LIME TREE FARM, BLAXHALL, SUFFOLK

DETAILED MAGNETOMETER SURVEY

Report Number: 1098 May 2015

LIME TREE FARM, BLAXHALL, SUFFOLK

Detailed Magnetometer Survey

Prepared for:

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Site Code	BLX 028	**NGR**	TM 3670 5630
Planning Ref.	Pre-application	**OASIS**	britanni1-209610
Approved By	Dan McConnell	**DATE**	May 2015

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CONTENTS

ABSTRACT

In May 2015 Britannia Archaeology Ltd undertook a detailed fluxgate gradiometer survey over c.7 hectares of land to the south of Lime Tree Farm, Blaxhall, Suffolk, in a single agricultural field over the footprint of a proposed agricultural reservoir.

The background magnetic susceptibility signature was found to be relatively low allowing the wide range of anomalies recorded (many of which have a high archaeological potential) to be prospected with good clarity.

Positive parallel and perpendicular linear anomalies interpreted as rectangular subdivided enclosures were recorded in close proximity to positive discrete anomalies (interpreted as potential rubbish pits) and areas of magnetic disturbance that may prove to be hearths, kilns, burnt pits or furnaces.

The full range of anomaly types should be targeted to investigate the interpretations given within this report, with particular attention given to those with an archaeological derivation.

1.0 INTRODUCTION

In May 2015 Britannia Archaeology Ltd (BA) undertook a detailed fluxgate gradiometer survey over *c.*7 hectares of land to the south of Lime Tree Farm, Blaxhall, Suffolk (NGR TM 3670 5630) in one harrowed and drilled agricultural field, over the footprint of a proposed agricultural reservoir (Figure 1).

This survey was commissioned by Dr Rhodri Gardner in response to a brief issued by SCCAS/CT (Brudenell, M. dated 14th January 2015) for a geophysical survey. The weather was sunny and windy with outbreaks of rain.

2.0 SITE DESCRIPTION

The site is located in a single agricultural field directly to the east of School Road in Blaxhall, Suffolk and lies at a height of between 20 and 25m aOD. It is bounded to the east by a hedgerow, to the south by the B1069 and to the north by agricultural fields and Lime Tree Farm.

The bedrock geology is described as Neogene and Quaternary Sedimentary Rocks of gravel, sand, silt and clay, formed up to 23 million years ago in the Quaternary and Neogene Periods when the local environment was dominated by shallow seas (BGS, 2015).

Superficial deposits are described as Glacial Sand and Gravel formed up to 3 million years ago in the Quaternary Period, when the local environment was dominated by ice age conditions (BGS, 2015).

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 *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.

4.0 ARCHAEOLOGICAL BACKGROUND

The site of the proposed reservoir lies in an area of archaeological potential as recorded by information held in the County Historic Environment Record (HER). A scatter of Roman pottery indicative of occupation has been recorded *c.*200m to the north of the development area. Although there are no recorded heritage assets within the proposed development area, the site has not been subject to any previous systematic archaeological investigation and recording. The scale of the development is such that there is potential

for the discovery of hitherto unknown important features and deposits. The proposed works could cause significant ground disturbance, that has the potential to damage any existing archaeological deposits and below ground heritage assets (Brief, Section 2.1).

5.0 PROJECT AIMS

The geophysical survey was required to establish the suitability of the area for development; the results of which may be used to inform the location of the proposed reservoir. The area was provisionally set at *c.*11ha, but was later reduced in size (Brief Section 3.2) to *c.*7 hectares.

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 background magnetic susceptibility signature was relatively low and a suitable zero station was located with ease.

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 sunny periods which caused a degree of sensor drift and the characteristic parallel traverse 'striping' that is present within 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 ±0.1m employing a Leica Viva Glonnass 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 a north-east to south-west alignment (Figure 1).

6.5 Data Capture

Instrument readings were recorded on an internal data logger that were downloaded to a laptop at midday followed by a second download 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.

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 plots are presented with no processing, and were clipped to produce a uniform greyscale plot, processed data schedules are also displayed below.

Raw Data:
Data Clipping: -5 to +5nT;
Display Clipping: +/- 3 standard deviations.

Processed Data:
De-stripe: Median Sensors: All;
Data Clipping: -2 to +2nT;
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). Digitised features recorded on Ordnance Survey Maps from 1883 until 1983 are also included in Figure 5 (purple lines). 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 did not position any reference stations within the field, three virtual geo-referenced survey stations are presented in Figure 1 that will allow the survey grid and anomalies to be accurately targeted.

7.0 RESULTS & DISCUSSION

High numbers of isolated dipolar ('iron spike') responses (yellow hatched circles) were prospected throughout the dataset that record the presence of ferrous material introduced into the topsoil probably through manuring processes and loss. These responses could also be caused by archaeological artefacts.

Seven areas of magnetic disturbance (brown hatching) were recorded on the periphery of the survey area and are likely to relate to ferrous material present within the field boundaries. A further five areas of magnetic disturbance were located in and around the parallel and perpendicular linear anomalies, they are therefore more likely to be of an archaeological derivation, potentially hearths, kilns, burnt pits or furnaces associated with the rectangular enclosures. One area of magnetic disturbance has been prospected in which a circular topographic feature was recorded on the 1883 to 1951 Ordnance Survey (OS) map. This topographic feature has been backfilled with material containing highly magnetic readings between the publication of the 1951 and 1958 OS maps.

A series of narrow weak negative parallel linear anomalies (green lines) recorded running north to south, delineate wheel and furrow ruts created by farm machinery and noted by the surveyors.

Seven weak positive broad linear and discrete anomalies (grey hatching) were prospected within the dataset. Their weak and broad nature suggests that a geological derivation is most likely.

A single weak negative linear trend (cyan line) orientated north-east to south-west in the south-western corner has been interpreted as a service run or land drain trench.

One weak positive linear trend (magenta hatching) orientated north-west to south-east was recorded near to the southern boundary. This anomaly is very straight in nature and is potentially of an agricultural origin.

One area of magnetic enhancement (blue hatching) located to the north and centre of the survey is located where an area of subsoil was noted in the topsoil matrix by the surveyors. This anomaly is potentially a large test pit or equally could be of geological derivation.

Twenty-seven positive discrete anomalies (orange hatching) were recorded across the survey area, some of which are spread out, and others that are clustered in groups. A group of six discretes present in the centre of the dataset are indicative of a cluster of rubbish pits, possibly associated with the parallel and perpendicular positive linear anomalies (red hatching) recorded further to the west. Eleven more positive discrete anomalies are recorded within and nearby positive linear anomalies. Those present within these enclosures appear to respect the positive linears, which suggests that they are potentially contemporary.

