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How NSW and Queensland Coalfields Differ - What We Need To Do Better

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ABSTRACT: There are obviously similarities and differences between NSW and Queensland underground coal mines. The major differences are related to rock strengths, stress regimes, location and operational approaches. Issues relating to these factors are addressed, with some suggestions as to how underground coal miners can do some things better to improve efficiencies and returns on investment.

The differences are many and varied. Some factors having a major bearing on mining efficiencies are discussed, with some examples of failures and successes being outlined.

INTRODUCTION

The subject of differences between the two major coal mining areas on the East coast of Australia is somewhat substantial. The elaboration of differences can be extremely detailed or can be outlined in general terms.

It is not intended (in this paper) to relate to detailed matters, but to outline the author's opinions formed after a number of years operating underground mines in NSW and both open-cut and underground mines in Queensland. No comparison will be made of open-cut operations. This paper only refers to underground longwall mines.

The paper will briefly outline the major geological, geotechnical and operational differences between the major coalfields. Specific reference and comparisons will be made relating to longwall mining operations.

LOCATIONS AND PRODUCTION 1999/2000

The major operations are spread across all the NSW Sydney basin and the full length of the Queensland Bowen Basin. A major difference geographically, is the substantial distance between groups of mines in the Bowen Basin.

Almost all underground coal mines are now longwall operations. A number of mines continue to operate either partial or pillar extraction systems. This comment applies to both coalfields, but there are very few non-longwall mines in Queensland (Cook and Laleham).

Total underground coal production from both states for financial year 1999/2000 was 90,938,000 ROM tonnes, (NSW 52,763,000 tonnes; Queensland 38,175,000 tonnes). Longwall coal produced during the same period was 71,221,900 ROM tonnes.

BASIC DIFFERENCES – AN OPERATOR'S PERSPECTIVE

Geological

The major differences directly affecting operations and most supporting activities revolve about rock strength factors. Rock strengths generally overlying NSW coal seams are considerably greater (more competent) than those immediately overlying the Bowen Basin coals, particularly the thicker Northern Bowen Basin seams. Rock strengths in the Goonyella measures are as low as 10 MPa in some locations bringing about specific support requirements. The coal itself is sometimes the strongest member in the stratigraphical section. Compared with

NSW, particularly the Illawarra (Bulli Seam) and Newcastle (Great Northern), the operational support requirements can be much more onerous. Coupled with complex faulting and water bearing strata, operational issues can be somewhat daunting. Conversely, the massive and strong rocks surrounding both Illawarra and Newcastle district coals also bring about their own specific issues relating to ground stability.

In my experience, the nearest comparable mining environment to the Illawarra is found in the German Creek measures at Capcoal and Oaky Creek. This comment does not apply to the shallow open-cut and sub-crop measures at both locations where overlying rock strengths can be very low. This was highlighted recently with the Oaky North longwall issue. Generally, the faulting associated with NSW measures is relatively "normal" with magnitudes of throw varying, but not usually over short distances. The faulting is much less frequent compared to the high density complex faulting found in the Northern Bowen Basin. Very close grid drilling is required to determine faulting, particularly in the Goonyella, Wrangles and Newlands measures. Faulting in these measures can vary very considerably over very short distances.

The complication of frequent reverse thrust faults creates further hazards during development but more particularly on the longwall faces. Where reverse thrust faulting occurs, it is associated with an obvious increase in seam thickness and also with considerable areas of shattered coal and roof strata. Mining through these structures can be extremely difficult and costly, particularly if the problem is not contained. Very major roof falls have resulted from this problem.

These face profiles, used to enable more effective management of the longwall face by both supervisors and shearer drivers, show the rapidity of change experienced on Goonyella middle seam coal faces. Failure to get the face control right can result in massive face falls and extensive downtimes. Recent examples of this are North Goonyella (3 months) and Kenmare (6 months and resulting in the need to pull off the face equipment.)

Sudden, undetected major reverse faulting within a longwall block, if not detected before installation, can result in the longwall being shortened and equipment being relocated (Newlands). From these examples, it can be seen that in the more geologically disturbed soft rock measures worked in the Queensland Bowen Basin, intense geological exploration, detailed mapping and precise interpretation is essential to minimise the risk of interruptions to the business.

