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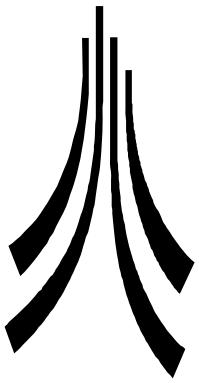

August 1998

BACKBARROW IRONWORKS

Cumbria

Assessment and Evaluation Report

Commissioned by: Ultratools Precision Mouldmaking Ltd

Backbarrow Ironworks, Cumbria

Assessment and Evaluation

Report no 1998-99/006/AUA7796

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SUMMARY

The Lancaster University Archaeological Unit (LUAU), at the request of J.G.R. Planning and Technical Services, and on behalf of Ultratools Precision Mouldmaking Ltd, in accordance with a brief by the Lake District National Park Authority, undertook a documentary survey and evaluation of the Backbarrow Ironworks (SD 3555 8470). This important monument has been scheduled as an Ancient Monument (SAM Cumbria no.506). This programme of work was undertaken in advance of an industrial development, which will involve the reuse of some buildings, infill development, new buildings, car parking and landscaping.

The documentary survey comprised a study of available archaeological records, primary, secondary and cartographic sources. This follows on from a survey undertaken by LUAU (1992) which primarily examined the furnace area of the complex. A further survey was subsequently undertaken by the RCHM(E) which examined the remainder of the site. Alongside the documentary study a site inspection was undertaken; however, this was severely limited by considerable vegetation growth over the site.

Following the documentary survey, evaluation trenching was undertaken between 22nd June and 29th June 1998. The combined results of the trial trenching and documentary study have demonstrated that the proposed Unit One will impact on the remains of a series of twentieth century casting sheds. The course of the leat, which according to cartographic sources should lie within the footprint of the proposed Unit Three was not located, but potentially may survive at a depth greater than 1.8m (the maximum depth of Trench 2). Trenches within the areas of Units Two and Three identified deep deposits of slag waste, which have been subject to extensive riddling to extract iron material and was undertaken subsequent to the abandonment of the ironworks (1964); consequently the deposits have been extensively disturbed. Units Two and Three will therefore not have an impact on an identified archaeological resource of any significance.

The Admin/Design Centre will be located on top of a concreted slag spoil mound which could not be economically penetrated by a bore-hole drill. The proposed new-build in this area will thus have little adverse impact on the archaeological resource, which if present, is sealed beneath this concreted material.

A series of recommendation options are proposed:

- The design and location of the proposed Unit One is adjusted to increase the separation between it and the furnace;
- The western area of the Unit One new build should be subject to mitigation excavation to record the archaeological deposits affected by the development; or
- The Unit One building is constructed on a concrete raft above the sensitive archaeological stratigraphy;
- A structural assessment of the furnace complex be undertaken to assess the condition of the monument;
- Structural Consolidation be undertaken of the Furnace complex to stabilise the structure;
- The store houses and the engine house should be subject to a fabric survey in advance of any conversion works;

- A watching brief should be undertaken within the area of the store houses or engine house during any below ground intervention.

ACKNOWLEDGEMENTS

Thanks are due to J.G.R. Planning and Technical Services for commissioning the project on behalf of Ultratools Precision Mouldmaking Ltd, and also for supplying digital plans of the site and proposed development.

The project was funded by Ultratools Precision Mouldmaking Ltd, South Lakeland District Council, Cumbria County Council and the Rural Development Commission.

Thanks are due to John Hodgson of the Lake District National Park Authority for supplying copies of an unpublished report on the site and for his help during the course of the project. Thanks also to the staff of the RCHM(E) for supplying a draft copy of the 1992 survey. LUAU is also grateful to the staff of the English Heritage Scheduling Section for providing a copy of David Crossley's 1980 inspection report. For assistance with deposited archives thanks are due to the staff of the Cumbria County Records Office at Barrow-in-Furness. We are particularly grateful to Mike Davies-Shiel for invaluable information concerning the pre-blast furnace organisation of the site and for addition information concerning the later development of the site, as well as for recommendations for additional consultees.

The excavations at Backbarrow Ironworks, Cumbria, engendered a great deal of local interest and support for which Lancaster University Archaeological Unit is grateful. Special thanks are due to Ronald Mein and Peter Sanderson (Leven Valley Local History Society) who provided invaluable information on the later development of the area east of the furnace.

Thanks are also extended to Kevin C Moir (Dunelm Drilling Company, Bleach Green, Hetton-le-Hole, Tyne and Wear, DH5 9HH) and the staff of J B Site Investigations for providing preliminary borehole data. Ian T Shaw Plant Hire are thanked for their assistance, and in particular for the skill of their drivers.

The documentary research was undertaken by Iain Hedley and Richard Newman. The evaluation was directed by Iain Hedley; Graham Suggett and Mark Chesterman were excavation assistants throughout. This report was compiled by Iain Hedley and the MPP assessment (*Appendix 4*) was written by David Crossley. The report was edited by Jamie Quartermaine and Rachel Newman. The project was managed by Jamie Quartermaine.

1. INTRODUCTION

1.1 PROJECT BACKGROUND

1.1.1 An archaeological assessment and evaluation was undertaken by the Lancaster University Archaeological Unit (LUAU), at the request of J.G.R. Planning and Technical Services on behalf of Ultratools Precision Mouldmaking Ltd, at Backbarrow Ironworks, Cumbria (SD 3555 8470) (Fig 1). The site is the subject of a planning application for development, which will involve the construction of factory units on the yard area of the former ironworks and an administration and design centre on a spoil mound to the south of the furnace. The assessment was undertaken in May 1998 and the evaluation was undertaken between 22nd and 29th June 1998.

1.1.2 This assessment and evaluation follows on from an earlier programme (LUAU 1992) which assessed the development of the furnace area, although the remit did not extend to a detailed examination of the yard areas to the east of the furnace or the store house areas to the west. The primary purpose of the present assessment was therefore to collate existing information on the archaeology and history of the site and to redress the imbalance of the earlier study. The purpose of the evaluation was then to investigate the sub-surface survival of the archaeological resource within the areas of the proposed development. The combined results of the documentary study and the evaluation trenching are presented within this report, which is intended to assess the archaeological implications of the proposed development.

1.1.3 The report sets out the results of the work and comprises a methodology, an archaeological background, an assessment of the archaeological potential of the development areas, recommendations for further work and site management, together with a site gazetteer.

1.2 BACKBARROW IRONWORKS

1.2.1 The Backbarrow Ironworks are of very considerable archaeological significance, which is reflected in its designation as a scheduled monument (SAM Cumbria no. 506). The Backbarrow site represents a small-scale, essentially eighteenth century, ironworks which has been modified throughout its history with the minimum of capital investment, and is now the only site in which many technological developments can be studied. It was the second blast furnace to be built in Cumbria, the first being at Cleator Moor (Riden 1987, 29-30 and Philips 1977, 26), and the last in Britain to convert to coke-firing. It also has a number of associations with important historical figures such as Wilkinson and Darby. Whilst a number of charcoal-fired blast furnaces survive in Britain, all are essentially eighteenth century in date and embody no nineteenth century developments (Crossley 1980, 3). The nineteenth century form of blast furnace, which differed markedly in its scale, build and site plan, has now totally disappeared. Backbarrow, therefore, is now the only site in Britain in which the development of nineteenth century blast furnace technology can be demonstrated (Crossley 1980, 4).

1.3 PREVIOUS WORK

1.3.1 In the latter part of the 1970s interest in the preservation and development of the site was encouraged by Cumbria County Council, Lake District National Park Authority and the centre for North West Regional Studies at the University of Lancaster. In 1976 a survey and discussion paper was produced by the Director of Planning, Cumbria County Council, and the Lake District National Park Officer. In addition, the Northern Mill Engine Society produced a report on the condition of the blowing engine. Further to this interest Dr David Crossley undertook a rapid survey of the structural condition of the monument in 1980. The survey, which included a photographic record, addressed the prioritisation of conservation measures and also paid particular attention to the storage sheds on the west side of the site which had been largely overlooked by previous surveys.

1.3.2 Subsequent to the 1980 report little archaeological work was undertaken until an archaeological investigation in 1992 by the Lancaster University Archaeological Unit (LUAU 1992). This programme of work involved an assessment of the ironworks in conjunction with a fabric survey of the furnace area, including elevation drawings of the furnace and roaster house. This was followed by a programme of survey by the RCHM(E) (report pending) which generated a ground plan of the whole site in conjunction with an oblique photographic survey of all the buildings.

2. METHODOLOGY

2.1 PROJECT DESIGN

2.1.1 A project design (*Appendix 3*) was submitted by LUAU in response to a request from J.G.R. Planning and Technical Services for an archaeological evaluation at the Backbarrow Ironworks. It was designed in accordance with a project brief (*Appendix 2*) by the Lake District National Park Archaeologist.

2.1.2 The project design provided for an archaeological assessment involving a desk-top survey and a site inspection culminating in an interim report and review. Following on from that an evaluation was undertaken to examine the sub-surface potential of the site. The work has been carried out in accordance with the project design.

2.1.3 The results of both the assessment and evaluation are presented within the present report.

2.2 DESK-TOP SURVEY

2.2.1 All potential sources identified by the earlier report (LUAU 1992) and the project design (*Appendix 3*) have been consulted as has the project archive from the earlier LUAU work, which includes copies of many of the early photographs of the site. Not all sources, however, had relevant information. A search of the records held by the National Library of Wales, in particular, found no reference to Backbarrow. Due to the extent of the surviving archive for the various companies and families connected with Backbarrow, which consist largely of account books, journals, and ledgers, the sources consulted for this desk-top search have been targeted at those which are of direct relevance to the development of the areas affected by the current proposal. Investigation of the Kings College Library, Newcastle upon Tyne established that this contained record account books and ledgers, which did not directly inform the present study and which for the most part were duplicates of documents held at the Cumbria County Record Office in Barrow.

2.2.2 All documents pertinent to Backbarrow have now been transferred from both the County Record Office in Kendal and the Barrow Public Library to the County Record Office in Barrow, which was therefore the primary source of material for the assessment. It contained considerable information pertinent to the present study, including maps, photographs and documents. The earliest map identified of Backbarrow was from 1808 (BDB H5/map 9 1808) showing the property of John Birch and Robt Robinson; it depicts the northern tip of the works, but does not show sufficient of the site to inform the present study.

2.2.3 A search of existing aerial photographic coverage was initiated with the National Aerial Photographic Library held by RCHM(E). The search revealed that seven vertical photographs are held, dating from 1945 to 1979. In addition, a further 14 photographs are held in the special collection, dating from 1994 and 1997.

2.2.4 Existing archaeological information was gathered from the LDNPA, English Heritage records and the RCHM(E). A preliminary ground plan of the site produced by RCHM(E) was obtained but the final report has yet to be compiled. A report by Cumbria County Council and the LDNPA (1976) on the viability of the monument as an industrial museum was supplied by John Hodgson (LDNPA Archaeologist). The report summarises the history of the study area and lists a range of documentary

sources, many of which were consulted during an earlier programme of work undertaken by LUAU (1991; 1992). Re-examination of these sources has been limited to those which include information directly relevant to the development of the site.

2.2.5 Mike Davies-Shiel was consulted and provided considerable help with the study, and also a set of photographs, mainly from the mid twentieth century, as well as a diagrammatic depiction of the site's operation immediately prior to its closure in 1964. An invaluable set of photographs has been provided by Ron Mein, mainly from the last days of the operation.

2.3 FIELD INSPECTION

2.3.1 A field inspection of the development area was undertaken. The areas of development on both the east and west sides of the main road that runs through Backbarrow and the ironworks were under dense vegetation cover. On the east side of the road the area of the former stack yard was densely planted with silver birch to a maximum height of 8m, thus making detailed examination of the ground difficult. However, some concrete foundations and other features were identified. On the west side of the road the storage buildings were densely vegetated, thereby restricting the detailed examination of the area.

2.4 EXCAVATION METHODOLOGY

2.4.1 Nine trial trenches in all were excavated across the site, concentrated in areas of proposed new build development (Fig 19). Three trenches were excavated within the extent of Unit One, two trenches were excavated within the environs of Unit Two and one trench was excavated within the extent of Unit Three. A single trench explored the store houses on the western side of the road and a further trench was excavated to the south of the engine house.

2.4.2 All evaluation trenches were machine-cut in the first instance using a 1m wide toothless ditching bucket, and all overburden was removed mechanically, under archaeological supervision. Machine excavation continued to the point at which archaeologically significant deposits/features were reached. Thereafter, the features were uncovered in plan, cleaned and recorded, and, where appropriate, were further excavated by hand or by machine.

2.4.3 Where trenches were excavated beyond a depth of 1.25m, the maximum safe depth for an unshored excavation, one side of the trench was battered back and in one case the trench was widened, and stepped sides excavated, to allow an additional 1m deep sondage to be excavated in the centre of the trench. Several trench edges were cleaned by hand and recorded as drawn sections at a scale of 1:20.

2.4.4 All elements of the work were, as a matter of course, recorded in accordance with current English Heritage guidelines (English Heritage 1991) and the best practices formulated by English Heritage's Central Archaeology Service and the Institute of Field Archaeologists. All excavation, by whatever method, was recorded by the compilation of *pro-forma* context and object records, and the production of accurately scaled drawings, as well as a comprehensive photographic record. Features were recorded in plan either by manual draughting or using a total station. On completion of the fieldwork the site was backfilled and made safe.

2.5 ARCHAEO-METALLURGICAL AND OTHER SAMPLING STRATEGIES

2.5.1 The sampling strategy formulated as part of the project design made an allowance for appropriate archaeo-metallurgical deposits (typically furnace slag) to be sampled, and the nature of an analysis was to be discussed in consultation with Mr J Hodgson. However, in practice, the majority of such deposits were disturbed by activity post-dating the closure of the iron works and did not warrant sampling.

2.5.2 Though an allowance was made in the project design for appropriate palaeo-environmental samples to be taken, no such deposits were encountered.

2.6 FINDS STRATEGY

2.6.1 All artefacts were handled and stored in accordance with standard practice (following current Institute of Field Archaeologists guidelines). However, all identifiable metal objects were photographed and contextually recorded, and were deposited in the turbine house for safe keeping.

3. TOPOGRAPHICAL AND HISTORICAL BACKGROUND

3.1 TOPOGRAPHICAL BACKGROUND

3.1.1 ***Location:*** the Backbarrow Ironworks (SD 3555 8470) is situated at the south end of the village of Backbarrow, approximately 4km south-west of Newby Bridge (Fig 1). It lies within the South Lakeland District of Cumbria and is within the Lake District National Park, though prior to 1974 it lay within the Lancashire Hundred of Lonsdale (Lancashire North of the Sands). The site extends on both sides of the road through the village and is situated between the Lakeside and Haverthwaite railway to the west and the river Leven to the east. The furnaces are set into the moderate to steep slope of the Leven Valley, and the ancillary buildings and water mill are set on the flat flood plain of the river. Ore, coke and scrap metal store-houses were constructed to the west of the furnace and higher up the slope, thereby using gravity to help with the movement of raw materials. These were directly supplied by the railway which was further east and up-slope of the store houses.

3.1.2 The position of the ironworks reflects the original need for a fast-moving river to provide power and the availability of raw materials. Charcoal was supplied from the surrounding woodlands, which were managed on a fourteen to fifteen year cycle over many centuries and there are many pitsteads (charcoal burning platforms) within the area laying testament to the scale of this industry. Iron ore was mined at Lindal in the Furness peninsula and was shipped around the coast to Haverthwaite.

3.1.3 ***Communication:*** initially Windermere and its outflow, the river Leven, were a primary artery for raw materials as the only transport overland was via packhorse routes. In 1763 a Turnpike Trust road was constructed linking Kendal and Kirkby Ireleth via Bouth and passed two kilomteres to the north of Backbarrow. In 1820 a further Turnpike road was constructed through the centre of the Backbarrow Ironworks, linking Lancaster to Ulverston. Prior to this construction a road had extended to the east of the furnace and this subsequently became an access road for the ironworks. Communications into the Furness peninsula were dramatically improved with the development of the Furness railway after 1846 (Fig 3). In 1868 a branch line was opened linking Newby Bridge and Backbarrow to the main line and from then onwards all raw materials and produce were transported by rail.

3.2 HISTORICAL BACKGROUND

3.2.1 ***Pre -1711 Iron-working:*** the Furness area is very rich in iron ore, abundant in water supply and has large areas of managed woodland. Early iron smelting using the direct or 'bloomery' smelting process is well represented in the area, including bloomery slag on the Backbarrow fulling mill site on the opposite bank of the river Leven (Davies-Shiel pers comm). Fell (1908) considered that bloomeries of this type belonged to a period of control by Furness Abbey. However, following the Dissolution of the Monasteries (1537-40), this relatively basic manually-powered process was replaced in the area first by the bloom smithies, which introduced water-power, and from about 1620 by the bloomery forge, where iron blooms were fashioned into a range of saleable goods.

3.2.2 The earliest documentary reference to iron working at Backbarrow is in 1685 when James Maychell of Haverthwaite took a lease at the site and established a bloomery forge, however, it is possible that the forge was erected on the site of an earlier bloom

smithy (Davies-Shiel pers comm). John Maychell's will, dated 1 November 1702, left his iron forge at Backbarrow to his son John Machell, and in the inventory of the 7 November 1702 he had stock at the forge to the sum of £100 (Lancs RO, WRWF 1702 after Cockerill 1989, 263).

3.2.3 ***The Backbarrow Company 1711-1818:*** in 1711 the Backbarrow Company, consisting of William Rawlinson of Force Forge, John Machell of Backbarrow, Stuart Crossfield of Plumpton and John Oliphant of Penrith, was formed and in the same year began the erection of a charcoal-fired blast furnace near to the site of the bloomery forge (CRO BZ5). The construction of the furnace was contracted to Christopher Burns using masons from Lancaster. The raw materials for the furnace came from as far away as Ireland (cast iron work) and Liverpool (fire-bricks). In the following year the bloomery forge was converted to a finery forge (Fell 1908, 208, CRO BZ185), where the pig iron produced in the furnace could be decarburised and converted into wrought iron.

3.2.4 The industry proved to be very successful and profitable, in part as a result of political events. Traditionally the main source of high quality iron had been from Sweden, but from some time prior to 1717 the trade had been interrupted by hostilities between Britain and Sweden causing the cost of Swedish iron to increase from '16 to 24 pounds per ton' (Marshall 1967, 294). The net effect was to increase significantly the demand for Furness iron.

3.2.5 Thirty years after its construction the furnace stack was rebuilt (Davies-Shiel pers comm) and once again in 1770 (Fell 1908, 208). In 1753 an anchor smithy was added, and in the following year a conveyance of land at Backbarrow Furnace (CRO B/2/1754) allowed the company to build one or more dwelling houses, outhouses and other buildings, which suggests a period of expansion. The conveyance refers to the Founders Parrock (a paddock or small enclosure) and the Madge Parrock, on the south and south-east side of the road respectively. By 1796 the Backbarrow Ironworks had an annual output of 700 tons (Riden 1987, 29).

3.2.6 ***Harrison Ainslie and Co 1818-1917/8:*** in 1818 the Backbarrow Company was taken over by Harrison Ainslie and Co (formerly the Newland Company) who installed a new blowing machine with cylindrical bellows (Fell 1908, 228). In 1852 the Ironworks was unsuccessfully advertised for sale, when it included a charcoal furnace, refinery and drawing forge with office, manager's cottage, other cottages, workmens' houses, gardens and land. The advertisement stipulated that the use of charcoal for iron manufacture was not to be continued at the site (CRO BZ87). In the event iron production continued and three years later (1855) a water lift was installed for charging the furnace and a drying shed was erected adjoining the casting shed (Fell 1908, 224, 230).

3.2.7 In 1820 a turnpike road was constructed through the centre of the ironworks and used the route of the westernmost road that is shown on the 1808 map (CRO BD/HJ/Plans9). Probably at this time but certainly between 1808 and 1848 the most easterly of the two roads through the site was blocked and became an access road for the ironworks.

3.2.8 At some time between 1866 and 1869 the Lakeside and Haverthwaite branch line was built as an addition to the main Furness Railway (Quayle and Jenkins 1977, 9-10), probably incorporating the siding to the ironworks at this time. This led to a

significant development to the western side of the site, including the construction of railway sidings for the works.

3.2.9 In 1870 the furnace was again rebuilt, as demonstrated by a dated lintel. By the 1880s the furnace was idle for one year in three to allow for the accumulation of adequate stocks of charcoal. At some time after 1888 a new water-wheel was installed.

3.2.10 ***Charcoal Iron Company to 1964:*** in 1917/18 Harrison Ainslie and Co became the Charcoal Iron Company, subsequently to be taken over by David Caid Ltd. This precipitated considerable changes to the works in 1921. The furnace was converted to coke from charcoal and this involved the rebuilding of the stack, and the installation of a steam engine for blowing air into the hearth. The casting hall was replaced and a system to use waste gases was installed. Photographs taken before and after the conversion to coke demonstrate that the site underwent considerable alterations.

3.2.11 At some time prior to 1936, the turnpike road through the site was improved. This caused some modification to the site and led to the erection of a new water lift and bridge for charging the furnace. In the 1950s a coke-fired cupola furnace was installed to recycle scrap metal. However, in 1963 the furnace was extinguished for the last time due to a dramatic fall in the world iron price. The fate of the company was withheld from its customers, however, to allow the substantial stocks of iron to be sold on. The company folded in 1964 and much of the equipment was dismantled and sold for scrap (Davies-Shiel pers comm), although remarkably the steam engine was left *in situ*.

4. DOCUMENTARY STUDY RESULTS

4.1 INTRODUCTION

4.1.1 This assessment presents the documented and physical evidence of archaeological features and structures within the extent and environs of the proposed development areas (Fig 18).

