RIVERSIDE FARM, CREETING ST MARY, SUFFOLK

DETAILED MAGNETOMETER SURVEY

Report Number: 1096 May 2015

RIVERSIDE FARM, CREETING ST MARY, SUFFOLK

Detailed Magnetometer Survey

Prepared for:
Mr Ron Ames
Riverside Farm
Creeting St Mary
Suffolk
IP6 8LL

By:
Timothy Schofield HND BSc PCIfA

Britannia Archaeology Ltd
115 Osprey Drive
Stowmarket, Suffolk,
IP14 5UX
T: 01449 763034
info@britannia-archaeology.com
www.britannia-archaeology.com
Registered in England and Wales: 7874460

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Site Code	CRM 084	**NGR**	TM 1040 5440
Planning Ref.	Pre-application	**OASIS**	britanni1-208313
Approved By	Martin Brook	**DATE**	May 2015

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CONTENTS

ABSTRACT

On the 17th April 2015, Britannia Archaeology Ltd undertook a detailed magnetometer survey over 0.75 hectares of land on a single field at Riverside Farm, Creeting St Mary, Suffolk. The survey was required ahead of the proposed construction of a single building with an associated access road and pond.

A narrow range of geophysical anomalies were recorded, the most numerous of which were isolated dipolar responses caused by ferrous objects deposited within the topsoil.

Two areas of magnetic disturbance on the southern limit record the close proximity of a brick outbuilding, an extant fire pit and a metal fence boundary.

One very large area of magnetic disturbance was recorded where a large extant depression is located and a pit is drawn on cartographic sources. It was potentially used for the extraction of aggregate and then subsequently backfilled with material of a magnetic nature.

A weak negative linear anomaly running parallel with the northern field boundary has been interpreted as a non-ferrous service pipe.

A cluster of four thermoremnant responses recorded close to the western boundary may be indicative of features that include bonfires, fire pits, hearths, kilns or furnaces.

Seven positive linear anomalies indicative of ditch type features, aligned north-east to south-west or perpendicular, provide evidence for an earlier phase of field boundary sub-division or enclosures of potential agricultural or archaeological origin.

1.0 INTRODUCTION

On Friday 17th April 2015 Britannia Archaeology Ltd (BA) undertook a detailed fluxgate gradiometer survey over *c.*0.75 hectares of land in one field at Riverside Farm, Creeting St Mary, Suffolk (NGR TM 1040 5440), in advance of the proposed construction of a single building with associated access road and pond (Figure 1).

The survey was commissioned by Mr Ron Ames in response to a design brief (Plouviez, J. dated 23rd March 2015) for a geophysical survey. The weather was sunny all day.

2.0 SITE DESCRIPTION

The site is located in one agricultural field to the south of Kettle Lane in Creeting St Mary, Suffolk, at a height of between 15 and 20m aOD. It is bounded to the east by the access trackway of Riverside Farm, to the west and north by hedgerows and to the south by a farm building.

The bedrock geology is described as Newhaven Chalk Formation; sedimentary bedrock formed approximately 71 to 86 million years ago in the Cretaceous Period in warm shallow 'Chalk' shelf seas, with little sediment input from land (BGS, 2015).

Superficial deposits are described as undifferentiated river terrace deposits of sand and gravel formed up to 3 million years ago in the Quaternary Period when the local environment was dominated by rivers, depositing mainly sand and gravel detrital material in channels to form river terrace deposits, with fine silt and clay from overbank floods forming floodplain alluvium, and some bogs depositing peat; also including estuarine and coastal plain deposits mapped as alluvium (BGS, 2015).

2.1 Site Visit 9th April 2015

A site visit was undertaken by the author to assess the suitability of the field for detailed geophysical survey and to undertake a risk assessment. The field was set-aside to pasture and covered in fairly short grass (DP1); overhead electric power cables traversed high over the site and were therefore no cause for concern. An extant depression was clearly visible in the south-western corner (DP2).

DP1

Site Shot, Looking South-East Towards Farm Buildings.

DP2

Site Shot, Looking North-East, Depression Visible in the Mid-Ground.

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). The relevant local planning policy is the *Mid Suffolk Local Plan; (1998)*.

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 Mid Suffolk Local Plan (1998).

The local plan for Mid Suffolk deals with the development on archaeological sites in policy HB14, this states the following:

- Where there is an overriding case for preservation, planning permission for development that would affect an archaeological site or setting will be refused.
- Having taking archaeological advice, the district planning authority may decide that development can take place subject to either satisfactory measures to preserve the archaeological remains in situ or for the site to be excavated and the findings recorded. In appropriate cases the district planning authority will expect a legally binding agreement to be concluded or will impose a planning agreement to be concluded or will impose a planning condition requiring the developer to make appropriate and satisfactory provision for the excavation and recording of the archaeological remains.

In section 2.2.3 of the Local Plan the Heritage and Listed Building objectives are:-

- To maintain or enhance the quality of Mid Suffolk's heritage, particularly through safeguarding its Conservation Areas and Listed Buildings.
- To protect ancient monuments and their settings.
- To give protection to parks and gardens of historic or landscape importance.
- To control change in ways that will protect the character of towns and villages and their settings.
- To give protection to archaeological sites and to ensure they are properly investigated and recorded if such sites are disturbed by development.

