GEOPHYSICAL SURVEY OF A PLAYING FIELD AT AILEY HILL, RIPON

A programme of research carried out on behalf of

York Archaeological Trust

by

GeoQuest Associates

INTRODUCTION

A geophysical survey has been carried out of school playing fields at Ailey Hill, Ripon prior to a proposed expansion of the Cathedral School. The research was undertaken on behalf of York Archaeological Trust, under the direction of Martin Stockwell, the aims being to detect and map sub-surface features of archaeological interest.

The study area is located approximately 120m east of The Cathedral of St Peter and St Wilfred and is consequently in a position of high archaeological potential. The geophysical survey was designed to test for the presence of surviving medieval features in the subsoil which might include post holes, timber slots, stone walls, burials, and rubbish pits.

The areas examined by geophysical survey are shown in Figure 1.

LANDUSE, TOPOGRAPHY AND GEOLOGY

The study area occupies approximately 1.36ha of undulating grassland at a mean elevation of about 27m AOD. The area is presently used as a playing field by the school and is divided into a number of sports pitches bordered by fences and scrub vegetation.

Information provided by the Geological Survey shows that the study area is underlain by Permian mudstones. There are no rock outcrops, major building structures or surface utilities.

THE GEOPHYSICAL SURVEY

Choice of Technique

The primary aim of the geophysical survey was to locate archaeological features of possible medieval date which might include stone and timber building, trackways, rubbish pits and ditches which should each be characterised by significant contrasts in magnetic susceptibility. Over a period of time, such features would have been covered or filled by topsoil to the extent that little or no surface expression survives. Previous research has shown that in the majority of cases a significant magnetic susceptibility contrast exists between the undisturbed subsoil and such archaeological features: an apparent 'lack of magnetisation' can be detected over sedimentary stone foundations in contrast to the surrounding soil, which in turn is usually not as magnetically susceptible as the fills of ditches and pits.

Research has also shown that there are significant contrasts in electrical resistivity

between stone structures or paving and the surrounding undisturbed subsoil. Such anomalies arise due to relative differences in water content.

Since both stone structures and soil-filled features may be present in the study area, it was decided to employ a combination of geomagnetic and resistivity survey techniques to provide an optimum data set for the location of buried archaeological features.

Field Methods

A geophysical survey grid, comprising 100x20m blocks, was first established using an optical square and tapes. The accuracy of this grid in relation to features recorded on the Ordnance Survey is estimated to be ±0.5m. Several paint marks and wooden pegs were left *in situ* at grid intersections to enable relocation of features detected by the geophysical survey (circle-cross symbols in Figures 1-6).

A geomagnetic survey of the entire site was first carried out using a Geoscan FM36 fluxgate gradiometer fitted with an ST1 sample trigger (Appendix A provides further information about the technique). A zig-zag traverse scheme was employed and data were logged in grid units of 20x20m at 1.0x0.5m intervals.

Measurements of soil electrical resistivity were then made over 30% of the study area using a Geoscan RM15 resistivity meter. A zig-zag traverse scheme was again employed and data were logged in units of 20x20m at 1.0x0.5m intervals. Preliminary tests indicated that the maximum variance in measured resistance values was achieved using a 0.5m spacing of the mobile probes and this value was therefore used for the entire resistivity survey. (Appendix B provides further information about this technique.)

All geophysical data were downloaded on-site into a Toshiba Satellite 110CT laptop computer for quality control, initial processing and storage. These data were subsequently transferred to a laboratory computer for further processing, interpretation and archiving.

Data Processing

The GeoQuest **InSite®** Windows software was used to process the geophysical data and produce continuous tone grey-scale images of the raw geomagnetic and resistivity data at a scale of 1:500 (Appendix C provides further information about data processing). These results are shown in Figures 2 and 3 on drawings digitised from plans supplied by York Archaeological Trust.

The following basic processing steps were applied to the data:

Removal of Random 'Spikes' present in the geomagnetic data due to small ferrous objects on or near the surface or in the resistivity data owing to occasional poor

electrode contact. This process replaces spikes with the mean of near-neighbours.

