

GEOPHYSICAL SURVEY REPORT

STRATASCAN™



Project name:
Wixam Park, Bedfordshire

Client:
Albion Archaeology

Job ref:
J10336

November 2016

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1 SUMMARY OF RESULTS

A detailed gradiometry survey was conducted over approximately 66 hectares of arable land. Two areas of settlement activity, comprising ditches, rectilinear enclosures and backfilled pits of likely late prehistoric origin have been detected. Further linear anomalies may be associated with the settlement activity, though the spread of green waste across the area makes further interpretation difficult. Evidence of ridge and furrow, modern ploughing and former field boundaries suggest the site has a largely agricultural past. The remaining features are modern, and include large areas of debris associated with green waste fertiliser, an area of made ground, an underground service and disturbance from nearby ferrous metal objects, such as fences.

2 INTRODUCTION

2.1 Background synopsis

Stratascan were commissioned to undertake a geophysical survey of an area outlined for residential and employment development. This survey forms part of an archaeological investigation being undertaken by Albion Archaeology.

2.2 Site Details

NGR / Postcode	TL 041 432 / MK45 3NG
Location	The site is located approximately 6km south of Bedford, Bedfordshire.
HER/SMR	Central Bedfordshire and Luton
Unitary Authority	Central Bedfordshire
Parish	Houghton Conquest CP
Topography	Mostly flat
Current Land Use	Arable
Weather Conditions	Clear, dry
Soils	The overlying soils are known as Evesham 3 which are typical calcareous pelosols. These consist of calcareous clayey and fine loamy over clayey soils (Soil Survey of England and Wales, Sheet 6 South East England).
Geology	The underlying geology across the majority of the site comprises mudstone of Stewartby Member and Weymouth Member (undifferentiated). The geology across the north of the site is mudstone of Peterborough Member. There is no recorded drift geology (British Geological Survey website).

Archaeology	<p>A search of Bedfordshire HER identifies a number of archaeological remains within the survey area, as well as within close proximity of the site.</p> <p>An area of cropmarks has been observed on aerial photographs in the north of the western field (HER3280). The cropmarks appear to indicate a linear feature, a small, incomplete rectangular enclosure and an area of small circular features, possibly pits.</p> <p>At the centre of the site, around Great Thickthorn Farm, cropmarks possibly associated with a moat or deserted medieval village (HER3282) are recorded. These cropmarks appear to correspond with enclosures visible on an 1808 map, which also shows buildings and small ponds or clay pits in each of the enclosures.</p> <p>The field name of 'Banky Close' (HER14010) is recorded at the east of the survey area, perhaps suggesting the presence of former earthworks.</p> <p>A medieval or post-medieval dovecote (HER13986) is located at Thickthorn Farm, though no remains are extant.</p>
Survey Methods	Detailed magnetic survey (gradiometry)
Study Area	c. 66 hectares

2.3 Aims and objectives

To locate and characterise any anomalies of possible archaeological interest within the study area.

3 METHODS, PROCESSING & PRESENTATION

3.1 Standards & Guidance

This report and all fieldwork have been conducted in accordance with the latest guidance documents issued by Historic England (2008) and the Chartered Institute for Archaeologists (2002 & 2014).

Stratascan Ltd are a Registered Organisation with the CIfA and are committed to upholding its policies and standards.

3.2 Survey methods

Given that cropmarks of uncertain and likely medieval date are recorded within the site detailed magnetic survey was used as an efficient and effective method of locating archaeological anomalies.

More information regarding this technique is included in Appendix A.

3.3 Processing

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

1. *De-stripe*
2. *De-stagger*

3.4 Presentation of results and interpretation

The presentation of the data for each site involves a plot of the minimally processed data as a greyscale plot and a colour plot showing extreme magnetic values. Magnetic anomalies have been identified and plotted onto the 'Interpretation of Anomalies' drawing.

When interpreting the results several factors are taken into consideration, including the nature of archaeological features being investigated and the local conditions at the site (geology, pedology, topography etc.). Anomalies are categorised by their potential origin. Where responses can be related to very specific known features documented in other sources, this is done (for example: Abbey Wall, Roman Road). For the generic categories levels of confidence are indicated, for example: probable, or possible archaeology. The former is used for a confident interpretation, based on anomaly definition and/or other corroborative data such as cropmarks. Poor anomaly definition, a lack of clear patterns to the responses and an absence of other supporting data reduces confidence, hence the classification "possible".

