GEOPHYSICAL SURVEY REPORT

STRATASCAN™

SUMO Survey Services
SUMO Group Member

Project name:
White Cross Farm, Wallingford, Oxfordshire

Client:
CgMs Consulting Ltd

Job ref:
J9580

April 2016

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Survey date: **22nd-24th February, 3rd-4th & 25th March 2016**	Report date: **April 2016**
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1 SUMMARY OF RESULTS

A detailed gradiometry survey was conducted over approximately 17.4 hectares of mixed arable and grassland. The survey has detected areas of modern disturbance that may be associated with the remnants of WWII defensive features along the banks of the River Thames. Two pit features may relate to archaeological activity, however they could equally be natural in origin. The remaining anomalies are natural or modern relating to ploughing, scattered magnetic debris, ferrous objects, and fencing.

2 INTRODUCTION

2.1 Background synopsis

Stratascan were commissioned to undertake a geophysical survey of an area outlined for mineral extraction. This survey forms part of an archaeological investigation being undertaken by CgMs Consulting Ltd.

2.2 Site Details

NGR / Postcode	SU 604 878 OX10 9HA
Location	The site lies to the south of Nosworthy Way, Wallingford, Oxfordshire, on the western bank of the River Thames
HER	Oxfordshire Historic Environment Record
District	South Oxfordshire
Parish	Cholsey
Topography	The site is generally flat, with a slight slope towards the River Thames
Current Land Use	Pasture in the northern and eastern field, with arable land in the western field
Weather Conditions	Dry
Soils	The overlying soils are known as Thames, which are typical pelo-calcareous alluvial gley soils. These consist of stoneless calcareous clayey soils (Soil Survey of England and Wales, Sheet 6 South East England).
Geology	The underlying geology for the majority of the site is Glauconitic Marl Member – glauconitic sandstone, with an area of West Melbury Marly Chalk Formation – chalk in the south-west. The drift geology is Northmoor Sand and Gravel Member, Upper Facet – sand and gravel

	across the west of the site, with alluvial deposits of clay, silt, sand, and gravel in the east (British Geological Survey website).
Archaeology	The Thames Valley area was clearly occupied and settled throughout the Prehistoric period and continued into the Roman period. The potential for such activity to be present within the survey area is therefore considered to be moderate. From the Anglo-Saxon period onwards, the survey area is sited beyond any known settlement focus and is likely to have remained an area agricultural land/riverside meadow up to present day. A low potential for significant archaeological activity for all other periods is identified (CgMs forthcoming). A previous gradiometer survey to the west of the site identified two ring ditches and an area of settlement activity including enclosure ditches, field boundaries, and trackways (Abingdon Archaeological Geophysics 2012). Archaeological Data Services' Defence of Britain Archive (2006) shows a number of pillboxes, gun emplacements, and anti-tank defences along both banks of the River Thames. Given the proximity of the site to the Thames it is possible that defences extend into the survey area.
Survey Methods	Gradiometry
Study Area	17.4ha, however areas of overgrown vegetation have reduced the surveyable area to 13.4ha.

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 the potential for prehistoric and Roman activity, 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 hand held collection data used in this report:

1. *Destripe*
2. *Destagger*

The following schedule is used for cart collected data:

1. *Destripe*
2. *Interpolation*

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 White Cross Farm 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

1 Eight areas of magnetically strong responses forming a north-south linear alignment across the west of the site. These are indicative of areas of modern disturbance or debris. WWII pill boxes, gun emplacements, and anti-tank defences are recorded along the banks of the River Thames (Archaeological Data Services 2006), and it is noted that the site is located on the opposite bank of the River Thames to Mongewell, utilised as the headquarters for Number 2 Group Bomber Command.

2 Two magnetically strong, parallel linear anomalies in the south-west of the site. These are likely to be modem debris, possibly related to WWII defensive infrastructure.

4.2 Possible Archaeology

3 Two small, discrete, positive anomalies in the south-east of the site. These are indicative of small former cut features, such as backfilled pits, and may be archaeological or natural in origin.

