

**Land north of  
Old Stowmarket Road  
Woolpit  
Suffolk**

**MAGNETOMETER SURVEY REPORT**

for

**New Hall Properties (Eastern) Ltd**

Kerry Donaldson & David Sabin

September 2016

Ref. no. J676

Suffolk County Council HER Event No: ESF24356

HER Parish Code: WPT 055

OASIS ID: archaeol20-258303

ARCHAEOLOGICAL SURVEYS LTD

**Land north of  
Old Stowmarket Road  
Woolpit  
Suffolk**

Magnetometer Survey Report

for

**New Hall Properties (Eastern) Ltd**

Fieldwork by David Sabin (Hons) MCIfA

Report by Kerry Donaldson BSc (Hons)

Report checked by David Sabin

Primary archive location - Archaeological Surveys Ltd, Yatesbury, Wiltshire

Survey date – 24th August 2016

Ordnance Survey Grid Reference – **TL 97755 62595**

Suffolk County Council HER Event No: ESF24356

HER Parish Code: WPT 055

OASIS ID: archaeol20-258303



Archaeological Surveys Ltd

1 West Nolands, Nolands Road, Yatesbury, Calne, Wiltshire, SN11 8YD

Tel: 01249 814231 Fax: 0871 661 8804

Email: [info@archaeological-surveys.co.uk](mailto:info@archaeological-surveys.co.uk)

Web: [www.archaeological-surveys.co.uk](http://www.archaeological-surveys.co.uk)

# CONTENTS

SUMMARY.....	1
1 INTRODUCTION.....	1
1.1 Survey background.....	1
1.2 Survey objectives and techniques.....	1
1.3 Site location, description and survey conditions.....	1
1.4 Site history and archaeological potential.....	2
1.5 Geology and soils.....	2
2 METHODOLOGY.....	3
2.1 Technical synopsis.....	3
2.2 Equipment configuration, data collection and survey detail.....	3
2.3 Data processing and presentation.....	4
3 RESULTS.....	5
3.1 General assessment of survey results.....	5
3.2 Statement of data quality.....	5
3.3 Data interpretation.....	5
3.4 List of anomalies .....	6
4 CONCLUSION.....	8
5 REFERENCES.....	8
Appendix A – basic principles of magnetic survey.....	9
Appendix B – data processing notes.....	10
Appendix C – survey and data information.....	10
Appendix D – digital archive.....	11
Appendix E – copyright and intellectual property.....	12

Appendix F – SCCAS HER monuments map and monuments details.....13

Appendix G – OASIS form .....17

Appendix H – Geophysical Survey WSI.....18

LIST OF FIGURES

Figure 01    Map of survey area (1:25 000)

Figure 02    Referencing information (1:1250)

Figure 03    Greyscale plot of raw magnetometer data (1:1000)

Figure 04    Greyscale plot of minimally processed magnetometer data (1:1000)

Figure 05    Abstraction and interpretation of magnetic anomalies (1:1000)

LIST OF TABLES

Table 1: List and description of interpretation categories.....6

## SUMMARY

A detailed magnetometer survey was undertaken by Archaeological Surveys Ltd over the eastern part of a single field at Woolpit in Suffolk. The site lies immediately adjacent to a medieval moated site and well, known as Lady's Well, which has been designated as a Scheduled Monument. The site lies outside of the scheduled area, and although a number of positive and negative anomalies have been located, they are so weak, short and indistinct that they cannot be interpreted as cut features and none can be clearly seen as having an association with Lady's Well. A number of former field boundaries and land drains have also been located.

## 1 INTRODUCTION

### 1.1 Survey background

- 1.1.1 Archaeological Surveys Ltd was commissioned by New Hall Properties (Eastern) Ltd, to undertake a magnetometer survey of an area of land at Woolpit in Suffolk. The site has been outlined for a proposed residential development and the survey forms part of an archaeological assessment of the site.
- 1.1.2 The geophysical survey was carried out in accordance with a Written Scheme of Investigation (WSI) produced by Archaeological Surveys (2016) and approved by Rachael Abraham, Senior Archaeological Officer for Suffolk County Council prior to commencing the fieldwork.

### 1.2 Survey objectives and techniques

- 1.2.1 The objective of the survey was to use magnetometry to locate geophysical anomalies that may be archaeological in origin so that they may be assessed prior to development of the site. The methodology is considered an efficient and effective approach to archaeological prospection.
- 1.2.2 The survey and report generally follow the recommendations set out by: English Heritage (2008) *Geophysical survey in archaeological field evaluation*; and Institute for Archaeologists (2002) *The use of Geophysical Techniques in Archaeological Evaluations*. The work has been carried out to the Chartered Institute for Archaeologists (2014) *Standard and Guidance for Archaeological Geophysical Survey* and Suffolk County Council Archaeological Service *Requirements for a Geophysical Survey* (SCCAS, 2011).

### 1.3 Site location, description and survey conditions

- 1.3.1 The site is located to the north of Old Stowmarket Road, on the eastern edge of Woolpit in Suffolk. It is centred on Ordnance Survey National Grid

Reference (OS NGR) TL 97755 62595, see Figs 01 and 02.

- 1.3.2 The geophysical survey covers approximately 3ha within the eastern part of a larger arable field. It is bounded to the south by the Old Stowmarket Road, a nursery to the east and lorry depot to the north. At the north western corner of the site, beyond the development boundary, are the remains of a medieval holy well and moated site which is a Scheduled Monument (List entry UID: 1005992) *Lady's Well*.
- 1.3.3 The ground conditions across the site were generally considered to be favourable for the collection of magnetometry data. Weather conditions during the survey were extremely hot with temperatures reaching 34C; however, this does not appear to have affected the data.

#### 1.4 *Site history and archaeological potential*

- 1.4.1 The site lies immediately south east of the Scheduled Monument (List entry UID: 1005992) *Lady's Well*, which relates to a medieval holy well and moated site. The survey area does not encroach into the scheduled area, which is currently heavily wooded, but it is possible that potential associated archaeological features may extend beyond the scheduled area into the site.
- 1.4.2 An Archaeological Desk-Based Assessment has been carried out by John Newman Archaeological Services (JNAS, 2016) and a full HER search has been carried out as part of this. In the south western corner of the same field, but lying outside of the survey area, are the location of a number of medieval and post-medieval pottery sherds, fragments of clay tobacco pipe and post-medieval brick (Suffolk HER no: WPT 044/MSF33495) with the findspots of three coins of 16th and 17th century date located just to the north (Suffolk HER no: WPT 045/MSF3392). These finds may indicate the presence of a medieval to post-medieval dwelling or dwellings fronting the Old Stowmarket Road, which had been removed before the 1845 tithe map as the survey area is shown divided into three fields.
- 1.4.3 In the wider vicinity there is some evidence of Roman activity and also further medieval and post-medieval activity and there is some potential for the survey to locate anomalies which relate to previously unrecorded archaeological features, should they be present within the site.

#### 1.5 *Geology and soils*

- 1.5.1 The underlying solid geology across the site is Crag Group - Sand with overlying deposits of Lowestoft Formation - Diamicton (BGS, 2016).
- 1.5.2 The overlying soil across the survey area is from the Newport 3 association and is a typical brown sand. It consists of a deep, well drained, sandy and coarse loamy soil (Soil Survey of England and Wales, 1983).

- 1.5.3 Magnetometry survey carried out across similar soils has produced variable results, often with low magnetic susceptibility causing weak or poorly defined anomalies. However, within areas of long term occupation there can be sufficient magnetic contrast for features to be visible within the data. The underlying geology and soils are therefore considered acceptable for magnetic survey.

## 2 METHODOLOGY

### 2.1 *Technical synopsis*

- 2.1.1 Magnetometry survey records localised magnetic fields that can be associated with features formed by human activity. Magnetic susceptibility and magnetic thermoremnance are factors associated with the formation of localised fields. Additional details are set out below and within Appendix A.
- 2.1.2 Iron minerals within the soil may become altered by burning and the break down of biological material; effectively the magnetic susceptibility of the soil is increased, and the iron minerals become magnetic in the presence of the Earth's magnetic field. Accumulations of magnetically enhanced soils within features, such as pits and ditches, may produce magnetic anomalies that can be mapped by magnetic prospection.
- 2.1.3 Magnetic thermoremnance can occur when ferrous minerals have been heated to high temperatures such as in a kiln, hearth, oven etc. On cooling, a permanent magnetisation may be acquired due to the presence of the Earth's magnetic field. Certain natural processes associated with the formation of some igneous and metamorphic rock may also result in magnetic thermoremnance.
- 2.1.4 The localised variations in magnetism are measured as sub-units of the Tesla, which is a SI unit of magnetic flux density. These sub-units are nano Teslas (nT), which are equivalent to  $10^{-9}$  Tesla (T).

### 2.2 *Equipment configuration, data collection and survey detail*

- 2.2.1 The detailed magnetic survey was carried out using a SENSYS MAGNETO®MXPDA 5 channel cart-based system. The instrument has 5 fluxgate gradiometers spaced 0.5m apart with readings recorded at 20Hz. The gradiometers have a range of recording data between 0.1nT and 10,000nT. The sensors are not zeroed in the field, as the vertical axis alignment is fixed using a tension band system. In order to produce visible, useful greyscale images a zero median traverse process is undertaken in TerraSurveyor. The system is linked to a Leica GS10 RTK GPS with data recorded by SENSYS MAGNETO®MXPDA software on a rugged computer.
- 2.2.2 Data are collected along a series of parallel survey tracks wherever possible.

The length of each track is variable and relates to the size of the survey area and other factors including ground conditions. A visual display aids accurate placing of tracks and their separation.

- 2.2.3 Data are not collected within fixed grids and data points are considered to be random even though the data are collected in a systematic manner covering all accessible areas (Aspinall, Gaffney and Schmidt, 2009).

### 2.3 *Data processing and presentation*

- 2.3.1 Magnetic data collected by the MAGNETO®MXPDA cart-based system are initially prepared using SENSYS MAGNETO®DLMGPS software. Survey tracks are analysed and georeferenced raw data (UTM Z30N) are then exported in ASCII format for further analysis and display using TerraSurveyor. In order to fulfil the Suffolk County Council Requirements for a Geophysical Survey (2011), a greyscale image of the raw data has also been displayed without any clipping or compensation, between the limits of the recorded values +2534.43nT and -2522.96nT (Fig 03).
- 2.3.2 Minimal processing is then undertaken using TerraSurveyor, with a zero median traverse function to balance the readings between the sensors and clipping for display at  $\pm 3$ nT. This would normally be considered as minimal enhancement of the raw data in order to effectively display it. A zero median traverse function is required in order to remove fixed offset values present within the sensors which do not undergo a zeroing procedure in the field. The approach ensures that the gradiometer sensors are very accurately aligned and fixed to the vertical magnetic field and are not influenced by localised magnetic fields or disturbed by vibration. Although a zero median traverse algorithm can remove anomalies aligned with the survey tracks, in practice this rarely occurs due to the use of long traverses, high resolution measurement and variability within the magnetic susceptibility of long linear features. Data are interpolated to a resolution of effectively 0.5m between tracks and 0.15m along each survey track and displayed as a greyscale image (Fig 04).
- 2.3.3 Appendix C contains metadata concerning the survey and data attributes and is derived directly from TerraSurveyor. Reference should be made to Appendix B for further information on any processes, such as clipping, carried out on the data.
- 2.3.4 A TIF file is produced by TerraSurveyor software along with an associated world file (.TFW) that allows automatic georeferencing (OSGB36 datum) when using GIS or CAD software. The main form of data display used in the report is the minimally processed greyscale plot.
- 2.3.5 The raster images are combined with base mapping using ProgeCAD Professional 2014, creating DWG (2010) file formats. All images are externally referenced to the CAD drawing in order to maintain good graphical



quality. The CAD plots are effectively georeferenced facilitating relocation of features using GPS, resection method, etc.