A complex arrangement of positive parallel and perpendicular linear anomalies (red hatching) have been recorded on the western side of the dataset, indicative of rectangular

enclosure ditches with associated (potentially contemporary) large areas of magnetic disturbance (hearths, kilns and furnaces) and discrete positive anomalies (rubbish pits). The northern-most boundary of which survived as a landscape feature until it was backfilled between the publication of the 1958 to 1976 OS maps. Similar anomaly types with comparable orientations in the south-western corner are potentially a continuation of these enclosures located further north. To the west of the dataset lies a broader discontinuous linear anomaly which turns through eighty-five degrees before heading off to follow a north-south orientation. This anomaly is thought to delineate the location of a backfilled remnant field boundary that is not recorded on cartographic sources.

8.0 CONCLUSION

A wide range of anomalies were recorded throughout the survey area that are potentially of an archaeological origin. Those with the highest potential are clustered around the positive parallel and perpendicular linear anomalies indicative of rectangular subdivided enclosures. Positive discrete anomalies interpreted as potential rubbish pits, and areas of magnetic disturbance that may prove to be hearths, kilns, burnt pits or furnaces are also of high archaeological potential.

The full range of anomalies should be targeted to investigate the interpretations given within this report, with particular attention focused on those of potential archaeological origin.

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 Suffolk Archaeology CIC for commissioning the survey and to Rachael Abraham of SCCAS/CT for her input throughout the project.

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Cartographic sources digitised from www.old-maps.co.uk

APPENDIX 1 METADATA SHEETS

Raw Data

Filename	Blax 1 R.xcp
Description	
Instrument Type	Grad 601-2 (Gradiometer)
Units	nT
Surveyed by	TPS/AL on 5/12/2015
Assembled by	TPS/AL on 5/12/2015
Direction of 1st Traverse	135 deg
Collection Method	ZigZag
Sensors	2 @ 1.00 m spacing.
Dummy Value	32702.00
Dimensions	
Composite Size (readings)	1440 x 220
Survey Size (meters)	360.00m x 220.00 m
Grid Size	20.00 m x 20.00 m
X Interval	0.25 m
Y Interval	1.00 m
Stats	
Max	5.00
Min	-5.00
Std Dev	1.44
Mean	1.94
Median	2.04
Composite Area	7.92 ha
Surveyed Area	6.68 ha
Program	
Name	ArcheoSurveyor
Version	2.5.16.0

Processed Data

Filename	Blax 1 P.xcp
Description	
Instrument Type	Grad 601-2 (Gradiometer)
Units	nT
Surveyed by	TPS/AL on 5/12/2015
Assembled by	TPS/AL on 5/12/2015
Direction of 1st Traverse	135 deg
Collection Method	ZigZag
Sensors	2 @ 1.00 m spacing.
Dummy Value	32702.00
Dimensions	
Composite Size (readings)	1440 x 220
Survey Size (meters)	360.00m x 220.00m
Grid Size	20.00 m x 20.00m
X Interval	0.25 m
Y Interval	1.00 m
Stats	
Max	2.00
Min	-2.00
Std Dev	0.89
Mean	0.01
Median	0.00
Composite Area	7.92 ha
Surveyed Area	6.68 ha
Program	
Name	ArcheoSurveyor
Version	2.5.16.0

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APPENDIX 2 TECHNICAL DETAILS

MAGNETOMETER

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 WRITTEN SCHEME OF INVESTIGATION

LIME TREE FARM, BLAXHALL, SUFFOLK

WRITTEN SCHEME OF INVESTIGATION
DETAILED MAGNETOMETER SURVEY

Project Number: 1107 April 2015

LIME TREE FARM, BLAXHALL, SUFFOLK

Written Scheme of Investigation
Detailed Magnetometer Survey

Prepared for:

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April 2015

Site Code	tbc	**NGR**	TM 367 563
Planning Ref.	Pre-application	**OASIS**	britanni1-209610
Approved By	Martin Brook	**DATE**	April 2015

 Project Number: 1107

CONTENTS

1.0 INTRODUCTION

This Written Scheme of Investigation (WSI) has been prepared by Britannia Archaeology Ltd (BA) on behalf of Dr Rhodri Gardner in response to a brief (Brudenell, M. dated 14th January 2015) for a geophysical survey ahead of construction of a proposed reservoir on land at Lime Tree Farm, Blaxhall, Suffolk (NGR TM 3670 5630).

2.0 SITE DESCRIPTION

The site is located in two agricultural fields directly to the east of School Road in Blaxhall, Suffolk and lies at a height of between 20 and 25m aOD. It is bounded to the east by a hedgerow, to the south by the B1069 and to the north by agricultural fields and the footprint of Lime Tree Farm.

The bedrock geology is described as Neogene and Quaternary Sedimentary Rocks of gravel, sand, silt and clay, formed up to 23 million years ago in the Quaternary and Neogene Periods when the local environment was dominated by shallow seas (BGS, 2015).

Superficial deposits are described as Glacial Sand and Gravel formed up to 3 million years ago in the Quaternary Period when the local environment was dominated by ice age conditions (BGS, 2015).

3.0 PLANNING POLICIES

The archaeological investigation is to be 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 *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. 31st 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 proposed reservoir site lies in an area of archaeological potential as recorded by information held in the County Historic Environment Record (HER). A scatter of Roman pottery indicative of occupation has been recorded *c.*200m to the north of the

Lime Tree Farm, Blaxhall, Suffolk
Detailed Magnetometer Survey
Written Scheme of Investigation

development area. Although there are no recorded heritage assets within the proposed development area, the site has not been subject to any previous systematic archaeological investigation and recording. The scale of the development is such that there is potential for the discovery of hitherto unknown important features and deposits. The proposed works would cause significant ground disturbance, that has potential to damage any existing archaeological deposits and below ground heritage assets (Brief, Section 2.1).

5.0 PROJECT AIMS

This geophysical survey is required to establish the suitability of the area for development; the results of which may be used to inform the location of the proposed reservoir. The area is provisionally set at *c.*11ha, but may be subject to change (Brief Section 3.2).

6.0 METHODOLOGY

6.1 Fieldwork

A detailed fluxgate gradiometer survey is required over *c*10.00 Hectares, scheduled to be undertaken in May 2015.

6.2 Instrument Type Justification

Britannia Archaeology Ltd will employ a Bartington Dual Grad 601-2 fluxgate gradiometer to undertake the survey, because of its high sensitivity and rapid ground coverage. The soils and underlying geology are receptive to magnetometer survey, but good results are heavily dependent on the contrast between the fills of a feature (with humic and charcoal rich deposits providing the best results) and the relative weakness of the local magnetic background field.

