LAND AT BAY FARM, RED LODGE, SUFFOLK

DETAILED MAGNETOMETER SURVEY

Report Number: 1008

23rd November 2012

LAND AT BAY FARM, RED LODGE, SUFFOLK

Detailed Magnetometer Survey

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Site Code	BTM 055	**NGR**	NGR TL 704 716
Planning Ref.	TBA	**OASIS**	britanni1-138078
Approved By	Matthew Adams	**DATE**	23rd November 2012

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The results and interpretation of the report cannot be considered an absolute representation of the archaeological or any other remains. In the case of geophysical surveys the data collected, and subsequent interpretation is a representation of anomalies recorded by the survey instrument. Britannia Archaeology Ltd will not be held liable for any errors of fact supplied by a third party, or guarantee the proper maintenance of the survey stations.

CONTENTS

ABSTRACT

Detailed fluxgate gradiometer survey on agricultural land at Bay Farm, Red Lodge, Suffolk, was successful in recording two discrete positive anomalies of possible archaeological origin and a series of broad positive linear anomalies indicative of a redundant agricultural strip field regime. Two weak negative and three weak positive linear trends delineate where modern farm machinery has tracked along the boundary, and the location of a former field subdivision. One broad weak positive linear trend may define the location of the easement associated with the construction of the A11. The position of three agricultural irrigation service pipe runs were also recorded. Areas of magnetic disturbance were present near to the boundaries and isolated dipolar (iron-spike) responses were also abundant throughout the dataset.

1.0 INTRODUCTION

Britannia Archaeology Ltd (BA) undertook 17 hectares of detailed fluxgate gradiometer survey on agricultural land at Bay Farm, Red Lodge, Suffolk (NGR TL 704 716) in advance of the construction of a solar farm, from the 7th to the 16th of November 2012. The survey was undertaken on behalf of Jane Hunting of Richard Pike Associates in response to a brief (dated 5th July 2012) prepared by Rachael Monk of Suffolk County Council Archaeology Service/Conservation Team (SCCAS/CT). The weather was a mixture of sunshine and overcast conditions.

2.0 SITE DESCRIPTION

The site is located in an area dominated by agriculture, bounded by a farm track to the north, the A11 to the south and east and by a hedgerow to the west. The area totals 17 hectares on land currently used for agriculture, the site slopes fdown from east to west 25 to 15m AOD.

The bedrock comprises Zig Zag Chalk Formation, a sedimentary bedrock formed approximately 94 to 99 million years ago in the Cretaceous Period when the local environment was dominated by warm chalk seas (BGS, 2012).

Superficial deposits are described as River Terrace sands and gravels formed up to 2 million years ago in the Quaternary Period in an environment previously dominated by rivers (BGS, 2012).

2.1 Site Visit 01/11/2012

A site visit was undertaken on the 1st November to assess the ground conditions and to undertake a risk assessment. The conditions were found to be suitable for survey with only overhead power cables documented as a potential hazard.

DP1 Site Shot, Looking East

3.0 PLANNING POLICIES

The archaeological investigation was undertaken 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 policies also include the Forest Heath Local Plan, (Policy 8.20, 1995).

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 Forest Heath Local Plan, (Policy 8.20, 1995)

Forest Heath's local plan development plan was adopted in 1995 and has undergone some revision since. A Core Strategy was released in 2010 and an updated assessment of their Heritage Policy is pending. The Council's position on heritage assets is summarised as follows:

- The District Council will seek provision to be made for the evaluation of archaeological sites of unknown importance and areas of high potential prior to the determination of development proposals. Where nationally or locally important sites, whether scheduled or not, and their settings, are effected by proposed development, there will be a presumption in favour of their preservation. On sites where there is no overriding case for preservation, development will not normally be permitted unless agreement has been reached to provide either for their preservation or for their recording and, where desirable, their excavation prior to development.

4.0 ARCHAEOLOGICAL BACKGROUND

Detailed magnetometer survey was undertaken over 17 hectares of agricultural land located in an area of archaeological importance in the County Historic Environment Record. A group of Bronze Age round barrows (HER numbers BTM004, BTM 012, BTM 013, BTM 028, WGN 003 one of which is a Scheduled Ancient Monument SF 31091) are present close to the site. Several medieval rabbit warrens are also sited nearby. There is therefore a high potential for archaeological assets to be disturbed by the proposed development.

5.0 PROJECT AIMS

A systematic geophysical survey is required to enable the archaeological resource, both in quality and extent, to be accurately quantified.

6.0 METHODOLOGY

6.1 Instrument Type Justification

Britannia Archaeology Ltd employed a Bartington Dual Grad 601-2 fluxgate gradiometer to undertake the survey, because of its high sensitivity and rapid ground coverage. The soils and underlying geology had a relatively very low magnetic background strength, allowing some very weak linear anomalies to be prospected. There was adequate contrast between the anomalies and the low magnetic susceptibility of the natural drift geology comprising River Terrace sands and gravels.

