Land north-east of Wenthill Plantation,

Darrington,

West Yorkshire.

(SE 4810 1825 site centred)

Geophysical Survey

Contents

Summary

A geophysical survey, covering an area of c. 8 hectares, was carried out along the ridge north-east of Wenthill Plantation. Aerial photographs show a concentration of cropmarks both on the site and to the north and south. Limited fieldwalking has recovered sherds of high status Roman pottery from the site. It was therefore considered possible that there may be a Roman villa within the area investigated..

The gradiometer survey has identified anomalies caused by infilled ditches which form a system of ancient land division and enclosure which extends along the whole length of the survey area. Numerous isolated discrete anomalies have also been identified. Although some probably have a geological origin many are thought to be caused by archaeological features such as pits, post-holes or other features indicative of human activity/occupation. There is also evidence for ridge and furrow ploughing and of geological features. No definite evidence for a villa has been identified from this geophysical survey.

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

1. Introduction & Archaeological Background

1.1 Archaeological Services (WYAS) was commissioned by Mr I. Sanderson, Principal Officer, WYAS Advisory Service, holders of the West Yorkshire Sites and Monuments Record, to carry out a geophysical (fluxgate gradiometer) survey in the field east of Wenthill Plantation (see Figs 1 & 2).

1.2 The site comprises a single large field bounded to the west by Wenthill Plantation and to the east by Westfield Lane and Wentbridge Road. An east/west aligned hedge delimits the northern edge of the survey area. The site enjoys a dominating aspect on top of a ridge (Went Hill) with good views both east and the west. To the south-west the land slopes steeply down to Moor Lane at the foot of the scarp whilst within the field the land slopes gradually down from the highest point in the north-west corner to the lowest point in the south-east corner of the field. However, there are a number of slight earthworks, including a possible flattened area, in the northern part of the site that are possibly related to cropmarks in the field (see below).

1.3 Aerial photographs held by the West Yorkshire Sites and Monument Record show numerous and complex cropmarks in all the fields along the ridge top at Went Hill, from the south-eastern corner of Wenthill Plantation to Round Ash Closes in the north-west. However, it is thought that some of these cropmarks are caused by fissures in the limestone bedrock.

1.4 Pot sherds, including a fragment of amphora, which have been identified as of probable Roman origin, were recovered during a limited fieldwalking exercise across part of the site undertaken by the Pontefract Young Archaeology Club in 1996. Unfortunately these finds have subsequently been lost.

1.5 The field was under stubble for the duration of the survey, which was carried out between August 9th and August 17th 1999, at which time the survey was curtailed by virtue of the field being ploughed.

1.6 The objectives of the geophysical survey were:

- to establish the presence and extent of any magnetic anomalies on the site and to characterise any such anomalies
- to enhance the archaeological record by defining any areas of occupation or enclosure along Went Hill.

2. Results (Figs 2, 3, 4 and 5)

2.1 The data has been presented in a greyscale format on an Ordnance Survey base map at a scale of 1:2500 in Figure 2. Figure 3 is a summary interpretation of the data showing only those anomalies that are most likely to be archaeological in nature; a full interpretation of all the anomalies is made in Figures 4 and 5 at a scale of 1:1000. Large scale, 1:500, dot density and X - Y trace plots of the data are produced in Appendix 4.

2.2 The survey was started towards the northern end of the site, on an area that appeared to have been flattened, as it was thought that the natural slope of the land had been artificially levelled to provide a possible site for occupation or enclosure. From this area the survey was extended to the north and south, adding blocks in order to trace the extent of magnetic anomalies as they were identified, until the survey was curtailed by the ploughing of the field.