6.3 Instrument Calibration

The Magnetometer will be left on for a minimum of 20 minutes in the morning for the sensors to settle before any recorded survey takes place. Sensor heights will be measured and equalised at the start of the first day so that a consistent height above the ground is maintained during the survey. Each sensor shall be positioned on the same side of the instrument throughout the survey. The instrument shall be zeroed after every three grids to minimise the effect of sensor drift. An area shall be chosen with low magnetic susceptibility to calibrate the instruments sensors, this same point shall be used to zero the sensors throughout the survey providing a common zero point.

6.4 Sampling Interval and Grid Size

The sampling interval shall be 0.25m along 1m traverse intervals, within 20 x 20m grids.

Lime Tree Farm, Blaxhall, Suffolk
Detailed Magnetometer Survey
Written Scheme of Investigation

6.5 Survey Grid Location

The survey grid shall be set out to the Ordnance Survey OSGB36 datum to an accuracy of ±0.01m employing a Leica Viva Glonnass Smart Rover GS08. Data will be converted to the National Grid Transformation OSTN02, and the instrument will be regularly tested using stations with known ETRS89 coordinates. The grid will be located parallel to the long axis of the proposed development to allow for ease of survey.

6.6 Data Capture

The grid order will be recorded on a BA pro-forma so that the composite plan can be inputted at the close of the day. Instrument readings will be recorded on an internal data logger, downloaded to a laptop at midday and in the evening. Data will be filed in job specific folders, broken up into daily data sets. All data will then be backed up onto an external storage device and finally a remote server. Raw data composites will be uploaded into an AutoCAD drawing and then printed out daily. This will allow BA to check data quality and to re-survey any grids if necessary.

6.7 Data Presentation and Processing

Only minimal processing of the datasets shall be undertaken, typically de-spike and zero mean traverse. Raw and processed greyscale plots shall be produced for comparison, this ensures that no anomalies are processed out of the original data set. An XY trace plot consisting of raw and processed data will be used in combination with raw and processed greyscale data. An interpretation plan characterising the anomalies shall be produced drawing on the evidence collated from the greyscale and XY trace plots. All figures will be tied into the National Grid and printed at an appropriate scale.

6.8 Software

The software used to process the data and produce the composites will be DW Consulting's Terrasurveyor v2.0. Datasets will be exported into AutoCAD and placed onto their corresponding grid positions. An interpretation plot will then be produced using AutoCAD.

7.0 PRESENTATION OF RESULTS

The prepared client/archive report will be commensurate with the results of the fieldwork, and will be consistent with the principles of the *Management of Research Projects in the Historic Environment* (*MoRPHE*), English Heritage, Edmund Lee, 2006 (minor revisions 2009), *Geophysical Survey In Field Evaluation,* English Heritage, Andrew David *et al*, 2008, and the *Standard and Guidance for Archaeological Geophysical Survey*, Institute for Archaeologists, 2011, containing the following:

- *Summary*. A concise summary of the work undertaken and the results.
- *Introduction*. Introduction to the project including the reasons for work, funding, planning background.

Lime Tree Farm, Blaxhall, Suffolk
Detailed Magnetometer Survey
Written Scheme of Investigation

- *Background*. The history, layout and development of the site.
- *Aims and Objectives*.
- *Methodology*. Survey strategy and techniques used.
- *Results*. Detailed description of findings outlining the nature, location and extent of the anomalies.
- *Discussion and Conclusions*. A synopsis interpreting the anomalies, impact assessment, site potential, possible locations of subsequent trial trenches.
- *Bibliography*.
- *Appendices*. Technical Details, Geo-referencing Information, Metadata Sheet, HER/OASIS Summary Sheet.
- *Illustrative Material*. Raw Data Plots, Processed Data Plots, XY Trace Plots, Interpretation Plots, Photographs.

Digital copies will be supplied to the client and the digital version of the final report will be submitted to the Suffolk Historic Environment Record (including a vector plan and AutoCAD .dxf file) and the National Monuments Record (NMR) in due course. A .pdf version will be uploaded to the ADS website and an OASIS form will be completed online and sent to the HER.

8.0 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.

9.0 HEALTH AND SAFETY

BA operates a comprehensive Health and Safety Policy in accordance with the Health and Safety Executive. BA operates under the Federation of Archaeological Managers and Employers (FAME) *Health and Safety Field Manual*, which is regularly updated by supplements.

BA are covered by employer's liability, public liability and professional indemnity insurance arranged through Towergate Insurance (see Appendix 2).

Lime Tree Farm, Blaxhall, Suffolk
Detailed Magnetometer Survey
Written Scheme of Investigation

9.1 Code of Practice, Risk Assessment and Site Induction

BA's Code of Practice covers all aspects of survey work and ensures all risks are adequately controlled. A site visit will be undertaken and an assessment of the potential risks highlighted, a full site risk assessment will be produced based on this information. The assessment of risk is continually monitored and this document can be updated if any change in risk occurs. A copy of the Risk Assessment is kept on site, read and countersigned by all staff and visitors during the BA site induction.

BA will liaise with the contractor or client on arrival and will follow any additional Health and Safety instructions given.

A qualified First Aider will be present on every site.

All BA staff members are CSCS registered.

10.0 RESOURCES

All archaeological projects are undertaken by a team of professional qualified archaeologists, a synopsis can be found at Appendix 3. Full CV's are available on request.

All site work will be undertaken by a Project Officer (with a field team if required) in close communication with a Project Manager. This project officer will also be responsible for post-survey publication.

11.0 TIMETABLE AND PROGRAMME OF WORK

The geophysical survey is scheduled to be undertaken in May 2015 and report production will commence thereafter. Preliminary greyscale and interpretation plots shall be issued at the end of the survey. It is understood that the client is aware of the working methods and provision has been made to allow access to undertake the survey as required.

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APPENDIX 1 TECHNICAL DETAILS

MAGNETOMETER

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 INSURANCE DETAILS

	Employers Liability Insurance	**Public Liability**	**Professional Indemnity**
Insurer	Towergate Insurance	Towergate Insurance	Towergate Insurance
Extent of Cover	£10,000,000	£2,000,000	£2,000,000
Policy Number	000436	000436	201101352/1236

APPENDIX 3 STAFF

The following members of staff have the skills and experience necessary to undertake the archaeological work required in the brief. All have a wide range of experience on a variety of site types.

