Wessex Archaeology

Derwentcote Forge, Derwentcote, County Durham

Archaeological Evaluation and Assessment of Results

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DERWENTCOTE FORGE, DERWENTCOTE, COUNTY DURHAM

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Summary

In July 2010 an archaeological evaluation was undertaken by Channel 4's 'Time Team' at the site of Derwentcote Forge (NGR 41306 55653), the site of one of the best examples of how the ferrous metal industry evolved in Britain during the Industrial Revolution and now a Scheduled Monument. Although excavations have been carried out within and around the cementation furnace, little work beyond an earthwork survey has been undertaken in the area thought to be the forge. Historical accounts of the forge suggest several ferrous metal processes were in operation throughout the forge's history, ranging from finery reduction to crucible steel manufacture.

Derwentcote as an industrial concern possibly developed out of agricultural processing, specifically corn milling, as recorded in a confiscation of land from John Swinburne in 1569. The site, on a slight plateau in a river bend with a slope immediately to the south, was topographically conducive to the construction of industrial structures such as a cementation furnace, crucible steel furnaces and a forge (but probably not a blast furnace). All the required elements (multiple levels, a source of water power, and a good transport network represented by the turnpikes) were present for metalworking to be established there. However, as the industry developed, and Derwentcote attempted to stay in line with its evolution, it found itself being left behind by more advanced infrastructure (railways) linking supply, manufacture and market.

An evaluation comprising seven trenches confirmed the layout, use and re-use of several of the industrial buildings and other structures in the forge area, as well as investigating the remains of the workers' cottages. After the forge was constructed sometime around 1719, and the dam had been built, waterwheels were added, for which some evidence was recorded. By the 1850s a steel melter was known to have been working at Derwencote, possibly operating the crucible steel furnace excavated in Trench 1, which may have been inserted into an existing building and is the first such installation to have been excavated outside of Sheffield. There is evidence (from the crucible remains) to suggest that this furnace failed catastrophically, and by the end of the 19th century only a small forge remained on the site.

Although the historical background of Derwentcote is well documented, little archaeological work has previously taken place within the forge and workers' cottages. The results of the fieldwork reported on here, although not extensive, are therefore of significance in confirming but also amplifying the historical records, and warrant dissemination. The evidence for crucible steel melting should be considered of national significance.

It is recommended that further targeted analysis of selected metalworking finds is carried out, and that a summary report is prepared (based on this assessment report), for publication in *Post-Medieval Archaeology*.

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The geophysical survey was undertaken by John Gater, Claire Stephens and Emma Wood of GSB Prospection. The field survey was undertaken by Henry Chapman, University of Birmingham, and landscape survey and map regression was undertaken by Stewart Ainsworth of English Heritage. The excavation strategy was devised by Francis Pryor. The on-site recording was co-ordinated by Chris Harrison, and on-site finds processing was carried out by Justin Wiles, both of Wessex Archaeology.

The excavations were undertaken by Time Team's retained archaeologists, Phil Harding (Wessex Archaeology), Matt Williams, Ian Powlesland, Raksha Dave, Amelia Fairman, and Tracey Smith, assisted by Phil Abramsom, Ray McBride, Jamie Scott, Naomi Sewpaul, Daniel Still, Jon Welsh and Penny Middleton. The metal detector survey was carried out by Terry Wayne.

The archive was collated and all post-excavation assessment and analysis undertaken by Wessex Archaeology. This report was compiled by Chris Harrison with specialist reports prepared by Lorraine Mepham (finds) with Rod MacKenzie (metallurgy) and John Tibbles (ceramics). The environmental sample was processed by Nicki Mulhall and assessed by Sarah F. Wyles. The assessment of the standing workers' cottages was undertaken by Lucy Dawson of Wessex Archaeology. The illustrations were prepared by Chris Breeden. The post-excavation project was managed on behalf of Wessex Archaeology by Lorraine Mepham.

Finally thanks are extended to the owners George Martin, Richard Hibbins and Mr and Mrs Rome for allowing access to the Site for geophysical survey and archaeological evaluation. Wessex Archaeology would also like to thank Mark Douglas (English Heritage), Kate Wilson (English Heritage Inspector) and David Cranstone (Cranstone Consultancy) for their help and advice during the excavation.

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Archaeological Evaluation and Assessment of Results

1 INTRODUCTION

1.1 Project Background

1.1.1 Wessex Archaeology was commissioned by Videotext Communications Ltd to undertake a programme of archaeological recording and post-excavation work on an evaluation undertaken by Channel 4's 'Time Team' at the site of Derwentcote Forge, County Durham (hereafter the 'Site') (**Figure 1**).

1.1.2 This report documents the results of the archaeological survey and evaluation undertaken by Time Team, and presents an assessment of the results of these works.

1.2 The Site, Location and Geology

1.2.1 The Derwentcote industrial landscape (Scheduled Ancient Monument number 28536, centred NGR 4132 5566) consists of a cementation steel furnace on higher ground to the south, and (on lower ground, from west to east): a headrace, a forge with remains of associated millpond, water races, housing, a 20th century coal mine (Forge Drift colliery), a small ravine (Bairns Gill) with further coal-mining and other features, and a quarry. The headrace forms a tree-covered earthwork within privately-owned pasture, and the remaining features lie within woodland (much of it on steep and rough terrain).

1.2.2 A track extends through the site from the bottom of Forge Lane, through the forge area to the site of the drift mine, and continues as footpaths up Bairns Gill and to the quarry, The area is known to be of nature conservation value, with the Durham Wildlife Trust reserve of High Wood *c*. 400m south-west of the furnace, and the Woodland Trust holdings of Galleyburn and Pontburn Woods extending to within *c*. 300m to the north-east.

1.2.3 The underlying geology includes boulder clay, glacial drift and undifferentiated alluvium (BGS Sheet 20). Derwentcote is approximately 5 miles north-west of Stanley and approximately 8km south-east of Prudhoe.

1.2.4 The Site forms a 'Y' shaped area, just north of the A694 and east of Derwentcote Farm. It lies within the Derwent valley and occupies a position south of the river that utilises its flow as a power source for machinery. The western part of the investigation area runs as a narrow strip (*c.* 150m long) along the headrace, widening at Forge Lane to encompass the Cementation Furnace (monument number 22576) to the south and the Workers' Cottages (monument number 948808) as well as the Forge (monument number 948809) to the north.

1.2.5 All areas under investigation are owned by English Heritage. The site is an English Heritage Guardianship Monument covering 2.12 hectares (**Appendix 1**). A number of important historic structures and landscape

features are located within the wider Guardianship area including (in addition to those mentioned in 1.2.2) two 20th century drift mines. The main visitor area for the public is centred on the cementation furnace and is the only part of the site not to be covered by an excessive amount of vegetation.

1.2.6 The Site appears on English Heritage's *Monuments at Risk Register*. Derwentcote's entry on the register states that the monument's condition is, 'Generally unsatisfactory with major localised problems', with its principle threat being posed by 'plant growth' and its condition recognised as 'declining'.

2 ARCHAEOLOGICAL AND HISTORICAL BACKGROUND

2.1 General

2.1.1 Historical research into the development of the entire site as well as excavation and building recording of the steel furnace was undertaken by David Cranstone in the late 1980s (Cranstone 1997) using a photogrammetric record of upstanding walls provided by English Heritage, and a landscape survey covering most of the Scheduled area was undertaken by the then RCHME and North Pennines Archaeology (NPA) (**Figure 2**). Below is a summary of information taken from Cranstone (1997).

2.2 Historical Background

2.2.1 The first mention of Derwentcote in the records was in 1569 when the land belonging to John Swinburn was confiscated by Elizabeth I and given to Sir William Constable. Within the particulars of the confiscation was a 'water-milne' (Surtees 1820) at Derwentcote, possibly a predecessor of the industrial mill. In 1660 the land was sold to William Carr who passed the land to Francis Carr. Carr granted the estate to Ambrose Stevenson, Robert Surtees and George Surtees, who divided it so that Stevenson ended up with the portion containing Derwentcote.

2.2.2 In 1719 the Swedish industrial spy Henrik Kalmeter reported on his tour of the north of England, during which he visited Derwentcote. A forge at Derwentcote belonging to 'Alderman Reed' was mentioned in his report, indicating for the first time that metal working was being undertaken on the premises. The forge passed to William and Richard Thomlinson on Reed's death in 1721.

2.2.3 In 1728 Derwentcote forge was included as part of the Stevenson estate in a marriage settlement. By 1733 the lease for the forge was sold by the Thomlinsons to Cuthbert Smith, Thomas Wrasse, Ralph Harle and George Bleinkinsopp and less than a year later Moncaster joined the partnership. The advert for the sale included a forge, warehouses and working houses.

2.2.4 Bleinkinsopp left the partnership in 1742 after trying to eject several members of the workforce. Derwentcote was again put up for sale, but this time contained a furnace and mill along with the forge, warehouses and workmen's houses. The property was readvertised in 1748 after an unsuccessful take-over bid.

2.2.5 In 1753 another Swede, Angerstein, reported on the industrial processes and output of England. Derwentcote was mentioned as being run by John

Hodgson and Gabriel Hall, who co-owned the nearby Blackhall Mill with John Cookson. Angerstein reported that Derwentcote had a forge with a hammer and two hearths (most likely finery and/or chafery) and a steel furnace with a drawing-out hammer (Berg and Berg 2001).

2.2.6 Hodgson sold his share in the company in 1782 after filing for bankruptcy. The sale notice advertised steel and iron forges. By 1788 the Medomsley land tax documents suggest that Derwentcote was being run by Reuben Ruitchley, possibly an agent for the Cookson family. Local papers nine years later reported that the company was under new management and was called Cookson and Company.

2.2.7 The Board of Agriculture in 1810 dispatched John Bailey to the county of Durham to catalogue the types of work and their output within the county. The Cooksons were listed as still operating the forge and furnace at this time. The 1861 census recorded a 'steel melter' as living within the works cottages, possibly the earliest evidence of a crucible furnace on site. At the same time a 'steel roller' was listed as an occupant, suggesting a rolling mill had been erected within the forge.

2.2.8 Census records from 1871 list the site as being administered by the Winter family and that iron working had ceased. By the 1891 census only one person living at Derwentcote forge was associated with metal working (Charles Winter, steel manufacturer). Ordnance Survey maps of this date show the forge and furnace as abandoned. The inhabitants of Derwentcote and the Site itself seems to have been converted to coal production.

2.3 Historical Summary

2.3.1 The forge was in operation by 1719, perhaps re-using an earlier water-powered site; the furnace was probably constructed between 1719 and 1742, converting imported Swedish wrought iron into 'blister' steel. The forge converted pig iron to wrought iron, initially using the finery-chafery process; in the 1780s it participated in the development of the puddling process. It also worked the blister steel from the furnace into high-quality 'faggot' and 'shear' steel, and in the 19th century a small crucible steel works was added, melting the blister steel to produce cast steel. Both furnace and forge closed between 1875 and 1891. The quarry had attained its present plan form by 1856. Coal mining on Bairns Gill started between 1895 and 1915, but the main workings at Forge Drift colliery started after 1915 and continued until after 1939.

2.4 Archaeological Background

2.4.1 A survey was commissioned by English Heritage in February 2009. It took the form of a gazetteer-style descriptive survey by David Cranstone, supplemented by a measured survey (by North Pennines Archaeology (NPA)) of those parts of the Scheduled area not covered by the earlier RCHME survey (Cranstone 2009).

3 AIMS AND OBJECTIVES

3.1.1 A project design for the work was compiled (Videotext Communications 2010), providing full details of the research aims and methods. A brief summary is provided below.

3.1.2 The aim of the project was to characterise the nature and date of the Site and place it within its historical, geographical and archaeological context. The project design also outlined a number of research aims, as follows.

3.2 Research Aim 1: Iron finery forge investigation

3.2.1 Research Aim 1 was to characterise the extent, condition and date range represented by surface and sub-surface (structural) archaeological remains likely to comprise or be associated with the historically attested forge believed to have been constructed sometime between 1718-9.

3.2.2 Research Aim 1 focused on the need to clear scrub, investigate and record the remains of an iron finery forge recorded in the 2009 survey. It is clear from the comprehensive survey work already conducted that the condition, date range, construction sequence and function of various aspects of what have been identified as features comprising or associated with the forge are poorly understood. Maps dating to the 19th century show that the forge consisted of two building complexes, one (north range) to the north of the millpond and the other (south range) straddling the main outflow channel from the mill pond (see **Appendix 1**). The remains of these buildings are visible as building platforms. The condition of these remains, and their sensitivity to significant change in their present environment was assessed as the current work was undertaken. The majority of the structures highlighted within Research Aim 1 were covered by dense woodland, the removal of which would have resulted in their rapid deterioration. It was therefore decided on site that much of this zone could not be investigated within the given time frame, as the removal of vegetation would have needed to have been undertaken carefully over a longer period.

