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# **THE GREEN, CAPEL ST ANDREW, SUFFOLK**

## DETAILED MAGNETOMETER SURVEY



Report Number: 1074

October 2014

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## THE GREEN, CAPEL ST ANDREW, SUFFOLK

### Detailed Magnetometer Survey

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<b>Site Code</b>	CSA 029	<b>NGR</b>	TM 365 487
<b>Planning Ref.</b>	DC/13/3478/AGO	<b>OASIS</b>	britanni1-190622
<b>Approved By</b>	Martin Brook	<b>DATE</b>	October 2014



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## **ABSTRACT**

*In September 2014, Britannia Archaeology Ltd undertook a detailed fluxgate gradiometer survey over c.2.10 hectares of land at The Green, Capel St Andrew, Suffolk, in two agricultural fields, covering the footprint of a proposed agricultural reservoir.*

*Background research indicated that this site was particularly favourable for occupation, located at the head of a tributary and on the outskirts of the former green. A series of enclosures, bordered by an associated droveway to the north and west, with a plethora of internal anomalies were recorded in the dataset that gives credence to this hypothesis. The date of this settlement will remain uncertain until further archaeological work is undertaken. It is most likely that these anomalies are the remains of the medieval settlement that formerly stood on the green's periphery, giving the area its name.*

*It would be prudent to ground test a cross-section of the various anomaly types that were recorded during the geophysical survey.*



## 1.0 INTRODUCTION

On Monday 29<sup>th</sup> September 2014 Britannia Archaeology Ltd (BA) undertook detailed fluxgate gradiometer survey over c.2.10ha of land at The Green, Capel St Andrew, Suffolk (NGR TM 365 487) in two agricultural fields that cover the footprint of a proposed agricultural reservoir (Figure 1).

This survey was commissioned by Rhodri Gardener of Suffolk County Council Archaeological Service/Field Team in response to a design brief issued by Suffolk County Council Archaeology Service/Conservation Team (SCCAS/CT, Brudenell, M. dated 17<sup>th</sup> April 2014). The weather was sunny all day.

## 2.0 SITE DESCRIPTION

The site is located in two agricultural fields, on the former Green of Capel St Andrew, it slopes down from 15m AOD in the south-west to 5m AOD in the north-east.

The bedrock comprises Chillesford Church Sand, a sedimentary bedrock formed approximately 2 million years ago in the Quaternary Period when the local environment was dominated by shallow seas depositing siliciclastic sediments as mud, silt, sand and gravel (BGS, 2014).

At the time of writing no superficial deposits were described for this area (BGS, 2014).

## 3.0 PLANNING POLICIES

The archaeological investigation was carried out on the recommendation of the local planning authority, 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 *Suffolk Coastal Local Plan; incorporating First and Second Amendments* (March 2006) which is due to be replaced with the *Suffolk Coastal Local Development Framework* in the near future.

### 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 Suffolk Coastal District Council (Policy AP7. 31<sup>st</sup> March 2006)

The local plan for the Suffolk Coastal District deals with development on archaeological sites in section AP7, this states the following:

In considering planning applications, outline or detailed, for development that might affect sites that are known or are likely to contain archaeological remains, the Council will require the following. Where necessary, these should be preceded by a professional archaeological assessment as to the likelihood that remains might be encountered and their importance.

- a field evaluation in those cases where the assessment suggests that important archaeological remains may exist but it is unable to be precise about their nature or extent. The field evaluation shall be carried out by an approved archaeological contractor in accordance with a specification agreed with the Council;
- the preservation of archaeological remains in situ where the assessment and/or field evaluation indicate that the remains are important. Even where lesser remains exist, consideration must be given to the desirability of preserving them in situ;
- adequate arrangements for "preservation by record" - a recording of the archaeological remains that would be lost in the course of works for which permission is being sought - in those cases where arguments in favour of the development outweigh the significance of the remains;
- Development that would adversely affect a Scheduled Ancient Monument, its setting or remains will not be permitted.

## 4.0 ARCHAEOLOGICAL BACKGROUND

The location of this proposed reservoir lies in an area of archaeological interest as defined by information held in the County Historic Environment Record (HER). Located on the edge of the former Capel St Andrew Green, believed to have a high potential for medieval green-side occupation. A number of medieval finds and artefact scatters have



been recorded to the north in similar green-edge locations (HER nos. CSA 013-016). Roman and Iron Age sherds have also been recorded to the north (CSA 003). Cropmarks identified as a boundary system are recorded to the southeast (CAS 017). The site is situated at the head of a tributary, in a topographic position that was favourable for early occupation of all periods. The large scale of the development is such that a high potential for the discovery of hitherto unknown important features and deposits is believed to be likely.

