BOURNE HILL, WHERSTEAD, SUFFOLK

DETAILED MAGNETOMETER SURVEY

Report Number: 1018

14th March 2013

BOURNE HILL, WHERSTEAD, SUFFOLK

Detailed Magnetometer Survey

Prepared for:
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Site Code	WHR 075	**NGR**	TM 156 410
Planning Ref.	TBC	**OASIS**	britanni1-145484
Approved By	Matthew Adams	**DATE**	14th March 2013

CONTENTS

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ABSTRACT

A detailed fluxgate gradiometer survey was undertaken by Britannia Archaeology Ltd to the east of the A137 at Bourne Hill, Wherstead Suffolk. Despite the relatively high susceptibility of the magnetic background a wide range of anomalies were recorded. The two most intriguing responses are the curvilinear anomalies, it is possible that they may be potential ring ditches or drip-gullies. Thirty positive discrete anomalies present throughout the dataset have been interpreted as being of a probable geological nature, although an archaeological cause cannot be ruled out. One of the two negative linear anomalies recorded may demarcate the location of a bank, the second is likely to be of geological origin. An irregular broad positive anomaly is also likely to be of a geological nature, being located at the top of a contour surrounding an extant depression. Eight areas of magnetic disturbance were present in the dataset, those centrally located may be worth targeting to reveal whether they have an archaeological origin. Iron spike responses were the most common anomaly recorded, indicating the presence of ferrous material buried within the topsoil.

1.0 INTRODUCTION

On the 5th March 2013 Britannia Archaeology Ltd (BA) undertook detailed magnetometer survey over 1.7 hectares of land at Bourne Hill, Wherstead, Suffolk (NGR TM 156 410) in advance of the construction of an animal welfare facility. The survey was undertaken on behalf of Dr Rhodri Gardner of the Archaeological Service at Suffolk County Council, in response to a brief (dated 30th May 2012) prepared by Dr Jess Tipper of Suffolk County Council Archaeology Service/Conservation Team (SCCAS/CT). This survey was part of a programme of archaeological works that also includes a subsequent trial trenching phase, partly to be targeted over the anomalies recorded by the fluxgate gradiometer. The weather was sunny all day following a period of rain.

2.0 SITE DESCRIPTION

The site is located in one field to the east of the A137 and north of the A14. It is bounded to the east by a copse of trees and is enclosed by a hedgerow. An overhead power cable bisects the field running on a north-east to south-west course.

The bedrock is described as Red Crag Formation sand, a sedimentary bedrock comprising siliciclastic sediments deposited as mud, silt, sand and gravel and formed 2 to 4 million years ago in the Neogene Period, where the local environment was dominated by shallow seas (BGS, 2012).

The superficial deposits are Lowestoft Formation Diamicton formed up to 2 million years ago in the Quaternary Period when the local environment was dominated by ice age conditions with glaciers scouring the landscape depositing moraines of till and outwash sand and gravel from seasonal post glacial melt-waters (BGS, 2012).

2.1 Site Visit 22.02.13

A site visit was undertaken to assess the suitability of the field for magnetometer survey and to carry out the risk assessment. The field was under short grass and the only causes of concern were power cables bisecting the site, and a fly-tipped gas tank. However overall the field was found to be suitable for survey.

DP 1. Site Shot, Looking South

DP 2. Site Shot, Looking North

3.0 PLANNING POLICIES

The archaeological investigation was carried out on the recommendation of the local planning authority, in consultation with SCCAS/CT, following guidance laid down by the *National Planning and Policy Framework* (NPPF, DCLD 2012) which replaces *Planning*

Policy Statement 5: Planning for the Historic Environment (PPS5, DCLG 2010). The relevant local planning policy is the draft Babergh Development Framework Core Strategy (2011-2031).

3.1 National Planning Policy Framework (NPPF, DCLG March 2012)

The NPPF recognises that 'heritage assets' are an irreplaceable resource and planning authorities should conserve them in a manner appropriate to their significance when considering development. It requires developers to record and advance understanding of the significance of any heritage assets to be lost (wholly or in part) in a manner proportionate to their importance and the impact, and to make this evidence (and any archive generated) publicly accessible. The key areas for consideration are:

- The significance of the heritage asset and its setting in relation to the proposed development;
- The level of detail should be proportionate to the assets' importance and no more than is sufficient to understand the potential impact of the proposal on their significance;
- Significance (of the heritage asset) can be harmed or lost through alteration or destruction, or development within its setting. As heritage assets are irreplaceable, any harm or loss should require clear and convincing justification;
- Local planning authorities should not permit loss of the whole or part of a heritage asset without taking all reasonable steps to ensure the new development will proceed after the loss has occurred;
- Non-designated heritage assets of archaeological interest that are demonstrably of equivalent significance to scheduled monuments, should be considered subject to the policies for designated heritage assets.

