4.0 COMPARATIVE ANALYSIS

Godden Mackay Logan following consultation with EJE Architecture and Hunter History Consultants has prepared the following comparative analysis.

Comparative analysis is important in understanding how a place may meet criteria (f) and (g) of the NSW Significance Assessment criteria. These two criteria relate to whether a place is significant because it is rare or significant because it is a good example of a common type of place. The two criteria are:

Criterion (f) an item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history; and Criterion (g) an item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places or cultural or natural environments.

Addressing these criteria assists in understanding the heritage values of a place within a broader context of the history of New South Wales.

In undertaking such an analysis, it is important to be aware of the dangers of comparing like with unlike, and the dangers of lumping and splitting in analysis.[1] As a way to overcome these issues, a thematic approach has been used to ground the comparative analysis in the context of history and associated physical evidence.

Thematic analysis is undertaken by comparing the history of a site in relation to broad historical themes characterising Australia's history. Such themes have been established by the Australian Heritage Commission and the NSW Heritage Office, and are outlined in synoptic form in *New South Wales Historical Themes,* issued by the NSW Heritage Office (2001).

The most relevant historical theme is mining. It is noted however that technically, under the New South Wales definition, coal mining is excluded as coal is not an ore or an inorganic substance (which is the scope of the physical description). However, coal mining does not fit under any other theme and it is likely that this is an oversight.

Table 4.1: Relevant Australian and New South Wales Themes

Australian Theme	NSW Theme	Notes	Examples of evidence
3. Developing local, regional and national economies	Mining	Activities associated with the identification, extraction, processing and distribution of mineral ores, precious stones and other such inorganic substances.	Mine, quarry, race, mining field or landscape, processing plant, manager's office, mineral specimen, mining equipment, mining license, ore laden shipwreck, collier, mine shaft, sluice gate, mineral deposit, slag heap, assay office, water race.

Within this broad theme of 'Mining' and the theme of 'Coal Mining in NSW', sub-themes have been developed for this project (outlined below) and examples of evidence relating to these themes given. The sub-themes have been drawn from a number of standard works on the history of coal mining in New South Wales.[2] Discussion of example of physical evidence relating to the sub-themes is based on the author's experience in undertaking archaeological surveys on New South Wales coal fields, supplemented by the experience of Barney Collins and Shea Hedley from EJE and from Hunter History Consultants.[3]

Sub-theme	Notes	Examples of physical evidence
Capital and the scope of operations	Initially mining was government run with small mines and then it was a government monopoly granted to the AA Company, which was broken in 1847 by emerging capitalists such as the Brown Brothers. There was a tendency in the late nineteenth century for there to be a number of large mines well capitalised. Intermixed with there were smaller mines (the rat holes[4]) which worked lesser seams. In the 1930s there was the merger of companies to form larger companies owning several mines and associated companies. Notable was JABAS (John & A Brown Abermain Seaham) which owned several mines and Hexham engineering. From the 1970s onwards trans-national companies owned many of the open cut mines in the Hunter. In the 1990s there was a rationalisation in the New South Wales industry resulting in a marked reduction in the number of coal companies.	Scale of buildings and plant and the quality of the materials and equipment used.
Seams worked	The geology of the coal measures (ie where coal was found) had an important impact on the nature of mining as it influenced the costs of extraction and transport. Initially mines were located by the sea, where exposed seams of coal were located and easily mined. Later, with improved geological knowledge of the location and nature of coal seams, mining moved to other areas, notably the Greta Coal measures developed from the 1880s. Some seams of coal produced poor quality coal that was not suitable for commercial use (eg they produced high	Location of mines in the landscape over time. Nature of mining (ie open cut versus underground).

Sub-theme	Notes	Examples of physical evidence
	levels of ash). Other seams were too variable in size or fractured to make mining commercially viable.	
Government	Government has always has an interest in mining as the Crown owns mineral rights in Australia. The government was involved in coal mining from the start, initially working seams by convict labour. Later it created a monopoly by allowing only the AA Co to mine. After passing of the *State Coal Mines Act* (1912), the New South Wales Government could establish state owned mines. There is at least one case of a 'foreign' state (South Australia) trying to purchase a mine in New South Wales. After the gold rushes, the government developed the Mines Department to: (i) assist miners through development assistance and geological information; and (ii) regulate mining activities through legislation, specifying safety requirements and control of mining tenements. After major disasters such as Bulli and Mount Kembla, Royal Commissions were used by the government to provide independent advice on the issues involved. The government later developed mine rescue stations on the major coal fields. The government also had a role through its industrial relations power and later this also involved the Commonwealth Government. The Victorian Government was involved in the 1917 strike in the South Maitland field. In the immediate post-World War II period, the government formed the Joint Coal Broad to improve health and safety, industrial relations, promote mechanisation and generally improve the coal industry. There was an increasing role for government in dealing with environmental impacts of mining, commencing with subsidence and	Certain items on coal mine sites are a direct result of government regulation (e.g. Magazines). The Joint Coal Board apparently had standard designs for some buildings. State mines were/are: – Lithgow State Coal Mine; – Awaba State Coal Mine; – Oakdale Mine in the Burragorang State Coal; and – Liddell, Munmorah and Wyee State Coal Mines (some of these have since been sold and renamed).