4.0 ARCHAEOLOGICAL BACKGROUND

The proposed development site is located on the north side of the Gipping Valley, just to the west of a small tributary where later prehistoric, Roman and early Anglo-Saxon activity is common. The site of a Roman villa-type building (wall footing, coarse tesserae, painted plaster) identified in drainage works in c.1957 (HER ref CRM 003) is recorded in the Historic Environment Record, just to the east of the proposed development. There is therefore high potential for early archaeological remains to be defined within the application site, which has not been the subject of any previous systematic investigation. A Roman building in this location might be unusually well preserved, and a strong candidate for minimal disturbance. However examination of the development site and of early maps (1904 OS) shows that there is a probable extraction pit in the south-east corner of the proposed development which could be an appropriate location for the proposed pond (Brief, Section 2.1).

5.0 PROJECT AIMS

A non-intrusive geophysical survey is required of the development; this is likely to lead to a programme of trial trenching to enable the archaeological resource, both in quality and extent, to be accurately quantified. However, any decision about the need for, and extent of trial trenching, will be taken following the geophysical survey (Brief Section 3.1).

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 low causing no difficulty in locating a suitable zero station.

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 periods of sunshine 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 was 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 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: +5/-5nT;
Display Clipping: +/- 3 standard deviations.

Processed Data:
De-stripe: Median Sensors: All;
Data Clipping: +3/-3nT;
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) and cartographic sources. 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, their co-ordinates will allow the survey grid and anomalies to be accurately targeted.

7.0 RESULTS & DISCUSSION

This survey was successful in recording a narrow range of geophysical anomalies, the most numerous of which were isolated dipolar 'iron spike' anomalies (yellow dots) recorded throughout the dataset. These readings are usually caused by ferrous objects deposited within the topsoil, some of which may have an archaeological derivation.

Two areas of magnetic disturbance (yellow hatching) were present on the southern limit; these readings have been caused by an extant fire pit, the close proximity of a brick outbuilding and the metal fence boundary.

One very large area of magnetic disturbance (blue hatching) was recorded in the south-eastern corner of the field, where an extant topographic depression is present. A pit type feature is recorded here on the 1904 and 1970-71 Ordnance Survey (OS) Maps (green line), potentially used to extract aggregate. The high dipolar readings recorded by the magnetometer reveal that it had been subsequently backfilled with material of a magnetic nature.

A weak negative linear anomaly (cyan hatching) running parallel with the northern field boundary (north-west to south-east) has been interpreted as a non-ferrous service pipe. It is possible that the entire length of this anomaly was not recorded by the magnetometer and its course may run beyond the survey area.

A cluster of four thermoremnant responses (magenta hatching) were recorded close to the western boundary. These readings are usually caused by the firing of iron particles present in the soil matrix of a fired pit or bonfire, or potentially within the walls of a hearth, kiln or furnace. Three of these responses are recorded within the footprint of a former structure recorded on the 1904 and 1905 OS but no longer depicted on the 1926 OS Map (Ordnance Survey 1904, 1905 and 1926). The structure itself was not recorded by the fluxgate gradiometer and therefore may have been constructed out of non-ferrous materials, for example wood. It is unclear whether the thermoremnant responses are related to this former structure, or through earlier or later non-related firing events.

Seven positive linear anomalies (red hatching) indicative of ditch type features were recorded within the dataset, all are on a *c*.north-east to south-west or perpendicular alignment, which is only slightly different to those existing today. None of these potential boundaries are recorded on the cartographic sources, which suggest that they form an earlier phase of field boundary sub-division or enclosures of potential agricultural or archaeological origin.

8.0 CONCLUSION

This detailed fluxgate gradiometer survey was successful in recording a fairly narrow range of geophysical anomalies. No anomalies indicative of a Roman villa were recorded; however the positive linear anomalies and thermoremnant responses are most likely to be of an archaeological origin.

It would be prudent to ground-truth the full range of anomaly types recorded during this magnetometer survey to assess the interpretations given within this report, with the main focus of further targeted intervention concentrated on those anomalies assigned a potential archaeological derivation.

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 Mr Ron Ames for commissioning the project and Jude Plouviez of Suffolk County Council Archaeological Service/Conservation Team for her help and advice throughout the project.

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APPENDIX 1 METADATA SHEETS

Raw Data

Filename	Creeting 1R.xcp
Description	
Instrument Type	Grad 601-2 (Gradiometer)
Units	nT
Surveyed by	TPS/AGL on 4/17/2015
Assembled by	TPS on 4/17/2015
Direction of 1st Traverse	45 deg
Collection Method	ZigZag
Sensors	2 @ 1.00 m spacing.
Dummy Value	32702.00
Dimensions	
Composite Size (readings)	400 x 100
Survey Size (meters)	100.00m x 100.00 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	2.85
Mean	1.05
Median	1.34
Composite Area	1.00 ha
Surveyed Area	0.51 ha
Program	
Name	ArcheoSurveyor
Version	2.5.16.0

Processed Data

Filename	Creeting 1P.xcp
Description	
Instrument Type	Grad 601-2 (Gradiometer)
Units	nT
Surveyed by	TPS/AGL on 4/17/2015
Assembled by	TPS on 4/17/2015
Direction of 1st Traverse	45 deg
Collection Method	ZigZag
Sensors	2 @ 1.00 m spacing.
Dummy Value	32702.00
Dimensions	
Composite Size (readings)	400 x 100
Survey Size (meters)	100.00m x 100.00 m
Grid Size	20.00 m x 20.00 m
X Interval	0.25 m
Y Interval	1.00 m
Stats	
Max	3.00
Min	-3.00
Std Dev	1.84
Mean	-0.02
Median	-0.03
Composite Area	1.00 ha
Surveyed Area	0.51 ha
Program	
Name	ArcheoSurveyor
Version	2.5.16.0

