# SPA CLOUGH, CASTLESHAW

## Interim Excavation Report

The Greater Manchester Archaeological Unit

November 1992

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# 1. Introduction

The existence of iron furnaces at the head of the Castleshaw valley near Delph in Saddleworth has long been known following the sagacious observations made by local poet and antiquarian Ammon Wrigley in 1912 (Wrigley 1912, 162-80). Recently, in the spring of 1990, interest in these furnaces was rekindled by the discovery of a quantity of tap slag, disturbed by a bulldozer whilst creating a vehicular turning circle just beyond the northern edge of Castleshaw Upper Reservoir. Later, analysis of the slag together with fieldwalking indicated the presence of a large, complex smelting operation, dating possibly to the medieval period or earlier (Redhead 1991). The archaeological potential of the site prompted the initial field investigations in May 1992 outlined in the following interim report.

# 2. Location and Extent of the Site

The site, located at grid reference SD 9987 1037, lies at the head of Castleshaw Valley in Saddleworth, Oldham (fig 1). The furnace complex is situated on the west slope of the valley, just south of the confluence of Spa and Cudworth Cloughs and above the most northerly point of Castleshaw Upper Reservoir. Despite being at *c* 270m above sea level, the site is reasonably protected from all but southerly winds by hills on three sides.

Initial fieldwalking showed that the bulldozer had clipped the southern edge of a bank of slag and sandstone rubble lying beside Spa Clough; to the west of this spoil heap was a concentration of shallow, grass-covered depressions, some associated with blocks of sandstone. This was the area upon which fieldwork has been focused (Redhead 1991). However, subsequent fieldwalking has indicated that possible iron furnace related earthworks may extend several hundred metres further up the valley side (Cudworth Pastures).

# 3. History

The history of the Castleshaw valley has been extensively researched by the Saddleworth Historical Society. Castleshaw in the later medieval period formed part of the lands belonging to Friarmere, which was owned by Roche Abbey (near Doncaster) from the 13th century until its dissolution in 1538. There may well have been a medieval farm at Grange which is situated in Castleshaw valley and mentioned in a valuation of Friarmere at the time of the Dissolution (Aveling 1870, 134).

Henry VIII sold Friarmere to Arthur Asheton of Rochdale in 1543, the deed mentioning 'the messuages lands tenements meadows feedings pastures and other hereditaments ...known by the name or by the names of Castylshaw' (Hunt 1986, 66). The Asheton family sold out to the tenant farmers of Castleshaw in 1618 by which time the valley had been transformed from open pasture and moorland into a complex of new farmsteads (*ibid*, 67). Many documents survive from subsequent enclosing of waste land at the head of the valley, which had previously been used as common pasture. Neither these deeds nor any other documents relating to Castleshaw mention metal working of any kind. The church registers are also unhelpful with no occupations being associated with metal smelting. Analysis of field names indicated in deeds and wills and on maps is equally uninformative. The earliest map showing this part of Castleshaw is the Saddleworth Township Map of 1822; this too gives no indication of the industrial site beside Spa Clough.

There is therefore no known historical reference to metal smelting in the Castleshaw valley. Considering how well documented the post-medieval period is for this area, one must conclude that the furnace complex is probably of medieval date or earlier. This view is supported by the typology of the slag which is discussed in detail later.

# 4. The Smelting Furnace discovered by Ammon Wrigley

Despite his great knowledge of local history, Ammon Wrigley also found no documentary references for iron working in the Castleshaw valley (Wrigley 1912, 162-80). Evidence for smelting in the valley was first revealed in 1889, when slag deposits were encountered in the bed of the Broadhead Reservoir by construction workers. Subsequently, more slag came to light on the northern edge of the reservoir on Oaken Hill before Wrigley found and excavated a furnace half-way up the hillside between Broadhead and Cudworth Quarry in July 1907 (*ibid*, 170-3).

Wrigley's excavated furnace was built of uncoursed stones bonded by a 'greyish cement' with the inner lining comprising hard, burnt clay. The wall of the structure was 12in (0.30m) thick, creating a central shaft 3ft 6in (1.07m) in diameter. The wall, which survived to a height of 2ft 6in (0.76m), was punctuated by a tap slag hole of *c* 12in (0.30m) square and a 'blast flue' of 6in (0.15m) diameter. At the base of the furnace was a slightly concave slag floor with a worn lip near the tap slag outlet indicating frequent use.

Wrigley was faced with a lack of comparative sites in Britain but his description, together with a sketch made shortly after the excavation, indicates that this was a free-standing shaft-type bloomery furnace. Charcoal would be fed into the top of the furnace shaft until the desired temperature had been reached, bellows being used to pump oxygen into the base of the furnace (through the 'blast flue') to increase the temperature. Alternating bands of iron ore and charcoal were then fed into the shaft. The iron would separate from the main impurity silica to form a spongy mass (called a bloom) in the hottest part of the furnace near the base, where the bellows hole (or tuyere) was located. The silicate ran to the bottom as slag where it was periodically allowed to run out through the tap slag hole. When the furnace cooled the bloom was removed and the furnace repaired ready for the next firing.

This type of smelting employed a relatively simple technology which was reflected in the high percentage of iron still remaining in the slag. A development in the late medieval period was the use of water power to drive the bellows, allowing higher temperatures and greater bloom sizes. Water power could also be used for primary smithing of the bloom where air and impurities were removed by constant hammering. Despite the close proximity of streams there is no evidence of water power use for the Castleshaw bloomery site; certainly Wrigley's furnace was well removed from a water source.

