa) does mean that it can be evaluated, in its own right, as a medium term source of supply.

SELECTION OF MINING SYSTEM

During the planning evaluation process, from early 1995, Ulan had also started to investigate and evaluate Highwall Mining Technologies. At that time operations at Oakey Creek and German Creek were in progress utilising two different contractors. No other Continuous Highwall Mining Systems were operating in Australia. The main systems available at that point were Continuous Miner/Add Car Systems (Addington based technology), Push beam technology and the Archveyor system (Arch Minerals).

It was not until the middle of 1996 that Ulan finally had board approval to include the Highwall Mining into its business plan for the following year. Ulan set a target date to start Highwall Mining from July 1, 1997.

The second half of 1996 was spent setting up a contract, short listing potential contractors for the project as well as receiving and evaluating tenders. While this was happening Ulan was also involving the on site and district levels of the union and its workforce on an understanding and agreement for the project.

Additionally, the company had started discussing the project with the Senior and District Inspectors of Mines. Ulan was advised to submit a report on resource recovery of the areas to the Department of Mineral Resources (DMR) (Geology Branch) to evaluate whether or not the project could gain support by the DMR. A date was also set for a planning focus meeting to discuss the approvals and planning process required by Ulan. This meeting was duly held, November 13 & 14, 1996.

The contract to Highwall mine at Ulan was awarded to Mining Technologies Australia, (MTA) initially a letter of intent was provided on December 13, 1996 with formal approval signed February 27, 1997.

MTA were chosen because of the following key reasons:-

1. Could supply a system to start July 1, 1997.
2. Had demonstrated ability to Highwall mine in Australia.
3. Had a trained workforce - mostly Australians.
4. Would provide a system capable of mining 500m.
5. Had an inertial navigation system for guidance control.
6. Had an established safety record.
7. Had established procedures.
8. Were advanced in negotiating an Industrial agreement in the Western District of NSW.

The contract period was set by the mining of the previously discussed regions, or a time limit of 18 months, whichever came first.

APPROVAL PROCESS

As Ulan was to be the first Highwall mining project (utilising a continuous miner system) in NSW, the approval process would be the first of its type. The Department of Mineral Resources had, in 1996, established a guideline for the approval of Highwall Mining. However, the NSW approvals process and The Act were never written with a view to Highwall Mining. While many of the principles of Underground or Open Cut mining can be transferred to a Highwall mining system - the question as to whether or not the Highwall mining is covered by the Underground or Open Cut regulations was not clear cut.

It was established that the Highwall mining operation would be treated as an Open Cut operation, even though there would be no intended surface disturbance. Ulan Open Cut was applying for the approval to operate the system from a final void in the Open Cut. Although the mining system would be operating underground, all personnel would remain outside of the entry, similar to an Open Cut situation.

Broadly, the approvals process for Highwall mining can be summarised as follows:-

1. DMR Approval Process:
    a. Resource recovery approval.
    b. 7 year Open Cut & Highwall mining approval including;
        - Highwall Mining Management Plan & Risk Review
        - Geotechnical Design Report.
    c. Equipment approvals.

2. Department of Urban Affairs & Planning (DUAP) approval.

    a. Applications under S102 of the Environmental Planning & Assessment Act 1979 to alter Development Consent to include Highwall Mining.

3. Industrial Approval

    Contractors certified agreement with Construction, Forestry, Mining and Energy Union (Western District) to permit Highwall mining at Ulan Coal Mine Open Cut.

The approvals process was tackled on a number of fronts. The geotechnical report, supplied by the Minserv Group was available in March 1996. A second report investigating the effects of groundwater on Highwall mining at Ulan was completed by July of 1996. With exploration commitments, this part of the process took 8 months to complete.

Key findings in the geotechnical report into Highwall Mining at Ulan Coal revealed the following major points:

- The mining section would range in thickness from 2.9 to 3.6m.
- The DTP (D-Tops), forming the immediate roof of the Mining horizon would be a stable roof.
- The dips on the coal seam would range between and 2
- That coal strength in the mining areas ranged between 35 and 50 Mpa (UCS)
- 2.25m pillars and a 3.5m wide mining entry would provide factors of safety between 2.05 and 3.45 - depending on cover depth.
- Recommended that any Highwall Mining system used to cut slender pillars be fitted with guidance equipment to ensure pillar thickness was monitored and maintained.
- A face length recovery of 61% and maximum penetration of 350m would likely yield .3Mt from the regions proposed in the contract.
- Recommended additional work include an investigation into the effects of static pressure heads on ground water as it was suggested that heads exceeding 5m would be detrimental to mining.