Source Grids: 18	
1	Col:0 Row:0 grids\01.xgd
2	Col:0 Row:1 grids\02.xgd
3	Col:0 Row:2 grids\03.xgd
4	Col:0 Row:3 grids\04.xgd
5	Col:0 Row:4 grids\05.xgd
6	Col:1 Row:0 grids\06.xgd
7	Col:1 Row:1 grids\07.xgd
8	Col:1 Row:2 grids\08.xgd
9	Col:1 Row:3 grids\09.xgd
10	Col:1 Row:4 grids\10.xgd
11	Col:2 Row:0 grids\11.xgd
12	Col:2 Row:1 grids\12.xgd
13	Col:2 Row:2 grids\13.xgd
14	Col:2 Row:3 grids\14.xgd
15	Col:2 Row:4 grids\15.xgd
16	Col:3 Row:2 grids\16.xgd
17	Col:3 Row:3 grids\17.xgd
18	Col:3 Row:4 grids\18.xgd

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 are 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

RIVERSIDE FARM, CREETING ST MARY, SUFFOLK

WRITTEN SCHEME OF INVESTIGATION
DETAILED MAGNETOMETER SURVEY

Project Number: 1102 9th April 2015

RIVERSIDE FARM, CREETING ST MARY, SUFFOLK

Written Scheme of Investigation
Detailed Magnetometer Survey

Prepared for:
Mr Ron Ames
Riverside Farm
Creeting St Mary
Suffolk
IP6 8LL

By:
Timothy Schofield HND BSc PCIfA

Britannia Archaeology Ltd
115 Osprey Drive
Stowmarket, Suffolk,
IP14 5UX
T: 01449 763034
info@britannia-archaeology.com
www.britannia-archaeology.com
Registered in England and Wales: 7874460

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Site Code	tbc	**NGR**	TM 1040 5440
Planning Ref.	Pre-application	**OASIS**	britanni1-208313
Approved By	Martin Brook	**DATE**	April 2015

 Project Number: 1102

Riverside Farm, Creeting St Mary, Suffolk
Detailed Magnetometer Survey
Written Scheme of Investigation

CONTENTS

1.0 INTRODUCTION

This Written Scheme of Investigation (WSI) has been prepared by Britannia Archaeology Ltd (BA) on behalf of Mr Ron Ames in response to a brief (Plouviez, J. dated 23rd March 2015) for a geophysical survey over the footprint of a proposed pond and building with associated access (0.75ha) on land at Riverside Farm, Creeting St Mary, Suffolk (NGR TM 1040 5440).

2.0 SITE DESCRIPTION

The site is located in one agricultural field to the south of Kettle Lane in Creeting St Mary, Suffolk, at a height of between 15 and 20m aOD. It is bounded to the east by the access trackway of Riverside Farm, to the west and north by hedgerows and to the south by a farm building.

The bedrock geology is described as Newhaven Chalk Formation a sedimentary bedrock formed approximately 71 to 86 million years ago in the Cretaceous Period in warm shallow 'Chalk' shelf seas, with little sediment input from land (BGS, 2015).

Superficial deposits are described as undifferentiated river terrace deposits of sand and gravel formed up to 3 million years ago in the Quaternary Period when the local environment was dominated by rivers, depositing mainly sand and gravel detrital material in channels to form river terrace deposits, with fine silt and clay from overbank floods forming floodplain alluvium, and some bogs depositing peat; also including estuarine and coastal plain deposits mapped as alluvium (BGS, 2015).

2.1 Site Visit 9th April 2015

A site visit was undertaken by the author to assess the suitability of the field for detailed geophysical survey and to undertake a risk assessment. The field was set-aside to pasture and covered in fairly short grass (DP1), overhead electric power cables traverse high over the site and therefore should not cause any danger to surveyors working beneath. An extant depression can be clearly seen in the south-western corner (DP2).

DP1

Site Shot, Looking South-East Towards Farm Buildings.

DP2

Site Shot, Looking North-East, Depression Visible in the Mid-Ground.

3.0 PLANNING POLICIES

The archaeological investigation is to be 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 *Mid Suffolk Local Plan; (1998)*.

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;
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The local plan for Mid Suffolk deals with the development on archaeological sites in policy HB14, this states the following:

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- Having taking archaeological advice, the district planning authority may decide that development can take place subject to either satisfactory measures to preserve the archaeological remains in situ or for the site to be excavated and the findings recorded. In appropriate cases the district planning authority will expect a legally binding agreement to be concluded or will impose a planning agreement to be concluded or will impose a planning condition requiring the developer to make appropriate and satisfactory provision for the excavation and recording of the archaeological remains.

In section 2.2.3 of the Local Plan the Heritage and Listed Building objectives are:-

- To maintain or enhance the quality of Mid Suffolk's heritage, particularly through safeguarding its Conservation Areas and Listed Buildings.
- To protect ancient monuments and their settings.
- To give protection to parks and gardens of historic or landscape importance.

Riverside Farm, Creeting St Mary, Suffolk
Detailed Magnetometer Survey
Written Scheme of Investigation

- To control change in ways that will protect the character of towns and villages and their settings.
- To give protection to archaeological sites and to ensure they are properly investigated and recorded if such sites are disturbed by development.

4.0 ARCHAEOLOGICAL BACKGROUND

The proposed development site is located on the north side of the Gipping Valley, just to the west of a small tributary where later prehistoric, Roman and early Anglo-Saxon activity is very common. The site of a Roman villa-type building (wall footing, coarse tesserae, painted plaster) identified in drainage works in c.1957 (HER ref CRM 003) is recorded in the Historic Environment Record just to the east of the proposed development. As a result, there is high potential for encountering early occupation deposits at this location.