# 5. Initial Field Survey

In the winter of 1990/91 the author, with the aid of volunteers, carried out an earthwork survey of the area adjacent to the vehicular turning circle where the slag spoil heap was located. As mentioned in the introduction, initial fieldwork concentrated on this area as a number of depressions and sandstone blocks were evident. A rapid surface plan was undertaken at a scale of 1:50, covering an area of approximately 50m by 30m. The results of this survey are shown in **fig 2**. A one metre interval contour survey showed the ground in this area of interest to be sloping at an angle of 8-10 degrees from north-west to south-east. This ground surface is punctuated by several discrete groups of depressions, one of which was examined in the 1992 excavation, as well as a shallow rectangular, flat based hollow. The pits generally appear to be open ended towards the south or south-east, they have a diameter of 2-3m and the depth is 0.20-0.30m. Slag and sandstone fragments, representing waste from the smelting process, appear to have been dumped on the eastern part of the area examined; there is a distinct edge to this spoil heap.

# 6. The 1992 Excavation

Following a magnetometer survey, carried out by Geophysical Surveys of Bradford, two exploratory trenches were opened in the area of the original field survey (**fig 2**). An area 10m by 12m (Area 1) was located to investigate the group of depressions 'A' in **fig 2** as well as two separate magnetic anomaly peaks showing to the north-west of the slag spoil heap.

A narrower area of 10m by 4m (Area 2) was opened up to the south of Area 1. This bisected the terrace of 'B' and the linear spread of stones 'C'. It was hoped that Area 1 would reveal the remains of smelting furnaces and Area 2 a possible stone-founded structure and working surface related to the smelting process which could yield artifactual evidence. Additionally, a cursory examination of the slag spoil heap was undertaken. The excavation lasted for two weeks and took place in May 1992.

Immediately after de-turfing, a metal detector was used on both trenches with negative results, except for a reading coincidental with one of the magnetometer survey anomalies. Apparently there was an almost total absence of metal objects, which seemed surprising in view of the high iron content in the slag from the adjacent spoil heap where the metal detector was very responsive.

**Area 1 (fig 3)**

On removal of the turf it was found that a homogeneous deposit of brown humified loam, context number [002], of *c* 0.15m depth covered the whole area. In several places this in turn was covered by dumped material [003], consisting of yellow, grey, brown and white sandy clays mixed with dark brown silty clay loam and frequent medium to large rocks. Significantly the dumped material was concentrated around depressions.

[002] was a natural accumulation of soil covering the light to mid yellow silty clay [006] which forms the sub-soil on this site, both deposits being heavily disturbed by root activity. Clearance of [002] revealed many apparent features cut into [006] and the trench was planned at this level (**fig 3**). It had been noted that some of these features, including the depressions [F080] and [F008], had cut through [002].

The large number of features and deposits evident in the plan suggested considerable activity on the site.

In the south-west corner of the trench a spread of red, oxidised clay [F104] occurred, coinciding with peaks on the magnetometer survey. When sectioned the red clay was found to be a maximum of 0.08m deep close to the south-west trench corner as though this was the centre of the deposit. The edge of the spread was found to be curved, indicating that only a segment, perhaps one quarter, of the deposit has been revealed in Area 1. The red clay contained several pieces of charred wood fragments.

The depressions recorded in the field survey had resolved themselves into two main hollows: an isolated one near the mid-part of the southern edge of the Area 1 and [F008] which was in the mid-northern half. In both cases there was a marked absence of

charcoal, slag and fire reddened clay or stone. On excavation the southern hollow was found to consist mainly of a trench, [F080], *c* 2m wide at the top and 0.40m wide at the base, cut in relatively recent times. There was about 0.15m of washed-in bands of silt filling the base of this trench and in section it could be seen that the feature had been cut through from turf level (see **fig 4, Section W - X**). On the north-west side of the hollow remnants of a very compact wall were revealed in the form of closely laid medium to large angular, smoothed, sandstones bonded by a matrix of very hard yellow clay, [F077]. This wall was only three courses high and revetted the natural clay surrounding the hollow. It would appear that [F077] is all that survived from the robbing-out associated with the trench [F080].

A similar situation was found the northern hollow in Area 1. Here a trench of *c* 2m width, [F008], ran from south-east to north-west where it terminated before a large sandstone set on edge in hard yellow clay [042] similar to that in [F077]. Again the base of the trench was filled to a depth of *c* 0.15m, the fill including large patches of packed sandstone chippings and gravel, [045] and [066]. Possibly contemporary with [042] was a deposit of light brown loam with numerous small patches of white or light yellow clay [007] and [028]. This material was sealed by [002] and cut, on its west side, by [F008]. It also appears to have been cut by a shallow, ill defined trench on its east side; this trench ran south where it seemed to merge with [F008].

It is now known that smelting furnaces were often sheltered inside structures or by windbreaks to enable firing in a controlled, darkened environment where there was no fluctuating wind and where the colour of the flame could clearly be seen. It was of great interest therefore that trowelling of the yellow sub-natural revealed many apparent post holes and small pits over much of Area 1. Some of these features seemed to be aligned, for instance [F011], [F013], [F015] and [F017], others clustered meaningfully around the edge of hollows, eg [F085], [F073] and [F072].

Unfortunately excavation proved that appearances can be deceptive and that very little can be taken for granted in archaeology. Time constraints allowed only half the post hole type features identified on plan to be investigated. These were half sectioned and the sections recorded at a scale of 1:10 (see **fig 4**). They were uniform in their surprising shallowness. Predominantly the fill was dark grey/brown silty clay loam. The section through [F011], which was in the west edge of Area 1, showed that this particular hole had been cut from the level of turf and topsoil through [002] and that the fill was derived from peat/black topsoil washing in.