The obvious advantages enjoyed by most of the Queensland mines are generally shallower deposits (at present) and easy access (during the dry season) to surface drill sites for exploration and mine servicing. Location of the mines, surface infrastructure (suburban and rural development) and substantially deeper deposits precludes most NSW mines from this intensity of exploration drilling from the surface. Hence, other inseam techniques which are usually more expensive and less accurate have to be used in the deeper NSW mining operations.

Both coalfields have varying *insitu* gas levels with their associated problems. Frequent faulting in thick seams with fairly high *insitu* gas content is making gas extraction essential at some Bowen Basin mines. Separating gas extraction and utilisation from the mining process is becoming a major issue requiring a re-think of how to achieve this objective. More research is needed into surface gas well techniques of extraction where shallow but gassy measures are being mined.

The mine gas problems are, in reality, not very different between the two states. How the problems are solved may be different in each location. NSW mines have the CO_2 problems while some Queensland mines have a H_2S problem. Both environments must have very precise and detailed hazard management plans in place to effectively mine in these conditions.

Spontaneous combustion is an issue in the Bowen Basin, particularly in the thick seams where considerable volumes of coal are left in the goaf after mining. Once again, very specific detailed management plans must be in place and understood by management and workforce to enable effective mining in these conditions. A combination of high *insitu* methane levels and a liability to spontaneous combustion is not a desirable combination.

Geotechnical Issues

The stress regimes in both coalfields vary considerably, region by region. Generally, the horizontal stress levels experienced in the Bowen Basin are of less magnitude than in the Illawarra. A reduced horizontal stress component in a soft rock – thick seam environment can, however, bring with it substantial mining problems, particularly

around longwall gate roads. Following a number of major falls in gate roads recently, accurate and more frequent determination of *insitu* stress levels and direction have become essential to more effectively predict potential influences on the longwall operations.

Frequent faulting, *insitu* stress levels and mining induced stresses have all to be considered when determining strata control requirements. Failure to adequately determine their collective impact will reduce operational efficiencies.

High quality coals with thick and shallow seams are not necessarily the longwall miner's dream. They can become the longwall miner's nightmare if not predicted, planned for, and accommodated with detailed mining engineering procedures.

SO HOW DO WE DEAL WITH THESE ISSUES?

The answer lies with a substantial collaborative effort in geological, geotechnical and mining engineering before defining mining plans.

As previously stated, the shallower measures being mined in the Bowen Basin lend themselves to serious, concentrated surface exploration of areas of coal down to the definition of individual longwall block structures. Failure to dedicate resources and money to these requirements will put high volume longwalling at risk.

With the cost of unplanned downtime on longwalls now running at +$38,000/h, it is critical that as much geotechnical knowledge of defined areas of extractable coal is gained before mining. To this end, detailed geological and geotechnical plans must be of high priority to the longwall miner. This can only be achieved in both coalfields with site specific and dedicated geological/geotechnical expertise. Whether that is by in-house or external expertise is irrelevant, providing the information is available before mining commences and that detailed monitoring takes place during the mining process. Continual up-dating of face and gate road data is essential.

Over 20 years ago, this type of assistance was put in place at some mines in the Illawarra. These requirements are only now being recognised and accepted by some operators in the Bowen Basin, and only after some major longwall strata problems. The provision of daily face profile data, horizon planning and gate end preparation by secondary support will reduce the operational problems substantially.

The development of strata hazard management plans is both an inspectorial and an operating management requirement. It is also good mining practice. Any operation not now having this type of management process will not optimise the effectiveness of its production nor will it eliminate the source of major injuries and fatalities. The important point is that this must be a **"tool to work with".**

Effective geological and geotechnical management is essential in both coal fields. It is unfortunate that the acceptance of this sort of management tool has been slow to arrive in some parts of the Bowen Basin.

As previously stated, one specific geological difference between the two coalfields is the frequency of faulting, particularly the reverse thrust faulting in the Northern Bowen Basin. The geotechnical requirements for adequate support of these types of structures on longwall faces or gate roads have resulted in substantial development of active roof tendon support systems and strata stabilisation injection techniques. The strata stabilisation systems now available through various organisations have basically resulted from "after the event" experiences in recovering falls. By effective determination of seam structures, injection techniques can be applied before the event (that is mining) instead of after the event (a major roof fall) has occurred.

