Archaeological Excavation

at

LLYNFI VALE IRON WORKS (NEW WORKS), LLYNFI ROAD, MAESTEG, GLAMORGAN, SOUTH WALES

for

Morbaine Ltd.

Report No. 1299/2009

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Centred on
N.G.R. SS 84880 91620

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NOTE
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April, 2009.

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Excavations on the site of the

LLYNFI VALE IRON WORKS (NEW WORKS),

MAESTEG, GLAMORGAN,

SOUTH WALES

By Timothy Longman

With contributions from David Cranstone, Darren Lankstead,
Stuart Whatley and Dr Tim Young

INTRODUCTION

Bristol and Region Archaeological Services (BaRAS) was commissioned by Willard Project Management Limited, on behalf of Morbaine Limited, to carry out an archaeological excavation of land formerly occupied by the Cornstores Industrial Estate and the northern part of the Maesteg Sports Centre car park (**Fig.1; Cover**), prior to the construction of a Tesco foodstore on the site. The excavation was undertaken by Bristol and Region Archaeological Services (BaRAS), under the supervision of Tim Longman, between 27 November 2006 and 7 February 2007.

The excavation came about as a result of the findings of an earlier archaeological evaluation (Lankstead 2005; BaRAS Report No.1299/2005) on the site (**Fig. 2**) during December 2004 and January 2005. BaRAS was commissioned by White, Young, Green Planning, on behalf of Morbaine Limited, to excavate a number of trenches in order to locate the remains of buildings belonging to the Llynfi Vale Iron Works (**Fig. 3**).

The study area (centred on NGR SS 84880 91620) lies about 250m north-west of Maesteg town centre and covers an area of approximately 3.2 hectares. It is situated on a raised area of land overlooking the town centre, to the north-west of the junction of Neath Road, Llynfi Road, Talbot Street and Commercial Street, at a height of approximately 144.5m above Ordnance Datum (aOD). South-west of the rugby ground there is a steep drop down to the Llynfi Road, while another steep descent occurs to the north-east down to the Llynfi River and Castle Street beyond. Immediately north-west of the site the ground rises steeply up to the Welfare Park.

The site is bounded to the west by a wooded hillside up which leads a public footpath leading to the Welfare Park (public park), north by industrial units (Forge Industrial Estate) on Coronation Terrace, north-east by a rugby training pitch, east by Maesteg rugby stadium, south-east by the former access road to the Cornstores Industrial Estate and south by the Maesteg Sports Centre car park. Prior to the commencement of the archaeological excavation part of the site was occupied by two light industrial buildings (Cornstores Industrial Estate) – these had been demolished by late November 2006.

The geology of the Maesteg area comprises Lower Coal Measures shales with coal seams and bands and nodules of iron ore, overlain on the higher ground by Upper Coal Measures, dominated by the Pennant sandstone and containing few workable coal seams or iron ore deposits.

Of the known archaeological sites in the area the closest prehistoric site to the study area is the Iron Age hillfort at Bwlwarcau near Llangynwyd, some 2.5km south-west of Maesteg. This part of the Llynfi Valley was rural in character until the arrival of industry in the 1820's, and most archaeological sites in the Maesteg area are of that date or later. The National Monuments Record (NMR) in Aberystwyth identifies eight sites on or near the study area (although one of these is erroneous); the county Sites and Monuments Record (SMR) in Swansea lists 5 sites.

Only two sites pre-date the early 19th century. One is a holy well of medieval origin, called 'Ffynnon Fair' (SMR 01156m), which lies a short distance up the valley from the study area. Its exact location is uncertain (approximately NGR SS 8592) and all trace of it may have disappeared as a result of later coal mining in the area. The other site is Nant-y-Crynwydd Farm (NGR SS 8487 9147; NMR NPRN 19393; SMR 01434m). The farmhouse, which stood south of the extant blast engine house, was listed

Grade II but was, unfortunately, demolished over 20 years ago when the Maesteg Sports Centre was built. Photographic evidence suggests that it was probably built in the late 18th or early 19th century. The brief SMR description states *' regional house with chimney backing on entry, outside cross-passage and fireplace stairs'*.

Only one previous programme of archaeological work had been undertaken on the site when a desk-based assessment of the sites' history and potential archaeology was undertaken by BaRAS in 2001 (Bryant 2001; BaRAS Report No.889/2001; revised in 2004).

The archive of records and finds deriving from the excavations on the site of the Llynfi Vale iron works will be deposited with the National Library of Wales – National Monuments Record, in Aberystwyth.

HISTORICAL BACKGROUND

General

The study area is situated in the historic parish of Llangynwyd, in the hundred of Newcastle in the county of Glamorgan. The ecclesiastical parish is Llangynwyd with Maesteg (St Cynwyd).

The subjugation of the Silures, a tribe who occupied much of south Wales, was begun by the Roman army about AD50, led by the general Ostorius Scapula. The conquest was completed some 25 years later by an army commanded by Julius Frontinus, who probably had constructed the great military road (Via Julia Maritima) between Glevum (Gloucester) and Menevia (St David's), with stations at Cardiff, Bovium (possibly Ewenny), Nidium (Neath) and Leucarum (Loughor).

After the departure of the Roman legions from Britain in AD410 the local Welsh tribes regained their independence under a line of Welsh chieftains, whose domain was consolidated into a principality known as 'Glwyssing' until the late 10th century when it became known as 'Morganwg' (the territory of Morgan, a prince who died *c*980) or 'Gwlad Morgan', hence Glamorgan.

The Norman conquest of Morganwg took place in the late 11th century, led by Robert FitzHamon, Lord of Gloucester (d.1107). Tiryarlh, one of the twelve lordships of Glamorgan, was originally centred on the castle of Kenfig, but by the early 13th century an additional upland castle had been built at Llangynwyd (some 2km south-west of the study area). It is first referred to in 1202 and appears to have been rebuilt in 1246. In 1257 the castle, then held by the De Clares, was attacked by Llywelyn, lord of Senghennydd. In 1262 it is referred to as being *'much injured by war'* and in 1306 it was stormed by local Welsh forces. In 1327 it was in Welsh hands and was besieged by King Edward II. The possible site of another castle in Llangynwyd parish, called Llwydarth (NGR SS 858 901) has also been tentatively identified by King (1983). He states that it was held by a family called Powell. Traces of a drovers road to/from the village of Llangynwyd survives south-west of Maesteg. Also in the Llynfi valley there is evidence of medieval agricultural practices, specifically field systems and sheep granges established by the monks of Margam abbey (Cistercian).

Llangynwyd Castle (NGR SS8517 8866; NMR NPRN 94553, 300448; SMR 00124m), of which only earthworks now remain, appears to have been largely extant as late as 1650.

The Llynfi Vale Ironworks, by David Cranstone

The iron ores of the Maesteg Anticline were not exploited by coke smelting until 1819, when a furnace was built at Cwmafan (5 miles west of Maesteg, and two miles east of Port Talbot on the coast); this was followed by works at Pontrhydyfen further up the Afan valley, and Oakwood close to Cwmafan. Pontrydyfen was short-lived, but Cwmafan /Oakwood continued reasonably successfully with several blast furnaces, a substantial puddling forge and rail mills until 1874, with one furnace remaining in operation until at least 1882 (Ince 1993, 151-2; Riden and Owen 1995, 10-11, 21)

Apart from John Bedford's colliery at Llwyni, the Llynfi Valley remained largely rural in character until the 1820's. In 1828 a horse-drawn railway (the Dyffryn Llynvi & Porthcawl Railway) was opened, running from the head of the Llynfi Valley through Maesteg to Tondu, then west past Cefn Cribwr ironworks (now completed, though only briefly in production) to a new enclosed dock (the first in South Wales) at Porthcawl (Riden 1992b, 85-88). This was rapidly followed by the opening of Maesteg Ironworks, on Bedford's former Llwyni leasehold to the east of the town. By 1848 this had three

furnaces, serving a foundry rather than a forge (Ince 1993, 153). The blackband ores were discovered in the 1830s (Barrow 1873, 183), though it is not clear by whom.

James H. Allen (of Neath) had built a zinc smelting works comprising four furnaces and a calciner at Caerau (then called Spelters) at about the same time. By 1838 he had formed a partnership (the Cambrian Iron & Spelter Co.) that acquired some 53 acres of land at Nant-y-Crynwydd Farm (the study area) on the opposite side of the valley from the Maesteg (Old Works) works. A 52½ inch beam blowing engine was constructed for the company by the Neath Abbey ironworks in the same year (Ince 1984, 106), indicating the construction of the engine house and at least the start of construction of the first furnace(s). By 1842 the first furnace was 'blown in'; the Tithe Map (**Fig. 4**) indicates two furnaces, served by blast pipes from the blowing engine house with no indication of any hot-blast stoves. The works were put up for sale in March 1844 and the wording of the sale notices indicates that the works were not yet complete. They mention two blast furnaces and the foundations of two more, the blast engine house and the casting house, and foundations for a forge and mill (Lewis 2001).

At this time the name of the Llynvi Vale Iron Works was changed to that of the Llynvi Iron Co. A new forge works was built in 1845, becoming operational in February 1846. Lewis (2001, 13) says that this building was 275 feet (84m) long by 44 feet (13.4m) wide with 12 puddling and 8 reheating furnaces. In August 1846 the new rail mill began production. The *Mineral Statistics* show four furnaces from 1849, though it was 1859 before all were in blast in any one year (Riden and Owen 1995, 19).

In 1852 the works was again up for sale and the company was re-formed, with a new name, the Llynvi Vale Iron Company. A large new rail mill was opened in 1855, and a second, 40 inch, blowing engine purchased from Neath Abbey (Ince 1984, 108). According to Truran, the site had four furnaces producing 18,720 tons of pig iron in the year at a weekly make of 90 tons per furnace; this latter figure was low for South Wales (figures ranging from 90 to 210 tons/week, with most producing 100-120). In 1856 the workforce numbered about 1,500 men and women. The works then comprised 4 blast furnaces, 28 puddling furnaces, 2 squeezers, 2 pairs of rolls, 4 mills, etc., 10 steam engines, 2 patches, 9 smithies and 3 carpenters shops. There was a pattern-shop, 107 coke furnaces and a brickworks producing about 17,000 bricks per week (Richards 1982) (**Fig. 5**). The absence of any mention of refineries indicates that Llynfi was using the one-stage 'pig boiling' variant of the puddling process. By South Welsh, and indeed British, standards this was a medium-sized integrated forge-sector works. According to the *Mineral Statistics* (Riden and Owen 1995, 19), the Llynfi [Vale] Iron Co also operated the Maesteg furnaces from 1855 onwards (three furnaces, all in blast from 1855-7, and four, all in blast, from 1858-1860). However according to Ince (1993, 153) the Maesteg Ironworks was owned by a separate company until 1862, when it was bought by the Llynfi Vale Iron Co; this discrepancy cannot be resolved from the available evidence. From 1862, the Maesteg furnaces were amalgamated with Llynfi in the *Mineral Statistics*, with either three or four in blast in any year (perhaps all at Llynfi – Colquhoun's report (see below) makes no mention of any activity on the Maesteg Works site).

In 1865 the works were producing pig iron, bar and rails; other products included angle iron, gas strip, hoops, sheets and nail rod. In 1866 the name of the ironworks business was changed again, this time to the Llynvi Coal & Iron Co. Ltd.. In 1871 the 4 blast furnaces were in operation, also 33 puddling furnaces and 4 mills (Lewis 2001). Further expansion in 1872 saw a new rail mill opened, driven by a horizontal engine. However in the same year the company sold out to the Llynvi, Tondu & Ogmore Coal & Iron Company Ltd, dominated by members of the Brogden family who had run Tondu Ironworks since 1854; Tondu, in the Llynfi valley where this crosses the southern outcrop of the Coal Measures, was a slightly smaller works boasting two blast furnaces, 23 puddling furnaces, four rolling mills, eleven balling furnaces, a forge, and 100 coke ovens (Ince 1993, 148).

Considerable detail on the blast furnace element of Llynfi (though not unfortunately of the forge element) is contained in a report by James Colquhoun (1875) and subsequent discussions (**Figs. 7 & 8**). Colquhoun had presumably been the furnace manager; he had made his alterations 'some years ago', after observing the working of the furnaces for about a year, so may have been recruited by the Llynfi Vale Company in the late 1860s, though by 1875 he appears to have moved to Tredegar (1875, 171). He may well have been the Dr Colquhoun whose analyses of Scottish argillaceous and carbonaceous (blackband) ores were used by Truran (1855, 7-8); if so, the Llynfi Vale Co were presumably importing a manager familiar with Scottish blackband ores, to improve smelting practice on the similar Maesteg ores.

The furnaces were smelting blackband ores, using hot blast. The ore was calcined in clamps at the mines; Colquhoun claimed that the calcined ore yielded 54.9% iron, though the representativeness of

this figure was challenged in discussion. Before Colquhoun's alterations, the blast was heated to 500-600ºF in syphon-pipe ovens fuelled by blast furnace gas. This was a relatively early use; the use of blast furnace gas as fuel (as opposed to waste-heat recovery, which is documented by Truran) appears to be first recorded by Percy (1864, 408-410) at Blaina. The furnaces were *c*46 ft high, closed-topped, with cup-and-cone filling, smelting on coke plus *c*4% raw coal, and the gas was taken off into a culvert-like chamber under the plated top of the furnace, and thence by downcomer to the ovens. Colquhoun altered the internal 'lines' of three furnaces, narrowing the boshes and throat, and redesigned the hot-blast stoves, notably by installing 'Argand' gas-burners. This reduced the blast-furnace gas consumption by two-thirds (perhaps implying that the gas was also used elsewhere in the works), raised the blast temperature to 1100ºF, and increased the average weekly 'make' of iron from 185 tons per furnace (already a dramatic improvement on the 90 tons reported by Truran for 1855) to 240 tons, with savings of *c*25% on coke consumption per ton and *c*60% on coal consumption in the blowing engine, and slight savings on ore and raw coal.

The final years of the works are confused, with discrepancies between the *Mineral Statistics*, Ince, and Lewis. Brogden's company benefited from settling early in a major strike in 1873, but failed in 1878 (Ince, Lewis) or possibly 1882 (*Mineral Statistics*) as the Welsh forge sector collapsed under the impact of the competition from Bessemer steel. A new company, the Llynvi & Tondu Co. Ltd, took over and kept one furnace in blast at Llynfi (two in 1880 and 1882) until 1885 when production ceased. However according to Ince the puddling furnaces and rolling mills had closed by 1881, so the furnace(s) were probably producing pig for sale or for forging at Tondu.

The New Works site (the study area), along with six collieries and an iron works at Tondu, was acquired by North's Navigation Collieries in 1888 and much of the Llynfi iron works site had been cleared by 1895 (**Figs. 10 & 11**), apart from the 4 blast furnaces, the blast engine house, the casting house, the bridge house and the mills and forges building. The old blast engine house initially found a new use as a provender store, containing feed for the many pit ponies used in the local coal mines, hence its later name of 'the Cornstores' (Lewis 2001).

In 1894 the Port Talbot Railway and Docks Company (P.T.R.) was incorporated. One of the aims of the company was to provide a rail link between the coal mines of the Llynfi Valley and the docks at Port Talbot. One of the railway lines' chief promoters was Col. J. T. North of North's Navigation Collieries. The line was finally opened for goods traffic on 31 August 1897 (**Fig. 12**). From the south a single-track line approached the site of the old Llynfi Works on an embankment passing between the blast engine house and the southernmost blast furnace (No. 1). In 1908 the Great Western Railway (G.W.R.) took over responsibility for the rail service between Port Talbot and Maesteg.

By 1914 three of the blast furnaces had been dismantled leaving only the present surviving example (**Fig. 13**). Lewis (2001) records that the stonework from the three furnaces was reused in the construction of St Michael's Church, Maesteg. In addition, the remains of the bridge house, the casting house and the ruins of the mills building had also been demolished. North's Navigation Collieries Co. Ltd. was purchased in 1916 by Lord Rhondda. In 1922 the Port Talbot Railway and Docks Co. (P.T.R.) was taken over by the G.W.R. Passenger services were withdrawn in 1933, while the freight service between Port Talbot and Maesteg ended in 1964 when the line was transferred to National Coal Board (N.C.B.) control.

In 1958 much of the dressed facing stone on the sole-surviving blast furnace was removed to use in work on the tower of St Michael's Church. In addition to the railway line and sidings an 'Omnibus depot', comprising two long sheds, was built in the 1950's just west of the rugby ground with access to/from Llynfi Road (**Fig. 14**).

The railway sidings were still in use in the 1970's but the track had all been lifted by 1983. The old blast engine house had fallen into disuse and had become a roofless shell, but it was subsequently renovated and incorporated into the new Maesteg Sports Centre. At the same time the surviving blast furnace was also consolidated. Together, they now constitute a scheduled ancient monument (Glamorgan 418).

The South Wales iron industry, by David Cranstone

The South Wales coalfield consists of a large syncline (structural basin) occupied by Coal Measures rocks, with earlier Carboniferous Millstone Grit and Carboniferous Limestone outcropping around the edges and dipping under the Coal Measures (George 1970, 83-100). Non-phosphoric haematite (iron

oxide) ores occur as veins and replacement bodies in the Carboniferous Limestone in places along the southern outcrop. However the main iron ores (at least in Post-Medieval terms) occur as nodules and bands of phosphoric siderite (iron carbonate) within the shales of the Lower Coal Measures; these beds also contain the main coal seams. The Lower Coal Measures outcrop along the south side of the coalfield as a strip of low ground running from Port Talbot, crossing the Llynfi valley north of Bridgend to Llantrisant and beyond, and along the north side from Ammanford via Aberdare and Merthyr Tydfil to Ebbw Vale. Most of the core of the coalfield is occupied at surface by the Upper Coal Measures, dominated by the thick Pennant Sandstone with few workable iron ore beds or coal seams, and rugged and infertile uplands. However Maesteg, although within the core of the coalfield, lies on the Maesteg anticline, a small east-west upfold that brings the Lower Coal Measures (with their iron ores and coal seams) back to the surface in a strip from east of the town westwards to the coast north of Port Talbot. These iron ores include 'blackband' ores (relatively rich carbonaceous ores which could be calcined without additional fuel, or smelted with only limited coke fuel once hot blast allowed their sulphur content to be slagged out) (Riden 1992b, 18, 108).

The coals of the South Wales coalfield vary considerably in 'rank', from bituminous coking coals in the south and east to anthracite in the west; the Maesteg coals are bituminous; they would now be considered as good metallurgical coking coals (Tim Young, pers. com), though their quality was controversial at the time (Colquhoun 1875, 172-177).

On present evidence, Roman ironmaking appears to be confined to the oxide ores on the boundary between the coalfield and the Vale of Glamorgan (Redknap and Young 1998; Tim Young pers. com.). Medieval bloomery ironmaking is poorly-known, but did include some sites within the coalfield. In the Maesteg area, a bloomery near Llangynwyd was disturbed by tramway construction, and there are antiquarian reports of bloomery smelting in Cwm Farteg (*c*3km south and west respectively from the Llynfi site). The first blast furnaces, in the 1560's, were again on the oxide ores (including Tongwynlais, probably the furnace which produced special cast-iron plates for conversion to steel by the finery process at Robertsbridge Forge in Sussex (Riden 1992a)). Blast furnaces did develop on the coalfield by the late 16th century, but not in the western valleys around Maesteg; this may have been because land-owning and land-management patterns in this Welsh lordship were not suited to sustained large-scale charcoal production (Tim Young pers. com.). The exception which proves the rule is Angelton (also known as Coity), just north of Bridgend (SS 904 819), where a furnace was built in 1589 and used until at least 1600; although outside the actual coalfield, it appears to have used Coal Measures ore (Riden 1992b, 20-21). This pattern continued through the remainder of the charcoal iron period; although there were a number of furnaces in the northern and eastern parts of the coalfield, some long-lived and important, after the closure of Angleton there were none in the Valleys west of the Taff and south of the Neath (Riden 1993, 10-33).

South Wales was the scene of at least one early attempt at coke smelting; a patent of 1620 probably relates to experimentation at Ponthenri or Pontiets furnaces in Carmarthenshire, where archaeological evidence may well survive (Page 2007). However this was (presumably) unsuccessful; there is no evidence for further attempts in the 17th century, and South Wales did not partake in the 'first generation' of coke smelting between Darby's success in 1709 and the widespread adoption of the process around 1750. The first coke furnace was built at Hirwaun in 1757 (though it is not certain that it used coke from the outset: Riden 1993, 19-23). This was followed by rapid development in the northeastern part of the coalfield, notably around Merthyr Tydfil where the Dowlais Ironworks was founded in 1759, the Plymouth Ironworks in 1763, and the Cyfarthfa Ironworks in 1765-7; the fourth major Merthyr works, Penydarren, was added in 1784 (Ince 1993, 1-3, 47-72). Development of the industry at this stage was grealy helped by the high carbon content of Welsh coal, which contributed substantially to fuel economy (Ince 1993, 1). Welsh furnaces tended to be very tall; the first Cyfarthfa furnace was 50ft high, and the two Neath Abbey furnaces of 1793 were *c*60ft high. Blowing was normally by waterwheel coupled to blowing cylinders (with some instances of water being recycled by an atmospheric steam engine); Boulton & Watt type blowing engines did not become common until after 1800, the Neath Abbey ironworks becoming a major producer in the early 19th century (Ince 1984) (though even then water power remained quite common, not surprisingly in view of the high rainfall and relief, allowing large overshot waterwheels).

The first South Welsh coke furnaces (Hirwaun, Dowlais, Plymouth) produced castings and foundry pig. However Cyfarthfa was designed from the outset as an integrated works, producing pig primarily for conversion to bar iron, using the recently-developed 'potting and stamping' process;

Charles Wood, who had developed this process in Cumberland, was brought down to Merthyr to supervise the construction of the works (Riden 2001). The Merthyr ironworks continued to participate actively in the development of forge technology; although Cort's puddling and rolling process was invented (if this is the correct term, for a process whose originality remains controversial) at Funtley in Hampshire, it was developed into a technically and commercially successful process under Richard Crawshay at Cyfarthfa (Evans (ed) 1990; Evans 1993). The development of coal-fuelled and large-scale forge technology at Merthyr set the course of the South Wales iron industry for the next century, concentrating on the large-scale production of low-cost and relatively low-quality bar iron and wrought-iron products.

The first attempt to develop coke smelting in the southwest of the coalfield was by John Bedford in the 1770's and 1780's (Riden 1992b). In 1772, Bedford leased land at Llwyni and Bryn-Rhug, on the east side of Maesteg opposite the Llynfi Ironworks site, seemingly with the intention of building a furnace (Riden 1992b, 27-8). In fact, Bedford erected an experimental forge on his own land at Cefn Cribwr (SS 851 835; 3 miles west of Tondu), followed in the 1780's by a blast furnace, though he did establish a colliery at Llwyni to provide good coking coal. The blast furnace was unsuccessful, and it is doubtful if it was ever brought into blast before Bedford's death in 1791.

The Welsh iron industry developed rapidly during the Napoleonic Wars. A short slump at the end of the Wars was followed by renewed growth in the 1820's; in 1826 South Wales produced 223,000 tons, over 38% of the British make (Ince 1993, 2-3). From the 1830's, South Wales concentrated increasingly on the production of wrought iron rails, initially for the domestic market but by the 1850's increasingly for the North American market. Although production continued to increase rapidly in absolute terms (to 985,000 tons by *c.*1860), the proportion of British output gradually fell, and the industry was vulnerable to boom-and-slump conditions with fluctuations in railway construction. The development of hot blast (initially by Nielson in Scotland in 1828) greatly improved fuel economy throughout Britain; however this worked to the disadvantage of South Wales, reducing the economic benefits of the region's high-carbon coals. It may however have facilitated the use of the relatively rich blackband ores in the Maesteg area. Furnace construction shifted from the traditional solid masonry 'stack', to a much lighter construction of thin masonry and firebrick bound externally with wrought iron bands, over a solid masonry base of more traditional form. By the 1850's, the top of the furnace was increasingly closed to allow the waste gasses to be drawn off and used for pre-heating the blast (in the hot-blast stove), and/or for firing boilers.

