

# GEOPHYSICAL SURVEY REPORT

# sumo

Survey

**GEOPHYSICS FOR  
ARCHAEOLOGY &  
ENGINEERING**

**Newmarket Road,  
Bury St Edmunds**

Client  
**Albion Archaeology**

Survey Report  
**11580**

HER Parish Site Code  
**BSE 674**

OASIS ID  
**sumogeop1-411326**

Date  
**September 2017**

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## GEOPHYSICAL SURVEY REPORT

Project name:  
**Newmarket Road, Bury St Edmunds**

SUMO Job reference:  
**11580**

Client:  
**Albion Archaeology**

Survey date:  
**7-13 August 2017**

Report date:  
**11 September 2017**

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## DIGITAL CONTENT (Archive Data)

- Minimally Processed Greyscale Images and XY Trace Plots in DWG format
- Digital Copies of Report Text and Figures (both PDF and native formats)



## 1 SUMMARY OF RESULTS

A detailed magnetometer survey was conducted over approximately 32ha of mixed use land. Rectilinear and irregularly shaped enclosures have been detected, along with tentative evidence of a ring ditch and further linear responses. Ridge and furrow and evidence of modern ploughing can be seen across much of the site, as can large areas of natural magnetic variation.

## 2 INTRODUCTION

### 2.1 Background synopsis

**SUMO Services Ltd** were commissioned to undertake a geophysical survey of an area outlined for development. This survey forms part of an archaeological investigation being undertaken by **Albion Archaeology**.

### 2.2 Site details

<b>NGR / Postcode</b>	TL 827 649 / IP33 3JQ
<b>Location</b>	The site lies on the western edge of Bury St Edmunds, Suffolk, immediately south of Newmarket Road. A railway line runs along the northern boundary of the site, with agricultural land to the south, Fornham Lane to the west and a residential area to the east.
<b>HER/SMR</b>	Suffolk
<b>HER Parish Code</b>	BSE 674
<b>OASIS ID</b>	sumogeop1-411326
<b>District</b>	St Edmundsbury
<b>Parish</b>	Westley CP
<b>Topography</b>	Flat
<b>Current Land Use</b>	Mixed use - grassland, orchard, nursery
<b>Weather</b>	Variable - sunny, overcast, showers
<b>Geology</b>	Solid: Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation and Culver Chalk Formation (undifferentiated) - chalk. Superficial: No superficial deposits are present over the majority of the area. Lowestoft Formation - diamicton is recorded across the south-west of the site (BGS 2017).
<b>Soils</b>	Swaffham Prior Association (511e) soils are recorded across the south and north-east of the site, with Melford Association (571o) present across the north-west. Swaffham Prior soils consist of calcareous coarse and fine loamy soils over chalk rubble, while Melford soils comprise well drained, fine loamy over clayey, coarse loamy over clayey and fine loamy soils (SSEW 1983).
<b>Archaeology</b>	Two heritage assets are recorded within the site. One of which comprises 'dubious oval rings on aerial photographs' (MSF6646), which are thought unlikely to be ring ditches. The second is that of a WWII reconnaissance airfield (MSF22951), which lay to the south of Newmarket Road and east of Westley Hall. The site was a small grass airfield, and included a small hangar and club house (Suffolk HER 2017).
<b>Survey Methods</b>	Magnetometer survey (fluxgate gradiometer)
<b>Study Area</b>	44.6 ha - several areas could not be surveyed due to overgrown vegetation/planting, reducing the total area surveyed to c. 32 ha.

## 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 (EH 2008) (then English Heritage), the Chartered Institute for Archaeologists (CIfA 2014) and the European Archaeological Council (EAC 2016).

### 3.2 Survey methods

Detailed magnetic survey was chosen as an efficient and effective method of locating archaeological anomalies.

Technique	Instrument	Traverse Interval	Sample Interval
Magnetometer	Bartington Grad 601-2	1.0m	0.25m

More information regarding this technique is included in Appendix A.

### 3.3 Data Processing

The following basic processing steps have been carried out on the data used in this report:

De-stripe; de-stagger; interpolate

### 3.4 Presentation of results and interpretation

The presentation of the results for each site involves a grey-scale plot of processed data. Magnetic anomalies are identified, interpreted and plotted onto the 'Interpretation' drawings. The minimally processed data are provided as a greyscale image in the Archive Data Folder with an XY trace plot in CAD format. A CAD viewer is also provided.

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 other existing evidence, the anomalies will be given specific categories, such as: *Abbey Wall* or *Roman Road*. Where the interpretation is based largely on the geophysical data, levels of confidence are implied, 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 survey has been divided into twenty survey areas (Areas 1-20) and specific anomalies have been given numerical labels [1] [2] which appear in the text below, as well as on the Interpretation Figure(s).*

### 4.1 **Probable Archaeology**

4.1.1 A series of positive linear anomalies [1-2] are visible in the south of the site (Areas 18 and 20). An irregularly shaped enclosure [2] appears to form the eastern extent of the archaeological responses while a smaller, rectilinear enclosure [1] comprising a double ditch on its eastern and southern edges, is also visible. This anomaly appears to be bisected by the irregularly shaped enclosure of [2]. It is possible that the archaeological responses detected relate to a later prehistoric field system, though a later medieval or modern origin cannot be entirely ruled out.