Once a contractor had been established a formal risk review process was undertaken, which included key members from Mining Technologies Australia and The Principal. This occurred February 3 through 6 of 1997. At the end of this review a comprehensive management plan was constructed to deal with the risks identified.

The Seven Year, Standard Open Cut, approval was carried out concurrently with the management plan. Final approvals were received prior to mining commencing on July 1, 1997.

COMMISSIONING AND PRODUCTION RESULTS

The first MTA personnel arrived on site on May 16, 1997. Ulan was fortunate in that it was able to provide MTA with the old underground mine offices and surface facilities for the project. MTA refurbished the offices, an old warehouse and bathhouse for their use.

Equipment started arriving in June. Initially ancillary equipment, then loaders (988 & 990) and eventually 28, 12.5m long Addcars. The Hog Miner (ex Moura) and the launch platform came last of all. The launch platform was transported in two sections, due to height restrictions on public roads. The top deck weighted in excess of 150T and required a 4 x 50T crane lift to erect it on top of its base.

With the equipment ready to go and final approvals received, mining commenced in the west pit . The first mining hole achieved 300m and during the mining of this hole some, albeit minor, ground water depressurisation occurred. The second

hole was dry. The first month's mining resulted in the completion of 41 entries, each averaging only 141m. A total of 96,020 tonnes of coal was mined for the period. Significantly, the system was mining in a region in the west pit known to contain geological impediments. These consisted of a diatreme and dykes emanating from that source.

A table of production results by month and graphs of entry depths, Fig. 3 and monthly production tonnages, Fig. 4 are shown below.

Table 1- Production Statistics

MONTH	TONNES MINES	ENTRIES	TOTAL DEPTH	DEPTH AUG ENTRY
JUL 97	96,020	41	5,772	141
AUG 97	96,200	18	6,267	348
* SEP 97	105,600	23	6,694	291
OCT 97	122,800	20	7,392	370
NOV 97	124,000	16	7,741	484
*DEC 97	113,400	18	8,051	447
TOTAL - 6 MTH	658,020	136	41,917	