## **5.0 PROJECT AIMS**

The geophysical survey was required to inform the location of the subsequent trial trench evaluation which will ground-truth the results recorded by the fluxgate gradiometer. Suffolk County Council Archaeological Service will be undertaking the trial trench evaluation and will prepare a separate written scheme of investigation.

## **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 the background magnetic susceptibility signature was relatively high; however a suitable zero station was located.

### **6.2 Instrument Calibration**

One hour 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 to five grids to minimise the effect of sensor drift. An area with a relatively low magnetic reading was chosen to calibrate the instrument; this same point was used to zero the sensors throughout the survey providing a common zero point. The survey was undertaken during a prolonged sunny period which caused a degree of sensor drift and the characteristic parallel traverse 'striping' that is prevalent throughout the raw dataset (Figure 2).

### **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 within 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  $\pm 0.1\text{m}$  employing a Leica Viva Glonass Smart Rover GS08 real time kinetic (RTK) survey system. Data were converted to the National Grid Transformation OSTN02 and the instrument was regularly tested using stations with known ETRS89 coordinates. The grids were positioned on an east to west alignment (Figure 1).





## 6.5 Data Capture

Instrument readings were recorded on an internal data logger that were downloaded to a laptop at lunchtime and then also at the end of the day. 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 field boundary magnetic disturbance, which slightly reduced the area available. The southern end of site was found to be unsuitable for survey (magenta hatching) due to overgrown foliage and large dumps of soil on the former mountain bike trail.

## 6.6 Data Presentation and Processing

Data are presented in both raw and processed data plots in greyscale format (Figures 2 and 3). An XY trace plot of the processed data has also been included (Figure 4).

The raw data is presented with no processing, and was clipped to produce a uniform greyscale plot, processed data schedules are also displayed below.

### *Raw Data:*

**Data Clipping:** 4.00 standard deviations;  
**Display Clipping:** +/- 3 standard deviations.

### *Processed Data:*

**De-stripe:** Median Sensors: All;  
**De-spike:** Threshold 2.5, Window Size: 3 x 3;  
**Data Clipping:** 1.00 standard deviation;  
**Display Clipping:** +/- 3 standard deviations.

An interpretation plan characterising the anomalies recorded can be found at Figure 5, drawing together the evidence collated from both greyscale and XY trace plots (Figures 2, 3 and 4). All figures are tied into the National Grid and printed at an appropriate scale.

## 6.7 Software

Raw data were downloaded using DW Consulting's Archeosurveyor v2.5.16.0 and will be stored in this format as raw data. The software used to process the data and produce the composites was also DW Consulting's Archeosurveyor v2.5.16.0. Datasets were exported into AutoCAD and placed onto the local survey grid. Interpretation plots were then produced using AutoCAD.



## 6.8 Grid Restoration

Britannia Archaeology Ltd positioned three reference stations within the field, these geo-referenced stakes are presented in Figure 1.

## 7.0 RESULTS & DISCUSSION

Isolated dipolar ('iron spike') responses (yellow hatched circles) were present throughout the dataset and record the presence of ferrous material within the topsoil. It is not clear whether they have been introduced during episodes of manuring or if they relate to buried archaeological artefacts.

One large area of magnetic enhancement (green hatching) is present within one of the enclosure type anomalies. It is unclear whether it is a set of individual anomalies that are closely spaced, or one larger anomaly causing these readings. It is possible that this could be the remains of a building structure within an enclosure.

Twenty positive discrete anomalies (orange hatching) have been recorded in the dataset. They have been interpreted as archaeological rubbish pits or similar. The majority of these anomalies are present within and associated with the positive perpendicular linear anomalies interpreted as settlement enclosures.

A series of positive perpendicular linear anomalies (red hatching) are located throughout the dataset, the majority of which are orientated east-north-east to west-south-west and perpendicular and are interpreted as enclosure ditches. Some are discontinuous in nature which may indicate the presence of entranceways into individual enclosures. Narrower positive linear anomalies are also present that appear to form internal enclosure sub-divisions, drainage gullies, or structural remains. Curvilinear anomalies are further recorded that are indicative of drainage or drip gullies. A set of linears are present on the northern boundary, turning through ninety degrees, with a rounded corner, these have been interpreted as driveway ditches that turn and run along the western boundary. Two sub-rectangular/sub-circular anomalies have also been recorded that could be indicative of structural remains or similar; both are located within an enclosure. One linear anomaly is aligned north-east to south-west that may be part of a separate phase of site activity.

