APPENDIX 13

Copy Archival Record and Statement of Heritage Impact, No 4 Blast Furnace

STATEMENT OF HERITAGE IMPACT

PROPOSED DEMOLITION OF THE No. 4 BLAST FURNACE

Figure 0.1 No. 4 Blast Furnace in opration.
Source: Erzetich. Ref: B01/02

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CONTENTS

1.0 THE PROPOSAL

Major changes have occurred in Newcastle and the Hunter Region over the past 20 years. The downsizing and eventual decision to close BHP steel making operations and the rationalisation of the coal industry are a reflection of these changes. The BHP steel making site is strategically placed, not only on a local and regional level, but on a State and National level. It has been proposed that the existing site be redeveloped as a major Multi Purpose Terminal servicing the east coast of Australia. The area to be developed as the Multi Purpose Terminal, would require the demolition of all above ground structures located within this area (see Appendices for location plan) to enable remediation of the land and redevelopment of the site. Development of the remainder of the site at a later stage for industrial / commercial purposes is also proposed. The buildings proposed for demolition are:

1. No. 1 Blast Furnace
2. No. 1 Blower House
3. Open Hearth Building
5. No. 1 Bloom & Rail Mill
6. Steel Foundry
10. DC Sub Station
11. Wharves
14. No. 3 Blast Furnace
15. AC Pump House
16. Power House
19. Open Hearth Change House
20. Mould Conditioning Building
21. BOS Plant
23. No. 4 Blast Furnace

2.0 THE CONTEXT OF THE PROPOSAL

2.1 Physical Context

The No. 4 Blast Furnace is located at the north eastern sector of BHP's Port Waratah works. The remnant of the No. 4 Blast Furnace is located near the western boundary of the Proposed Multi-Purpose Terminal Precinct. It is immediately west of the No. 1 Blower House and to the north east of the Open Hearth Change House.

2.2 Statutory Context

The No. 4 Blast Furnace is identified within the group identification forming Part B of Schedule 4 (Port Waratah – BHP Steelworks and Office) of "The Hunters Heritage" – Hunter Regional Environmental Plan 1989. It is identified individually within Schedule 4 of The Newcastle Local Environmental Plan 1987 as having an item of Local – level heritage significance. (This ascribed level of significance is consistent with the level of significance determined in the Port Waratah Steelworks Conservation Plan prepared by EJE Architecture in 1991). The item does not fall within a Conservation Area and is not included on the State Heritage Register. Under the EP and A Act, if an item is of State level heritage significance, the local council is required to obtain the consent and concurrence of the Department of Urban Affairs and Planning to any major intervention into the item. Under the Integrated Approvals Amendment Act 1998, "Integrated development" is development (not being complying development) that, in order for it to be carried out, requires development consent and approval under other, listed environmental legislation (s 91 (1)). The "other listed environmental legislation" includes the Heritage Act 1977. Under the new legislation, (in Section 91a):

(2) Before granting development consent to an application for consent to carry out the development, the consent authority must, in accordance with the regulations, obtain from each relevant approval body the general terms of any approval proposed to be granted by the approval body in relation to the development. Nothing in this section requires the consent authority to obtain the general terms of any such approval if the consent authority determines to refuse to grant development consent. A Consent granted by the consent authority must be consistent with the general terms of any approval proposed to be granted by the approval body in relation to the development and of which the consent authority is informed. For the purposes of this Part, the consent authority is taken to have power under this Act to impose any condition that the approval body could impose as a condition of its approval.

(3) A consent granted by the consent authority must be consistent with the general terms of any approval proposed to be granted by the approval body in relation to the development and of which the consent authority is informed. For the purposes of this Part, the consent authority is taken to have power under this Act to impose any condition that the approval body could impose as a condition that the approval body could impose as a condition of its approval.

3.0 HISTORICAL REVIEW

In 1960 the BHP Steelworks had three blast furnaces in operation. Constructed in 1915, 1918 and 1921, they produced the molten iron required for steelmaking. By the introduction of the BOS (basic oxygen steelmaking) Plant in 1962, it became possible to greatly reduce production time in the manufacture of steel, which in turn increased the demand for molten iron.

On the 7th of October 1960, the Board of Directors authorised the expenditure of £5,237,000.00 for the construction of the new furnace. It was to be the largest on the Newcastle site. No. 1 Blast Furnace produced 800 tonnes per day, No. 2 and No. 3 Blast Furnaces produced 1050 tonnes per day. The new furnace initially had the potential of producing 1650 tonnes per day, later to rise to 2460 tonnes per day. Considered one of the most modern installations in the world at the time, the No. 4 Blast Furnace was designed by Ashmore, Benson and Pease & Co. of Stockton on Tees, England, whose responsibility also included the supply of some of the specialised equipment. They were chosen on the basis of technical ability and lower price. The design incorporated automatic charging control, continuous gas analysis and the introduction of belt conveyors to deliver charge materials to the skip cars.

Many construction difficulties arose due to the limited site space, the required alteration of gas and saltwater mains and a series of interworks service mains. BHP's Construction Department carried out initial foundation work, and the erection of the Blast Furnace was carried out by a 60 tonne, self-erecting tower crane developed by BHP Newcastle engineers.

The No. 4 Blast furnace was commissioned in July 1963 and was the largest on the site. It contains 7,500 tonnes of structural steelwork and mechanical items, 1.9 million bricks, 1,000 tonnes of sheet steel piling and 535 tonnes of reinforcing for concrete.

In 1970 the furnace was partially relined and converted to high top pressure. It was relined and converted to stave cooling in 1973, initially developed in Russia, but refined and improved by BHP engineers. Another partial reline was completed in 1989 during which time further technological innovations were incorporated into the furnace bringing the daily production from the 1608 tonnes per day to 2460 tonnes per day.

The No. 4 Blast Furnace developed a large crack in a high level weld on the underside of the down comer during the process of shutting down the furnace in September 1999. As a result of the crack and other safety issues, the furnace was left burdened with 800 tonnes of coke and metallics in a partially fused state.

