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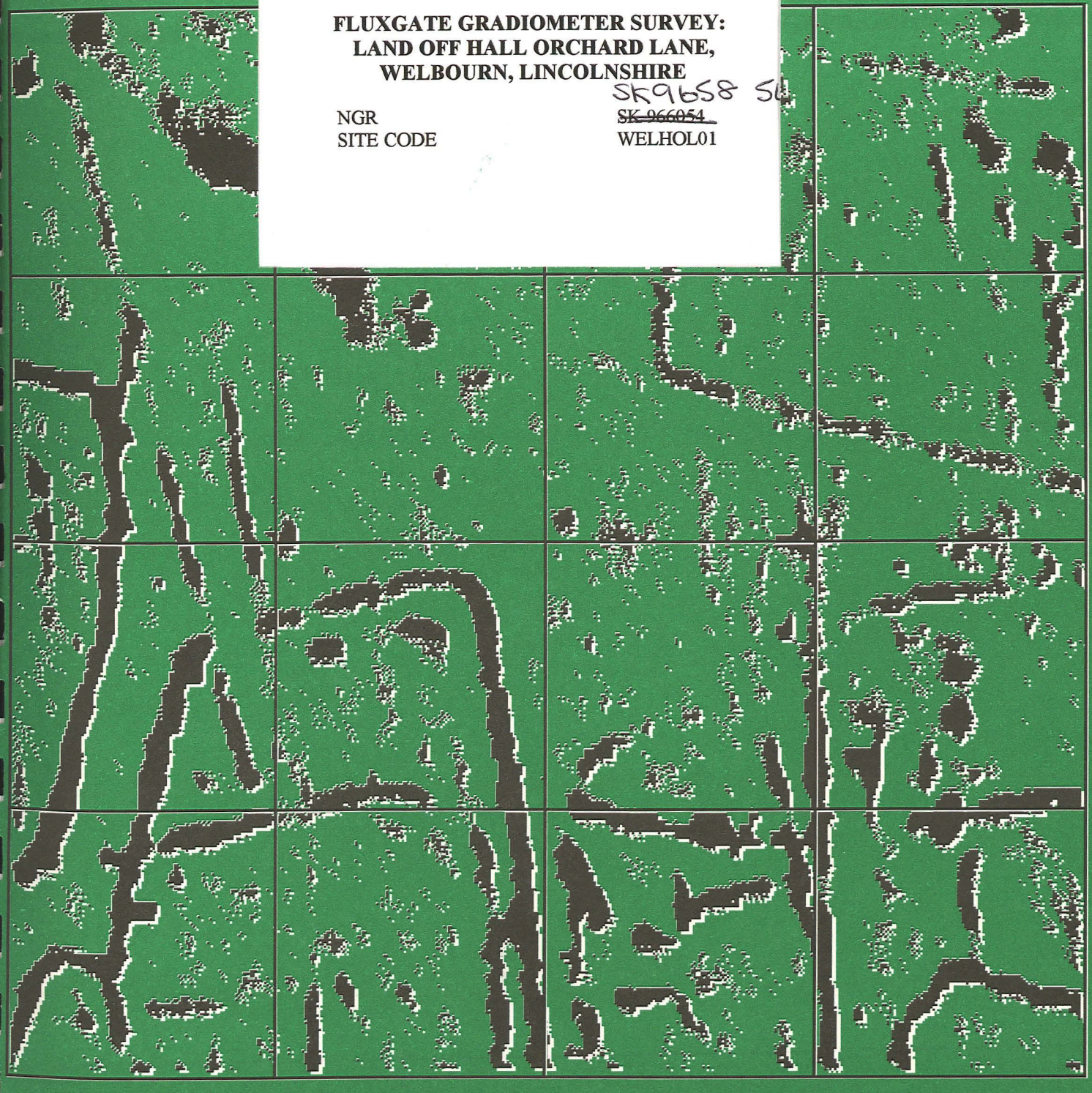
PRE-CONSTRUCT GEOPHYSICS

FLUXGATE GRADIOMETER SURVEY: LAND OFF HALL ORCHARD LANE, WELBOURN, LINCOLNSHIRE

NGR	~~SK 966054~~ SK9658 56
SITE CODE	WELHOL01



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FLUXGATE GRADIOMETER SURVEY: LAND OFF HALL ORCHARD LANE, WELBOURN, LINCOLNSHIRE