* Includes pit Move/Location Change

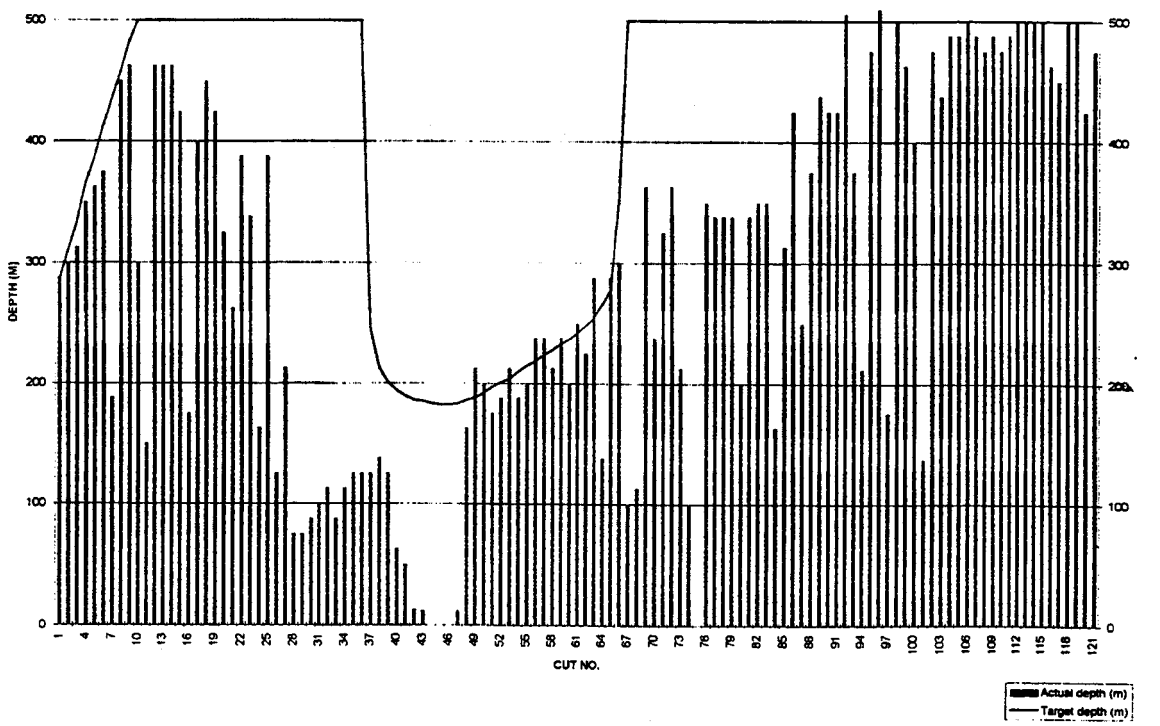


Fig. 3 - West pie Drives

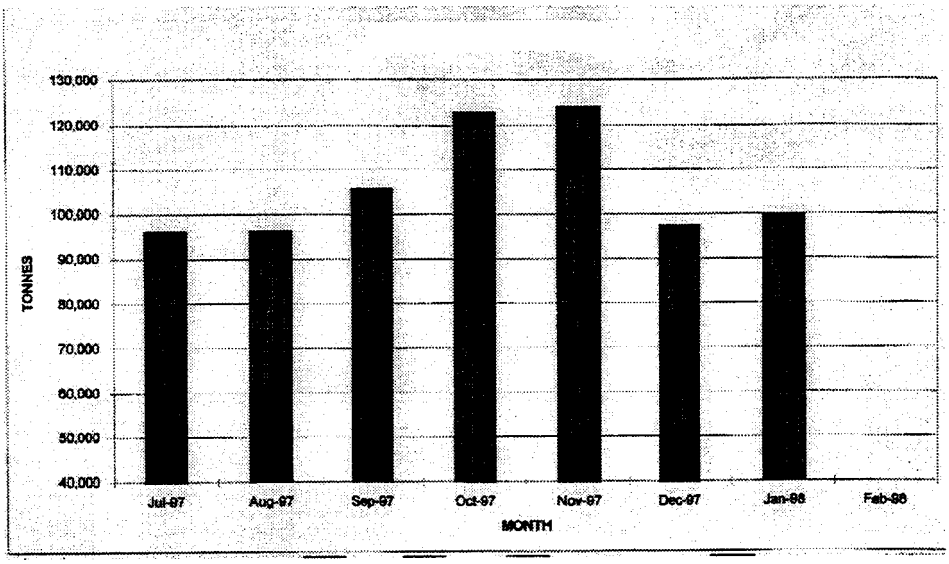


Fig. 4 – Monthly Production

The first two months of production were effected by the presence of geological intrusions - graph 1 clearly shows the presence of the diatreme. During the course of the first two months more addcars arrived at site, bringing the system up to its contract required 500m potential. Fig. 4 demonstrates monthly production from the Highwall System and Fig. 5 outlines the typical scatter of daily production from the system.

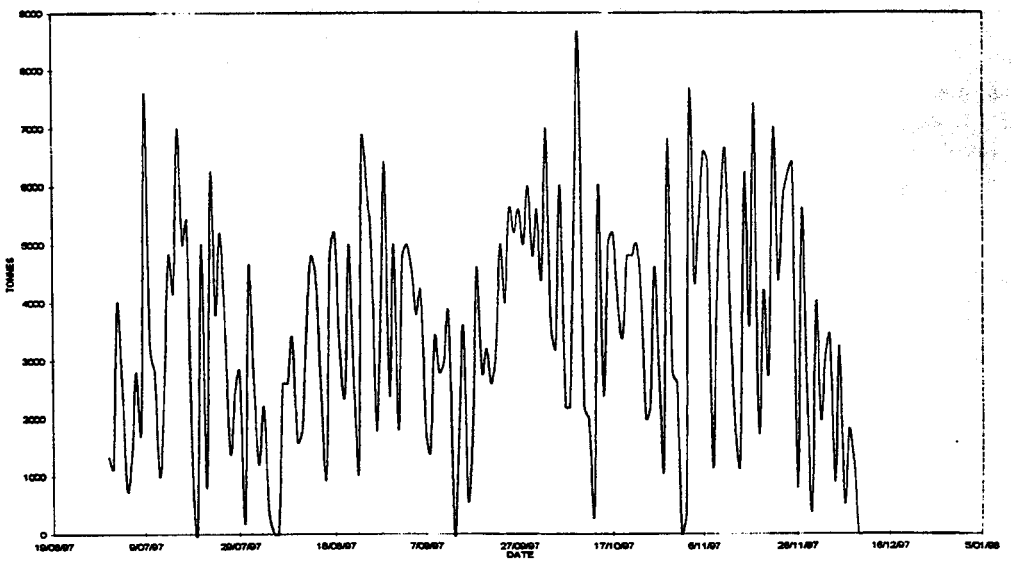


Fig. 5 – West pit tonnes per day

Moving to the next location in the west pit and mining back to the East certainly reveals a significant increase in average depth of penetration achieved away from the altered zone.