- 2.3.6 An abstraction and interpretation is also drawn and plotted for all geophysical anomalies located by the survey. Anomalies are abstracted using colour coded points, lines and polygons. All plots are scaled to landscape A3 for paper printing.
- 2.3.7 A brief summary of each anomaly, with an appropriate reference number, is set out in list form within the results (Section 3) to allow a rapid and objective assessment of features within the survey area.
- 2.3.8 A digital archive is produced with this report, see Appendix D below. This has been produced under the requirements of the Suffolk County Council Archaeological Service Conservation Team (SCCAS, 2015). The raw data will be archived as proprietary files from the manufacturer's software. Additionally the raw data as well as the minimally processed data will also be archived as CSV files.

## 3 RESULTS

### 3.1 *General assessment of survey results*

- 3.1.1 The detailed magnetic survey was carried out over 3ha within the eastern part of a single arable field.
- 3.1.2 Magnetic anomalies located can be generally classified as positive and negative anomalies of an uncertain origin, anomalies associated with land management and strong discrete dipolar anomalies relating to ferrous objects and magnetic disturbance. Anomalies located within each survey area have been numbered and are described in 3.4 below.

### 3.2 *Statement of data quality*

- 3.2.1 Data are considered representative of the magnetic anomalies present within the site. There are no significant defects within the dataset. High magnitude magnetic disturbance was encountered along the northern and eastern edges of the survey area. Although it has the potential to obscure other weak anomalies, this would only be possible within a very narrow band immediately adjacent to the field boundaries.

### 3.3 *Data interpretation*

- 3.3.1 The list of sub-headings below attempts to define a number of separate categories that reflect the range and type of features located during the survey. A basic explanation of the characteristics of the magnetic anomalies is

set out for each category in order to justify interpretation, a basic key is indicated to allow cross referencing to the abstraction and interpretation plot. CAD layer names are included to aid reference to associated digital files (.dwg/.dxf). Sub-headings are then used to group anomalies with similar characteristics within the survey area.





Report sub-heading CAD layer names and plot colour	Description and origin of anomalies
<p><b>Anomalies with an uncertain origin</b></p> <p>AS-ABST MAG POS LINEAR UNCERTAIN                      AS-ABST MAG NEG LINEAR UNCERTAIN                      AS-ABST MAG POS DISCRETE UNCERTAIN                      AS-ABST MAG POS UNCERTAIN</p> 	<p>The category applies to a range of anomalies where <u>there is not enough evidence to confidently suggest an origin</u>. Anomalies in this category <u>may well be related to archaeologically significant features, but equally relatively modern features, geological/pedological features and agricultural features should be considered</u>. Positive anomalies are indicative of magnetically enhanced soils that may form the fill of 'cut' features or may be produced by accumulation within layers or 'earthwork' features; soils subject to burning may also produce positive anomalies. Negative anomalies are produced by material of comparatively low magnetic susceptibility such as stone and subsoil.</p>
<p><b>Anomalies relating to land management</b></p> <p>AS-ABST MAG FIELD BOUNDARY                      AS-ABST MAG LAND DRAIN</p> 	<p>Anomalies are mainly linear and may be indicative of the magnetically enhanced fill of cut features (i.e. ditches). The anomalies may be long and/or form rectilinear elements and they may relate to topographic features or be visible on early mapping. Associated agricultural anomalies (e.g. headlands, plough marks and former ridge and furrow) may support the interpretation. Land drains can appear in a classic herringbone pattern of interconnected multiple dipolar linear anomalies, or as parallel linear anomalies. The multiple dipolar response indicates a ceramic land drain.</p>
<p><b>Anomalies associated with magnetic debris</b></p> <p>AS-ABST MAG STRONG DIPOLAR</p> 	<p>Magnetic debris often appears as areas containing many small dipolar anomalies that may range from weak to very strong in magnitude. It often occurs where there has been dumping or ground make-up and is related to magnetically thermoremanent materials such as brick or tile or other small fragments of ferrous material. This type of response is occasionally associated with kilns, furnace structures, or hearths and <u>may therefore be archaeologically significant</u>. Strong discrete dipolar anomalies are responses to ferrous objects within the topsoil.</p>
<p><b>Anomalies with a modern origin</b></p> <p>AS-ABST MAG DISTURBANCE</p> 	<p>The magnetic response is often strong and dipolar indicative of ferrous material and may be associated with extant above surface features such as wire fencing, cables, pylons etc.. Often a significant area around such features has a strong magnetic flux which may create magnetic disturbance; such disturbance can effectively obscure low magnitude anomalies if they are present. Fluxgate sensors may respond erratically and with hysteresis adjacent to strong magnetic sources. Buried services may produce characteristic multiple dipolar anomalies dependant upon their construction.</p>

Table 1: List and description of interpretation categories

### 3.4 List of anomalies

Area centred on OS NGR 597755 262595, see Figs 04 & 05.

### *Anomalies with an uncertain origin*

(1) - The survey area contains a number of short, weakly positive linear anomalies. Their weak response and lack of coherent morphology prevents confident interpretation.

(2) - A small number of negative linear anomalies are evident in the northern half of the survey area. They have a east north east to west south west orientation, with one appearing to be associated with a more positive response at both ends. Such an anomaly indicates a feature with less magnetic enhancement than the surrounding soils, agricultural activity can also produce such responses.

(3) - Two negative linear anomalies appear to extend between two land drains and may be associated. Agricultural activity could produce such a response and they are parallel with the plough trend.

(4) - A group of discrete positive responses are located in the central part of the survey area. Although they appear pit-like, it is not possible to determine if they are of anthropogenic or natural origin.

(5) - At the western edge of the survey area is a broad positive response. It is possible that it is associated with a former field boundary as the current field boundary appears to have been established some time in the late 20th century.

### *Anomalies associated with land management*

(6, 7 & 8) - Linear anomalies appear to be associated with former field boundaries removed during the 1970s. The strength of the northern part of anomaly (6) may indicate that it contains a pipe. The responses may also indicate that they contain land drains.

(9) - A series of parallel linear anomalies relate to land drains.

### *Anomalies associated with magnetic debris*

(10) - Strong, discrete, dipolar anomalies are a response to ferrous and other magnetically thermoremanent objects within the topsoil.

### *Anomalies with a modern origin*

(11) - Magnetic disturbance is located around the external edge of the field. It is possible that a buried service lies just beyond the southern extent of the survey area and it is likely that nursery greenhouses to the east and vehicles to the north have caused the response.

## 4 CONCLUSION

- 4.1.1 The detailed magnetometry survey has revealed the location of several formerly mapped field boundaries. A series of land drains is also evident. A number of weakly positive and negative anomalies have also been located, but these are short, indistinct and lack a coherent morphology preventing interpretation.

## 5 REFERENCES

Archaeological Surveys, 2016. *Land north of Old Stowmarket Road, Woolpit, Suffolk, Geophysical Survey Written Scheme of Investigation*. Unpublished typescript document.

Aspinall, A., Gaffney, C. and Schmidt, A. 2009. *Magnetometry for Archaeologists*. Lanham (US), AltaMira Press.

British Geological Survey, 2016. *Geology of Britain viewer, 1:50 000 scale [online]* available from <http://mapapps.bgs.ac.uk/geologyofbritain/home.html> [accessed 21/7/2016].

Chartered Institute for Archaeologists, 2014. *Standard and Guidance for archaeological geophysical survey*. IfA, University of Reading.

English Heritage, 2008. *Geophysical survey in archaeological field evaluation. Research and Professional Service Guideline No.1*. 2<sup>nd</sup> ed. Swindon: English Heritage.

Institute for Archaeologists, 2002. *The use of Geophysical Techniques in Archaeological Evaluations*. IfA Paper No. 6. IfA, University of Reading.

JNAS, 2016. *Land off Heath Road, Woolpit, Suffolk, Archaeological Desk-Based Assessment*. Unpublished typescript document.

SCCAS, 2011. *Requirements for a Geophysical Survey*. Suffolk County Council.

SCCAS, 2015. *Archaeological Archives in Suffolk: Guideline for preparation and deposition*. Suffolk County Council Archaeological Service Conservation Team.

Soil Survey of England and Wales, 1983. *Soils of England and Wales, Sheet 4 Eastern England*.

## Appendix A – basic principles of magnetic survey

Iron minerals are always present to some degree within the topsoil and enhancement associated with human activity is related to increases in the level of magnetic susceptibility and thermoremanent material.

Magnetic susceptibility is an induced magnetism within a material when it is in the presence of a magnetic field. This can be thought of as effectively permanent due to the presence of the Earth's magnetic field.

Thermoremanent magnetism occurs when ferrous material is heated beyond a specific temperature known as the Curie Point. Demagnetisation occurs at this temperature with re-magnetisation by the Earth's magnetic field upon cooling.

Enhancement of magnetic susceptibility can occur in areas subject to burning and complex fermentation processes on biological material; these are frequently associated with human settlement. Thermoremanent features include ovens, hearths, and kilns. In addition thermoremanent material such as tile and brick may also be associated with human activity and settlement.

Silting and deliberate infilling of ditches and pits with magnetically enhanced soil can create an area of enhancement compared with surrounding soils and subsoils into which the feature is cut. Mapping enhanced areas will produce linear and discrete anomalies allowing an assessment and characterisation of hidden subsurface features.

It should be noted that areas of negative enhancement can be produced from material having lower magnetic properties compared to the topsoil. This is common for many sedimentary bedrocks and subsoils which were often used in the construction of banks and walls etc. Mapping these 'negative' anomalies may also reveal archaeological features.

Magnetic survey or magnetometry can be carried out using a fluxgate gradiometer and may be referred to as gradiometry. The SENSYS gradiometer is a passive instrument consisting of two fluxgate sensors mounted vertically 65cm apart. The instrument is carried about 10-20cm above the ground surface and the upper sensor measures the Earth's magnetic field as does the lower sensor but this is influenced to a greater degree by any localised buried field. The difference between the two sensors will relate to the strength the magnetic field created by the buried feature.