NGR	~~SK 966054~~ SK9658 5434
SITE CODE	WELHOL01

Report prepared for Ploughsound Ltd.
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Illustrations

Summary

- *A fluxgate gradiometer survey was undertaken on 1.0 ha of land at Welbourn in Lincolnshire. This identified significant levels of magnetic variation, and some of this variability can be resolved into a series of morphologically diagnostic anomalies*

- *Some magnetically strong anomalies are associated with modern activities, whereas others almost certainly reflect sub-surface features of potential archaeological significance*

- *Traces of medieval ridge and furrow appears to dominate the north-west side of the site*

- *A series of linear and curvilinear anomalies towards the east and south-east sides of the site can be resolved largely as components of enclosures*

- *Small discrete anomalies distributed across the site suggest the presence of ferrous and ceramic debris in the topsoil*

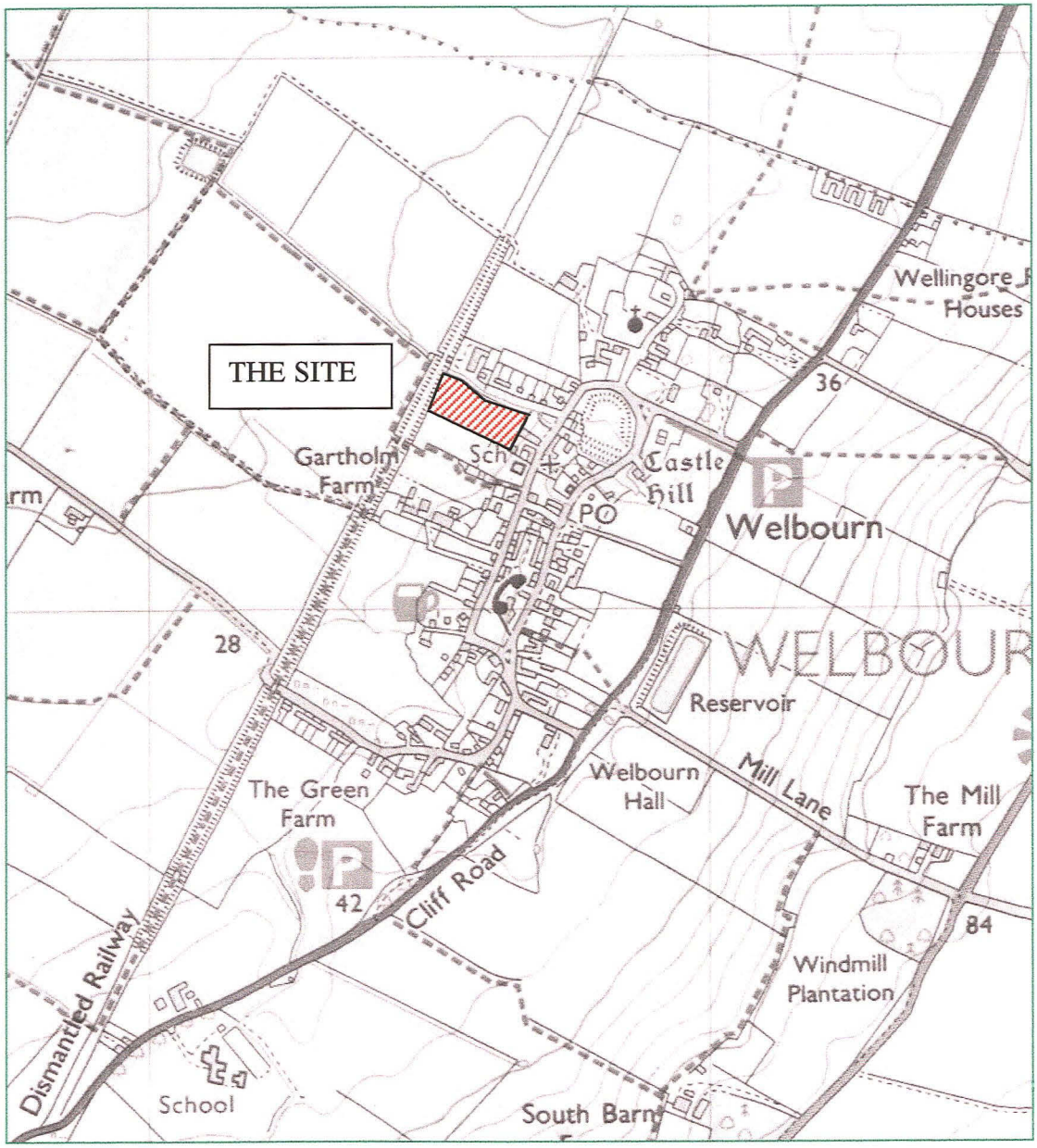
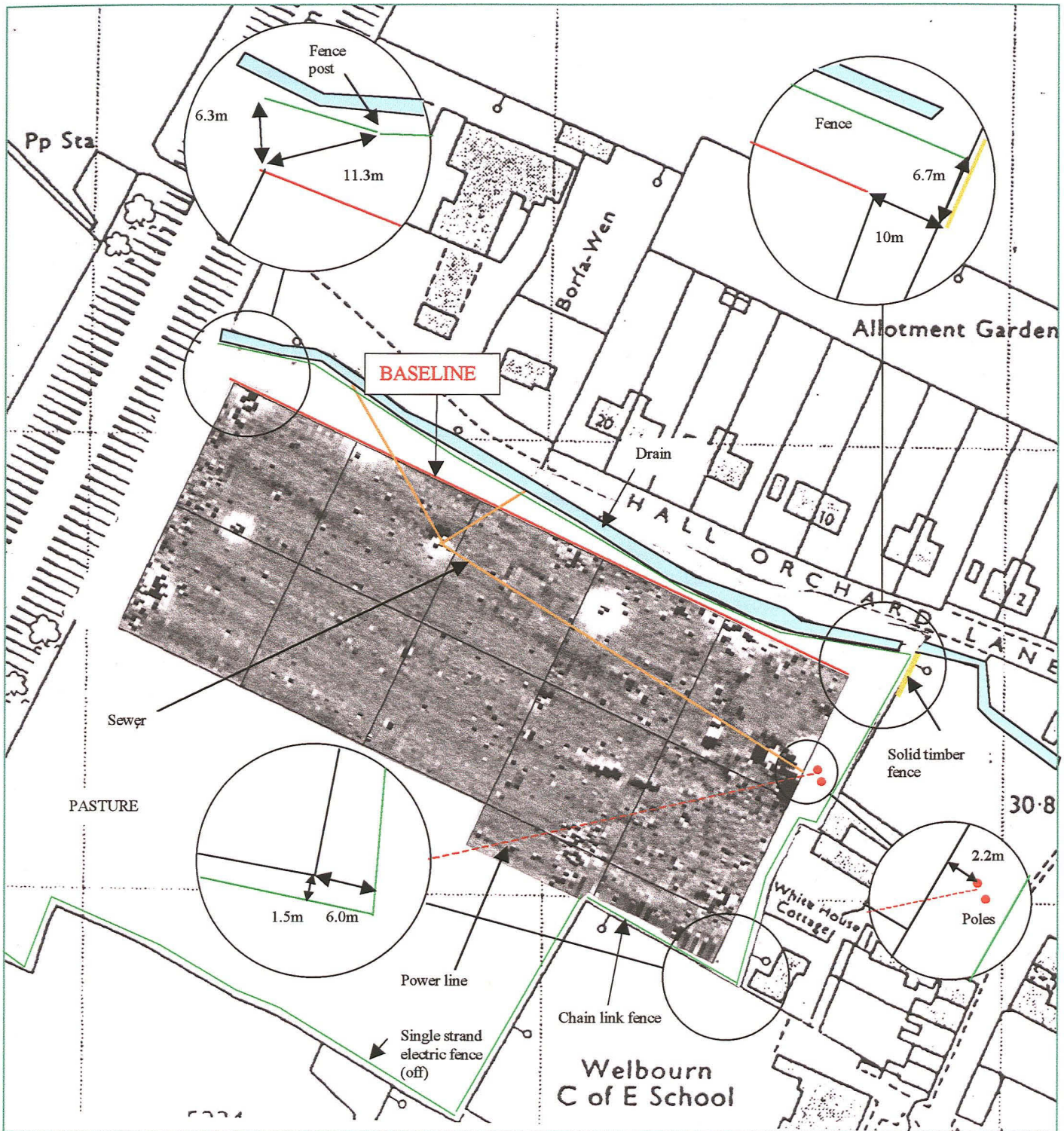