The puddling process as originally perfected at Merthyr involved an initial refining phase, in a hearth where the metal was melted under an oxidising blast to remove silicon, phosphorus, and sulphur, followed by puddling to remove carbon in a reverberatory furnace with a sand bed ('dry puddling'). The efficiency of the 'dry puddling' process was much improved by the substitution of a cast iron bottom for the sand layer, in the 1810's. From the late 1830's, the improved 'dry puddling' process was increasingly replaced by 'wet puddling' or 'pig boiling' in which an iron oxide bed made from calcined cinder reacted with the carbon and other impurities in the iron; this was quicker, more efficient, and often obviated the need for prior refining (though many Welsh works did continue to use refineries in conjunction with the improved dry puddling; Truran 1855, 122-145, Pl 8-9). The spongy mass of iron produced was consolidated into a 'bloom' – initially by traditional trip-hammers, but later by a 'crocodile squeezer' (a heavy jaw-crusher with serrated jaws to hold the bloom; Truran 1865, 141-4, Pl 10)). From the 1860's, Nasmyth steam hammers were increasingly used. The slabs of iron produced were then rolled, reheated (in 'balling furnaces') and rolled several times to form bar iron of various grades, or piled and rolled for railmaking (Ince 1993, 20-23; Truran 1855, 147-157). The furnaces and other equipment of Welsh puddling forges are particularly well illustrated by Truran (1855, 1862).

Throughout this period, South Wales was a major producer of bar iron and wrought iron products, and remained at the forefront of puddling-forge technology; it is noteworthy that the authors of two of the major contemporary accounts of the British iron industry, Scrivenor (1841) and Truran (1855, 1862), were employed in the South Wales industry. However both the contemporaneous sources and more recent historical works have tended to concentrate on the major ironworks of the northeast part of the coalfield (Merthyr, Blaenavon etc), or on well-preserved outlying failures such as Cefn Cribwr, with much less coverage of the smaller but broadly successful works such as Llynfi which were perhaps more typical (at least numerically, if not in total production or economic importance). An exception is Roberts' (1983) work on Briton Ferry, which is also reasonably close

geographically to Llynfi; this therefore forms the closest published parallel for Lynfi, though based entirely on historical rather than archaeological evidence. There is virtually no published archaeological work on the forge sector of the industry, though 'grey literature' is known to exist.

By the 1850's, the richer local ores were becoming exhausted, and from the 1860's mild steel produced by the Bessemer process began to replace wrought iron for many applications; the phosphoric Welsh ores were unsuitable for use in the original ('acid') Bessemer process. After falling production in the 1860's, a brief revival in 1870-1873 was followed by collapse due to falling rail prices, strikes as the ironmasters attempted to reduce wages, and the collapse of the demand for wrought iron rails. The development of the 'basic Bessemer' process at Blaenavon in 1878 allowed some revival, since the phosphoric local ores could now be used for steelmaking. However only the larger and financially stronger works could afford the necessary investment; the majority of ironworks closed, and those that survived were increasingly large blast-furnace plant feeding into 'basic Bessemer' or open-hearth steelworks, with the virtually complete collapse of the traditional forge sector (Ince 1993, 5-7).

THE EVALUATION, by Darren Lankstead

Objectives

The fieldwork complied with the methodology contained within the Written Scheme of Investigation (BaRAS 2004). The aim of the fieldwork was to determine the location, extent, degree of survival and dates of specific archaeological features and associated deposits.

Methodology

At the request of the client a sub surface magnetometry and radar survey was carried out on the application area to ascertain the effectiveness of the technology. The results of the survey were inconclusive owing largely to the quantity of ferrous materials present in the area.

Initially four trenches were mechanically excavated, then manually cleaned and recorded between 14 - 20 December 2004. Trench 2 had to be relocated owing to an abandoned car being placed where the trench was originally intended.

Following the visit of Neil Maylan (GGAT; representing Bridgend County Borough Council) it was decided to excavate a further trench (Trench 5; **see Fig. 2**). The purpose of this trench was to determine the physical condition of the most northerly of the blast furnaces (No.4) and to investigate the phasing of the structure. This was initially unsuccessful and a further trench (Trench 6) had to be excavated. The second phase of the evaluation was carried out between 5 – 7 January 2005.

The six trenches were placed to locate specific features, these were:
Trench 1: located to find the small extension of the 'New Mill'
Trench 2: located to intercept the boiler house
Trench 3: positioned to locate the east wall of the casting house
Trench 4: located to investigate the north side of blast furnace No.3
Trenches 5 & 6: positioned to locate the northernmost blast furnace (No.4)

Trench 1

The trench measured 10m long x 1.5m wide and was oriented in an ENE-WNW direction and was sited on the grass verge in the south-east portion of the proposed development area. The trench was excavated to a maximum depth of 1.5m (**Figs. 15 & 16 & plates 1 & 2**).

Stratigraphically the earliest deposit recorded in the trench was an indurated dark reddish brown deposit (103) containing large amounts of ferrous material and occasional sandstone blocks. Despite repeated attempts to break through the indurated surface with the mechanical excavator it proved impossible. Analysis indicated that context (103) contained significantly more material associated with secondary iron smelting processes and may suggest a change of activity from primary to secondary smelting processes during the sites development (Dr. T. Young pers. Comm.).

The indurated surface (103) was truncated by two regular steep-sided cuts which, although not fully exposed, would seem to have been either square or rectangular in plan (105 & 107). The cuts contained a friable mixture of building rubble and mortar and coal debris in their uppermost fills and a layer comprising hot blast furnace slags varying from a pale mid grey to dark green at their base (104, 106 & 108). Neither cut was excavated to its maximum depth owing to health and safety considerations. The purpose of the two regular cuts is uncertain owing to the limited exposure in the trench. A possible function is that they acted as substantial bases for structures that were once sited in the area.

Stratigraphically overlying fills 106 & 104 and physically overlying surface 103 was a friable dark greyish black deposit (102) containing 90% coal fragments with occasional slag and clinker fragments. This could possibly be associated with the later use of the site as railway sidings and as a bus depot. Overlying deposit 102 was a mid-orange brown clayey silt (101), deposited as part of the landscaping associated with the car park.

Trench 2

It measured 4.3m long x 2.5m wide and was oriented in an E-W direction. The trench was excavated in the grass verge at the northern end of the sports centre car park. It was excavated to a maximum depth of 1.4m below the present ground surface. As mentioned above the trench had to be relocated as a car had been abandoned over the site of the original trench (**Fig. 17 & plate 3**).

The earliest deposit, context (203), consisted of dark reddish black clayey silt containing roughly hewn sandstone masonry and mid-whitish grey mortar fragments. Stratigraphically sealing this deposit was a coal rich dark greyish black layer (202) containing occasional sandstone fragments. Above this lay a topsoil horizon, which had been deposited at the same time as the landscaping associated with the modern car park and the aggregate filled cut for the car parks kerbs (201).

No structural remains were present within Trench 2 with the deposits probably representing landscaping horizons containing some demolition debris. These horizons are possibly related to the mid-1890's railway embankment and may suggest that the structural remains thought to be present in the trench had been demolished prior to landscaping. However, the natural substrate was not encountered within the trench, thus wall foundations may survive at a greater depth than that evaluated.

Trench 3

Trench 3 measured 10m long x 1.5 m wide and was oriented in an ENE-WNW direction. It was situated on the grass verge to the north of the sports centre car park's north-eastern limit. The trench was excavated to a maximum depth of 1.2m below the present ground surface (**Figs. 18, 19, 20 & 21 & plates 4, 5 & 6**).

The natural substrata (303), consisting of boulder clay of a probably colluvial nature, was encountered at the base of Trench 3. Physically cutting this deposit were the remains of two walls. The more substantial of the walls (304) ran in a NW-SE direction and consisted of squared to roughly hewn Pennant sandstone bonded by a light whitish grey mortar containing lime and charcoal flecks. The wall was faced to the west and contained a rubble core. It could not be determined if the wall was faced to the east owing to the indurated surface (305) not allowing excavation in this area (see below).

Wall 302 ran in an E-W direction and was built of both brick and Pennant sandstone bonded with a light whitish/grey mortar containing lime and charcoal flecks. It was less substantial than wall 304 with its eastern extent disturbed by machining. Walls 302 and 304 were bonded together with the smaller structure (302) seemingly abutting 304. The walls are thus likely to be broadly contemporary and are thought to represent the main eastern wall of the casting house and an internal partition.

Evidence for the in-situ casting house floor was also present within the trench in the form of a layer of sand (310) contained within cut 309. The sand was mixed with ferrous material at the south-west corner of the trench, which is possibly debris associated with the casting process (Dr. T. Young pers. comm.). A further oval cut and fill was encountered to the east of the casting house floor (307 & 308) with the fill consisting of a friable light greyish white mortar containing lime and charcoal flecks. The exact function of this feature is uncertain but it is stratigraphically contemporary with the casting house floor and is probably related to the casting process.

Sealing both the remains of the casting house floor and fill 307, to the west of the trench, was a compact dark blackish brown deposit (306) containing a substantial quantity of ferrous and slag debris including iron bars. The mixed nature, and the amount of debris contained with the deposit, suggests it contains material dumped over the casting room floor after its abandonment.

Cutting layer 306 were two substantial cuts (314 & 312) filled by friable dark blackish grey silty clay containing frequent sandstone and mortar fragments (301 & 313 respectively). Both features were interpreted as robber trenches excavated so as to remove the upper courses of walls 302 & 304. The fact that both features truncated the layer of debris deposited over the casting house floor suggests that the stone was utilised elsewhere (perhaps in the construction of St. Michaels' Church) some time after the abandonment of the casting house floor.

To the north of the trench lay an indurated ferrous rich deposit (305) identical to that recorded within Trench 1 (103). Again it proved impossible to break through the surface and its physical and stratigraphic relationship with cut 312 could not be determined.

Stratigraphically overlying surface 305 and physically overlying deposit 306 was the mid reddish brown clayey silt topsoil deposited as part of the landscaping associated with the car park (300).

Trench 4

The trench measured 5m long x 1.5m wide and was oriented in a N-S direction. It was excavated to a maximum depth of 1.2m below the present ground surface (**Figs. 22 & 23 & plates 7 & 8**).

The earliest deposit, context 407, was encountered at the northern end of the trench and consisted of a dark reddish brown clayey silt containing large tabular Pennant sandstone fragments. The deposit was not excavated owing to health and safety considerations so its exact stratigraphic position could not be ascertained, however it was physically seen to abut the foundation course of wall 405.

Wall 405 consisted of 3 courses of dressed Pennant sandstone blocks above a faced protruding footing. The wall was bonded using a light whitish grey lime mortar containing occasional charcoal and slag inclusions. The wall retained a rubble infill, context 406, consisting of roughly hewn Pennant sandstone rubble bonded with an identical mortar to that within wall 405. The rubble layer continued southwards to the edge of the trench so was at least 2.6m in length. Wall 405 and rubble infill 406 are thought to represent the in-situ remains of the northern face of the blast furnace No.3.

Physically abutting and overlying wall 405 and infill 406 was a substantial demolition deposit, context 404, consisting of sandstone rubble and mortar. Overlying layer 404 was a mid reddish/brown deposit containing frequent slag and ferrous material that had formed a firm surface (403). Above this layer a friable dark blackish grey clayey silt containing frequent slag and coal fragments was present (402). Overlying this lay a redeposited landscaping horizon, context 401, consisting of heavily bioturbated Mercia Mudstone (formerly known as Triassic Keuper Marl).

It would appear that a managed landscaping and demolition episode had taken place after the demolition of blast furnace No.3. Initially the area surrounding the blast furnace had been levelled using demolition rubble (404) after which an iron rich deposit (403) and a silty layer (402) had been deposited to aid stabilisation. Above this depositional sequence a non-local topsoil layer had been deposited.

Trench 5

Trench 5 measured 5m long x 1.5m wide and was sited 2m to the north-west of Trench 4 (**Fig. 24 & plate 9**). It was excavated to a maximum depth of 1.9m. The trench contained successive layers of demolition debris stratified within differing deposits, being either mortar or slag rich (contexts 505,504,503,502).

No structural remains of the northern-most blast furnace (No.4) were apparent within the trench although the earliest deposits (504 & 505) contained heat affected fire-bricks associated with the inner core of the structure. Given health and safety guidelines it was not possible to further excavate the trench so it could not be ascertained if the blast furnace was located beneath the successive deposits of demolition debris.

Trench 6

This trench was oriented in a N-S direction and measured 5.3m long. The northern end of the trench measured 1.7m wide but the trench width increased to 2.5m towards the southern end. It was deemed necessary to widen the trench in order to fully explore the exposed industrial features (**Figs. 25, 26 & 27 & plates 10, 11, 12 & 13**).

The remains of a wall (608) was identified within the western limit of trench 6. The wall fragment was constructed of roughly hewn Pennant sandstone bonded by a light whitish grey limestone mortar. The main body of the wall was heavily disturbed and consisted of mortar-bonded rubble reaching a maximum height of 0.6m above the base of the excavated trench. The eastern limit of the wall exhibited a definite face and is most likely to be the base of the tapping arch, which would have led from the main base of the blast furnace. This is supported by the presence of heat affected fire-bricks to the rear of the arch, which are likely to have formed the internal superstructure of the blast furnace itself.

The fire-bricks themselves were laid upon a substantial Pennant sandstone base (609) situated to the north and east of wall 608. A substantial ferrous fragment appeared to be integral to the base but whether or not it was a fitting or simply a waste product of the industrial process could not be ascertained. The limited exposure of the base did not allow any definite conclusions to its' shape, but it appeared to be circular in plan.

To the southeast of wall 608 and base 609 lay wall 615. Again this was constructed of Pennant sandstone and bonded by a whitish grey mortar. It was faced to the north and west. Wall 615 lay broadly parallel to wall 608 and may be part of the same blast furnace structure, perhaps being a subsidiary wall supporting the chimney of the blast furnace (see conclusion & **Fig. 7**).

Possibly abutting both wall 608 and 615 was a friable black sandy silt containing 80% coal debris and occasional slag fragments. This deposit was not excavated so its exact stratigraphic relationships could not be ascertained. However, it would seem likely, given that it abutted both walls 608 and 615 and was cut by possible robber trenches 610 and 612, that it was deposited as part of the landscaping/ make up event which occurred immediately after the demolition of the blast furnace.

Stratigraphically overlying wall 615 lay deposit 617 being a moderately compacted mid grey silty clay containing a distinct lens of mortar at its interface with overlying deposit 616. Deposit 616 itself was a heavily disturbed loose to friable deposit consisting of topsoil and modern debris.

Deposits 616, 617 and 614 had each been truncated by a substantial linear cut feature (612). The amount of bioturbation and disturbance witnessed within deposit 616 had obscured the uppermost reaches of the cut, but it was clear within the lower reaches of 616 and the whole of 617. The cut was interpreted as a robber trench dug in the 1950's to remove the facing stones from wall 608, so as to construct St. Michael's church tower.

The lowermost fills of the cut (613 and 606) contained frequent roughly hewn Pennant sandstone block and mortar fragments within a mortar rich and dark blackish brown slag rich deposit (613 and 606 respectively). The uppermost fills of the cut (604 and 603) contained predominantly coal (90%) fragments (604) and light whitish grey mortar fragments (603).

A further linear cut and fill (610 and 611) extended north-eastwards from the eastern face of wall 608. The linear nature of the cut and fill would suggest a robbed structure which once formed an integral part at the base of the tapping arch.

Overlying the base of the blast furnace 609 to the north of wall 608 was a deposit (607) consisting entirely of demolition debris within a matrix of light whitish grey mortar. The deposit contained frequent angular Pennant sandstone blocks some of which appeared to be facing stones. Stratified above deposit 607 lay a friable to moderately compacted, dark blackish brown clayey silt containing lenses of mortar and coal fragments (605). Both deposits were interpreted as being demolition and landscaping horizons associated with the demolition of wall 608.

Stratigraphically overlying fill 603, and physically overlying deposit 605, was a friable black sandy silt containing fragments of mortar, charcoal, coal and slag (602). Above this deposit lay a heavily disturbed topsoil horizon containing angular sandstone, slag and charcoal fragments (601). Both deposits were interpreted as recent make up and landscaping events which occurred after the robbing of the walls in the late 1950's.

Interpretation

It was the stated aim of the evaluation to determine the location, extent, degree of survival and dates of, in particular, archaeological features and deposits associated with the former Llynfi Vale Iron Works. To assist this programme the 1876 Ordnance Survey plan (original scale 1:2500) was enlarged and transposed onto the modern O.S. plan of the area (**Fig. 2**). Results from Trenches 3 and 4 corresponded almost exactly with what was expected, ie. Trench 3 contained the remains of the eastern wall of the casting house and Trench 4 contained the remains of the northern wall of blast furnace No.3.

Trench 5 contained only demolition debris where it had been expected to locate the remains of blast furnace No.4. As a contingency plan Trench 6 was excavated, the archaeology within which confirmed that the remains of blast furnace No.4, including its base, were indeed present. Therefore, one can conclude that the extrapolation of the 1876 plan onto the modern O.S. plan shows that it is broadly accurate in relation to the location of the remains of both blast furnaces and the casting house.

It has already been mentioned that blast furnace No.4 had been altered from a square to a round structure in 1867 (**Figs. 7 & 8**). A comparison of Colquhoun's plans and sections of his two designs of blast furnace show distinct similarities in their ground plans. The excavated structural remains recorded within Trench 6 would seem to correspond with the earlier square-type blast furnace (**see Fig. 7**). If this is the case it would seem reasonable to assume that the earlier blast furnace was not demolished, rather that its upper portion was altered to encompass Colquhoun's circular design improvements. However, the limited area exposed within Trench 6 does not allow any firm conclusions to be drawn from the available evidence.

THE EXCAVATION

Objectives

The purpose of the excavation was to record the nature and extent of any surviving archaeology and to seek to interpret any occupation on the site, particularly associated with the 19th century Llynfi Vale Iron Works.

The excavation resulted largely from the findings of the earlier archaeological evaluation on the site (Lankstead 2005; BaRAS Report No.1459/2005), and it was decided that the results of the evaluation justified further work. The archaeological excavations carried out between late November 2006 and early February 2007 showed that substantial remains of the various 19th-century iron works buildings survived in the general area and it was considered an important exercise to carry out a further programme of excavation and recording.

Proposals for an archaeological excavation were then drawn up by Bristol and Region Archaeological Services (BaRAS) and these were approved in November 2006 by Glamorgan-Gwent Archaeological Trust Limited (GGAT), acting on behalf of Bridgend County Borough Council.

Methodology

The excavation commenced on 27 November 2006 and was due to be completed on 12 February 2007. The excavation area (the footprint of the proposed food store; **Fig. 3**) was located NNE of the sports centre and north-west of the rugby ground in an area of land that formerly constituted a small industrial estate and the northern portion of the neighbouring sports centre car park.

The project was carried out in three stages: 1) archaeological monitoring was carried out between November 27 – December 21, 2006 during a) the mechanical excavation/removal of the concrete foundations and the services associated with the 1970's light industrial buildings that formerly occupied part of the site, and b) the exposing of the remains of several industrial buildings belonging to the iron works 2) between January 2 – February 7, 2007 more of the remains of several of the iron works buildings were revealed by closely monitored mechanical excavation before being manually cleaned, recorded and surveyed, and 3) an archaeological watching brief was undertaken between March 15 and June 8, 2007 during ground work associated with the construction of the new

food store, as well as the installation of roads and services. The site was redeveloped by Britannia Construction Ltd, on behalf of Morbaine Ltd.

Introduction

The concrete foundations, demolition rubble and laid services, such as drains and electricity cables, associated with the two light industrial units that formerly stood at the northern end of the site were removed utilising a 360º slew mechanical excavator (**Plates 14 & 15**).

Initially, only some 300mm (average depth) of Type-1 & -2 stone chippings were mechanically stripped across the northern half of the site to the 'formation level' of 144.3m aOD. This failed to expose any archaeological features, structures or deposits. Therefore, during the second week it was decided, after consultation with both GGAT and Willard Project Management Ltd, that the depth of excavation should be increased to the top of any in-situ archaeology, concentrating on the specific locations (according to the 1st Edition O. S. map of 1876 [**Fig. 9**]) where iron works buildings were presumed to be situated.

Over the following weeks a number of buildings that formed part of the ironworks complex during much of the nineteenth century were mechanically excavated, under close archaeological supervision, then planned and recorded. After examining the light whitish-grey lime mortar apparently used in the construction of most of the walls it looked likely that many of the buildings represented a near contemporary phase of construction dating from the mid-nineteenth century (*c*1855). The exposed walls, floor surfaces and any other structures were then hand-cleaned, recorded and surveyed (**Fig. 3**).

New Puddling Forge

The first building to be exposed formed part of a puddling forge erected *c*1855, which lay in the north-east corner of the site (**Fig. 28 & plates 17-20**, **36 & 37**, **39 & 40**, **43 & 44**, **46 & 47**). It became apparent at an early stage that much of the structure had been demolished almost level with the foundations; this proved to be the case with much of what survived on the site in general. The area initially excavated measured approximately 14m N-S x 22m E-W, with fairly well preserved structures mostly restricted to the northern end. The overlying layer of Type-2 stone scalpings had been deposited on top of a layer of geotextile membrane, which both sealed and protected the archaeology beneath. This must have been laid immediately prior to the construction of the two light industrial units on the site in the 1970's.

The remains of several contemporary structures, all probably dating from the buildings original construction in the 1850's were recorded at approximately 143.7m aOD. A section of 2m thick wall (117) constructed of randomly coursed Pennant sandstone bonded with hard, whitish grey coarse mortar flecked with lime and charcoal was interpreted as part of the west-wall of the building. Because of the function of the building and the need for good ventilation it was probably not a continuous length of wall. The structure was probably open-sided so 117 may well have been one of several masonry bases upon each of which was set an iron column which helped support the buildings' superstructure.

Immediately east of the latter structure were a number of narrow interconnecting Pennant sandstone walls (102, 103, 105, 107, 108, 110, 111, 113-116) belonging to a number of features, probably mostly flues, located within the former puddling forge building. All were of identical construction and were bonded with the same hard, mid grey mortar flecked with lime and charcoal. The flues contained slag/ash deposits, however, it was difficult to determine if they were in-situ or had been redeposited from elsewhere. Near the northeast corner of the excavated area was uncovered a large irregular-shaped platform-like structure (104). The excavated portion measured 4.8m (E-W) x 3.4m (N-S). Composed of Pennant sandstone masonry, three-courses high, bonded with the same ubiquitous mortar as previously recorded it differed in form from the other nearby features and may represent the remains of a machine plinth.

In late January 2007 excavation work resumed on the site of the puddling forge after large mounds of spoil, which had been deposited from elsewhere on site, had been cleared away by slew mechanical excavators. Beneath the covering layers of Type-1 and –2 stone scalpings (100) considerable quantities of slag-type industrial fill (311) had to be mechanically removed to reveal surviving structural remains of the mid/late-nineteenth century building. The deposit was a mixture of furnace waste, other smelting by-products and rubble and included slag, clinker and ash in a matrix of black silty sand. The

deposit was not bottomed, merely enough was cleared to expose any sandstone and brick masonry features belonging to the forge.

Immediately south-east of the area first opened up for excavation the previous November, beneath a hard, compacted lens of fine, black ash (283), a working surface composed of Pennant flagstones (282), bounded to the west by the remains of a narrow N-S oriented stone wall (286), was uncovered. Two cast iron rods (298) protruded from the floor and were probably holding down bolts to which a machine had been fitted. One of the rods was square-shaped (measuring 50mm x 50mm) with a rectangular hole near the top, while the top few centimetres of the other had a screw thread. The floor surface had abutted a substantial E-W oriented sandstone wall (281), which was bonded using the same ubiquitous whitish-grey lime and charcoal flecked mortar as recorded elsewhere on site. This area is interpreted as a machine-base, though the precise nature of the machine remains uncertain.

Adjacent to this area was a curvilinear brick-built flue (285). Made utilising yellow firebricks, bonded with hard mid-grey lime-flecked mortar, it contained a black, fine silty deposit (296) probably deposited in the early 1880's just before the works ceased operating. Another flue, though much smaller and narrower (150mm wide), was recorded just beyond the southern terminus of the brick flue. Oriented E-W it comprised two narrow Pennant sandstone walls (contexts 295 & 317), the tops of which lay at the same level as an adjacent flagstone floor (290). The flue contained two fills; the primary fill being a stiff blue-grey oily substance (360), which was sealed beneath a yellow brown deposit (359).

South of wall 281 a narrow N-S oriented brick wall (291) was recorded. Standing at least five courses high and measuring 1.10m long x 0.2m wide it appeared to have originally continued much further to the south. This likelihood was supported by the evidence of the imprint of further brickwork in the east-facing elevation of a substantial compact dump deposit of slag (376), which had accumulated against the brick wall. At right-angles to the latter wall, though apparently not contiguous with it, was another narrow brick wall (364). It may well have formed part of the east wall of the building, though it is slightly inside the line indicated by the overall 'best-fit' correlation of the excavation to the 1876 OS (**Fig. 3**); if so, structure 361 (see below) also lay on this wall-line.