### 4.2 **Uncertain**

4.2.1 A weak, sub-circular anomaly [3] has been detected in Area 11. This is within the same location as the possible ring ditch (MSF6646), though the response is extremely weak and cannot be interpreted as archaeology with confidence. It is equally likely that the response is of natural origin, and is a result of the natural striations visible across the site.

4.2.2 To the south of the possible circular anomaly [3], in Areas 14-15, two curving, parallel linear responses [4] have been identified. These are again of uncertain origin, and could be of archaeological or agricultural origin.

4.2.3 A curvilinear and partial rectilinear anomaly [5] are visible in the north-west of the site (Area 5). These could be of archaeological origin, and be associated with the field system evident to the south, though could also be of modern or agricultural origin.

4.2.4 Several linear anomalies and trends have been detected across the site (Areas 5, 9, 17 and 18). Due to the dispersed nature of the responses, and their lack of context, they have been categorised as being of uncertain origin. It is possible that they are related to the system of enclosures to the south, though they could equally be natural or a result of modern agricultural activity.

### 4.3 **Agricultural – Ploughing**

4.3.1 Evidence of ridge and furrow cultivation and more recent ploughing is present across much of the site, indicating that the area has had a largely agricultural past.

4.3.2 Areas of magnetic disturbance forming linear anomalies [5] are visible in Areas 14-15 and 17. These relate to modern trackways, visible on aerial photographs.

### 4.4 **Natural / Geological / Pedological / Topographic**

4.4.1 Large areas of enhanced magnetic variation are visible across the site, and are indicative of natural striations within the underlying chalk geology.

### 4.5 **Ferrous / Magnetic Disturbance**

4.5.1 Areas of magnetic disturbance have been detected in Areas 9 and 18. These are likely to be of modern origin, and are a result of ferrous debris within the topsoil.

- 4.5.2 Several strong, bipolar, linear anomalies can be seen in the data, running across Areas 17, 18, 19 and 20. These are indicative of buried underground services, such as pipes.
- 4.5.3 Ferrous responses close to boundaries are due to adjacent fences and gates. Smaller scale ferrous anomalies ("iron spikes") are present throughout the data and their form is best illustrated in the XY trace plots. These responses are characteristic of small pieces of ferrous debris (or brick / tile) in the topsoil and are commonly assigned a modern origin. Only the most prominent of these are highlighted on the interpretation diagram.

## 5 DATA APPRAISAL & CONFIDENCE ASSESSMENT

- 5.1 Historic England guidelines (EH 2008) Table 4 states that the average magnetic response on chalk geologies is generally good, but can vary. Given that archaeological responses have been detected within the site, along with evidence of agricultural activity, it can be concluded that the technique has been effective.