Fig.1: Location of site **Scale 1:12500**



5	4	3	2	1
6	7	8	9	10
			12	11

30m

N
W
E
S

Fig.2: Location of survey **1:1250**

1.0 Introduction

Ploughsound Ltd. commissioned Pre-Construct Geophysics to undertake a fluxgate gradiometer survey of land off Hall Orchard Lane, Welbourn, Lincolnshire. This work was carried out as part of a pre-planning archaeological evaluation of the site. The evaluation is a recommendation of the Heritage Officer for North Kesteven District Council.

The survey was undertaken in accordance with a specification prepared by Pre-Construct Archaeology (Palmer-Brown, 2001). The methodology was based upon guidelines set out in the English Heritage document *'Geophysical Survey in Archaeological Field Evaluation'* (David, 1995).

2.0 Location and description

Welbourn is approximately 15km south-south-east of Lincoln. The site of proposed development is situated at the west edge of the village, immediately to the south of Hall Orchard Lane, and comprises a 1ha component of a 1.95 ha paddock. In the event of any development, an area in the north-east of the site would remain open space (Fig.2).

The site is bounded to the north by a drain and hedge. Fencing and hedging define the eastern boundary, beyond which lie houses and gardens. Welbourn C of E School lies to the south-east of the site. The southern and western edges are unbounded, although a disused railway embankment extends along the latter. A single strand electric fence (switched off) extends along all the bounded edges of the site, and electricity poles are located on the eastern edge.

The modern ground surface gently undulates, reflecting partially levelled earthworks, which are more apparent in the north-east corner of the site. In this area also, a main sewer is known (Fig.2).

The site appears to lie at a geological junction of Jurassic Marlstone Rock Bed, comprised of Ferruginous oolitic limestone, ironstone and calcareous sandstone, and underlying deposits of Jurassic Middle Lias grey sandy clay and micaceous clay (B.G.S., 1972).

Central National Grid Reference ~~SK 9660 54~~. SK9658 5434

3.0 Archaeological and historical background

The site is within 100m of Welbourn Castle, a medieval ringwork that possibly dates from soon after the Norman Conquest. The southern components of an earthwork, which is no longer visible, appear to correspond to the current position of Hall Orchard Lane. It is possible that this earthwork represents an outer bailey or moated area of the castle (Source: *Archaeological Project Brief for Geophysical Survey on*

Land off Hall Orchard Lane, Welbourn, Lincolnshire. North Kesteven Heritage Officer).

Aerial photographs of the site, taken in 1932 and 1967, show cropmark evidence of ridge and furrow ploughing and the corner of a square enclosure, which is located in the north-east corner. Despite extensive levelling, most of the remaining undulations appear to correspond with the ridge and furrow cropmarks (*Ibid*). Uneven ground toward the north-east of the site may also reflect the enclosure (see above).

4.0 Methodology

Detailed area survey using a fluxgate gradiometer is a non-intrusive method of evaluating the archaeological potential of a site. The fluxgate gradiometer detects magnetic anomalies created by areas of high or low magnetic susceptibility. These areas are caused by changes in the composition of the subsoil or the underlying geology. Archaeological features result from man-made changes to the soil and the introduction of intrusive materials such as brick and stone. These features can create detectable magnetic anomalies. In addition, activities that involve heating and burning will create magnetic anomalies, as will the presence of ferrous metal objects.