4.0 SUMMARY CONDITION ASSESSMENT

As it stands today, many of No. 4 Blast Furnaces key components have already either been removed, sold for removal or have been rendered un-reusable or unsafe because of the shutdown problems of 1999. Ad hoc removal of other components at various levels has made access to elevated levels totally unsafe.

Although the Blast Furnace components have been removed, the structure/fabric remains generally in sound condition, of similar detail silhouette to Blast Furnace No. 3. the ancillary roofed structures on the northern and western façade remain generally intact in respect of framing, cladding and roofing materials.

The condition of each of the subject buildings is fully described in written and photographic form in the Archival Record document produced to accompany this Statement of Heritage Impact.

Asbestos in the No.4 Blast Furnace:
AC sheeting was used in the office block ceilings on both the upper and lower floors, the electrical workshop, control rooms and contactor houses. The blast furnace stoves all have a layer of asbestos bricks between the shell plate and the checker bricks as an insulating layer.

5.0 ASSESSMENT OF SIGNIFICANCE

The remains of the No. 4 Blast Furnace have been assessed (1991 Port Waratah Steelworks Conservation Plan) as having Local Significance within the context of the development of the Steelworks.

The following detailed Assessment of Significance has been undertaken to reflect current NSW Heritage Act, Heritage Amendment Act and Burra Charter requirements.

Historic Significance

Although of much later vintage than the three earlier furnaces, No. 4 Blast Furnace was designed by well known Engineers to be equal to the most modern of type in the world. Over a thirty year period it continued to evolve with advances in technology and this demonstrates continuity of technical process. Even so, Blast Furnace No. 4 does not have the same level of historic association with the evolution of the Steelworks site as earlier blast furnaces. However, on its own, for the above reasons, it had technical sophistication for its period and must be considered to have HIGHEST – level LOCAL HISTORIC significance.

Aesthetic Significance

No. 4 Blast Furnace stands some forty metres above ground level and along with adjacent associated structures, helps define the landmark Steelworks site. Of its type and similar to the remaining blast furnaces in the state, it is associated with creative design accomplishment and thus has high – level LOCAL AESTHETIC significance.

Social Significance

The No. 4 Blast Furnace has significance for its association with the development of iron and steel making in Newcastle and for its important linkage with the creation of work and social fabric of Newcastle resulting from that work in the Newcastle area. It has had a shorter association with the cultural association of the site as a whole, than other buildings and structures, but nevertheless has associations for the wider workforce. It has LOCAL SOCIAL significance.

Technical Significance

The No. 4 Blast Furnace employed the latest techniques in technology during the design process and continued to develop methods to improve output and quality during its operation and therefore has highest level potential to reveal industrial archaeological information of significance for the region and state.

No. 4 Blast Furnace represents the growth of local technical expertise and knowledge enabling BHP to develop its Newcastle Steelworks, into a world class facility. As such it is an important benchmark site of its type in the region and state and has STATE level TECHNICAL heritage significance.

Overall, the item has highest-level LOCAL heritage significance.

6.0 OPTIONS FOR PHYSICAL INTERVENTION

The Conservation Plan BHP Port Waratah Site Addendum 1999 described the following options:

"After closure of steelmaking, the 27 items of heritage significance identified in the Newcastle LEP 1987 (as well as all other heritage items identified in this Conservation Plan), will remain in situ until:

a) the item becomes unsafe and/or uneconomic to maintain; or
b) the item is to be removed to facilitate remediation of the site; or
c) the item is sold; or
d) the item is to be removed to facilitate the proposed redevelopment

Where "Front End" items are to be demolished they should, where easily transportable and relocatable, be relocated, to a low impact, operating environment within the overall Steelworks site. Components/elements of existing structures/buildings should be similarly relocated or preferably, be relocated to either the proposed Interpretation Centre or, (if that is not appropriate), to the proposed State Industrial Archaeological Repository, both being within the existing Steelworks site. Items capable of continuing to provide service within a steel-making operation, should be relocated to Port Kembla Steelworks or other iron and steel making operation elsewhere in Australia or the world. Where buildings/structures of higher level significance are demolished and removed, interpretation of the building form at ground level is required (Burra Charter and NSW Heritage Act – As Amended).

e) This item is to be removed to facilitate this proposal. Therefore in accordance with Burra Charter and NSW Heritage Office requirements, recording and interpretation must be undertaken.

It would be preferred for the building to remain. However, this proposition is considered untenable given:

a) If the No.4 Blast Furnace remains, it cannot be adapted for any other use, will require continuous expensive stabilisation and maintenance, or will otherwise deteriorate and become a potential health and safety hazard.

b) Remediation of this area of the site is required. The remediation proposal involves capping the proposed Multi Purpose Terminal site with a monolithic concrete slab.

c) The item generally is unsaleable in its present form, although some components (see below) are capable of re-use elsewhere on BHP Group sites.

Off-site (i.e. not in-situ) interpretation, will only be undertaken where on-site interpretation is not possible and will involve samples of highest-level fabric/fittings/equipment.

Possible re-use or interpretation items include: The Paul Worth top, which is to be shipped to Whyalla Steelworks for re-use.

Other smaller items will be used and interpreted around the main site, but where possible, any significant elements will be located in the proposed Iron and Steel Interpretative Centre.

Items identified as having been removed or with potential for removal elsewhere is tabled as follows:

Items transferred / sold to other BHP Centres	**Items sold Externally**
>Dust collection bag-houses >Torpedo Ladles >Cast House Floor equipment >Heat exchangers >Taphole gun / Taphole drill >Hot blast valves >Skip hoist drum >Pumps >Electrical equipment >Material bins >Weight feeders >Paul Wurth Top (Furnace Charging System) Note: Removal of the top involves removal of the top section of the furnace up to the tunnel head ring.	>Cast House Floor Baghouse (de-dusting equipment) >Dust collection equipment >Nine Torpedo Ladles >Blast Furnace Plant & equipment *

* Represents item receiving expression of interest from external customer.