There is potential for archaeological remains to be defined within the application site, which has not been the subject of any previous systematic investigation. A Roman building in this location might be unusually well preserved, and a strong candidate for minimal disturbance. However examination of the development site and of early maps (1904 OS) shows that there is a probable extraction pit in the south-east corner of the proposed development which could be an appropriate location for the proposed pond (Brief, Section 2.1).

5.0 PROJECT AIMS

A non-intrusive geophysical survey is required of the development; this is likely to lead to a programme of trial trenching to enable the archaeological resource, both in quality and extent, to be accurately quantified. However, any decision about the need for, and extent of, trial trenching will be taken following the geophysical survey (Brief Section 3.1).

6.0 METHODOLOGY

6.1 Fieldwork

A detailed fluxgate gradiometer survey is required over *c.*0.75 Hectares, scheduled to be undertaken in April 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.

Riverside Farm, Creeting St Mary, Suffolk
Detailed Magnetometer Survey
Written Scheme of Investigation

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.

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

Riverside Farm, Creeting St Mary, Suffolk
Detailed Magnetometer Survey
Written Scheme of Investigation

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.
- *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 in due course (including a vector plan and AutoCAD .dxf file) and the National Monuments Record (NMR). 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

working methods and provision has been made to allow access to undertake the survey as required.

Riverside Farm, Creeting St Mary, Suffolk
Detailed Magnetometer Survey
Written Scheme of Investigation

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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.

Riverside Farm, Creeting St Mary, Suffolk
Detailed Magnetometer Survey
Written Scheme of Investigation

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 supervision of archaeological work as required in the brief. All have a wide range of experience on a variety of site types.

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) PIfA

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 PIfA

Qualifications: University of Bournemouth, BSc Archaeological Studies (1999-2000)

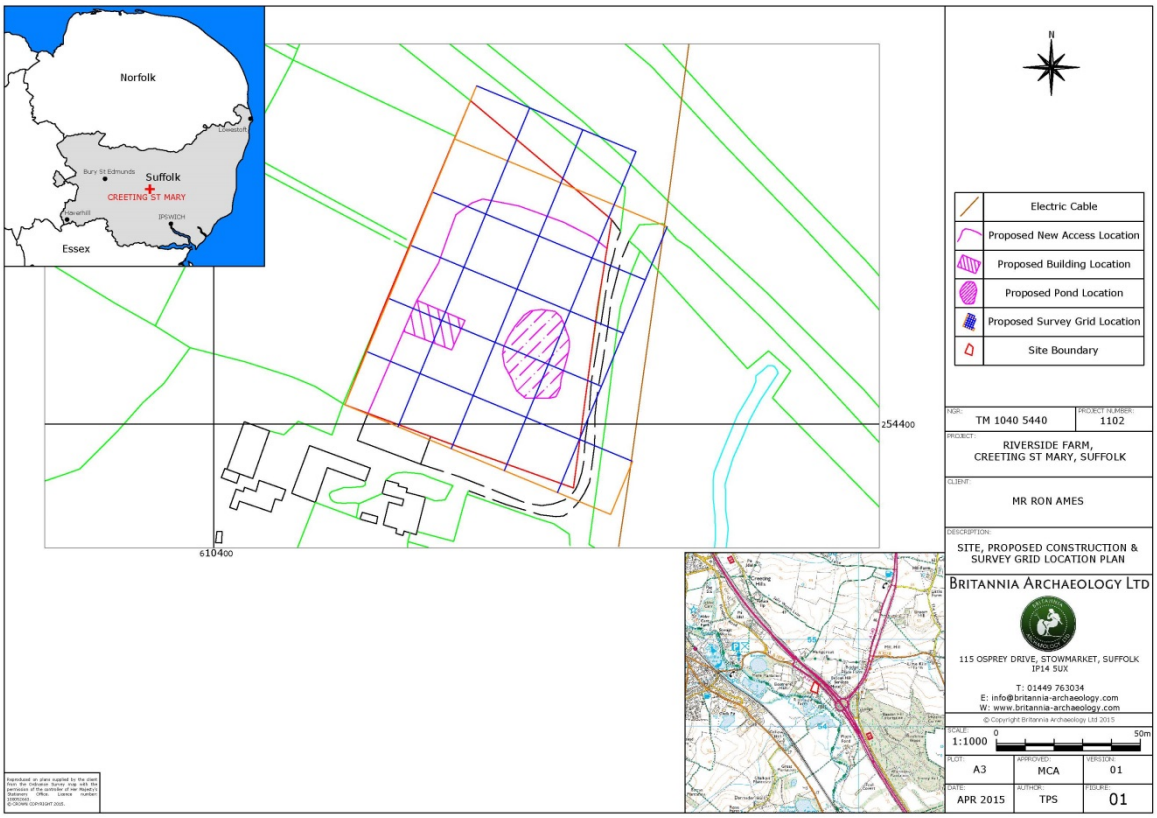
Yeovil College, HND Practical Archaeology, (1997-1999)

