Grange-le-ings Farm, Faldingworth, Lincolnshire

Magnetometer (gradiometer) survey

(Survey Ref : 1740299/FAL/BAC)

FEBRUARY 1999

Produced by

OXFORD ARCHAEOTECHNICS LIMITED

under the direction of

A.E. Johnson *BA(Hons)*

Commissioned by

Mr J. Connor

On behalf of

Mr E. Backus

OXFORD ARCHAEOTECHNICS

99/6.

Event: LI881
LI882

Specialist Archaeological Field Evaluation

OXFORD ARCHAEOTECHNICS
Noke
Oxford OX3 9TX

Tel / Fax 01865 375536
Mobile 0831 383295
Email archaeotechnics@dial.pipex.com
http://www.archaeotechnics.co.uk/archaeotechnics/

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SUMMARY

A geophysical evaluation programme comprising detailed gridded magnetometer (gradiometer) survey was carried out on land at Grange-le-ings Farm on the southeastern outskirts of the village of Faldingworth, c.5 km southwest of Market Rasen, Lincolnshire (centred on NGR 506780 384650).

The survey was based upon the principle that past human activity and its associated debris usually creates slight but persistent changes in the local magnetic environment which can be sensed from the surface.

Several anomalies with archaeological potential were recorded, including a curvilinear enclosure with associated pits situated close to the western boundary of the site, adjacent to the A 46 Lincoln Road, which yielded evidence from hand augering for the presence of charcoal, burnt clay and a single ceramic fragment of possible Romano-British date.

Two circular (5 m diameter) positive anomalies spaced c.12 m apart and linked by a zone of magnetically erratic material (including ferrous debris) were recorded: it is uncertain whether they are of relatively modern origin, or relate to earlier (?industrial) activity.

Topographic survey mapped previously noted earthwork features (hollows), probably the remains of silted boundary ditches. No magnetic evidence was recorded suggestive of domestic activity within these plots which might relate to the shrunken Medieval village of Faldingworth. A level platform adjacent to the farm house was confirmed as the site of a former tennis court.

Several further extremely weak linear and curving anomalies probably represent agricultural striations or drainage features.

1. INTRODUCTION

1.1 Geophysical survey was commissioned by Mr. James Connor on behalf of the landowner, Mr. E. Backus, on land at Grange-le-ings Farm, situated on the southeastern outskirts of the village of Faldingworth, some 5 km southwest of Market Rasen, Lincolnshire, in advance of proposed development. The fieldwork was carried out in February 1999.

1.2 The survey area, which lies immediately west of Grange-le-ings farmhouse, comprised a roughly L-shaped land c.1 ha in area (centred on NGR 506780 384650) within the northern part of OS Field 8254, bounded on the west by the A 46 Lincoln Road, on the north by the farm access track, on the south by farmland, and on the southeast by a small pond. The location is shown on Fig. 1. The area available for survey was constrained by the course of sewer pipes running close to and parallel with both the northern and western boundaries of the field, and disturbance associated with the construction of a manhole within the northwestern angle of the field (Fig. 2).

1.3 The geology is reported as boulder clay and till, lying within the southern part of the Lindsey Clay Vale (CLAU 1998). The land, which was under pasture (paddock) at the time of survey, slopes gently from north (c. 23.6 m AOD) to south (21.5 m AOD).

1.4 A previous desk-top archaeological assessment had highlighted the presence of earthwork features, visible as hollows on the ground, which probably represent the course of former boundary ditches (one following the approximate line of the southern boundary of the survey area, and the other running perpendicular, on a northnorthwest-southsoutheast axis), which may mark the course of former property boundaries of the shrunken Medieval village; a level platform close to the eastern boundary of the field was also been identified, although it probably represents the site of a recent tennis court rather than a former house site (CLAU 1998).

1.5 The geophysical survey comprised magnetometry (gradiometer) survey. An explanation of the techniques used, and the rationale behind their selection, is included in an Appendix to the present report.

2. MAGNETIC SURVEY DESIGN

2.1 The fenceline and position of the three manholes serving the sewers along the northern and western periphery of the survey area were surveyed by EDM Total Station.

2.2 Detailed gridded magnetometer (gradiometer) survey was conducted within seven contiguous 30 x 30 m survey grids (0.72 ha) using a Geoscan Research FM 36 Fluxgate Gradiometer (sampling 4 readings per metre at 1 metre traverse intervals in the 0.1 nT range). The nanotesla (nT) is the standard unit of magnetic flux (expressed as the current density), here used to indicate positive and negative deviations from the Earth's normal magnetic field.