7.0 THE HERITAGE IMPACT OF THE PROPOSAL

This item is substantiated as having LOCAL level significance, therefore demolition of the item to enable development of the Multi Purpose Terminal will impact on the significance of the item. The closure of operations at the Newcastle Steelworks impacted on the interpretation of the processes of iron and steel making, demolition of the item changes the interpretation of the processes and the significance of the item.

This impact will be ameliorated by fully recording the item in accordance with the NSW Heritage Council Guidelines and interpretation and protection of the in-situ remains below the pavement of the proposed Multi-Purpose Terminal. The individual site will be interpreted using pavement treatment that can identify the extent of the item and accommodate the operation of the Terminal. The processes associated with the item will be further interpreted on the main site at Port Waratah via the Delprat Interpretive Centre and supplemented by selected items being deposited in the proposed State Archaeological Repository. However, the physical site will remain and its location will be identified through interpretive design within the pavement of the Multi Purpose Terminal.

8.0 APPENDICES:

Appendix 8.1 **Site Development Masterplan – showing area of proposed Multi Purpose Terminal in yellow**

Appendix 8.2: Three Precincts Concept Plan – Showing Identified Heritage Items to be demolished

Appendix 8.3: Conceptual Paving Pattern to existing Heritage items

ARCHIVAL RECORD

WATERFRONT PRECINCT HERITAGE BUILDINGS, MAIN SITE BHP PORT WARATAH STEELWORKS, NEWCASTLE

NO.4 BLAST FURNACE

Figure 0.1: Western Façade of No 4 Blast Furnace
Source: Erzetich, 1999

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TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Background to the project

Major changes have occurred in Newcastle and the Hunter region over the past 20 years. The downsizing and eventual decision to close BHP steel making operations and the rationalisation of the coal industry are a reflection of these changes. The BHP steel making site is strategically placed, not only on a local and regional level, but also on a State and National level. It has been proposed that the existing site be redeveloped as a major Container Handling Terminal servicing the east coast of Australia. The area to be developed as the Container Handling Terminal would require the demolition of all above ground structures located within this area to enable remediation of the land and redevelopment of the site. Development of the remainder of the site at a later stage for industrial /commercial purposes is also proposed.

In light of the above, EJE Architecture has been commissioned to prepare detailed archival records of the buildings proposed to be demolished that are considered to have heritage value. These records involve documenting the relevant buildings and items they contain as well as the industrial processes that took place within them. Designed to help ascertain the heritage significance of the buildings and associated processes, these archival records also form a statement for the future interpretation of this now redundant part of Newcastle's industrial culture.

The following document constitutes the Archival Record of the No. 4 Blast Furnace - an item classified as having a 'Local level of heritage significance'[1].

1.2 Archival Recording Methodology

The approach taken in recording these heritage items and the document format is based on heritage consultant input and current NSW Heritage Office's guidelines including those relating to the preparation of archival records and their photographic recording.

A number of important aspects have been identified in the statement of heritage significance included in the report whose recording was necessary to reflect the item's character and value described. Hence it is this statement that drives the rationale for the report and determines the relevance of information collected. Derived from three main elements - buildings (structure and fabric), the individual items they housed and the processes that took place within them - these aspects are elaborated on in a number of different ways, which reflect their respective social, technical and aesthetic qualities.

As a way of dealing with the items various facets of heritage value, the report is broken into 3 main components:

-Written descriptions (history, process and heritage statement),
-Pictorial descriptions (photographs and working drawings)
-Inventories and other supporting information

Together these components create a comprehensive account of the chronological development of both the buildings and the industrial technologies held within them that have invariably changed throughout their lives. At times the components are incorporated into each other to provide a more coherent and illuminating description.

[1] Identified individually within Schedule 4 of The Newcastle Local Environmental Plan 1987 and the Port Waratah Steelworks Conservation Plan 1991.

All material is cross-referenced to each other and referenced to archival registers and source publications.

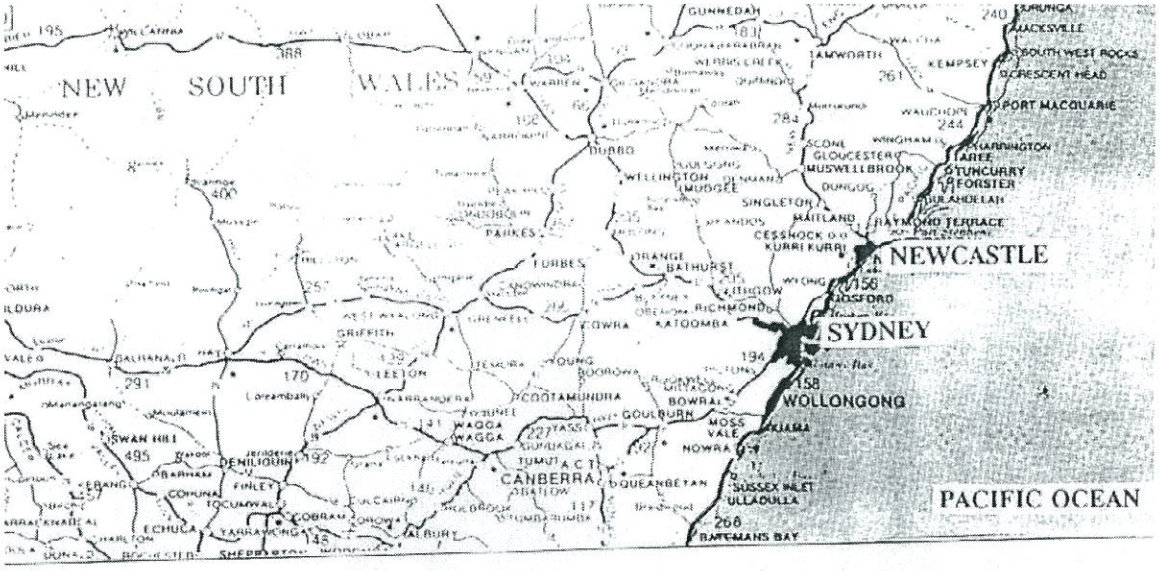
The written descriptions provide a background to the building and the functions that it housed and incorporate relevant photographs. As an essential part of the written component, a statement on the item's heritage significance details why the item is valued.