There are a number of factors that may affect the magnetic survey and these include soil type, local geology and previous human activity. Situations arise where magnetic disturbance associated with modern services, metal fencing, dumped waste material etc., obscures low magnitude fields associated with archaeological features.

## Appendix B – data processing notes

### Clipping

Minimum and maximum values are set and replace data outside of the range with those values. Extreme values are removed improving colour or greyscale contrast associated with data values that may be archaeologically significant. It has been found that clipping data to ranges between  $\pm 5nT$  and  $\pm 3nT$  often improves the appearance of features associated with archaeology. Different ranges are applied to data in order to determine the most suitable for anomaly abstraction and display.

### Zero (destripe) Median/Mean Traverse

The median (or mean) of each traverse is calculated ignoring data outside a threshold value, the median (or mean) is then subtracted from the traverse. The process is used to equalise differences between the baseline value of gradiometer sensors.

### High Pass Filtering

A mathematical process used to remove low frequency anomalies relating to survey tracks and modern agricultural features.

## Appendix C – survey and data information

### Raw data

COMPOSITE  
 Path: C:\Business\Jobs\J676 Woolpit\Data\Mag\comps\  
 Filename: J676-mag.xcp  
 Description: Imported as Composite from: J676-mag.asc  
 Instrument Type: Sensys DLMGPS  
 Units: nT  
 UTM Zone: 31U  
 Survey corner coordinates (X/Y): OSGB36  
 Northwest corner: 597675.211944776, 262719.485652904 m  
 Southeast corner: 597839.911944776, 262445.585652904 m  
 Collection Method: Randomised  
 Sensors: 5  
 Dummy Value: 32702  
 Source GPS Points: 982900

Dimensions  
 Composite Size (readings): 1098 x 1826  
 Survey Size (meters): 165 m x 274 m  
 Grid Size: 165 m x 274 m  
 X Interval: 0.15 m  
 Y Interval: 0.15 m

Stats  
 Max: 2534.43  
 Min: -2522.96  
 Std Dev: 27.28  
 Mean: -17.21  
 Median: -17.37  
 Composite Area: 4.5111 ha  
 Surveyed Area: 3.0725 ha

PROGRAM  
 Name: TerraSurveyor  
 Version: 3.0.23.0

Processes: 1  
 1 Base Layer

GPS based Proce2  
 1 Base Layer.  
 2 Unit Conversion Layer (Lat/Long to OSGB36).

### Minimally processed data

COMPOSITE  
 Path: C:\Business\Jobs\J676 Woolpit\Data\Mag\comps\  
 Filename: J676-mag-proc.xcp  
 Description: Imported as Composite from: J676-mag.asc  
 Instrument Type: Sensys DLMGPS  
 Units: nT  
 UTM Zone: 31U  
 Survey corner coordinates (X/Y): OSGB36  
 Northwest corner: 597675.211944776, 262719.485652904 m  
 Southeast corner: 597839.911944776, 262445.585652904 m  
 Collection Method: Randomised  
 Sensors: 5  
 Dummy Value: 32702  
 Source GPS Points: 982900

Dimensions  
 Composite Size (readings): 1098 x 1826  
 Survey Size (meters): 165 m x 274 m  
 Grid Size: 165 m x 274 m  
 X Interval: 0.15 m  
 Y Interval: 0.15 m

Stats  
 Max: 3.32  
 Min: -3.30  
 Std Dev: 1.31  
 Mean: 0.05  
 Median: 0.06  
 Composite Area: 4.5111 ha  
 Surveyed Area: 3.0725 ha

Processes: 1  
 1 Base Layer

GPS based Proce4  
 1 Base Layer.  
 2 Unit Conversion Layer (Lat/Long to OSGB36).  
 3 DeStripe Median Traverse:  
 4 Clip from -3.00 to 3.00 nT

## Appendix D – digital archive

Archaeological Surveys Ltd hold the primary digital archive at their offices in Wiltshire. Data are backed-up onto an on-site data storage drive and at the earliest opportunity data are copied to CD ROM for storage on-site and off-site.

Once a draft copy of the report has been approved by Rachael Abraham, Senior Archaeological Officer, the geophysical data, CAD, report and graphics will be sent to the Suffolk County Council Archaeological Service (SCCAS) Senior Archaeological Officer Faye Minter for archiving. A SCCAS Archive Data Collection Form will also be sent accompanying the data.

A printed copy of the report and a PDF copy will be supplied to the Suffolk Historic Environment Record. The report will also be uploaded to the Online Access to the Index of archaeological investigationS (OASIS) and a copy of the form included in the final report. The WSI will also be included as an additional appendix.

Archive contents:

<b>CD - path: HER_WPT055\Admin\</b>				
<b>Path and Filename</b>	<b>Software</b>	<b>Description</b>	<b>Date</b>	<b>Creator</b>
WPT055_J676_Woolpit_geophysical_survey_WSI.pdf	Solid PDF creator	Geophysical survey Written Scheme of Investigation in PDF/A format	06/09/16	K.T. Donaldson
WPT055_SCCAS_Archive_Data_Collection_Form_v4.xls	OpenOffice calc	SCCAS Excel Spreadsheet archive data collection form	06/09/16	K.T. Donaldson
<b>CD - path: HER_WPT055\Digital\Data\Raw_data\Sensys_proprietary_files\</b>				
.prm .dgb .disp	Sensys MXPDA	Proprietary data formats with 253 of each file type representing magnetometer survey traverses logged to a PDA .	24/08/16	D.J.Sabin
<b>CD - path: HER_WPT055\Digital\Data\Raw_data\Sensys_magneto_DLMGPS_files\</b>				
WPT055_J676_mag.dlm	Sensys DLMGPS	Proprietary data format for display in Sensys Magneto software	24/08/16	D.J.Sabin
WPT055_J676_mag.prp	Sensys DLMGPS	Proprietary data format composite of survey traverses	24/08/16	D.J.Sabin
<b>CD - path: HER_WPT055\Digital\Data\Raw_data\CSV_file\</b>				
WPT055_J676_mag.csv	Sensys DLMGPS	ASCII CSV (tab) file representing survey area in eastings, northings (UTM Z30N), magnetic measurement, traverse file and sensor number.	02/09/16	D.J.Sabin
<b>CD - path: HER_WPT055\Digital\Data\Processed_data\TerraSurveyor_files\</b>				
WPT055_J676_mag_proc.xcp	TerraSurveyor 3.0.23.0	Processed composite data file (zmt and clipping to $\pm 3nT$ ).	02/09/16	K.T. Donaldson
WPT055_J676_mag_proc.csv	TerraSurveyor 3.0.23.0	Processed composite data file exported as a CSV file.	06/09/16	K.T. Donaldson
<b>CD - path: HER_WPT055\Digital\Data\Graphics</b>				
WPT055_J676_mag_raw.tif	TerraSurveyor 3.0.23.0	TIF file showing a raw greyscale plot	02/09/16	K.T. Donaldson
WPT055_J676_mag_raw.tfw	TerraSurveyor 3.0.23.0	World file for georeferencing TIF to OSGB36.	02/09/16	K.T. Donaldson
WPT055_J676_mag_proc.tif	TerraSurveyor	TIF file showing a minimally processed greyscale	02/09/16	K.T. Donaldson

	3.0.23.0	plot clipped to $\pm 3nT$ .		
WPT055_J676_mag_proc.tfw	TerraSurveyor 3.0.23.0	World file for georeferencing TIF to OSGB36.	02/09/16	K.T. Donaldson
<b>CD - path: HER_WPT055\Digital\CAD</b>				
WPT055_J676_CAD.dwg	ProgeCAD 2016	CAD file for creating plots of greyscales, abstraction, interpretation and mapping. Grid coordinates as OSGB. AutoCAD 2010 format.		K.T.Donaldson
<b>CD - path: HER_WPT055\Report</b>				
WPT055_J676_mag_survey_report.pdf	Solid PDF Creator	Report in PDF/A format		K.T.Donaldson

## Appendix E – copyright and intellectual property

This report may contain material that is non-Archaeological Surveys Ltd copyright (eg Ordnance Survey, Crown Copyright) or the intellectual property of third parties, which we are able to provide for limited reproduction under the terms of our own copyright licences, but for which copyright itself is non-transferable by Archaeological Surveys Ltd. Users remain bound by the conditions of the Copyright, Design and Patents Act 1988 with regard to multiple copying and electronic dissemination of this report.

Archaeological Surveys Ltd shall retain intellectual property rights for the materials and records created as part of this project. A non-exclusive, transferable, sub-licensable, perpetual and royalty-free licence shall be granted to the client on full payment of works in order for them to use, reproduce and enhance the reports, documentation, graphics and illustrations produced as part of this project for the purpose for which they were commissioned. Copyright licence will also be granted to the local authority for planning use and within in the Historic Environment Record for public dissemination upon payment by the client. Any document produced to meet planning requirements may be freely copied for planning, development control, research and outreach purposes without recourse to the originator, subject to all due and appropriate acknowledgements being provided and to the terms of the original contract with the client. Archaeological Surveys Ltd shall retain the right to be identified as the author and originator of the material.

The report, data and any associated material produced by Archaeological surveys Ltd cannot be freely used for any commercial activity other than those set out above. Any unauthorised use will be considered to be in breach of copyright.

Title of Goods remains with Archaeological Surveys Ltd until payment has cleared. Late payment may jeopardise any planning decision as there will be no transfer of title, licensing or any other right of copy or use of this report. Archaeological Surveys Ltd do not give permission for use of the report and associated data in cases of late payment. Any such use will be considered to be in breach of copyright. Late payment may also incur interest at 8% over the Bank of England base rate. Non-payment will be pursued by legal action.