The central/southern area of the building contained the most significant structural remains, interpreted as the substructures of possibly four puddling or reheating furnaces. The most northerly and least intact of the four comprised a sub-square Pennant sandstone feature (112), which may have been the base of the furnace chimney. It measured 0.49m x 0.35m x 0.18m high and was bonded with a hard mid-grey mortar flecked with charcoal and lime. Much of the remainder of the furnace appears to have been truncated by pit cut 125, which was filled with a mixed deposit of burnt debris (126) including fragments of firebrick, ash and slag. This deposit may have included materials that originally formed parts of the furnace.

The best preserved of the furnaces consisted of a NW-SE oriented rectilinear feature, some 7.1m long x 1.6m wide. It was faced with longitudinally laid firebricks (299) on three sides, which were bonded with whitish grey mortar. Beneath a thin lens of coal dust and sand (301) the main structure of the furnace, a brick floor (300), was also composed of firebricks, but laid on their sides. Two-thirds of the brick floor showed significant heat damage, which had caused the brick surface to fragment (contexts 302 and 304). The brick surface abutted a square-shaped Pennant sandstone feature (312), bonded with pinkish white mortar, which may be a chimney base. It measured 3.1m x 1.98m x 0.49m high. It has been constructed partly on top of an earlier Pennant sandstone possible pillar base (132), upon which may have stood a cast iron column helping to support the roof. This suggests that the interior of the building, including where and how its roof was supported and how the furnaces were arranged, had been altered at least once during its working life.

The third possible furnace lay some 3m away to the south and was also oriented NW-SE (**Plate 40**). It comprised three abutting structures – a brick floor (326), the brick base of a furnace (327) and the Pennant sandstone base of a chimney (328). The remnant of brick floor covered an area in excess of 1m, while the brick furnace base measured 2.2m x 1.2m and was constructed from regularly coursed firebricks. The chimney base, in turn, measured 2m x 1.7m x 0.26m high. The stones were bonded with whitish grey lime and charcoal flecked mortar. The laid brick floor (326) abutted a length of Pennant sandstone wall oriented N-S. This possible internal dividing wall (324), which was bonded using a pinkish mortar, measured 6.5m long x 1.7m wide x 0.4m high.

No more than 0.5m south-west of the remnant of brick floor (326), which probably would have originally continued further to the south, was the location of the possible remains of the fourth furnace, also oriented NW-SE. Only the sub-square Pennant sandstone base of a possible chimney (329) and a

small area of brick floor (363) survived (**Plate 43**). The chimney base measured 2.5m x 2m and the stones were bonded with whitish grey lime flecked mortar. The north-west corner of the structure had been truncated by a pipe trench (308). Partially sealed beneath a thin, mixed layer of coal dust, ash and slag (370) was a small remnant of laid brick floor (363), which was abutted by a possible facing of firebricks (371), laid on their sides, which measured 2m x 1.4m. This may represent the north-western end of the furnace.

To the east of wall 324 the remains of a severely truncated Pennant sandstone feature (361), which could have been a pillar base, a chimney base or a machine platform, were recorded; it lay on or close to the line of the east wall of the building on the 1st Edition OS. Any firm interpretation though, based on the evidence available was problematic. The dimensions of the feature were 2.2m x 1.9m x 0.52m high and it was composed of randomly coursed stonework bonded with a mid-grey mortar that included flecks of lime and charcoal. Immediately north of the latter feature was a black, compacted ashy deposit (368), which sealed a spread of greyish mortar (369).

Another, rather enigmatic feature lay to the south of wall 324. Measuring 2.8m x 2.7m x 0.5m high this square structure (335) was also built utilising Pennant sandstone masonry bonded with whitish grey lime and charcoal flecked mortar.

West of the latter feature was a heavily truncated length of brick wall (362), which measured 8.2m long x 0.46m wide, aligned with the south edge of structure 335. It is tempting to interpret wall 362 as the south wall of the building, in which case the 'local fit' of the excavation plan to the 1876 OS is several metres further north than the overall 'best fit' shown in fig. 3; this also applies to several other buildings and features. In this case, structure 335 may well form the termination of wall 324 (or of whatever lay on top of it, if it was a plinth rather than an upstanding wall at the end of the building, and structures 335, 324 and 361 may together form the remnants of a rectangular room or structure measuring some 12 x 6m occupying the SE corner of the building.

The 'Mills and Forges' Building

Immediately west of the latter building stood the 'mills and forges' building first shown on a plan of *c*1855 (**Fig. 5**), but believed to have been built in 1846. Like the previously described building this structure (**Fig. 29 & plates 25-28 & 30-32**) was also positioned on a SW/NE alignment. The excavated southern half of the building was found to have survived to a significant extent, therefore enabling more of an understanding of how the building may have functioned.

The foundations of the south-facing gable-end wall (235) survived largely intact. The Pennant sandstone wall, at least four courses high, was bonded with a hard, whitish grey mortar. It measured 15.48m long (E-W) x 1.35m wide (N-S) and was recorded at a height of approximately 143.8m aOD. Projecting about 0.3m from the top of the wall were four pier-bases (236, 237, 238 and 239) composed of the same materials as the wall itself. Photographs of *c*1895-6 (**Figs. 10 & 11**) indicate that they represent the bases of a set of three archways in the south-facing elevation.

The east side of the building, which appears to have been open-sided like the later nearby puddling forge building, comprised a series of roughly square plinths constructed of randomly coursed Pennant sandstone rubble, bonded with a pinkish white mortar, each of which would have supported a single cast iron column. Four largely extant plinths were recorded (153, 152, 197 and 227) along with, possibly, the partial remains of a fifth (265), each positioned some 4m apart. Feature 153 measured 1.2m x 1.36m, feature 152 measured 1.44m x 1.3m, feature 197 measured 1.39m x 1.2m, while the remains of the heavily truncated 227 measured 1.6m x 1.4m. The positioning of a concrete pile cap, probably associated with one of the modern light industrial units, was responsible for the apparently almost total destruction of the fifth plinth (265) located between features 197 and 227. Plinths 153 and 197 both had corroded cast iron mountings (196 and 241) still in-situ, set into their upper surfaces, to which a cast iron column would have been bolted. Those plinths, while some showed evidence of partial demolition, survived up to 0.27m high, above any surviving internal floor surfaces, traces of which (contexts 154 & 199) were recorded near the east side of the building.

Similarly, the west-side of the building would appear to have also been open-sided. However, only two roughly square-shaped plinths were recorded (features 212 and 214), both located towards the northern end of the excavated part of the building some 4m apart. Constructed of randomly coursed Pennant sandstone rubble, bonded with pale grey mortar, they each measured approximately 1.2m x 1.3m. Both also had corroded cast iron mountings (213 and 215) still in-situ, set into their upper surfaces to

which the base of a cast iron column would have been bolted. None of the three plinths that one would have expected to find to the south of plinth 214 were recorded. Their apparent absence can probably be explained by later demolition and subsequent disturbance. Any surviving remnants may lie beneath a substantial deposit of slag waste (context 210), which was present throughout the interior of the building.

Internally, the building was dominated by numerous roughly square features interpreted as chimney bases (eight of which were excavated – features 151, 204, 206, 209, 219, 220, 231 & 232), each of which is thought to have been associated with a reverberatory furnace. Evidence for the furnaces was provided by the presence of areas of heat reddened and blackened substrate (contexts 200, 221, 222, 224, 228, 229 & 262) between the chimney bases and the exterior of the building. These are interpreted as 'thermal halos' from reverberatory furnaces at a higher level, which did not survive directly. Located between chimney bases 231 and 232 was the only section of flue (233) recorded within the interior of the building. Of brick construction, the dimensions of the surviving L-shaped length of flue were 2.8m (E-W run) long x 2.2m (N-S run) long x 0.55m wide. Its' stratigraphic relationship with chimney 232 strongly suggests that the flue was constructed after the chimney. Several intact patches of brick floor were also recorded. One such surface (feature 199), located at 143.55m aOD, between plinths 152 and 197, comprised a number of yellow bricks laid lengthways on an underlying layer of greyish black sand (198). The exposed floor remnant measured 1.1m x 2.3m and was overlain by a compact deposit of black ash. An identical deposit, context 154, was recorded immediately south of plinth 153 at 143.65m aOD and was interpreted as a working surface. As on the east-side of the building, two surviving remnants of floor surface were recorded near the west side. Feature 216 was recorded at a height of approximately 143.8m aOD. It was a brick surface, measuring 1.1m x 2.2m and was composed of yellow bricks laid lengthways into the underlying yellowish brown clay deposit, context 207. An almost identical surface (258) was recorded, just a few metres away to the south, partially truncated by disturbance associated with another modern concrete pile (256). The surviving patch of brick floor measured some 1.6m (E-W) x 1.3m (N-S).

Between 1m - 2.2m beyond the SW-end of the building were the remains of two apparently contemporary structures (242 & 266) composed largely of Pennant sandstone masonry bonded with pale grey mortar. These appear on both a plan of *c*1855 (**Fig. 5**) and the 1st Edition O. S. map (**Fig. 9**) surveyed in 1876; on the latter, which matches the excavated evidence more closely, they appear as two squarish structures with a railway running between them and turning very tightly west to pass between the western structure and the main Mills and Forges building. This suggests that they may possibly have formed the supports for an overhead water tank serving the railway engines, or for a hoist for loading/unloading heavy goods between the railway and the building.

Casting House

Towards the south-west corner of the study area archaeology associated with the casting house (built 1839) was revealed (**Figs. 30 & 31 & plates 21-24, 29 & 45**). Parts of this building had already been recorded in 2005 (see evaluation).

Intact remains recorded during the latest programme of excavations included three Pennant sandstone rubble exterior walls (163, 366 & 389). Several surviving lengths of the eastern exterior wall (163 - 1.2m wide) were recorded at a height of approximately 144.39m aOD. The north-end wall (context 366 – 18m long x 1.5m wide) of the building was also uncovered, at approximately 144.1m aOD, much further north on the site than had been anticipated, based on its suggested position as shown on several mid/late 19th century plans. In addition, a heavily truncated length of the western exterior wall (389) was also recorded close to the western limit of excavation at a height of 144.14m aOD. That section of wall measured 4m long x 1.2m wide.

Within the interior of the former building were areas of yellowish orange sand (159), which were interpreted as remnants of the sand casting floor onto which the molten iron from the blast furnaces was run to solidify into pigs. Indeed, much waste iron was noted as being present within the deposit. The sand was partially sealed by a black indurated layer (161), the surface of which was recorded at 144.2m aOD. Also recorded, at a height of approximately 144.2m aOD, close to the western edge of excavation, were the remains of a partially truncated rectangular-shaped plinth (160) measuring 2.2m (E-W) x 3.8m (N-S). It was constructed using Pennant sandstone rubble (with some firebricks along the N-edge) bonded with pink and grey mortars. This end of the casting house appears to have been an unroofed pig-casting bed on the 1876 OS map; since there is no obvious machine or furnace to be expected in this location, the most probable interpretation is as the base for a crane, for loading cooled pigs onto the railways which threaded

the area. Recorded towards the northern end of the building was a linear feature (157), oriented N-S. It appears likely that the feature traversed the full length of the building – it certainly extended beyond the north-end where it was allocated the context number 367. It was constructed from firebricks, and had a concave base with a capping of cast iron plates (158), each measuring 0.99m long x 0.94m wide. The plates were about 300mm thick. This feature was most probably a drain, to remove any infiltrating water from the casting beds (where its contact with the molten iron could have had disastrous consequences). Towards the north-west side of the building, two small features (155 & 156) were identified, which may be remnants of internal partition walls in that part of the building. They were of identical construction, both being composed of Pennant sandstone masonry bonded with hard, whitish grey mortar.

Beyond the northern end of the casting house the only other features recorded (not including flue 367) were, due to the high degree of disturbance, very fragmentary. Some 4m north of the north-west corner of the building was located the remnant of a Pennant sandstone wall (393) bonded with pinkish white mortar. It may represent part of one of two iron works buildings (of unknown function) shown on the 1st Edition O. S. map (**Fig. 9**). East of the latter structure were two small patches of brick floor (391 & 394). They may originally have been contiguous, forming part of a larger working surface, but have been truncated by the cut (384) for a drain (385).

Towards the northern site boundary several structures possibly belonging to the second (northernmost) of the two iron works buildings just mentioned were recorded. They consisted of two short lengths of heavily truncated Pennant sandstone walls (377 & 382) that may have formed the south-east corner of the building. Both were of identical construction, the bonding material being a pinkish lime flecked mortar. However, abutting (north of) wall 382 was another section of Pennant sandstone wall which would seem to be a later rebuild, the mortar being a greyish coloured lime and charcoal flecked mix. Immediately east of (abutting) wall 382 was another possible flue-like structure comprising two narrow parallel walls (373 & 381) built of firebricks bonded with pinkish mortar. The fill was composed of black (378) and brownish red (379) silty sand. About 1m north of the latter structure was another small area of brick floor (374), a vestige of another working surface.

Boiler House

Another building that lay partly within the site was the remains of a boiler house (**Fig. 32 & plates 38 & 42**), at the southern limit of the excavated area. This structure was first mapped in 1855, and appears to have been modified by the time of the 1876 OS survey; it had been largely demolished by the time of the 1895 photos (**Figs. 10 & 11**), but a plinth in the centre of fig. 10 may be the remains of its boiler settings, immediately to the right of the massive chimney (which would have been just beyond the southern limit of excavation). This building had been very substantially robbed, the main surviving feature being a mass of rather incoherent sandstone and brick rubble interpreted as the base of the boiler settings. Within this the sites of three boilers could be discerned, mainly from the 'thermal halos' (contexts 279, 313 & 314) where the heat of the boiler furnaces had discoloured the Pennant sandstone rubble layers (including context 280) a deep reddish orange colour. Elements of three Pennant sandstone walls were recorded (272, 274 & 277), each bonded with pinkish mortar, but no direct structural relationships between the walls could be ascertained. At least two possible Pennant floor surfaces (278 & 293) were also recorded between the walls and surviving below the general level of truncation. These were probably the walls and floors of the ashpits beneath the boiler furnaces.

The only probable exterior wall recorded (context 325) also formed the south wall of part of a 2m wide tunnel (oriented E-W beyond the north wall of the building) as well as its junction with a N-S oriented tunnel that lay between the boiler house and the nearby rail mill. Since the walls and vaults of the tunnels showed no sign of heat damage or sooting it is likely that they carried steam pipes from the boiler house to the various steam-powered machines used in the rail mill and elsewhere in the ironworks.

Rail Mill

The space between the Boiler House (to the W) and the Rail Mill (to the E, and extending *c*10m further north than the Boiler House) was occupied by a large vaulted N-S tunnel formed by walls 325, 336 and 338 (**plates 33-35**), which was some 2.5m high from floor to crown of vault. This tunnel, which also measured some 2m wide, had a T-junction with the E-W tunnel already described along the north exterior of the Boiler House, and appeared to be an integral element of the design of both buildings. It is thought to have carried steam pipes (and perhaps other services) from the Boiler House to engines (and perhaps

steam-hammers) in the various contemporary works buildings. The tops of the vaults, in both tunnels, had been systematically removed, presumably to recover the pipes for scrap during the demolition of the works. Areas of surviving mortar surface (337 & 339), over the tops of the side-walls and the surviving sides of the vault, indicated the level of a surfaced yard/alley between the Boiler House and the Rail Mill, over the underground tunnels.

The tunnel and yard-surface were adjoined to the E by the substantial remains of the Rail Mill (the 'New Mill' on the *c*1855 plan) (**Fig.33 & plates 33, 41-42 & 50**); only the NW corner of this large structure lay within the excavated area. The original building was opened in October 1855 (**Fig. 5**) and was one of the largest in the world at that time. In February 1872 an extension (including nine puddling furnaces) was opened.

The external Pennant sandstone walls (contexts 343, 356 & 395), bonded using whitish grey mortar, were approximately 1.5m thick. The north wall (343) had no openings at the level of survival, though it became narrower at its E end, and was possibly overlain by the end of a northward return (356) 4.5m long, right on the edge of excavation; this may have been the W end of a smaller building attached to the NE corner of the Rail Mill, and added between 1855 and 1876 (compare figs. 5 & 9). At its W end, wall 343 returned S for *c*6m (externally) to a stopped end, separated by a gap of 7.5m from a probable resumption (395), again right on the edge of excavation. The wall and roof of the external tunnel (338) continued across this gap, and near its N end a brick-lined opening (340), 0.3m wide, led through wall 338, angled downwards to open into the shoulder of the vault of the tunnel. This presumably carried a pipe (or possibly served as a drain); since it aligned with the S end of structure 346/347 (see below) it may have carried the steam pipe for an engine on this plinth.

Internally, the NW corner was occupied by a plinth *c*1.5m square (344), with some further damaged stonework (345) to its east; the plinth may possibly have been a crane-base, or the chimney-base for a reverberatory reheating furnace. To the east of these, a massive plinth (346 & 347) of Pennant sandstone extended south from the north wall of the building,; it was 6.4m long x 3.3m wide, and consisted of heavy side-walls, with two much lighter stone walls along its top., 1.3m apart and each *c*1m from the respective outer faces of the plinth. Seven in-situ iron holding-down bolts projected from the surface of the plinth. The plinth in turn formed the west side of a rectangular cellar-like area, defined to the north by wall 355 (against the north wall of the building), and to the south by wall 348. The 'cellar' measured *c*5.5m x 3.5m, and was excavated to *c*1m deep from the surviving top of the plinth; however, its W side was occupied by another wall (349), 1.4m wide, with a flattish but un-surfaced top, forming a shelf *c*0.3m above the base of excavation. The east side of the 'cellar' was formed by the W side of what appeared to be another, squarish and badly damaged plinth (353 & 354), measuring *c*4m N-S and destroyed to the E; its north side defined an opening *c*2m wide between the 'cellar' and the north wall of the building. The plinth may have held a horizontal steam engine; the structures to its east cannot be reliably interpreted at this stage of research.

The only other apparently significant feature was a possible pier base comprising Pennant sandstone masonry bonded with hard grey lime and charcoal flecked mortar *c*3.5m S of the plinth and measuring 1m x 1m; this may have held a cast iron column which helped support the roof of the building.

The Watching Brief

The excavation was concluded on 7 February 2007 to be followed by a watching brief on the site, during the initial phase of construction groundwork, between April and June 2007. This latest monitoring (**see plates 51-66**) failed to reveal much additional archaeology beneath the footprint of the store other than an arched brick-built flue that had been concealed beneath the structure of the rail mill. In the areas beyond the footprint of the new store the stone piers of a late 19th century railway bridge (**Figs. 12-14**) were uncovered, plus the roof of a stone-built tunnel (all that survives of a Victorian three-arched railway bridge) which carried a railway line over the River Llynfi, while further extant remains of the rail mill were recorded beneath the rugby club car park, comprising part of the eastern exterior wall, the south-east corner of the building and two further plinths with integral iron holding-down bolts.

Interpretation

The excavation produced a total of two hundred and ninety-two contexts. Of these, forty-two contexts were assigned to features such as the cuts for pits and construction/robber trenches. A further one hundred and forty-nine contexts were assigned to walls/structures with the remaining one hundred and one numbers given to layers and pit fills. The contexts can be divided into the following periods on the basis of stratigraphical relationships and historical information:

Late 1830's
Mid 1840's
Mid 1850's
Early 1870's
Mid 1890's
Modern

The phasing of the excavation is given below and is based on analysis of the stratigraphy, the physical sequence of features, and detailed historical information. Virtually all of the contexts on the site related to iron processing and manufacturing activity dating from 1842, when the first blast furnace (No.4) was blown in, until the final closure of the works in 1884. Only a small minority of the contexts produced datable finds and their poor distribution through the stratigraphy provided little data with which to help interpret and phase the development of the site.

Period I (Late 1830's)

The earliest activity on the site was represented by structural remains of the casting house and two blast furnaces (Nos.3 & 4), all built in 1839. These remains comprised the Pennant Sandstone foundations of the north, west and east-walls of the casting house, the partially surviving casting floor composed of areas of yellowish-orange sand, and the base of a rectangular-shaped Pennant Sandstone structure, possibly a machine plinth [?], within the casting house.

Period 2 (Mid 1840's)

The only structure to be recorded that was built during this period of development on site was the *'mills and forges'* building thought to have been erected in 1845-6 and brought into production in February 1846.

Period 3 (Mid 1850's)

Most of the building remains recorded on site date from this decade and are associated with the second major phase of development of the Llynfi Vale Iron Works in the years 1853-55. The structures, all dating from *c.*1855, are the *'new puddling'* (forge) building, the *'new mill'* (a rail mill) and *'boilers'* (a boiler-house).

Period 4 (Early 1870's)

The sole structure known to date from this period, part of which lay within the study area, was an extension to the *c*1855 rail mill, which was enlarged *c*1872.

Period 5 (Mid 1890's)

The post-Iron Works archaeology that was recorded during the excavation consisted solely of demolition rubble and slag waste in a matrix of dark brown topsoil sealing the remains of the various buildings and their internal features.

Period 6 (Modern)

This stratigraphy is associated with 20th century activity on the site, with it being used during much of the century as railway sidings and by a bus depot and then subsequently by the Cornstores Industrial Estate and as car parking for the neighbouring Maesteg Rugby Football Club and Maesteg Sports Centre. The small industrial estate comprised two single-storey buildings that were subdivided into several light-industrial premises. Those two buildings, which sat on piled foundations, and associated areas of hard standing were demolished in late 2006 immediately prior to the commencement of the latest programme of archaeological excavation.

DISCUSSION, by David Cranstone

The Llynfi Ironworks can be summarised as a medium-sized mid-19th century blast furnace and forge sector works, seemingly fairly typical for the South Wales iron industry. The surviving historical record is relatively poor, with no detailed business records and few surviving plans or other design drawings. The archaeological record was of moderate quality and difficult to excavate under extremely inclement winter conditions; the site was quite heavily truncated, and in many areas slag-dominated post-abandonment deposits directly overlay pre-construction slag-dominated substrates, with no surviving floor or yard surfaces between the 'pods' of surviving substructures, cut-in features, and use-period stratigraphy. However, these conditions now appear to be rather typical for the emerging archaeology of 19th-century ironworks, and the issues that they raise are therefore of broader importance. The area of excavation was determined by the 'footprint' of the ensuing development rather than by any research criteria. Again this is typical, and indeed a revision of the footprint in the light of the evaluation, to avoid the furnace base located in Trench 6 and hence to exclude it from excavation, represents a success for the conservation process.

Despite its obvious importance to the British economy and the development of industry and technology, and to broader narratives of industrialisation, empire, and society, the 19th-century iron industry has until recently received remarkably little archaeological or site-historical attention (with the exception of early-19th-century masonry-stack blast furnaces, reasonably well-covered in consequence of their good field survival and iconic character). This applies with particular force to the forge sector. In the present decade this situation is starting to change rapidly, with increasing numbers of excavations (largely in development-control contexts). However, as yet these excavations have rarely been disseminated beyond 'grey literature' reports and unpublished conference papers (Llynfi may indeed be the first to be formally published), or in some cases public display material on-site (commendably more accessible to the general visitor and local community, but not to the professional and academic communities). Archaeo-metallurgical approaches are also very much in their infancy. A recent Historical Metallurgical Society workshop (http://www.hist-met.org/sheffield2008.html) has allowed a broader picture to be seen, and this discussion draws heavily on the currently unpublished papers given at this workshop.

Modern historical understanding of the 19th century forge sector (still based on Tylecote (eg 1976, 105-155; 1991) in the absence of a more-recent synthesis) still relies heavily on the major contemporary published books (eg Scrivenor 1841, Truran 1855 and 1862, Fairburn 1861, and especially Percy 1864), with more limited and selective use of contemporary journal articles, and surprisingly limited use of primary documentation such as works plans. This may well be projecting a

simplified, over-standardised and 'manager's-eye' view of what (on a close reading of even these sources) was probably a complex reality. The archaeological record, of what actually happened on the ground, should and hopefully soon will offer an independent perspective, in dialogue with the historical record. Archaeo-metallurgy, of refractories, vitrified and heat-affected structures and other process residues as well as the more traditional slags and metal products, must also form an essential element of any archaeological approach. However at present we are still at the stage of 'calibrating the record' of sites, structures and residues, before this dialogue, and other more sophisticated research questions, can be fully developed.