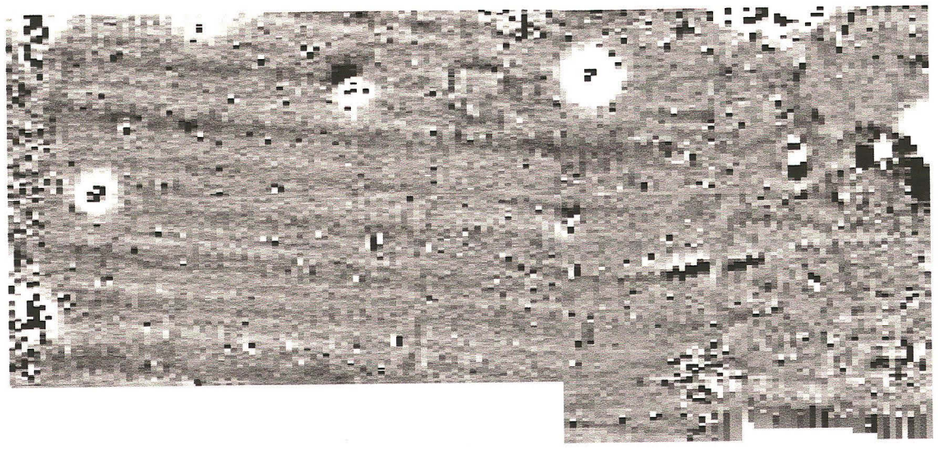
The anomalies detected by a fluxgate gradiometer survey can often be resolved into entities sharing morphological characteristics with features of known archaeological provenance. This enables the formulation of an informed, but subjective, interpretation.

Magnetic variation between archaeological or naturally occurring features and natural geological strata can result from:

- their relative depth or density of fill
- the magnetic properties of materials introduced as a result of human activity (e.g. rubble, stone, brick/tile, ferrous metal etc.) in contrast to those within surrounding natural deposits
- magnetic enhancement associated with areas of burning
- the magnetic properties of localised, naturally deposited, minerals, such as those occurring in the fills of palaeo-channels.

The area survey was conducted using a *Geoscan Research* fluxgate gradiometer (model FM36) with an electronic sample trigger set to take four readings per metre (a sample interval of 0.25m). The zigzag traverse method of survey was used, with 1 wide traverses across 30m x 30m grids. The sensitivity of the machine was set to detect magnetic variation in the order of 0.1 nanoTesla. A base line was established along the northern edge of the survey area (Fig.2). Pegs were placed at all grid corners to facilitate relocation of the survey.

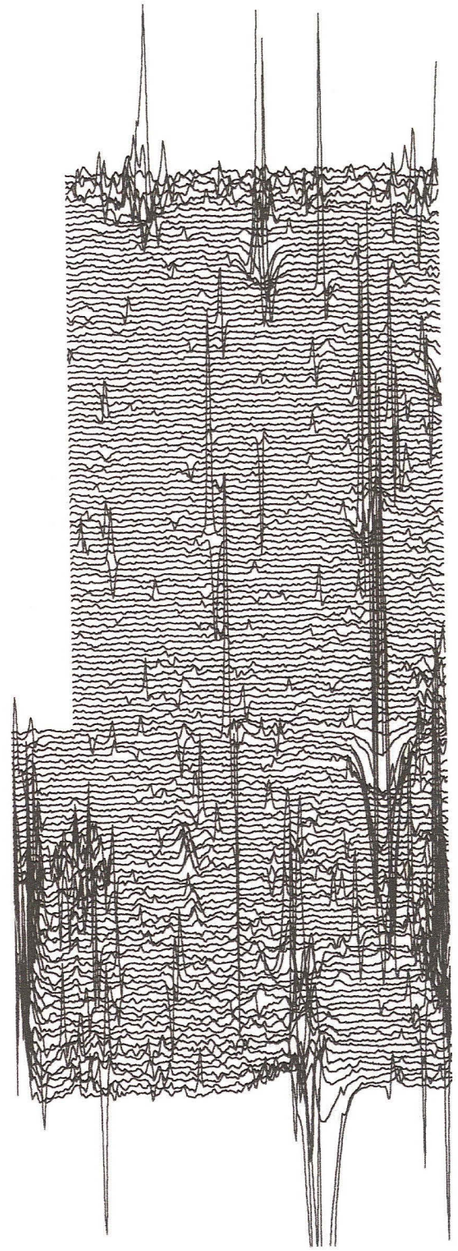
Data from the survey was processed using *Geoplot* (*v. 3.0*). It was desloped (a means of compensating for sensor drift during the survey) and clipped to reduce the



30m

N

Fig. 3: Greyscale image of clipped data 1:1000



N

30nT/cm

30m

Fig.4: trace plot of the raw data 1:1000

distorting effect of extremely high or low readings caused by discrete pieces of ferrous metal. The results are plotted as greyscale and trace images.

The site was surveyed by David Bunn on 28th March 2001.