3.2 Babergh Development Framework Core Strategy (2011-2031) Submission Draft

The local development framework for Babergh states the following:

- Careful consideration of the character of other, unlisted, historic assets is important and that developments which may affect historic assets make a positive contribution to local character and distinctiveness (3.3.5 & 3.3.6).

4.0 ARCHAEOLOGICAL BACKGROUND

Detailed magnetometer survey was undertaken over 1.7 hectares of agricultural land located in an area of archaeological potential that has never before been archaeologically investigated. A number of sites have been recorded within the immediate vicinity of the proposed development area in the County Historic Environment Record (CHER).

The archaeological activity recorded nearby includes 2 Bronze Age ring ditches (0008 and 0028), a Bronze Age barrow and inhumations (WHR 025). Excavations at the Ski Centre on Bourne Hill (WHR 037) immediately to the north-east, revealed Roman and Iron Age settlement activity.

5.0 PROJECT AIMS

As per the brief (Section 3.1 Tipper, J. 2012) a systematic geophysical survey and subsequent linear trenched evaluation was required of the development area to enable the archaeological resource, both in quality and extent, to be accurately quantified.

6.0 METHODOLOGY

6.1 Instrument Type Justification

Britannia Archaeology Ltd employed a Bartington Dual Grad 601-2 fluxgate gradiometer to undertake the survey, because of its high sensitivity and rapid ground coverage. The surveyors noted that that the site had a fairly high magnetic background susceptibility, which made finding a location to zero the instrument moderately difficult.

6.2 Instrument Calibration

A minimum of 20 minutes was allowed in the morning for the magnetometers sensors to settle before the start of the first grid. The instrument was zeroed after every three grids to minimise the effect of sensor drift. A set-up station with low magnetic susceptibility was moderately difficult to locate. This same station was used exclusively throughout the survey to align the sensors providing a common zero point. Sensor drift was noted throughout the day caused by the sun.

6.3 Sampling Interval and Grid Size

The sampling interval was set at 0.25m along 1m traverse intervals, providing 4 readings a metre, the magnetometer survey was undertaken on 20 x 20m grids.

6.4 Survey Grid Location

The survey grid was set out to the Ordnance Survey OSGB36 datum to an accuracy of ±0.1m employing a Leica Viva Glonnass Smart Rover GS08 differential global positioning system (DGPS). Data were then converted to the National Grid Transformation OSTN02 and the instrument was regularly tested using stations with known ETRS89 coordinates. The grids were positioned parallel to the long axis of the field for ease of survey progression (Figure 2).

6.5 Data Capture

Instrument readings were recorded on an internal data logger that were downloaded to a laptop at midday and at the end of the survey. The grid order was recorded on a BA pro-forma to aid in the creation of the data composites. Data were filed in job specific folders. These data composites were checked for quality on site by BA, allowing grids to be re-surveyed if necessary. The data were backed up onto an external storage device in the office and finally a remote server at the end of the day. A five metre exclusion

zone was left between the boundaries and the survey area to reduce the amount of magnetic disturbance.

6.6 Data Presentation and Processing

The raw corrected greyscale and XY trace plots were of a high enough quality that processed datasets were not required. Corrections allowing the dataset to be viewed in a raw format are shown below.

De-spike: X diameter = 3, Y diameter = 3, Threshold = 1, centre value=mean, replace with = mean;
Data Clipping: 1 standard deviation;
De-stripe: Traverse, Median, X (Horizontal).
Data Display: Clip to -1/+1.

An interpretation plan characterising the anomalies recorded can be found at Figure 5, it draws together the evidence collated from both greyscale and XY trace plots (Figures 3 and 4). All figures were tied into the National Grid and printed at an appropriate scale.

6.7 Software

Raw data was downloaded using Bartington software Grad601 and will be stored in this format as raw data. The software used to process the data and produce the composites was DW Consulting's Archeosurveyor v2.0. Datasets were exported into AutoCAD and placed onto the local survey grid. An interpretation plot was then produced using AutoCAD.

6.8 Grid Restoration

Britannia Archaeology Ltd positioned two reference stations (orange wooden stakes) in the field (Figure 2) along the baselines, these same stations should be used to relocate both the grid and the geophysical anomalies.

7.0 PRESENTATION OF RESULTS

Isolated dipolar 'iron-spike' responses were the most abundant anomaly within the dataset (Figure 5). These responses probably demarcate the location of small fragments of magnetic material that have been introduced into the topsoil by agricultural practices.

Eight areas of magnetic disturbance were present within the data, three of which are located on the extremities of the survey, it is likely that the proximity of the field boundaries and a metal gate present in the north-eastern corner attributed to these high readings. The remains of a bonfire were extant over an area of magnetic disturbance, located to the north of the larger curvilinear anomaly. There are four other areas of magnetic disturbance within the dataset, that may be worth targeting by the trial trench evaluation to establish a potential archaeological origin.

