STRATASCAN

Geophysical Survey Report

North Killingholme, Grimsby, Lincolnshire

for

Able UK Ltd

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1 SUMMARY OF RESULTS

A detailed magnetometry survey carried out over 10ha on land near North Killingholme, Lincolnshire has successfully located a number of geophysical anomalies. Although positive anomalies indicating possible cut features were evident in all survey areas, features that are characteristically archaeological are most evident in the north of the survey area. The presence of a possible settlement site is indicated by linear and rectilinear positive anomalies in Area 5 (G5) and a possible ring ditch is also evident in Area 4 (G4).

2 INTRODUCTION

2.1 Background synopsis

Stratascan were commissioned by Able UK Ltd to undertake a geophysical survey of an area outlined for development. This survey forms part of an archaeological investigation overseen by RPS Planning, Transport and Environment on behalf of Able UK Ltd.

2.2 Site location

The site is located close to North Killingholme, near Grimsby, Lincolnshire and approximately centred on OS ref. TA 158 193.

2.3 Description of site

The survey area is 10ha of flat arable and grassland . The underlying geology is Chalk with overlying Boulder Clay and Morainic Drift to the west of the site and marine alluvium to the east (British Geological Survey South Sheet, Third Edition Solid, 1979; First Edition Quaternary, 1977). The overlying soils to the west are known as Holderness soils which are typical stagnogley soils which consist of slowly permeable seasonally waterlogged fine loamy soils and similar soils with only slight waterlogging and narrow strips of clayey alluvial soils. The overlying soils to the east are known as Newchurch 2 soils and are Pelo-calcareous alluvial gley soils which consist of deep stoneless mainly calcareous clayey soils (Soil Survey of England and Wales, Sheet 1 Northern England).

2.4 Site history and archaeological potential

No specific details were available to Stratascan.

2.5 Survey objectives

The objective of the survey was to locate any features of possible archaeological significance in order that they may be assessed prior to development.

2.6 Survey methods

Detailed magnetometry was used as an efficient and effective method of locating archaeological anomalies. More information regarding this technique is included in the Methodology section below.

3 METHODOLOGY

3.1 Date of fieldwork

The fieldwork was carried out over 9 days from the 6th to the 19th May 2004. Weather conditions during the survey were warm and dry.

3.2 Grid locations

The location of the survey grids has been plotted in Figure 2 at a scale of 1:6000 together with the referencing information for each survey grid in Figures 3, 9, 15, 21, 27 at 1:2000 or 1:1000.

3.3 Description of techniques and equipment configurations

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 (thermoremnant features). 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 dual FM256 Fluxgate Gradiometers, manufactured by Geoscan Research and a dual sensor Grad601-2 Magnetic Gradiometer manufactured by Bartington Instruments Ltd. The FM256 gradiometers are suspended

on a frame CF6. One gradiometer acts as a master trigger that controls the second slave gradiometer. The instruments each consist of two fluxgates mounted 0.5m vertically apart, and very accurately aligned to nullify the effects of the Earth's magnetic field. Readings relate to the difference in localised magnetic anomalies compared with the general magnetic background. The Grad601-2 consists of two high stability fluxgate gradiometers suspended on a single frame. Each sensor has a 1m separation between the sensing elements giving a strong response to deep anomalies.

3.4 Sampling interval, depth of scan, resolution and data capture

3.4.1 Sampling interval

Readings were taken at 0.25m centres along traverses 1m apart. This equates to 3600 sampling points in a full 30m x 30m grid.

3.4.2 Depth of scan and resolution

The FM256 and Grad601-2 has a typical depth of penetration of 0.5m to 1.0m. This would be increased if strongly magnetic objects have been buried in the site. The collection of data at 0.25m centres provides an appropriate methodology balancing cost and time with resolution.

3.4.3 Data capture

The readings are logged consecutively into the data logger which in turn is daily down-loaded into a portable computer whilst on site. At the end of each job, data is transferred to the office for processing and presentation.

3.5 Processing, presentation of results and interpretation

3.5.1 Processing

Processing is performed using specialist software known as *Geoplot 3*. This 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 further processing which may include low pass filtering to reduce 'noise' in the data and hence emphasise the archaeological or man-made anomalies.

The following schedule shows the basic processing carried out on all processed gradiometer data used in this report:

1. *Despike* (useful for display and allows further processing functions to be carried out more effectively by removing extreme data values)

   Geoplot parameters:
   X radius = 1, y radius = 1, threshold = 3 std. dev.
   Spike replacement = mean

2. *Zero mean grid* (sets the background mean of each grid to zero and is useful for removing grid edge discontinuities)

   Geoplot parameters:
   Threshold = 0.25 std. dev.

3. *Zero mean traverse* (sets the background mean of each traverse within a grid to zero and is useful for removing striping effects)

   Geoplot parameters:
   Least mean square fit = off

3.5.2 Presentation of results and interpretation

The presentation of the data for each site involves a print-out of the raw data both as greyscale (eg Figure 4) and trace plots (eg Figure 5 and 6), together with a greyscale plot of the processed data (eg Figure 7). Magnetic anomalies have been identified and plotted onto the 'Abstraction and Interpretation of Anomalies' drawing for the site (eg Figure 8).

4 RESULTS

The magnetometry survey successfully located a number of anomalies across the five survey areas. These are classified into the following; positive and negative linear anomalies, positive and negative area anomalies, areas of magnetic disturbance and debris relating to ferrous and thermoremnant materials and strong discrete positive anomalies with negative returns relating to ferrous objects within the topsoil. For ease of clarity the results from each area will be dealt with individually.

Area 1 (D2) (Figures 3-8)

The results show a large volume of positive and negative area anomalies across this survey area. These irregular anomalies are likely to be responses to palaeo-fluvial anomalies such as former channels and marshes. The site is currently 600m west of the River Humber and 3m above sea level.