Sub-theme	Notes	Examples of physical evidence
	broader environmental concerns from the 1970s.	
Mine working	How a mine worked was influenced by the amount of capital invested, as well as changing mine technology safety concerns and union pressure. The process of mechanisation was the major issue in mine working during the twentieth century, especially with the introduction of mechanical coal cutters (c1902), rope or electrical skip haulage, and compressed air drills. These were followed by attempts at mechanisation (bitterly fought by Unions) from the late 1930s. These involved cutters and loaders, then in the 1950s the continuous miner, and shuttle cars and finally the long wall miner was adopted in the 1970s (although few of the older mines could be adapted for long wall mining). Power for running the mine was initially using steam and compressed air but increasingly electricity was used on the surface and underground. Petrol and diesel powered machinery had limited use, largely due to the need to extract fumes. Mine ventilation was another issue. Initially ventilation was achieved by using underground furnaces which were later replaced by various types of fans. Mining strategies — different types of mining strategies, such as open cut, bord and pillar, Wongawilli, miniwall and long wall, were adopted depending on the nature of the coal seam. A major problem in the 1930s and the post war period was pillar extraction.	Evidence of mine access, drifts versus tunnels or shafts. Open cut versus underground. Mine workers facilities such as bath houses and lamp rooms. Surface office and stores facilities. Surface maintenance faculties, blacksmiths, workshops, displays of old and redundant equipment. Power houses and related facilities. Air compressors. Ventilation shafts, fan houses, fans, turbines. Underground mining facilities (possibility different patterns of subsidence on the surface.
Coal preparation	Initially little preparation was undertaken, usually stone picking and grading through screens but as a result of customer pressure, coal preparation plants were developed to wash and size coal.	Coal boxes, coal preparation plants, washeries. Waste rock dumps, waste coal spoil, coal washery rejects.

Sub-theme	Notes	Examples of physical evidence
Transport of coal to markets	This was an important factor in mining operations as efficient transport of a bulk commodity would have been a key part of mining profitability. Initially rail was the major method of getting coal to a port and thence to market (either Sydney, interstate or internationally). Later in the 1960s and 1970s, road haulage began to overtake coal and extensive networks of conveyors were used to move coal from mines to power stations.	Private and public rail lines, engines and rolling stock, railway infrastructure, conveyors, staithes, wharfs, jetties, cranes shoots, coal bins, coal loaders and unloaders, ships (60-milers).
Industrial relations	The industrial relations situation in the mines was dire to say the least with a on-going series of strikes in the early twentieth century, culminating in the 'Great Strike/Lockout' of 1929, and then the 1948 Miners strike where Chifley sent in the troops to work the mines on the South Maitland field. There were major strikes in 1905, 1917, 1929–30 and 1949. Union campaigns against mechanisation prevented the mechanisation of mines from 1941–the mid 1950s.	Police camp sites, union buildings, sites where miners met, Rothbury mine, Muswellbrook open cut.
Development of towns and villages	Associated with the development of coal mining was the development of towns and villages associated with mining, primarily as residences for miners. While it seems no detailed analysis has been undertaken of the development pattern[5], it is clear that there was a hierarchy of towns and villages ranging from a town like Newcastle, incorporated villages associated with mining but had other industries. Towns like Cessnock and Kurri Kurri were large and developed because of their location within a mining area. Villages such as West Wallsend, Plattsburg, Mount Kembla grew up around individual mines. Some mines, such as Richmond Main, had no associated village.	Settlement patterns, town and village layouts, company style housing.

4.1 ANALYSIS

The comparative analysis is undertaken by discussing the historical and identified physical evidence from Catherine Hill Bay in relation to the sub-theme, and then comparing with that with other coal mines in New South Wales (principally the South Maitland, Newcastle and Illawarra fields).

