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Newnes shale oil complex archaeological report

NEWNES SHALE OIL COMPLEX
ARCHAEOLOGICAL REPORT

VOLUME ONE

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VOLUME ONE

SUMMARY

Newnes is the site of a major early twentieth century shale oil plant, which operated between 1906 and 1937. The technology present here included not only that capable of mining the raw shale, but also of distilling and refining it into a variety of marketable products. A total of over 100 historical archaeological features were located and recorded during two field seasons, the first during January - March 1990 and the second February - March 1991 (see Appendix 10.1).

When Newnes was originally established it was considered a major venture of its kind. Although at the time of establishment the company which initiated the scheme also controlled two of the only other viable competitors in New South Wales, this monopoly on production did not extend to the marketplace. The Newnes works were not readily adaptable and were not able to cope with, in the short term, producing small batches of specialist products or, in the longer term, with changes in emphasis between marketable products. As a result Newnes never succeeded as a completely functioning or economically viable enterprise.

The archaeology of this site is extremely complex as Newnes demonstrates the interrelationships between a variety of material remains, including both purely technical aspects (technology for mining shale, for distilling the oils, for refining them and for manufacturing specific products) and associated but necessary secondary processes (the provision of an adequate power supply, water supply and fuel supply or the production of construction materials), as well as certain domestic aspects (the provision of adequate housing or necessary services). The material remains at Newnes also represent more than one operational event or period, as five successive companies attempted to run it as a financial enterprise during its 31 year lifespan.

The analysis of historical and archaeological evidence allows the identification of the significance represented by the place and its elements. This is discussed more fully in section 5.

Principally the entire site of Newnes is an important archaeological and historical resource due to its size and the complexity of its remains. Newnes has the potential to demonstrate such varied themes as the introduction and adaptation of technology to the Australian environment, the changes in emphasis between marketable products in the first third of this century (for example as a result of the introduction of electricity or the increase in importance of the automobile) and the living and working conditions of employees and their families.

The principal significance of the Newnes site can be summarised as:

Newnes was one of the largest self contained shale oil production schemes in Australia during the early part of the twentieth century. It was established as a major venture, by a company which already owned the only other viable competitors.

It is a major historical monument to the oil shale industry in New South Wales in the early twentieth century. Its key role in this industry is illustrated by the sheer size of the works and the complexity and variety of plants and processes which were established there.

It contains an extensive archaeological resource for the study of contemporary shale mining, retorting, refining and by-product technology, the adaptation of this technology to the Australian environment and the broad spectrum of living standards and conditions present amongst employees.

In its growth and planning it testifies to the confidence which was placed in the marketability of certain particular products, but in its subsequent history of operations and ownership transfers it demonstrates the rapid changes which occurred in lighting and transport technology during the first thirty years of the twentieth century, which eventually rendered the complex obsolete.

Within this framework several features assume greater significance than others due to their state of preservation and their rarity. Particularly important for these reasons are the coke ovens (of which thirteen survive intact), the crude oil stills, the refining tanks, the paraffin production area and the upcast shaft for the Number Two shale mine. Other features are significant because they demonstrate particular processes specific to the Newnes site, such as the paraffin production area, which illustrates the complete process of manufacturing paraffin wax candles, the retort bench or the distillation and refining plants. Features such as the Big house and the remains of several other domestic buildings are also significant as they demonstrate a complementary aspect of the works: namely the living conditions and construction resources available to employees from different socio-economic groups.

LIST OF FIGURES

1. INTRODUCTION

Newnes is the site of an early twentieth century shale-oil mining venture. Apart from the mine itself, the site consists of a complete distillation, refining and treatment plant, plus subsidiary manufacturing industries such as a candle factory, sulphate of ammonia plant and brickworks. Newnes was also the site for a sizeable township with railway access between the mine, the town and the Great Western line. Both part of the site of the township and the entire site of the works at Newnes lie within the boundaries of Wollemi National Park at the northeastern end of the Wolgan Valley, approximately 40 km northwest of Lithgow and 191 km by road from Sydney.

1.1. Objectives.

The main objectives of this project were:
* To review existing documentary evidence on the study area
* To record the cultural elements of the study area
* To assess the relative importance of each feature within the study area, as well as of the area as a whole.

This involved identifying both known and potential historic sites and features, as well as identifying areas of archaeological or historical potential not previously considered (see Appendix 10.2).

1.2. The Study Area.

This project was completed in two stages. The study area covered by the project was restricted primarily to the main industrial complex on both sides of the Wolgan River. The boundaries for this area were determined by a number of factors. Firstly the Wollemi National Park boundary excludes most of the gazetted township area from ownership or management by the National Parks and Wildlife Service. Secondly, as the majority of substantial above-ground archaeological remains are restricted to the industrial area, this section serves as a focus for visitors to the site. As many of these remains are substantial and as visitor use is frequent and largely unchecked, the main works area was identified as being crucial to record. This was not only so as to determine the precise extent and content of the industrial area, but also to evaluate its condition and the possible effects of constant visitation. As a result of the sheer size and complexity of the industrial area however, the first field season only covered the main nucleus of the works area, namely that on the southern side of the Wolgan River in the immediate vicinity of the distillation, refining and treatment plants (Fig. 1.1). This formed Stage 1 of the project and was conducted between January and March 1990. For consistency the second field season was designed to complete the recording of the remainder of the industrial zone only, so as to place the central industrial section within the context of the rest of the works. Many of the areas surveyed during Stage 2 were thus peripheral, but complementary to the main works area. Stage 2 was completed between 11th February and 20th March 1991 and concentrated on the three outlying areas of the works complex which had been excluded from Stage 1. These were located southwest, north and southeast respectively of the Stage 1 survey area, on both sides of the River (Fig. 1.1). Although the project was directed towards recording the industrial complex only, thus excluding the official township, as many employees elected to live in closer proximity to the works than the township allowed, many domestic structures were also recorded as part of the survey.

1.3. Methodology.

1.3.1. *Design and Survey Method (Stage One)*

As the area of the Newnes works has already been extensively mapped and the layout and spatial arrangements of the site established for the period circa. 1911 by the company active during that period, the Commonwealth Oil Corporation, this provided a convenient basis from which to conduct the survey. On the basis of this detailed map it was unnecessary to instigate a complete survey in terms of the spatial relationships between the major features and thus the c. 1911 map was adopted as a base map.

In order to subdivide the site into smaller and more manageable survey units the major access tracks (both vehicular and walking) were plotted onto the base map using a compass and pacing method. The tracks were used to divide the site into seven main areas which were then labelled

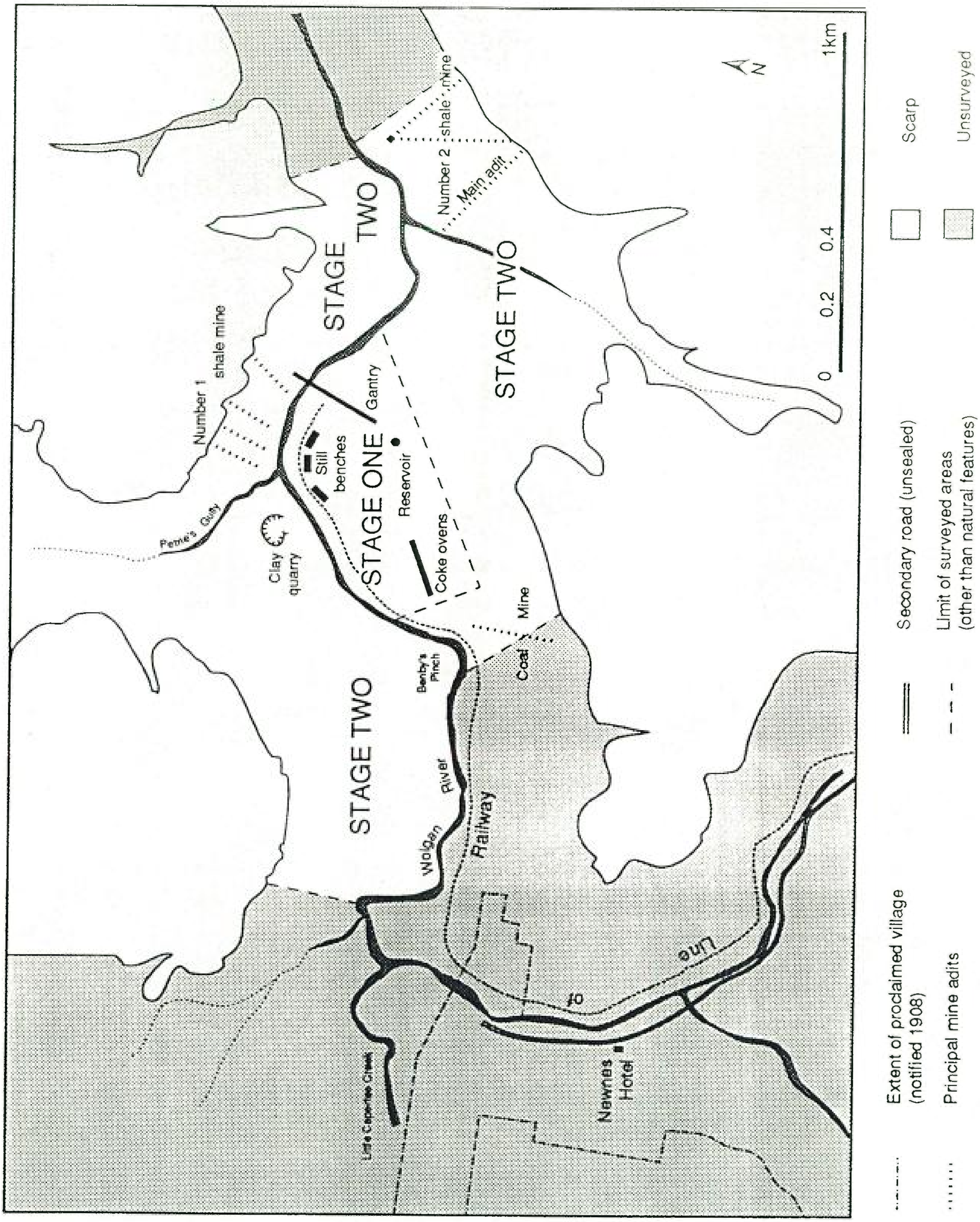

Figure 1.1: Newnes township and industrial complex in the Wolgan Valley.

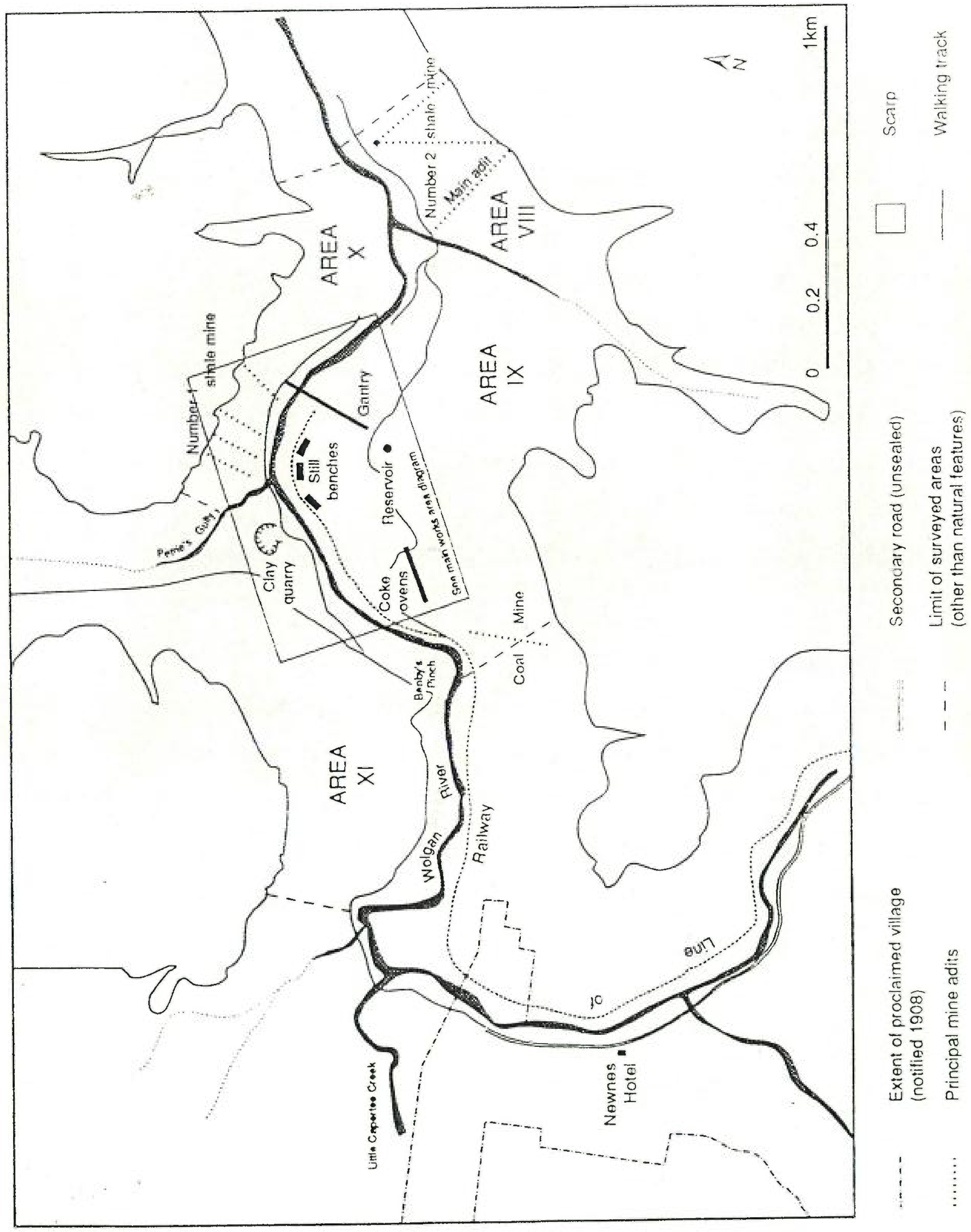

Figure 1.2a: Survey areas for both Stage 1 and Stage 2 archaeological surveys.

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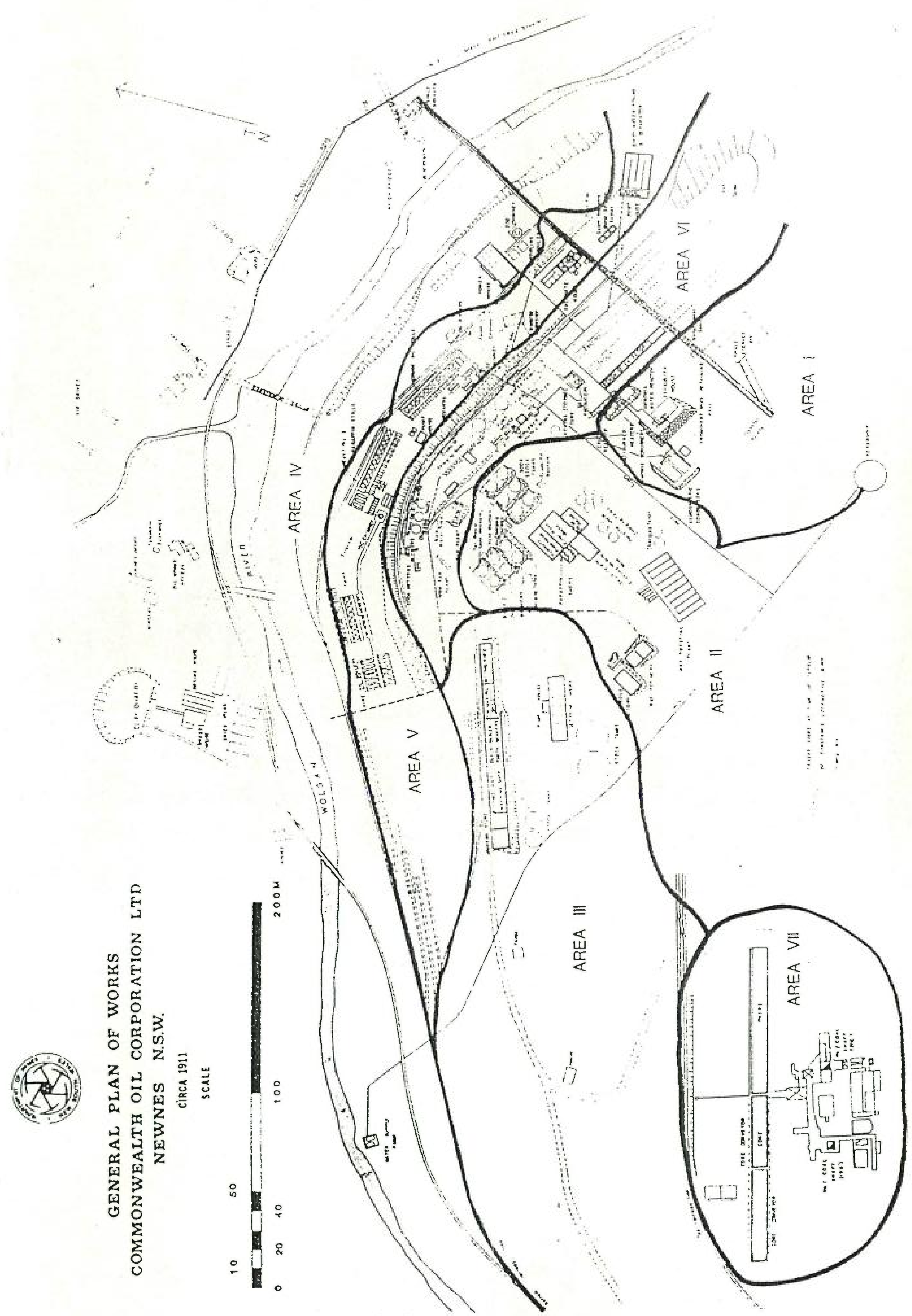


Figure 1.2b: Inset Main works area.

using Roman numerals from I to VII (Fig. 1.2). This meant each area could be re-located more efficiently on the ground using known geographic features as reference points.

Each major feature within the seven areas was then assigned a number given in Arabic numerals and any peripheral features associated with it labelled alphabetically. For some of the larger and more complex features their component parts were also subdivided into alphabetical units and labelled consecutively along with any secondary features. For example, as Area II contains a total of six features, the full reference number for the wax refinery is II/2 and the boiler, firebox and chimney associated with it is II/2/a. Initially a dumpy level was used in an attempt to plot in subsidiary features, however even in the more open areas vegetation cover proved too dense to make this efficient. Consequently subsidiary features were plotted in relation to major features using a compass and pacing technique, which was cross checked as often as possible. A similar unique recording number was assigned to features which could not be located in the field, but which are known from documentary sources to have existed on site. In these cases the historical feature was numbered consecutively, so as to follow on from the last recorded associated archaeological feature and the prefix H attached (eg. HIV/3/i, the weir associated with the water supply pump).

1.3.2. *Design and Survey Method (Stage Two)*
The survey strategy adopted for Stage Two followed the system already established during Stage One. The 1991 survey areas were designated with Roman numerals so as to follow on consecutively from the areas recorded the previous year. It was less convenient to divide these areas into easily manageable units, as the total area to be covered was not only greater, but less easily defined in terms of known geographic reference points. The designated Areas VIII, IX, X and XI were thus of greater size than the survey units recorded in 1990 and were defined according to either the established boundaries of other surveyed areas or, where possible, to readily identifiable topographic features (such as Petrie's Gully) (Fig. 1.2).

Vegetation overgrowth was the major problem with this survey and although the aim was to produce scaled drawings for each major feature and its subsidiary elements, in some cases this was not possible. Difficulty of access to certain areas of the site proved to be a problem, particularly feature I/4, the crude oil reactor and feature XI/23, the brick kilns. Consequently drawings of this and some other features were either not possible or are not to scale. The error factor worked to in this survey was 1 in 100. In general there was not time enough to adequately clear all features which were heavily overgrown. The Fine oil boilers (V/7), the Workshop complex (III/4) and the front section of the Sulphate house (V/3), which were some of the more densely covered features in the main works area, were partially cleared during Stage One of the project. Unfortunately this was not according to the archaeologist's specifications (i.e: it was not conducted by hand and was done without adequate knowledge of what the archaeologist required).

For both stages of the project, all features were recorded descriptively using standard National Parks and Wildlife Service historic place recording forms. Overview photographs were taken of each feature and specific detailed photographs of particular elements or aspects also taken where relevant. Plan drawings were completed for each feature, except where the feature was considered to be adequately described by narrative. For example, the ceramic pipe culverts and certain landscape features such as clearings, cuttings or mounds could not have been better recorded using scaled drawings. Where vegetation cover was sufficiently dense for there to be serious doubt as to the accuracy of such a plan (for example, the brick kilns, the workshop complex or the area of the Number One shale mine) these were also considered best recorded using recording forms and photographs only.

For recording features onto the site recording forms several characteristics were noted as consistently as possible. Apart from general observations of salient descriptive points these included the dimensions, brick bonds or other construction techniques used, the current state of the physical remains, possible threats to the feature, locations and descriptions of any relevant portable surface artefacts and the state and type of vegetation growth. This last characteristic, along with amounts of soil/sediment/leaf litter cover, was included as part of the general level of visibility of features across the site.

Full details of the archaeological survey form Volume Two of this report.

As discussed each feature surveyed was allocated a unique site reference number. For most features this worked quite adequately, however with the gantry, sections of which span the entire width of the site, all of its component parts were grouped under the one reference number, assigned according to which area its features were first recorded in. Consequently even though sections of the gantry's foundations occur in Areas I, IV, V, VI and X, throughout it has been referred to as feature I/6.

At least one field assistant was present at all times during both survey periods and half of these volunteers were either professional archaeologists or competent post-graduate archaeology students. Such trained assistants were placed in charge of recording features independantly. Where field assistants had received no formal training in archaeology however, they were accompanied by the consultant, who completed all of the detailed recording.

The names for each major feature are taken from William Petrie's 1911 map of the works, rather than the 1977 Department of Mines copy, as there appear to be several discrepancies in the manner in which features are labelled and depicted (see Appendix 10.1). It is assumed that Petrie's copy more faithfully represents the titles and relationships between features.

Individual descriptions of features have been included as Volume Two of this report, although they have been kept to a minimum. More detailed information is available in the site recording forms (Appendix 4.2, Volume 2).

All archaeological features recorded have been listed in Appendix 10.1. This appendix also correlates this information with the known historical names for each feature and with known historical features which were not located in the field.

1.4. Sources of Information.

In order to reconstruct the buildings and processes present at Newnes as accurately as possible a wide range of sources were consulted (see Appendix 10.3). Primary documentation in the form of Company records, accounts, maps, blueprints or Government reports were an obvious source, although there is little of this available for consultation and what is available is mostly late in date and therefore concerned with the tail end of operations at Newnes (c. 1930s - 1940s). Several boxes of archived blueprints, plans and documents relating to Newnes from as early as 1906 are located at the Australian Archives office, Sydney, however consultation of these could not be accomodated within the time frame of this report (see Appendix 10.3). The contents of AA Box 50, which contains plans and blueprints relating directly to the Newnes works is included as Appendix 10.4. Particularly useful were two schedules of assets prepared in the early 1930s, which listed specific equipment and buildings present at the Newnes site. The most comprehensive of these lists is included as Appendix 10.5.

Secondary sources, such as recent archaeological or technical reports, historical publications and newspaper cuttings provided background information on the history of the area, some of the major events in the operation of the mines and works and various interpretations of the remains at the site. Contemporary technical reports (ie: c. 1890s - 1930s) particularly provided a wealth of information regarding the standard methods and equipment available for mining and processing oil shale and, due to a lack of specific references to the process in use at Newnes, it is from these sources that an overview of operations has been reconstructed.

Other sources of information were able to throw light on various aspects which were not covered by official or technical records. Photographs of the works during various stages of operation were a valuable source, as were personal reminiscences of people who had been involved with the site. Unfortunately, there are very few people still alive who have any firsthand knowledge of the Newnes site and many of those who were consulted during the course of this research were only present during their childhood or as casual visitors to the site. Records of these interviews are included as Appendix 10.6. Taped recordings of these sessions were not made.

1.5. Acknowledgements.

Field assistance at various stages of the project was given by Noeleen Steel, Bronwyn Conyers, Sherri Lee Evans, Luke Godwin, Neil Stone, Fiona Porteous, Leonie Knapman, Greg Knapman, Trevor Evans and Patrick Clementson. Comments and constructive suggestions on various drafts of the report were provided by Luke Godwin, Bronwyn Conyers, Denis Gojak, Noeleen Steel and John Appleton.

Photos and technical information were kindly provided by George Hicks, Jim Norcross (especially for his copy of William Petrie's 1911 map), Daryl Mead, George and Mavis Wilson, Leonie Knapman and Alan Watson.

Several past residents of or visitors to Newnes also gave kindly of their time: thanks to Jim Norcross, Bill Norcross, Isobel Fynch, Jenny Hall, Heather Webb and George Wilson.

2. HISTORICAL BACKGROUND

2.1. The Mining of Oil Shale.

Oil shale is a fine textured sedimentary rock containing organic matter known as kerogen, from which oil can be distilled through the application of heat. The destructive distillation of kerogen breaks down the large carbon compounds contained within it and converts these into simple molecules of gas, liquid and solid hydrocarbons and their derivatives (Simpson 1983, 82). Oil shale is thought to have originated in large lakes or shallow stagnant seas and in lagoon conditions associated with coal-producing swamps. The principle source of its organic material is thought to have been the algae present in these environments (Wall 1972, 23).

A process for the extraction of oil from shale was first patented as early as 1694 in Great Britain, however the first commercial plants did not come into existence until 1838 in France and 1850 in Scotland (*Encyclopaedia Britannica* 1989/10, 692). With James Young's patented process for the dry distillation of coal and shale and its subsequent refining with sulphuric acid and caustic soda (patented in 1850), shale oil became the basis for a major industry (Scheithauer 1923, 4-5). Demand was a result, not of the oil itself, but of the various products which could be distilled and extracted from its constituent parts: chiefly kerosene, paraffin wax, lighting oils, lubricants and, after the turn of the century, motoring fuel. The shale oil extraction industry began operating in Australia during the nineteenth century. At the same time it became operational in Great Britain (mainly Scotland), Germany, France, Brazil and the United States. Other countries such as China, Estonia, New Zealand, South Africa, Spain, Sweden and Switzerland did not begin to extract oil from shale until the twentieth century (*Encylopaedia Britannica* 1989/10, 692; Scheithauer 1923, 6-30). In terms of the relative yield of oil per ton of shale, the shales of Scotland are often rated as the richest, although it seems to have been a constant source of disagreement as to whether the shales of Australia should be rated as first or third in the world (eg: Alderson 1919, 6; *Sydney Morning Herald* 22/12/39).

2.2. Oil Shale Mining in Australia.

The majority of oil shale mining which has taken place in Australia has been confined to New South Wales, with a handful of exceptions occurring in Tasmania, Victoria and Queensland (Birmingham, Jack and Jeans 1979, 120) (Fig. 2.1).

The shale oil industry developed in Australia in the mid to late 1860s, although it has been claimed that the existence of shale was mentioned as early as 1807 by a French scientific expedition and later by the Reverend W. B. Clarke (Kraemer and Thorne 1951, 4; Morrison 1928, 347). Some sixteen mines were producing in New South Wales between the years 1865 and 1952, the earliest being Mt. Kembla (1865 - 1878), Hartley Vale (1865 - 1907/1913) and Joadja (1873/4 - 1904) (Birmingham, Jack and Jeans 1979, 120; Knapman 1988). The economic incentive for the establishment of the shale industry lay chiefly in the supply of raw shale and gas oil distilled from the shale to the gasworks companies, which used the shale and its product to improve the quality of domestic gas lighting (Mead 1986, 88, 536). Other marketable products available from the shale oil included kerosene, various grades of naphtha, lubricating oils and greases and paraffin wax candles.

By the early 1890s production was on quite a large scale, continuing so after the turn of the century and eventually peaking in 1912. Demand began to slump after this as a result of competition from American flow oil, until by the mid to late 1920s production had ceased entirely (Figs. 2.2 and 2.3). It was only recommenced on a viable scale with the demands of World War 2 (Commonwealth Bureau of Census and Statistics 1928 - 1953; Egloff, Mead and Egloff 1987, 5; Morrison 1928, 360).

The major mines of the twentieth century were Newnes, Glen Davis, Marrangaroo and Murrurundi, while others such as Baerami, Ulan, Barrigan Creek and Capertee were of relatively minor scale.

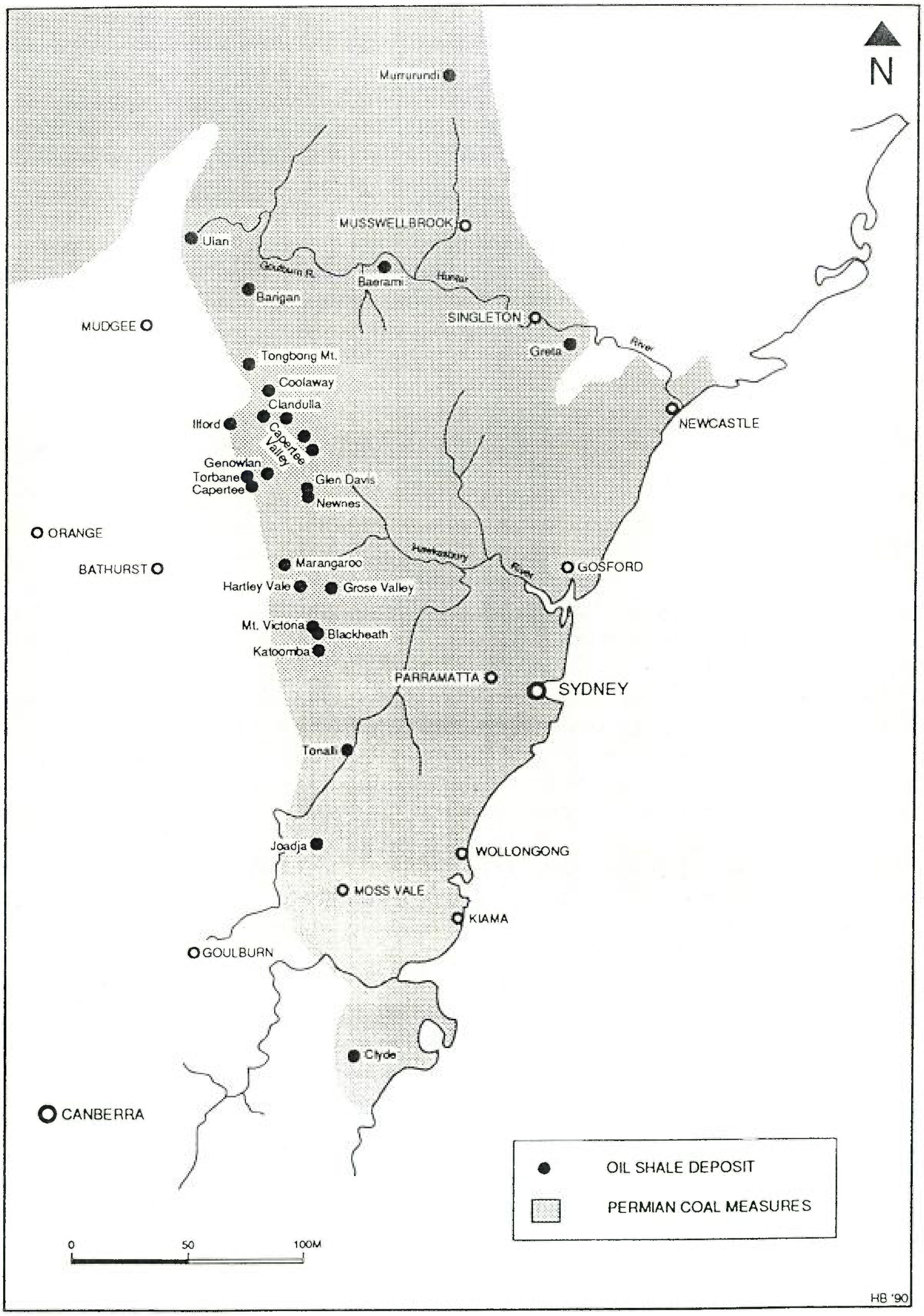


Figure 2.1: Oil shale mining locations in New South Wales.

YEAR	QUANTITY	AV. PRICE PER TON	TOTAL VALUE	YEAR	QUANTITY	AV. PRICE PER TON	TOTAL VALUE
	Tons	£ s. d.			Tons	£ s. d.	
1865	570	4 2 5.47	2,350	1908	46,303	0 11 3.11	26,067
1866	2,770	2 18 10.48	8,150	1909	48,713	0 9 8.35	23,617
1867	4,079	3 14 9.21	15,249	1910	68,293	0 9 11.11	33,896
1868	16,952	2 17 7.11	48,816	1911	75,104	0 9 10.17	36,980
1869	7,500	2 10 0	18,750	1912	86,018	0 8 1.01	34,770
1870	8,580	3 4 3.18	27,570	1913	16,985	0 10 8.64	7,739
1871	14,700	2 6 3.91	34,050	1914	50,049	0 10 11.25	27,372
1872	11,040	2 11 11.91	28,700	1915	15,474	0 16 7.92	12,890
1873	17,850	2 16 6.55	50,475	1916	17,425	1 0 4.78	17,772
1874	12,100	2 5 1.48	27,300	1917	31,661	1 3 1.17	36,565
1875	6,197	2 10 2.22	15,500	1918	32,395	1 4 6	39,676
1876	15,998	3 0 0	47,994	1919	25,453	1 9 10	37,968
1877	18,963	2 9 .81	46,524	1920	21,004	2 3 10	46,082
1878	24,371	2 6 11.40	57,211	1921	32,489	2 7 8	77,380
1879	32,519	2 1 1.96	66,931	1922	23,467	2 11 8	60,641
1880	19,201	2 6 7.03	44,725	1923	1,207	2 6 11	2,831
1881	27,894	1 9 2.59	40,748	1924	642	1 9 11	962
1882	48,065	1 15 0	84,114	1925	0	0 0 0	0
1883	49,250	1 16 10.77	90,862	1926	0	0 0 0	0
1884	31,618	2 5 7.86	72,176	1927	0	0 0 0	0
1885	27,462	2 8 11.62	67,239	1928	2600		
1886	43, 563	2 5 10.79	99,976	1929	4300		
1887	40,010	2 3 10.43	87,761	1930	346		
1888	34,869	2 2 2.66	73,612	1931	2000		
1889	40,561	1 18 3.55	77,667	1932	2691		
1890	56,010	1 17 2.07	104,103	1933	0		
1891	40,349	1 18 8.77	78,160	1934	200		
1892	74,197	1 16 8.16	136,079	1935	0		
1893	55,660	1 16 4.44	101,221	1936	0		
1894	21,171	1 10 .28	31,781	1937	0		
1895	59,426	1 5 3.78	75,219	1938	0		
1896	31,839	1 1 5.81	34,202	1939	0		
1897	34,090	1 3 9.91	40,612	1940	43,805		43,805
1898	29,689	1 1 5.34	31,834	1941	123,578		96,671
1899	36,719	1 2 2.83	40,823	1942	117,324		142,343
1900	22,862	0 18 .79	26,652	1943	116,875		160,215
1901	54,774	0 15 1.79	41,489	1944	137,458		165,285
1902	62,880	0 18 11.93	59,717	1945	123,170		164,648
1903	34,776	0 18 11.93	28,617	1946	121,654		139,902
1904	37,871	0 16 5.50	26,771	1947	138,427		193,798
1905	38,226	0 14 1.65	21,247	1948	136,352		204,528
1906	32,446	0 17 6.59	28,470	1949	120,956		181,437
1907	47,331	0 13 6.54	32,055	1950	93,487		185,084

Figure 2.2: Australian oil shale production 1865-1950.

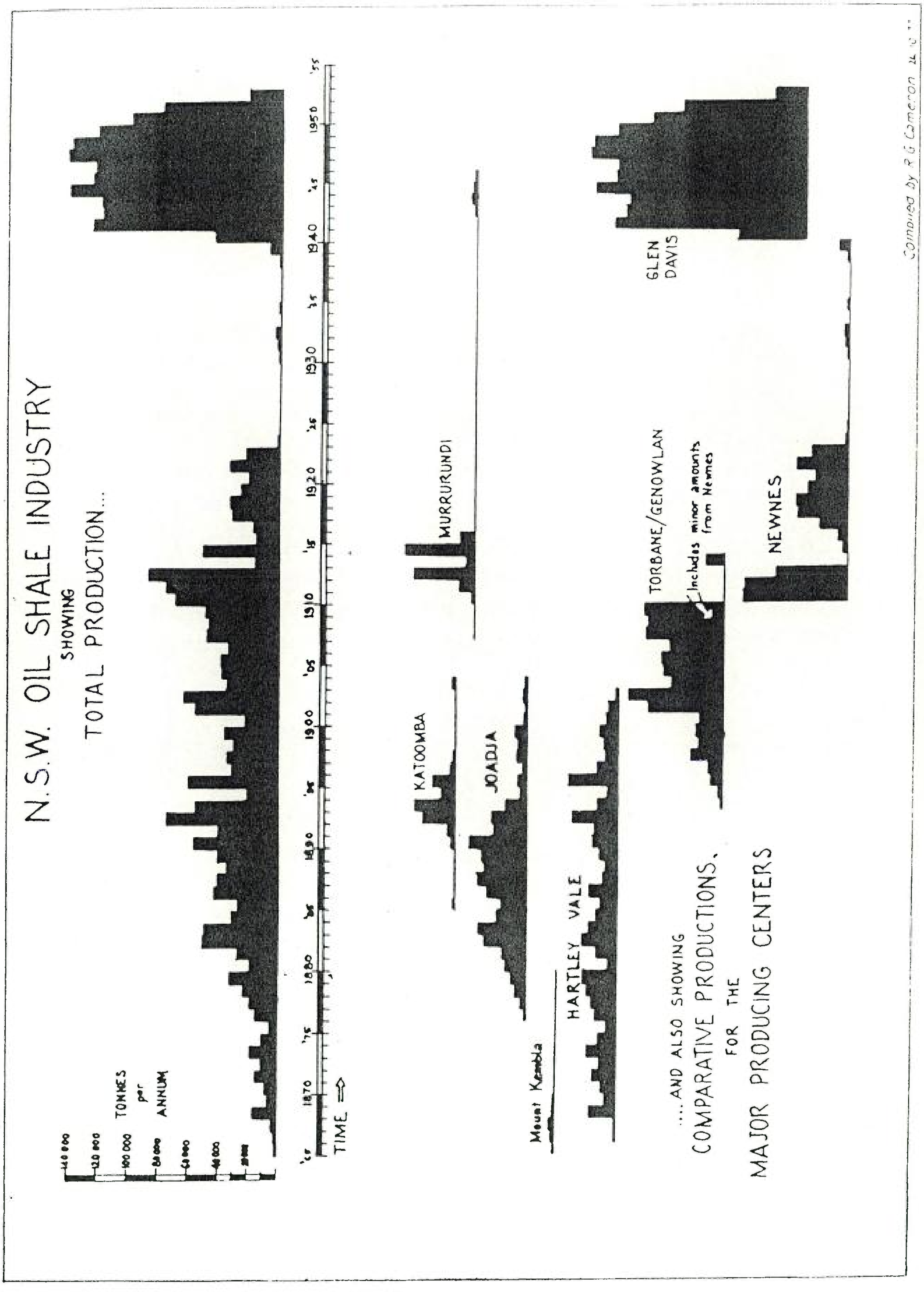


Figure 2.3: New South Wales oil shale production 1865-1955.

2.3. Newnes.

The Wolgan Valley was settled by Europeans some time after 1822, when James Walker established an outstation for his property Wallerawang in the valley and named it Wolgan (MacLeod Morgan 1959, 87). According to J. E. Carne (1903, 177-178) one Campbell Mitchell was the first person to seriously open a shale seam in the Wolgan Valley in 1873, although he also mentions the possibility of some earlier superficial investigation in the form of an 'opening', which was noted on the site of Mitchell's earlier prospecting operations in 1868. In 1883 after Mitchell had abandoned his leases, they were taken up by a Knoblanche and Wilkins, who continued mining operations in the area.

From the 1880s the Wolgan Valley was the site of numerous and often short lived mining and prospecting ventures. Two of these took place on what was later to become the site of Newnes itself. In 1884 Duff and Hartman drove prospecting tunnels along the eastern side of Petrie's Gully, on the site of what later became the Number One shale mine, and in the early 1900s George Anderson began mining further east, an operation which established the Number Two shale mine (Carne 1903, 178-179; Salter 1982, 1).

In terms of larger scale commercial interest in the valley, this was first manifested by the New South Wales Shale and Oil Company operating in Hartley Vale in the late 1880s. This was a direct consequence of doubts shown in the Hartley Vale seam, which resulted in the Company actively searching for other deposits (*Lithgow Mercury* 1/9/33; Salter 1982, 1). Although a prospecting party was sent into the Wolgan Valley in 1887, no commercial mining of shale was undertaken until the Commonwealth Oil Corporation purchased first George Anderson's and then the New South Wales Shale and Oil Company's assets and subsequent established itself permanently in the Wolgan Valley in 1905 (*Lithgow Mercury* 1/9/33; Salter 1982, 1). This was the beginning of four major periods of shale mining activity at Newnes during its lifetime.

1. *Commonwealth Oil Corporation Period 1903 - 1912/13.*

The Commonwealth Oil Corporation was officially floated and formed in 1905, raising as total capital £800,000 (Lane and Lane 1977, 1-2). Its principal directors were Sir George Newnes, Sir William Avery and Sir William Ramsey (Lane and Lane 1977, 1), who are reported to have conceived the Corporation in response to recommendations made by D. Sutherland, an engineer who was sent to Australia to investigate the Capertee Valley shale deposits. Although the yield in the Capertee Valley was considered exceptionally high, the Wolgan Valley was mined in preference, due to its better water supply and greater accessibility to Sydney (Lane and Lane 1977, 2; *Lithgow Mercury* 4/1/40; *Sydney Morning Herald* 22/12/39).

Work was begun on construction of the production complex almost immediately after the establishment of the Corporation in the Valley, although the scale and complexity of the project meant that it would take another five years to complete. Despite this lengthy construction period shale was being extracted from both of the Corporation's mines (the Number One and the Number Two) on a large scale from 1906 onwards. Prior to the Newnes complex coming on line the raw shale was sent to the sites of the Commonwealth Oil Corporation's other shale mining ventures: first to Torbane for retorting and the production of crude oil and then to Hartley Vale for refining (*Australian Mining and Engineering Review* 1910, 412).

Despite these auspicious beginnings however the plant, though begun in 1906, was not ready for production until the 12th of June 1911 and it was only six months after this in January 1912 that the Corporation went into liquidation (Eardley and Stephens 1974, 207; Salter 1982, 12). It is unclear precisely why the Corporation folded so soon after their first successful retorting operation, although both labour problems and the inability of the Scottish-designed Pumpherston retorts to cope with the richer Australian shales have been cited as major factors (Lane and Lane 1977, 5; Simpson 1983, 121). After the establishment and erection of the plant, the Company seems to have been beset almost continually with industrial problems until it closed down completely and liquidated in 1912/1913.