3.3 Research Aim 2: Crucible furnace context and operation

3.3.1 Research Aim 2 was to characterise the extent, condition and date range represented by surface and sub-surface (structural) archaeological remains likely to comprise or be associated with the historically attested crucible furnace, the possible remains of which were recorded in the 2009 (Cranstone) survey.

3.4 Research Aim 3: Workers' cottages and gardens investigation

3.4.1 Research Aim 3 was to characterise the extent, condition, date range and sequence of construction represented by surface and sub-surface (structural) archaeological remains likely to comprise or be associated with the historically attested workers' cottages and gardens. The style of masonry observed in the 2009 survey suggested an 18th century origin for the structures, with continuing alterations until the mid 20th century. The cottages (and associated structures) appear to have been in domestic use from at least 1856 onwards, with progressive subdivisions represented on successive Ordnance Survey maps; their depiction on the 1856 edition suggests their use as two cottages, increasing to probably four by 1897.

4 METHODS

4.1 Geophysical Survey

4.1.1 Prior to the excavation of evaluation trenches, a geophysical survey was carried out across the Site using a combination of resistance and magnetic

survey. The survey grid was set out by Dr Henry Chapman and tied in to the Ordnance Survey grid using a Trimble real time differential GPS system.

4.2 Landscape and Earthwork Survey

4.2.1 A landscape survey and analysis of the cartographic evidence was undertaken by Stewart Ainsworth, Senior Investigator of the Archaeological Survey and Investigation Team, English Heritage. The relevant findings are incorporated into the discussion.

4.3 Evaluation Trenches

4.3.1 A total of seven trenches were excavated (see **Figure 2**), although Trench 4 was assimilated into Trench 2. The trenches were placed to investigate and to answer specific research objectives.

4.3.2 The trenches were excavated using a combination of machine and hand digging. All machine trenches were excavated under constant archaeological supervision and ceased at the identification of significant archaeological remains, or at natural geology if this was encountered first. When machine excavation had ceased all trenches were cleaned by hand and archaeological deposits investigated.

4.3.3 At various stages during excavation the deposits were scanned by a metal detector and signals marked in order to facilitate investigation. The excavated up-cast was scanned by metal detector.

4.3.4 All archaeological deposits were recorded using Wessex Archaeology's *pro forma* record sheets with a unique numbering system for individual contexts. Trenches were located using a Trimble Real Time Differential GPS survey system. All archaeological features and deposits were planned at a scale of 1:20 with sections drawn at 1:10, or as appropriate. All principal strata and features were related to the Ordnance Survey datum.

4.3.5 A full photographic record of the investigations and individual features was maintained, utilising digital images. The photographic record illustrated both the detail and general context of the archaeology revealed and the Site as a whole.

4.3.6 At the completion of site work, all trenches were reinstated using the excavated soil and monitored by English Heritage.

5 RESULTS

5.1 Introduction

5.1.1 Details of individual excavated contexts and features and the full geophysical report (GSB 2010) are retained in the archive. Summaries of the excavated contexts can be found in **Appendix 2**.

5.2 Geophysical Survey

5.2.1 Geophysical survey was carried out over a total area of 0.05ha using a fluxgate gradiometer. The following discussion and accompanying data is taken from the report compiled by GSB (2010).

5.2.2 Data were collected along the current trackway (Forge Lane) through the Site. Responses, as expected, were magnetically strong due to the presence of slag material throughout, although some trends can be seen within the data. An anomaly lies perpendicular to the trackway and may relate to the cottages, as it is on an alignment with the boundary shown on the OS mapping. Similar anomalies can be seen elsewhere against the noisy background levels, but an interpretation for these is difficult due to the limited extent of survey.

5.2.3 An area of increased disturbance lay directly south of the forge which would account for the increase in magnetism here. Magnetic susceptibility readings were taken adjacent to and within some of the trenches. Results from the 'crucible furnace' (Trench 1, Area A) indicated readings in the order of 50 SI units on the floor levels, 200-400 SI units over a domestic fireplace and in excess of 2000 SI units around the forge itself.

5.3 Evaluation Trenches

Introduction

5.3.1 Trenches 1, 2, 4 and 6 were located within an area known to have been the site of a forge in operation from the early 18th century, possibly incorporating or existing alongside a water-powered corn mill. Trench 1 was located adjacent to a sandstone wall believed to be the most easterly extent of the forge complex. Trenches 2 and 4 (subsequently amalgamated into Trench 2) were sited around part of the dam walling to investigate the likelihood of a waterwheel having been located here. Similarly, Trench 6 was located over two fixing points on a wall on the south side of the southernmost head race east of the dam, in order to demonstrate the existence of a wheel-pit / waterwheel in this location. Trenches 3 and 5 were located within the workers' cottages, whilst Trench 7 was located over the possible site of a charcoal store.

5.3.2 All trenches contained topsoil formed from humic matter, above a layer of demolition. This demolition layer was interspersed with silting episodes, suggesting a slow degradation of buildings rather than wholesale demolition. Bioturbation had taken place in layers up to *c*. 0.25m in depth from ground surface. Most of the trenches were subject to flooding during excavation, resulting in the termination of deeper investigations.

Trench 1 (Figures 3-5)

5.3.3 Trench 1 was located adjacent to and south of an extant wall that ran from north to south at the east end of the forge complex. Trench 1 provided an opportunity to excavate a section across the forge buildings in this area and evaluate their nature and sequence of use.

5.3.4 Excavation of Trench 1 identified three phases of activity (Phases 1 – 3), within the northern (Area A), central (Area B) and southern (Area C) parts of the 18m-long trench. Trench 1 was extended in various directions as excavation progressed in order to investigate the extent and relationships of the archaeology uncovered, but was not easily accessible due to constant flooding from the leats / tailraces. The entire trench was covered in humic topsoil **1001**.

5.3.5 The sequence is described below by phase, as far as possible, though some elements remain uncertainly phased or unphased.

Phase 1

5.3.6 The northernmost part of Area A (**Figure 4, Plate 1**) contained the southern end of a north-east – south-west aligned wall (**1003**) which incorporated a redbrick culvert that ran below it from west to east. The culvert ran from the area believed to contain the original corn mill towards one of the leats / tailraces of the later forge / steel production works. Wall **1003** was abutted by wall **1004** assigned to Phase 3 (see below). Wall **1003** was built from well-hewn and regularly coursed sandstone, which contrasted with the more irregular nature of wall **1004**.

5.3.7 Within Area B was an L shaped sandstone structure approximately 1.5m deep. This was defined by walls **1006** to the north, **1009** to the west and, **1038** and **1039** to the south east. Wall **1038** contained an opening through which an uncovered leat ran from east to west. This leat was later covered with red brick (**1037** and **1041**) in phase 2. Walls **1006**, **1009**, **1038** and **1039** were built on natural gravel (**1046**) and constructed of regularly coursed sandstone, with larger blocks used in the basal courses. This structure probably formed the foundations of a structure. Although the structure pre-exists phase 2, its later function broadly assigned to Phase 2 has removed any evidence of function dating to phase 1.

5.3.8 Within Area B, to the south of Area A, was a structure approximately 1.5m deep. This was defined by walls **1006**, **1009** to the north and east respectively, and **1038, 1039** and **1041** at the southern end, the latter wall of redbrick and built parallel and immediately to the south of brick culvert **1037** (see below) (**Figure 4, Plate 2; Figure 5: Plates 3-4**).

Phase 2

5.3.9 The structure described above appears to have formed the focus of activity in Phase 2 (at least within the excavated area), and it is clear that it was associated with crucible steel production.

5.3.10 Overlaying the western part of wall **1006** was a rectangular sandstone structure (**1051**), measuring at least 2m by 1.15m, which is likely to have been the base of a chimney. This formed part of structure **1033** which incorporated at least two refractory / fire-brick lined chambers (**Figure 4, Plates 1-2; Figure 5: Plates 3-4**). These chambers, each measuring 1.4m by 0.4m and at least 1m high, formed by fire-brick walls **1007**, **1049** and **1050**, were partly accessible from the cellar to the south, with a pair of associated flues (**1012**) built into the chimney structure to the north. The sides of the chambers and flues all showed evidence of having been affected by intense heat. Structure **1033** is typical of the arrangement of crucible steel furnaces, which showed little change from that used by Huntsman in 1740 to those in use at the beginning of the 20th century. The upper part of each of the chambers (the 'melting hole') would have held a crucible (surrounded by coke and supported on fireclay blocks placed on an iron grill) that was accessed from a floor (which doesn't survive) above, with an ash pit below and access from the cellar.

5.3.11 The base of the cellar was covered with a floor (**1043**) constructed of re-used redbrick and refractory brick, laid flat, with the bricks generally running in north to south rows. Floor **1043** was built around structure **1033** and lay approximately 2m below existing ground level (**Figure 5, Plate 4**). The floor was to the east by further bricks (**1045**) laid on edge and running north to south approximately 2m west of structure **1033**, suggesting some division within the cellar, with cellar wall **1009** a further 1.75m to the east. Perhaps the area between **1045** and wall **1049** was for temporary ash storage, for example or housed a free standing stairwell or hatch for entrance into the cellar.

5.3.12 To the south, floor **1043** was built up against a 0.8m-wide double-skinned redbrick culvert (**1037**) which covered a leat / tailrace (**Figure 5: Plate 4**). A narrow redbrick wall (**1041**) defined the southern extent of the cellar, and abutted sandstone walls **1039** and **1038** (identical in construction to **1006** and **1009**), which formed an L-shape to the north, forming part of the cellar walls. The addition of the covering to the culvert and red brick walling suggests that the structure originally had a different function, and was possibly a foundation. The foundations were converted into a cellar and the crucible furnace added.

5.3.13 At the northern end of the cellar, part of wall **1006** was overlain by wall **1005/1032** which also butted structure **1033** to the west. This suggests more than one phase (or sub-phase) of structure is represented. Wall **1005/1032**, constructed of sandstone, ran north to south, turning to the east at the southern end where it overlay wall **1006**, suggesting a rebuild over this part of the cellar wall; wall **1005/1032** was butted by wall **1004** (Phase 3) at its northern end.

5.3.14 The structural remains in Area B were overlain by a demolition layer (**1012**) containing ganister (furnace lining), heat-affected fire-bricks and failed crucible pots.

5.3.15 Area C lay at the southern end of the trench, to the south of the cellared structure and north of an extant track. The phasing of features here is uncertain, though they have been provisionally assigned to Phase 2. Terminating within this area was a north-south aligned foundation trench (**1042**) which contained the remains of a brick wall (**1049**) that appeared to have been robbed. At the northern end of this wall was a small area of redbrick (**1040**) interpreted as a possible machine base or similar. Various machine fittings were recovered in Area C, from a layer of grey silt (**1029**) containing frequent iron concretions, possibly a deposit resulting from inundation of this area, with collapse / demolition rubble (**1028**) sealing this.

Phase 3

5.3.16 Phase 3 developments appear to have been largely confined to Area A at the northern end of the trench. Wall **1004** formed an angled arrangement in the gap between Phase 1 wall **1003** to the north and Phase 2 wall **1005/1032** to the south (**Figure 4, Plate 1**). It was relatively poorly constructed in comparison to the two earlier walls. The 1898 OS map appears to show a building not present on the 1895 OS map, part of which appears to correspond with wall **1004.**

5.3.17 To the west of and abutting wall **1005/1032**, north of and abutting wall **1006** and south of wall **1004** was a C-shaped arrangement of redbricks (**1024**, **1025** and **1027**), measuring approximately 2m by 1.75m. No mortar was present on the upper surface of these bricks, suggesting that they did not originally continue above the layer uncovered. Inside this arrangement of bricks and abutting wall **1032** were two sandstone pads (**1053** and **1054**), possibly the base for a hearth / forge, though they could have been foundations for a superstructure that covered this area. Bricks **1034** also appeared to form part of this arrangement. Brick 'edging '**1027** to the west did not abut a wall, but bordered a cobbled area (**1035**), suggesting that this was a working surface or that the west side of the structure was open.

5.3.18 Overlaying the area enclosed by the redbricks was a deposit of hammerscale (**1023**). This suggests that the area housed a hearth / hammer for small-scale forging. A brick fireplace (**1020/1021**) lay to the north of wall **1025**, in the angle between walls **1004** and **1005/1032**, and was filled with soot (**1019** and **1022**). The small size and location of the fireplace suggests that it did not serve an industrial function.

Trenches 2 and 4 (Figures 6 & 7)

5.3.19 Trench 2 was located on the north side of an extant, 4.5m-square, sandstone structure (**2008**) which lay immediately in front of the earthen dam at the west end of the former mill pond (this pond measured approximately 100m long by 25m wide). An extension of Trench 2 westward linked it with the adjacent Trench 4 located along the east side of structure **2008**, creating an L-shaped trench.