An irregular broad positive anomaly is present centre-west of the dataset. It is located on top of a contour around a visible depression in the field, it has been interpreted as having a geological origin.

Two weak negative linear anomalies are also present within the dataset. The first runs parallel to the field boundary and may demarcate the location of a bank, although a geological origin cannot be ruled out. The second weak negative linear anomaly is both broader and shorter, and is therefore of probable geological origin.

There are 30 positive discrete anomalies within the dataset most of which are likely to have been caused by pockets of sand within the natural drift geology, some however may be of an archaeological nature. It would be prudent to further target this type of anomaly to discover their true origin.

Two curvilinear anomalies both located in the northern half of the plot appear most likely to have an archaeological origin, although a geological cause cannot be ruled out.

8.0 DISCUSSION & CONCLUSION

The geophysical survey was successful in locating a wide range of anomalies that could be identified despite the reasonably high magnetic susceptibility of the field. It is likely that the natural drift geology is a contributing factor to these high readings, together with a degree of ground disturbance (in the form of bonfires) that were present within the field.

Iron spike anomalies are the most common response recorded and indicate the presence of ferrous material buried within the topsoil. The areas of magnetic disturbance present on the sites periphery are likely to have been caused by ferrous fencing. A few of the more central areas of magnetic disturbance could however be targeted to reveal if they are in fact of an archaeological origin.

It would be useful to trench the broad positive anomaly that is present on the contour surrounding the depression to confirm that the geology has caused the readings recorded. The discrete positive anomalies are also of a probable geological origin and it would be prudent to target a sample of these to test this theory.

The two curvilinear anomalies are perhaps the most intriguing in the dataset and have been interpreted as being of potential archaeological origin, possibly ring ditches or drip-gullies. Trenching will help to identify the cause of these anomalies.

9.0 PROJECT ARCHIVE AND DEPOSITION

A full archive will be prepared for all work undertaken in accordance with guidance from the *Selection, Retention and Dispersion of Archaeological Collections,* Archaeological Society for Museum Archaeologists, 1993. Arrangements will be made for the archive to be deposited with the relevant museum/HER Office.

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Heritage Gateway www.heritagegateway.org.uk

Archaeological Data Service (ADS) www.ads.ahds.ac.uk

English Heritage National List for England
www.english-heritage.org.uk/professional/protection/process/national-heritage-list-for-england

DEFRA Magic http://magic.defra.gov.uk/website/magic

Appendix 1 – Technical Details

Magnetometer Survey

The magnetometer differs from the 'active' magnetic susceptibility meter by being a 'passive' instrument. Rather than injecting a signal into the ground it detects slight variations in the Earth's magnetic field caused by cultural and natural disturbance (Clark).

Thermoremanent magnetism is produced when a material containing iron oxides is strongly heated. Clay for example has a high iron oxide content that in a natural state is weakly magnetic, when heated these weakly magnetic compounds become highly magnetic oxides that a magnetometer can detect.

The demagnetisation of iron oxides occurs above a temperature known as the Curie point; for example haematite has a Curie point of 675 Celsius and magnetite 565C. At the time of cooling the iron oxides become permanently re-magnetised with their magnetic properties re-aligned in the direction of the Earth's magnetic field (Gaffney and Gater). The direction of the Earth's magnetic field shifts over time and these subtle alignment differences can be recorded. Kilns, hearths, baked clay and ovens can reach Curie point temperatures, and are the strongest responses apart from large iron objects that can be detected. Other cultural anomalies that can be prospected include occupation areas, pits, ditches, furnaces, sunken feature buildings, ridge and furrow field systems and ritual activity (David, 2011). Commonly recorded anomalies include modern ferrous service pipes, field drainage pipes, removed field boundaries, perimeter fences and field boundaries.

Fluxgate Gradiometers

Fluxgate gradiometers are sensitive instruments that utilise two sensors placed in a vertical plane, spaced 1 metre apart. The sensor above reads the Earth's magnetic (background) response while the sensor below records the local magnetic field. Both sensors are carefully adjusted to read zero before survey commences at a 'zeroing' point, selected for its relatively 'quiet' magnetic background reading. When differences in the magnetic field strength occur between the two sensors a positive or negative reading is logged. Positive anomalies have a positive magnetic value and conversely negative anomalies have a negative magnetic value relative to the site's magnetic background. Examples of positive magnetic anomalies include hearths, kilns, baked clay, areas of burning, ferrous material, ditches, sunken feature buildings, furrows, ferrous service pipes, perimeter fences and field boundaries. Negative magnetic anomalies include earthwork embankments, plastic water pipes and geological features.

The instruments are usually held approximately 0.30m to 0.50m above the ground surface and can detect to a depth of between 1-2metres. Best practice dictates that the optimal direction of traverse in Britain is east to west.