4 RESULTS

The detailed magnetic gradiometer survey conducted at Wixam Park has identified a number of anomalies that have been characterised as being either of a *probable* or *possible* archaeological origin. The following list of numbered anomalies refers to numerical labels on the interpretation plots.

4.1 *Probable Archaeology*

A series of positive linear and rectilinear anomalies **[1]** are visible in the south of the survey area, along with an area of positive linear anomalies **[2]** in the east. These are both indicative of areas of former settlement activity, comprising rectilinear enclosures and backfilled pits. The morphology of the features suggests that they are of later prehistoric origin, i.e. Iron Age or Romano-British, though a later origin cannot be ruled out given that a deserted medieval village (HER3282) is recorded within the survey area. It is likely that the settlement at the south of the site extends further to the north and east, though the effects of the modern 'green waste' has masked weaker archaeological responses.

4.2 *Possible Archaeology*

A number of weak positive linear anomalies **[3]** have been detected in the south of the eastern field. These are indicative of former cut features, and may be archaeological in origin. It is possible that these are associated with the settlement activity visible to the west **[1]**, however the effects of the modern green waste fertilizer in this area makes further interpretation difficult. Two areas of enhanced magnetic response **[4]** in the east of the site may be associated with the settlement activity visible to the north-west **[2]**, though it is possible that these are natural in origin.

4.3 **Medieval/Post-Medieval Agriculture**

Two linear trends [5-6] in the north and east of the site are related to former field boundaries, visible on available mapping from 1883 to 1960. Areas of magnetic disturbance forming linear anomalies [7] and a weak bipolar linear anomaly [8] are likely to be former field boundaries but are not visible on available mapping. Anomaly 8 may also be related to a drain. A small area of enhanced magnetic response [9] is in the location of a former pond, visible on OS maps from 1883 to 1960.

Evidence of ridge and furrow cultivation [10] is visible across much of the site in the former of widely spaced, slightly curved, parallel linear anomalies. Evidence of modern ploughing [11] is visible in the north of the site in the form of magnetically weak, closely spaced, parallel linear anomalies.

4.4 **Other Anomalies**

An area of enhanced magnetic response [12] in the north-east of the site is of uncertain origin. Given that the anomaly is oriented perpendicular to the possible field boundary to the north [7] it is also possible that this is a field boundary that is not recorded on available historic mapping. A weak positive linear anomaly [13] in the north of the site is also of uncertain origin, though is likely a result of agricultural activity.

A large area of strong magnetic debris [14] is visible in the area to the south of Great Thickthorn Farm itself. This is indicative of an area of made ground, and is likely to be modern. A strong, bipolar linear anomaly [15] in the south of the site is likely associated with an underground service, though may also be related to a former field boundary, similar to anomalies 7.

Much of the site is covered by magnetic debris which is characteristic of modern green waste fertiliser. The effects of this debris has the potential to mask weaker archaeological anomalies. Areas of magnetic disturbance are a result of substantial nearby ferrous metal objects, such as boundary fences and electricity pylons. Smaller magnetic 'spikes' are likely to be modern rubbish.

5 **DATA APPRAISAL & CONFIDENCE ASSESSMENT**

Mudstone geologies, such as those present across the site, can provide variable results for magnetic survey. Given that a number of archaeological remains have been detected, it can be determined that the geology is conducive to magnetic survey.

Large portions of the site are covered with modern 'green waste' fertiliser. This waste contains a high proportion of ferrous rubbish and has the potential to mask weaker anomalies. In the south of the site, the evidence of settlement activity would likely extend northwards but cannot be seen as a result of the debris. It is therefore likely that there are archaeological remains which cannot be seen as a result of the modern spread of green waste, however the data collected does provide a good indication of buried features.

6 CONCLUSION

The survey at Wixam Park has identified two areas of settlement activity, comprising ditches, rectilinear enclosures and backfilled pits. The morphology of the features suggests they are of late prehistoric origin, though a deserted medieval settlement is recorded within the site meaning the anomalies may be of later origin. Further linear anomalies may be associated with the settlement activity, though the spread of green waste across the area makes further interpretation difficult.