4.1.1 SCOPE OF OPERATIONS/CAPITALISATION

The initial mining at Catherine Hill Bay was exploratory in nature from 1865. It was the floating of the New Wallsend Company in 1873 that was the entity that allowed sufficient capital to develop coal mining in the area. The lack of transport from the site meant that inevitably a company would be required in order to finance the construction of a jetty and coal loading facilities. However, the New Wallsend Company went broke in March 1876, largely because it could not afford the costs involved.[6]

The second attempt at mining was again a company using capital raised in the United Kingdom – the Wallarah Coal Company. This of course was not unusual — the AA Co, the Caledonian Coal Company and the Scottish Australian Company were capitalised from the United Kingdom. This is in contrast to companies such as the Wickham and Bullock Island Coal Company and J & A Brown which raised capital in Australia.

While it is evident that Wallarah Coal Company had sufficient resources to develop the coal resources of the area, the level of investment was modest, as shown in images of the buildings. This was no model colliery, such as those developed at Richmond Main or Lambton B, where the mines were developed with a high level of capital, as shown through modern plant, substantial structures etc.

The Wallarah Coal Company seems to have survived the economic ups and downs of the early twentieth century. Nevertheless, in the grim economic conditions of the 1950s, when the coal industry was in decline, Wallarah was taken over by John and Alexander Brown Abermain Seaham (JABAS) in 1955, which in turn united with Caledonian Collieries and RW Miller to form Coal and Allied Industries in 1960.

It was only after Wallarah was acquired by JABAS that major reinvestment into the facilities was undertaken to develop mining on the lease, with the works involving the development of the Moonee and Cranagan Bay (later Wallarah) coal preparation plant and the jetty. This development work was required firstly to recover coal from existing working and secondly to reduce transport costs in accessing the coal face from the main tunnel. Similar investment was undertaken on mines of similar age, such as Neath and Aberdare, in order to make coal winning more efficient.

The physical evidence of the capitalisation of the mine is substantially lacking as only the most recent buildings and structures survive. These demonstrate through their extent the nature of the more recent investment into the mine.

4.1.2 SEAMS WORKED

The main seam worked was the Wallarah seam which is the top seam of the Newcastle Coal measures and is argued to be the equivalent of the Bulli seam in the Illawarra.[7] Like the Coal Cliff Colliery, the initial mine was driven directly into the seam from the cliff face. However, when the Wallarah Coal company took over the mining, they developed a series of pits away from the jetty site utilising the hilly nature of the terrain to drive tunnels into the outcropping seam. No. 1 was an audit into the side of a hill and a second audit into another hill was developed in 1894 as Pit B. A series of other pits up to E were dug although only B and E were developed until the 1960s.[8]

The Wallarah mine was the only colliery on the northern coal fields working this seam as it was at the top of the Newcastle coal measures. The coal measures dip to the south so in the northern areas the seam has been eroded and removed. The main Newcastle collieries worked the Borehole or the Burwood seams.[9] The Bulli seam worked on the South Coast was generally worked by adit or drift as it was exposed in section on the coast or on the escarpment and so could be directly accessed.

The location of the initial exposure of the Wallarah seam was absolutely fundamental for the development of the area. It was located where the jetty is (ie extending underneath the Coal Preparation Plant). Construction of the jetty by the company was a private affair and the jetty was effectively closed to others. However, it was the best location for a landing or a jetty on the coast in the vicinity so control of the jetty effectively monopolised the coal deposits in the Catherine Hill Bay area.

The shallowness of the Wallarah seam also apparently made pillar extraction difficult as the resulting subsidence may have let surface water in, flooding the mine.[10]

Unlike the Greta seam, the Wallarah seam had little risk of fire through spontaneous combustion so the life of the mine was not plagued by fires such as those experienced in some mines on the South Maitland field. The mines were also not thought to be particularly gassy and were comparatively easy to work.

When reserves of the Wallarah seam were exhausted, the Moonee mine was developed to work the underlying Great Northern Seam which appears to be relatively close. The Great Northern Seam (which outcrops at the base of the jetty) is a high volatile low sulphur medium ash thermal coal, which is used for power generation.[11] The seam was mined to a height of around 3.1 metres by the long wall method.

The geological sequence is demonstrated in the exposed section in the cliff at the jetty which shows the Great North Seam and possibly the Wallarah seam above it. Such demonstration is only really possible in coastal areas where cliffs are exposed.