Less than 3m away from [F011] the corroded iron head of a spade had been found, wedged under a large sandstone in [F046]. This find coincided with an anomaly from the magnetometer plot and a positive reading from the metal detector. It provided a further indication that the area had been extensively robbed; the 'post holes' with the dark silty clay loam fill were in fact test or search pits associated with the robber trenches already described above.

Some of the hollows in the vicinity of the two robber trenches [F008] and [F080] were filled with packed gravel or medium sized sandstones; all were shallow. These may represent packing which provided a good barrow run.

In the very centre of Area 1 was a large sandstone of peculiar interest. Its southern face was curved and formed a vertical face of *c* 0.30m depth. A small depression, [F064], lay

against this face but, as elsewhere, there was no evidence of burning or slag and the depression merely had *c* 0.5m of silt filling its base.

None of the post-hole features that were excavated showed direct evidence of having been a post setting; there were no post-pipes evident in the fills. There were no finds from the holes.

**Area 2 (fig 5)**

This narrower area investigated a terrace platform and a linear ridge of stones. The north part of the excavation revealed a bank of medium to large sandstones set in a light grey/yellow clay, [203], similar to that encountered around the two hollows in Area 1. There was no apparent structure or layering to the stones. The bank of stones and clay was directly overlain by [201], the same brown loam encountered in Area 1, making it roughly contemporary with the oxidised red clay feature from Area 1.

Both [201] and [203] were cut to form the terrace platform. Immediately beneath the turf and topsoil was a level surface, [208], comprised of a lower layer of medium to large stones forming a fairly uneven surface which was filled in and levelled by a layer of small, crushed sandstones. In many places the smaller stones were missing, presumably due to erosion both by water and by usage. Initially the surface seemed to be *c* 2m wide and ran south-west to north-east across Area 2 from its western edge to a point approximately 1m short of its eastern edge where it appeared to respect a group of large stones, [209], pitched downwards and inwards. The relationship between [208] and [209] was not examined. Although Area 2 was too narrow to make confident interpretations, [208] had the character of a broad track running towards the slag spoil heap. This theory must, however, be treated with caution as a large patch of stone cobbling similar to [208] became evident near the eastern edge of Area 2 beside the linear mound of stones.

There were several features around [208] that were without finds and enigmatic in function. One of these, [F212], was located just to the north of [208] against the western edge of Area 2. It was 0.35m in diameter and 0.7m deep and could perhaps be interpreted as a shallow post hole or post pad (**fig 4, Section V - X**). Also in the north-west corner was a negative feature, [F214], (**fig 4, Section EE - FF**) filled with mottled orange clay and shale with no evidence of burning. The feature was cut or set into the bank but, due to disturbance in this area, it was not clear whether it was associated with the cobbling [208] or the remnants of a hollow similar to the two in Area 1.

To the south of [208] two features, [F216] and [F218], which contained dark fills proved to have flat bases and steeply angled sides (**fig 4, Sections CC - DD and AA - BB**). They were both overlain by [208] and may represent the truncated remains of pits.

Evidence for robbing out of materials from the site which was apparent in Area 1 was also present in Area 2. The relative chronological sequence indicates that the terrace with its cobbled surface came much later than the vestiges of stone and clay structures seen in the bank at the north end of the area. The terrace either gave access to activity associated with this bank, perhaps to rob out materials from it, or to some process not wholly evident in the narrow confines of Area 2 but which may be partly represented by [209]; alternatively, it was part of a track linking the slag spoil heap with another part of the site.

The linear mound of large stones running east to west across the middle of Area 2 was interpreted as the remains of a possible structure in the earthwork survey. Unfortunately, excavation showed that the stones were in fact dumped; they were not bonded or coursed in any way, they were loose and jumbled with large voids between them and they lay on top of a buried turf. The area to the south of the linear band of stones was also found to be strewn with dumped stones. It is likely that these stones were dumped when the terrace platform was created; perhaps they were originally part of the clay and stone structures surviving in the bank at the north end of Area 2.

One can only speculate at this stage on the date and reason for the apparent robbing activity evident in Areas 1 and 2. However, the use of locally available materials in the construction of the reservoir and the tramway leading up to the quarry must be a likely cause considering their close proximity to the smelting complex.

**The Slag Spoil Heap**

The south facing bank of the slag spoil heap previously exposed by the bulldozer was cleaned down to look for buried features; so too was an adjoining 2m length of the east facing bank (**fig 2**). Material removed during the cleaning process was sieved and all slag fragments retrieved. The south facing slope proved to be full of slag in a loose brown loam; it was clearly dumped material. The east facing slope, however, was quite different. A dense concentration of small to medium, rounded soft gritstones, many of which were fire reddened, was revealed above the natural hard grey shale. There was a thin band of charcoal within the stone deposit but no slag. A section was cut through this deposit at right angles to the face of the bank. The section revealed that the stones were not bonded in any way yet formed a discrete, tightly packed deposit. They may well have been part of a structure truncated by water work activity in the late 19th century when the nearby stream was canalised and a track created beside it. A buried turf line *c* 0.20m deep occurring in the section showed the original surface of the slag spoil heap; material above this was of a secondary deposition, probably as a result of the waterworks activity.