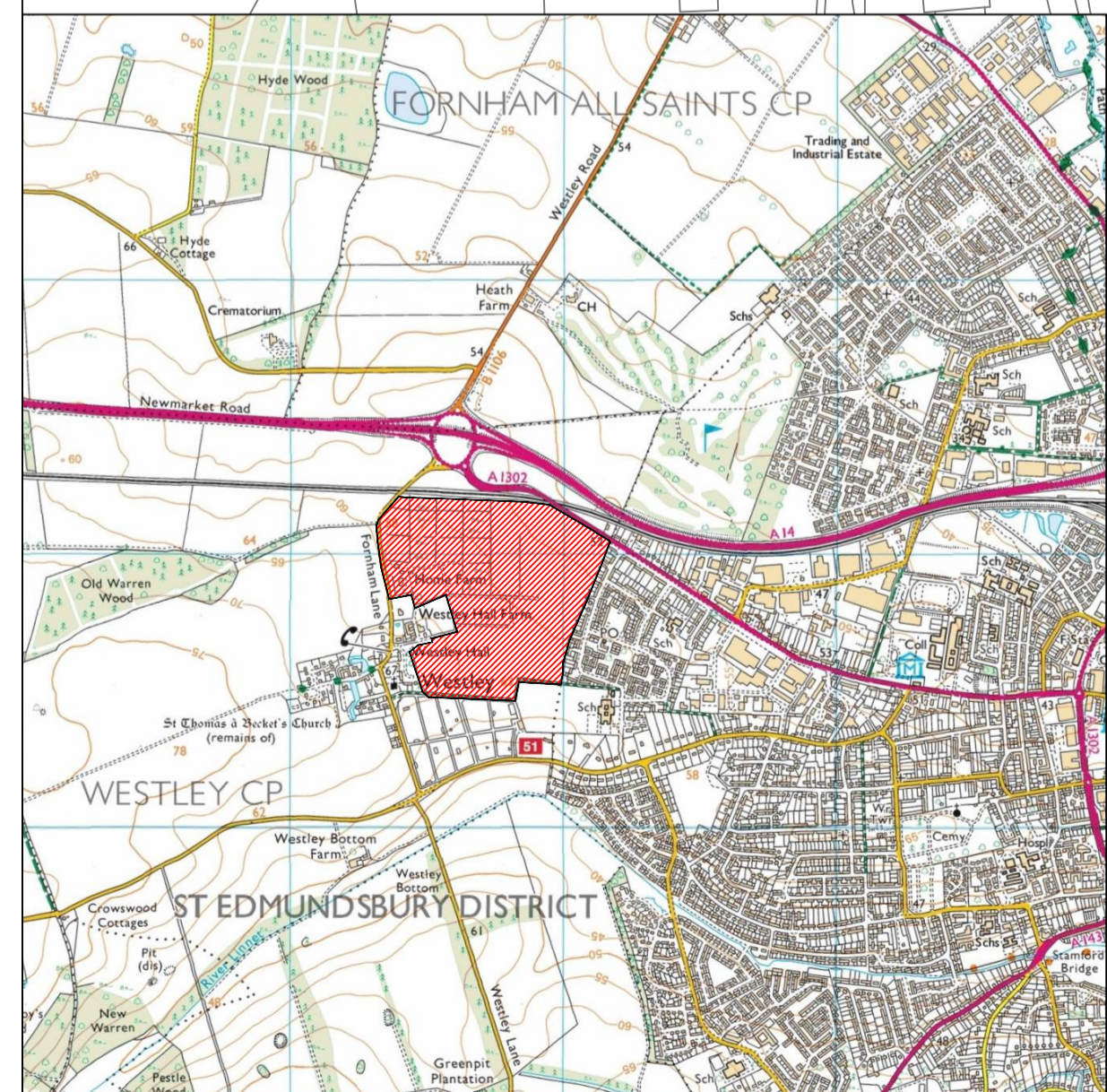
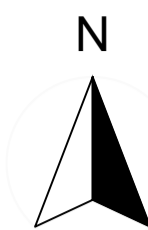
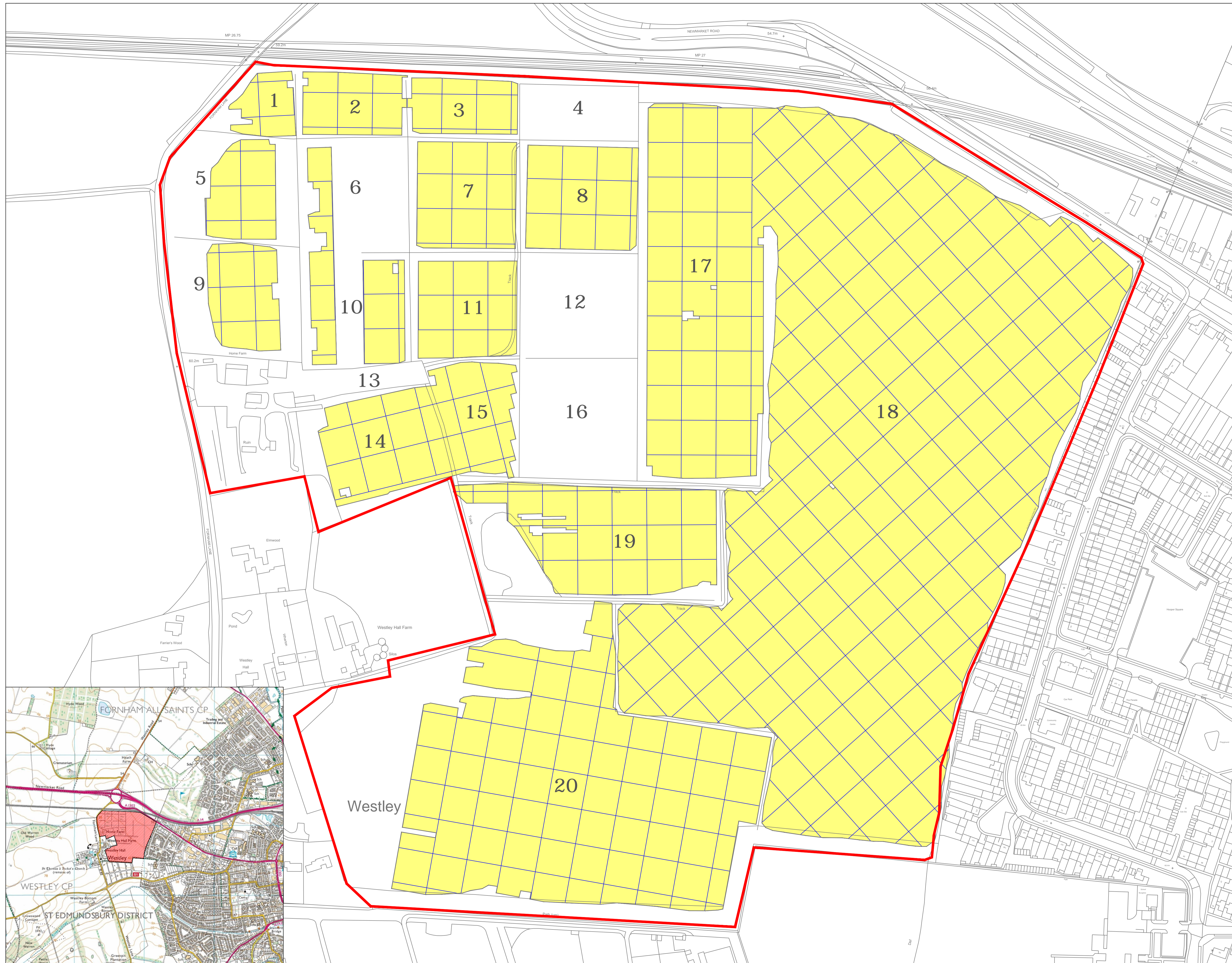
## 6 CONCLUSION


- 6.1 The survey at Bury St Edmunds has revealed a series of linear and rectilinear anomalies, which may be indicative of a later prehistoric field system; however, a medieval or more recent origin cannot be ruled out elsewhere. The remains of a possible ring ditch have been detected, though its interpretation as such is tentative at best. Evidence of ridge and furrow and modern ploughing are visible in the data, along with modern trackways, underground services and areas of natural magnetic variation.