The designs of injection systems and improvements in various stabilisation products are now available to assist in minimising the effect of geotechnical issues caused by geological structures within mining areas. Drilling and injection expertise is available from several companies. We need to involve them early, rather than later in the mining process.

OPERATIONAL ISSUES

The issues here can be categorised as:

- Industrial
- Management structures

Industrial

The major difference between NSW and Queensland lies with the power given to front line supervision workers (deputies) within the Queensland legislation. The way the law is drafted in Queensland gives the deputy (who is predominantly in the C.F.M.E.U. in Queensland) considerable supervisory and industrial power. This is not the case in NSW, with some deputies being members of other industrial organisations. The effect of this type of structure is the frustration of plans when attempting operational improvements and management structure changes. When this is combined with the mining town or fly in – fly out syndrome where the employees live together almost continuously, then major constraints can be applied to the attempts of management to improve systems and management control.

This is not to say that all operations in Queensland are faced with this type of problem. There are indeed many good front line supervisors, but the fact is that I believe they could be better if the industrial reins were removed. This has, in fact, been proven at some locations. Until the law is changed to remove this power from certain categories, industrial progress will be more difficult to achieve. Accountability of individuals will be more difficult and performance appraisal systems will be harder to implement.

The NSW operations are not, in my experience, constrained to the same degree at supervisor level. This industrial environment makes it easier to bring front line managers into the management team.

In both states, there is nothing to stop operators from designing a structure to most effectively manage their production and industrial issues. They just have to have the determination to do things differently. Certified agreements, like longwall mining, can be beneficial or a burden. It depends on the wording of those agreements.

In Queensland there are some very good agreements, but there are also some that give a great deal of power to the employees. This power can be used to frustrate management in its efforts to improve operational efficiencies. At the end of the day, the employees have no direct responsibility for the fiscal health of the business nor are they ultimately accountable for the safety record of the mine.

Management Structures

With the exception of the deputy position as discussed above, management structures have, until recently, been similar in both states. The traditional mine management structure has prevailed to accommodate statutory requirements. The introduction of more flexible working arrangements brought about in part by new industrial agreements following changes to the Federal industrial relations legislation (Workplace Relations Act 1997), different management structures have been implemented in both states. It is becoming more common to have a supervisory structure designed to suit business needs and not to accommodate mining legislation as its main objective. The opportunities provided here are many and varied and managements who have grasped these opportunities are beginning to reap the benefits in improved business results.

The main resistance to these changes has come from middle management who seems to perceive a threat to their security instead of a challenge to stretch their capabilities. Being removed from their comfort zone is not accepted easily.

It is not practical, in this paper, to compare structures, but one area for comment is the longwall management structure. Reference has been made to front line supervision. With a business capable of generating in excess of $500,000 per day in revenue, a strong management structure has to be in place. Gone are the days when we can leave a longwall to a frontline supervisor and crew. We must now have a full technical backup and shift supervision group in the management team which is accountable for the longwall business.

In a recent paper (Nicholls, 2001), I espoused the requirement for the "face boss" position to be implemented on longwall faces. The benefits from having the right people in this position can be enormous. This, I believe, is the area most lacking in both coalfields. There are many longwall deputies who could fill this role, given the

opportunity. Neither coalfield can afford to ignore these structural requirements. This paper has not discussed the differences in longwall management structures in the two coalfields but has highlighted what I believe is a common shortcoming in the way we manage our longwalls.

Procedures associated with different longwalls are obviously determined by capacity, volume requirements and industrial issues. All longwalls should be set utilisation criteria for which the management team is held accountable. Increased utilisation is the key to improved efficiencies and productivity. We do not focus enough on this particular aspect of the business. Again, this is not a comparison, but it is a common problem.

WHAT WE NEED TO DO BETTER

From the comments made in this paper, which are by no means a significant comparison or critique of the NSW and Qld. Longwall mining operations, the following are just some of the suggestions I make for doing things better. Substantial effort must be put into geological and geotechnical advice and data collection before, during and after mining.

