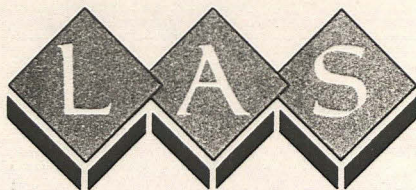


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LINDSEY ARCHAEOLOGICAL SERVICES

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**KIRKBY ON BAIN
Sand and Gravel Extraction
Archaeological Desk Top Assessment**

February 1995

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KIRKBY ON BAIN

Sand and Gravel Extraction

Archaeological Desk Top Assessment

Introduction

The following report has been prepared for David Jones and Co., Chartered Civil Engineers, acting on behalf of Woodhall Spa Sand and Gravel Co and has been prepared in advance of a planning application for minerals extraction. The desk top study is the first part of an evaluation which also comprised a geophysical survey (see separate report by Stratascan Ltd). It was also intended to carry out a fieldwalking survey of the site but current ground conditions were unsuitable .

Planning Considerations

This report has been prepared in the consideration of the requirements of the following planning policies.

Lincolnshire County Council Minerals Local Plan 1991

Planning and Policy Guidance Archaeology and Planning (PPG16)
Department of Environment , November 1990

Lincolnshire County Council Approved Structure Plan and the Explanatory Memorandum 1982

Policies 95, 111 now superseded by Alteration no. 3

Lincolnshire Structure Plan Alteration No. 3 Written statement and Explanatory Memorandum. Deposit Draft , October 1993

Policies 34A, 53A, 54A, 56A

(This draft has not been formally adopted by the County Council but refers to more recent legislation than the Structure Plan.)

See Appendix 3 for excerpts of the above documents.

Physical Setting

The River Bain cuts through a series of glacially deposited gravels which overlie Kimmeridge Clay in the valley bottom. The proposed extraction site comprises an area of 39.38 acres (15.75 ha) south of Kirkby on Bain, close to the parish boundary below the 16m OD contour. It lies adjacent to other areas of gravel extraction, which has been extensive in this part of the Bain Valley. The study area is arable land, much of which is currently set aside (Fig. 1).

METHOD

Records from Kirkby on Bain Tattershall Thorpe and Tumby parishes lodged at the Lincolnshire Sites and Monuments Record (SMR) were examined and sites plotted onto a 1:25,000 map (Fig. 2). They are also listed under Appendix 1. Aerial photographs and a few additional records, held at the offices of LAS, were also incorporated into the list. Examination of records held in the Local Collection of the Lincoln Reference Library provided no additional information relevant for the purposes of this study.

Cartographic evidence at the Lincolnshire Archives Office was examined. There are no known surveys of the area predating the survey of the parish in 1796-8 as part of the proposals for enclosure. The Lord of the Manor at that time was the Rt. Hon. Earl Fortescue, who already owned large parts of the parish which had been privately enclosed. The proposed extraction site lay within the old South Field and was assigned to Earl Fortescue after enclosure. A new enclosure road was built which forms the eastern boundary of the site and was called Tattershall Road. Originally part of a larger piece of the land the present field boundaries and drains were created at some time between 1798 and a survey of Earl Fortescue's lands in Tattershall Thorpe and Kirkby on Bain carried out in 1867 by James Lighton and Sons (LAO ref. Chat. 6/2).

The records of the Cambridge University Collection of Aerial Photographs (CUCAP) and the National Air Photographic Library (Swindon) were investigated. There are no specialist oblique photographs of the proposed extraction site held at Cambridge. Two photographs held at Swindon show the site, one of which is the same as that held by LAS. The other, a vertical air photograph (Fig. 3) shows faint traces of ploughed out medieval plough furrows in the western half of the site and possible cropmarks of rectilinear enclosures near the north boundary of the site, adjacent to an animal feeding area. This area was more closely examined during the geophysical survey of site.

Evidence from aerial photographs of the general area have added substantially to our archaeological knowledge and the sites are marked on Fig. 2 and incorporated into Appendix 1

Archaeological Background

The Bain Valley has been the subject of a series of surveys and excavations over the past 18 years. A survey of mineral extraction and its impact on archaeological sites in North Lincolnshire in 1976 (Field 1977) identified the area as one of considerable archaeological potential and led to excavations at West Ashby in 1977 (Field 1985). Further archaeological investigations were carried out at Tattershall Thorpe, Iron Age enclosure in 1980 (Chowne et al. 1986) and 1986 (Chowne 1986); Tattershall Thorpe, Neolithic settlement in 1981 (Chowne et al. 1993) and West Ashby in 1984.

Chance finds made in the lower Bain Valley, many from gravel workings, have demonstrated the variety and richness of the archaeological record in the area.

The area has also been the subject of selected survey and excavation which has helped to put the chance finds into a better context. Quite apart from the Pleistocene deposits beneath the gravel deposits, which are of particular note, discoveries from the modern land surface have ranged in date from the Neolithic through to the post-medieval period, with only the Anglo-Saxon period being poorly represented. Neolithic finds include numerous flint scatters and a concentration of flint and stone axes north-west of Tattershall Thorpe village (13-17). Settlement remains of this period were excavated in 1981 just south-east of the proposed site.

A concentration of Bronze Age metalwork west of Tattershall Thorpe village is probably too far away from the site to be of direct significance but shows that the area continued to be settled at the time (20,21). Of outstanding importance in the immediate area was the large oval enclosure of Middle Iron Age date at Tattershall Thorpe, parts of which were excavated in 1980 and 1986 (27). The surviving part of the enclosure is a Scheduled Ancient Monument, a designation which recognizes the site as being of national importance.

Since publication of the excavation report in 1986 further evidence from aerial photographs has shown that this was not an isolated feature in the Iron Age landscape with at least three further similar enclosures being located in an area around the disused airfield in Tattershall Thorpe (Griffiths and Collcutt 1994) (28,30). The discovery of further associated settlement and field enclosures cannot be discounted.

Evidence for Roman settlement is less clear although at least some of the various cropmarks recorded on aerial photographs probably date from this period (e.g. 14,24,25,29). Roman pottery was found in the tops of the backfilled Iron Age enclosure ditch and the discovery of a coin hoard during quarry workings close by, to the east (23), confirm continued occupation of the area during this period.

Little is known of pagan Anglo-Saxon settlement in Lincolnshire and it is not yet possible to draw general conclusions about its character. The majority of sites dating from this period are cemeteries, many of which have been recorded in the Wolds to the north of the present study area. Although only two finds of Anglo-Saxon date (18,26) are recorded from the area one is of international importance, that of the smith's grave found during the excavation of the Neolithic settlement south-east of the proposed site (26). This may well be an isolated find but pagan Saxon settlement may be located anywhere.

The modern distribution of settlement and the layout of parish developed in the Anglo-Scandinavian period of the 9-11th centuries AD, reflecting a time

of settlement nucleation, in contrast to the dispersed settlement known to have existed in the Roman period. The position of the village and the enclosure award evidence shows that the site lies within one of the old village fields and it is unlikely that medieval settlement will be found. There is slight evidence for medieval plough furrows on the 1983 air photo (Fig. 3).

Walkover Survey

Fieldwalking undertaken during the Bain Valley Survey between 1983 and 1986 (Chowne and Field 1985) located worked flint scatters in one of the fields included in the study area and a single worked flint in another (5,7). It is not known how intensive the fieldwalking was at that time or if all the fields within the present study area were actually available for walking at that time.

The flint scatter was easily relocated in the northern half of the field adjacent to the Tattershall Road when the site was visited in December. Unfortunately the land is currently set aside and not suitable for fieldwalking. However, the ease with which the worked flint could be identified indicates the potential of the site.

Ground conditions in the other three fields were not good enough for even a general walkover.

The Geophysical Survey

Geophysical survey was carried out to investigate the potential of the site suggested by the presence of worked flint on the east side of the site and the possibility of cropmarks. Magnetic susceptibility survey covered the whole area and three areas were selected for magnetometry, covering about 20% of the site. Full results of the survey are contained in the accompanying report.

In summary it is of note that there was enhanced magnetism of the soil in Field 1, a zone running along the east boundary of the land which includes the scatter of worked flints. A second enhanced area was recorded in Field 4 on the west side of the study area, extending into Field 3. The enhanced readings were not considered by Stratascan to be the result of different agricultural practices in the separate fields.

The lack of defined features in the areas surveyed using the magnetometer suggests, however, a low level of human activity. There is a possible linear ditch showing in Area 1 and a less distinct curving feature to its north, west of the electric fence (Fig. 10). Without further investigation it is not possible to tell whether these anomalies represent archaeological remains.

Excavations east of Tattershall Road in 1981 (26) showed that the Neolithic settlement had been badly damaged by modern ploughing (Chowne 1993). It is possible that any settlement remains associated with the flint scatter in Field 4 may have suffered a similar fate and surviving features may be too slight to register on the magnetometer survey.

Conclusions

In conclusion the general area surrounding the proposed quarry extension contains sites of all periods including examples of national and international importance. However, the site of the proposed quarry extension itself appears to have a low potential for archaeological remains apart from the scatter of worked flints in Field 4 whose nature and extent are still not fully explained.

The results of the geophysical survey were inconclusive but suggest that there may have been human activity in Fields 1 and 4. They add weight to the view that if there were any features associated with the flint scatter extensive plough damage may have occurred but excavation of a sample area is the only way to confirm this hypothesis. The present ground conditions are not really suitable for additional fieldwalking but when the land is ploughed the full extent of the flint scatter should be mapped in conjunction with any field investigations. It may also be advisable to investigate the few anomalies in Field 1 to determine their date and character.

Although not of immediate relevance to the evaluation, which has considered archaeological material on the present land surface, it should be noted that important deposits of Pleistocene remains have been found in pockets on the surface of the clay at the bottom of the glacial gravels at several spots in the quarry complexes at Kirkby on Bain and Tattershall Thorpe. Further deposits may be present in the proposed quarry extension.

References

Chowne, P. and Field N., 1985 'Bain Valley Survey', *Archaeology in Lincolnshire 1984-1985: First Annual report of the Trust for Lincolnshire Archaeology*, 59.