4.2 ADMIN/DESIGN CENTRE

4.2.1 The proposed site of the new Admin/Design Centre building lies to the south of the blowing house on a fairly level terrace formed by a spoil heap (Site 1; Fig 17). The spoil heap, which stands up to 3m high, is formed by very hard lime waste (residues from the limestone used as a flux during smelting) which has the consistency of concrete. Teeth marks from the bucket of a mechanical excavator in the top surface, possibly from an unsuccessful attempt to remove the heap, testify to the solidity of the deposit as did the bore-hole sampling (*Section 6*). As a consequence no trenches were excavated on the surface of the spoil.

4.2.2 The spoil heap is situated within the extent of a small enclosure with woodland, as shown on the 1848 Ordnance Survey (OS) map (Fig 3); this enclosure was edged to the east by a dry-stone wall, which is shown on an early photograph (While: *c*1920). Trees are also depicted on the 1888 2nd edition OS map (Fig 5), but not on the 1911 OS map (Fig 4). The lime was used as a flux during the coke phase of the site's history so the large lime spoil mound must post-date the 1920's. A photograph taken prior to the coke conversion (While: *c*1920; Fig 8) shows the area as very undulating ground and it would appear that it was probably in use as a spoil heap at that time. A photograph taken subsequent to the coke conversion but prior to the 1938 OS map shows the spoil heap for the most part in its present form (LDNPA; Fig 9). No structures are represented in this area until the 1938 OS map which shows an open-fronted building (Site 2) on the west side and the spoil heap edge to the east. A photograph dated to 1959 (Bowden) shows the spoil heap as a white area, opposite the open-fronted brick building, which had been extended to the south since the 1938 OS map.

4.3 UNIT ONE

4.3.1 The proposed site of Unit One is on the north-eastern side of the site against the bank of the river Leven (Fig 17). The OS map of 1848 (Fig 16) depicts a building (Site 14) at the northernmost extent of the proposed new build. This building was still in place on the 1877 estate map (CRO BD/HJ/320) but the character and shape of this building had altered significantly by the time of the 1888 OS map (Fig 5) and it is probable that it had been rebuilt. By the time of the closure this building was in use as stables and it is possible that was also its function in 1888. The 1888 OS map depicts a small rectangular structure in the southern part of the development, which continues on all of the later maps and is clearly a small structure (Site 6), but its precise function is not known. An irregular spoil heap (Site 4) is first shown in this area on the 1911 1:2,500 OS map and its extent and shape was clearly restricted to the south by the presence of this small structure (Site 6) which was therefore still in use at that stage.

4.3.2 A comparison between the 1888 and the 1911 OS maps reveals that the shape of the river bank had been altered in the intervening period, with a significant amount of land being reclaimed from the river Leven. Indeed, the spoil heap (Site 4) shown on the latter map overlies the major part of Unit One and protrudes into the river. The spoil heap continues to occupy the same location into the *c*1920s (While print; Fig 8) but the northern part had been removed and a stack yard created by the later part of that decade (LDNPA print). This had been partly removed by the time of the 1938 OS map and had been completely removed by the time of the Bowden photograph (1959). Field inspection of the river bank revealed considerable amounts of slag along its course. The extent of Unit One may, therefore, overlie made-up ground consisting of slag and other process residues and this has been confirmed by a geophysical trial survey, which demonstrated very considerable amounts of sub-surface iron material within the extent of both Units One and Two (*Section 4.7*).

4.3.3 The 1888 OS map (Fig 5) also includes the words 'Old Quarry' between the proposed locations of Units One and Two; the precise extent of this quarry is not shown on that map. It corresponds, however, to the location of a rectangular feature shown on the 1848 6" map, which was probably a small paddock and had a small shelter in the north-east corner. The quarry is not shown on subsequent maps or photographs and was probably filled with spoil.

4.3.4 During the remodelling of the works in 1921 a rectangular brick-built structure was erected over the north end of Unit One. It is shown on the 1920s/30s photograph (LDNPA print; Fig 9) as being open to the east and was apparently an extension of the larger open steel-framed casting shed between it and the furnace. This building was extant in 1959 (Fig 10) at which time most of the area was an open yard.

4.4 UNIT TWO

4.4.1 Unit Two is on the eastern side of the works adjacent to the river Leven. In common with Unit One, this area is within the vicinity of the Old Quarry (*Section 4.3.3*) and its eastern part may similarly overlie made-up ground. Photographs from the 1920s (LDNPA and While prints; Figs 9 and 8) indicate that the southern part of the area was divided up into small paddocks for livestock, although none of the boundaries are shown on any of the OS maps. The conveyance of the Madge and Foundry Parrocks in 1754 (CRO B/2/1754) suggests that the whole of the area adjacent to the river Leven may once have been divided up in such a way. By 1959, this area had been incorporated within the Ironworks and formed part of the large open stack yard area (Bowden; Fig 10).

4.5 UNIT THREE

4.5.1 Unit Three is at the south-eastern end of the Ironworks and immediately north of the Levens Dale cottages (Fig 17). Within its extent, the 1848 OS map depicts an open tail race and a wooded area immediately to the east of it. By 1888 the tail race had been partly covered and the woodland had been cleared. The photographs of the 1920s/30s show the tail race not only in existence but actually in use, as water is shown spilling out from it into the river. The walk-over survey demonstrated that none of the tail race survives on the surface, within the area of Unit Three or even at the outfall, and it is not clear if it survives as a subterranean feature or has been removed subsequent to the closure of the site. The date of the tail race is uncertain, but it could potentially relate

to the earliest use of the site by John Maychell in 1685 who constructed a weir to provide a head of water to drive the forge water wheel (Fell 1908, 200).

4.5.2 The 1920s/30s photograph (LDNPA) shows the area to the east of the tail race subdivided into small pastoral fields. None of these boundaries is shown on the contemporary OS maps. By the time of the Bowden photograph (1959) the area of plots had been incorporated into the open stack yard area.

4.6 STORAGE BUILDINGS, WEST OF ROAD

4.6.1 The buildings on the western side of the road were principally storehouses for materials such as scrap metal, ore and charcoal, and also some offices (Fig 15). The 1848 map predates the construction of the branch line and shows the line of store houses and offices which were built into the slope of the valley. They were at that time supplied by tracks leading up from the road and also by a track leading across the area of woodlands of Haverthwaite heights behind the Ironworks complex. It is probable that this track provided for the import of charcoal from pitsteads in the surrounding woodlands. From the store houses materials were transported via a water-pressure-operated lift to a conveyor which crossed the road to the furnace area.

4.6.2 The 1888 OS map (Fig 5) shows a somewhat altered arrangement, principally because of the branch line introduced in 1868, although the southernmost part of the storage complex appears little changed since the 1848 OS map. A siding is shown leading directly from the branch line to the northern end of the store room complex, and this end of the store complex was substantially expanded, which involved linking the large coke house to the smaller ore house to the north, thereby expanding the ore storage facility. The sidings ran along the upper side of the storage bins and so permitted the dumping of raw materials into the bins directly from the rail wagons. An additional charcoal store was built on the west side of the railway line, its purpose being to provide primary storage for the charcoal brought in from the Haverthwaite woodlands.

4.6.3 The 1911 OS map (Fig 6) shows an almost identical configuration of the store houses to that in 1888. By the time of the *c*1920 photograph (While print; Fig 8), one of the store houses (Site 11) has fallen out of use and is shown as partly collapsed. By the time of the LDNPA print (1920s/30s) the water-pressure-operated lift had been constructed. The 1959 Bowden photograph shows the configuration of the store houses almost unchanged since the LDNPA photograph.

4.7 GEOPHYSICAL SURVEY

4.7.1 An investigatory geophysical survey was undertaken at the Backbarrow site by Geophysical Surveys of Bradford (GSB) to assess the potential for further recording.

4.7.2 ***Resistance Survey:*** it was established that the majority of the study area had a hard-core surface which precluded the use of geophysical survey.

4.7.3 ***Gradiometric Survey:*** it was known that the site, because of its history as an ironworks, would be magnetically noisy. However, it was hoped that the gradiometer survey would be able to differentiate between the noisy background and discrete areas of very strong or saturated readings (readings off the scale), sufficient to record strong anomalies associated with stanchion foundations. Once on site it became apparent that the level of magnetic noise was extremely high and widespread due to the presence of

lumps of slag and metal fragments. Given the level of noise, anomalies suggestive of stanchions would not be distinguishable from other ferrous noise.

4.7.4 Given that neither the gradiometer or resistance survey would provide any useful information, the survey was abandoned.

5. TRIAL TRENCHING RESULTS

5.1 INTRODUCTION

5.1.1 Nine trenches (Trenches 1-9) were excavated across the site but for the most part within the areas of proposed new build. Trenches 3 and 5-7 were excavated within the extent of Unit One, Trench 4 was excavated to the south of the blowing house in order to examine the impact of parking and landscaping proposals, Trenches 1 and 8 examined the area of Unit Two, Trench 2 examined the putative position of the leat within the area of Unit Three and Trench 9 was positioned within the former scrap house in anticipation of restoration works of the scrap and ore houses.

5.2 TRENCH 1

5.2.1 Trench 1 was positioned in the southern part of the stack yard and ran from the north end of the main retaining wall eastwards into the stack yard area. The trench measured 9.5m in length by 2m wide and was excavated to a maximum depth of 1.25m. The trench was designed to test for the survival of the leat (*Section 4.5*), which was depicted in this part of the site by the OS, and any other deposits/features within the western side of Unit Two.

5.2.2 The trench was originally designed to begin 3.5m further west. However, initial machining in this area revealed a very deep deposit of concreted limy furnace slag which proved impossible to excavate with a toothed bucket and the location of the trench was moved to the east of this surface. It corresponds to the line of the access road that led to the furnace from the southern end of the ironworks site, which is the line of the original road through Backbarrow prior to the construction of the turnpike in 1820; however, the surface exposed during the excavation was clearly of a later date.

5.2.3 The trench divides into two clearly defined areas: that to the west comprised a series of stratified slag deposits [3-6 and 8] and these were all cut by [9] at an angle of approximately 45º at about 6m from the eastern end of the trench. The cut contained a uniform deposit of mixed, blackish fine to coarse glassy slag with occasional limy slag and brick fragments [2], which extended throughout the eastern end of the trench and clearly was deeper than the excavated section (1.25m deep from the top). This was stratigraphically the latest deposit in the trench.

5.2.4 ***Western deposits:*** of the stratified deposits at the west end of the trench, the lowest identified was at a depth of 0.64-0.96m and comprised a deposit of fine to coarse undisturbed glassy slag [8]. Above this was a 0.6m deep lensed deposit of bright red brick dust [4] with occasional larger brick fragments. This and [8] were overlain by a layer of very fine powdery charcoal [3] which was only present at the western end of the trench and had a maximum depth of 0.24m. Above this was a 0.2m deep layer of dark brown sandy silt [6] with occasional fragments of slag and charcoal and again was localised at the western end of the trench. Both layers [4] and [6] sloped down to the south. Deposits [3] [4] and [6] were overlain by a 0.42m deposit of mixed rubble [5], which included whole machine made bricks and occasional slag fragments. A 1.90m long and 0.05m deep deposit of concreted limy furnace slag [7] lay directly above [5]. This was overlain by the topsoils which varied in thickness but did not exceed 0.16m in depth.

5.2.5 No datable finds were recovered. However, immediately beneath the western section of the trench a large iron artefact, possibly connected with shovelling slag or casting, was recovered from [5].

5.3 TRENCH 2

5.3.1 Trench 2 was situated at the southern end of the stack yard, approximately 20m to the south of Trench 1, and was oriented broadly east/west. The trench measured 12.5m by 1m and a 1m wide batter was excavated along the southern side; it was excavated to a maximum depth of 1.25m. The trench was designed to test for the possible survival of the leat which was depicted in this part on the 2nd and 3rd editions of OS maps, and also other potential archaeological features within the extent of Unit Three.

5.3.2 The trench consisted entirely of redeposited fine to coarse mid brown limy and glassy slag [11], with occasional brick and stone fragments, and a number of very large boulders of concreted limy slag. This deposit was similar to [2] in Trench 1 but was significantly lighter in colour.

5.4 TRENCH 3

5.4.1 Trench 3 was positioned immediately opposite the furnace (Fig 19), and measured 3.5m by 10m with a north-south orientation. Archaeological features were encountered immediately below the surface and the trench was widened from an original 1m width to 3m wide in order to uncover the relationships between features in plan. It was designed to test for the survival of building remains associated with the furnace and evidence of the activities which took place within them. The trench was also designed to determine the relationship between the concrete platforms visible as surface remains and any archaeological feature/deposits beneath them. The assessment had identified that a casting shed was erected to the east of the furnace during the remodelling of the works in 1921 (LUAU 1998, 13) and is shown on a 1920s/30s photograph. Photographs taken in 1964 show that the building was still in place by that date (Fig 12) and there is the likelihood that the platforms relate to this documented structure.

5.4.2 The south edge of the trench consisted of a layer of concrete [50], 0.3m thick, which incorporated the steel bases of single steel stanchions [51] and [52] (the latter falling outside the excavated area); these were 'U'-shaped in plan and approximately 0.2m square on a 0.45m square, slightly raised, concrete plinth, situated 4.9m apart at the east and west ends of the trench (both had been cut a little above ground level). The concrete continued beyond the trench to the south though its full extent was not uncovered. It formed the south edge of a casting bed [53] consisting of buff coloured gravelly sand 2.5m east/west by approximately 4m north/south, with occasional small rounded silver grey pebbles. The pebbles were fairly heavy and are likely to have resulted from the reaction of splashes of molten metal dropping into the sand. The sand was defined on the east side by two vertically set iron plates [54] and to the north by an horizontally laid timber [55], whilst the sand continued beyond the west edge of the trench towards the furnace. At the north end of the casting bed at least two layers of loose-laid red bricks [56] had been inserted into the sand. The bricks, which were approximately 0.22m long by 0.10m in width, bore the manufacture's name 'Furness Brick Co Ltd, Barrow'. To the west of the bricks the sand was oxidised bright red.

5.4.3 To the east of the casting bed was an area of 'metalled' slag [57] (1-1.5m in width) which formed a distinct surface separating the casting bed from the large concrete platform to the east [58]. A deposit of the casting sand (up to 0.25m wide) ran north/south on the east side of [54] and overlay [57] suggesting that the casting bed was cut into [57].

5.4.4 A 0.5m wide by 1.30m long sondage was machine-excavated into the south end of [57] to a maximum depth of 0.7m, which revealed that the concrete at the south edge of the trench was 0.3m in depth. At a depth of 0.55m beneath concrete layer [50], a deposit of oxidised casting sand [61] was revealed. This was overlain by a 0.15m deep mid brown fairly loose fine to coarse layer [62] which consisted of glassy slag and charcoal in a fine black powdery matrix. The upper part of the section consisted of a 0.4m deep layer of limy slag in a mid brown sandy matrix [63]. The upper surface was formed by [57] which proved to be of the same material but finer in texture and more greatly compressed. The central area of slag [57] included a circular spread of concreted limy slag [64] 1.2m in diameter.

5.4.5 Immediately on the east side of the sondage through [50] some phasing of the concrete was evident with the remains of a further steel stanchion [59] set in a concrete foundation [60] which appeared to be overlain by [50] and [58].

5.4.6 At the north end of [57] was the base of a more substantial steel stanchion [65], which was 'H'-shaped in plan, 0.35m wide and was set into a concrete foundation. The base of the stanchion, which survived to a maximum height of 0.65m, was set square on to stanchions [51] and [52] and all were possibly components of the same structure. Its east side appeared to be overlain by a deposit of light brown sand [66], which was 0.12m deep where exposed, and to the south was overlain by two L-shaped 'concrete' blocks made of limy slag [67]. Both [66] and [67] butted against [58].

5.4.7 A substantial concrete plinth [68], 1.2m east/west by 0.8m north/south and standing at least 0.4m high, was situated immediately on the north side of stanchion [65]. The plinth formed a foundation for a substantial steel stanchion [69] formed by two uprights 0.6m apart linked at the base by steel plates set into the concrete. The remains of 'L'-sectioned steel plates, which would have been employed for strengthening, were attached to the base of the eastern upright. Patches of green paint survived on the surface. The edges of the plinth were defined by a single course of machine-made red bricks.

5.4.8 The level and depth of the concrete was continued northward by a further block of concrete [70], which may have been contemporary but was certainly laid separately and in two distinct layers, the lower of the two forming a 0.3m wide protrusion extending 0.2m westwards from the north-west corner. Both [68] and [70] were overlain by a 0.1-0.2m deep layer of fine to coarse slag [71] which was in turn overlain by a line of concrete blocks [72], individually 0.4m long by 0.2m high, set in a thin layer of concrete [73]. The blocks formed an edge to concrete platform [58].

5.4.9 On the west side of [68] and [70] was a series of three substantial horizontal timbers [74], laid east/west and parallel with [55]. The timbers were approximately 0.25m wide and were at least 2.5m in length, the western extent falling beyond the section. The upper surfaces of the timbers included patches of charring from direct contact with very hot materials/objects. Compact slag deposits [75], including fragments of blue glassy slag and rusty coloured iron concretions, were situated between individual

timbers and also between the timbers and [68] and [70], and along the northern edge of the timber. A layer of the oxidised casting sand [76] overlay the timbers.

5.4.10 The northern part of the trench was occupied by a concrete floor [77], separated from [70] and [74] by a 0.2-0.25m wide slag-filled cut [80]. The concrete floor appeared to have been cut, leaving a jagged edge, to allow the insertion of [70] and [74]. The floor continued to the east and west beyond the trench section but the north edge was sharply defined by a strip of iron. In the north-west corner of the trench a 1.5m east/west by 1.5m north/south section of the floor had been removed, revealing that the floor was approximately 0.05m thick. To the west the floor was partly overlain by oxidised sand [76] and to the east by a mixed demolition layer [78] which was up to 0.75m in depth. A single loose iron rod, approximately 1.75m in length and running broadly east/west, ran from the east section across the surface of the floor. A small number of miscellaneous iron objects situated to the north of [70] were rusted to the surface of the concrete.

5.5 TRENCH 4

5.5.1 Trench 4 was situated to the south of the blowing house and was designed to test for the survival of archaeological features/deposits in that area. An original design to excavate a 10m east-west trench in this area proved impossible due to the prevailing ground conditions. An area measuring 7m by 7m was stripped by machine which revealed a consistent deposit of concreted lime slag immediately below the surface and therefore excavation was stopped at this level.

5.6 TRENCH 5

5.6.1 Trench 5 was situated to the east of the furnace and to the south of a large concrete platform visible as a surface feature. The trench, which was oriented east/west, measured 10m in length by 1m wide with a 1m wide batter on the south side. The trench, which was on the west side of the proposed Unit One, was designed to test for the survival of building remains related to the casting sheds constructed in the 1920's and other potential archaeological deposits/features in this area.

5.6.2 At a depth of 0.5m, at the west end of the trench, a deposit of very loose cindery, vesicular slag [23], with a powdery black matrix, was revealed. The deposit sloped down to the east at approximately 30º. This was overlain by a compact sandy layer [22], 0.3m in depth, which sloped at a similar degree. The layer consisted of mixed material with frequent lenses of oxidised sand and grey/black slag, including fragments of baked sand from casting moulds. This was overlain by a deposit of glassy furnace slag [21] in a dark brown/black sandy matrix, beginning at the west end of the trench as a 0.02m thick layer but deepening westward to at least 0.92m in depth. This deposit was present along the entire length of the trench. Demolition rubble [19 and 20] in a sandy matrix (0.30m in depth) formed the uppermost layer.

5.6.3 A large cast iron disc, 0.8m in diameter by 0.04m thick, was recovered from within [21] at the base of the trench.

5.7 TRENCH 6

5.7.1 Trench 6 lay to the north of the concrete platform. The trench, which was oriented east/west, measured 6.2m by 3m with a 1m wide extension running eastwards for 14.6m. The trench was excavated to a maximum depth of 2m and was stepped

internally to allow a 1m wide sondage to be excavated beyond 1.2m in depth. The trench was designed to test for the survival of archaeological deposits/features at the north end of Unit One.

5.7.2 At a depth of 0.8m the remains of a concrete foundation [39] were revealed running east/west along the north side of the trench. The foundation measured 2.5m in length by 0.4m wide and up to 0.5m in depth. The upper surface included the impressions of six blocks which would have formed the first course, whilst the base of the foundation consisted wholly of yellow refractory (heat resistant) bricks [41]. The foundation was cut into a deposit of glassy, vesicular furnace slag [38] which produced a very strong sulphurous smell when initially machined. The full extent of the deposit could not be tested since it continued below 2m in depth. The upper surface of the slag was at approximately the same level as the top of foundation [39], suggesting that this may have been a former ground level.

5.7.3 The remains of a single line of flagstones [43], laid directly on top of [38], were revealed running in a south-south-east/north-north-west direction at the east end of the trench. Initially a single course, the line rose to four dry stone courses at the south end, reflecting truncation at the northern end. The east side of the structure appeared to form a sharp face whilst the west side was roughly dressed. The precise function of this structure could not be determined though it may have served as a revetment wall or possibly the west side of a culvert. The east side of the structure, however, was obscured by a 0.75m deposit of concreted limy slag [44]. On the west side of the wall a single breeze block [42], 0.5m wide by 0.4m high, was exposed in the south section of the trench. The space between the block and [43] consisted of a mixed deposit of light brown sand with small rounded pebbles and limy slag fragments [45]. Both [42] and [45] overlay glassy slag [38]. To the west of [42] a dark compact layer, approximately 0.37m thick, was recorded. This layer, consisting of glassy slag, charcoal fragments and rounded pebbles, butted [42] and overlay [38].

5.7.4 A deposit of buff coloured sand [36], 0.35m in depth in the north section, overlay contexts [38], [39], [43] and the edge of [44]. A massive concrete foundation [40], up to 0.4m in depth, the edge of which formed the northern extent of the trench, overlay the sand. In the south section the sand butted the breeze block [42] and both were overlain in turn by a mixed demolition layer up to 0.4m in depth.