6.2 Instrument Calibration

The Magnetometer was left on for a minimum of 20 minutes in the morning for the sensors to settle before the start of the first grid. The instrument was zeroed after every

three grids to minimise the effect of sensor drift. A set-up station with low magnetic susceptibility was fairly easy to locate, this same station was used exclusively throughout the survey to align the sensors providing a common zero point. Sensor drift was more prevalent during the sunny weather in the first week and conversely the overcast conditions of the second week allowed the sensors to remain stable.

6.3 Sampling Interval and Grid Size

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

6.4 Survey Grid Location

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

6.5 Data Capture

Instrument readings were recorded on an internal data logger that was downloaded to a laptop both at midday and at the end of each day. The grid order was recorded on a BA pro-forma to aid in the creation of the composites. Data were filed in job specific folders and broken up into individual day composite datasets. These data composites were checked for quality on site by BA, allowing grids to be re-surveyed if necessary. The data were backed up onto an external storage device in the office and finally a remote server at the end of the day. A five metre exclusion zone was left between the boundaries and the survey area to reduce the amount of disturbance caused by the boundary. Topographic details such as telegraph poles were recorded accurately by the DGPS (see Figure 5).

6.6 Data Presentation and Processing

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

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

An interpretation plan characterising the anomalies recorded can be found at Figure 5. They draw together the evidence collated from both greyscale and XY trace plots

(Figures 3 & 4). All figures were tied into the National Grid and printed to an appropriate scale.

6.7 Software

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

6.8 Grid Restoration

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

7.0 PRESENTATION OF RESULTS

The data reveals two discrete positive anomalies, thirty-three broad positive linear anomalies, two weak negative linear and three weak positive linear trends, one broad weak positive linear trend, three positive linear anomalies, areas of magnetic disturbance and a plethora of isolated dipolar 'iron-spike' responses (Figures 3, 4 & 5).

Two positive discrete anomalies of possible archaeological origin are present that are commonly indicative of rubbish pits. Although equally, they may demarcate patches of superficial geology that have a higher magnetic susceptibility.

Perhaps the most notable anomalies recorded within the dataset are the broad positive linear trends that are present in the north-eastern corner of the field and run east to west and north-east to south-west. These trends are likely to be the result of ridge and furrow ploughing in former strip fields, they appear to have been fairly heavily modern-plough truncated. They are also located within a smaller field and are on a different alignment to the current situation, suggesting that the previous configuration has been remodelled. This area was extensively wooded with a man-made plantation until relatively recently which may also account for these linear anomalies (Upton, H., pers. comm.)

Two weak negative linear anomalies running along the southern boundary south-west to north-east are of modern agricultural origin and show the location of farm vehicle movement.

Three weak positive linear trends are also present, the two in the eastern corner are also indicative of modern farm vehicle movement. The third linear trend that is located in the western corner running south-west to north-east may have been a former field boundary.

One broad weak positive linear anomaly running 60m north and parallel to the A11 (orientated south-west to north-east) may define the location of the easement associated with the construction of the A11.

Three positive linear anomalies are present within the dataset that delineate underground irrigation pipes associated with the modern farm.

There are three areas of magnetic disturbance which perhaps unsurprisingly are present on the field boundaries, no magnetic remains were witnessed on the surface and so they are therefore likely to represent buried ferrous or magnetic material.

There are many isolated dipolar 'iron-spike' anomalies present throughout the dataset, caused by fragments of ferrous material that were probably introduced into the plough-soil during episodes of manuring and general agricultural activity.

Sugar beet crop rows running the length of the field and aligned north-west to south-east, can also be clearly identified on the greyscale and XY trace plots (Figures 4 and 5).

8.0 DISCUSSION & CONCLUSION

A relatively very low background magnetic susceptibility level of the superficial geology allowed the Bartington DualGrad 601-2 fluxgate gradiometer to perform well over the superficial geology. Data were tightly clipped to one standard deviation allowing relatively weak responses to be prospected. The height of the sensors had to be raised a little from the optimum level to ensure that they cleared the tops of the sugar beet crop rows. Therefore it is possible that some deeper anomalies have not been prospected.

The positive discrete anomalies and the broad linear agricultural ridge and furrow anomalies are both worthy of further archaeological investigation to ascertain whether they are indeed of archaeological and/or agricultural origin. It may also be prudent to target and clarify the nature of the weak positive linear trend in the south-western corner. Areas of low magnetic susceptibility could also be targeted to determine whether the gradiometer had been unsuccessful in detecting surviving archaeological features.

9.0 ACKNOWLEDGEMENTS

Britannia Archaeology Ltd would like to thank Jane Hunting of Richard Pike Associates for commissioning the project and for her help and support throughout and Hugo Upton for funding the project.

We are also grateful for the advice of Rachael Monk of SCCAS/CT.