A major feature of the Llynfi excavation was the vaulted brick tunnels. At Llynfi, these were fairly uniform in construction and showed no evidence of vitrification, thermal reddening, or surface encrustations, and since they appear to radiate from the site of the boiler house (as determined by both historical and field evidence) they are interpreted with reasonable confidence as having carried steam pipes from the central boiler facility to steam engines powering the various squeezers, rolling mills and other machinery of the works; they may also of course have carried other pipework, and/or functioned as air inlets. On other sites, a much wider range of tunnels, flues, culverts, and pipe-runs is often encountered, serving a much wider range of functions; field observation of such features as stanchions for pipes (not seen at Llynfi, where only limited exposure of the interiors was possible), and scientific examination of vitrified and other heat- and/or chemical-affected surfaces and of any encrustations, is likely to be crucial for interpretation. The presence of substantial underground voids (which do appear to be a normal feature of most 19th century ironworks sites), potentially close beneath the foundations of any new development, also has obvious implications both for the stability of the development and for safety during developent and pre-development works.

Another major element was the number and variety of machine-bases, plinths and other substructures. Some of these can be clearly identified as machine-bases from their complex forms, and/or the presence of substantial holding-down bolts or bolt-holes; in principle many of these should be interpretable in detail, by comparison with those contemporary illustrations which show mountings and substructures. However simple or truncated mountings are not always clearly distinct from plinths and other foundations. A further complication in interpreting the latter is the open-sided nature of many ironworks buildings, designed to dissipate the heat from the furnaces and other processes. Even so, conditions could become intolerable in summer (Truran 1862, 210). While gable ends tend to be walls of conventional brick or masonry form, sides of building frequently consisted of widely-spaced brick or iron columns, resting on squarish plinths or foundations respectively. Crane- and chimney-bases can look very similar.

A case in point is the 'Mills and Forges' building, where the area behind the gable wall was occupied by (at first sight) a confusing array of square mortared-rubble foundations, and areas of reddening in the various slag and earth layers of the substrate between these. On closer examination, the square foundations resolved into two outer lines of smaller unburnt plinths with small iron mountings on their tops (where these survived) representing the outer wall-lines; and two inner lines of larger heat-reddened foundations, each with a vaguely-rectangular area of heat-reddened substrate running from its outer side to just short of the outer wall-lines. These are interpreted with reasonable confidence as the 'signatures' of reverberatory furnaces at a higher level, the reddened areas being the thermal halo of the actual furnaces, and the square foundations being the bases for chimneys at the inner end of each furnace, presumably rising through the roof of the building (**see Fig. 6**). This corresponds nicely with the internal layout of the puddling forge at Dowlais as illustrated by Truran (1862, Pl 52). However, contemporary illustrations of puddling furnaces, whether 'wet' or 'dry', consistently show that the lower part of the box-like external structure was occupied by a substantial air chamber beneath the cast-iron baseplate of the working hearth, and this may well have been essential to prevent melting of the plate; it is doubtful whether a puddling furnace of this form would have produced such a substantial thermal signature some distance beneath its base, and it seems unlikely that old-style sand-bottomed furnaces (which often were built direct on the substrate; Truran 1855, 137) would be present in a forge constructed in the 1840s or 1850s. It is therefore possible that the reverberatory furnaces were 'balling' furnaces, used for reheating the iron during rolling to bar or rails; these were sometimes built up direct from the substrate with no intervening void (Truran 1862, Pl 66); however the absence of any obvious rolling mill bases in the vicinity argues against this interpretation.. On balance, the puddling furnace (or strictly 'boiling furnace' in Truran's terminology) interpretation seems the more probable, but some uncertainty remains.

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ACKNOWLEDGEMENTS

Bristol and Region Archaeological Services (BaRAS) wishes to thank Neil Maylan of Glamorgan-Gwent Archaeological Trust Limited (GGAT), Laurence Burr of CADW, Keith Willams of Morbaine Limited, Bill Kendrick and Mat Forde of Willard Project Management Limited, and David Files (Project Manager) and Tony Dummett (Site Manager) of Britannia Construction Ltd, Martin Morris (slew operator), and Chris Morgan (slew operator) and Alan Billingham (dumper driver) of J. McCarthy Plant, the site team from KTL Groundworks, the specialists Dr Tim Young of GeoArch Consultancy for his analysis of and report on the metallurgical residues, David Cranstone for his significant contributions and advice on the South Wales iron industry in the nineteenth century and the development of the Llynfi works, and Stuart Whatley for his analysis of and reports on the various finds. Thanks also to Bruce Williams (Manager, BaRAS) for his management of the project and to Ann Linge (Design & Production Officer, BaRAS) for her work on this report, as well as the BaRAS site team of Kevin Potter (Deputy Project Supervisor), Dave Stevens (Surveyor), Nick Corcos, Joss Davis, Jane Harris, Rachel Heaton, Jim Toseland, Gareth Wilkinson and Steve Yeates. BaRAS also wishes to thank members of the Llynfi Valley Historical Society, particularly Neil Perry, for their assistance and cooperation.

David Cranstone adds his thanks to the BaRAS team, to Dr Tim Young, to the staff of the Literary and Philosophical Society and the Mining Institute Library (both of Newcastle upon Tyne) for their help during research for the project, to Rob Kinchin-Smith (now of RPS Planning & Development Ltd) and Jon Gill (Oxford Archaeology) for copies of the Tondu Assessment Report and for valuable discussions on 19th-century ironmaking, and to all contributors (both from the rostrum and the floor) to the Historical Metallurgy Society workshop on *'19th Century Ironmaking'* held at Sheffield in April 2008.

APPENDIX 1: Policy Statement

This report is the result of work carried out in the light of national, devolved and local authority policies.

NATIONAL POLICIES

Statutory protection for archaeology is enshrined in national legislation passed in the Westminster Parliament, including the Ancient Monuments and Archaeological Areas Act (1979), amended by the National Heritage Act, 1983. Nationally important sites are listed in the Schedule of Ancient Monuments (SAM). Scheduled Monument consent is required for any work that would affect a SAM.

Welsh Office Circular 60/96 – Planning and the Historic Environment: Archaeology

Paragraph 8 states that:

Development plans should reconcile the need for development with the interests of conservation, including archaeology. They should include policies for the protection, enhancement and preservation of sites of archaeological interest and their settings.

Paragraph 10 states that:

The desirability of preserving an ancient monument and its setting is a material consideration in determining a planning application whether that monument is scheduled or unscheduled.

Paragraph 18 states that:

There will be occasions, particularly where remains of lesser significance are involved, when planning authorities may decide that the significance of the archaeological remains is not sufficient when weighed against all other material considerations, including the need for development, to justify their physical preservation in situ, and that the proposed development should proceed. Planning authorities will, in such cases, need to satisfy themselves that the developer has made appropriate and satisfactory arrangements for the excavation and recording, or other investigation, of the archaeological remains and the publication of the results.

Paragraph 19 states:

From the archaeological point of view excavation should be regarded as a second best option…. The preservation in situ of important archaeological remains is therefore to be preferred.

Paragraph 20 states that:

Archaeological investigations, such as excavation and recording, should be carried out before development commences, working to a project brief prepared by the planning authority (with reference to their archaeological advisers). Investigation can be achieved through agreements reached between the developer, the archaeologist and the planning authority. Such agreement should secure and implement an appropriate scheme of archaeological investigation, to an agreed timetable, and provide for the subsequent publication of its results.

DEVOLVED POLICIES

Planning Policy Wales (2002)

Current land use planning policy is contained in 'Planning Policy Wales' (2002), drawn up by the Welsh Assembly Government, which provides the strategic policy framework for the effective

preparation of local planning authorities' development plans.

Planning Policy Wales (2002, section 6.5) indicates that archaeology forms a material consideration in the planning process and states that there should be a presumption in favour of the preservation of nationally important archaeological features and sites, whether scheduled or not. Where local authorities decide that preservation *in situ* is not justified and destruction of the archaeological remains may proceed, they must be satisfied that the developer has made appropriate provision for archaeological investigation, recording and publication (ibid, para. 6.5.3).

Paragraph 6.5.1 states that:

The desirability of preserving an ancient monument and its setting is a material consideration in determining a planning application, whether that monument is scheduled or unscheduled. Where nationally important archaeological remains, whether scheduled or not, and their settings are likely to be affected by proposed development, there should be a presumption in favour of their physical preservation in situ. In cases involving lesser archaeological remains, local planning authorities will need to weigh the relative importance of archaeology against other factors, including the need for the proposed development.

Paragraph 6.5.7 states that:

Where a development proposal affects a listed building or its setting, the primary consideration is the statutory requirement to have special regard to the desirability of preserving the building, or its setting, or any features of special architectural or historic interest which it possesses.

LOCAL POLICIES

Unitary Authority Policy

Bridgend County Borough Council has included two policies on 'Development and Ancient Monuments' (Policies EV47 & EV48) in its Unitary Development Plan. In this particular instance the term *'ancient monument'* refers to nationally important monuments, whether scheduled or not. Policy EV48 refers to mitigation measures, which may either:

- Preserve, protect and enhance the archaeological remains and their surrounding setting 'in-situ'; and/or

- Facilitate the excavation and proper recording of the detail, extent and characteristics of the site, its artefacts and remains, and where appropriate, their rescue

The local planning authority (Bridgend County Borough Council) had indicated that an *'archaeological excavation and the subsequent recording of non replacement archaeological assets'* should be secured for this site.

APPENDIX 2: The Finds by Stuart Whatley

The Glass

Introduction

The glass assemblage from the excavation at Llynfi Iron Works was analysed to assess its potential for further work. In considering this potential due regard was given to the needs of site interpretation and to work already published on similar material both locally and regionally.

Methodology, Quantification and Discussion

The glass was quantified by the number of fragments and the material was scanned to identify the major types of glass present: window glass, bottle glass and other types of vessel. An attempt was made to date the glass where the fragments were especially diagnostic and apparently not residual in later contexts.

Unstratified Glass

A total of six bottles were retrieved in near immaculate condition from unstratified contexts and dated from the nineteenth and early twentieth centuries. The small assemblage consisted of a flat-bottomed Hamilton bottle from Pontyclun, a Codd style bottle from 'South Wales Glass Makers', Newport and a blue glass rim from the Bristol factories.

Stratified Glass

The only stratified glass sherd was from context 366. This comprised one body-sherd of a nineteenth century transparent aqua glass bottle with an internal screw top rim.

The Pottery

Introduction

The pottery assemblage was examined to assess its potential for further work. In considering this potential due regard was given to the needs of site interpretation and to work already published on similar material both locally and regionally. The method of study, results and recommendations are the subject of this report.

Methodology

The pottery was quantified by sherd count and weight using an electronic digital balance. The material was scanned to identify the major fabric types present and provisionally dated by the presence or absence of key date types.

Quantification

The assemblage consisted of 16 sherds weighing 1097g. The sherds were retrieved from 2 stratified contexts or were unstratified from the overburden.

The pottery is fragmentary from stratified deposits. A few complete vessels were also collected from un-stratified contexts to increase the knowledge of the fabric series in the locality.

Apart from one possible early post-medieval sherd, the majority of the assemblage dates from between the late 18th and early 20th century.

Early Post Medieval:

A single glazed Ewenny-type handle from a jug or storage vessel. Slightly abraded and from an unstratified context.

Late Post-medieval:

There were four stoneware sherds and one whole stoneware vessel retrieved from unstratified contexts weighing 608gm. There was a small stoneware inkpot, whose form dates to the nineteenth century, probably of local manufacture. Two of the four stoneware sherds were from a ginger beer bottle from the Price and Powell Company in Bristol. The other two sherds were from stoneware bottles.

Ten body sherds from a 19th-century stoneware storage vessel were retrieved from context 201, and a single 19th-century yellow glazed jug type handle was retrieved from context 210.

The Clay Tobacco Pipe

Introduction

The clay tobacco pipe assemblage was analysed to assess its potential for further work. In considering this potential due regard was given to the needs of site interpretation and to work already published on similar material both locally and regionally.

Methodology

The clay tobacco pipe was quantified by number and weight then scanned to identify the major types of clay pipe present. An attempt was made to date the clay pipe where the fragments were especially diagnostic and apparently not residual in later contexts.

Quantification

One clay tobacco pipe bowl, weighing 9gms, was recovered.

Date Range

The clay tobacco pipe bowl dated from the mid-nineteenth century.

Discussion

The clay pipe bowl is decorated with vine leaves, a style common in the mid-19th century. The makers' mark was found on the bowl.

Iron artefacts

Introduction

The iron artefact assemblage was analysed to assess its potential for further work. In considering this potential due regard was given to the needs of site interpretation and to work already published on similar material both locally and regionally.

Methodology

The iron artefact assemblage was quantified by number and weight and then scanned to try and identify each iron object. The iron artefacts were given a brief description, then measured and drawn. An attempt was made to date the iron artefacts where they were especially diagnostic and apparently not residual in later contexts.

Quantification

A total of 12 iron artefacts were examined. The artefacts were all structural artefacts or tools.

Date Range

The iron artefact assemblage dated from the mid-nineteenth century, with one modern find comprising two objects fused together dating from the mid/late-twentieth century.

Discussion

The ironwork was all very corroded and discoloured, with all fragments containing exterior corrosive growth. The objects were mostly structural artefacts, which was largely expected on a nineteenth century industrial-site.

Seven artefacts were unstratified comprising three large screws and four large iron rods. The stratified objects comprised a cast-iron tuyere, which had been re-used in the construction of wall 295, while from context 296 a large iron rod, a hexagonal iron nut and a large fused valve and spanner were recovered.

The tuyere is undoubtedly the most interesting object to have been found. A cast-iron funnel or pipe, through which air is forced into a blast furnace or forge to facilitate combustion, it is likely to have been either used somewhere within the 'new puddling' (forge) or has been redeposited from elsewhere within the former ironworks site.

APPENDIX 3: Metallurgical Residues and structures from an evaluation at Llynfi Ironworks, Maesteg, by Dr Tim Young

Abstract

Materials sampled during the evaluation fall into two groups.

In material from the earlier group there is evidence for iron smelting, with a casting floor sand deposit in trench 3 and a dump of hot-blast blast furnace slag in trench 1.

These earlier features are then covered with a dark deposit, now hard and concreted, containing a higher proportion of residues from secondary puddling and forge processes. Particularly noteworthy is the deposit in context 305 of abundant sub-mm scale slag spheres (spheroidal hammerscale), which are probably the spatter from a power hammer. These deposits indicate that the evaluated area was more influenced by the secondary processing than the primary smelting of iron at this period, possibly indicating abandonment of the northern furnaces during the later history of the ironworks.

Background

The metallurgical residues discussed in this report were sampled during BaRAS' evaluation on the site of the former Llynfi Ironworks in December 2004 (Trenches 1 and 3).

In the context of the nature of this particular evaluation, it was considered most appropriate to discuss on-site the significance of materials, deposits and structures with the field staff. Only a very limited amount of significant stratified deposits were dug, therefore there is only very limited reporting on the metallurgical residues retrieved.

The descriptions are limited to visual observations. No petrographic, analytical or sieved grain size analysis has been undertaken.

Description

Context 305

Hard, dark, heterogeneous, concretionary layer. The fine matrix contains a large amount of sand, broadly comparable with that present in 310/311, but containing a large admixture of other materials. These include small pieces of coke, coal and shale, together with larger pieces (up to several 10s of mm) of slag. The slag clasts are dominantly of dark, almost black, vesicular glass, but also include rarer pieces of dense fayalitic slag. The deposit is cemented by large amounts of iron oxides, indicating a large availability of iron in the deposit, most likely from corrosion of metallic iron.

Most significantly, the finer grained parts of the deposit contain a large proportion of slag spheres (spheroidal hammerscale). These spheres are mostly in the range of 100-600μm in diameter, with a hard, shiny exterior. This material is most likely to represent spatter produced by a power-hammer (probably during the production of wrought iron from puddle blooms).

Context 306

Hard, dark, heterogeneous, concretionary layer. The sampled material was rather more sand-rich than the material from 305, with the sample from 306 apparently lacking the spheroidal hammerscale. Given the heterogeneity of the deposit and the small sample size, the significance of the difference is unknown. The material was rather variable cemented, with some pockets of very poorly indurated material. The material was seen to be particularly well-cemented adjacent to fragments of scrap wrought iron, including both rod up to about 40mm diameter and bar of about 40mm width.

The slag inclusions within the sandy matrix include the same dark vesicular glass as in 305, but also contain some pieces of paler glassy slag, probably blast furnace slag.

Context 311

Yellow-brown concretionary layer of sand, dominantly in the very fine sand class (but rarely up to about 600μm, particularly in small angular chips of chert/flint), well-cemented by iron oxides. The material contains some small clasts of other materials, particularly coke, especially near the top. This material is essentially the same as 310 but having undergone post-depositional cementation.

Context 310

Unconsolidated very fine sand. Grains with moderate to good sorting and with shapes varying from sub-rounded to well-rounded. Grains dominantly quartz (>95%). Some small localised patches of partial cementation occur.

Context 106

A highly heterogeneous mix of metallurgical residues and demolition material. Sampling was restricted to a few more unusual clasts, including a 17mm diameter section of wrought iron rod, a piece of probably only partly reacted iron core and some dense iron oxide-rich slags.

Context 108

Unconsolidated and uncemented loose accumulation of blast furnace slags. The slags vary from a pale/mid grey crystalline material, through to dark, usually greenish glass. Rare patches of bright blue glass are seen in some specimens. The texture and colour of this material would indicate that it is hot-blast slag.

Discussion

The metallurgical residues recovered, together with those observed in-situ, suggest a broadly two-fold division of deposits. The earlier deposits are almost entirely from iron smelting, whereas the younger deposits have a dominant input from the secondary processes of puddling and forging.

The major deposit seen in context 108 suggests that a large body of blast furnace slags may underlie that part of the site. It may be significant for the development of the site that these slags are loose and uncemented with a high bulk porosity. Cranstone has suggested that the stratified slag dump may preserve a history of changing blast furnace technology, but it is not possible to indicate where within that story the present material lies. The close proximity of trench 1 to the blast furnaces, and the location of the trench in front of the northern furnaces may suggest that these slags are likely to be relatively early within the site development.

Also presumably early in the site history is the structure seen in trench 1, where context 310 (and its secondarily cemented top, 311) is likely to represent the base of the casting sand, within a casting house. This is located in the 'gap' between the northern two furnaces (Nos. 3 and 4) , but apparently associated with the northernmost furnace (because it lies to the north of the 'partition'). This association is strengthened by the apparent skew seen on the line of the dam on the northernmost furnace in trench 5.

Both the casting floor material in trench 3 and the unconsolidated blast furnace slags in trench 1 are overlain by an extremely hard, cemented, dark sandy layer (305, 306). The residues from this are mixed, but bear significantly more material associated with the secondary processes than the earlier deposits. This includes small fragments of dense slag, likely to be from puddling hearths, but particularly the large amount of spheroidal spatter in context 305. Whether that spatter arrived in the deposit directly, or by some secondary process of redeposition, cannot be determined on the present material. This concretionary dark layer is therefore likely to represent usage of the site, not demolition, but under a very different organisation than in the earlier period. The evidence is compatible with the layout seen on the 1876 OS, by which time the northern furnaces do not appear to have a casting house. The investigated area appears as open ground between the northern blast furnaces (possibly not then in blast) and the processing sheds, possibly partially covered by an open sided building, and crossed by several tramways.

APPENDIX 4: Archaeometallurgical residues from Llynfi Ironworks, by Dr Tim Young

Abstract

Bulk samples from an excavation at Llynfi Ironworks have been evaluated through the extraction and wet sieving of small sub-samples.

Only Sample #4 was potentially closely linked to direct metallurgical activity. It comprised spheroidal hammerscale, probably representing spatter from a steam-hammer or similar equipment.

Sample #1 was clinker from a coal-fired hearth, quite possibly a steam boiler. Samples #6, 7, 9, 11 were all dominated by fine-grained coal detritus. Some of these samples, and possibly all of them, were laminated and therefore possibly at least partially water-lain.

Samples #2 and #3 were somewhat similar in the nature of their brown clay matrix. Both were rich in coal detritus, but #3 also contained a great deal of varied gravel-grade debris from a variety of sources.

Samples #5 and #10 contained assemblages of rather coarser detritus, including slag fragments as well as fuel-related materials. These detrital materials were very varied, indicating that the material was not associated with any particular metallurgical process.

Sample #8 comprised a tough dark slabby material, containing a fibrous substance. This was not examined in detail because of the risk of this material being asbestos. The sample was likely to have been some form of pipe lagging.

No bags labelled #12, #13 or #14 were present. However two bags with no labels were present. The contents of these bags appeared similar (so were presumably either #12 or #13). The material comprised an ochreous collection of mixed coal detritus and varied slags. One sample contained soft material, possibly degraded leather or rubber.

Methods

The samples were tested to assess the likelihood of yielding significant information. Small sub-samples of each bulk sample were examined and wet sieved at 100µm. The residues were examined optically using a handlens or binocular microscope as appropriate.

Because this is an evaluation the identifications and interpretations offered are not intended to be definitive and are limited by the optical approach employed.

Results

Sample 1 (C138): ochre-coated contorted clinker bearing abundant fired shale fragments. The clinker is dominantly of a rather pale colour and much seems to have the form of twisted plates.

Sample 2 (C145, fill of 108): soft brown clay containing coal debris (dominant) and a little spheroidal hammerscale. The coal debris is mainly very fine grained. There is also a range of fragments of a khaki coloured mudstone.

Sample 3 (C147, fill of 115): brown clay, containingcoarser and more varied debris than sample 2, including slag fragments, spheroidal and flakehammerscale, brick, coal and fired coal shale.

Sample 4 (C148, fill of 102, 103, 113, 135 & 136): dense mass of spheroidal scale up to 2mm in diameter, bearing a few larger slag lumps, mainlydense slag fragments. Mostly uncemented material, although some lumps of material possibly cemented bysecondary corrosion products are included.

Sample 5 (C144, fill of 122): mixed coarse debris, including blast furnace slag, limestone, coal, coal shale, clinker, mortar, and sandstone.

Sample 6 (C149): fine coal debris, mainly sand grade, rarely extending up to 10mm. Includes a very smallproportion of coke fragments, but dominantly unburnt.

Sample 7 (*C250, fill of 217/249; 2 bags)*: soft blackfinely-layered sediment. Finest grades probably coal fines or soot, sieved residue dominated by sand grade coal particles. It has small enclaves of yellow-brown quartz sand, of uncertain significance. The material includes some coarse grains including rounded blistered masses, which appear to be a low density fuel ash slag.

Sample 8 (C283): fine dark material, locally hard and concretionary, which was fractured to reveal that it was bound by fibrous, transparent brown hair-like material. This would appear to be lagging. This material may well contain asbestos, so is not being examined further at this stage.

Sample 9 (C370): dense cemented layer of dark material. Although indurated, this material otherwise resembles closely the material in Sample 7. It is dominated by small sand-grade coal particles, it contains soft quartzose sandstone grains a few mm in diameter, and harder pale sandstone fragments, sometimes with glazed and clinker coated surfaces.

Sample 10 (C376): up to several tens of mm fragments of iron, limestone, coal, coal shale, fired coal shale and bottle glass, cemented probably by the corrosion of the iron inclusions. This is very heterogeneous debris.

Sample 11 (C305): soft black material apparently dominated by coal fines, but also bearing some small proportion of hammerscale.

Sample unlabelled: ochre-rich partially cemented material bearing clasts of vesicular low density and high density slags. The material is apparently dominated however, by cemented coal debris. Also contains a few rare grains of probable spheroidal hammerscale.

Sample unlabelled: description as previous unlabelled bag. Also includes small soft fragments of degraded leather or rubber?

Interpretation

Only sample #4 was close to being a deposit of primarily metallurgical character. It is almost entirely composed of small spheroidal bodies. Such spheroidal particles are most likely to be "spheroidal hammerscale". These are slag droplets expelled forcefully from the work piece during hammering. Most examples in archaeometallurgy have been described from blacksmithing (Starley 1995), but it is clear that similar droplets are expelled during steam hammering, but on much greater scale (see http://www.youtube.com/watch?v=vRqLfiC7uCU for an early 20th century steam hammer in action).

The accumulation of the spheroids would not normally be permitted on the forge floor – so material such as sample #4 would be expected to accumulate in a secondary position. Somewhat similar material, although more indurated than the present sample was recorded in the initial evaluation of the site (Young 2005, context 305).

A group of samples (#6, 7, 9, 11) were all characterised by an abundance of coal fines. This ranges (in the sieved residue) up from sand-grade material to fragments several mm across. Several of these samples also contain slaggy material in the form of vesicular slag blebs and vitrified stone fragments. This material is frequently seen to have been laminated, but it remains unclear whether some or all were water-lain, or whether these were deposits from flues, with moving gas responsible for the particulate transport.