Adjustment of Grid Mean Values to achieve an optimum match along the lines of contact between data grids (geomagnetic and resistivity data).

Interpolation of the data, using a bilinear function, to generate a regular mesh of values at 0.25x0.25m intervals (geomagnetic and resistivity data).

Printing of the processed data on a Hewlett Packard HP650C DesignJet plotter with 256 grey shades and 600 dpi resolution. A sigmoid function was used to map the data to printed grey tones since this provides a measure of contrast equalisation.

Figures 2 and 3 include keys which relate the grey scale intensities to anomaly values in nano Tesla and Ohms.

Figure 4 shows the resistivity data after application of a north-south aligned shadowing algorithm. This has the effect of emphasising subtle anomalies of possible archaeological interest.

INTERPRETATION

Key to Figures

The first stage in the interpretation has been to extract significant anomalies in the geomagnetic and resistivity data and present them on a plan using coded colours and patterns (Figure 5). An archaeological interpretation has then been prepared as shown in Figure 6. The classes of anomalies which have been distinguished are depicted as follows:

1 **Green:** Significant regions of anomalously *high magnetic field gradient* which might be associated with high susceptibility soil-filled structures such as *pits or ditches.*

2 **Blue:** Areas of anomalously *low magnetic field gradient,* corresponding to material with low magnetic susceptibility, such as *sedimentary stone foundations, trackways or rock rubble.*

3 **Red:** Strong *dipolar anomalies* (paired positive-negative) which mostly reflect *ferrous litter* such as fence-wire and chain links or *fired materials* such as clay brick/tile.

4 **Brown:** Significant regions of anomalously *high electrical resistivity* reflecting a reduced soil water content at the time of survey. Such anomalies might relate to stoney features such as *walls, stone drains or trackways.*

5 **Orange:** Areas of anomalously *low electrical resistivity* reflecting a relative increase in soil moisture content. In appropriate contexts these can be interpreted as *pits or ditches*.

Discussion

A number of features of archaeological interest have been detected in the study area:

1 Significant concentrations of ferrous litter or burnt material (some of which may be of archaeological origin) have been detected. This material is particularly abundant in areas immediately within the boundary fences of the site.

2 A c. 3m wide curvilinear, positive magnetic lineation has been detected traversing the eastern and northern parts of the area. The form and magnitude of the anomaly is consistent with a ditch (**f1**) which appears to partly enclose the central part of the study area. This feature is not visible in the electrical resistivity data.

3 A further positive magnetic lineation, of width c. 3m, has been detected extending S from the NW limit of feature **f1**. This anomaly may reflect the presence of a ditch (**f2**) that represents a continuation of the enclosure system described above.

4 Both the resistivity and geomagnetic surveys have mapped a pattern of connected lineations that appear to form a rectangular network in the central part of the study area. Of particular interest are features **f3** and **f4** which are visible as negative gomagnetic and positive resistivity lineations, implying the presence of wall footings or rubble-cored banks. The remainder of the network is defined by further wall and ditch style features **f4**, **f5** and **f6**. This pattern suggests the survival of a small field system or garden plan of uncertain date.

5 Several high resistivity anomalies of amorphous form have been detected and may mark the positions of demolition debris, quarrying or areas of shallow bedrock (**f8** & **f9**)

6 The geophysical surveys have located several anomalies that are consistent with pits or infilled quarries (eg. **f7**).

7 No further anomalies of archaeological interest have been detected by the geophysical surveys.

8 No geophysical anomalies consistent with buried services have been detected by the resistivity or geomagnetic surveys.

SUMMARY AND CONCLUSIONS

The results of this research are summarised below:

1 Geomagnetic and electrical resistivity surveys have been made of a playing field at Ailey Hill in Ripon, prior to a construction of a proposed school extension.

2 The geophysical surveys have found evidence to suggest that a number of enclosure ditches, pits and wall footings may be present in the central part of the study area.

3 No buried services or further features of archaeological interest have been identified by the surveys.

CREDITS

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