2.3 A series of parallel linear anomalies can be seen across all parts of the site on a broadly west to east alignment, parallel with the extant field boundary that defines the northern edge of the site. These anomalies are created by the practice, begun in the Medieval period, of ploughing fields in a series of relatively narrow strips using a plough utilising a moulder board rather than a share to turn the sod. Over many years, if the exact form of the original strip is maintained, a characteristic ridged topography will result. Often, even when modern ploughing has destroyed any visual evidence for ridge and furrow ploughing, as in this case, magnetic traces can still be detected. The orientation of these anomalies is at variance with the alignment of the current agricultural regime which is parallel with the eastern edge of Wenthill Plantation; a few anomalies on this alignment are seen at the north-western end of the field. This change in the orientation of the ploughing regime over time is due to the removal of two intermediate field boundaries, (shown on the 19 1:10000 Ordnance Survey map), which were parallel with the extant hedgerow that marks the northern limit of the site, to create one large field. Interestingly all the field boundaries which sub-divide the land between Went Hill and Westfield Lane and between Westfield Lane and the Great North Road exhibit the characteristic reversed 'S' curved sides which indicates that they were formed by enclosing pre-existing open field strips (Taylor 1975).

2.4 Another non-archaeological anomaly is the sinuous, slightly curvilinear negative/positive response that meanders along part of the south-western edge of the survey area at the northern end of the field. This is possibly caused by an old field boundary or footpath.

2.5 The remaining anomalies are thought to be indicative of either infilled archaeological ditches or soil filled features that have a natural origin; the problems in differentiating between anomalies with a geological origin and those with an anthropological cause are discussed fully in Section 3.

2.6 The archaeological ditches form a series of field divisions and enclosures. Associated discrete anomalies are thought likely to be caused by features such as pits or areas of burning or other features indicative of human occupation. Unless referred to otherwise all the linear/curvilinear anomalies discussed are assumed to be caused by infilled archaeological ditches.

2.7 From Figure 3 it can be seen that there are seven linear anomalies, interpreted as infilled ditches, radiating at right angles away from the scarp edge on a south-west to north-east alignment. As the scarp edge turns slightly to the east at the southern end of the survey area the orientation of the ditches changes to maintain a broadly orthogonal bearing relative to the scarp edge. These ditches have been used to partition the site into seven areas of landscape division ('fields' - Fig. 3; A to G), from north-west to south-east, which are discussed in detail below; each ditch demarcating the south-eastern boundary of each area.

2.8 **Area A (Figs 3 and 4)**

2.8.1 Bisecting this area, 75m from and parallel to the scarp edge, is a major ditch division, the fill of which has a strongly enhanced magnetic susceptibility. This ditch continues to the north-western edge of the survey area. Parallel with this, 8m to the north-east, is a curvilinear ditch that terminates immediately north of a small enclosure, (30m by 35m), which is identified at the intersection of the two major ditches. Within this enclosure are other linear anomalies suggesting further internal ditched divisions. Numerous isolated anomalies have been identified both within this enclosure and to the west of the intersection which are thought to be caused by infilled discrete features such as pits or more general areas of burning.

2.8.2 At the northern edge of the area another ditch type response is thought to locate the southern boundary of a further enclosure. Further isolated responses indicate more features probably associated with occupation.

2.9 **Area B (Figs 3 and 4)**

2.9.1 No major divisions are evident within this area although the ditch does turn through a right angle at the south-western end before petering out after about 25m. This ditch is noticeably straighter than any of the other major ditches.

2.9.2 At the northern end, immediately south of the enclosure in Area A, there are isolated anomalies again probably indicative of human activity.

2.10 **Area C (Figs 3 and 4)**

2.10.1 In the south-western corner of this area there is again evidence for enclosure and possible occupation. At least three intersecting rectangular enclosures have been identified with discrete features within all of them. At the extreme south-western edge a short right angled anomaly, possibly indicative of another small enclosure, is visible. However, this is on a different alignment to the other three enclosures.

2.10.2 Approximately 5m north-east of the enclosure furthest from the scarp edge a linear ditch links this area with Area B although there are possible entrances at either end.

2.11 **Area D (Figs 3, 4 and 5)**

2.11.1 A linear ditch sub-divides this area 130m from the scarp edge. This ditch, aligned from north-west to south-east, continues on the same alignment, to form a similar division within Area E (see below).

2.11.2 Several linear and curvilinear anomalies have been identified, predominantly in the south-western third of the area. It is unclear whether these are archaeological ditches or natural features.

2.12 **Area E (Figs 3 and 5)**

2.12.1 Similar anomalies to those described in Section 2.11.2 above are found in the same region of this area.

2.12.2 In the north-east corner of this 'field' an inverted L-shaped ditch anomaly can be seen. This may indicate a small sub-enclosure. Several isolated anomalies of a probable archaeological origin can also be seen both within and immediately adjacent to this sub-enclosure.