Sample #1 contained contorted pieces of clinker, comprising partially fused fragments of coal-shale. Such clinkers are not necessarily the waste from a metallurgical process (particularly given the lack of slag). It is more likely that these clinkers are derived from a coal fired hearth, such as a boiler.

Samples #2 and #3 were distinguished from all of the above group by a prominent brown clay matrix, rather than a black coal-dust rich matrix. Sample #2 contained only coal fines and pieces of a khaki-mudstone, whereas sample #3 contained a wider variety of clasts. These clasts appear to sample the whole range of particles likely to have been in the local environment including coal detritus, various stone, brick and mortar fragments, together with some slag.

Sample #8 has not been examined in detail, because cursory examination suggested it might be lagging material, and therefore very likely to contain asbestos.

Samples #5 and #10 contained assemblages of rather coarser detritus, including slag fragments as well as fuel-related materials. These detrital materials were very varied, indicating that the material was not associated with any particular metallurgical process. Sample #5 contained some blast furnace slag (separating this sample from the others). This might have been introduced as contemporary material from elsewhere on-site, but equally might have been derived from the underlying dump of blast furnace slag upon which the ironworks was built. Sample #10 contains a sherd of what appears to be bottle glass; again providing evidence for these coarse deposits as generalised waste accumulations.

No bags labelled #12, #13 or #14 were present. However two bags with no labels were present. The contents of these bags appeared similar (so were presumably either #12 or #13). The material comprised an ochreous collection of mixed coal detritus and varied slags. One sample contained soft material, possibly degraded leather or rubber. The high ochre context linked these samples with sample #1. The most likely source of the ochre is as a post-depositional precipitate resulting from the passage of iron-rich groundwater through the deposit. The source of the iron in such a situation is not limited to the ironworks waste, but may also be generated from water from coal mines or coal waste.

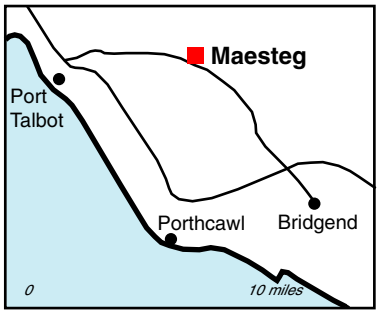
Conclusions

The samples have a rather limited potential to illuminate site activities and processes. Sample #4 is likely to represent residues from the operation of a steam hammer or similar equipment. Similar spheroids occur in several other samples (as well as in material from the site evaluation in 2004). This sample is the only one to show direct linkage to a particular metallurgical process. Its interest may lie in the apparent lack of documentary evidence for a steam hammer on the site, and if this is true, then documentation and analysis of the spheroids may prove useful. However, to the author's knowledge, no detailed description of steam hammer spatter has been published with which comparison could be made.

Material with high levels of coal fines may represent deposits from flues, but sediment texture may be more informative for depositional processes. Coal fines would likely to be widely distributed around the site.

Slag occurs in several of the samples, but it seems unlikely that there is a direct relationship (since the material in the samples is so mixed) between any of the slag-bearing samples and any particular metallurgical process.

The tentative identification of sample #8 as lagging material could be pursued if important to the interpretation, but for Health and Safety reasons (the potential of the sample to contain asbestos) this has not been undertaken.



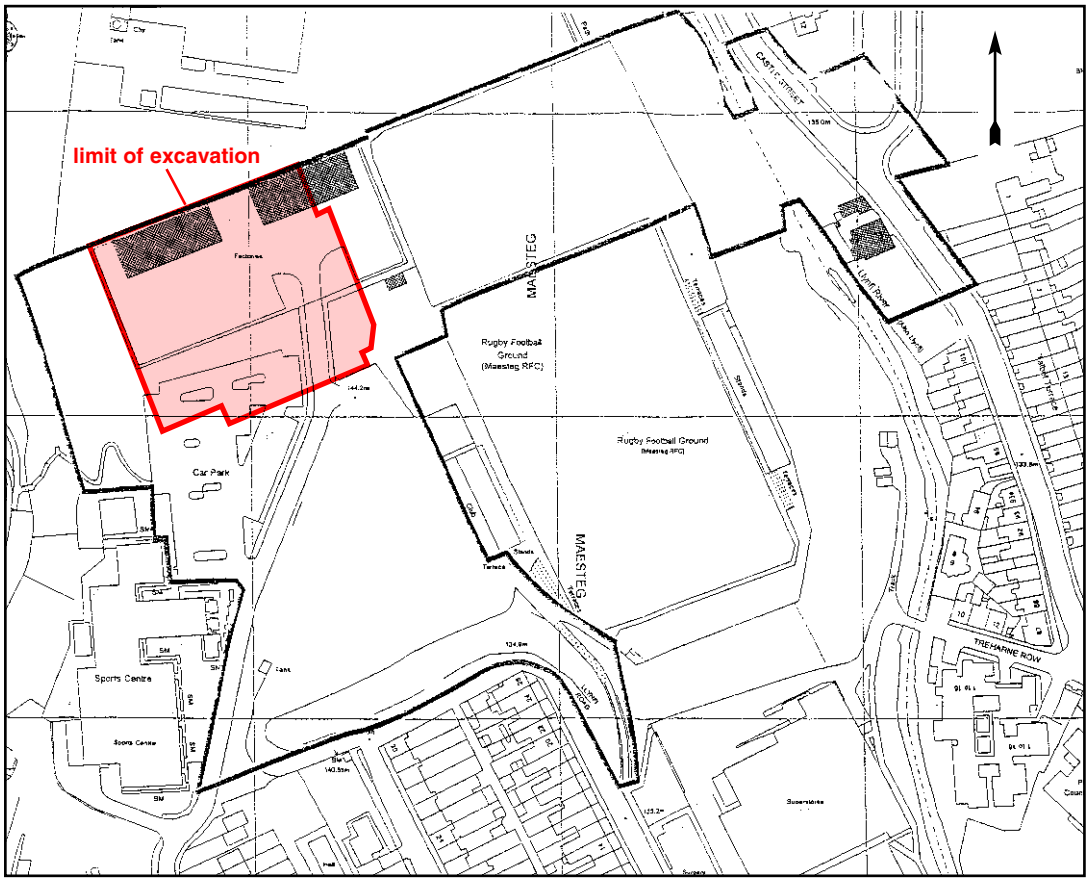


Fig.1 Site location plan, scale 1:2500

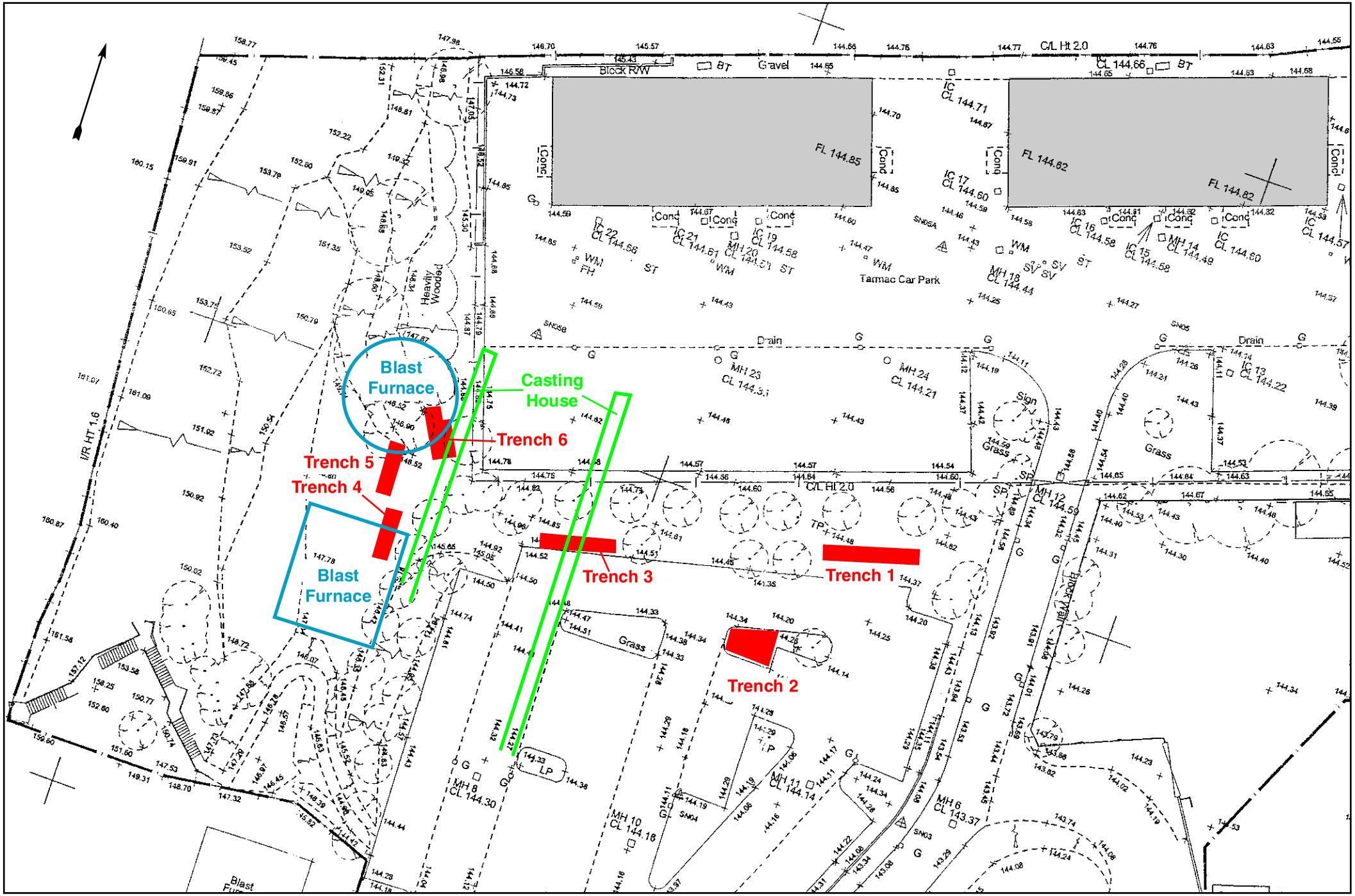


Fig.2 Plan showing location of 2005 evaluation trenches, (scale 1:500)

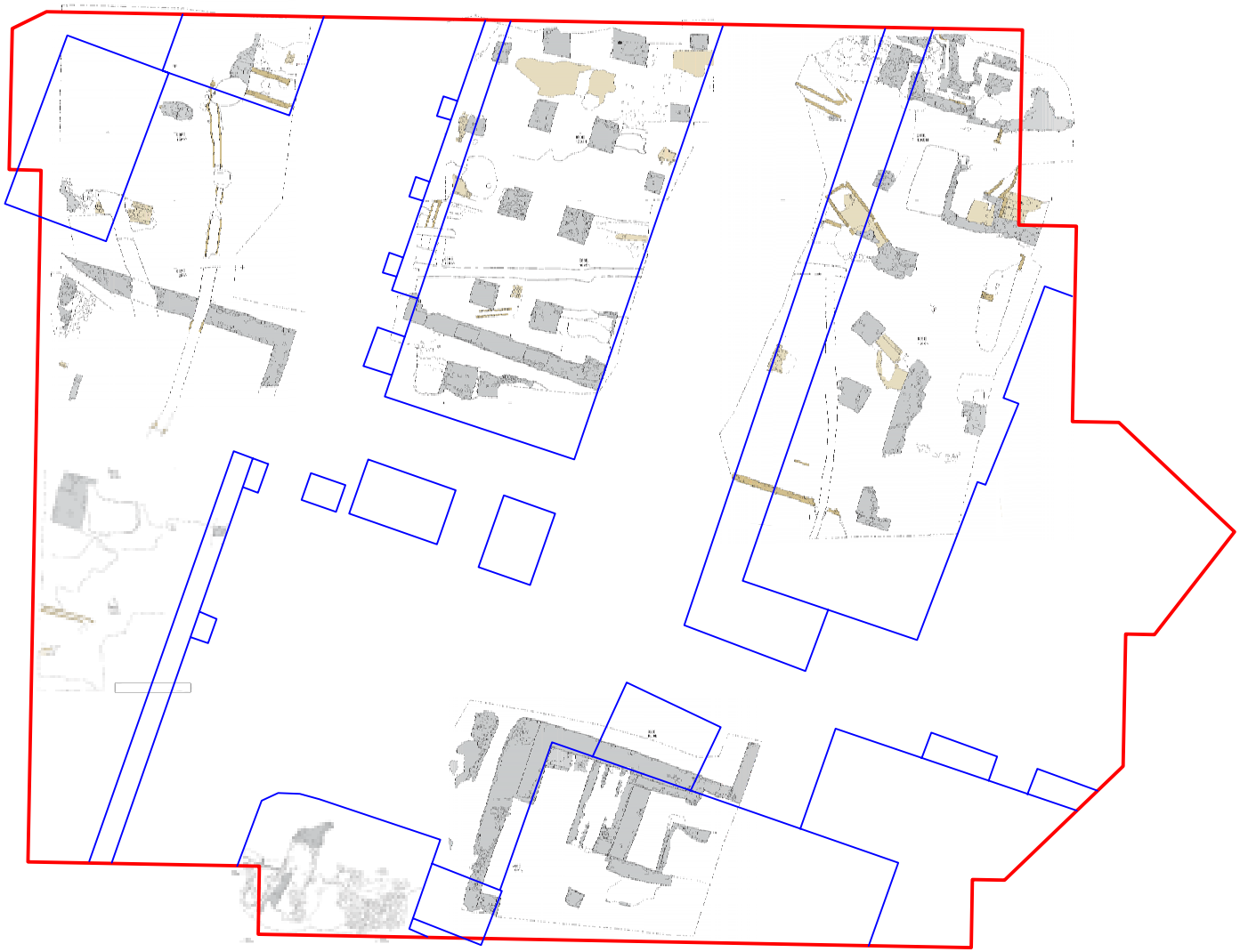


Fig.3 Site plan, showing the remains of the ironworks buildings excavated in 2006-7 (scale 1:500) overlain on 1876 Ordnance Survey Data

MAESTEG IRONWORKS		drawn by SR	drwg. no. 2009/MI/2
OVERALL SITE PLAN WITH 1876 ORDNANCE SURVEY DATA		date 18th February 09	
Bristol & Region Archaeological Services	St. Nicholas Church, St. Nicholas Street, Bristol, BS1 1UE. Tel: 0117 9039010 Fax: 0117 9039011 www.baras.org.uk	scale 1:500	

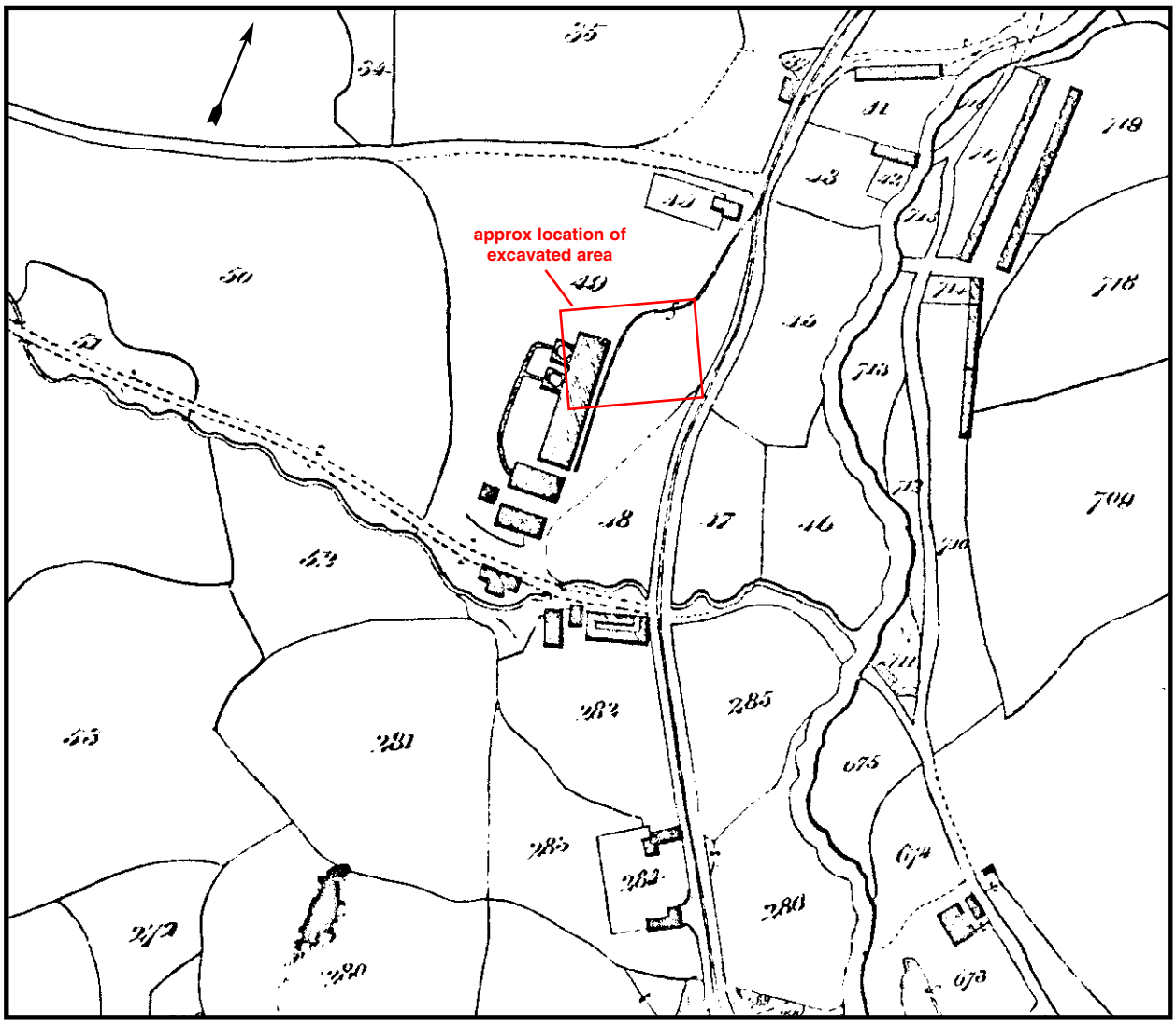


Fig.4 Extract from the 1841 Tithe map of Langondyd (Llangynwyd) parish

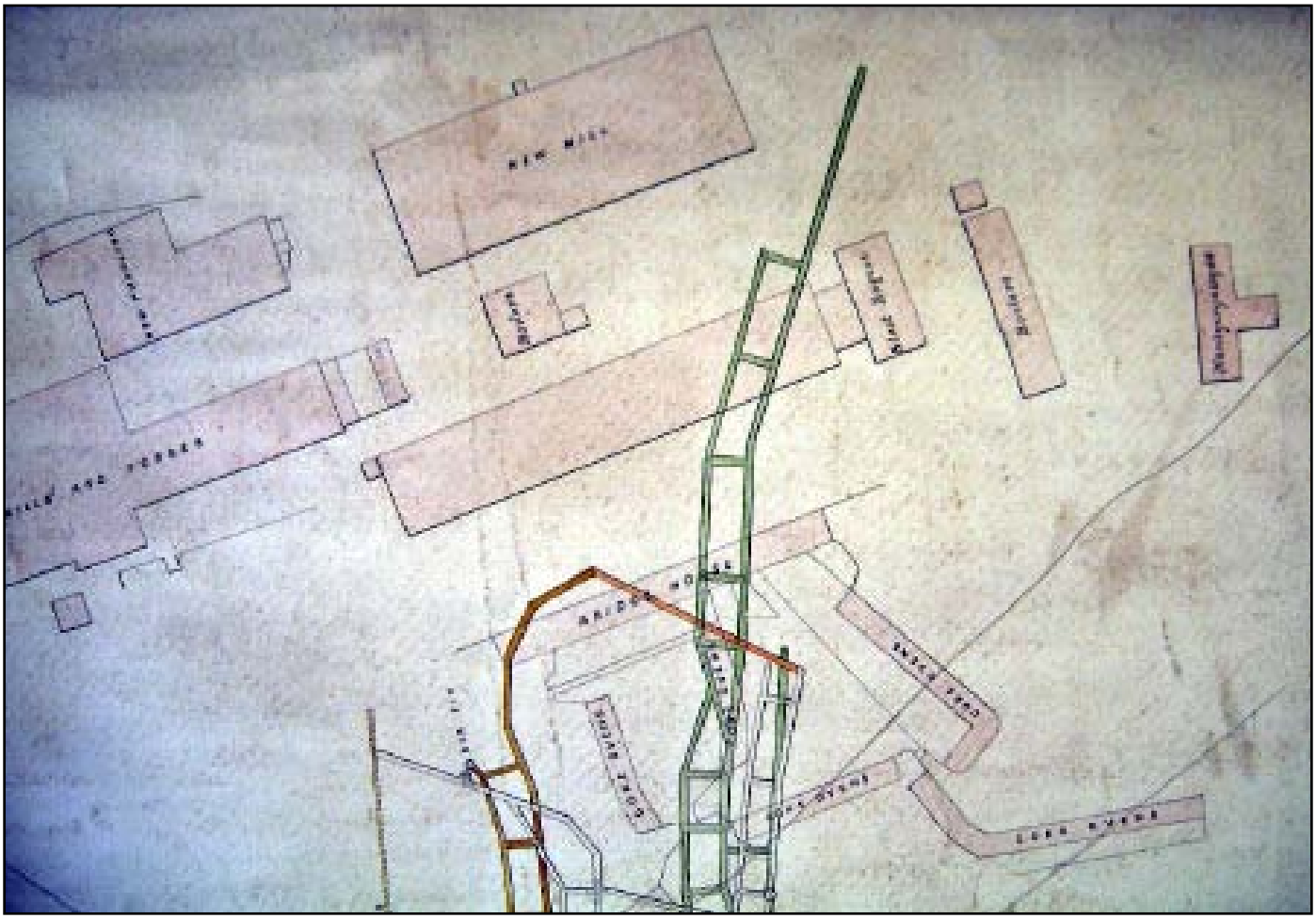


Fig.5 Extract from the c.1855 plan of Llynfi Iron Works – also shows underground coal workings

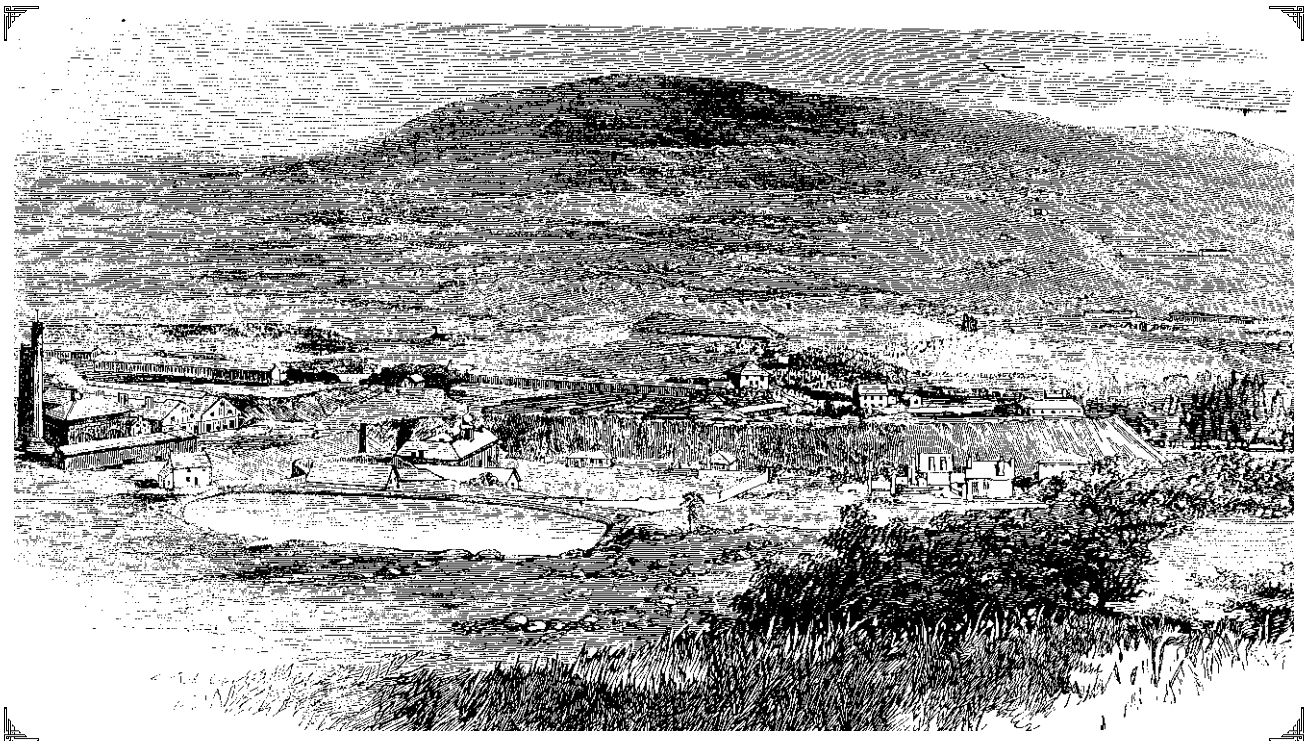


Fig.6 Illustration of 15 July 1858 (from the Illustrated London News) showing part of the Llynfi Iron Works