5.7.5 A single sherd of early twentieth century pottery was recovered from [38].

5.8 TRENCH 7

5.8.1 Trench 7 was excavated immediately adjacent to the northern edge of concrete platform [58] (Trench 3). The trench was oriented east/west, and measured 2.3m long by 1m wide with a maximum depth of 0.77m. It was designed to test the potential for surviving archaeological features/deposits beneath the concrete platform.

5.8.2 A concrete floor [12] was revealed at a depth of 0.77m below the surface level of concrete platform [58]. This floor was clearly a continuation of concrete floor [77] encountered at the north end of Trench 3 (see above *Section 3.2.10*). The floor ran under the concrete platform and was clearly earlier. A 0.55m deep blackish mixed deposit [17], consisting of powdery charcoal, red brick fragments and limy slag, overlay the floor and had been deposited to make up ground for another concrete floor, 0.1m in depth, laid at the same level as the concrete platform [58]. This latter floor survived in the east end of the trench but had been demolished within the main area of

the trench which was filled with a loose demolition deposit of red brick, stone and concrete rubble.

5.9 TRENCH 8

5.9.1 Trench 8 lay to the north-east of Trench 1. The trench, which was oriented east/west, measured 13m by 1m with a 1m wide batter on the south side, and was excavated to a maximum depth of 1.25m. The trench was designed to test the potential for surviving archaeological deposits/features within the footprint of Unit Two.

5.9.2 A uniform deposit of very dark/black mixed glassy and limy slag [25] occupied the easternmost two-thirds of the trench from its base to the thin topsoil [1] cover. The western 4m of the trench comprised a deposit of similar composition and texture [24], but was a lighter pinkish brown in colour; it overlay [25] at a 45º angle. The extent of both deposits could not be determined.

5.10 TRENCH 9

5.10.1 Trench 9 was sited within the Scrap House on the north side of the road. The trench, which was oriented east/west, measured 7m long by 1m wide and was excavated to a maximum depth of 1.2m. The trench was designed to test the potential survival of archaeological deposits/features in that area of the site.

5.10.2 At a depth of 0.18m a natural drift deposit [29] was encountered, consisting of cobble-sized angular stone fragments in a light greeny brown sandy matrix. This deposit was consistent to the base of the trench. It was overlain in the central part of the trench by a clayey silt deposit [27], which may have been deposited to make up the ground level for concrete floor [26] laid immediately above it. At the west end, a charcoal-rich layer [28], with frequent glassy slag and large charcoal fragments and up to 0.2m in depth, overlay both [27] and [29] and was itself overlain by the concrete floor of the structure [26].

5.10.3 Two cut features were revealed in the north section, each cut from a level immediately beneath the concrete floor. At the east end of the trench the natural had been cut [34] to a depth of 0.7m for two cast iron pipes [35] which ran broadly north-south. A post hole [31] for a square timber post [32] with a single slate padstone, cut to a depth of 0.48m, was situated a little to the west.

5.10.4 Two sherds of nineteenth century glazed ware were found within the pipe trench [34] (*Section 5.11.2*).

5.11 THE FINDS

5.11.1 The artefacts recovered from the trial trenches were all broadly datable to the nineteenth or twentieth centuries and comprised a miscellaneous assemblage of metal objects and three sherds of pottery.

5.11.2 A single sherd of black glazed ware with a brick red fabric from [34] and an unstratified sherd of light brown glazed ware with orange streaks and a pinkish red

fabric were recovered from Trench 9. Trench 6 produced a single sherd of blue white ware from [38].

5.11.3 The metal objects, many too heavy to lift manually, were moved from the excavation area by machine and deposited in vegetation on the north side of the furnace.

5.11.4 In addition, Trench 2 produced a miscellaneous collection of oil can fragments from the base of the west end section. One can bore the makers name 'Universal Lubricants, Gateshead-on-Tyne' and may date broadly to the middle years of the twentieth century. The oil cans were in a very fragmentary and hazardous condition and were reburied in the backfill of trench 2.

6. BOREHOLE RESULTS

Heights are in metres from ground surface

6.1 BOREHOLE 1

0.00-0.20m	Grass over topsoil.
0.20-1.10m	Medium dense brown and black fine to coarse sand, with occasional fine to coarse slag gravel.
1.10-5.00m	Dense grey fine to coarse slightly sandy gravel, with frequent well rounded cobbles and boulders (natural).
5.00-5.45m	Hard dark grey and brown siltstone (bedrock).

6.2 BOREHOLE 2

0.00-0.15m	Grass over topsoil.
0.15-1.70m	Slag.
1.70-2.80m	Slag ash and gravel.
2.80-7.10m	Dense grey fine to coarse gravel with cobbles (natural).
7.10-7.55	Hard grey-green-brown siltstone (bedrock).

6.3 BOREHOLE 3

0.00-0.15m	Grass over topsoil.
0.15m-2.80m	Medium dense brown sandy clayey gravel, slag, siltstone fragments and brick.
2.80-5.90m	Dense grey fine to coarse gravel, cobbles, boulders (natural).
5.90-6.30m	Hard dark grey and brown siltstone (bedrock).

6.4 BOREHOLE 4

0.00-0.30m	Grass over topsoil.
0.30-2.70m	Medium dense bricks, concrete and metal, with much slag throughout. Much lime slag below 2.10m.
2.70-4.10m	Dense grey fine to coarse slightly sandy gravel, with frequent well rounded cobbles and boulders (natural).
4.10-4.60m	Hard dark grey and brown siltstone (bedrock).

6.5 BOREHOLE 5

0.00-0.15m	Topsoil
0.15-3.30m	Medium dense black slag, ash, gravel, brick.
3.30-10.40m	Dense grey fine to coarse gravel, cobbles (natural).
10.40-10.80m	Hard dark grey and brown siltstone (bedrock).

6.6 BOREHOLE 6

0.00-0.40m	Slag at ground level, above black slag and ash fill.
0.40-1.80	Very strong grey/brown siltstone and sandstone (bedrock).

6.7 BOREHOLE 7

0.00-0.80m	Slag - abandoned due to the hardness of the deposit.

6.8 BOREHOLE 8

0.00-0.20m	Grass over topsoil.
0.20-2.10m	Light grey slag.
2.10-3.30m	Medium dense brown sandy ash, bricks, gravel, slag, becoming black with depth.
3.30-5.60m	Dense grey fine to coarse slightly sandy gravel with frequent well rounded cobbles and occasional boulders (natural).
5.60-6.20m	Hard dark grey and brown siltstone (bedrock).

6.9 BOREHOLE 9

0.00-0.40m Slag at surface above loose slag and ash fill.
0.40-3.40m Small, medium and large dense coarse and fine gravels with cobbles and boulders.

6.10 BOREHOLE 10 AND 10A

0.00-0.30m Slag - abandoned due to the hardness of the deposit.

7. DISCUSSION

7.1 UNIT ONE

7.1.1 The trenches in this area have shown that a considerable number of archaeological features survive to the east of the furnace. In many cases these features can be identified from cartographic and photographic evidence and it is possible to suggest a sequence of development.

7.1.2 Trench 3, situated immediately in front of the furnace, revealed a number of structural components which can be tentatively identified. The line of stanchions, [51], [60] and [65], corresponds fairly closely to the edge of the casting shed shown on the OS 1938 map (Fig 7). It is probable therefore that steel stanchion [65] relates to a roof support for this large open-sided casting shed, as photographed in the late 1920s/early 1930s. The two less substantial stanchions, [50] and [51], may relate to the lean-to building which was built sometime after 1938 and which is shown on a photograph of 1959. A photograph from 1963 (Fig 11) shows this building to have had a large opening in the middle of the south side.

7.1.3 The double stanchion [69] with the additional strengthening bar, which was built into a very substantial concrete plinth [68], suggests from its form that it was associated with greater stresses than the other stanchions. The 1959 photograph clearly shows a substantial overhead girder for a travelling hoist entering the south-east corner of the main shed. Given the close proximity of stanchions [65] and [69], and the overhead girder to the south-east upright of the main shed, it is tempting to associate [69] with a girder support. This may also tie in with the stratigraphic relationship between the plinth [68] and the concrete bed of [69] which was demonstrably earlier.

7.1.4 One other stanchion [59], which was overlain by [50] and therefore earlier than the lean-to, could not be associated with any known structure. Its location may, however, coincide with the site of a weighing machine depicted on the 1938 OS map. It is also possible that the lean-to building was rebuilt at some stage. The photograph of the site in 1963 (Fig 11) shows that at some time after 1959 the main shed was extended to the north, and a lean-to building on the east side (dating after 1938) had been re-roofed and extended to the south.

7.1.5 The casting bed [53], which lay immediately beneath topsoil, at the north end of Trench 3, is likely to have remained in use until the closure of the works. The red bricks [56] at the north-east corner of the casting bed are likely to have been laid to support a heavy load though its precise function could not be determined.

7.1.6 The horizontal timbers [74] on the north side are also likely to have been laid as a support, and the charring of the surface suggests direct contact with a hot object or substance. The oxidisation of the sand in this area is in keeping with the casting operations associated with the casting bed.

7.1.7 The remains of the concrete floor [77] at the north end of the trench continues beneath the timber and is earlier than the plinth for the overhead girder and the concrete platform. It is likely that this floor represents the original floor of the late 1920s/early 1930s main casting shed whose construction followed the reorganisation of the site following the conversion to coke fuel.

7.1.8 The sondage at the south end of the site revealed a deposit of oxidised casting at a depth of 0.55m below the later casting bed. It is possible that evidence of the buildings

shown in a photograph from the early 1920s, which pre-date the conversion, may survive at this level.

7.1.9 The concrete platform [58] represents the latest structural development in this area and may relate to the construction of the lean-to on the east side at some time after 1938. It was certainly laid after the construction of the plinth which may be associated with the overhead girder hoist. It is reported that this platform was in place at the closure of the site in 1964 (Mein pers comm) and although of relatively late date it was not constructed during the post-closure usage of the site. However, it is reported that it was used as a platform for plant, by Murphys in the 1970's/80's (Mr Milburn (resident of Dale Cottage) pers comm).

7.1.10 Trench 6, situated to the north of the concrete plinth, produced two distinct structural phases of activity. The earliest, which consists of a short east/west foundation and a linear drystone feature, does not coincide with any known structures on the site. The second, which consists of a substantial concrete layer running northward, is similarly without association but is nonetheless of very late construction. The slag revealed at the base of the trench appeared to be undisturbed and is likely to be present beneath the major part of the northern end of Unit One.

7.2 UNITS TWO AND THREE

7.2.1 Evidence from Trenches 1, 2 and 8 indicate that substantial disturbance has occurred in these areas following the closure of the works. Oral evidence, from Mr Milburn of Dale Cottage, suggests that this area was 'riddled' (where deposits are mechanically excavated and scrap metal extracted magnetically). This is supported by the irregular boulders of concreted limy slag in Trench 2 which may have been part of the stack yard surface (Site 3) that is shown white in the 1959 photograph. The riddled deposits correspond with [2] in Trench 1, [11] in Trench 2 and [25] in Trench 8. The perspective of the early photographs makes it difficult to collate the present topography with that depicted on them. However, it is likely that, in the southern stack yard area, the original ground surface, which survived until the 1930s, was substantially lower than today. This has a significant implication for any attempt to locate features related to the leat, which was still active in 1938. If the leat survived the post-abandonment disturbance, its remains will be at this lower level and, consequently, well below the depth of the trenches. Borehole data from BH5 and BH8 suggests that the disturbed (riddled) slag deposits are 3.3m deep in the area of Units Two and Three.

7.3 ADMIN AND DESIGN CENTRE

7.3.1 The excavation of a bore-hole (BH7) was attempted within the extent of the Admin and Design Centre, which it is proposed should be set on top of the large spoil mound in the southern part of the site. However, this was abandoned because of the hardness of the concreted lime slag deposits and as a consequence no trenching was undertaken in this area. There are no structures or features identified from the documentary study within the immediate vicinity of the structure, with the exception of the slag mound itself which is of low archaeological significance.

7.4 THE SCRAP HOUSE

7.41 Trench 9, which was designed to test for archaeological remains within the Scrap House, revealed natural till lay only 0.2-0.3m below the modern ground surface. It is likely that the deposits and cut features situated between the till and the concrete floor of the Scrap House represent the only survival of more substantial archaeological deposits truncated by the construction of the floor. The cast iron water pipes at the east end of the trench are likely to be services for the office/cottage situated on the south side of the Scrap House.

8. ARCHAEOLOGICAL IMPACT AND RECOMMENDATIONS

8.1 IMPACT

8.1.1 Units Two and Three are within the area of the former stackyard and the sub-surface deposits comprise slag waste that has been subject to extensive riddling subsequent to the closure of the site in 1964. The proposed new-build will therefore not have an undue impact upon the archaeological resource.

8.1.2 It is proposed that the Admin and Design Centre is set on the top of the slag spoil heap to the south of the furnace complex. This area was not trenched by the evaluation, since the borehole through it demonstrates a considerable depth of solidified slag, which was too hard to allow an effective penetration by the drill. Assuming that the new-build is constructed on this very solid material, the proposals will not have an undue impact upon any archaeological resource.

8.1.3 The proposed position of Unit One will be close to the furnace area, and the evaluation has established that the western part of the proposed new-build impacts upon the 1920s casting floors; Trenches 3 and 6 have both exposed significant survival of sub-surface remains. The western corner of the proposed new-build will extend to a distance of only 12m away from the extant furnace stack, and is likely to have an adverse impact on the visual setting of the furnace complex.

8.1.4 The proposed roadway will extend to within 4.5m of the furnace; this will similarly affect the setting of the furnace complex and the movement of heavy vehicles could potentially have an adverse impact on the structural stability of the furnace.

8.1.5 The proposal that the store houses on the western side of the road be converted for office or presentational purposes would inevitably have a significant impact upon the surviving fabric, but would also affect any below ground deposits.

8.2 RECOMMENDATION OPTIONS

8.2.1 Current policy dictates that wherever possible identified sites of archaeological importance are preserved *in-situ* as embodied in the Institute of Field Archaeologists' *Code of Conduct* and the Department of Environment *Planning Policy Guidance Note 16*. Our concern must be to protect and preserve archaeological sites wherever possible, and only where this is not feasible are destructive techniques of record advocated. Presented below are a series of options for the management and further recording of the site which if at all possible will provide for the preservation by management of the archaeological resource and for the full mitigative recording of that resource where it is not possible to preserve it.

8.2.2 ***Units Two, Three and the Admin and Design Centre:*** as the areas of proposed new build will have little negative impact upon an identified archaeological resource, it is recommended that they be subject only to a watching brief during the laying of the foundations. The evaluation has established that a substantial proportion of the yard area is to all intents and purposes archaeologically sterile, which may have implications for the status of this part of the site. An assessment of the scheduling of the Iron and Steel industrial sites in England is presently being undertaken by English Heritage as part of its Monuments Protection Programme.

8.2.3 ***Unit One Design/Location:*** the proposed design and location of Unit One will impact on the former casting sheds and is also relatively close to the surviving furnace stack. One option, therefore, would be the alteration of the design or location or both which would limit the westerly extension of the new build in the direction of the furnace. This would therefore minimise the impact on the proposals upon the identified resource.

8.2.4 ***Mitigation Excavation Option:*** if Unit One is constructed in the proposed position then it may be appropriate to undertaken a programme of mitigation excavation across the western part of the new build to record those features and archaeological stratigraphy that will be destroyed by the new build construction.

8.2.5 ***Engineering Solution:*** the preferred option, however, is that the archaeological resource in the area of Unit One be preserved, rather than recorded archaeologically. If the Unit is to remain in its current proposed position, this could potentially be achieved by constructing the new build on a concrete raft above the sensitive archaeological stratigraphy. As the archaeological stratigraphy is only 0.2m, in places, below the present ground surface this would necessitate the import of material to the site.

8.2.6 ***Structural Assessment:*** the furnace complex has been established as the most archaeologically important element of the site, but is in a state of decay. There has been a noticeable degradation of the structural condition of the furnace since the 1992 survey undertaken by LUAU. The structure could potentially be affected by the movement of heavy vehicles in its vicinity and it is suggested that a structural survey be undertaken by an engineer to assess its condition and stability.

8.2.7 ***Structural Consolidation:*** to enhance the visitor potential of the site and to ensure its long-term survival it is recommended that the furnace complex and potentially also the engine house be subject to structural consolidation works. This would also be necessary to ensure that the site is made safe for the work force and visitors to the former Ironworks.

8.2.8 ***Store Houses and Engine House:*** the store houses and engine house will be subject to considerable change in the course of their conversion to office/presentational use. It is therefore suggested that they be subject to recording by detailed fabric survey as mitigation for the conversion works. The fabric survey would serve to supplement the information presented in the background study, effectively filling in the gaps for which no historical accounts appear to exist. At present the store houses have been recorded in plan and by oblique photography by the RCHM(E); it is therefore recommended that the elevations should be recorded to RCHM(E) level 3.

8.2.9 ***Store House Watching Brief:*** any below ground intervention for drains, surfaces or reflooring should be subject to a continuous presence watching brief by an appropriately trained archaeologist.

9. BIBLIOGRAPHY

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9.1.1 *Cumbria County Record Office (Barrow)*

BDB2 Charcoal Iron Co Ltd, Backbarrow:

8/5 Blast furnace site survey by W C Holmes & Co Ltd 1960 [technical text only]

17/1-63 Plans and drawings 1919-1963:

- 1-15 Detail of plant
- 17 Store: Foundation plan 16/8/1948
- 18 Store Layout and marking plan
- 20-21 Gantry: Foundation plan 15/7/1952
- 22-23 Gantry Layout plan
- 58 Sketch plan showing railway, coke house and road, nd
- 59 Proposed extension to foundry buildings, nd
- 60 Sketch of coke barrows, nd

23/1 Historical notes: "Cold Valley Blast", *c*1960s

Iron Manufacture: Miscellaneous Smaller Deposits:

BDX 209/1/3 Bundle of title deeds. Inc deeds relating to Backbarrow Furnace

BD/HJ Hart Jackson & Sons, Sols, Ulverston:

BD/HJ/89Bundle 11 Includes letter of complaint about conditions and pay from Clerk of the Furnace, Backbarrow 1st September 1713

Bundle 14 Report on Backbarrow Iron Works 25th September 1718

BD/HJ/245 Plans relating to the Backbarrow Estate (late 19th century)

BD/HJ/320 Backbarrow Estate Map, 1877

BD/HJ/Plan no. 9 Plan of Backbarrow Estate dated 1808

BD/L Iain Maci Livingston & Co, Sols, Ulverston:

4/2/16-41 Copy draft release of Backbarrow Ironworks 1819

4/2/21 Letter: unsigned, re ambiguities in draft conveyance of Backbarrow Ironworks 1819

Correspondence and papers re the conveyance of Backbarrow ironworks to the Newland Co 1819-1821

Iron & Steel Manufacture Records: The Furness Collection:

BZ5 Copy lease: Force Forge 29 Jan 1711

BZ87 Sales particulars with plan [no plan]: Backbarrow Ironworks and Spark Forge June 1852

BZ185 Day book of the Backbarrow Company 1711-15

B/2/1754 Conveyance of land. Backbarrow Furnace

9.2 PHOTOGRAPHIC SOURCES

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Mein, R - General view of Backbarrow Ironworks from the east, *c*1963

Mein, R - General view of Backbarrow Ironworks from the south immediately post closure, *c*1964

9.3 SOURCES IDENTIFIED BUT NOT EXAMINED

Tom Clare c/o School of Biological and Earth Science, John Moore's University. A number of black and white photographs dating to shortly after the closure of the furnace when dismantling was taking place

J V Lancaster of High Harrington, Workington, has much technical information on the operation of the furnace

9.4 PUBLISHED CARTOGRAPHIC SOURCES

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APPENDIX 1
GAZETTEER OF SITES

Number 1
Location Admin/Design centre
Type Spoil heap
Date 1920 - 1959
Source LDNPA and Bowden photographs; OS 1938 1:2500 map
Description A flat-topped spoil heap forming a platform. The deposit consists of 'concreted' lime-rich material, which is up to 3m deep. On the east side of the platform are some open-fronted sheds (Site 2).

Number 2
Location Admin/Design centre
Type Building
Date *c*1920s - 1938
Source Bowden photographs (1959); OS 1938 1:2500 map
Description A long rectangular open-fronted building of breeze-block construction with corrugated iron roofing. It is situated on the west side of Site 1. The building is first shown on the OS 1938 map, but it is not shown on the LDNPA photograph (late 1920s/early 1930s) The building was extended to the south between 1938 and 1959 (Bowden photograph).

Number 3
Location Units One - Three
Type Yard
Date post-1920s
Source Photographic (LDNPA and Bowden photographs)
Description Extensive flat stack yard area is shown on the post-coke conversion photograph (late 1920s/early 1930s) and on the Bowden photograph (1959). Prior to the conversion of the site to coke this was a spoil tip (Site 4).

Number 4
Location Unit One - Two
Type Spoil heap
Date post-1888 - 1920s
Source Cartographic; photographic
Description A large spoil heap covered much of the area of Unit One. The earliest representation is on the OS 1911 map, where it is shown as a localised mound; however, by the time of the pre-coke conversion photograph of the *c*1920 (While) the spoil extends across most of the area of the yard (Site 3). By the time of the LDNPA photograph (late 1920s/early 1930s) the spoil has been concentrated into a single high but localised mound. The spoil may survive as a buried deposit forming part of the present river bank and may, therefore, underlie the south-east corner of Unit One.

Number 5
Location Unit One
Type Building
Date 1920s - 1938
Source Cartographic OS 1938 1:2500 map; Bowden (1959) and LDNPA (20s/30s) photograph
Description A brick casting house constructed following the conversion of the site to coke in the 1920s. It is shown on the 1959 Bowden photograph, but now survives as a concrete foundation, coupled with a series of stanchions.