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Naomi Field
January 30th 1995

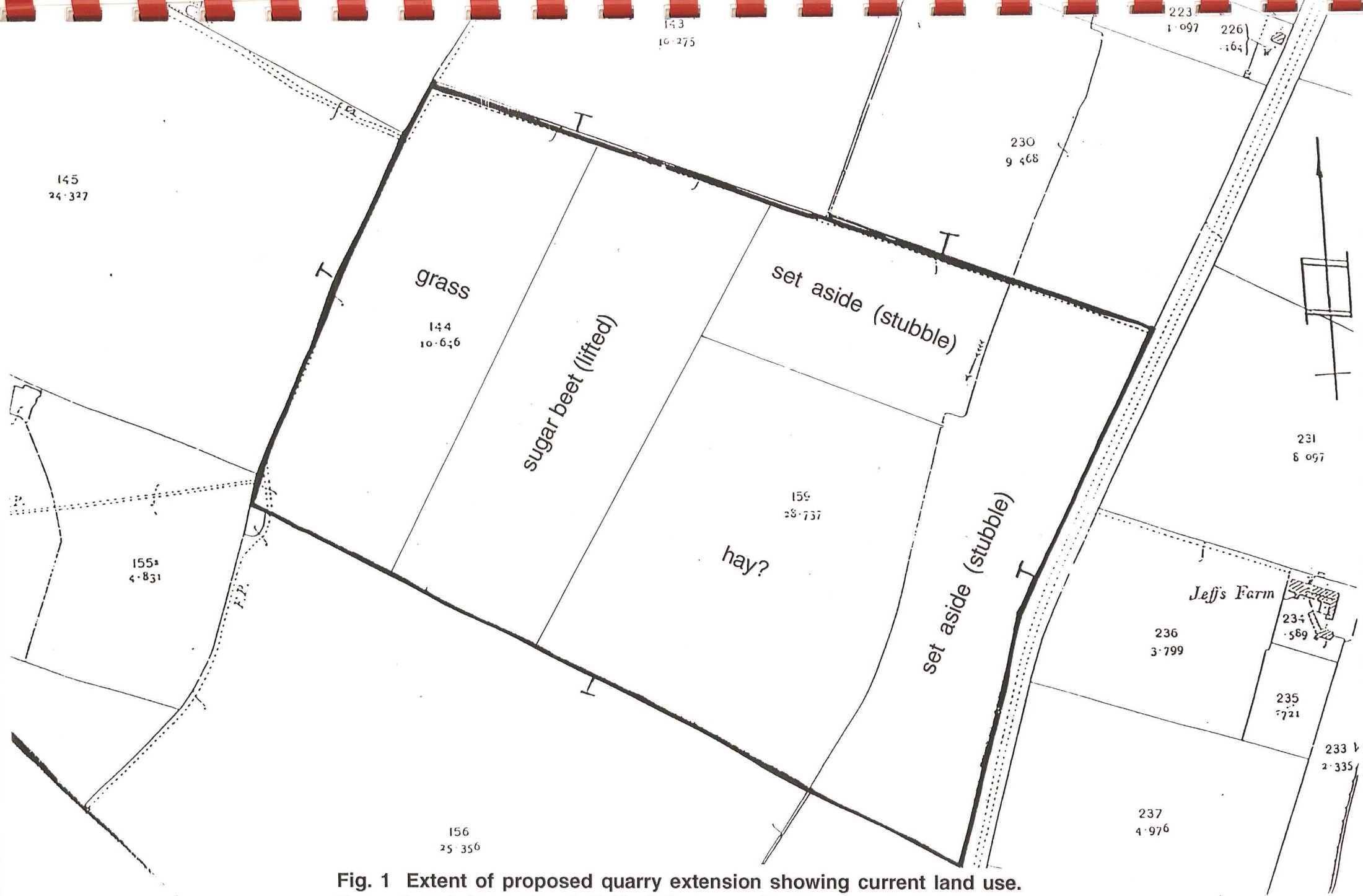


Fig. 1 Extent of proposed quarry extension showing current land use. Reproduced from the 1:2500 O.S map with the permission of the Controller of HMSO, Crown copyright. Licence no. AL50424. (Reduced scale)

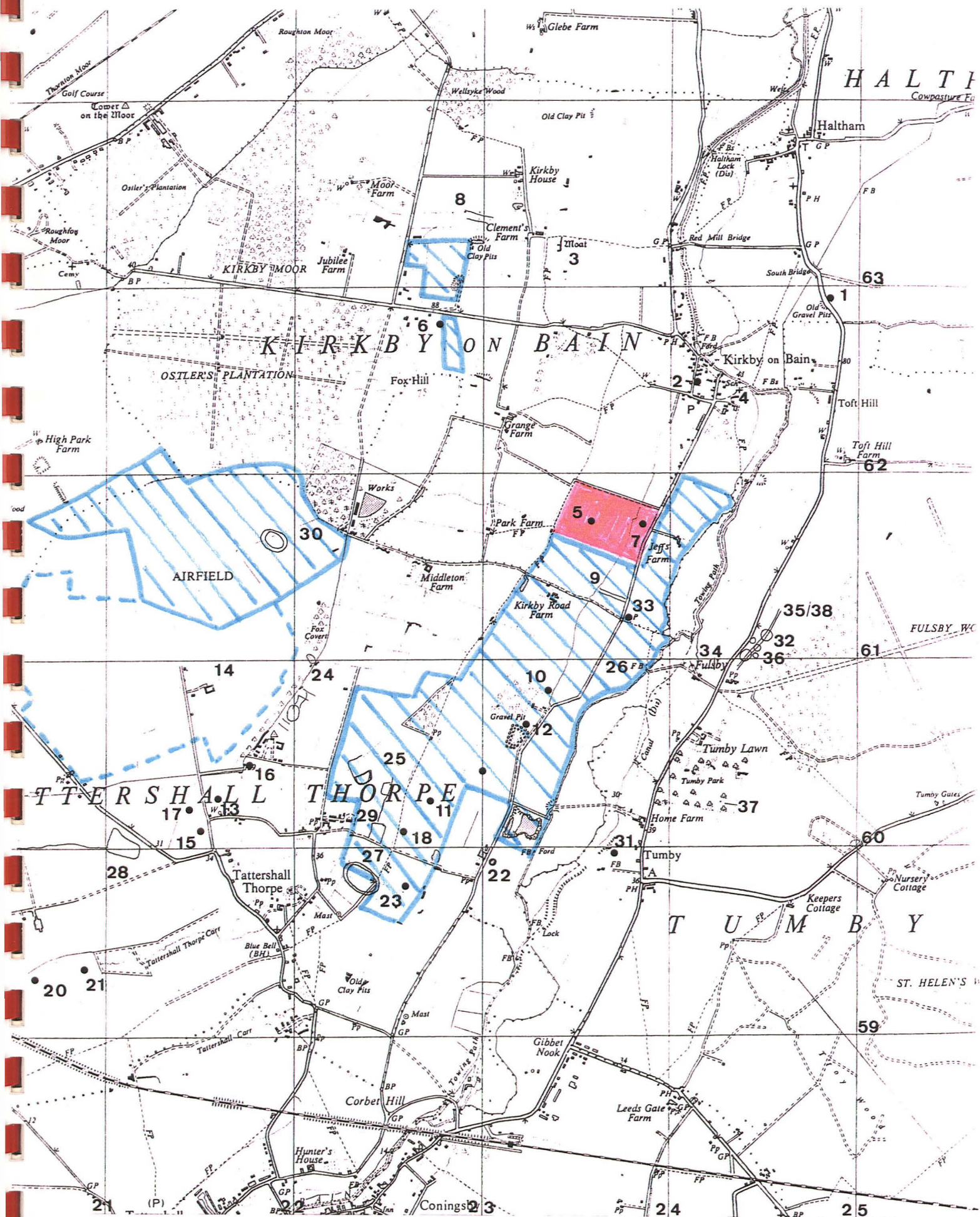


Fig. 2 Location of archaeological finds and sites in the area of Kirkby on Bain. Shaded area (blue) shows extent of gravel extraction. Shaded area (pink) shows proposed quarry extension. Reproduced from the 1:25000 O.S. map with the permission of the Controller of HMSO, Crown copyright. Licence no. AL50424.



Fig. 3 Vertical air photograph showing the proposed quarry extension, with slight traces of cropmarks visible (arrow). Film ref. 2146/1186, Crown copyright.

APPENDIX 1

Archaeological remains in the vicinity of the proposed extraction site

Abbreviations

NGR National Grid Reference

LBA Late Bronze Age

R-B Romano-British

C = century

IA Iron Age

A-S Anglo-Saxon

SAM Scheduled Ancient Monument

LM City and County Museum, Lincoln. Alphabetical references.

Air photo references are given in brackets in the description and refer to photos held at the National Air Photo Library, Swindon

References computerised by the SMR have five-figure number references.

Kirkby on Bain

	NGR	SMR	LM	Description
1	248 629	40117	E/P	3 pieces of Samian and greyware from gravel p
2	24166 62499	40118	G	3rd C greyware colander base
3	2340 6323	40119	Q	?moat/decoy
4	2437 6245	40121	V	St Mary's church
5	2360 6172	40123	Z	flint core and 2 flakes
6	227 628	40124	AA	flint flakes
7	2385 6172	40125	AB	flint scatter and post med. pot
8	2290 6345	40426		linear ditches (2963/14,15)
9	2362 6130	40427		double linear ditched feature (2988/18A)
	unlocated	40120	T	4 polished stone axes
	unlocated	40122	W	14-15th C key

Tattershall Thorpe

	NGR	SMR	LM	Description
10	234 608	40126	A	Beaker rim, corded and grooved deco.
11	2270 6040	40127	B	mammoth and other pleistocene remains
12	2314 6055	40128	C	mammoth and horse remains
13	2163 6022	40129	F	stone axe
14	215 608	40130	H	R-B site, identified in the 1920s
15	214 601	40131	J	stone axe
16	218 604	40132	L	2 stone axes
17	2143 6020	40133	K	polished flint axe
18	2258 6012	40134	M	A-S thread picker, double ended bone point
19	2300 6040	40136		flint
20	206 593	40140	Y	'Wilburton' sword blade + 2 bronze spears
21	2088 5935	40141	AC	LBA spearhead
22	2310 5985	40147	BI	dense flint scatter over ring ditch (2957/27)
23	225 598	40152	BR	R-B coin hoard, 5-7,000 coins
24	2204 6070	40429		circular and rectangular enclosure complexes (2957/39,40; 2918/4; 2260/1)
25	2235 6032	40430		D-shaped enclosure + rectangular enclosure + assoc. linear ditches (2957/30)
		40437		enclosures and linear ditches (2988/25A)
		42788		Neolithic excavation 1981
		42789		Iron Age pottery
		42790		Roman pottery
		42791		Anglo-Saxon smith's grave
26	2378 6080			
27	2235 5982	329		IA enclosure, excavated 1980, SAM
28	224 600			rectangular enclosure + linear ditch (2957/28)
28	212 599			rectangular enclosure + linear ditch (2917/8)
30	219 617			double ditched enclosure (vertical air photo)