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) AIfA**

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: britanni1-208313

Project details

Project name	Riverside Farm, Creeting St Mary, Suffolk; Detailed Magnetometer Survey
Short description of the project	On the 17th April 2015, Britannia Archaeology Ltd undertook a detailed magnetometer survey over 0.75 hectares of land on a single field at Riverside Farm, Creeting St Mary, Suffolk. The survey was required ahead of the proposed construction of a single building with an associated access road and pond. A narrow range of geophysical anomalies were recorded, the most numerous of which were isolated dipolar responses caused by ferrous objects deposited within the topsoil. Two areas of magnetic disturbance on the southern limit record the close proximity of a brick outbuilding, an extant fire pit and a metal fence boundary. One very large area of magnetic disturbance was recorded where a large extant depression is located and a pit is drawn on cartographic sources. It was potentially used for the extraction of aggregate and then subsequently backfilled with material of a magnetic nature. A weak negative linear anomaly running parallel with the northern field boundary has been interpreted as a non-ferrous service pipe. A cluster of four thermoremnant responses recorded close to the western boundary may be indicative of features that include bonfires, fire pits, hearths, kilns or furnaces. Seven positive linear anomalies indicative of ditch type features, aligned north-east to south-west or perpendicular, provide evidence for an earlier phase of field boundary sub-division or enclosures of potential agricultural or archaeological origin.
Project dates	Start: 17-05-2015 End: 17-05-2015
Previous/future work	Yes / Not known
Any associated project reference codes	P1102 - Contracting Unit No.
Any associated project reference codes	CRM 084 - Sitecode
Any associated project reference codes	R1096 - Contracting Unit No.
Type of project	Field evaluation
Site status	None
Current Land use	Grassland Heathland 3 - Disturbed
Monument type	NONE None
Significant Finds	NONE None
Methods &	"Geophysical Survey"

techniques	
Development type	Small-scale (e.g. single house, etc.)
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Between deposition of an application and determination
Solid geology (other)	Newhaven Chalk Formation
Drift geology	RIVER TERRACE DEPOSITS
Techniques	Magnetometry

Project location

Country	England
Site location	SUFFOLK MID SUFFOLK CREETING ST MARY Riverside Farm, Creeting St Mary, Suffolk
Study area	0.75 Hectares
Site coordinates	TM 1040 5440 52.1472246449 1.07556398714 52 08 50 N 001 04 32 E Point
Height OD / Depth	Min: 15.00m Max: 20.00m

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

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	"Report","Survey ","Unpublished Text"

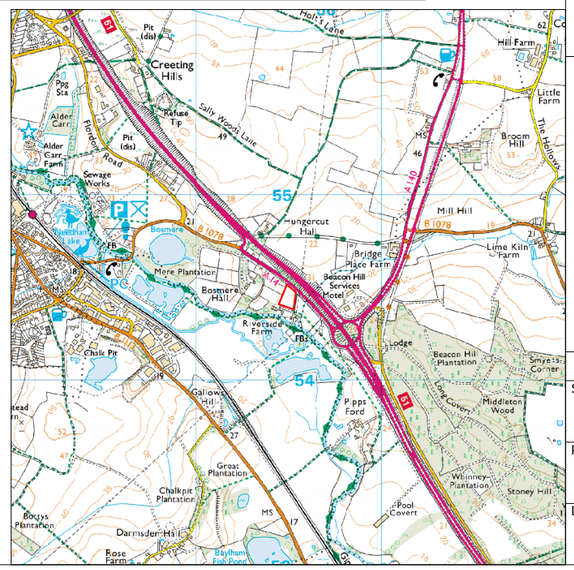
Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	Riverside Farm, Creeting St Mary, Suffolk; Detailed Magnetometer Survey
Author(s)/Editor(s)	Schofield, T. P.
Other bibliographic details	R1096
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	4 June 2015

N

STATION	EASTING	NORTHING
01	610490.374	254501.962
02	610452.216	254409.529
03	610507.674	254386.633

	Electric Cable
	Proposed New Access Location
	Proposed Building Location
	Proposed Pond Location
	Survey Grid Location
	Site Boundary