Negative linear anomalies (cyan hatching) have also been recorded, running parallel with the positive linear anomalies. They have been interpreted as earthwork banks, containing material with lower magnetic susceptibility than the deposits present within the enclosure ditches. These readings may originate from the superficial geology that was removed when the ditches were originally constructed.

## 8.0 CONCLUSION

Overall the results from this geophysical survey are extremely interesting and there is a very high archaeological potential for the dataset. The background research indicates



that this site was particularly favourable for occupation, being located at the head of a tributary and on the outskirts of the former green. A series of enclosures, bordered by an associated driveway located to the north and west, with a plethora of internal anomalies gives credence to this hypothesis. The date of this enclosure settlement will remain uncertain until further archaeological work is undertaken. It is most likely that these anomalies are the remains of the medieval settlement that formerly stood on the green's periphery, giving the area its name.

It would be prudent to ground test a cross-section of the various anomaly types that have been recorded in the dataset. This will help qualify the interpretations that have been given within this report, while providing dating evidence and the potential form and function of the 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.

## **10.0 ACKNOWLEDGEMENTS**

Britannia Archaeology Ltd would like to thank Dr Rhodri Gardener of SCCAS for commissioning the project, and to Dr Matthew Brudenell of Suffolk County Council Archaeological Service/Conservation Team for his advice throughout.



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## APPENDIX 1 METADATA SHEETS

### Raw Data

Filename	CSA 1R.xcp
<b>Description</b>	
Instrument Type	Grad 601-2 (Gradiometer)
Units	nT
Surveyed by	TPS/MCA on 9/29/2014
Assembled by	TPS on 9/29/2014
Direction of 1st Traverse	45 deg
Collection Method	ZigZag
Sensors	2 @ 1.00 m spacing.
Dummy Value	32702.00
Dimensions	
Composite Size (readings)	720 x 100
Survey Size (meters)	180.00m x 100.00 m
Grid Size	20.00 m x 20.00 m
X Interval	0.25 m
Y Interval	1.00 m
<b>Stats</b>	
Max	9.13
Min	-9.26
Std Dev	1.77
Mean	-0.10
Median	-0.22
Composite Area	1.80 ha
Surveyed Area	1.37 ha
<b>Program</b>	
Name	ArcheoSurveyor
Version	2.5.16.0

### Processed Data

Filename	CSA 1P.xcp
<b>Description</b>	
Instrument Type	Grad 601-2 (Gradiometer)
Units	nT
Surveyed by	TPS/MCA on 9/29/2014
Assembled by	TPS on 9/29/2014
Direction of 1st Traverse	45 deg
Collection Method	ZigZag
Sensors	2 @ 1.00 m spacing.
Dummy Value	32702.00
<b>Dimensions</b>	
Composite Size (readings)	720 x 100
Survey Size (meters)	180.00m x 100.00 m
Grid Size	20.00 m x 20.00 m
X Interval	0.25 m
Y Interval	1.00 m
<b>Stats</b>	
Max	1.00
Min	-1.00
Std Dev	0.69
Mean	0.02
Median	0.00
Composite Area	1.80 ha
Surveyed Area	1.37 ha
<b>Program</b>	
Name	ArcheoSurveyor
Version	2.5.16.0



<b>Source Grids: 42</b>		
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42	Col:8	Row:3 grids\42.xgd



## **APPENDIX 2 – 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 3 OASIS FORM

OASIS ID: [britannia1-190622](#)