Archaeologist **Adam Leigh BA (Hons)**

Qualifications: University of Reading, BA (Hons) History (2008-2011)

Experience: Adam joined Britannia Archaeology in early 2015 as an Archaeologist and has four years post-graduation experience within commercial archaeology. After graduating from Reading with First Class Honours, Adam began his career in the finds room of an archaeological unit based in East Anglia. In 2012 he became responsible for the processing, archiving and deposition of finds and learned a wide range of fieldwork skills on numerous sites within and beyond the East Anglian region. Adam's main research interests lie in the archaeology and history of the Medieval period that stemmed from his higher education studies.

Senior Project Manager **Dan McConnell BSc (Hons)**

Qualifications: University of Bournemouth, BSc (Hons) Archaeology (1995-1998)

Experience: Dan is a Senior Project Manager at Britannia Archaeology and has sixteen years post-graduation archaeological experience. He took part in several archaeological projects in the north of England from the late 1980's onwards, including the Wharram Percy Research Project and Mount Grace Priory excavations. As a postgraduate he has been involved with many small to large scale archaeological projects in the United Kingdom and Ireland including major infrastructure schemes. Since relocating to East Anglia in 2004 he has carried out and managed several small to large scale excavations. In 2008 Dan became a County Archaeologist for the Cambridgeshire County Council Historic Environment Team before joining Britannia in 2014. His main research interests focus on the early pre-historic period (in particular the Neolithic) of the British-Isles and late post-medieval archaeology.

Senior Project Manager **Martin Brook BA (Hons) PCIfA**

Qualifications: University of Leicester, BA (Hons) Archaeology (2003 – 2006)

Experience: Martin is a Project Manager at Britannia Archaeology and has seven years post-graduation archaeological experience. He specialises in logistical project management and archiving. He has carried out numerous excavations and evaluations throughout East Anglia and is familiar with all local museum and county archiving requirements. His research interests are focused on the British Iron age specifically funerary traditions in the south of England and in East Yorkshire. He has developed a keen specialisation in metalwork finds from the period.

Director **Timothy Schofield HND BSc PCIfA**

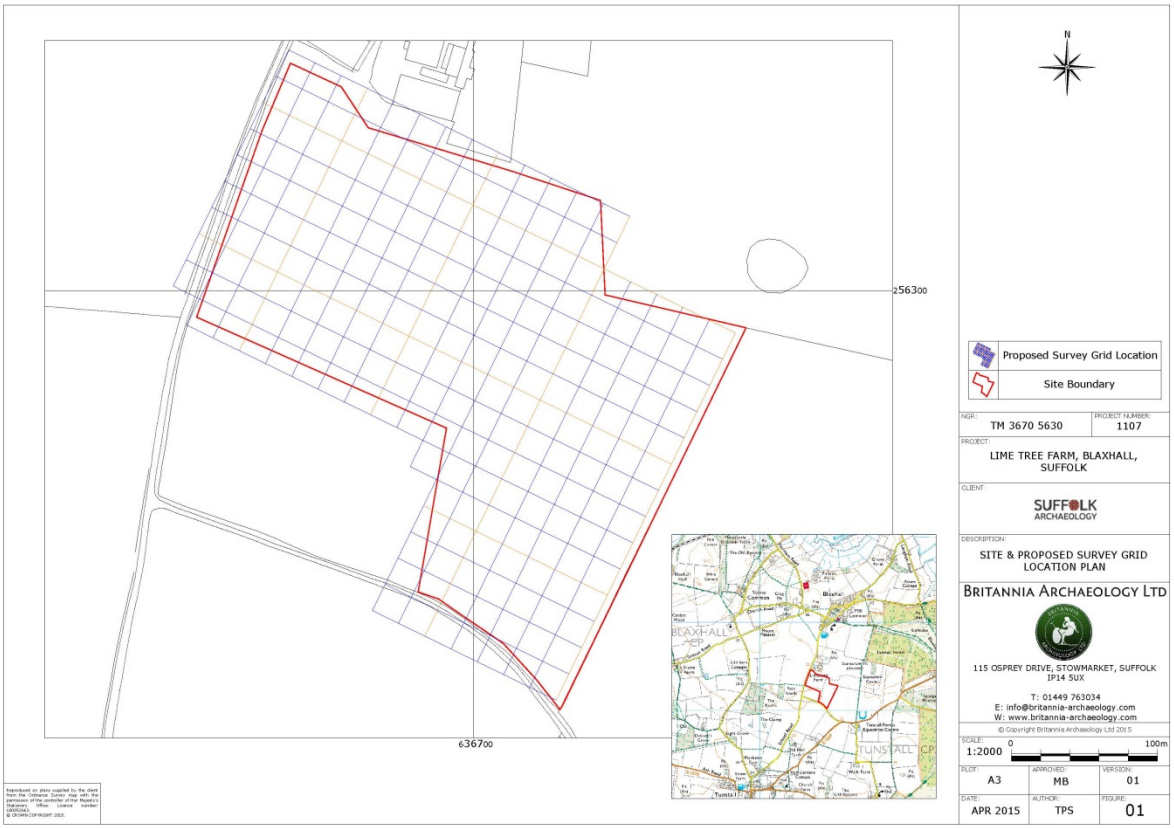
Qualifications: University of Bournemouth, BSc Archaeological Studies (1999-2000)
Yeovil College, HND Practical Archaeology, (1997-1999)

Experience: Tim is the Co-Director of Britannia Archaeology and has twelve years post-graduation archaeological experience. He specialises in geophysical survey, topographic survey, GIS, computer aided design and archaeological excavation. He has carried out numerous surveys and excavations across the UK. His research interests focus mainly on prehistoric and post-Roman archaeology and in the use and application of modern technological advances in archaeology.

Director **Matthew Adams BA (Hons) ACIfA**

Qualifications: University of Durham, BA (Hons) Classical Studies (1997-2000)

Experience: Matt is the Co-Director of Britannia Archaeology and has seven years post-graduation archaeological experience. He was involved in several archaeological projects in the North East of England as an undergraduate and has since worked in Lincolnshire and the Midlands. Since 2007 he has been based in East Anglia where he has specialised in all areas of practical field work, running numerous projects both large and small. He is also an experienced surveyor and AutoCAD operator. Matt is an occasional contributor to the popular TV series Time Team and is experienced at presenting talks and seminars to interested organisations. His main research interests focus on 'transitional periods' and include the late Iron Age and early Romano-British period, and the late Roman and early Anglo-Saxon period in Britain.