NGR: TM 1040 5440

REPORT NUMBER: 1096

PROJECT:
RIVERSIDE FARM,
CREETING ST MARY, SUFFOLK

CLIENT:
MR RON AMES

DESCRIPTION:
SITE, SURVEY GRID &
GEOREFERENCING INFORMATION PLAN

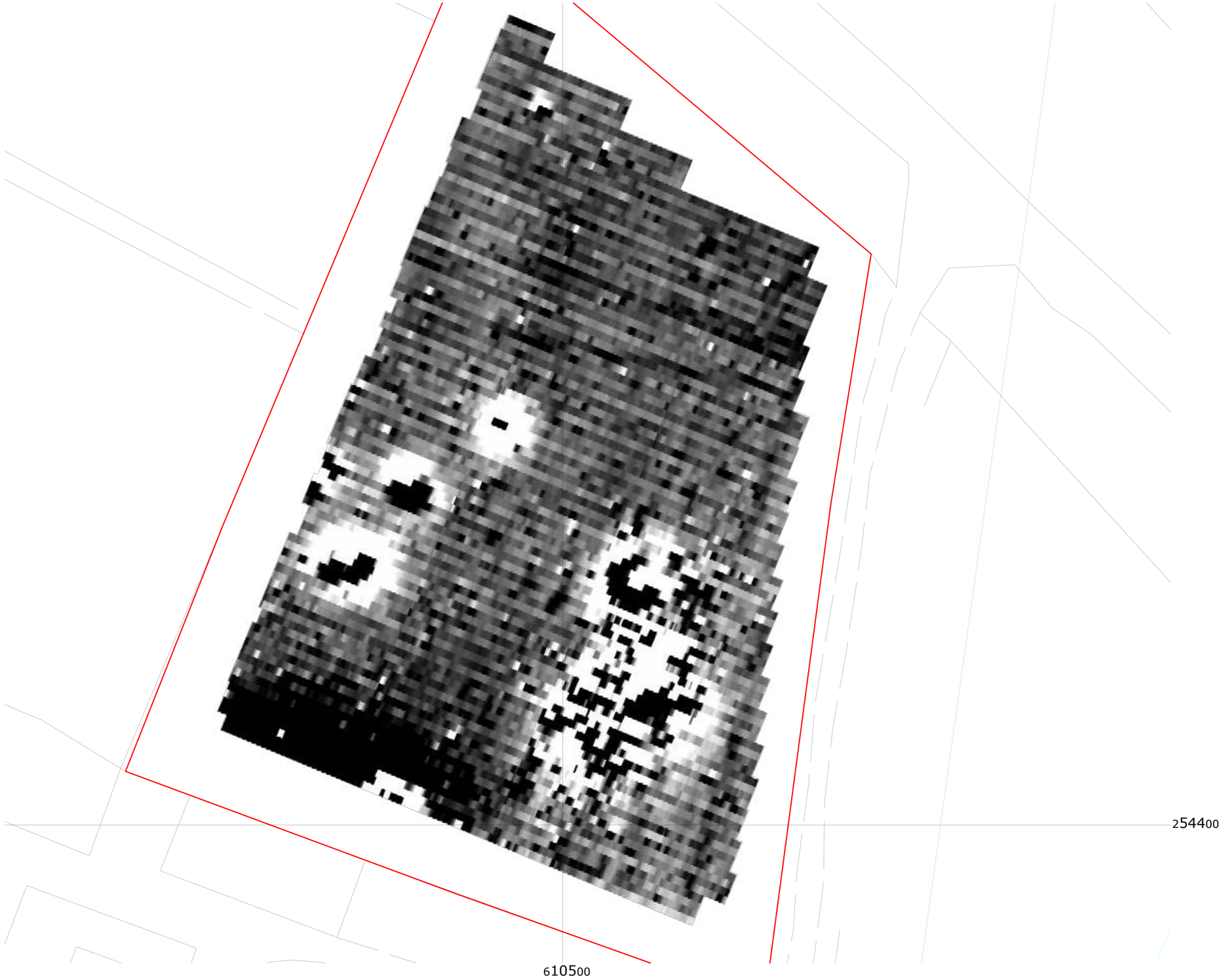
BRITANNIA ARCHAEOLOGY LTD

115 OSPREY DRIVE, STOWMARKET, SUFFOLK
IP14 5UX

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

SCALE: 1:1000 (0 – 50m)