Besides issues associated with geology, teething problems existed with the navigational equipment on board the system. A significant number of hole throughs (one hole intersecting a previous entry) were occurring. It appeared that the slight cross grade on the pit dip was forcing the miner across into the previous entry while the miner was attempting to tram to stay straight - the effect was that miner was crabbing across into the previous entry, even though the heading was showing the hole alignment to be on course. The Horta is basically a super compass adapted by CSIRO for Highwall Mining applications and shows the heading at one point. It was not showing relative, lateral deviation. This problem has since been improved - to the point where hole throughs still occur but, perhaps only one in six or seven near full depth entries. The system continues to be developed by the contractor - and as Ulan now expects consistent performance at 500m, the

emphasis is on continuous improvement.

Previous to the Ulan operation, no remote Highwall Mining system had been set up to mine 500m. It is the author's understanding that a system in the USA was set up for 1500 feet (457m) - but that this depth had not been achieved. To that end, a hole mined at Ulan on 14 October 1997 at 506m became the first entry to pass the 500m barrier. A hole mined on 20 October 1997 at 510m (measured by addcars into pit) is therefore claimed to be the deepest ever entry from a remote Highwall Mining System.

While records of this order are certainly welcome, Ulan is more concerned with consistently deeper penetration results. Certainly future mining opportunities at Ulan will focus at depths beyond 500m. A continuous improvement process to increase depth of penetration does need investigation. After all, in 1996 500m was seen as a dream. Systems were only achieving 375m of penetration at other Australian sites. Ulan has good conditions for Highwall Mining and it is an expectation of the site's management that increases in depth are obtained.

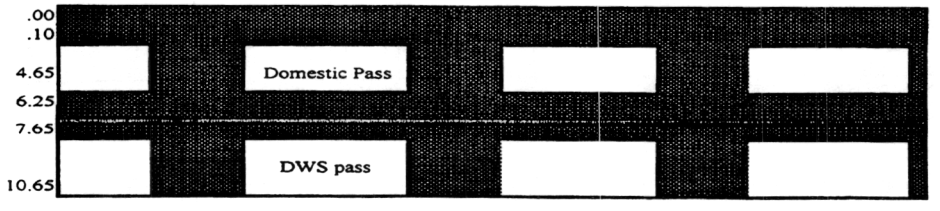
While the contract production has continued to move in a pleasing direction, not all of the Highwall operation has run smoothly. Managing a system capable of producing over 100Kt per month does require a commitment from the Principal. Ulan has suffered from larger than intended stockpiles in part because of industrial activity in the Open Cut Mine. The negotiation of an enterprise agreement has meant some flexibility has been lost because of protected actions being invoked. In the longer term Ulan will certainly be a very prospective site for ongoing and successful Highwall Mining conditions.

The safety features of the Highwall Mining system have not been lost on the principal. The contractor has mined for over 6 months without a lost time injury. Several Recordable incidents have occurred, and 4 soft tissue injuries have been recorded. Most notably these have involved finger/hand injuries, twisted ankles and a pinched foot as an operator attempted to kick out a piece of coal from the clevis plates of an addcar. The principal manages the contract with a project manager, a safety coordinator and normal Open Cut statutory cover. Daily meetings between the contractor focus on resolving safety and production related issues.

POSSIBILITIES FOR THE FUTURE

With initial results from the Highwall operation showing steady improvement in resource recovery it has been possible to further investigate the future of this mining method at Ulan. Several ideas for the future are being evaluated. The first it the use of trench excavation and subsequent Highwall mining to recover coal remnants under steeply tipping topography. Trench strategy involves accelerated opening of final pit endwalls which will ultimately allow Highwall mining on only one side of the trench (Fig. 4). Beyond this, a series of full blown trenches which would allow double sided excavation are also being evaluated.

The second, significant, Highwall project under evaluation involves a multi layer Highwall mining technique. In this situation the Highwall system would be used to extract the value, Coal section first (Fig. 5). After the extraction of this section, an initial bench of coal, or spoil, would be used to build the floor up to the base of the floor of the second, upper pass. Mining would then recommence at this level, with coal being used to continue to build the floor pad for the miner. As the miner progressed, coal could be recovered from the floor pad. Fig. 6 demonstrates the stacked upper pass.