Number	6
Location	Unit One
Type	Building
Date	pre-1888 - post-1938
Source	OS 1888, 1911 and 1938 1:2,500 maps; Pre-coke conversion photograph (*c* 1920)
Description	Small stone-built structure of unknown function.

Number	7
Location	Units One and Two
Type	Deposit
Date	post-1888
Source	Cartographic: OS 1911 map
Description	Area of river bank taken in from the river Leven between the 1888 and 1911 OS maps. It was possibly associated with the spoil heap (Site 4) which extended into the river. Examination of the river bank has shown that it is largely composed of spoil.

Number	8
Location	Between Units One and Two
Type	Quarry
Date	1848-1888
Source	Cartographic: OS 1948 and 1888 maps
Description	An area recorded as 'Old Quarry' by the Ordnance Survey 1888 map. It is in the vicinity of an earlier enclosure (Site 12) shown on the OS 1848 map. There are no physical traces of the feature and will now have been filled with slag waste.

Number	9
Location	Unit Three
Type	Tail race
Date	?1685
Source	Fell 1908, 200; Cartographic (OS 1848 - 1938 maps)
Description	An open tail race is shown on all the maps from 1848 and is orientated towards the furnace. The northern part of the tail race is subterranean. The tail race was still in use in the late 1920s/30s, according to the LDNPA photograph.

Number	10
Location	Unit One
Type	Structures
Date	pre-1888
Source	Cartographic (OS 1848 - 1888 maps)
Description	A series of small structures are shown on the OS 1888 and subsequent maps; their function is unknown. The spoil heap on the 1911 map was constrained to the west to avoid them and so they were evidently still in use at that time.

Number	11
Location	Storage buildings - west of road
Type	Structures
Date	pre-1888
Source	Cartographic (OS 1848 - 1911 maps)
Description	Two charcoal storehouses are shown on the OS 1848 to 1911 maps, but by the time of the *c*1920 photograph (While) the northernmost of these had been partly dismantled.

Number	12
Location	Building to the south of the Pug Mill
Type	Structure
Date	pre-1808
Source	Cartographic: Backbarrow Estate Map (BD/J/Plan No. 9 and OS 1848 map)
Description	A building is shown to the south of the Pug Mill on both the 1808 estate map and the 1st edition map. It has been removed by the time of the 1877 estate map. The function of the building is unknown.

Number	13
Location	Enclosure to the south of the site
Type	Enclosure
Date	pre-1845
Source	Cartographic: (OS 1848 map)
Description	An enclosure is shown at the western side of the yard area on the OS 1st edition map. It is not shown as roofed, but there is a possible very small structure set in the north-eastern corner of the enclosure. It is on the line of the leat which presumably extended underground at this point. It is not on the OS 1888 map, but there is a cryptic reference to an old quarry (Site 8) in its vicinity.

Number	14
Location	Building to the south-east of the Pug Mill
Type	Structure
Date	pre-1808
Source	Cartographic: Backbarrow Estate Map (BD/J/Plan No. 9 and OS 1848 map)
Description	A small building is shown to the south-east of the Pug Mill on the 1808 estate map and by the time of the OS 1st edition map it has become a much longer structure, which extends to the northern edge of the proposed new-build. It is probable that the later is structure is an extended version of the earlier structure as there is a close correlation between the earlier building and the northern part of the 1848 building. The 1848 is still in place by the time of the 1877 map, but by the time of the 1888 map there is a pair of parallel buildings on the site. These parallel buildings become one by the time of the 1911 map. In the latest phase of the site the building was a stable, and it is probable that it had a similar function in 1888.

APPENDIX 2
PROJECT BRIEF

APPENDIX 3
PROJECT DESIGN

Lancaster
University
Archaeological
Unit

February 1998

BACKBARROW IRONWORKS

CUMBRIA

ARCHAEOLOGICAL EVALUATION
PROJECT DESIGN

Proposals

The following project design is offered in response to a request by J.G.R. Planning and Technical Services and in accordance with a brief by the Lake District National Park Authority, for an archaeological assessment and evaluation at the Backbarrow Ironworks, Cumbria.

1. INTRODUCTION

1.1 This project design is offered in response to a request by J.G.R. Planning and Technical Services for an archaeological assessment and evaluation of the Backbarrow Ironworks, Haverthwaite, Cumbria (SD 3555 8470) in advance of the development of the site. This will involve the reuse of some buildings, infill development, new buildings, car parking and landscaping.

1.2 The Backbarrow Ironworks is of very considerable archaeological significance, reflected in its scheduled status (SAM Cumbria no. 506); there has been documented iron processing here since 1685, when John Machell built a bloomery forge until 1964, when the Backbarrow furnace closed. The first blast furnace in the Lake District was built here in 1711 and, after a long and successful history, the furnace was, in the 1920s, the last British furnace to convert from charcoal to coke. During this period the site has seen considerable changes; during its life the furnace stack appears to have been rebuilt at least three times - in 1770, 1870 and finally in the 1920s as a result of the conversion from charcoal as fuel to coke. This conversion also resulted in substantial alterations to the works, as evidenced by surface photographs taken before and after the conversion (LUAU 1992).

1.3 The Backbarrow Ironworks was the subject of an archaeological investigation in 1992 by the Lancaster University Archaeological Unit (LUAU 1992), which involved an assessment of the ironworks in conjunction with a fabric survey of the furnace area. This was followed by a programme of survey by the Royal Commission on the Historical Monuments (England) which generated a ground plan of the whole site in conjunction with an oblique photographic survey of all the buildings. The LUAU survey generated elevation drawings for the furnace and roaster house, but otherwise there are no elevation drawings for the remaining buildings of the complex.

1.4 Lancaster University Archaeological Unit (LUAU) has considerable experience of the archaeological survey and evaluation of sites and monuments of all periods, having undertaken a great number of small and large projects during the past 15 years. LUAU has particular experience in the archaeological recording and analysis of standing ancient monuments, historic buildings and industrial landscapes. Projects have been undertaken to fulfil the different requirements of various clients and planning authorities, and to very rigorous timetables. LUAU has considerable experience of the investigation of the North-West Iron and Steel industry. LUAU undertook the original assessment of the Backbarrow site in 1992 and is presently undertaking an assessment of the Iron and Steel Industry Steps 2 and 3 as part of the English Heritage Monuments Protection Programme, during which the Backbarrow Ironworks will be examined as part of that assessment. LUAU undertook a detailed Level 3 survey of the Leighton Beck ironworks complex, near Arnside which was the sister ironworks to Backbarrow. LUAU has undertaken a mitigative excavation of the Netherhall Blast furnace, in Maryport, Cumbria. LUAU is involved in leading the Society of Antiquaries excavations at the Glantlees Farm medieval bloomery iron smelting complex.

1.5 LUAU has the professional expertise and resources to undertake the project detailed below to a high level of quality and efficiency. LUAU and all its members of staff operate subject to the Institute of Field Archaeologists' (IFA) Code of Conduct.

2. OBJECTIVES

2.1 The following programme has been designed in accordance with a written brief by the Lake District National Park Archaeologist to enable an evaluation of the development area. This is required to collate existing documentation of the history and archaeology of the site, to evaluate the survival, condition and significance of the archaeological remains and to provide recommendations for the mitigation of the archaeological resource.

2.2 The required stages to achieve the project objectives are as follows:

2.3 **STAGE 1 DOCUMENTARY SURVEY**
A desk top study will be undertaken of available archaeological records, primary sources, secondary sources and cartographic sources. This will involve the abstraction of the survey data created by the RCHM(E), in both hard and digital formats.

2.4 **STAGE 1 IDENTIFICATION SURVEY**
A visual inspection of the whole site to augment the recording previously undertaken by LUAU and RCHM(E).

2.5 **STAGE 1 INTERIM REPORT AND REVIEW**
The dissemination of the results of the documentary study and identification survey. This will make recommendations for the detailed programme of evaluation and survey fieldwork (Stage 2) and will be subject to discussions with the client and LDNPA.

2.6 **STAGE 2 GEOPHYSICAL SURVEY**
Subject to the recommendations of the Stage 1 report, and advice from geophysical specialists a geophysical survey will be undertaken.

2.7 **STAGE 2 TRIAL TRENCHING**
Subject to the recommendations of the Stage 1 report a programme of trial excavations will be undertaken to establish the nature, extent, chronology, and preservation of any archaeological deposits encountered. Suitable samples recovered will be assessed for their palaeoenvironmental or metallurgical potential.

2.8 **STAGE 2 EVALUATION REPORT**
A written evaluation report will assess the significance of the data generated by this programme within a local and regional context.

3. METHOD STATEMENT

3.1 In line with the objectives and stages of the archaeological work stated above the following work programme is submitted.

3.2 STAGE 1 DOCUMENTARY SURVEY

3.2.1 The following will be undertaken as appropriate, depending on the availability of source material. The level of such work will be dictated by the timescale of the project.

3.2.2 ***Documentary and Cartographic Material:*** This work will rapidly address the full range of potential sources of information identified by the Backbarrow Ironworks assessment:

- Barrow Public Library
- Cumbria County Council Planning Office
- Cumbria Record Office (Barrow) - including the BDB/2 Charcoal Iron Company ltd, Backbarrow records
- Cumbria Record Office (Kendal)
- Kings College Library, Newcastle upon Tyne
- Lancashire Record Office - including DDmc the muniments of the Machell family
- National Library of Wales

3.2.3 It will examine the potential of private collections, particularly those of Dennis A While, Mike Davies-Shiel, Mr Bailey of Hathersage, Mr Baynes and Major J Ulf Machell of Penny Bridge Hall.

3.2.4 The emphasis of the documentary study will be placed on investigating early maps or photographic material which may inform the developmental sequence of the site. However, it will also include an appraisal of secondary sources and such primary documentation as may be reasonably available. Published documentary sources will also be examined and assessed. Such sources will include trade and technical journals, published industrial archaeological literature, including Philip Riden's early blast furnace statistics. A copy of the survey data generated by the RCHM(E) will be obtained.

3.2.5 ***Aerial Photography:*** A survey of the extant air photographic cover will be undertaken. This will potentially inform the later development of the ironworks and also the post-closure development of the site. Aerial photographic work may entail liaison with the Royal Commission on the Historical Monuments (England).

3.2.6 ***Analysis:*** a programme of analysis will examine the development of the site, and will examine the locational evidence for the early iron working structures on the site. It will present the evidence for the site plan at different stages of development. The analysis will also appraise the Backbarrow site within a national context and in this respect the documentary study will be undertaken alongside Step 2 and Step 3 of the MPP iron and steel assessment, presently being undertaken by LUAU for English Heritage, which will appraise the national archaeological significance of key iron and steel industrial sites, and will including Backbarrow.

3.3 STAGE 1 IDENTIFICATION SURVEY

3.3.1 It is proposed to undertake an identification survey of the site which will follow on from that already undertaken previously by LUAU (1992) as part of the original assessment and that undertaken by the RCHM(E). It will rapidly examine the extent of the development area and will enable a detailed correlation between the physical remains and the documentary results. It will also examine the physical evidence for the chronology of surviving structures. The results of the site investigation will be superimposed on the base plan of the RCHM(E) survey and the elevation drawings of the LUAU survey and will involve sketch survey of any features not previously recorded.

3.3.2 In conjunction with the identification survey a photographic record will be generated of significant features identified as well as the general landscape and will enhance the photographic record already undertaken.

3.4 STAGE 1 REVIEW / REPORT

3.4.1 An interim report will present and interpret the results of the documentary study and the identification survey. This will include an index of archaeological features identified in the course of the project, with an assessment of the sites' development. It will incorporate appropriate illustrations, including enhanced copies of the site maps and possibly also elevation drawings, all reduced to an appropriate scale. The report will consist of acknowledgements, list of contents, introduction, methodology, interpretative account of the site and associated structures, gazetteer of sites, a complete bibliography of sources from which data has been derived, and a list of further sources identified during the programme of work. The report will assess the potential for early structures, as well as the development of the site, presented in map form, and also the significance of the site within a national context. The report will make recommendations for the implementation of Stage 2 of the evaluation programme; highlighting those areas with the greatest potential for geophysical survey and evaluation trenching.

3.5 STAGE 2 GEOPHYSICAL SURVEY

3.5.1 Subject to discussions with Geophysical Surveys of Bradford, who are the leading exponents of archaeological geophysical survey in the UK, we are advised that on this type of site it is not possible to determine the most appropriate geophysical survey technique or even if it will generate productive results without a trial survey. It is therefore proposed that a pilot survey be undertaken on a single hectare of land (the location to be recommended by the Stage 1 report) and, subject to the satisfactory results of this pilot survey, then implement a more expansive survey with the most appropriate technique should be implemented. The costs defined below are for the pilot survey of a single hectare of resistance survey (which is the more expensive of the two). If it is apparent from the outset of the pilot study that there is no potential for geophysical survey then a minimum call-out charge of £ 411.20 will need to be imposed.

3.5.2 The pilot survey will involve the investigation of both resistance and magnetometer surveys and the most appropriate technique will then be applied for the remainder of the hectare of land. The two survey methods are as follows:

3.5.3 ***Magnetometer Survey:*** the survey area will be divided into 20m x 20m grids within which data collection is taken. Survey measurements are collected with a Geoscan Research FM36 instrument, sampling at two readings per metre with inter-transect distances being 1m. Therefore 800 readings are collected within each 20m x 20m grid. The data are captured in the internal memory of the FM36 and then downloaded to a portable computer. The individual grids are matched together to produce an overall plan of the surveyed area, the results being analysed using a variety of software. A report, including diagrams, text and interpretation on a CAD system, will then be prepared.

3.5.4 ***Resistivity Survey:*** the survey area will be divided into 20m x 20m grids within which data collection is taken. Survey measurements are collected with a Geoscan research RM15 instrument, normally sampling at one reading per metre with inter-transect distances being 1m. Therefore 400 readings are collected within each 20m x 20m grid. The data are captured in the internal memory of the RM15 and then downloaded to a portable computer. The individual grids are matched together to produce an overall plan of the surveyed area, the results being analysed using a variety of software. A report, including diagrams, text and interpretation on a CAD system, will then be prepared.

3.6 STAGE 2 TRIAL TRENCHING

3.6.1 This programme of trenching will establish the presence or absence of any archaeological deposits and, if established, will then briefly test their date, nature, and quality of preservation. This element of the work is invaluable in order to assess those parts within the proposed study area where there is a potential for archaeological deposits to survive which are not visible on the surface.

3.6.2 The trenches will target features of suspected archaeological significance in the light of the Stage 1 assessment report, be they documented structures or physical features. The study area totals 20500sqm, and the evaluation of a 2% sample of which is required to be excavated would involve the excavation of 410 sqm of trench; this is equivalent to seven 30m x 2m trenches. The precise positions and sizes of the trenches would be determined in discussions with the client and Lake District National Park Archaeologist at a meeting prior to Stage 2. The costs defined below for the evaluation trenching will be subject to any variation in the number of trenches as a result of this meeting. The present costs assume that half the trenches will be in areas of high potential and half in areas of low potential; if this proportion is varied as a result of the discussions there may need to be a slight variation in the defined costs.

3.6.3 ***Methodology:*** to maximise the speed and efficiency of the operation the removal of topsoil will be undertaken by machine, where accessible, under careful archaeological supervision (with a standard five foot toothless ditching bucket); however, all deposits below topsoil will be excavated by manual techniques, unless they are clearly disturbed, or spoil which may be excavated by machine depending on its extent and/or situation.

3.6.4 Manual excavation will be used to evaluate any sensitive deposits, and will enable an assessment of the nature, date and survival of deposits. The deposits will be investigated sufficiently to establish their character but the full depth of the deposits to natural will not necessarily be established across the whole trench. In accordance with current health and safety regulations, excavation will not be continued below 1.25m without shoring. Given the lack of current information for the potential of deep stratigraphy, the costs do not include provision for shoring at this stage. If it is required to excavate below this depth, then there will be additional costs to enable shoring of the requisite elements. All trenches will be excavated in a stratigraphical manner, whether by machine or by hand.

3.6.5 All features exposed will be sample excavated, which typically would involve the excavation of 50% of discrete features and 25% of linear features. No feature or structure will be wholly excavated as the intention is simply to evaluate only the archaeological resource at this stage. Trenches will be accurately located with respect to the original LUAU survey control, by use of a total station survey instrument.

3.6.6 Samples will be taken for environmental and metallurgical analysis. The extent of analysis undertaken will be subject to the results of the evaluation and discussions with the Lake District National Park Archaeologist and the client. A contingency cost for this element is provided below.

3.6.7 ***Evaluation Recording:*** all elements of the work will, as a matter of course, be recorded in accordance with current English Heritage guidelines (*Management of Archaeological Projects, 2nd edition* 1991) and the best practices formulated by English Heritage's Central Archaeology Service. All excavation, by whatever method, will be recorded by the compilation of context records, and of object records for any finds, and the production of manually drawn accurately scaled plans and section drawings (probably at scales of 1:20 and/or 1:10), as well as a photographic record. Finds recovery and sampling programmes will be in accordance with best practice (current IFA guidelines). All typologically significant and closely datable finds will be contextually recorded. Three-dimensional recording of selected finds' classes will be undertaken using a data-logging total station if this proves beneficial. All artefacts and ecofacts will be handled and stored according to standard practice (following current Institute of Field Archaeologists guidelines) in order to minimise deterioration. Finds storage during fieldwork and any post-excavation assessment and analysis (if appropriate) will follow professional guidelines (UKIC). Emergency access to conservation facilities is maintained by LUAU. Any discard policy for finds should be formulated with care, and with advice from the Lake District National Park Authority. All archaeological features within the trenches will be planned by manual techniques.

3.7 EVALUATION REPORT

3.7.1 ***Archive:*** The results of Stages 3.1-3.6 above will form the basis of a full archive to professional standards, in accordance with current English Heritage guidelines (*Management of archaeological projects*, 2nd edition, 1991). The project archive represents the collation and indexing of all the data and material gathered during the course of the project. The deposition of a properly quantified, ordered, and indexed project archive in an appropriate repository is considered an essential and integral element of all archaeological projects by the Institute of Field Archaeologists in that organisation's Code of Conduct. This archive will be provided in the English Heritage Central Archaeology Service format, as a printed document, and a synthesis (the evaluation report and index of the archive) will be submitted to the relevant Sites and Monuments Record.

3.7.2 All drawings will be produced on dimensionally stable drafting film on standard 'A' size sheets and in metric format. Each sheet will be fully titled. Line thicknesses will be chosen to allow for ease of duplication and/or reduction. Particular attention will be paid to achieving drawings of the highest quality and accuracy.

3.7.3 The archive will be formed of all the primary documentation, including the following:

- Survey Information
- Context Records
- Finds Records
- Sample Records
- Field / Inked Drawings and digital copies of CAD data
- Photographic negatives, prints and colour transparencies
- Written report
- Administrative records

3.7.4 ***Report:*** one copy of a written synthetic report will be submitted to the client and five copies to the Lake District National Park Authority which will be delivered within two months of completion of the field work. The report will present, summarise, and interpret the results of the programme detailed in Stages 3.1-3.5 above, and will include an index of archaeological features identified in the course of the project, with an assessment of the sites development. It will incorporate appropriate illustrations, including copies of the site plans and elevation drawings, and the topographic survey mapping all reduced to an appropriate scale. The report will consist of an acknowledgements statement, list of contents, executive summary, introduction summarising the brief and project design and any agreed departures from them, methodology, interpretative account of the site and associated structures, gazetteer of sites, list of archive contents, a complete bibliography of sources from which data has been derived, and a list of further sources identified during the programme of work. The report will make recommendations for further mitigative recording if required. The report will be in the same basic format as this project design. A copy of the report can be provided on 3.5" IBM compatible disk

in either ASCii or Word for Windows format and the drawings can be provided as DXF files if required.

3.8 GENERAL CONDITIONS

3.8.1 ***Access:*** it is understood that LDNPA will ensure pedestrian and vehicular access to the site.

3.8.2 ***Health and Safety:*** full regard will, of course, be given to all constraints (services) during the survey, as well as to all Health and Safety considerations. The LUAU Health and Safety Statement conforms to all the provisions of the SCAUM (Standing Conference of Unit Managers) Health and Safety manual. Risk assessments are undertaken as a matter of course for all projects. The Unit Safety Policy Statement will be provided to the client, if required. The survey will not examine the blowing house because of the risk of ingesting asbestos from the cladding within the building. Trenches will be excavated up to one metre away from any standing walls to present any risk of destabilisation of structures. There is a potential risk of chemical contamination in the spoil, and it is understood that basic chemical analysis will be undertaken prior to the implementation of the evaluation. If it is established that there is a risk to personnel as a result of this contamination, then there will need to be a variation to the defined costs to provide for protective clothing and appropriate washing facilities.

3.8.3 ***Confidentiality:*** The report is designed as a document for the specific use of Lake District National Park Authority, for the particular purpose as defined in this project design, and should be treated as such. Any requirement to revise or reorder the material for submission or presentation to third parties or for any other explicit purpose can be fulfilled, but will require separate discussion and funding.

3.8.4 ***Project Monitoring:*** any proposed changes to this project design will be agreed with the client, the Lake District National Park Archaeologist and the English Heritage Inspector of ancient monuments. A meetings will be on completion of the Stage 1 report in order to discuss the details of the Stage 2 fieldwork.

3.8.5 ***Insurance:*** the insurance in respect of claims for personal injury to or the death of any person under a contract of service with the unit and arising out of an in the course of such person's employment shall comply with the employers' liability (Compulsory Insurance) Act 1969 and any statutory orders made there under. For all other claims to cover the liability of LUAU, in respect of personal injury or damage to property by negligence of LUAU or any of its employees, there applies the insurance cover of £ 1m for any one occurrence or series of occurrences arising out of one event.

3.8.6 ***Contingencies:*** Stage 2 of the evaluation is dependant upon the results of the Step I results and a meeting with the Lake District National Park Authority. The costs for Stage 2 trial trenching may vary slightly as a result of that meeting. The geophysical survey is only a pilot study and subject to the successful implementation of that study there may be a requirement for further geophysical work. Any further work will be subject to discussions with the Lake District National Park Authority and the client.