Tumby

	NGR	SMR	LM	Description
31	237 599	5162		amorphous cropmarks, enclosures (2359/5)
32	244 610	5165		at least 2 ring ditches (2461/7)
33	2368 6120	40137		flint
34	242 609	40250		medieval hamlet of Fulsby
35	2465 6142	40433		linear cropmark(2991/11-12A)
36	2442 6100	40434		7 ring ditches, ditched trackway (2991/4-10A)
37	2416 6037	40435/6		ridge and furrow under parkland (2932/21)
38	246 613	42899		linear cropmark, see 40433 and 40434

APPENDIX 2

Air Photographs of the Proposed Extraction Site

Ref.	Frame no.	Date
PLE 5162	13	30/11/77
NMR 2146	1186	22/7/83

APPENDIX 3

Lincolnshire County Council Minerals Local Plan 1991

POLICY M.10

THE COUNTY COUNCIL WILL PERMIT APPLICATIONS FOR SURFACE MINERAL WORKING ONLY WHERE IT IS SATISFIED THAT THE OPERATIONS CAN BE CARRIED OUT IN SUCH A MANNER AS WILL MINIMISE DISTURBANCE DURING WORKING AND THAT SATISFACTORY RESTORATION TO AN APPROPRIATE AFTER-USE CAN BE ACHIEVED. THE COUNTY COUNCIL WILL NORMALLY IMPOSE CONDITIONS REQUIRING MEASURES TO BE TAKEN TO MINIMISE EFFECTS OF THE DEVELOPMENT AND TO PROVIDE FOR THE AFTER-TREATMENT OF THE MINERAL SITE. IN PARTICULAR CONDITIONS MAY PROVIDE FOR:-

a-h)

i) ACCEPTABLE STANDARDS OF ARCHAEOLOGICAL RECORDING OF THREATENED SITES AND TIMETABLE OF ACCESS FOR ARCHAEOLOGICAL WORK

EXPLANATORY TEXT

4.10

Whilst mineral working can be a highly disruptive activity, it is nevertheless a transient use and its effects on the land can often be overcome: agricultural land can be restored, woodland can be replanted. However, the County possesses a rich archaeological and architectural heritage which once destroyed is lost forever. Similarly there are numerous sites which because of a particular plant or animal species or geological features are considered to be of scientific or natural history interest. These include a great number of former mineral workings.

4.11

The County Council's policy towards archaeological sites and artefacts is provided by Structure Plan Policy 95:

THE LOCAL PLANNING AUTHORITIES WILL SAFEGUARD THOSE CURRENTLY IDENTIFIED ARCHAEOLOGICAL AND INDUSTRIAL ARCHAEOLOGICAL SITES AND ARTEFACTS, AND WILL CONTINUE TO IDENTIFY ADDITIONAL SITES FOR SAFEGUARDING. WHERE SAFEGUARDING CANNOT BE SECURED IN THE CASE OF THOSE SITES AFFECTED BY PROPOSED OPPORTUNITIES FOR THEIR DETAILED INVESTIGATION IN ADVANCE OF THAT DEVELOPMENT.

4.12

The most definitive record of known sites of archaeological interest is the County Sites and Monuments Record. Only a small number of known sites (less than 2%) have been scheduled by Central Government as Ancient Monuments, ensuring that they are safeguarded from development. The County Council recognises that there are other categories of sites that merit protection and these include both sites worthy of scheduling as Ancient Monuments, and sites of local/County importance.

4.13

It is not always appropriate to prevent or restrict mineral working if the site contains archaeological features but it is desirable that adequate provision is made for recording the site to an acceptable archaeological standard. Until relatively recently monitoring of mineral workings was concentrated on East and West Lindsey Districts and with the co-operation of the industry three major excavations have been undertaken in the Bain Valley. The County Council, through its County Sites and Monuments Record now extends this monitoring service to all mineral working areas in the County.

Lincolnshire County Council Approved Structure Plan and the Explanatory Memorandum 1982

**THE BUILT ENVIRONMENT
POLICY 95
(See above)**

Explanation. Archaeological sites are the principal source of information about conditions in the period before written records were kept. Together with features of more recent origin, including those associated with the industrial and technological development of the County, such sites contribute to a better understanding of past circumstances and how these have influenced present day conditions. Many also constitute tourist attractions. Many sites have already been scheduled by Central Government as Ancient Monuments and this status ensures that they are safeguarded from development. The record is by no means complete, however, and further sites are being and will continue to be identified in the light of information provided to the local authorities by an archaeological survey of Lincolnshire at present being carried out, under the auspices of the Royal Commission on Historical Monuments, by the Archaeological Units and Trusts and other appropriate organisations operating in Lincolnshire.

Certain sites may not be worthy of preservation and in these circumstances, before development destroys the archaeological features, details can be recorded providing that access to the site can be secured and development takes place consistent with the needs of the archaeologist.

Action. Scheduled Ancient Monuments and other sites of outstanding importance as may be decided by the local authorities following advice, including that from Archaeological Units, will be preserved unless exceptional circumstances require otherwise by:

- (a) entering into voluntary agreements with owners under Section 52 of the Town and Country Planning Act 1971;
- (b) refusing planning permission for proposed development;
- (c) using powers under the Ancient Monuments Acts (1913, 1931, 1953) including powers of purchase and maintenance of monuments, whether scheduled or not.

In the case of other sites of particular importance, as defined by the local planning authorities, the authorities will seek through voluntary agreement to create opportunities for the recording of site detail before and during development.

Action. The County Council will contribute to the support of appropriate Archaeological Units.

Action. The local planning authorities will consult the Archaeological Units and the County Museums Service in their local planning activities and in dealing with relevant planning applications. Consultations will ensure that features of archaeological interest are taken into account in the preparation of detailed land use plans and in reaching development control decisions.

**MINERALS
POLICY 111**

PROPOSALS FOR DEVELOPMENT ON LAND CONTAINING KNOWN MINERAL RESERVES WILL BE CONSIDERED WITH REGARD TO THE NEED TO SAFEGUARD THESE RESERVES. PROPOSALS FOR THE EXTRACTION OF MINERALS WILL BE CONSIDERED IN RELATION TO THE FOLLOWING REQUIREMENTS;

(a) AS FAR AS POSSIBLE TO EXCLUDE MINERAL WORKINGS FROM

- (i) HIGH GRADE AGRICULTURAL LAND**
- (ii) AREAS AFFORDED LANDSCAPE PROTECTION**
- (iii) WOODLAND**
- (iv) AREAS OF IMPORTANT ARCHAEOLOGICAL, HISTORIC, SCIENTIFIC OR NATURAL HISTORY INTEREST.**

Lincolnshire Structure Plan Alteration No. 3 Written statement and Explanatory Memorandum. Deposit Draft , October 1993

POLICY 34A

DEVELOPMENT ADVERSELY AFFECTING A SCHEDULED ANCIENT MONUMENT, A DESIGNATED AREA OF ARCHAEOLOGICAL IMPORTANCE OR A SITE OF REGIONAL OR LOCAL SIGNIFICANCE WHICH IS WORTHY OF PRESERVATION WILL NOT NORMALLY BE PERMITTED.

WHERE EXCEPTIONALLY DEVELOPMENT IS PERMITTED THE DEVELOPER WILL BE REQUIRED TO PROVIDE FOR PRESERVATION IN SITU OR TO FACILITATE RECORDING PRIOR TO AND DURING DEVELOPMENT.

EXPLANATION

34.1

Archaeological sites are the principal source of information about conditions in the period before written records were kept. Together with features of more recent origin, including those associated with the industrial and technological development of the county, such sites contribute to a better understanding of past circumstances and how they have influenced present day conditions. Many also constitute tourist attractions, and it is important that they are adequately protected. There has recently been an increased awareness and understanding concerning the value of archaeological remains, and PPG 16 (Archaeology and Planning) states that "care must be taken to ensure that (they) are not needlessly or thoughtlessly destroyed". In these circumstances, where it is not possible to preserve or enhance a Scheduled Ancient Monument or site of archaeological interest to an acceptable extent then planning permission will normally be refused. The County Council will continue to offer the District Council advice on development affecting archaeological sites. Where a proposal is considered to be acceptable in principle then any permission is likely to be subject to appropriate planning conditions or agreements.

POLICY 54A

PROPOSALS FOR THE EXTRACTION OF MINERALS, PARTICULARLY AGGREGATES, WILL BE CONSIDERED IN RELATION TO LOCAL AND REGIONAL NEEDS FOR AN ADEQUATE SUPPLY OF MINERALS AND TO THE IMPACT OF THE EXTRACTION PROPOSAL ON THE ENVIRONMENT AND ON THE LOCAL HIGHWAY NETWORK.

EXPLANATION

54.1

The working of minerals is related to demand arising both within the county and outside. In considering applications for mineral extraction the County Council will have regard to the prevailing demand and supply situation. In particular, the County Council will have regard to

the current national and regional guidelines for aggregate provision, as set out by the Central Government in Mineral Planning Guidance Note 6 and its successors.

54.2

In seeking to make provision for meeting these demands the County Council recognises the significant, and often detrimental, impacts mineral working can have on the environment, taking land out of agricultural use and in some cases leading to a local deterioration in the appearance of the countryside, and having direct and indirect effects on the living conditions of people nearby and further afield. The County Council will only grant planning permission for working in appropriate locations where it is satisfied that this can be carried out with the minimum of disturbance to people living in the area and to the environment generally. Detailed criteria are set out in the Minerals Local Plan and include consideration of landscape character, agricultural land, woodland, areas of important archaeological, historic, scientific or natural history interest, visual amenity, traffic and the minimising of noise, dust and vibration.

A Report for

**LINDSEY ARCHAEOLOGICAL
SERVICES**

on a

Geophysical Survey

carried out at

KIRKBY-ON-BAIN

January 1995

STRATASCAN

GEOPHYSICAL & SPECIALIST SURVEY SERVICES

A Report for

LINDSEY ARCHAEOLOGICAL SERVICES

on a

Geophysical Survey

carried out at

KIRKBY-ON-BAIN

January 1995

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INTRODUCTION

This geophysical survey was commissioned as part of the archaeological evaluation of a proposed sand and gravel extraction site at Kirkby-on-Bain.