2. *John Fell and Company Period 1914 - 1927.*

Following the liquidation of the Commonwealth Oil Corporation the works were closed in 1913 and in 1914 the company was placed with receivers. Sometime between 1911 and 1915 William Petrie had control of the works for six months, prior to John Fell's arrival. It was during this time that he erected his experimental retorts (section 3.3.1) (Goodberg 1982, 98). In 1915 John Fell resurrected operations at Newnes in association with the Commonwealth Oil Corporation under the name John Fell and Company (Eardley and Stephens 1974, 207; Lane and Lane 1977, 5; Salter 1982, 12). Once in control of the operations at Newnes, John Fell and Company proceeded to redesign the original retort bench to render it more capable of processing the rich Newnes shale, re-timber the Number Two shale mine and transport a variety of equipment from other allied ventures such as Hartley Vale, Glen Alice and Torbane (Eardley and Stephens 1974, 207). Between February 1916 and March 1918, as well as handling and processing its own output, the Newnes plant was also treating shale mined at Torbane (Eardley and Stephens 1974, 207).

The John Fell and Company period was one of constant industrial disputes and periodic closures of the mines and the works. Brown (1990, 181) infers that this was at least partially due to the launching of the Australian Coal and Shale Employees Federation in 1915, to which the majority of Newnes shale miners belonged. Twice in 1917 for brief periods and once in 1919 for three months industrial disputes forced cessations of work, until in 1922 mining was suspended completely. By 1924 operations had ceased permanently and in 1927 the Commonwealth Oil Corporation advertised for tenders for the purchase of all assets (Eardley and Stephens 1974, 213; *Lithgow Mercury* 1/9/33; 11/9/33).

3. *Mixed Period 1929 - 1936.*

Following this there were three further attempts to take over and operate the Newnes works, however none was successful. Initially A. E. Broué took over the mining leases in partnership with several Broken Hill companies in 1929, however after they withdrew from the partnership Broué continued alone, operating Newnes for a total of one month (Eardley and Stephens 1974, 213). Following this the Shale Oil and Development Committee Limited commenced mining and retorting in

1931. It also soon ceased operations, although after a slightly longer stretch, in 1932. Finally Robert Treganowan and Cecil Chambers were placed in possession of the works, however their venture never eventuated due to lack of finance (Eardley and Stephens 1974, 215). Subsequent to this, in 1934 the site was the subject of interest from the Newnes Investigation Committee, a combined federal and state government body formed to investigate the potential for revival of the oil shale industry. Despite their title this committee focussed its attention not only on Newnes, but also on the Capertee Valley and was a necessary precursor to the final stage in Newnes' industrial lifetime.

4. *National Oil Company Period 1937 - 1939/40.*

In 1937 George Davis, in partnership with both the Federal and State Governments, agreed to take over the operation of the oil industry at Newnes, forming the National Oil Company and establishing the site of Glen Davis in the same year. This heralded the end of Newnes as a viable concern and much of the plant is stated to have been dismantled and removed for later use at the Glen Davis works (Eardley and Stephens 1974, 217) (Fig. 2.4). Newnes was last actively used as a staging post for the petrol pipeline running between Glen Davis and Newnes Junction.

There is no doubt that Newnes was one of the largest and most complete oil shale processing plants in Australia during its heyday, with a rich reserve of shale upon which to draw. It is a mark of the importance invested in the Newnes venture that when it was established the Commonwealth Oil Corporation had already purchased the total assets of their nearest recognisable competitor, the New South Wales Shale and Oil Company (Goodberg 1982, 9). Thus when Newnes was conceived and created it was as the sole viable production centre for the oil shale industry in New South Wales, if not also in Australia. A government report to the Shale Oil Investigation Committee in 1926 described it as being, 'the largest of its kind in the southern hemisphere' (Report from the Joint Committee of Public Accounts 1926, 5) and the Geological Survey of New South Wales in a report for 1928 claimed the Newnes shale deposit was 'the most extensive yet discovered in the state' (Morrison 1928, 352).

Around 1900	George Anderson takes up land in the Wolgan Valley. Digs shale from 'Anderson's tunnel'.
1903	Commonwealth Oil Corporation purchases Anderson's assets. First consignment of shale brought out of the valley.
1905	Commonwealth Oil Corporation officially formed.
Dec. 1905 - June 1906	Township named after Sir George Newnes.
June 1906	Population approximately 100.
Sept. 1906	Road into Newnes completed. Layout of township established.
Oct .1906	Work begins on railway line from Newnes Junction to Newnes.
1906	Coal first mined.
March 1907	Population approximately 800.
June 1907	School opens (52 children enrolled).
1907	Railway completed. Coke works ready for continuous operation.
1910/1911	Pumpherston retorts begin operation.
1911	General labour strike. Population approximately 1652.
Jan. 3, 1912	Commonwealth Oil Corporation liquidated.
Feb. 1912	Works closed.
Feb. 16, 1914	Company placed with receivers - "D. Fell and Co."
1914	Initial conversion of two Pumpherston retorts to Fell retorts
April 1915	John Fell begins operations at Newnes. Associated with Commonwealth Oil Corporation under name "John Fell and Co."
1917	Population approximately 800.
Nov. 1919- Feb. 1920	Works closed due to industrial troubles.
Jan. 1923	Operations cease, except refinery which continues to treat imported crude oil from March 1923.
April 1924	Population approximately 200.
Sept. 1924	Refinery closed.
July 30, 1927	Commonwealth Oil Corporation advertise for tenders for purchase of all assets.
April 1929	School closes.
1929/1930	A. E. Broue takes over mining leases with the backing of the main Broken Hill Companies under name "Shale Oil Investigations Ltd."
1930	Broken Hill companies withdraw from partnership. Broue operates alone as "Oil Producers (Newnes) Ltd."
Feb. 1931	48 men employed.
March 24, 1931	Work ceases - no money for wages.
Aug. 12, 1931	Newnes re-opened under federal government grant (£ 39,000) under "Shale Oil and Development Committee Ltd."
Sept. 1931	School re-opens.
Nov. 1, 1931	Mining and retorting commenced.
March 1932	"Shale Oil and Development Committee Ltd." ceases operations.
April 16, 1932	Works closed.
June 28, 1932	Robert Treganowan and Cecil Chambers placed in possession of plant and works as "Australian National Shale Oil Company Ltd."
1933	Population approximately 339.
May 1936	Federal Government announces nationalising of Newnes and calls for tenders to take over and operate the oil works.
April 1937	Agreement between Federal Government, State Government and George Davis for operation of oil industry at Newnes. "National Shale Oil Co." formed.
1937	Glen Davis site established. Some machinery and plant (retorts, refinery and power house) demolished for re-erection at Glen Davis.
1939	More of plant at Newnes dismantled.
May 1940	School closed. Production at Glen Davis commenced.
1941-1942	Rail line taken up. Some shipped to Tobruk for use in war effort.
Nov. 1948	"P. King and Sons Marrickville" dismantle boilers at Newnes works.

Figure 2.4: Chronology of Newnes.

The thickness of the shale deposit in the Wolgan Valley was given by John Fell in 1925 as ranging between 14 and 50 inches, with an average of 20 inches. This yielded an average 101.5 gallons of crude oil per ton of shale (Wade 1925, 16), although in 1931 - 32 the average yield was only 98.2 gallons per ton (Newnes Investigation Committee 1934, 33). The geological survey estimated in 1928 that the probable reserves of shale in the Wolgan deposit amounted to approximately 20,000,000 tons which, with an average yield of 100 gallons to the ton meant there was roughly 2,000,000,000 gallons of crude oil available in the area (Morrison 1928, 352). Later, in 1930 A. E. Broué claimed there was enough oil in the shales at Newnes to last Australia for 100 years (*Sydney Morning Herald* 21/7/30).

Briefly the extractive process employed at Newnes took place in four main stages. Once mined the shale was crushed and transported to the retorting area. Following retorting the resulting crude oil was withdrawn from the retorts as vapour, condensed into liquid form and then transported to the distillation area where it was fractionated into its various products, which in turn were refined with a succession of chemical treatments, stored and then transported for sale. The sequence of crude oil distillation relies upon the varying boiling points of its constituent fractions. A rough guide to the relative boiling points of crude oil fractions is provided by Williams (1978, 544) which, although derived from the behaviour of flow oil, can be broadly adapted to apply to shale-produced crude oil. Petrie's (1905, 998) scale is derived specifically from his analysis of New South Wales shale and has therefore been used here to modify Williams' results.

Approx. Boiling Point	*Fraction*	*Products*
40 - 100°C	Light Naphtha	Gasoline
130 - 220°C	Heavy Naphtha	Solvent, Dry-Cleaner's Spirit
150 - 275°C	Light Oil	Kerosenes, Heating Fuel
220 - 350°C	Gas Oil	Diesel
275 - 400°C	Heavy Oil	Lubricants, Paraffin Waxes
400 - 420°C	Chrysene	Still Coke

During the peak periods of Newnes' activity (between 1909 - 1912 and 1915 - 1923) the works produced a total of 25,260,015 gallons of crude oil and crude naphtha. In addition to this the following products were also derived (Report from the Joint Committee of Public Accounts 1926, 5):

Product	*Amount in Gallons*
Gas Oil	13,915,065
Kerosene	3,136,670
Lubricating Oil	2,316,126
Motor Spirit	1,689,279
Power Kerosene	743,380

By-product	*Amount in Tons*
Paraffin Wax	230
Oil Coke	307
Oil Pitch	528
Sulphate of Ammonia	718

In a rough breakdown the average distillation yield of one ton of shale would result in 20% fuel oil, 25% gas oil, 20% kerosene, 5% benzine and motor spirit (naphtha), 5% wax and a loss in treatment of 25% (loss including coke and permanent gas). In addition 22lb of sulphate of ammonia could be produced from each ton of shale, plus a small amount of oil coke (Morrison 1928, 352).

No expense seems to have been spared at Newnes to create a complete commercial unit, with the processes representing not just the mining and retorting of the shale, but also the distillation of the resulting crude oil and its refining. In addition the plant at Newnes was geared towards producing a full range of by-products from the crude oil, ranging from a concentration on kerosene and fuel oils down to the production of sulphate of ammonia fertilizer and paraffin wax candles. There are a number of versions for the precise figure which the Newnes plant cost initially. W. J. Hall, one time general manager for the New South Wales Shale and Oil Company, placed the figures for the initial cost of the plant at Newnes at around £875,000, with the expenditure later constituting more than double that amount (*Lithgow Mercury* 1/9/33). 1924 estimates however (*Lithgow Mercury* 30/4/24) placed the figure at around £2,428,000, with a further £1,000,000 constituting wages also having been outlaid.

3. SHALE MINING AND PROCESSING TECHNOLOGY

The technology employed at Newnes was based very much upon the established Scottish practises in use at the beginning of the twentieth century. It was set up to be a complete self-contained complex, designed to accomplish each successive step in the process, from retorting the mined shale to distilling its crude products, refining them with chemical treatments and manufacturing certain by-products. To this end the central industrial complex at Newnes can be divided into seven major areas:

1. The shale mines and crushing plant
2. The retorting and condensing plant
3. The distillation plant
4. The refining plant
5. The wax production plant
6. The subsidiary by-product plant
7. The waste treatment plant.

In addition to this the coke ovens and colliery form a separate area to the main oil shale production zone, as do the brickworks.

Specific information relating to the particular processes employed at Newnes is rare and by no means comprehensive, consequently the descriptions of the main functions of various sections of the plant have been compiled primarily from a wide range of contemporary literature dealing with the manufacture of shale oil in the early twentieth century. This is intended to give only a general idea of the method of working, as the details of refining and processing may have varied according to any number of variables operating at Newnes during its lifetime. For the precise details of what equipment was present at Newnes, and in some cases the buildings in which this were housed, two lists of assets, compiled primarily for the information of investors in the early 1930s, have been continually referred to. These are the Shale Oil Development Committee's 1931 list of assets, prepared as part of an indenture between Albert Edward Broué and the Committee, and the later Australian National Shale Oil Company's 1932 prospectus list. The later of these two schedules contains somewhat less detailed information than that of the

Shale Oil Development Committee: it is likely that this edition was a summary prepared from the former schedule. Appendix 10.5 is a transcription of the more comprehensive 1931 list of assets.

3.1. Mining - Shale.

3.1.1. *Mining Methods.*

The two most common methods for mining a seam of any mineral are classic bord-and-pillar and the longwall system, either of which could be used to mine shale depending upon variables such as the thickness and extent of the seam (Lishmund 1974, 10). Bord-and-pillar (also known as stoop-and-room) mining operates selectively, dividing the shale seam into a series of rectangular blocks or pillars supporting the roof, separated by a matrix of interconnecting tunnels called bords. Often only the shale from the bords was extracted, the pillars being necessary to support the weight of the overlying strata, although there were also methods which removed the pillars at a later stage, allowing the roof to collapse as work progressed (Caldwell 1927, 134-139; Goodberg 1982, 92). Longwall mining involves driving two parallel tunnels into the seam which are connected by a third perpendicular tunnel. The face of this third tunnel marks the beginning of the mining face which moves forward with the working. As the face advances closer to the entrance the roof behind is allowed to collapse and fill the vacant space (Caldwell 1927, 134-139; Goodberg 1982, 92).

3.1.2. *Ventilation.*

Shafts and adits have two functions within a mine - they are a route linking the working face with the surface for the access of both miners and materials and they provide passages through which the mine can be adequately ventilated. As a consequence there must be at least two openings into every mine: one inlet and one outlet (Caldwell 1927, 145; Simpson 1983, 155). As the gases found in shale workings could be quite dangerous, shafts and adits driven into the mining seam were placed with as much thought to ventilation as to access to the working face. Natural ventilation was usually enhanced by artificial means and initially furnaces were constructed at the mouth of a shaft to create a thermal draught, however later more efficient exhauster fans came into common use. Both

Corporation period, the number two shaft was in use as a downcast shaft for access of miners and materials and the number three as an upcast shaft for ventilation (Undated map 'Commonwealth Oil Corporation Ltd. Newnes Coal and Shale Workings'). By 1910 mining plans record the existence of an 'adit tunnel mouth' further west of both shafts. By 1923 the area of workings near the number two downcast shaft were marked 'old workings' and abandoned, while the shale adit had been extended and driven a considerable distance into the seam ('Commonwealth Oil Corporation Ltd. Shale Workings Newnes' 30/6/10; 'Plan of Number Two Shale Mine Newnes. John Fell and Company Ltd.' 1/3/23). By the end of the John Fell period this adit was the primary means of working the shale seam, although the number three upcast shaft still being employed for ventilation purposes. At the mouth of this adit were a compressor for supplying air to the workings, an engine house, a weighbridge and a smithy, as well as an extensive mullock heap ('Plan of Number Two Shale Mine Newnes. John Fell and Company Ltd.' 1/3/23). It is unknown whether these were in place before Fell took over the works in 1914 or whether they were installed by Fell as part of his improvements to the shale mines in general (Eardley and Stephens 1974, 207).

The only means of ventilation recorded for the Number Two shale mine is a Sirocco fan, listed in both the 1931 and the 1933 schedules of assets. This type of fan was one of the chief types used in mine ventilation and was customarily driven by electricity. Caldwell (1927, 145) describes an 'average' Sirocco fan as being eight feet in diameter, with a capacity of 80,000 cubic feet of air per minute and requiring a motor of 60 horse power for its operation. The fan at the mouth of the upcast shaft at the Number Two mine at Newnes was only six feet in diameter and was likely very similar to the one in later use at Glen Davis (Fig. 3.1). These two fans may have, in fact, been one and the same, as the ultimate fate of the Sirocco fan from Newnes has not been recorded.

3.1.5. *Haulage.*

Once cut from the mining face the shale needed to be loaded into skips and removed from the mine to the surface and then transported to the shale crusher and storage bin. Haulage from the working face to the surface could be effected by rail, by manual labour or by the use of pit

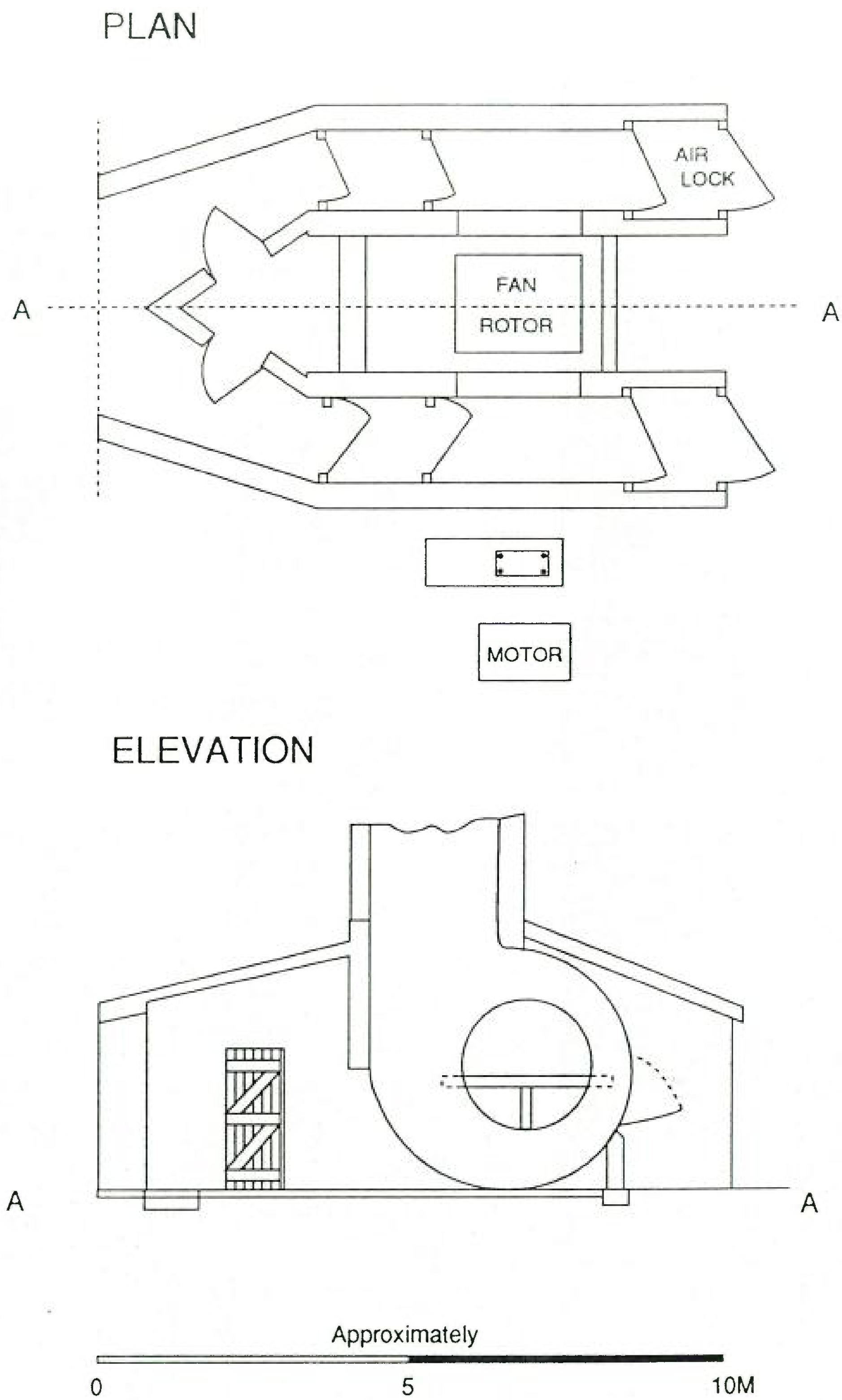


Figure 3.1: Sirocco fan installed at Glen Davis, 1937.

ponies. At Newnes it appears that pit ponies were used predominantly for underground haulage (*Australian Mining and Engineering Review* 1910, 413; Goodberg 1982, 91). Once at the surface the skips were sent to a weighbridge, where the shale was examined, any unsuitable material discarded and the remaining material weighed (Caldwell 1927, 157). Following this the skips were sent to the shale breaker along Barbour's Haulage road. Named for an early mine manager (Goodberg 1982, 9) this 'road' was actually an endless rope skipway running between the mines and the shale crusher. The principle of endless rope haulage depended upon two sets of rails: one for the full outbye skips and one for the empty inbye skips. Where necessary the direction of the skips was guided or altered by pulleys positioned at strategic points. Endless rope was a common system for long distance haulage (Caldwell 1927, 154).

It seems that two different types of mining skip were used at Newnes: one exclusively for hauling the shale or coal between mine and crusher (square one or half ton skips) and one for loading the retorts (hopper skips) (A. Watson, pers. comm. 1/3/91)

3.1.6. *Shale Crusher.*

Crushing is necessary to reduce the shale to a size that is suitable for retorting. A Hadfield and Jack's patent gyratory crusher was installed at Newnes and operated on the principle of a moveable crushing surface, which revolved around the inside of a fixed crushing surface in the shape of an inverted cone (Bell 1948, 77). A tippler emptied the skips from the mines into the top of the shale breaker, further skips at the base of the structure receiving the crushed shale and conveying it along the shale haulage gantry to the storage bin and retorts.

3.2. Shale Haulage Gantry and Storage Bin.

The shale haulage gantry ran between the shale crusher near the Number One shale mine across the river to the works and then into an elevated storage bin. The gantry was mostly constructed of timber and consisted of an endless rope haulage system with a 25 horse power electric motor (Shale Oil Development Committee Ltd. List of Assets 21/7/31). The storage bin was V-shaped, with an approximate capacity of 800 - 1,000 tons of crushed shale (Report on Newnes Capertee Shale Oil Project 1934, 24).

3.3. Retorting and Condensing.

3.3.1. *The Retorts.*

The purpose of a retort is primarily as a vessel for heating the shale. This heating, or destructive distillation, drives off in gaseous form the volatile products released from the shale (Halse 1927, 79). A form of vertical retort was initially erected at Newnes, with most references describing these as Pumpherston retorts (Shale Oil Ministers File 1911; Australian National Shale Oil Company Ltd. Prospectus 1932, 16; Connacher 1935, Appendix B), although in one reference they are referred to as American Vertical retorts (Birmingham, Jack and Jeans 1979, 127). On March 5 1907 the *Lithgow Mercury* reported on the purchase of retorting equipment:

> It is stated on sound authority that upwards of £100,000 has been paid in America for the most modern retorting machinery and a large portion of the consignment is on the high seas at present.

This would seem to suggest that the retorts were indeed American, though whether of the Pumpherston type or not is unclear. These retorts were erected some time after March 1907 and were certainly in operation by the close of 1910 (Commonwealth Bureau of Census and Statistics 1912, 520; Shale Oil Ministers File 1911).

The Pumpherston retort is a vertical retort which originated in Scotland. It was designed specifically to prevent the shale from choking the retort by keeping it moving in a continuous downward flow. The shale was charged from a charging hopper to the upper cylindrical cast iron portion of the retort, where distillation actually took place. It then passed through the lower firebrick section and finally into a lower hopper, from which the spent shale and ash was discharged into skips and taken to the waste (ash) dump (Abraham 1961, 53)

The original retorts erected at Newnes were considered (by John Fell at least) to be inadequate for retorting the higher grade Newnes shale and consequently during the second period of intense operation at Newnes, William Petrie, the company engineer, re-designed the retort bench with improvement of yield in mind (Fig. 3.2). This improvement was effected by increasing the number of gas offtakes to a total of four and by injecting steam as well as air into the base of the retort, although other minor alterations were also made (Australian Parliamentary Standing Committee on Public Works 1943, 5; Crichton and Connacher 1935, Appendix B; L.J. Rogers report 26/7/44) (Fig. 3.3).

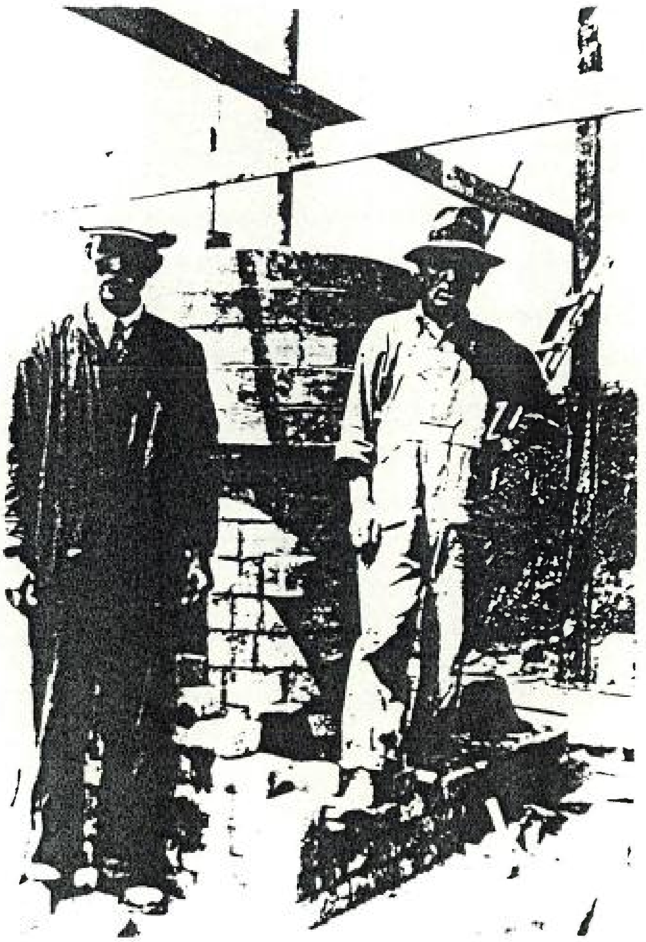
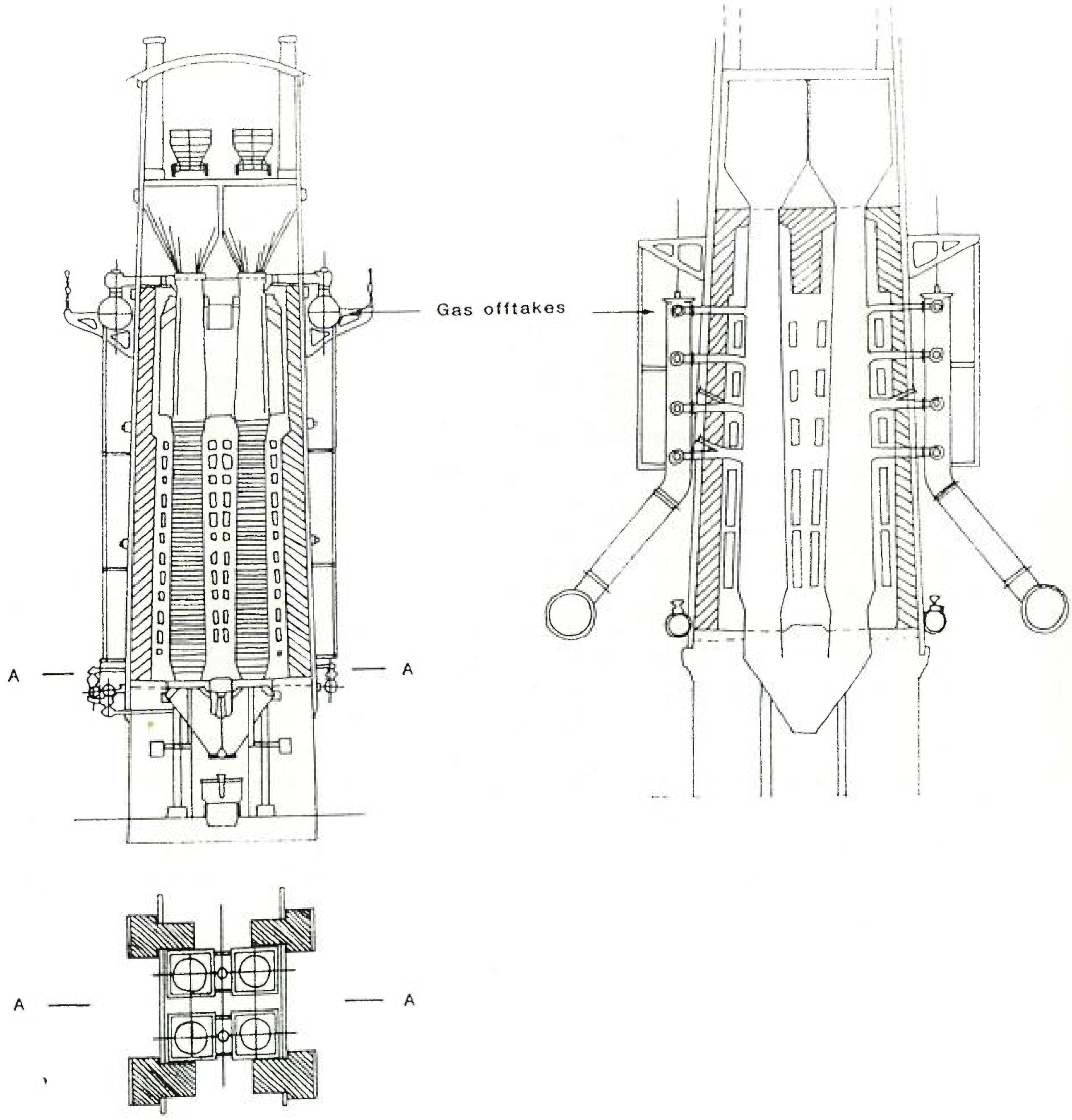


Figure 3.2: Standing on the retort bench at left is Wiliam Petrie, the designer of the modifications to the Pumpherston retorts at Newnes. On the right is William Boland, a furnace bricklayer working on the first chamber to carry Petrie's modifications. c. 1914. (Photo from Jim Norcross collection).

The conversion of the retorts was accomplished some time prior to December 1914, with Petrie converting an initial two retorts only (*Lithgow Mercury* 16/12/14). Prior to the cessation of operations in 1923, 28 out of the original total of 64 retorts had been converted in this manner (Crichton and Connacher 1935, Appendix B). This innovation in retort design later became known as the Fell Downcomer or Fell Patent Retort. Goodberg (1982, 98) suggests that during the period 1911 - 1914, William Petrie also constructed an extra experimental retort onto the end of the Pumpherston retort bench, though how this differred from the existing retorts is not specified. The 1931 list of assets records the existence of two experimental retorts in association with the retort bench (Shale Oil Development Committee Ltd. List of Assets 21/7/31).

Each retort consisted of a vertical tube, circular in cross section, approximately 9-10m tall tapering from 90cm inside diameter at the bottom to 60cm diameter at the top. The uppermost section was of cast iron and approximately 2.32m in length, while the lower portion was of firebrick. The firebricks used at Newnes were not manufactured on site, but were from the Torbane brickyards (*Australian Mining and Engineering Review* 1910, 412). The retorts were built in nests of four, each nest enclosed in a brickwork 'house' with 16 houses in total (Crichton and Connacher 1935, Appendix B; Kraemer and Thorne 1951, 18).

Both the Fell and the Scottish Pumpherston retorts used steam to distil the oil shale, obtaining the necessary temperature (800 - 900°F) via the combustion of residual carbon at the base of the retort with a controlled supply of air and steam (Boyd Guthrie 1938, 20). Although external flues encircling the retort were kept at a low red heat, the actual distillation of the shale was controlled and effected mainly by internal temperature (Crichton and Connacher 1935, Appendix B). The introduction of steam provided a number of functions: allowing the high temperatures of the heat transmitting walls of the retort to be transmitted to the shale charge, equalizing the temperature within the retort (regardless of distance from the retort walls) and generally lowering the temperature necessary for vapourization of the shale oil (Boyd Guthrie 1938, 20).



PUMPHERSTON RETORT

FELL RETORT

Figure 3.3: Comparison of Pumpherston and Fell retorts.

Once the oil was vapourized it was extracted from the retort chambers at various intervals through the four offtakes, these feeding into a common manifold leading to the condensing section. Operating records indicate a throughput of five to six tons of shale per day per retort attained during operating periods of fourteen days. After this time the retort had to be closed down and emptied for cleaning, an operation which itself took between 24 and 36 hours to complete. Despite the fact that 28 Fell retorts were available for operation, Crichton and Connacher claim that only a maximum of sixteen were in use at any one time (Crichton and Connacher 1935, Appendix B).

The sequence of operation for the Fell retorts at Glen Davis has been recorded in detail. Although differing to Newnes in certain minor details (for example throughput tonnage), the retorts initially erected at Glen Davis were those removed from Newnes upon its closure and therefore the process would have been broadly similar.

> To start operation, a retort is brought up to full working temperature, with the offtake valves closed. Spent shale is charged through the base of the shale hopper ... until the retort is filled to the region of the top takeoff, the remainder of the space being filled with raw shale ... steam only then is injected.
>
> As the column of shale moves downward, raw shale is charged at the rate of 8 - 9 tons per retort per day, and when a pressure becomes evident owing to the distillation taking place, the valve of the top offtake is opened and then each successively downward until all four offtakes are open. air is then added to the steam injected into the residue hopper, and the retort is working normally (Kraemer and Thorne 1951, 20).

3.3.2. *The Condensers.*

Once the shale had been retorted the resulting gases were withdrawn from the retorts and passed through the atmospheric condensers and scrubber towers. Two large Baker's exhausters were connected to the retort bench gas main and functioned to draw the shale gas through first the condensing and then the scrubbing system (*Australian Mining and Engineering Review* 1910, 414). The function of the condensers is self-evident: the gases from the retorts were passed over metal surfaces kept cool by a flow of air or water and cooled to form immediate products, namely crude oil and ammonia water, which then flowed first into separating and then into charging tanks.

Hurst (1925, 44) describes typical atmospheric condensers as consisting of:

> upright - shaped tubes, standing on large iron boxes divided into compartments, so that one limb is in communication with one compartment and the other limb in the next compartment. These tubes being in the open air act as condensers, the arrangement of the condensers on the iron compartment boxes ensuring that the products will pass through the whole series of tubes and therefore the products will become fairly well cooled

One account of Newnes recalls that it had, 'many, many miles of pipes behind the retorts. Where the gases were not cooled in this way, pipes were taken through cold water baths' (Luchetti 1979, 18). The 1932 Prospectus for the Australian National Shale Oil Company Ltd. states there were, 'approximately 5 miles of pipes with spray tower, separating tank and measuring boxes' as part of the condensing plant. The spray tower referred to was also known as the wash tower and its main purpose was to spray a fine mist of water onto the gas to cool and partially condense it and to remove any dust particles contained within it (Petrie quoted in Goodberg 1982, 103).

Once condensed the products were allowed to separate. A separating tank consisted of an iron box divided into two chambers by a partition extending to just short of the bottom and dividing the box into two unequally sized compartments. An inlet pipe conveyed the condenser products into the upper part of the larger of the two compartments, on either side of which were openings to allow the crude oil and uncondensed gases to escape. The ammonia water, being heavier than the oil, sank to the bottom of the separator and passed under the dividing partition via a separate exit pipe, while the oil remained in the first division of the separator and flowed out through another exit pipe (Hurst 1925, 44-45) (Fig. 3.4).

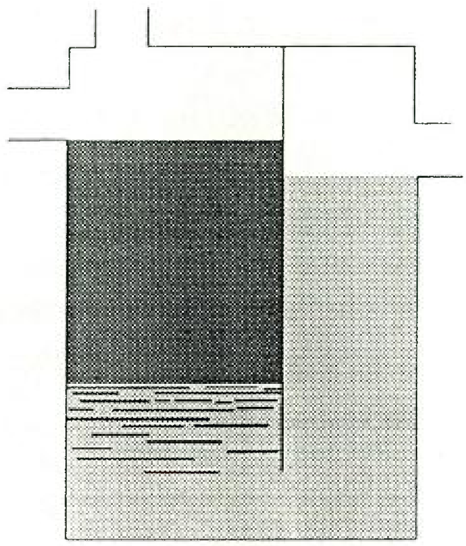


Figure 3.4: Stylised diagram of a typical separator tank.

After the crude oil and ammonia water had been removed there was still a certain volume of permanent gas remaining, which carried in suspension quantities of 'volatile oils', namely ammonia and naphtha which needed to be removed (Knutsen 1933, 34-38). These gases were first passed through the ammonia scrubbers. In typical Scottish practice the ammonia scrubber plant consisted of a large vertical pipe or series of pipes filled with layers of wooden baffles down which water was sprayed. The gas from the condensers entered the pipe column near the base and ascended through the layers of baffles, the water spray absorbing the ammonia in the gas.

The resulting ammonia water left the pipe at the base and was discharged to a separator tank (Williams 1919, 32). Both the ammonia water from the condensers and the ammonia water from the scrubbers was then sent to the sulphate of ammonia plant (section 3.7.1). The functioning of an ammonia scrubber tower is sufficiently similar to that of the wash tower that there is some doubt whether both were in use at Newnes. William Petrie's brother, James (quoted in Goodberg 1982, 103) asserts that although the wash towers were not intended as ammonia scrubbers they were used for that purpose. It is unclear from this whether the gas needed to be 'scrubbed' twice (ie: once immediately after retorting to partially condense it in the wash towers and then again later to remove further ammonia from the permanent gas in the ammonia scrubber), or whether only one washing episode was necessary. If the latter is the case than the twin ammonia scrubber towers marked on the 1911 plan of the site are more likely the spray wash towers.

The gas was then further treated in the naphtha scrubbing tower which performed a similar function to the ammonia scrubbers, by washing the gas in oil in a baffled tower at atmospheric pressure. At Newnes, according to James Petrie, coke was used in the scrubbing tower as the dispersal agent as opposed to wooden baffles, resulting in the final product being labelled 'coke tower naphtha' (quoted in Goodberg 1982, 110). The mixture of gas oil and naphtha was then steam distilled, the scrubber naphtha being collected as a condensate, while the gas oil was cooled and returned to the scrubbing plant (Bailey and Grant 1936, 211; Knutsen 1933, 38; Newnes Investigation Committee 1934, 184). At Newnes, the naphtha scrubbers were contained within the exhauster house. The ammonia scrubbers at Newnes constituted 'six scrubber towers with the necessary motors and pumps', compared to the naphtha recovery plant which is described merely as 'consisting of the necessary coolers, heaters, condensers, separators and pumps and motors for driving same' (Australian National Shale Oil Co. Ltd. Prospectus 1932, 18).

The permanent gases, once stripped and cleaned, were then passed back to the retorts as fuel. This occurred via the gas producers, which also produced gas to heat the retorts from coal, the gas being consumed in the space around the brick column of the retort (*Australian Mining and*

Engineering Review 1910, 414; Findlater 1912, 5). Two Mason's coal gas producers supplied fuel to the Newnes retort bench (*Australian Mining and Engineering Review* 1910, 414).

Figure 3.5 presents in diagrammatic form the spatial and product relationships between the retorting and condensing sections of the process.

3.4. Distilling.

The terms distilling and refining are often confused or used interchangeably, however they are quite separate. Distillation consists of heating the products to the point of evaporation in stills in order to separate the required fractions, both separating and purifying them to some extent (Knutsen 1933, 20; Scheithauer 1923, 146). Refining is used to further purify the distillates by chemical treatment (usually with sulphuric acid and caustic soda) to remove substances which may alter the colour or smell or lessen the suitability of the oils for use (Scheithauer 1923, 146).

3.4.1. *Crude Oil Stills.*

After the crude had settled to allow dust and water to separate out (usually between 12-18 hours) it was sent to charging tanks feeding into the crude oil stills. These stills were either of the intermittent or continuous type. The continuous process was used at Newnes, its advantages being that it yielded a greater quantity of oil with less wear and tear on the stills (Hurst 1925, 56)(Fig. 3.6). The continuous system of distillation originally patented in 1885, utilized a set of sequential stills comprising three interconnected boiler shaped stills (heated by separate fireplaces) connected to smaller coking or pot stills, the number of which could vary (Hurst 1925, 55; Scheithauer 1923, 140). At Newnes the crude oil from the retorts was distilled once to produce once run oil, treated with acid and soda washes (section 3.5.1) and then distilled again to produce further fractions.