5.3.20 Excavation of Trench 2 revealed very dark reddish-brown humic topsoil (**2001**) above a rubble deposit (**2002**) deriving from the collapse of the upper part of structure **2008**. The removal of these deposits exposed a grey alluvial silt layer (**2003**) above an iron pan deposit (**2004**). The iron pan had formed above a layer of coal ash and hammerscale derived from the erosion (and re-deposition) of industrial residues from the forge area; this layer, in turn, overlay natural fluvial gravels (**2006**).

5.3.21 Built into the natural gravels was structure **2008** (see above) (**Figure 7, Plates 5-6**), and abutting this was a roughly built east-west sandstone wall (**2007**) with large sandstone blocks pushed up against its west face (**Figure 7, Plates 5-6**). Structures **2007** and **2008** together formed the facing to the earthen dam at the west end of the mill pond containing the water that would have powered waterwheels located to the east (see below, Trench 6). Two square holes in the east face of **2008** (**Figure 7, Plate 6**) perhaps served to drain water from the rubble core (which included some blast furnace slag) of the structure, though the smaller, uppermost hole (0.3m square, lined with fire-bricks), may have held a timber for a bridge or some other structure (eg a sluice) at the front of the dam, and the larger hole (0.45m square) could have served a similar purpose. The existence of a larger possible opening (0.8m square) in the north face of structure **2008** is less convincing.

5.3.22 The southernmost head-race or leat ran immediately to the south of structure **2008** and whether a waterwheel was located here, with structure **2008** forming part of the arrangement is unlikely. However, the material used to consolidate the dam (pieces of ach, furnace lining and slag-attacked stone work) may suggest that structure **2008** could have originally been a

blast furnace. If this was the case the blast furnace would have had arches to the south and west, which collapsed after use. It is not clear if this may have been the original function of this structure as very little of what may have been the blast furnace remains. However, in form and location (at the base of slopes near a water channel) structure **2008** on balance, may have once functioned as a blast furnace.

Trench 3 (Figure 8, Plate 7)

5.3.23 Trench 3 was located within the workers' cottages (see below) and specifically targeted a chimney breast, believed to be the most stable area of the derelict cottages. The removal of humic and rubble-filled topsoil (**3001**) revealed a demolition layer (**3002**) that lay above rotting roof timbers (**3003**). The roof timbers were still nailed together and were made from softwood, possibly pine (Jacqui Huntley *pers. comm.)*. The condition of the wood was poor and the decision not to take a sample for assessment was made by English Heritage's Regional Science Advisor (Jacqui Huntley) during a site visit.

5.3.24 The roof timbers lay above demolition/collapse deposits containing complete panes as well as fragments of window glass (**3004**, **3005** and **3006**).

5.3.25 Below the demolition layers was a red quarry tile floor (**3011**) which abutted an extant fireplace (of refractory brick and cement) and the remains of a stone chimney (**3007**, **3008, 3009** and **3010**).

Trench 5 (Figure 8, Plate 8)

5.3.26 Trench 5 was located along the northern edge of the workers' cottages (see below) and was excavated to assess the condition of the cottages as well as aiding their phasing. Excavation ceased once the precarious state of the walling was confirmed. The only layer to be removed was rubble (**5000**) deriving from the demolition / collapse of the cottages.

Trench 6 (Figure 9 & Figure 12, Plate 9)

5.3.27 Trench 6 was located along the south side of the southern wall (**6003**) of the southernmost tail-race or leat, to the south of the furnaces and forge in Trench 1. Excavation of the topsoil (**6001**) and underlying alluvial deposits (**6002**) revealed what was probably the south wall (1m wide) of a stone-lined wheel-pit (**6009**) with the fixing points (**6003**) for a waterwheel (**Figure 12, Plate 9**). These were partly overlain by a rubble wall (**6011**), perhaps a later modification or the disturbed upper courses of wall **6009**. A deposit of mixed slag (**6012**) was exposed on the south side of wall **6009** and suggests that this area was used for dumping waste during the operation of the forge.

Trench 7 (Figures 10-11 & Figure 12, Plate 10)

5.3.28 Trench 7 was located within a partly extant sandstone building (identified as structure 013 by RCHME (1990)), between the forge and the workers' cottages, believed to have been a coal or charcoal store. Excavation of the topsoil (**7001**) revealed a slightly compacted possible floor surface (**7002**) overlying subsoil / make-up **7003** at the north-west end of the trench. This sealed a probable demolition deposit (**7004**). Towards the south-east end of the trench was a robbed out wall (**7009**; robber trench **7010**) with an external cobbled surface (**7011**) beyond this. Adjacent to robber trench **7010** (but predating it) was a cut (**7016**) containing and several deposits of charcoal-

rich clay (**7014** and **7015**). The charcoal inclusions probably derived from two in-situ, relatively thick charcoal deposits (**7006** and **7008**), which lipped up to the wall that once occupied the robber trench **7010.** These deposits lay on top of a sandstone wall (**7012**) running north-west to south-east along the north-east edge of the trench and cut into natural (**7013/7018**) (Figure 12, Plate 10). Only a very small part of wall **7012** was exposed and thus interpretation is difficult, though its presence clearly indicates a sequence of two or more structures in this area, the later at least almost certainly a store for charcoal.

Workers' Cottages (Figures 13 & 14)

5.3.29 Located to the north-west of Derwentcote Forge, and fronting the north side of Forge Lane, are the remains of a small block of former workers' cottages. This structure has accommodated between two and possibly five cottages at various times and comprises several phases of expansion and alteration which followed its initial construction in the late 18th century. Its most recent occupation was in the 20th century. Trenches 3 and 5 (see above) were located within or adjacent to the cottages. It must be noted that due to the ruinous state of the cottages, the amount of vegetation coverage and the clear reuse of stone and bricks in its construction has made the interpretation and phasing problematic.

5.3.30 The structure probably began as an agricultural building in the late 18th century (Phases 1-2) and is first depicted on the 1856 OS map (Phase 3). By this time the general footprint of the cottages had been established with an extension to the north. The internal layout of the structure is clearly visible, divided into two properties, with a possible third to the north-west. Front gardens were directly adjacent to the south of the building with further designated gardens to the south side of Forge Lane. There was also a small outbuilding located to the east which was probably a privy.

5.3.31 The 1897 OS map shows that the building had by then been partitioned into five properties with associated garden divisions. Two of these inserted divisions creating the five separate properties were removed in the 20th century however, and not present during the survey.

5.3.32 Phases 4 and 5 have been assigned to changes made during the 20th century. Little altered in the basic layout and property divisions of the cottages between 1900 and the 1920s/30s, although between 1920 and 1939 the boundary to the north was altered. It had previously run close to, and parallel with, the north-east facing elevation of the building. However, the 1939 OS map depicts the boundary with an angled projection to the north and with an additional small rectangular structure. This structure (partially retained on site, but in poor condition) was a brick-built privy which replaced the former privy structure to the east, no longer shown on the OS map by 1939.

5.3.33 It would appear that various alterations to the cottages occurred post 1890's, after the steel works had ceased production. Prior to this, census information shows that between the 1840s and 1860s, the people living at 'Derwent Cote' had a range of occupations, including farming, mining and quarrying as well as those associated with the production of steel. By 1871, however, the 'Derwent Cote Cottages' were specified by this name on the census

return, with the records indicating that there were at least three cottages housing steel workers and their families.

5.3.34 Evidence from the remaining standing elements of the building (**Figure 13**) indicate a relatively long and narrow stone-built structure of late 18th-century origin, which was rectangular in plan and likely open-sided to the south elevation (Phase 1). This indicates a non-domestic, probable agricultural origin of the building, likely in the form of a barn.

5.3.35 There is a stone-built extension to the north (Phase 4), with an angled north-west corner. The brick-built extension attached to the north and the brick constructed section of the south elevation are all built from handmade red bricks, along with at least three internal divisions and inserted fireplaces. The 20th-century (Phase 4/5) privy to the north is also constructed with the same handmade red bricks, indicating the constant reuse of materials in the building's construction and the difficulty in then dating and phasing the building. Most recently the building was divided into three properties (Phase 4/5), although this had clearly been altered from the former five divisions. Modern brick blockings and additions were also present.

5.3.36 The present condition of the structure is poor and unstable. The upper sections of the structure have largely collapsed, leaving large areas of rubble on top of the lower sections of walling and floor surfaces. The structure is also completely covered with vegetation (**Figure 14, Plates 11 and 12**). These factors have obscured the majority of the building which in turn has made recording the structure accurately very difficult. In order to properly record and understand the building within its own and wider context of the site, clearance, stabilisation and further archaeological recording are needed.

6 FINDS

6.1 Introduction

6.1.1 Finds were recovered from all seven of the trenches excavated. The assemblage is entirely of post-medieval date, and relates to the use of the Site from the early 18th century to the late 19th century as a steel production centre. Artefacts include structural elements as well as domestic refuse. A list of all artefacts from the Site can be found in **Appendices 3** (metallic finds) and **4** (all other finds).

6.1.2 Following quantification, all finds have been at least visually scanned, in order to ascertain their nature, probable date range, and condition. This information provides the basis for an assessment of the potential of the finds assemblage to contribute to an understanding of the Site, with particular reference to the construction and use of selected buildings within the steel production centre.

6.2 Metallic Finds

Introduction

6.2.1 The main aim of this assessment has been to identify items of archaeological significance, whose analysis could expand existing knowledge of activities at the site or metals produced there. A basic identification and catalogue of the material had been prepared by Wessex

Archaeology prior to this assessment. As part of this assessment, a provisional identification of items has been added to the existing catalogue tables. It should be noted that, at this stage, no microscopic or chemical analysis has been carried out.

6.2.2 The assemblage consists of three types of material: metals, slags and fragments of metallurgical crucibles. A brief overview and interpretation of each type of material is given below.

Overview of materials

6.2.3 The ferrous metal objects in the assemblage are predominantly structural or undiagnostic in nature; these items are of limited archaeological significance, however any items that warrant further action are highlighted in **Appendix 3**. The potentially most significant items are the fragments of cast ferrous metal from contexts **1001** and **6001**, and possible spillages of crucible steel recovered from contexts **1001**, **1008** and **1017**. Metallurgical analysis would be required to determine whether the pieces of cast ferrous metal are crucible steel, and whether the spillages relate to crucible steelmaking.

6.2.4 The metals sub-assemblage also contains several wrought iron wedges (from contexts **1001**, **1019**, **6001** and **6002**), which are typical of those used to secure and balance waterwheels onto their axles, and their presence suggests the presence of waterwheels in the vicinity.

6.2.5 The slag in the assemblage appears to consist of three groups: blast furnace or cupola furnace slags, fuel ash slags and possible metalliferous slags that are undiagnostic of their production process.

6.2.6 The blast furnace/cupola slags range from the typical glassy type of varying porosity, to dense iron-rich tap slags with coke inclusions. Although the blast furnace/cupola slags form a large proportion of the slag assemblage, there does not appear to be enough to suggest that a blast furnace was present at the Site. It is possible that larger quantities of blast furnace slag are deposited outside the area of the excavation; however it is also worth noting that blast furnace slag was commonly used as ‘hardcore’ foundation material for building paths and roadways. Fragments of blast furnace slag were also recovered during the excavation of cementation furnace (Cranstone 1997), although only a small amount was found (less than 1kg).

6.2.7 The fuel ash slags all appear to relate to the burning of coal or coke. Both of these fuels would have been used at the site for steel production: coal in the cementation furnace and coke in the crucible furnaces and in smiths’ hearths. The most interesting pieces in the slag assemblage appears to be the result of a metal spillage that has combined with fuel, fuel ash slag and furnace lining to create an unusual metal-rich ‘slag cake’. The fragment of crucible stand embedded near the centre of the slag cake suggests that it was the result of a catastrophic failure of a crucible pot within the furnace. The pieces of ‘slag cake’ were all recovered from contexts that are thought to relate to the demolition of the furnaces in Trench 1, and it is therefore possible that the spillage relates to the final use of the furnace before it was demolished.

6.2.8 The type of crucible fragments in the assemblage appear to be typical of the range and type found at South Yorkshire sites where the 'Huntsman method' of crucible steelmaking was carried out, although detailed analysis would be required to identify any regional variations present. The fragments of crucible pot are all from used steelmaking crucibles and the assemblage also contains fragments of used crucible stands and lids. One of the more unusual features of the assemblage is the presence of biscuit fired, but unused crucible lids.

6.3 Ceramic Building Material

Introduction

6.3.1 A total of 30 complete/part brick and tiles totalling 51,961g were submitted for assessment. The majority of the assemblage was recorded from early-modern structures: floors, walls, deposits, culverts, workers' cottages and a possible furnace. The remaining material was recovered from topsoil and modern dumps.