## 7 REFERENCES

- BGS 2017 British Geological Survey, Geology of Britain viewer [Accessed 11/09/2017] *website:* (<http://www.bgs.ac.uk/opengeoscience/home.html?Accordion1=1#maps>)
- ClfA 2014 *Standard and Guidance for Archaeological Geophysical Survey*. Amended 2016. ClfA Guidance note. Chartered Institute for Archaeologists, Reading  
[http://www.archaeologists.net/sites/default/files/ClfAS%26GGeophysics\\_2.pdf](http://www.archaeologists.net/sites/default/files/ClfAS%26GGeophysics_2.pdf)
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- SSEW 1983 *Soils of England and Wales. Sheet 4, Eastern England*. Soil Survey of England and Wales, Harpenden.
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 Survey Area - showing 30m grid

 Site Location

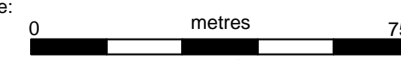
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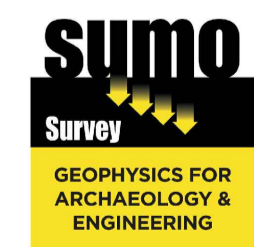
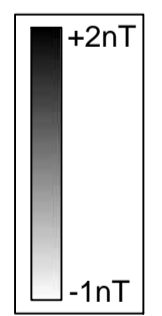
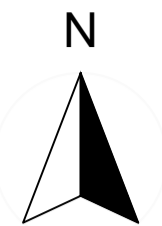
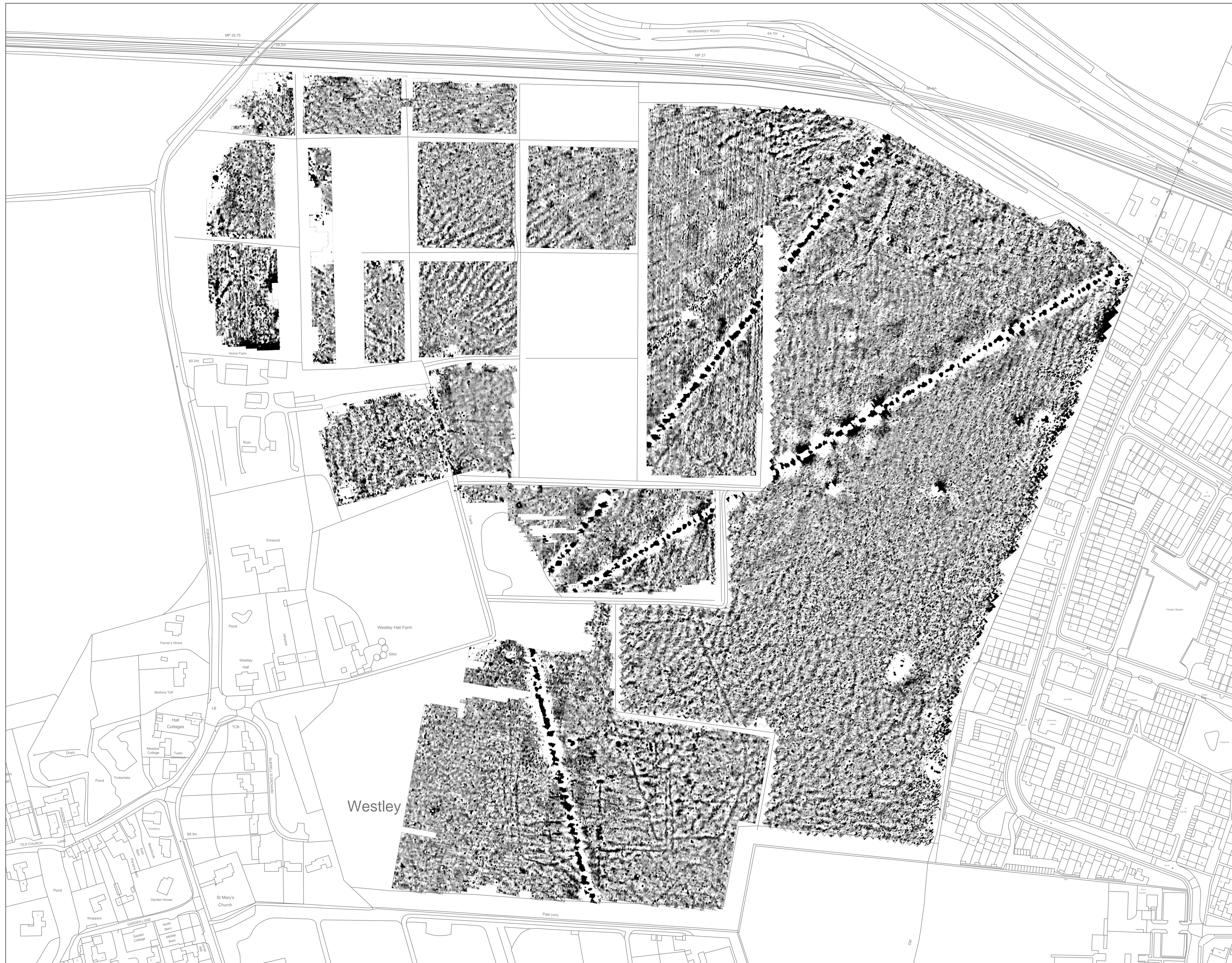