The surface of the slag spoil heap was covered in stone rubble and slag. In order to obtain a reasonable sample of slag material from the site, surface slag was selectively retrieved. During this exercise, 3 body sherds of coarse pottery were recovered. These were provisionally identified as Pennine Gritty Ware dating to the late medieval period. At this early stage in the site investigations and given that the pottery was unstratified, it would be unwise to use these finds to date the site. The pottery may assume more significance in the light of future excavation work.

In all, 95 kgms of slag were removed from the spoil heap, which represented a very small proportion of the total slag heap. The material from the cleaned south face was mostly smooth, glassy tap slag typical of that found in tap slag run-off channels and settling pools; ripples were clearly visible on the upper surface whilst the base was rough where it had been in contact with the ground. The material varied in weight and thickness, depending on the volume of air trapped in it and its original viscosity. In some samples complete sections indicated the profile of the run-off channel. Conversely, half the material from the northern surface of the spoil heap was of a cinder type, being coarse, light, fragmentary and with frequent small lumps or impressions of charcoal. This slag was almost certainly derived from inside the iron furnaces, an observation

supported by the occurrence of fragments of refractory material consisting of baked, reddened clay and a flat stone, all of which had glassy slag adhering to them.

Two samples of slag have been analysed, with the following results:

| | | |
|---|---|---|
| Tap Slag: | 57% | Iron Oxide |
| | 27% | Silica |
| | 8% | Alumina |
| | 4.5% | Manganese Oxide |
| | 1% | Phosphorous Oxide |
| | 1% | Lime |
| Furnace lining: | 6% | Iron Oxide |
| | 72.5% | Silica |
| | 19.5% | Alumina |
| | 2.5% | Potash |
| | 0.5% | Sulphur |

The high quantity of iron remaining in the tap slag confirms the suspicion that technology on the site was fairly primitive and of an early period.

Dr Gerry McDonnell of Bradford University has been kind enough to supply the following report based on the samples taken from the slag heap:

**'The technological background to the ironworking site at Spa Clough, Castleshaw**

The early production of iron artefacts was a two stage process; first the iron was extracted from the ore by the smelting process, and then it was fabricated into artefacts by the smithing process. Both processes generated iron silicate slag as a waste by-product. The smelting process required a high grade iron ore, fuel, usually charcoal, and a furnace structure, usually clay built. Prior to smelting the ore was processed, eg crushed and washed, to enrich it and roasted to oxidise the iron compounds. During the smelting the iron ore was reduced to the metallic state by reaction between the iron oxide present in the ore and carbon monoxide, formed by the reaction between air blown in by bellows and the carbon of the fuel. The process also required the sacrifice of some iron oxide in reactions with gangue oxides, eg silica and alumina, to form a liquid slag. The metallic iron was never fully liquefied, and therefore slag-metal separation was achieved by removing the liquid slag. The method of slag removal varied with different furnace technologies, and slag morphology is characteristic of some furnace technologies. The process produced a spongy lump of iron known as a bloom. It contained a high proportion of slag that had not been separated. The bloom was refined, and the slag removed by the primary smithing process. The cleaned iron is termed a billet, whose composition depended on the smelting process but could either be ferritic iron (pure iron), phosphoric iron (iron containing up to 1% phosphorus) or steel ranging in carbon content from 0.1-1.0% carbon. The bloom could also be a heterogeneous mix of these alloys.

The Castleshaw Site has a slag heap of iron smelting tap slag. This slag is characteristic of the smelting process and is formed by allowing the slag to run freely from the furnace, forming plates or runs of slag with the characteristic ropey morphology of the upper cooling surface. This slag type is most common on sites dating to the Roman and

medieval periods, however it is not restricted to these periods. The size of the surviving slag heap is typical of small scale operations rather than prolonged large scale operations. The exact scale of the smelting activity must await further analysis. Excavation and post-excavation analysis must examine the following:

1. Ore type and source – the type of ore must be considered, the most probable source being bog ore, an ore deposited in a waterine environment.

2. Fuel type and source – the fuel used was probably charcoal, but it was unlikely to have been transported more than hundreds of metres. Thus the presence of iron smelting has implications for interpreting the archaeology of the landscape.

3. Furnace type and construction – the furnace was probably of clay or clay/stone construction, but its dimensions need to be determined.

4. Type of product – examination of bloom fragments may indicate the type of iron produced, ie ferritic iron, phosphoric iron or steel.

5. Date – Dating of the site would contribute to understanding the development of iron smelting technology, and provide vital information for the development of the Castleshaw landscape.'

# 7. Conclusion

Recent field survey and slag analysis, coupled with Ammon Wrigley's investigations, have confirmed the existence of an early iron smelting technological process being carried out at the head of Castleshaw Valley. The two week exploratory excavation yielded surprising results in that an unlooked for extensive disturbance of features and deposits provisionally associated with iron smelting has taken place. The excavation was very instructive in indicating where future exploratory trenches should be located.

As Dr McDonnell has pointed out above, there are many questions to be addressed concerning the extent and date of the site, the typology of the furnaces, the existence of other processes like roasting and primary smithing, and the source and nature of the fuel and iron ore. On a wider scale the site needs to be put into its regional context: were there other, contemporary, smelting sites nearby and, if so, what effect did they have on the landscape and economy?

Clearly, a great deal of research needs to be undertaken in the Castleshaw valley and the surrounding central Pennine area. The provisional programme of work consists of the following:

**Historical Research**

i) Study references to iron smelting on abbey lands throughout the country.

ii) Look for documentary material concerning smelting and charcoal burning in the central Pennine area in the medieval and early post-medieval period.

iii) Identify any blast furnaces in the locality which may have re-smelted tap slags from bloomery sites such as the one at Castleshaw.