4.1.3 GOVERNMENT

The evidence of direct government involvement in the Wallarah mine is slim as there were no major disasters; no need to prospect for new coal reserves etc. The influence of government was not directly felt in the mine except for the requirements for the mine to comply with statutory controls.

The 1917 coal miners strike saw the introduction by the government of 'volunteers' to work the mines. These 'volunteers' were to work mines to provide coal for New South Wales and for Victoria, and inevitably they were seen as strike breakers. Similar squads of volunteers worked Richmond Main mine but they were a short lived phenomena.

The indirect evidence of government involvement lies in the nature of mine infrastructure and mine working. On the surface the most tangible evidence lies in the construction of bath houses for workers after 1927. Bath houses are common on all mines from this time and apparently a standard design was developed by the Joint Coal Board in the 1950s. There were the remains of five bath houses in the study area (although two were being demolished).

4.1.4 MINE WORKING

Because of the landscape setting of the Catherine Hill Bay area and the position of the Wallarah seam, the mining leases were worked as a series of small mines moving around the landscape. This process is similar to the working of mining leases at Minmi and the neighbouring mines in the Blue Gum Creek area (the Duckenfield and later Stockrington mines) by J & A Brown, and the mines at Aberdare by Caledonian Collieries Limited. In contrast were mines such a Richmond Main where the mine entry was more or less at the centre of the lease and the coal within the lease accessed from a central place.

The archaeological remains of mine shafts in the coalfields are often surprisingly insubstantial. This is because much of the associated infrastructure has been demolished and removed. The Mines Department has also been assiduous in closing shafts and drifts to prevent unauthorised entry. It seems likely that there are remains of the earlier mine workings around the Catherine Hill Bay area in the form of the archaeological remains of mine shafts and tunnels, that are outside the area covered by the CMP.

Mechanisation

Wallarah was initially worked by Bord and Pillar mining. This involved the miners initially cutting headings into a new underground district and then mining out bords which are passageways 2–6m wide. The bords were interconnected creating a roughly grid shaped network with pillars in between to support the roof. Theoretically the pillars would then be mined to form a goaf which would be abandoned and allowed to collapse.[12] Pillar extraction was a much vexed question largely as pillars generally contained the majority of the potentially winnable coal and removal was inherently dangerous.

Mining was undertaken by undercutting the desired seam (either by pick or mechanical coal cutter) and then exploding a charge in the area above to fragment the coal. The coal would be then loaded into skips, which would be wheeled down the headings to the main haulage way and lead outside of the mine. Like most of the larger mines of the period, the Wallarah mine (then working Pit E) is reported by Danvers Powers, c1912, as using coal cutters. Otherwise the mine was unmechanised.

Wallarah was among the pioneers of mechanisation with the introduction of with Sampson cutters and Joy 8BU caterpillar tracked loaders in 1936.[13] These loaded into the familiar mining skips for haulage out of the mine. The BHP run collieries were leading the way in mechanisation at this time, with Elrington and Lambton B being fully mechanised from 1935.[14] There is no mention in the site history of whether Wallarah were undertaking mechanised pillar extraction which was banned from 1941 by the New South Wales Government.[15] In some mines this reversed the mechanisation process.

By 1947 Eelford and McKowan describe the mining process as mechanised at least in so far as mining bords was concerned.[16] Interestingly, despite mechanised cutting, boring holes for shots and loading, the skips were hauled by pit horses. Underground haulage was at least partly by battery electric locomotives, although, curiously, surface haulage was by steam. Again, this is very typical of larger mines operating in the South Maitland and Newcastle Districts at this time.

Finally, with the development of the Cranagan Bay Drift (now Wallarah Coliery), from 1957 mining was fully mechanised using cutters and loaders and shuttle cars to replace skips. The shuttle cars discharged coal onto an underground conveyor which took it to an underground storage bin and discharged onto the main haulage conveyor taking the coal to the surface. A pioneering monorail conveyor replaced the shuttle cars in the Moonee mine in 1987 but this system proved unable to work the Great Northern Seam when the mine was developed into this underlying seam in the early 1990s.

In 1996 the Moonee mine was reopened to work the Great Northern Seam by the long wall method. The seam was mined to a height of around 3.1 metres. In the mine each long wall panel was developed by continuous miners and a 90m wide long wall miner was then installed that worked each long wall panel. The mine was plagued by numerous unpredicted windblast events from goaf falls.[17] Eventually the combination of limited reserves and extraction costs caused the mine to be closed 2002.