3.8.7 The requirements for environmental assessment will be subject to the results of the Stage 2 fieldwork; however a provisional contingency cost for analysis is shown below. The implementation of that contingency will be subject to discussions with the Lake District National Park Authority and the client.

4. WORK TIMETABLE AND RESOURCES

4.1 It is envisaged that the various stages of the project outlined above would follow on consecutively, where appropriate. The phases of work would comprise:

i ***Stage 1 - Documentary Survey***
6 days (desk-based)

ii ***Stage 1 - Identification Survey***
1 day (on site)

iii ***Stage 1 - Preliminary Report***
3 days (on site)

iv ***Stage 2 - Geophysical Survey (Pilot Study)***
1 day (on site)

v ***Stage 2 - Trial Trenching***
9 days (on site)

vi ***Stage 2 - Evaluation Report***
4 days (desk-based).

4.1.2 LUAU can execute projects at very short notice once an agreement has been signed with the client. The project (field work, report and archive) is scheduled for completion within two months from the completion of the field work.

4.1.3 The project will be under the project management of **Jamie Quartermaine, BA Surv Dip MIFA** (LUAU Project Manager)to whom all correspondence should be addressed. Jamie Quartermaine undertook the fabric survey of the Backbarrow furnace as part of the 1992 LUAU assessment. He also undertook the detailed survey of the Leighton Beck Ironworks and the fabric survey of the Netherhall Blast Furnace, undertaken alongside the excavation.

4.1.4 It is proposed that the documentary study be undertaken by **Ian Hedley BA AIFA** (Project Officer) and **David Crossley MA PhD** who are together presently undertaking the Steps 2 and 3 of the assessment of the Iron and Steel Industry for the English Heritage Monument Protection Programme (MPP). David Crossley's is probably the countries foremost expert on the charcoal blast furnace industry; his doctorate was on the early blast furnace industry and he undertook the Step 1 assessment of the MPP Iron and Steel Industry for English Heritage. He has excavated a number of blast furnaces, notably the sixteenth century Wealden furnace at Panningridge, Sussex. He has published widely on the subject (eg Crossley 1968, 1972, 1983 and 1984) and is very familiar with the Backbarrow site.

4.1.5 Ian Hedley has undertaken industrial MPP coverage for the Arsenic, Coal, Copper, Lead, Lime, Minor Metals, Stone Quarrying, Tin and Zinc industries. He has recently undertaken the excavation of the Carlton Bank Alum works, North Yorks. He is a member of the Historical Metallurgy Society and is currently undertaking field research into the medieval bloomery iron industry of Northumberland. He is site director of the Society of Antiquaries excavations at Glantlees Farm medieval bloomery iron smelting complex, Long Framlington, Northumberland.

4.1.6 It is proposed that the trenching programme is undertaken by Iain Hedley.

4.1.7 All Unit staff are experienced, qualified archaeologists, each with several years professional expertise.

APPENDIX 4
ENGLISH HERITAGE MONUMENT PROTECTION PROGRAMME ASSESSMENT OF BACKBARROW FURNACE

KEY TO MPP NOMENCLATURE

Condition

D	Derelict	**1**	Good Preservation of industrial period features
DM	Derelict Machinery	**2**	Moderate Preservation of industrial period features
E	Earthwork	**3**	Poor Preservation of industrial period features
S	Site of		

Importance

Imp the individual importance of the component in isolation and is a subjective assessment based on professional judgement as to the intrinsic importance of the component type, any unusual features of the specific example, and its preservation relative to other examples assessed in the survey

Grading

******* Sites of exceptional national importance for which statutory protection will almost always be appropriate, and whose preservation will be of high priority for resource allocation.

SUMMARY DESCRIPTION

A stone blast furnace of 1712. It was modified and developed in the nineteenth century, to work with hot blast. Charcoal was used until *c*1920, and then coke up to 1963. It has a surviving twentieth century hearth, tuyeres, stoves and blowing engine. There are indications of an earlier water system.

VISITED

19th June 1998

DETAIL ASSESSMENT

Component No.	Description	Condition	Importance
01	Furnace	D2	High
02	Barns: Storage	D2	High
03	Engine House	D2	High
04	Engine	DM3	High
05	Water System	E3	High
06	Stoves	D3	High
07	Office	D3	Moderate
08	Slag	S	High

LANDSCAPE

It is a striking complex in which barns and furnace relate to road, railway and surrounding woodlands.

ARCHAEOLOGY
An outline recording programme has taken place, with site evaluation [See above] in June 1988; there is considerable potential for work to clarify the water system and casting floor.

GENERAL ASSESSMENT
Backbarrow is one of four substantially-surviving blast furnaces in the Furness valleys, the others being Duddon [restored stack without hearth], Newland [stack and adjacent buildings under long-term restoration] and Nibthwaite [furnace base beneath domestic conversion of later bobbin mill]. The importance of Backbarrow lies firstly in the 1926 incorporation of a repertoire of nineteenth century technological improvements not otherwise surviving in Britain. Despite being incorporated in an archaic eighteenth-century stack, this is a survival of national importance. All major components survive except the casting house, and that survives as a below ground feature. The survival of these components, which includes notably the blowing engine and a fine group of storage buildings, adds to the significance of the site.

In view of this importance, the current condition of the site gives grounds for grave concern. Despite interest in Backbarrow over the past 30 years, deterioration has taken place, as shown by photographs (Crossley 1980) and surveys (LUAU 1991 1992). The furnace and hot-blast stoves have become unsafe due to cracking of masonry and brickwork and the vandalisation of the steam engine has continued. However, on the west side of the road the roofs of the storage buildings have been fitted with emergency covers, and the means of access to this part of the site have been blocked off. It was not possible to explore this area during the MPP field visit.

In summary, Backbarrow unquestionably deserves three-star grading, and MPP is an opportunity to contrast the importance of the site with the neglect which it has suffered. Backbarrow remains of major importance and justifies conservation.

There is a need to secure co-operation of current owners and the planning authority for a plan for management and conservation.