**Survey**

i) Carry out a field survey to record the potential extent of the site indicated by earthworks on Cudworth Pasture.

ii) Conduct fieldwalking in the neighbouring valleys to look for other smelting sites and evidence of charcoal burning.

**Excavation**

i) Examine the northern part of the slag spoil heap in order to understand its stratigraphy and recover stratified dating evidence. There may be an early furnace structure buried by the later slag spoil. The results of this work could facilitate clearer interpretations of magnetometer survey data on smelting sites, enabling a distinction between slag spoil and furnace base.

ii) Identify a well preserved furnace site further up the valley side, on Cudworth Pasture, and make a detailed record of it through excavation.

The excavation of a well preserved furnace base would provide material for radiocarbon and archaeo-magnetic dating as well as stratified slag for scientific analysis; there is also the possibility of finding an in-situ bloom from the furnace's last firing.

The iron smelting site beside Spa Clough has exciting potential. The programme of investigation outlined above could yield important new scientific data for a field of research that is still in its infancy. There is an opportunity to add to our currently limited knowledge of the early development of industry and landscape in the central Pennine area, focusing on the Castleshaw valley.

Norman Redhead
November 1992

# 8. Sources

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# 9. Acknowledgements

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Peter Price and Richard O'Neill also assisted on post-excavation drawings.

Especial thanks to Jayne for her support, encouragement and delicious cakes!

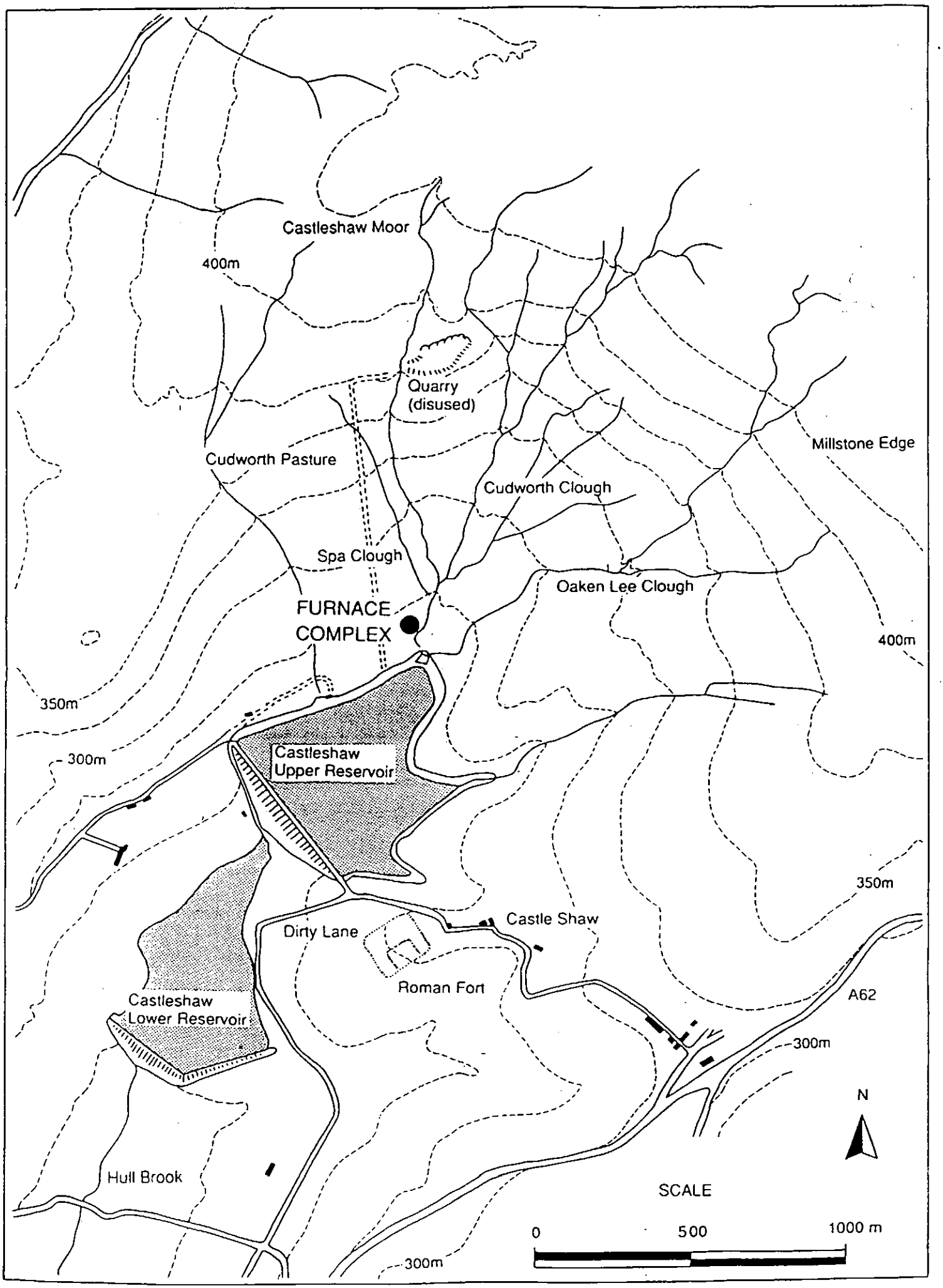


Fig. 1 - Location of the furnace complex in Castleshaw Valley.