10.0 PROJECT ARCHIVE & DEPOSITION

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

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English Heritage PastScape www.pastscape.org.uk

Heritage Gateway www.heritagegateway.org.uk

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

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

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

APPENDIX 1 – TECHNICAL DETAILS

Magnetometer Survey

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

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

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

Fluxgate Gradiometers

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

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

APPENDIX 2 – OASIS SHEET

OASIS ID: britanni1-138078

Project details

Project name	Land at Bay Farm, Red Lodge, Suffolk
Short description of the project	Detailed fluxgate gradiometer survey on agricultural land at Bay Farm, Red Lodge, Suffolk, was successful in recording two discrete positive anomalies of possible archaeological origin and a series of broad positive linear anomalies indicative of a redundant agricultural strip field regime. Two weak negative and three weak positive linear trends delineate where modern farm machinery has tracked along the boundary, and the location of a former field subdivision. One broad weak positive linear trend may define the location of the easement associated with the construction of the A11. The position of three agricultural irrigation service pipe runs were also recorded. Areas of magnetic disturbance were present near to the boundaries and isolated dipolar (iron-spike) responses were also abundant throughout the dataset.
Project dates	**Start:** 07-11-2012 **End:** 16-11-2012
Previous/future work	No / Yes
Any associated project reference codes	P1010 - Contracting Unit No.
Type of project	Field evaluation
Site status	Area of Archaeological Importance (AAI)
Current Land use	Cultivated Land 3 - Operations to a depth more than 0.25m
Monument type	NONE None
Significant Finds	NONE None
Methods & techniques	"Geophysical Survey"
Development type	Solar Farm
Prompt	Direction from Local Planning Authority – PPS
Position in the planning process	Pre-application
Solid geology	CHALK (INCLUDING RED CHALK)
Drift geology	GLACIAL SAND AND GRAVEL
Techniques	Magnetometry

Project location

Country	England
Site location	SUFFOLK FOREST HEATH BARTON MILLS Bay Farm, Red Lodge

Postcode	IP28 6BS
Study area	17.00 Hectares
Site coordinates	TL 704 716 52 0 52 18 56 N 000 30 00 E Point
Height OD / Depth	**Min**: 15.00m **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	Matthew Adams
Type of sponsor/funding body	Landowner
Name of sponsor/funding body	Mr Hugo Upton