GRADING: ***

ILLUSTRATIONS

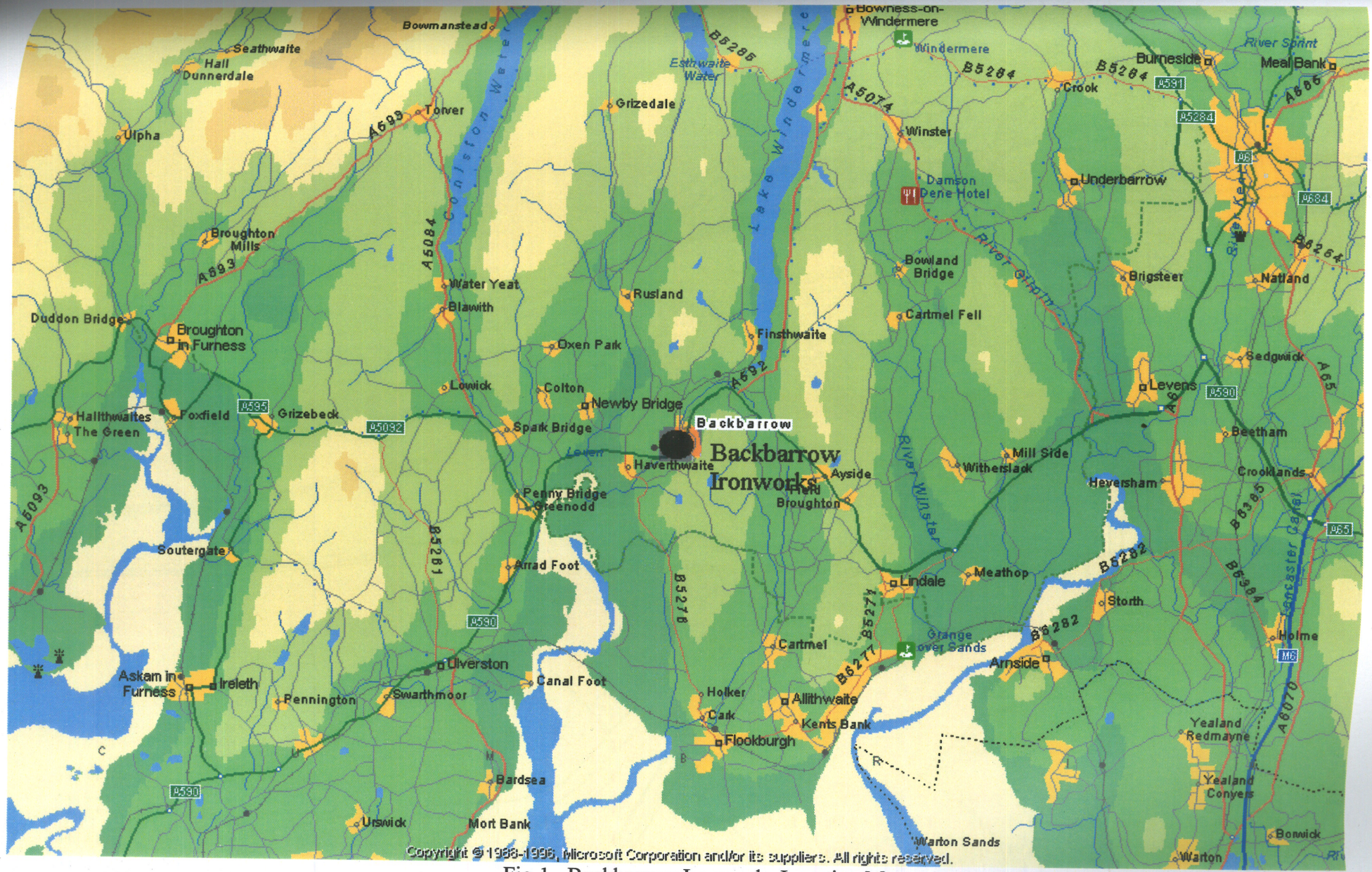


Fig 1 Backbarrow Ironworks Location Map

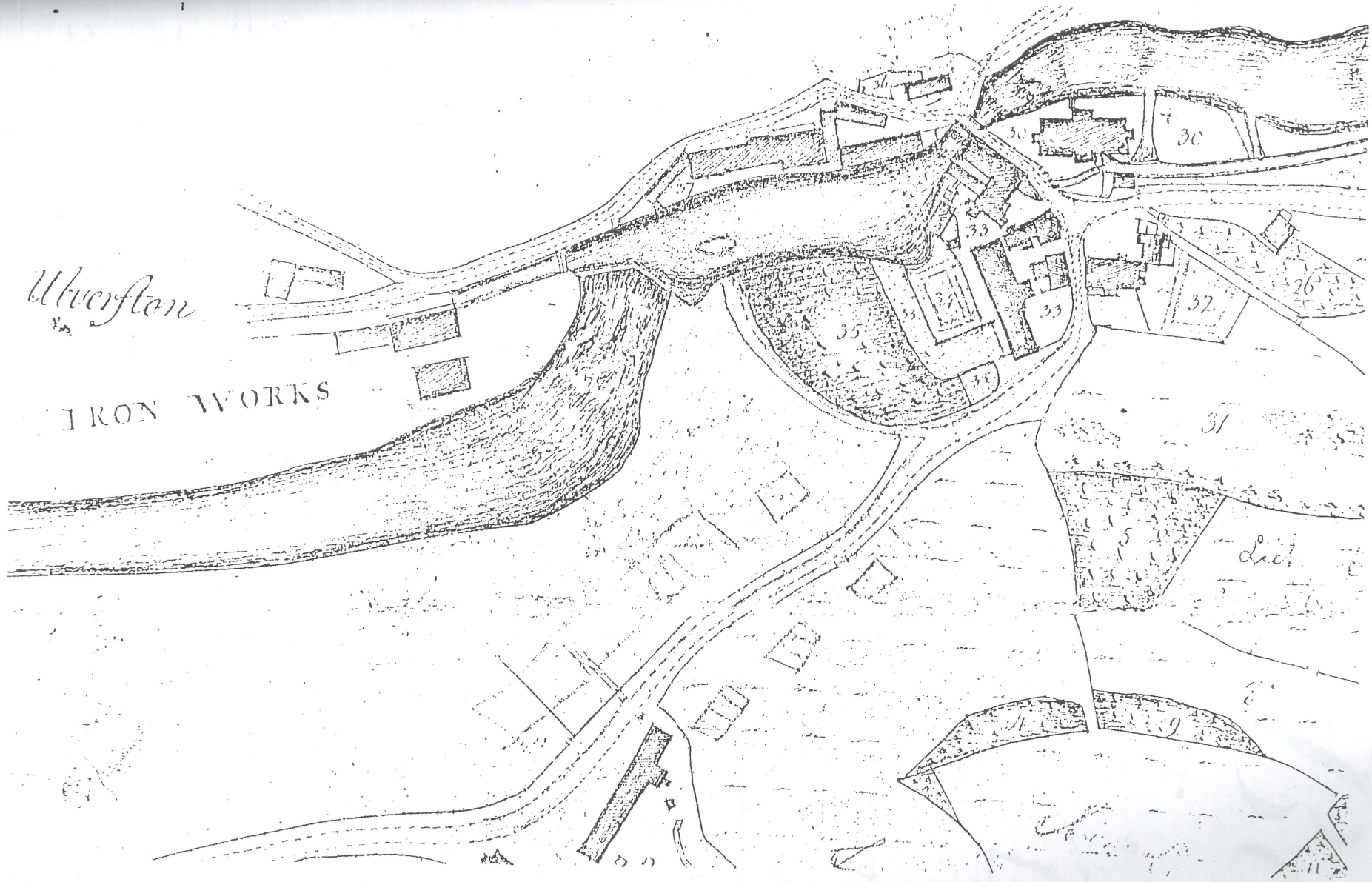


Fig 2 Backbarrow Estate Map (1808) - BD/HJ/Plan No. 9

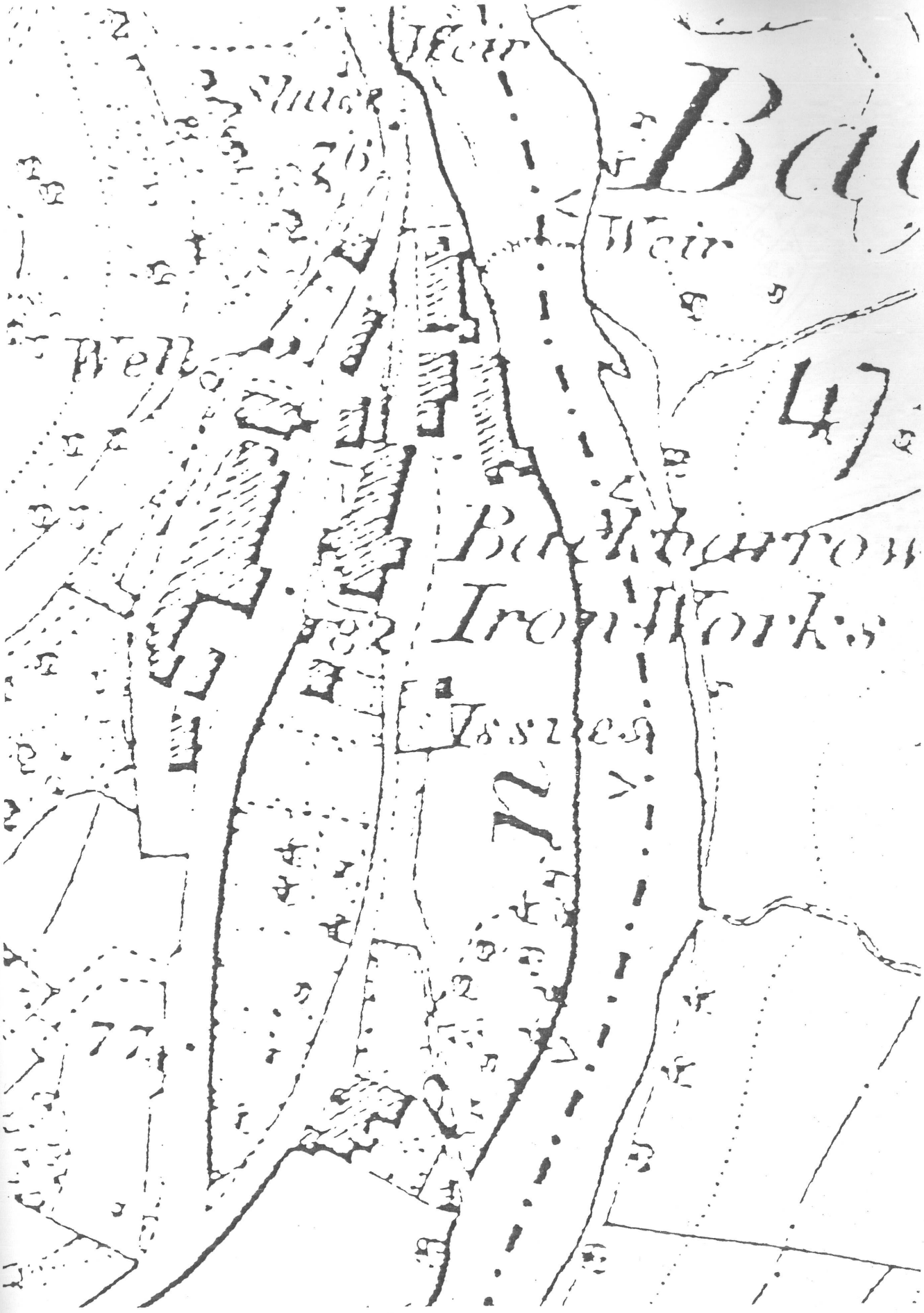


Fig 3 OS 1848 6" to 1 mile map

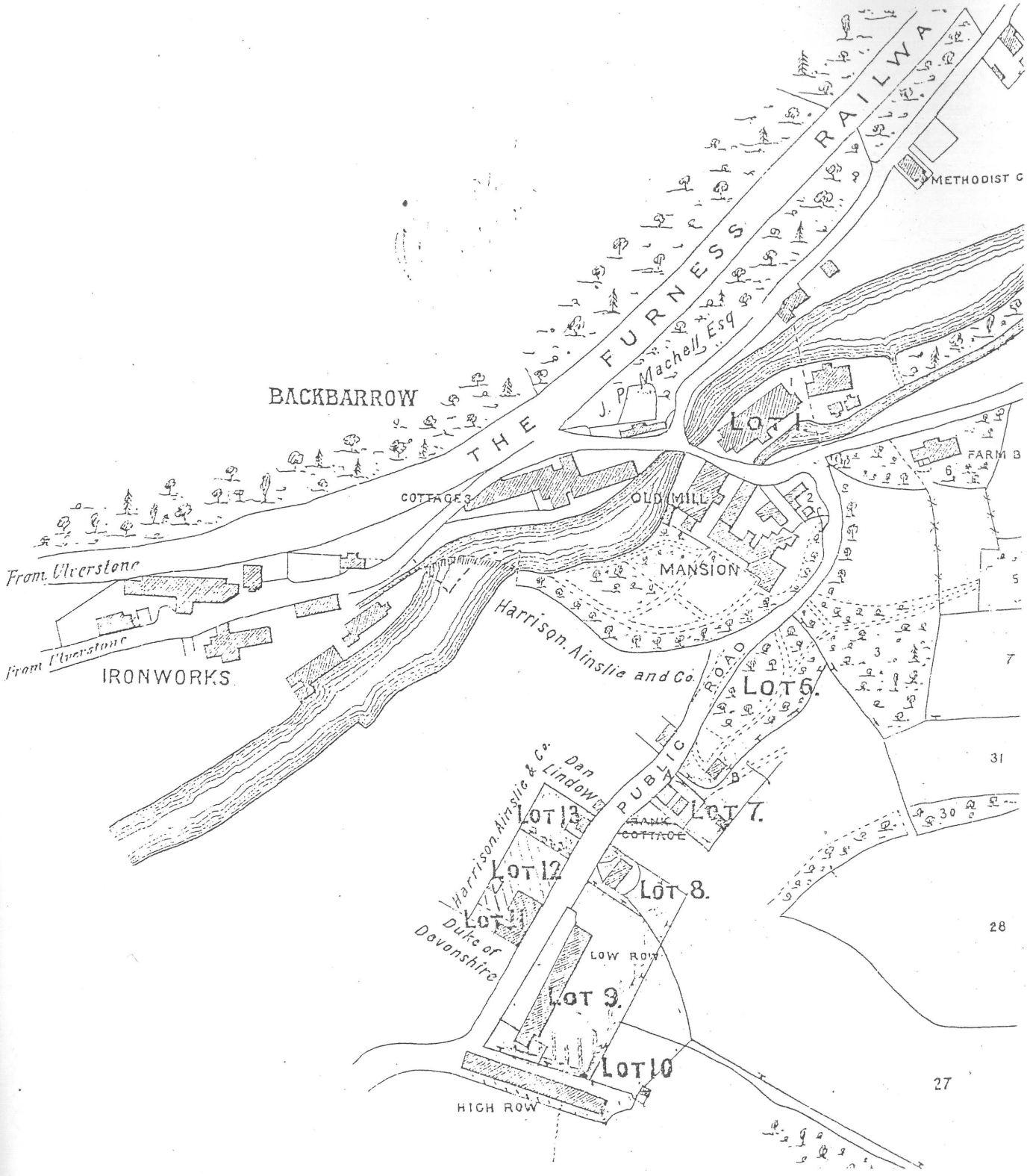


Fig 4 Backbarrow Estate Map (c1877?) - BD/HJ 320

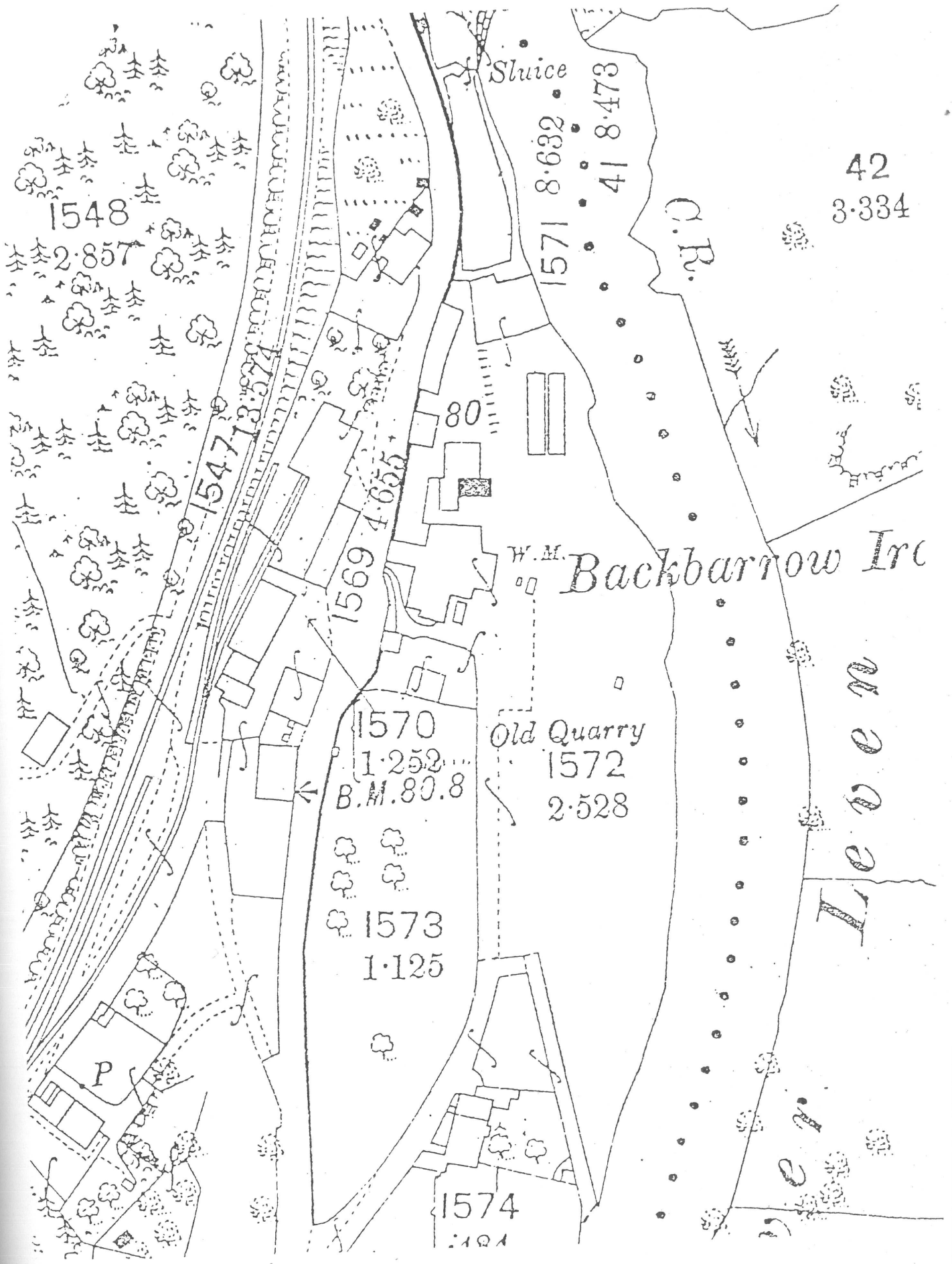


Fig 5 OS 1888 1:2500 map

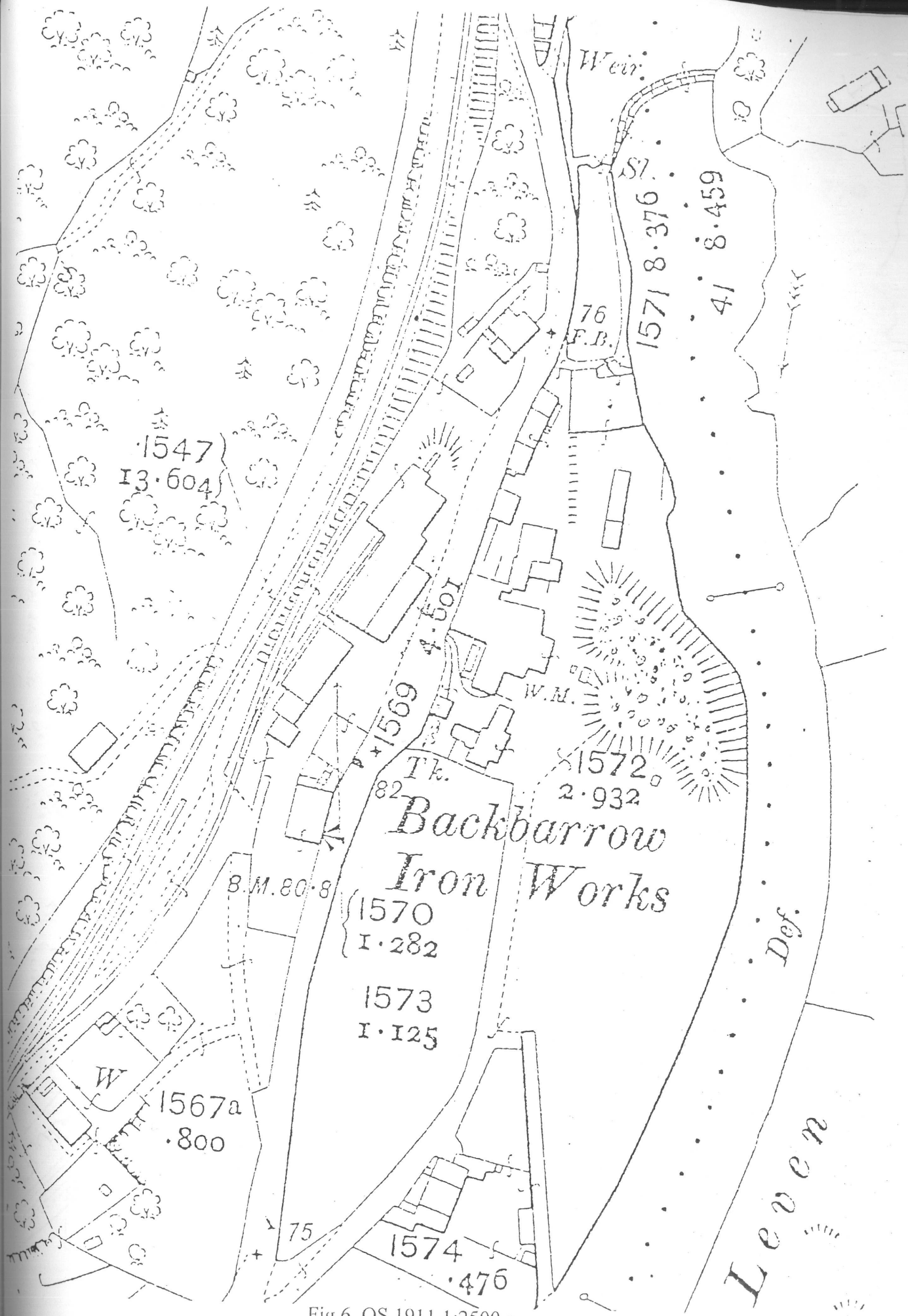


Fig 6 OS 1911 1:2500 map

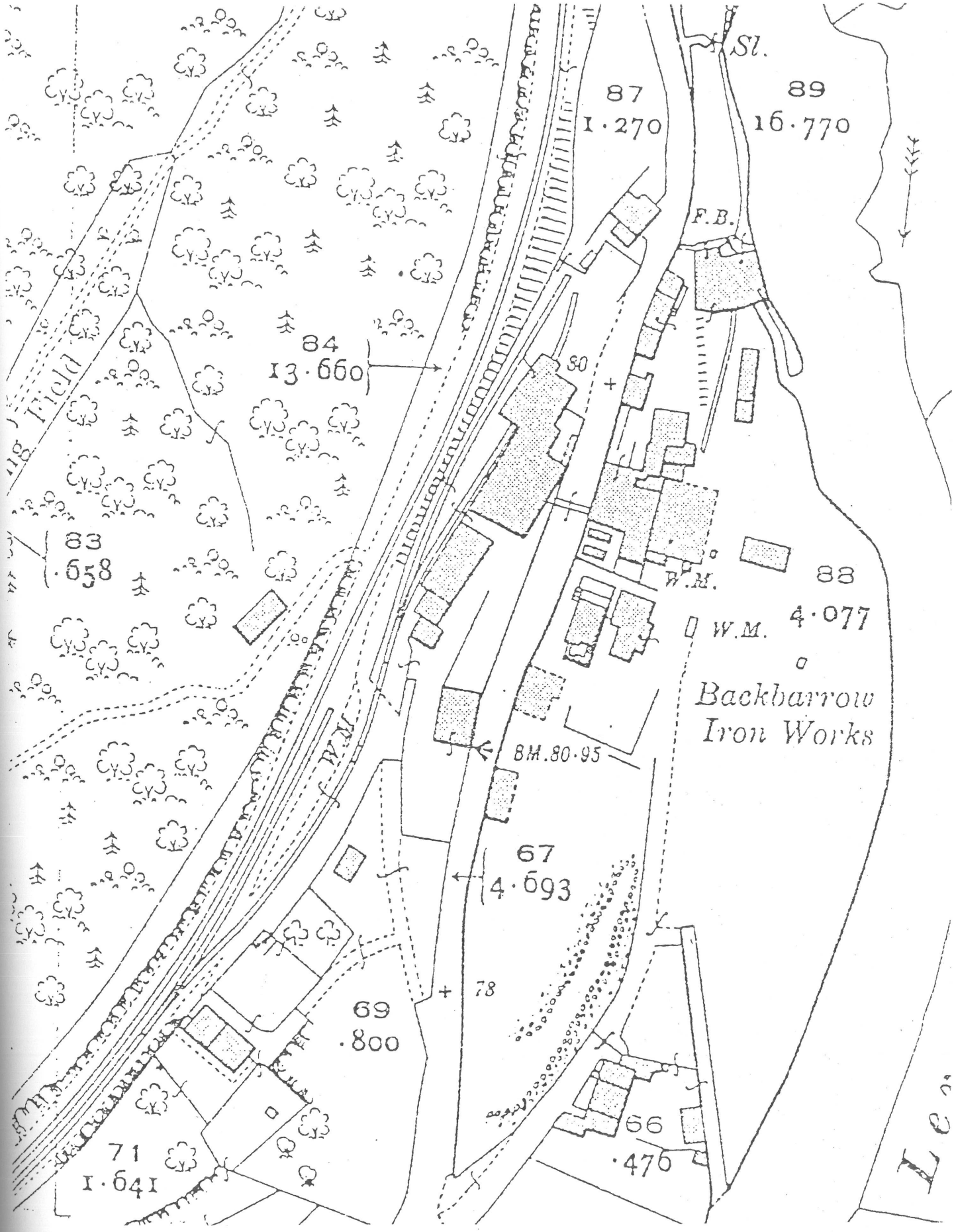


Fig 7 OS 1938 1:2500 map

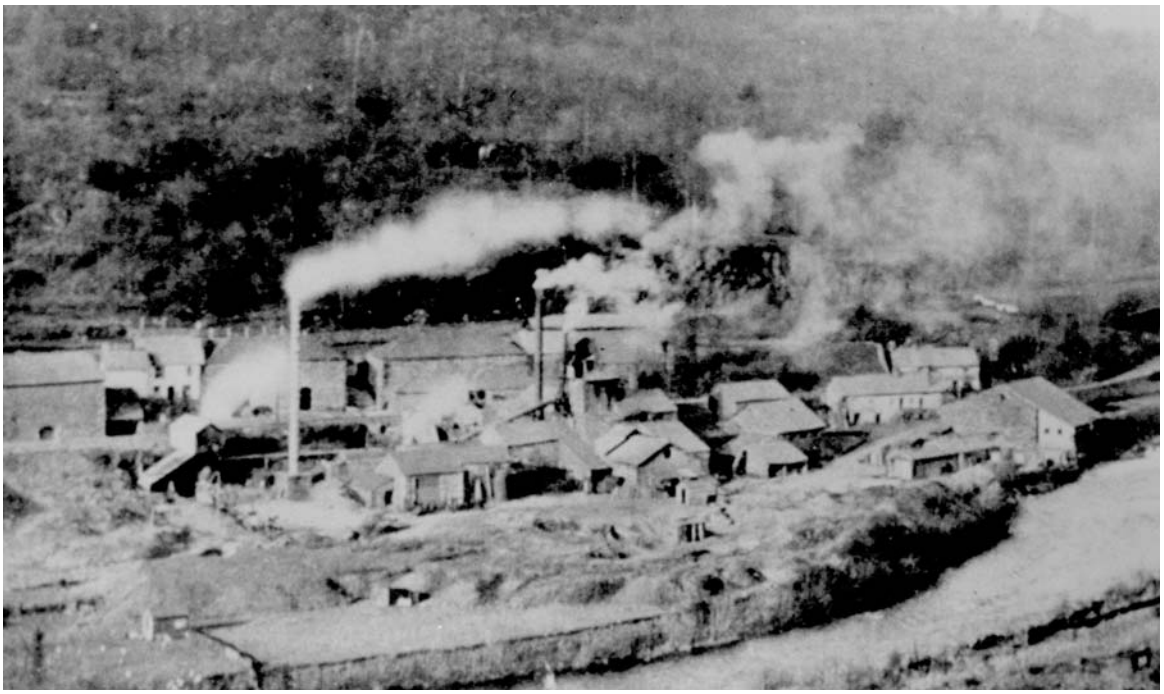


Fig 8 Photograph of the Backbarrow site from the south-east – *c* 1920 prior conversion of the furnace to coke (While DA)

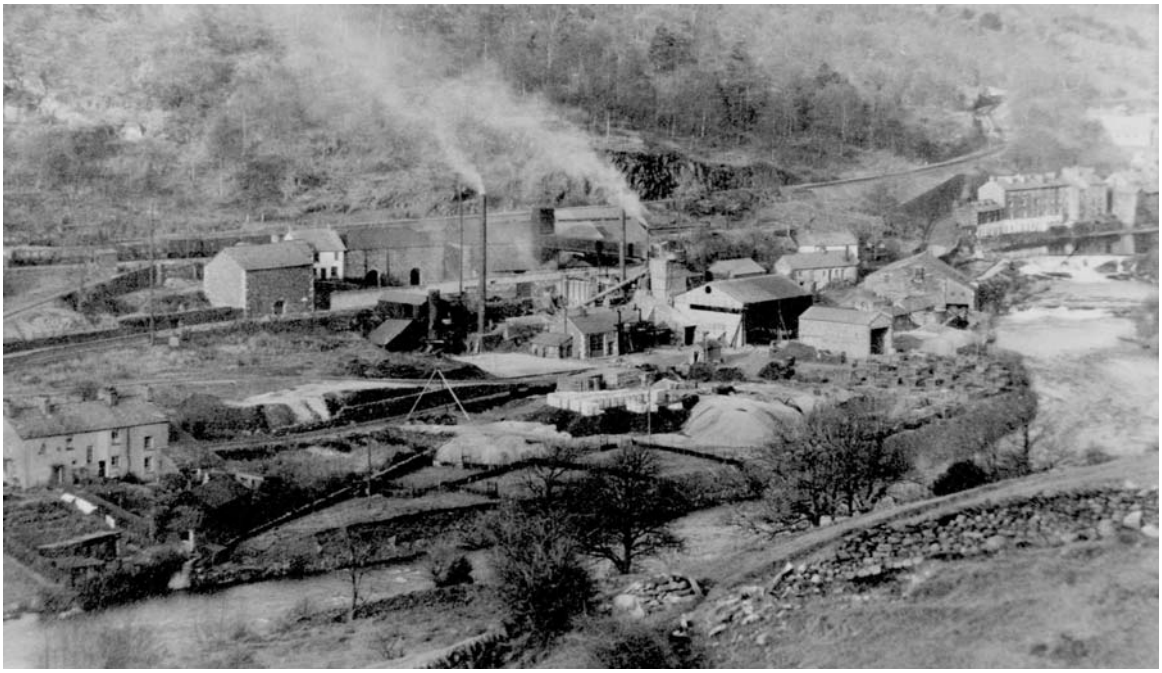


Fig 9 Photograph of the Backbarrow site from the south-east – Late 1920's / early 1930's (LDNPA)

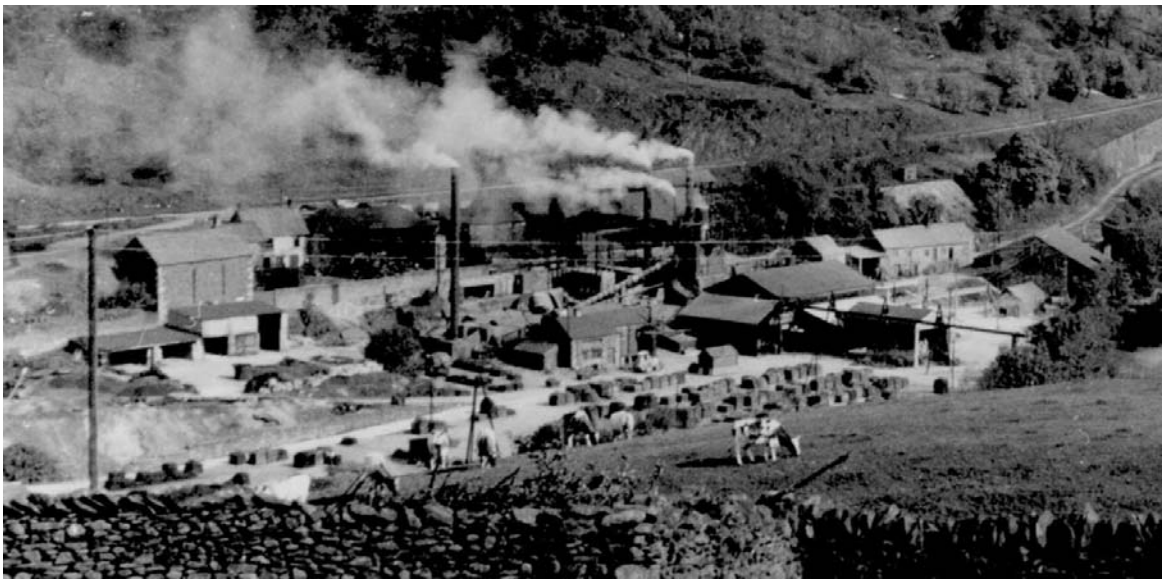


Fig 10 Photograph of the Backbarrow site from the south-east – 1959 (Bowden)

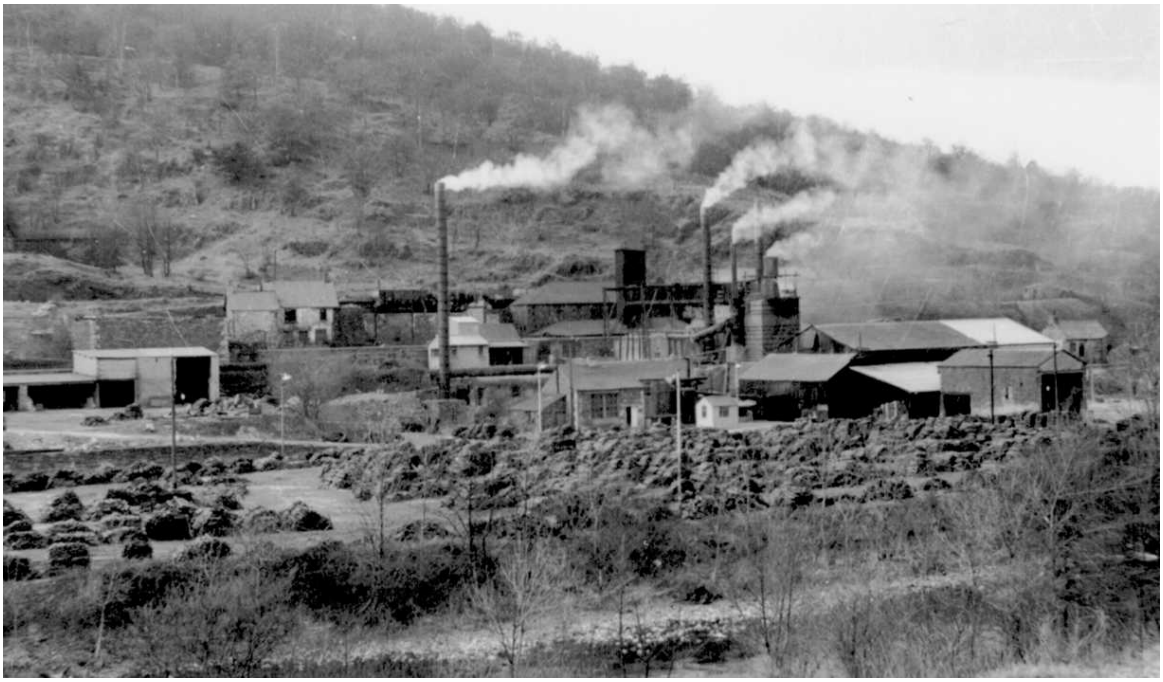


Fig 11 Photograph of the site just before closure – 1963 (Mein)