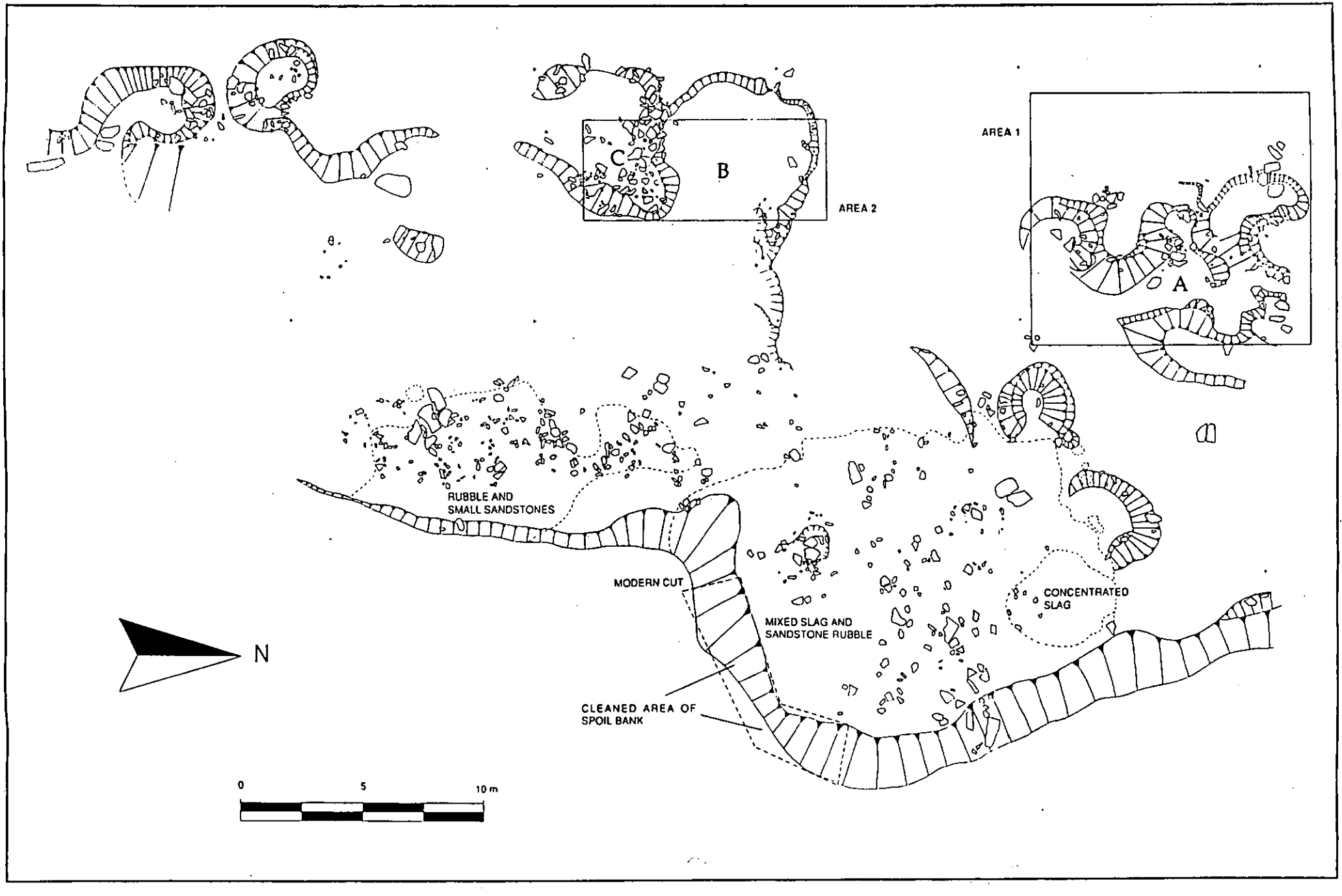


Fig. 2 - Rapid surface plan showing depressions, slag spoil heap and location of excavation areas.