2.3 Magnetometer data have been presented as grey scale and stacked trace (raw data) plots (Figs. 3 & 5); and an interpretation of results is shown on Fig. 4.

2.4 In view of the known earthwork features previously recorded within the survey area (see 1.4 above), the opportunity was taken to make a topographic survey of the site. Approximately 500 data points, sufficient to record the general landform, were recorded. Topographic contours, mapped at 20 cm intervals, are shown on Fig. 6. Heights were tied in with a spot height mapped by the OS at the centre of the road junction, some 20 m beyond the northwestern angle of the survey area (centred on NGR 506720 384665: at 23.6 m AOD).

3. SURVEY RESULTS

3.1 Despite interference caused by the proximity to sewer pipes, concentrations of buried ferrous debris, the stanchions of the tennis court perimeter fence, and a single lined well borehole (all marked on Fig. 4), a sufficiently large area (0.72 ha) was nevertheless available to permit the identification of several magnetic anomalies of potential archaeological interest. The location of the gradiometer survey grids is shown on Fig. 2.

3.2 A curvilinear anomaly (former ditch), truncated to the west by the modern sewer pipe, is visible close to the western edge of the survey area, together with a number of substantial anomalies, probably pit forms, some 2 - 3 m in diameter. When tested by hand auger both the ditch and two of the probable pits produced charcoal and burnt clay at a depth of 0.8 - 1 m (although the bases of none of the features was necessarily reached); a single small fragment of well-fired ceramic material derived from the ditch may indicate a Romano-British date. The absence of ferrous material, and the general 'smoothness' of the magnetic signals suggests the presence of underlying features with some archaeological potential. Topographic survey confirmed that this feature retained no surviving surface expression.

3.3 Situated at a distance of some 60 m to the northeast, adjacent to the pond, a much weaker anomaly appears to be the northeastern angle of a former enclosure ditch. Just 5 m north of this anomaly are indications of what may be a ring form, almost 15 m in diameter, together with a possible further pit (although the magnetic signal resembling a pit form cannot always be differentiated from the response from a more deeply buried ferrous object).

3.4 Two circular anomalies, each c.5 m in diameter and spaced 12 m apart, are visible upon an area of higher ground just north of the centre of the survey area. They are seemingly linked by a zone of magnetically erratic material, suggestive of the presence of ferrous or other strongly magnetic material (possibly fired/burnt debris, brick, or industrial residue). There is no obvious recent brick or ferrous material on the surface of the (grass) field, nor has the farmer (Mr. Backus) any recollection of former structures at this location.

3.5 A cluster of strong signals identified 20 m to the west is the result of a recent bonfire.

3.6 Two extremely strong magnetic anomalies visible within the northeastern angle of the survey area are caused by buried metalwork associated with the perimeter fence of the former tennis court.

3.7 A number of further extremely weak linear and curvilinear anomalies which are shown on Fig. 4 are probably the result of relatively recent drainage and agricultural features.

4. CONCLUSIONS

4.1 The site responded favourably to gradiometer survey, identifying a curvilinear enclosure probably associated with (large) pit forms close to the western boundary of the survey area. This location has clear archaeological potential. Elsewhere, several further features are suggested, notably within the area immediately north of the pond, although none can be identified with such confidence as having archaeological significance.

4.2 The position of modern services and debris precluded survey within 10 - 20 m of the northern and western (road frontage) boundaries of the field.

4.3 The level platform, precisely located by topographic survey within the northeastern angle of the survey area, displays ferrous debris associated with the former tennis court, which is believed to have incorporated modern imported material (pers. comm. E. Backus, CLAU 1998).

4.4 The positions of two linear hollows, probably representing boundary ditches of former land parcels have also been mapped by topographic survey. Neither of the plots enclosed have yielded obvious magnetic evidence for domestic occupation associated with the shrunken Medieval village of Faldingworth.

4.5 Two (5 m diameter) circular anomalies associated with considerable quantities of magnetic material are provisionally interpreted as being of relatively modern origin, although as the magnetic signal may be indicative of burnt/fired material, the possibility of industrial features cannot be discounted.

REFERENCES

CLARK, A.J. 1990. *Seeing Beneath the Soil*. B.T. Batsford Ltd: London.

CLAU 1998. *Land at Grange-le-ings Farm, Faldingworth, Lincs. Archaeological Desk-top Assessment.* Report by the City of Lincoln Archaeology Unit for Mr. J. Connor on behalf of Mr. E. Backus, 1998.