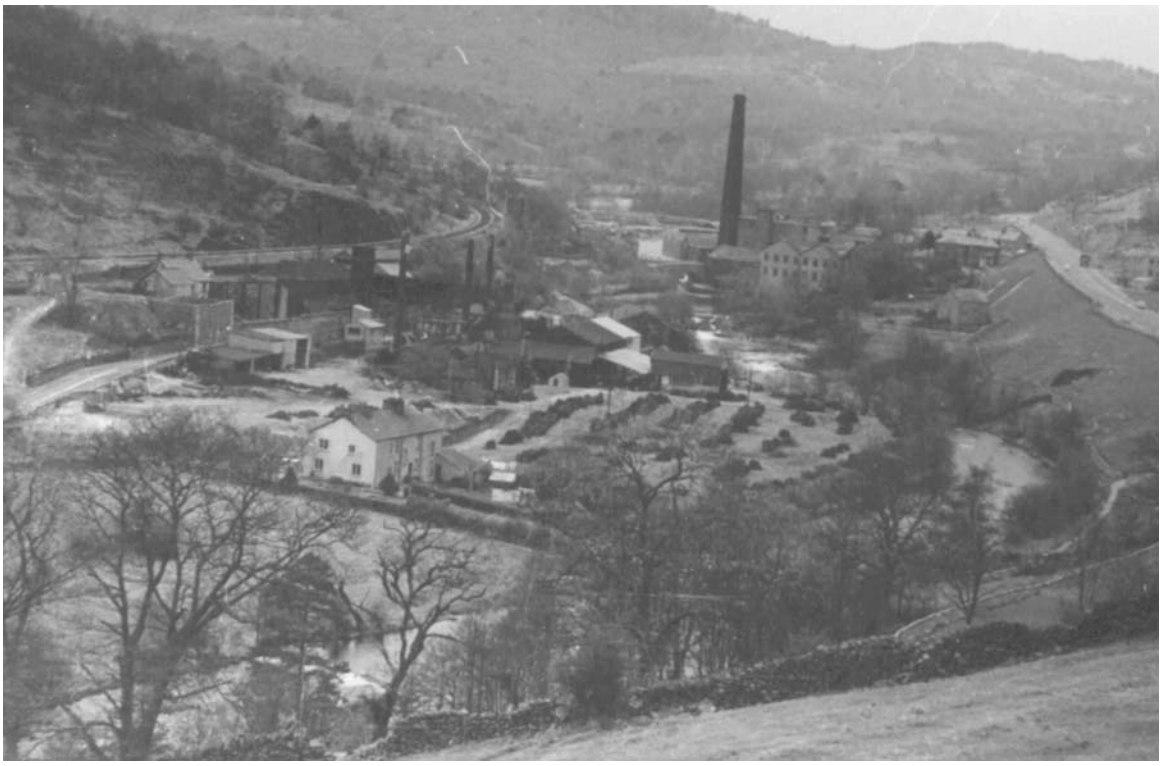


Fig 12 Photograph of the site from the south immediately post closure - *c* 1964 (Mein)