Evidence of ridge and furrow and modern ploughing, along with a number of former field boundaries indicate that the site has been used for agricultural purposes since the medieval period.

The remaining features are modern, and include large areas of debris related to green waste fertiliser, an area of made ground, an underground service and disturbance from nearby ferrous metal objects, such as fences.

7 REFERENCES

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Appendix A - Technical Information: Magnetometer Survey Method

Grid Positioning

For hand held gradiometers the location of the survey grids has been plotted together with the referencing information. Grids were set out using a Trimble R8 Real Time Kinematic (RTK) VRS Now GNSS GPS system.

An RTK GPS (Real-time Kinematic Global Positioning System) can locate a point on the ground to a far greater accuracy than a standard GPS unit. A standard GPS suffers from errors created by satellite orbit errors, clock errors and atmospheric interference, resulting in an accuracy of 5m-10m. An RTK system uses a single base station receiver and a number of mobile units. The base station re-broadcasts the phase of the carrier it measured, and the mobile units compare their own phase measurements with those they received from the base station. This results in an accuracy of around 0.01m.

Technique	Instrument	Traverse Interval	Sample Interval
Magnetometer	Bartington Grad 601-2	1m	0.25m

Instrumentation: Bartington *Grad601-2*

Bartington instruments operate in a gradiometer configuration which comprises fluxgate sensors mounted vertically, set 1.0m apart. The fluxgate gradiometer suppresses any diurnal or regional effects. The instruments are carried, or cart mounted, with the bottom sensor approximately 0.1-0.3m from the ground surface. At each survey station, the difference in the magnetic field between the two fluxgates is measured in nanoTesla (nT). The sensitivity of the instrument can be adjusted; for most archaeological surveys the most sensitive range (0.1nT) is used. Generally, features up to 1m deep may be detected by this method, though strongly magnetic objects may be visible at greater depths. The Bartington instrument can collect two lines of data per traverse with gradiometer units mounted laterally with a separation of 1.0m.

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 site survey, data is transferred to the office for processing and presentation.

Data Processing

Zero Mean Traverse	This process sets the background mean of each traverse within each grid to zero. The operation removes striping effects and edge discontinuities over the whole of the data set.
Step Correction (Destagger)	When gradiometer data are collected in 'zig-zag' fashion, stepping errors can sometimes arise. These occur because of a slight difference in the speed of walking on the forward and reverse traverses. The result is a staggered effect in the data, which is particularly noticeable on linear anomalies. This process corrects these errors.

Display

Greyscale/ Colourscale Plot	This format divides a given range of readings into a set number of classes. Each class is represented by a specific shade of grey, the intensity increasing with value. All values above the given range are allocated the same shade (maximum intensity); similarly all values below the given range are represented by the minimum intensity shade. Similar plots can be produced in colour, either using a wide range of colours or by selecting two or three colours to represent positive and negative values. The assigned range (plotting levels) can be adjusted to emphasise different anomalies in the data-set.
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Interpretation Categories

In certain circumstances (usually when there is corroborative evidence from desk based or excavation data) very specific interpretations can be assigned to magnetic anomalies (for example, *Roman Road, Wall*, etc.) and where appropriate, such interpretations will be applied. The list below outlines the generic categories commonly used in the interpretation of the results.