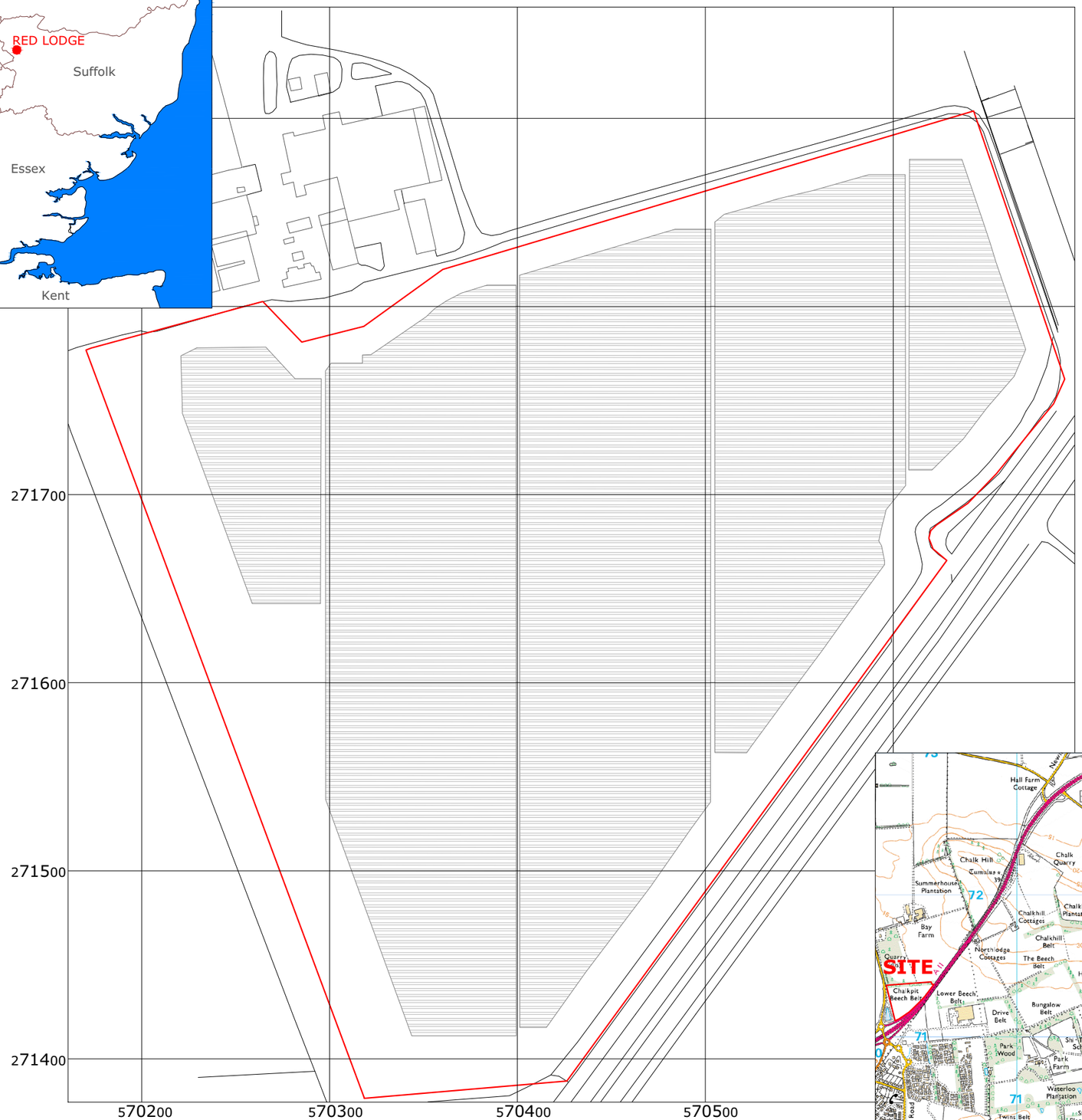
Project archives

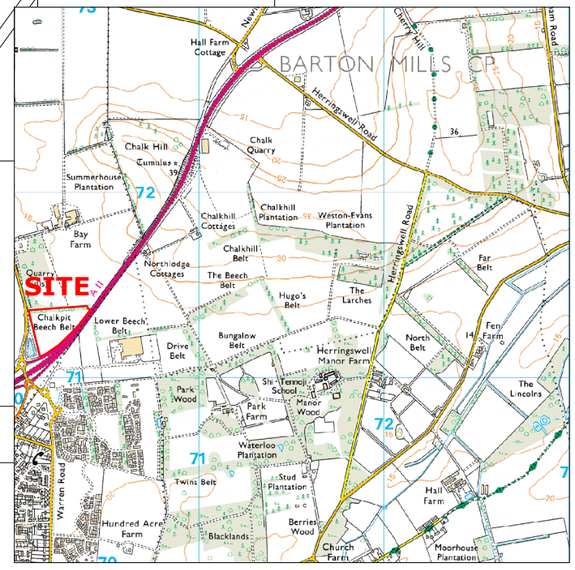
Physical Archive Exists?	No
Digital Archive recipient	Suffolk HER
Digital Contents	"Survey"
Digital Media available	"Database", "GIS", "Geophysics", "Images raster / digital photography", "Images vector", "Spreadsheets", "Survey", "Text"
Paper Archive recipient	Suffolk HER
Paper Contents	"Survey"
Paper Media available	"Map", "Photograph", "Survey ", 'Unpublished Text"

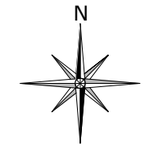
Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)

Title	Land at Bay Farm, Red Lodge, Suffolk, Detailed Magnetometer Survey
Author(s)/Editor(s)	Schofield, T.P.
Other bibliographic details	R1008
Date	2012
Issuer or publisher	Britannia Archaeology Ltd
Place of issue or publication	Stowmarket, Suffolk
Description	Bound report with text and figures.
URL	www.britannia-archaeology.com







Proposed Solar Panel Arrays

Site Boundary

NGR: 5704 2716

REPORT NUMBER: 1008

PROJECT:
LAND AT BAY FARM, RED LODGE, SUFFOLK

CLIENT:
RICHARD PIKE ASSOCIATES

DESCRIPTION:
SITE LOCATION & PROPOSED DEVELOPMENT PLAN

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E: info@britannia-archaeology.com
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SCALE: 1:2500