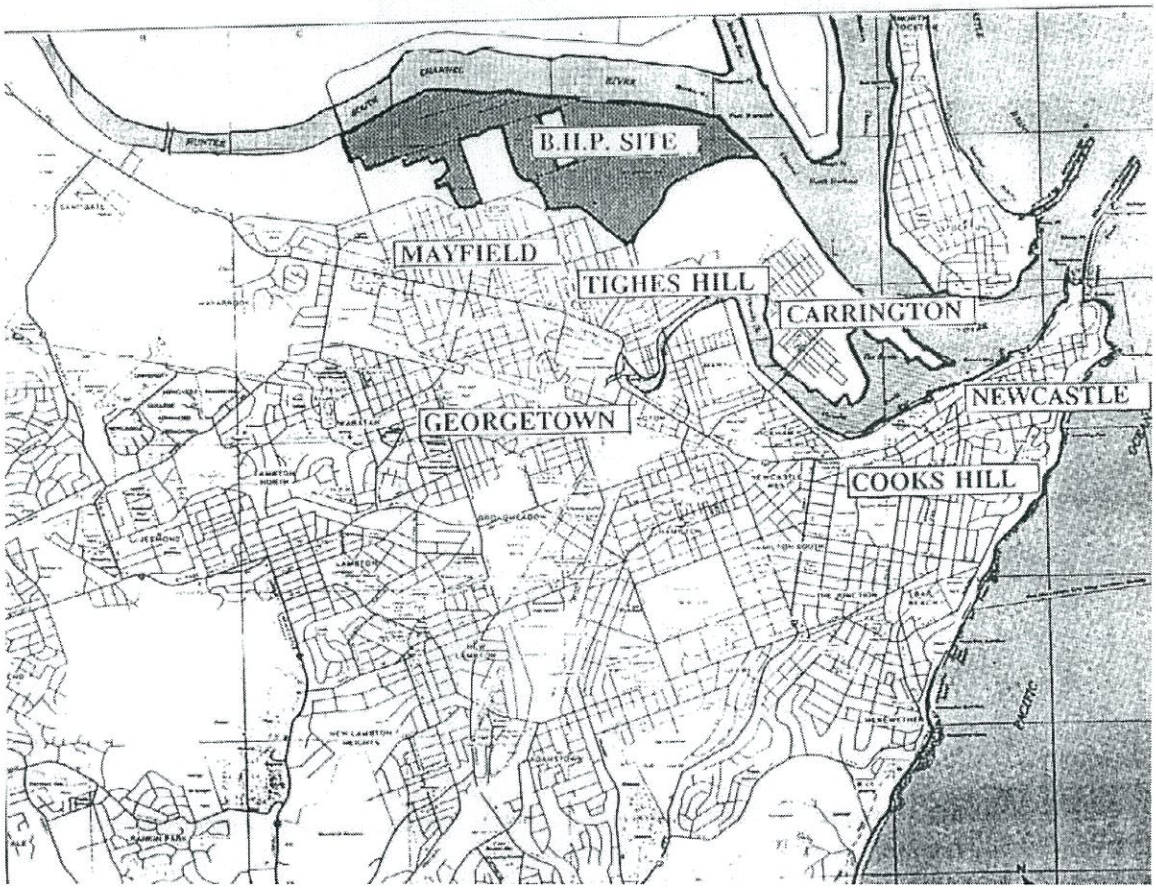
The bulk of the information in this report comes from the pictorial descriptions. Comprising of both historic and contemporary photographs, an account of the building fabric, the various industrial processes contained and the changes that have taken place through time is made. In addition, a selection of original working drawings provide a detailed picture of the construction techniques, structure and fabric details and offer substantial dimensions and measurements, making largely redundant any requirement for contemporary measured drawings or scaled photographs.