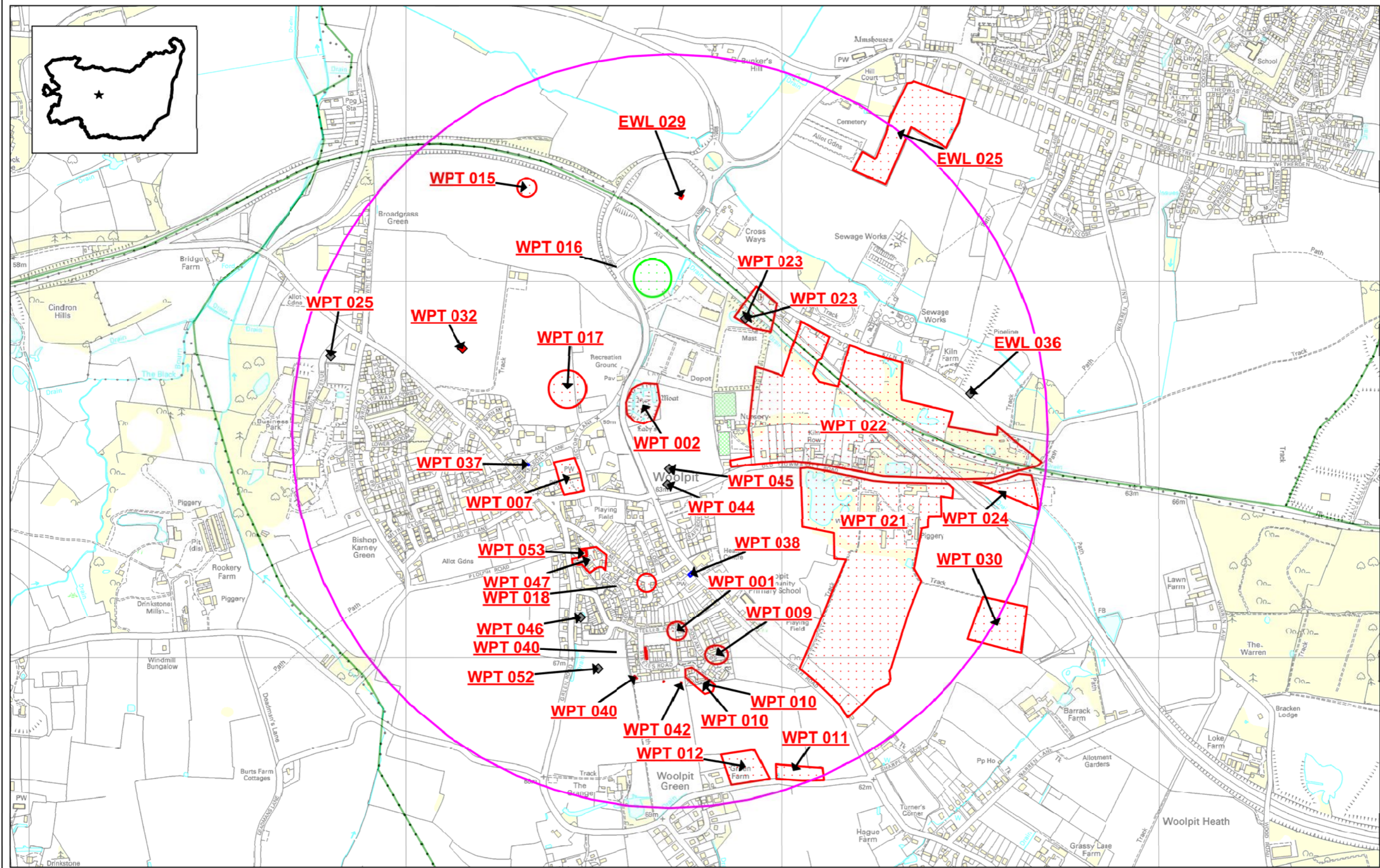
# JNAS Woolpit

## HER monuments

Compiled by on 7 March 2016

Suffolk Historic Environment Record  
Suffolk County Council Archaeological Service  
9/10 The Churchyard, Shire Hall, Bury St Edmunds, IP33 1RX  
01284 741237 / archaeology.her@suffolk.gov.uk

Scale 1:10000



## Suffolk County Council Archaeological Service Sites and Monuments Record

07/03/2016

Parish ELMSWELL, MID SUFFOLK,  
SUFFOLK

Ref	Site Name	Period	Summary Description	NGR
EWL 025	Elmswell Community Woodland MSF24084		Metal detector survey located medieval or early post medieval finds, and also a mount from an Early Saxon hanging bowl that may be indicative of a cemetery site.	Centred TL 9830 6339 (297m by 274m)
EWL 029	Post-medieval ditch, Land Adjacent to Kiln Lane, Elmswell MSF28706		Evaluation identified a single post-medieval ditch, which appears to be the one shown on the OS 1st edition 1880's.	Centred TL 9773 6322 (10m by 12m)
EWL 036	OUTLINE RECORD: Kiln site suggested in 1841 tithe records (BACKLOG) MSF33166			TL 9850 6270 (point)
WPT 001	12 Steeles Road MSF6326	Rom	Sestertius of Hadrian found in garden.	Centred TL 9772 6207 (10m by 10m)
WPT 002	Lady's Well (Holy Well and Moat) MSF6327	Med	Lady's Well (Holy Well and Moat) (& site of chapel ?).	Centred TL 9763 6267 (10m by 10m)
WPT 007	Church of St Mary (Med)Woodland MSF2028	Med	Church lies in the diocese of St Edmundsbury and Ipswich, the archdeaconry of Sudbury and the deanery of Lavenham.	Centred TL 9745 6248 (10m by 10m)
WPT 007	Church of St Mary (Rom)Two MSF2029	Rom	Remains found in the churchyard.	Centred TL 9745 6245 (100m by 100m)
WPT 009	Field No. 0082 MSF6334	Rom	Roman pottery scatter.	Centred TL 9782 6200 (10m by 10m)
WPT 010	Field No. 0082 (Rom)Roman MSF6335	Rom	Pottery scatter.	Centred TL 9779 6193 (10m by 10m)
WPT 010	Field No. 0082 (Med)Pottery MSF6336	Med	Medieval.	Centred TL 9779 6193 (10m by 10m)
WPT 011	Field No. 0082 MSF6337	Rom	Roman pottery scatter.	Centred TL 9803 6170 (10m by 10m)
WPT 012	Field No. 0082 MSF6338	Med	C12-C14 pottery scatter.	Centred TL 9790 6171 (10m by 10m)
WPT 015	Small scatter of pottery - grey wares and single plain sherd of Samian. MSF9990	Rom	Small scatter of pottery - grey wares and single plain sherd of Samian.	Centred TL 9722 6325 (10m by 10m)
WPT 016	Small ?socketed axe blade fragment metal detected from field. MSF11622	BA	Small ?socketed axe blade fragment metal detected from field.	Centred TL 9765 6305 (100m by 100m)

Ref	Site Name	Period	Summary Description	NGR
WPT 017	Small blade fragment of socketed axe, surviving width 2. (BA) MSF13085	BA	Small blade fragment of socketed axe, surviving width 2.	Centred TL 9745 6265 (100m by 100m)
WPT 017	Lead scallop shaped ampulla with twin triangular loops at base of neck. (Med) MSF13086	Med	Lead scallop shaped ampulla with twin triangular loops at base of neck.	Centred TL 9745 6265 (100m by 100m)
WPT 018	Pykes Mill MSF14778	PMe	TL 976 622 Post Mill, demolished c.	Centred TL 9764 6218 (10m by 10m)
WPT 021	Woolpit Brick Works MSF17037	PMe	Site of large brick works shown on first (1880s) and second editions (1904) OS maps (S1) and on 1st ed 1" 1834 OS map (S3); shown to be disused on 1958 OS map (S2).	Centred TL 9835 6235 (100m by 100m)
WPT 022	Kiln Lane Brick Works MSF17038	PMe	Site of brick works shown on 1st (1880s) & 2nd edition (1904) OS maps (S1) and shown to be disused on 1958 OS map (S2).	Centred TL 9835 6275 (100m by 100m)
WPT 023	New Kiln/Crossways (PMed) MSF17039	PMe	Site of brick works and kiln shown on 2nd edition (1904) OS map (S1).	Centred TL 9795 6295 (100m by 100m)
WPT 023	OUTLINE RECORD: ANIMAL REMAINS (Pal) MSF31065	Pal		TL 9790 6290 (point)
WPT 024	Cropmark of three parallel lines, probably road/trackway. MSF17695	Un	Cropmark of three parallel lines, probably road/trackway.	Centred TL 9859 6244 (170m by 94m)
WPT 025	Former site of Elmer's Mill MSF31066	PMe	Former site of Elmer's Mill	TL 9680 6280 (point)
WPT 030	Single rectangular cropmark of field boundaries - slightly different alignment to those existing today. MSF21994	Un	Single rectangular cropmark of field boundaries - slightly different alignment to those existing today.	TL 9857 6208 (point)
WPT 032	Metal detected scatter of Medieval metalwork. MSF24187	Med	Metal detected scatter of Medieval metalwork.	TL 9715 6282 (point)
WPT 037	Garage at the former Woolpit Interiors premises MSF25560	19th	19th C garage, which was originally constructed as a cartshed, but was also used as a dwelling at some point	Centred TL 9732 6251 (9m by 5m)
WPT 038	Woolpit Methodist Chapel MSF27214	19th	19th C methodist chapel	Centred TL 9775 6222 (14m by 15m)

Ref	Site Name	Period	Summary Description	NGR
WPT 040	Undated ditch, Iron Age and Medieval pottery from Land at Steeles Road MSF31071		Undated ditch, Iron Age and Medieval pottery found during evaluation work at Land at Steeles Road	Centred TL 9762 6198 (35m by 83m)
WPT 042	Two undated ditches identified during an evaluation at Steeles Road (Phase 2) MSF31276		Two undated ditches identified during an evaluation at Steeles Road (Phase 2)	Centred TL 9770 6193 (48m by 6m)
WPT 044	OUTLINE RECORD: Medieval pottery and Post Medieval pottery, claypipe, brick and tile (BACKLOG) MSF33495			TL 9769 6245 (point)
WPT 045	Findspot of three coins of 16th and 17th century date MSF33992		Findspot of three coins of 16th and 17th century date found during metal detecting.	TL 9770 6250 (point)
WPT 046	Findspot of 13th century lead seal matrix found in garden MSF33993		Findspot of 13th century lead seal matrix found in garden of Walnut Tree Cottage	TL 9746 6210 (point)
WPT 047	Post Medieval pits, pottery and building material identified at Cow Fair MSF33994		Post Medieval pits, pottery and building material identified at Cow Fair	Centred TL 9748 6225 (91m by 68m)
WPT 052	OUTLINE RECORD: Land between Green Road and Steeles Road, Woolpit (EVAL) SA MSF34426			TL 9751 6197 (point)
WPT 053	WWII machine gun emplacement MSF34567		WWII machine gun emplacement . Now removed	Centred TL 9747 6227 (15m by 17m)

## Appendix G - OASIS DATA COLLECTION FORM: England

OASIS ID: archaeol20-258303

### Project details

Project name Land north of Old Stowmarket Road, Woolpit, Suffolk, Magnetometer Survey Report

Short description of the project A detailed magnetometer survey was undertaken by Archaeological Surveys Ltd over the eastern part of a single field at Woolpit in Suffolk. The site lies immediately adjacent to a medieval moated site and well, known as Lady's Well, which has been designated as a Scheduled Monument. The site lies outside of the scheduled area, and although a number of positive and negative anomalies have been located, they are so weak, short and indistinct that they cannot be interpreted as cut features and none can be clearly seen as having an association with Lady's Well. A number of former field boundaries and land drains have also been located.

Project dates Start: 24-08-2016 End: 24-08-2016

Previous/future work Not known / Not known

Any associated project reference codes WPT 055 - Related HER No.