GALE, S.J. & HOARE, P.G. 1991. *Quaternary Sediments: petrographic methods for the study of unlithified rocks*. Belhaven Press: London (see Section 4.7, pp.201-229, "The magnetic susceptibility of regolith materials").

SCOLLAR, I., TABBAGH, A., HESSE, A. & HERZOG, I. 1990. *Archaeological Prospecting and Remote Sensing*. Cambridge University Press.

THOMPSON, R. & OLDFIELD, F. 1986. *Environmental Magnetism*. Allen & Unwin: London.

Magnetometer survey by Oxford Archaeotechnics Limited under the direction of A.E. Johnson *BA(Hons)*, with M. Tomkins *BA(Hons), MA* and M. Laidlaw *BA*.

APPENDIX 1 - MAGNETIC TECHNIQUES: GENERAL PRINCIPLES

A1.1 It is possible to define areas of human activity (particularly soils spread from occupation sites and the fills of cut features such as pits or ditches) by means of *magnetic survey* (Clark 1990; Scollar et al. 1990). The results will vary, according to the local geology and soils (Thompson & Oldfield 1986; Gale & Hoare 1991), as modified by past and present agricultural practices. Under favourable conditions, areas of suspected archaeological activity can be accurately located and targeted for further investigative work (if required) without the necessity for extensive random exploratory trenching. Magnetic survey has the added advantages of enabling large areas to be assessed relatively quickly, and is non-destructive.

A1.2 Topsoil is normally more magnetic than the subsoil or bedrock from which it is derived. Human activity further locally enhances the magnetic properties of soils, and amplifies the contrast with the geological background. The main enhancement effect is the increase of *magnetic susceptibility*, by fire and, to a lesser extent, by the bacterial activity associated with rubbish decomposition; the introduction of materials such as fired clay and ceramics - and, of course, iron and many industrial residues - may also be important in some cases. Other agencies include the addition and redistribution of naturally magnetic rock such as basalt or ironstone, either locally derived or imported.

A1.3 The tendency of most human activity is to increase soil magnetic susceptibility locally. In some cases, however, features such as traces of former mounds or banks, or imported soil/subsoil or non-magnetic bedrock (such as most limestones), will show as zones of lower susceptibility in comparison with the surrounding topsoil.

A1.4 Archaeologically magnetically enhanced soils are therefore a response of the parent geological material to a series of events which make up the total domestic, agricultural and industrial history of a site, usually over a prolonged period. Climatic factors may subsequently further modify the susceptibility of soils but, in the absence of strong chemical alteration (e.g. during the process of podzolisation or extreme reduction), magnetic characteristics may persist over millions of years.

A1.5 Both the magnetic contrast between archaeological features and the subsoil into which they are dug, and the magnetic susceptibility of topsoil spreads associated with occupation horizons, can be measured in the field.

A1.6 There are several highly sensitive instruments available which can be used to measure these magnetic variations. Some are capable, under favourable conditions, of producing extraordinarily detailed plots of subsurface features. The detection of these features is usually by means of a *magnetometer* (normally a fluxgate gradiometer). These are defined as passive instruments which respond to the magnetic anomalies produced by buried features in the presence of the Earth's magnetic field. The gradiometer uses two sensors mounted vertically, often 50 cm

apart. The bottom sensor is carried some 30 cm above the ground, and registers local magnetic anomalies with respect to the top sensor. As both sensors are affected equally by gross magnetic effects these are cancelled out. In order to produce good results, the magnetic susceptibility contrast between features and their surroundings must be reasonably high, thereby creating good local anomalies; a generally raised background, even if due to human occupation within a settlement context, will sometimes preclude meaningful magnetometer results. The sensitive nature of magnetometers makes them suitable for detailed work, logging measurements at a closely spaced (less than 1 metre) sample interval, particularly in areas where an archaeological site is already suspected. Magnetometers may also be used for rapid 'prospecting' ('scanning') of larger areas (where the operator directly monitors the changing magnetic field and pinpoints specific anomalies).

A1.7 *Magnetic susceptibility measuring systems*, whilst responding to basically the same magnetic component in the soil, are 'active' instruments which subject the sample area being measured (according to the size of the sensor used) to a low intensity alternating magnetic field. Magnetically susceptible material within the influence of this field can be measured by means of changes which are induced in oscillator frequency. For general work, measuring topsoil susceptibility *in situ*, a sensor loop of around 20 cm diameter is convenient, and responds to the concentration of magnetic (especially ferrimagnetic) minerals mostly in the top 10 cm of the soil. Magnetically enhanced horizons which have been reached by the plough, and even those from which material has been transported by soil biological activity, can thus be recognised.