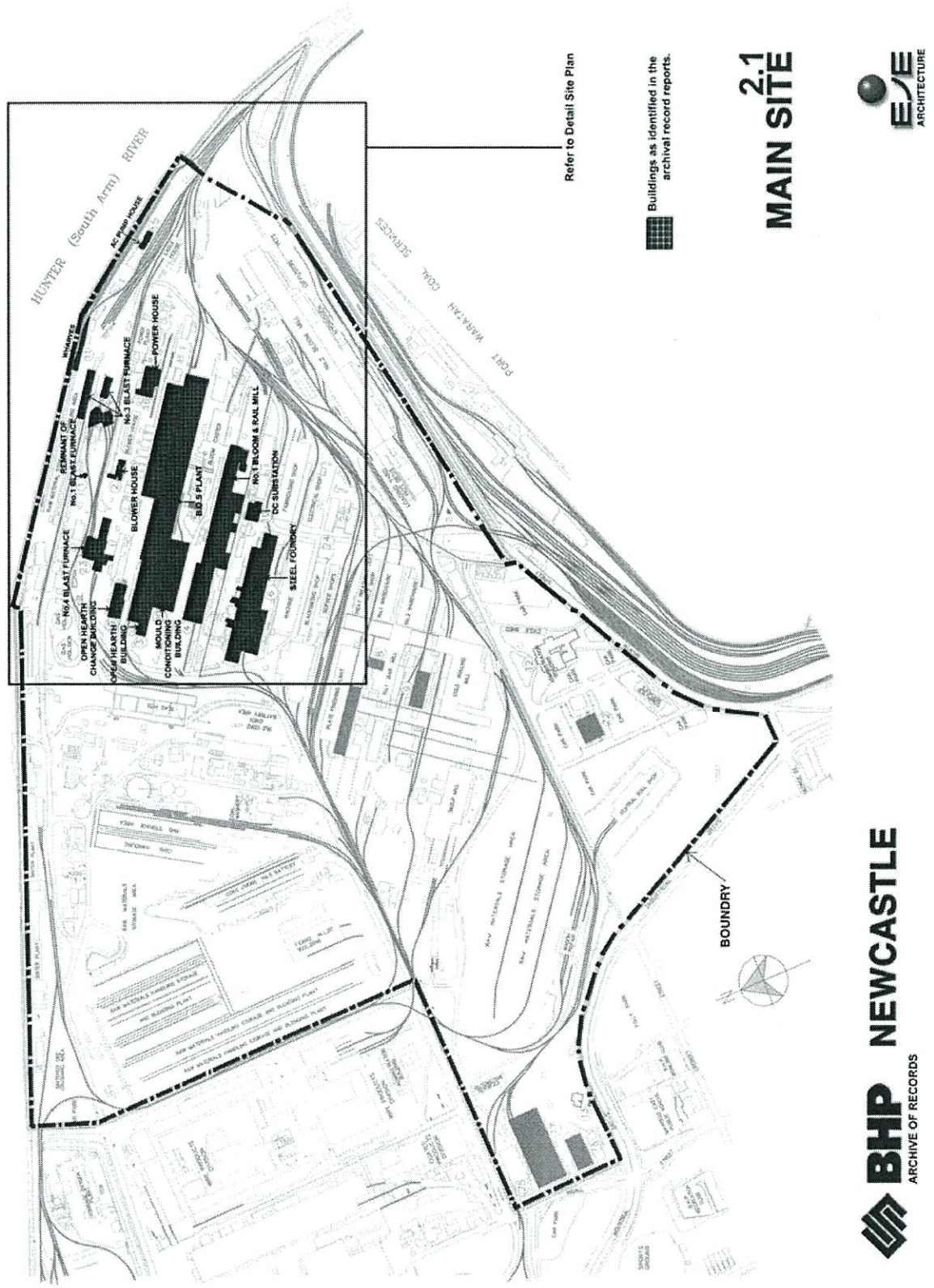
Supporting both the written and pictorial information is a series of inventories and tables which provide details of equipment contained within the building, cross referenced descriptions of photographs and shot locations, and bibliographical information.

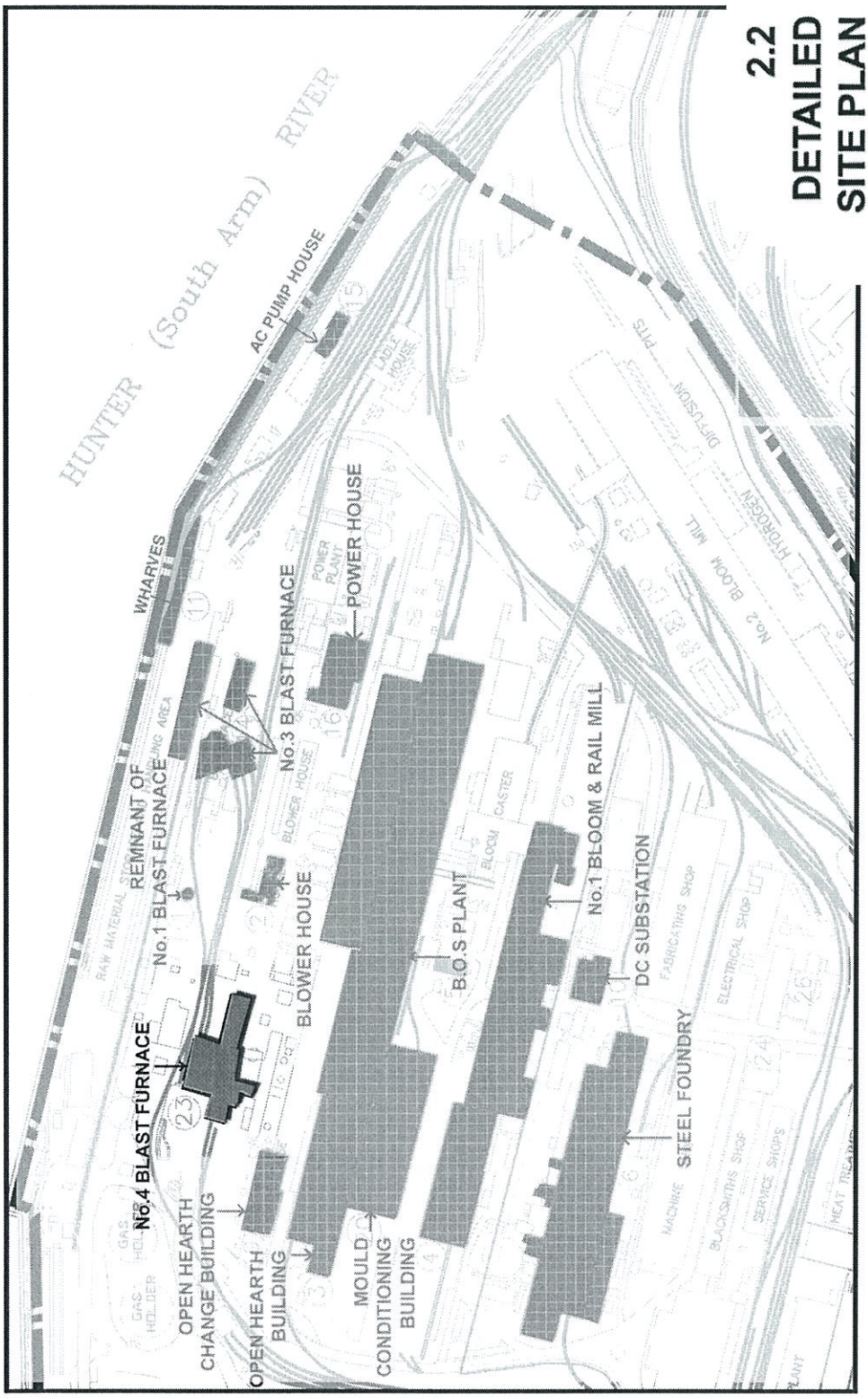
The process of documenting the heritage items involved a number of input teams, of which EJE was the coordinator.