There is some variation on the number of boiler stills present per battery at Newnes. In the Australian National Shale Oil Company's Prospectus for 1932 (p.18) the crude oil stills at Newnes are described as containing,

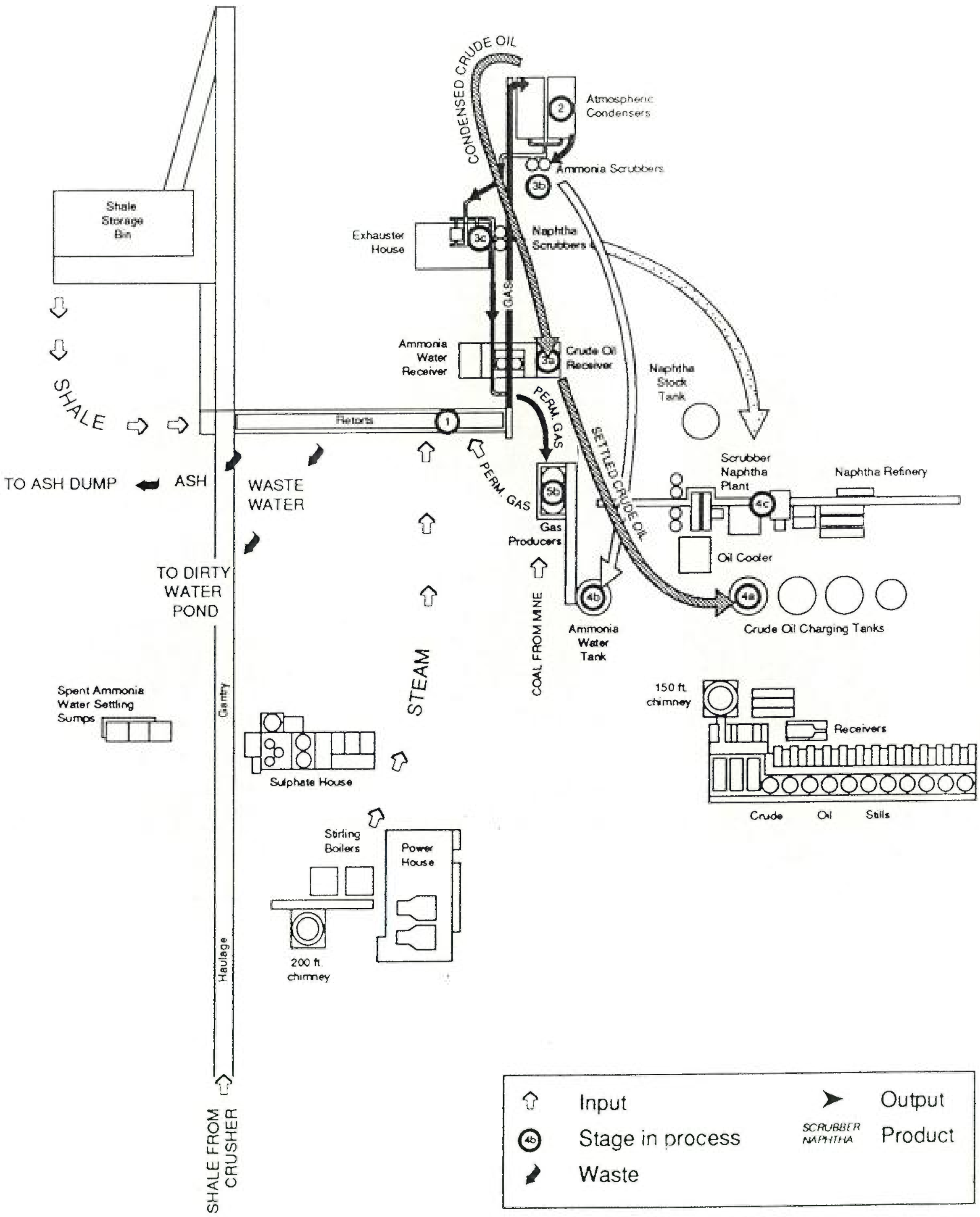
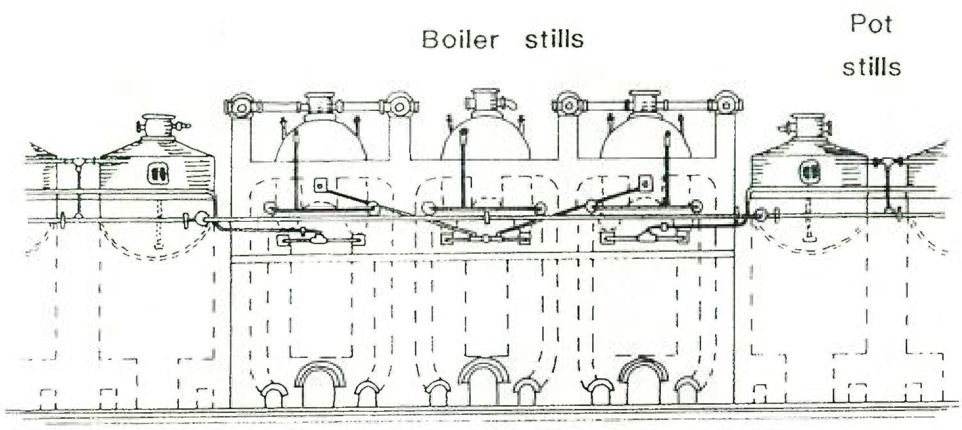
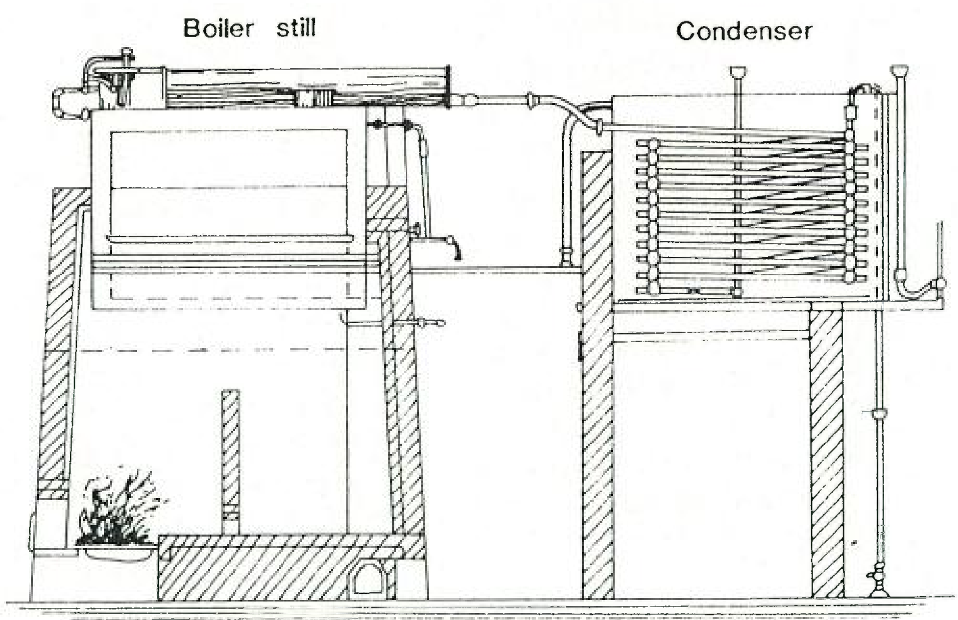


Figure 3.5: Spatial and product relationships involved in the processes of retorting, scrubbing and condensing.



(a) Continuous oil stills



(b) Cross section through a single still

Figure 3.6: Front elevation and cross section through a typical continuous still bench.

'... three continuous feed oil boilers with heaters, domes, condenser boxes, coils, stills, separator boxes and the necessary receivers, troughs, ponds and 150 ft. brick chimney and flues'. The *Australian Mining and Engineering Review* (1910, 121) however asserts that there were six boiler stills and 24 pot stills per battery.

Under the distillation process the crude oil was run into the central boiler still and heated until the lightest fraction began to distil off. The heat provided to this still was then regulated so that only this light fraction continued to be removed, although crude oil was fed in continuously. The oil from which the light (naphtha) fraction had been removed was then run into either of the end boiler stills, which were heated to a higher temperature to distil a second fraction of 'green' or heavy oil (Hurst 1925, 59). The residue from these second stills was run into the smaller coking or pot stills and distilled to dryness, the distillate being added to the green oil fraction (Lyder 1925, 109; Hurst 1925, 55-56; Scheithauer 1923, 140). The residue from the coking stills was known as oil-coke and was used as fuel. The light naphtha fraction was sent to the naphtha refinery (section 3.5.2), while the crude 'green' oil was sent to be washed, first with sulphuric acid and then with caustic soda to remove impurities (section 3.5.1). Following this process the crude oil was piped to the heavy oil and paraffin stills for further fractionating (section 3.4.2).

In both cases, as each fraction was distilled off it was run through a condenser (most often consisting of condenser coils submerged in water cooling tanks) and stored. In most Scottish works all distillations were effected by the aid of steam, the boiler stills being fitted with perforated steam pipes running along the base inside the still. All stills were heated by using tar sprays injected and atomised with steam into the brick furnace underneath the stills. The outlet vapour pipe for each still was connected to a condenser, the distillate flowing from the exit end of the condenser pipe and box into a light moveable metal trough and then into pipes leading to receivers (Bailey 1927, 200). The pot or coking stills varied in design to the boiler stills and consisted of a cast-iron base with a cylindrical flanged malleable iron lid, through which passed a steam pipe reaching nearly to the bottom of the still and a feed pipe for the admission of oil. In the side of the upper portion of the still was a door through which the

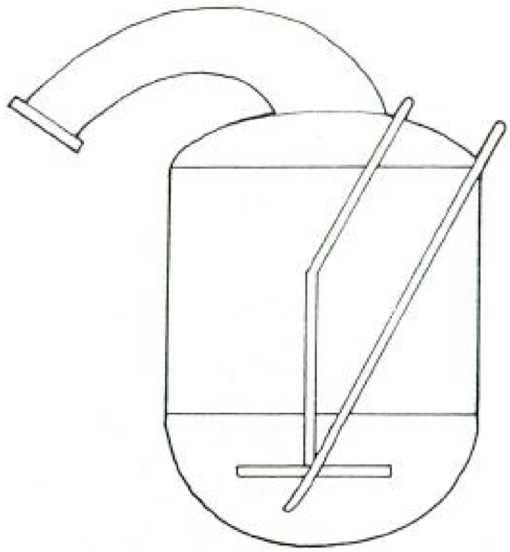


Figure 3.7: Cross section through a typical pot still.

coke was withdrawn using a pick and shovel. From the still-head passed the neck which was connected to a condenser (Bailey 1922, 201) (Fig. 3.7).

Figure 3.8 presents in diagrammatic form the product and spatial relationships between the crude oil production section of the process.

3.4.2. *Heavy Oil and Paraffin Stills.*
The heavy or green oil fraction extracted from the crude was re-distilled following a process very similar to, or identical with that used for the crude fraction. At Newnes the heavy oil and paraffin stills consisted of, 'three continuous feed oil boilers with condenser boxes, coils, stills, separators, receivers, with 150 ft. brick chimney and the necessary motors and pumping gear' (Australian National Shale Oil Co. Ltd. Prospectus 1932, 18).

Upon distillation this fraction yielded a crude burning oil and a heavy oil with paraffin. The crude burning oil was first treated with an acid and

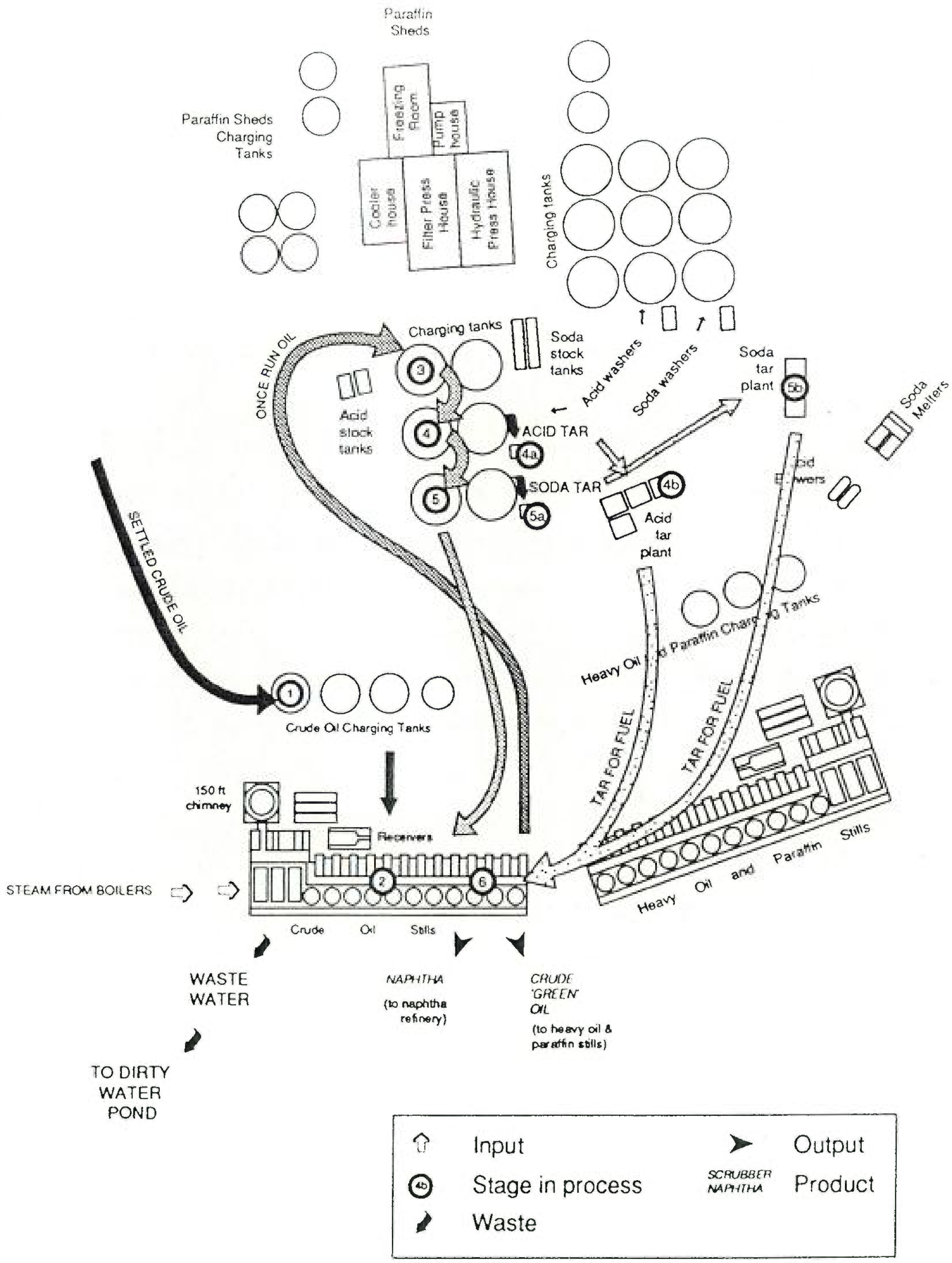


Figure 3.8: Spatial and product relationships involved in the process of distilling crude oil.

soda wash (section 3.5.1) and then sent to the fine oil stills (Findlater 1912, 6).

The heavy oil containing paraffin was sent to the paraffin works for a different process of treatment (section 3.6.1) to yield primarily paraffin wax and blue oil, the latter of which was further treated to yield various grades of lubricating oil (section 3.4.3).

Figure 3.9 presents a diagram of the relationships involved in the production of the heavy oil and paraffin fraction at Newnes.

3.4.3. *Lubricating Oil Stills.*

Once the blue oil was extracted from the heavy oil and paraffin fraction (section 3.6.1) it was treated with acid and caustic soda (section 3.5.1) and then redistilled into crude lubricating stocks and gas oil, although in some works this process was reversed. The lubricating oil stocks were then acid and caustic soda washed and in some works re-distilled or bleached by exposure to sunlight in shallow tanks under a glass roof (Hurst 1925, 63; Lyder 1925, 111; Scheithauer 1923, 143). The lubricating oil stills at Newnes possessed 'two boiler stills with condenser boxes, coils, aerial condensers, receivers and necessary fittings' (Australian National Shale Oil Co. Ltd. Prospectus 1932, 18). The gas oil and lubricating oil distillates still contained quantities of paraffin and were therefore in some works stored in separated storage tanks and passed through separate coolers, filters and hydraulic presses to remove this paraffin. The solid paraffin from this process could then be melted and pumped to the wax refinery for the production of wax (section 3.6.5). It is unknown whether this second purification was undertaken at Newnes. The gas oil and lubricating oil was then collected in separate receivers, the gas oil being virtually ready for market, while the lubricating oil was washed in acid and caustic soda before being stored for market (Bailey 1927, 210-211). James Petrie (in Goodberg 1982, 121) asserts that not much lubricating oil was ever produced at Newnes, as it was derived from the wax treatment section of the process, which never really got off the ground during Newnes' operation. He claimed that as a result the lubricating oil stills were only used to produce kerosene. Behind the 'kerosene' stills there was reportedly also an old Shay boiler used as a superheater to dry the steam

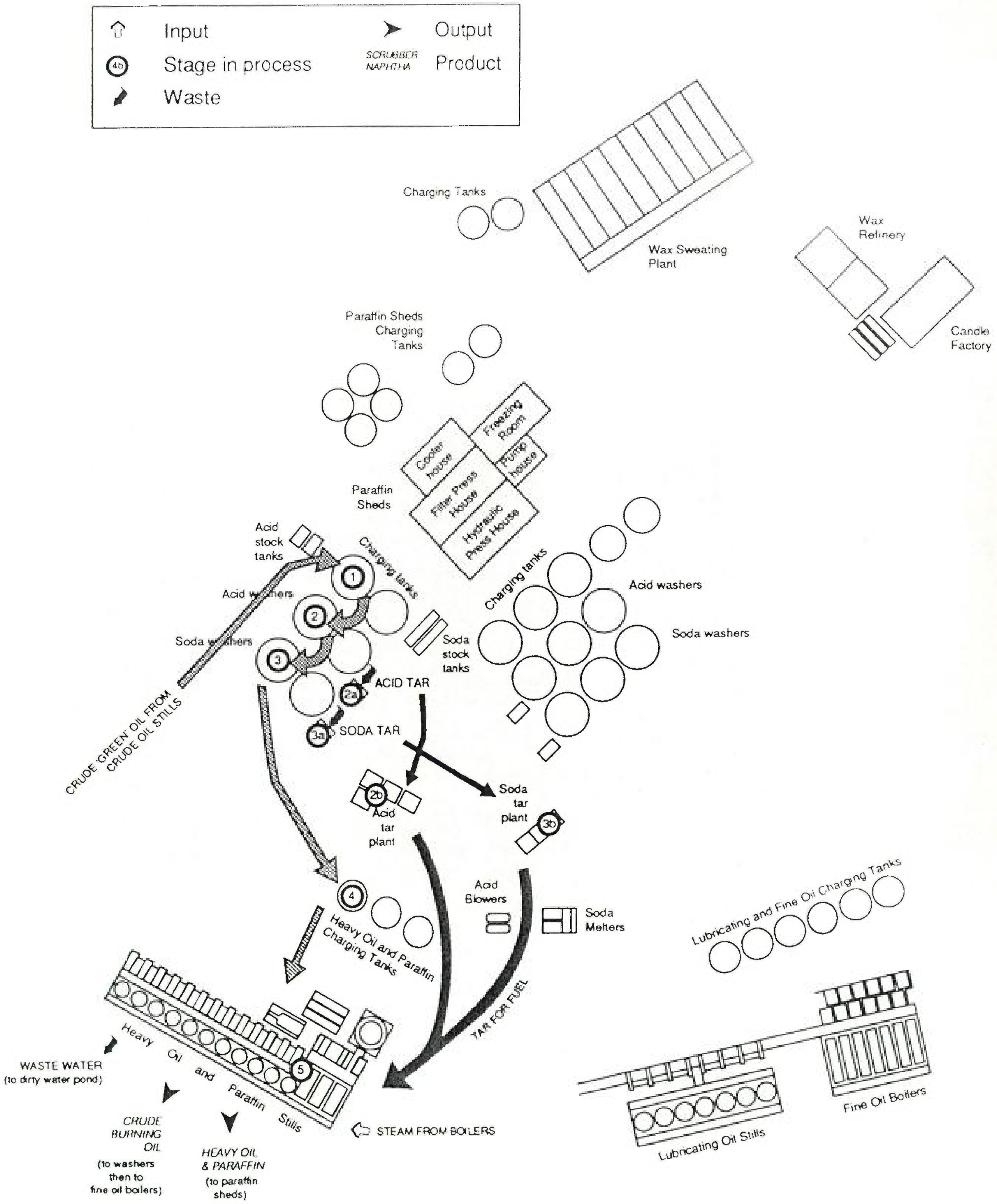


Figure 3.9: Spatial and product relationships involved in the process of distilling the heavy oil and paraffin fraction.

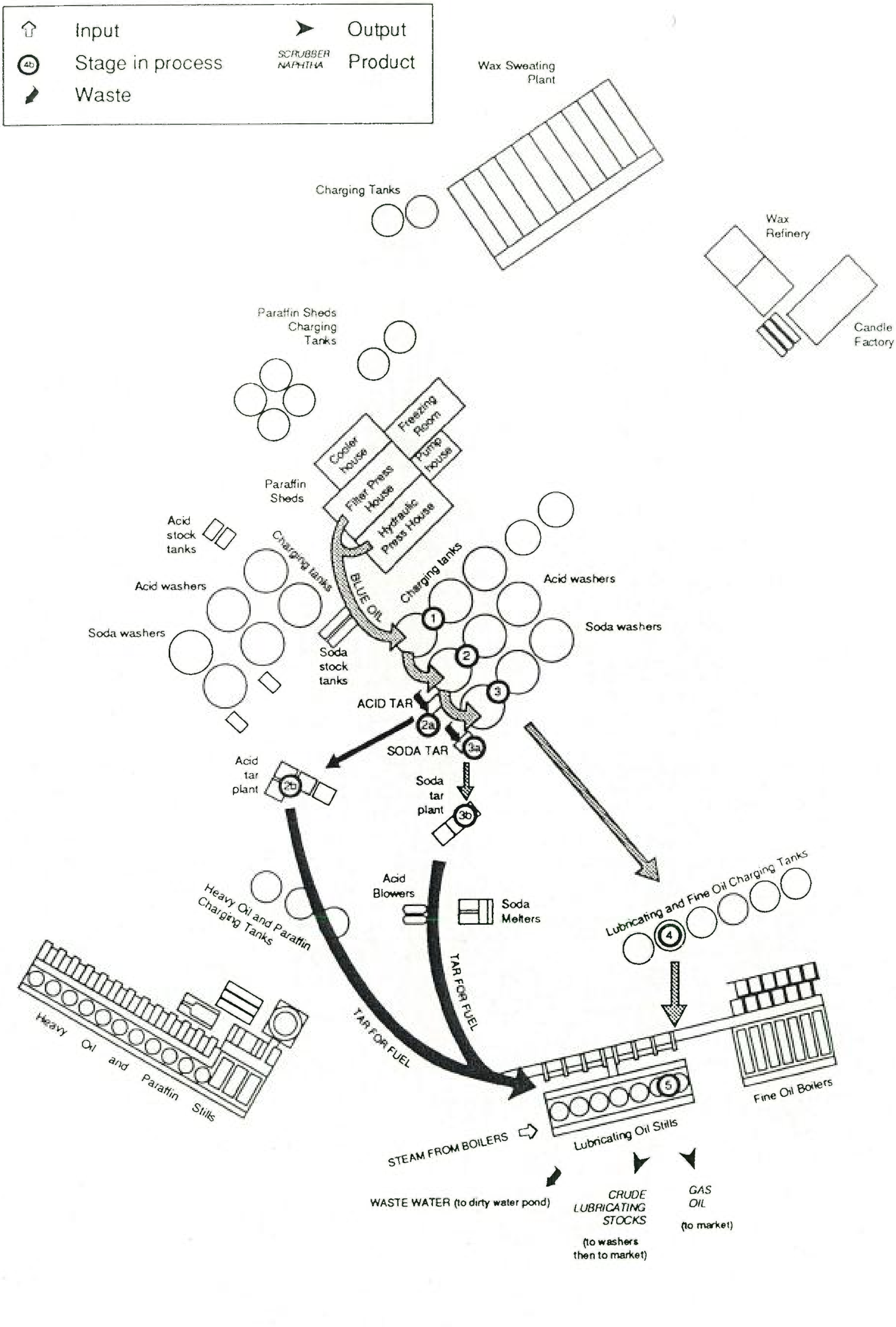


Figure 3.10: Spatial and product relationships involved in the process of distilling the lubricating oil fraction.

used in the distillation of the kerosene fractions. This boiler/superheater is mentioned in the 1931 schedule of assets, but in connection with the fine oil boilers, not the lubricating oil stills. In both lists of assets the lubricating oil stills are also referred as the high pressure stills.

Figure 3.10 presents a diagram of the product and spatial relationships involved in the production of lubricating oil at Newnes.

3.4.4. *Fine Oil Boilers.*

At Newnes these consisted of 'two boiler stills, condenser boxes, coils, aerial dephlegmator with pump house and all necessary motors, injectors, superheaters and driving gear' (Australian National Shale Oil Company Prospectus 1932, 18).

The crude burning oil, after acid and soda treatment, was re-distilled in a series of boiler stills to extract lamp oil or kerosene, power oil or power kerosene (used as fuel for tractors, boats etc.) and in some cases lighthouse and other burning oils. The kerosene fractions, once distilled, could be washed again before transport to market (Bailey 1927, 205).

The distillation process in use for this fraction was similar to the previous distillation processes mentioned, although on a slightly smaller scale. The one exception was the use of a dephlegmator to separate the gases of low and high boiling points. This was a fractionating column which partially condensed the oil vapours to a particular temperature, allowing the less volatile components (with higher boiling points) to be removed and leaving behind gas rich in more volatile products (Green 1984, Section 18, 3; Tver and Berry 1980, 78).

Figure 3.11 presents the various relationships involved in the production of the fine oil fraction.

3.5. The Refining Plant.

This area of the plant processed a wide variety of fractions, including crude oil, kerosene, blue oil and lubricating oil, by washing them in sulphuric

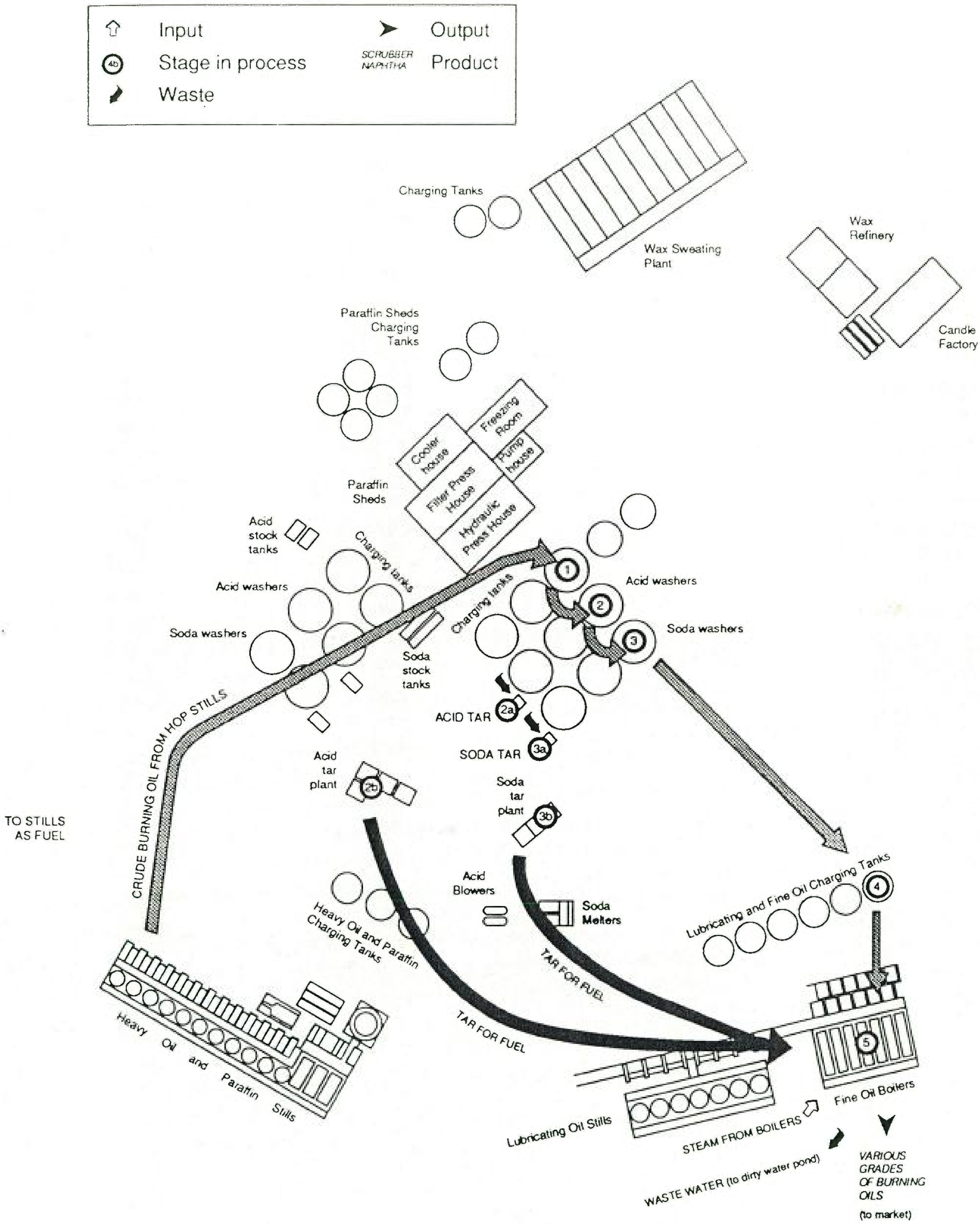


Figure 3.11: Spatial and product relationships involved in the process of distilling the fine oil fraction.

acid and caustic soda. The naphtha fractions from the scrubber towers and crude oil stills were also refined here.

3.5.1. *Acid and Soda Washers.*

These were central to most stages in the oil producing process and basically consisted of vertical cylindrical steel tanks with conical bottoms in which the oil was agitated using either mechanical agitators or compressed air. A mechanical agitator usually consisted of an iron shaft carrying arms which were revolved in the oil, while a compressed air agitator consisted of a perforated metal box at the base of the tank linked to a blower which forced air through the oil mixture (Bailey 1927, 204; Hurst 1925, 50; Scheithauer 1923, 155). Once the oil had been pumped to an elevated charging tank it was first fed into the acid washer where it was mixed with a percentage solution of sulphuric acid (the strength varying depending on the particular fraction) which was added after the oil had begun agitating (Findlater 1912, 5-6; Hurst 1925, 50; Scheithauer 1923, 155). The acid was introduced through a pipe projecting through the side of the tank. This pipe was perforated along its length so that the acid was distributed fairly evenly over the surface of the oil (Bailey 1927, 204). This mixture was agitated for a specific time period and then allowed to stand and settle for up to 24 hours, after which time the acid tar which had settled to the bottom of the tank was drawn off through an outlet pipe at the base of the tank. This washing process could have taken place as one event or as several separate washes, the acid tar on each occasion being run off into tar boxes, where it was eventually subjected to further treatment (section 3.8.1) (Bailey 1927, 204). The spent sulphuric acid from the acid washing tanks was conveyed to the sulphate house for the treatment of ammonia water in the production of sulphate of ammonia.

The soda washers were similar in design and function to the acid washers. The acid washed oil was run under gravity feed into the soda washing tanks from the acid washing tanks. Under this second treatment the oil was mixed with a percentage solution of caustic soda, thoroughly agitated and then allowed to stand and separate (Bailey 1927, 204; Hurst 1925, 51; Scheithauer 1923, 155). This process could also be accomplished as one washing event or as several consecutive washes.

Once the oil had settled the resulting soda tar was run off from the base of the tank into a tar blower (section 3.8.2). The newly washed oil was then pumped into storage tanks ready for further processing. The acid and soda refining plants at Newnes consisted of four 50,000 gallon charging tanks (for crude oil, lubricating oil, kerosene oil and blue oil), three 35,000 gallon acid washers and three 35,000 gallon soda washers (for the crude oil, lubricating oil and blue oil), one 20,000 gallon acid washer, one 20,000 gallon soda washer and two 30,000 gallon storage tanks (for the kerosene oil) (Australian National Shale Oil Co. Ltd. Prospectus 1932, 18-19).

Figure 3.12 presents in diagrammatic form, the product and spatial relationships in this section of the process.

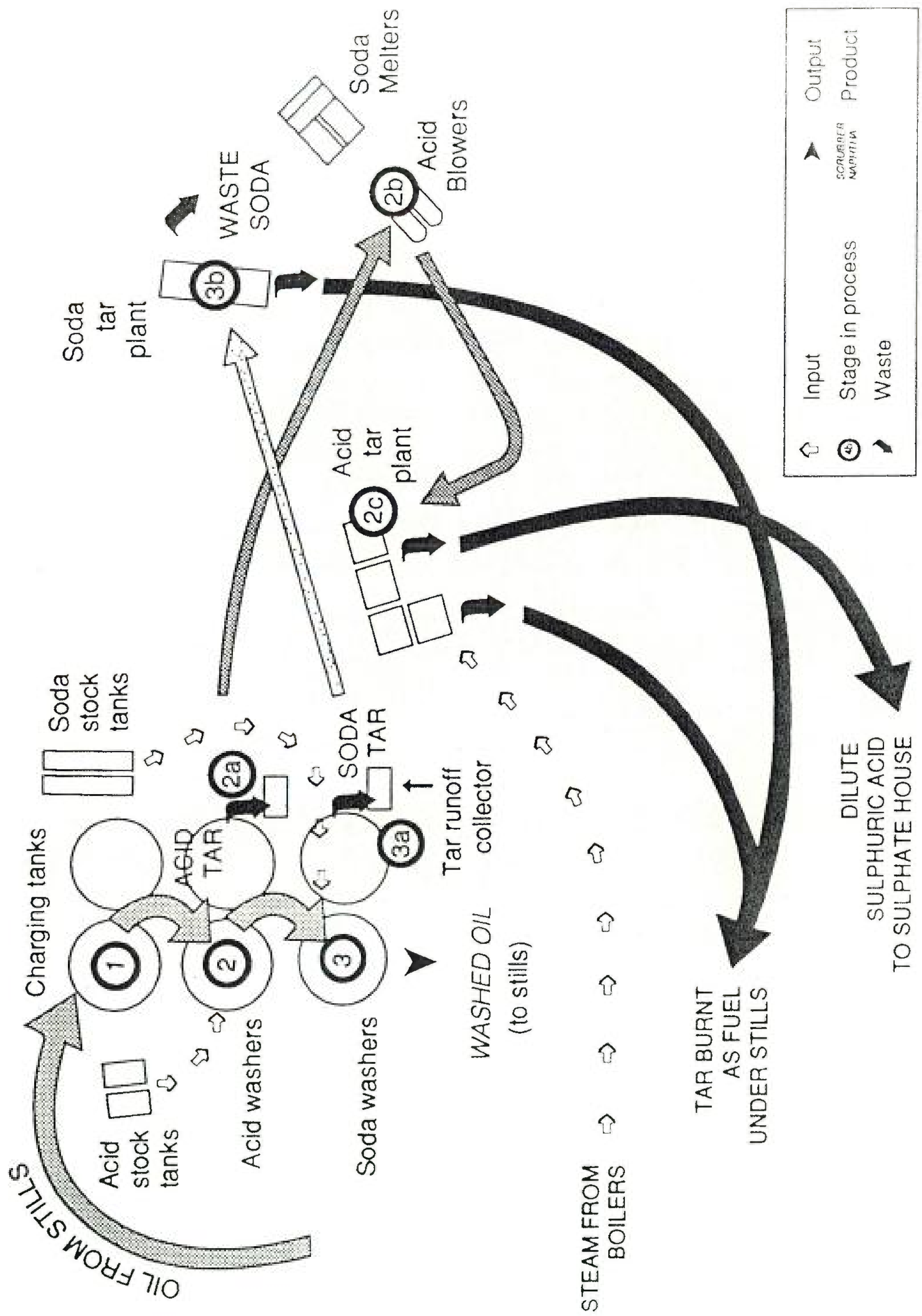


Figure 3.12: Spatial and product relationships involved in the washing process.

3.5.2. *Naphtha Refinery.*
The naphtha recovered from the crude oil stills and the naphtha from the scrubbers both needed to be further refined and although they followed slightly different processes, they both yielded similar products.

The scrubber naphtha contained within the oil from the scrubber towers first needed to be distilled with steam to drive off the naphtha as a gas. After this the steam and naphtha were condensed and separated, the naphtha being collected in a receiver as crude scrubber naphtha prior to further refining. The hot oil leaving the bottom of the still was run into a sump and cooled and then returned to the scrubbing tower for re-use (Bailey and Grant 1936, 211; Knutsen 1933, 38; Newnes Investigation Committee 1934, 184).

The naphtha from the crude oil stills was first washed with acid and soda treatments and then run into a still and heated until fractionated into the various grades of naphtha required, including solvent naphtha and cleaners' naphtha (for dry cleaning). The scrubber naphtha yielded a lighter grade of product and was employed as 'motor spirit'. Naphtha in some cases is also referred to as benzine. (Bailey and Grant 1936, 211; Hurst 1925, 56-57; Lyder 1925, 111; Scheithauer 1923, 198-199).

Figure 3.13 presents in diagrammatic form the product and spatial relationships involved in the naphtha production section of the process.

3.6. Wax Treatment Plant.

3.6.1. *Refrigeration.*
The heavy oil and paraffin from the heavy oil and paraffin stills (section 3.4.2) was first run into shallow tanks where it was cooled to atmospheric temperature and the still liquid oil separated from the first solid paraffin. The oil was then pumped through a series of refrigerating vessels. A typical cooler consisted of a horizontal cast iron tubular casing (approximately 6m long by 52 cm wide), containing within it a 38cm wide steel tube. The space between the inner tube and outer casing formed a space for the circulation of liquid ammonia from the compression refrigerating machinery. Through the centre of the inner tube was a steel

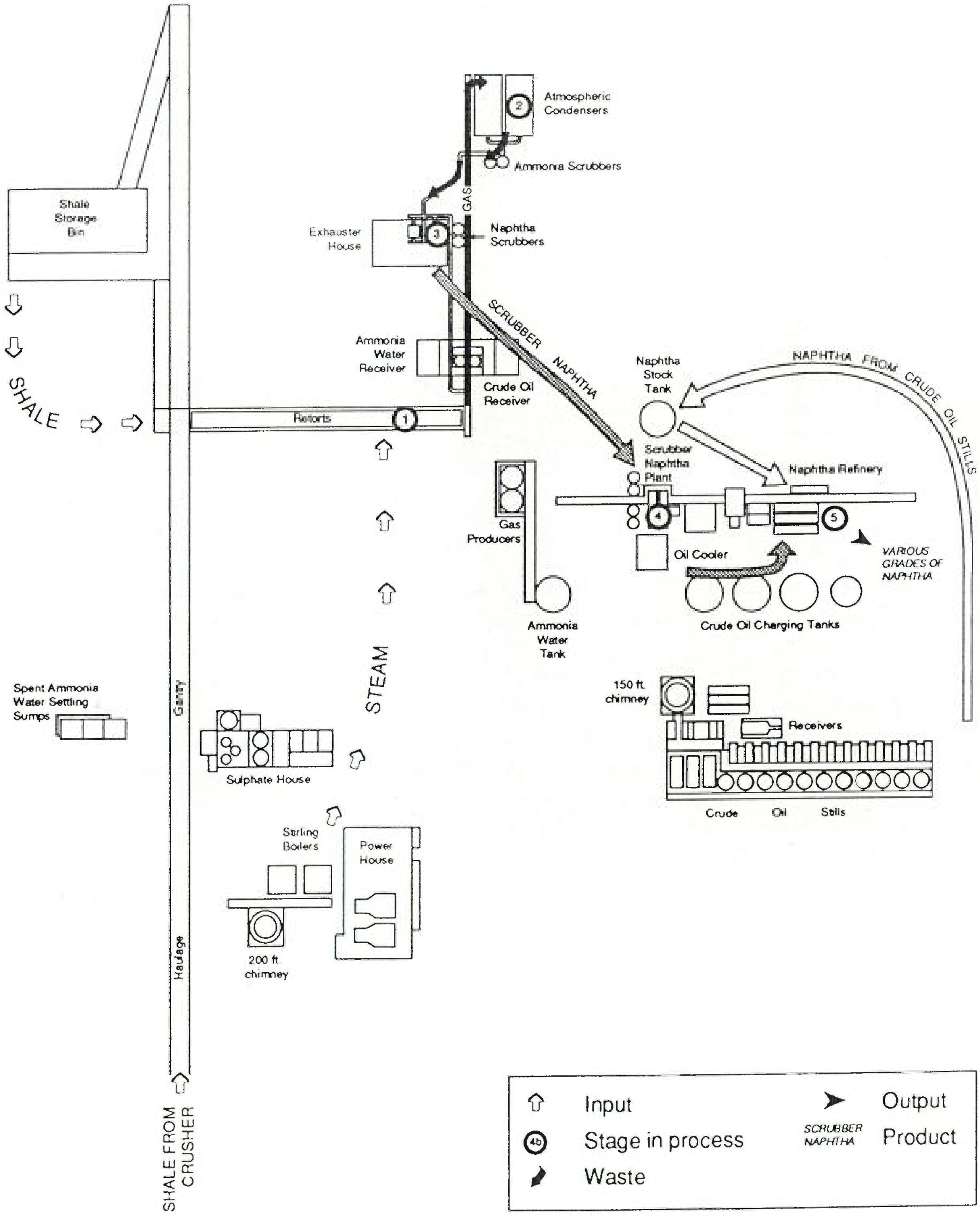


Figure 3.13: Spatial and product relationships involved in the naphtha production process.

shaft on which scrapers to scrape off the coating of hardened paraffin were fixed and rotated by gearing at the ends of the coolers (Bailey 1927, 204-206; Scheithauer 1923, 175-176). The liquid ammonia was pumped under pressure from a compression engine into the jacket of the coolers, where it became a gas under atmospheric pressure and absorbed heat from the oil. The gas then left the jacket and returned to the compressor where it was re-liquified, cooled and then re-circulated through the coolers (Bailey 1927, 206) (Fig. 3.14).

3.6.2. *Filter Presses.*

Once cooled and broken up the oil was pumped to a series of filter presses which were made up of round or square steel filter plates set vertically into a cast iron frame with a shallow metal trough fitted with a conveyor underneath. Each plate had a central circular opening and was covered by a stretched canvas filter cloth. Once the plates were placed on the frame they were screwed up close together and under pressure from the pump the cooled oil was forced through the central channel and filter cloth and passed out through holes at the base of the plates into troughs leading to a receiver. A mass of solid paraffin crystals was retained between the surfaces of the plates and after a specified length of time the feed of oil from the cooler was either diverted or shut off completely and the solid paraffin cakes in the filter press prised loose and allowed to fall into the trough (Bailey 1927, 206-207; Scheithauer 1923, 166) (Fig. 3.15).

The oil running from the filter presses was known as blue oil and was collected in a receiver and pumped to a storage tank before further refining and treatment (section 3.4.3).

3.6.3. *Hydraulic Presses.*

The filter pressed cakes of paraffin still retained 20-30% oil which was removed using hydraulic presses. The paraffin was packed into press cloths and layered inside a square wooden frame between thin steel latticed plates, which were placed on the shelves of the pressing machine. The press forced the plates upwards, the pressure being gradually increased and kept at maximum for up to six hours (Bailey 1927, 208) (Fig. 3.16). The oil which was forced out of the hydraulic press drained into receivers and

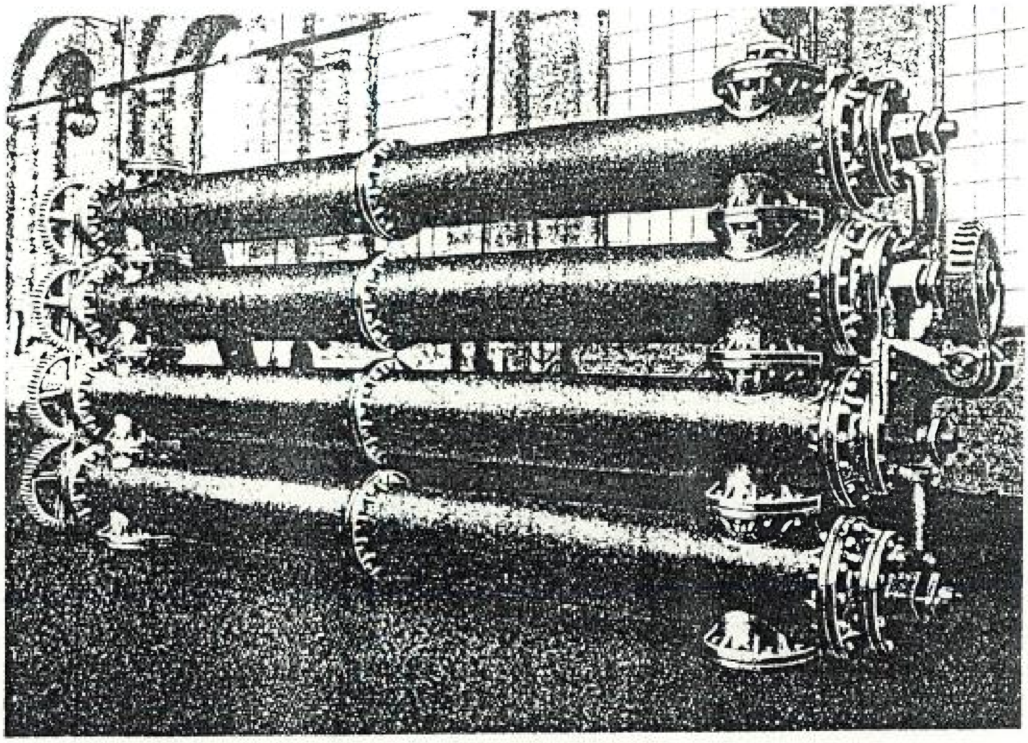


Figure 3.14: Shale oil coolers manufactured by A.F. Craig.