A1.8 Whilst only rarely encountering anomalies as graphically defined as those detected by magnetometers, magnetic susceptibility systems are ideal for detecting magnetic spreads and thin archaeological horizons not seen by magnetometers. Using a 10 m interval grid, large areas of landscape can be covered relatively quickly. The resulting plot can frequently determine the general pattern of activity and define the nuclei of any occupation or industrial areas. As the intervals between susceptibility readings generally exceed the parameters of most individual archaeological features (but not of the general spread of enhancement around features), the resulting plots should be used as a guide to areas of archaeological potential and to suggest the general form of major activity areas; further refinement is possible using a finer mesh grid or, more usually, by detailing underlying features using a gradiometer.

A1.9 Magnetic survey is not successful on all geological and pedological substrates. As a rule of thumb, in the lowland zone of Britain, the more sandy/stony a deposit, the less magnetic material is likely to be present, so that a greater magnetic contrast in soil materials will be needed to locate archaeological features; in practice, this means that only stronger magnetic anomalies (e.g. larger accumulations of burnt material) will be visible, with weaker signals (e.g. from the fillings of simple agricultural ditches) disappearing into the background. Similar problems can arise when the natural background itself is very high or very variable (e.g. in the presence of sediments partially derived from magnetic volcanic rocks).

A1.10 The precise physical and chemical processes of changing soil magnetism are extremely complex and subject to innumerable variations. In general terms, however, there is no doubt that magnetic enhancement of soils by human activity provides valuable archaeological information.

A1.11 As well as locating specific sites, topsoil magnetic susceptibility survey frequently provides information relating to former landuse. Variations in the soils and subsoils, both natural and those enhanced by anthropogenic agencies, when modified by agriculture, give rise to distinctive patterns of topsoil susceptibility. The containment of these spreads by either natural or man-made features (streams, hedgerows, etc.) gives rise to a characteristic chequerboard or strip pattern of varying enhancement, often showing the location of former field systems, which persist even after the physical barriers have been removed. These patterns are often further amplified in fields containing underlying archaeological features within reach of the plough. More subtle landuse boundaries and indications of former cultivation regimes are often suggested by topsoil magnetic susceptibility plots.

A1.12 Where a general spread of magnetically enhanced soils contained within a long-established boundary becomes admixed over a long period by constant ploughing, it can be diffused to such a point that the original source is masked altogether. Magnetically enhanced material may also be moved or masked by natural agencies such as colluviation or alluviation. Generally, it appears that the longer a parcel of land has been under arable cultivation, the greater is the tendency for topsoil susceptibility to increase; at the same time there is increasing homogeneity of the magnetic signal within the soils owing to continuous agricultural mixing of the material. Some patterns of soil enhancement derived from underlying archaeological features are, however, apparently capable of resisting agricultural dispersal for thousands of years (Clark 1990).