Case Description.	Excavate	Pillar	Rec X %	Thk - m	Seam	Rec Z %	Total Rec
DWS pass only	3.5	2.75	56.0%	3.00	10.35	29.0%	16.2%
Domestic pass.	3.5	2.75	56.0%	2.55	10.35	24.6%	13.8%
Two pass total							30.0%

Fig. 5 – Highwall mining – Multi pass ply extraction

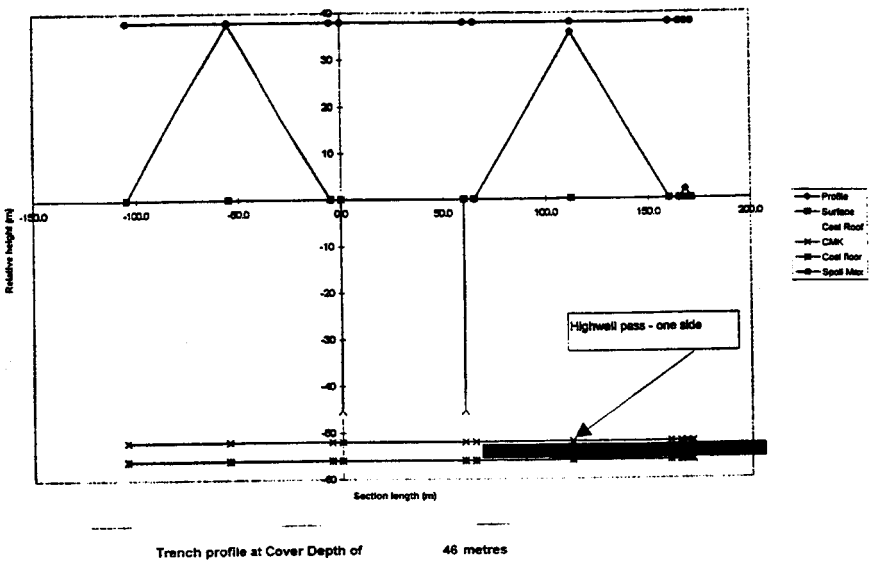


Fig. 6 – Stacked upper pass

The first stage of trenching has already commenced at Ulan. A trench is being excavated along the northern boundary of the existing Open Cut. The coal will be mined from the trench, thus creating a final endwall for Highwall operations to advance from. In a typical cover of 40m of overburden, the value of Highwall coal has the effect of reducing the insitu ratio (Prime/ROM T) from 2.6 BCM/tonne to 1.10 BCM/tonne - See table 2 - profile by depth of trench per 100m reserve block advance. It is assumed that double sided spoil stacking is approximately as productive as Highwall chopping. Simplisticly it is 2.6/1.10 = 236% more efficient to orient stripping equipment to single sided trenching and benefit by gaining more "exposure" to coal. If it were possible to double side Highwall mine from the trench the effective strip ratio would further reduce to 0.70BCM/tonne. (371% more efficient than typical stripping). Ulan has a current Open Cut operation that is bounded on three sides by steep topography. It is therefore very prospective in terms of evaluating the usefulness of trench mining.

In terms of upper pass Highwall Mining, Ulan has had preliminary geotechnical design conducted on the upper pass section. Initial work suggests that with an increase in pillar width at the base to 2.75m it would be possible to mine sections of the plies above. As previously noted, the quality of the upper seam is poor (See Fig. 1) - however, the plies UB1 & 2 and UC1 would provide a weight average product at 28% Ash. This may well be valuable as a future Domestic supply coal, to supply existing contracts or for future contracts if the coal price were to appreciate.

SUMMARY

Initial Highwall Mining results at Ulan have been pleasing. Ulan is a very prospective site which has both the areas and conditions to enable ongoing Highwall Mining operations. Ulan views the use of the Highwall Mining System as a means to maximise resource recovery by extracting coal which would not otherwise be taken. Indeed, the value of this coal continues to under pin future Open Cut operations and therefore assist in supporting 170 jobs in the Open Cut. The Highwall System has further created local opportunities for Mudgee people to gain skills in the Mining Industry. The Contractors employs 36 persons, most of whom are housed in the towns of Mudgee, Gulgong and the surrounding districts. The significance of this cannot be understated at a time when the coal industry is suffering substantially.

Ulan will continue to evaluate the potential for Highwall Mining operations as its business plan and economic conditions allow.