2.13 **Area F (Figs 3 and 5)**

2.13.1 Two parallel ditches 105m apart can be seen dividing up this area. Both of these two ditches continue on the same alignment thus also subdividing Area G.

2.13.2 Adjacent to the scarp edge part of another probable enclosure can be seen. Both within this enclosure and between and adjacent to the other sub-dividing ditches many isolated anomalies suggest fairly intensive human activity in this area.

2.14 **Area G (Figs 3 and 5)**

2.14.1 Immediately south of the enclosure further isolated anomalies can be seen together with further ditched divisions.

2.14.2 Parallel, and 5m south-east of the ditch demarcating the southern boundary of this area is a second ditch. This may suggest a trackway with a ditch either side of the trackway.

3. Discussion

3.1 On some geologies, such as Magnesian Limestone, it can be extremely difficult to differentiate between anomalies that have a natural origin and those that result from human activity. This is due to the physical and chemical properties of the limestone that render it susceptible to erosion by water and ice, particularly along lines of weakness such as bedding planes or faults. The action of these agents can result in the formation of features, such as fissures, gullies or solution hollows, which when filled with soil, can appear as magnetic anomalies which are extremely difficult to distinguish from the magnetic anomalies caused by infilled man made features such as ditches or pits. In this case it is thought that many of the cropmarks identified on aerial photographs of the area are caused by soil filling fissures or solution hollows formed as the glaciers retreated at the end of the last Ice Age. The strength and characteristic of the magnetic response of such natural features is often similar or identical to that from an infilled archaeological feature thereby making a definitive interpretation of the data impossible.

3.2 In attempting to determine the origin of some of the anomalies identified during the course of this survey one of the main criteria has been the shape of the anomaly and whether it conforms to a regular pattern which could be thought to indicate an anthropogenic origin. For this reason it is entirely possible that there are more archaeological anomalies than have been definitively interpreted.

3.3 The majority of the linear anomalies interpreted as probably being natural are located in the northern half of the site, many adjacent to linear anomalies which are almost certainly archaeological in origin. Whether this implies that more of them have an archaeological origin than has been interpreted is unclear. Indeed many of these anomalies are on similar alignments possibly suggesting a different phase of activity. Alternatively it is thought more likely that the broad similarity in alignment merely reflects the direction of jointing in the bedrock. It is also possible that these natural features helped drain those parts of the site and that this factor influenced the areas chosen for occupation. Whatever the origin of these anomalies none appear to form part of the regular system of land division and enclosure interpreted below.

3.4 The site has obvious locational advantages for settlement and enclosure; the ridge itself has a dominating aspect with extensive views to the east and west and the scarp edge affords protection to the south-west with the land sloping gradually down to the Roman (Great North) Road less than a mile away. It is therefore possible that the ridge may have been the focus for settlement in this area for a considerable time. This may be reflected in the layout of the field system, particularly the enclosures on the higher ground at the north-western end of the site, which appear to have developed on an *ad hoc* basis.

4. Conclusions

4.1 The survey has revealed an extensive system of land division, that radiates at right angles away from the edge of the ridge, and which obviously continues both to the north-west, along the top of the ridge, and to the south-east.

4.2 Within this system of land division three distinct areas of enclosure have been identified, two of which are situated on the higher, flattened, ground at the northern end of the site. Associated with these enclosures are many isolated anomalies which are thought to be caused by features such as pits, hearths or other discrete features which suggest human occupation. However, it is recognised that many of these anomalies could also have a natural origin.

The absence of geophysical anomalies should not be interpreted as indicating an absence of archaeological remains. Confirmation of the presence or absence of archaeological remains can only be achieved by direct investigation of sub-surface deposits. This is usually undertaken by means of targeted trial trenching.

The results and subsequent interpretation of geophysical surveys should not be treated as an absolute representation of the underlying archaeological and non-archaeological remains. The nature of any sub-surface remains can normally be determined by direct investigation of these deposits by targeted trenching.