DESCRIPTION OF THE SITE

The site lies some 28 km south east of Lincoln and 8 km south of Horncastle (OS Ref TF 236 618) and covers an area of 15.75ha. The underlying glaciofluvial drift (the subject of the proposed extractions) have given rise to a deep permeable sandy and coarse loamy topsoil which has been extensively cultivated.

The site is divided into two by the course of a ditch/stream running approximately north to south and parallel with the nearby River Bain. The larger western section is further divided into three fields by post and wire fences and electric fences (see Figure 2).

The land use at the time of the survey - January 1995 - was stubble in Field 1, uncut grass in Field 2, bare soil following a recently harvested beet crop in Field 3 and grazing in Field 4.

Fielding walking has found flint scatters on the site, notably in the north eastern corner of Field 1 and an aerial photograph has also revealed a crop mark at the northern end of Field 3. Both suggest an archaeological relationship with the site.

METHODOLOGY

The selected methodology was to survey the whole site using a rapid scanning technique called magnetic susceptibility. Using these results a 20% sample of the site was selected for the more intensive technique of magnetometry

Both these techniques are discussed briefly below.

Magnetic Susceptibility

Alteration of iron minerals in topsoil through biological activity can enhance the magnetic susceptibility (MS) of that soil. Thus measuring the MS of a soil can give a measure of past (i.e. archaeological) activity and can be used to target the more intensive and higher resolution technique of Magnetometry.

Measurements of MS can be carried out in two various ways.

- 1/ Field coils provide rapid scanning and have the benefit of allowing "insitu" readings though problems with ground contact can be experienced.
- 2/ Alternatively samples can be taken out in the field for analysis back in a laboratory. This overcomes the ground contact problem, but is slower and more laborious.

The equipment used on this contract was an MS2 Magnetic Susceptibility meter manufactured by Bartington Instruments Ltd. A field coil known as an MS2D was used to take field samples at the nodes of a 10m x 10m grid. This assessed the top 200mm or so of topsoil. To overcome the problem of ground contact all readings were taken 4 or 5 times and an average taken. All obvious localised "spikes" were ignored.

The readings were stored and later loaded into a computer. From this data grey scale plots have been generated which are reproduced in this report at a scale of 1:2500 and overlain onto the site plans at the same scale.

Magnetometer

Although the changes in the magnetic field resulting from differing features in the soil are usually weak, changes as small as 0.2 nanoTesla (nT) in an overall field strength of 48,000nT, can be accurately detected using an appropriate instrument.

The mapping of the anomaly in a systematic manner will allow an estimate of the type of material present beneath the surface. Strong magnetic anomalies will be generated by buried iron-based objects or by kilns or hearths. More subtle anomalies such as pits and ditches can be seen if they contain more humic material which is normally rich in magnetic iron oxides when compared with the subsoil.

To illustrate this point, the cutting and subsequent silting or backfilling of a ditch may result in a larger volume of weakly magnetic material being accumulated in the trench compared to the undisturbed subsoil. A weak magnetic anomaly should therefore appear in plan along the line of the ditch.

The magnetic survey was carried out using an FM36 Fluxgate Gradiometer, manufactured by Geoscan Research. The instrument consists of two fluxgates mounted 0.5m vertically apart, and very accurately aligned to nullify the effects of the earth's magnetic field. Thus readings relate to the difference in localised magnetic anomalies compared with the general magnetic background. Readings are taken automatically with a sample trigger at 0.5m spacings along traverses 1m apart i.e. 800 readings per 20m grid square. The readings were held in an 'on board' data logger and later downloaded into a computer for processing and presentation as grey scale plots. The scale used for these plots is 1:1000.

Processing can emphasise various aspects contained within the data but which are often not easily seen in the raw data. Basic processing of the magnetic data involves 'flattening' the background levels with respect to adjacent traverses and adjacent grids. 'Despiking' is also performed to remove the anomalies resulting from small iron objects often found on agricultural land. Once the basic processing has flattened the background it is then possible to carry out low pass filtering to reduce 'noise' in the data and hence emphasise the archaeological or man-made anomalies. The presentation of the data for each area involves a print-out of the 'despiked and filtered' data.

Magnetic features have been identified and plotted onto the 'Abstraction of Anomalies' drawing for each area, numbered for ease of reference and prefixed with the letter 'M'.

DISCUSSION

The results of the magnetic susceptibility survey

Figure 3 is a plot of the MS results using one set of plotting parameters for the whole site. This shows the relative range of values across the site. It can be seen that Field 4 and the western half of Field 3 have enhanced magnetisation. The eastern half of Field 1 also is more magnetic particularly in the north east corner. Field 2 and the eastern part of Field 3 have markedly lower MS levels.

It is also useful to plot the results using plotting parameters for each field based on a standard deviation about a mean value for that field. This has the effect of stretching contrast and so highlighting enhancements in areas which are generally low in magnetisation. These "standard deviation" plots are reproduced in Figure 4.

Using this information three areas were selected for magnetometer survey. The reasons behind these decisions are given below:

- Area 1 - Figure 4 shows a notable enhancement in Field 4 about 2/3 down from the northern fence. Area 1 was selected to cover this enhancement and extended to the east to cover the enhancement in the west side of Field 3.
- Area 2 - This area contains a crop mark seen in an aerial photograph which also coincides with a small area of magnetic enhancement.
- Area 3 - The areas of enhancement seen in Figure 4 in the north east corners of both Field 1 and 2 suggest potential archaeology particularly as flint scatters had already been found in that section of Field 1.

The results of the magnetometer survey

Area 1

The linear feature M1 crossing the site is the magnetic effect from an electric fence. However, a weak positive linear feature M2 crosses the line of the fence at right angles. It meanders gently in line and terminates at its south eastern end with a Y shaped anomaly. It is thought likely that it is man made but may be a shallow ditch forming part of an earlier field boundary - it is parallel with the modern field boundary.

Other features within the area include a short, weak linear anomaly M3 and several "spikes" from ferrous objects which are normal on cultivated land i.e. old horseshoes or other pieces of metal from agricultural machinery. None are thought to be of any archaeological importance.

Area 2

M4, like M1 above, is the magnetic response to a post, wire and electric fence crossing the site. M5 and M6 are two weak but similar parallel features which are thought to be modern rather than of archaeological interest. There are also several metal "spikes" which are to be expected.

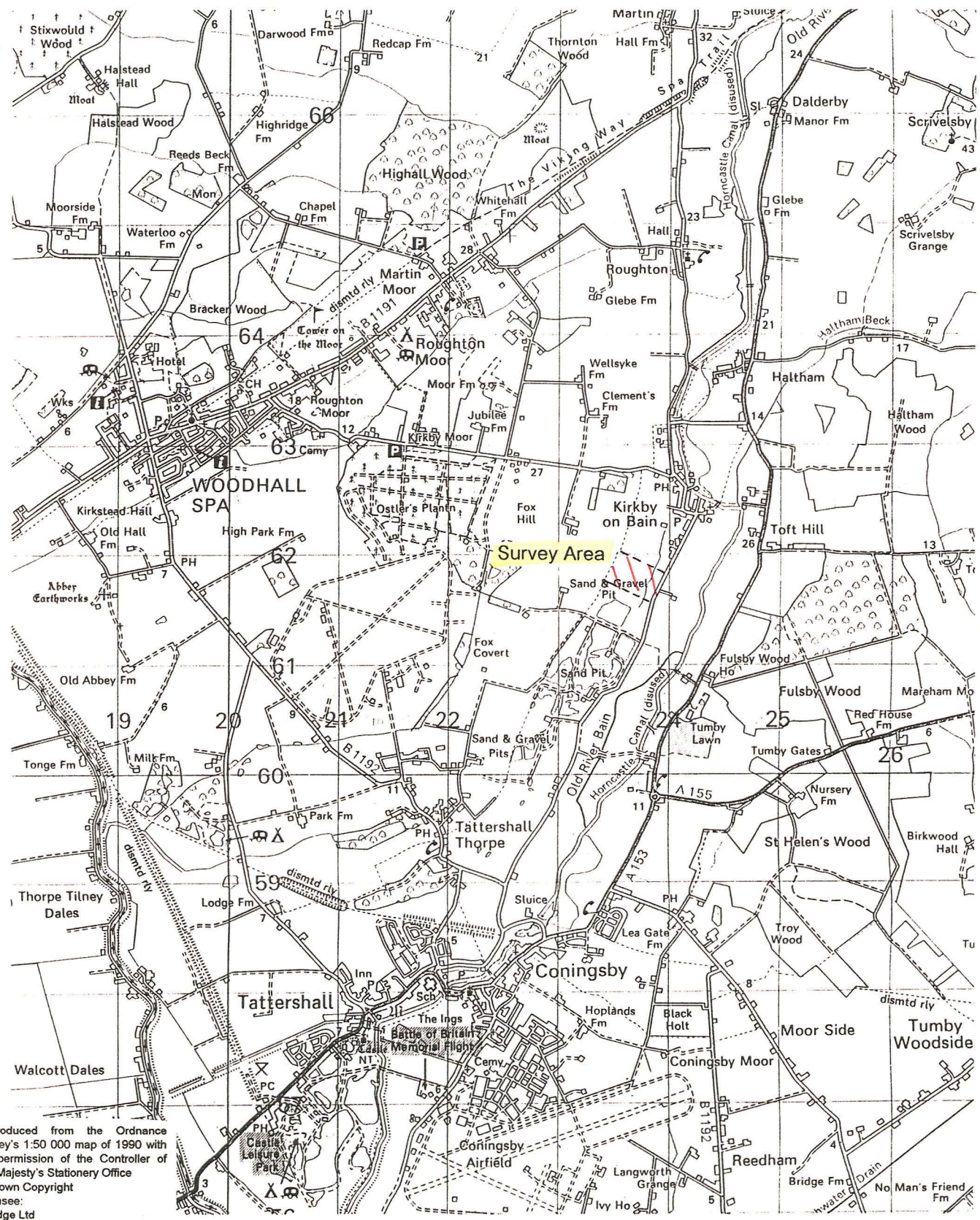
Area 3

There are almost no anomalies worthy of mention in Field 1 apart from a weak linear feature M9 which aligns with M8 in Field 2. This may be part of an earlier enclosure or field which predates the cutting of the ditch/stream. Within field 2 are a number of weak discrete positive anomalies which could be the sites of bonfires or pits. It is thought that one of these should be investigated by excavation to ascertain its true nature. M7 is a modern ploughline.