6.3.2 Based upon the available information, the material dated from the 18th and 19th century, although earlier bricks from the very late 16th or 17th century may have been re-used on the Site.

Methodology

6.3.3 The assemblage was visually examined and cross-referenced with photographic evidence where provided. Information regarding the dimensions, shape, fabric and stamps was noted.

6.3.4 It should be noted that the diversity of size and colour within bricks and tiles caused during the manufacturing process must be taken into consideration when comparing examples within collected assemblages and local typologies. The varying sizes and colours in earlier brick manufacture can be attributed to the variation in the clays used, shrinkage during drying, firing within the kiln or clamp, and the location of the brick/tile within the kiln. However, as technology advanced bricks became less prone to these processes, particularly those manufactured in fire-clays.

Range and variety of material

6.3.5 A significant proportion of the material (36%) appears to be machine-made brick, suggesting a post-1840 date. However, at least two examples may have been 'pressed' creating a sharp profile. Such hand-presses were in use by the turn of the 19th century.

6.3.6 The hand-made bricks were rather crudely manufactured in a dense light red (7.5R/6/8) and red (10R/6/8) fabric. The example from **1008** displayed silica inclusions suggesting that the bricks were for engineering use rather than domestic buildings. Most of the assemblage displayed aspects of their manufacture (i.e. moulding lips, pressure marks, finger impressions, sand adhesions and straw marks).

6.3.7 Based upon the dimensions of the hand-made brick (**Table 1**), manufacture dates are between the medieval period to the 19th century. However, the earlier brick dimensions of 230mm x 110mm x 52mm (9" x 4 ¼" x 2") (Lloyd 1925) were recovered from the topsoil **1001**. The remainder display dimensions associated with 17th-19th century manufacture. It should be

noted that bricks of these dimensions have been manufactured in England from the medieval period through to the late 17th century (Lloyd 1923, 89-90), but the Brickmakers Charter of 1571 established a size of 9" x 4 ½" x 2", close to that of some of the samples. It is thought that this regulated size was not closely followed because of the poor technology of the period (Harley 1974, 74).

Firebricks

6.3.8 A large proportion (57%) of the brick assemblage was manufactured from fire clays where bricks needed to withstand high temperatures and stress, particularly in furnace linings (Douglas and Oglethorpe 1993). Such bricks have been hand-made in the Midlands from the 1700s until the 1960s (Cooksey 2003). However, Bourry suggests that the manufacture of fire-clay goods in special factories only dates from the beginning of the 19th century (Bourry 1901).

6.3.9 The examples within the assemblage were provisionally identified as plain bricks, knife/wedge bricks and slabs, and described by Bourry as:

- **Plain bricks**: Usually the shape and dimensions of building bricks (9.44" x 4.72" x 3.15")
- **Knife/wedge bricks**: Generally used for dome building. Many varied patterns of which the larger ones are defined as blocks. A length and width of 24" by a thickness of 15 ¾" should not be exceeded.
- **Slabs:** Manufactured to 3.94" thick, by lengths which may exceed 39" and widths of 20-24".

6.3.10 Within the firebrick assemblage a significant proportion (26%) bore makers' names stamped across the stretcher surfaces or within impressed frogs. At least seven different stamps were primarily identified as manufacturers' stamps, of which at least two were from relatively local sources (HAMSTERLEY and RAMSAY) and at least one from Wales (DINAS). The remainder of the stamps have yet to be researched.

Tiles

6.3.11 Seven fragments of roofing tile were identified including pantile, stone tile and slate, representing 23% of the total assemblage.

6.3.12 The pantile assemblage was exceptionally small, and included two joining fragments from topsoil **7001** and dump **7003**. The remaining two fragments displayed rectangular nibs (40mm x 20mm and 50mm x 20mm), the size, fabric and manufacturing characteristics suggesting a probable 18th-early 19th century date of manufacture. Pantiles were imported into Britain by the 16th century but there is little evidence for their manufacture in this country before 1700 (Neave 1991). Pantile roof covering within the eastern counties of Britain during the 18th and 19th centuries became popular, but it is difficult without fabric analysis to differentiate between the imported Dutch tiles (*Dakpannen*) and English pantiles manufactured locally. During the reign of George I an Act of Parliament was passed stating that a fired tile [pantile] should not be smaller than 13 ½" long by 9 ½" wide and ½" thick (342mm x 240mm x 15mm), which has been the accepted size to date (Lucas 1998).

6.4 Stone Building Material

6.4.1 The stone roof tile assemblage consisted of two fragments of sandstone tile each displaying a single 19mm diameter suspension hole. The example from deposit **2002** displayed a rounded shoulder and a chipped suspension hole, whereas the suspension hole in the example from demolition deposit **3001** appears to be bored. Dating of such material is difficult due to the durability of stone roof tile, which was often reclaimed and reused. On stylistic grounds, the examples are likely to be of a late medieval-post medieval date of manufacture.

6.4.2 The single fragment of slate identified within **2002** was of a Welsh blue material, which became common throughout the United Kingdom on the advent of railways in the 19th century. Slate has not only been utilised for roofing but paving, steps, stairs, window sills and surrounds, copings, chimney pieces, shelves, water tanks, gravestones and later damp-proof courses (Clifton-Taylor 1987, 158)

6.4.3 The fissile character of Welsh slate enabled it to be split into finer laminae than sandstone or limestone slates (6mm compared to 13-26mm), therefore significantly reducing the total roof weight and subsequently reducing the roof timber size.

6.5 Pottery

6.5.1 Only a limited amount of pottery was recovered from the Site, and it is all of modern date, with a potential date range of late 18th to 20th century. However, unlike the glass (see below), there is nothing that definitely post-dates the end of steel production at Derwentcote at the end of the 19th century.

6.5.2 Wares represented include coarse utilitarian redwares, seen here only in bowl forms (some internally white-slipped); stoneware storage jars (including the typical ribbed preserve jars of the late 19th and early 20th centuries); and finer tablewares in creamware, pearlware, bone china and refined whiteware.

6.6 Glass

6.6.1 The glass includes both window and vessel glass. Amongst the latter are bottles and jars for various products – bottles for wine, beer and other beverages (two are embossed but insufficient survives of the labels to ascertain manufacturers); and smaller, rectangular bottles for various liquid products.

6.6.2 All these could be accommodated within a 19th century date range, apart from two small bottles (contexts **1001** and **6002**) which contained syrup of figs (a mild laxative), and which are embossed with the label of the ‘Successors to the California Fig Syrup Co’, and the trademark ‘Califig’. The California Fig Syrup Company operated in San Francisco from around 1879 until the earthquake of 1906; this bottle must post-date this period.

7 PALAEOENVIRONMENTAL EVIDENCE

7.1 Introduction

7.1.1 A single bulk sample was taken from a charcoal dump (**7008**) within a building believed to be a charcoal store, and was processed for the recovery and assessment of charred plant remains and wood charcoal.

7.1.2 The bulk sample was processed by standard flotation methods; the flot retained on a 0.5 mm mesh, residue fractionated into 5.6 mm, 2mm, 1mm and 0.5mm fractions and dried. The coarse fraction (>5.6 mm) was sorted, weighed and discarded. The flot was scanned under a x10 – x40 stereo-binocular microscope and the presence of charred remains quantified (**Table 2**) to record the preservation and nature of the charred plant and wood charcoal remains.

7.1.3 The flot was large with low numbers of roots and modern seeds that can be indicative of stratigraphic movement and the possibility of contamination by later intrusive elements. Charred material showed varying degrees of preservation.

7.2 Results

7.2.1 No charred plant remains were recovered from this deposit.

7.2.2 Wood charcoal was noted from the flot of the bulk sample and is recorded in **Table 2**. Very large quantities of wood charcoal fragments were retrieved from dump **7008**. The charcoal appeared to be mainly mature wood fragments with some round wood pieces. A number of these charcoal pieces were ring-porous and may be fragments of oak (*Quercus* sp.).

8 DISCUSSION

8.1 Research Aim 1: Iron finery forge

8.1.1 The evaluation at Derwentcote has provided some information on the development and use of the Site, but did not address as much of Research Aim 1 as hoped at the beginning of the investigation. This was largely due to the fact that the current woodland coverage is too dense to enable easy access, and trees and scrub would need to be removed carefully to avoid causing damage to underlying archaeological deposits and structures. However, it is clear from excavation elsewhere on the Site that buried archaeological remains survive well and that future work on the forge area should produce valuable results. Furthermore, recording of the workers' cottages and the dam wall, and excavation within Trench 1, have shown that early structures were altered during the lifespan of the forge. Early parts of the industrial complex, therefore, still survive as standing remains and below ground structures.

8.1.2 The possibility that a blast furnace may have been in use before the dam wall was consolidated is, on balance, probable. If a blast furnace was present on Site, then it was probably out of use by 1719 as no mention of it was made by Kalmeter following his visit at this time.

8.2 Research Aim 2: The crucible furnace

8.2.1 Trench 1 identified the existence of a crucible furnace at Derwentcote, possibly added to the forge in 1861. The crucible furnace may have been built into an existing building within the forge. The last firing of the furnace appeared to have been a failure, as indicated by split crucibles, resulting in its abandonment. No ancillary rooms, such as 'pot-room', weighing up/charge room, or coke storage area were identified, though this probably reflects the limited excavations and the fact that most of these activities probably took place on the floor level (which did not survive) above the cellar in Trench 1. A small forge to the north of the crucible furnace continued to be used after its abandonment. The crucible furnace is the first excavated example outside Sheffield, South Yorkshire.

8.3 Research Aim 3: Workers' cottages and gardens

8.3.1 No details about the gardens were uncovered during the evaluation. However, limited building recording and excavation within the workers' cottages revealed some information regarding the structural sequence and the people who worked at Derwentcote.

8.3.2 Evidence from the remaining standing elements of the building indicates a late 18th-century, agricultural origin for the cottages, with a sequence of later divisions and alterations, following the conversion to domestic occupation which was likely contemporary with the development of the forge and crucible steel melting industry.

9 SUMMARY OF POTENTIAL

9.1.1 Derwentcote represents a unique opportunity to investigate the genesis and decline of a rural industrial complex. Much of the data from early-modern industrial complexes of steel and iron manufacture has derived from cities such as Sheffield or Birmingham. However, the nature of the Industrial Revolution was that of an era of pragmatism and competitive development. Therefore, areas of industrial working and process were widespread and varied in success.

9.1.2 Derwentcote has been recognised by English Heritage as a nationally important site and landscape. The findings from the investigations carried out here help to show the state of preservation as well as informing further on the pragmatic evolution of steel production at Derwentcote. The findings are of **high national** significance and should be analysed further.

9.2 Finds

Metallic finds

9.2.1 The material was recovered from the only excavated example of a crucible steel furnace outside South Yorkshire.

9.2.2 Because of the relatively high value of crucible steel and the ease with which it can be recycled, it is very unusual to find historic crucible steel that has not been manufactured into finished items; perhaps surprisingly, it is also unusual to find the metal at its point of origin. Crucible steel recovered from furnace sites is, therefore, highly significant.

9.2.3 The metal, slag and crucible sub-assemblages each contain material that is of potential national significance.

9.2.4 The assemblage may contain fragments of crucible steel that was produced at the Site, although metallographic analysis is required to determine this. As most surviving 'Huntsman type' crucible steel is incorporated into finished objects, it is generally extremely difficult to obtain samples for metallographic and chemical analysis. If the pieces of cast metal recovered are found to be made from crucible steel, they will be useful reference material for future research into this historic metal. The assemblage also contains possible evidence of a catastrophic failure of a crucible within the furnace. Metallurgical analysis could be used to investigate whether the fragments of cast metal are made from crucible steel, and whether the 'slag cake' was the result of a crucible pot failure. If this 'spillage material' is evidence of such a failure, it would be the first time that this has been found archaeologically, and could provide valuable information on the challenges faced by historic steelmakers.

9.2.5 The crucible fragments within the assemblage are also of national significance. The fragments are the first used steelmaking crucibles to be found in a furnace context outside the Sheffield, South Yorkshire area. In future, the fragments could provide useful comparative material for the study of crucible steelmaking refractories. The refractoriness of the crucible was one of the key aspects to successful steelmaking and, if the spillage material does relate to the failure of a crucible, it would be especially interesting to investigate the differences between the fabric of the Derwentcote and Sheffield crucibles, to see whether differences in refractoriness may have been a contributing factor.

9.2.6 The crucible assemblage also contains some more unusual items, including the unused crucible lids. Although the scope for scientific analysis of their fabric is limited (as it was common practice for them to be made from a less refractory mixture to the crucibles), they are of some interest, as they have impressions of the pot maker's finger marks.