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DATE:	AUTHOR:	FIGURE:
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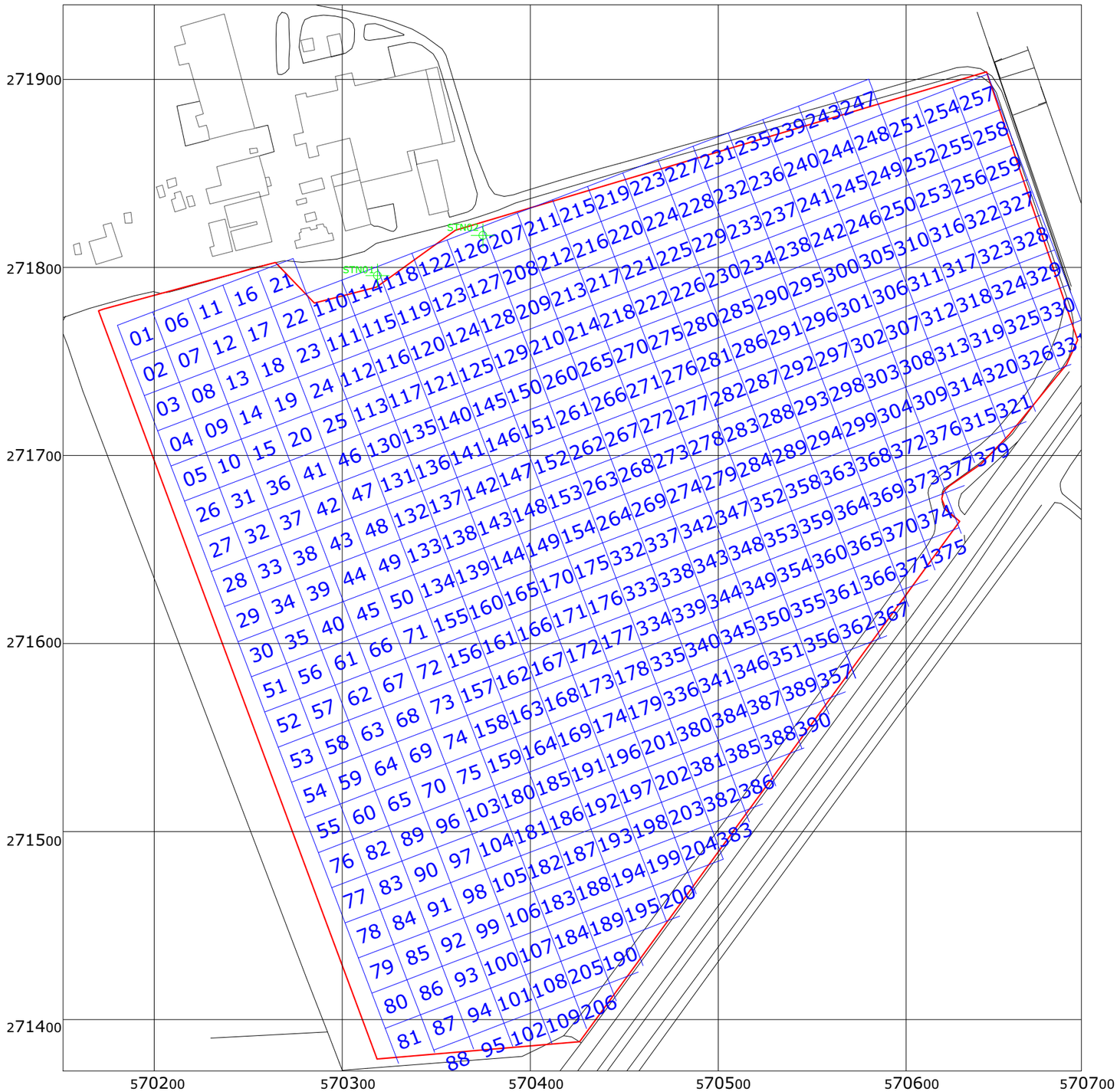

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STATION	EASTING	NORTHING	ZENITH
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02	570374. 483	271821.686	17.81