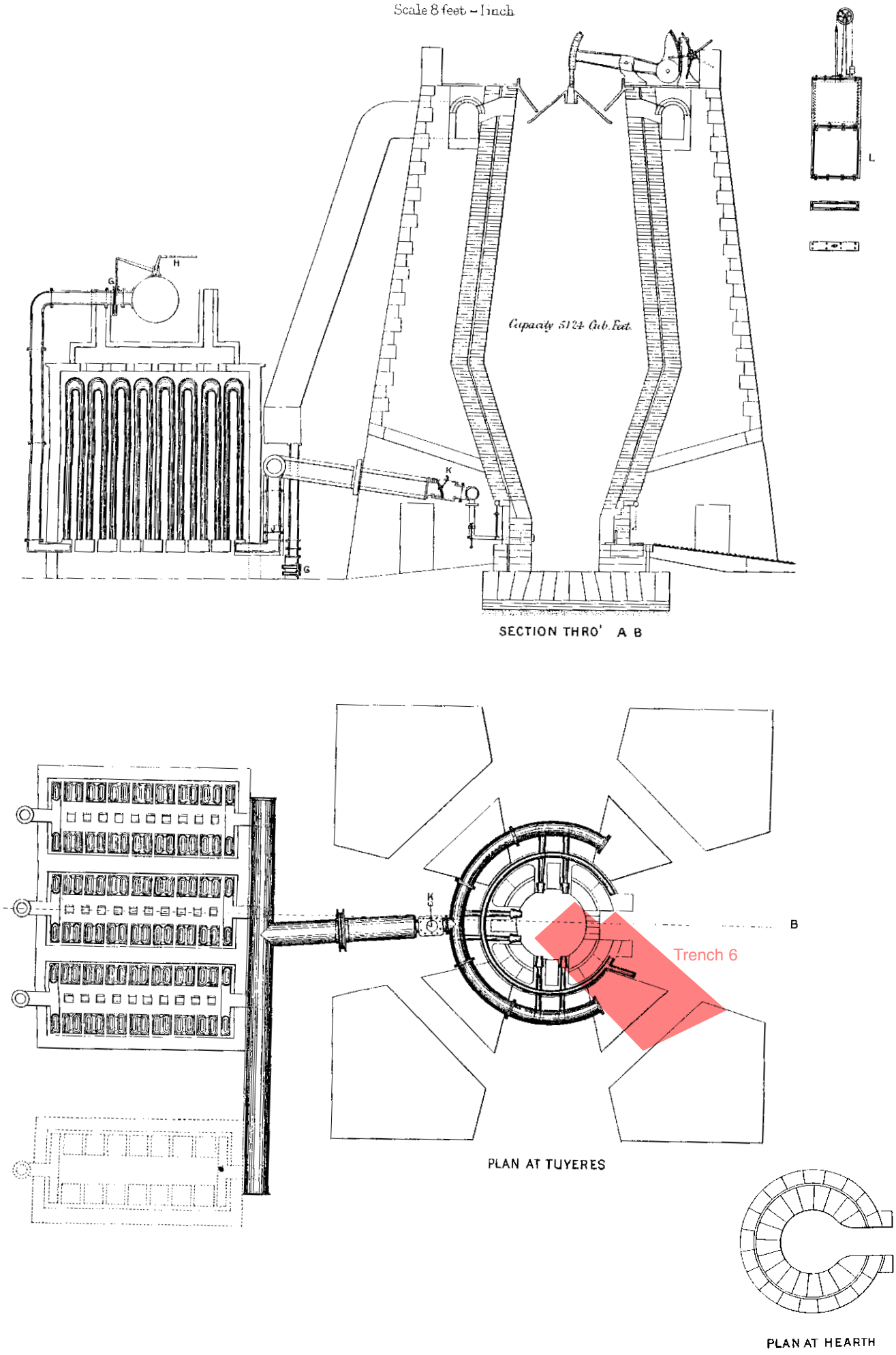


Fig.7 Plan and section of one of the square blast furnaces (Colquhoun). Also showing possible location of Trench 6

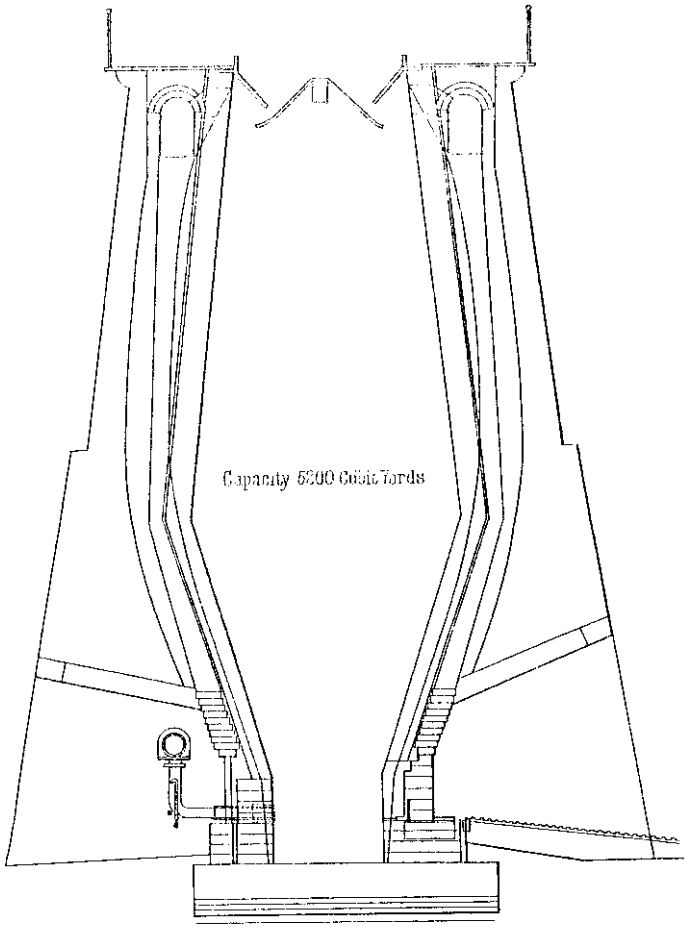


Fig.8 Plan and section of the circular northern blast furnace (Colquhoun)

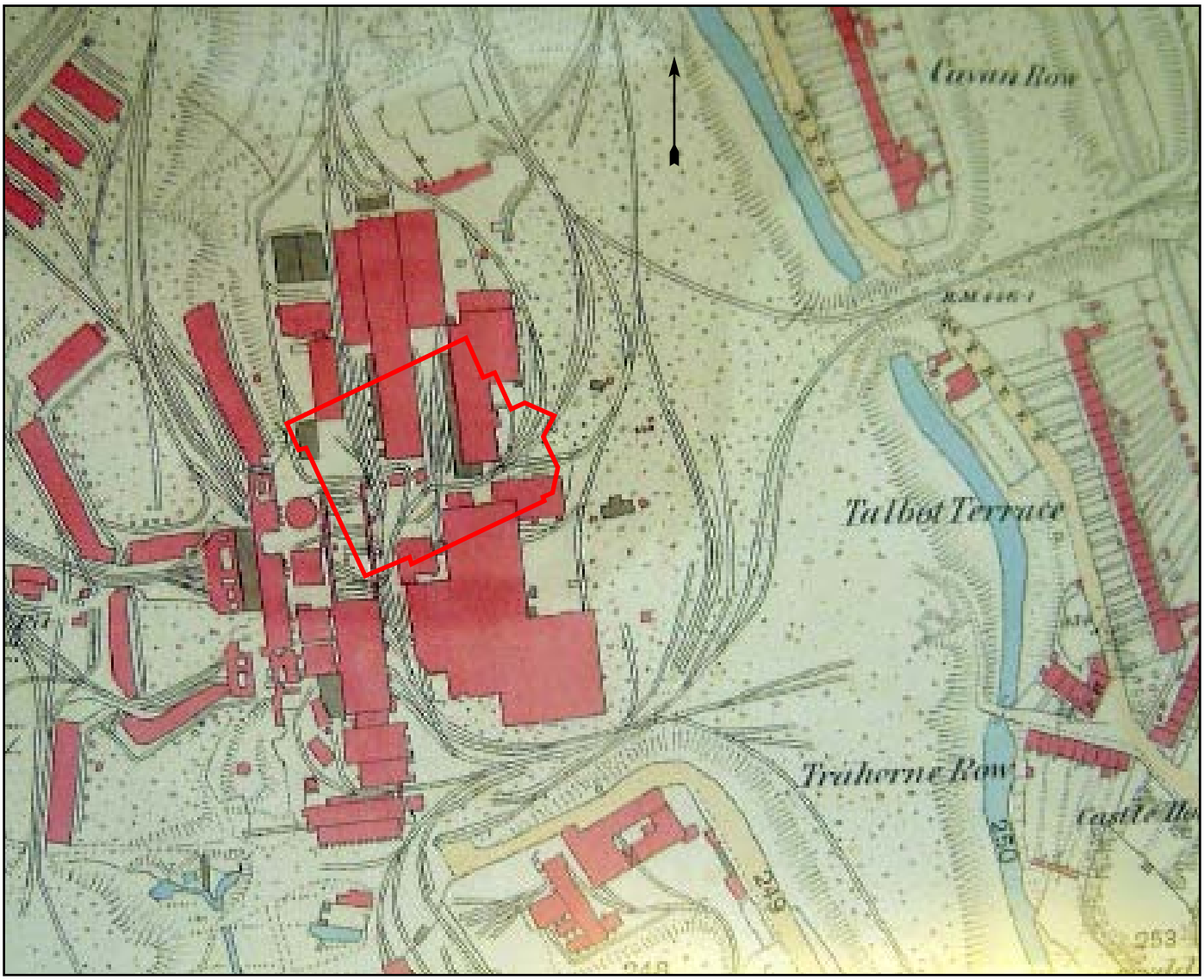


Fig.9 Extract from 1st Edition Ordnance Survey 1:2500 (reduced), surveyed 1876

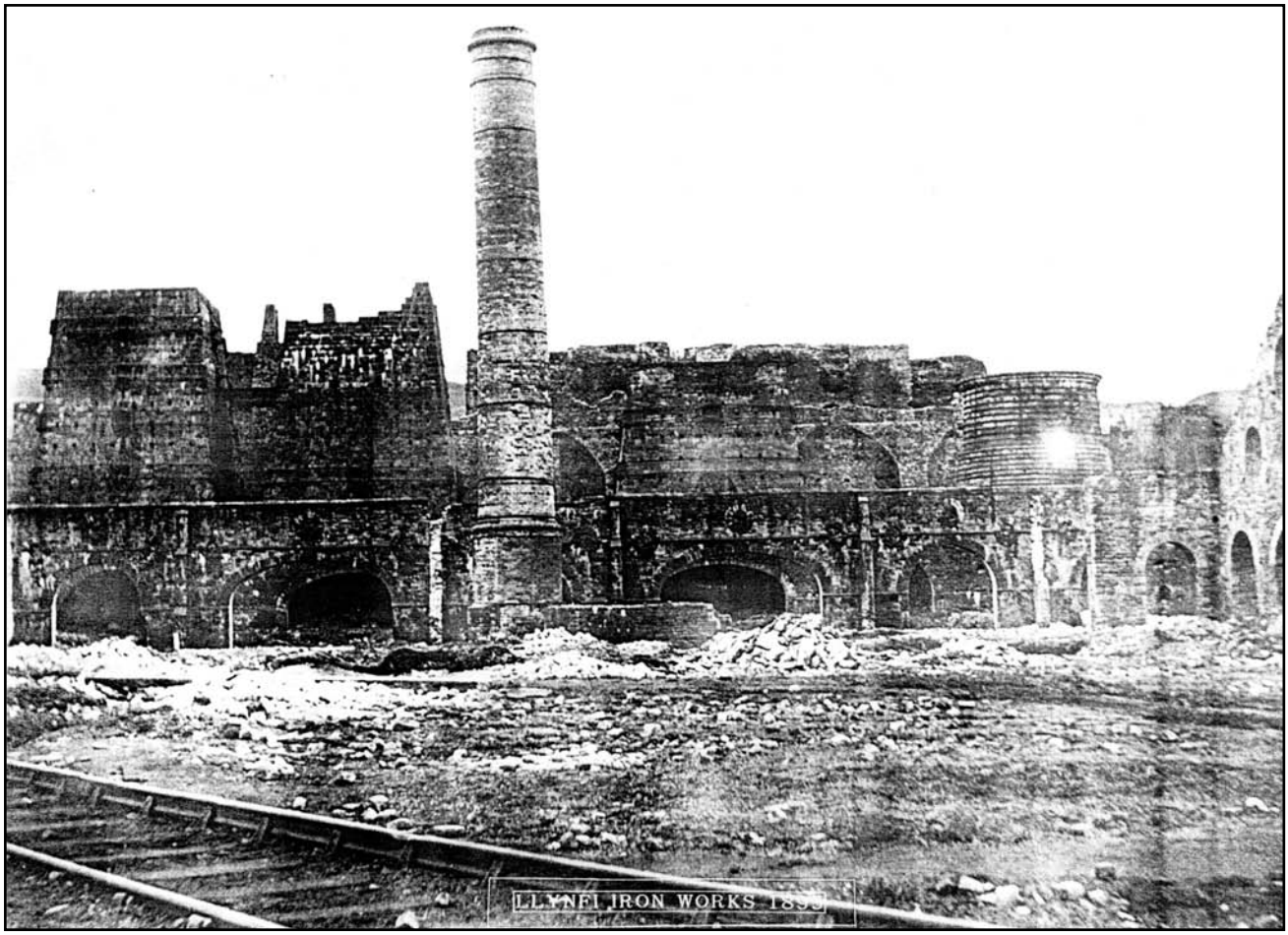


Fig.10 A photograph of 1895-6 showing the partially demolished remains of Llynfi Vale Ironworks. Behind the chimney are the arches of the casting house, beyond which are the four blast furnaces, and beyond them ‘Bridge House’. To the right can just be seen the façade of the mills and forges building

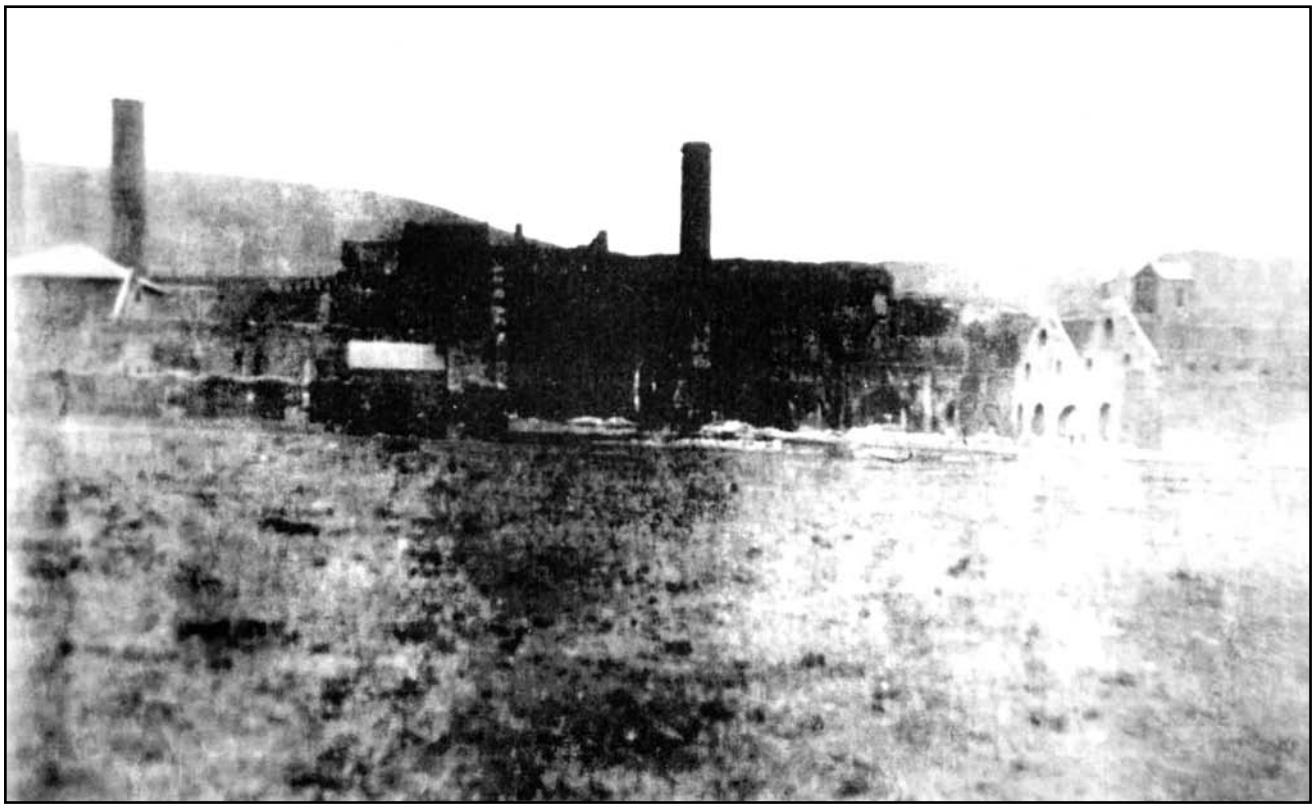


Fig.11 A rather grainy photograph of 1895-6 showing a wider view of the old ironworks site. To the left is the former Blast Engine House (later known as the ‘Cornstores’, now part of Maesteg Sports Centre)