Ceramic building material

9.2.7 Just over a third (36%) of the assemblage was recovered from the topsoil (**1001** and **7001**) and may have been imported to the site, and therefore must be treated with caution. Within the remainder of the assemblage there is insufficient evidence to determine the re-use of the material prior to deposition, due to the paucity of mortar adhesions and alteration of the material. However, the stamped and special-shaped bricks can add considerable information to the construction methods of the forge and its source of materials. The assemblage can also enhance our knowledge of the economics of fire-clay products and their distribution throughout the United Kingdom.

Other finds

9.2.8 Other finds are of lower significance. Small quantities of pottery, glass and building stone were recovered, but none of high significance. These categories of material have already been recorded to an appropriate archive level, and no further analysis is proposed.

9.3 Palaeoenvironmental

9.3.1 The analysis of the wood charcoal from charcoal dump **7008** within Trench 7 has the potential to provide information on any species selection for use in the ironworking activities present on site. There may also be a limited amount of information on the management and species composition of the exploited woodland resource.

10 PROPOSALS FOR FURTHER ANALYSIS AND PUBLICATION

10.1.1 Although the historical background of Derwentcote is well documented, little archaeological work has previously taken place within the forge complex and workers cottages. The results of the fieldwork reported on here, although not extensive, are therefore of significance in confirming but also amplifying the historical records, and warrant dissemination.

10.1.2 It is recommended that a summary publication report is prepared for submission to *Post-Medieval Archaeology*. This report, which would be based on the information presented in the current assessment report, would be in the region of 3000 words of narrative text, with up to three accompanying plans of the archaeological results, and one or two historic plans or drawings. Artefactual and environmental information would be integrated into the narrative text as appropriate, but the results of further analysis of the metallic finds in particular would be presented in full.

10.1.3 A copy of this assessment report will be submitted to the county Sites and Monuments Record, and information on the excavation will also be submitted to the OASIS website.

10.1.4 As the site is being damaged by vegetation, a condition survey and management plan should be formulated to help preserve the site *in-situ*. This is beyond the scope of the current project.

10.2 Finds

10.2.1 Further analysis is proposed for the metallic finds and the ceramic building material only.

Metallic finds

10.2.2 Action required on individual items is shown in the 'further action/analysis' column in **Appendix 3**.

10.2.3 It is recommended that before any metallurgical analysis of items is carried out, some should be photographed or illustrated prior to sampling; the relevant items are listed in **Appendix 3**.

10.2.4 A small number of items from contexts **1029** and **1030** are concretions that may contain identifiable and/or significant metal objects and it recommended that these should be X-rayed to allow them to be fully assessed.

10.2.5 Following any photography or illustration required, metallurgical analysis should be undertaken on the fragments of cast ferrous metal from contexts **1001** and **6001** and possible crucible steel spillages from contexts **1001**, **1008** and **1017**. The main aim of analysis should be to identify what type of metal these items are composed of.

10.2.6 If the fragments of possible blast furnace slag from context **2006** are not found to be backfill/secondary deposits (though this is considered to be very likely), the fragments should be investigated using metallurgical and chemical analysis.

10.2.7 The results of the analysis should be incorporated within a written interpretation of the overall assemblage.

Ceramic building material

10.2.8 It is recommended that further work should be undertaken on the manufacturers' stamps and any published account of this excavation should include a short discursive account of the ceramic building material. Upon completion of work on the ceramic building material assemblage, a selective discard policy should be implemented. The material deemed worthy of retention as part of the archive should be processed and packaged in accordance with the delegated museum's guidelines, prior to deposition of the finds assemblage as a whole within the appropriate museum.

10.3 Palaeoenvironmental

10.3.1 It is proposed to analyse the wood charcoal from dump **7008**. Identifiable charcoal will be extracted from the 2mm residue together and the flot (>2mm). Larger, richer samples will be sub-sampled. Fragments will be prepared for identification according to the standard methodology of Leney and Casteel (1975, see also Gale and Cutler 2000). Charcoal pieces will be fractured with a razor blade so that three planes can be seen: transverse section (TS), radial longitudinal section (RL) and tangential longitudinal section (TL). They will then be examined under bi-focal epi-illuminated microscopy at magnifications of x50, x100 and x400 using a Kyowa ME-LUX2 microscope. Identification will be undertaken according to the anatomical characteristics described by Schweingruber (1990) and Butterfield and Meylan (1980). Identification will be to the lowest taxonomic level possible, usually that of genus and nomenclature according to Stace (1997), individual taxon (mature and twig) will be separated, quantified, and the results tabulated.

11 ARCHIVE

11.1.1 The project archive comprises the following components

- 1 file records
- A1 graphics
- artefacts: 4 boxes
- environmental material: 1 box unsorted residue and assessed flots
- 330 digital photos
- other digital data (word processed files; spreadsheets; database; CAD drawings)

11.1.2 The archive has been prepared in accordance with the *Guidelines for the preparation of excavation archives for long term storage* (UKIC 1990) and *Archaeological archives: a guide to best practice in creation, compilation, transfer and curation* (Brown 2007). The archive is currently held at the Wessex Archaeology offices In Sheffield under the project code 74157. It is intended that the archive will be deposited at the English Heritage store at Helmsley.

12 REFERENCES

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12.2 Cartographic

- Ordnance Survey Landranger 88. 1:50 000. Newcastle Upon Tyne
- Ordnance Survey Explorer 307. 1:25 000. Consett and Derwent Reservoir
- British Geological Survey. Sheet 20 (Drift Edition). 1:50 000. Newcastle

TABLES

Table 1: Brick dimensions

Context	Brick size	Date range
1001	230mm x 110mm x 60mm (9" x 4 ¼" x 2")	13th-15th century
1001	215mm x 100mm x 60mm (8 ½" x 4" x 2⅜")	18th-19th century
1008	?mm x 110mm x 57mm (?" x 4 ¼" x 2 ¼")	17th-19th century
1014	222mm x 110mm x 57mm (8¾ " x 4¼" x 2 ¼")	17th-19th century
6002	230mm x 115mm x 52mm (9" x 4 ½" x 2 ¼")	17th-18th century
6002	?mm x 100mm x 60mm (?" x 4" x 2⅜")	18th-19th century.

Table 2: Assessment of the charred plant remains and charcoal

Samples				***Flot***								
Feature	*Context*	*Sample*	*Vol. Ltrs*	*Flot (ml)*	*% roots*	*Charred Plant Remains*			*Charcoal*		*Other*	*Analysis*
						Grain	*Chaff*	*Other*	*>4 mm*	*2 mm*		
Trench 7												
dump	***7008***	***1***	***6***	***1900***	***2***	***-***	***-***	***-***	***850 ml***	***500 ml***	***coal***	***C***

Key: A*** = exceptional, A** = 100+, A* = 30-99, A = >10, B = 9-5, C = <5;
Analysis: C = charcoal

APPENDIX 1: ENGLISH HERITAGE SCHEDULING

Name: DERWENT COTE STEEL FURNACE (THE CONE)

List Entry Number: 1240411

Location

FORGE LANE
The building may lie within the boundary of more than one authority.

County:
District: County Durham
District Type: Unitary Authority
Parish:

National Park: Not applicable to this List entry.

Grade: I

Date first listed: 06-Jun-1951

Date of most recent amendment: Not applicable to this List entry.

LEGACY SYSTEM INFORMATION

The contents of this record have been generated from a legacy data system.

Legacy System: LBS

UID: 438836

ASSET GROUPINGS

This List entry does not comprise part of an Asset Grouping. Asset Groupings are not part of the official record but are added later for information.

List Entry Description

Summary of Building

Legacy Record - This information may be included in the List Entry Details.

Reasons for Designation

Legacy Record - This information may be included in the List Entry Details.

History

Legacy Record - This information may be included in the List Entry Details.

Details

NZ 15 NW CONSETT FORGE LANE

(East side)
Hamsterley Colliery
1/40 Derwent Cote
6/6/51 steel furnace
("The Cone")
GV I
Steel-making furnace. First half of eighteenth century, for the cementation process. Coursed sandstone rubble with some ashlar dressings; no roof at time of survey. One storey, 4 bays with high cone on second-bay furnace. 3 buttresses support cone; small square openings between buttresses, that at right blocked; rough wood lintels to partly-blocked door to right of furnace, and empty window in first bay; stone sill to window in fourth bay (with ruined lintel) has O.S. bench mark. Return gables survive to full height, the left with large buttress. Rear elevation shows 3 buttresses to furnace, the central truncated and the left built into later one-storey, one-bay outshut. High stone cone has 2 square flue openings at top of ground floor; cone contains square opening with rebated stone lintel and jambs and plain stone sill.
Interior: iron lintels over funnelled entrances to cone, with inner brick pointed arch in that at right and stone lintel in that at left, both flanked by buttresses.
The only complete surviving example in England of a cementation furnace.
Empty and derelict at time of survey.
An Ancient Monument in Guardianship.

LISTING NGR: NZ1304656508

Selected Sources
Legacy Record - This information may be included in the List Entry Details.

Name: Derwentcote steel cementation furnace, iron finery forge and drift coal mine

List Entry Number: 1015522

Location

The monument may lie within the boundary of more than one authority.

County:
District: County Durham
District Type: Unitary Authority
Parish:

National Park: Not applicable to this List entry.

Grade: Not applicable to this List entry.

Date first scheduled: 01-May-1970

Date of most recent amendment: 16-May-1997

LEGACY SYSTEM INFORMATION

The contents of this record have been generated from a legacy data system.

Legacy System: RSM

UID: 28536

ASSET GROUPINGS

This List entry does not comprise part of an Asset Grouping. Asset Groupings are not part of the official record but are added later for information.

LIST ENTRY DESCRIPTION

Summary of Monument

Legacy Record - This information may be included in the List Entry Details.

Reasons for Designation

Large scale iron and steel production developed in Britain during the early 18th century. The centre of the steel industry at this time was the Derwent Valley in County Durham where the use of new technology enabled the production of more and better steel by a process known as cementation. Cementation involved adding carbon to malleable (wrought) iron within a cementation furnace, in order to produce blister steel bars so called because of their blistered surface texture. Iron bars were packed in charcoal dust and sealed into stone chests within the furnace. The chests were then fired for ten days and allowed to cool. The resultant steel bars could be forged into billets or finished artefacts, or were melted in crucibles to produce cast steel. High grade imported Swedish wrought iron was normally used as locally produced iron was found to contain too many impurities. Cementation furnaces characteristically have three main elements. At the base a hearth, which ran the length of the building, fed flames and hot gases into a vaulted chamber below a tall cone which acted as a chimney. In addition cementation furnaces are accompanied by ancillary buildings such as offices, stores and smiths and other features such as spoil tips and hollow ways.

The technique of forging was primarily used in order to convert cast iron into malleable iron bars by a process known as finery/chafery. During the finery process the iron was re-heated in an open charcoal fired hearth, blown by water powered bellows. Large quantities of water were required and typical mill water supply features are often found in association with forge buildings. These include weirs, headraces, ponds, dams, wheel pits and tailraces.

Drift mining can be recognized by the existence of a regular straight mine entrance, dipping inwards at a uniform angle. Drift mining commenced during the 18th century but most known examples date from the 20th century.

As well as being the earliest cementation steel furnace in the British Isles, Derwentcote is also the only intact and complete example. It represents a

steel making technology which lasted for more than 300 years and was an essential part of the Industrial Revolution. The associated finery forge retains significant archaeological deposits and will add greatly to our knowledge of the development of the Iron and Steel industry in England. The continued industrial use of the site for coal mining into the middle of the 20th century will add to its overall significance as an industrial complex of great longevity.

History

Legacy Record - This information may be included in the List Entry Details.

Details

The monument includes the remains of a steel cementation furnace and associated buildings and tips, an iron finery forge and water related earthworks and a drift coal mine and associated structures and tips. They are situated on the south side of the River Derwent above its confluence with the River Tyne. The cementation furnace at Derwentcote is the only one of an original six furnaces known to have been situated in the Derwent Valley during the 18th century. Documentary evidence has established that the furnace was constructed around the year 1733 and remained in use until 1875 when in its latter years there was a shift to crucible steel production. A forge, originally accompanied by a corn mill was constructed in 1718-19 and remained in use until the 1850s when at this date it began to forge steel and later changed to crucible steel production until its closure in 1891. The coal mine dates from the 20th century and is known to have been operational during the 1930s.