Site Boundary

NGR: 5704 2716

REPORT NUMBER: 1008

PROJECT: LAND AT BAY FARM, RED LODGE, SUFFOLK

CLIENT: RICHARD PIKE ASSOCIATES

DESCRIPTION: SITE GRID NUMBER & SITE GRID REFERENCING PLAN

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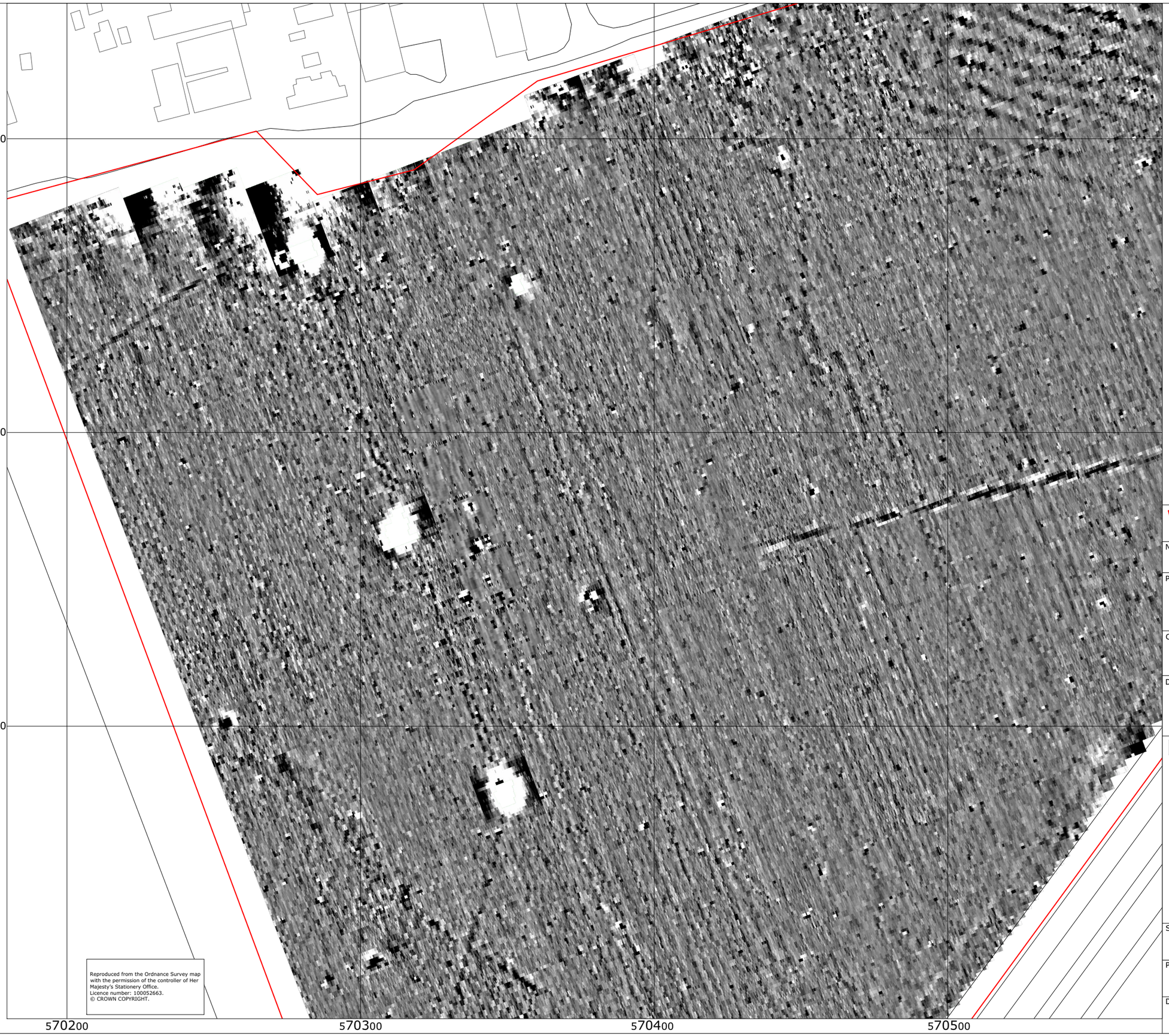

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Site Boundary

NGR: 5704 2716

REPORT NUMBER: 1008

PROJECT:
LAND AT BAY FARM, RED LODGE, SUFFOLK

CLIENT:
RICHARD PIKE ASSOCIATES

DESCRIPTION:
RAW CORRECTED MAGNETOMETER GREYSCALE PLOT

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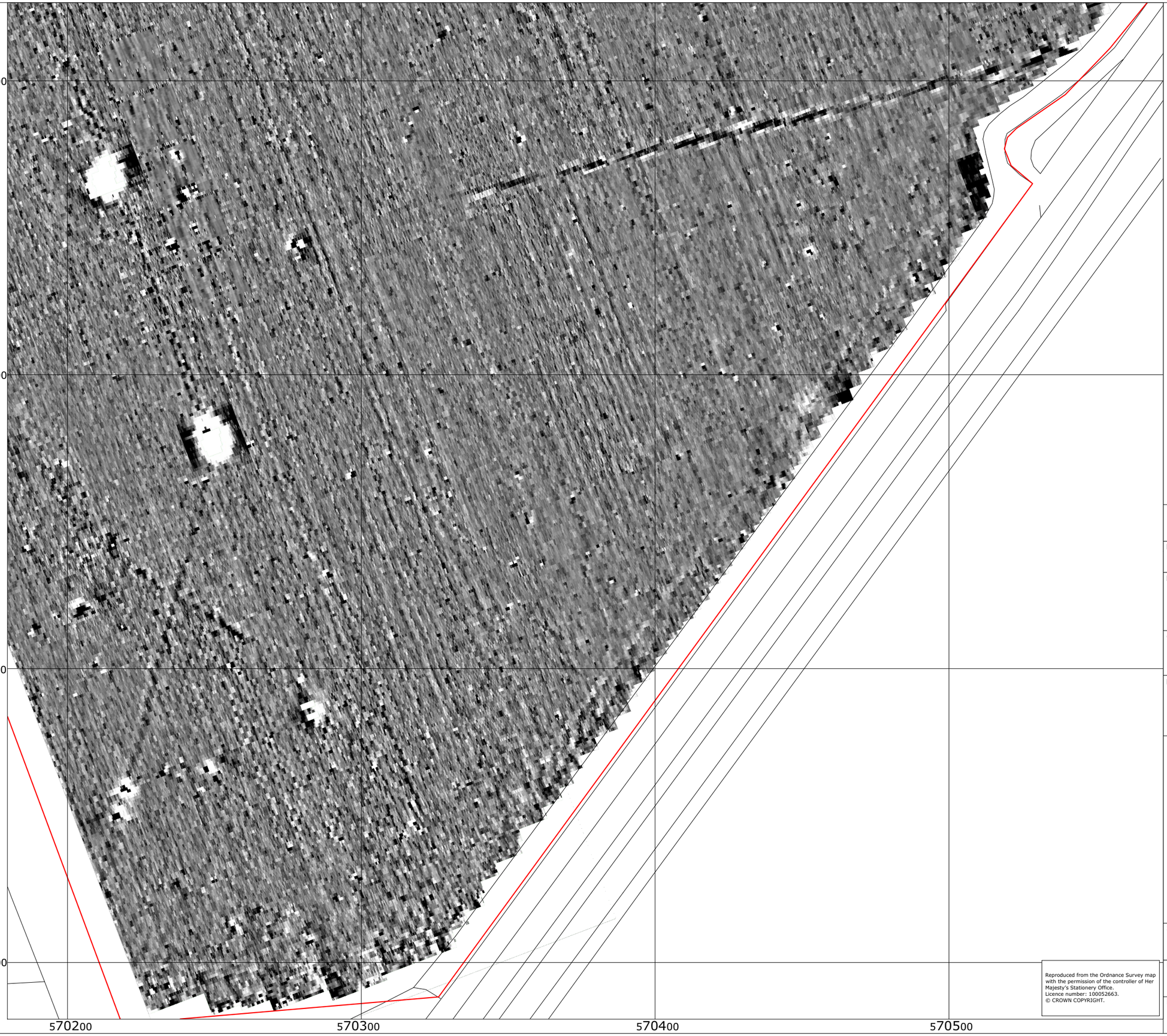