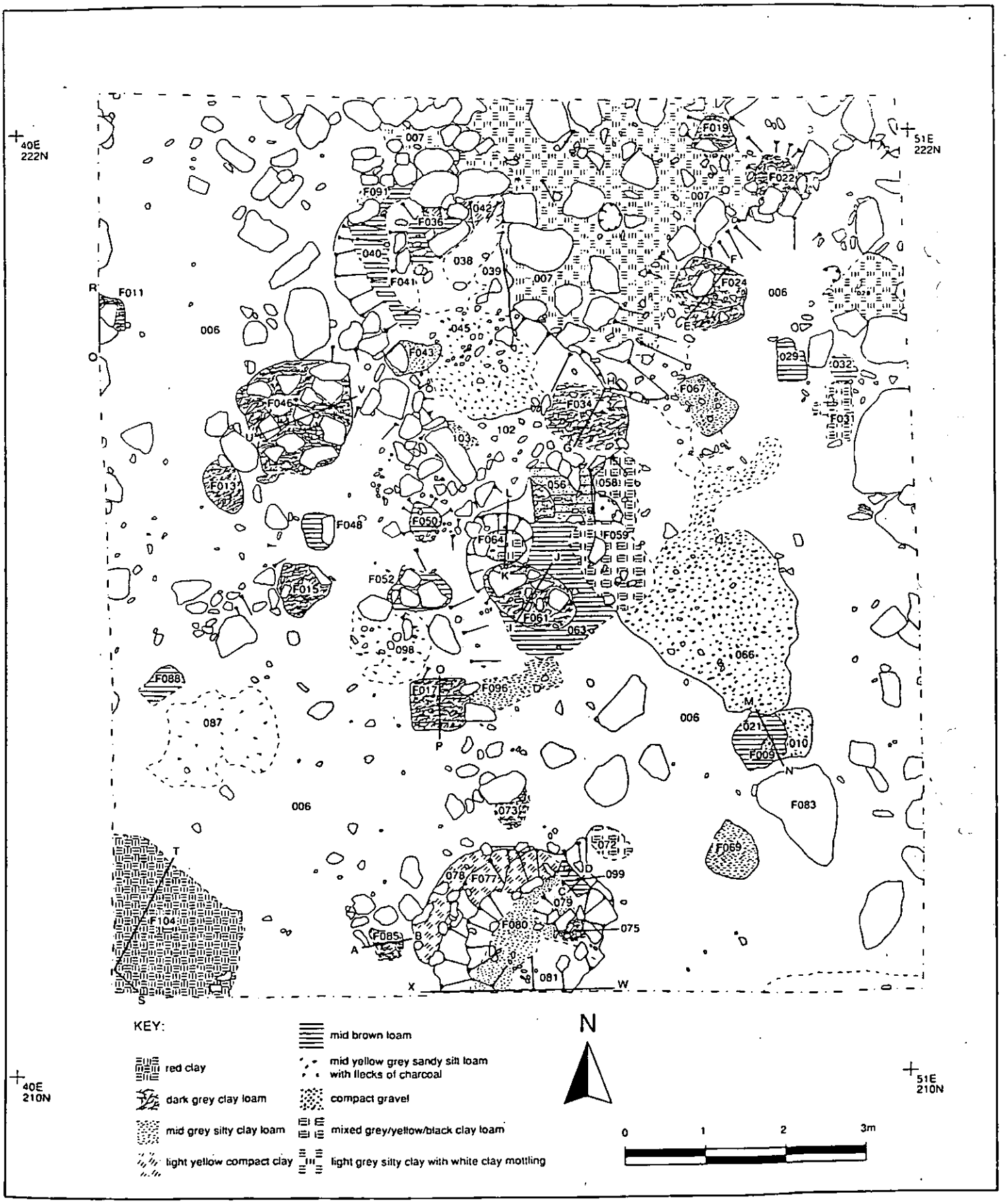


Fig. 3 - Plan of Area 1 after removal of deposit 002 showing features pre-excavation.

# List of Sections through features in Areas 1 and 2

The following sections are shown in fig 4.