Summary


It is thought that little if any of the anomalies found are of archaeological interest. The anomalies in Field 2 are more likely to be bonfires but excavation of one would quickly clarify whether they have any archaeological potential. Similarly M8/M9 could justify a small exploratory trench to learn more of this feature.

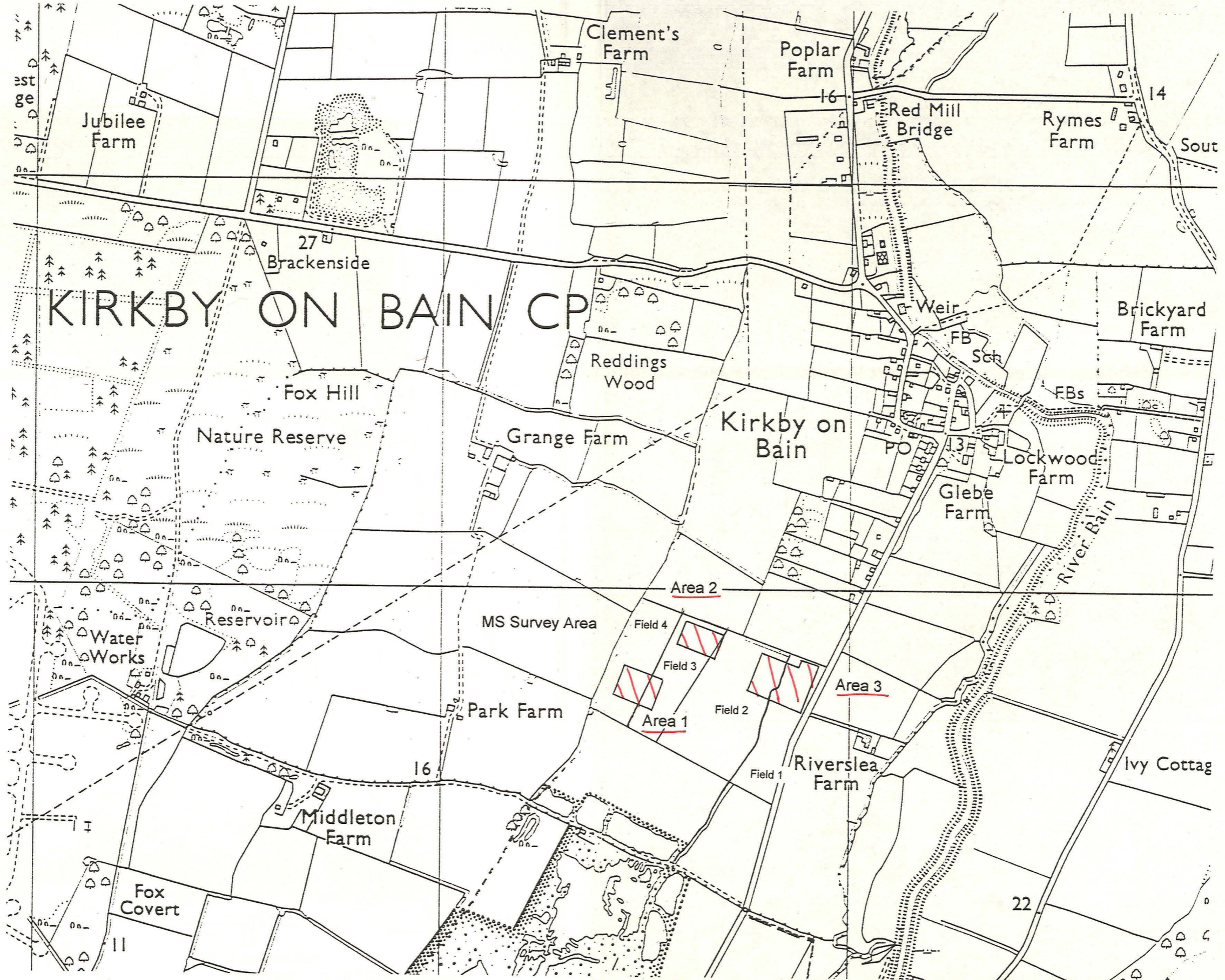
In view of the crop mark, the flint scatters and the areas of enhanced MS, it is thought possible that any archaeology was only of shallow stratigraphy and that any evidence has been ploughed up and incorporated into the topsoil. This would account for the flint scatters, the enhanced MS readings, possibly the crop mark and why no significant features appear in the magnetometer survey.




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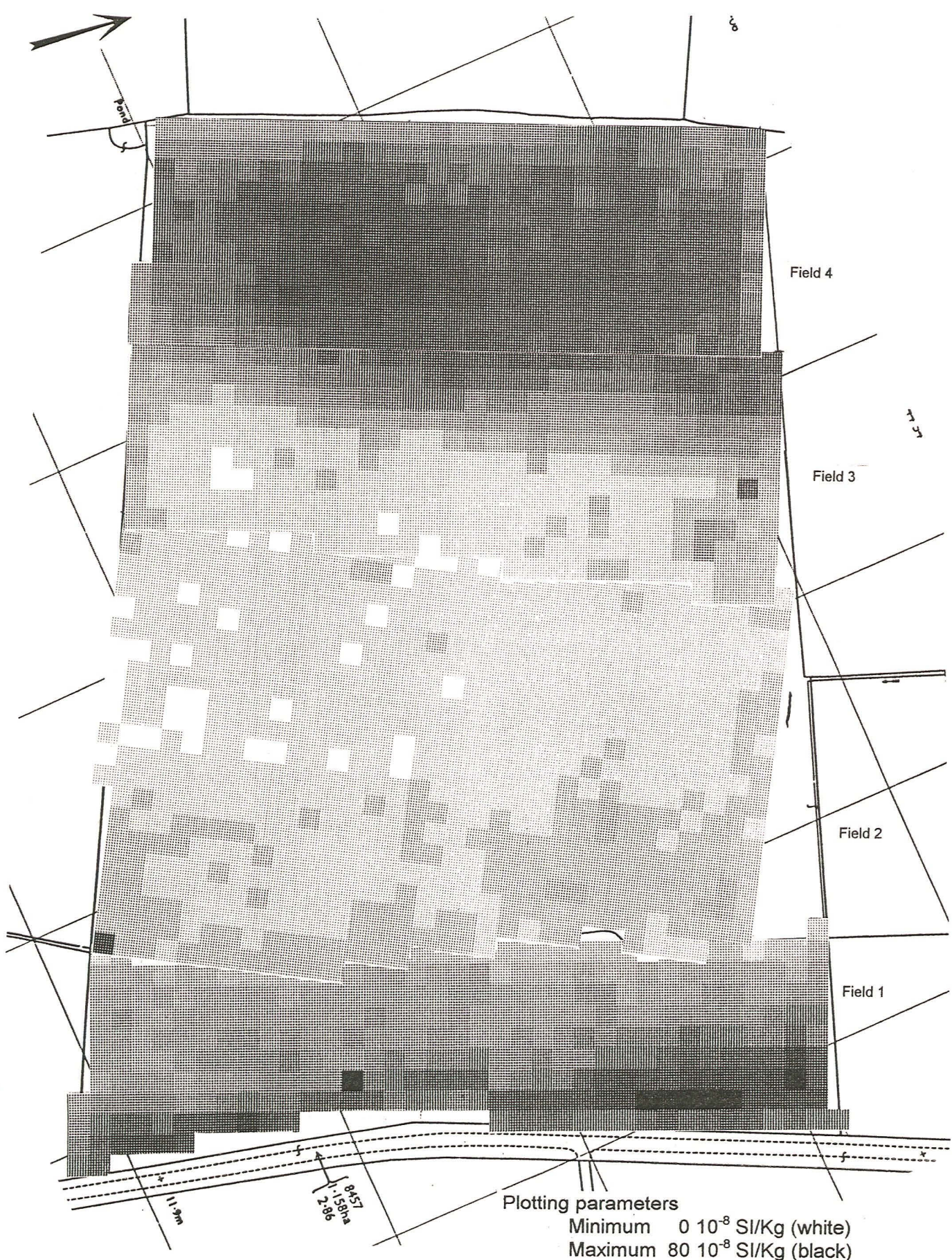
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Scale 1:50 000	Subject Geophysical Survey Kirkby-on-Bain General Location Plan	
Figure 1		