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Site Boundary

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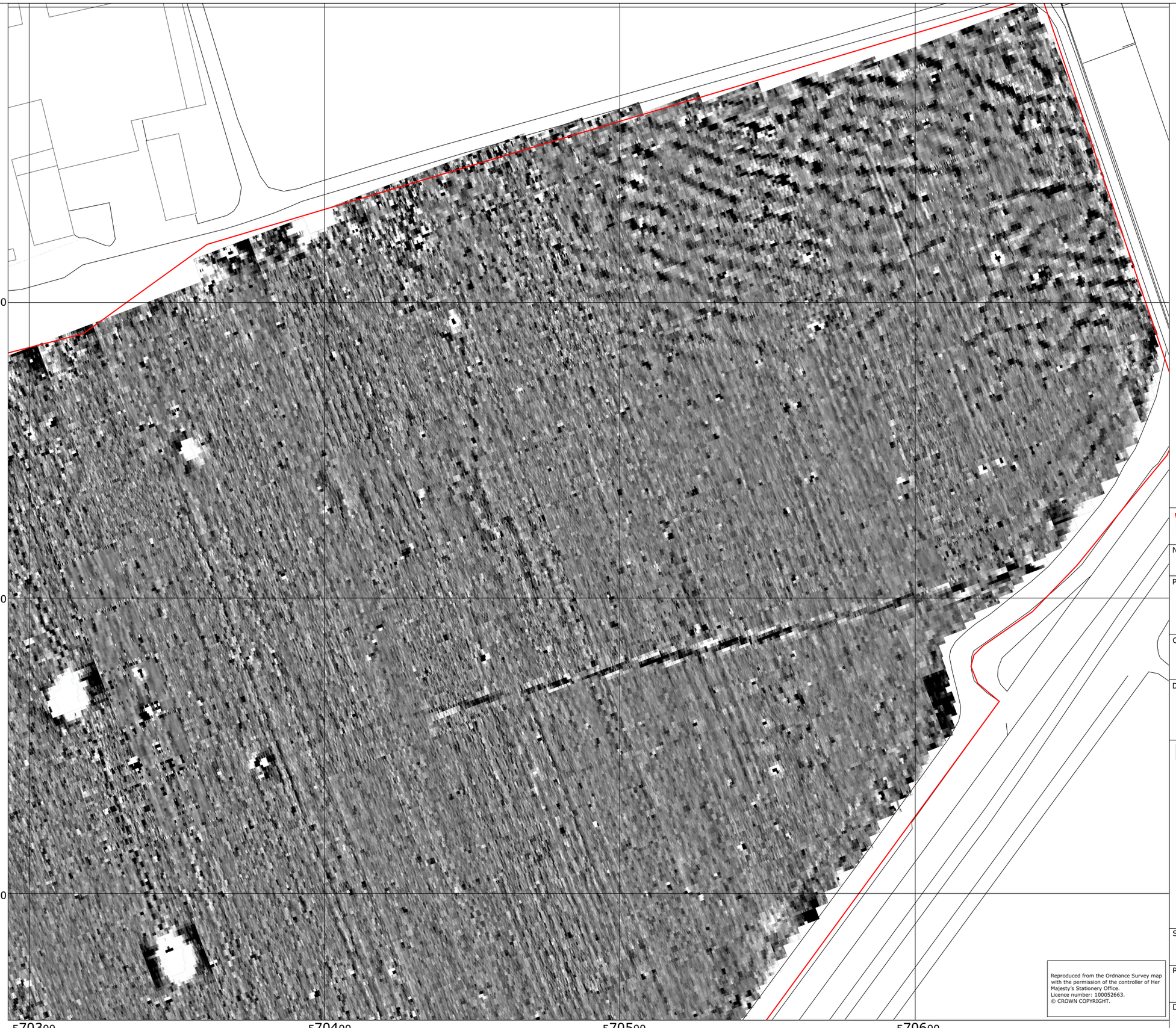