### Project details

Project name	The Green, Capel St Andrew, Suffolk; Detailed Magnetometer Survey.
Short description of the project	In September 2014, Britannia Archaeology Ltd undertook a detailed fluxgate gradiometer survey over c.2.10 hectares of land at The Green, Capel St Andrew, Suffolk, in two agricultural fields, covering the footprint of a proposed agricultural reservoir. Background research indicated that this site was particularly favourable for occupation, located at the head of a tributary and on the outskirts of the former green. A series of enclosures, bordered by an associated droveway to the north and west, with a plethora of internal anomalies were recorded in the dataset that gives credence to this hypothesis. The date of this settlement will remain uncertain until further archaeological work is undertaken. It is most likely that these anomalies are the remains of the medieval settlement that formerly stood on the green's periphery, giving the area its name. It would be prudent to ground test a cross-section of the various anomaly types that were recorded during the geophysical survey.
Project dates	Start: 29-09-2014 End: 29-09-2014
Previous/future work	No / Not known
Any associated project reference codes	P1077 - Contracting Unit No.
Any associated project reference codes	R1074 - Contracting Unit No.
Any associated project reference codes	CSA 029 - Sitecode
Type of project	Field evaluation
Site status	Area of Archaeological Importance (AAI)
Current Land use	Cultivated Land 3 - Operations to a depth more than 0.25m
Monument type	NONE None
Significant Finds	NONE None
Methods & techniques	"Geophysical Survey"
Development type	Agricultural Reservoir
Prompt	National Planning Policy Framework - NPPF



Position in the planning process	Pre-application
Solid geology (other)	Chillesford Church Sand
Drift geology	Unknown
Techniques	Magnetometry

#### Project location

Country	England
Site location	SUFFOLK SUFFOLK COASTAL CAPEL ST ANDREW The Green, Capel St Andrew, Suffolk
Study area	2.10 Hectares
Site coordinates	TM 365 487 52.0854462421 1.45241798357 52 05 07 N 001 27 08 E Point
Height OD / Depth	Min: 5.00m Max: 15.00m

#### 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	Timothy Schofield
Type of sponsor/funding body	Archaeological Contractor
Name of sponsor/funding body	Suffolk County Council Archaeological Service

#### Project archives

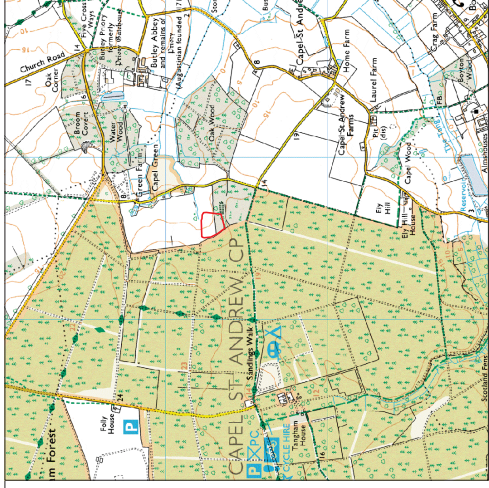
Physical Archive Exists?	No
Digital Archive recipient	Suffolk HER
Digital Contents	"Survey"
Digital Media available	"Geophysics", "Survey", "Text"
Paper Archive recipient	Suffolk HER
Paper Contents	"Survey"
Paper Media available	"Plan", "Report", "Survey", "Unpublished Text"






**Project  
bibliography 1**

Publication type Grey literature (unpublished document/manuscript)  
Title The Green, Capel St Andrew, Suffolk; Detailed Magnetometer Survey  
Author(s)/Editor(s) Schofield, T. P.  
Other bibliographic details R1074  
Date 2014  
Issuer or publisher Britannia Archaeology Ltd  
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Entered on 9 April 2015



STATION	EASTING	NORTHING
01	636666.066	248777.493
02	636666.066	248717.493
03	636566.066	248717.493

	Unsuitable for Survey
	Survey Grid Location
	Site Boundary

NGR: TM 3650 4870  
 REPORT NUMBER: 1074

PROJECT: THE GREEN, CAPEL ST ANDREW, SUFFOLK


CLIENT: 