Acknowledgements

Project Management
Alistair Webb BA

Report
Alistair Webb

Graphics
Mark Whittingham BSc MA

Fieldwork
Alistair Webb
Mark Whittingham

Bibliography

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Figures

Appendices

Appendix 1

Gradiometer Survey: Technical Information

1. Magnetic Susceptibility and Soil Magnetism

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 magnetic ferrous compounds to become concentrated 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 may 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.

2. Types of Magnetic Anomaly

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

Isolated Dipolar Anomalies (Iron Spikes)

These responses are typically caused by ferrous objects on the surface or in the topsoil.Whilst they could be caused by archaeological artefacts, unless there is supporting evidence for an archaeological interpretation, then little emphasis is given to such anomalies, as modern ferrous objects are common on rural sites, often being present as a consequence of manuring.

Areas of Magnetic Disturbance
These responses can have several causes and are often associated with burnt material, such as industrial waste or other strongly magnetised/fired material. They are usually assumed to have a modern origin unless there is other supporting information.

Positive Curvi/Linear Anomalies
They are commonly caused by infilled ditches which may be archaeologically significant. Former or current agricultural practice can also result in these anomalies.

Isolated Positive Anomalies
These anomalies can exhibit a magnitude of response of between 2nT and 300nT and can be caused by pits or post holes, ovens or kilns. They can also be caused by natural/geological features on certain geologies. It can often be very difficult to establish an anthropogenic origin without intrusive investigation.

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.

3. Methodology

3.1 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 on the instrument display panel 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. Once anomalous responses are identified they are marked in the field with bamboo canes and approximately located on a base plan. This method is usually employed as a means of selecting areas for detailed survey when only a percentage sample of the whole site is to be subject to detailed survey. In ideal circumstances scanning may be used to map out the full extent of features located during a detailed survey.

3.2 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.

3.3 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.

4. Data Processing and Presentation

4.1 The data has been presented in this report in X-Y trace, dot density and greyscale formats. The former option shows the 'raw' data with no processing other than grid biasing whilst in the latter two options a line filter has been selectively used to remove some of the striping effects and edge discontinuities caused by instument drift and inconsistencies in survey technique.

4.2 An X-Y plot presents the data logged on each traverse as a single line with each successive traverse incremented on the Y-axis to produce a stacked plot. A hidden line algorithm has been employed to block out lines behind major 'spikes' and the data has been clipped at 10nT. The main advantage of this display option is that the full range of data can be viewed, dependent on the clip, so that the shape of individual anomalies can be discerned and potentially archaeological anomalies differentiated from 'iron spikes'. In-house software (XY3) was used to create the X-Y trace plots.

4.3 In-house software (Geocon 9) was used to interpolate the data so that 1600 readings were obtained for each 20m by 20m grid. Contors software was used to produce the greyscale and dot density images in which maximum and minimum cut-off limits have been chosen to best present the data; in both these display options the data is displayed using a linear incremental scale.

Appendix 2

Survey Location Information

1. Layout procedure

1.1 A baseline was laid out broadly parallel with the edge of Wenthill Plantation, and the site grid points set out using a Geotronics Geodimeter 600 series total station theodolite. Survey points (wooden stakes) were left at two points along the field boundary. These points together with the field boundaries were also tied-in to enable the grid to be accurately relocated should further work be required. This Geodimeter plan has been overlaid on an Ordnance Survey digital map base as a 'best fit' to produce Figure 2. This also shows the local site grid (co-ordinates for this grid are shown in Figures 3, 4 and 5).
N.b Any (Ordnance Survey) co-ordinates derived from Figure 2 will be accurate to approximately +/- 2m.

Archaeological Services (WYAS) cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party.

Appendix 3

Geophysical Archive

The geophysical archive comprises:-

- an archive disk containing the raw data, grid location information, report text (Word 6), and compressed (AutoCAD 2000) files of the graphics
- a full copy of the report

At present the archive is held by Archaeological Services WYAS although it is anticipated that it will eventually be lodged with the Archaeology Data Service (ADS). Brief details will also be forwarded for inclusion on the English Heritage Geophysical Survey Database (no information on the client shall be included) after the contents of the report are deemed to be in the public domain (*i.e* available for consultation in the relevant Sites and Monument Record Office).

Appendix 4

Gradiometer Data Plots