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



Site Boundary

NGR: TM 1040 5040

REPORT NUMBER: 1096

PROJECT:
RIVERSIDE FARM,
CREETING ST MARY, SUFFOLK

CLIENT:
MR RON AMES

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: 1:500 — 0 — 25m

PLOT: A3

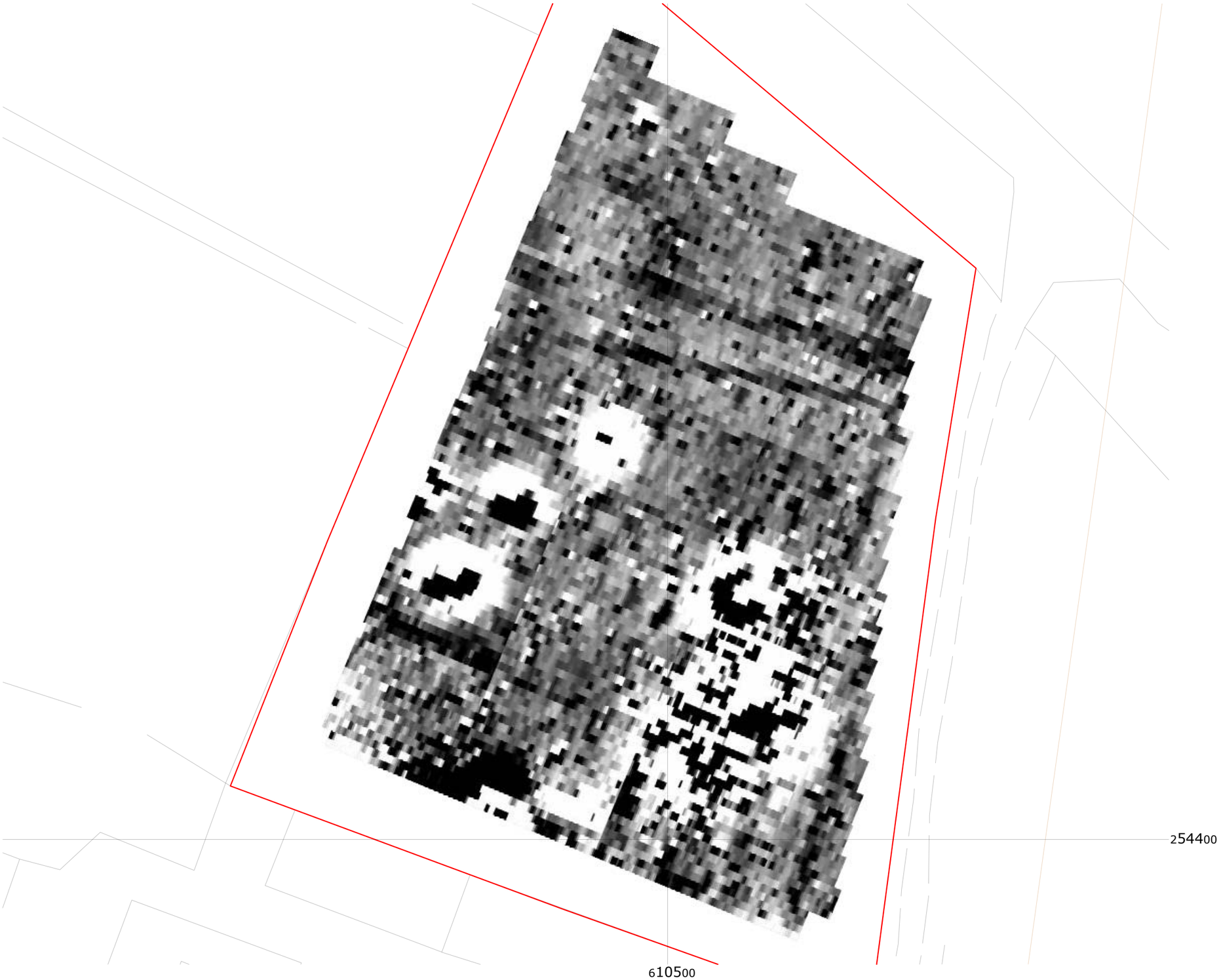
APPROVED: MCA

VERSION: 01

DATE: MAY 2015

AUTHOR: TPS

FIGURE: 02



Site Boundary

NGR: TM 1040 5040

REPORT NUMBER: 1096

PROJECT:
RIVERSIDE FARM,
CREETING ST MARY, SUFFOLK

CLIENT:
MR RON AMES

DESCRIPTION:
PROCESSED MAGNETOMETER
GREYSCALE PLOT

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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: 1:500 (0 – 25m)

PLOT: A3

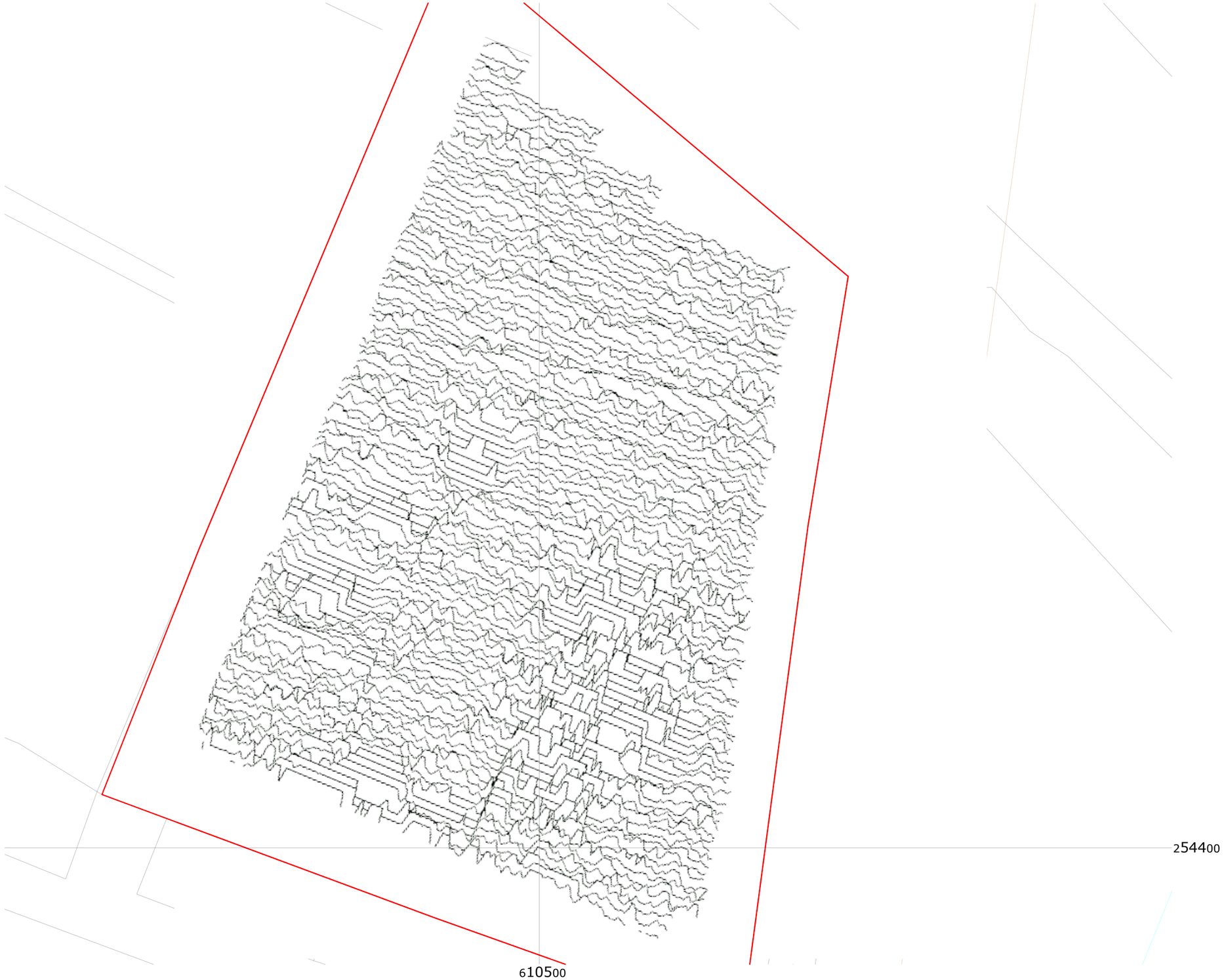
APPROVED: MCA

VERSION: 01

DATE: MAY 2015

AUTHOR: TPS

FIGURE: 03



19nT/cm	Scale Interval
	Site Boundary

NGR: TL 6960 7720

REPORT NUMBER: 1096

PROJECT:
RIVERSIDE FARM,
CREETING ST MARY, SUFFOLK

CLIENT:
SUFFOLK ARCHAEOLOGY

DESCRIPTION:
PROCESSED MAGNETOMETER
XY TRACE PLOT

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115 OSPREY DRIVE, STOWMARKET, SUFFOLK
IP14 5UX