2.0 LOCATION PLANS






HUNTER (South Arm) RIVER
PORT WARATAH COAL SERVICES
Refer to Detail Site Plan
Buildings as identified in the archival record reports.
2.1
MAIN SITE
EJE ARCHITECTURE
BHP NEWCASTLE
ARCHIVE OF RECORDS
BOUNDRY
No.4 BLAST FURNACE
No.3 BLAST FURNACE
No.1 BLAST FURNACE
REMNANT OF No.1 BLAST FURNACE
BLOWER HOUSE
POWER HOUSE
B.O.S PLANT
No.1 BLOOM & RAIL MILL
DC SUBSTATION
STEEL FOUNDRY
OPEN HEARTH CHARGE BUILDING
OPEN HEARTH BUILDING
MOULD CONDITIONING BUILDING


HUNTER (South Arm) RIVER
AC PUMP HOUSE
WHARVES
REMNANT OF No.1 BLAST FURNACE
No.3 BLAST FURNACE
POWER HOUSE
No.4 BLAST FURNACE
OPEN HEARTH CHANGE BUILDING
OPEN HEARTH BUILDING
BLOWER HOUSE
MOULD CONDITIONING BUILDING
B.O.S PLANT
No.1 BLOOM & RAIL MILL
DC SUBSTATION
STEEL FOUNDRY
2.2
DETAILED SITE PLAN
No.4 BLAST FURNACE
EJE ARCHITECTURE
BHP NEWCASTLE
ARCHIVE OF RECORDS

3.0 OUTLINE OF HISTORY, INDUSTRIAL PROCESS & DESCRIPTION

The blast furnace produced molten iron for steel making and iron foundries. The furnace is a roughly cylindrical steel shell about 30m high, lined with water-cooled castings called staves and refractory bricks. Iron making is a continuous process where the raw materials – iron ore, coke and limestone, are fed into the top of the furnace by a skip car (at Newcastle) or conveyor (at some other steelworks). Air, which has been pre-heated to about 1050°C in stoves, is blown into the furnace through nozzles called tuyeres, which are spaced around the lower section of the furnace. This causes the coke to burn, producing carbon monoxide, which reacts with iron oxide to produce iron and carbon dioxide. Molten iron and slag collect in the bottom (hearth) of the furnace and combustion gases pass out of the top into a gas cleaning plant.

Every two or three hours one of the two tap holes at the base of the furnace is opened and the molten iron and slag is drained from the furnace hearth. The molten iron runs into rail units called torpedo ladles and is transported to the steel-making department for refining into steel.[2]

In the early 1960s, three blast furnaces, constructed in 1915, 1918 and 1921, produced the molten iron required for steel making at the Newcastle Steelworks. However, the transition from open hearth steel making to basic oxygen steel making greatly reduced the time taken to produce steel, thereby increasing the steel making capacity of the works. As it was judged that there would be a market for this additional steel, the decision was made to build a fourth blast furnace to satisfy the increased demand for molten iron. On 7 October 1960, the Board authorized the expenditure of £5,237,000 for the construction of the new furnace.[3]

However, the area in which the blast furnaces were located was too congested to introduce much of the new technology that was developed after 1950 and this factor, together with financial constraints, adversely affected the design, installation and operation of No.4 Blast Furnace.[4]

Ashmore, Benson & Pease were chosen, on the basis of cheaper price and a belief in their technical superiority, to supply the design of the furnace and equipment, together with certain items of specialised equipment.[5] In 1959, No.4 Blast Furnace at BHP's Port Kembla steelworks had been built to an Ashmore Benson & Pease design, although the furnace was larger than that built at Newcastle.[6]

Power Gas Corporation (Aust.), a subsidiary of Ashmore, Benson and Pease, was contracted to design the stock bins, coke breeze screens and conveyors and to supply specialised overseas items, Zimmerman and Jansen stove valves and stove changing equipment. BHP Newcastle was responsible for the manufacture and supply of Australian equipment.[7]

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[2] J. Sansom (ed.) *The Blast is Past, A Collection of Stories about the Iron Makers of Newcastle,* BHP Newcastle, 1999, *p.7.*
[3] General Manager Development & Shipbuilding to Chief General Manager, 10 March 1961, BHPA: D9/1/1228.
[4] Discussion with M. Oughton, former Superintendent, Blast Furnace, Newcastle Steelworks.
[5] General Manager Development & Shipbuilding to Chief General Manager, 10 March 1961, BHPA: D9/1/1228.
[6] B.N. Black & J.R. Ellis, "A Century of Engineering in BHP, 1885-1985", Draft, May 1985.
[7] General Manager Newcastle Works to Power Gas Corporation (Aust.) Pty. Ltd., 23 March 1961. BHPA: D9/1/1228

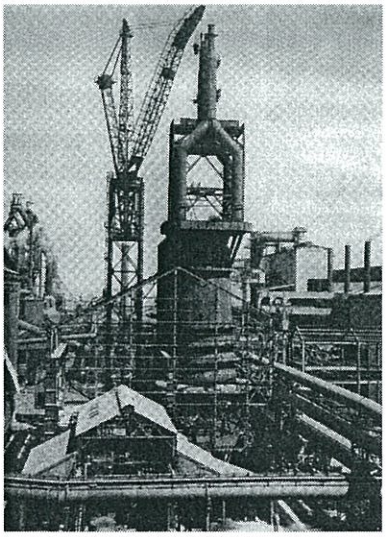

Figure 3.1: Construction of No4 Blast Furnace
Source: Rod Bar Newspaper, No 36 September, 1999: 10

No.4 Blast Furnace was the largest furnace on the Newcastle site, but was of medium size by world standards. At that time, No.1 Blast Furnace had a capacity of 800 tons per day (tpd), while Nos.2 and 3 each had a capacity of 1050 tpd. The new furnace was capable of producing 1650 tpd. No.4 Blast Furnace included many features of design and practice not normally found on a furnace of its size. The centres of the 21 tuyeres were 3'7" apart at the face of the lining. Very few furnaces were operating at the time with tuyere centres of this low order, although it was in line with a general trend in Australia. Provision was made for fuel oil injection through the blowpipe walls, and this procedure was commenced in 1965. Fuel oil injection gave way to natural gas in 1980.