- Geological and geotechnical expertise must be attached to each longwall operation. They must be part of the management team which must be accountable for longwall results.
- Define and delineate any areas of abnormality predicted before mining following geological/geotechnical investigations and previous experience. Establish plans to deal with these predicted issues. Sign off and inform the operating supervisors and crews of the plans. Make sure that they are regularly updated on the plans and their responsibilities to the plan.
- Involve the crews in the reasoning behind the plans, seek their contributions – there is a wealth of knowledge out there.
- Put in place a management structure to drive the face at its optimum rate.
- The industry needs to treat each longwall as an independent business. Install the management structure with accountability to match. Use key indices on a regular basis comparing to the actual plan.
- Ensure that management, supervisors and operators in the key longwall businesses are the best you have available. Train them well and keep them focussed on continually improving their performance.
- Bring in external expertise if the business is not performing to its optimum level. Asking for help is not a deficiency – not asking for help is!
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In summary, this has, of necessity, been a generalisation of some differences and some similarities within the NSW and Queensland coalfields. There are many other issues which could have been discussed within this topic. Some suggestions have been made which could be applied in both coalfields. It has been my experience that applying these principles will improve the overall performance of the longwall mining operations in both states.

REFERENCE

Nicholls, B, 2001. *What's wrong with Australia Longwalls?,* McCluskey's Coal Forecast 2001 Conference, Brisbane, Qld, Nov. 2001.