Appendix 4 OASIS FORM

OASIS DATA COLLECTION FORM: England

List of Projects | Manage Projects | Search Projects | New project | Change your details | HER coverage | Change country | Log out

Printable version

OASIS ID: britanni1-209610

Project details

Project name	Lime Tree Farm, Blaxhall, Suffolk; Detailed Magnetometer Survey
Short description of the project	In May 2015 Britannia Archaeology Ltd undertook a detailed fluxgate gradiometer survey over c.7 hectares of land to the south of Lime Tree Farm, Blaxhall, Suffolk, in a single agricultural field over the footprint of a proposed agricultural reservoir. The background magnetic susceptibility signature was found to be relatively low allowing the wide range of anomalies recorded (many of which have a high archaeological potential) to be prospected with good clarity. Positive parallel and perpendicular linear anomalies interpreted as rectangular subdivided enclosures were recorded in close proximity to positive discrete anomalies (interpreted as potential rubbish pits) and areas of magnetic disturbance that may prove to be hearths, kilns, burnt pits or furnaces. The full range of anomaly types should be targeted to investigate the interpretations given within this report, with particular attention given to those with an archaeological derivation.08
Project dates	Start: 08-05-2015 End: 13-05-2015
Previous/future work	No / Yes
Any associated project reference codes	P1107 - Contracting Unit No.
Any associated project reference codes	R1098 - Contracting Unit No.
Any associated project reference codes	BLX 028 - Sitecode
Type of project	Field evaluation
Site status	None
Current Land use	Cultivated Land 3 - Operations to a depth more than 0.25m
Monument type	ANOMALIES INDICATIVE OF SETTLEMENT ACTIVITY Uncertain
Significant Finds	NONE None
Methods & techniques	"Geophysical Survey"
Development type	Agricultural Reservoir
Prompt	Direction from Local Planning Authority - PPS
Position in the	Pre-application

planning process	
Solid geology (other)	Neogene and Quaternary Gravel, Sands and Silt
Drift geology	GLACIAL SAND AND GRAVEL
Techniques	Magnetometry

Project location

Country	England
Site location	SUFFOLK SUFFOLK COASTAL BLAXHALL Lime Tree Farm, Blaxhall, Suffolk
Study area	7.00 Hectares
Site coordinates	TM 3670 5630 52.1535702141 1.46061686988 52 09 12 N 001 27 38 E Point
Height OD / Depth	Min: 20.00m Max: 25.00m

Project creators

Name of Organisation	Britannia Archaeology Ltd
Project brief originator	Local Authority Archaeologist and/or Planning Authority/advisory body
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 Archaeology CIC

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	Lime Tree Farm, Blaxhall, Suffolk; Detailed Magnetometer Survey
Author(s)/Editor(s)	Schofield, T. P.
Other bibliographic details	R1098
Date	2015
Issuer or publisher	Britannia Archaeology Ltd
Place of issue or publication	Stowmarket
Description	A4 Bound Report with A3 fold-out Figures
URL	www.britannia-archaeology.com
Entered by	Tim Schofield (tim@britannia-archaeology.com)
Entered on	10 June 2015

OASIS: Please e-mail Historic England for OASIS help and advice
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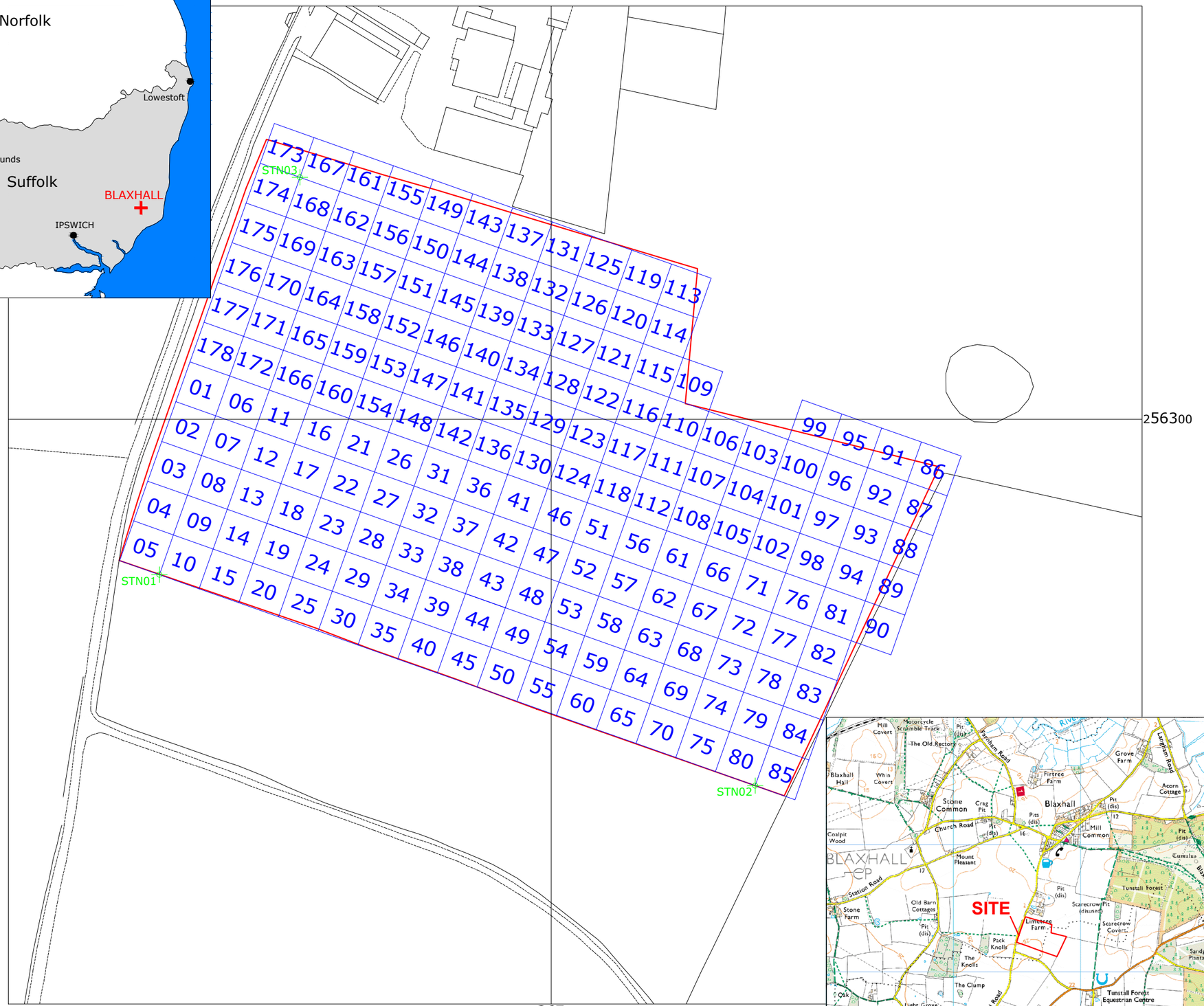
Cite only: http://www.oasis.ac.uk/form/print.cfm for this page