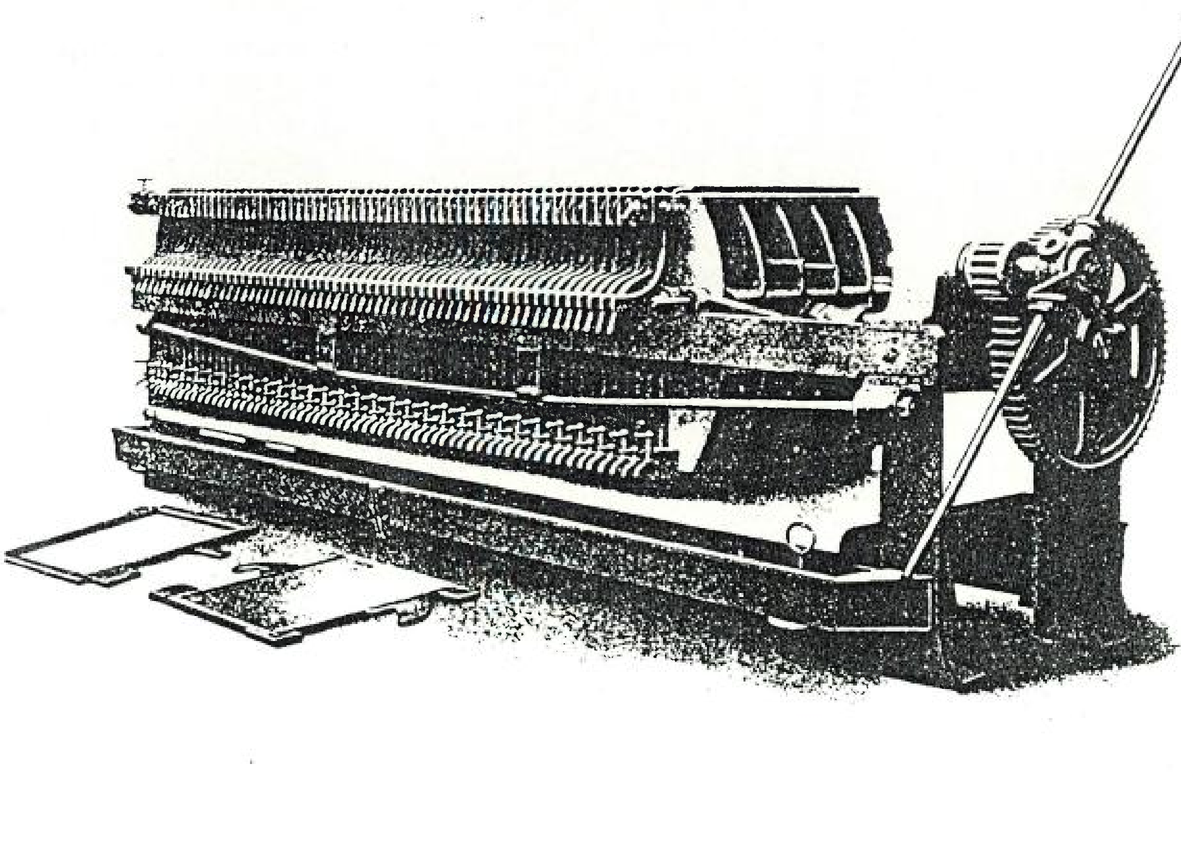


Figure 3.15: Filter press manufactured by A.F. Craig.

in most works was combined with the oil from the filter presses as blue oil (Hurst 1925, 62) and treated accordingly (section 3.4.3). According to the 1932 Prospectus for the Australian Shale Oil Co. Ltd. (19) the wax treatment plant at Newnes was, 'housed in a brick girded building with concrete floor and consists of one vertical De La Vergne 2-cylinder 80 ton refrigerator with 150 hp motor and 130 hp motor and all auxilliary plant, ammonia condensers, water tank, three Bryson oil coolers, four filter presses, four spiral conveyors and four vertical hydraulic presses by A. F. Craig, three hydraulic pumps and seven plunger pumps with all gear in excellent condition.

3.6.4. *Wax Sweating Plant.*

The crude solid paraffin from the presses needed to be purified further by the process of sweating it in large sweating houses or stoves to remove the small remaining quantity of oil which discoloured the wax. The sweating houses were narrow rectangular brick structures with closely fitting iron doors at either end, and a series of steam coils for regulating the internal temperature running lengthwise along the inner wall (Bailey 1927, 211).

Large shallow iron trays or pans resting upon supporting racks were fitted along the length of the building in rows and into these was poured the wax. Each pan had a false bottom approximately 5cm higher than the actual base, the space between being filled with water to the level of the false bottom, so that when the liquid paraffin was run into the top of the tray it rested upon the water. When the wax was cooled to atmospheric temperature and solidified, the water was run off leaving a space beneath the solid wax to collect the sweated oil (Fig. 3.17).

The doors of the sweating house were then closed and the temperature raised slowly. As the paraffin was heated it expanded and became porous and the yellow oil it contained, along with the portions of paraffin of low melting point, gradually sweated out and were collected in the base of the tray to be run off into receivers. By this process the solid paraffin became not only whiter in colour, but of a higher melting point and when it was purified to the desired standard the temperature of the sweating house

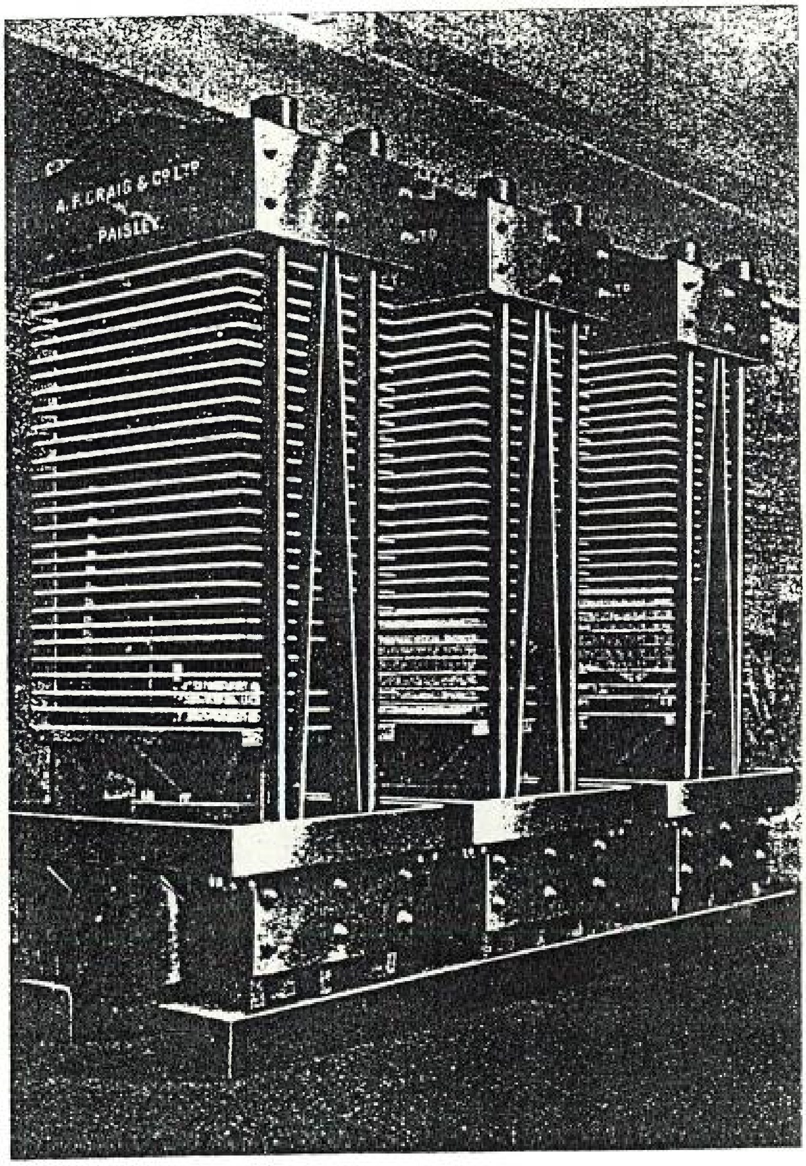


Figure 3.16: Vertical hydraulic presses manufactured by A. F. Craig.

was raised quickly and the remaining wax melted and run off into separate receivers. This wax was re-sweated a second time in some works before further refining (Bailey 1927, 211-213; The Pumpherston Oil Co. Ltd. Glasgow n.d., 15).

The wax sweating plant at Newnes is recorded in the 1931 prospectus as consisting of a brick building, reinforced with girders and concrete containing two sets of Henderson's sweating plants, complete with gauzes, coils, filling and draining pipes (Shale Oil Development Committee Ltd. List of Assets 21/7/31).

3.6.5. *Wax Refinery.*

Once the wax had been sweated and settled it still needed to be further refined by filtration to remove any remaining traces of colour or odour. This could utilize a number of methods, by filtration through Fuller's earth, charcoal or any number of similar materials (e.g. Bailey 1927, 213). The wax was often dissolved in a small amount of naphtha and then cooled and separated in either a finishing filter or hydraulic press, the solvent being removed by steaming (Hurst 1925, 65). The 1932 Prospectus for the Australian National Shale Oil Co. Ltd. (19) simply mentions the existence of 'a jacketted pan, cooling racks, trays and all necessary equipment' as part of the wax refinery. The 1931 prospectus is slightly more detailed, including a description of the building (constructed from timber and corrugated iron) and listing wax cooling racks and trays, two jacketted aluminium wax pans, one large filter press and one small circular filter press as amongst its assets (Shale Oil Development Committee Ltd. List of Assets 21/7/31).

Figure 3.18 presents in diagrammatic form the product and spatial relationships involved with the wax production section of the process.

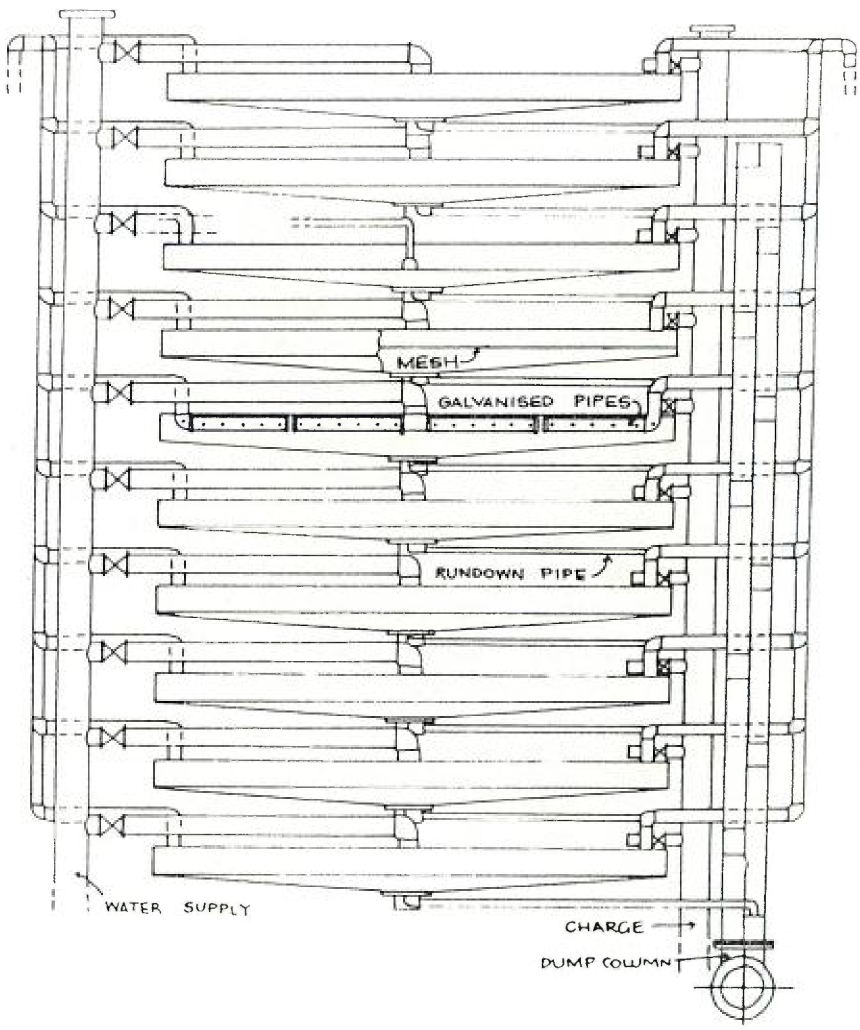


Figure 3.17: Cross section through a series of typical wax sweating trays.

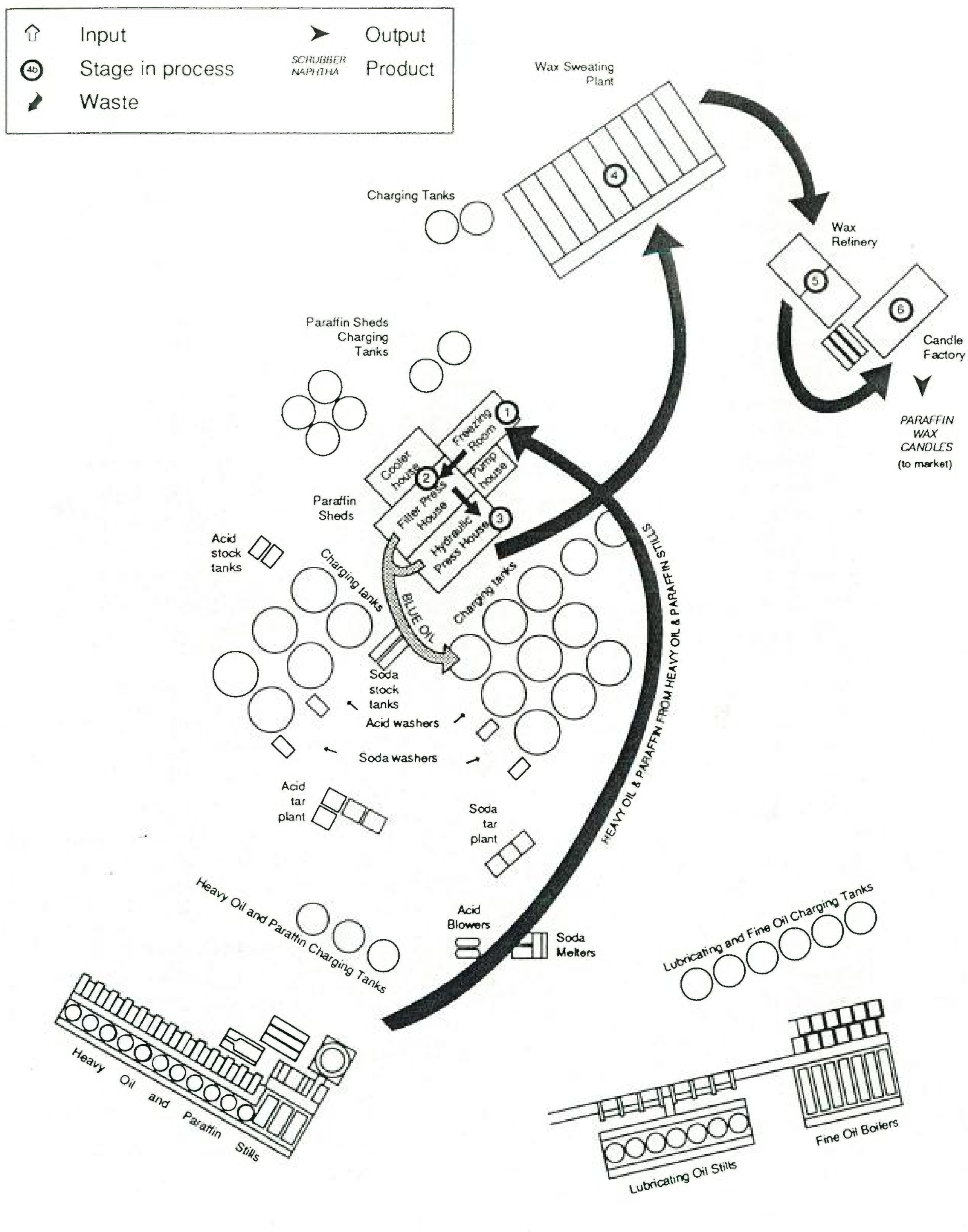


Figure 3.18: Spatial and product relationships involved in the production of paraffin wax.

3.6.6. *Storage Equipment.*
Associated with most of the stages in the various distilling and refining processes was the necessity for adequate storage of products. This was so for products at different stages of the refining process, as well as for finished marketable products. The Australian National Shale oil Co. Prospectus lists '... six 50,000 gallon Stock Tanks, one 40,000 gallon Stock Tank and eleven 30,000 gallon Stock Tanks and numerous other Tanks throughout the Works with an approximate carrying capacity of 1,750,000 gallons ... There are also six 10,000 gallon Settling Tanks fitted with Steam Coils ... and Acid Handling Tanks.' The settling tanks were probably located within the settling house.

Domestic water storage was also a necessity and one common practice throughout was that of using Ship's tanks, which held about 400 gallons, as water storage tanks (Eardley and Stephens 1974, 131, 149).

3.7. Subsidiary By-Product Plants.

During its period of operation the emphasis at Newnes seemed to rest largely upon the production of by-products such as sulphate of ammonia and paraffin wax candles.

3.7.1. *Sulphate of Ammonia Manufacture.*
A number of products from other areas of the plant were sent to the sulphate house for use in the manufacture of sulphate of ammonia: the ammonia from the scrubbers (section 3.3.2), the ammonia water from the crude oil separators (section 3.3.2) and the acid water from the tar plant following washing of the acid tars (section 3.8.1) from the refining process (3.5.1).

An average batch of ammonia water from the condensers and scrubbers could yield approximately 3.9% commercial sulphate of ammonia, the manufacture taking place in three principal stages:

1. Distillation

2. Absorption in sulphuric acid
3. Evaporation

Distillation took place in an ammonia still - either a horizontal furnace-heated boiler or a cylindrical steel still which uses a steady supply of steam to heat the ammonia water and drive off the ammonia as a gas. The ammonia gas was then run into a 'cracker' or absorber, where it was combined with a solution of sulphuric acid, water (generally resulting from the washing of the acid tars from the refining process) and lime to form dissolved sulphate. Once the acid solution was saturated with ammonia, it was piped into lead-lined wooden settling tanks where tar derived from the recovered acid could be separated and removed. The sulphate water was then passed into an evaporator where solid crystals of sulphate of ammonia separated out. These were then deposited into centrifugal drying machines, spun and conveyed to a drying room before being bagged ready for market (Abraham 1961, 58; Bailey 1927, 195-196; The Scottish Oil Agency Glasgow n.d., 12; Williams 1919, 21). The 1931 list of assets notes that the sulphate house was composed of a 'two storey timber building with malthoid roof, 1 ammonia tower, 1 liming vessel, 1 lime mixer, 1 ... acid egg, 1 lime pan, 3 ... sulphate skips' and a 50,000 gallon stock tank. Little else is recorded of the sulphate house at Newnes, it is not mentioned in the 1932 prospectus, nor is the process of manufacturing sulphate of ammonia detailed. L. J. Rogers' report, prepared in 1932 (9), stated that it was 'not considered profitable to prepare ammonium sulphate' as the market was unfavourable and the yield was very low. Mead (1986, 538) asserts that due to the low ammonia content of the New South Wales shales there was less of an emphasis upon this process, as opposed to the parent situation in Scotland, where sulphate of ammonia manufacture was a major economically viable product.

Figure 3.19 presents in diagrammatic form the product and spatial relationships involved in the production of sulphate of ammonia at Newnes.

3.7.2. *Paraffin Wax Candles.*

The 1932 prospectus mentions 'a complete candle manufacturing plant' (Australian National Shale Oil Co. Ltd. 1932, 19) as part of the Newnes

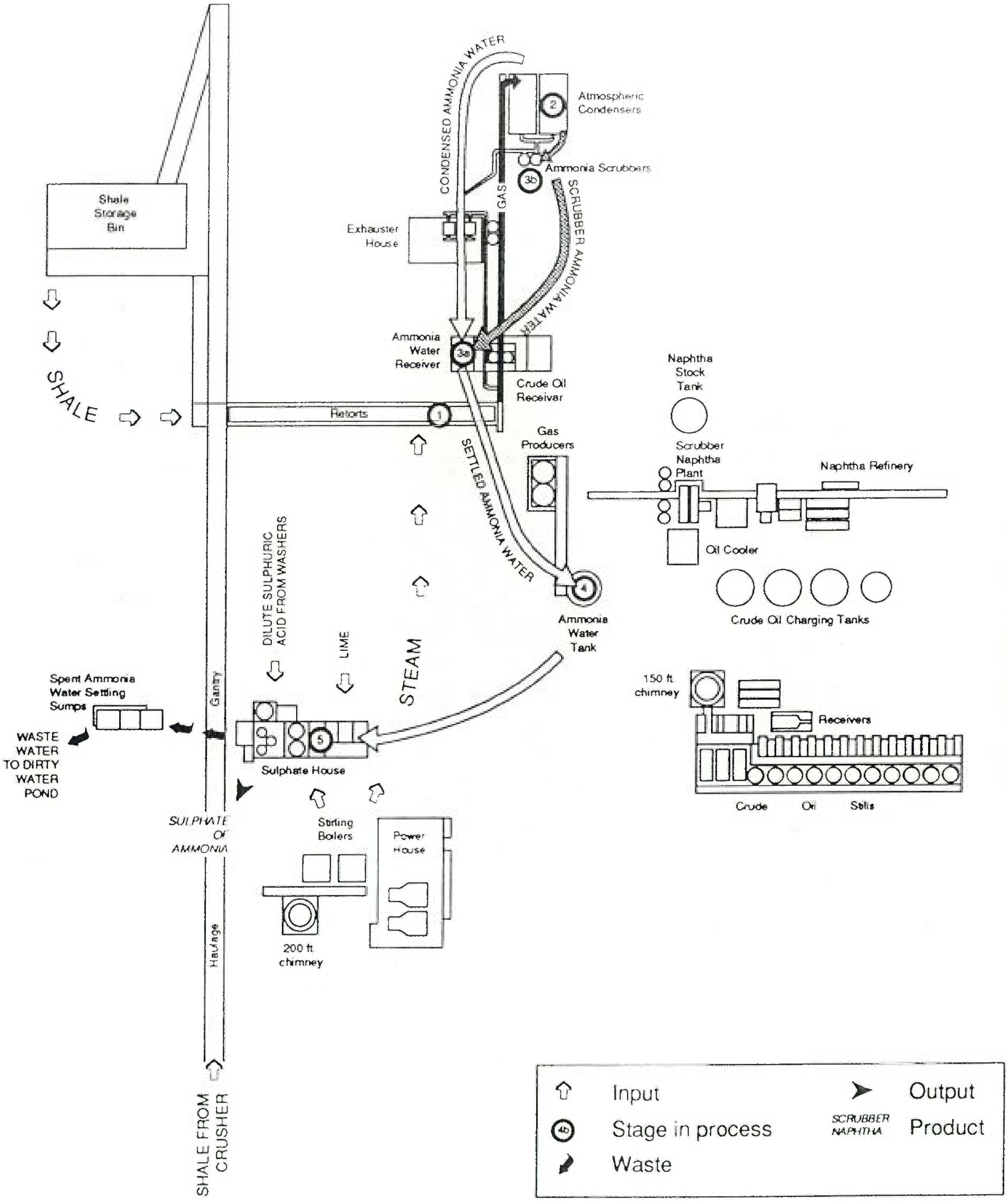


Figure 3.19: Spatial and product relationships involved in producing sulphate of ammonia.

works. Any number of different candle making machines may have been in use, all consisting basically of a number of candle moulds in a frame, provided with a charging trough and fitted with a device to eject the candles when set.

A basic machine consisted of a mould with a perpendicular plunger, mounted on a tubular carrier which, when at its lowest point closed the mould prior to pouring in the liquid paraffin. Once the wax was poured, cooled (using cold water) and set, the plunger was forced upward, ejecting the candle (Scheithauer 1923, 211) (Fig. 3.20).

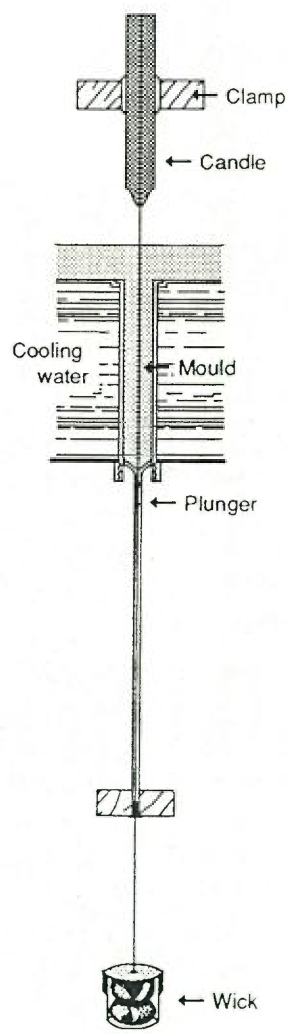


Figure 3.20: Cross section through a basic candle making device.

Generally only paraffin of high melting point (greater than 53°C) was used to manufacture candles and was often mixed with a small proportion of stearine or mutton fat to make it firmer (Bailey 1927, 224; Scheithauer 1923, 204). The 1931 schedule of assets notes only that two candle making machines were part of the candle factory (Shale Oil Development Committee Ltd. List of Assets 21/7/31).

3.8. Waste Treatment Plant.

During all stages of the complete process there were waste products which resulted and which needed to be either treated or disposed of. Chiefly these wastes originated from the refining process as acid and soda tars, from the sulphate of ammonia manufacturing process as spent ammonia water and as waste water generally from the distillation process.

3.8.1. *Acid Tar.*
The acid tar from the successive processes was run off into tar boxes (wooden vessels lined with lead) from which it was run down into a tar blower - basically a horizontal boiler with an air pipe, from which the tar could be blown using compressed air to a series of tar boxes for the recovery of the acid (Bailey 1927, 204). To recover the acid the tar was broken down by boiling it with steam so that the resins separated out on the surface of impure dilute sulphuric acid and could then be removed. The dilute acid could either be re-used as part of the preliminary refining process for crude oil or sent to the sulphate house for the manufacture of sulphate of ammonia (Hurst 1925, 51; Scheithauer 1923, 156).

3.8.2. *Soda Tar.*
After collection this refinery waste was run off into a soda tar blower and treated by blowing air into it, resulting in the formation of carbonate of soda and releasing the oily tar constituents. The carbonate of soda could be re-causticated for future use, while the remaining soda tar and acid tar was combined, after which the resulting sludge was used as fuel for the stills where it was injected into the furnaces and burnt (Abraham 1961, 60; *Australian Mining and Engineering Review* 1910, 414; Bailey 1927, 204; Hurst 1925, 51). Neither the acid tar nor the soda tar plant at Newnes is recorded in either of the lists of assets.

3.8.3. *Spent Ammonia Water.*

The amount of ammonia contained within the waste water resulting from the ammonia distillation process would have depended upon the particular system of distillation in use. If distilled using a vertical cylindrical steel still (section 3.7.1) only very small traces of ammonia were contained within the waste. If an older style horizontal boiler still was employed for the purpose (section 3.7.1) approximately one third of the total ammonia water utilized could be run off as waste (Bailey 1927, 195). In either case the water was run off into settling ponds and then discharged into the waste water treatment plant.

3.8.4. *Waste Water.*

Steam was used as an adjunct to most of the major processes and therefore a considerable quantity of waste water resulted. Chief amongst these was the water from the stills as it could often contain large proportions of waste products. Waste water from the distillation process was charged to successive settling ponds where the oil could be skimmed from the surface before release. On site at Newnes there was 'a large brick dirty water pond and a brick pump house containing one three throw 'Tangye' pump with 15 hp motor to handle the dirty water used in the distillation process' (Australian National Shale Oil Co. Ltd. Prospectus 1932, 18).

Figure 3.21 is a simplified diagrammatic representation of the shale oil extraction process showing end products, processes and the various locations for each of these activities.

3.9. Coal Mine and Coke Ovens.

In New South Wales the oil shales are associated closely with the coal measures and the coal mine at Newnes was one of the first operations established on site, the coal being extracted using the longwall system of mining (section 3.1.1). The *Lithgow Mercury* (23/10/06) recorded in October 1906 that the 'coal measures are to be worked on a big scale' and by 1907 the Commonwealth Oil Corporation had already erected a trial set of four coke ovens, with the likelihood of additional ovens being built at a later date (Department of Mines 1907, 36). In 1909 the Department of Mines was able to report that the 'only addition to the coke oven plants

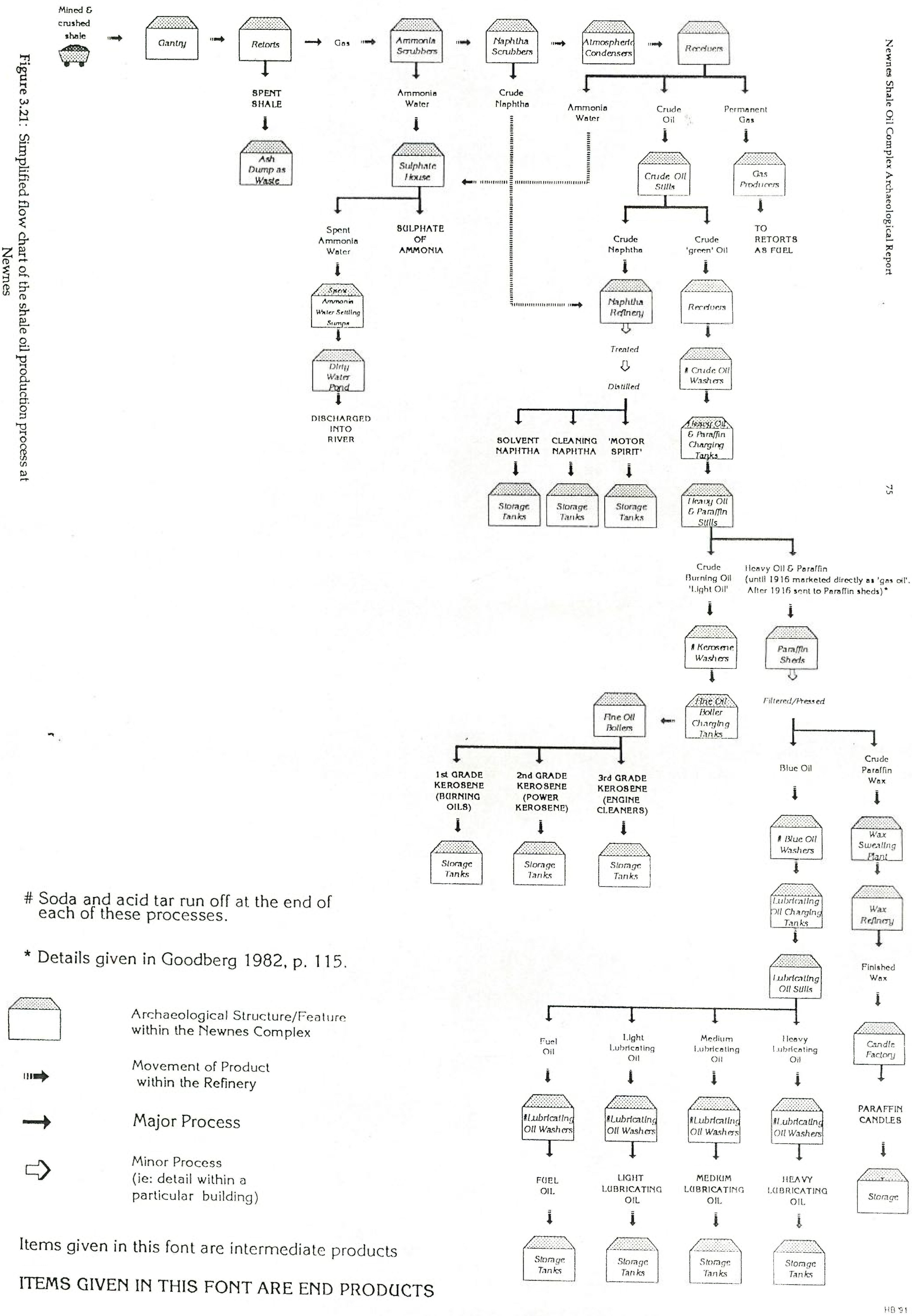


Figure 3.21: Simplified flow chart of the shale oil production process at Newnes

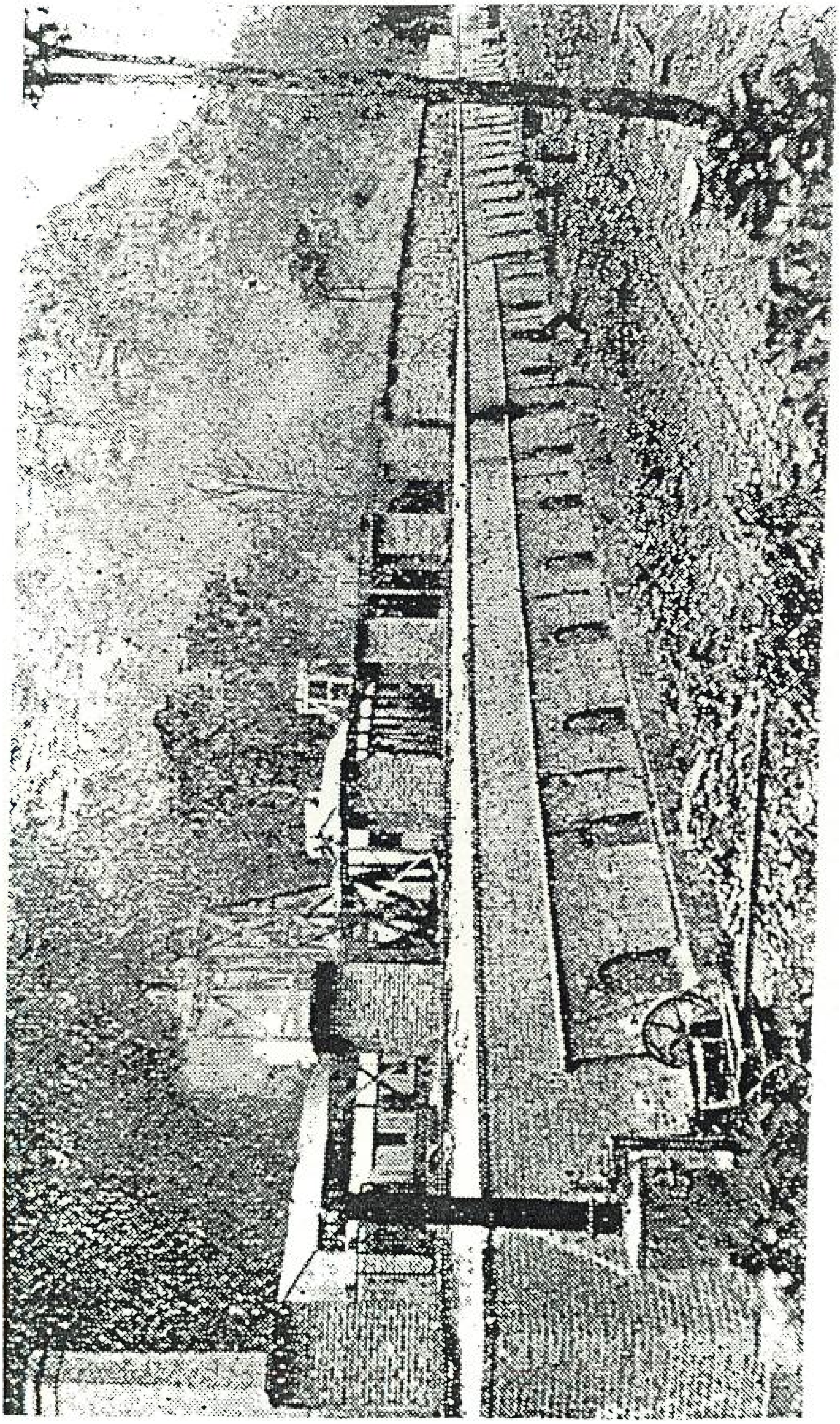


Figure 3.22: Coke ovens complex c. 1911. (Photo from Department of Mines collection).

[already in existence] of any importance now being made is at the Commonwealth Oil Corporation's Wolgan Mines' (Department of Mines 1909, 117). In 1910 the *Australian Mining and Engineering Review* (413), recorded that 88 beehive ovens were working and producing approximately 500 tons of coke per week (Fig. 3.22). The number of ovens erected is not recorded, though elsewhere they are numbered up to 120, arranged back to back in two rows of sixty (Eardley and Stephens 1974, 149). These ovens were of the distinctive bee-hive shape, a form initially introduced in England in the 1760s (Birmingham, Jack and Jeans 1979, 118) and the coke was exported largely to the Lithgow iron works and the Cobar copper smelter (Lane and Lane 1977, 4). The greater part of the coal produced at Newnes was used in the manufacture of coke, the remainder being utilized for the railway and the works generally (Commonwealth Oil Corporation to Inspector of Mines 13/10/11, 3).

Coke is the solid residue which results from the partial combustion of coal, this carbonized product serving as a better fuelstuff than raw coal (Christopher and Byrom 1952, 1). A typical bee-hive oven has an inner lining of refractory brickwork, with a space between the inner and outer walls which is filled with sand or a similar substance to retain heat. Coking itself is a slow process and took approximately three days (70 hours) for completion in a bee-hive (*Australian Mining and Engineering Review* 1910, 413; Christopher and Byrom 1952, 51).

Briefly the process would have taken place as follows:
The doorway is partially built up and the charge fed into the oven. Sometimes a small fire is necessary at the door to begin the process, but when in full working order the internal heat retained in the brickwork is usually sufficient. The charge is levelled and the doorway built up. As the heat gradually increases gases are expelled slowly, taking up to three days to fully expel all volatile matter as gas. When all the gas is extracted the coke is quenched and the charge raked out (Christopher and Byrom 1952, 51). At Newnes the coke was drawn out of the ovens by means of two patent extractors and conveyor belts travelling along either side of the bench delivered the coke onto waiting railway trucks (*Australian Mining and Engineering Review* 1910, 413).

In addition to the coke ovens there were two coal shafts (one upcast, one downcast) with pit heads and winding engine units, as well as conveyors, extractors and a coal crushing plant, all erected before June 1911 (Eardley and Stephens 1974, 147; Commonwealth Oil Corporation Directors Report and Balance Sheet 27/6/11). A year earlier, in 1910, the Number 2 coal shaft had just begun operation, with a winding engine supplied by Roberts in Bendigo, Victoria and power originating with two Babcock and Wilcox boilers. In addition a 48 inch Sirocco double fan had been installed for ventilation to exhaust stale air from the mines (section 3.1.2). Once mined the coal was passed through a crusher, elevated by a Jeffrey bucket elevator to storage bins and then conveyed to the coke ovens (*Australian Mining and Engineering Review* 1910, 413). It appears that by the time John Fell had taken over operations the coal shafts had become too costly to maintain and operate, resulting in an adit being driven into the seam (Goodberg 1982, 127). A haulage and tipping plant was also established by 1924 and was located just above the lower railway line. This appears to have consisted of two sections of railway with a loading staith ('John Fell and Co. Plan of Coal Workings Newnes' - 19/6/24). The 1932 Australian National Shale Oil Company's Prospectus (19) lists a steam boiler and injector, winding winch, coal skips, tippler, haulage rope, electric motors, weighbridge and coal shute as amongst the assets of the coal mine.

At some stage before 1914 the coke ovens ceased to operate, possibly resulting from the closure of the Cobar smelting works around 1911 (Eardley and Stephens 1974, 153). After this date the coal mine continued to operate with only a small output to cater for the oil works, brick yard and railway (Eardley and Stephens 1974, 153). The coal mine eventually ceased production altogether on March 31st, 1924 ('John Fell and Company Plan of Coal Workings Newnes' - 19/6/24).

The stone facing from the coke works is alleged to have been removed around 1914 and used to replace the timbering of the Newnes railway platform (Stephens 1959, 190).

3.10. Power Supply and Boilers.

Newnes possessed an extensive power plant and boiler system, the power house consisting of a concrete floored brick building with two sets of 750-800 hp compound Bellis and Morcom vertical engines, linked to Westinghouse three-phase generators. The plant also had a complete repair shop as well as minor features such as switchboards and dynamos and was capable of producing sufficient light and power for all electrical requirements both commercial and domestic (Australian National Shale Oil Co. Ltd. Prospectus 1932, 18).

The boiler plant possessed four sets of Stirling water tube boilers with stokers, a 200 ft brick chimney and flues and steam piping throughout the entire works. It was capable of producing steam to operate the whole of the works and was fuelled by coal taken from the Company's mine, as well as permanent gases from the retorts (Australian National Shale Oil Co. Ltd. Prospectus 1932, 18).

3.11. Water Supply.

To ensure sufficient supply of water to the works there was always the necessity for adequate pumping and storage facilities. Initially two Pearn pumps with a capacity of 30,000 gallons per hour were installed to raise water from the river to the reservoir, which itself had a capacity of 200,000 gallons (*Lithgow Mercury* 24/10/10). Later, however, the 1932 prospectus records the existence of a brick and corrugated iron pump house containing two sets of horizontal pumps and two 75 hp motors being connected to the concrete and brick reservoir. Water pipes were laid throughout the whole of the works (Australian National Shale Oil Co. Ltd. Prospectus 1932, 18).

3.12. Brickworks.

The brickworks were established on the north bank of the river to cater for the huge demand for bricks involved in the construction of virtually every building in the Newnes complex. Five Hoffman type brick kilns fired with coal were in operation by 1910 (Goodberg 1982, 125; Simpson

1983, 118), initially to provide bricks for the coke oven complex. Only standard bricks were manufactured on site, the firebricks used in the retorts, the inner refractory lining of the coke ovens and in the boilers being manufactured at Torbane (*Australian Mining and Engineering Review* 1910, 412). Behind the kilns was the clay quarry, where the raw material for the bricks was extracted. A press house and a drying house were also erected in close proximity to the kilns and an extension of the rail line from the works ran to the brickyard, terminating at the quarry.

3.13. Additional Features.

There were many features additional to the main sections of the plant which were still a part of the overall operating process at Newnes. Features such as an air compressor and a forge are obvious on the 1911 map, although they are not related specifically to any particular building or process. Several workshops were necessary for servicing equipment and machinery and for repairing damage or for new construction. As part of the continual process of maintenance and construction Newnes possessed several workshops, including a carpenter's shop, blacksmith's shop, machine and fitter's shop, boilermaker's shop and an engineering shop, each with all the necessary equipment (Shale Oil Development Committee Ltd. List of Assets 21/7/31; Australian National Shale Oil Co. Ltd. Prospectus 1932, 18-19). A full list of equipment from each of these workshops is included in Appendix 10.5.

Offices were required for day to day administration purposes and Newnes possessed both a general works office as well as a drawing office, both of timber and corrugated iron construction (Shale Oil Development Committee Ltd. List of Assets 21/7/31). There was also a storehouse, a telephone exchange and a Doctor's surgery within the immediate vicinity of the Number One shale mine.

3.14. Housing - Company and Private.

Many domestic dwellings were associated with the works, including both company owned and private houses. Although a sizeable official township developed nearby, there were still a large number of workers who elected to remain in closer proximity to the mines and works and it is their dwellings which are scattered across all areas of the Newnes site. There was great range and variety in the size, construction and permanence of these dwellings: these variables reflecting the social, economic and employment position of the inhabitants. Those individuals important in the administrative hierarchy were provided with comfortable company constructed housing, from the directors through to the company engineers and mine managers, while the average miner was largely left to their own devices and the most cheaply and readily available materials.