Fig 13 Photograph of the furnace during the 1992 survey

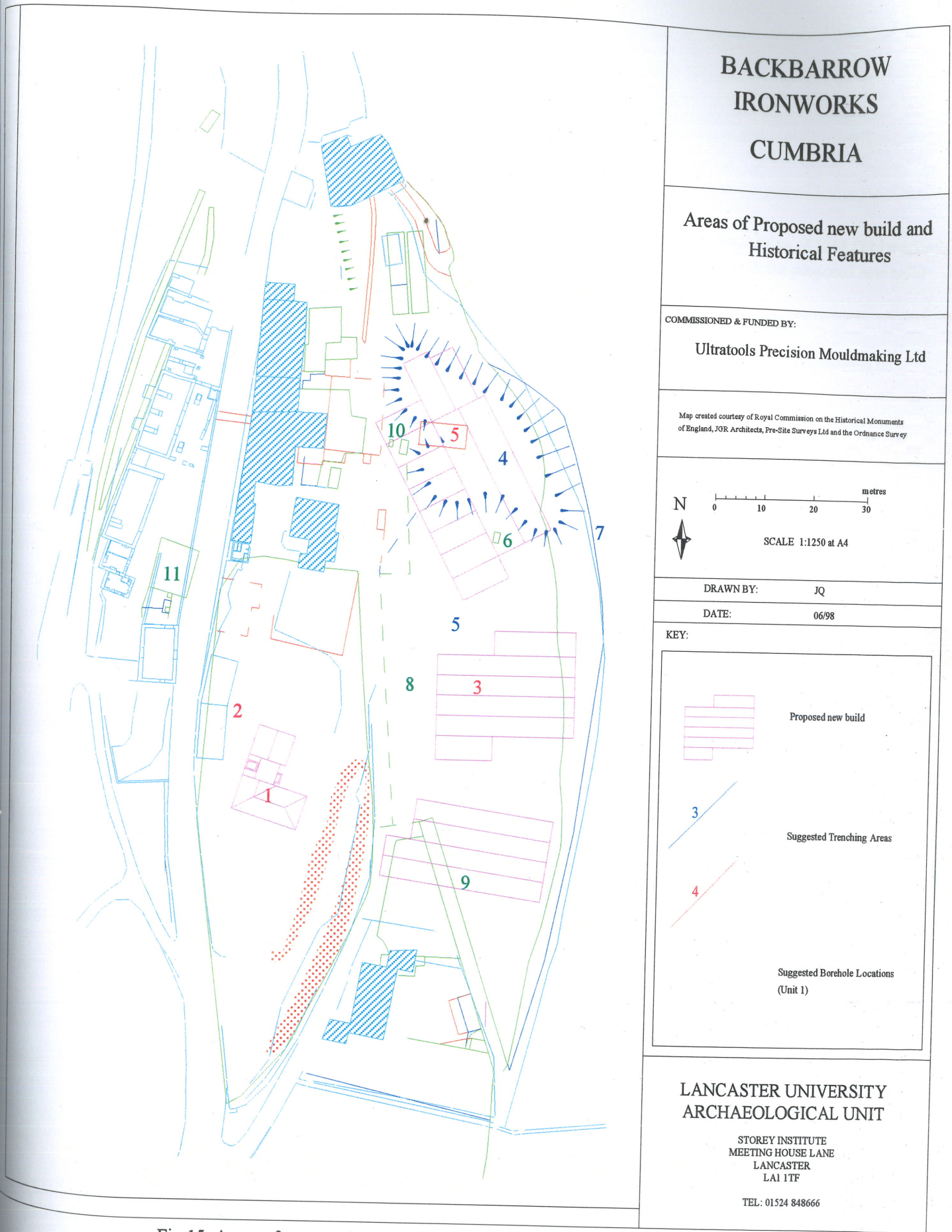


Fig 15 Areas of proposed new build and historical features

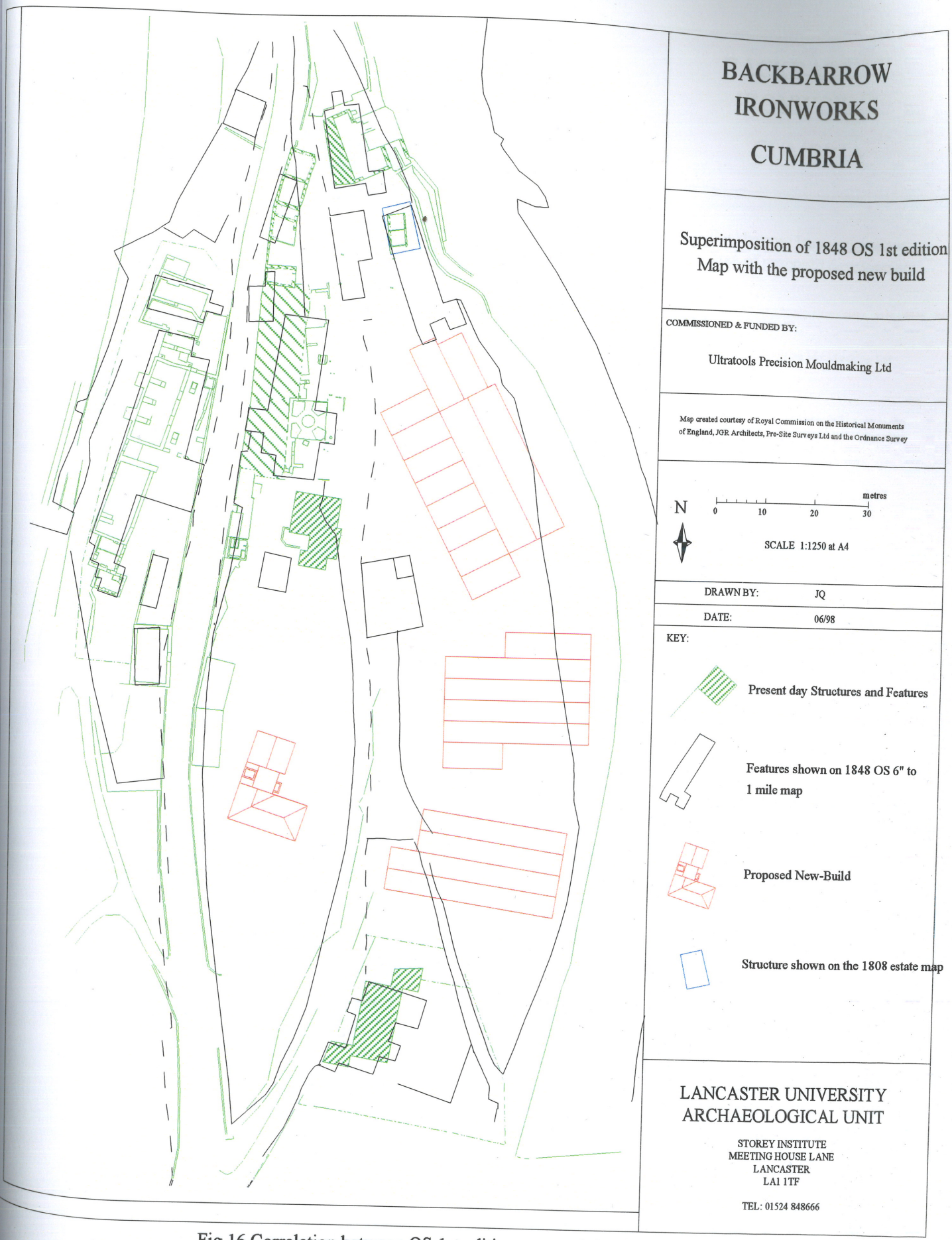


Fig 16 Correlation between OS 1st edition map and the proposed new build

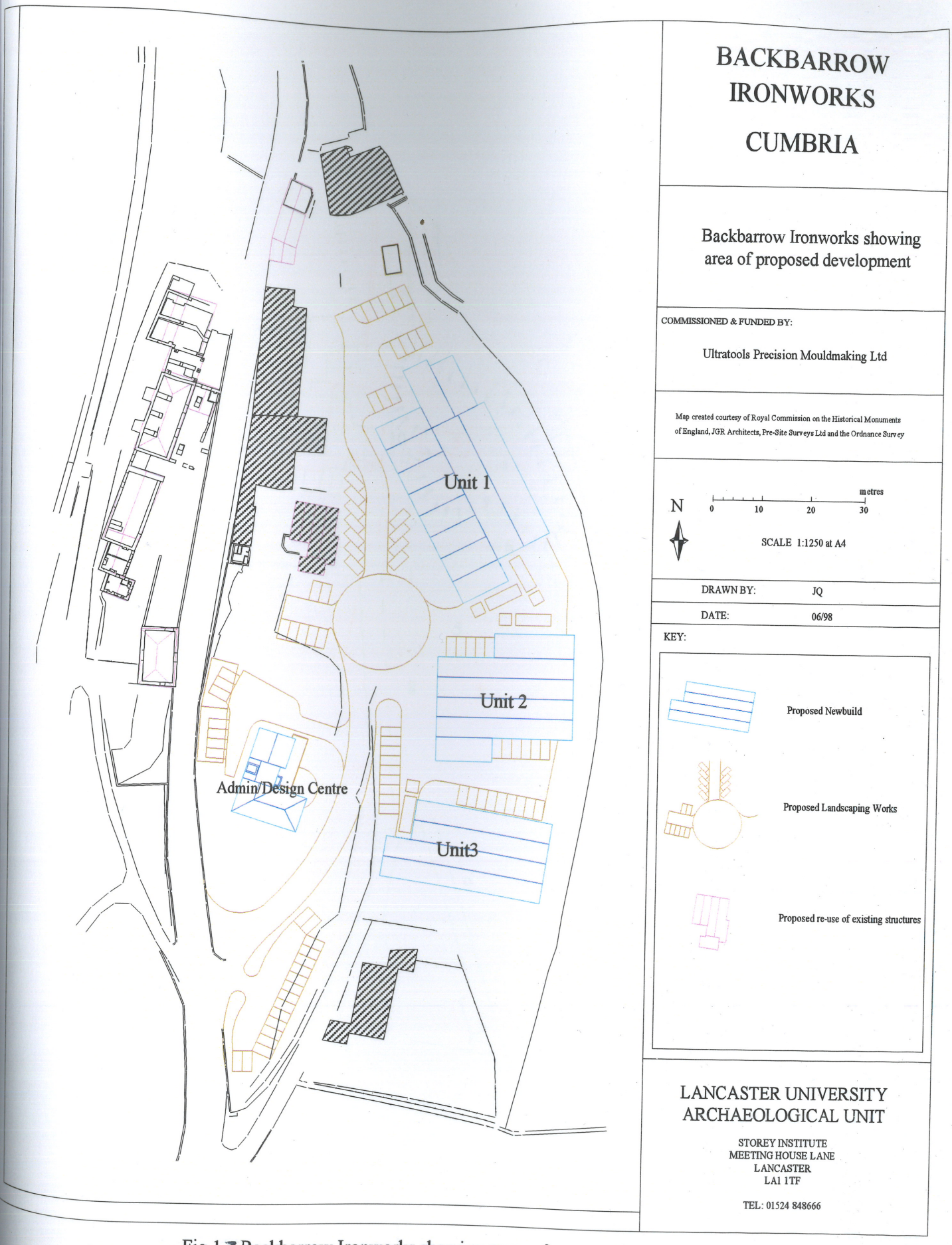


Fig 1 Backbarrow Ironworks showing areas of proposed development

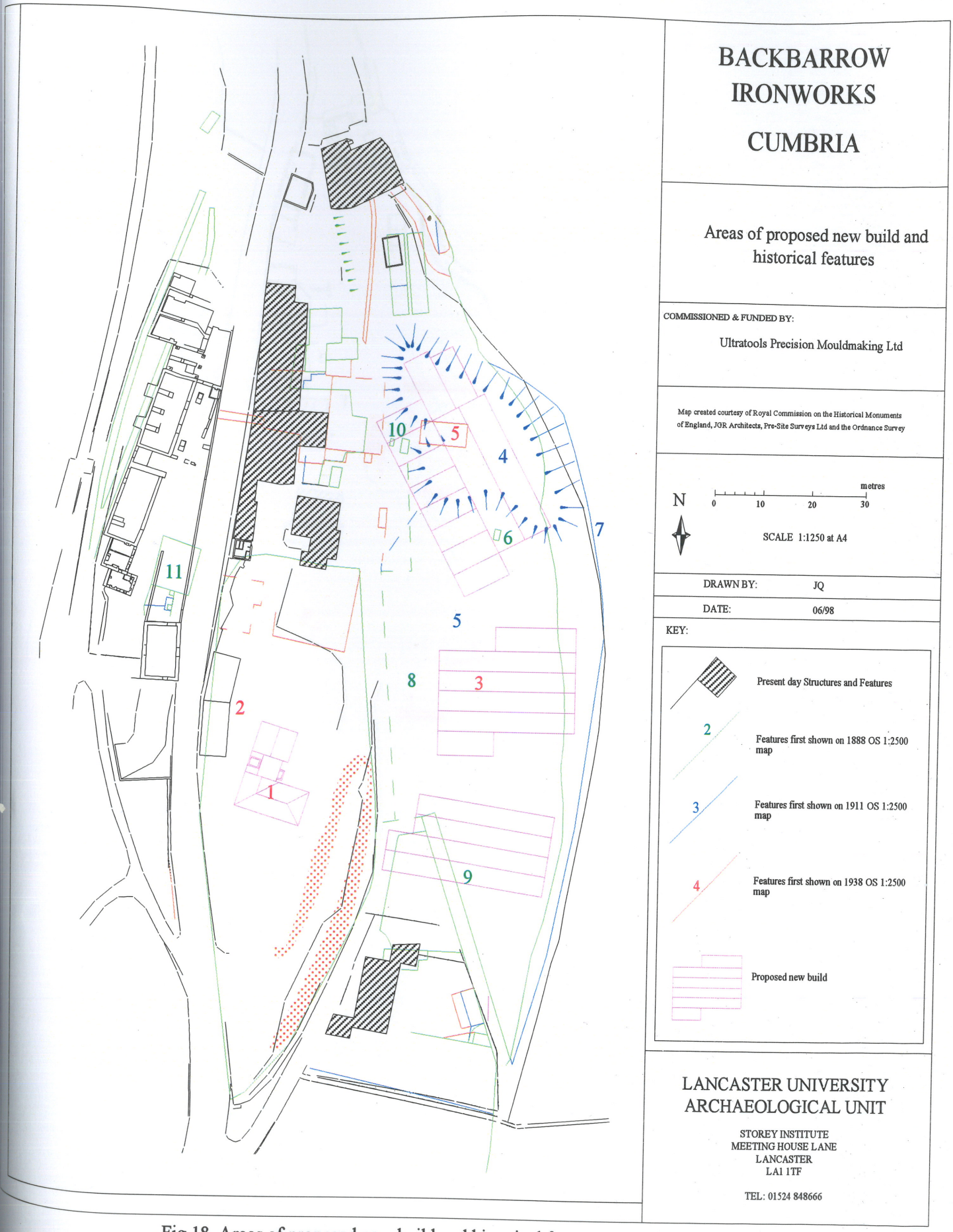


Fig 18 Areas of proposed new build and historical features

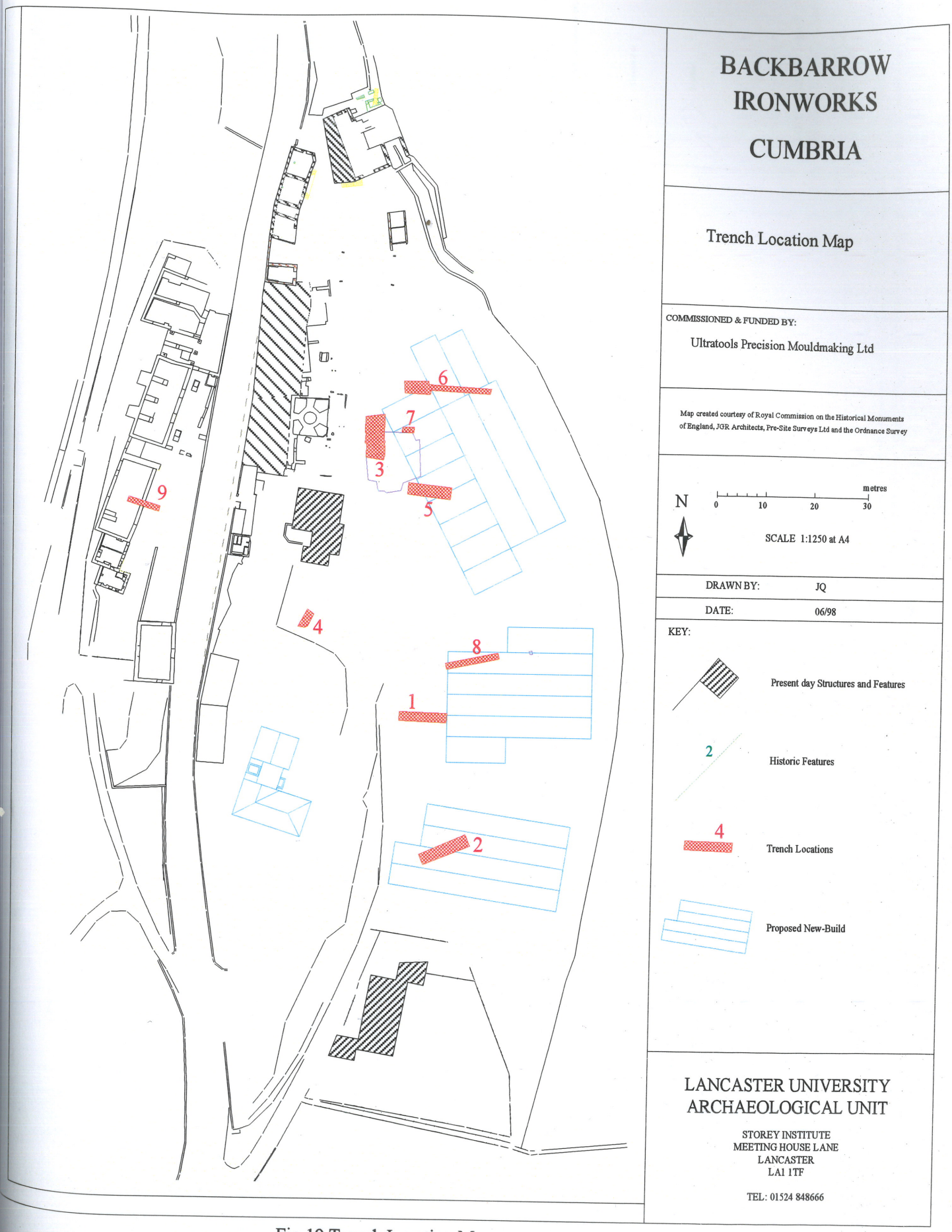


Fig 19 Trench Location Map

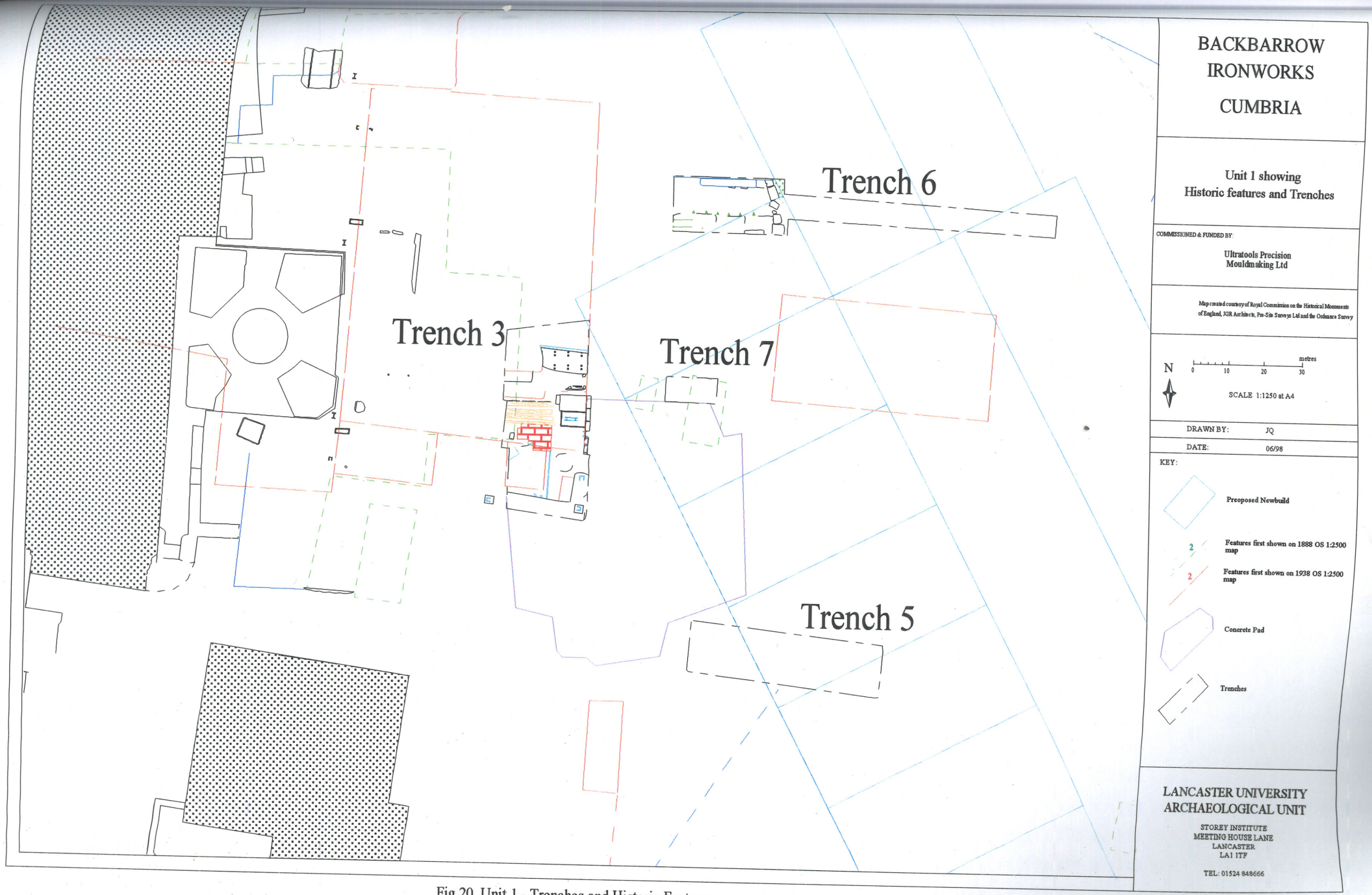


Fig 20 Unit 1 - Trenches and Historic Features

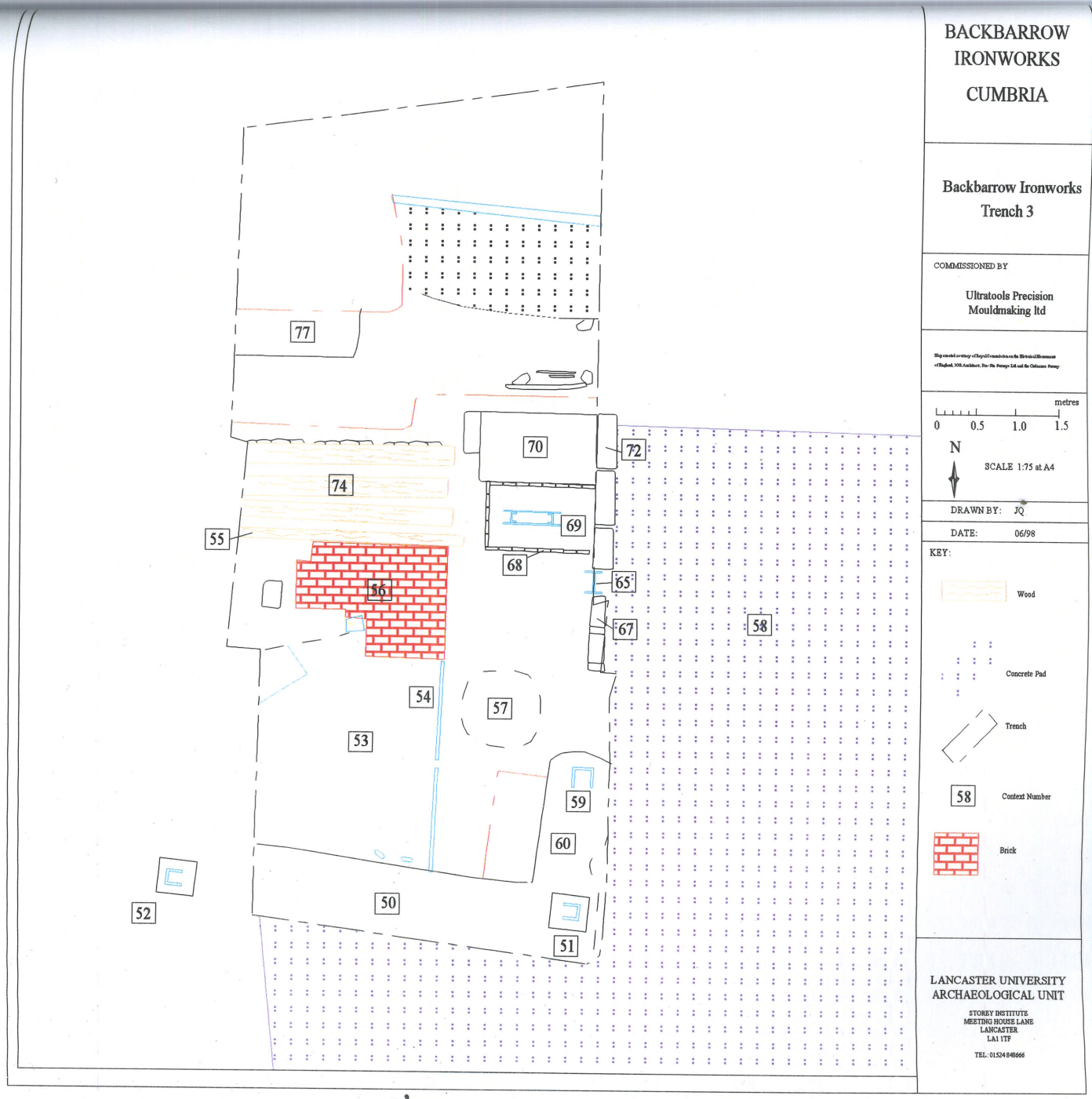


Fig 21 Backbarrow Ironworks - Trench 3

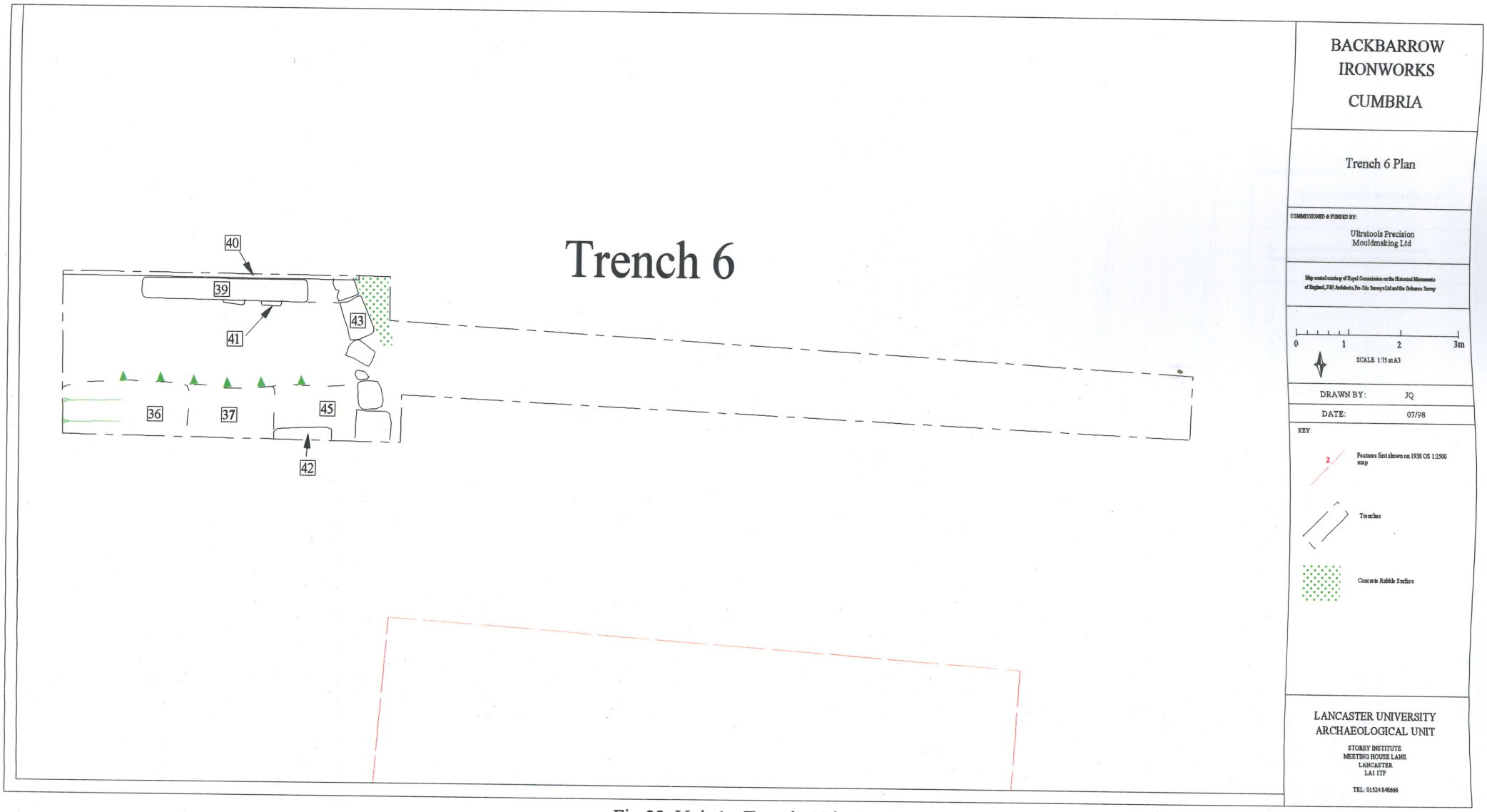
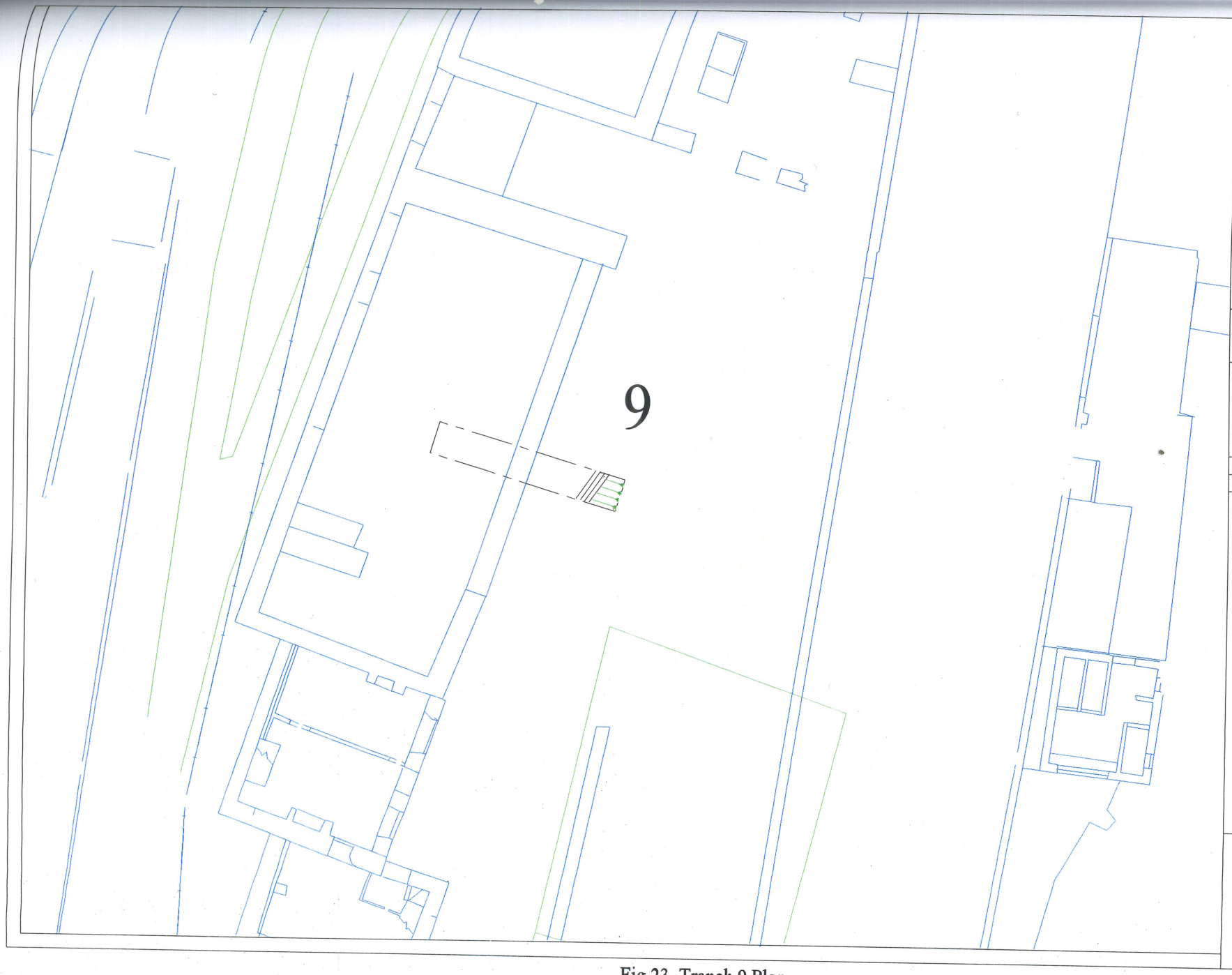


Fig 22 Unit 1 - Trench 6 Plan



BACKBARROW IRONWORKS

CUMBRIA

Trench 9 Plan

COMMISSIONED & FUNDED BY:

Ultratools Precision Mouldmaking Ltd

Map created courtesy of Royal Commission on the Historical Monuments of England, JGR Architects, Pre-Site Surveys Ltd and the Ordnance Survey

N

metres 0 1 2 3

SCALE 1:250 at A4

DRAWN BY: JQ

DATE: 06/98

KEY:

Present day Structures and Features

2 Historic Features

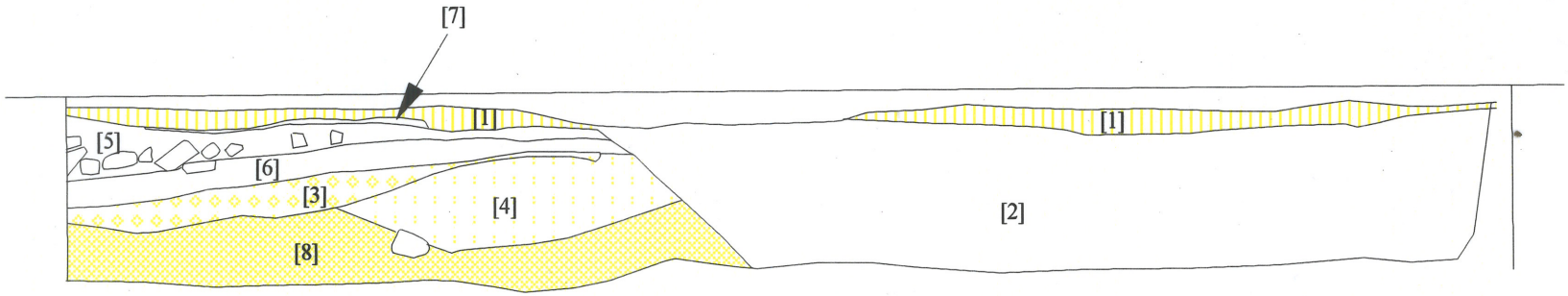
4 Trench Locations

LANCASTER UNIVERSITY ARCHAEOLOGICAL UNIT

STOREY INSTITUTE
MEETING HOUSE LANE
LANCASTER
LA1 1TF

TEL: 01524 848666

Fig 23 Trench 9 Plan



BACKBARROW
IRONWORKS

CUMBRIA

East Section - Trench 1

COMMISSIONED & FUNDED BY:

Ultratools Precision
Mouldmaking Ltd

0 0.5 1 1.5m

DRAWN BY: JQ

DATE: 07/98

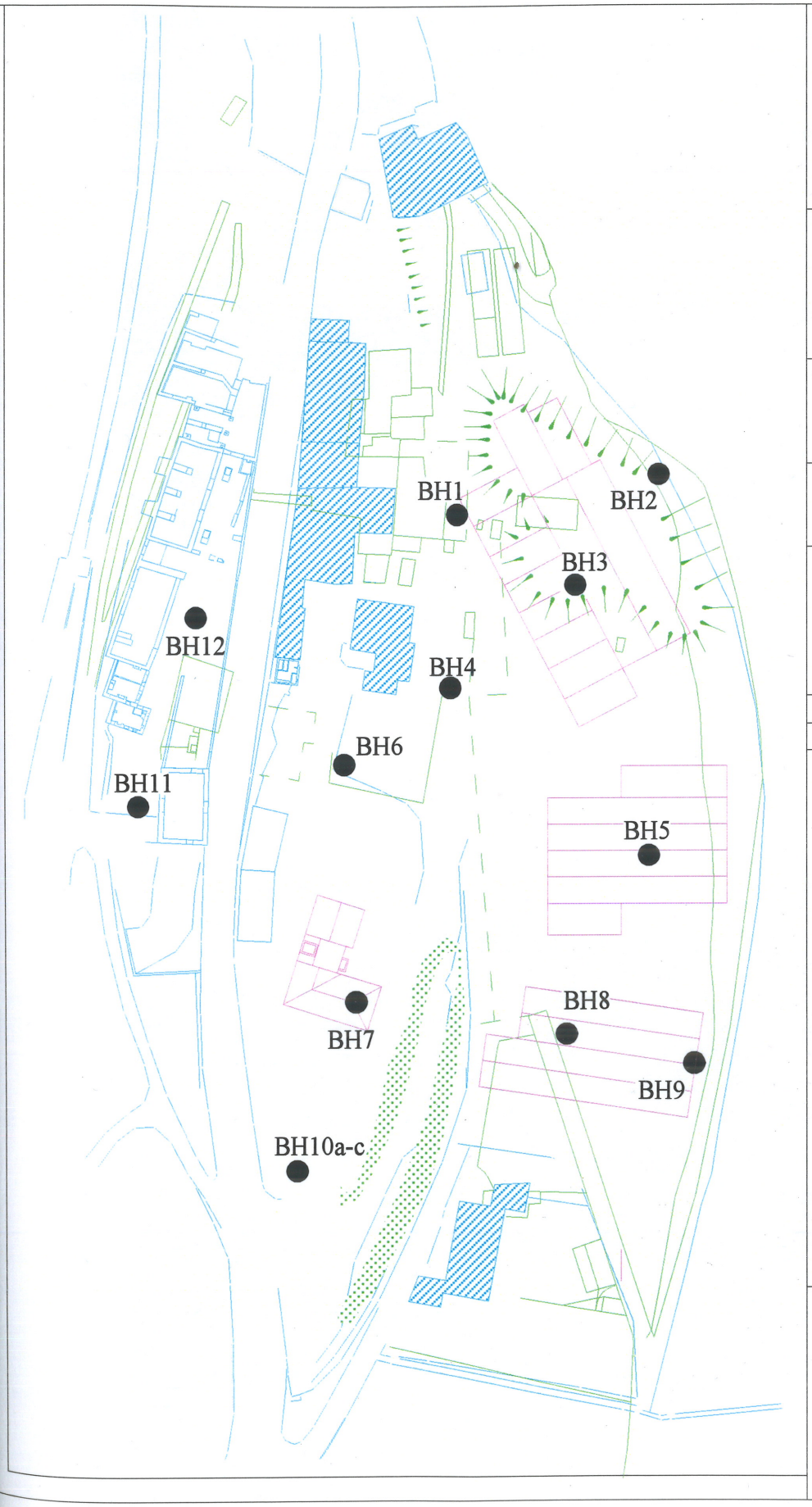
KEY:

LANCASTER UNIVERSITY
ARCHAEOLOGICAL UNIT

STOREY INSTITUTE
MEETING HOUSE LANE
LANCASTER
LA1 1TF

TEL: 01524 848666

Fig 24 North Section - Trench 1



BACKBARROW IRONWORKS

CUMBRIA

Borehole Location Map

COMMISSIONED & FUNDED BY:

Ultratools Precision Mouldmaking Ltd

Map created courtesy of Royal Commission on the Historical Monuments of England, JGR Architects, Pre-Site Surveys Ltd and the Ordnance Survey

N

metres 0 10 20 30

SCALE 1:1250 at A4

DRAWN BY: JQ

DATE: 06/98

KEY:

Proposed new build

Historic Features

BH5 Borehole Locations

LANCASTER UNIVERSITY ARCHAEOLOGICAL UNIT

STOREY INSTITUTE
MEETING HOUSE LANE
LANCASTER
LA1 1TF

TEL: 01524 848666

Fig 25 Borehole Location Map

Figure 26 Photograph of Trench 3 from the North

Figure 27 Photograph of casting bucket from Trench 1