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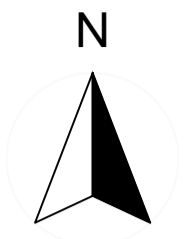
Client: Albion Archaeology

Project: 11580 - Newmarket Road, Bury St Edmunds









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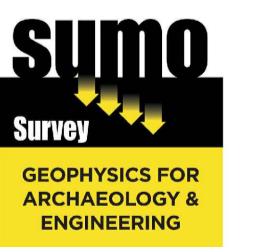


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 Client: Albion Archaeology  
 Project: 11580 - Newmarket Road, Bury St Edmunds  
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 Fig No: 02



**KEY**

-  Probable archaeology (discrete anomaly / trend)
-  Uncertain Origin (discrete anomaly / trend)
-  Agriculture (plough)
-  Natural (e.g. geological / pedological)
-  Trackway (corroborated)
-  Magnetic disturbance
-  Service
-  Ferrous



Title: **Magnetometer Survey - Interpretation - Overview**

Client: **Albion Archaeology**

Project: **11580 - Newmarket Road, Bury St Edmunds**

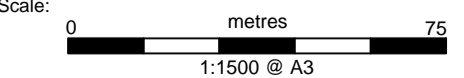
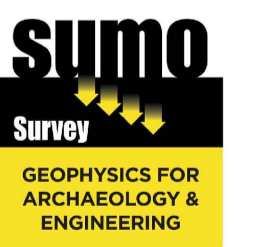
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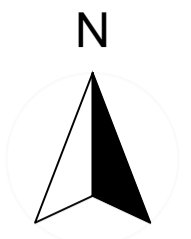
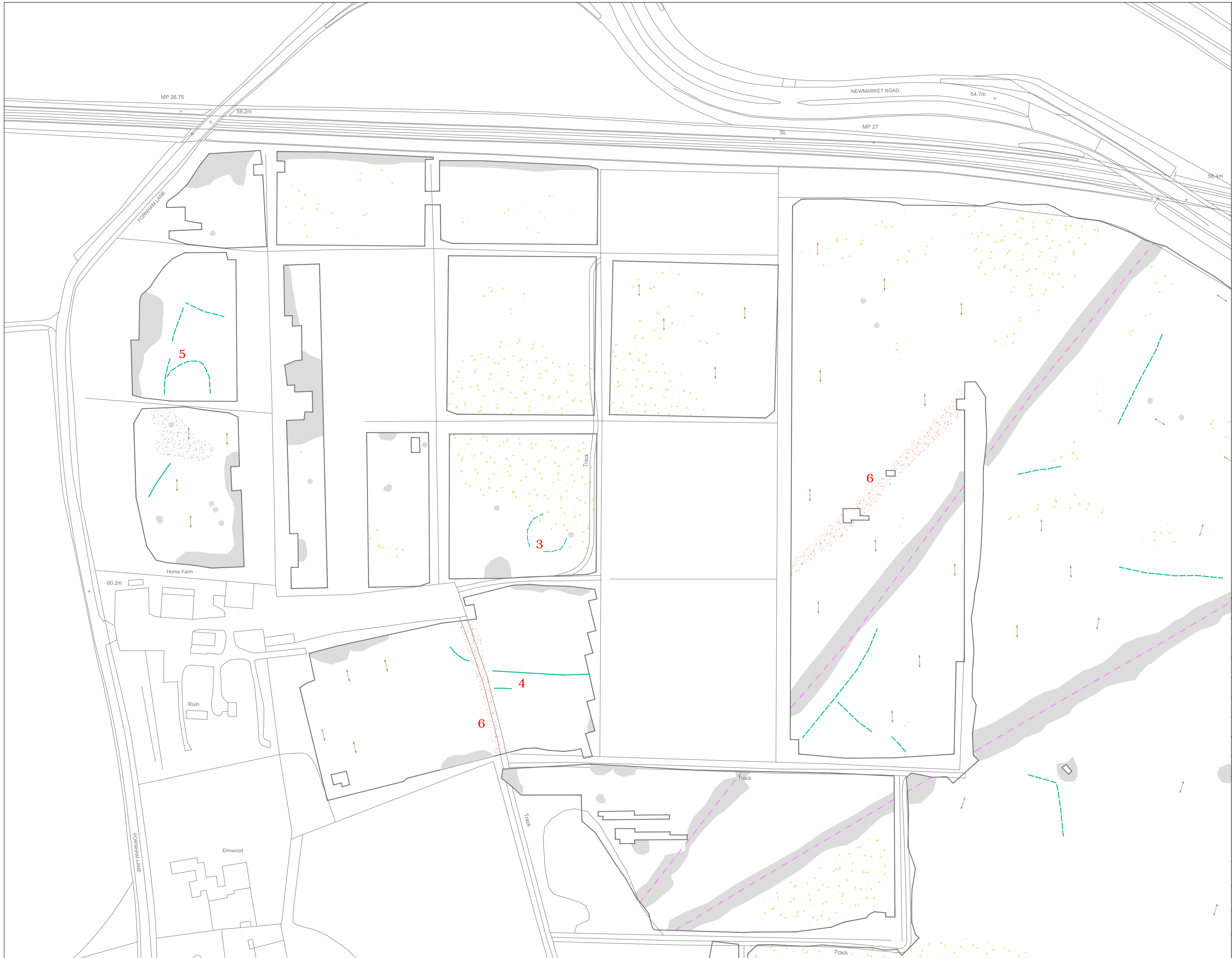
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- North-West