Unfortunately there is very little recorded information available on the precise extent or types of housing present at Newnes. A series of photographs taken by the works engineer, William Petrie, in the early 1900s, records all of the company owned and private domestic dwellings located on company mining leases. However, although all photographs contain a record of rental charges and occasionally the surnames of occupants, there is no way to fix the location of any of these structures on a map. Rate books held by the Greater Lithgow City Council for the years 1930, 1933 and 1939 record occupants names and the value of improvements on each property, however these can only be located to within the boundaries of the particular mining lease concerned. The chief importance of such rate records is that the relative value of various buildings can be determined and although properties become less valuable over time, the more expensive (and therefore extensive) houses can still be readily distinguished from smaller, less impressive dwellings (Appendix 10.8).

3.15. Removal.

For various reasons the Newnes plant and works never achieved the outstanding commercial success which was envisioned. Following its final closure much of its equipment was dismantled and removed, even as some of this had originally come from earlier works such as Torbane and Hartley Vale.

It seems that this removal took place in roughly two stages - at the end of the John Fell period and again in 1938/39 when the emphasis was transferred from Newnes to Glen Davis. Three years after the initial major closure in 1924, the Commonwealth Oil Corporation advertised for tenders to purchase all assets, however several references mention some isolated removal as occurring before this date.

In October 1927 the *Labour Daily* reported that,'everything moveable had been taken away from the mine' and that 'all the machinery was gone or rusting to pieces' (Shale Oil Ministers File 8/10/27). It is unclear whether this refers to the mines only or to the works as well, however in July 1930 the *Sydney Morning Herald* (21/7/30) carried an article stating that 'some of the refining plant and the ammonia and acid plant had been removed since the works closed' .

Luchetti, without giving dates, states that John Fell was responsible for at least some of this removal, particularly equipment for an oil refinery which he established at Duck Creek, as well as tanks and 'other equipment' which he used at a receiving place established for imported oils at Gore Bay (Luchetti 1979, 23-24).

Following this initial removal activity, when Newnes was taken over by George Davis' National Oil Company fourteen years later, it was decided to abandon the old works site and construct a new one, resulting in further removal of equipment and parts. In 1934 the Newnes Investigation Committee recommended certain sections of the plant viewed as worthwhile for removal - namely the boilers, generators, machine tools, exhausters, atmospheric condensers, pumps and pipes (Report on the Newnes-Capertee Shale Oil Project 1934, 29).

Dates for this period of removal are given variously as 1938 (Luchetti 1979, 25) and 1939 (Antill 1944, 14). Luchetti states that at this time 'Newnes was destroyed' and that 'until that time it had been allowed to remain ... the brickwork in the smoke stacks and power station could not have been bettered in a public building anywhere ... much of the brickwork had been cemented, making any form of reclamation impossible' (Luchetti 1979, 25). This not only implies removal of equipment but also destruction of some of the major buildings, however Kraemer and Thorne visited Newnes in September 1947 and at this time the chimney stacks were still standing relatively intact (Kraemer and Thorne 1951, figures 2 & 3).

In November 1948 the *Lithgow Mercury* reported on another episode of at least partial removal by 'P.King and Sons, Marrickville', who by this date had almost completed the job of dismantling the boilers at Newnes, also stating that 'apart from two brick houses ... there is nothing of value left of the once prosperous shale oil working' (*Lithgow Mercury* 26/11/48).

3.16. Reasons for Failure.

The basic reasons for Newnes' failure despite numerous optimistic appraisals, were largely a result of inadequate or outdated production methods and the prohibitive costs of mining. Newnes was erected primarily for the production of kerosene at a time when the automobile industry was in its infancy. Consequently its production of 'motor spirit' amounted to only a minor percentage of the completed products, a situation which became highly detrimental as cars increased in numbers and importance. This was one of the reasons for establishing Glen Davis, as at maximum Newnes could only produce five gallons of petrol per ton of shale, whereas with new processing technology Glen Davis was capable of producing 60 gallons (*Sydney Morning Herald* 22/12/39).

Other advances in technology, such as improved methods of lighting, reduced the importance of the paraffin industry - another major feature of the Newnes works. Not only was there less demand for paraffin products, but on top of this, general improvements in the lighting industry made the sale of natural shale to gas companies unnecessary. Previously a lucrative market had existed in supplying raw shale and gas oil to gas works companies, as the addition of as little as 5% shale to coal gas was sufficient to raise the 'brightness' of the flame by the equivalent of eight candles (*Australian Mining and Engineering Review* 1910, 410; Norcross 1950, 3; *Sydney Morning Herald* 22/12/39).

Added to this the costs of mining - both of extraction and miner's wages - increased, gradually placing extra burdens on the industry. This was particularly so as American products and crude oil supplied from flow oil, which has negligible extraction costs, were imported at ever cheaper prices. In 1925 John Fell supplied figures to the effect that an American producer of flow oil could sell crude for £3 per ton, a price which included profit to the producer, whereas although the cost of retorting was negligible, the cost alone of mining shale amounted to more than £3 per ton of finished crude oil, a price to which a profit margin and then the costs of transportation still needed to be added (Wade 1925, 16). In an effort to combat the toll which the high price of mining was taking upon his profits, Fell during 1921-22 attempted to establish a scheme for *in situ* retorting, which was intended to omit the costs of mining altogether. This involved walling up all openings into the adit, setting the underground seam alight while admitting a regulatable current of air, and then drawing off the resultant oil gases with suction and scrubbing them at the mouth of the adit. This was apparently undertaken inside the Number One shale mine's number two adit, however although it was received with much media attention, it was unsuccessful (James Petrie quoted in Goodberg 1982, 68). The 1931 list of assets notes two Bakers exhausters and a quantity of gas mains as present at the 'number two old shale tunnel', however whether these are remnants of the *in situ* retorting experiment or not is unclear.

Goodberg (1982, 136) provides a concise synopsis of some of the reasons for the failure of the works at Newnes, citing the Corporation's belief that they held a monopoly on production as being in fact a major problem, and one which was never fully (or officially) recognised. Although the fact of a production monopoly was indeed true, this did not extend to the marketplace and in fact the high costs of equipment and labour were never met by demand, merely countered by competition. The desire to create a complex which was entirely self-contained and which was therefore adequate to exploit the Corporation's monopoly, meant that the works were constructed on such a large and permanent scale that it was highly inflexible. It could not be adapted to refine small batches of specialist products and it was not able to cope with rapid changes in production technology or with transfers of emphasis between products (Goodberg 1982, 136).

4. ARCHAEOLOGICAL CONTEXT

During the course of two field seasons, over 100 archaeological features were located and recorded, along with a number of peripheral features (Appendix 10.1). Areas on both the north and south bank of the Wolgan River were systematically surveyed and the condition of each feature was noted, as were any threats to its continued survival. The only limit to complete recording in some areas was the level of vegetation overgrowth or the inaccessibility of particular features (such as I/4 the crude oil receiver).

The range of archaeological material recorded represented a wide variety of different components within the Newnes site. This included the remains of technological processes, such as the retorting, refining, distilling and by-product plants, surface mining features, from both the coal and the shale mines, associated industrial remains such as the brickworks, water and power supply and waste treatment plants and archaeological evidence for domestic housing belonging to a range of employees at the complex.

Details of individual features are provided in Volume Two of this report.

4.1. General Condition of the Works.

The majority of the buildings at the Newnes site have been demolished to foundation level and therefore most of the site is in relatively similar condition

The extent to which these features survive intact is a function of their original construction, in terms of whether or not they housed important equipment which was considered advantageous to remove upon abandonment (see section 5) and whether they were constructed as sub-surface or above ground features. It is noticeable that only those features which are set into the ground survive in excellent condition and that virtually all above ground remains have been reduced to foundation level. Of those few above ground features which survive up to 50% intact many, such as the paraffin sheds, sections of the Crude oil stills, Heavy oil and paraffin stills, Lubricating oil stills and the Fine oil boilers and the coke oven complex are in quite unstable and potentially dangerous condition.

In addition to the building sites proper, there are also external subsidiary features which need to be considered. Sections of the three massive retaining walls are in a precarious condition and rapid change in the rate of their collapse was very noticeable just between the two field seasons. Storm water and waste water drainage lines are also a problem, particularly as most of these are infilled with silt and leaf litter.

4.2. Discussion

One of the most obvious features of the entire Newnes site is the wide variety of material remains present. The archaeology of Newnes demonstrates the interrelationships between a variety of material remains, including both purely technical aspects (technology for mining shale, for distilling the oils, for refining them and for manufacturing specific products) and associated but necessary secondary processes (the provision of an adequate power supply, water supply and fuel supply or the production of construction materials), as well as certain domestic aspects involved in such a large scale enterprise (the provision of adequate housing or necessary services).

4.2.1. Removal.

One of the most striking aspects of the Newnes site is the relatively similar condition of the majority of its archaeological features. Although the Newnes complex only ceased to be actively occupied some fifty years ago, in most areas there is very little apart from ground level or limited foundations visibly remaining. Obviously this is not merely a function of natural decay processes, as the site was constructed from extremely durable materials on a permanent scale. The main explanation for the lack of observable material remains then rests with the behaviour of people following the abandonment of the works. Although the definintion of a site presupposes that it is created by human beings, people also have the potential to destroy the sites they make, generally by a number of processes which either remove, destroy or otherwise alter the spatial patterning of material remains. As a distinct site formation process the human contribution can far outweigh that of other physical processes, such as erosion and weathering and can result in sites which are heavily depleted of artefactual material. One of the main cultural formation processes which has operated on the Newnes site is that of reclamation, or the removal of objects, resources or materials by various groups of people. Generally speaking cultural reclamation processes fall into six categories (Burke 1990, 3):

1. Lateral cycling, or the transfer of used items from one person or group of persons to another, typically involving the selling or giving away of objects.
2. Re-use, or the use of objects or materials removed from one site for the same purpose in another place.
3. Secondary use, where objects or materials from a site are used for a different purpose elsewhere.
4. Recycling, which involves a change in the form of objects or materials so that they may be used as raw materials in a new situation.
5. Souveniring, or the perception of things as interesting, curious or collectable and therefore worthy of removal.
6. Conscious cleaning up, where materials or objects are perceived as dangerous, unwanted or a nuisance and therefore removed to prevent a potential threat.

As none of these categories involves specificity of time, they can take place at any time once a site or part of a site has ceased to be actively used and can be carried out by the original owners, by other members of the same social unit or by other, different groups of people altogether. Although people reclaim things with a variety of end purposes in mind there is an underlying principle which governs all reclamation: namely the value of the material in question. In other words, people perceive an item to have a certain value which then makes that item worth reclaiming. Of course value is not so much a property of cultural materials as of cultures and is therefore a dynamic concept, which will change over time as variables such as technology, social conceptions of heritage awareness or cultural preferences change. At Newnes the operation and effects of at least five of the six reclamation categories can be observed in the archaeological record. The operation of these processes took place both within the confines of the site upon abandonment of certain areas asnd following the two major periods of closure, initially following the end of the John Fell period in 1923 and again when Newnes became part of the Glen Davis project in 1937 (see section 2.3).

1. Lateral cycling, re-use and recycling.
In the purely economic venture which was Newnes considerable capital outlay was devoted to equipment and machinery. This was a requirement of all sections of the process and to a certain extent was particular to each section. As value relates to such criteria as the range of purposes to which an item may be put, the length of its uselife or its replacement cost, specialist equipment would have possessed a high intrinsic value as something which was designed for a directly economic purpose (the nett benefits of mining or processing being, in a sense, more direct than the benefits to be acquired from old bricks), as something which could be immediately re-used in a similar situation, and as something which, if acquired new, would cost far more. Not surprisingly then, such highly valued resources were among the first things to be removed from the site upon abandonment. This uniformly high value is of course ideal and would have been mitigated by various factors such as the rapid changes in technology which had occurred in the shale mining industry, which may have rendered much equipment obsolete, and the issue of the cost of salvage versus the reliability of the resource as removal, renovation or replacement costs may in fact have ended up being greater than the cost of a new replacement.

At Newnes, specific plant such as the retorts, the refinery tanks, machinery from the powerhouse and the boilers are all mentioned quite frequently as having been removed immediately after 1937 (Eardley and Stephens 1979, 217; Kraemer and Thorne 1951, 9; *Lithgow Mercury* 26/11/48), while other references merely make unspecific mention of the removal of 'machinery' (*Labour Daily* 8/10/27), 'equipment' (Luchetti 1979, 23) or of 'pumps, pipes' and 'machine tools' (Newnes Investigation Committee 1934, 29). It is important to remember that removal from one site cannot be viewed as entirely separate from what is taking place at other sites, as very often material removed from one archaeological situation will become deposited in another, a dynamic cycle which theoretically may have no end. This can be demonstrated with the movement of materials both into the Newnes site upon its establishment and away from it upon abandonment. As the Commonwealth Oil Corporation already owned the nearest commercial competitors to Newnes, plant from sites such as Torbane and Hartley Vale was transferred to the Newnes site at the beginning of its working life. As part of this movement the atmospheric condensers are recorded as originating from Torbane (*Australasian Hardware and Machinery* 1914, 185) and the kerosene tin making plant from Hartley Vale (Eardley and Stephens 1979, 207). In some instances there are even clear indications of the locations to which Newnes equipment was subsequently removed. Much of it seems to have gone to John Fell's refinery at Duck Creek after the first major period of closure in 1923 (Eardley and Stephens 1979, 211) or to Glen Davis following the final closure in 1937 (Eardley and Stephens 1979, 217). In both of these cases a reasonable assumption is that it was intended for re-use, while material which is recorded as being removed for scrap would have been more likely destined for recycling.

Apart from machinery, other materials were obviously also removed from the Newnes site. Foremost amongst these are bricks, as their degree of value is dictated by the fact that they are highly re-usable, easily transportable and that if they are obtained from a secondary context then the costs of their production have already been met by someone else. Firebricks for example are known to have been removed to John Fell's refinery at Duck Creek after 1923. These possibly came from the brick kilns, as the other features which would have contained such bricks are either still intact today (the coke ovens) or were certainly still intact after the 1923 closure and were used by later company's (the retorts and the stills). One mitigating factor which would have influenced the likelihood of and methods for the removal of bricks is the practice followed at Newnes of cementing the brickwork together, which would have necessitated the complete destruction of buildings to reclaim the bricks. Other highly re-usable and easily removed and transportable materials such as galvanised iron or sawn and finished timber would also be prime targets for reclamation for re-use or secondary use.

2. *Souveniring.*
The practice of souveniring materials is linked to two conservatory processes (Schiffer 1987, 32-35), which involve changes in an artefact's use, such that permanent preservation is intended. These are 'heritage consciousness' and 'collectability', and the value of items in these terms is a response to either absolute age or antiquity, demonstrable links to broader social concepts such as 'heritage' or 'history' or to other factors which make a resource collectable, such as its ability to be easily stored, the aestheticness of its appearance or its ability to embody certain things which are held as important by the collector, such as an historical event, cultural group or geographical area.

Bottles are probably the most obvious objects to be removed from the Newnes site by souveniring, although items such as mining skips, bricks or nails may also be targets. Domestic rubbish tips are one of the most likely locations for this type of activity.

3. *Conscious cleaning up.*
This is a process which operates, not because the resources or materials in question are seen as being particularly valuable, but precisely because they are viewed as not being so. In this situation the material remains of a site are altered, removed or destroyed to prevent them from becoming a potential hazard. In these terms, materials are viewed as having uniformly low value. Both shale mines and the coal mine have been infilled or partially destroyed for this reason as a deliberate safety measure. It is unknown precisely when or how this was done.

Obviously a great range of materials may be removed from a site for a wide variety of purposes and this is largely a function of the many and varied and often ideosyncratic needs of the reclaimer in question. For archaeology one of the important links between value and the various cultural reclamation processes which may operate upon a site is that the value of an object will determine the specific reclamation process which will be responsible for its removal and thus the ultimate fate which the resource will meet. This has implications for both the study and the public perception of historical archaeology, as only those items which are immediately recognisable as the original artefact (ie. those which have not been recycled) or which have been removed for permanent conservation (by souveniring) will be recognised and assessed as having a direct connection with the site.

Also important is the fact that the removal of materials from a site has the potential to profoundly alter both the integrity and the condition of structures, as well as the amount and types of material which are left on site for the archaeologist to analyse.

Specific details of removal, correlated with the present physical condition of all archaeological features located during the two field seasons is summarised in figure 4.1. This information has also been correlated with the likelihood of sub-surface archaeological data remaining *in situ*. 'Period' has been used here to refer to the most likely operational period during which the feature was constructed and therefore refers to the four main stages outlined in section 2.3.

[Over]

Figure 4.1: Survival table for archaeological elements

Feature	Period	Known Removal/ destruction?	Survival of visible remains	Likely sub-surface remains	Comments
I/1 - Reservoir	COC		Excellent	Nil	
I/2 - Atmospheric Condensers I/2/a - Low rectangular brick structure I/2/b - Parallel foundations of condensers I/2/c - Concrete floor slab	COC	Condensers recommended for removal by Newnes Investigation Committee (1934, 29)	Ground level/limited foundations only	Foundations	
I/3 - Exhauster House and Retaining Wall I/3/a - Brick retaining wall I/3/b - Pipe/boiler support platform I/3/c - Drain	COC Retaining wall later than Ex. house	Exhausters recommended for removal by Newnes Investigation Committee (1934, 29)	Ground level/limited foundations only. Retaining wall in excellent condition	Foundations	
I/4 - Crude Oil Receiver and Retaining Wall I/4/a - Low rectangular brick structure I/4/b - Brick piers I/4/c - Parallel brick footings I/4/d - Brick retaining wall	COC		Ground level/limited foundations only. Retaining wall in excellent condition	Foundations	
I/5 - Shale Storage Bin (cutting) I/5/a - Low brick wall I/5/b - Remains of mining skips (4)	COC		Primarily a landscape feature	Foundations?	

I/6 - Gantry I/6/a - Parallel wall foundations I/6/b - Parallel wall foundations I/6/c - Cutting with pick marked boulders I/6/d, e & f - Brick foundations I/6/g - Low brick footing I/6/h - Low brick footing I/6/i - Low brick footing I/6/j - Low brick footing I/6/k - Welded metal pipe supports (2)	MP? COC		Ground level/limited foundations only	Foundations Footing foundations only	Possibly part of the re-routing of the haulage road from the Number Two shale mine direct to the storage bin (associated with the Newnes Investigation Committee)
II/1 - Wax Sweating Plant II/1/a - Foundations for sweating houses II/1/b - Charging tank bases (2) II/1/c - Brick sump II/1/d - Brick pipe/boiler bases (2)	COC		Ground level/limited foundations only	Foundations	
II/2 - Wax Refinery II/2/a - Boiler/firebox and chimney II/2/b - Brick/stone retaining wall II/2/c - Foundations of wax refinery building	COC JF?		Ground level/limited foundations only	Foundations	

II/3 - Candle Factory II/3/a - Brick pipe/boiler support II/3/b - Brick pipe/boiler support II/3/c - Brick & concrete floor slab	COC		Ground level/limited foundations only	Foundations	
II/4 - Blue Oil Washers II/4/a - Soda wash tank II/4/b - Soda wash tank II/4/c - Soda wash tank? II/4/d - Acid wash tank II/4/e - Acid wash tank II/4/f - Acid wash tank? II/4/g - Charging tank II/4/h - Charging tank II/4/i - Charging tank II/4/j - Tank II/4/k - Tank II/4/l - Brick footings & solidified tar II/4/m - Brick storm water drain	COC		Up to 50% intact	Foundations	

II/5 - Crude oil washers II/5/a - Soda wash tank II/5/b - Soda wash tank II/5/c - Acid wash tank II/5/d - Acid wash tank II/5/e - Charging tank II/5/f - Charging tank II/5/g - Brick footings II/5/h - Brick footings II/5/i - Brick footings & solidified tar II/5/j - Stone storm water drain	COC		Up to 50% intact	Foundations	
II/6 - Paraffin Sheds II/6/a - Filter press house room II/6/b - Hydraulic press house room II/6/c - Pump house room II/6/d - Freezing room II/6/e - Boiler house room II/6/f - Tank bases (2) II/6/g - Tank bases (4)	COC		Up to 50% intact	Foundations	
III/1 - Settling House Stock Tanks (2) III/1/a - Stone/brick retaining wall	COC		Ground level/limited foundations only	Foundations	
III/2 - Pump House and Settling House III/2/a - Foundations of settling house III/2/b - Foundations of pump house III/2/c - Brick pipe/boiler supports	COC		Ground level/limited foundations only	Foundations	

III/3 - Stock Tanks III/3/a - Tank base III/3/b - Tank base III/3/c - Tank base III/3/d - Tank base	COC		Ground level/limited foundations only	Foundations	
III/4 - Workshops III/4/a - Brick pipe/boiler supports (3) III/4/b - Brick pedestals (4)	COC		Ground level/limited foundations only	Foundations	
IV/1 - Stirling Boilers and Chimney IV/1/a - Brick drain IV/1/b - Brick wall	COC	Boilers recommended for removal by Newnes Investigation Committee (1934, 29)	Represented primarily by rubble mounds/scatters of debris	Foundations	Chimney still standing in 1947
IV/2 - Power house IV/2/a - Brick base IV/2/b - Brick pit IV/2/c - Brick retaining wall & plinths	COC	Generators recommended for removal by Newnes Investigation Committee (1934, 29). Machinery removed to Glen Davis (Eardley & Stephens 1974, 217)	Ground level/limited foundations only	Foundations	
IV/3 - Water Supply Pump IV/3/a - Picked recess with bolts IV/3/b - Metal ring bolt IV/3/c - Metal ring bolt IV/3/d - Cement footing IV/3/e - Grafitti '19' IV/3/f - Metal ring bolt IV/3/g - Metal ring bolt IV/3/h - Metal ring bolt	COC		Ground level/limited foundations only	Foundations	
V/1 - Dirty Water Pond and Separator V/1/a - Cement foundations	COC		Excellent	Nil	

V/2 - Spent Ammonia Water Settling Sumps V/2/a - Heavily overgrown drain?	COC		Excellent	Nil	
V/3 - Sulphate House V/3/a - Brick pit & drain V/3/b - Drain	COC		Ground level/limited foundations only	Foundations	
V/4 - Crude Oil Stills V/4/a - Brick floor slab V/4/b - Cement slab V/4/c - Brick/cement pit V/4/d - Brick/cement pits (2) V/4/e - Stone retaining wall V/4/f - Cement & brick footings	COC		Up to 50% intact	Foundations	Chimney still standing in 1947
V/5 - Heavy Oil and Paraffin Stills V/5/a - Chimney base V/5/b - Brick flue V/5/c - Brick pipe/boiler supports	COC		Ground level/limited foundations only	Foundations	Chimney still standing in 1947
V/6 - Lubricating Oil Stills V/6/a - Brick pipe/boiler supports (4)	COC		Ground level/limited foundations only	Foundations	
V/7 - Fine Oil Boilers V/7/a - Brick pits (2) V/7/b - Brick pipe/boiler supports (6) V/7/c - Brick outer wall buttresses (2)	COC		Ground level/limited foundations only	Foundations	
V/8 - Lubricating and Fine Oil Charging Tanks (6 tank bases)	COC		Up to 50% intact	Foundations	

V/9 - Railway Servicing Pit V/9/a - Sandstone blocks (7) V/9/b - Sandstone blocks (4)	JF?		Excellent	Nil	
VI/1 - Retorts VI/1/a - Brick retaining wall VI/1/b - Flight of brick steps VI/1/c - Ash dump	COC/JF	Retorts taken to Glen Davis (Kraemer & Thorne 1951, 9). Firebricks removed to Duck Creek by John Fell (Eardley & Stephens 1974, 211)	Represented primarily by rubble mounds/scatters of debris	Foundations	Constructed between 1907-1910
VI/2 - Gas Producers VI/2/a - Tank base VI/2/b - Ground level brick walling	COC		Up to 50% intact	Foundations	
VI/3 - Scrubber Naphtha Plant, Naphtha Refinery and Pump House VI/3/a - Stone retaining wall VI/3/b - Naphtha stock tank VI/3/c - Brick steps (2 flights) VI/3/d - Stone retaining wall VI/3/e - Brick walled area	COC		Ground level/limited foundations only	Foundations	
VI/4 - Crude Oil Charging Tanks (four tank bases)	COC		Ground level/limited foundations only	Foundations	
VI/5 - Air Compressor	COC		Ground level/limited foundations only	Foundations	
VI/6 - Heavy Oil and Paraffin Charging Tanks	COC		Ground level/limited foundations only	Foundations	
VI/7 - Acid Tar Plant (brick footings & walling)	COC		Ground level/limited foundations only	Foundations	

VI/8 - Soda Tar Plant (brick footings & walling)	COC		Ground level/limited foundations only	Foundations	
VI/9 - Acid Blowers and Soda Melters VI/9/a - Brick foundations VI/9/b - Shallow cutting & stone retaining wall VI/9/c - Drain	COC		Ground level/limited foundations only	Foundations	
VI/10 - Unidentified Brick Structure	JF?		Ground level/limited foundations only	Foundations	
VI/11 - Unidentified Brick Structure	JF?		Ground level/limited foundations only	Foundations	
VII/1 - Coke Ovens VII/1/a - Brick trench & retaining walls (2) VII/1/b - Brick structure	COC	Stone from facade used in Newnes Station platform? (Stephens 1959, 190)	Up to 50% intact	Foundations	Constructed between 1907-1909
VII/2 - Coal Mine VII/2/a - Number 2 coal shaft VII/2/b - Area of Number 1 coal shaft VII/2/c - Brick walling VII/2/d - Depressions, stone retaining walls VII/2/e - Stone walling, brick blocks (3) VII/2/f - Stone walling, picked rock face VII/2/g - Brick & rubble mound, brick walling	COC		Ground level/limited foundations only	Foundations	Begun operations 1910 Begun operations 1907? Coal mine ceased operations 1924.

VII/3 - Remains of Domestic Structure VII/3/a - Stone, brick chimney VII/3/b - Stone, brick chimney VII/3/c - Brick steps (2)	COC?	Removed to Glen Davis (now demolished)? (J. Norcross, pers. comm. 28/2/91)	Ground level/limited foundations only	Foundations, possible domestic rubbish tip	Possible coal mine manager's house? (J. Norcross pers. comm. 28/2/91)
VII/4 - Remains of Domestic Structure	COC?	Removed to Glen Davis (now demolished)? (J. Norcross, pers. comm. 28/2/91)	Ground level/limited foundations only	Foundations, possible domestic rubbish tip	Possible coal mine manager's house? (J. Norcross pers. comm. 28/2/91)
VIII/1 - Upcast Shaft, Number Two Shale Mine (Shaft & fan house) VIII/1/a - Rough timber yard VIII/1/b - Brick, cement engine base VIII/1/c - Brick, cement engine base	COC		Up to 50% intact	Foundations	Immediate area mined first in early 1900s
VIII/2 - Downcast Shaft, Number Two Shale Mine VIII/2/a - Brick foundation VIII/2/b - Stone retaining wall VIII/2/c - Skipway staith VIII/2/d - Low earth mounds VIII/2/e - Stone walling	COC		Ground level/limited foundations only	Foundations	
VIII/3 - Adit, Number Two Shale Mine VIII/3/a - Brick walling VIII/3/b - Tarred surface VIII/3/c - Brick paving	JF		Ground level/limited foundations only	Mine	
VIII/4 - Compressor Foundations VIII/4/a - Ship's tank VIII/4/b - Ship's tank	JF		Ground level/limited foundations only	Foundations	

VIII/5 - Engine House Foundations VIII/5/a - Brickwork VIII/5/b - Brick foundations	JF		Ground level/limited foundations only	Foundations	
IX/1 - Low Earth Mound IX/1/a - Stone retaining wall IX/1/b - Tree with skip rail IX/1/c - Stone fireplace?	MP (early 1930s)		Primarily landscape feature	Foundations?	Newnes Investigation Committee?
IX/2 - Skipway Platform IX/2/a - Picked boulder, bolts IX/2/b - Cement footing IX/2/c - Narrow cutting	COC		Ground level/limited foundations only	Foundations?	
IX/3 - Fireplace Foundations	?		Ground level/limited foundations only	Possible domestic rubbish tip	
IX/4 - Section of Tarred Surface	?		Ground level/limited foundations only	Nil	
IX/5 - Low Earth Mound IX/5/a - Bolt protruding from tree	MP?		Primarily landscape feature	Foundations?	Newnes Investigation Committee?
IX/6 - Chimney and Remains of Domestic Structure IX/6/a - Domestic rubbish tip?, remains of mining skip	?		Ground level/limited foundations and standing chimney	Foundations, domestic rubbish tip	
IX/7 - Skipway Foundations IX/7/a - Metal bolts (2) IX/7/b - Brickwork	COC?		Ground level/limited foundations only	Foundations?	
IX/8 - Remains of Domestic Structure	?		Represented primarily by rubble mounds/scatters of debris	Foundations, possibly domestic rubbish tip	

IX/9 - Cleared Area IX/9/a - Old road cutting	?		Primarily landscape feature	Foundations?	
IX/10 - Foundations and Pipe Culvert IX/10/a - Pipe culvert	COC?		Ground level/limited foundations only	Foundations	
IX/11 - Remains of Domestic Structure	?		Represented primarily by rubble mounds/scatters of debris	Foundations, possibly domestic rubbish tip	
IX/12 - Unidentified Foundations IX/12/a - Ship's tank IX/12/b - Tin bathtub	?		Represented primarily by rubble mounds/scatters of debris	Foundations, possibly domestic rubbish tip	
IX/13 - Stone Retaining Wall	COC?		Excellent	Nil	
IX/14 - Stone Retaining Wall	COC?		Excellent	Nil	
IX/15 - Haulage and Tipping Plant	?		Represented primarily by rubble mounds/scatters of debris	Foundations	Construction date unknown, but must be prior to 1924
IX/16 - Gully and Retaining Walls	?		Excellent	Nil	
IX/17 - Air Shaft for Colliery IX/17/a - Brick retaining wall	?		Up to 50% intact	Mine	
IX/18 - Remains of Domestic Structure	?		Ground level/limited foundations only	Foundations? Possible domestic rubbish tip	
IX/19 - Remains of Domestic Structure	?		Ground level/limited foundations only	Foundations? Possible domestic rubbish tip	

IX/20 - Remains of Domestic Structure	?		Represented primarily by rubble mounds/scatters of debris	Foundations? Possible domestic rubbish tip	
IX/21 - Remains of Domestic Structure	?		Represented primarily by rubble mounds/scatters of debris	Foundations? Possible domestic rubbish tip	
X/1 - Unidentified Foundations	COC?		Represented primarily by rubble mounds/scatters of debris	Foundations	Possible tunnel office?
X/2 - Unidentified Foundations X/2/a - Stone retaining walls (2) X/2/b - Stone retaining wall	COC?		Ground level/limited foundations only	Foundations	
X/3 - Sandstone Steps	NOC?		Excellent	Nil	
X/4 - Fan House	COC		Ground level/limited foundations only	Foundations	Immediate area mined as early as 1884
X/5 - Shale Breaker X/5/a - Parallel brick piers (4) X/5/b - Cement slab X/5/c - Piece of metal equipment X/5/d - Brick foundations X/5/e - Broken brickwork	COC		Ground level/limited foundations only	Foundations	
X/6 - Chimney and Remains of Domestic Structure	?		Ground level/limited foundations and standing chimney	Foundations? Possible domestic rubbish tip	

X/7 - Chimney and Remains of Domestic Structure	?		Ground level/limited foundations and standing chimney	Foundations? Possible domestic rubbish tip	
X/8 - Earth Mound X/8/a - Pulleys (7)	COC		Primarily landscape feature	Foundations?	
X/9 - Iron Pipe Culvert	COC?		Up to 50% intact	Nil	
XI/1 - The Big House (Brick foundations for house & garage, remnant garden, tennis court)	COC		Ground level/limited foundations only	Foundations Possible domestic rubbish tip	
XI/2 - Rivetted Metal Tank XI/2/a - Metal links XI/2/b - Remains of Domestic Structure (house)	NOC		Excellent	Nil	
XI/3 - Bridge (cement footings) XI/3/a - Stone retaining wall	COC		Ground level/limited foundations only	Nil	
XI/4 - Remains of Domestic Structure (The Doctor's Bungalow)	COC?		Ground level/limited foundations only	Foundations Possible domestic rubbish tip	
XI/5 - Remains of Domestic Structure (Jack Fell's House)	?		Ground level/limited foundations only	Foundations Possible domestic rubbish tip	
XI/6 - Tennis Court	?		Primarily landscape feature	Nil	

XI/7 - Remains of Domestic Structure XI/7/a - Single fireplace chimney XI/7/b - Double fireplace chimney XI/7/c - Double fireplace chimney XI/7/d - Double fireplace chimney XI/7/e - Tank remains, garden edging XI/7/f - Cement slab XI/7/g - Cement slab XI/7/h - Brick steps (3)	?	Several pits noticeable in various areas around the house from attempts to locate rubbish tip	Ground level/limited foundations and standing chimneys only	Foundations Possible domestic rubbish tip. Rubbish tip may already be disturbed	
XI/8 - Remains of Domestic Structure (Petrie's House)	COC		Ground level foundations and standing chimney	Foundations Possible domestic rubbish tip	
XI/9 - Remains of Domestic Structure XI/9/a - Double fireplace chimney XI/9/b - Single fireplace chimney XI/9/c - Brick bases XI/9/d - Metal sign XI/9/e - Brick steps (2)	?	Several pits noticeable in various areas around the house from attempts to locate rubbish tip	Ground level/limited foundations and standing chimneys only	Foundations Possible domestic rubbish tip. Rubbish tip may already be disturbed	
XI/10 - Remains of Domestic Structure	?		Ground level foundations and standing chimney	Foundations Possible domestic rubbish tip	

XI/11 - Mines Office and Surgery XI/11/a - Foundations for offices XI/11/b - Stone retaining wall XI/11/c - Foundations for surgery XI/11/d - Stone retaining wall	COC	Surgery demolished (date unknown) (WP photograph)	Ground level/limited foundations only	Foundations	
XI/12 - Concrete Slab Foundations XI/12/a - Cement sump XI/12/b - Brick steps (2) XI/12/c - Ship's tank, recent fireplace	?		Ground level/limited foundations only	Foundations	
XI/13 - Brick Foundations	?		Ground level/limited foundations only	Foundations	
XI/14 - Cutting, Petrie's Gully	?		Primarily landscape feature	Foundations?	
XI/15 - Oil Works Offices XI/15/a - Single fireplace chimney XI/15/b - Single fireplace chimney	COC		Ground level/limited foundations only	Foundations?	
XI/16 - Remains of Domestic Structure	?		Ground level/limited foundations only	Foundations? Possible domestic rubbish tip	
XI/17 - Ceramic Pipe Culverts XI/17/a - Pipe culvert XI/17/b - Pipe culvert XI/17/c - Pipe culvert	COC?		Ground level/limited foundations only Up to 50% intact	Nil	
XI/18 - Cutting, Petrie's Gully Road	?		Primarily landscape feature	Foundations?	

XI/19 - Remains of Domestic Structure	?		Ground level/limited foundations only	Foundations Possible domestic rubbish tip	
XI/20 - Cuttings (2)	?		Primarily landscape features	Foundations?	
XI/21 - Cleared Area	COC?		Primarily landscape feature	Foundations?	Possible site for sawmill?
XI/22 - Possible Building Site XI/22/a - Ship's tank	?		Primarily landscape feature	Foundations?	
XI/23 - Brickworks and Clay Quarry XI/23/a - Cutting for clay quarry XI/23/b - Drying house XI/23/d - Brick kilns	COC		Primarily landscape feature Ground level/limited foundations only	Foundations? Foundations?	

4.2.2. Chronology.

Archaeological sources.

One of the most challenging aspects of the archaeology of the Newnes site is to attempt to assess whether the site has undergone successive periods of growth or decline over time and whether this is reflected in the archaeological record. Unfortunately because most of the site is reduced to foundation level this leaves little diagnostic information available which could be used to formulate a chronology for the site based on physical evidence alone. Although many artefact types, such as bottles (Hutchison 1987), nails (Varman 1987) or paint layers (Coutts 1977), have been used as a dating criterion there is very little of this type of information left on site at Newnes without resorting to excavation. Consequently the only avenue open for an interpretation of chronology relies on structural evidence from the remaining buildings. Given that there are four distinct historical periods to Newnes' operation (section 2.3) this provides an excellent basis upon which to construct a chronology of the site. Obviously most of the layout and spatial arrangements within the site will have been established during the Commonwealth Oil Corporation period, when all of the major structures were built. As the third period of Newnes' life was a product of its ownership by several short lived and unsuccessful companies, it is not likely that much construction would have taken place during this stage. All of the companies which attempted to operate Newnes between 1929 and 1936 would have been more concerned with keeping the complex running than with enlarging or substantially altering it. Apart from the Commonwealth Oil Corporation period (1903 - 1913/14) the only other major period of activity on the site sufficient to warrant the erection of new features or the alteration of old ones on a large scale was during the John Fell period (1914 - 1927). Finally the National Oil Company period (1937 - 1939/40) was largely concerned with destruction, rather than construction, although as the site of Newnes was useful to them as more than just a source of materials, some alterations may be attributable to this period.

The most likely indicator of chronological stages would be the brickwork used in the construction of the extant buildings. From a preliminary analysis it is obvious that a number of different bonding schemes are used throughout the site including english, colonial, stretcher and header bond (see Glossary). As all of the bricks used in the construction of the Newnes plant (excluding the firebricks which were employed only in certain particular situations) were produced on site from the Company quarry and brickworks, the composition, size or standards of manufacture cannot be used to judge change over time. A tabulation of the various brick bonds used across the site is presented in figure 4.2. This only includes those features for which sufficient brickwork exists to be able to evaluate their construction method and is a small sample. For many features it is impossible to ascertain the brick bonding technique used.

From this preliminary analysis it is onvious that the majority of features at the site were constructed in english bond. Of those which were not (only a small proportion of features in comparison) some are of stretcher and some of colonial bond. As english bond is known as a much stronger bonding technique it is not surprising that this was employed for the majority of structures. Given that these structures were all erected during the Commonwealth Oil Corporation's six year establishment period when the future of the shale oil industry looked promising and when all bricks were produced at the Corporation's on site quarry and brickworks, the extra labour or quantity of bricks that this construction technique required would not have posed any problem. There is no apparent explanation for why some definitely early and completely brick features (eg. the retort bases, the reservoir or the upcast shaft and fan house at the Number Two shale mine) are constructed from alternative bonds, particularly as, for example, the retort bases would have required constructional strength on a par with other (english bond) features. It is notable however that most of the features which are known to be later in date than 1911 are not constructed in english bond. As a chronological indicator however this is not particularly revealing as the method of construction for these varies between stretcher and colonial bond.

As the majority of the Newnes complex was erected during one six year period of construction this leaves little opportunity of assessing subsequent changes over time. The alterations which are known to have occurred from historical sources were not on a large scale nor did they involve the construction of large individual buildings. As a result the

ENGLISH BOND	COLONIAL BOND	STRETCHER BOND
I/2 Atmos. condensers I/3 Ex. house retaining wall I/4 Crude oil receiver I/6 Gantry features c* & d II/1 Wax sweating plant II/4 Blue oil washers II/5 Crude oil washers II/6 Paraffin sheds III/1 Sett. house stock tanks III/2 Sections of settling house III/3 Workshop stock tanks IV/1 Stirling boilers V/1 Dirty water pond V/3 Sulphate house V/4 Crude oil stills V/8 Lub. and fine oil charging tanks VI/3 Pump house and nap. scrubber plant VI/3/b Naphtha storage tank VI/7 Tar plant VI/8 Soda tar plant VI/9 Acid blowers	III/2 Sections of settling house IV/3 Water supply pump VI/1 Retort bases VI/2 Gas producers VI/11 Unid. building* VII/1/a Coke loading staith VIII/1 upcast shaft, No. 2 shale mine IX/17 Air shaft for colliery XI/1 Big house garage* XI/11 Mines office	I/1 Reservoir II/2/a Boiler, firebox and chimney* VI/10 Unid. building* VII/1 Interior of coke ovens

* Features either not marked on 1911 map or presumed to be later in date than the bulk of the construction.

Figure 4.2: Brick bonds identifiable in archaeological features at the Newnes site.

bulk of the archaeological evidence left on site relates to one construction event and to attempt to determine individual phases within this event would be futile.

No other archaeological features of the site currently provide a useful guide to site chronology. Although paintwork is evident on some domestic chimneys (feature XI/7) in a variety of colour combinations this is not a chronological indicator as this appears due to a single painting event, ie. the brown, green and cream are combined as an overall colour scheme, not as a result of successive painting episodes.

Historical sources.

As the standing archaeology of the site is not particularly revealing in terms of evidence for chronological change, historical sources provide one alternative. Analysis of the 1911 map provides some clues to changes over time within the site. As it was compiled in 1911 it represents the extent and configuration of the site following the massive capital investment of the Commonwealth Oil Corporation and features not marked on this map are likely to be post 1911 in date. These include features I/6/a & b, II/2/a, II/4/j & k, V/9, VI/10 and VI/11. Some historical references also mention alterations made to the extent or functioning of the complex over time, most notably concerning the retort bench and the dates for the cessation of use of certain sections of the plant (see sections 2.3 - 3.10 for details). Figure 4.3 lists all known alterations to the Newnes site over time, derived from both archaeological and documentary evidence.

One future avenue for pursuing the question of chronology lies in the considerable quantity of contemporary photographs which exist in various collections. The ordering and placing of these photographs in chronological sequence may enable changes through time to be recognised. If the reverse perspective technique for compiling plan drawings from photographs was employed (see Mead 1986, Appendix 1) plan drawings of each major period could then be constructed.

DATE	COC PERIOD	JOHN FELL PERIOD	MIXED PERIOD	NATIONAL OIL PERIOD
1903	COC acquires George Anderson's assets. Expansion and operation of Number One and Number Two shale mines.			
1905	Beginning of establishment and layout of site and the construction of all major buildings and features.			
1907	Four trial coke ovens erected			
1909	Coal mine established. [1910 - additions to coke oven complex. Total = 88. Adit added to Number Two shale mine. Compressor etc. added also?]			
1911	June 1911 - complex officially opened	[1912 - Erection of experimental retorts by William Petrie]		
1913		[1914 - Alterations to retort bench by Fell and Petrie. Coke ovens cease production. Rail lines from Constance added to Newnes works]		
1915		Number Two Shale mine retimbered.		
1917		[No date - Construction of features not on 1911 map? Water supply pump improved]		
1919				
1921		1921/1922 - Exhausting and scrubbing plant erected at mouth of number two adit /Number One shale mine]		
1923		[1924 - Coal mine closes]		
1925				
1927				
1929			[No date - Skipway altered to run direct to shale storage bin?]	
1931				
1933				
1935				
1937				[No date - Metal collection tank constructed]
1939				Most of works abandoned and/or demolished
1941				

Figure 4.3: Known physical alterations to the Newnes site over time.