STATION	EASTING	NORTHING
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02	636796.858	256126.219
03	636580.763	256414.842

Survey Grid Location

Site Boundary

NGR: TM 3670 5630

REPORT NUMBER: 1098

PROJECT: LIME TREE FARM, BLAXHALL, SUFFOLK

CLIENT: SUFFOLK ARCHAEOLOGY

DESCRIPTION: SITE, SURVEY GRID & GEOREFERENCING INFORMATION PLAN

BRITANNIA ARCHAEOLOGY LTD

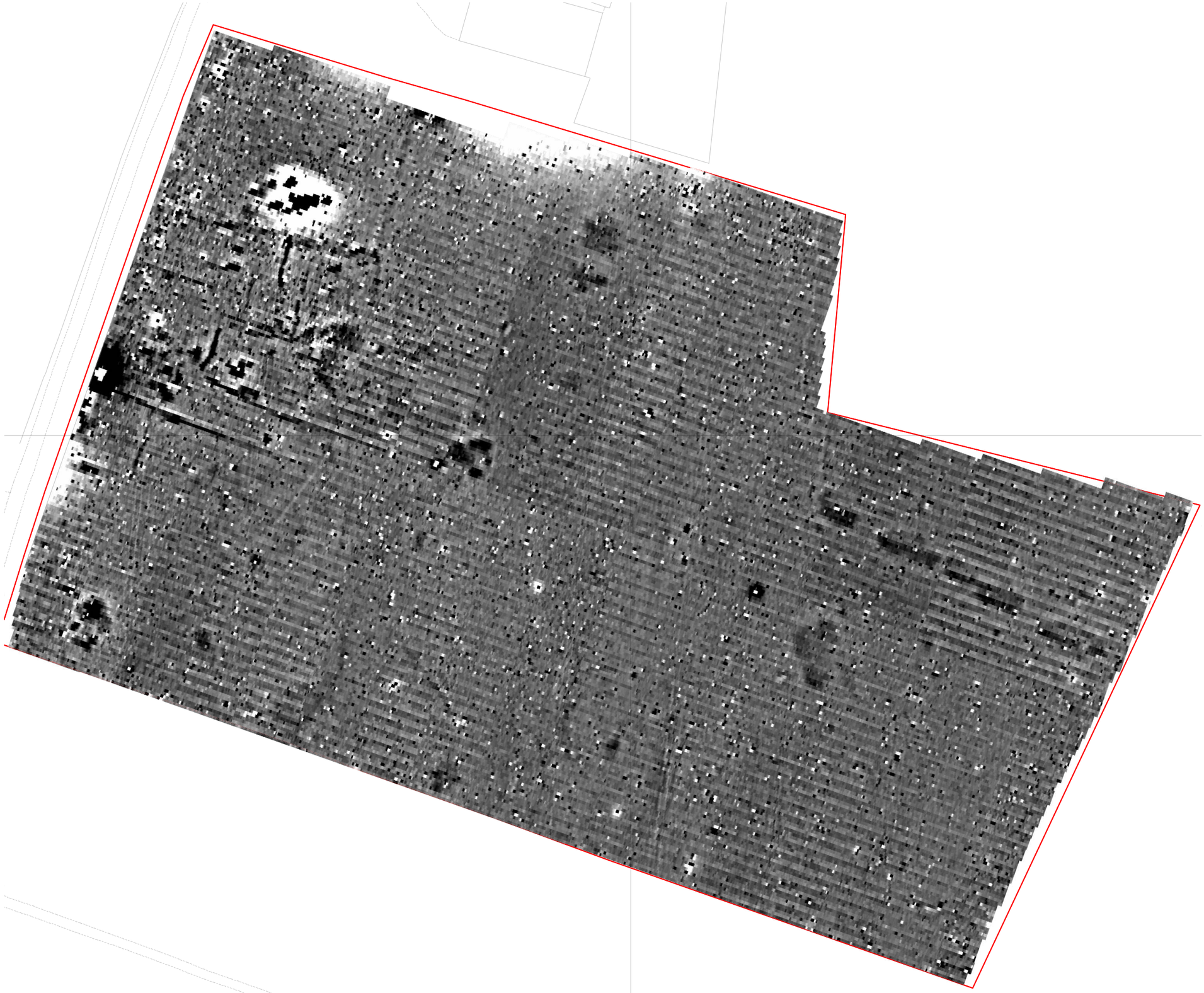
115 OSPREY DRIVE, STOWMARKET, SUFFOLK
IP14 5UX

T: 01449 763034
E: info@britannia-archaeology.com
W: www.britannia-archaeology.com

SCALE: 1:2000 (0 – 80m)

PLOT:	APPROVED:	VERSION:
A3	DPM	01

DATE:	AUTHOR:	FIGURE:
MAY 2015	TPS	01



N

+5nT

-5nT

Site Boundary

NGR: TM 3670 5630

REPORT NUMBER: 1098

PROJECT: LIME TREE FARM, BLAXHALL, SUFFOLK

CLIENT: SUFFOLK ARCHAEOLOGY

DESCRIPTION: RAW MAGNETOMETER GREYSCALE PLOT

BRITANNIA ARCHAEOLOGY LTD

115 OSPREY DRIVE, STOWMARKET, SUFFOLK
IP14 5UX

T: 01449 763034
E: info@britannia-archaeology.com
W: www.britannia-archaeology.com