Perhaps the most significant feature of the No.4 Blast Furnace was the introduction of belt conveyors to deliver charge materials from the materials bins to the hoist skips, which were then hauled to the top of the furnace and unloaded. Each bin was fitted with a vibrating feeder, which supplied the material to a belt weigher, which weighed the required amount and delivered it to a gathering belt. The material was conveyed by the gathering belt to check weigh hoppers positioned above the skip pit. Charging of the furnace was fully automatic. (Automatic systems were later installed on Nos.1, 2 and 3 Blast furnaces, where materials were delivered by larry cars, which dropped material into storage bins, which in turn fed the hoist skips)

The three hot blast stoves were also automatically operated, in that each change was initiated by the movement of the mixed blast butterfly valve. If required, coke ovens gas was automatically added in a controlled proportion to the blast furnace gas for efficient heating of the stoves.[8]

Building the furnace created many construction problems arising from the limited space available and the close proximity of interworks service mains including gas mains and salt water mains ranging in diameters up to 5 ft. These mains formed a barrier approximately 50 ft. high running through the full length of the site. The furnace was built on a site that included the western end of the open-hearth stockyard and an area immediately west of the existing blast furnace precipitators, which included the old blast furnace ladle house, the old manganese blower house and a portion of the existing blast furnace change house. Part of the site preparation included the construction of a new change house and a new ladle house, and modifications to the service mains in the area.

The Construction Department carried out the initial foundation work on the site but the majority of the work on the furnace was carried out by contractors. The lower section of the furnace foundation consisted of 904 cubic yards of concrete, at that time the largest single pour ever made on the steelworks and also the largest single pour that the concrete suppliers had ever supplied. The section was poured continuously in 9 ¾ hours at an average rate of 99 cubic yards per hr for the first eight hours. In all, 5760 cu.yds of concrete was poured in the foundations of the furnace and ancillaries.

The most difficult section of the foundations was the skip pit. The bottom of the concrete in this pit is 36 ft. below ground level, which is 28 ft. below water level. In order to carry out foundation work at such a depth, 50 ft. long sheet piles were driven

[8] K.J. Figgis, "No.4 Blast Furnace – Newcastle", *The BHP Review,* Christmas, 1962, p.24.

around the outside of the pit to a maximum depth of approximately 52 ft. below ground level. The area enclosed was then excavated to its full depth. In order to carry out this operation, it was necessary to use 12 tons of steel and 20,000 super ft. of timber to support the sheet piling in order to overcome the soil and water pressures. The sheet piling then became the outer formwork of the pit, this being particularly necessary on the south side, because the existing open-hearth tar tank pump house foundations were only 2 ft. away.

The original furnace contained some 7,500 tons of structural steelwork and mechanical items, approximately 1.9 million bricks, 1,000 tons of sheet piling and 535 tons of reinforcing in the concrete.

In order to provide cold blast air for the furnace it was necessary to install the new "D" 100,000 cu.ft. / min turbo blower.[9]

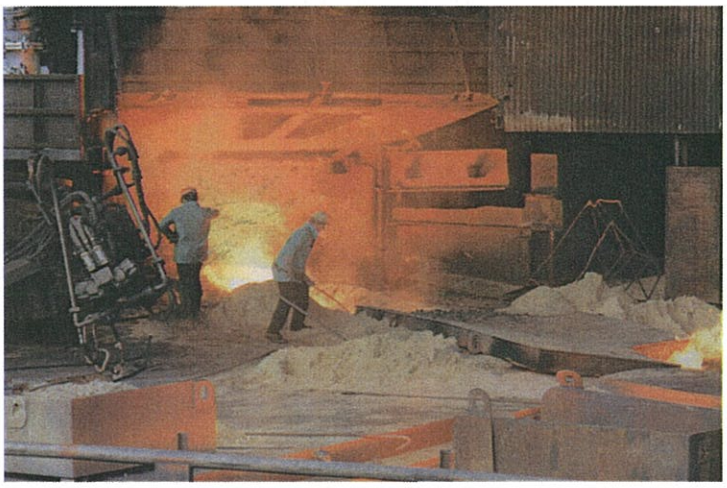

Figure 3.2: Tapping No4 Blast Furnace
Source: Sansom (1999:27)

Initially the furnace did not perform to expectations. Although Ashmore, Benson and Pease were acknowledged leaders in blast furnace design during the 1950s, it became apparent that Japanese technology had overtaken British furnace design by the time Newcastle's No.4 Blast Furnace was ordered. This furnace did not reach its full potential until after the second reline in 1973, by which time major items of equipment had been replaced with new installations, mainly of Japanese design.[10]

In 1970 the furnace was partially relined and converted to high top pressure[11]. During the next reline in 1973 critical items of equipment, including the mud gun, tuyere stock and bleeders, were replaced.[12] The furnace was also converted to stave cooling, an innovation which was of Russian origin but was developed by BHP to the point where their advanced stave technology was sought after around the world.[13] The staves, of the order of 1m x 1.8m, were made of cast iron with cast-in cooling pipes which carried cooling water vertically through the furnace at nominally 200 mm. centres. They were installed between the furnace shell and the refractory lining. The staves were cast at the Steel Foundry.

A further reline followed in 1979, followed by a partial reline in 1989 during which a Paul Wurth top was installed, replacing the bell top with a rotating chute to allow more control over the delivery of feed materials into the furnace.[14] A major reline in 1995 was expected to provide continuity of iron supply until the planned replacement of the integrated steelworks with electric arc furnaces in 2002. However, in April 1997 it was announced that the front end of the steelworks would close in 1999. As a result of various modifications over the years, the average daily production of No.4 Blast Furnace had increased from 1608 tpd to 2460 tpd.