4.2.3. *Spatial Relationships.*

One practice which becomes obvious when studying the main works site is the construction of the bulk of the processing works into the side of a hill. Presumably this was intended to make use of the local topography to the best advantage and to facilitate the gravity feed of products between different sections of the process and plant, a practice which is exemplified by the arrangement of the crude oil and blue oil washing plants. The design and general arrangement of mining plant is obviously influenced by a number of factors, not the least of which is the extent of space at disposal for the arrangement of the plant and the contour of the ground, as both of these will affect all means of transport within the property (Tinney 1906, 1). At Newnes the products of the first section of the process, from condensers to receivers to either the crude oil charging tanks and crude oil stills, the naphtha refinery or the sulphate of ammonia plant, could take advantage of gravity and the slope of the ground. Following this however, to move the crude distillate to the washing plant (and indeed to move distillates from any of the four still benches to be washed) would have required pumping uphill. Transportation of the paraffin fraction from the stills to the wax production area would likewise have required movement against gravity, as would the pumping of any fraction to the settling house for standing. Goodberg in fact, far from highlighting the general economic sensibility of the location of the works on a hillside, cites James Petrie as claiming that the initial pumping of materials uphill so as to take advantage of the gravity feed, eventually proved to be more expensive in the long run than continuous pumping at ground level (Goodberg 1982, 97).

4.2.4. *Worker Housing.*

A substantial range of variation in construction methods, materials and permanence of structures is apparent in the cross section of worker housing present on site. This is logical considering that the term 'worker' could as easily be applied to the company managers and engineers as to the ordinary miner or labourer. At Newnes it is not only the dwellings of the important company officials which are apparent, but also those belonging to the average, but anonymous, miner and worker. As each would have had differential access to amounts of capital for investing in a house (particularly as important figures within the company seemed to have their housing supplied for them) such social and economic distinctions are reflected in the scale of the buildings and the materials used in their construction. Housing then can be seen as hierarchical and is linked to socio-economic position and in turn the willingness of the company to provide substantial housing. Consequently, the way in which these dwellings are reflected in the archaeological record (if at all) is a direct function of the amount of capital the owner is able and willing to spend: obviously those buildings which required greater outlays of capital leave more substantial remains in the archaeological record as they are constructed on a larger scale using a greater range of durable materials (cf Steel 1990). This has repercussions for assessing the archaeology of the Newnes site. For the archaeologist this means that it may not be possible to locate the full range of housing present, as ephemeral structures will leave little visible artefactual remains behind. For the integrity of archaeological deposits however, this factor may work to the archaeologist's advantage, as features which are not readily recognisable as archaeological sites should not have undergone attempts by others to remove artefacts for collection. In this sense it may be such sites which possess the best range of artefactual material from this social strata.

William Petrie's series of photographs illustrates well the variation present in housing materials and construction (Figs. 4.4 - 4.9. Photographs from Jim Norcross collection). Luchetti (1979, 20) remembers this himself:

> 'Some of the houses ... were made out of galvanised iron, others with timber from the sawmill. Many people built their own huts close to the mines. Some of these were very sad places, some were comfortable with bark roofs, slab sides, ant-bed floors and mats.'

The most common visible archaeological remains surviving of such ephemeral housing are scatters of rubble and galvanised iron and levelled foundation areas with cuttings. More than anything else, at Newnes, where most of the site is located on a slope, it is the tell-tale levelness of an area of ground which indicates the presence of a possible domestic site. Occasionally sections of low stone walling and stacked stone chimney bases are also present. From a perusal of William Petrie's series of photographs this latter feature is explainable by a common fire prevention

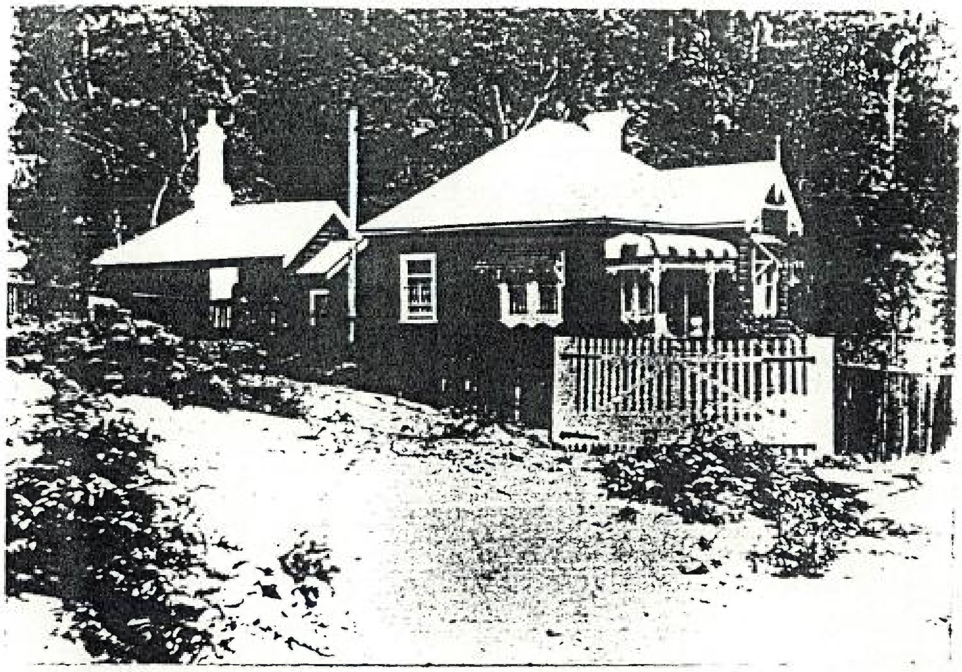


Figure 4.4: An example of Company built housing for important employees: the Company engineer, William Petrie's house.

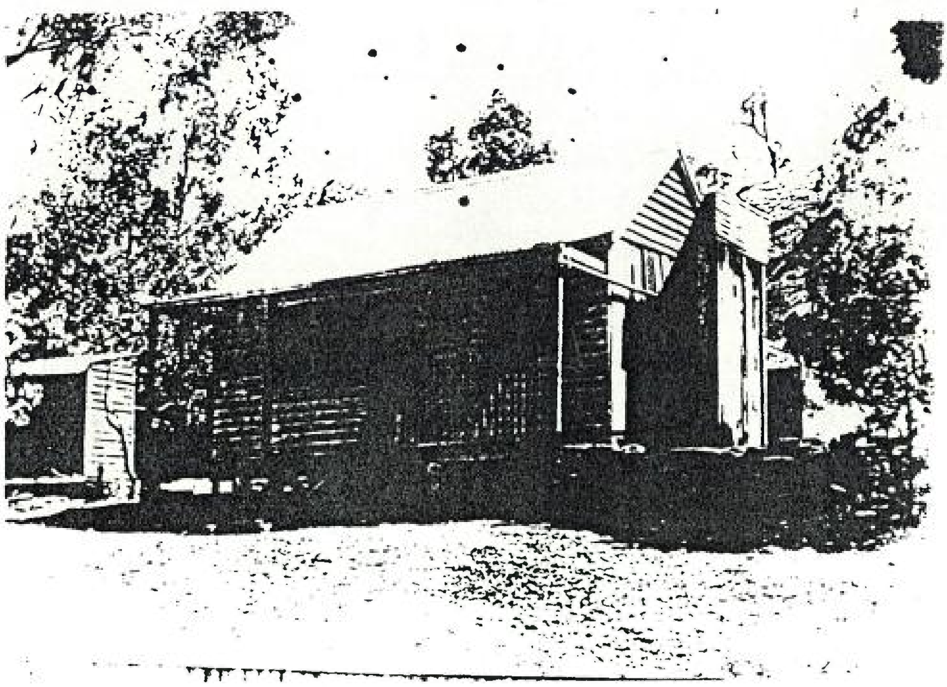


Figure 4.5: Less substantial Company built housing, consisting of a kitchen, two rooms and an outhouse.

Figure 4.6: Part of the range of privately owned and built housing at Newnes.

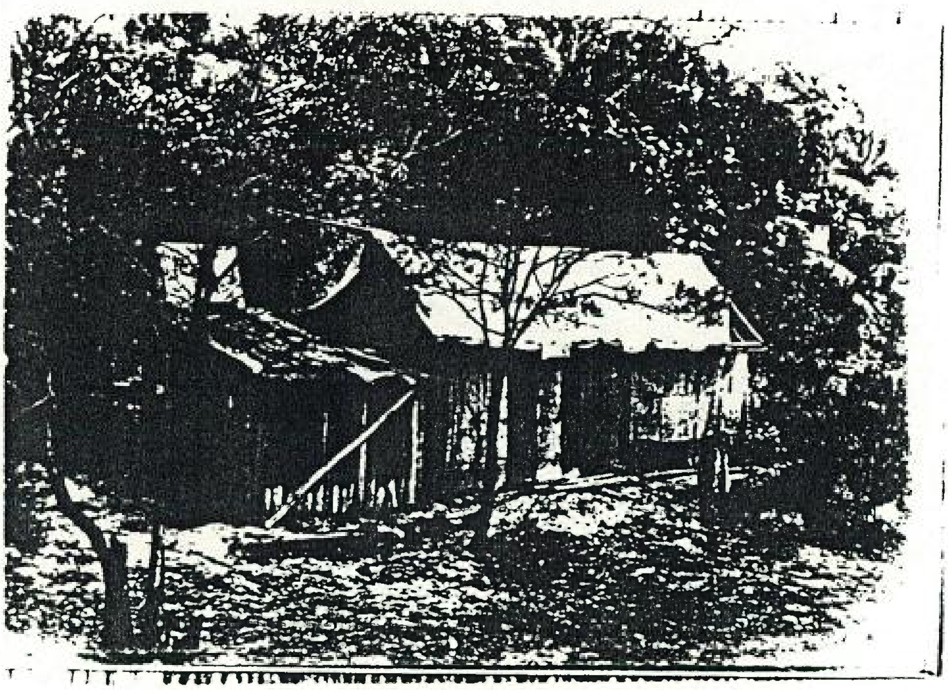


Figure 4.7: Privately built and owned housing at Newnes.

Figure 4.8: Privately built and owned housing at Newnes, note stacked stone around fireplace.

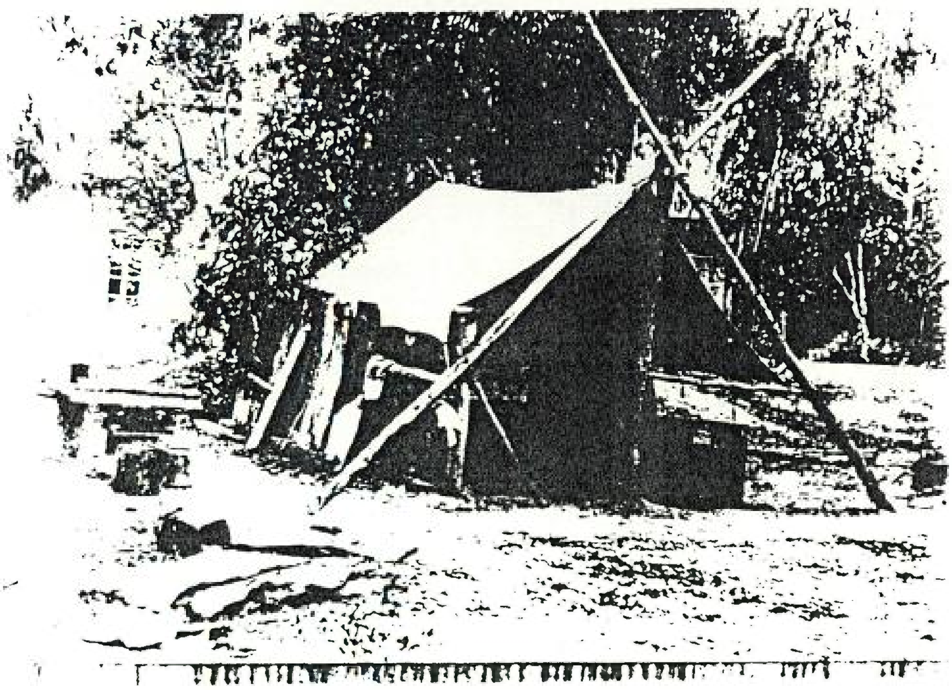


Figure 4.9: One of the most ephemeral types of housing present on site: a canvas tent.

practice used in chimney construction. This appears to be the establishment of a solid stone base around the chimney, which was then sometimes supported by timber corner frames holding in place sheets of corrugated iron, bark or timber constituting the upper portion of the chimney (see for example fig. 4.8).

The location of known domestic structure sites would indicate that there was little if any formal organisation as to where people situated themselves. Known sites are scattered around the periphery of all the main working areas, the only sites with some evidence for organisation being the houses located in Petrie's Gully, which have been arranged in a linear fashion fronting the road. It is interesting to note that despite the fact that a township was established relatively close by at an early date, many people chose to live in closer proximity to the mines and the works.

A particularly interesting feature of some of the housing presumably belonging to the average worker is the opportunistic use of local materials and natural features. Feature X/6 not only has an excellently constructed stone chimney, but the flat surface of a large boulder nearby is covered by a thin layer of paint, indicating that it may have served as an interior wall for this structure (section 2.11, Volume Two). Likewise feature IX/18 also incorporates part of a large sandstone overhang into its construction (section 2.10, Volume Two). At present, although a series of photographs is known to exist of housing sited on Company leases and although there is rate book information available for the later period of Newnes' life, it is not possible to correlate these two. Housing information given in the rate books is not only later than the period of the photographs, but also provides only vague locations for each dwelling. Unless it becomes possible to positively locate either the subjects of Petrie's photographs or the addresses of dwellings listed in the rate book, these cannot be compared to the archaeological record, apart from a few exceptionally well-known cases such as the Big House or William Petrie's house. Additionally distinguishing archaeologically between company and private housing is not possible at this stage as, apart from the relative proportions of durable and costly materials on site (ie. company housing could be expected to have a greater proportion of durable materials such as bricks than private housing and be constructed on a larger scale) , there are no other obvious criteria for judging between the two. This issue is complicated by the fact that all workers may not neccessarily have come from the same social class and therefore may not all have been limited by the same reserves of capital, private owner/builders may have been excellent craftsmen and created dwellings on a par with company structures and the existence of any private entrepreneurs on site may also have resulted in the construction of large scale and durable buildings.

4.2.5. Early Township Sites.

Although the official township of Newnes was established in 1906, several references mention a 'bag town', which was located closer to the mines and which formed the nucleus of the earliest settlement at Newnes prior to the emphasis being transferred to the town proper. Winchester (n. d., 5) describes this 'bag town' as comprising, 'shops, boarding houses, huts etc.', which was 'situated near where the large tank is now. A Doctor paid by the Company kept several horses and rode around the camps to his patients. Faddy and Simpson, Muir and Henry conducted general stores, but these with the huts were eventually moved to the village site.' The large tank may be a reference to the rivetted metal pipeline tank, which would place the town somewhere in Petrie's Gully. This would agree with Isobel Fynch's statement that the first coaching station was located here (pers. comm. 7/3/91). An unidentified local history source held by the Lithgow Regional Library however, places the location of 'bag town' as on the opposite side of the river, close to the powerhouse and still benches (Manilla folder 'Newnes' in local history collection). It is not clear why this location has been chosen although other sources mention shops as being located near here (eg, Goodberg 1982, 93a; Luchetti 1979, 22). The historical archaeology of an early 'bag town', if able to be positively located, would be extremely interesting from the point of view of size, growth, technology and living conditions.

5. SIGNIFICANCE

Cultural significance is a concept used to identify and assess attributes which make a place of value to society (Kerr 1985, p. 3). Significance can generally be assessed in terms of a place's aesthetic (landscape), historic, scientific (archaeological) or social (public) importance.

Aesthetic significance:
This relates to the formal or aesthetic qualities of a site or place which make it visually pleasing (Kerr 1985, pp. 10-11). Aesthetic significance can be assessed in terms of individual elements such as the unity of scale, materials, texture and colour present and the degree of contrasting elements which may or may not be intrusive or disruptive, or as a whole landscape setting in which each of these elements are combined to produce an overall impression (Kerr 1985, p. 11).

Historic significance:
Historic significance relates to the degree to which a place illustrates various historical themes and processes. A place may have historic significance because it typifies past practices, or because it may be the site of an important event (Guidelines to the Burra Charter in Kerr 1985, p. 26; Pearson 1984, p. 32)

Scientific/archaeological significance:
This is based on the ability of a site to answer research questions which may be applicable beyond the context of the single site being studied (Schiffer and Gummerman 1977; Pearson 1984). When anticipating potential research needs this should take into consideration the issue that future research capabilities and interests cannot be predicted with any confidence.

Public significance:
The significance of any site in terms of 'public' interest lies mainly in its potential as an educational resource. Conservation of representative sites or samples of sites is of value in terms of changes in public significance, as the public's appreciation of archaeological sites may change over time, possibly in tandem with changing academic interests and publicity

(Pearson 1984, p. 31). Sites of public value would be those which could be used successfully for public education, exhibit or enjoyment or which would be of benefit to local tourism (Pearson 1984, p. 32).

5.1. General significance

The principal cultural significance of the site of Newnes is that:

Newnes was one of the largest and most self contained shale oil production schemes in Australia during the early part of the twentieth century. It was established as a major venture, by a company which already owned the only other viable competitors.

It is a major historical monument to the oil shale industry in New South Wales in the early twentieth century. Its key role in this industry is illustrated by the sheer size of the works and the complexity and variety of plants and processes which were established here.

It contains an extensive archaeological resource for the study of contemporary shale mining, retorting, refining and by-product technology, the adaptation of this technology to the Australian environment and the broad spectrum of living standards and conditions present amongst employees.

In its growth and planning it testifies to the confidence which was placed in the marketability of certain particular products, but in its subsequent history of operations and ownership transfers it demonstrates the rapid changes which occurred in lighting and transport technology during the first thirty years of the twentieth century, which eventually rendered the complex obsolete.

The site of Newnes is also significant because:

5.1.1. Aesthetic Significance.

The landscape at Newnes represents a variety of different landforms and vegetational types, ranging from river bed to steep scarps. Although the area was heavily depleted of timber during Newnes' operation, subsequent regeneration has meant that a healthy cover of timber and grasses are now present across the site. The combination of the Wolgan River and the relatively gently rising hillslopes upon which the site is located with the massive soaring scarps bounding the valley create a distinctive and visually attractive landscape. The physical presence of the remains of the Newnes complex over such a varied bushland setting also creates a pleasing contrast, which complements the overall impression. The aesthetic significance of this site could be enhanced by the removal or curtailment of the growth of the introduced species of plants which are prolific on the lower sections of the site.

5.1.2. Historic Significance.

Various historical themes are represented by the Newnes complex, including industrial, technological and social themes. Industrial and technological themes would include:

- the growth and development of the shale oil processing industry in Australia
- the adaptation of overseas technology/techniques to suit Australian conditions and materials
- the growth and development of associated industries dependant upon the shale industry, such as lighting and fuel
- the rapid changes in emphasis between marketable products in the space of thirty years (1905 - 1935) and how this affected the shale industry (e.g. due to the growth of the automobile industry and changes in the domestic lighting industry)
- the effect which the advent of the second World War, and the necessity to produce adequate supplies of fuel from local resources, had upon the resurgence of the shale oil industry.

Aspects of technological significance would include:

- the overall design and layout of the complex, especially the use of the hillside to take advantage of gravity feed
- the actual economic feasibility of such an arrangement
- the alterations to the retort bench to cope with the Australian shales.

Social themes include:

- the changes which occurred in the domestic lighting industry (e.g. initially the improvements which took place in the gas lighting industry and then with the change from gas to electricity)
- the rapid growth of the automobile industry in the early part of the twentieth century
- the growth and demise of a township
- working conditions in the mines and at the plant (e.g. the technology employed, safety conditions, hours worked)
- the living conditions of employees and their families, from company officials and managers to the ordinary worker
- the effect of the formation of unions on working conditions for miners and on the running of companies

5.1.3. Scientific (Archaeological) Significance.

The Newnes complex is an important resource for archaeological or industrial research on a variety of potential historical and technical questions. To a certain extent some of these themes may overlap with those which give the place historic significance.

- the positive location of the first township site would provide valuable information on the growth and development of housing in the Wolgan Valley and possibly on changes in living conditions and amenities. This could be used in conjunction with an archaeological survey or excavation, to provide information on the sequence of living sites at Newnes and their change over time.
- an analysis of the range of domestic housing present would provide information on the variation in housing conditions between socio-economic groups (particularly interesting here is the opportunistic use of local materials and natural features by the average worker who had no access to large amounts of capital)
- the archaeological remains are a general source of information on the technology of oil shale mining and processing in Australia, the growth of this industry and the effects of changes in the economic climate on the industry

There are other areas of research potential, which include themes that could not be accomodated within the time frame of this project such as:

- the line of the railway, which could provide information on the technology used in its construction, the feat of engineering which it represented and the condition and extent of the archaeological features remaining along its length.
- the history of the Fell family, who played an important part in the history of Newnes. This could be used to supplement the archaeological evidence for their lives and ambitions.
- the range of machinery present on site, particularly where this would help to clarify or illustrate a specific process important at the Newnes site, for example candlemaking.
- oral history, as specific descriptions of the operation of Newnes and of the processes employed are rare. General areas of enquiry would include:
    * The specific process of working at Newnes, including the order of product manufacture and uses of various sections of the plant
    * Problems faced at any stages of the process and how these were overcome
    * Changes between the Commonwealth Oil Corp. period and the John Fell period.
    * Specifics relating to the removal of equipment
    * Information relating to the numerous private dwellings scattered throughout the industrial site area
    * Information relating to the function of features not marked on the 1911 map
    * Relative construction dates

5.1.4. Educational Significance.

Educational significance applies to all of the issues discussed above. Especially relevant are the archaeological, technical and social/historical aspects which can be demonstrated easily with above ground artefacts.

5.2. Significance of the Physical Fabric

5.2.1. VII/1 - Coke Ovens.

Important for their intactness and rarity. Although complexes of ovens were built in association with many collieries in New South Wales, very few of these survive substantially intact (Cremin, Jack, Murray, Powell and Schulstad 1987; Powell 1982; Schulstad 1980). At Newnes there are still 13 ovens which are completely intact. In addition, because the remaining ovens are in varying states of intactness, this site can be used to demonstrate the precise methods and techniques used in their construction. The ovens are also important for the fact that they demonstrate a secondary process in operation at Newnes which has close links to the oil shale industry. This is reflected in the purposes to which the output of the ovens was put (ie: as fuel for the retorts) and is also indicative of the close nature of coal and oil shale origins.

5.2.2. VI/1 - Retort Bench.

Important as the site of one of the fundamental processes operating at the Newnes site, as well as demonstrating the resolution of technical problems encountered in the retorting of shale over time.

5.2.3. V/4 - Crude Oil Stills.

Important because it is the best preserved example of a still bench remaining at Newnes and therefore is the best representative of this central section of the process.

5.2.4. II/4 and II/5 - Blue Oil Washers and Crude Oil Washers.

Important as representative of the refining process,as the chemical treatment of oils was integral to all stages of the production process.

5.2.5. II/1, II/2, II/3, II/6 - Paraffin Production Area.

Important because each of these features show the smaller separate stages in the complete manufacture of one of Newnes' major subsidiary by-products - from the treatment of the heavy oil and paraffin at the paraffin sheds to the treatment of the wax at the sweating plant and refinery, culminating in the manufacture of individual paraffin wax candles.

5.2.6. *XI/1 - The Big House.*
Important because it is associated with one of the major historical figures involved with Newnes, John Fell. The extent of the house and gardens also provides a sharp contrast with the more basic accommodation of the ordinary worker, illustrating the range of lifestyles present.

5.2.7. *VIII/1 - Upcast Shaft, Number Two Shale Mine.*
Important as the best preserved example of mine ventilation technology. Ventilation was an integral part of the mining process and as few remains of the underground workings are present, this could be used to illustrate the conditions and technology present in the mines at Newnes. This is in contrast to VIII/3, the main mine adit, which is a different approach to mining the shale and which illustrates the change between periods from the use of shafts to the use of adits.

5.2.8. *XI/7, XI/9, IX/6 and X/6- House Sites.*
Important as the best preserved remains of domestic housing present at Newnes, XI/9 and IX/6 in particular. These have aesthetic value as part of their bushland setting and, as they represent a variety of different building materials and styles, educational value as part of the range of lifestyles present at Newnes.

6. CONSTRAINTS

6.1. Constraints Arising from the Statement of Cultural Significance.

The following constraints on the development and conservation of the place follow directly from the statement of cultural significance.

6.1.1. The place should be conserved as a place of high cultural significance, particularly as a monument to the wide variety of products which could be extracted and manufactured from oil shale, the importance of the shale oil industry to many other major industries (such as lighting and transport) during the first half of the twentieth century and the effects which changes in world markets had upon the continuation of this industry.

No new works or activities should be carried out which will obscure or detract from the cultural significance of the place. All works and activities should be designed to either retain or reveal the cultural significance of the place and its elements.

6.1.2. The archaeological potential of the place should be conserved. No removal, excavation or disturbance of relics should take place, unless this is designed to enhance the cultural significance of the place.

6.1.3. The substantial above ground structural remains (the Paraffin sheds, the refinery tank bases, the retort bases, the still bases) should be conserved and then maintained as ruins. Reconstruction or restoration is not warranted, except where these may be the only appropriate methods of conservation.

6.1.4. The aesthetic qualities of the landscape setting are identified as part of the site and should be maintained.

6.1.5. The coke ovens complex should be conserved as a priority as one of the few remaining benches with intact coke ovens associated with an early twentieth century coal mine.

6.1.6. The educational potential of the place to specialists and to the general public should be conserved and the place should be interpreted to reveal its cultural significance.

6.2. Procedural Constraints Arising from the Statement of Cultural Significance.

Since the place is of high cultural significance the articles of the ICOMOS Burra Charter apply to all management works and activities at the place.

6.3. External Constraints Arising from the Statement of Cultural Significance.

6.3.1. The works, the coke ovens and the village are all classified by the National Trust of Australia (NSW).

The inclusion of a place in this register does not have any legal implications, but is widely recognised as an indication of the significance of the place.

6.3.2. As the site of Newnes pre-dates 1940 all artefacts, remains and deposits have legal protection under the Heritage Act 1977 (amended 1990).

6.4. Constraints Arising from the Condition and Integrity of the Place.

6.4.1. Integrity is a concept which assesses the degree to which a place has been affected by later activities. It is not a very useful concept when discussing the majority of the Newnes site which consists of ground level or foundational remains only. Newnes has had its integrity affected by the removal and demolition of structures, by the removal of artefacts from their archaeological context and by exposure to weather, falling trees and vegetation growth. Only a handful of elements can be considered to be significantly intact to their original form.

In the above circumstances the stabilization of the surviving parts of the site is the minimum intervention necessary to ensure their conservation. No action will eventually result in further decay.

The fact that many elements of the site consist of limited above ground remains only also constrains the possibilities of restoring or reconstructing these parts of the works.

7. RECOMMENDATIONS

7.1. Main Threats.

7.1.1. Vegetation.

Breckwoldt (1977, 8-9) lists the main vegetational species within the valley floor region of the Wolgan Valley as consisting of: native kangaroo grass (*Themeda australis*), yellow box (*Eucalyptus mellidora*), Forest Red Gum (*Eucalyptus terreticornis*), Ribbon Gum (*Eucalyptus viminalis*), *Acacia decurrens*, *Acacia falciformes*, *Casuarina cunninghammi*, *Eucalyptus cypellocarpa* and *Eucalyptus bosostoana*, as well as blackberry (*Rubus fruticosos L. agg*).

A major feature of the Newnes site is the density of vegetation growth, the entire site being subjected to it to one degree or another. In terms of vegetation, the upper slopes and terraces support mainly Australian native vegetation, while the lower terraces are supporting mainly introduced species, specifically blackberry and tree of heaven. The relative damage by each of these vegetation types also varies - some natives grow to a considerable height and where these coincide with walls or foundations the damage can be considerable. Blackberry on the other hand is characterized by particularly dense growth and as a result obscures large portions of the site. While its root system will in no way cause damage on the scale of larger native trees, it is much more prolific and its damage more a function of density rather than absolute size. Tree of heaven has a particularly damaging interconnected root system and is also densest on the lower sections of the site.

The problems of vegetation overgrowth have already been briefly discussed. The extent and type of damage to the site varies with the type of vegetation: larger species chiefly through the activity of their root systems in disturbing wall alignments or foundations, smaller species such as blackberry in obscuring large parts and details of the site. Large trees can also cause damage by collapsing across part of the site. This is the case with the crude oil receiver retaining wall and is a situation which is only waiting to be repeated. Blackberry, on the other hand, also needs to be considered in terms of the limited protection it may be providing to particular parts of the site or to particular features. Although it obscures much, this may also be serving the function of preventing visitor access and activity to certain areas and therefore minimizing their rate of disturbance. Both blackberry and tree of heaven are however, noxious plants and, as such, the Service has a responsibility to control their growth and removal.

7.1.2. Erosion.

As a great part of the Newnes site is built into the slope of the hillside above the river, water erosion downslope is one of the most obvious threats to parts of the site. This is particularly noticeable around the edges of the three large retaining walls, which in places have quite severe erosion problems. This is no doubt compounded by the fact that the drainage lines established when the site was functioning have long since ceased to operate and have become infilled with silt and vegetation. In the length of time covered by two field seasons at the site noticeable erosion damage had taken place behind the retort bench, which will continue if allowed to remain unchecked (Fig 7.1). Archaeological remains which occur along the river bank (eg: the weighbridge and the blacksmith's) are also in imminent danger, though there is little which can be done to save this evidence.

7.1.3. Visitation.

The Newnes site is the focus for a great deal of camping and recreational activity by horseriders, four wheel drive and trail bike enthusiasts, campers, bushwalkers and 'outback adventure' groups and this also has its attendant problems. Most obviously this results in visitation to most areas of the site and uncontrolled climbing on and exploration of various features. Temporary and permanent camping on or near the site also causes problems, particularly as the most common materials for the construction of campfires are bricks and stone blocks removed from the site. This is especially so in the area of the coke ovens (where bricks are easily removed and where in at least one instance the intact interior of an oven has been turned into a camping area complete with brick chimney and fireplace) (Fig 7.2) and in the cleared space between the powerhouse and the stills. The removal of bricks from already demolished structures does not exacerbate structural damage, however because the coke ovens are still reasonably well preserved, removal of *in situ* bricks would do irreparable damage. As visitor access is presently largely uncontrolled the potential for removal of such artefacts from the site is also a serious problem, although its precise scope remains unknown. Certainly several quite extensive 'excavations' are evident near many of the house sites in Petrie's Gully, presumably from the efforts of bottle hunters to locate domestic rubbish tips. Many visitors to the site are also quite willing to discuss their personal bottle collections and the sites from which they obtained them.

Uncontrolled access is also a major problem with visitors with four wheel drives and trail bikes. The rough unsealed road, existence of old mining and industrial site roads and the general atmosphere of isolation make Newnes the ideal location for off-road activity. At the eastern extremities of the industrial area, between the Newnes station platform and the site itself, there are several examples of illegal trail bike and four wheel drive activity, resulting in the creation of numerous off-road tracks. The network of tracks and trails across the industrial site is also a result of this problem. Vehicular access to the site is also the major cause of damage to the remnants of the railway line, as for much of its length the road follows the railway and its continual use contributes to the degradation of any archaeological features still remaining.

7.1.4. Mechanical Failure.

As most sites are reduced to ground level there is little danger of mechanical failure. Only those sites which are mostly intact such as the paraffin sheds, the crude, heavy oil and lubricating oil stills, the tiered series of retaining walls, the soda and acid washing tanks and the coke ovens would therefore be affected by this. If left without any management these may degenerate over time.

7.1.5. Fire.

In terms of the above ground archaeological remains there is not much left on site to burn. Most features consist of brick, stone or cement and do not by themselves constitute a fire hazard. However as part of the process of vegetation regrowth across the site this is resulting in the build up of large amounts of flammable material, particularly with the dense thickets

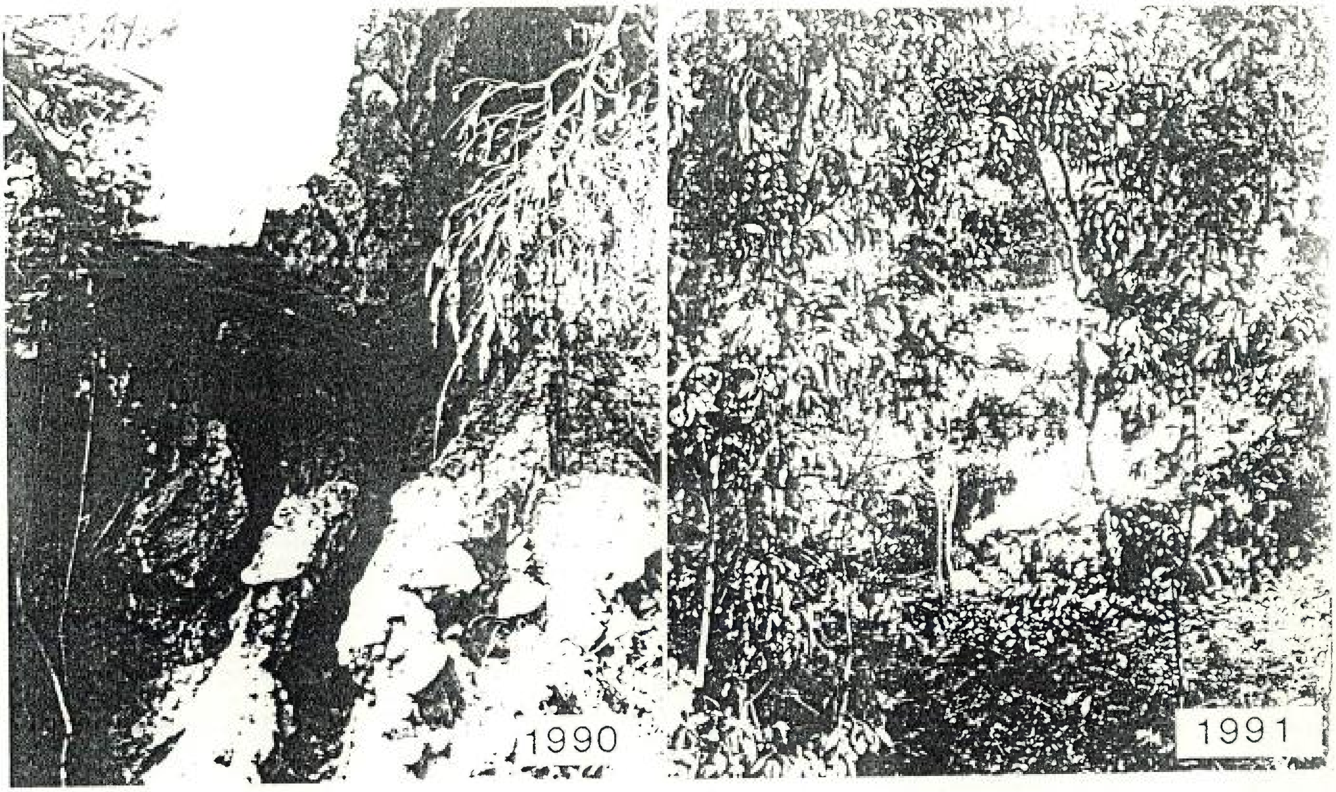


Figure 7.1: Acceleration of erosion behind retort bench.

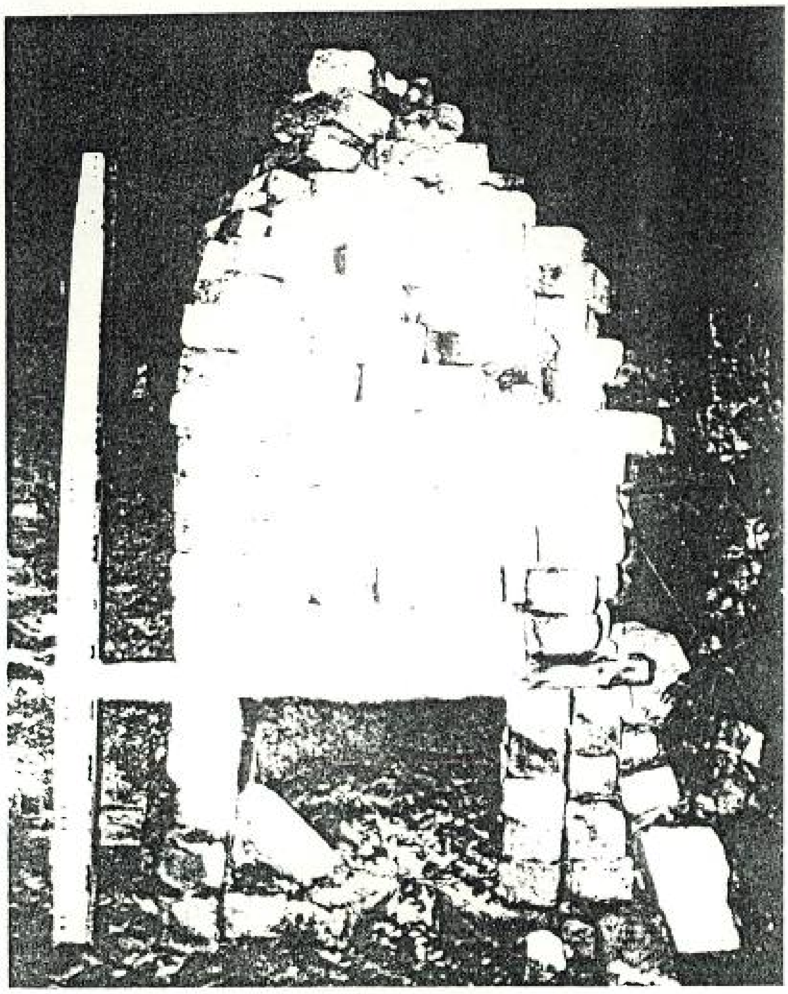


Figure 7.2: Converted interior of coke oven.

of bracken fern and blackberry which are present, which would certainly promote a fire, which would in turn damage archaeological remains. This would probably exacerbate any structural problems which features may be experiencing and result in further mechanical failure or collapse.

7.2. Management Considerations.

The close proximity of Newnes and the Wolgan valley to Sydney, Lithgow and Bathurst/Orange virtually guarantees it at least some degree of constant visitation, particularly on long weekends and school holidays. During the five weeks of the 1990 archaeological survey period, although conducted on weekdays only, a total of 16 people visited the industrial site, while 19 people camped at the campsite near the old township. An organised camping tour arrived every weekend, staying for up to four days and including groups of between 6 and 15 people. Numbers increase dramatically over long weekends, particularly Easter, and it is not uncommon during these times for campers and visitors to number in the hundreds.

Clearly there will be much conflict with future management as this established use will need to be curtailed and/or more strictly regulated than it is at present. Apart from the huge potential which Newnes possesses as an educational and historic resource, visitor use is one of the major threats to the continued survival of certain areas of the site.

Ideally the whole site needs to be monitored so that the effects of visitor use can be more effectively assessed and long term plans formulated. A piecemeal approach will work in the short term, but eventually this will need to be broadened and integrated.

7.3. Recommendations.

7.3.1. General Recommendations for Works.

The main problem with the Newnes site is its size and the range of archaeological features present. The extent and scale to which any works are accomplished needs to be considered in terms of the future use of the Newnes site, a decision on which needs to be made and long term maintenance designed accordingly. In reality the entire Newnes site needs to be given at least minimal maintenance attention in terms of:

* General vegetation growth control/clearance and prevention of regrowth, particularly of large species on or in close proximity to archaeological features. This applies more to large species, such as Eucalypts, which are likely to damage features with their root system (see section 7.3.2 Specific Recommendations for Works). As long term management plans for the Newnes site have not yet been determined and visitor access cannot really be monitored effectively, it would seem desirable to allow a light covering of blackberry overgrowth to remain covering features, as this certainly deters visitors from gaining access and may offer the best form of protection currently available. This growth should be monitored however, to ensure that it does not cause further problems. The issue of blackberry overgrowth should be given due consideration however, when long term management plans are finally formulated.

* Specific control of noxious plant growth, particularly blackberry and tree of heaven on the lower terraces of the site on both the north and south banks of the river.

* Slope erosion control, particularly in the steepest areas of the site. In the space of two field seasons noticeable erosion damage has been caused to the slope at the rear of the retort bench in particular. Not only are parts of the slope collapsing beside the brick retaining wall but they are taking sections of stone retaining wall and perhaps other archaeological features from above with them.

As a certain proportion of the original drainage lines are still extant at the site re-establishment of visible brick and cement drains across the site is one option for the control of water erosion. If this option is to be followed, clearance of the drainage lines should be done by hand, under the supervision of suitably qualified personnel. Once established, original drainage lines should be inspected regularly to ensure that re-opening them for use does not in fact cause further damage.

Where new drainage lines are to be established this should also be done by hand and under suitable supervision.

Where vegetation growth is to be cleared off or away from archaeological features this should be conducted by hand and under suitable supervision.

Where slope erosion damage is to be repaired or stabilized this should be conducted under suitable supervision. Any construction of additional walling or slope support necessary to prevent further damage should be accomplished with easily recognisable modern materials, and care should be taken that this does not compromise the site.

7.3.2. Specific Recommendations for Works.

This is based upon the features needing the most obvious and urgent maintenance attention and in part is a result of their relative archaeological/educational importance and the necessity to preserve this.

* Coke ovens -

As part of 1990s maintenance activities much encroaching vegetation was removed from the roof of the coke ovens complex. This not only afforded a better view of the complex but attended to one of the most damaging problems. The prevention of visitor access to and climbing upon the roof of the complex is also necessary for preserving the importance of this structure, as the stability of the thirteen intact ovens remaining cannot be guaranteed if uncontrolled activity is allowed to continue. At present the intact ovens do not appear to be in imminent danger of collapse, however prohibiting access to the roof of the complex will ensure their preservation. It may be that a light covering of blackberry across the roof of the complex would be desirable to maintain, as this would certainly deter people from gaining access to the roof of the ovens. If this is to be implemented however, the growth of the blackberry should be carefully monitored to ensure that the root system is not causing damage to the brickwork, particularly that of the intact ovens. The growth of more damaging species (i.e. larger trees) should be continually monitored and carefully controlled.

* Paraffin sheds -
The standing walls need stabilization, although this may not be possible without some demolition. If left as is the site will become extremely dangerous. To ascertain the precise problems and measures for rectification, an inspection should be conducted by a service engineer, with a view to recommending precise measures for stabilization.

* Still benches (particularly Crude oil stills) -
These need to be monitored to ensure that large tree species do not take root on or immediately around the complex. Regrowth of such species will need to be prevented. As visitor access and climbing on and around the site is a major problem, blackberry cover should be allowed to remain.

* Brick Retaining Walls (rear of exhauster house, crude oil reactor and retorts) - Erosion control is necessary at the rear and along the sides of the walls, as is the removal of vegetation (live and dead) from the immediate top of the walls, as well as any along the sides which is considered likely to damage them. Regrowth will need to be prevented. The structural condition of these walls will need to be monitored periodically, to ensure there is no undermining or weakening taking place behind or beside them.

* Wax Sweating Plant -
Removal of large tree causing root damage to brickwork.