Any associated project reference codes ESF24356 - HER event no.

Any associated project reference codes J676 - Contracting Unit No.

Type of project Field evaluation

Monument type BOUNDARY Post Medieval

Monument type LAND DRAIN Modern

Significant Finds NONE None

Methods & techniques "Geophysical Survey"

Development type Housing estate

Prompt National Planning Policy Framework - NPPF

Position in the planning process Not known / Not recorded

Solid geology NORWICH CRAG, RED CRAG AND CHILLESFORD CLAY

Drift geology BOULDER CLAY AND MORAINIC DRIFT

Techniques Magnetometry

### Project location

Country

Site location SUFFOLK MID SUFFOLK WOOLPIT Land North of Old Stowmarket Road, Woolpit, Suffolk

Study area 2.85 Hectares

Site coordinates TL 97755 62595 52.225511095964 0.895766895507 52 13 31 N 000 53 44 E Point

### Project creators

Name of Organisation

Project brief originator Archaeological Surveys Ltd

Project design originator Archaeological Surveys Ltd

Project director/manager Archaeological Surveys Ltd

Project supervisor Archaeological Surveys Ltd

### Project archives

Physical Archive Exists?

Digital Archive recipient Suffolk County Council Archaeological Service

Digital Contents "Survey"

Digital Media available "Geophysics", "Text"

Paper Archive Exists? No

Entered by Kerry Donaldson (kerry.donaldson@archaeological-surveys.co.uk)

Entered on 8 September 2016



**Land north of  
Old Stowmarket Road  
Woolpit  
Suffolk**

**GEOPHYSICAL SURVEY  
WRITTEN SCHEME OF INVESTIGATION**

for

**New Hall Properties (Eastern) Ltd**

David Sabin and Kerry Donaldson

August 2016

Ref. no. 676

Suffolk County Council HER Event No: ESF24356

HER Parish Code: WPT 055

OASIS ID: archaeol20-258303

ARCHAEOLOGICAL SURVEYS LTD

**Land north of  
Old Stowmarket Road  
Woolpit  
Suffolk**

Geophysical Survey Written Scheme of Investigation

Suffolk County Council HER Event No: ESF24356

HER Parish Code: WPT 055

OASIS ID: archaeol20-258303



Archaeological Surveys Ltd  
1 West Nolands, Nolands Road, Yatesbury, Calne, Wiltshire, SN11 8YD  
Tel: 01249 814231 Fax: 0871 661 8804  
Email: [info@archaeological-surveys.co.uk](mailto:info@archaeological-surveys.co.uk)  
Web: [www.archaeological-surveys.co.uk](http://www.archaeological-surveys.co.uk)

## CONTENTS

1 INTRODUCTION.....	1
1.1 Survey background.....	1
1.2 Survey objectives, techniques and standards.....	1
1.3 Site location, description and survey conditions.....	1
1.4 Site history and archaeological potential.....	3
1.5 Geology and soils.....	4
2 METHODOLOGY AND REPORTING.....	4
2.1 Technical synopsis.....	4
2.2 Equipment configuration, data collection and survey detail .....	5
2.3 Data processing and presentation .....	5
2.4 Reporting.....	6
2.5 Archive.....	7
3 HEALTH AND SAFETY.....	8
4 INTELLECTUAL PROPERTY RIGHTS.....	8
5 REFERENCES.....	10
Appendix A – basic principles of magnetic survey.....	11

## LIST OF FIGURES

Fig 1: Location of survey area.....	2
Fig 2: Architect plan of development area.....	3





# 1 INTRODUCTION

## 1.1 *Survey background*

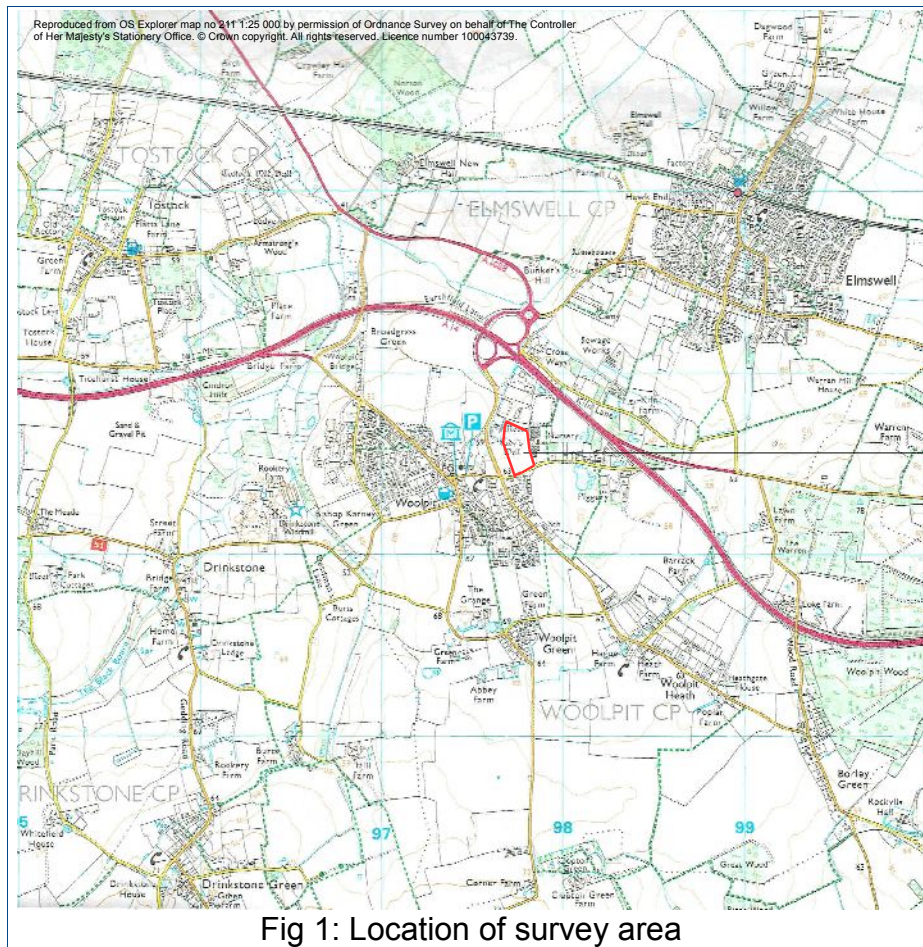
- 1.1.1 Archaeological Surveys Ltd has prepared this Written Scheme of Investigation for New Hall Properties (Eastern) Ltd with regard to a geophysical survey at land to the north of Old Stowmarket Road, Woolpit, Suffolk, see Fig 1. The survey would provide information on the archaeological potential of land likely to be disturbed by a proposed residential development, see Fig 2.
- 1.1.2 Archaeological Surveys Ltd are a small company undertaking specialist geophysical and topographic surveys throughout the UK, Europe and Ireland and is a Registered Organisation with the Chartered Institute for Archaeologists (CIfA). The company directors are David Sabin (Specialised BSc Remote Sensing and Geographic Information Systems, Certificate in Practical Archaeology, Member of the Chartered Institute for Archaeologists) and Kerry Donaldson (BSc Geography, HNC Heritage Management, Certificate in Practical Archaeology). All fieldwork is led by David Sabin.

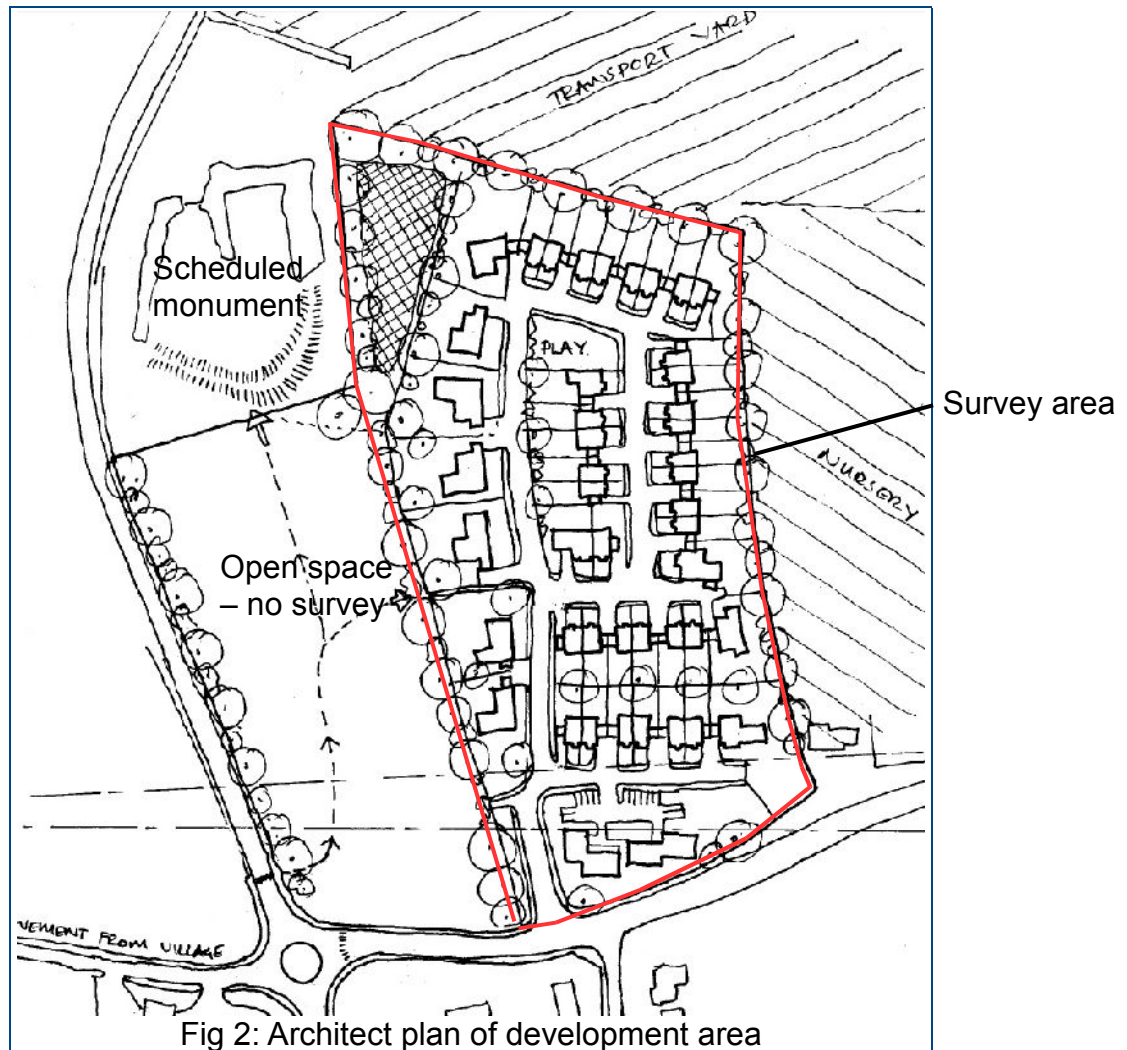
## 1.2 *Survey objectives, techniques and standards*

- 1.2.1 The objectives of the survey are to use non-intrusive geophysical techniques to establish the presence/absence, extent, condition, character, quality and date of any archaeological deposits within the proposed development area.
- 1.2.2 The survey and report will generally follow the recommendations set out by English Heritage, 2008: *Geophysical survey in archaeological field evaluation*; and Institute for Archaeologists, 2002, *The use of Geophysical Techniques in Archaeological Evaluations* and Chartered Institute for Archaeologists (2014) *Standard and Guidance for Archaeological Geophysical Survey* and Suffolk County Council Archaeological Service standard *Requirements for a Geophysical Survey (SCCAS, 2011)*. Archaeological Surveys Ltd may deviate from the guidelines where it is considered appropriate and justifiable with regard to enhancing the archaeological information that may be derived from the results of the survey.