DESCRIPTION: SITE, SURVEY GRID & GEOREFERENCING INFORMATION PLAN

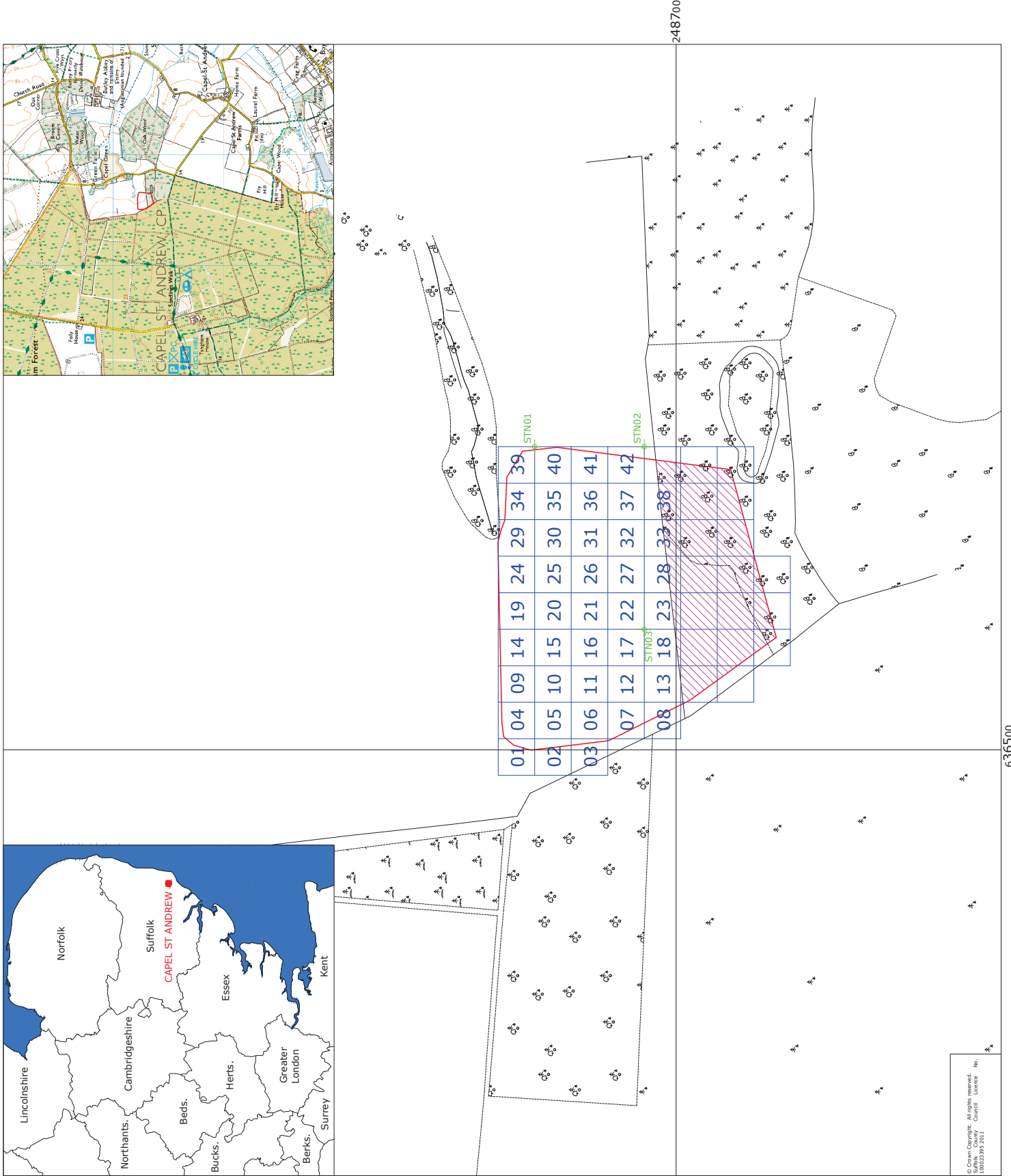
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 115 OSPREY DRIVE, STOWMARKET, SUFFOLK IP14 5UX  
 T: 01449 763034  
 E: info@britannia-archaeology.com  
 W: www.britannia-archaeology.com

SCALE: 1:2000



APPROVED: MCA	VERSION: 01
PILOT: A3	AUTHOR: TPS
DATE: OCT 2014	FIGURE: 01





+9.13nT



-9.26nT

Unsuitable for Survey

Site Boundary

NGR: TM 3650 4870  
REPORT NUMBER: 1074

PROJECT:

THE GREEN, CAPEL ST ANDREW,  
SUFFOLK

CLIENT:



DESCRIPTION:

RAW MAGNETOMETER  
GREYSKALE PLOT

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SCALE:

1:1000



APPROVED:

MCA

VERSION:

01

DATE:

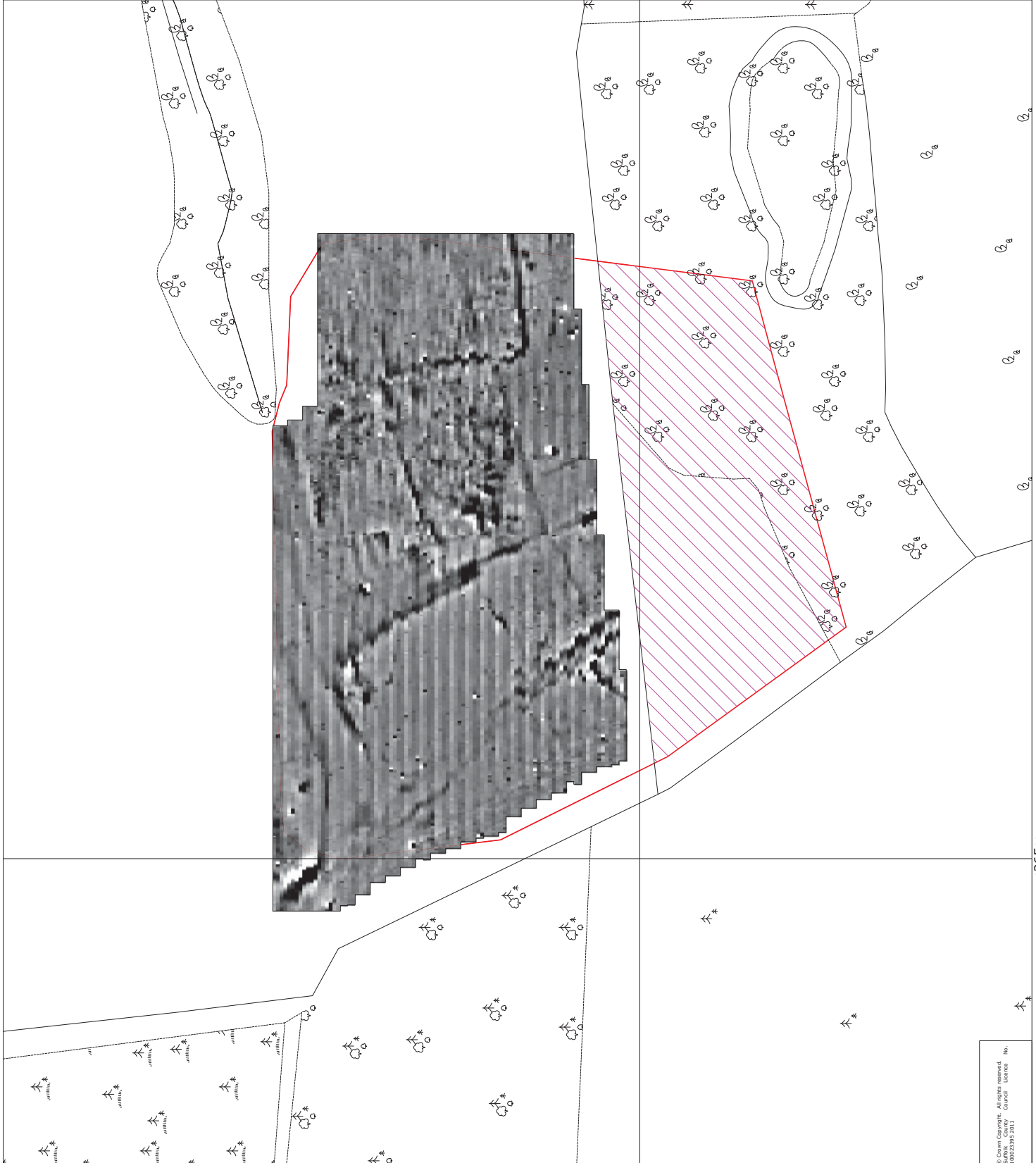
OCT 2014

AUTHOR:

TPS

FIGURE:

02







Unsuitable for Survey

Site Boundary

NGR: TM 3650 4870  
REPORT NUMBER: 1074

PROJECT:  
THE GREEN, CAPEL ST ANDREW,  
SUFFOLK

CLIENT:



DESCRIPTION:  
PROCESSED MAGNETOMETER  
GREYSKALE PLOT

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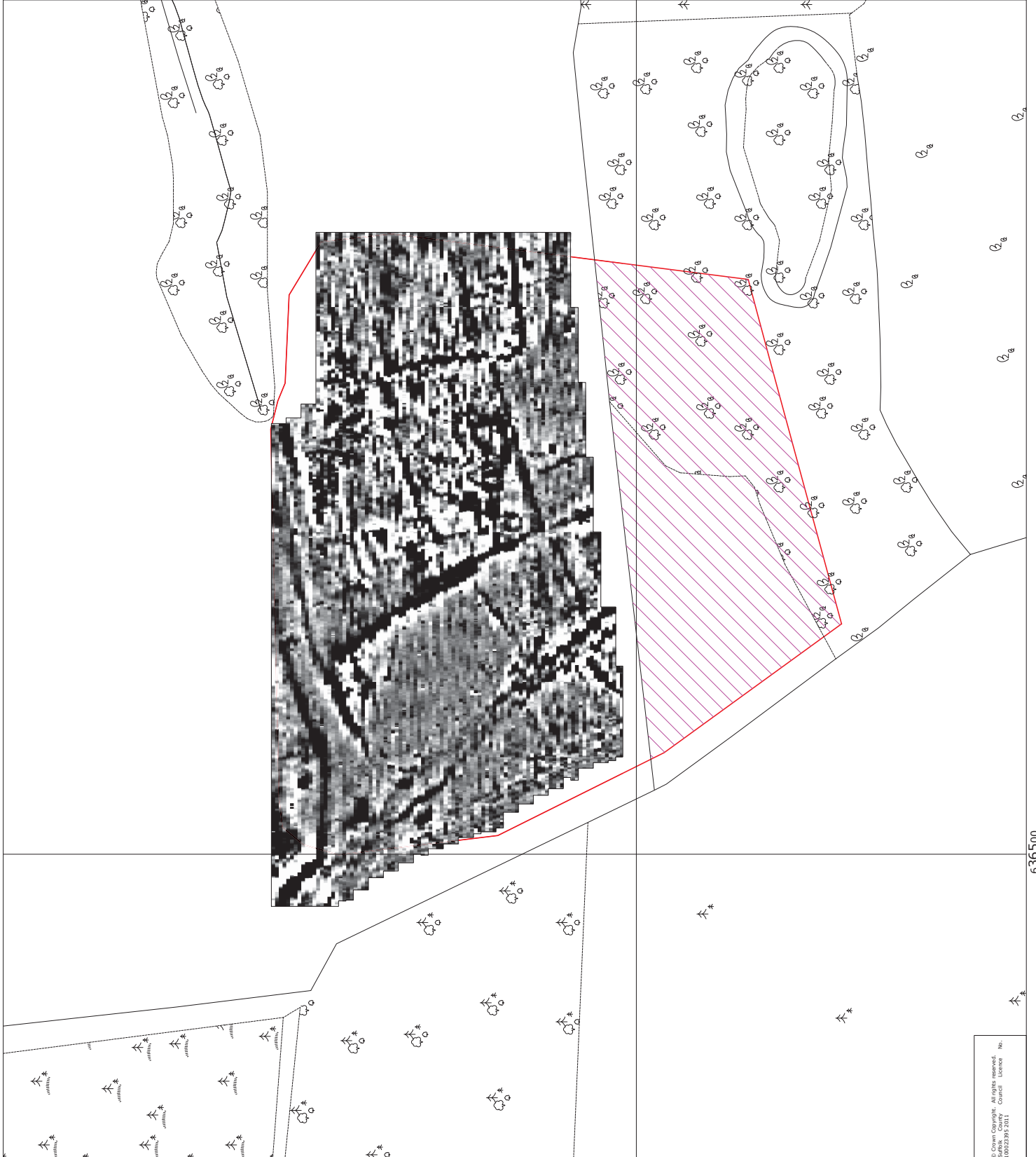
115 OSPREY DRIVE, STOWMARKET, SUFFOLK  
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W: www.britannia-archaeology.com

SCALE: 1:1000  
APPROVED: MCA  
VERSION: 01



DATE: OCT 2014  
AUTHOR: TPS  
FIGURE: 03





6nT/cm

Scale Interval

Unsuitable for Survey



Site Boundary



NGR: TM 3650 4870

REPORT NUMBER:  
1074

PROJECT:  
THE GREEN, CAPEL ST ANDREW,  
SUFFOLK

CLIENT:  
 Suffolk  
County Council

DESCRIPTION:  
PROCESSED MAGNETOMETER  
XY TRACE PLOT

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W: www.britannia-archaeology.com