The steel furnace complex, oriented north to south, is situated at the top of a steep north east facing slope. A road visible as a slight hollow way at the extreme south end of the monument gave access to it from the former main road between Derwent and Shotley Bridge. The furnace is a stone built structure, buttressed on all sides with a central chimney or cone, containing two flue openings on the ground floor. It is adjoined by buildings to the north, south, and south east which have been interpreted as stores. Internally, the furnace consists of a rectangular working space 5.2m by 3.2m, topped by an arched brick vault. Two sandstone chests are situated either side of a central flue, below which lay the ash pit. Part excavation at the steel furnace in 1987 and 1988 revealed that it was constructed slightly earlier than the adjoining stores although they were all part of an original plan. Deposits of iron and steel slag within the southern building suggest that it had been used for forging or smithing; a tree stump embedded in the floor may have been used as an anvil and an adjacent pit may have been the base for a second anvil or hammer. In the northern part of this building the base of a possible charcoal grinding mill was uncovered. The central ash pit beneath the furnace itself was excavated and shown to have stairs giving access at either end. Part excavation outside the furnace revealed the presence of further structures; the first, to the west of the northern end was interpreted as a timber lean to, while two timber framed buildings were interpreted as sand stores. A series of track ways with metalled surfaces, containing debris from the furnace and forge, were uncovered north of the latter. It is thought that the track way was constructed at an early stage in the history of the monument. Finally, excavation outside the southern part of the furnace buildings revealed the existence of deep deposits interpreted as rubble from the clearance of an earlier building on this part of the site.

The foundations of a rectangular building 7.5m by 3.5m, situated 29m south of the furnace are thought to represent the remains of an associated office. Immediately to the north and east of the furnace an arc of flat topped tips radiating outwards are visible as a series of scarps up to 4m high. Analysis of their composition has shown that they consist of an assortment of slag as well as building stone and slate. A prominent hollow way bounded by a steep bank connects the furnace with the site of the forge buildings, which is situated at the foot of the steep north facing slope upon which the cementation furnace stands. Several other tracks, visible as hollow ways and slight scarps, are visible at the foot of the scarp in this area connecting the buildings with each other and Forge Lane, which lies outside of the area of the scheduling to the east.

The forge complex which occupies the flood plain of the River Derwent was powered by water, and several of the water related earthworks are visible in this area. The weir which dammed the River Derwent some 250m west of the monument is no longer visible but water was removed from the river via a brick inlet sluice which survives in a tumbled state. A headrace, running from the sluice to the forge, is visible as a prominent earthwork 200m long, 5.5m wide and a maximum of 1.9m deep, flanked by slight earthen banks. At its western end it has become partly infilled. The mill pond, which provided a head of water to operate the forge, now drained and silted, survives as an elongated marshy hollow 100m long by 25m wide and to a maximum depth of 1.5m. The mill pond was dammed at its eastern end by a stone dam and although this has been breached it survives as an earthwork 2m high. A tailrace carried water from the mill pond to the forge buildings and traces of an artificial channel 1.3m deep to the east of the mill pond are thought to be the remains of this feature.

Maps dating from the 19th century show that the forge consisted of two building complexes. The first, or north range is situated immediately north of the mill pond. This range is visible as a series of scarps 0.3m high, a sub-rectangular depression 0.2m to 0.3m deep and a sub-rectangular platform 0.4m to 0.5m high, in addition to the footings of several stone and brick walls and mounds of tumbled rubble. The southern range straddled the main outflow channel from the mill pond. Its north eastern corner is visible as a series of earthworks 0.3m high, and hollows 1.3m deep, while parts of its eastern and southern walls stand to a height of 0.5m. A wall 2m high which is visible on the outer face of the mill pond dam is thought to be the remains of a wheel pit.

Immediately west of the forge buildings there is a line of associated, ruined buildings terminating in the ruins of a row of three stone cottages with adjacent out-buildings and gardens standing to a maximum height of 2m in places. The cottages had been converted by 1856, from an earlier rectangular building containing a large opening in its south wall and this earlier building formed part of the industrial complex.

East of the forge complex are the remains of a drift coal mine known from documentary sources to have originated during the 20th century. The remains include a mine known as Forge Drift surrounded by associated buildings, platforms and spoil heaps as well as a mineral railway track. At the extreme western end there is a depression 1.5m deep with a stone retaining wall and an external bank. This feature has been interpreted as a loading bay for wagons taking on coal from the railway lines which are depicted on a map but are no longer visible on the ground. A mound of coal mining waste 1.2m high, is situated immediately east of the latter feature. The forge drift mine workings are visible as a concrete platform and a concrete edged hole 0.7m deep. The entrance to the mine has been obscured by a collapse of the natural slope

across it. Several other features survive to its east as sub-rectangular depressions and low scarps; these are all associated with the mine workings and represent building platforms and mounds of mining waste.

The core of the monument is in the care of the Secretary of State and the cementation furnace is a Grade I Listed Building.

The custodians office and the surfaces of all paths associated with public access to the monument, all fences and the metal handrail adjacent to the furnace, are excluded from the scheduling, although the ground beneath these features is included.

APPENDIX 2: CONTEXT LIST

Trench 1		
Context No	Type	Description
1001	Topsoil	Very dark reddish brown silty clay loam topsoil containing abundant humic matter
1002	Deposit	Pinkish grey demolition layer with frequent rubble inclusions, including complete firebrick and redbrick. Abandonment of the forge
1003	Wall	Large north-south sandstone wall with redbrick culvert exiting through east face. 1004 abuts 1003
1004	Wall	Sandstone wall running east west angling between 1003 and 1005. 1005 is a rebuild of the return of 1004 and 1004 is later than 1003.
1005	Wall	Rebuilt area of wall 1032 possibly extending it to 1004 and 1003. Unlike other walls 1005 is very roughly built
1006	Wall	North wall of crucible cellar, originally foundations for building. 1032 overlies and ties into crucible cellar
1007	Wall	North-south firebrick plinth extending from crucible stack south. Eastern most edge of bays for firing crucibles
1008	Deposit	Material built up along 1006 and 1032 post-abandonment, goes over crucible cellar and external to forge, suggesting crucible cellar was out of use and the forge continued to operate.
1009	Wall	Sandstone east wall of crucible cellar
1010	Deposit	Iron-pan layer accreted over 1057 and stains into 1057, after cellar has silted up post-abandonment.
1011	Deposit	Yellowish brown sandy clay subsoil with frequent root matter, below 1008
1012	Deposit	Demolition layer over crucible area associated with gradual degradation after abandonment of crucible cellar.
1013	Deposit	Layer on south side of crucible furnace, gradual build up of rubble and humic matter.
1014	Wall	Redbrick east-west wall over culvert 1037 and abutting 1038
1015	Fill	VOID
1016	Deposit	Crucible demolition layer, contemporary with 1012, above the cellar floor.
1017	Deposit	Mid grey clay silt above iron- working surface 1018 south of 1014 and overlying beam slot 1030
1018	Deposit	Iron- working surface, built up around 1040.
1019	Deposit	Light purplish grey ash within 1020 and 1021 and above 1023. Last firing within fireplace.
1020	Structure	Redbrick surround of small fireplace within forge adjacent to 1021 above 1023
1021	Structure	Redbrick surround of small fireplace within forge adjacent to 1020 above 1023
1022	Deposit	Silica-rich ash around fireplace 1020 and 1021 above 1023
1023	Deposit	Iron-conglomerated floor across forge
1024	Structure	Edging of firebricks lain on sides, east-west along north edge of 1051. Top surface is worn
1025	Structure	Adjacent lining to 1024
1026	Deposit	Light grey clay with a slight blue hue, deposited within 1024, 1025 and 1027 with frequent small flecks of charcoal
1027	Structure	North-south continuation of 1024 and 1025 creating a square, 'working area' in which 1026 and 1056 have been deposited.
1028	Fill	Rubble deposit overlying dark silt 1029 in south extension of Trench 1, below 1017
1029	Deposit	Dark silt layer with iron concretions, underlying 1028 and abutting 1030. Ironworking surface in south of Trench 1
1030	Fill	Very dark grey silt filling the destruction cut /post-use removal of a beam slot associated with 'machine base' 1040
1031	Deposit	Mid grey sand below 1029 in sondage within south area of trench.
1032	Wall	East-west wall of forge area, rebuild of 1005 and contemporary to 1006 and 1004

1033	Structure	Group No.
1034	Structure	Redbrick edging inside 1024, 1025 and 1027. Part of later forge use
1035	Floor	Cobbled surface, external to forge and crucible furnace.
1036	Deposit	Ash and iron-conglomerated deposit over forge area immediately north of the crucible cellar and over 1023. Late sweepings or residue form forge.
1037	Structure	Redbrick arched culvert with crucible cellar built over, suggesting an earlier tail race through the building, predating the crucible steel process. Wall 1014 is built on top of 1037
1038	Wall	North-south sandstone wall built over 1037 and edging the crucible cellar
1039	Wall	East-west wall adjoining north edge of 1038 and running parallel to 1033 into the west section. Part of the creation of the crucible cellar.
1040	Structure	Redbrick structure at north end of beam slot 1030. Part of a 'machine base' within building at south end of trench. 1029 lips up and abuts 1040
1041	Fill	Grey silt and gravel below 1029 and cut into by beam slot 1030
1042	Cut	
1043	Floor	Redbrick and firebrick flooring, constructed using recycled bricks varying in size, shape and manufacturer, within crucible cellar. No obvious patching or areas of reworking bricks and mainly running north south lain on bed.
1044	Structure	Sandstone lain in base of beam slot 1030 to aid levelling of base.
1045	Structure	Redbrick edging, slightly raised from floor 1043 and forming a boundary between 1043 and 1046. Possibly a wall and edging to the crucible cellar
1046	Deposit	Light yellowish grey river gravels. Natural
1047	Cut	
1048	Cut	
1049	Structure	Middle (as excavated) firebrick plinth of crucible firing bays; larger than bay 1007 but the same size as bay 1050.
1050	Structure	Western plinth of crucible firing bays adjacent to bay 1049 and constructed against chimney 1051. same size as bay 1049
1051	Structure	Sandstone rebuild of chimney stack of crucible furnace. Built into wall 1006 and constructed using small lumps of sandstone as a core within faced larger blocks.
1052	Deposit	Light yellowish grey sand within 1024, 1027 and 1034. Overlies 1023.
1053	Structure	Sandstone flag pad in northeast corner of forge area.
1054	Structure	Sandstone flag adjacent to 1053 and forming a base on which a machine or hammer could have sat.
1055	Deposit	Iron hammerscale and sand mixed deposit within 1053 and 1054, suggesting forging activities. (possible small castings and forging).
1056	Deposit	Dark bluish grey clay silt below 1010

Trench 2		
Context No	Type	Description
2001	topsoil	Very dark reddish brown humic layer
2002	Deposit	Rubble deposit full of large, angular blocks and smaller lumps of worked sandstone. Derives from the collapse of structure 2008.
2003	Deposit	Very dark grey humic lens, above iron pan
2003	Deposit	Very dark grey humic lens, above iron pan
2004	Deposit	Iron pan below 2003 and above 2005
2005	Deposit	Mid grey coal ash and hammerscale. Redeposited industrial residues within localised deposit.
2006	Deposit	Natural fluvial gravels
2007	Wall	Retaining wall of dam cut into natural gravels 2006, with rubble backing, for dam east of mill pond
2008	Structure	Square sandstone structure with cement render / repointing, Thought to have possibly originally been a blast furnace I(though this seems very unlikely), later used as part of the dam wall / sluice arrangements.

Trench 3		
Context No	Type	Description
3001	Deposit	Demolition/degradation layer consisting of redbrick (late 18th C), pan tile and roof slates.
3002	Deposit	Deposit of plaster/mortar below 3001 and above ceiling timbers 3003. Most likely from walls which have fallen after ceiling has collapsed.
3003	Deposit	Rotting ceiling/roof timbers, nail jointed small nails suggesting roofing.
3004	Deposit	Collapse of chimney, through chimney and spilling out over floor within workers' cottage 3011. Comprised of bricks consistent with the standing structure. Below 3003. Possibly part of the initial degradation of the workers' cottage.
3005	Deposit	Collapse of workers' cottages to the south side of fireplace. Comprised of brick, some burnt, and mortar. Below 3003 and contemporary with 3004, but not derived primarily from the chimney.
3006	Deposit	Thin layer of greenish grey silt, abundant broken window glass and frequent rotted wood, (possibly window frame). Deposit contained sash weight. Initial degradation of cottage.
3007	Deposit	Thick deposit of ashy silt in fireplace below 3004 and within chimney. Abundant soot possibly from degradation of chimney rather than last fire.
3008	Deposit	Deposit within the fireplace; mid grey ashy silt below 3007 and darker. Has two semi-charred fragments of wood..
3009	Structure	Iron ash pan with handles and hook for dragging when hot. Part of fireplace furniture.
3010	Structure	Fireplace constructed of a stone surround with firebrick as the main walling.
3011	Floor	Red square tiles forming the floor around the fireplace

Trench 5		
Context No	Type	Description
5000	Deposit	Demolition material around workers' cottages, full of redbrick and stone.