## 1.3 *Site location, description and survey conditions*

- 1.3.1 The site lies to the north of Old Stowmarket Road, on the eastern edge of Woolpit in Suffolk, see Fig 1 below. The central OS Grid Reference is TL 97755 62595. The area covered by the site is approximately 2.85ha within the eastern half of a 4.8ha arable field. The eastern part of the field has been outlined for the housing development, the western part has been outlined for use as open space and will not be subject to development or therefore survey, see Fig 2.





#### 1.4 Site history and archaeological potential

- 1.4.1 The site lies immediately south east of the Scheduled Monument (List entry UID: 1005992) *Lady's Well*, which relates to a medieval holy well and moated site. The survey area does not encroach into the scheduled area, which is currently heavily wooded, but it is possible that potential associated archaeological features may extend beyond the scheduled area into the site.
- 1.4.2 An Archaeological Desk-Based Assessment has been carried out by John Newman Archaeological Services (JNAS, 2016) and a full HER search has been carried out as part of this. In the south western corner of the same field, but lying outside of the survey area are the location of a number of medieval and post-medieval pottery sherds, fragments of clay tobacco pipe and post-medieval brick (Suffolk HER no: WPT 044/MSF33495) with the findspots of three coins of 16th and 17th century date located just to the north (Suffolk HER no: WPT 045/MSF3392). These finds may indicate the presence of a medieval to post-medieval dwelling or dwellings fronting the Old Stowmarket Road, which had been removed before the 1845 tithe map, which shows the survey area divided into three fields.

- 1.4.3 In the wider vicinity there is some evidence of Roman activity and also further medieval and post-medieval activity and there is some potential for the survey to locate anomalies which relate to previously unrecorded archaeological features, should they be present within the site.

## 1.5 *Geology and soils*

- 1.5.1 The underlying solid geology across the site is Crag Group - Sand with overlying deposits of Lowestoft Formation - Diamicton (BGS, 2016). The overlying soil across the survey area is from the Newport 3 association, which are typical brown sands. They consist of deep, well drained, sandy and coarse loamy soils (Soil Survey of England and Wales, 1983).
- 1.5.2 Magnetometry survey carried out across similar soils has produced variable results, often with low magnetic susceptibility causing weak or poorly defined anomalies. However, within areas of long term occupation there can be sufficient magnetic contrast for features to be visible within the data. The underlying geology and soils are therefore considered acceptable for magnetic survey.

## 2 METHODOLOGY AND REPORTING

### 2.1 *Technical synopsis*

- 2.1.1 Magnetometry survey records localised magnetic fields that can be associated with features formed by human activity. Magnetic susceptibility and magnetic thermoremnance influence the formation of localised fields. Additional details are set out below and within Appendix A.
- 2.1.2 Iron minerals within the soil may become altered by burning and the break down of biological material; effectively the magnetic susceptibility of the soil is increased and the iron minerals become magnetic in the presence of the Earth's magnetic field. Accumulations of magnetically enhanced soils within features such as pits and ditches can produce magnetic anomalies that can be mapped during magnetic prospection.
- 2.1.3 Magnetic thermoremnance can occur when ferrous minerals have been heated to high temperatures such as in a kiln, hearth or associated with other industrial processes. On cooling, a permanent magnetisation may be acquired due to the presence of the Earth's magnetic field. Certain natural processes, associated with the formation of some igneous and metamorphic rock, may also result in magnetic thermoremnance.
- 2.1.4 The localised variations in magnetism are measured as sub-units of the Tesla which is a SI unit of magnetic flux density. These sub-units are nano Teslas (nT), which

are equivalent to  $10^{-9}$  Tesla (T).

## 2.2 *Equipment configuration, data collection and survey detail*

- 2.2.1 The survey will be carried out using a SENSYS MAGNETO®MXPDA 5 channel cart based system. The instrument has 5 fluxgate gradiometers spaced 0.5m apart with readings recorded at 20 Hz. It is linked to a Leica GS10 RTK GPS with data recorded by SENSYS MAGNETO®MXPDA software on a rugged PDA computer system.
- 2.2.2 Due to the fixed offsets within the fluxgate sensors, as a result of the manufacturing and tensioning process, the survey data do not provide a visually useful dataset until a zero median traverse algorithm is applied. It is recognised that this has the potential to affect some anomalies detrimentally by removing linear features orientated parallel to survey transects. However, this has not been noted as a particular problem with the system due to the high resolution data collection, generally long length of traverses and variability within the magnetic characteristics of a linear anomaly.
- 2.2.3 Data are collected along a series of parallel survey transects wherever possible to achieve 100% coverage of the surveyable land. The length of each transect is variable and relates to the size of the survey area and other factors including ground conditions. A visual display allows accurate placing of transects and helps maintain the correct separation between adjacent traverses.
- 2.2.4 Fluxgate sensors are highly sensitive to temperature change and this is manifest as drift during the course of a survey. This can be particularly noticeable during the morning as temperatures rise and the equipment warms or cools. Sensor drift within the course of a traverse will appear as a line trending from negative to positive after processing with a zero median traverse algorithm. To remove the effects of temperature drift the surveyor will assess the weather conditions and adjust the length of traverses accordingly. Where temperatures are suspected as rising or falling traverses will be limited to 30s duration. In more stable conditions it is possible to survey traverses for several minutes duration with no noticeable drift; however, traverses will be limited to approximately 60s. In addition, the surveyor will ensure the sensors are kept perpendicular to the ground surface as this may also produce noise within the dataset.

## 2.3 *Data processing and presentation*

- 2.3.1 Magnetic data collected by the MAGNETO®MXPDA cart-based system are initially prepared using SENSYS MAGNETO®DLMGPS software. Survey tracks are analysed and georeferenced raw data (UTM Z30N) are then exported in ASCII format for further analysis and display using TerraSurveyor.
- 2.3.2 The data are collected between limits of  $\pm 10000$ nT and clipped for display at  $\pm 3$ nT. Data are interpolated to a resolution of effectively 0.5m between tracks

and 0.15m along each survey track. A zero median traverse function is required in order to remove fixed offset values present within the sensors which do not undergo a zeroing procedure in the field. The approach ensures that the gradiometer sensors are very accurately aligned and fixed to the vertical magnetic field and are not influenced by localised magnetic fields or disturbed by vibration. Although a zero median traverse algorithm can remove anomalies aligned with the survey tracks, in practice this rarely occurs due to the use of long traverses, high resolution measurement and variability within the magnetic susceptibility of long linear features. A TIFF file (UTM ETRS89 Zone 30) is produced by TerraSurveyor software and is reprojected to Ordnance Survey co-ordinates (OSGB36) using the OSTN02 transformation parameters.

- 2.3.3 The main form of data display used in the report will be the minimally processed greyscale plot (clipped and zero median traversed), although a plot of the "raw" data will be shown at absolute values. If further filtering needs to be applied, another greyscale plot will also be shown as filtered data. An abstraction and interpretation plot will outline anomalies using coloured points, polylines and polygons. Plots will be scaled at 1:1000 where suitable, but at other scales if this better defines the context and will include scale bars, scales indicating data range and north arrows (OS Grid North).
- 2.3.4 The raster images will be combined with base mapping using AutoCAD LT 2007 and ProgeCAD 2010 creating DWG file formats. All images will be externally referenced to the CAD drawing in order to maintain good graphical quality. Quality can be compromised by rotation of graphics in order to allow the data to be orientated with respect to grid north; this is considered acceptable as the survey results are effectively georeferenced allowing relocation of features using GPS, resection method etc.. A digital archive including raster images will be produced with the report allowing separate analysis if necessary, see 2.5 below.
- 2.3.5 An abstraction and interpretation is offered for all geophysical anomalies located by the survey. A brief summary of each anomaly with an appropriate reference number will be set out in list form within the results to allow a rapid assessment of features. Where further interpretation is possible, or where a number of possible origins should be considered, more detailed discussion will follow.

## 2.4 Reporting

- 2.4.1 Preliminary greyscale results will usually be made available to the client within 1 week of completion of fieldwork. A draft copy of the report is generally submitted to the client within 3 weeks of completion of the fieldwork, depending on complexity of anomalies. A draft copy will also be supplied to Rachael Abraham, Senior Archaeological Officer for Suffolk County Council for comment before a final copy is issued.
- 2.4.2 Reporting will be carried out in accordance with English Heritage, 2008:

*Geophysical survey in archaeological field evaluation*; and Institute for Archaeologists, 2002, *The use of Geophysical Techniques in Archaeological Evaluations* and Chartered Institute for Archaeologists (2014) *Standard and Guidance for Archaeological Geophysical Survey* and Suffolk County Council Archaeological Service standard *Requirements for a Geophysical Survey (SCCAS, 2011)* will include the following:

- Title page (title of report, authors, contractor, client, reference no. and date)
- Summary of results
- Introduction (survey background, survey objectives and techniques, site location, description and survey conditions, site history and archaeological potential, geology and soils)
- Methodology (technical synopsis, equipment configuration, data collection, survey detail, data processing and presentation)
- Results (general assessment of survey results, statement of data quality, data interpretation, list of anomalies within each survey area)
- Discussion
- Conclusion (assessment of achievement of aims and objectives, results summarised, implications)
- References
- Appendices (technical details, data processing notes, survey and data information, digital archive)
- Figures (plots in A3 format, location map, referencing layout, greyscale data eg 1:2500 for site and 1:1000 and abstraction and interpretation plot).

## 2.5 Archive

2.5.1 The main archive is held at the offices of Archaeological Surveys Ltd. Survey results will be produced in hardcopy using A4 for text and A3 for plots (all plots will be scaled for A3). In addition digital data created during the survey is provided on CD (see 2.5.2). Further information on the production of the report and the digital formats involved in its creation are set out in 2.5.4 below.

