Adwalton Moor
Drighlington,
West Yorkshire.

(SE 2100 2920)

Gradiometer Survey

Contents

Summary

A gradiometer survey was carried out over sample areas totalling 4.4 hectares at Adwalton Moor near Drighlington, a possible site of a major Civil War battle, in advance of development proposals. Although many linear anomalies have been identified it is thought that they reflect former agricultural practices (ridge and furrow ploughing) and recent attempts to improve drainage over the site rather than archaeological features. An area of possible industrial activity has been identified as has an anomaly thought to be a trackway of unknown date. No other anomalies of likely archaeological origin have been detected.

Archaeological Services WYAS
14 St John's North, Wakefield WF1 3QA

1. *Introduction & Archaeological Background*

1.1 Archaeological Services (WYAS) was commissioned by Mr. R. Gregory of Commercial Development Projects Ltd. to conduct an archaeological evaluation at Adwalton Moor, near Drighlington (see Figs 1 and 2).

1.2 The archaeological evaluation of the application area (*c*. 11ha) was in advance of a proposal for an industrial development and consisted of a desktop assessment, walkover appraisal and metal detector and magnetometer survey. It was agreed with the client that the gradiometer survey should initially cover a 40% sample of the site in blocks of no less than 40m by 40m.

1.3 The gradiometer survey was carried out between May 5th and May 8th 1998. At this time the site was under rough pasture.

1.4 The drift geology of the site comprises an unknown depth of topsoil overlying ?.

1.5 Archaeology stuff.....

2. *Results & Discussion*

2.1 The gradiometer data are presented in Figure 2 as a dot density plot super-imposed on an Ordnance Survey digital map base at a scale of 1:2500. A dot density plot and an interpretative overlay are presented at the same scale in Figures 3 and 4. The data are also presented as dot density and X - Y trace plot formats at a scale of 1:500 in Appendix 3.

2.2 The site is divided into several fields by a stream (Inmoor Dyke), relict hedges and by open field drains; not all of these are marked on the Ordnance Survey Digimap although they were surveyed when the site was tied-in and are shown as part of Appendix 2. Almost without exception all the identified anomalies are aligned either parallel with, or at right angles to, one or more of these features (see below).

2.3 North of Inmoor Dyke the strongest anomalies are the positive linear responses which are aligned from west to east, the same orientation as the dyke. These responses are caused by the practice, that dates back to the medieval period, of ploughing using a moulder board rather than a share which was a later development to break up the sod. Over time this method of ploughing leads to the formation of distinctive ridges and furrows whose magnetic traces can still be detected even after there are no longer any visible remains. These anomalies are particularly prominant in the north-eastern corner of the site despite a degree of magnetic disturbance and several strong isolated responses which are probably associated with the earthworks in this part of the field which are thought to be recent in origin.

2.4 On the same alignment is a dipolar, linear response identified in two sample blocks. This is caused by a drain, the continuation of which can be seen east of the A650 on Figure 2.

2.5 In the most north-westerly survey block are two parallel, negative linear anomalies on a north-west to south-east alignment. These anomalies are thought to be modern field drains.

2.6 South of Inmoor Dyke the anomalies are, with a couple of exceptions, aligned from south-west to north-east parallel with two open field drains (again shown on Figure 2) which are in turn perpendicular with the dismantled railway that defines the southern limit of the site. This orientation reflects the alignment of the field boundaries as shown on the first edition Ordnance Survey map. All these anomalies are thought to be either due to land drains of differing type or to ridge and furrow ploughing as defined in Section 2.1 above, although the stronger responses may indicate the location of the now extinct field boundaries.

2.7 The anomalies which do not conform to the south-west to north-east orientation are the parallel, linear, dipolar anomalies aligned roughly from west to east which are caused by ferrous drainage pipes and the pair of positive linear anomalies in the most south-western survey block. This latter pair of anomalies are about 5m apart and aligned from south-east to north-west. These could be ditches either side of a trackway/tramway of unknown date which is shown on the first edition Ordnance Survey map of the area branching north-eastwards from the railway.

2.8 East of the A650, in the projected area of the balancing ponds, further linear anomalies probably caused by land drains or ridge and furrow ploughing are visible south of Inmoor Dyke. To the north the whole of the area is severely magnetically disturbed reflecting the intense concentration of earthworks. The regularity of these earthworks could indicate some type of industrial activity, the responses possibly being due to iron slag or to the demolition of buildings.

2.9 Throughout the surveyed areas are numerous isolated dipolar responses, ‘iron spikes’, of varying magnitude. These are caused by ferrous material in the topsoil which are not usually archaeologically significant.