While the long wall mining method is now common for new underground mines, following its introduction from the late 1970s[18], the system was rarely installed in older mines due to the difficulty of adapting the existing infrastructure to the long wall. An example of a similar installation to that at Moonee is at Ellalong Colliery. This was a modern extension of the original Paxton colliery using long wall mining and is, or was, the last colliery operating in the South Maitland

field.

It is clearly difficult to demonstrate this change on the surface apart from patterns of subsidence. However, there is a considerable amount of mining machinery exhibited in the coalfields. The best and most comprehensive collection is that at Richmond Main colliery which has a good representative range of equipment used.[19] The machinery at Moonee is only a small collection but at least contains some items that can interpret this aspect of mining history.

Power

The winder attached to 'B' Pit in 1994 was a steam powered winder with a boiler (ex-locomotive) attached nearby.[20] This is typical for mines at this time, however a decade later most of the larger mines were constructing electrical power plants. Initially these seem to be for surface lighting and powering of machinery underground (although some coal cutters were powered by compressed air) rather that lighting the coal face for the workers.

By 1912 Danvers Power was able to report on a powerhouse at Wallarah containing a steam driven Siemans Bros 250 volt dynamo which lit the jetty, allowing night working to occur. This seems to be a typical sized plant for a mine of this size. In the South Maitland field, after amalgamations, some mines shared power. For example, J & A Brown developed the powerhouse at Richmond Main so it could supply power to that mine and the adjacent Pelaw Main mine. When JAABS was formed, the Abermain Seaham collieries where added to the grid and their powerhouses closed. The Caledonia Colliery supplied all its mines from its powerhouse at Cockle Creek. In addition to the mines, power was also sold to local government for domestic use.

The history of the powerhouse at Catherine Hill Bay is not clear. Certainly, based on the complaints about housing at Catherine Hill Bay, power was not supplied for domestic use. In the immediate post-war period, electrically powered machinery was in use at the mines but it is not clear where the power came from.

The remains of sub-stations in the study area indicate that power was being drawn from the statewide grid, at least for the last few years of operation.

There are no remains of the power station in the study area.

Ventilation

Mine ventilation seems to have originally been by natural circulation there is little discussion of any surface or sub-surface ventilation such as furnaces or fans in the site history. A ventilation shaft is reported as being sunk to serve the working based on 'E' tunnel and it is likely that there is more to be found out about ventilation in this mine.
The axial fans which were installed at Wallarah and at Moonee appear to be quite recent. Shoebridge notes that the Sirrocco fans installed at most large mines from the 1920s were themselves replaced by axial flow units by the

1980s.[21].

4.1.5 COAL PREPARATION

The initial method of coal preparation at mines was screening and picking of skip loads. It is not clear whether this stemmed from a desire to provide customers with quality coal or make sure all skips were full of coal rather than a layer of coal over waste rock, as miners were paid per skip of coal produced. Generally larger lumps of coal were desired while the smaller lumps and rubbish were stored in a 'small coal box' for later sale.

In the 1930s mines began to experiment with coal preparation to firstly improve the quality of small coal and then improve the overall quality of coal. Two forms of coal preparation were utilised — a form of cleaning without water (ironically called dry cleaning) and washing. A coal washing plant was established at Hebburn No. 2 and a dry cleaning plant was established to serve the Aberdare and Neath mines. Both date from the mid-1930s. From the 1950s coal washeries were common but were not at every colliery. Rather coal from mines was washed at central locations which served several collieries.

The coal preparation plant at Catherine Hill Bay was not unique in any way, apart from the underground coal bins and the direct jetty loading which were simply a function of the local geography. The large concrete bin is unusual as it is set into the ground rather than, as most coal bins, being constructed above ground.

4.1.6 TRANSPORT OF COAL TO MARKETS

Coal mines were noted for the extensive system of tramways and railways that linked mines with transhipment points where coal was loaded for transport to domestic and international users. At Catherine Hill Bay, the railway was the major transport to the jetty until the reconstruction of the loading facilities in early 1960s. The Crangan Bay drift (now Wallarah Colliery) was designed to use road transport from the coal storage bins to the Jetty, and Moonee also worked on the same system of transport. When the preparation plant was established, it was deigned for the delivery of coal by road. This reflects the major post-war shift away from rail transportation.