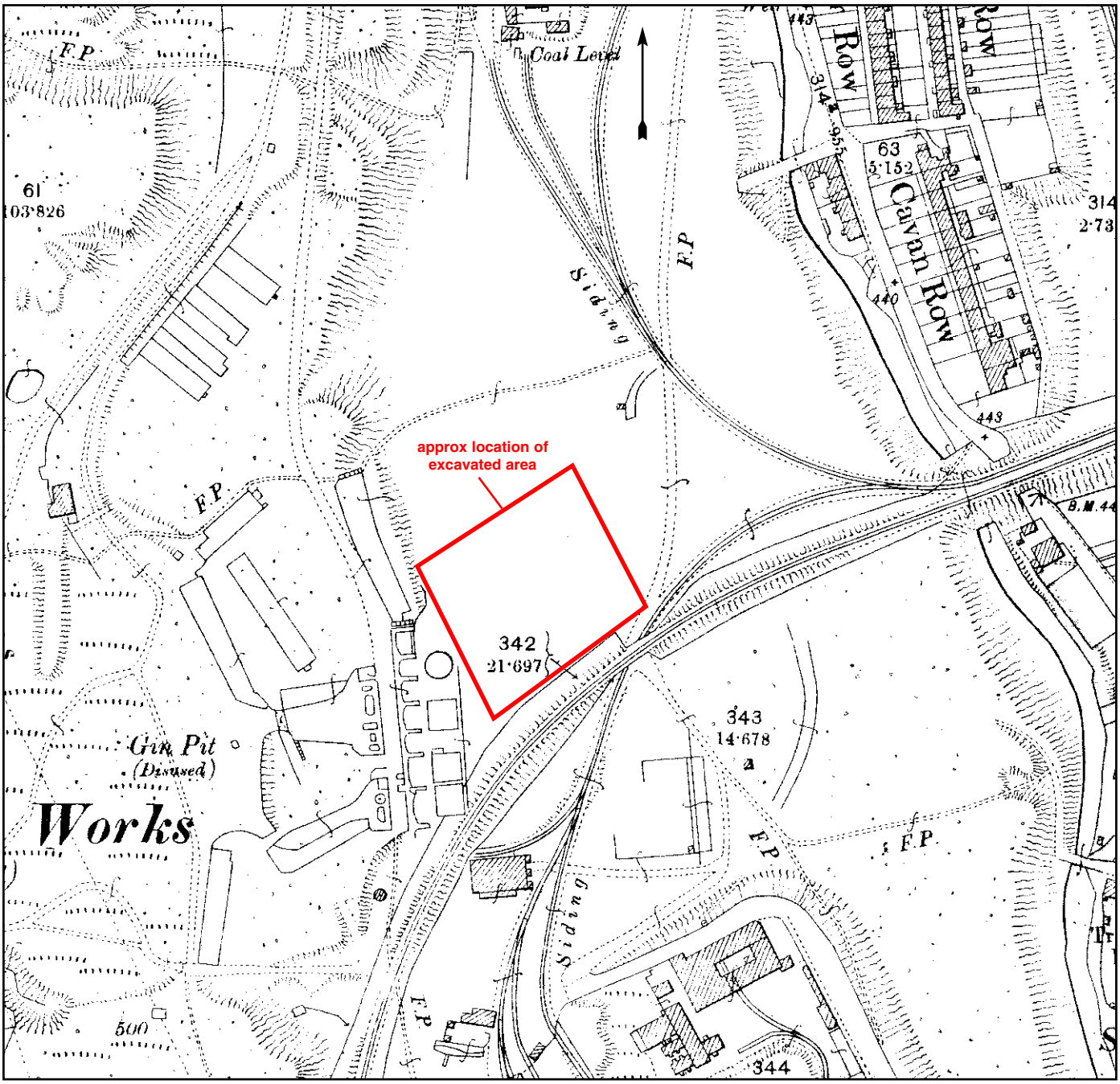


Fig.12 Extract from 2nd Edition Ordnance Survey map, revised 1897

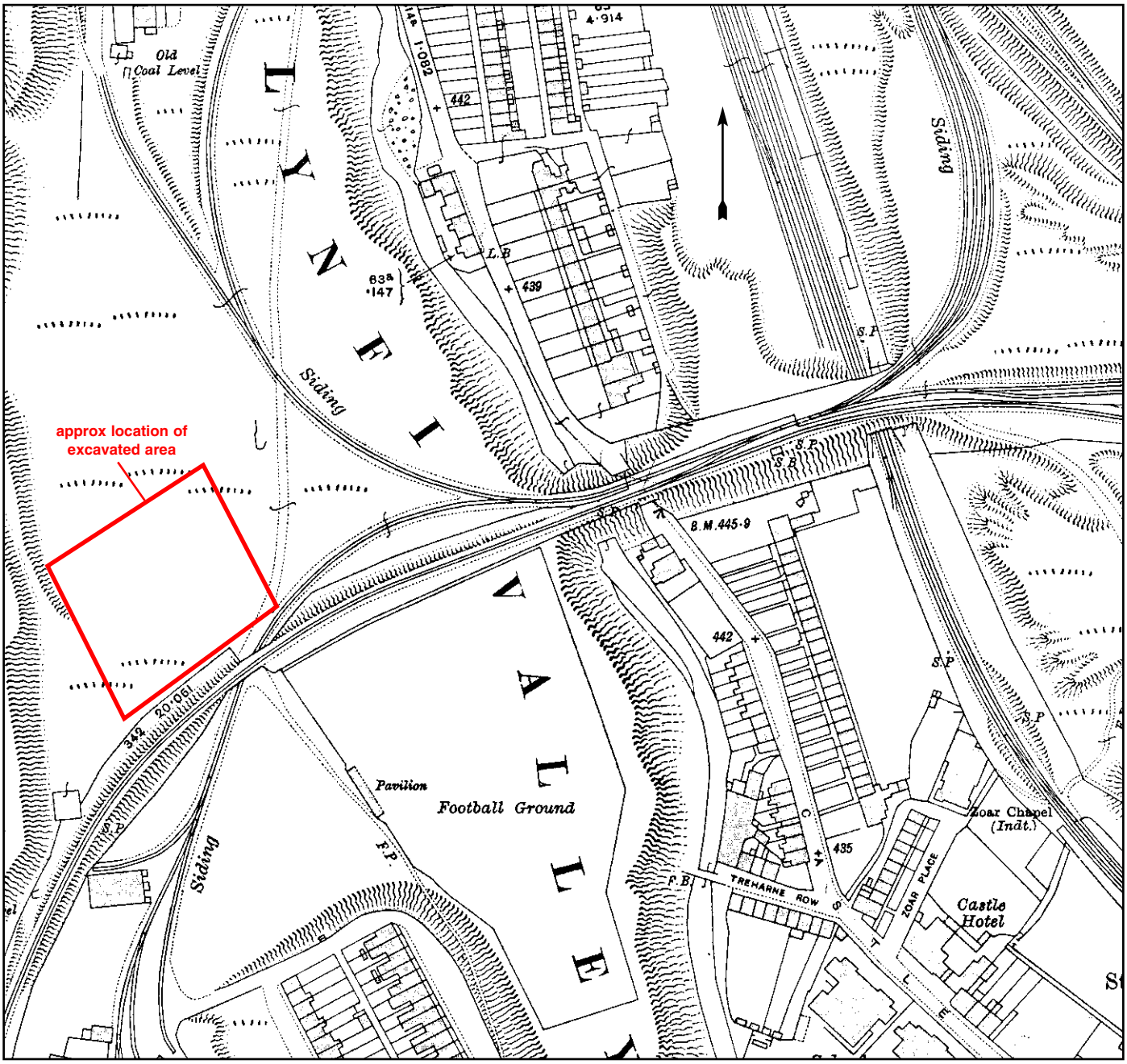


Fig.13 Extract from 1919 Edition Ordnance Survey map, revised 1914

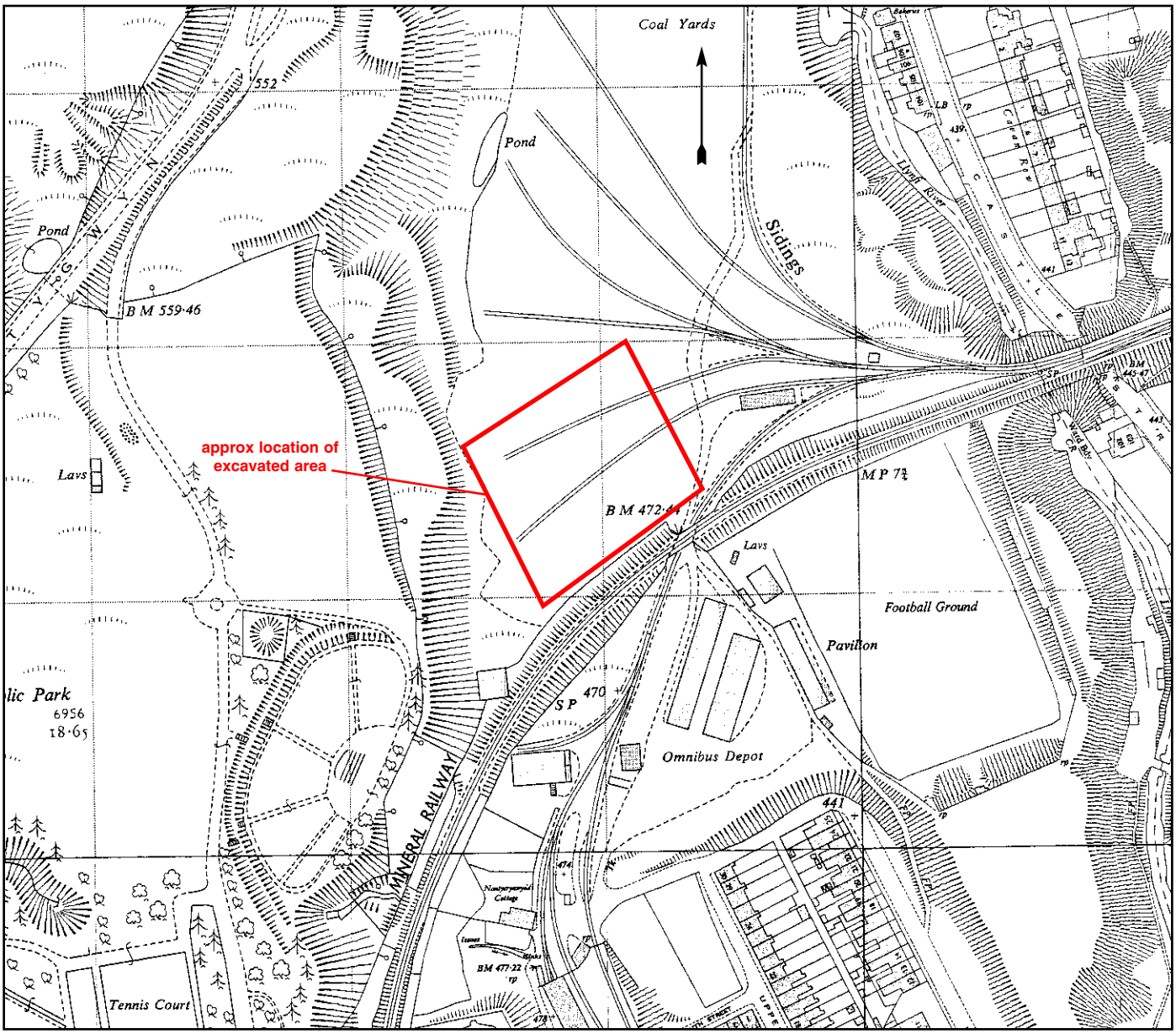


Fig.14 Extract from 1962 Edition Ordnance Survey map, revised 1950

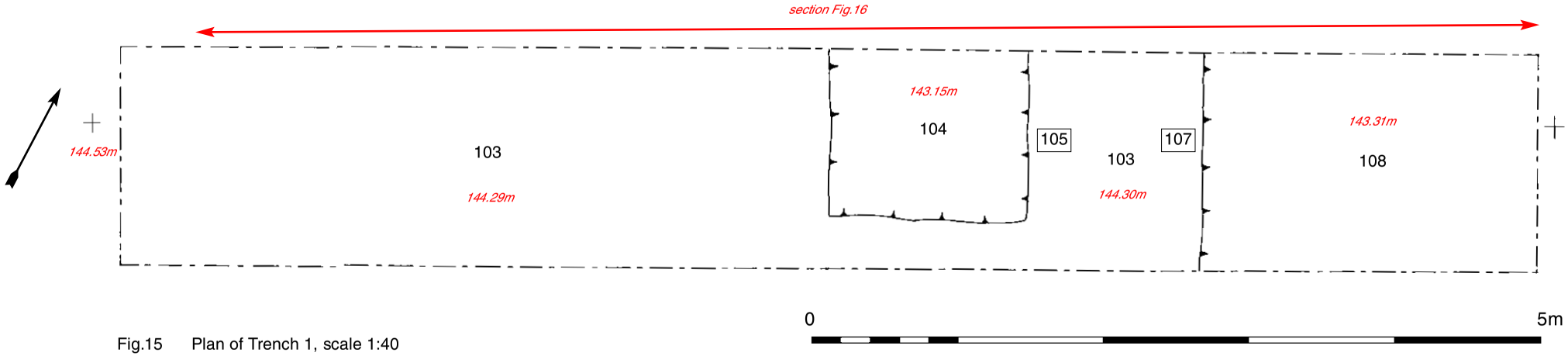


Fig.15 Plan of Trench 1, scale 1:40

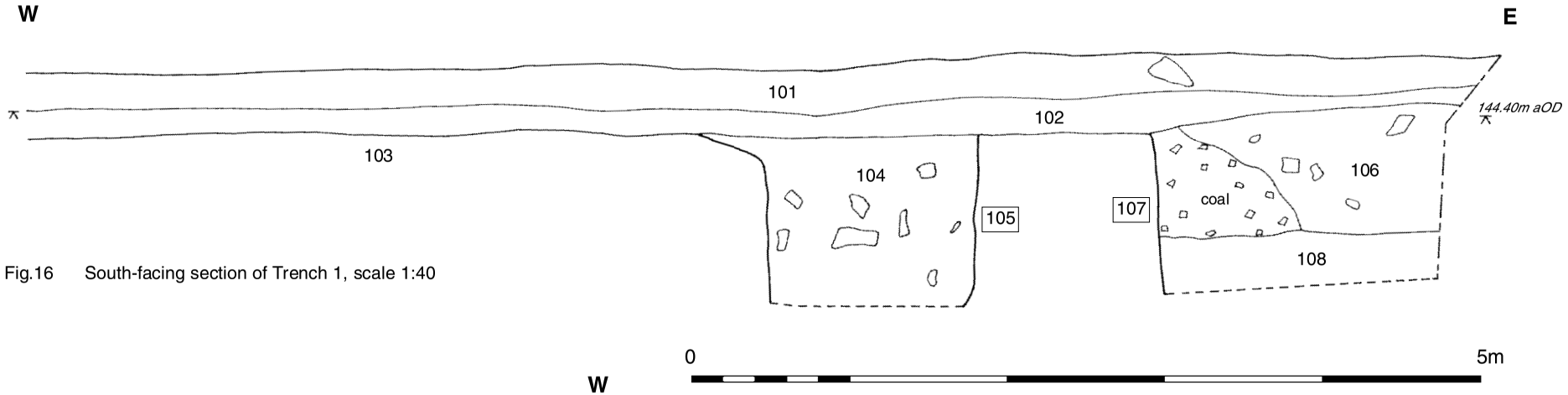


Fig.16 South-facing section of Trench 1, scale 1:40

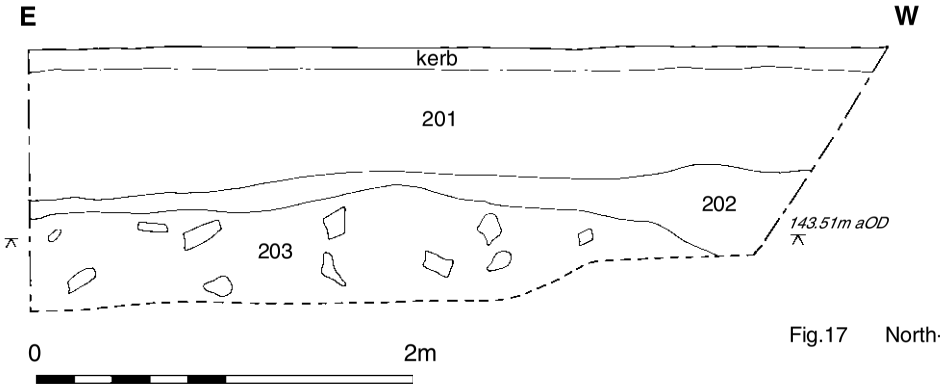


Fig.17 North-facing section of Trench 2, scale 1:40

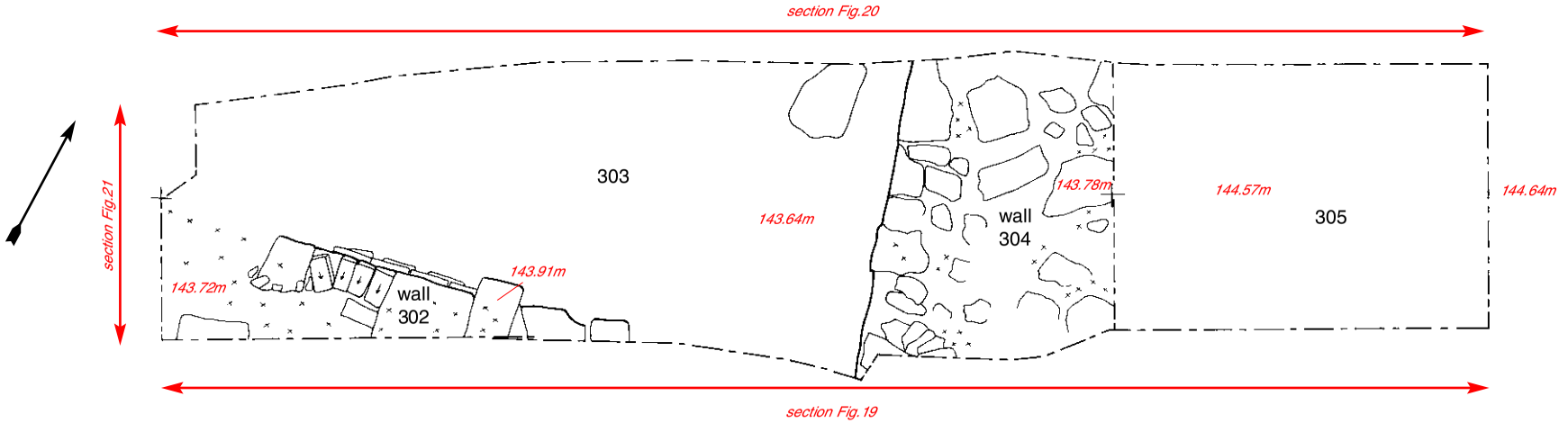


Fig.18 Plan of Trench 3, scale 1:40

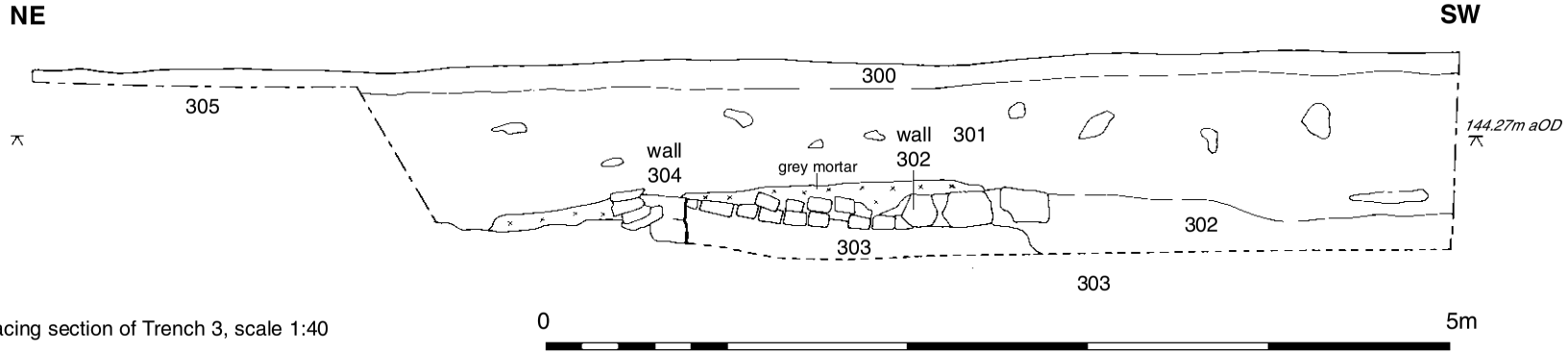


Fig.19 North-west facing section of Trench 3, scale 1:40

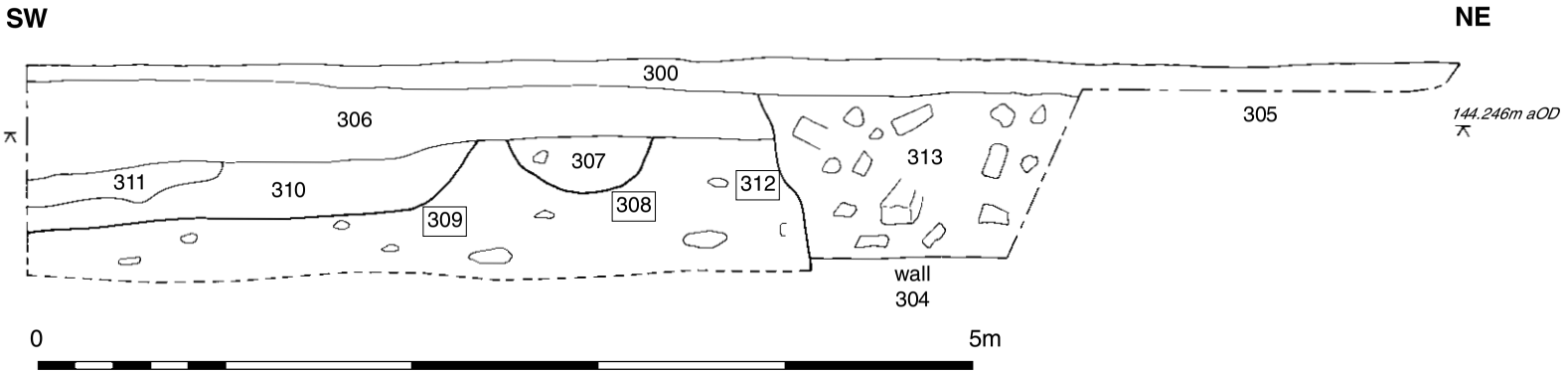


Fig.20 South-east facing section of Trench 3, scale 1:40

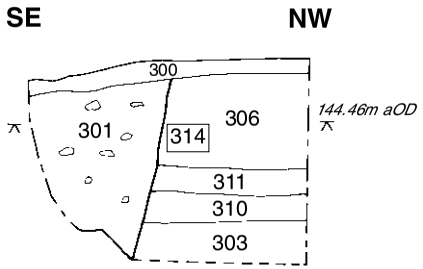


Fig.21 North-east facing section of Trench 3, scale 1:40

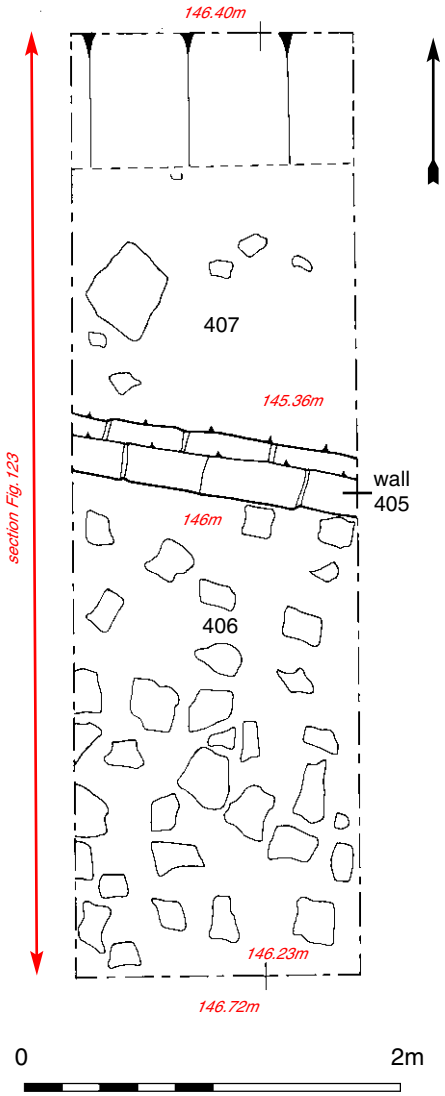


Fig.22 Plan of Trench 4, scale 1:40

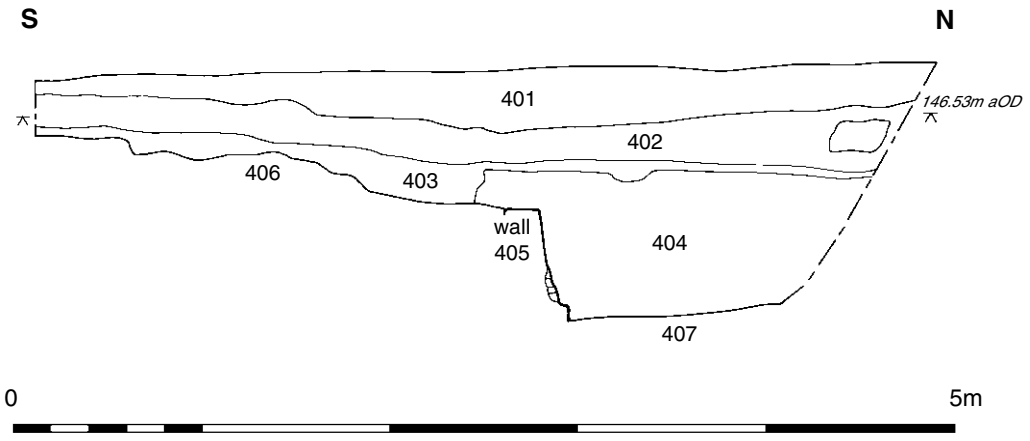


Fig.23 East-facing section of Trench 4, scale 1:40

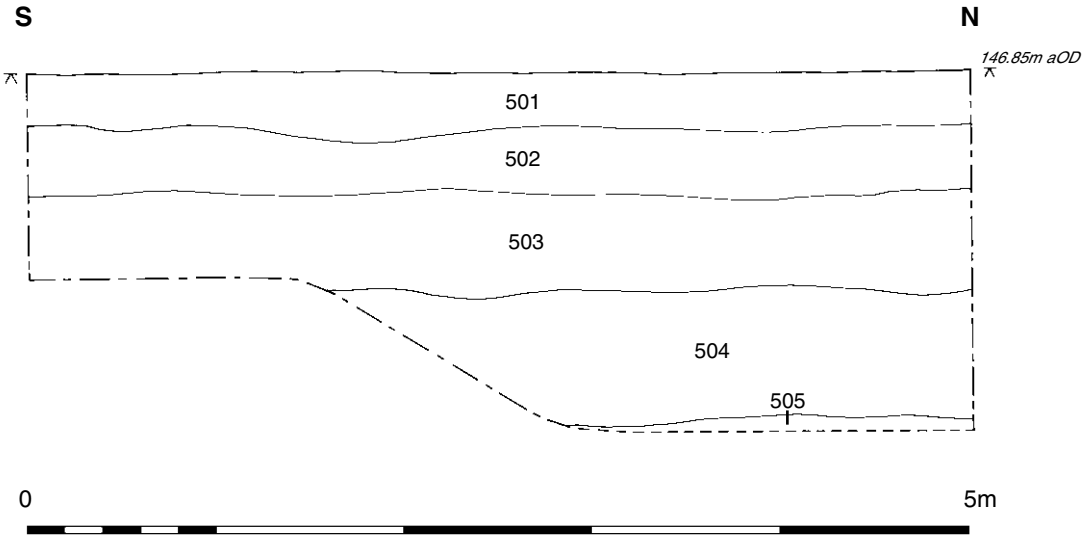


Fig.24 East-facing section of Trench 5, scale 1:40

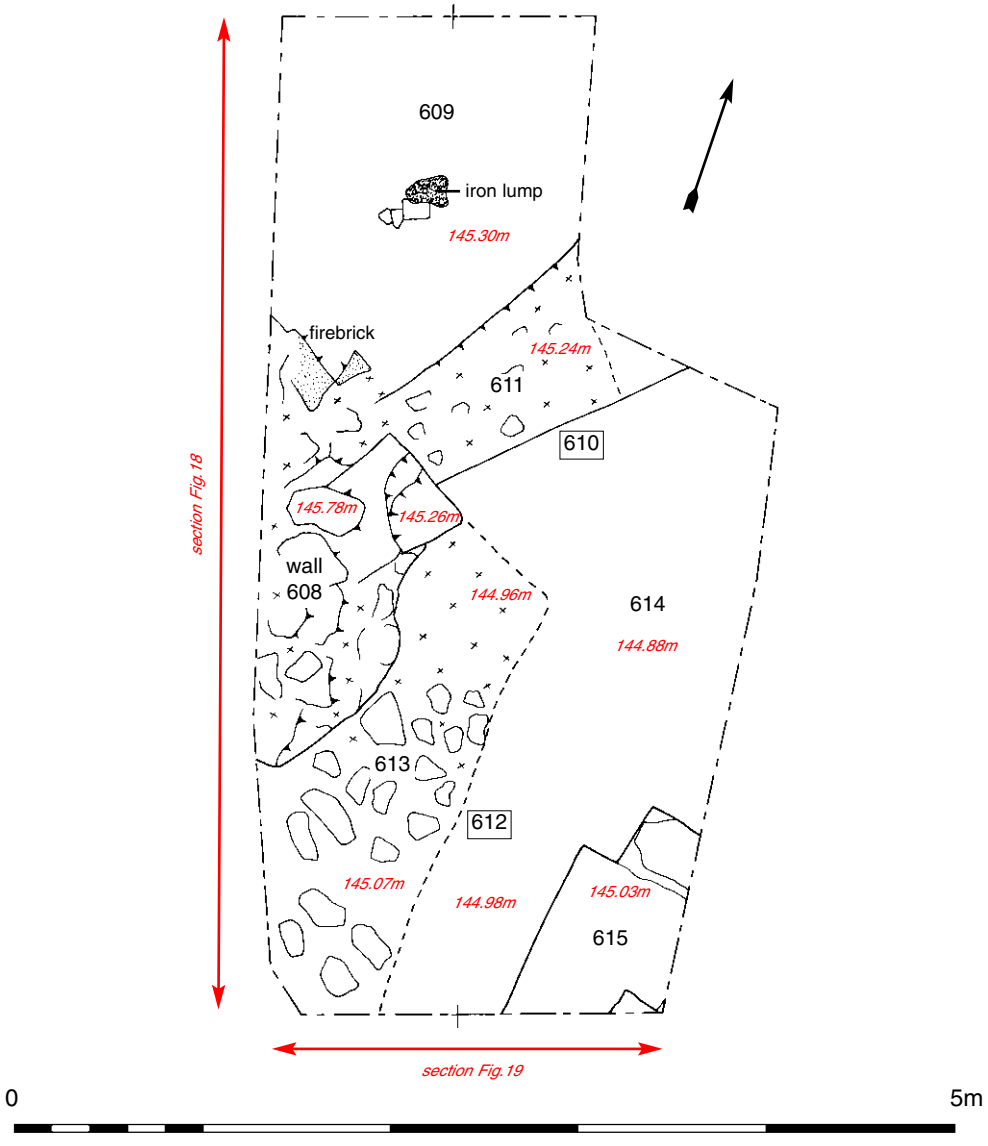


Fig.25 Plan of Trench 6, scale 1:40

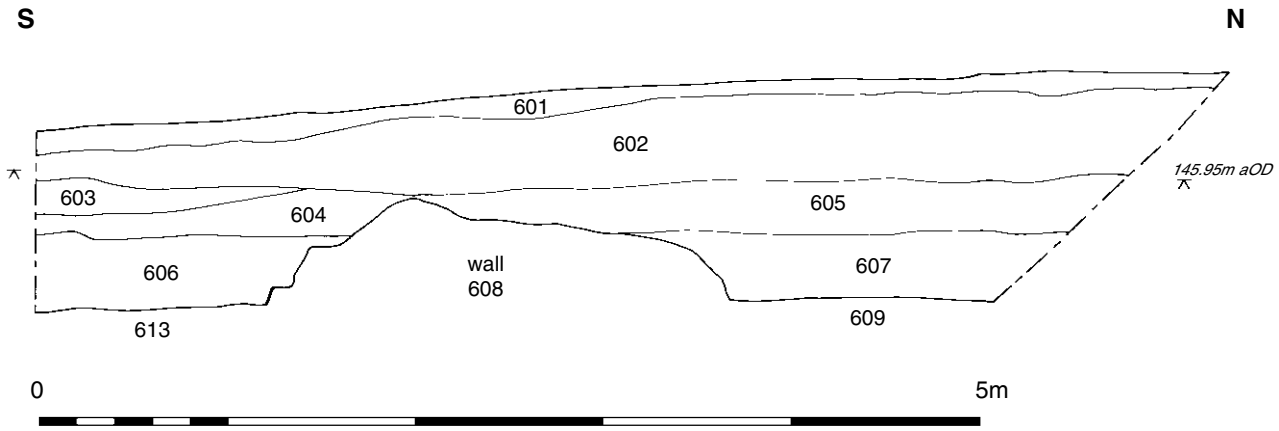


Fig.26 East-facing section of Trench 6, scale 1:40

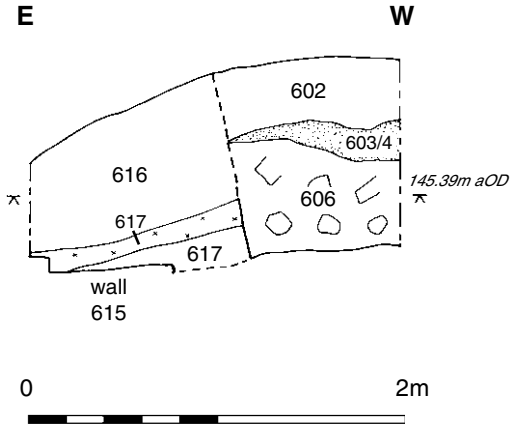


Fig.27 North-facing section of Trench 6, scale 1:40

Fig.28 Plan of the c.1855 ‘new puddling’ (forge)

Fig.29 Plan of the c.1846 ‘mills and forges’

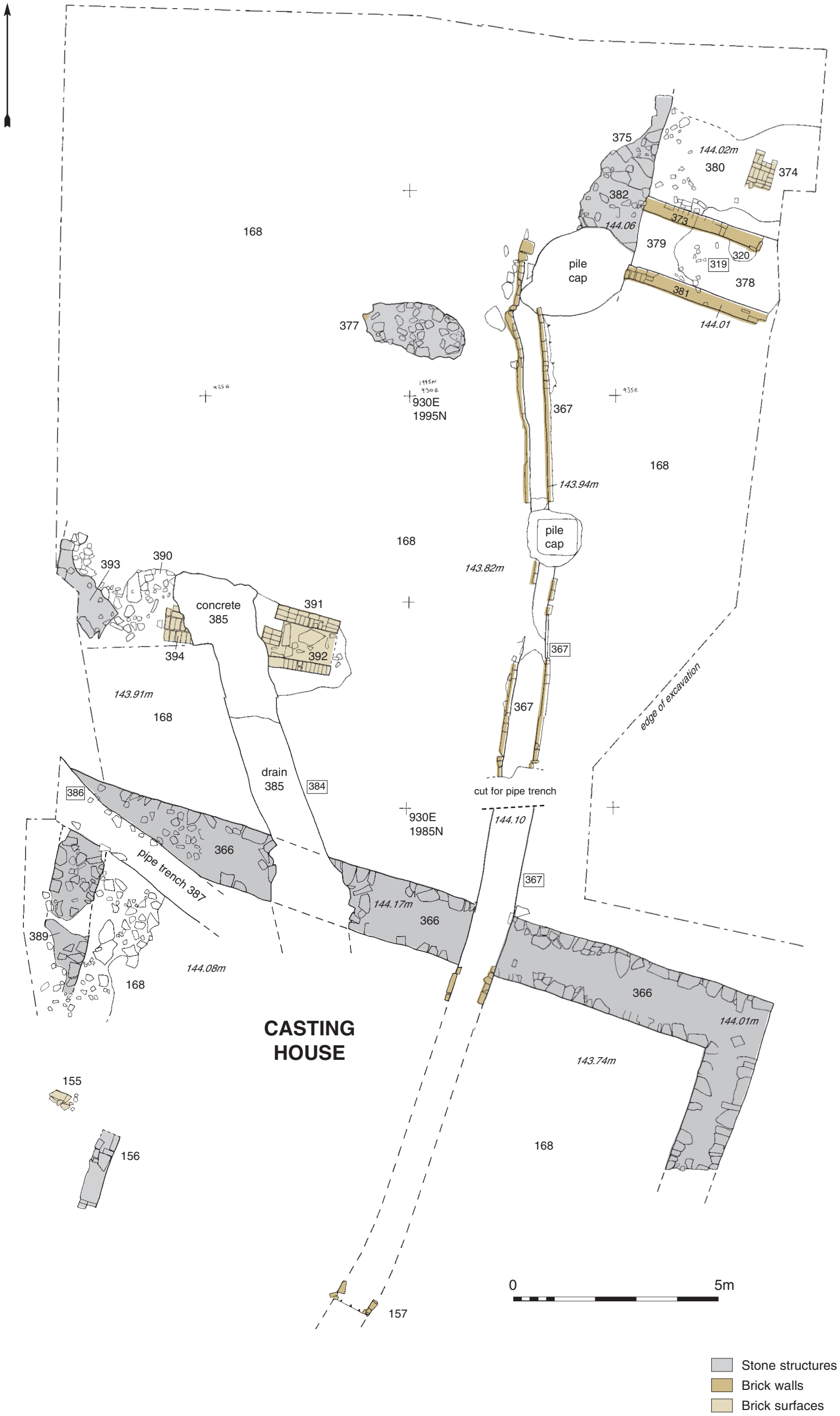


Fig.30 Plan of the c.1839 ‘Casting House’

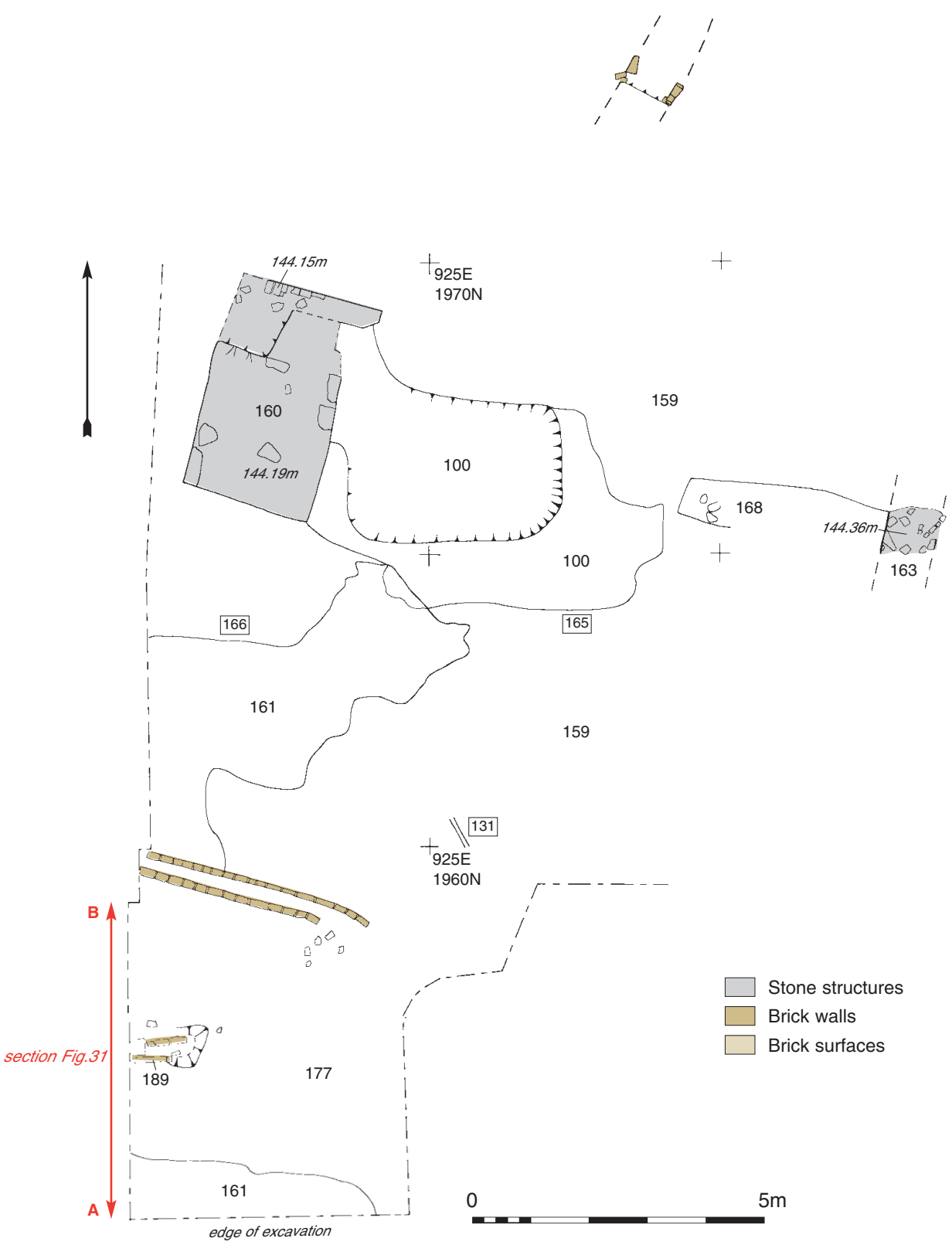


Fig.30 continued Plan of the c.1839 ‘Casting House’ southern part

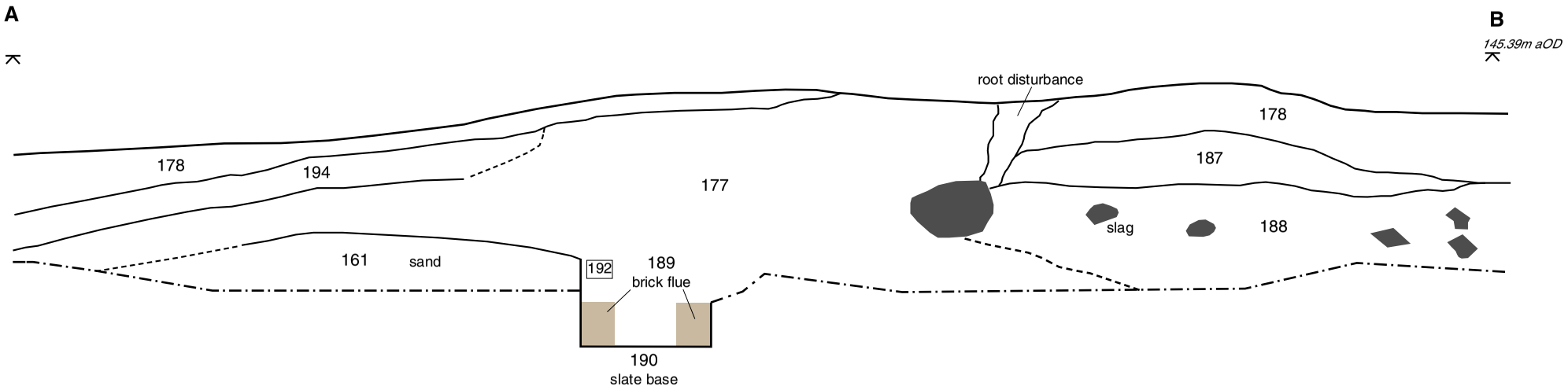


Fig.31 East-facing section (A-B) within former 'Casting House' (see Fig. 30 continued), scale 1:20

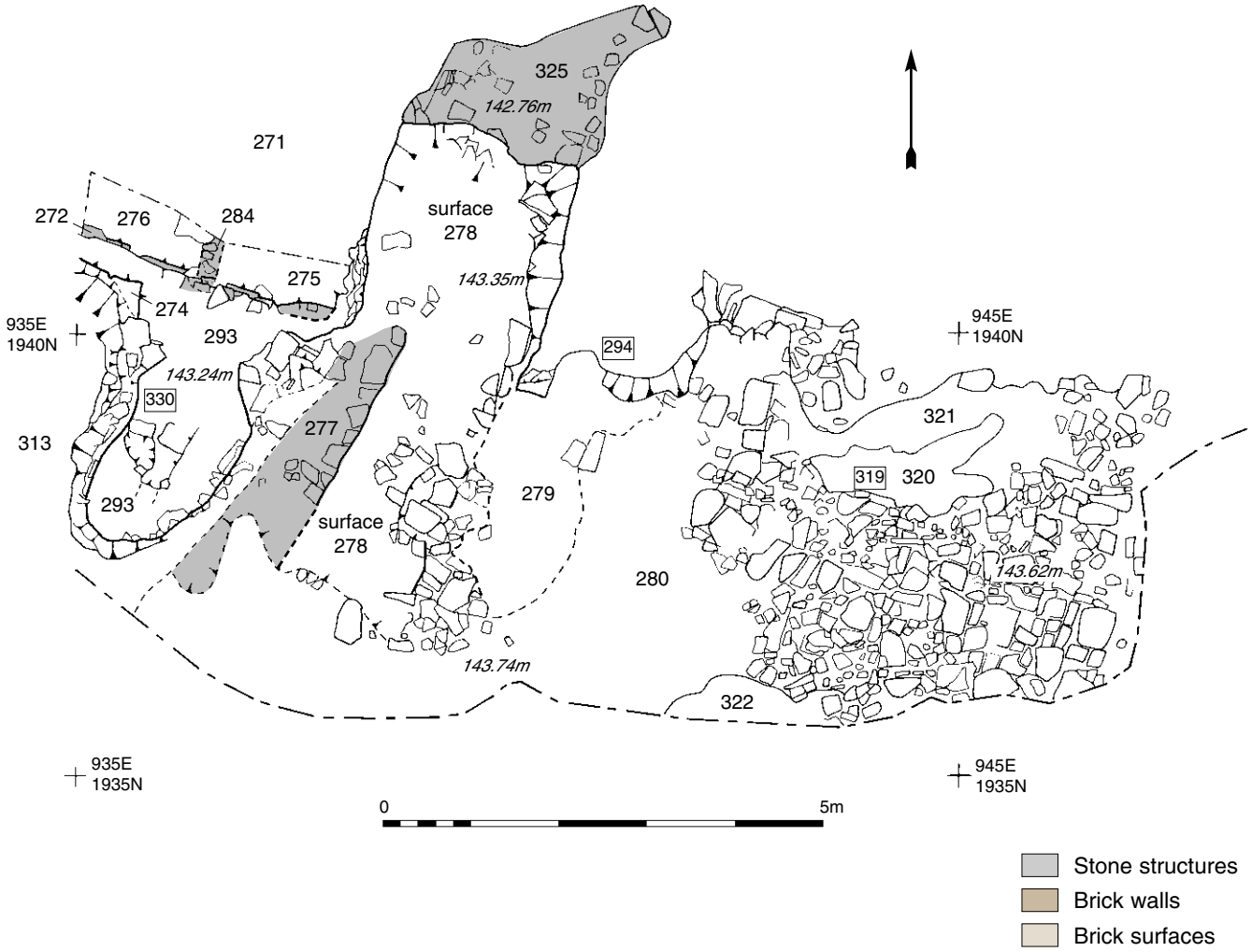


Fig.32 Plan of the c.1855 ‘boilers’ (boiler house)

Fig.33 Plan of the c.1855 ‘new mill’ (rail mill), scale 1:100

Plate 1
Trench 1, cuts 105 and 107 at eastern limit of trench

Plate 2
Trench 1, cut feature 107 and fills 106 and 108

Plate 3
Trench 2, north-facing section

Plate 4
Trench 3, walls 302 and 304 and north-facing section

Plate 5
Trench 3, looking west

Plate 6
Trench 3, Casting House floor at western limit of trench

Plate 7
Trench 4, wall 405 and rubble infill 406

Plate 8
Trench 4, wall 405 and associated demolition debris and landscaping horizons

Plate 9
Trench 5, east-facing section

Plate 10
Trench 6, looking north

Plate 11
Trench 6, wall 608 and internal fire bricks

Plate 12
Trench 6, view of structural features and robber trench to north-west of trench

Plate 13
Trench 6, wall 608 and 615 and robber trench

Plate 14
Looking west across the site of the former 'Cornstores Industrial Estate', after the demolition of the two modern buildings

Plate 15
Looking south-west across the site of the former 'Cornstores Industrial Estate'. In the distance (through the trees) can be seen the 'Cornstores' building, the former blast engine house of the Llynfi Ironworks

Plate 16
Initial excavation work in progress in late November 2006 – looking west

Plate 17
View south-west across the northern end of the excavated remains of the 'new puddling' (forge) building

Plate 18
Looking west across the northern end of the excavated remains of the 'new puddling' (forge) building

Plate 19
View north-west along the line of a 'flue-like' structure formed by walls 116 (left) and 114 (right) in 'new puddling' (forge). Note remnant of fire brick lining to left

Plate 20
View north-east showing the northern end of the excavated remains of the 'new puddling' (forge) building

Plate 21
Large Pennant sandstone built 'plinth-like' feature (160), a possible machine base located within the former 'Casting House' – looking north

Plate 22
Looking north at truncated masonry feature 156, within the former ‘Casting House’

Plate 23
A ‘flue-like’ feature (157) constructed using fire bricks and capped with rectangular cast iron plates – looking south-west

Plate 24
View north-east along the line of wall 163 – the eastern exterior wall of the ‘Casting House’

Plate 28
Looking north at the Pennant sandstone pier base 253. Note the in-situ cast iron mounting to which an iron column would have been bolted to help support the roof structure of the 'mills and forges' building

Plate 29
Looking north, within the former 'Casting House', at traces of the sand casting floor (159) and a brick-built possible flue

Plate 30
View of brick floor 216 and Pennant sandstone pier base 214, complete with integral cast iron mounting – looking north in the former 'mills and forges' building

Plate 31
View of south-east corner of 'mills and forges' building showing furnace chimney base 231 (left), heat affected deposits 228 and 229 (centre) and remains of pier base 227 (right)

Plate 32
Looking north-west along the line of wall 235, the southern gable-end wall of the former 'mills and forges' building (see Fig. 10)