3. Conclusions

3.1 Many linear anomalies have been identified. However, with one exception these can be attributed, with a reasonable degree of certainty, to ridge and furrow ploughing, field drains and former field boundaries.

3.2 The one exception is the trackway in the south-western corner of the site. This feature is marked on the first edition Ordnance Survey map of the area. However, it is very close to the projected line of a Roman Road so an archaeological origin cannot be ruled out.

3.3 East of the A650 may be an area of industrial activity.

3.4 There is no obvious concentration of 'iron spikes' that could indicate that the site might be the location of the battle of Adwalton Moor. However, the absence of evidence does not necessarily indicate evidence of absence.

The results and subsequent interpretation of geophysical surveys should not be treated as an absolute representation of the underlying archaeology. It is normally only possible to prove the archaeological nature of anomalies through intrusive means such as by trial excavation.

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Project Management
Paul Wheelhouse Bsc

Report
Mark Whittingham BSc MA
Alistair Webb BA

Graphics
Mark Whittingham

Fieldwork
R. B. McNaught BSc
Alistair Webb
Mark Whittingham

Appendices

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Appendix 1

Gradiometer survey: technical information and methods

1. Technical Information

1.1 Iron makes up about 6% of the Earth's crust and is mostly dispersed through soils, clays and rocks as chemical compounds. These compounds have a weak, measurable magnetic response which is termed its magnetic susceptibility. Human activities can redistribute these compounds and change (enhance) others into more magnetic forms. These anthropogenic processes result in small localised anomalies in the Earth's magnetic field which are detectable by a gradiometer.

1.2 In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of topsoils, subsoils and rocks into which these features have been cut, which causes the most recognisable responses. This is primarily because there is a tendency for the more magnetic compounds to concentrate in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected. Less magnetic material such as masonry or plastic service pipes which intrude into the topsoil will tend to give a negative magnetic response relative to the background level.

1.3 The magnetic susceptibility of the soil can also be enhanced significantly by heating. This can lead to the detection of features such as hearths, kilns or burnt areas.

1.4 High, sharp responses are usually due to iron objects in the topsoil. These produce a rapid change from positive to negative readings ("iron spikes").

1.5 The types of response mentioned above can be divided into five main categories which are described below:

Iron Spikes (Dipolar Anomalies)
These responses are referred to as dipolar and are caused by buried or surface iron objects. Little emphasis is usually given to such responses as iron objects of recent origin are common on agricultural sites. Occasionally, however, iron spikes can indicate the presence of smithing activity by detecting hammerscale.

Rapid, strong variations in magnetic response
Also referred to as areas of magnetic disturbance, these can be due to a number of different types of feature. They are often associated with burnt material, such as industrial waste or other strongly magnetised material. It is not always easy to determine their date or origin without supporting information.

Positive, linear anomalies
The strength of these responses varies depending on the underlying geology. They are commonly caused by ancient ditches or more recent agricultural features.

Isolated positive responses
These usually exhibit a magnitude of between 2nT and 300nT and, depending on their response, can be due to pits, ovens or kilns. They can also be due to natural features on certain geologies. It can, therefore, be very difficult to establish an anthropogenic origin without an intrusive means of examining the features.

Negative linear anomalies
These are normally very faint and are commonly caused by features such as plastic water pipes which are less magnetic than the surrounding soils and geology. They too can be caused by natural features on some geologies.

2. Methodology

2.1 There are two main methods of using the fluxgate gradiometer for commercial evaluations. The first of these is referred to as *scanning* and requires the operator to visually identify anomalous responses whilst covering the site in widely spaced traverses, typically 10-15m apart. The instrument logger is not used and there is therefore no data collection. This method is used as a means of selecting areas for detailed survey when only a percentage sample of the whole site is to be surveyed. Scanning can also be used to map out the full extent of features located during a detailed survey.

2.2 The second method is referred to as *detailed survey* and employs the use of a sample trigger to automatically take readings at predetermined points, typically at 0.5m intervals, on zig-zag traverses 1m apart. These readings are stored in the memory of the instrument and are later dumped to computer for processing and interpretation.

2.3 During this survey a Geoscan FM36 fluxgate gradiometer and ST1 sample trigger were used to take readings at 0.5m intervals on zig-zag traverses 1m apart within 20m by 20m square grids. Eight hundred readings were taken in each grid and in-house software (Geocon Version 9) was used to interpolate the “missing” line of data so that 1600 readings in total were obtained for each complete grid.

Survey location information and sample strategy

Appendix 3

Gradiometer data plots (1:500)