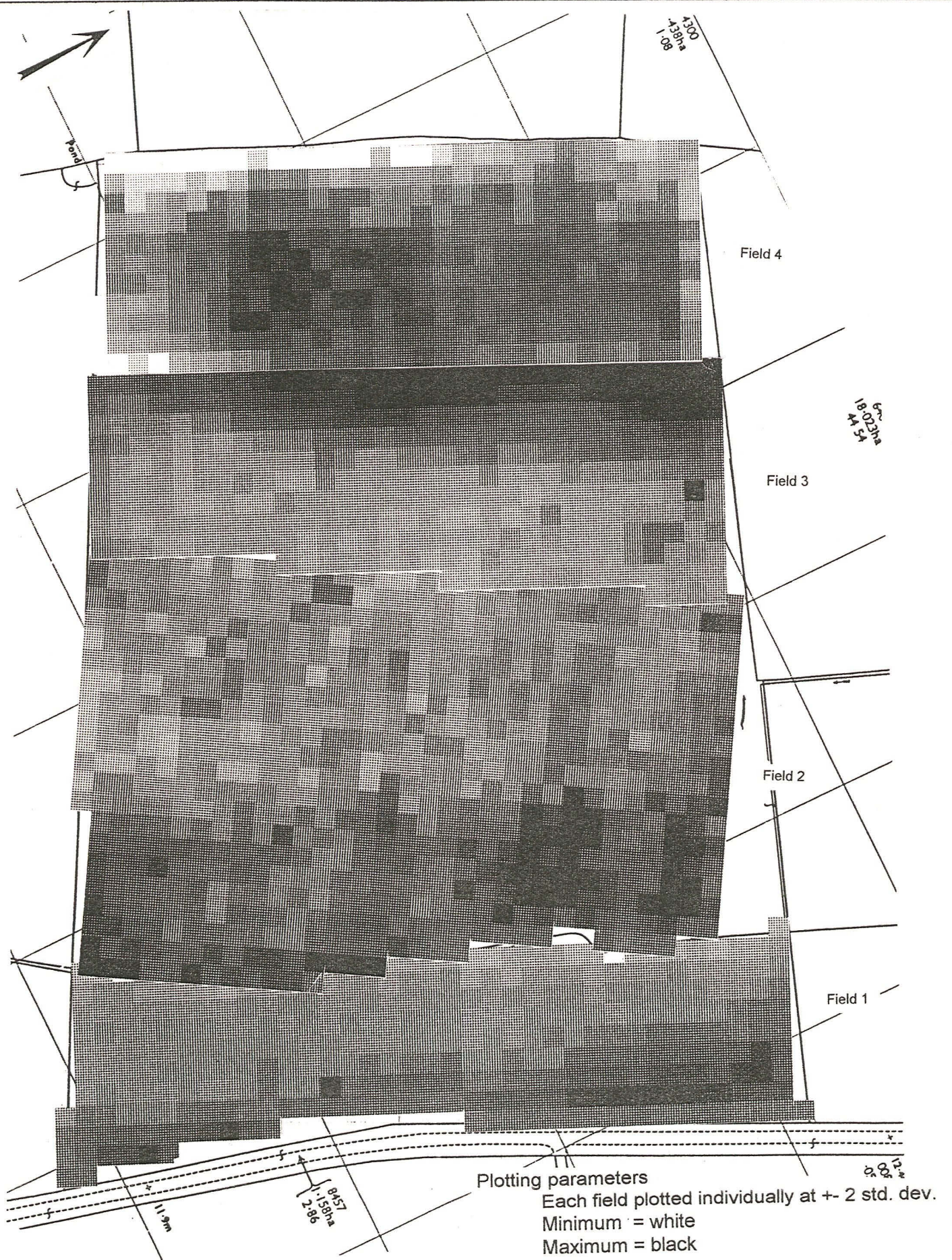


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Scale	1:2500	Subject	Geophysical Survey Kirkby-on-Bain Plot of MS data	
Figure	3			



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Scale 1:2500

Figure 4

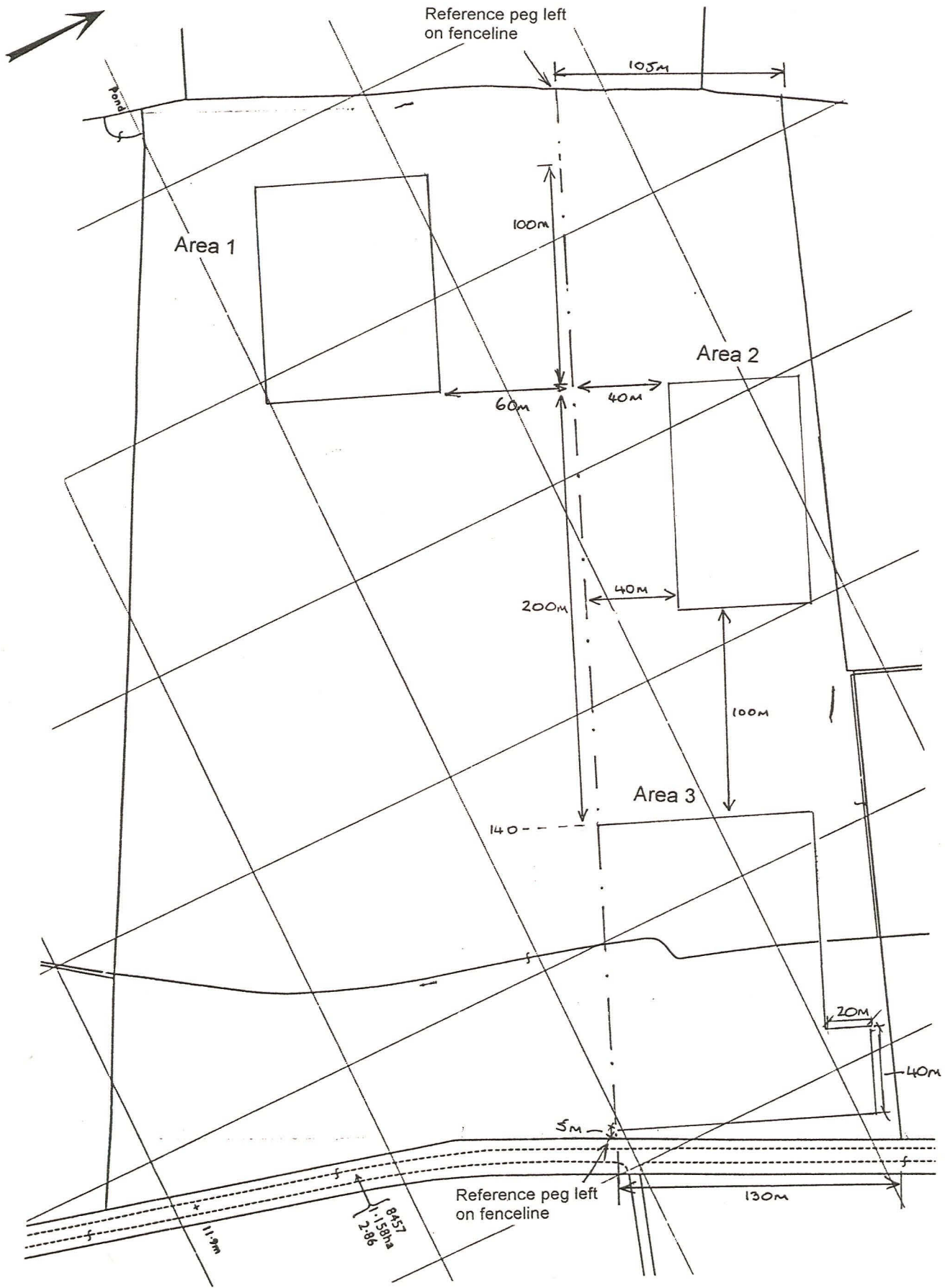
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Subject Geophysical Survey
Kirkby-on-Bain
Plot of MS data
Standard Deviation Plot

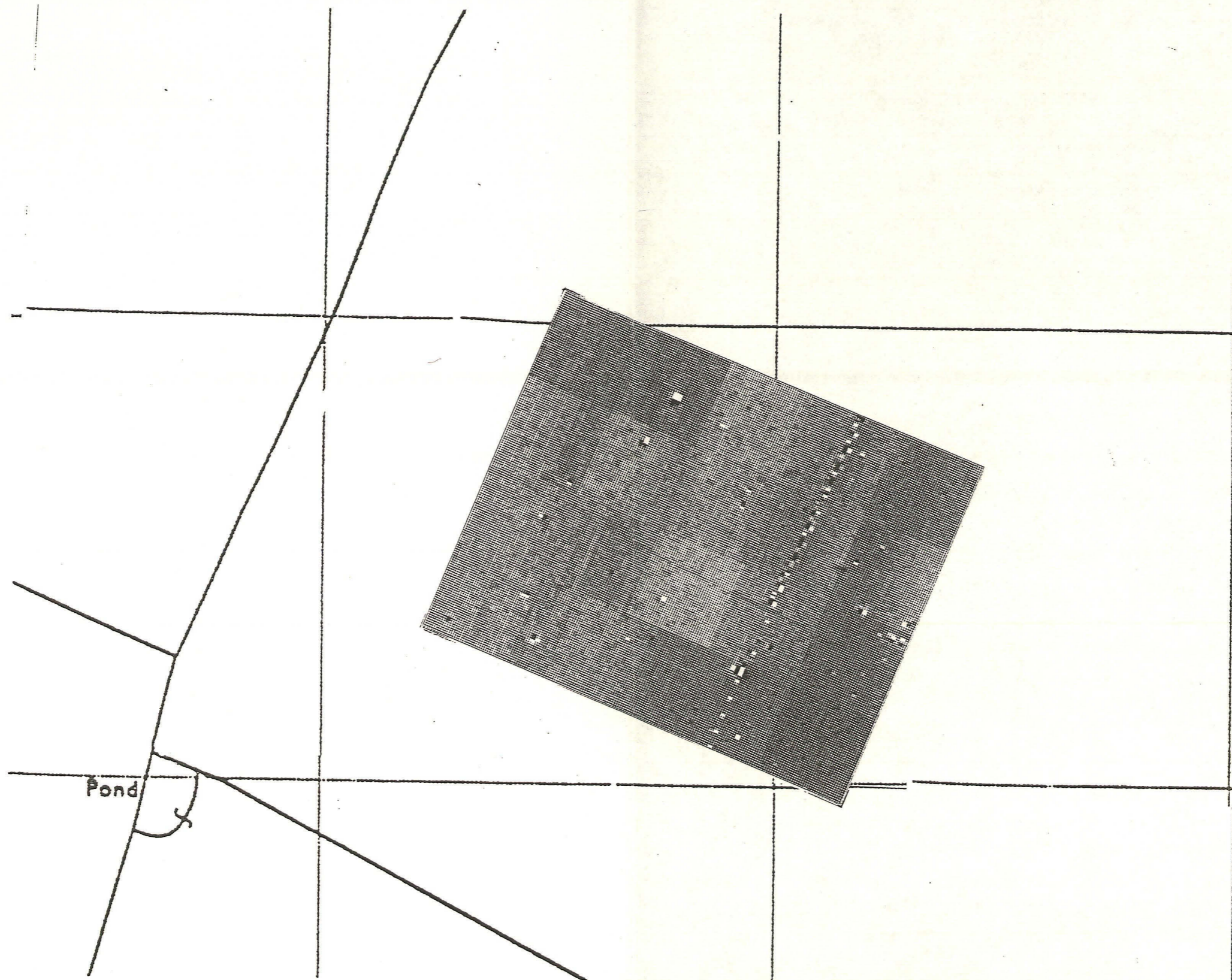
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Scale 1:2500	Subject Geophysical Survey Kirkby-on-Bain Areas of magnetometer survey	
Figure 5		



Plotting parameters
Minimum -7nT (white)
Maximum +3nT (black)