* Lubricating and Fine oil charging tanks -
Removal of large tree causing root damage to brickwork.

* Refinery complex -
Removal of any large tree species from the interior of the tank bases and from on top of the retaining walls. The prevention of regrowth of these species will also need to be considered. Covering blackberry should be left as is. The walls of the standing bases should also be monitored to ensure that they are continuing to remain stable.

* Sulphate house -
Vegetation clearance from top of foundations, prevention of regrowth.

* Beginning of Pipeline track -
Signage needs renewing at the beginning of the track as at present this is not clearly marked.

In each case where vegetation growth is to be cleared off or away from archaeological features this should be conducted by hand and under the supervision of suitably qualified personnel.

7.3.3. Recommendations for Archiving of Recording Material.
All field notebooks and project ephemera should be kept together and archived in a suitable and accessible storage place. Complete sets of photographs should be kept with the National Parks and Wildlife Service. One set should be held at the Central Region Office and a second set at the Blue Mountains District Office.

8. GLOSSARY

Adit	Horizontal or near horizontal entrance into a mine. This is also known as a tunnel.
Airway	Underground passageway along which air passes.
Artefact	(In historical archaeology) any deposit, object or material evidence relating to the non-Aboriginal settlement of Australia, which is at least fifty years old.
Baffle	Artificial obstruction for checking or deflecting the flow of a gas.
Bond	Any one of five methods for arranging bricks in a wall so that the wall is bound in a stable fashion (see also Colonial bond, English bond, Flemish bond, Header bond and Stretcher bond).
Coke	Solid residue resulting from the destructive distillation or partial combustion of coal.
Colonial bond	The method by which bricks are laid with anywhere between three and eight rows of stretchers between each two rows of headers
Condensation	The conversion of a gas to a liquid or solid by cooling (Knapman 1988, 8)
Course	(In bricklaying) A row of bricks.
Dephlegmator	Device for fractionating and partially condensing oil gas to remove the less volatile components.
Distillation	Decomposition of raw material into fractions of different boiling points by applying heat and then condensing the results.

Distillate	Fraction produced as a result of the distillation process.
Downcast	Shaft or other mine opening down which fresh air from the surface passes.
English bond	The method by which bricks are laid in alternate rows of headers and stretchers.
Firebrick	Hard fire-resistant brick made from clay with a high alumina and silica content.
Flemish bond	The method by which bricks are laid so that in each course headers and stretchers alternate.
Fractionation	Separating the various constituents of oil through the distillation process.
Frog marks/Frogs	Identifying marks impressed upon bricks during manufacture.
Header bond	The method by which bricks are laid exclusively with the ends of the bricks (headers) facing out.
Inbye (airway)	In a direction towards the working place. Opposite of outbye.
Intake	Opening along which fresh air is passing.
Kerogen	Organic matter forming oil shale. The principle source of this organic material is algae.
Outbye	In a direction away from the working face. Opposite of inbye.
Permanent Gas	Gas which is not condensible to a liquid by cooling under normal conditions.

Refining	1. Entire process of purifying and separating oil into its different marketable fractions. 2. Particular section of the process where distilled fractions are washed in chemical agents (sulphuric acid, caustic soda) to remove impurities and to improve both colour and smell.
Retorting	Process of heating raw shale to obtain crude shale oil in the form of gas.
Return (airway)	Opening along which air returns from the working face.
Shaft	Vertical entrance into a mine. Depending on its function a shaft can be either upcast or downcast. An upcast shaft is primarily used for ventilation, a downcast shaft for access of workers, materials and equipment.
Skip	Wheeled container into which mined material is loaded for transport purposes.
Skipway	Railed transport system for hauling skips.
Stearine	Soft, white odourless solid found in many natural fats. Often mixed with palmitic acid in candlemaking.
Stretcher bond	The method by which bricks are laid exclusively with the sides of the bricks (stretchers) facing out.
Tippler	Rotating frame for automatically discharging material from skips.
Vapourisation	The conversion of a liquid or a solid to a gas by heating.

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A. O. N. S. W.	Archives Office of New South Wales

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10. APPENDICES

APPENDIX 10.1

Summary list of recorded archaeological features cross referenced with known historical names and known historical features not located in the field.

For more details see Volume Two of this report.

All historical names are taken from Petrie's 1911 map unless otherwise specified. Where historical names conflict references have been provided:

(WP) - William Petrie's 1911 map
(DM) - Department of Mines 1977 copy of map
(Gdbg) - Goodberg 1982
(Luc) - Luchetti 1979
(L A '31) - Shale Oil Development Committee 1931 List of Assets
(JN) - Jim Norcross, personal communication
(IF) - Isobel Fynch, personal communication
(JH) - Jenny Hall, personal communication
(AW) - Alan Watson, personal communication
(COC M nd) - 'Commonwealth Oil Corp. Ltd. Newnes Coal and Shale Workings' map, not dated
(COC M '10) - 'Commonwealth Oil Corp. Ltd. Shale Workings Newnes', map dated 30/6/10
(JF M '23) - 'Plan of Number 2 Shale Mine - Newnes. John Fell and Co. Newnes', map dated 1/3/23
(JF M '24) - 'John Fell and Co. Plan of Coal Workings, Newnes', map dated 19/6/24
(MRS .....) - Dept. of mines mineral resource data sheets, for appropriate mining lease or permit
(DMPh) - Department of Mines Photographs
(RB) - Blaxland Shire Council Rate Books 1930, 1933 and 1939

* - Feature located in the field, but not marked on 1911 map
† - Feature not identified historically

ARCHAEOLOGICAL FEATURES LOCATED DURING 1990/1991 FIELD SEASONS	CORRESPONDING NAME OF KNOWN HISTORIC FEATURES	KNOWN HISTORIC FEATURES NOT LOCATED DURING 1990/1991 FIELD SEASONS
I/1 - Reservoir	*Reservoir*	
I/2 - Atmospheric Condensers	*Atmospheric condensers*	
I/2/a - Low rectangular brick structure	*Ammonia scrubbers?(WP)/wash towers (Gdbg)*	
I/2/b - Parallel foundations of condensers		
I/2/c - Concrete floor slab	*Pump house (WP)*	
I/3 - Exhauster House and Retaining Wall	*Exhauster house*	
I/3/a - Brick retaining wall		
I/3/b - Pipe/boiler support platform		
I/3/c - Drain	*Naphtha scrubbers (WM)*	
I/4 - Crude Oil Receiver and Retaining Wall	*Crude oil receiver (WP)/Crude oil reactor (DM)/separating tanks*	
I/4/a - Low rectangular brick structure	*Multitubular heaters (WM)/Multi burner heaters (DM)/multitubular condensers (LA '31)*	
I/4/b - Brick piers		
I/4/c - Parallel brick footings	*Ammonia water receiver(WM)/separating tank*	
I/4/d - Brick retaining wall		
I/5 - Shale Storage Bin (cutting)	*Shale storage bin*	
I/5/a - Low brick wall		
I/5/b - Remains of mining skips (4)		
I/6 - Gantry	*]*	
I/6/a - Parallel wall foundations*	*] Gantry*	
I/6/b - Parallel wall foundations*	*]*	
I/6/c - Cutting with pick marked boulders	*]*	
I/6/d, e & f - Brick foundations	*Motor under gantry (DM)*	
I/6/g - Low brick footing	*]*	
I/6/h - Low brick footing	*]*	
I/6/i - Low brick footing	*] Gantry*	
I/6/j - Low brick footing	*]*	
I/6/k - Welded metal pipe supports (2)*		
II/1 - Wax Sweating Plant	*Wax sweating plant*	
II/1/a - Foundations for sweating houses		
II/1/b - Charging tank bases (2)	*Charging tanks*	
II/1/c - Brick sump		
II/1/d - Brick pipe/boiler bases (2)		

II/2 - Wax Refinery	*Wax refinery*	
II/2/a - Boiler/firebox and chimney*		
II/2/b - Brick/stone retaining wall*		
II/2/c - Foundations of wax refinery building		
II/3 - Candle Factory	*Candle factory*	
II/3/a - Brick pipe/boiler support		
II/3/b - Brick pipe/boiler support		
II/3/c - Brick & concrete floor slab		
II/4 - Blue Oil Washers	*Blue oil washers/refining plant*	HII/4/n - Tar blower
II/4/a - Soda wash tank		
II/4/b - Soda wash tank		
II/4/c - Soda wash tank?		
II/4/d - Acid wash tank		
II/4/e - Acid wash tank		
II/4/f - Acid wash tank?		
II/4/g - Charging tank		
II/4/h - Charging tank		
II/4/i - Charging tank		
II/4/j - Tank*†		
II/4/k - Tank*†		
II/4/l - Brick footings & solidified tar†	*Tar runoff collector?*	
II/4/m - Brick storm water drain		
II/5 - Crude oil washers	*Crude oil washers (WP)/Soda stock tanks (DM)/Refining plant*	
II/5/a - Soda wash tank		
II/5/b - Soda wash tank		
II/5/c - Acid wash tank		
II/5/d - Acid wash tank		
II/5/e - Charging tank		
II/5/f - Charging tank		
II/5/g - Brick footings	*Acid stock boxes (WP)/crude oil washers (DM)*	
II/5/h - Brick footings	*Soda stock tanks (WP)*	
II/5/i - Brick footings & solidified tar*†	*Tar runoff collector?*	
II/5/j - Stone storm water drain*		

II/6 - Paraffin Sheds	*Paraffin sheds*	
II/6/a - Filter press house room		
II/6/b - Hydraulic press house room		
II/6/c - Pump house room		
II/6/d - Freezing room		
II/6/e - Boiler house room		
II/6/f - Tank bases (2)	*Paraffin shed charging tanks*	
II/6/g - Tank bases (4)	*Paraffin shed charging tanks*	
III/1 - Settling House Stock Tanks (2)	*Stock tanks (WP)*	
III/1/a - Stone/brick retaining wall		
III/2 - Pump House and Settling House	*Settling house*	
III/2/a - Foundations of settling house		
III/2/b - Foundations of pump house	*Pump house*	
III/2/c - Brick pipe/boiler supports		
III/3 - Stock Tanks	*Stock tanks*	
III/3/a - Tank base		
III/3/b - Tank base		
III/3/c - Tank base		
III/3/d - Tank base		
III/4 - Workshops	*Workshops*	
III/4/a - Brick pipe/boiler supports (3)†	*'FMS'(WP)*	
III/4/b - Brick pedestals (4)*†		
IV/1 - Stirling Boilers and Chimney	*Stirling boilers and 200ft. chimney*	
IV/1/a - Brick drain	*Blow off drain (WP)*	
IV/1/b - Brick wall*		
IV/2 - Power house	*Power house(DM)/power station (WP)*	Plumber's workshop (DM)
IV/2/a - Brick base		
IV/2/b - Brick pit*†		
IV/2/c - Brick retaining wall & plinths†	*Faddy & Sampson's grocery store then testing laboratory?(Gdbg)/O'Grady's hop beer shop? (Luc)*	

IV/3 - Water Supply Pump IV/3/a - Picked recess with bolts IV/3/b - Metal ring bolt IV/3/c - Metal ring bolt IV/3/d - Cement footing IV/3/e - Grafitti '19' IV/3/f - Metal ring bolt IV/3/g - Metal ring bolt IV/3/h - Metal ring bolt	*Water supply pump*	HIV/3/i - Weir
V/1 - Dirty Water Pond and Separator V/1/a - Cement foundations	*Dirty water pond & separator (WP)/Dirty water pound & separator (DM)* *Pump house*	
V/2 - Spent Ammonia Water Settling Sumps V/2/a - Heavily overgrown drain?	*Spent ammonia water settling sumps*	
V/3 - Sulphate House V/3/a - Brick pit & drain V/3/b - Drain	*Sulphate house*	
V/4 - Crude Oil Stills V/4/a - Brick floor slab† V/4/b - Cement slab† V/4/c - Brick/cement pit V/4/d - Brick/cement pits (2) V/4/e - Stone retaining wall V/4/f - Cement & brick footings	*Crude oil stills* *Pitch ponds (LA '31)* *Pitch ponds (LA '31)* *Pump house*	Forge (WP)/oil boilers (DM)
V/5 - Heavy Oil and Paraffin Stills V/5/a - Chimney base V/5/b - Brick flue V/5/c - Brick pipe/boiler supports	*Heavy oil and paraffin stills*	
V/6 - Lubricating Oil Stills V/6/a - Brick pipe/boiler supports (4)	*Lubricating oil stills (WP)/kerosene stills (Gdbg)/high pressure stills (LA '31)*	
V/7 - Fine Oil Boilers V/7/a - Brick pits (2) V/7/b - Brick pipe/boiler supports (6) V/7/c - Brick outer wall buttresses (2)	*Fine oil boilers*	
V/8 - Lubricating and Fine Oil Charging Tanks (6 tank bases)	*Lubricating and fine oil charging tanks*	

V/9 - Railway Servicing Pit*† V/9/a - Sandstone blocks (7)* V/9/b - Sandstone blocks (4)*		
VI/1 - Retorts VI/1/a - Brick retaining wall VI/1/b - Flight of brick steps* VI/1/c - Ash dump	*Retorts/retort bench*	HVI/1/d - Experimental retorts
VI/2 - Gas Producers VI/2/a - Tank base VI/2/b - Ground level brick walling*	*Gas producers* *Ammonia water tank*	
VI/3 - Scrubber Naphtha Plant, Naphtha Refinery and Pump House VI/3/a - Stone retaining wall* VI/3/b - Naphtha stock tank VI/3/c - Brick steps (2 flights)* VI/3/d - Stone retaining wall VI/3/e - Brick walled area*†	*Scrubber naphtha plant, naphtha refinery, pump house (WP)/Scrubber naphtha plant, pump house (DM)* *Naphtha stock tank (WP)/naphtha storage tank (DM)*	
VI/4 - Crude Oil Charging Tanks (four tank bases)	*Crude oil charging tanks*	
VI/5 - Air Compressor	*Air compressor (WP)/Naphtha refinery (DM)*	HVI/5/a - Pneumatic [illegible]
VI/6 - Heavy Oil and Paraffin Charging Tanks	*Heavy oil and paraffin charging tanks*	
VI/7 - Acid Tar Plant (brick footings & walling)	*Acid tar plant (WP)/Tar plant (DM)*	
VI/8 - Soda Tar Plant (brick footings & walling)	*Soda tar plant*	
VI/9 - Acid Blowers and Soda Melters VI/9/a - Brick foundations VI/9/b - Shallow cutting & stone retaining wall VI/9/c - Drain	*Acid blowers* *Soda melters (WP)/soda metters (DM)*	
VI/10 - Unidentified Brick Structure*†		
VI/11 - Unidentified Brick Structure*†		
VII/1 - Coke Ovens VII/1/a - Brick trench & retaining walls (2) VII/1/b - Brick structure†	*Coke ovens* *Coke conveyor*	

VII/2 - Coal Mine VII/2/a - Number 2 coal shaft VII/2/b - Area of Number 1 coal shaft VII/2/c - Brick walling† VII/2/d - Depressions, stone retaining walls† VII/2/e - Stone walling, brick blocks (3)† VII/2/f - Stone walling, picked rock face† VII/2/g - Brick & rubble mound, brick walling†	*Coal mine* *Number two coal shaft (downcast)* *Number one coal shaft (upcast)*	HVII/2/h - Storage bin HVII/2/i - Pump motor HVII/2/j - Crushing plant HVII/2/k - Sirocco fan house HVII/2/l - Mine adit HVII/2/m - Unid. building near coke ovens (DM)
VII/3 - House Site* VII/3/a - Stone, brick chimney VII/3/b - Stone, brick chimney VII/3/c - Brick steps (2)	*Coal mine manager's house? (JN)*	
VII/4 - House Site*	*Coal mine manager's house? (JN)*	
VIII/1 - Upcast Shaft, Number Two Shale Mine (Shaft & fan house) VIII/1/a - Rough timber yard† VIII/1/b - Brick, cement engine base VIII/1/c - Brick, cement engine base	*Number two shale shaft (COCMnd)*	
VIII/2 - Downcast Shaft, Number Two Shale Mine VIII/2/a - Brick foundation VIII/2/b - Stone retaining wall VIII/2/c - Skipway staith† VIII/2/d - Low earth mounds† VIII/2/e - Stone walling	*Number three shale shaft (COCMnd)*	
VIII/3 - Adit, Number Two Shale Mine VIII/3/a - Brick walling VIII/3/b - Tarred surface† VIII/3/c - Brick paving†		
VIII/4 - Compressor Foundations VIII/4/a - Ship's tank VIII/4/b - Ship's tank	*Compressor (JFM '23)*	
VIII/5 - Engine House Foundations VIII/5/a - Brickwork VIII/5/b - Brick foundations	*Engine house (JFM '23)*	

IX/1 - Low Earth Mound† IX/1/a - Stone retaining wall IX/1/b - Tree with skip rail IX/1/c - Stone fireplace?†	*Skipway to shale storage bin? (AW)*	
IX/2 - Skipway Platform IX/2/a - Picked boulder, bolts IX/2/b - Cement footing IX/2/c - Narrow cutting	*Barbour's haulage road (COCMnd)*	
IX/3 - Fireplace Foundations†		
IX/4 - Section of Tarred Surface†		
IX/5 - Low Earth Mound† IX/5/a - Bolt protruding from tree	*Skipway to shale storage bin?(AW)*	
IX/6 - Stone Chimney† IX/6/a - Domestic rubbish tip?, remains of mining skip		
IX/7 - Skipway Foundations IX/7/a - Metal bolts (2) IX/7/b - Brickwork	*Weighbridge (JFM '23)*	
IX/8 - House Site†		
IX/9 - Cleared Area† IX/9/a - Old road cutting		
IX/10 - Foundations† and Pipe Culvert IX/10/a - Pipe culvert		HIX/10/b - Forge
IX/11 - House Site†		
IX/12 - Unidentified Foundations† IX/12/a - Ship's tank IX/12/b - Tin bathtub		
IX/13 - Stone Retaining Wall		
IX/14 - Stone Retaining Wall		
IX/15 - Haulage and Tipping Plant	*Haulage and tipping plant (JFM '24)*	
IX/16 - Gully and Retaining Walls		
IX/17 - Air Shaft for Colliery IX/17/a - Brick retaining wall	*Air shaft for colliery*	
IX/18 - Remains of domestic structure†		
IX/19 - Remains of domestic structure†		

IX/20 - Remains of domestic structure†		
IX/21 - Remains of domestic structure†		
X/1 - Unidentified Foundations†	*Tunnel Office? (MRSMP)*	HX/1/a & b - Number one shale mine adits (2) HX/1/c - Bridge & loading staith HX/1/d - Unid. buildings near no. 1 shale adit
X/2 - Unidentified Foundations† X/2/a - Stone retaining walls (2) X/2/b - Stone retaining wall		
X/3 - Sandstone Steps		HX/3/a - Store
X/4 - Fan House	*Fan house*	
X/5 - Shale Breaker X/5/a - Parallel brick piers (4) X/5/b - Cement slab X/5/c - Piece of metal equipment X/5/d - Brick foundations X/5/e - Broken brickwork†	*Shale breaker/shale crusher* *Blacksmith (DM)*	HX/5/f - Experimental *in situ* retorting plant
X/6 - Chimney and Remains of domestic structure†		
X/7 - Chimney and Remains of domestic structure†		
X/8 - Earth Mound X/8/a - Pulleys (7)	*Barbour's haulage road (COC M nd)*	
X/9 - Iron Pipe Culvert		
XI/1 - The Big House (Brick foundations for house & garage, remnant garden, tennis court)	*Company Manager's house/John Fell's house (JN) (IF)*	
XI/2 - Rivetted Metal Tank XI/2/a - Metal links XI/2/b - Remains of domestic structure (house)	*Glen Davis pipeline tank (JN)*	
XI/3 - Bridge (cement footings) XI/3/a - Stone retaining wall		
XI/4 - Remains of domestic structure (The Doctor's Bungalow)	*John Fell's House (DMPh)/Doctor's Bungalow (JN) (IF) (JH)*	
XI/5 - Remains of domestic structure (Jack Fell's House)	*John Fell's son's house (Jack Fell's) (IF)* *John Fell's brother's house (JN)* *'Sunny Brae'? (RB)*	
XI/6 - Tennis Court		

XI/7 - Remains of domestic structure† XI/7/a - Single fireplace chimney XI/7/b - Double fireplace chimney XI/7/c - Double fireplace chimney XI/7/d - Double fireplace chimney XI/7/e - Tank remains, garden edging XI/7/f - Cement slab XI/7/g - Cement slab XI/7/h - Brick steps (3)		
XI/8 - Remains of domestic structure (Petrie's House)	*Petrie's house (JN) (IF)*	
XI/9 - Remains of domestic structure† XI/9/a - Double fireplace chimney XI/9/b - Single fireplace chimney XI/9/c - Brick bases XI/9/d - Metal sign XI/9/e - Brick steps (2)		
XI/10 - Remains of domestic structure†		
XI/11 - Mines Office and Surgery XI/11/a - Foundations for offices XI/11/b - Stone retaining wall XI/11/c - Foundations for surgery XI/11/d - Stone retaining wall	*Mines office and surgery (WP)*	HXI/11/e - Police station (MRSMP16)
XI/12 - Concrete Slab Foundations† XI/12/a - Cement sump XI/12/b - Brick steps (2) XI/12/c - Ship's tank, recent fireplace	*Stables? (AW)*	
XI/13 - Brick Foundations†		
XI/14 - Cutting, Petrie's Gully†		
XI/15 - Oil Works Offices XI/15/a - Single fireplace chimney XI/15/b - Single fireplace chimney	*Oil works office (WP)*	HXI/15/c - Telephone exchange
XI/16 - Remains of domestic structure†		
XI/17 - Ceramic Pipe Culverts XI/17/a - Pipe culvert XI/17/b - Pipe culvert XI/17/c - Pipe culvert		

XI/18 - Cutting, Petrie's Gully Road†		
XI/19 - Remains of domestic structure†		
XI/20 - Cuttings †(2)		
XI/21 - Cleared Area†	*Sawmill? (MRSMP6)*	
XI/22 - Possible Building Site XI/22/a - Ship's tank	*Stables? (JN)*	
XI/23 - Brickworks and Clay Quarry XI/23/a - Cutting for clay quarry XI/23/b - Drying house XI/23/d - Brick kilns	 *Clay quarry (WP)* *Drying house (WP)* *Brick kilns (WP)*	HXI/23/c - Press house

APPENDIX 10.2

NPWS Brief

BM/1229
AJ; 22/9.89

BRIEF

Newnes/Glow Worm Tunnel Precinct Conservation Plan Stage 1

Historical Elements, Newnes Ruins Wollemi National Park

1.0 INTRODUCTION

The Newnes historic ruins and village in the Wolgan Valley and the Glow Worm Tunnel, Old Coach Road and remnants of the Wolgan Valley railway on the Newnes Plateau form a distinct cultural precinct within Wollemi National Park. These historic features, combined with the outstanding natural scenery, spectacular rock formations, majestic cliffs, habitats of rare, threatened and endangered fauna and flora and the occurrence of numerous Aboriginal sites make this area a significant part of our Australian heritage.

Management of this precinct will reflect these important natural and cultural values with the major emphasis on the protection of remaining cultural sites and features, provision of visitor facilities to resolve existing conflicts of use and damage to the environment and relics, and most importantly, the provision of high quality interpretation facilities to assist visitor appreciation and respect for the area.

Improved visitor facilities and community awareness about the area will thus help to protect its important natural and cultural values. The visitor facilities will also have a major positive impact on tourism in the Lithgow area which is suffering economically from recent mine closures.

If appropriate, a formal camping area with amenities will be established. It will generate revenue for future management of the precinct and the gradual upgrading of facilities to make the area accessible to as many people as possible.

2. SITE DESCRIPTION AND MANAGEMENT

Wollemi National Park includes over 487,000 hectares and is the second largest national park in NSW. This extensive park is dissected by deep, rugged gorges formed by the Wolgan, Capertee and Colo Rivers and their tributaries.

The Wolgan Valley and Newnes Plateau areas within Wollemi National Park include important historic relics such as the Newnes industrial ruins and village, the Old Coach Road, the Glow Worm Tunnel and the original Wolgan Valley Railway Line. Numerous Aboriginal sites and fauna and flora species which are rare, threatened and endangered also occur in the area which is characterised by outstanding scenery, spectacular rock formations, magestic cliffs and a diversity of vegetation communities.

The precinct is situated 40 km North West of Lithgow, West of the Blue Mountains in New South Wales. The precinct was included as part of Wollemi National Park in 1979 when the Park was established.

Newnes is situated at the head of the Wolgan Valley, 35 km north of Wallerawang. 8 km past the Ligthgow turn-off, the Mudgee Road is followed to the Wallerawang/Lidsdale junction. The Wolgan Road is then followed through Lidsdale to the Wolgan Valley. The last 25km of the Wolgan Road is unsealed. Access to the Glow Worm Tunnel is via the Newnes Plateau. From the Bells Line of Road at Clarence, unsealed roads are followed for 34 kms to the Wollemi National Park boundary on the original Wolgan Valley railway formation. Glow Worm Tunnel is 5 km further along. The last kilometre is only accessible by walking or cycling.

The closure of the Newnes Hotel in September 1988 has substantially changed traditional use of the area from predominantly vehicle and trail bike users to mainly bushwalkers and cyclists. 4wd vehicles and trail bikes regularly bypass NPWS barriers and signs to drive through the ruins and follow the Wolgan River as far as possible.

Informal picnic and camping areas are provided in the Newnes area of Wollemi National Park however, there are no amenities. The area is popular, particularly during school holidays and long weekends. Most visitors come to look at the industrial ruins and go for walks to the Glow Worm Tunnel and along the Wolgan River.

Severe erosion is occurring along the original railway alignment which forms the main access to the industrial ruins area of the Newnes shale oil works and also Glow Worm Tunnel. Pest plants such as blackberry and St John's Wort are common. Pest plants in the picnic and camping areas are regularly slashed, however those in the ruins area presently provide the only protection from vandalism for many of the historical features.

3.0 MANAGEMENT CONSIDERATIONS

3.1 Planning framework

A Draft Plan of Management has been prepared for Wollemi National Park. This Plan recognises the importance of the Newnes/Glow Worm Tunnel precinct and identifies the preparation of a Conservation Plan for the area as very high priority.

The Service, Region and District Strategies also recognise the area's importance and urgent need for thorough evaluation and conservation.

3.2 Objectives

- To protect the cultural sites and features in the area;
- To protect the natural values of the area, in particular, the riperian communities along the Wolgan River, the spectacular pagoda-like rock formations, the Glow Worms in Glow Worm Tunnel and habitats of rare, threatened and endangered plants and animals;
- To provide quality recreational opportunities with appropriate visitor facilities to mitigate conflicts of use between visitors and damage to natural and cultural features;
- To provide high quality interpretive facilities which will enhance visitor awareness and appreciation of the significant natural and cultural values of the area;
- To complement the local tourism strategy and economy by providing an exciting area for day and overnight visitors;
- To control erosion which is affecting natural and cultural features;
- To control the spread of noxious plants and animals;

4.0 CONSERVATION PLAN

The Conservation Plan will be prepared in accordance with the Burra Charter of Australia ICOMOS. The study area refers to the Newnes/Glow Worm Tunnel precinct outlined on the attached map (Appendix 1).

4.1 Objectives

Stages 1, 2 and 3 : Consultant

(a) To review the documentary evidence on the study area;

(b) To record the cultural elements of the study area;

(c) To prepare a *Statement of Significance* of the study area;

(d) To prepare a *Statement of significance* of each element or site in the study area;

Stages 4 and 5 : NPWS

(e) To identify constraints for management arising from the *Statements of Significance,* e.g. protection, interpretation, pest plant removal, erosion control, provision of visitor facilities etc;

(f) To prepare conservation policies for the planning of the study area as a whole and for each element or potential archaeological site within the study area;

(g) To determine management strategies required to implement the conservation policies;

4.2 Conservation Plan Stages

Stages 1, 2 and 3 of the Conservation Plan will be carried out by the Consultant as detailed below. Officers of the NSW National Parks and Wildlife Service will prepare Stages 4 and 5 of the Conservation Plan.

4.2.1 Stage 1 : Historical Research Duration: 2 weeks

The Consultant will:

(a) Review existing documentation on the area and prepare a thematic summary on the prehistory and history of the planning area in its local and regional context;

(b) Identify known and potential historic sites and features, including landscape elements, and relate these to the thematic summary;

(c) Identify areas of potential documentary and oral evidence not previously considered

(d) Prepare a survey and element/site recording strategy;

(e) Submit 3 copies of a draft report on Stage 1 to the Steering Committee. The report must contain a bibliography of all sources cited as well as all sources searched or oral interviews carried out, with an indication of their value to the management of the study area.

4.2.2 Stage 2 : Field Investigation and Recording Duration: 3 weeks

The Consultant will:

(a) Undertake field investigation and recording of the study area and features associated with the study area. Record all cultural features in the study area including architectural, historical, archaeological and landscape elements.

(c) Identify areas of archaeological sensitivity which require sub-surface testing to confirm their existence and location;

(d) Prepare an inventory of elements and use the physical evidence to test the adequacy of the historic record for veracity and bias;

4.2.3 Stage 3 : Assessment of Significance Duration: 2 weeks

The Consultant will analyse the historical and physical evidence, and will:

(a) Prepare a *Statement of Significance* for the study area based on its relative local, regional and national importance;

(b) Prepare a *Statement of Significance* for each element within the study area;

(c) Identify the hierarchy of significance of these elements;

(d) Identify constraints arising from the *Statements of Significance;*

(c) Submit 1 copy of a draft report to the Steering Committee on Stage 3;

APPENDIX 10.3

Documentary sources consulted during the project

Key to locations:
SL - State Library
ML - Mitchell Library
NP - National Parks and Wildlife
LRL - Lithgow Regional Library
SA - NSW State Archives
AA - Australian Archives, Sydney
FL - Fischer Library, University of Sydney

Key to type of document:
B - Book
P - Paper
A - Article
D - Primary document
R - Report
Th - Thesis

Technical (General) Australia & Overseas	Technical (NSW/Newnes specific)	Archaeological (Recent)	History (local/regional /Newnes specific)	Government/ Company documents	Where held	Type	Comments
Abraham 1961					SL	B	
Alderson 1919					SL	P	
	Austral. Mining & Engin. Review 1910 (Newnes)				SL	A	
	Antill 1944 (NSW)				ML	P	
				Aust. Nat. Shale oil Co. Prospectus 1932 (Co.)	NP	D	
				Aust. Parl. Stan. Comm 1943 (Gov.)	NP	R	
Bailey 1927					SL	B	
Bailey & Grant 1936					SL	P	
Bell 1948					SL	B	
		Birmingham, Jack, Jeans 1979 (general)			SL	B	
			Breckwoldt 1977 (Newnes)		NP	R	
	Brown 1990 (NSW)				Author	B	
	Carne 1903 (NSW/Newnes)				SL	B	Geology
Caldwell 1927					SL	P	

Christopher & Byrom 1952					SL	B	
				Comm. Bureau of Census & Stats. 1912, 1928 - 1953.	SL	B	
		Cremin, Jack, Murray, Powell, Schulstad 1987			LRL	R	
	Crichton & Connacher 1935 (Newnes)				SL	R	
	Eardley & Stephens 1974 (NSW/Newnes)				SL	B	Contains history also
		Egloff, Mead & Egloff 1987			NP	R	
Encyclopaedia Britannica 1989					SL		
	Findlater 1912 (NSW)				ML	P	
Green 1984					SL	B	
	Goodberg 1982 (Newnes)				Author	Th	Specific to Newnes
Guthrie 1938					SL	B	
Halse 1927					SL	B	
	Harper & Mingaye 1916 (NSW)				LRL	R	Concerns the coke industry
Hurst 1925					SL	B	
	Knapman 1988 (NSW)				Author	B	Concerns Joadja Creek shale mine
	Knutsen 1933 (NSW)				SL	B	

	Kraemer & Thorne 1951 (Newnes)				SL	R	Newnes specific
			Lane & Lane 1977 (Newnes)		LRL	P	
	Lishmund 1974 (NSW)				Author	P	
			Luchetti 1979 (Newnes)		SL	P	
Lyder 1925					SL	B	
	Mead 1986 (NSW)				Author	Th	Concerns Joadja, Hartley Vale, Torbane, Airly
				Wade 1925	SA	R	Mines Dept. special files AONSW 19/2554
				Pumpherston Oil Co.	SA	booklet	Undated, concerning Scottish works. Mines Dept. special files AONSW 19/2554
				Scottish Oil Agency	SA	booklet	Undated, concerning Scottish works. Mines Dept. special files AONSW 19/2554
				Shale Oil Inv. Comm. Minutes 1931	SA		Newnes particularly. AONSW 19/2563
	Morrison 1928 (NSW)				SL	B	
				Newnes Inv. Comm. 1934	SL	R	

				Dept. of Mines Annual Reports 1907 - 1909	SL	R	
	Norcross 1950 (NSW)				SL	P	Shale oil exploitation at Glen Davis
	Petrie 1905 (NSW)				SL	P	Shale oil exploitation at Torbane
		Powell 1982			Author	P	Coke ovens
				Rogers 1944	AA		Glen Davis AABox 16 SP954/1 Correspondence Files Glen Davis 1906-1951.
			Salter 1982 (Newnes)		LRL	P	Mainly township & railway
Scheithauer 1923					SL	B	
		Schulstad 1980			Author	P	Coke ovens
				Shale Oil Dev. Comm. Ltd. 1931	AA		Correspondence AA Box 27 SP954/1. Correspondence Files Glen Davis 1906-1951.
				Shale Oil Minister's File 1911, 1927	SA		Correspondence AONSW 19/2564
		Simpson 1983			FL	Th.	Archaeology of NSW coal/shale sites
			Stephens 1959 (Newnes)		NP	P	Railway
Tinney 1906					SL	B	Gold mining machinery
Tver & Berry 1980					SL	B	
Wall 1972					SL	B	
Williams 1919					SL	P	
Williams 1978					SL	B	

			Winchester (Newnes)		NP		Undated typescript
				Australian Archives Correspondence Files on Glen Davis (Boxes 9, 17, 26, 27, 48 & 50)	AA		NOT CONSULTED (contain blueprints, plans and documents) SP954. Correspondence Files Glen Davis 1906-1951.

APPENDIX 10.4

Contents of Correspondence files Glen Davis, Box 50 A. A. No. SP954 - Blueprints and plans relating to Newnes works 1907 - 1939

Company	Date	Plan	Plan No.
COC	1908	Special brick for flues.	
COC	1910	Pump house gear	
COC	1910	Oil travelling tanks - valve connections	
NOP		High pressure belt driven air compressor	
NOP		High pressure belt driven air compressor	
COC		Storage tank	
COC		Condenser	
COC	1908	Multitubular oil condenser	
	1909	Oil boilers and stills (damaged)	
	27/3/07	Atmospheric condenser	990
		Tank farm plan (damaged)	
	3/5/07	Mid steel mains	1048
	26/4/10	Naphtha refining plant	1054
COC	4/4/09	Crude oil receiving tank	1044
COC		Erection marks for assembling tanks	1042
COC		Tanks E & F, marks for assembling tanks	1040
COC		Tanks S, T, U & V, marks for assembling tanks	1041
COC		Tanks L, M & N, marks for assembling tanks	1037
COC		Tanks Q & R, marks for assembling tanks	1038
COC		Tanks W & X, marks for assembling tanks	1039
COC		Mild steel charging tank	1036
COC	7/10	Brick base for 20ft. dia. tank	953
COC	5/10	Tar boxes	954
COC	8/4/10	Detail of soda vessels and melter	955
COC	26/8/10	Acid neutralising box	956
John Fell	1920	Retorting bricks A, B, C, D types	1069
John Fell	1920	Details of retort firebricks	1068
COC	1908	Detail of piers on datum line	1064
COC	2/07	Arrangement of bench	1066
COC	4/07	Gas connections for oil works	1063
COC	14/12/09	Brickwork plan of crude oil boilers and stills	1062
COC	26/4/07	Gas mains for oil works	1061
COC	13/1/11	Soda tank for naphtha refinery	1660
COC	16/1/11	General arrangement of lubricating oil stills	1059
COC	1910	Ammonia water heater for sulphate house	1058

Company	Date	Plan	Plan No.
COC	15/9/10	Base or seat for 500, 000 gallon tank	1057
COC	1910	Vessels for naphtha refining plant	1055
COC	1910	Cast iron retort, cast iron stool	1080
COC	1910	Roll steel	1090
COC	27/5/39	30" x 50 single roll crusher and foundations	1091
COC		Damaged	1092
COC	1908	Firebricks for lining of retorts at Newnes and order in which bricks are required	1077
COC	27/9/12	Special bricks for cone of retorts	1076
COC		Pumpherston patent retort showing different floor levels	1071
COC	1908	Lining for brick in retorts (depth of column)	1073
COC		Retorting bricks (c retort brick)	1074
		Damaged	993
COC	8/8/12	Special cone blocks for retorts	1075
COC	1908	Arrangement of a pair of class V13 boilers	1011
COC	1908	Coking still (damaged)	1010
COC	1908	Arrangement of condenser pipes for oil boilers	1009
		Damaged	1008
COC	1908	Stirling boilers (amount of bricks in one boiler)	1012
COC	1911	Fine oil boilers	1013
COC	1905	Ammonia still	1007
	1907	Coolers for naphtha plant	1006
	1908	Oil boilers	1035
	1908	Cover and stool for still	1034
	1911	Kerosene washers	1005
		Conveyor stringer (damaged)	
		Screen house (damaged)	
		Screen house (damaged)	
		Screen house (damaged)	

APPENDIX 10.5

Transcription of list of assets.
From an indenture between
Albert Edward Broué and the Shale Oil Development
Committee Ltd.

21/7/31.

(Correspondence Files Glen Davis 1906-1951
Box 27 A. A. No. SP954.).

NB: Where illegible these sections framed by []

SHALE CRACKER PLANT:

1 Hadfield (Jacks Patent) Gyratory Crusher Size S.
1 40 H. P. Motor and Starter and Switchboard.
1 Leather Driving Belt.
Timber Framing Shutes, screens, tippler etc.

SHALE HAULAGE TO RETORTS:

Timber Gantry and Bridge, Skip Rails, Greasers, &c.
11/16" Haulage rope on endless drive.
25 H. P. Electric haulage with two Clifton Wheels and back balance, guide pulleys, cone rollers &c.

STORAGE BIN AND INCLINE:

Shale Bin 800 tons capacity.
11/16" Haulage rope with pulleys on incline.
8 Hopper Charging Skips.

RETORTS - BENCH OF 28 RETORTS:

8 Spent Shale Skips, 2 Gas Producers, Spent Shale 2 Cage Hoists, Spent Shale tip, 1 5 ton Steam Contractors Crane, Hydraulic gear for Retorts, 1 Pan-mill and Engine, 2 Experimental Retorts, 1 Avery 35 Cwt. Weighbridge.

EXHAUSTER HOUSE - BRICK AND IRON:

2 Bakers Exhausters Size 45, 1 12" Steam Engine (Tangye) 1 Electric Motor with belt drive, shafting and belts, Spur wheel gears, Switchboards and Starter.

CONDENSING PLANT AND GAS MAINS:

Atmospheric Condensers consisting of 4" C. 1.pipes and headers, steam pipes and Separators.
3'6" dia. 3' dia. 30" dia. 20" dia. 15" dia. etc.
Gas Mains 1 Spray Tower and Separating Tank, 2 Multitubular Condensers and Separator, 1 Crude Oil Measuring Box, 1 Ammonia Water measuring box.

SCRUBBER TOWERS:

4 Towers 30' 9" x 8' 6" dia., 2 Towers 30' 9" x 6' 9" dia. Wood Grid, trays and nozzle sprays, 2 Three throw circulating pumps 8" x 6".

NAPHTHA RECOVERY PLANT:

2 Multitubular Coolers in tanks, 1 multitubular Heater, 3 Condensers in boilers, 1 Circulating three throw pump, 2 Receivers for Naptha (Crude) 1 8" Tangye Steam Engine, Shafting and belts etc., 1 vertical Coffee Still, 1 Separator, 1 15 H. P. Motor and Starter, 1 3" Cent. Pump.

CRUDE OIL STILLS: (Comprising)

3 Continuous feed oil boilers 20' 0" x 7' 0" 2 (Pre) Heaters, Domes etc., 6 Condenser Boxes 12' 0" x 9' 0" x 4' 0" with 8" to 4" coils etc., 7 Pot stills for coking 8' 6" dia. 7 Pot Stills Condensers 12' 0" x 8' 0" x 4' 0" with 4" coils etc., 7 Boiler Receivers Flat and egg and, 5 Separator Boxes, Brick Pitch Ponds, 150 ft. brick chimney and flues, 1 C. I. Trough.

HEAVY OIL AND PARAFFIN STILLS:

3 Continuous feed oil boilers 20' 0" x 7' 0" dia. 6 Condenser Boxes 12' 0" x 9' 0" x 4' 0" with 8" to 4" coils etc., 2 Pot stills 8' 6" dia. 4 Condenser Boxes 12' 0" x 8' 0" x 4' 0" with 4" coils, 3 Boiler Receivers Flat and about 26' 0" x 8' 0", 4 Separator Boxes, 150 ft. brick chimney and flues, 2-3 throw H. P. Pumps Motor and Switchboard complete 1 Pump House and shafting.

HIGH PRESSURE STILLS:

2 Boiler Stills 25' 0" long 6' dia. 2 Condenser Boxes 12' 0" x 8' 0" x 4' 0" with coils 2" dia. 2 Aerial Condensers (All steel) 8" dia. 2 small

Vertical Receivers and fittings, Steel Roof
framing and corrugated iron roof.

FINE OIL BOILERS (Comprising):

2 Boiler Stills 24' 0" x 8' 0" dia. 4 Condenser Boxes 12' 0" x 8' 0" x 4' 0" with coils 6" to 4" etc., 2 - 10" dia. Aerial Dephlegmator on steel frame, 10 Worm end Boxes and run off pipes, 1 pump House and shafting (Brick) 3 3 throw Pumps 8" x 6" (Tangye) 1 15 H. P. Motor and Belt Drive, Switchboard and Starter, 6 Tar Injectors, 1 Old Shay Loco. Superheaters, 1 Long Brick Flue to Chimney.

CRUDE OIL REFINING PLANT (Comprising):

1 - 50, 000 gallon conical bottom charging tank,
1 - 35, 000 " " " acid washer,
1 - 35, 000 " " " soda washer,
Timber Gangways and Scaffolding etc.

LUB. OIL REFINING PLANT (Comprising):

1 - 50, 000 gallon flat bottom charging tank,
1 - 35, 000 " conical bottom acid washer,
1 - 35, 000 " " " soda washer,
Timber Scaffolding and Platforms, etc.

KEROSENE OIL REFINING PLANT:

1 - 50, 000 gallon flat bottom charging tank,
1 - 20, 000 " conical " acid washer,
1 - 20, 000 " " " soda washer,
2 - 30, 000 " flat " finished Kerosene Tank.

BLUE OIL REFINING PLANT:

1 - 50, 000 gallon flat bottom charging tank,
1 - 35, 000 " conical " acid washer,
1 - 35, 000 " " " soda washer,
Timber Gangways and scaffolding etc.