Magnetic Anomalies

Linear trends

Linear trends can be both positive and negative magnetic responses. If they are broad, relatively weak or negative in nature they may be of agricultural or geological origin, for example periglacial channels, land drains or ploughing furrows. If the responses are strong positive trends they are more likely to be of archaeological origin. Archaeological settlement ditches tend to be rich in highly magnetic iron oxides that accumulate in them via anthropogenic activity and humic backfills. Conversely surviving banks will be negative in nature, the material is derived from subsoil deposits that is less likely to be positively magnetic. Curvilinear trends can also be recorded and are indicative of archaeological structures such as drip-gullies.

Discrete anomalies

Discrete anomalies appear as increased positive responses present within a localised area. They are caused by a general increase in the amount of magnetic iron oxides present within the humic back-fill of for example a rubbish pit.

'Iron spike' anomalies

These strong isolated dipolar responses are usually caused by ferrous material present in the topsoil horizon. They can have an archaeological origin but are usually introduced into the topsoil during manuring.

Areas of magnetic disturbance

An area of magnetic disturbance is usually associated with material that has been fired. For example areas of burning, demolition (brick) rubble or slag waste spreads. They can also be caused by ferrous material, e.g. close proximity to barbwire or metal fences and field boundaries, buried services, pylons and modern rubbish deposits.

Appendix 2 – OASIS Sheet

OASIS ID: britanni1-145484

Project details

Project name	Bourne Hill, Wherstead, Suffolk
Short description of the Project	A detailed fluxgate gradiometer survey was undertaken by Britannia Archaeology Ltd to the east of the A137 at Bourne Hill, Wherstead Suffolk. Despite the relatively high susceptibility of the magnetic background a wide range of anomalies were recorded. The two most intriguing responses are the curvilinear anomalies, it is possible that they may be potential ring ditches or drip-gullies. Thirty positive discrete anomalies present throughout the dataset have been interpreted as being of a probable geological nature, although an archaeological cause cannot be ruled out. One of the two negative linear anomalies recorded may demarcate the location of a bank, the second is likely to be of geological origin. An irregular broad positive anomaly is also likely to be of a geological nature, being located at the top of a contour surrounding an extant depression. Eight areas of magnetic disturbance were present in the dataset, those centrally located may be worth targeting to reveal whether they have an archaeological origin. Iron spike responses were the most common anomaly recorded, indicating the presence of ferrous material buried within the topsoil.
Project dates	**Start:** 05-03-2012 **End:** 05-03-2012
Previous/future work	No / Yes
Any associated project reference codes	P1023 - **Contracting Unit No**. WHR 075 - **HER event no**.
Type of project	Field evaluation
Site status	None
Current Land use	Grassland Heathland 3 – Disturbed
Monument type	NONE
Significant Finds	NONE
Methods & techniques	'"Geophysical Survey"'
Development type	Small-scale (e.g. single house, etc.)
Prompt	National Planning Policy Framework – NPPF
Position in the planning process	Pre-application
Solid geology	Red Crag Formation Sand
Drift geology	Lowestoft Formation Diamicton
Techniques	Magnetometry

Project location

Country	England
Site location	SUFFOLK BABERGH WHERSTEAD Bourne Hill, Wherstead, Suffolk
Study area	1.70 Hectares
Site coordinates	TM 156 410 **Point**
Height OD / Depth	**Min:** 35.00m **Max**: 38.00m
Project creators	
Name of Organisation	Britannia Archaeology Ltd
Project brief originator	Local Planning Authority (with/without advice from County/District Archaeologist)
Project design originator	Timothy Schofield
Project director/manager	Timothy Schofield
Project supervisor	Matthew Adams

Type of sponsor/funding body	Developer

Project archives

Physical Archive Exists?	No
Digital Archive recipient	Suffolk HER
Digital Contents	"Survey"
Digital Media available	"Geophysics", "Images raster / digital photography", "Images vector", "Survey", "Text"
Paper Archive Exists?	Yes
Paper Archiverecipient	Suffolk HER
Paper Contents	"Survey"
Paper Media available	"Map", "Report", "Survey ", "Unpublished Text"

Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	Bourne Hill, Wherstead, Suffolk; Detailed Magnetometer Survey.
Author(s)/Editor(s)	Schofield, T.P.
Other bibliographic details	R1018
Date	2013
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Place of issue or publication	Stowmarket, Suffolk
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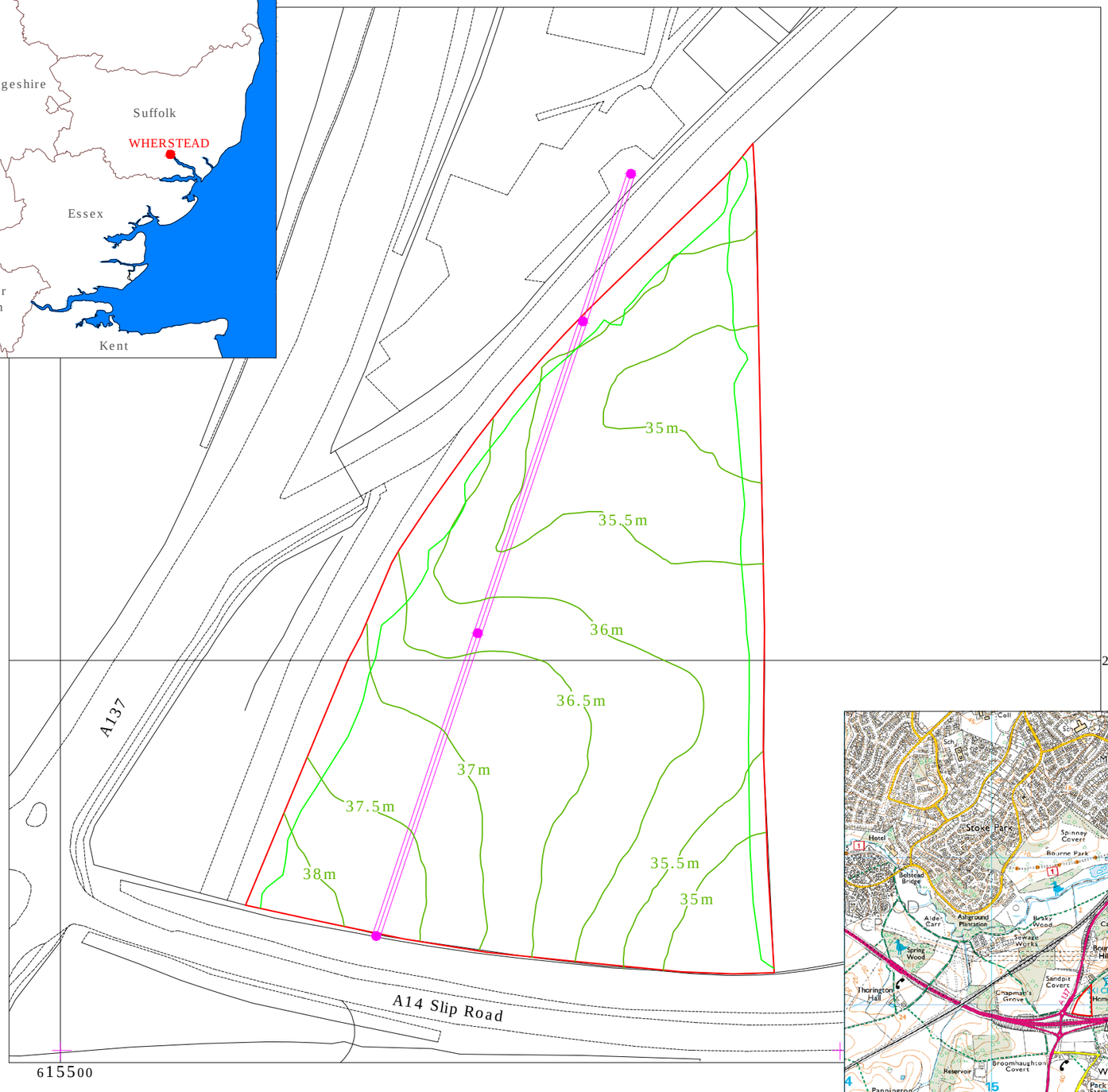
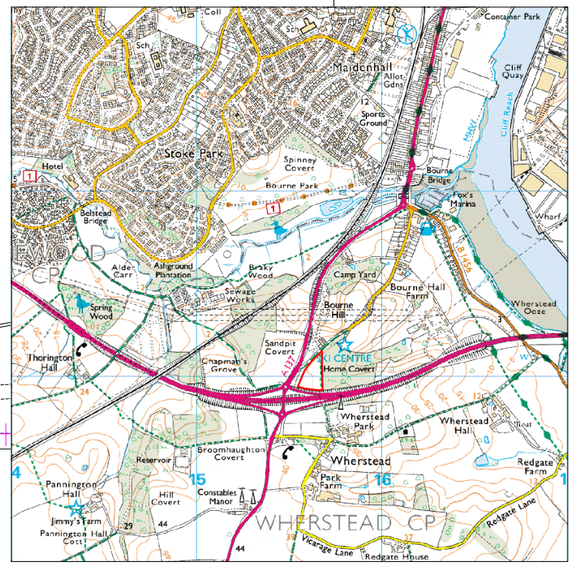
Entered on	15 March 2013