Plate 33
West-facing elevation of east wall (339) of N-S oriented tunnel located between 'boilers' (Boiler House) and 'new mill' (Rail Mill)

Plat3 34
Surviving remnant of Pennant sandstone wall at junction of N-S oriented and E-W oriented tunnels next to 'new mill' (Rail Mill) – looking south-west

Plate 35
Looking west at the remains of the E-end of the E-W oriented tunnel that lay north of the 'boilers' (Boiler House)

Plate 36
View west, through the middle of the 'new puddling' (forge) building, showing (in the foreground) floor surface 282, complete with two cast iron holding down bolts (mountings) for some sort of machine

Plate 37
View east, of a brick reverberatory furnace structure (contexts 299/302/304), a chimney base (312) and a pier base (132) within the former 'new puddling' (forge)

Plate 38
Looking west at the remains of the 'boilers' (Boiler House), showing three thermal halos caused by the intense heat generated by furnaces used to heat the boilers

Plate 39
South-facing section in brick-built flue 101. Note cast iron tuyere reused in the construction of flue 317 (left foreground)

Plate 40
Looking south-east, within the 'new puddling' (forge), at a chimney base (329) – foreground, a brick floor (326) – left, a Pennant sandstone wall (324) – centre and a Pennant sandstone feature (361) – background

Plate 41
View south, across the excavated north-west part of the 'new mill' (Rail Mill)

Plate 42
Looking south at the north-west corner of the 'new mill' (Rail Mill), the partially excavated N-S oriented tunnel alongside it (right) and in the background the remains of the 'boilers' (Boiler House)

Plate 43
Looking north-west along the line of wall 362, the south-end wall of the 'new puddling' (forge)

Plate 44
Looking north-east at brick feature 363/371, a brick working surface associated with furnace chimney 329

Plate 45
View west of the northern end of the 'Casting House'

Plate 46
Looking south-west at the excavated remains of the 'new puddling' (forge). In the distance (left) is the sole remaining blast furnace (No.1)

Plate 47
The 19th century cast iron tuyere that was recovered from the site of the 'new puddling' (forge)

Plate 48
View east of brick-built flue-like structure comprising walls 373 and 381. Located to the north of the 'Casting House'

Plate 49
A view of the north-west corner of the site, to the north of the ‘Casting House’

Plate 50
Looking south-west at the remains of the north end of the ‘new mill’ (Rail Mill). In the centre of the photograph is a massive structure, built using Pennant sandstone masonry, complete with seven integral cast iron holding down pins attached to which was a machine or machines used in the process of manufacturing iron rails

Plate 51
Looking north-west (the main excavation site was beyond the concrete block wall) at the remains of stone piers belonging to a railway bridge (see Figs. 12 – 14) that carried the G. W. R. line over a branch line leading to sidings

Plate 52
Ground reduction work in progress, looking south-west across former rugby club car park

Plate 53
Looking south-east along the line of the eastern exterior wall of the rail mill, located beneath the former rugby club car park

Plate 54
Two stone-built machine plinths, complete with cast iron holding down pins, located towards the south-east corner of the former rail mill, looking south-west

Plate 55
Looking south-east at the brick remains of a ‘flue-like’ structure within the footprint of the rail mill

Plate 56
Excavation of a pipe trench across the former rugby club car park, looking south

Plate 57
Excavation of a pipe trench close to the southern limit of the site, looking west towards Maesteg Sports Centre

Plate 58
Excavation of a pipe trench across the sports centre car park. It exposed much redeposited sandstone masonry used to infill partially demolished brick built tunnel

Plate 59
View of ground work in progress in the vicinity of the former casting house, close to the western site boundary, looking north-west

Plate 60
Looking north-east, during construction ground work, at the site of the 2006-7 excavation

Plate 61
North-facing section through exposed Pennant sandstone structure of northern part of rail mill. Within masonry base can be seen a semi-circular brick-built flue or duct

Plate 62
A view within the flue-like structure. The lack of any signs of heat affected brickwork indicates that it may have been an air duct

Plate 63
Looking south-east at the exposed roof of a mid 19th-century stone-built tunnel through which flows the river Llynfi. It is the surviving remnant of a three-arched railway bridge that carried a line to/from the Llynfi Vale ironworks

Plate 64
Looking north-west at part of the surviving east wall of Blast Furnace No. 3

Plate 65
A masonry structure, possibly part of the circular Blast Furnace No. 4, located at the western limit of the site during construction ground work

Plate 66
View of north-facing archway of tunnel through which flows the river Llynfi. A second arch, belonging to the former railway bridge, formerly spanned the road