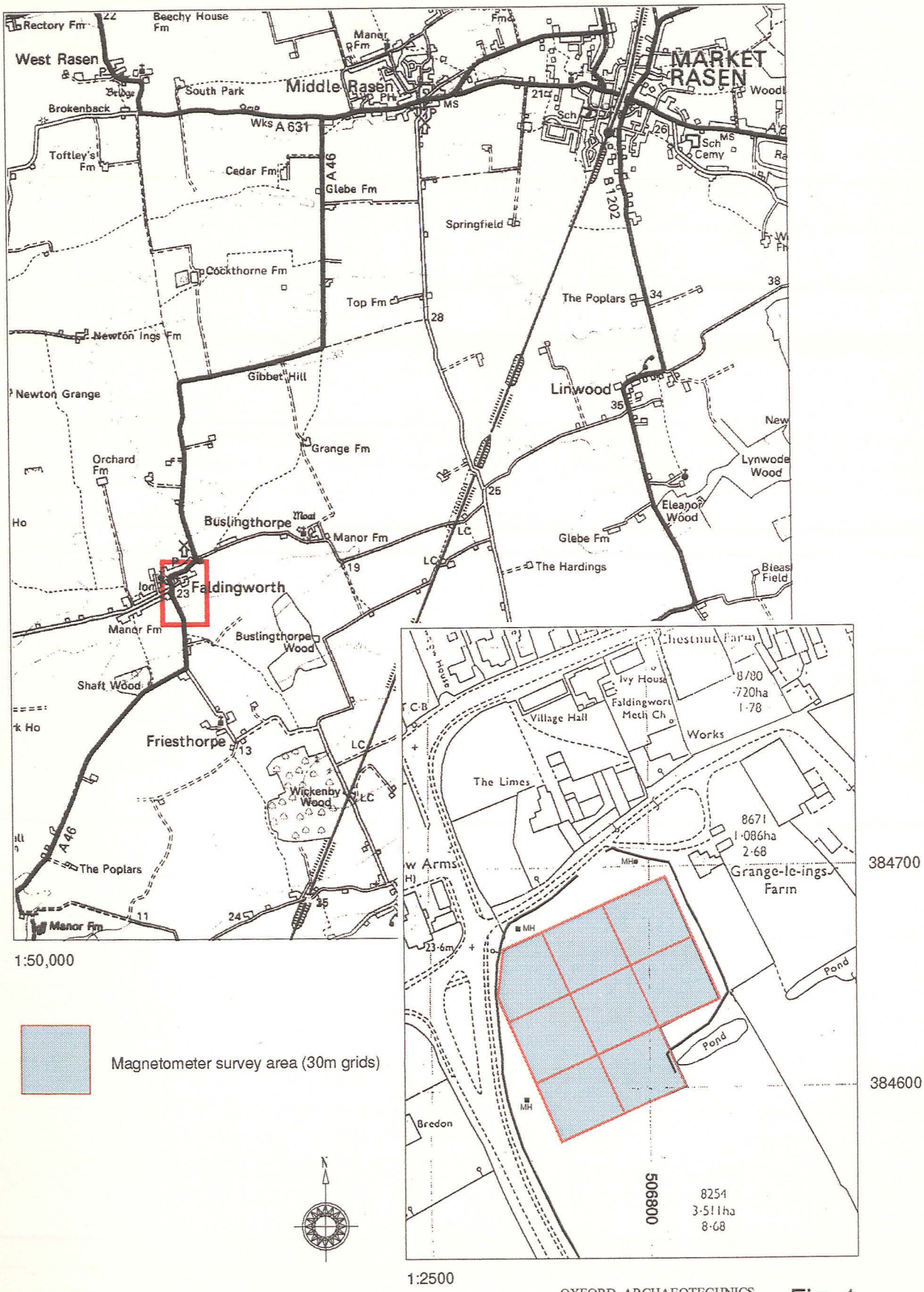
FIGURE CAPTIONS

Figure 1.	Location maps. Scale 1:50,000 and 1:2500. Based upon OS 1:50,000 Map 121 and OS 1:2500 Sheet TF 0684.
Figure 2.	Magnetometer (gradiometer) survey: location of survey grids. Scale 1:1250.
Figure 3.	Magnetometer (gradiometer) survey: grey shade plot. Scale 1:1000.
Figure 4.	Magnetometer (gradiometer) survey: interpretation. Scale 1:1000.
Figure 5.	Magnetometer (gradiometer) survey: stacked trace (raw data) plot. Scale 1:1000.
Figure 6.	Topographic survey. Scale 1:1250.

Grange-le-ings Farm, Faldingworth, Lincolnshire

Magnetometer (gradiometer) survey

Location



Magnetometer survey area (30m grids)