N

	Power Line & Poles
	Hedge Line
35m	Contour Line
	Site Boundary

NGR: 615600, 241000

REPORT NUMBER: 1018

PROJECT:
BOURNE HILL, WHERSTEAD, SUFFOLK

CLIENT:
Suffolk County Council

DESCRIPTION:
SITE LOCATION & TOPOGRAPHIC PLAN

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W: www.britannia-archaeology.com

SCALE: 1:1250 (0 – 50m)

PLOT:	APPROVED:	VERSION:
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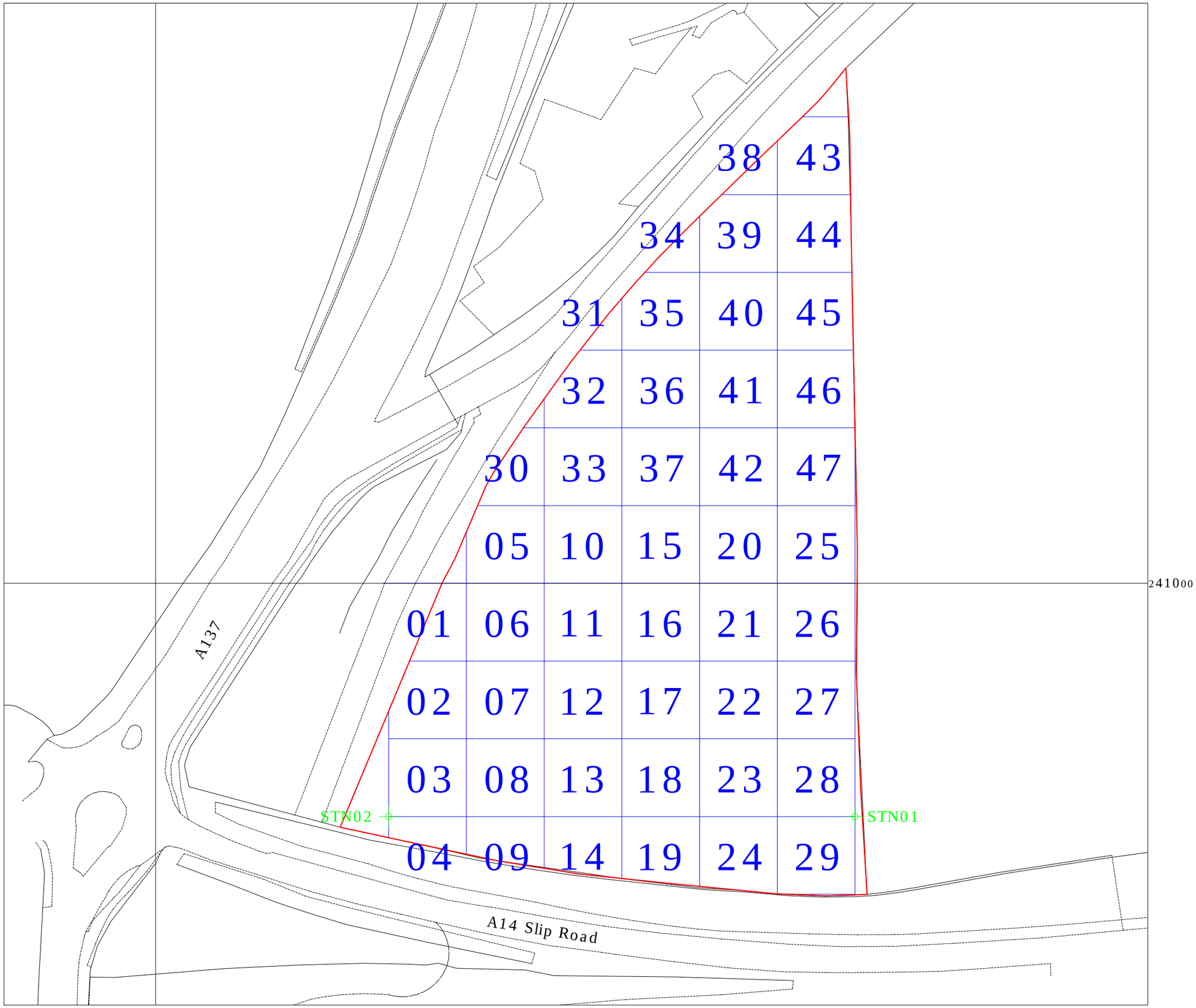
DATE: MAR 2013	AUTHOR: TPS	FIGURE: 01



N

STATION	EASTING	NORTHING	ZENITH
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02	615560.000	240940.000	33.57