SCALE: 1:1250

0 50m

PLOT: A3

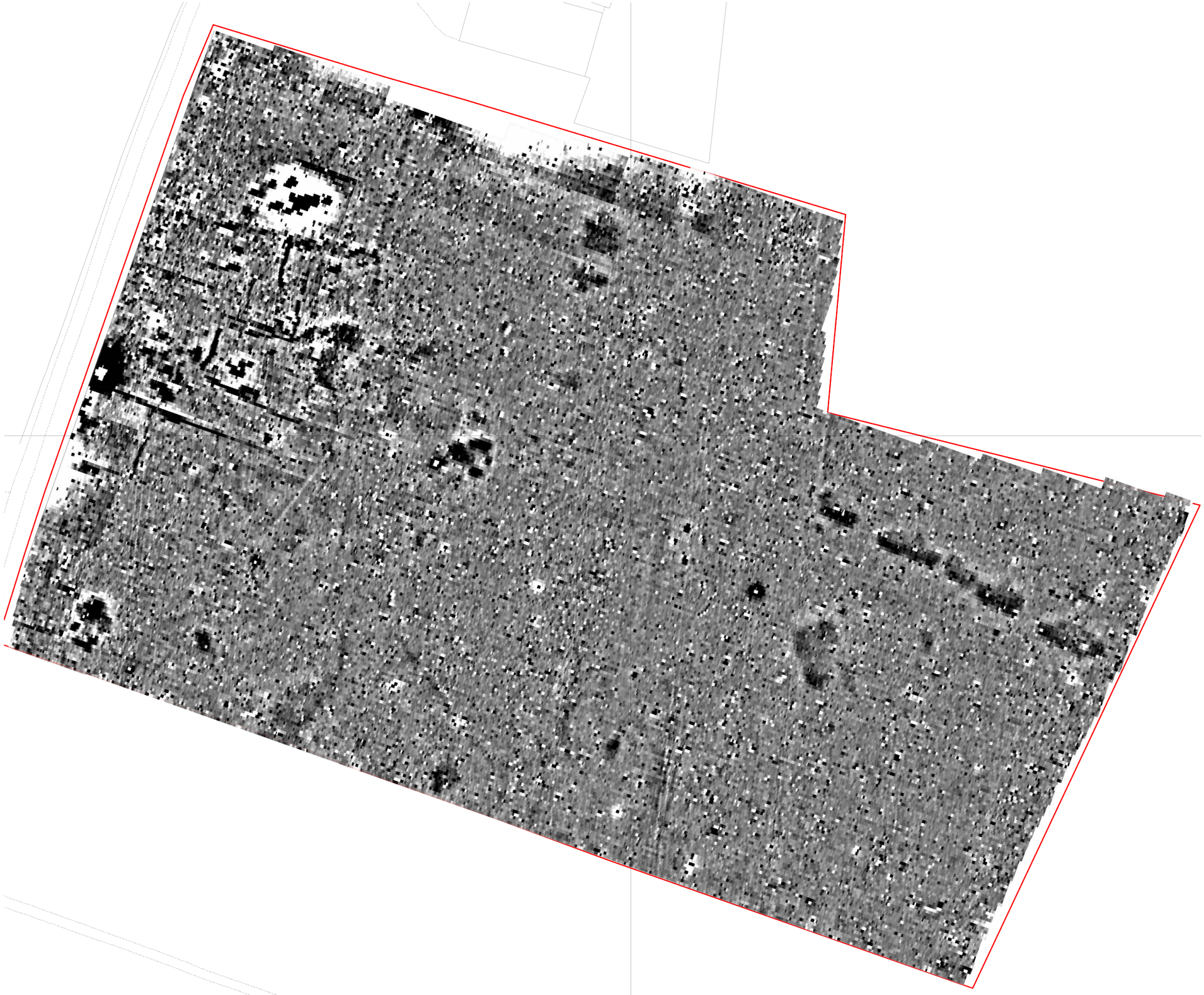
APPROVED: DPM

VERSION: 01

DATE: MAY 2015

AUTHOR: TPS

FIGURE: 02



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+2nT

-2nT

Site Boundary

NGR: TM 3670 5630

REPORT NUMBER: 1098

PROJECT:
LIME TREE FARM, BLAXHALL, SUFFOLK

CLIENT:
SUFFOLK ARCHAEOLOGY

DESCRIPTION:
PROCESSED MAGNETOMETER GREYSCALE PLOT

BRITANNIA ARCHAEOLOGY LTD

115 OSPREY DRIVE, STOWMARKET, SUFFOLK
IP14 5UX

T: 01449 763034
E: info@britannia-archaeology.com
W: www.britannia-archaeology.com