<i>Archaeology/Probable Archaeology</i>	This term is used when the form, nature and pattern of the response are clearly or very probably archaeological and /or if corroborative evidence is available. These anomalies, whilst considered anthropogenic, could be of any age.
<i>Possible Archaeology</i>	These anomalies exhibit either weak signal strength and / or poor definition, or form incomplete archaeological patterns, thereby reducing the level of confidence in the interpretation. Although the archaeological interpretation is favoured, they may be the result of variable soil depth, plough damage or even aliasing as a result of data collection orientation.
<i>Industrial / Burnt-Fired</i>	Strong magnetic anomalies that, due to their shape and form or the context in which they are found, suggest the presence of kilns, ovens, corn dryers, metal- working areas or hearths. It should be noted that in many instances modern ferrous material can produce similar magnetic anomalies.
<i>Former Field Boundary (probable & possible)</i>	Anomalies that correspond to former boundaries indicated on historic mapping, or which are clearly a continuation of existing land divisions. Possible denotes less confidence where the anomaly may not be shown on historic mapping but nevertheless the anomaly displays all the characteristics of a field boundary.
<i>Ridge & Furrow</i>	Parallel linear anomalies whose broad spacing suggests ridge and furrow cultivation. In some cases the response may be the result of more recent agricultural activity.
<i>Agriculture (ploughing)</i>	Parallel linear anomalies or trends with a narrower spacing, sometimes aligned with existing boundaries, indicating more recent cultivation regimes.
<i>Land Drain</i>	Weakly magnetic linear anomalies, quite often appearing in series forming parallel and herringbone patterns. Smaller drains will often lead and empty into larger diameter pipes and which in turn usually lead to local streams and ponds. These are indicative of clay fired land drains.
<i>Natural</i>	These responses form clear patterns in geographical zones where natural variations are known to produce significant magnetic distortions.
<i>Magnetic Disturbance</i>	Broad zones of strong dipolar anomalies, commonly found in places where modern ferrous or fired materials (e.g. brick rubble) are present. They are presumed to be modern.
<i>Service</i>	Magnetically strong anomalies usually forming linear features indicative of ferrous pipes/cables. Sometimes other materials (e.g. pvc) cause weaker magnetic responses and can be identified from their uniform linearity crossing large expanses.
<i>Ferrous</i>	This type of response is associated with ferrous material and may result from small items in the topsoil, larger buried objects such as pipes, or above ground features such as fence lines or pylons. Ferrous responses are usually regarded as modern. Individual burnt stones, fired bricks or igneous rocks can produce responses similar to ferrous material.
<i>Uncertain Origin</i>	Anomalies which stand out from the background magnetic variation, yet whose form and lack of patterning gives little clue as to their origin. Often the characteristics and distribution of the responses straddle the categories of <i>Possible Archaeology</i> and <i>Possible Natural</i> or (in the case of linear responses) <i>Possible Archaeology</i> and <i>Possible Agriculture</i> ; occasionally they are simply of an unusual form.

Where appropriate some anomalies will be further classified according to their form (positive or negative) and relative strength and coherence (trend: weak and poorly defined).

Appendix B - Technical Information: Magnetic Theory

Detailed magnetic survey can be used to effectively define areas of past human activity by mapping spatial variation and contrast in the magnetic properties of soil, subsoil and bedrock. Although the changes in the magnetic field resulting from differing features in the soil are usually weak, changes as small as 0.2 nanoTeslas (nT) in an overall field strength of 48,000nT, can be accurately detected.

Weakly magnetic iron minerals are always present within the soil and areas of enhancement relate to increases in *magnetic susceptibility* and permanently magnetised *thermoremanent* material.

Magnetic susceptibility relates to the induced magnetism of a material when in the presence of a magnetic field. This magnetism can be considered as effectively permanent as it exists within the Earth's magnetic field. Magnetic susceptibility can become enhanced due to burning and complex biological or fermentation processes.

Thermoremanence is a permanent magnetism acquired by iron minerals that, after heating to a specific temperature known as the Curie Point, are effectively demagnetised followed by re-magnetisation by the Earth's magnetic field on cooling. Thermoremanent archaeological features can include hearths and kilns and material such as brick and tile may be magnetised through the same process.

Silting and deliberate infilling of ditches and pits with magnetically enhanced soil creates a relative contrast against the much lower levels of magnetism within the subsoil into which the feature is cut. Systematic mapping of magnetic anomalies will produce linear and discrete areas of enhancement allowing assessment and characterisation of subsurface features. Material such as subsoil and non-magnetic bedrock used to create former earthworks and walls may be mapped as areas of lower enhancement compared to surrounding soils.

Magnetic survey is carried out using a fluxgate gradiometer which is a passive instrument consisting of two sensors mounted vertically 1m apart. The instrument is carried about 30cm above the ground surface and the top sensor measures the Earth's magnetic field whilst the lower sensor measures the same field but is also more affected by any localised buried field. The difference between the two sensors will relate to the strength of a magnetic field created by a buried feature, if no field is present the difference will be close to zero as the magnetic field measured by both sensors will be the same.

Factors affecting the magnetic survey may include soil type, local geology, previous human activity, disturbance from modern services etc.

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