Client: Albion Archaeology

Project: 11580 - Newmarket Road, Bury St Edmunds

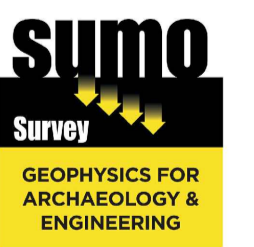
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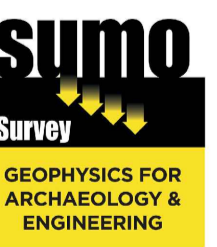


**KEY**

	Probable archaeology (discrete anomaly / trend)
	Uncertain Origin (discrete anomaly / trend)
	Agriculture (plough)
	Natural (e.g. geological / pedological)
	Trackway (corroborated)
	Magnetic disturbance
	Service
	Ferrous



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 Client: Albion Archaeology  
 Project: 11580 - Newmarket Road, Bury St Edmunds  
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 Fig No: 05



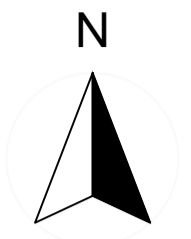
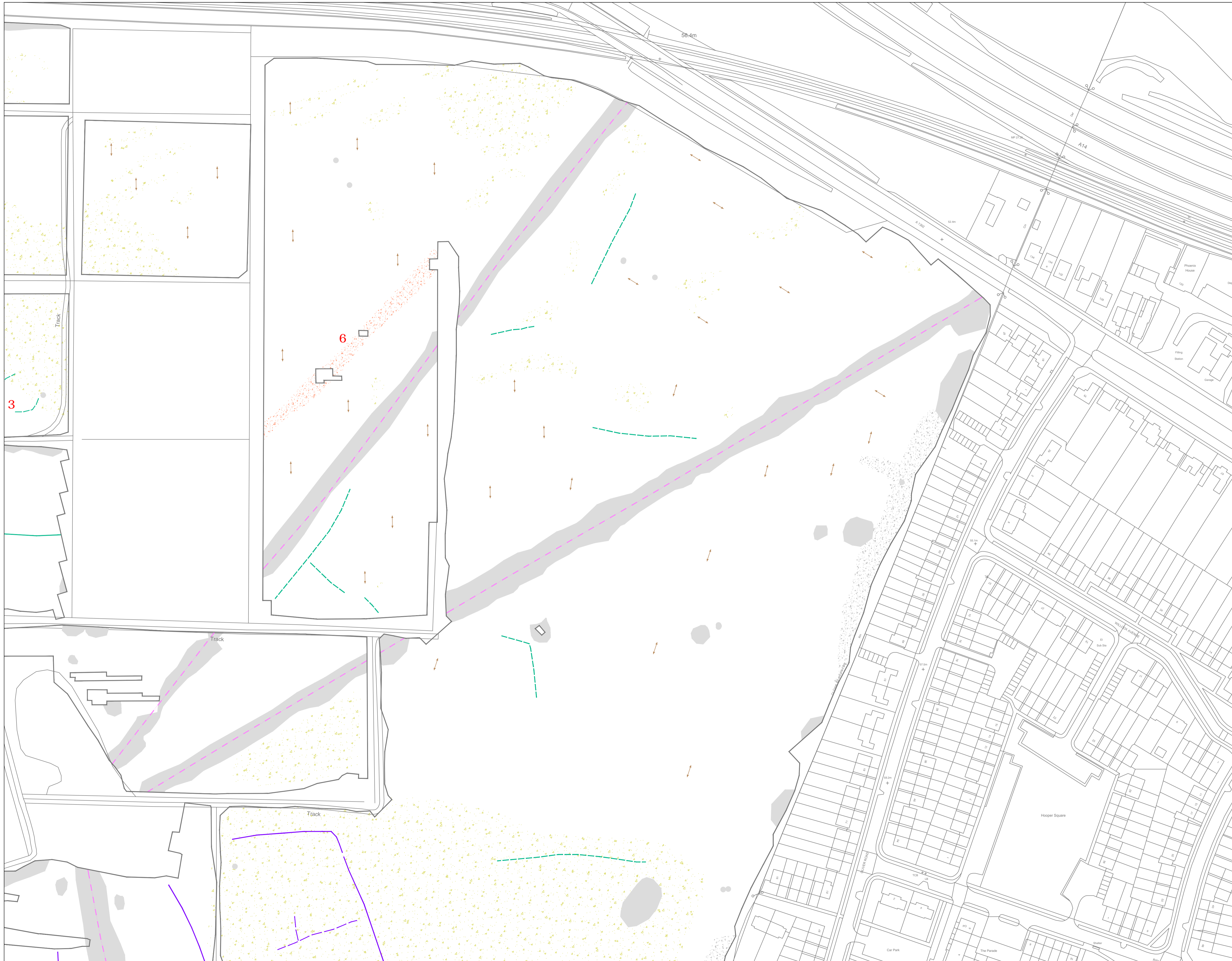
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 - North-East