SCALE: 1:1000



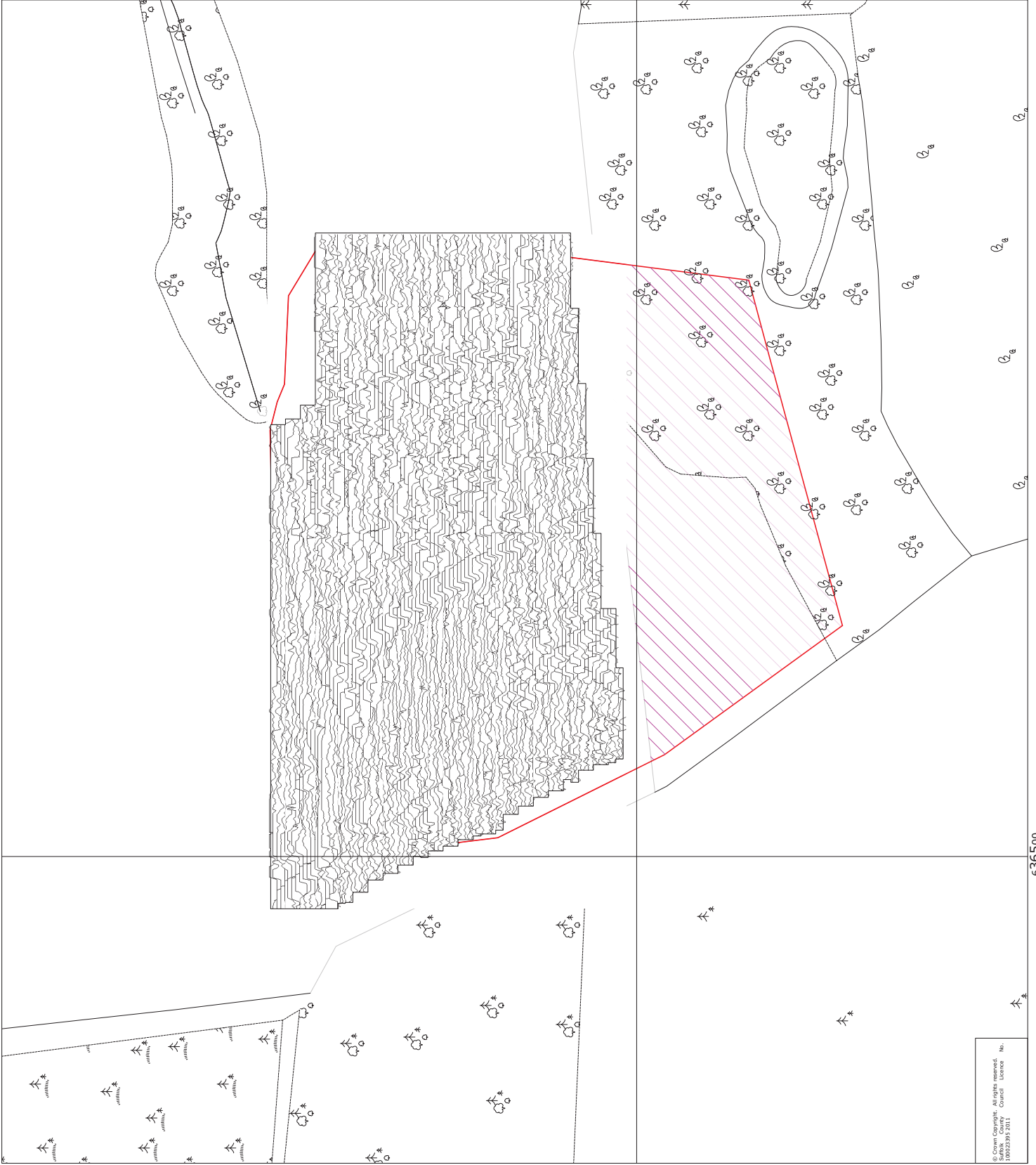
APPROVED: MCA

VERSION: 01

DATE: OCT 2014

AUTHOR: TPS

FIGURE: 04





	Negative Linear Anomaly, Archaeology
	Positive Linear Anomaly, Archaeology
	Positive Discrete Anomaly, Archaeology
	Area of Magnetic Enhancement, Archaeology
	Isolated Dipolar Responses
	Unsuitable for Survey
	Site Boundary

NGR: TM 3650 4870  
 REPORT NUMBER: 1074

PROJECT:  
 THE GREEN, CAPEL ST ANDREW,  
 SUFFOLK

CLIENT:  
 Suffolk  
 County Council

DESCRIPTION:  
 INTERPRETATION PLOT OF  
 MAGNETOMETER ANOMALIES

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SCALE: 1:1000  
 0 50m  
 APPROVED: MCA  
 VERSION: 01  
 AUTHORITY: TPS  
 DATE: OCT 2014  
 FIGURE: 05