2.5.2 Once payment has been cleared, the geophysical data, CAD, report and graphics will be sent to the Suffolk County Council Archaeological Service (SCCAS) Senior Archaeological Officer Faye Minter for archiving following the Suffolk County Council archives guidelines (SCCAS, 2015). A SCCAS Archive Data Collection Form will also be sent accompanying the data.

2.5.3 A printed copy of the report and a PDF copy will be supplied to the Suffolk Historic Environment Record. The report will also be uploaded to the Online AccesS to the Index of archaeological investigationS (OASIS) and a copy of the form included in the final report. The WSI will also be included as an additional appendix.

2.5.4 The report will be prepared using the following software on a Windows XP platform:

- TerraSurveyor version 3.0.23.0 (geophysical data analysis),



- SENSYS MAGNETO®ARCH version 1.00-04 (geophysical data analysis),
- AutoCAD LT 2007/ ProgeCAD 2014 (report figures),
- OpenOffice.org 3.0.1 Writer (document text),
- PDF Creator version 0.9 (PDF archive)
- Solid PDF Creator version 8 (PDF archive).

Digital data produced by the survey and report include the following files:

- TerraSurveyor grid and composite files for all geophysical data,
- CSV files for raw composites,
- geophysical composite file graphics as Bitmap images,
- AutoCAD DWG files in 2000 and 2007 versions,
- report text as OpenOffice.org ODT file,
- report text as Word 2000 doc file,
- report text as rich text format (RTF),
- report text as PDF,
- PDFs of all figures.

### 3 HEALTH AND SAFETY

3.1.1 All work will be carried out under within terms of the Health and Safety at Work Act 1974. Archaeological Surveys Ltd general statement of policy is as follows:

- to provide adequate control of the health and safety risks arising from our work activities;
- to consult with our employees on matters concerning their health and safety;
- to provide and maintain safe equipment;
- to ensure safe handling and use of equipment;
- to provide information, instruction and supervision;
- to ensure all employees are competent to do their tasks and to give them adequate training;
- to prevent accidents and work-related cases of ill health;
- to maintain safe and healthy working conditions;
- to review and revise this policy at regular intervals.

3.1.2 Archaeological Surveys Ltd holds employers liability insurance (£10m), public liability insurance (£5m) and professional indemnity insurance (£2m) and all risk insurance with a reputable UK based insurer, copies of which can be made available on request:

### 4 INTELLECTUAL PROPERTY RIGHTS

- 4.1.1 Archaeological Surveys Ltd shall retain intellectual property rights for the materials and records created as part of this project. A non-exclusive, transferable, sub-licensable, perpetual, irrevocable and royalty-free licence shall be granted to the client in order for them to use, reproduce and enhance the reports, documentation, graphics and illustrations produced as part of this project for the purpose for which they were commissioned. Copyright licence will also be granted to the local authority for planning use and within in the Historic Environment Record for public dissemination upon payment by the client. Any document produced to meet planning requirements may be freely copied for planning, development control, research and outreach purposes without recourse to the originator, subject to all due and appropriate acknowledgements being provided and to the terms of the original contract with the client. Archaeological Surveys Ltd shall retain the right to be identified as the author and originator of the material.
- 4.1.2 This report may contain material that is non-Archaeological Surveys Ltd copyright (eg Ordnance Survey, Crown Copyright) or the intellectual property of third parties, which we are able to provide for limited reproduction under the terms of our own copyright licences, but for which copyright itself is non-transferable by Archaeological Surveys Ltd. Users remain bound by the conditions of the Copyright, Design and Patents Act 1988 with regard to multiple copying and electronic dissemination of this report.

## 5 REFERENCES

Aspinall, A., Gaffney, C. and Schmidt, A. 2009. *Magnetometry for Archaeologists*. Lanham (US), AltaMira Press.

British Geological Survey, 2015. *Geology of Britain viewer, 1:50 000 scale [online]* available from <http://mapapps.bgs.ac.uk/geologyofbritain/home.html> [accessed 26/11/2015].

Chartered Institute for Archaeologists, 2014. *Standard and Guidance for archaeological geophysical survey*. IfA, University of Reading.

English Heritage, 2008. *Geophysical survey in archaeological field evaluation. Research and Professional Service Guideline No.1*. 2<sup>nd</sup> ed. Swindon: English Heritage.

Institute for Archaeologists, 2002. *The use of Geophysical Techniques in Archaeological Evaluations*. IfA Paper No. 6. IfA, University of Reading.

JNAS, 2016. *Land off Heath Road, Woolpit, Suffolk, Archaeological Desk-Based Assessment*. Unpublished typescript document.

SCCAS, 2011. *Requirements for a Geophysical Survey*. Suffolk County Council.

SCCAS, 2015. *Archaeological Archives in Suffolk: Guideline for preparation and deposition*. Suffolk County Council Archaeological Service Conservation Team.

Soil Survey of England and Wales, 1983. *Soils of England and Wales, Sheet 4 Eastern England*.

## Appendix A – basic principles of magnetic survey

Iron minerals are always present to some degree within the topsoil and enhancement associated with human activity is related to increases in the level of magnetic susceptibility and thermoremanent material.

Magnetic susceptibility is an induced magnetism within a material when it is in the presence of a magnetic field. This can be thought of as effectively permanent due to the presence of the Earth's magnetic field.

Thermoremanent magnetism occurs when ferrous material is heated beyond a specific temperature known as the Curie Point. Demagnetisation occurs at this temperature with re-magnetisation by the Earth's magnetic field upon cooling.

Enhancement of magnetic susceptibility can occur in areas subject to burning and complex fermentation processes on biological material; these are frequently associated with human settlement. Thermoremanent features include ovens, hearths, and kilns. In addition thermoremanent material such as tile and brick may also be associated with human activity and settlement.

Silting and deliberate infilling of ditches and pits with magnetically enhanced soil can create an area of enhancement compared with surrounding soils and subsoils into which the feature is cut. Mapping enhanced areas will produce linear and discrete anomalies allowing an assessment and characterisation of hidden subsurface features.

It should be noted that areas of negative enhancement can be produced from material having lower magnetic properties compared to the topsoil. This is common for many sedimentary bedrocks and subsoils which were often used in the construction of banks and walls etc. Mapping these 'negative' anomalies may also reveal archaeological features.

Magnetic survey or magnetometry can be carried out using a fluxgate gradiometer and may be referred to as gradiometry. The gradiometer is a passive instrument consisting of two fluxgate sensors mounted vertically 0.65m apart. The instrument is carried about 10-20cm above the ground surface and the upper sensor measures the Earth's magnetic field as does the lower sensor but this is influenced to a greater degree by any localised buried field. The difference between the two sensors will relate to the strength the magnetic field created by the buried feature.

There are a number of factors that may affect the magnetic survey and these include soil type, local geology and previous human activity. Situations arise where magnetic disturbance associated with modern services, metal fencing, dumped waste material etc., obscures low magnitude fields associated with archaeological features.

**Geophysical Survey  
Land north of  
Old Stowmarket Road  
Woolpit  
Suffolk**

**Map of survey area**

Reproduced from OS Explorer map no.211 1:25 000  
by permission of Ordnance Survey on behalf of The  
Controller of Her Majesty's Stationery Office.  
© Crown copyright. All rights reserved.  
Licence number 100043739.



● Survey location

Site centred on OS NGR  
TL 97755 62595

SCALE 1:25 000



SCALE TRUE AT A3



Survey location

**Geophysical Survey  
Land north of  
Old Stowmarket Road  
Woolpit  
Suffolk**

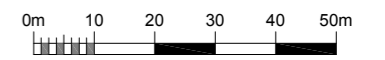
**Referencing information**

Referencing grid to OSGB36 datum at 50m intervals

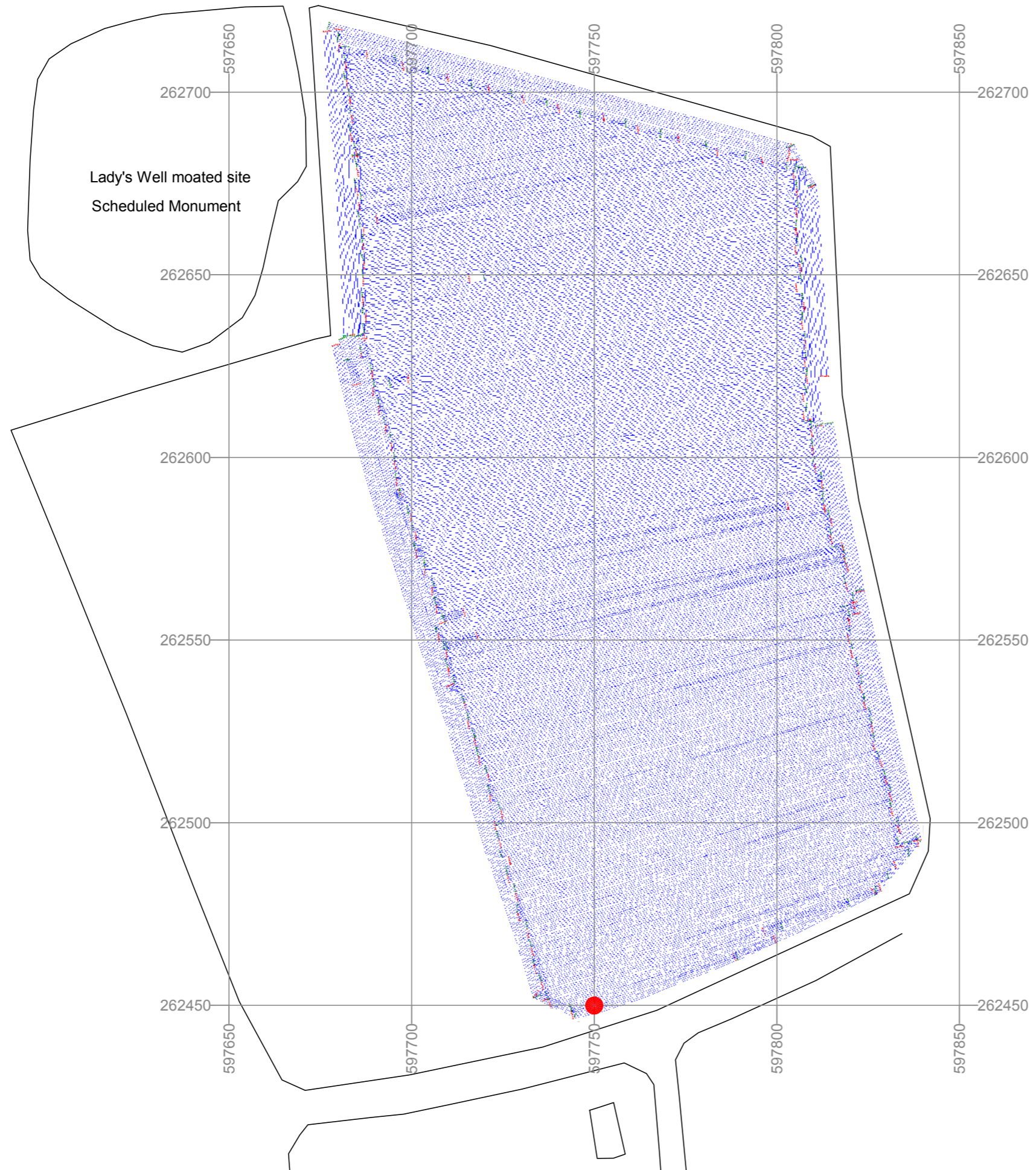
Data collected at 20Hz and georeferenced to ETRS89 zone 30 with conversion to OSGB36 using OSTN02