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Fig. 1

Grange-le-ings Farm, Faldingworth, Lincolnshire

Magnetometer (gradiometer) survey

Grid Location

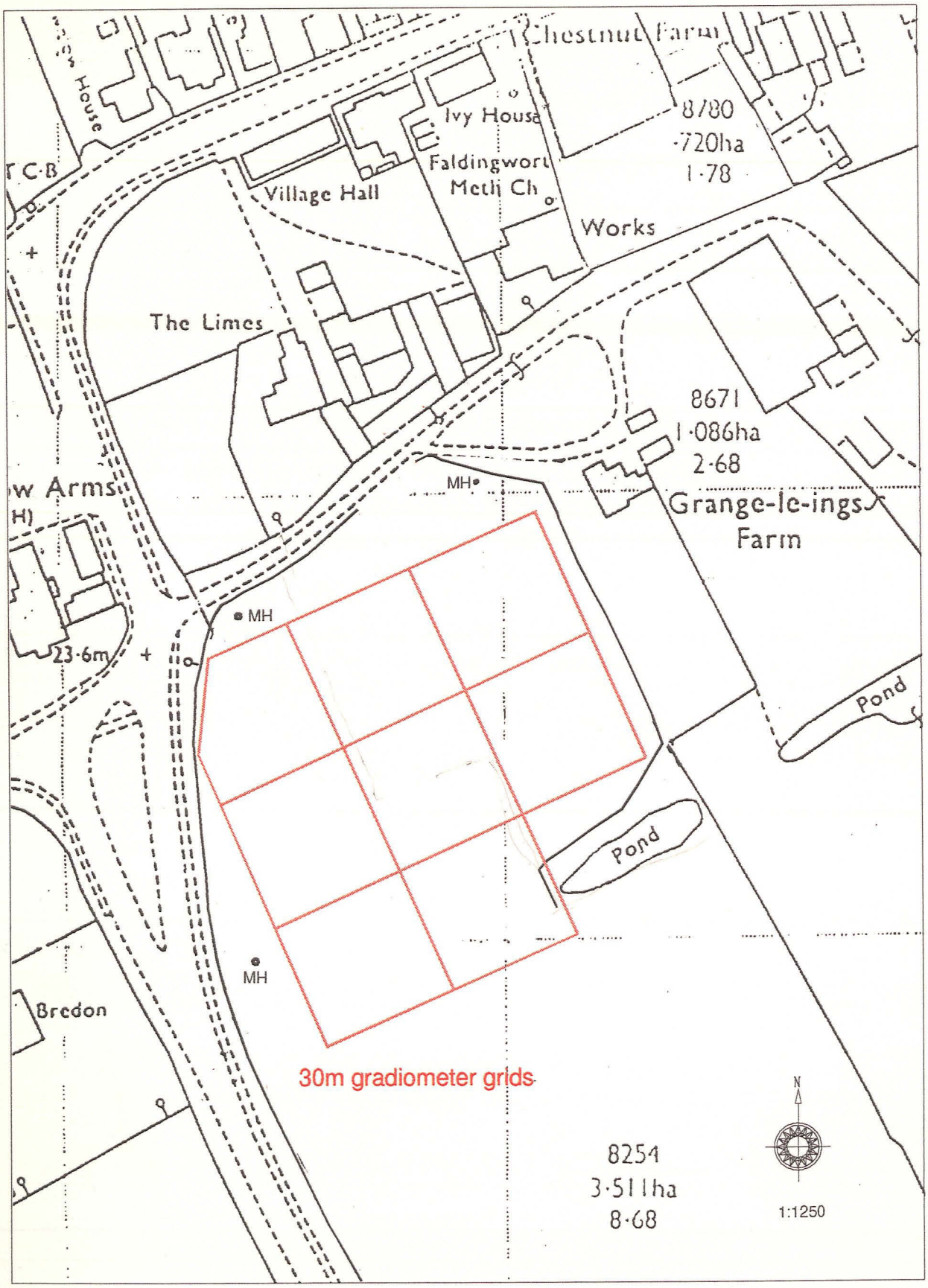

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Fig. 2

Grange-le-ings Farm, Faldingworth, Lincolnshire

Magnetometer (gradiometer) survey

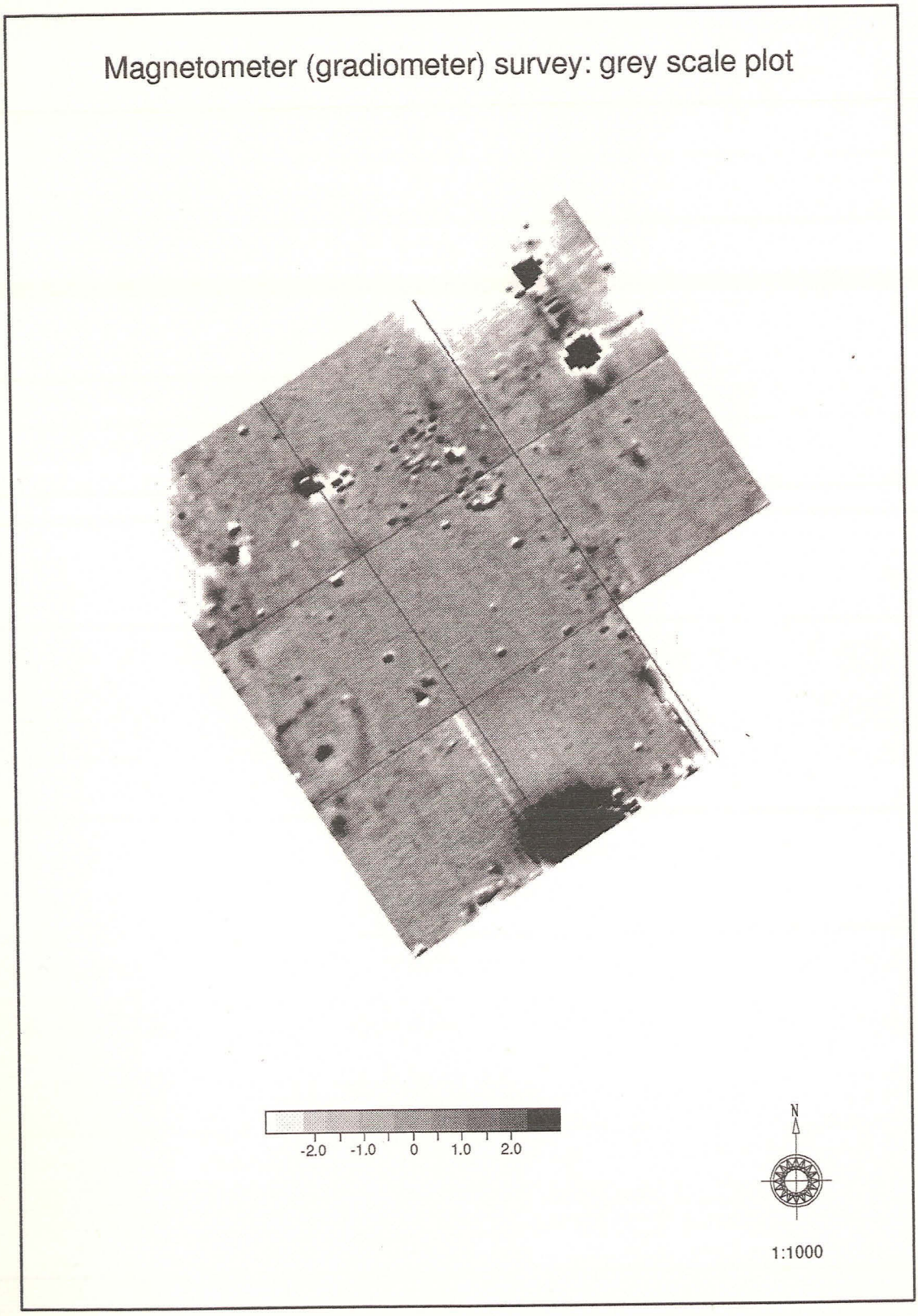

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Fig. 3

Grange-le-ings Farm, Faldingworth, Lincolnshire