4.3 Medieval/Post-Medieval Agriculture

4 Two parallel linear anomalies in the centre of the site. Whilst these share an alignment with the possible WWII defensive features they are most likely related to modern agricultural activity.

5 An area of closely spaced, parallel linear anomalies in the west of the site. This is indicative of modern agricultural activity, such as ploughing.

6 A linear area of strong magnetic responses. This is related to a modern track.

4.4 Other Anomalies

7 Six short, positive liner anomalies across the site. These are of unknown origin, however their isolated nature suggests they are more likely to relate to modern agriculture than any archaeological features.

8 Areas of magnetic variation across the east of the site. These anomalies are related to alluvial deposits in the area.

9 Areas of scattered magnetic debris across the north of the site. These are likely to be modern in origin. Those nearby WWII defences may be debris from that time.

10 Areas of magnetic disturbance are the result of substantial nearby ferrous metal objects such as fences and underground services. These effects can mask weaker archaeological anomalies, but on this site have not affected a significant proportion of the area.

11 A number of magnetic ‘spikes’ (strong focussed values with associated antipolar response) indicate ferrous metal objects. These are likely to be modern rubbish.

5 DATA APPRAISAL & CONFIDENCE ASSESSMENT

West Melbury chalk geologies, such as that seen across the west of the White Cross Farm site, generally give poor responses to magnetic survey. However, the success of a previous geophysical survey to the immediate west of the site, and within the wider area, suggests that the geology is conducive to magnetic survey and would have detected archaeological features were they present. The alluvial deposits identified across the eastern extent of the site have the potential to mask weaker archaeological features in this area. However, the majority of the survey area does not contain alluvial deposits of great depth that would potentially impede the identification of archaeological features (CgMs forthcoming).

6 CONCLUSION

The survey at White Cross Farm has detected a small number of probable and possible archaeological features primarily relating to possible remnants of WWII defensive features along the banks of the River Thames. No evidence for potential prehistoric or Roman activity, which is seen in the surrounding area, is identified within the survey area. Two discrete pits may relate to archaeological activity, however they could equally be natural in origin. The remaining anomalies are modern or natural in origin. The modern anomalies relate to ploughing, a track, scattered magnetic debris, ferrous objects, and fencing.

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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.

For cart collected data each data point had its position recorded using a Trimble R10 Real Time Kinematic (RTK) VRS Now GNSS GPS system. The geophysical survey area is georeferenced relative to the Ordnance Survey National Grid.

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
Magnetometer	Bartington cart system (Bartington Grad 601 sensors)	1m	0.25m

Instrumentation: Bartington *Grad*601-2

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 cart system has four gradiometer units mounted at 1m intervals across its frame – rather than working in grids, the cart uses an on-board survey grade GNSS for positioning. The cart system allows for the collection of topographic data in addition to the magnetic field measurements.

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.
Interpolation	When geophysical data are presented as a greyscale, each data point is represented as a small square. The resulting plot can sometimes have a 'blocky' appearance. The interpolation process calculates and inserts additional values between existing data points. The process can be carried out with points along a traverse (the x axis) and/or between traverses (the y axis) and results in a smoother greyscale image.

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.

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.

Archaeology/Probable Archaeology	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.
Possible Archaeology	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.
Industrial / Burnt-Fired	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.
Former Field Boundary (probable & possible)	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.
Ridge & Furrow	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.
Agriculture (ploughing)	Parallel linear anomalies or trends with a narrower spacing, sometimes aligned with existing boundaries, indicating more recent cultivation regimes.
Land Drain	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.
Natural	These responses form clear patterns in geographical zones where natural variations are known to produce significant magnetic distortions.
Magnetic Disturbance	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.
Service	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.
Ferrous	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.
Uncertain Origin	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 *Possible Archaeology* and *Possible Natural* or (in the case of linear responses) *Possible Archaeology* and *Possible Agriculture*; 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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