Unlike the collieries in Newcastle and South Maitland fields, Wallarah loaded more or less directly from the mine to the ship. In this way it was similar to the mines from the Southern Collieries such as Coal Cliff, Bulli, or South Bulli which had their own jetties to load from. Over the years these jetties however were abandoned as the coal mines either shipped coal through the internal NSW railways or as the mines closed. This leaves the jetty at Catherine Hill Bay in a unique situation being the sole representative of a common type of industrial site that has now disappeared though a combination of economics and natural processes.

4.1.7 INDUSTRIAL RELATIONS

As far as can be understood, Wallarah Colliery remained comparatively free from the major industrial disputes that plagued the coal industry.

The Stump Building at Moonee Colliery is a rare building that relates to the theme of industrial relations through its association with the Miners Union.

4.1.8 DEVELOPMENT OF TOWNS AND VILLAGES

Like most mines (with the notable exception of Richmond Main), a small village of miners' cottages and dwellings developed to house mine workers. The layout and design of Catherine Hill Bay is similar to many small towns in the Hunter Valley such as Minmi, Plattsburg, Wallsend, West Wallsend, Kearsley, Kitchener etc, where an adjacent mine being a source of employment caused a mixture of permanent and semi-permanent dwellings to be established.

The settlement at Catherine Hill Bay is located in several 'clumps' which relate to the location of the various pits and facilities associated with the mine. Unlike the small mining towns in the Hunter Valley, Catherine Hill Bay had isolated access, being mainly by ship or ferry across Lake Macquarie and then walking. In contrast, the mining towns developed in areas already with a developed network of small farms and larger towns. The township of Catherine Hill Bay is outside the current study area.

ENDNOTES

[1] Lumping is undertaking too course an analysis where every place seems the same whereas, splitting uses minute variations to split places into different categories and thus all places become unique.

[2] See Armstrong, J (ed) 1983, *Shaping the Hunter: A Story of Engineers and the Engineering Contribution to the Development of the Present Shape of the Hunter Region, Its River, Cities, Industries and Transport Arteries*, Newcastle Division of the Institution of Engineers, Newcastle.
Andrews, Brian Robert, *Coal Railways and Mines: The Story of the Railways and Collieries of J & A Brown,* Sydney, Iron Horse Press, 2004.
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Stuart, Iain Malcolm 1997, *A Revision of the Conservation Plan for Richmond Main Colliery for Cessnock City Council,* report to Cessnock City Council by HLA-Envirosciences Pty Ltd.
Wells, David 2005, *A History of the Greta Coal Measures* (April 1989) [Internet Site], Newcastle Regional Museum 1989 [cited March 2005], available from http://amol.org.au/newcastle/greta/index.html.

[3] There is no thematic history or typological study of the New South Wales coal industry available for reference.

[4] Rat holes were small scale under-capitalised mines which existed between the larger mining leases, their nature is best expressed by the term rat holes.

[5] Apart from a brief mention in Jeans, D 1972, *An Historical Geography of New South Wales to 1901,* Sydney, Reed Education, 1972.

[6] Longworth, J 2002, The Coal Cliff Adit and Jetty Tramway, 1797 to 1910, Light Railways No. 167, pp 5–13.

[7] Jones, LJ, Coal Resources of the Newcastle–Maitland District Geological survey, Department of Mines, 1926.

[8] Danvers Powers, F 1912, Coalfields and Collieries of Australia, quoted in the CMP, op cit, p 42.

[9] Ibid p 11.

[10] Ibid p 42.

[11] McDonell, Shaun 2001, Longwall Mining Beneath the Pacific Highway Moonee Colliery — An Overview, unpublished paper to Australian Surveyors Conference.

[12] For a definition of these terms, see Ritchie, N and R Hooker 1998, An Archaeologist's Guide to Mining Terminology, *Australasian Historical Archaeology*, Vol 15, pp 3–29.

[13] Hargraves, op cit, p 121.

[14] Shoebridge 1983, in Armstrong, J (ed), op cit, p 53, and Stuart, IM 1998, A Heritage Assessment of Elrington Colliery, Report to Elrington Industries Pty Ltd, HLA-Envirosciences Pty Ltd.

[15] Hargraves, op cit, p 121.

[16] As quoted in the CMP, op cit, p 56.

[17] Hayes Peter 2000, Risk Minimisation in Longwall Operations in Massive Goaf Conditions Using Microseismic and Hydraulic Fracturing Techniques, unpublished paper to the Queensland Mining Council Annual Conference.

[18] Hargraves, op cit, p134.

[19] The collection was catalogued by the author in 1997.

[20] CMP, op cit, p 35, Plate 14.

[21] Shoebridge, op cit, p 47.