Site Boundary

NGR: 615600, 241000

REPORT NUMBER: 1018

PROJECT: BOURNE HILL, WHERSTEAD, SUFFOLK

CLIENT: Suffolk County Council

DESCRIPTION: SITE GRID NUMBER & SITE GRID REFERENCING PLAN

BRITANNIA ARCHAEOLOGY LTD

4 THE MILL, CLOVERS COURT, SUFFOLK
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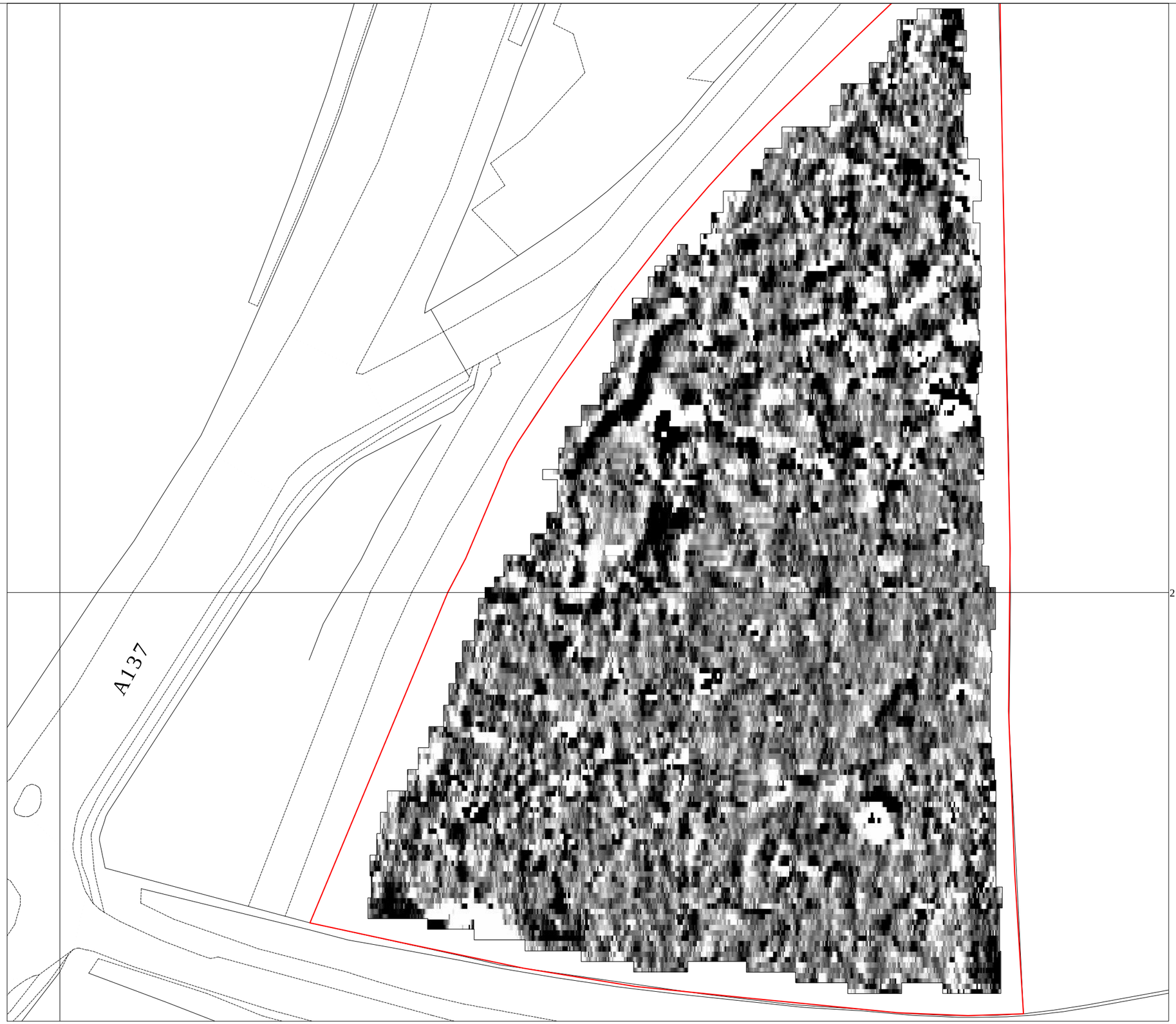
DATE:	AUTHOR:	FIGURE:
MAR 2013	TPS	02