SCALE: 1:1250

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PLOT: A3

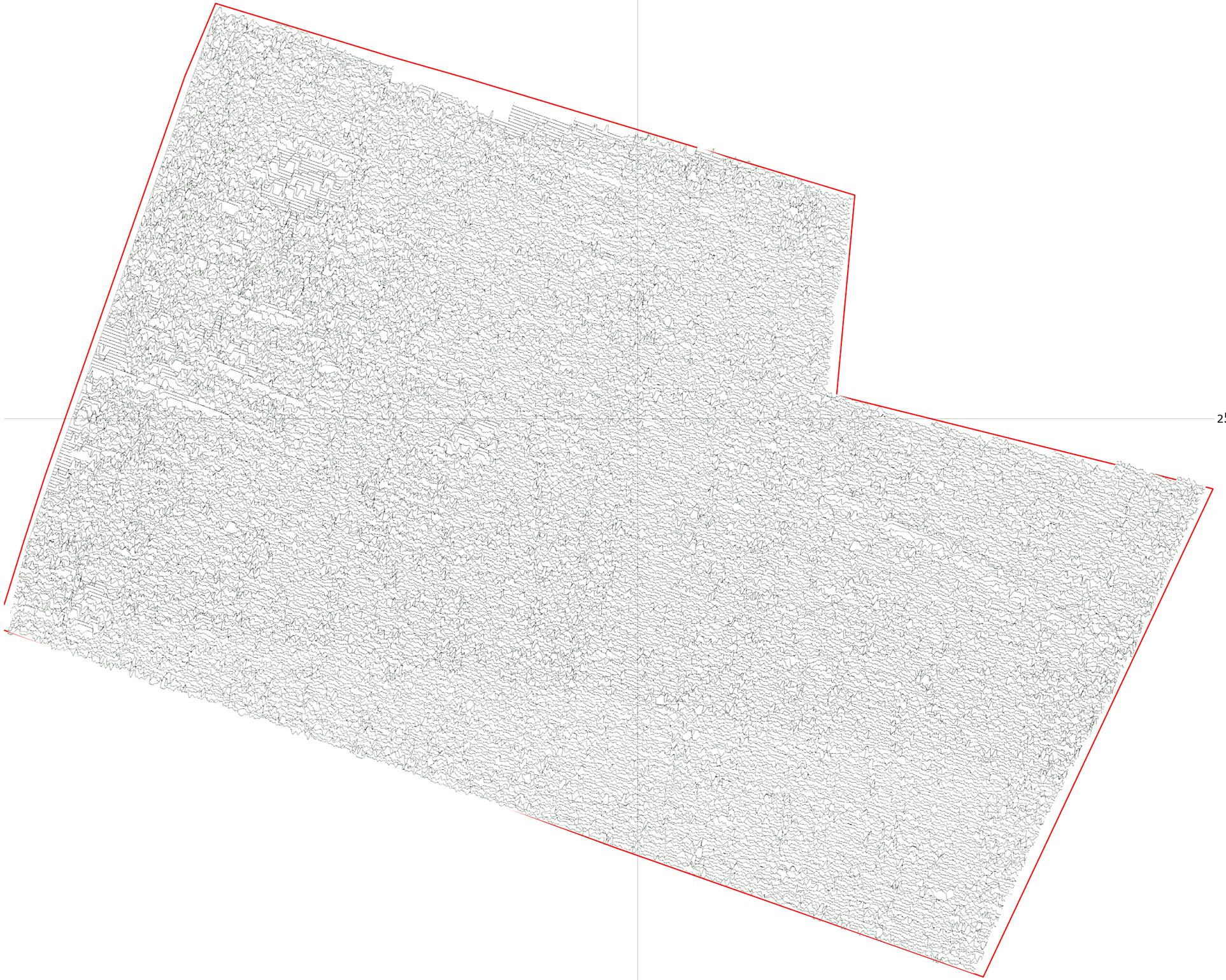
APPROVED: DPM

VERSION: 01

DATE: MAY 2015

AUTHOR: TPS

FIGURE: 03



30nT/cm	Scale Interval
	Site Boundary

NGR: TM 3670 5630

REPORT NUMBER: 1098

PROJECT:
LIME TREE FARM, BLAXHALL, SUFFOLK

CLIENT:
SUFFOLK ARCHAEOLOGY

DESCRIPTION:
PROCESSED MAGNETOMETER XY TRACE PLOT

BRITANNIA ARCHAEOLOGY LTD

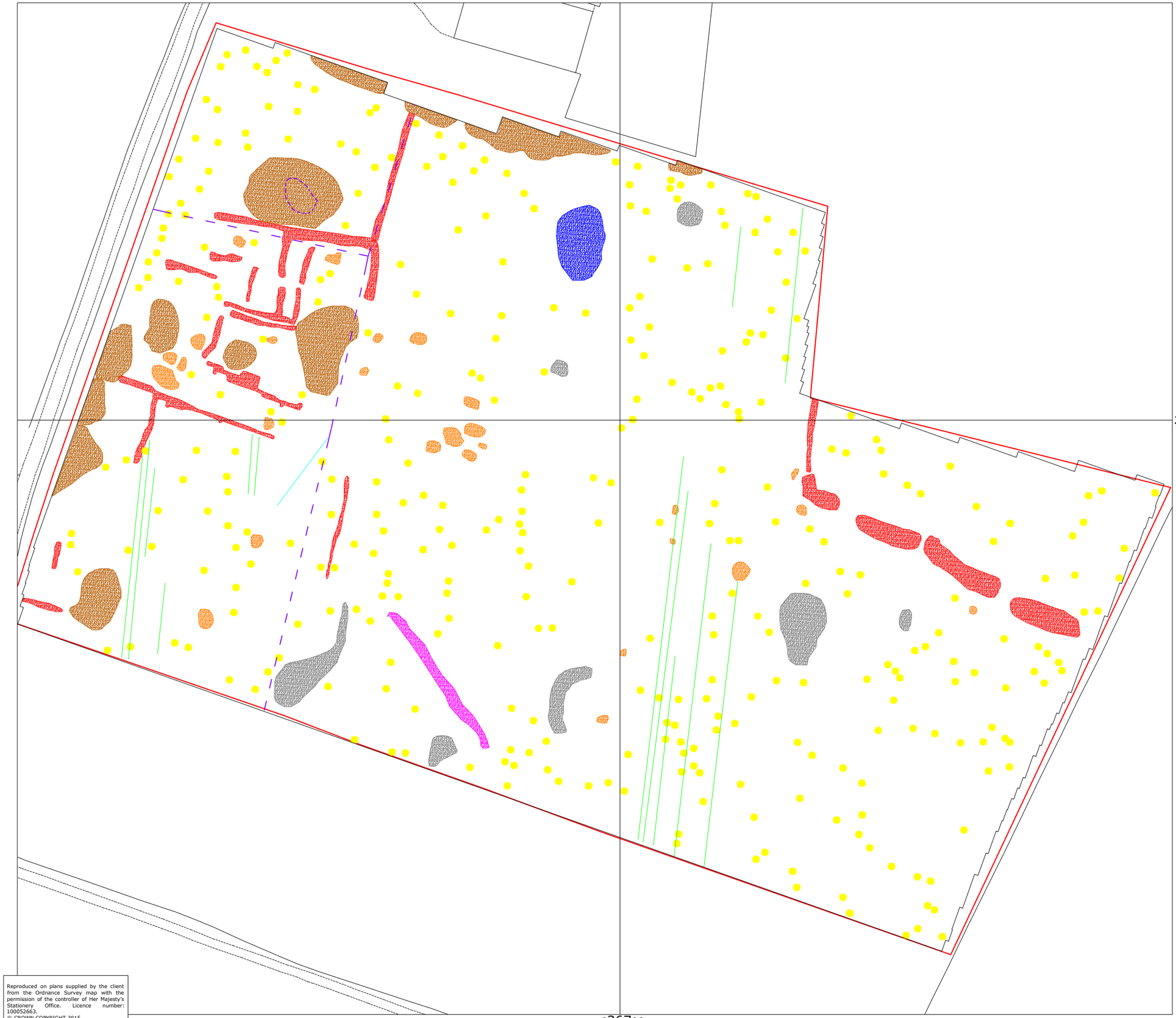
115 OSPREY DRIVE, STOWMARKET, SUFFOLK
IP14 5UX

T: 01449 763034
E: info@britannia-archaeology.com
W: www.britannia-archaeology.com

SCALE: 1:1250 (0 – 50m)

PLOT:	APPROVED:	VERSION:
A3	DPM	01

DATE:	AUTHOR:	FIGURE:
MAY 2015	TPS	04



N

	Positive Linear Anomaly, Archaeology
	Positive Discrete Anomaly, Archaeology
	Area of Magnetic Enhancement, Test Pit?
	Weak Positive Linear Trend, Agricultural Ditch?
	Weak Negative Linear Trend, Service Run?
	Weak Positive Broad Discrete, Geology?
	Narrow Weak Negative Linear Anomalies, Agricultural Furrows
	Area of Magnetic Disturbance, Modern?
	Isolated Dipolar Responses

	Digitised Historic OS Map Features
	Site Boundary

NGR: TM 3670 5630

REPORT NUMBER: 1098

PROJECT:
LIME TREE FARM, BLAXHALL, SUFFOLK

CLIENT:
SUFFOLK ARCHAEOLOGY

DESCRIPTION:
INTERPRETATION PLOT OF MAGNETOMETER ANOMALIES

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SCALE: 1:1250 (0 – 50m)

PLOT:	APPROVED:	VERSION:
A3	DPM	01
DATE:	AUTHOR:	FIGURE:
MAY 2015	TPS	05