[9] D.P. Buchhorn, "No.4 Blast Furnace, Newcastle", *The BHP Review,* October 1963, pp.24-27.
[10] Discussion with M. Oughton, former Blast Furnace Superintendent, 13 May 2000.
[11] Sansom, *The Blast is Past",* p.14.
[12] Discussion with M. Oughton.
[13] G. Blaxell, quoted in R. Melville (ed), *Drawing to a Close: An Anecdotal History of the Newcastle Drawing Office, Newcastle*, 1999, p.105.
[14] G. Blaxell, "Time Chart of Significant Events at BHP Newcastle Steelworks".

During the process of shutting down the furnace in September 1999, a large crack was detected in a weld on the underside of the downcomer. Attempts to stabilise the crack were hampered by the failure of a specialised hoist which was necessary for the task, and by an explosion in the gas plant which raised concerns for safety of personnel working in the area. It was finally decided to "walk away" from the furnace, leaving it burdened with 800 tons of coke and metallics.[15]

Steel conditions & protection at BHP Steelworks site

The BHP site in Newcastle is in a "Marine" to "Severe Marine" zone in accordance with AS/NZ 2312:1994 — "Guide to protection of iron and steel against exterior atmospheric corrosion". Now that the localized micro-climate from the operation of the plant has been removed, protection of the steelwork needs to be considered in terms of this Standard.

Observation at the site indicates that none of the steelwork on site has a coating system complying with this Standard for a design life of greater than 5 years. Some of the steelwork, such as the blast furnaces, is not protected at all and has been designed to operate in a hot environment where corrosion is inhibited by high temperatures driving off moisture; other steelwork was designed with extra thickness to form a sacrificial layer. In almost all buildings and in areas nearby the high temperature operations have been successful in keeping the corrosion under control except where steel has been insulated by brickwork which has trapped moisture and corrosion has been severe. There does not appear to be any general galvanic protection (i.e. galvanizing or zinc-rich coating) on major structural elements.

If major structural elements were to be retained on the site for a period in excess of 10 years the Standard gives the following coating systems:

(i) galvanizing plus a two coat paint system (not possible in situ);

(ii) various two and three coat paint systems applied after abrasive blast cleaning and having either a zinc based primer or high-build epoxy;

(iii) a sprayed metal coating followed by a two coat painting system.

Of these, only (ii) is likely to be practical. All would be extremely expensive and require continuing maintenance.

[15] J. Sansom, The *Blast is Past,* epilogue, Newcastle, 1999.

4.0 STATEMENT OF HERITAGE SIGNIFICANCE

The No. 4 Blast Furnace is identified within the group identification forming Part B of Schedule 4 (Port Waratah – BHP Steelworks and Office) of "The Hunters Heritage" – Hunter Regional Environmental Plan 1989. It is identified individually within Schedule 4 of The Newcastle Local Environmental Plan 1987 as having an item of Local – level heritage significance. (This ascribed level of significance is consistent with the level of significance determined in the Port Waratah Steelworks Conservation Plan prepared by EJE Architecture in 1991). The item does not fall within a Conservation Area and is not included on the State Heritage Register. The following Assessment of Significance has been undertaken to reflect current NSW Heritage Act, Heritage Amendment Act and Burra Charter requirements.

Historic Significance
Although of much later vintage than the three earlier furnaces, No. 4 Blast Furnace was designed by well known Engineers to be equal to the most modern of type in the world. Over a thirty year period it continued to evolve with advances in technology and this demonstrates continuity of technical process. Even so, Blast Furnace No. 4 does not have the same level of historic association with the evolution of the Steelworks site as earlier blast furnaces. However, on its own, for the above reasons, it had technical sophistication for its period and must be considered to have HIGHEST – level LOCAL HISTORIC significance.

Aesthetic Significance
No. 4 Blast Furnace stands some forty metres above ground level and along with adjacent associated structures, helps define the landmark Steelworks site. Of its type and similar to the remaining blast furnaces in the state, it is associated with creative design accomplishment and thus has high – level LOCAL AESTHETIC significance.

Social Significance
The No. 4 Blast Furnace has significance for its association with the development of iron and steel making in Newcastle and for its important linkage with the creation of work and social fabric of Newcastle resulting from that work in the Newcastle area. It has had a shorter association with the cultural association of the site as a whole, than other buildings and structures, but nevertheless has associations for the wider workforce. It has LOCAL SOCIAL significance.

Technical Significance
The No. 4 Blast Furnace employed the latest techniques in technology during the design process and continued to develop methods to improve output and quality during its operation and therefore has highest level potential to reveal industrial archaeological information of significance for the region and state.

No. 4 Blast Furnace represents the growth of local technical expertise and knowledge enabling BHP to develop its Newcastle Steelworks, into a world class facility. As such it is an important benchmark site of its type in the region and state and has STATE level TECHNICAL heritage significance.

5.0 INVENTORY OF ARCHIVAL DOCUMENTS

The Following list constitutes the archival documents used for this report and other documents that contain related material for this archival record. For archival drawings, the BHP drawings document register (documents located in the BHP archive, Melbourne) may be found on the computer disk located in the appendix.

Black, B.N. & Ellis, J.R.	"A Century of Engineering in BHP, 1885-1985", unpublished draft, May 1985.
Blaxell, G.	"Time Chart of Significant Events at BHP Newcastle Steelworks", unpublished, 1999.
Buchhorn, D.P.	"No.4 Blast Furnace, Newcastle", The BHP Review, October 1963.
Figgis, K.J.	"No.4 Blast Furnace – Newcastle", The BHP Review, Christmas, 1962.
Melville, R. (ed),	Drawing to a Close: An Anecdotal History of the Newcastle Drawing Office, Newcastle, 1999.
Sansom, J. (ed.)	The Blast is Past: a Collection of Stories about the Iron, Makers of Newcastle, Newcastle, 1999.
Discussion with:	M. Oughton, former Superintendent, Blast Furnace, Newcastle Steelworks.