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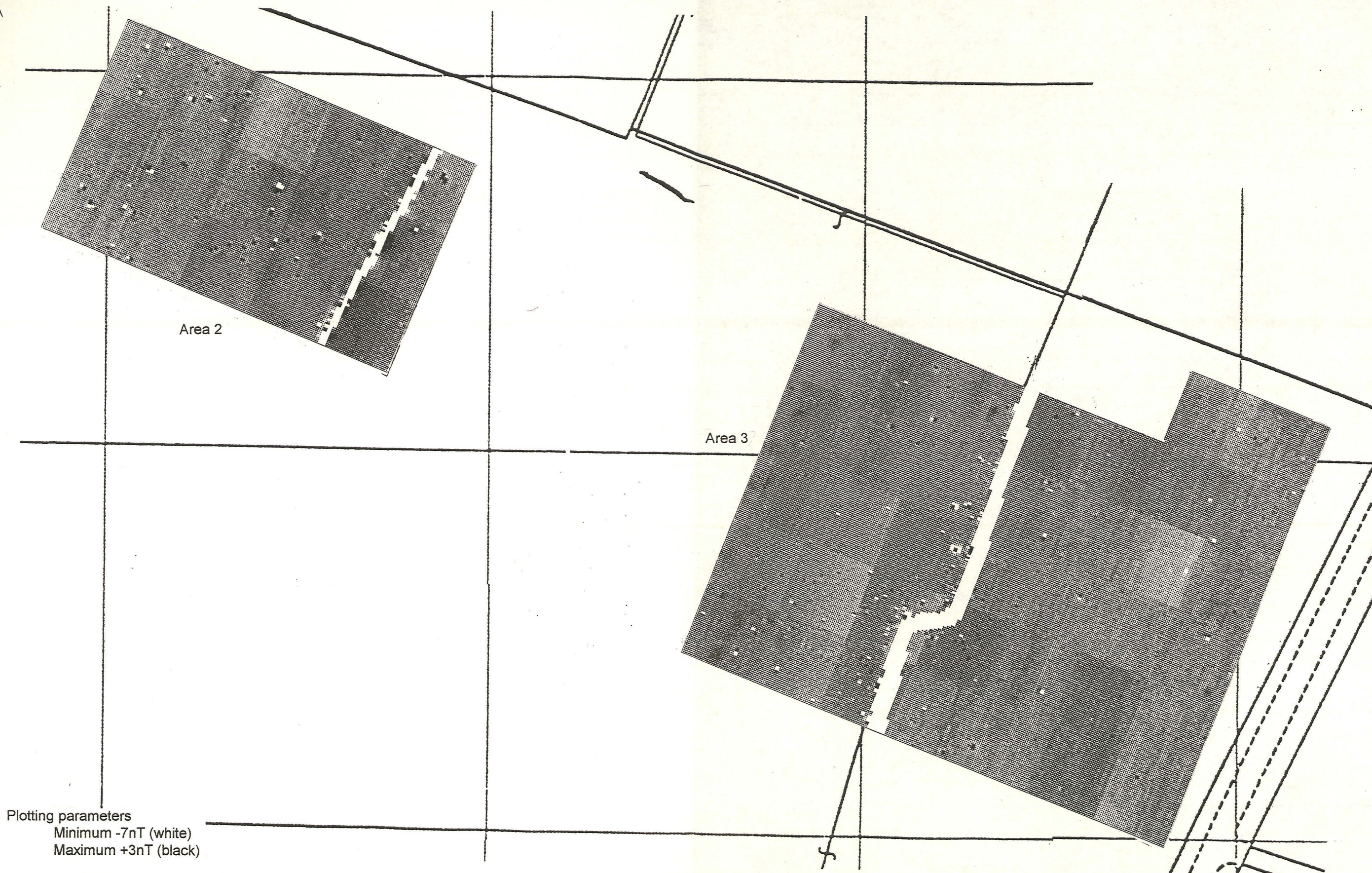
Figure 6

Scale 1:1000

Subject Geophysical Survey - Kirkby-on-Bain
Plot of raw magnetometer data, Area 1

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Area 2

Area 3

Plotting parameters
Minimum -7nT (white)
Maximum +3nT (black)

Date January 1995

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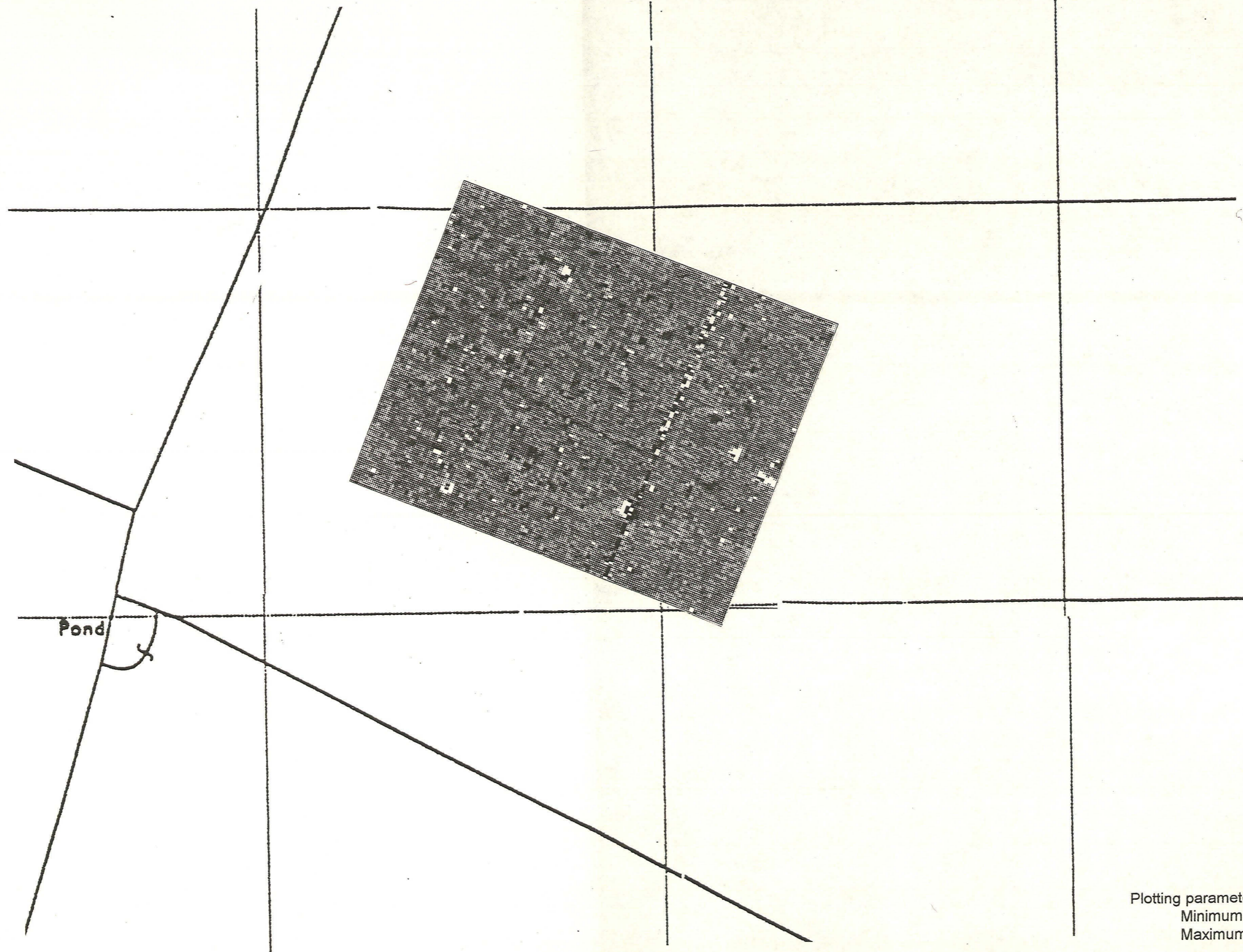
Figure 7

Scale 1:1000

Subject Geophysical Survey - Kirkby-on-Bain
Plot of raw magnetometer data, Areas 2 and 3

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Plotting parameters
Minimum -1.5nT (white)
Maximum +1.5nT (black)

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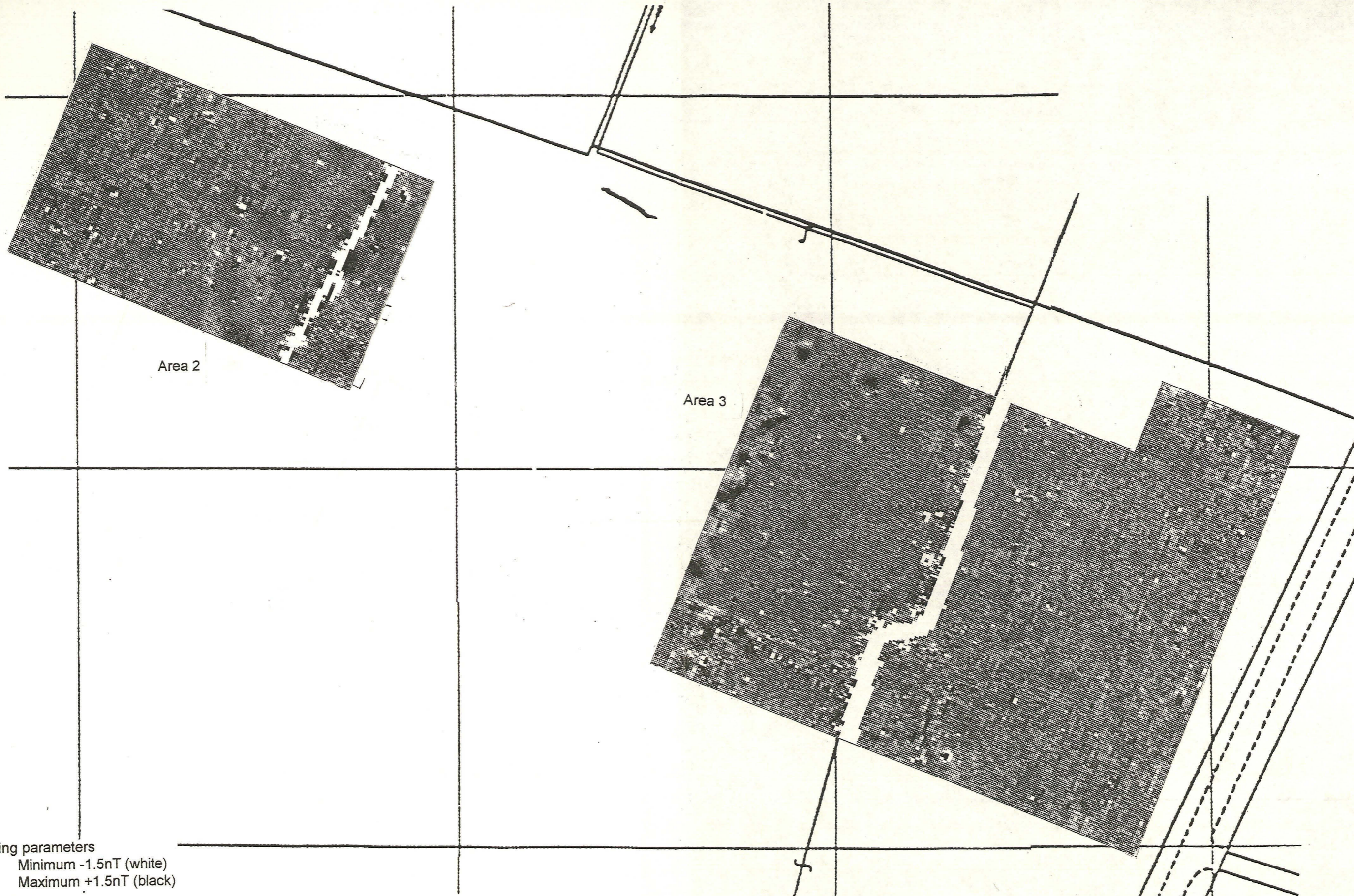
Figure 8