Instrument	Geoscan Research fluxgate gradiometer FM36 Sample trigger ST1
Grid size	30m x 30m
Sample interval	0.25m
Traverse interval	1.0m
Traverse method	Zigzag
Sensitivity	0.1nT
Processing software	Geoplot (*v. 3.0*)
Weather conditions	Fair, occasional showers
Area surveyed	c.0.95ha

Table 1: Summary of survey parameters

5.0 Results

The survey detected a range of magnetic anomalies, some of which appear to reflect archaeological features of diagnostic form.

The results are presented as:

- greyscale images of the clipped and smoothed data (Figs. 3 and 5)
- an image of the raw data, with the strongest anomalies highlighted in colour (Fig.6),
- a trace plot of the raw data (Fig.4),
- an interpretive image of the clipped data (Fig.7).

Figure 6 and a corresponding trace plot of the raw data (Fig. 4) graphically indicate the differences in magnetic variation across the survey. The strongest anomalies probably reflect modern features/debris. For example, (**1**) was detected along the western edge of the survey, and this relates to materials contained within the railway embankment (Fig.2).

A series of anomaly groups (**2, 3, 4, 5**) were recorded along the south-eastern, eastern and northern edges of the site, and in close proximity to a wire fence (**2**), electricity poles (**3**) and a drain (**4/5**). Anomaly groups **4** and **5** may result from the presence of rubble debris that has been extracted during drain maintenance.

Anomaly **6** relates to a manhole cover that was noted at the time of survey. **6** and possibly **6a** (which remains hidden) appear to reflect the position of an associated,