Client: Albion Archaeology

Project: 11580 - Newmarket Road, Bury St Edmunds

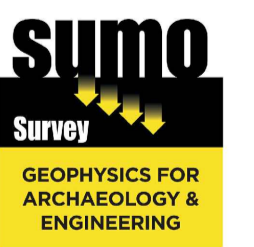
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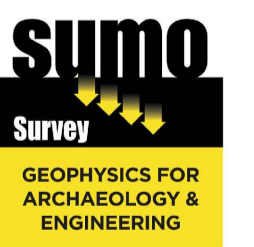
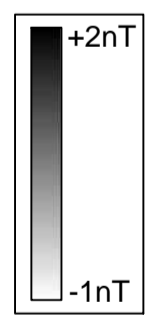


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	Uncertain Origin (discrete anomaly / trend)
	Agriculture (plough)
	Natural (e.g. geological / pedological)
	Trackway (corroborated)
	Magnetic disturbance
	Service
	Ferrous

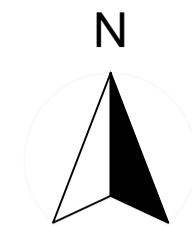
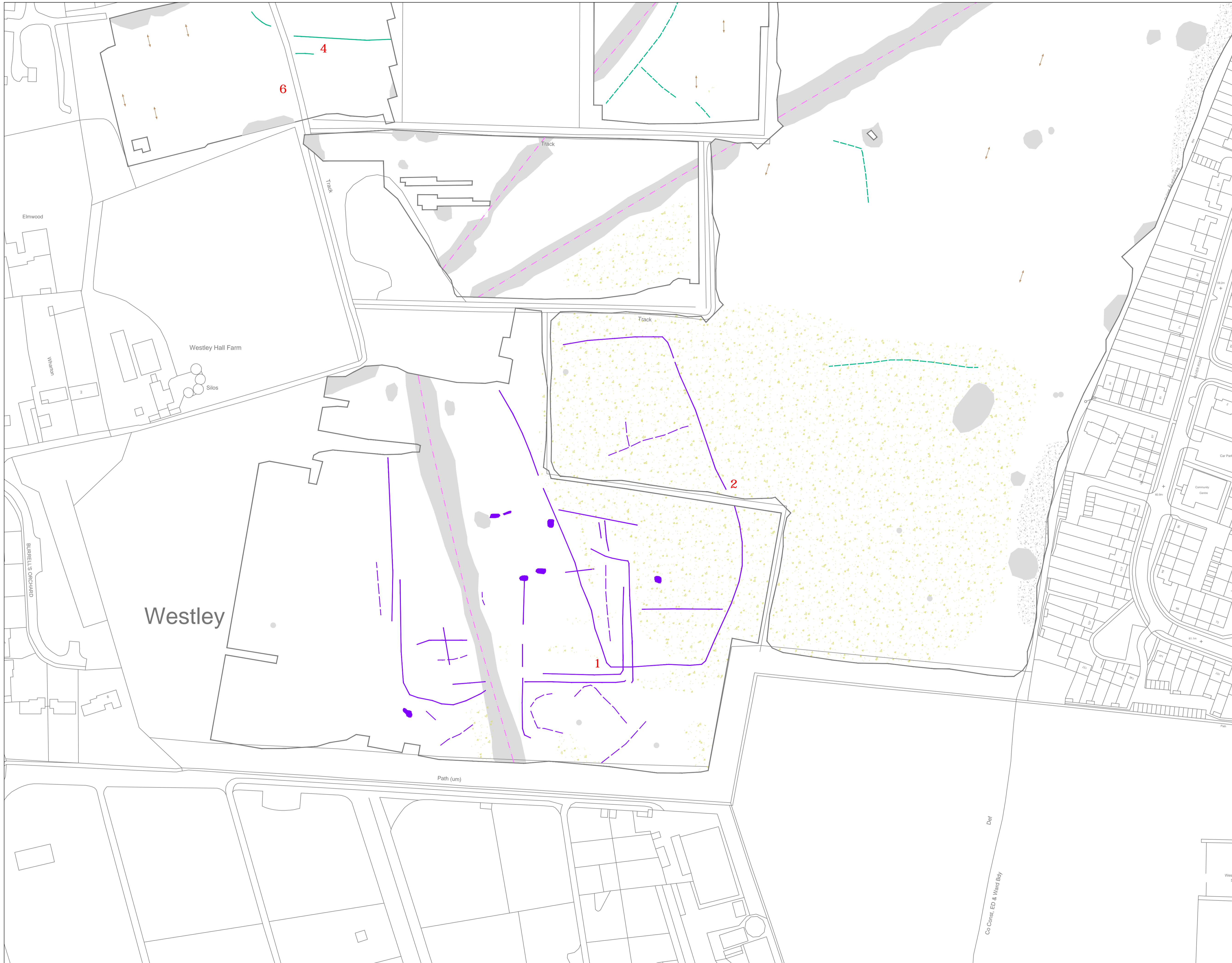