Scale 1:1000

Subject Geophysical Survey - Kirkby-on-Bain
Plot of processed magnetometer data, Area 1

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Plotting parameters
Minimum -1.5nT (white)
Maximum +1.5nT (black)

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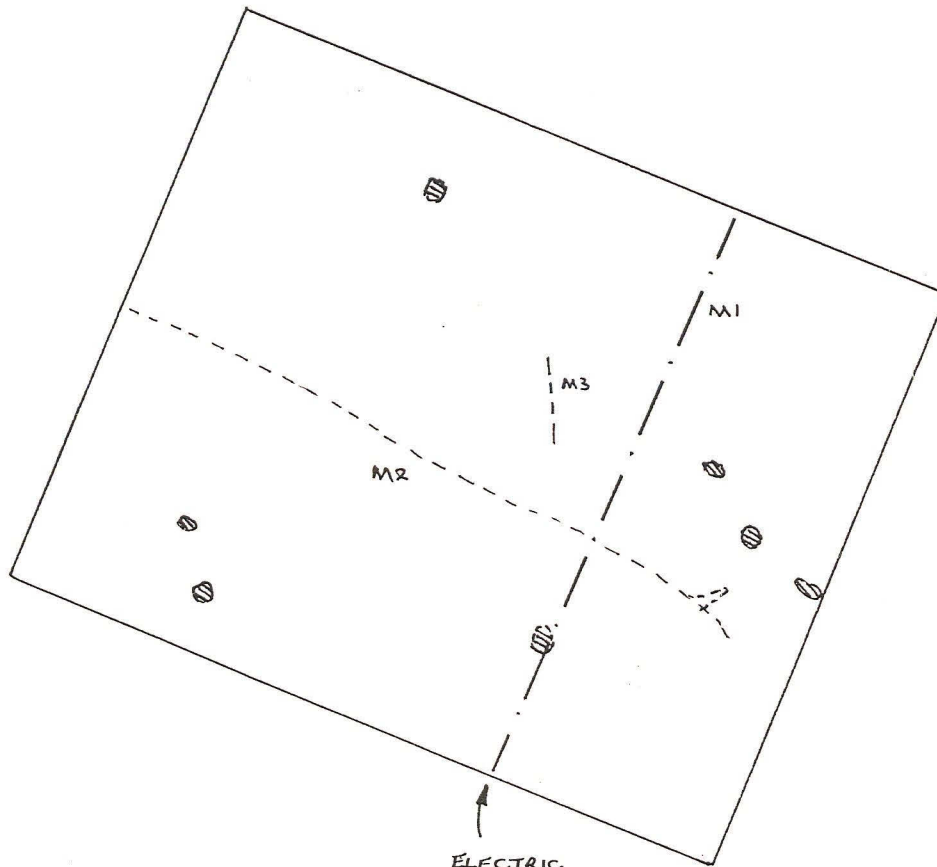
Figure 9

Scale 1:1000

Subject Geophysical Survey - Kirkby-on-Bain
Plot of processed magnetometer data, Areas 2 and 3

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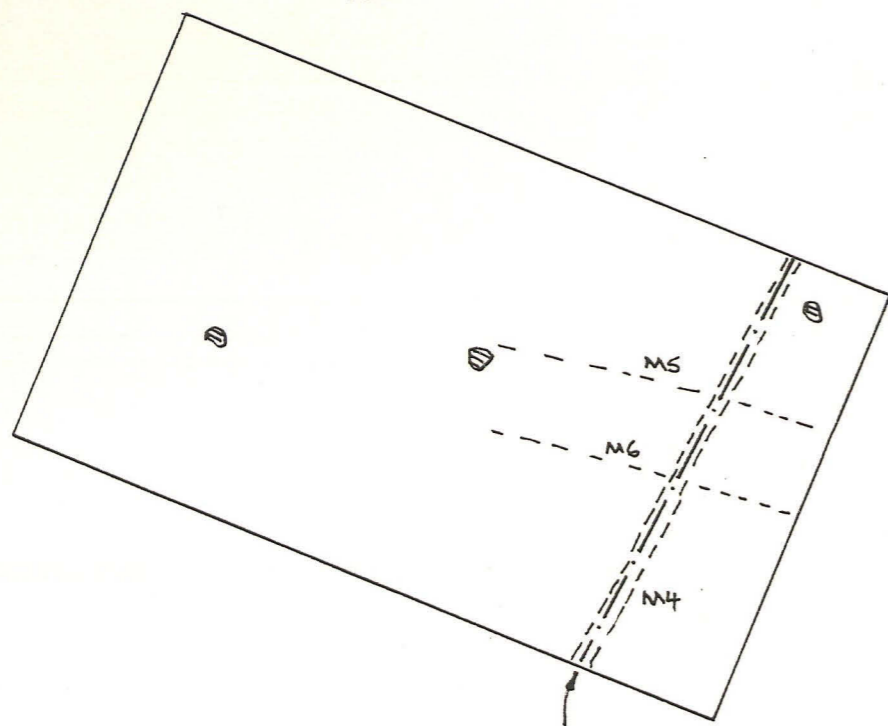


⊗ METAL "SPIKE"

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Scale 1:1000	Subject Geophysical Survey - Kirkby-on-Bain Abstraction of Features Area 1	
Figure 10		



Area 2

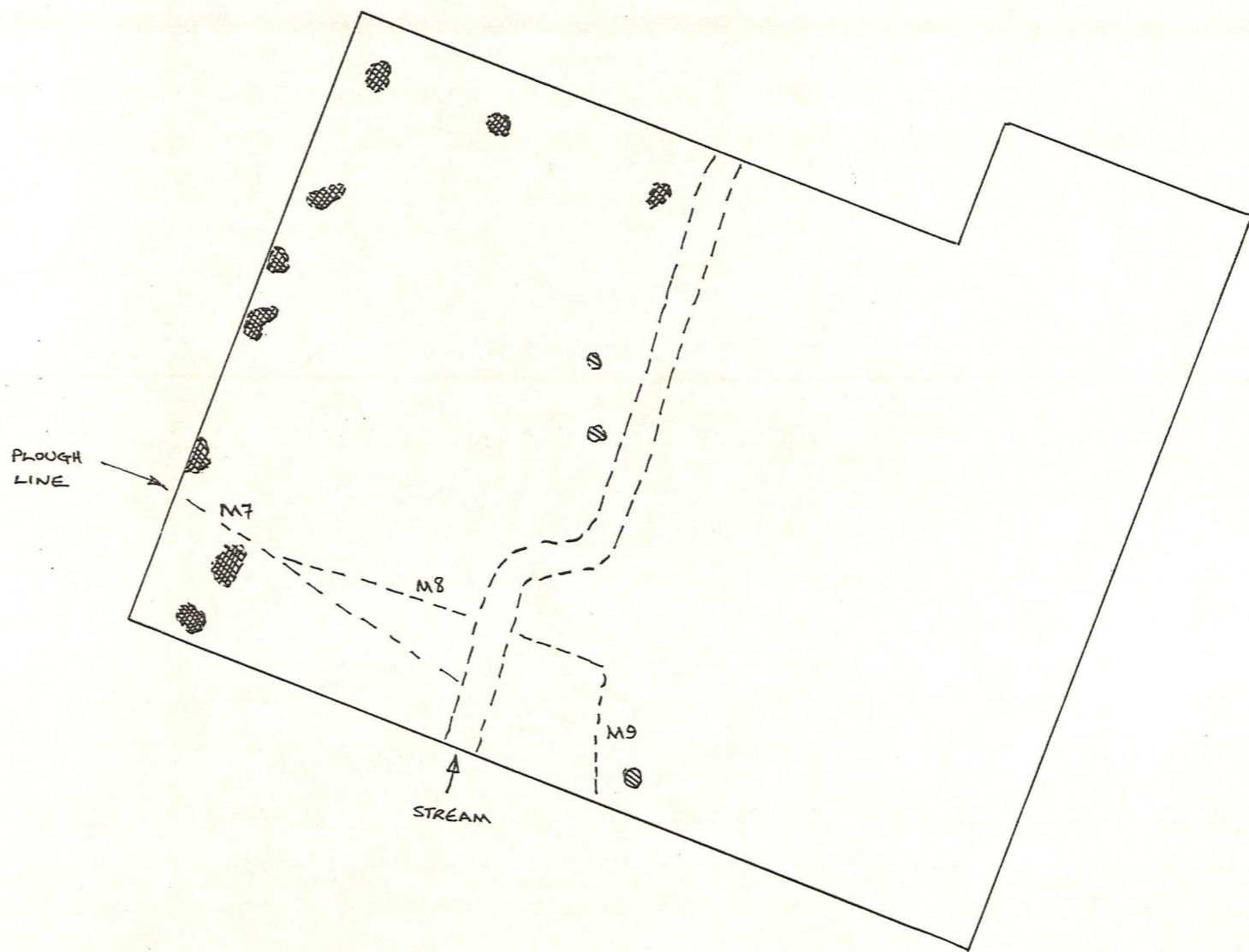


ELECTRIC FENCE
& POST + WIRE
FENCE

⊙ METAL "SPIKE"

⊙ POSITIVE MAGNETIC ANOMALY

Area 3



PLOUGH
LINE

STREAM

Date January 1995

Client LINDSEY ARCHAEOLOGICAL SERVICES

Figure 11

Scale 1:1000

Subject Geophysical Survey - Kirkby-on-Bain
Abstraction of Features, Areas 2 and 3

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