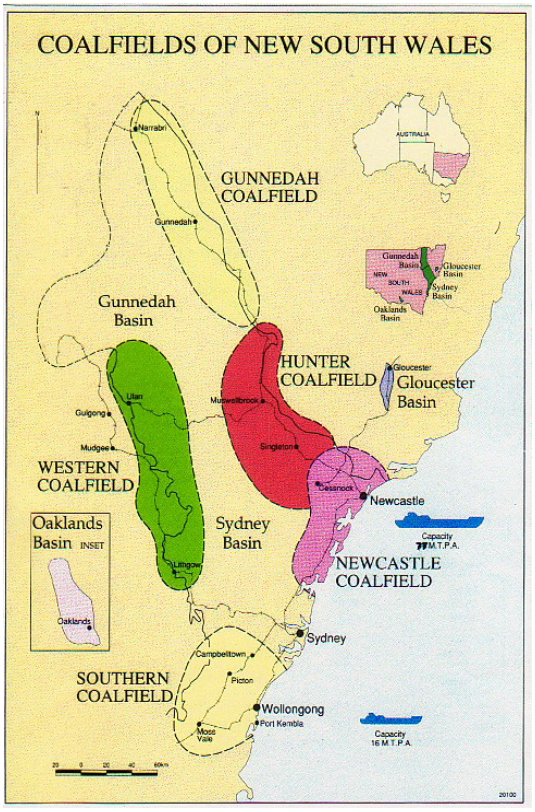

Fig. 1 The Coalfields of NSW

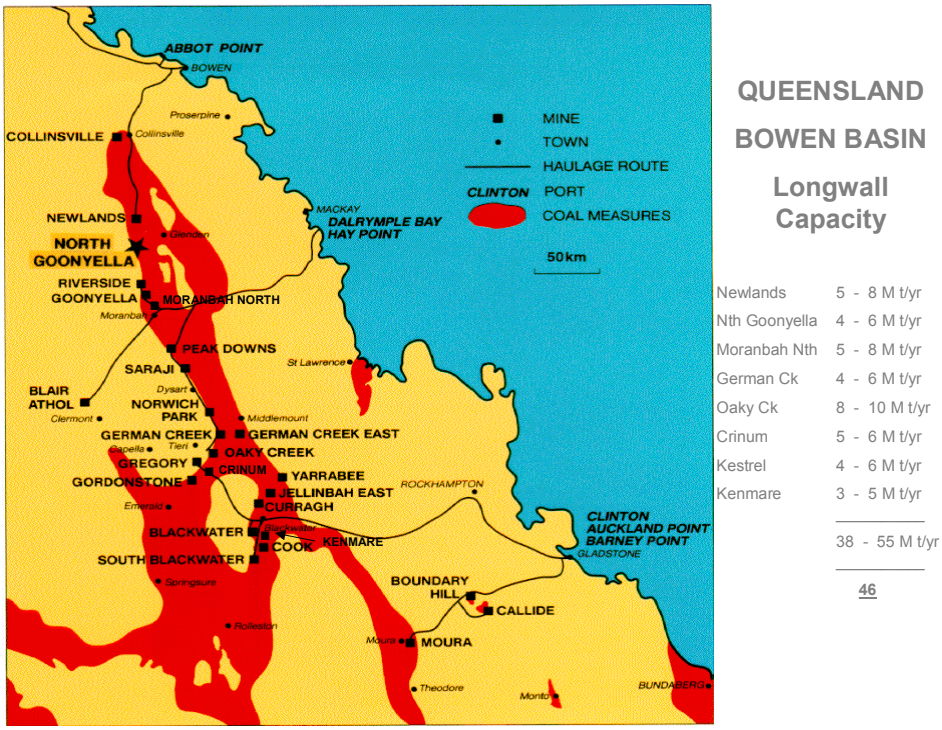

Fig. 2 Queensland Bowen Basin – Longwall Capacity

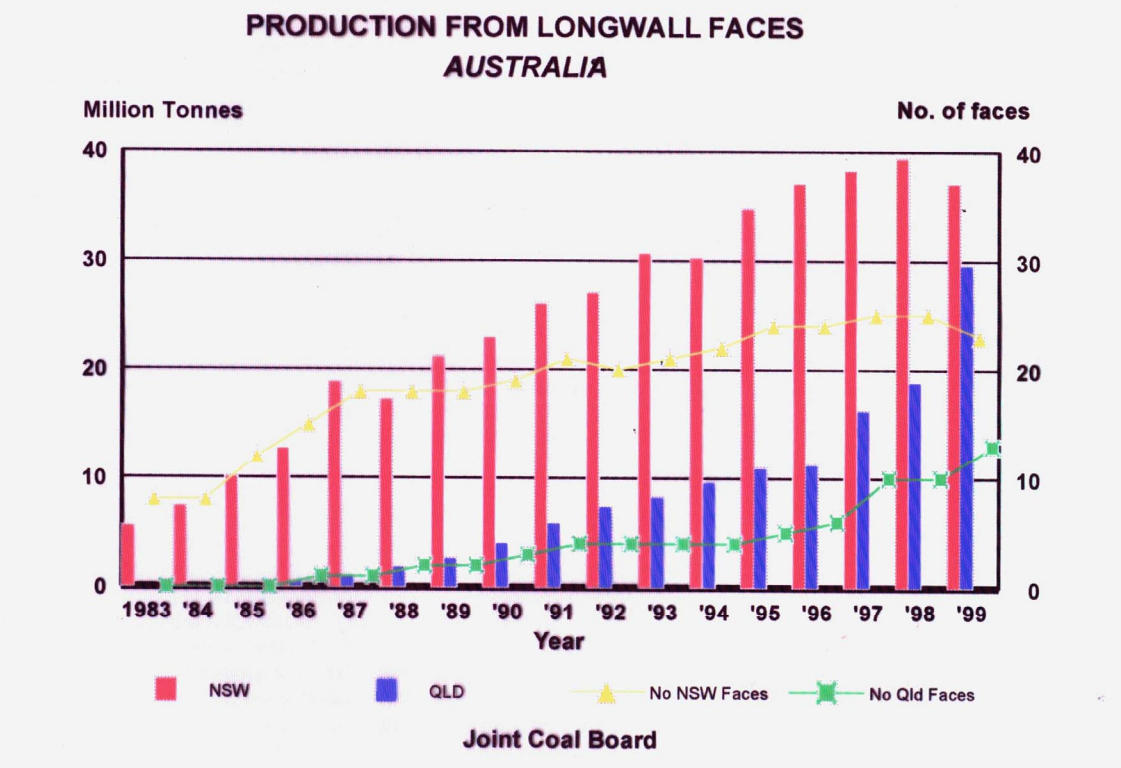