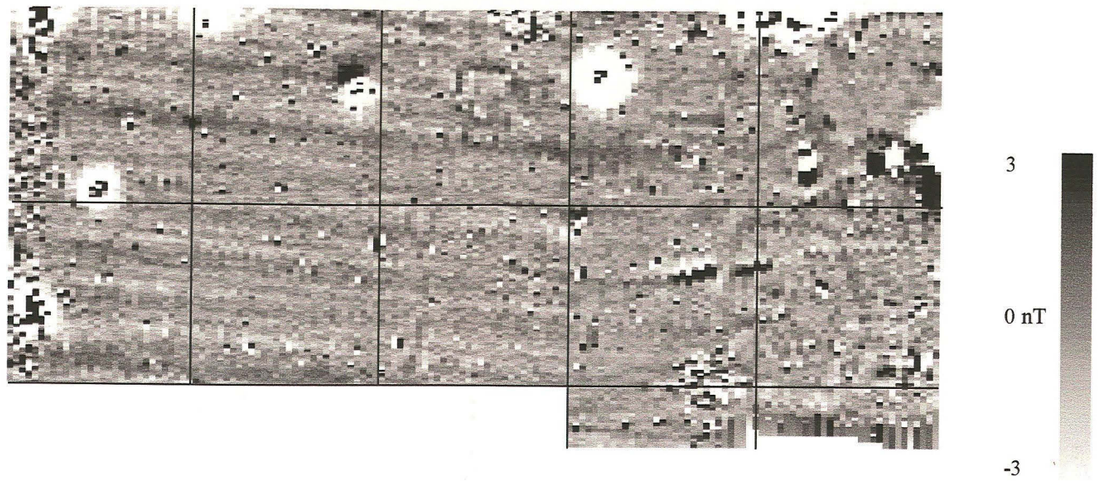


Fig.5: Greyscale image of clipped and smoothed data 1:1000

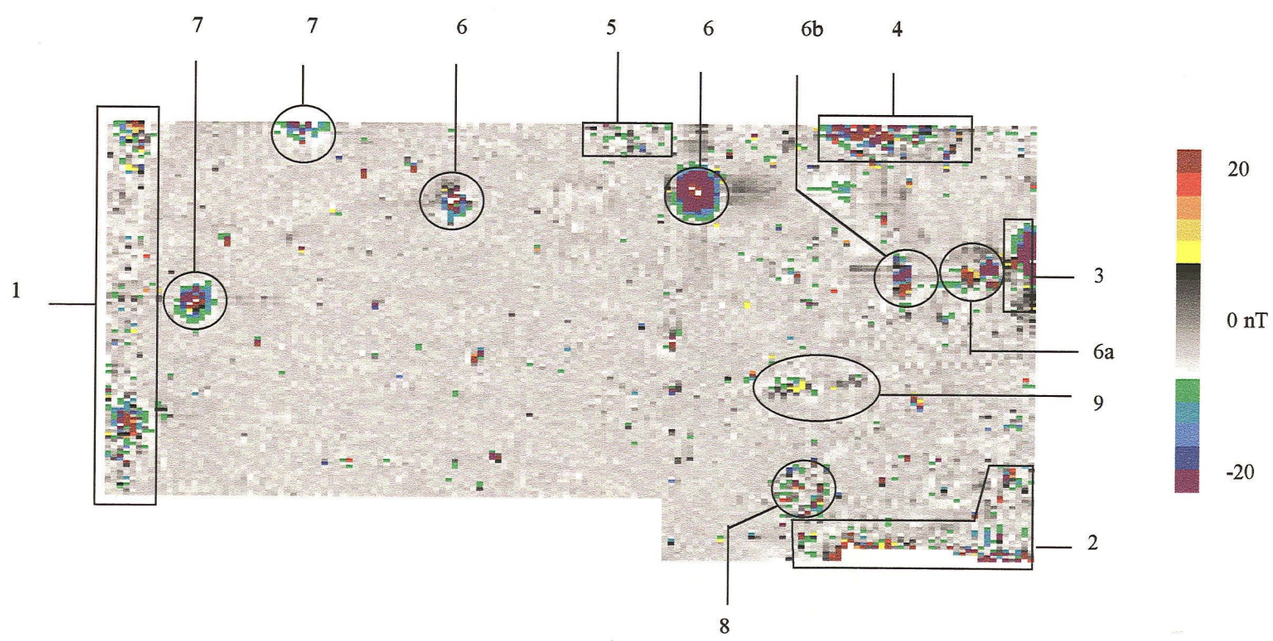
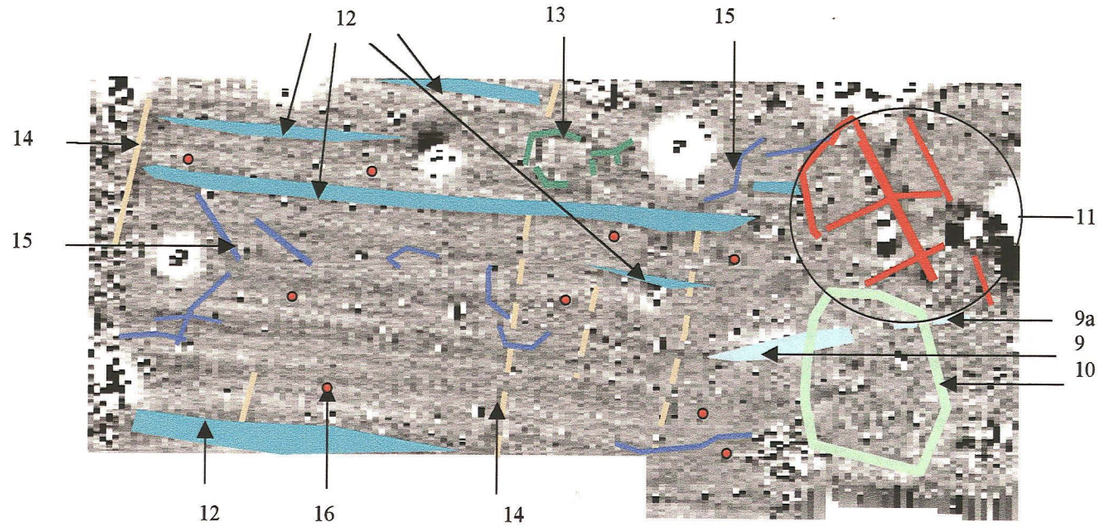