Trench 6		
Context No	Type	Description
6001	Topsoil	Very dark reddish brown silty sand with abundant humic matter (roots and rootlets).
6002	Deposit	Dark reddish grey silt sand with frequent coarse fragments of limestone filling wheel pit / leat. Alluvial silts in wheel pit.
6003	Structure	Mid-section of wheel support cut into larger block within eastern wall of wheel pit / leat.
6004	Structure	Western wall of wheel pit / leat, adjacent to 6003 and with 6002 abutting it.
6005	Deposit	Rubble north of wheel pit / leat created from the degradation and demolition of wheel support and housing.
6006	Deposit	Dark grey silt within 6003 alluvial deposition. Part of the post-demolition silting.
6007	Fill	Deposit of slag derived from mixed processes - possibly crucible smelting and puddling. Overlies the structures in Trench 6, suggesting they were deposited post-demolition.
6008	Fill	Dark greyish brown with abundant ash. Conglomerated deposit over slag debrist 6007.
6009	Wall	Wheel pit walling, exposed during machine excavation of the wheel pit / leat. Immediately backfilled after machine excavation due to excessive flooding.
6010	Structure	Rubble face of wheel pit / leat wall; same as 6009 but south face. No markings.
6011	Structure	Poor quality rubble wall associated with the wheel pit.
6012	Cut	Square cut into 6011 as part of the wheel supports within the wheel pit / leat wall.

Trench 7		
Context No	Type	Description
7001	Topsoil	Dark reddish brown silty loam topsoil. Frequent rotted humic matter.
7002	Surface	Rough clinker and ash surface, very compact. Late 19th-20th C.
7003	Deposit	Mid yellowish brown clay silt, common medium-sized, sub-angular sandstone fragments. Dumped deposit. Common coal and charcoal fragments up to 3mm.
7004	Deposit	Mid yellowish brown clay-silt, common medium-sized sub-rectangular sandstone fragments; common charcoal lumps. Lenses of ash, dumped after robbing of wall 7012.
7005	Deposit	Mid yellow-brown clay silt, with abundant medium and large, well-embedded, sub-rounded cobbles.
7006	Deposit	Charcoal deposit at west end of trench within southern half; infrequent patches of mid yellowish brown silty clay.
7007	Fill	Pale cream ashy deposit intermixed around its edges with charcoal dump 7008, though in places seems to overly charcoal dump. Not excavated.
7008	Deposit	Thick charcoal deposit over two large sandstone flags. Possibly part of material once stored in building
7009	Deposit	Fill of robber cut 7010; loose grey silty loam. 19C finds.
7010	Cut	Near vertical-sided robber cut at east end of trench. Not fully excavated. Filled by 7009.
7011	Surface	Cobbled surface at east end of trench; rounded cobbles up to 0.35m in size.
7012	Wall	Early wall exposed within sondage at west end of trench, running east-west; comprises large, sub-rounded stones with roughly finished north and south faces. Foundation trench cut into 7013.
7013	Deposit	Mid greyish-yellow brown sand-silt, with patches of brown sandy-silt; frequent charcoal inclusions.
7014	Deposit	Within 7015. Mid yellow-brown clay silt, with abundant medium and large stone fragments.
7015	Deposit	Dark brown clay silt, with abundant medium and large stone fragments. Contains 7014 as lenses.
7016	Cut	Bioturbated area; possibly a removed tree, pre-dating the construction (and robbing) of wall 7009/7010.
7017		Void
7018	Deposit	Same as 7013
7019	Cut	Robber cut of early wall 7012, filled by 7004

APPENDIX 3: METALLIC FINDS LIST

Context	Type	Fragment Count	Weight (g)	Notes	Further action/analysis?
1001	Crucible	6	1298	Fragments from side of crucible pot. No base or lid fragments.	No
1001	Crucible	4	2963	Crucible stand and fragment of side and base.	No
1002	Crucible	5	1970	Fragments from side of pot.	No
1002	Crucible	4	1680	Crucible pot lids, 2 used and 2 unfired and unused.	Yes, photo/illustrate
1002	Crucible	4	1375	Fragments from side of pot.	No
1002	Crucible	1	2100	Large base and side fragment.	No
1008	Crucible	7	550	Misc fragments	No
1008	Crucible	1	10000	Crucible base with slag.	Yes, photo/illustrate
1016	Crucible	1	1125	Misc fragments.	No
1016	Crucible	1	9000	Crucible base with slag.	No
1001	Slag	3	2013	1 x fuel ash slag, 1 x slag with coke inclusion, 1 x undiagnostic	No
1001	Slag	1	13250	Slag-like' residue with very high ferrous metal content and coke inclusions, also contains remains of crucible stand. Possible residue from burst crucible pot.	Yes, photo/illustrate and metallurgical analysis to identify
1001	Slag	1	4510	Ropey dense tap slag with coke inclusions. Probable blast furnace tap slag.	No
1001	Slag	8	1518	Small fragments of undiagnostic and fuel ash slag.	No
1001	Slag	1	1660	Weathered undiagnostic slag.	No
1002	Slag	5	1718	All fragments have coke inclusions, one with fragment of refractory furnace lining attached. Probable blast furnace slag.	No
1008	Slag	4	8	Possible fragments of blast furnace slag	No

1008	Slag	3	1698	1 x fuel ash type slag from crucible furnace, 1 x possible blast furnace tap slag, 1 x undiagnostic.	No
1008	Slag	1	1330	Slag-like' residue with very high ferrous metal content, possible crucible spillage.	Yes, metallurgical analysis to identify
1017	Slag	1	1995	Slag-like' residue with very high ferrous metal content, possible crucible spillage.	Yes, metallurgical analysis to identify
1030	Slag	1	16	Fragment of blast furnace slag.	No
1031	Slag	7	130	Possible fragment of blast furnace slag	No
2001	Slag	1	142	Undiagnostic slag	No
2002	Slag	5	1717	Undiagnostic slag	No
2006	Slag	1	1100	Drossy slag, possibly from blast furnace	No
2006	Slag	5	1132	Heavily weathered, possible blast furnace slag	Possible metallurgical analysis - Dependant upon context interpretation
2006	Slag	1	2115	Heavily weathered undiagnostic slag.	No
2006	Slag	3	114	2 x probable blast furnace slag, 1 x undiagnostic slag	No
6001	Slag	2	558	1 x undiagnostic, 1 x possible consolodated floor layer	No
7002	Slag	2	188	1 x possible consolodated floor layer, 1 x possible blast furnace slag	No
1002	CBM/Slag	1	532	Fragment of refractory brick with coke based fuel ash slag attached - from demolished crucible furnace?	No
1008	Slag/fuel	4	74	2 x Coke, 2 x Coal	No
1019	Slag/fuel	2	36	Coke	No
1001	Slag/steel	2	2080	2 x fragments of cast ferrous metal, possibly crucible steel	Yes, illustrate/photograph and metallurgical analysis
1001	Fe Object	7	1020	Misc objects including nails and wrought iron wedge.	Yes, illustrate iron wedge

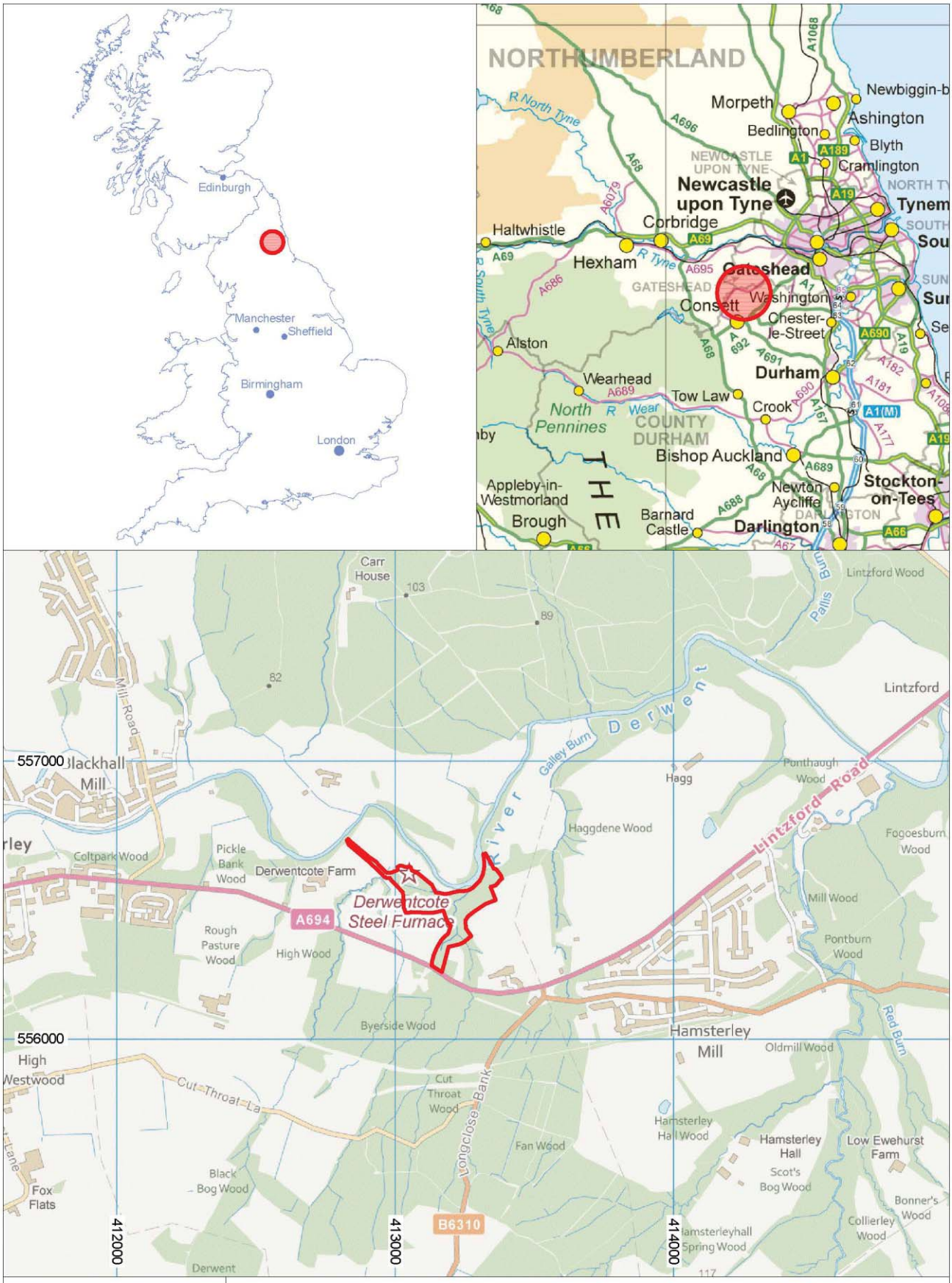
1001	Fe Object	2	26	Nails	No
1001	Fe Object	2	1226	Fragments of Fe bar.	No
1002	Fe Object	3	4080	Ferrous metal hoop and possible iron timber fixings.	No
1011	Fe Object	1	174	Large pin/nail.	No
1017	Fe Object	1	158	Horseshoe fragment.	No
1019	Fe Object	3	446	Includes wrought iron wedge and nails.	Yes, photograph/illustrate wedge
1028	Fe Object	2	12	Possible fragments of handle from 'tin'/enamelled mug	No
1029	Fe Object	9	604	Undiagnostic small heavily corroded ferrous metal fragments.	Yes, possibly investigate using X-ray if context supports this
1030	Fe Object	2	178	Heavily corroded, unidentifiable ferrous metal objects, one with ring attached	Yes, possibly investigate one item using X-ray if context supports this
1036	Fe Object	4	316	Misc objects. Undiagnostic	No
2002	Fe Object	2	326	Part of small funnel/tundish, 1 x short length of wire.	No
2002	Fe Object	4	1668	Includes Fe sheet and 2 rings.	No
2002	Fe Object	4	4252	Includes padlock, pin, plate and cast iron rainwater downspout.	No
3001	Fe Object	1	118	Pin/hook.	No
5001	Fe Object	4	3615	Includes counterweight from sash windows and fragment of cast iron fireplace surround.	Yes, possibly illustrate/photograph fragment of fireplace surround if context supports this
6001	Fe Object	7	2632	1 x wrought iron wedge, 2 x nails, 2 x fragments of ferrous metal strip, 1 x undiagnostic fragment	Yes, photograph/illustrate iron wedge
6001	Fe Object	2	2269	1 x wedge/pin, 1 x fragment of cast iron or steel.	Yes, metallurgical analysis of fragment of cast ferrous metal
6002	Fe Object	1	284	Wrought iron wedge with concretion attached	Yes, photograph/illustrate iron wedge

6012	Fe Object	1	5000	Conglomerate of earth, small coal fragments, stones and crushed slag. Probable compacted floor material	No
7001	Fe Object	3	240	Includes chain fragment and nail.	No
7003	Fe Object	1	36	Metal reinforcement from heel of shoe.	Yes, illustrate/photograph if context supports this
7001	Metal (Non-Fe)	3	56	Includes parts of 20th century light fittings	No