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+1nT

-1nT

NGR: 615600, 241000

PROJECT NUMBER: 1023

PROJECT:
BOURNE HILL, WHERSTEAD, SUFFOLK

CLIENT: Suffolk County Council

DESCRIPTION:
PRELIMINARY RAW CORRECTED MAGNETOMETER GREYSCALE PLOT

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SCALE: 1:750

0 25m

PLOT:	APPROVED:	VERSION:
A3	MCA	01
DATE: MAR 2013	AUTHOR: TPS	FIGURE: 03

N

25 nT/cm | Scale Interval

NGR: 615600, 241000

REPORT NUMBER: 1018

PROJECT:
BOURNE HILL, WHERSTEAD, SUFFOLK

CLIENT: Suffolk County Council

DESCRIPTION:
RAW CORRECTED MAGNETOMETER XY TRACE PLOT

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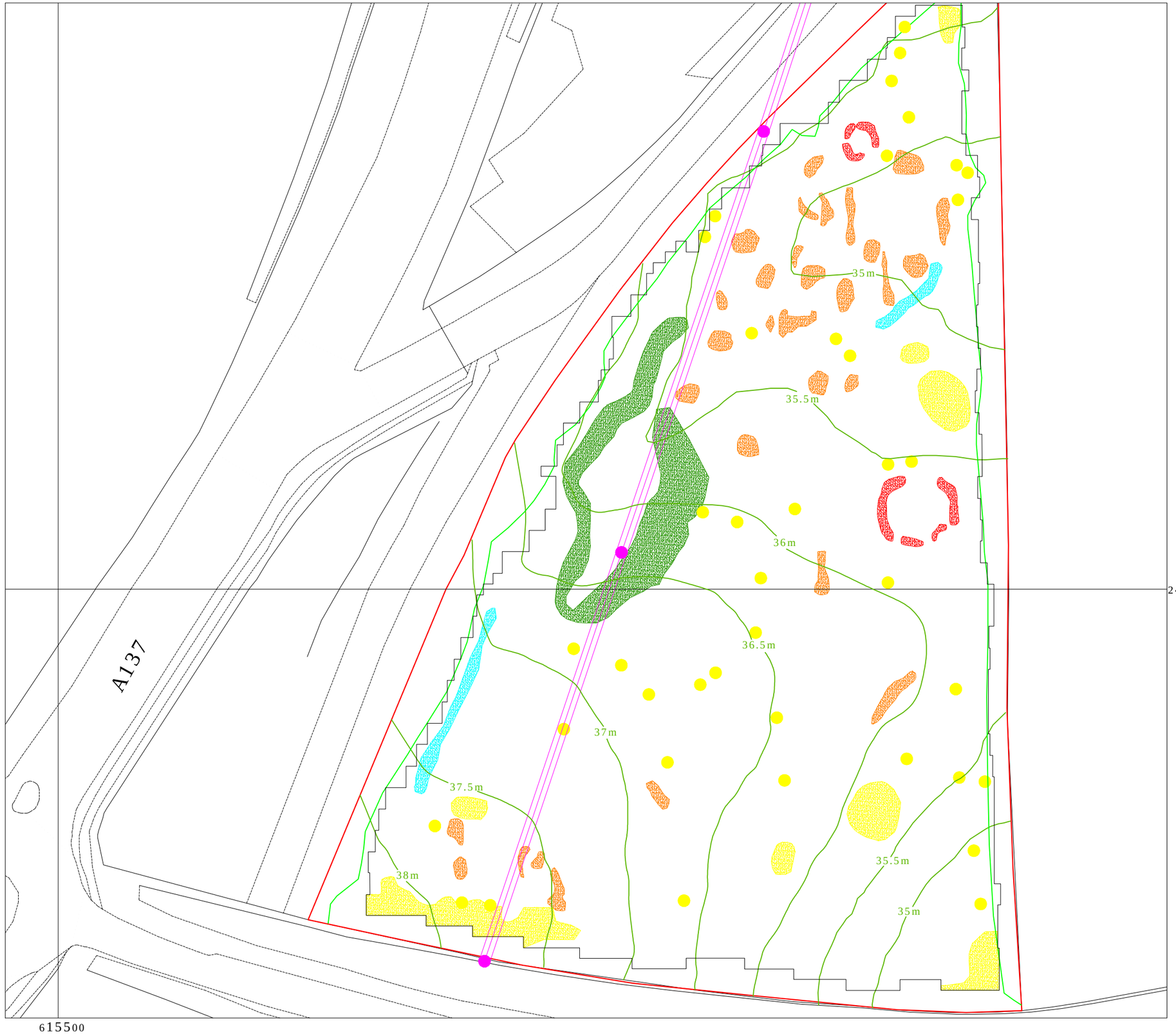
DATE: MAR 2013	AUTHOR: TPS	FIGURE: 04



N

	Positive Curvi-linear Anomaly, Archaeology
	Positive Discrete Anomaly, Archaeology?
	Weak Negative Linear Anomaly, Archaeology?
	Irregular Broad Positive Anomaly, Geological
	Area of Magnetic Disturbance
	Isolated Dipolar Responses
	Power Line & Poles
	Hedge Line
35m	Contour Line

NGR: 615600, 241000

REPORT NUMBER: 1018

PROJECT:
BOURNE HILL, WHERSTEAD, SUFFOLK

CLIENT:
Suffolk County Council

DESCRIPTION:
INTERPRETATION PLOT OF MAGNETOMETER ANOMALIES

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SCALE: 1:750

0 25m

PLOT:	APPROVED:	VERSION:
A3	MCA	01
DATE:	AUTHOR:	FIGURE:
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