- 597750 262450
- Survey tracks
- ⋯ Survey track start
- ⋯ Survey track stop

SCALE 1:1250



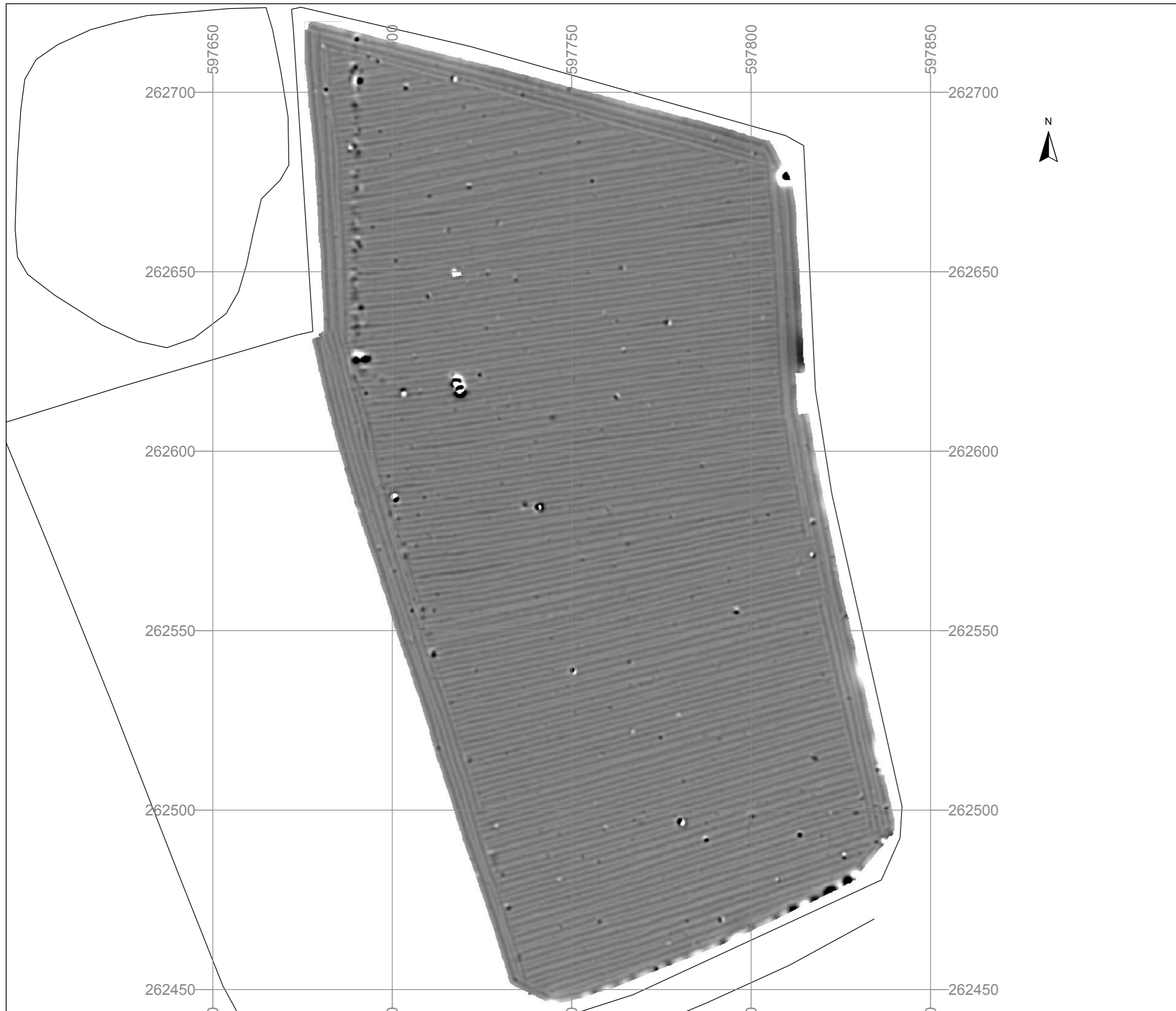
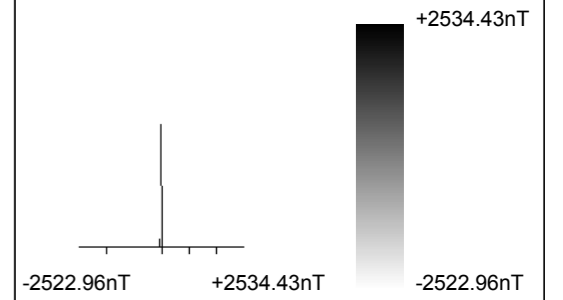
SCALE TRUE AT A3



Lady's Well moated site  
Scheduled Monument

**Geophysical Survey  
Land north of  
Old Stowmarket Road  
Woolpit  
Suffolk**

**Greyscale plot of raw  
magnetometer data**



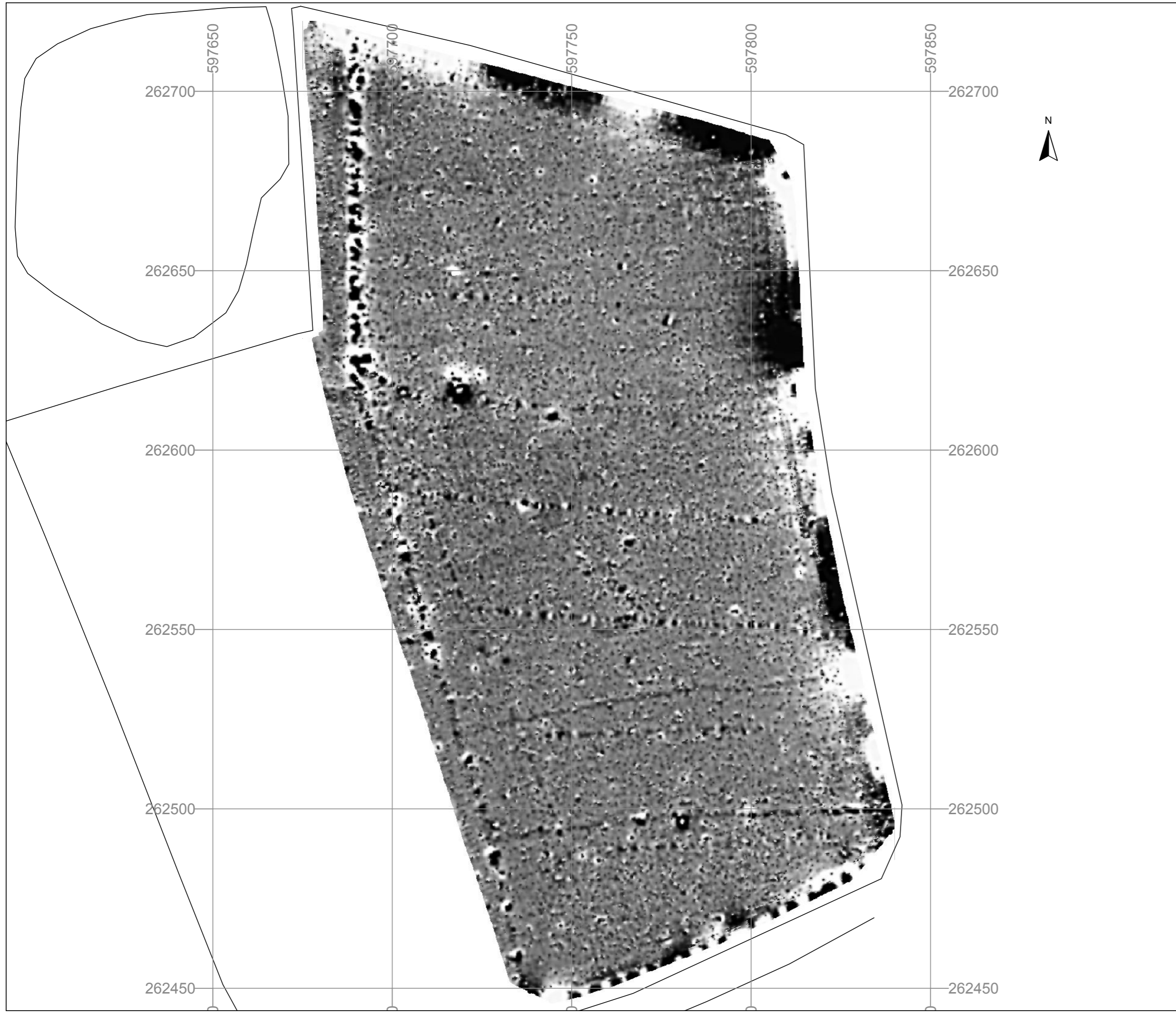
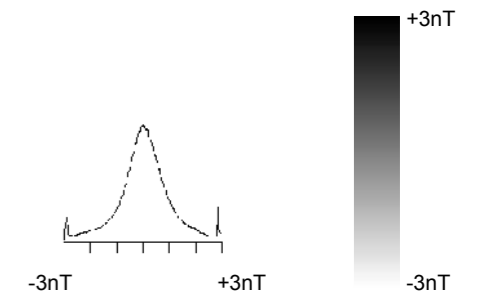
SCALE 1:1000



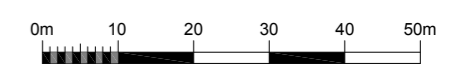
SCALE TRUE AT 3

**Geophysical Survey  
Land north of  
Old Stowmarket Road  
Woolpit  
Suffolk**

**Greyscale plot of minimally  
processed magnetometer data**



SCALE 1:1000











SCALE TRUE AT AS

FIG 04



**Geophysical Survey  
Land north of  
Old Stowmarket Road  
Woolpit  
Suffolk**

**Abstraction and interpretation of  
magnetometer anomalies**

-  Positive linear anomaly - possible ditch-like feature
-  Positive linear anomaly - land drain
-  Positive linear anomaly - possible former field boundary
-  Negative linear anomaly - material of low magnetic susceptibility
-  Discrete positive response - possible pit-like feature
-  Positive anomaly - magnetically enhanced material
-  Magnetic disturbance from ferrous material
-  Strong dipolar anomaly - ferrous object

SCALE 1:1000



SCALE TRUE AT A3