Fig. 3 Production from Longwall Faces Australia

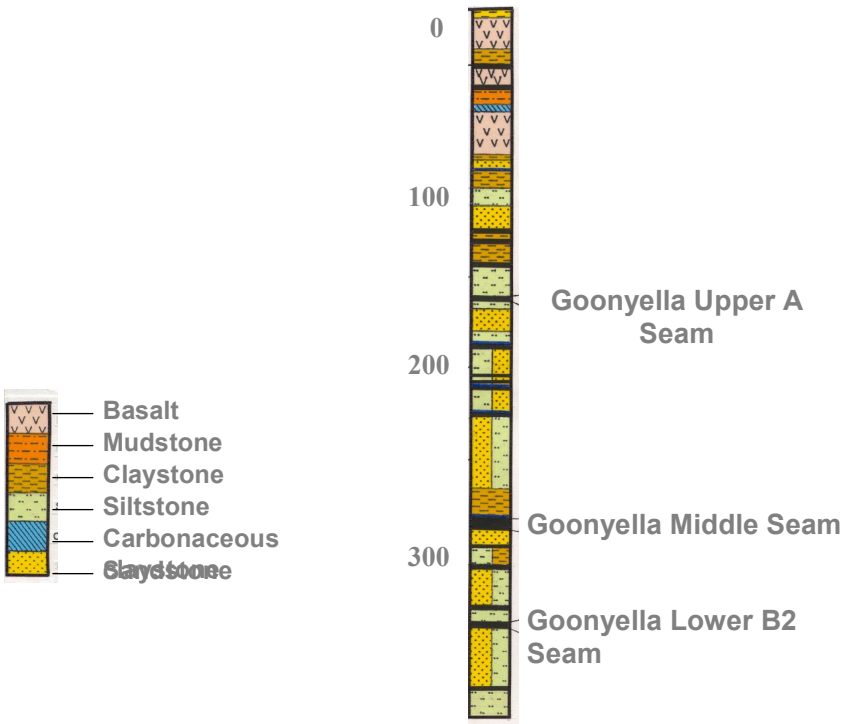

Fig. 4 Coal Resource

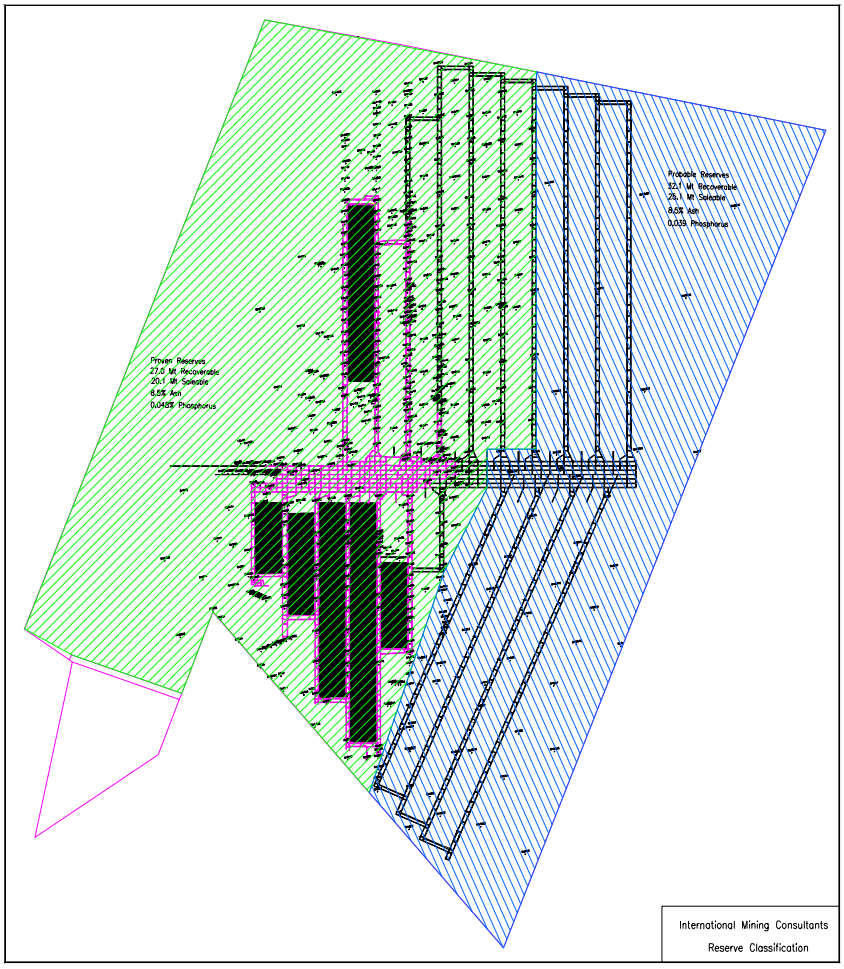

Fig. 5 Coal Reserve Classification