APPENDIX 4: NON-METALLIC FINDS LIST

Context	Type	Fragment Count	Weight (g)	Notes
1001	Glass	8	352	Includes Complete clear bottle with "SUCCESSORS TO THE CALIFORNIA SYRUP CO" on one side.
1001	Pottery	11	138	Misc sherds including marble.
1001	CBM	1	1850	Firebrick material, wedge shaped with stamp
1001	CBM	1	976	Firebrick fragment with "B.." on one side.
1001	CBM	1	1040	Handmade brick, fingermarks on one side.
1001	CBM	1	2850	Firebrick, no frog or stamp.
1001	CBM	1	830	Small firebrick.
1001	CBM	1	2156	Firebrick material worn on one face.
1001	CBM	1	1500	Firebrick material with "VCC" stamp.
1001	CBM	1	1170	Firebrick material
1001	CBM	1	2100	Handmade unfrogged brick.
1001	CBM	1	2200	Firebrick with "HAMSTERLEY" stamp.
1001	Clay Pipe	2	6	Decorated bowl and decorated stem fragments.
1002	CBM	1	610	Fragment of pipe?
1002	CBM	1	3000	Complete firebrick, vitrified with "VCC" stamp.
1008	Glass	4	206	Bottle glass, 1 dark green with "…OND…"
1008	Pottery	8	86	Misc sherds.
1008	CBM	2	1528	Partial handmade brick, fragment of vitrified firebrick.
1008	CBM	1	978	Partial firebrick.
1008	CBM	1	1920	1/2 - 3/4 complete firebrick, no frog.
1008	CBM	1	746	Pan tile
1008	Clay Pipe	1	8	Partial bowl and stem.
1011	Pottery	2	24	1 white glazed, 1 Cream/yellow glaze.
1014	CBM	1	2500	Complete handmade brick with mortar attached.
1024	CBM	1	1900	3/4 complete unfrogged firebrick with "..RAMSA.." and "NEWCAST.." on one side.
1028	CBM	1	102	Pan tile.
1033	CBM	1	1595	1/2 width firebrick with "BUTE" stamp"
1033	CBM	1	2200	"HAMSTERLEY" firebrick.
1033	CBM	1	1850	Wedge shaped firebrick with "VC.." stamp.

2001	Glass	1	118	Complete bottle.
2002	Glass	2	350	Complete clear glass jar. Green bottle glasss fragment.
2002	Stone	2	658	Sandstone roof tile and possible slate roof tile?
3001	Stone	1	2750	Sandstone roof tile.
3006	Glass	3	38	Clear window glass.
4001	Pottery	1	4	White glaze with green and gold design.
6001	Glass	1	266	Dark green base of bottle
6002	Glass	1	70	"CALIFIC" on sides, "SUCCESSORS TO THE CALIFORNIA FIG SYRUP CO" on front.
7001	Pottery	3	28	Misc sherds.
7001	CBM	1	366	Pantile.
7003	CBM	1	662	Pantile.



Site location

Scheduled area

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Site location

Figure 1

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Scheduled area

Topographic map courtesy of RCHME

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Site plan, showing trench locations (superimposed on topographic map)

Figure 2

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Trench 1: plan

Figure 3

Plate 1: Trench 1 Area A, showing small forge north of crucible furnace (view from the south-west; scales = 2m)

Plate 2: Trench 1, showing crucible furnace and demolition area over top (view from the east; scale = 2m)

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Plate 3: Trench 1 Area B, showing crucible furnace bays within cellar (view from the south; scale = 2m)

Plate 4: Trench 1 Area B, showing covered tailrace at south end of crucible furnace (view from the south; scales = 2m)

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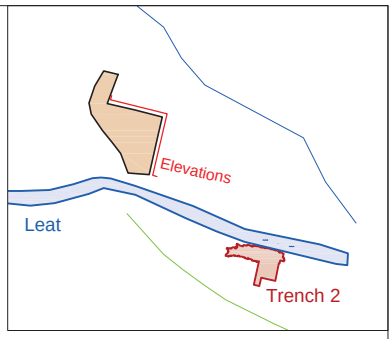
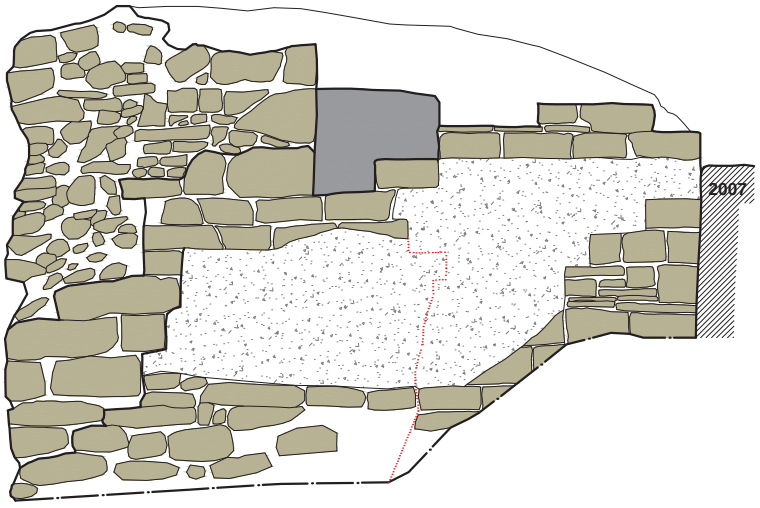
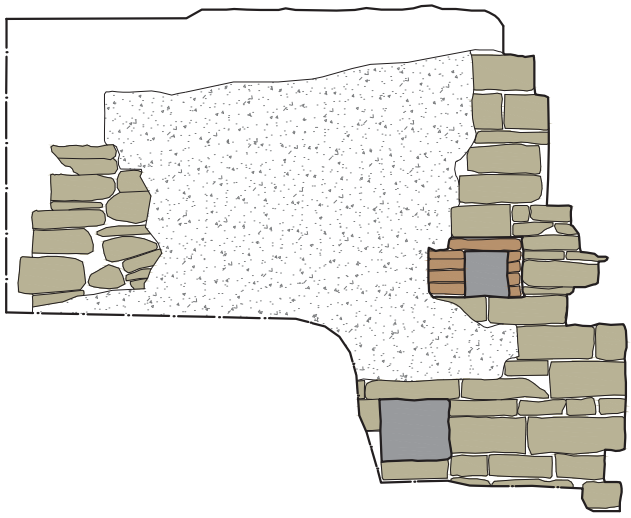




North facing section



East facing section

Sandstone

?Drain hole

Mortar

Fire Brick

Crack

0 1 2m

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Trench 2: elevations of structure 2008

Figure 6

Plate 5: Trench 2, showing north-face of structure 2008, abutted by wall 2007 (right) (view from the north-east; scales = 2m)

Plate 6: Trench 2, showing east-face of structure (view from the north-east; scales = 2m)

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Plate 7: Trench 3, showing fireplace, floor and demolition deposits within workers' cottages (view from the east; scale = 2m)

Plate 8: Trench 5, showing precarious nature of walls (view from the north-west; no scale)

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Trenches 3 & 5: photographs

Figure 8

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Trench 6: plan

Figure 9

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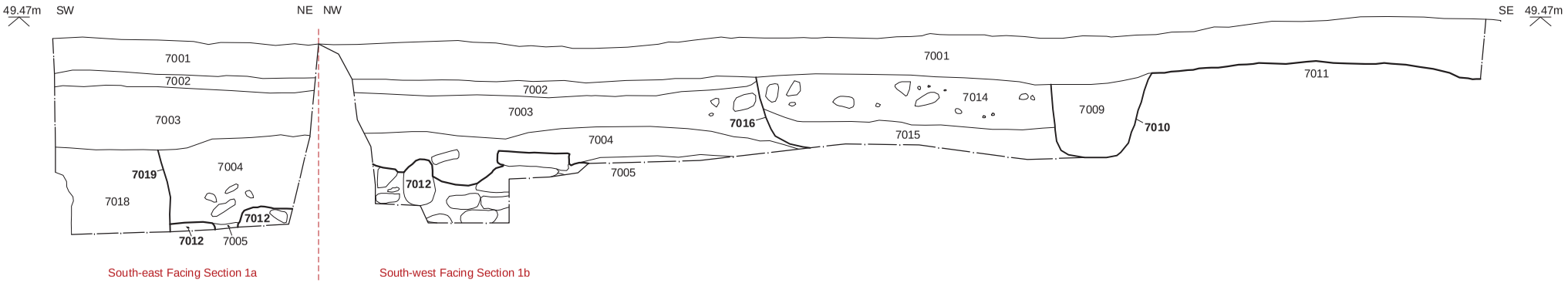
Trench 7: plan

Figure 10



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Trench 7: South facing section

Figure 11

Plate 9: Trench 6, showing wheel-pit wall **6009** with waterwheel fixing points **6003** (view from the north-east; no scale)

Plate 10: Trench 7, showing wall **7012** (view from the south-west; scale = 2m)

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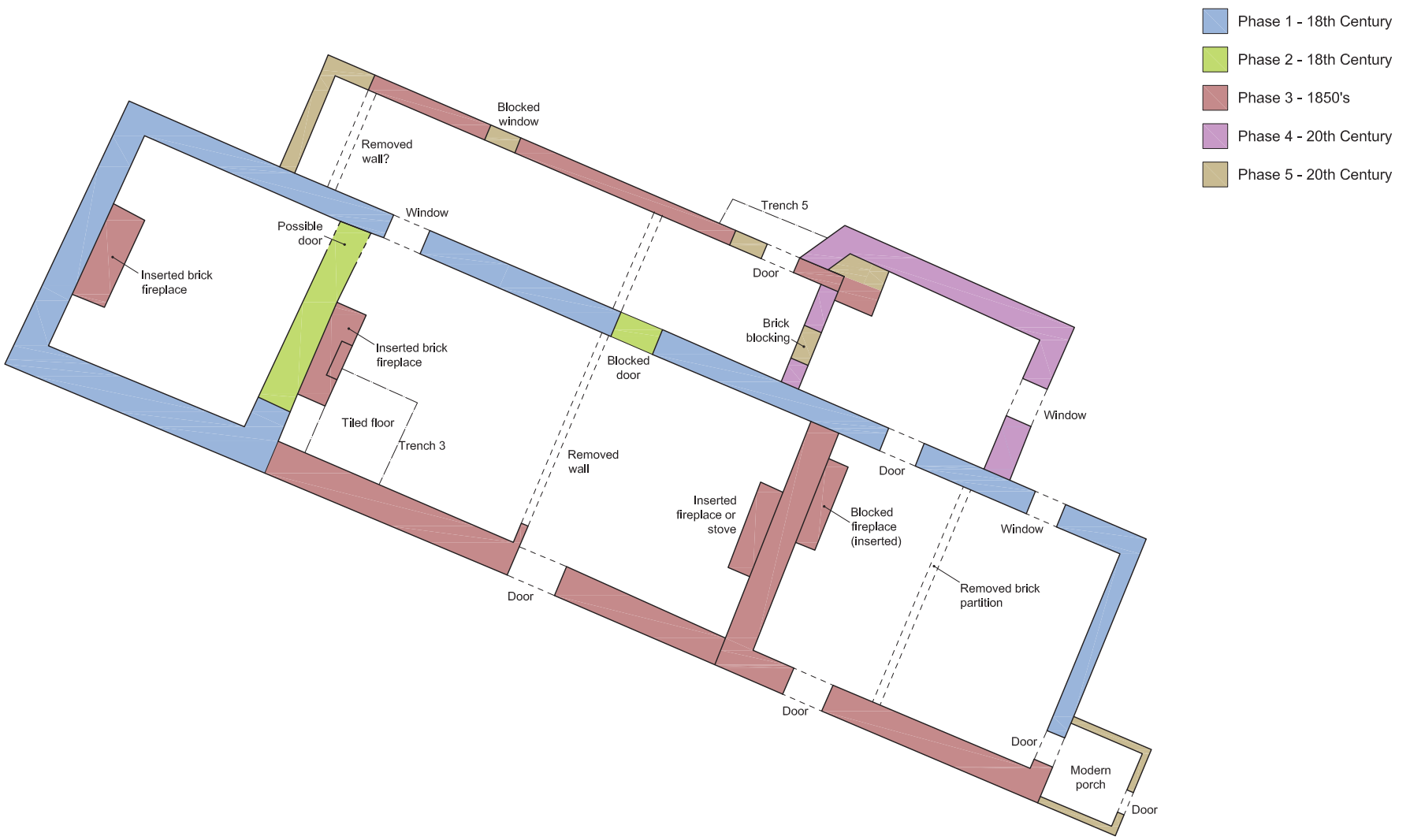
Trenches 6 and 7: photographs

Figure 12



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0 5m

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Phased building plan of workers' cottages

Figure 13

Plate 11: General view looking into workers' cottages (view from the south)

Plate 12: Trench 7, showing wall **7012** (view from the south-west; scale = 2m)

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