T: 01449 763034
E: info@britannia-archaeology.com
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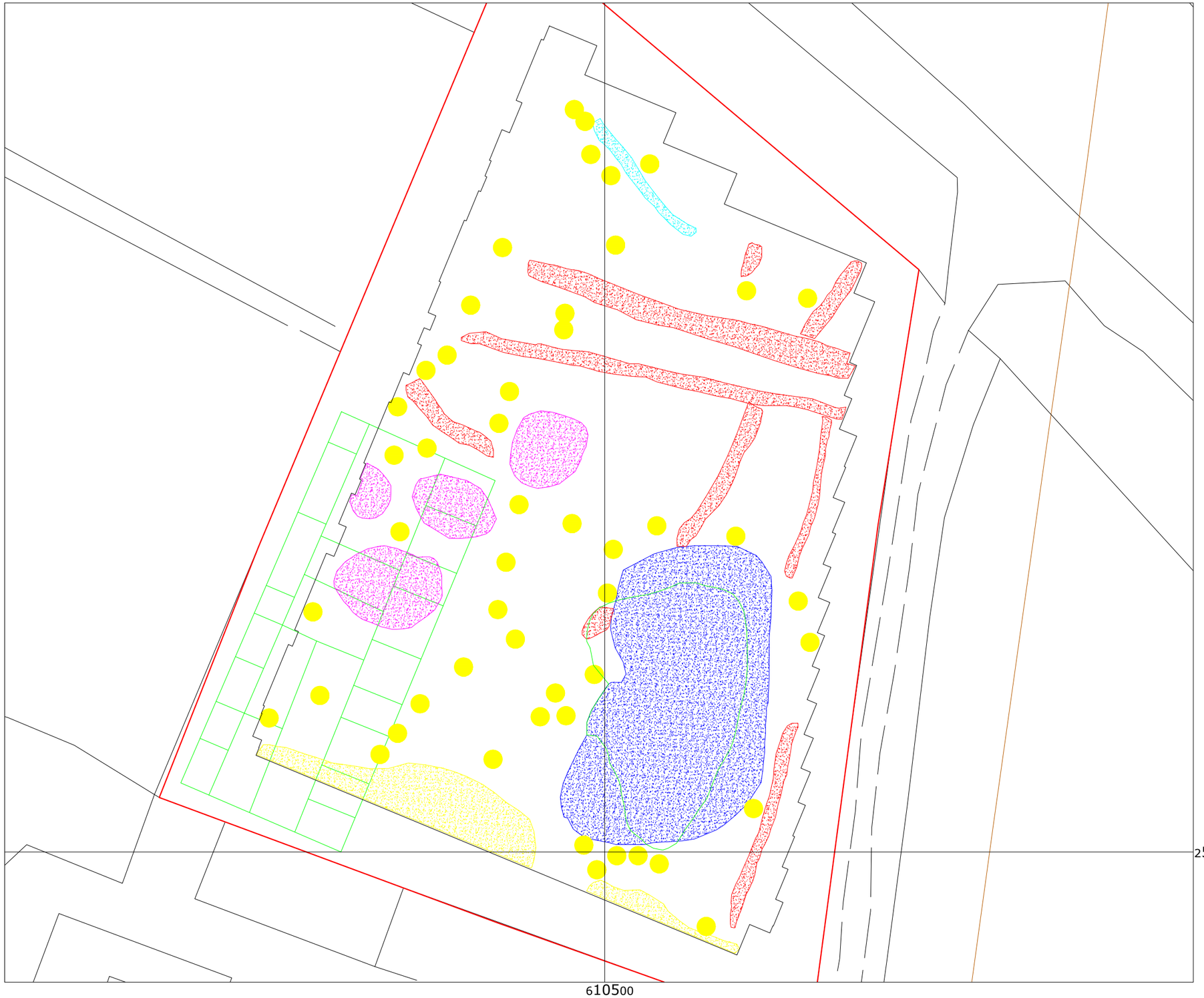
SCALE: 1:500 — 0 — 25m

PLOT:	APPROVED:	VERSION:
A3	MCA	01

DATE:	AUTHOR:	FIGURE:
MAY 2015	TPS	04



	Positive Linear Anomaly, Archaeology?
	Thermoremnant Response, Areas Of Burning, Industry?
	Negative Linear Anomaly, Service Trench Run
	Magnetic Disturbance, Associated With Extant Hollow
	Area of Magnetic Disturbance, Modern
	Isolated Dipolar Responses

	1904 OS Map Features
	Site Boundary

NGR: TM 1040 5040

REPORT NUMBER: 1096

PROJECT:
RIVERSIDE FARM,
CREETING ST MARY, SUFFOLK

CLIENT:
MR RON AMES

DESCRIPTION:
INTERPRETATION PLOT OF MAGNETOMETER ANOMALIES

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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: 1:500 (0 – 25m)

PLOT:	APPROVED:	VERSION:
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DATE: MAY 2015	AUTHOR: TPS	FIGURE: 05