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







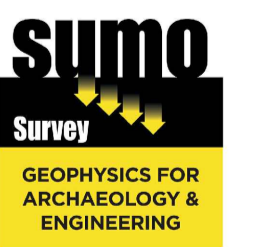
Title: Magnetometer Survey - Greyscale Plot - South  
 Client: Albion Archaeology  
 Project: 11580 - Newmarket Road, Bury St Edmunds  
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**KEY**

-  Probable archaeology (discrete anomaly / trend)
-  Uncertain Origin (discrete anomaly / trend)
-  Agriculture (plough)
-  Natural (e.g. geological / pedological)
-  Trackway (corroborated)
-  Magnetic disturbance
-  Service
-  Ferrous



Title: Magnetometer Survey - Interpretation - South

Client: Albion Archaeology

Project: 11580 - Newmarket Road, Bury St Edmunds

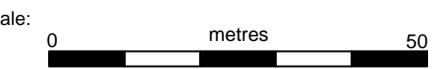
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Fig No: 09

## 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	1.0m	0.25m
Magnetometer	Bartington Cart System	1.0m	0.125m

### Instrumentation:

Bartington instruments operate in a gradiometer configuration which comprises fluxgate sensors mounted horizontally, 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.

### Bartington Grad 601-2

Hand-Held: Data will be collected using a Bartington Grad 601-2. The instrument consists of two paired sensors and readings are logged at 0.25m centres along traverses 1.0m apart across 30m grids. The collection of data at 0.25m centres provides an appropriate methodology balancing cost and time with resolution as per Historic England guidelines

### Bartington Cart System

Data will be collected using a cart carrying four paired Bartington magnetic sensors. Each data point is geographically referenced using an on-board Trimble RTK survey grade GPS system. Readings will be taken at 0.125m centres along traverses 1.0m apart.

### 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 (De-stagger)	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 responses 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 &amp; 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 &amp; 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 may lead and empty into larger diameter pipes, 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.
<i>Service</i>	Magnetically strong anomalies, usually forming linear features are indicative of ferrous pipes/cables. Sometimes other materials (e.g. pvc) or the fill of the trench can cause weaker magnetic responses which can be identified from their uniform linearity.
<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 / Natural</i> or (in the case of linear responses) <i>Possible Archaeology / 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 0.1 nanoTeslas (nT) in an overall field strength of 48,000 (nT), 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; material such as brick and tile may be magnetised through the same process.

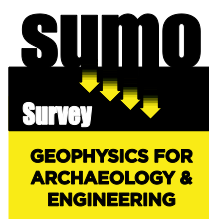
Silting and deliberate infilling of ditches and pits with magnetically enhanced soil creates a relative contrast against the much lower levels of magnetism within the subsoil into which the feature is cut. Systematic mapping of magnetic anomalies will produce linear and discrete areas of enhancement 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 feature. The difference between the two sensors will relate to the strength of a magnetic field created by this 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 and disturbance from modern services.

## Summary for sumogeop1-411326

OASIS ID (UID)	sumogeop1-411326
Project Name	Newmarket Road, Bury St Edmonds
Sitename	Newmarket ROad, Bury St Edmonds
Activity type	GEOPHYSICAL SURVEY
Project Identifier(s)	11580
Planning Id	
Reason For Investigation	Academic research
Organisation Responsible for work	Sumo Geophysics
Project Dates	07-Aug-2017 - 13-Aug-2017
Location	Newmarket ROad, Bury St Edmonds NGR : TL 82700 64900 LL : 52.2519362628022, 0.675098687785999 12 Fig : 582700,264900
Administrative Areas	Country : England County : Suffolk District : West Suffolk Parish : Westley
Project Methodology	A detailed magnetometer survey was conducted over approximately 32ha of mixed use land. Rectilinear and irregularly shaped enclosures have been detected, along with tentative evidence of a ring ditch and further linear responses. Ridge and furrow and evidence of modern ploughing can be seen across much of the site, as can large areas of natural magnetic variation.
Project Results	This was not collected in OASIS IV when this record was originally created
Keywords	
Funder	
HER	Suffolk HER - revPassed - STANDARD
Person Responsible for work	Davies, R
HER Identifiers	
Archives	Digital Archive - to be deposited with Archives: no repository; Accession Id(s): 11580



- Archaeological
- Geophysical
- Laser Scanning
- Measured Building
- Topographic
- Utility Mapping

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