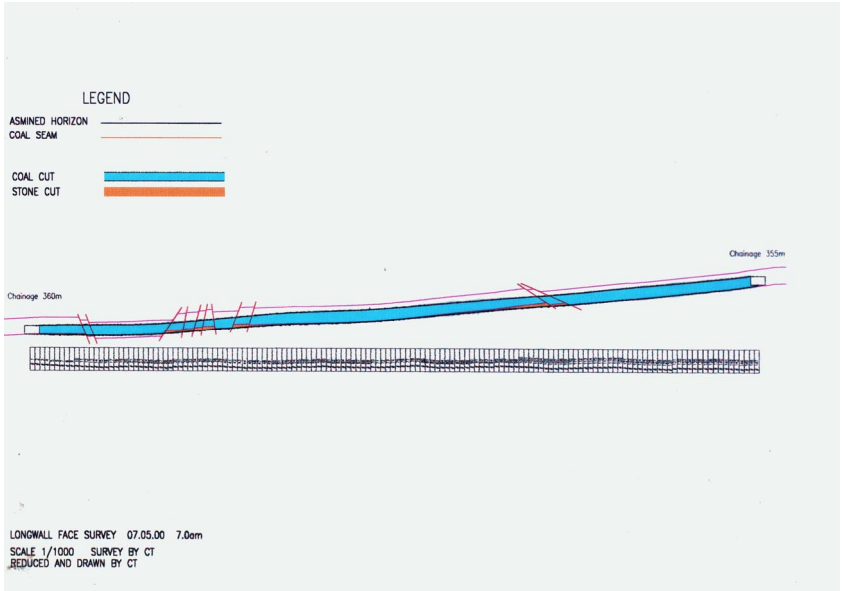

Fig. 6 Longwall Face Survey (07.05.00 at 7:00am)

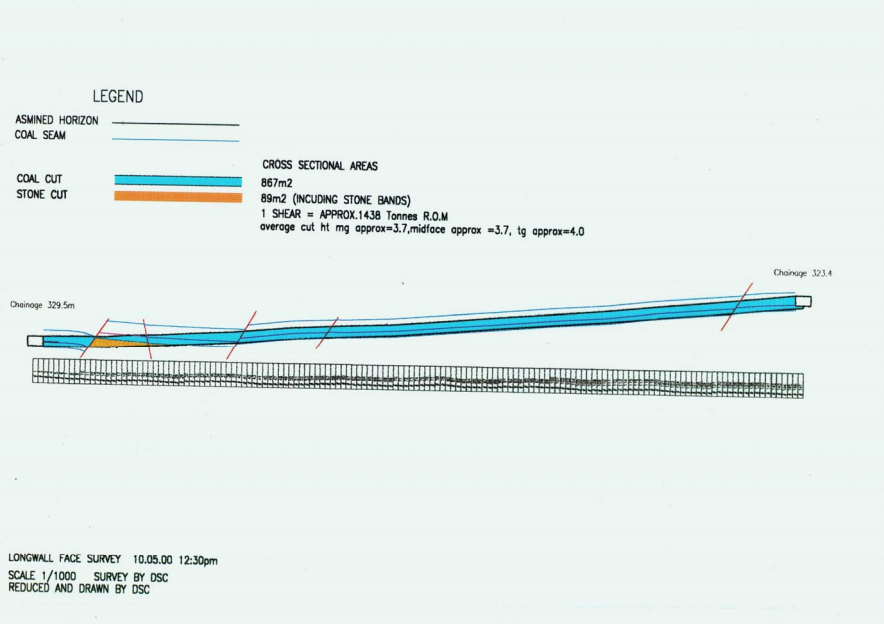

Fig. 7 Longwall Face Survey (10.05.00 at 12:30pm)