Magnetometer (gradiometer) survey

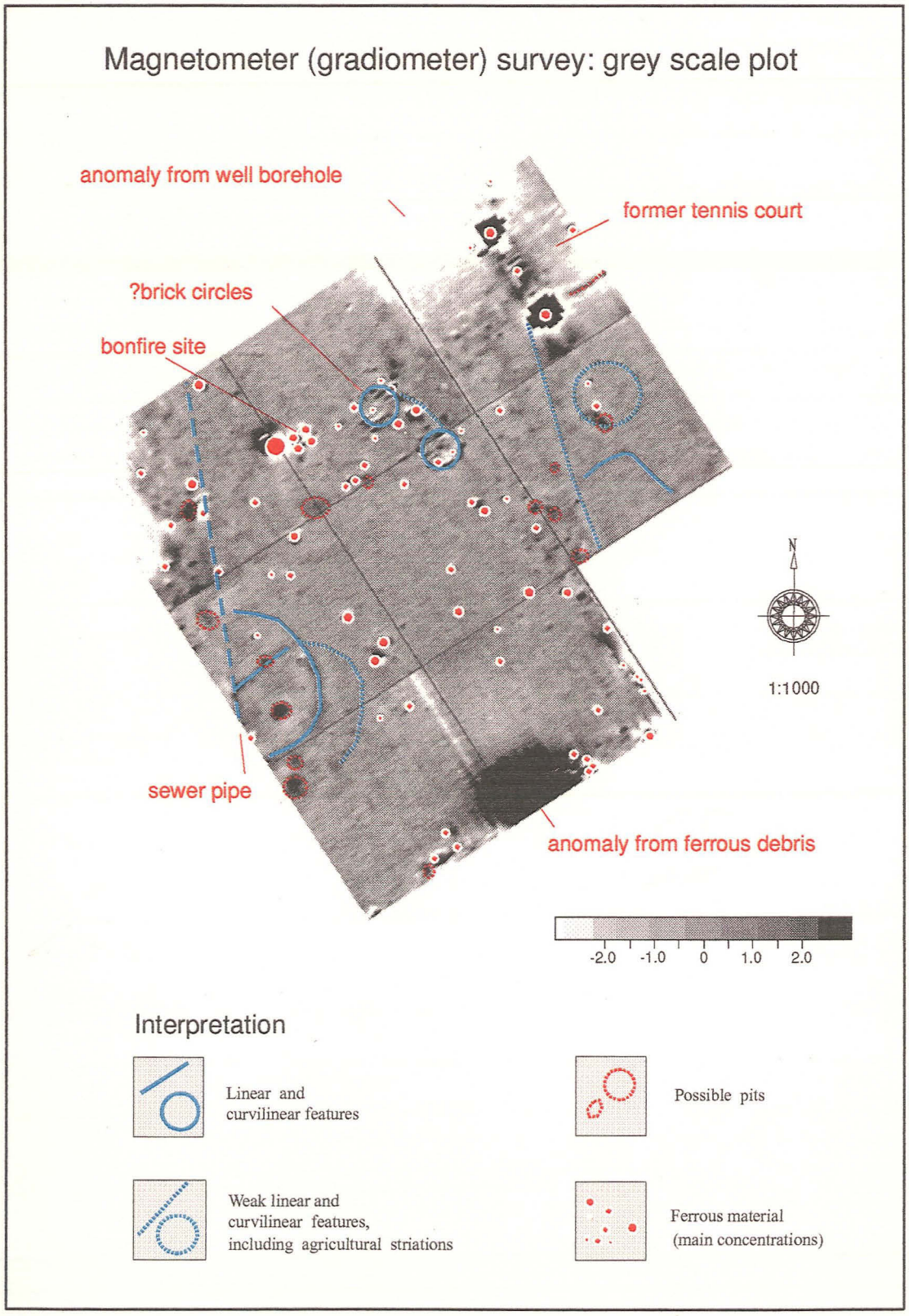

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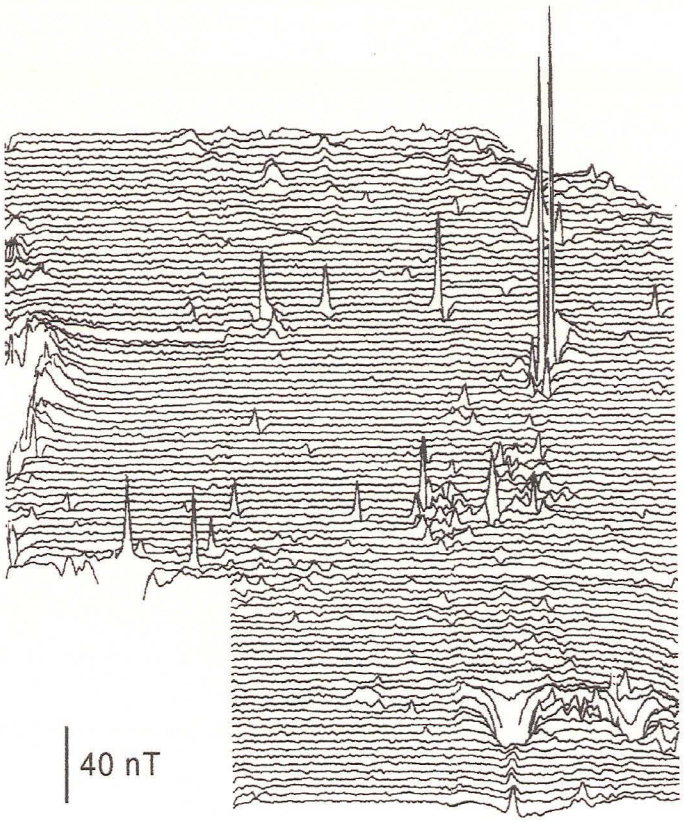
Fig. 4

Grange-le-ings Farm, Faldingworth, Lincolnshire

Magnetometer (gradiometer) survey

Magnetometer (gradiometer) survey: stacked trace plot (raw data)



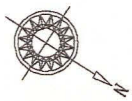


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Fig. 5

Grange-le-ings Farm, Faldingworth, Lincolnshire

Magnetometer (gradiometer) survey

Topographic contours

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Fig. 6

INTERNAL QUALITY CHECK

Survey Reference	1740299/FAL/BAC		
Primary Author		Date	25/02/99
Checked By	APJ	Date	25.02.99
Checked By		Date	
Further Corrections		Date	

OXFORD ARCHAEOTECHNICS LIMITED
NOKE
OXFORD OX3 9TX

Tel & Fax: *01865 375536*
Mobile: *0831 383295*
E-mail: *archaeotechnics@dial.pipex.com*
Http://www.archaeotechnics.co.uk/archaeotechnics/