Fig.6: Image of raw data showing strongest anomalies (colour) 1:1000



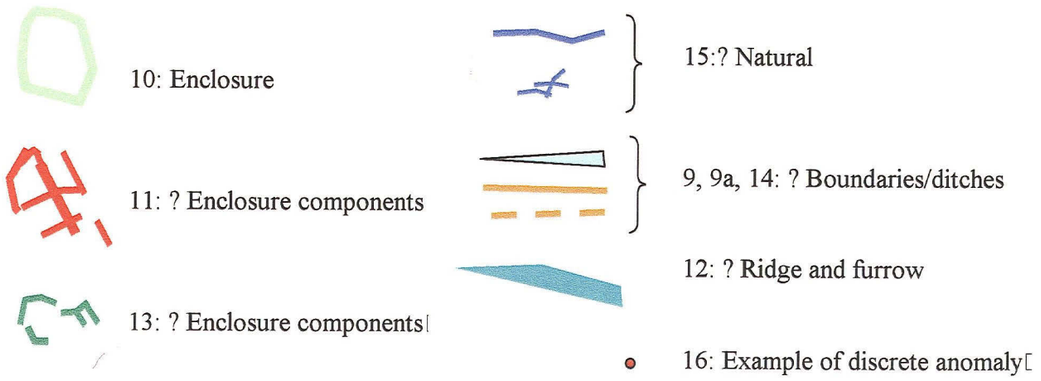
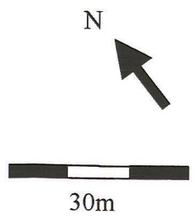


Fig.7: Interpretive plan 1:1000



though undetected sewer main. **6b** and elements of **3** could also be related to this service.

Two localised anomalies towards the north of the site (**7**) probably relate to ferrous/ceramic materials of modern origin, although nothing was noted on the surface. Smaller examples (dotted elsewhere on the survey) probably mark the location of plough shares, horseshoes etc.

Anomaly **8** occurred close to a boundary and probably reflects sub-surface rubble debris. Slightly stronger than **8**, **9** possibly represents a more significant feature, such as a ditch. This appears to pre-date an enclosure-type feature, **10**, that occupies much of the south corner (Fig.7).

Linear **9a** may represent an easterly continuation of **9**. However, the magnetic strengths, and to a lesser extent the orientation, of **9** and **9a** are not evenly matched.

Elements of anomaly group **11**, detected to the north of **10**, may reflect traces of the enclosure previously identified from aerial photographs (see Section 4). The others may represent similar features. However, the diffuse nature of these anomalies, and the distorting effects of **3**, **4**, **6a**, and **6b**, has impaired a clear definition of their morphology.

Well-defined ridge and furrow has been detected in the western two thirds of the site. The north-west to south-east alignment of these linears respects the current position of Hall Orchard Lane. The clearest examples are highlighted in colour (**12**).

A group of short curvilinear anomalies (**13**) was detected in the central-northern part of the site. Some of these appear to define a small sub-circular enclosure. The anomalies on the eastern and south-eastern edge of this feature are less clearly defined. The easternmost element of the group may be masked by anomaly **6**.

A number of diffuse linear anomalies were detected elsewhere on the site. Anomaly group **14** runs perpendicular to the ridge and furrow and Hall Orchard Lane. These anomalies may represent land drains.

Anomalies **15** exhibit an irregular morphology that possibly results from natural processes, such as geological reticulation. This interpretation is tentative.

A random distribution of discrete anomalies was detected (**16**). Such anomalies often mark the location of *in-situ* burning, or burnt materials, the magnetically enhanced fills of pits, or pieces of ferrous or ceramic debris in the topsoil. The latter are often introduced as a result of agricultural activities, such as midden spreading.

6.0 Conclusions

The survey has identified significant levels of magnetic variation across the site. While some of this variation is definitely associated with modern activities (e.g. services, drain maintenance and railway construction), there are anomalies present that appear to be of potential archaeological significance.

The north-western part of the site appears to be dominated by ridge and furrow that is orientated north-west to south-east. While there are some subtle/underlying anomalies in this area, it is possible that many or most of these could represent natural features such as ice wedges (similar features have been noted over limestone at Navenby, for example, where they respond well to gradiometry (Snee and Bunn,1999)).

The south-east end of the site incorporates a series of anomalies that appear to define enclosures. One of these, **10**, appears to be relatively simple in plan, and it appears to post-date linear anomaly **9**. The other enclosure or enclosure group, **11**, is more complex, and the survey results in this area have been compromised by the presence of relatively modern anomalies/features (**4, 3, 6a**).

In summary, the data suggests that the majority of the site is dominated by ridge and furrow. The exception is the eastern sector. Some of this sector is to be allocated as public open space; however, the suggested enclosure **10** may be vulnerable to development proposals, as these currently stand.

7.0 Acknowledgements

Pre-Construct Geophysics would like to thank Ploughsound Ltd. for this commission.

8.0 References

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