DIRTY WATER PONDS - BRICK:

Large brick pond with baffle walls, Brick Separators, and trough, Brick Pump House, 1 three throw 8' 0 " x 6" Tangye pump, 1 15 H. P. Motor Belting and shafting etc.

PARAFFIN EXTRACTION PLANT (COMPRISING - BRICK):

1 Vertical De La Vergne 2 cylinder 50 tons Refrigerator 1 105 H. P. Motor Squirrel Cage Type, 1 130 H. P. Motor Squirrel Cage Type, 2 Croft and Parkins Friction Clutches and 3' rope wheel 1 6' 6" C. I, 6 Groove Rope Wheel, 1 3' 3" C. I. 8 Groove Rope Wheel, 1 12' 0" C. I. 8 Groove Rope Fly Wheel on machine 14 $1^1/_2$ dia. cotton ropes, Switchboard, starter, cut-out, Ampeter, Volt Motor etc., Ammonia Condensers with trap Receivers etc., Water Tank for circulating water, 3 Bryson Oil Coolers, Worm gear and Spur Wheel driver, 4 filter Presses each 160 plantes 26" square, 4 Spiral Conveyors and trough worm wheel driven fitted with Clutches and Hand Levers, 4 Vertical Hydraulic Presses by A. F. Craig, 2 Hydraulic Pumps three throw belt driven 1 25 H. P. Motor with Switchboard and Starter, counter shafting and belts, Brick buildings with Steel Girder and concrete reinforces roof, cement floors throughout 1 Filter cloth Steaming Box etc., 1 Counter Shaft 8" dia. 4 High Speed Plummer Block, 1 three throw Hydraulic Pump. 7 plunger Pumps.

SWEATING PLANT:

Brick Building steel Girder and Reinforced Concrete roof, 2 sets of Henderson's sweating plant with gauzes, coils, filling and draining pipes and eccentric shaft complete, 1 Brick Pump House, Counter Shaft bearings and column etc.

WAX REFINING PLANT AND CANDLE PLANT:

1 large Circular bottom jacketted pan with shaft and stirrers, Counter shaft and belting for same, Building

of timber and corrugated iron, wax cooling Racks and Trays 2 Candle making machines, 2 Jacketted Wax Pans, aluminium, 1 large Filter Press, 1 small Circular filter press.

SETTLING HOUSE - GALVANISED IRON:

6 - 10, 000 gallon settling tanks with steam coils etc.

TIN FILLING SHED - GALVANISED IRON (Comprising):

Corrugated iron building with Railway siding, 2 Tank filling pipes, 1 Tangye Vertical Engine with Counter shaft and belting.

SULPHATE AMMONIA PLANT - WOOD AND IRON:

Two storey timber building with Malthoid roof, 1 Ammonia Tower, 1 Liming Vessel, 1 Lime Mixer, 1 C. I. Acid Egg, 1 Lime Pan, 3 W. 1. Sulphate Skips and Rail (overhead) 1 - 50, 000 Gallon stock tank.

ACID HANDLING TANK:

Timber Gantry, Steam winch and wire rope.

SODA MELTING PLANT:

1 - 6 drum soda Melter, 2 dished and Receivers 20' 0" x 5' 0".

STORAGE TANKS:

6 - 50, 000 gallon stock tanks)
1 - 40, 000 " " tank) Complete and used.
11 - 30, 000 gallon stock tanks)

AIR COMPRESSOR PLANT - GALVANISED IRON (Comprising):

1 Vertical High-speed Air Compressor, 1 25 H. P. Motor and belt drive, 1 Air Receiver, 1 Switchboard and starter.

YARD:

1 Portable Railway Yard Crane, 10 tons.

MAIN WATER SUPPLY - BRICK AND IRON:

2 sets of three throw Tangye horizontal 10" Ram Pumps, geared, belt driven, 2 75 H.P. Motors with Switchboards and starters, 10" Suction pipe and 6" Mannesman discharge pipe concrete and brick reservoir 200, 000 galls capacity Steam and Water pipes throughout works, Air, Oil, Soda, Acid, etc., pipes throughout works.

MACHINE SHOPS:

Brick building with corrugated roof, comprising:

FITTING SHOP CONTENTS:

1 Wheel Lathe for rolling stock, 1 Ordinary Screw-cutting lathe with gap 11' bed 10" centres, 2 ordinary Screwcutting lathes with gap 6' bed, 6" centres, 1 Shaping Machine, 12" stroke, 1 Planing Machine 6' stroke, 1 Slotting Machine, 12" stroke, 1 Milling Machine and teeth cutting, 1 Radial drill double geared up to 2" holes, 1 Vertical drill double geared, 2 Sensitive drills, 2 Emery Wheels, 1 Wheel press hydraulic for rolling stock, 2 Bench Vices, various tools, stocks and dies etc.

BOILERMAKERS SHOP - CONTENTS:

1 heavy Shearing and punching machine, 1 set of Plant Rolls 6 ft. wide, 1 C. 1. Boilermaker's slab, 1 3cwt. Anvil with tools., 25 H.P. Motor with Switchboard and starter, Counter Shafting and Belt Drives to all machines, travelling 5 ton Crane (overhead).

BLACKSMITH'S SHOP - CONTENTS:

2 - 3 cwt. Anvils, 2 Swage Blocks, 1 Pilking 3 cwt. Power Hammer, 1 Bakers Blower, 3 hearths Blacksmith's tools.

CARPENTER'S SHOP - CONTENTS:

1 Circular Saw bench, 1 Band saw, 1 Lathe, Several Spare Saws for 6 circular saw bench, 2 Carpenters benches.

STORES:

Brick building cement floor, Racks and Shelving, 2 Platform Weighbridges, Counter and Desk.

POWER HOUSE:

Brick building with corrugated iron roof, 1 - 10 ton overhead hand travelling crane, 2 sets of 750-850 H.P. Compound Bellis and Morcom Vertical Engines, direct coupled, to Westinghouse, three phase Generators fitted with Exciters, Switchboard and Distributing Meters etc., 1 small Lighting set Continuous current dynamos driven by 70 H.P. Vertical Tangye Engine, Various spare [ ], 1 small foot lathe, 1 Bench vice and tools, etc., Workshop for Electrical Mechanic, Linesman, 2 small motors, tools.

STEAM BOILERS:

4 sets of Sirling Water Tube Boilers fitted with Chain Grate, Stokers, Working pressure 1 [ ]lbs. 1 small vertical steam Engine for driving chain Grate stoker, 2 Vertical boiler Feed Pumps, 1 Horizontal Spare Feed pump, 16" Duplex Ta[ ] Auxillary, 200 ft. brick Chimney, Brick f[ ] and Dampers, Steampiping throughout works, Wa[ ] Piping throughout works, Air piping throughout works, Oil Piping throughout works, Experimental Retorts etc.

IN YARD:

About 100 tons of various scrap iron in yard, about 50 tons of various scrap iron in yard from Torbane, 1 Old Gyratory Gates Crusher from Torbane, 2 Exhausters (broken) from Torbane, 1 Old Haulage Engine from Torbane, quantity of spare pulleys and shafting, quantity of spare Cast steel pulleys and rollers, quantity of Blacksmiths Bar iron in rack, 3 old Cast iron Still bottoms (scrap).

WORKS OFFICE:

Building of timber with corrugated iron roof.

Contents:

1 Roll top Desk, 1 Safe, 2 Copying Presses, 3 Cabinets, 4 office tables, 4 chairs, 2 Telephones and 1 exchange board, 2 Typewriting Machines, 1 Clock, quantity of shelving and 2 cash boxes.

DRAWING OFFICE:

1 Cupboard, 3 Drawing tables and tressels, 3 sets of Drawers under bench and 3 drawing boards and T squares, 2 Tables, shelving.

SHALE MINE:

1 Belt Driven Air Compressor (capacity 6 Siskol Machines) dismantled, 1 80 H. P. 3 Phase Motor, Switch-board and starter, 1 12" Mandor Belt 64 ft. long, 1 Air Receiver 8' 0" x 3' 0" diameter, 1 Endless Haulage gear 30 H. P., 2 Belts 8" and 6" wide, 1 30 H. P. Motor 3 phase, 1 liquid Switchboard and starter, 1 Small Endless Haulage gear, belt driven, 1 20 H. P. Motor 3 phase, Switchboard and starter, 1 skip weighing Machine, 5 Siskol Coal cutting machines with Rods, Hoses and fittings - In mine - quantity of Siskol spare parts, 3 Ingersoll Rand popper drills, 6 shale Conveyors and pulleys - In mine - 4 Conveyors ropes

quantity of tools ($^1/_2$ ton), Blacksmiths shop, Anvil, bellows, tools, etc., 1 Sirocco Fan 6' diameter, 1 25 H. P. D. C. Motor, Switchboard and starter, 1 Air Receiver 12 ft. by 4 ft. diameter, 6 Conveyor winches 4 $^1/_2$ " to 6" cylinders - In Mine - Steel wire haulage rope $^3/_4$" dia. 3000 ft, 3" W. I. Piping 3000 ft. about, 2" W. I. piping, 3000 ft. about, 105 Shale Skips, 2 Skips tipplers, 36 Haulage ropes, clips, 40 couplings, 70 tons of skip rails, 14 to 20 lbs. per yard above and below grd. 2 Colonial steam boilers, 1 coupled winding winch, 1 old winding engine and drum, 5 Tangye pumps 3" to 4" diameter (duplex), Poppet head and 2 wheels.

PLANT AT NO. 2 OLD SHALE TUNNEL:

2 Bakers Exhausters size 45, quantity of Gas mains 36" & 17" diameter.

COAL TUNNEL: (Some in Mine).

1 Colonial Steam Boiler with injector, 1 Winding Winch, 28 Coal Skips, 1 Skip tippler, 450 ft. of Haulage rope $^3/_4$" diameter, 1 three throw electric driven pump 3" rams, 1 Motor 12 H. P. Switchboard and starter, 200 ft. of 2" W. I. piping, 2000 ft. of 14 lb. rails, 1 weighbridge, 1 Coal shute.

SHALE HAULAGE FROM MINE TO CRACKER:

6000 ft. of 11/16" dia. wire rope, 1 Haulage gear, 1 Skip tippler, 1 80 H. P. Motor, 1 Skip Weighbridge, Corrugated iron shed, 24 Haulage Clips, 2 Skip Greasers.

OLD COAL SHAFTS:

1 pair of first motion coupled winding engines 22" cyls., 1 pair of First motion coupled Geared Winding Engines, 10" cyls., 1 Poppet head and 2 wheels, 12 ft. diameter about, 2 double shaft Cages, 1 Poppet and wheel, 1 18 single Cylinder Ruston Proctor Steam Engine,

Quantity of bricks in old coke ovens, 1 brick chimney, 5 tons scrap iron, 2 Engine House wood and iron.

APPENDIX 10.6

Summarised Transcriptions of Interviews:

10.6.1. Isobel Fynch, Ryde, 7/3/91.
(William Petrie's Daughter)

10.6.2. Jenny Hall, Wallerawang, 11/3/91.
(Former Newnes resident)

10.6.3. Jim Norcross, Glen Davis, 28/2/91.
(William Petrie's Grandson)

10.6.4. Alan Watson, Newnes, 1/3/91.
(Railway Researcher and Lessee of the Newnes Hotel)

10.6.1. Notes of Conversation with Isobel Fynch, Ryde, 7/3/91.

[Isobel Fynch is William Petrie's daughter and lived at Newnes with her family when she was a child. The Petrie's lived at Newnes between about 1911 and 1926.]

* Isobel remembers two doctors: Dr. Edna Smith, who had a house in the town and an earlier doctor, Dr. Murray Gibbes, who lived in the Bungalow.

* The Bungalow was closer to the town than the Big House and the Big House had 10 bedrooms, a bay window and double doors.

* Jack Fell's house (Jack was John's son, who was killed at Duck Creek) was also a large house.

* Isobel's Grandfather (James Ramsey Petrie) and her uncle came to Australia from Scotland in 1910.

* The Illingsworths, Guthries, Struthers and Bairds all lived behind the coke ovens.

* The Arthurs had the Newnes Hotel when Isobel lived at Newnes.

* There was a cinema on the rail station side of the river, this was run by a Mr. Breedon.

* On the railway, a Mr. Joe Cox was a guard and a Mr. Minney was one of the train drivers.

* The Luchettis lived east of the main works area, past the (No. 2) mine. One of their children is buried where the ash heap is now.

* The coach station was originally located at the stables in Petrie's Gully (Leo Finn's?).

* *Re*: Houses in Petrie's Gully:

The Petries lived at the northern most end of Petrie's Gully (no-one lived past them). There was a little-used road running past the rear of the Petrie's house, which ran to either the tennis courts or to the dam in the gully from which William Petrie pumped water to the house.

Next to them, on the west side of Petrie's gully road moving toward the works, were Shepherd's Boarding House, George Baker, Mrs. Hay, Burrell's and Miss Morrison.

Between and opposite Burrell's and Miss Morrison's (again moving towards the works) were the Riles family, next to them the Carruthers and then the stables, run by Leo Finn.

10.6.2. Notes of Conversation with Jenny Hall, Wallerawang, 11/3/91.

[Jenny Hall lived at Newnes in the late 1920s, early 1930s, her husband, Patrick, was a train driver for the Shay locomotives.]

* Jenny and her husband, Patrick Hall, used to live near the catholic church.

* Her husband's father (Richard Hall) came to the Wolgan Valley before 1921.

* Richard Hall and his father, James Joseph Hall, were both main train drivers for the Newnes line.

* A boarding house and a police station were located behind the train station.

* The photograph entitled 'John Fell's House' is in fact the Doctor's Bungalow, which was located on the hill behind the cricket pitch. This house was always called the Doctor's house. Tommy Halloran also had a house near the cricket pitch/football oval.

* The Doctor's house was near to where 'old Grimshaw' lived.

* Roy McDonald used to live on the road above the pump house and he used to look after horses (in the 1930s).

* Jenny Hall's brother-in-law (Jim Hall) and his wife used to live in the Big House as caretakers (this was at the beginning of the Glen Davis period).

10.6.3. Notes of Conversation with Jim Norcross, Glen Davis. 28/2/91.

[Jim Norcross is William Petrie's grandson and visited Newnes often, both while the Petrie family lived there, as well as after the works ceased production.]

* The stables in Petrie's Gully belonged to Leo Finn. These were located at the fork of the road just past the 'Big House' on the right hand side.

* When William Petrie first came to Newnes he and his family lived in a weatherboard house on the riverbank opposite the pump house (this was the first house they lived in). Subsequent to this they moved to Shale Gully (later known as Petrie's Gully).

* The Doctor's Bungalow was located on the flat just past the present Little Capertee Camping area, on the right hand side. The Grimshaws and the Crowes lived beyond the Doctor (moving towards the works), but below the level of his house along the riverbank (Grimshaw's just below the Doctor's Bungalow, Crowe's further along the riverbank towards the works).

* There was a mine manager's house located near the coke ovens. This was moved to Glen Davis and has since been demolished.

* James Ramsey Petrie (the works advisor and William's father) at one time lived in the house with the long steps (no date for this).

* Robert Petrie (William's brother) was the works chemist.

* John Fell's brother's house was located further around towards the Newnes Hotel from the Big House (at some stage Jim's grandfather, William, lived in this house - possibly at the same time as James Ramsey)

* *Re*: Houses in Petrie's Gully:

Petries lived in Petrie's Gully. Their house was the one with two brick(?) chimneys and the striped awning at front.

There was a boarding house south of the Petries' house. This had a grass courtyard in the centre, the building being constructed on a square. This was the staff quarters for the men.

Petrie's were the highest house along Petrie's Gully, below them was Cook's (mine manager?), then the boarding house.

* Many of the labour problems which beset Newnes were in part due to the difficulties of mining shale. Because it was a much harder substance than coal there were no mechanical aids which could help, which led to many labour problems.

10.6.4. Notes of Conversation with Alan Watson, Newnes, 1/3/91.

[Alan Watson is the current lessee of the Newnes hotel, has spoken to many former residents of Newnes who have returned to visit the site and is an expert on the shale railway.]

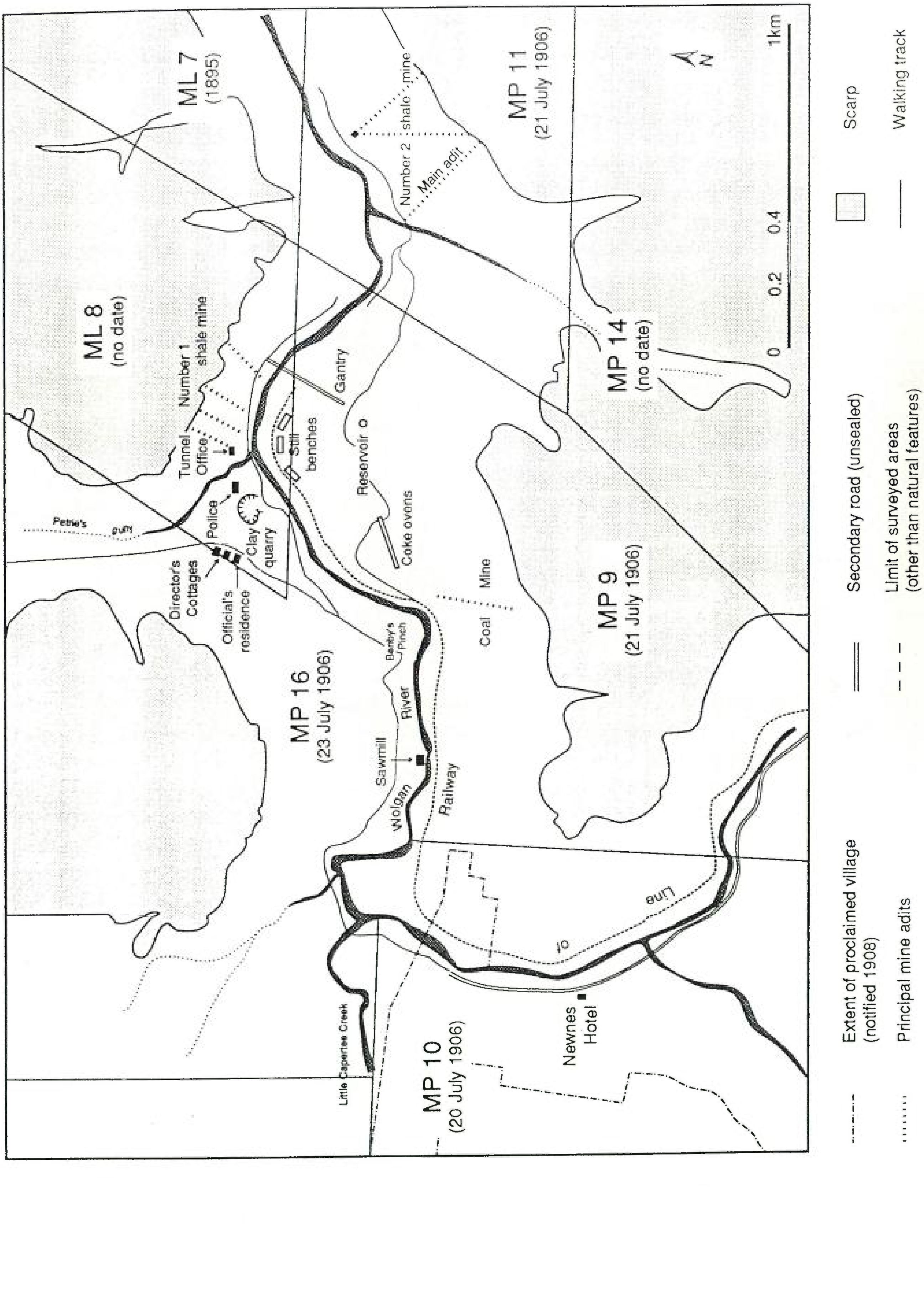
* The adit for the No. Two shale mine had both inbye and outbye skipways, the outbye at least was raised on a brick platform (there is a photograph of this). Some time after this adit became established (no date) a brick housing was built over the adit.

* The shale haulage skipway was changed during the Newnes Investigation Committee period, to run directly to the storage bin rather than across the river to the shale crusher.

* The garage at the Big House was added by Fell during the time that he lived there.

APPENDIX 10.7

Mining Permits and Lease Applications held in the Wolgan Valley, including dates first surveyed.
(From Department of Mines Mineral Resources Sheets)
Buildings shown in white are major archaeological features: those shown in black are recorded on original leases and permits only.



ML 7
(1895)
ML 8
(no date)
MP 11
(21 July 1906)
MP 14
(no date)
MP 9
(21 July 1906)
MP 16
(23 July 1906)
MP 10
(20 July 1906)
Number 2 shale mine
Main adit
Number 1 shale mine
Tunnel
Office
Police
Clay quarry
Directors Cottages
Official's residence
Petrie's gully
Still benches
Gantry
Reservoir
Coke ovens
Coal Mine
Bentry's Pinch
Sawmill
Wolgan River
Railway
Line
Little Capertee Creek
Newnes Hotel
0 0.2 0.4 1km
N
Extent of proclaimed village (notified 1908)
Principal mine adits
Secondary road (unsealed)
Limit of surveyed areas (other than natural features)
Scarp
Walking track

APPENDIX 10.8

Tabulated information from Blaxland Shire
Rate Books 1930, 1933 and 1939.
Held by Greater Lithgow City Council.

Date	Owner's Name	Occupation	Type of structure	Location	Value	Comments
2/12/ 1930	The Crown		255 acres 2 roods 32 perches	MP10, MP16, MP27, MP28	Unimp.£6 38 Imp. £638	Leased to John Alexander Jones, William Sydney Cripps. [William Sydney Cripps had died by 13/9/33, his estate was left to his wife Sarah]
30/12/ 1930	The Crown		9040 acres	ML9, ML5, ML4, ML6, ML7, ML8. MP1, MP8, MP5, MP14, MP3, MP4, MP26, MP11, MP9	Unimp. £18080. Imp. £18080	Leased to ALbert Edward Broué. Rent 2/- per acre = £904
1930	Roman Catholic Church			Sect. 1/Lot 1 & 2	£320	
1930	Augustus Sparkes	Miner	Old dwelling	Sect. 1/Lot 9	£1	
1930	Mrs. Celia Frances Moreley	lived Newnes		Sect. 3/Lot 8	£1	
1930	E. J. Quince	lived Newnes		Sect. 6/Lot 6	£1	
1930	Mary Hall	lived Newnes		Sect. 20/Lot 5	£1	
1930	Sydney Burge	lived Newnes		Sect. 31/Lot 7	£1	
1930	Alexander McDonald	Teacher		Sect. 32/Lot 1 & 2	£1	
1930	Thomas Deveney			Sect. 32/Lot 4	£1	
1930	Joseph Hutton			Sect. 32/Lot 13	£1	
1930	Godfrey William Bradshaw	Motor Driver		Sect. 33/Lot 13	£1	
1930	Alexander McDonald	Teacher		Sect. 34/Lot 12	£1	
1930	Arthur Nathaniel McAndrew	Labourer		Sect. 35/Lot 8	£1	

Date	Owner's Name	Occupation	Type of structure	Location	Value	Comments
1933	Shale Oil Investigation Pty. Ltd.		Shack	ML 11. Section A	not rateable	Crown Lease. Murphy
1933	Shale Oil Investigation Pty. Ltd.		Cottage	ML 11. Section A/Lot 1	not rateable	Crown Lease. Church of England Rectory
1933	Shale Oil Investigation Pty. Ltd.		Cottage	ML 11. Section A	£50	Crown Lease. Opposite Lot 6
1933	Shale Oil Investigation Pty. Ltd.		Church	ML 11. Sect. C/Lot 13	£35	Crown Lease. St. David's Church of England
1933	Shale Oil Investigation Pty. Ltd.		Cottage	ML 11. Sect. C - Between Sutherland, Harmsworth, Alvers & Numietta Streets	£12	Crown Lease. Delraine
1933	Shale Oil Investigation Pty. Ltd.		Cottage	ML 11. Sect. C - Between Sutherland, Harmsworth, Alvers & Numietta Streets	£100	Crown Lease.
1933	Shale Oil Investigation Pty. Ltd.			ML 11. Sect. D/ Lot 1 & 19	£100	Crown Lease.
1933	Shale Oil Investigation Pty. Ltd.		Cottage	ML 11. Sect. D/Lot 20	£60	Crown Lease. House No. 180
1933	Shale Oil Investigation Pty. Ltd.		Cottage	ML 11. Sect. E/Lot 12 &13	£70	Crown Lease.
1933	Shale Oil Investigation Pty. Ltd.		Cottage	ML 11. Sect. E/Lot 17	£40	Crown Lease. House No. 156
1933	Shale Oil Investigation Pty. Ltd.		Cottage	ML 11. Sect. E/Lot 18	£40	Crown Lease. House No. 157
1933	Shale Oil Investigation Pty. Ltd.		Cottage	ML. 11. Sect. E/Lot 20 & 21	£40	Crown Lease. House No. 158
1933	Shale Oil Investigation Pty. Ltd.		Shack	ML. 11. Sect. F/Lot 6, 7 & 8	£25	Crown Lease.
1933	Shale Oil Investigation Pty. Ltd.		Shack	ML. 11. Sect F/Lot 11	£20	Crown Lease.
1933	Shale Oil Investigation Pty. Ltd.		Cottage	Ml. 11. Sect. G/Lot 6 - 9	£50	Crown Lease. House No. 10
1933	Shale Oil Investigation Pty. Ltd.		Cottage	ML. 11. Sect. G/Lot 4 & 5	£65	Crown Lease.

Date	Owner's Name	Occupation	Type of structure	Location	Value	Comments
1933	Shale Oil Investigation Pty. Ltd.		Cottage	ML. 11. Sect. H/ Lot 3 & 4	£70	Crown Lease. House No. 11
1933	Shale Oil Investigation Pty. Ltd.		Cottage	ML. 11. Sect. H/ Lot 4 & 5	£80	Crown Lease. House No. 12
1933	Shale Oil Investigation Pty. Ltd.		Cottage	ML. 11. Sect. H/ Lot 6 & 8	£120	Crown Lease. House No. 322 (Hall's)
1933	Shale Oil Investigation Pty. Ltd.		Cottage	ML. 11 Sect. H/Lot 8 , 9 & 10	£30	House No. 14
1933	Shale Oil Investigation Pty. Ltd.		Cottage	ML. 11, near rectory on left hand of Capertee Creek	£40	Gelick
1933	Shale Oil Investigation Pty. Ltd.		Cottage	ML. 11, on Capertee Creek	£30	Neilen
1933	Shale Oil Investigation Pty. Ltd.		Shack	ML. 11	£15	Munro Hut
1933	Shale Oil Investigation Pty. Ltd.		Shack	ML. 11	£15	Neilen
1933	Shale Oil Investigation Pty. Ltd.		Shack	ML. 11	£15	Lowry
1933	Shale Oil Investigation Pty. Ltd.		Shack	ML. 11	£15	Hume
1933	Shale Oil Investigation Pty. Ltd.		Cottage	ML. 11	£35	Cottage No. 115
1933	Shale Oil Investigation Pty. Ltd.		Hall	MP. 16	£25	Crown Lease.
1933	Shale Oil Investigation Pty. Ltd.		Cottage	MP. 16	£50	Crown Lease. Crowe's, below Doctor's residence.
1933	Shale Oil Investigation Pty. Ltd.		Cottage	MP. 16	£200	Crown Lease. Doctor's residence
1933	Shale Oil Investigation Pty. Ltd.		Shack	MP. 16	£20	Crown Lease. McAndrew's, near Doctor's
1933	Shale Oil Investigation Pty. Ltd.		Cottage	MP. 16	£25	Crown Lease. Grant's

Date	Owner's Name	Occupation	Type of structure	Location	Value	Comments
1933	Shale Oil Investigation Pty. Ltd.		Cottage	MP. 16	£50	McDonald's
1933	Shale Oil Investigation Pty. Ltd.		Cottage	MP. 16	£110	Riley's
1933	Shale Oil Investigation Pty. Ltd.		Cottage	MP. 16	£130	Hyham
1933	Shale Oil Investigation Pty. Ltd.		Cottage	MP. 16	£50	Norris
1933	Shale Oil Investigation Pty. Ltd.		Cottage	MP. 16	£50	House No. 101
1933	Shale Oil Investigation Pty. Ltd.		Cottage	MP. 16	£220	House No. 102
1933	Shale Oil Investigation Pty. Ltd.		Cottage	MP. 16	£320	Ankus, House No. 103
1933	Shale Oil Investigation Pty. Ltd.		Cottage	MP. 16	£320	House No. 104
1933	Shale Oil Investigation Pty. Ltd.		Cottage	MP. 16	£220	Hampson
1933	Shale Oil Investigation Pty. Ltd.		Cottage	MP. 16	£80	Next to Hampson
1933	Shale Oil Investigation Pty. Ltd.		Cottage	MP. 16	£600	Wilson
1933	Shale Oil Investigation Pty. Ltd.		Cottage	MP. 16	£400	Sunny Brae, near Manager's
1933	Shale Oil Investigation Pty. Ltd.		Cottage	MP. 16	£80	Grimshaw
1933	Shale Oil Investigation Pty. Ltd.		Cottage	MP. 16	£25	Near Grimshaw
1933	James Joseph Hall		Cottage	Sect. 1/Lot 5	£200	
1933			Cottage	Sect. 2/Lot 5	£25	
1933	Mrs. Celia Frances McKenzie		Cottage	Sect. 3/Lot 8	£20	
1933	John Thomas Simpson		Cottage	Sect. 3/Lot 9	£30	

1933	William Leighton Wilson		Cottage	Sect. 9/Lot 4	£25	
1933	Ellen Arburkle			Sect. 10/Lot 3	£5	
1933	C. W. Chant			Sect. 10/Lot 6	£5	
1933	The Crown		Shack	Near Capertee Creek. Sect. 13, adjoining Lot 1	£20	
1933	The Crown		Shack	Sect. 30/Lot 1	£15	
1933	Henry Maber		Store	Sect. 30/Lot 3	£25	
1933	Henry Maber		Store	Sect. 30/Lot4	£200	
1933	Thomas A. Tweedie		Shop and dwelling	Sect. 30/Lot 5 and pt. 4	£250	
1933	Mrs. Berta Pearson		Shop	Sect. 30/ Lot 6	£25	
1933	E. Gill		Cottage and oven	Sect. 30/Lot 20	£150	
1933	Arthur Roy Armstrong		Cottage	Sect. 33/Lot 10	£30	
1933	William Thomas Heslin		Cottage	Sect. 34/Lot 1	£15	
1933	Alexander McDonald		Cottage	Sect. 34/Lot 12	£200	
1933	Walter Coulson		Cottage	Sect. 34/Lot 19	£25	
1933	Herbert Penrose		Cottage	Sect. 35/Lot 2	£20	
1933	James Hillyard		Cottage	Sect. 35/Lot 7	£20	
1933	Dept. of Education		School	Portion 35	£700	
1933	John Alexander Jones		Hotel	Private sub. 9. Sect 1/Lot1	£1000	
1933	John Alexander Jones		Store	Private sub. 9 Sect. 1/Lot1	£250	
1933	John Alexander Jones		Store	Private sub. 9 Sect. 1/Lot 2 & 3	£200	
1933	John Alexander Jones		Store and dwelling	Private sub. 9 Sect. 1/Lot 4	£200	
1933	John Alexander Jones		Dwelling	Private sub. 9	£100	

Date	Owner's Name	Occupation	Type of structure	Location	Value	Comments
1939	National Oil Pty. Ltd.		Cottage rectory	Near ML 11. Cnr. Sutherland and Numietta Sts.	£25	House no. 107, near Church of England
1939	National Oil Pty. Ltd.		Cottage	Near ML 11. North side Numietta St.	£15	Opposite lot 5, Sect. 3 & 4
1939	National Oil Pty. Ltd.		Church	Near ML 11.	£250	House No. 136. St. David's Church of England
1939	National Oil Pty. Ltd.		Cottage	Near ML 11. Sect. C Between Sutherland and Harmsworth Sts and Alvers and Numietta	£30	
1939	National Oil Pty. Ltd.		Cottage	Near ML 11. Sect. C	£75	House No. 110
1939	National Oil Pty. Ltd.		Cottage	Near ML 11. Sect. D/Lot 20. Cnr. Harmsworth and Blyth Sts.	£15	House No. 136 (Griffith)
1939	National Oil Pty. Ltd.		Shack	Near ML 11.	£15	A. Bourke
1939	National Oil Pty. Ltd.		Shack	Near ML 11.	£5	Lamb
1939	National Oil Pty. Ltd.		Cottage	Near ML 11.	£25	House No. 102. T Cameron
1939	National Oil Pty. Ltd.		Cottage	Near ML 11.	£50	Mr. Hall
1939	National Oil Pty. Ltd.		Cottage	Near ML 11.	£40	House No. 103. Mr. Blacklock
1939	National Oil Pty. Ltd.		Cottage	Near ML 11.	£40	House No. 104. A. J. Bourke, below Blacklock
1939	National Oil Pty. Ltd.		Cottage	Near ML 11.	£75	Mr. Riley, House No. 105
1939	National Oil Pty. Ltd.		Cottage	Near ML 11.	£15	Cottage never completed. House No, 106
1939	National Oil Pty. Ltd.		Cottage	Near ML 11.	£25	J. Gelick (miner's right)
1939	National Oil Pty. Ltd.		Cottage	Near ML 11.	£15	Neilan, next to Gelick
1939	National Oil Pty. Ltd.		Stable house	Near ML 11.	£25	Number 155
1939	National Oil Pty. Ltd.		Cottage	MP 16	£75	Mine Manager's house with little office attached. House no. 119
1939	National Oil Pty. Ltd.		Cottage	MP 16	£75	House No. 120. Mrs. Hay (next to 119)
1939	National Oil Pty. Ltd.		Cottage	MP 16	£75	House No. 121. George Baker

1939	National Oil Pty. Ltd.		Cottage	MP 16	£150	House No. 122. Ankus. Official Barracks
1939	National Oil Pty. Ltd.		Cottage	MP 16	£125	House No. 104. Petrie (now dec)
1939	National Oil Pty. Ltd.		Cottage	MP 16	£175	House No. 148. Hampson
1939	National Oil Pty. Ltd.		Cottage	MP 16	£60	No number. Luchetti
1939	National Oil Pty. Ltd.		Cottage with garage	MP 16	£500	House No. 146. Wilson
1939	National Oil Pty. Ltd.		Cottage	MP 16	£250	Jack Fell. 'Sunny Brae'
1939	National Oil Pty. Ltd.		Cottage	MP 16	£60	A or G Grimshaw
1939	National Oil Pty. Ltd.		The Band Hall	MP 16	£15	Number 141
1939	National Oil Pty. Ltd.		Cottage	MP 16	£40	Crowe (derelict)
1939	National Oil Pty. Ltd.		Cottage	MP 16	£75	The Bungalow (Riley present owner) House No. 108
1939	National Oil Pty. Ltd.		Cottage	MP 16	£15	B. Grant (also Burroughs)
1939	National Oil Pty. Ltd.		Church	Sect. 1/Lot 1 & 2	£200	
1939	Francis Richard Tomlinson			Sect. 1/Lot 3		
1939	Crown			Sect. 1/Lot 4		
1939	James Joseph Hall		Cottage	Sect. 1/Lot 5	£75	
1939	Mrs. Margaret Fitzgerald		Hut	Sect. 1/Lot 6	£15	
1939	Kenneth Gordon McAndrew			Breula St. Sect. 1/Lot 7	£5	
1939	Louisa McAndrew			Breula St. Sect. 1/Lot 8	£5	
1939	Augustine Sparks	Miner		Sect. 1/Lot 9		
1939	Edmund Sparks	Labourer		Sect. 1/Lot 10		
1939	Crown			Sect. 2/Lot 1		
1939	Henry Leslie Johnson	Miner		Sect. 2/Lot 2		
1939	Crown			Sect. 2/Lot 3 & 4		
1939	Walter Muller		Cottage	Sect. 2/Lot 5	£10	
1939	Elsie Evelyn Muller			Sect. 2/Lot 6		

1939	James McGuiness	Labourer		Sect. 2/Lot 7		
1939	Rose Jane Waldron			Sect. 2/Lot 8		
1939	Crown			Sect. 2/Lot 9		
1939	Crown			Sect. 3/Lot 1		
1939	Francis George Illesley	Engineer		Sect. 3/Lot 2		
1939	Crown			Sect. 3/Lot 3		
1939	Crown			Sect. 3/Lot 4		
1939	Mrs. Celia Francis McKenzie		Cottage	Sect. 3/Lot 8	£15	
1939	John Thomas Simpson	Miner	Cottage	Sect. 3/Lot 9, 10 & 11	£25	
1939	Miss Betty Hegarty			Sect 6/Lot 1		Reverted to Crown
1939	John Thomas Simpson	Miner		Sect. 6/Lot 2 & 3		
1939	Crown			Sect. 6/Lot 4		
1939	F. Pratt			Sect. 6/Lot5		Also late James McGuiness
1939	E. J. Quince			Sect. 6/Lot 6		
1939	Frederick John			Sect. 6/Lot 7		
1939	Crown			Sect 6/Lot 8 -11		
1939	Samuel Major Berry			Sect. 6/Lot 12		
1939	Miss Betty Hegarty			Sect. 6/Lot 13		Reverted to Crown
1939	Crown			Sect. 7/Lot 1-6		
1939	Miss Agnes Morgan			Sect. 7/Lot 7		Reverted to Crown
1939	Miss Catherine Proudlock			Sect. 7/Lot 8		
1939	Charles Arbuckle			Sect. 7/Lot 9		
1939	William T. Marriot			Sect. 8/Lot 1		
1939	Crown			Sect. 8/Lot 2-6		
1939	Mrs. Agnes Harriet Muldoon			Sect. 8/Lot 7		
1939	Crown			Sect. 8/Lot 8		
1939	Messrs. Pointer Bros.			Sect. 8/Lot 9 & 10		
1939	Mrs. Annie Arbuckle			Sect. 9/ Lot 1		

1939	Crown			Sect. 9/Lot 2		
1939	Mrs. Jessie May Wilson			Sect. 9/Lot 3		
1939	William Leighton Wilson		Cottage kitchen	Sect. 9/Lot 4	£20	
1939	George			Sect. 9/Lot 5		
1939	Thomas Whitehead			Sect. 9/ Lot 6		
1939	Crown			Sect. 9/Lot 7 & 8		
1939	William Burrows	Engineer		Sect. 9/ Lot9		
1939	Crown			Sect. 9/Lot 10 - 12		
1939	James Potts Proudlock	Miner		Sect. 9/Lot 13		
1939	Crown			Sect. 9/Lot 14		
1939	John M. Anderson	Labourer		Sect. 9/Lot 15		
1939	Crown			Sect. 9/Lot 16 & 17		
1939	Archibald Doig Anderson			Sect. 9/Lot 18		
1939	Crown			Sect. 9/Lot 19 & 20		
1939	Crown			Sect. 10/Lot 1-2		
1939	Ellen Arbuckle			Sect. 10/Lot 3		
1939	Crown			Sect. 10/Lot 4 & 5		
1939	Crown			Sect. 10/Lot 7, 8 & 10		
1939	Samuel Major Berry			Sect. 10/Lot 9		
1939	Crown			Sect. 13/Lot 2		
1939	John Thomas Simpson	Miner	Shed	Sect. 13/Lot 3	£20	
1939	Crown			Sect. 13/Lot 3 - 8		
1939	Mrs. Hannah Bella Heslin			Sect. 13/Lot 9		
1939	Harold John McDonnell			Sect 20/Lot 1		
1939	Crown			Sect. 20/Lot 3 - 4		
1939	Mary Hall			Sect. 20/Lot 5		
1939	Martin James Curran			Sect. 20/Lot 6		
1939	Henry Mow			Sect. 20/Lot 7		
1939	Mary Agnes			Sect. 20/Lot 8		

1939	Crown			Sect. 24/Lot 1 - 3		
1939	J. Denard			Sect. 24/Lot 4		
1939	Crown			Sect. 24/Lot 5 & 6		
1939	John McDonnell			Sect 24/Lot 7		
1939	Crown			Sect 31/Lot 1		
1939	COC			Sect 30/Lot 2		
1939	Henry Maber		Shop	Sect. 30/Lot 3	£40	
1939	Henry Maber		Shop and dwelling	Sect 30/Lot 3	£75	
1939	Thomas A. Tweedie		Shop and dwelling	Sect. 30/Lot 5	£75	
1939	Mrs. Stella Kathleen Pearson			Sect. 30/Lot 6		
1939	COC			Sect. 30/Lot 7 - 9		
1939	Ernest and Richard Gill	Bakers		Sect. 30/Lot 10		
1939	Denis Manion		Cottage	Sect. 30/Lot 20	£50	Was E. Gill. Reverted to Crown
1939	Mrs. Agnes Hughes			Sect. 30/Lot 12		
1939	Thomas A. Tweedie			Sect. 30/Lot 13		
1939	Thomas A. Tweedie			Sect. 30/lot 14		
1939	Annie Henry			Sect. 30/Lot 15		
1939	Mary Ann Oldfield			Sect. 30/Lot 16		
1939	Edwin Muir			Sect. 30/Lot 17		
1939	Ernest R. Henry			Sect. 30/Lot 18		
1939	Henry Doran			Sect. 30/Lot 19		
1939	Denis Manion			Sect. 30/Lot 20		E. Gill first owner. Reverted to Crown
1939	J. C. Mortlock			Sect. 31/Lot 1		
1939	William Henry Mortlock			Sect. 31/Lot 2		
1939	Matilda Mortlock			Sect. 31/Lot 3		
1939	Charles W. Stirling	Accountant		Sect. 31/Lot 4		
1939	Caroline Jane Hollis			Sect. 31/Lot 5		

1939	William Thomas Heslin			Sect. 31/Lot 6		Reverted to Crown
1939	Sydney Burg			Sect. 31/Lot 7		
1939	Miss Agnes Maud Morgan			Sect. 31/Lot 8		
1939	Thomas Grove			Sect. 31/Lot 9		
1939	Sylvester T. Kennedy	lived Newnes		Sect. 31/Lot 18		
1939	Mary Price	lived Newnes		Sect. 31/Lot 19		
1939	Alex McDonald	Teacher, lived Newnes		Sect. 32/Lot 1 & 2		
1939	Thomas Deveney	lived Newnes		Sect. 32/Lot 4		
1939	Joseph Hutton	lived Newnes		Sect. 32/Lot 13		
1939	Mary Maber	lived Newnes		Sect. 34/Lot 14		
1939	Mary Maber	lived Newnes		Sect. 34/Lot 16		
1939	Mechanics Institute	lived Newnes		Sect. 34/Lot 21		
1939	Mrs. Blanche Louisa Carratti	lived Newnes		Sect. 35/Lot 5		
1939	Arthur Nathaniel McAndrew	Labourer, lived Newnes		Sect. 35/Lot 8		
1939	Arthur Roy Armstrong	Teacher, lived Newnes		Sect. 33/Lot 10	£15	
1939	Education Department		Dwelling	Sect. 34/Lot 9 & 10	£250	
1939	Ernest Walter Gill		Cottage	Sect. 34/Lot 12	£100	
1939	Newnes Public School		School	Section 35	£350	