A - B: south facing through F085

C - D: south facing through F099

E - F: south facing through F024

G - H: east facing through F034

I - J: south-east facing through F061

K - L: east facing through F064

M - N: south-west facing through F009

O - P: west facing through F017

Q - R: west facing through F011

S - T: north-east and south-east facing through F104

U - V: south-east facing through F046

W - X: north facing through F080

Y - Z: east facing through F212

AA - BB: north-west facing through F218

CC - DD: south-east facing through F216

EE - FF: south-east facing through F214

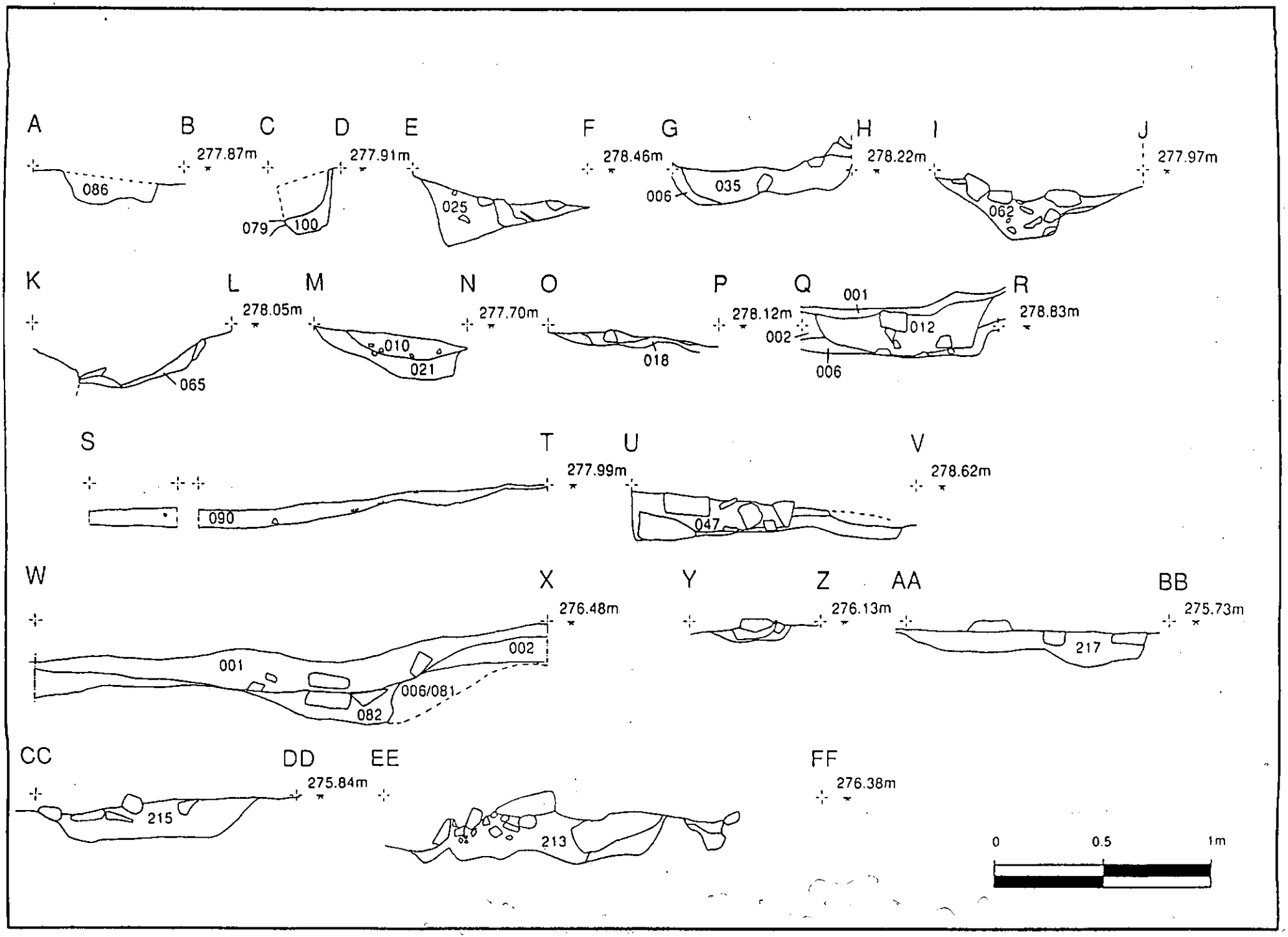


Fig. 4 - Sections through features in Areas 1 and 2. See Figs. 3 and 5 for location of section lines.

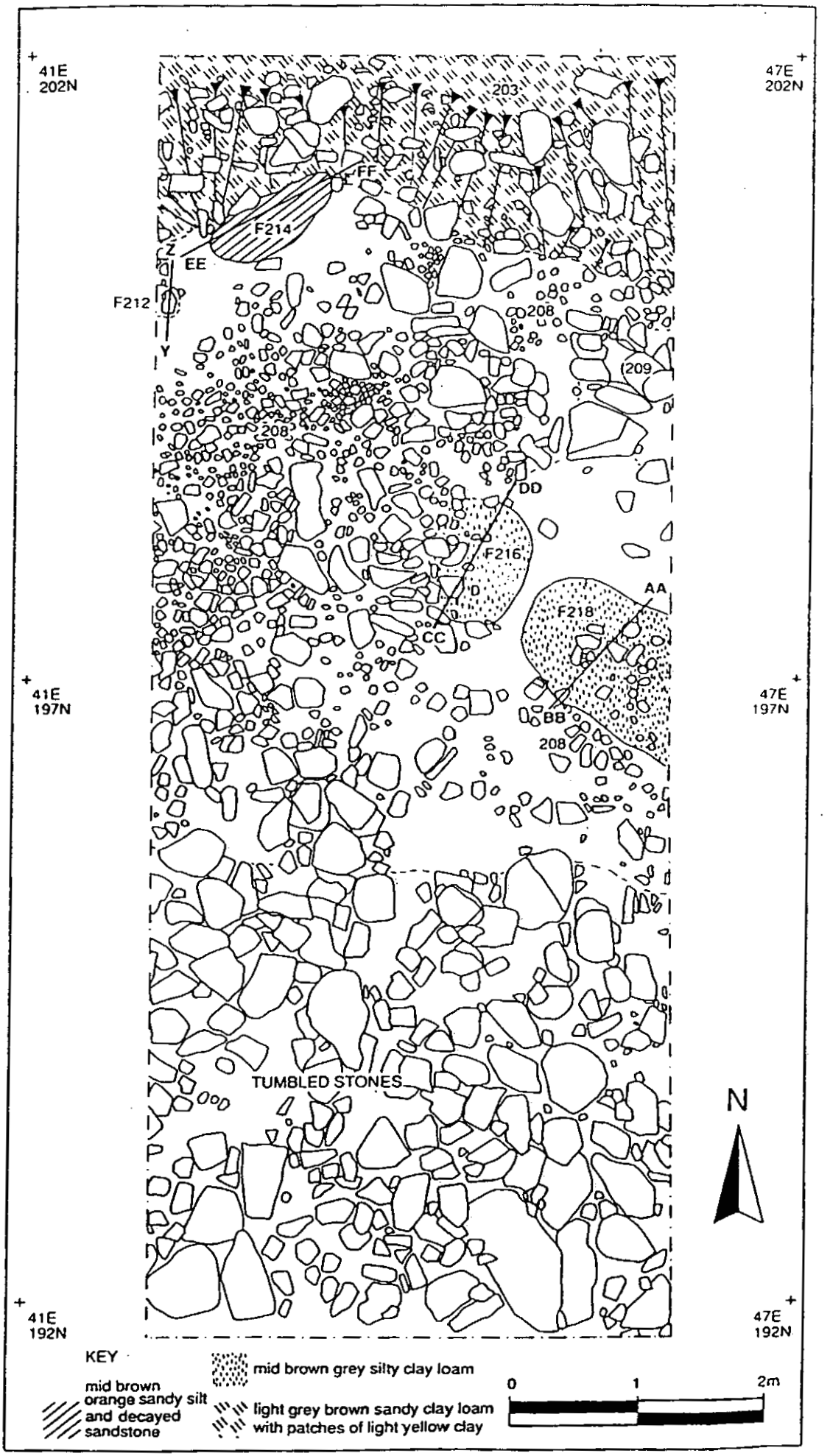


Fig. 5 - Plan of Area 2 after removal of topsoil and deposit 201, showing features pre-excavation.