Several positive and negative linear anomalies can be seen towards the southern edge of the survey grid. It is difficult to distinguish the nature of these anomalies from the area anomalies mentioned above. They may also be responses to natural environmental changes although this cannot be certain and their more linear form may indicate a man made origin.

A positive and parallel negative linear anomaly can be seen running across the site and corresponds to the "drain" that leads from the nearby power station indicated on the base mapping. This anomaly appears in the form of a cut feature with parallel embankment and is likely to represent the backfilled ditch and subsoil created when the drain was constructed. A strong linear area of magnetic disturbance can be seen approximately 30m to the north and parallel with it. This anomaly is characteristically a response to a buried service or ferrous pipeline.

Area 2 (D4, D5) (Figures 9-14)

This area extends across three separate fields and will be discussed in the following text as northern, central and southern survey areas. Anomalies located have been annotated (a) to (i) for ease of reference (Figure 14).

Two curvilinear anomalies (a) are located in the west of the southern survey area. These low magnitude anomalies may relate to cut features and although their origin is uncertain, archaeology cannot be ruled out.

Several small positive area anomalies (b) can be seen in the centre of the southern survey area. These may relate to cut features such as pits or represent the remains of fragmented linear features but this is not certain. Other small positive area anomalies (c) may also have a similar origin.

A series of positive and negative anomalies (d) can be seen towards the southern edge of the central survey area. It is difficult to be certain of the origin of these anomalies, they appear to extend beyond the limits of the survey area and although they may also relate to natural changes within the environment, their regular form indicate that they may have an archaeological origin.

A positive linear anomaly (e) is located in the west of the southern survey area and oriented northeast – southwest. It is difficult to be certain of the origin of this anomaly, is may be a response to a cut feature that has been infilled with thermoremnant material from the area of magnetic debris indicated by anomaly (f) to the north of it.

Areas of magnetic debris (f) can be seen across the entire survey area. The strong responses to these anomalies indicate the presence of thermoremnant material. Several areas of magnetic disturbance (g, h and i) are responses to adjacent pylon, buried service/pipeline and to a modern/buried ferrous object respectively.

Area 3 (G2) (Figures 15-20)

Several faint positive linear anomalies are located towards the centre of the survey area. It is difficult to be certain of the origin of these low magnitude anomalies although they may be a response to cut features. Several small positive area anomalies can be seen towards the east of the survey area. Again these anomalies may relate to cut features although this is not certain.

A series of positive linear anomalies can be seen extending across the entire survey area and oriented northwest – southeast. These regular linear responses are characteristic of anomalies created by former agricultural activity.

Several areas of magnetic debris indicate the presence of thermoremnant material. Strong discrete positive anomalies with negative returns are a response to ferrous objects within the topsoil.

Area 4 (G4) (Figures 21-26)

A curvilinear positive anomaly is located towards the northern limit of the survey area. It appears to contain two small low magnitude positive anomalies indicative of pits and may also be associated with two positive linear anomalies to the south of it. These linear anomalies extend towards the circular feature although do not appear to intersect with it. This circular feature is characteristic of a ring ditch and is likely to have an archaeological origin. It is also possible that the linear anomalies and interior pit like features have an archaeological origin also.

A series of positive linear anomalies can be seen extending across the survey area. These anomalies are on a similar orientation to those in Area 3 (see Figure 33) and are likely to have the same origin and have been caused by agricultural activity.

A large area of magnetic debris dominates the western half of the survey area. This is a response to large amounts of thermoremnant material which may have obscured low magnitude anomalies within the vicinity. Although this type of response is often associated with modern activity and dumping, it should be considered that this may relate to more ancient 'industrial' processing or production.

A strong response to a service or pipeline can be seen close to the south eastern corner of the survey area. Strong positive anomalies with negative returns are responses to ferrous objects within the topsoil.

Area 5 (G5) (Figures 27-32)

A series of positive linear, curvilinear and rectilinear anomalies are located in the centre of the survey area and oriented approximately east to west and north to south. These anomalies are likely to be responses to in-filled cut ditches with increased depth of topsoil within the fill, combined with magnetic enhancement of the soil due to biological activity or burning, resulting in a good contrast with the surrounding areas. This grouping of anomalies may represent a settlement site some elements of which suggest a later prehistoric to early Romano-British date. The main axis of orientation of these

anomalies is on an east-west alignment with other linear anomalies perpendicular to it. Several faint positive linear anomalies are located to the north of the main site and are likely to be associated with it. The low magnitude of these anomalies may be due to their distance from the main habitation site leading to less enhanced soils.

Several low magnitude positive area anomalies are located within the settlement site, some of which appear as fragmented linear anomalies whilst others may represent pits. Several other low magnitude positive area anomalies can be seen outside the settlement area and may also relate to pit like features.

An area of strong magnetic disturbance can be seen in the southern corner of the survey area and is a response to a service associated with the nearby power station. Areas of magnetic debris are responses to thermoremnant material and strong discrete positive anomalies are responses to ferrous objects in the topsoil.

5 CONCLUSION

The detailed magnetometry survey successfully located a number of anomalies in each of the survey areas. Anomalies located towards the east of the survey area in Area 1 (D2) indicate changes in the environment possibly due to in-filled salt marshes or caused by former fluvial activity. All areas had positive anomalies that may be associated with cut features although Areas 5 (G5) and Area 4 (G4) have the greatest potential for archaeology. Area 5 (G5) contains cut features that may be associated with a settlement site, while Area 4 (G4) contains a circular feature that may represent a ring ditch. Further archaeological investigation targeted over anomalies would enable them to be fully evaluated and set in context.