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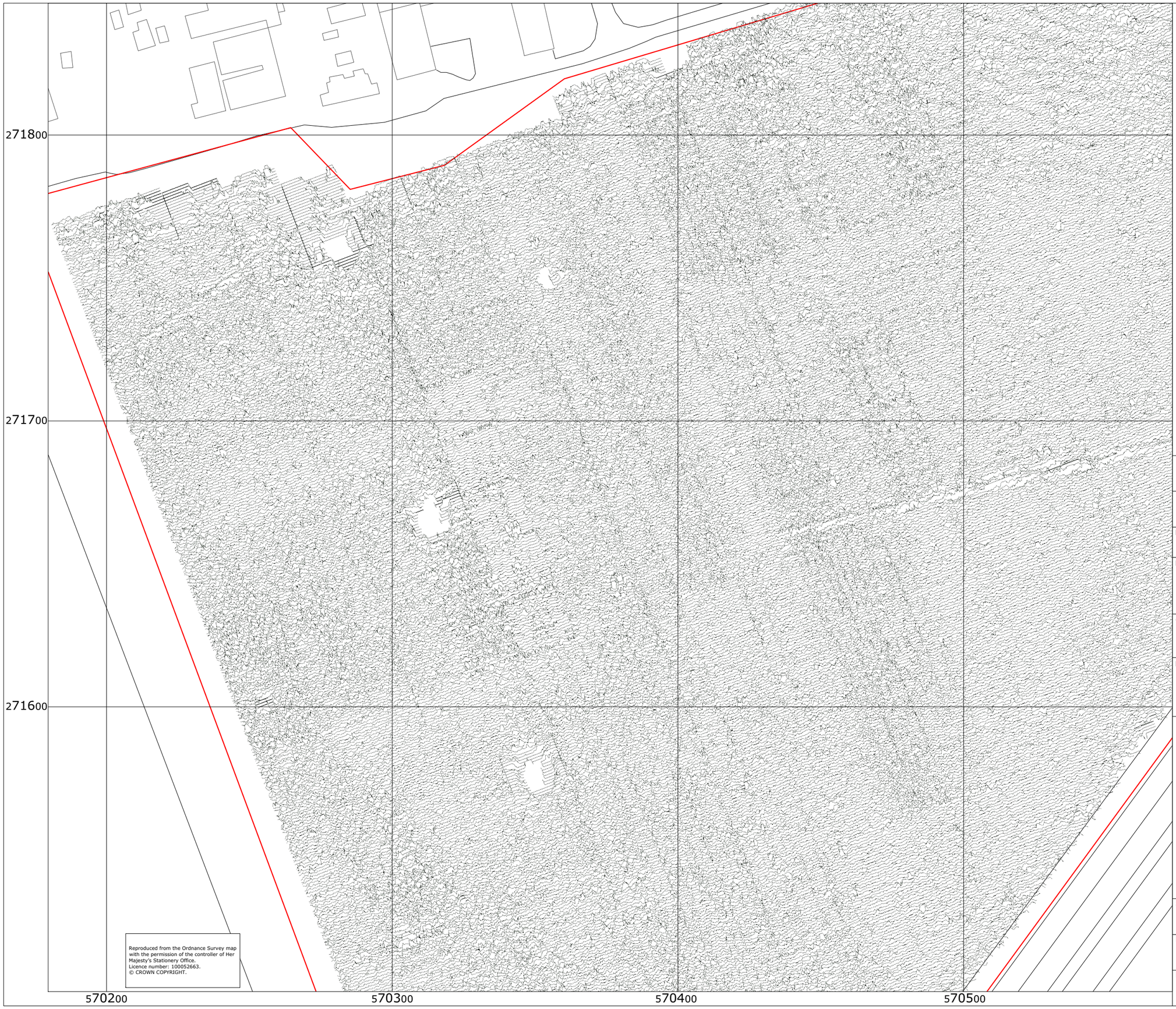

19 nT/cm	Scale Interval
	Site Boundary

NGR: 5704 2716

REPORT NUMBER: 1008

PROJECT: LAND AT BAY FARM, RED LODGE, SUFFOLK

CLIENT: RICHARD PIKE ASSOCIATES

DESCRIPTION: RAW CORRECTED MAGNETOMETER XY TRACE PLOT

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SCALE: 1:1250 (0 – 50m)

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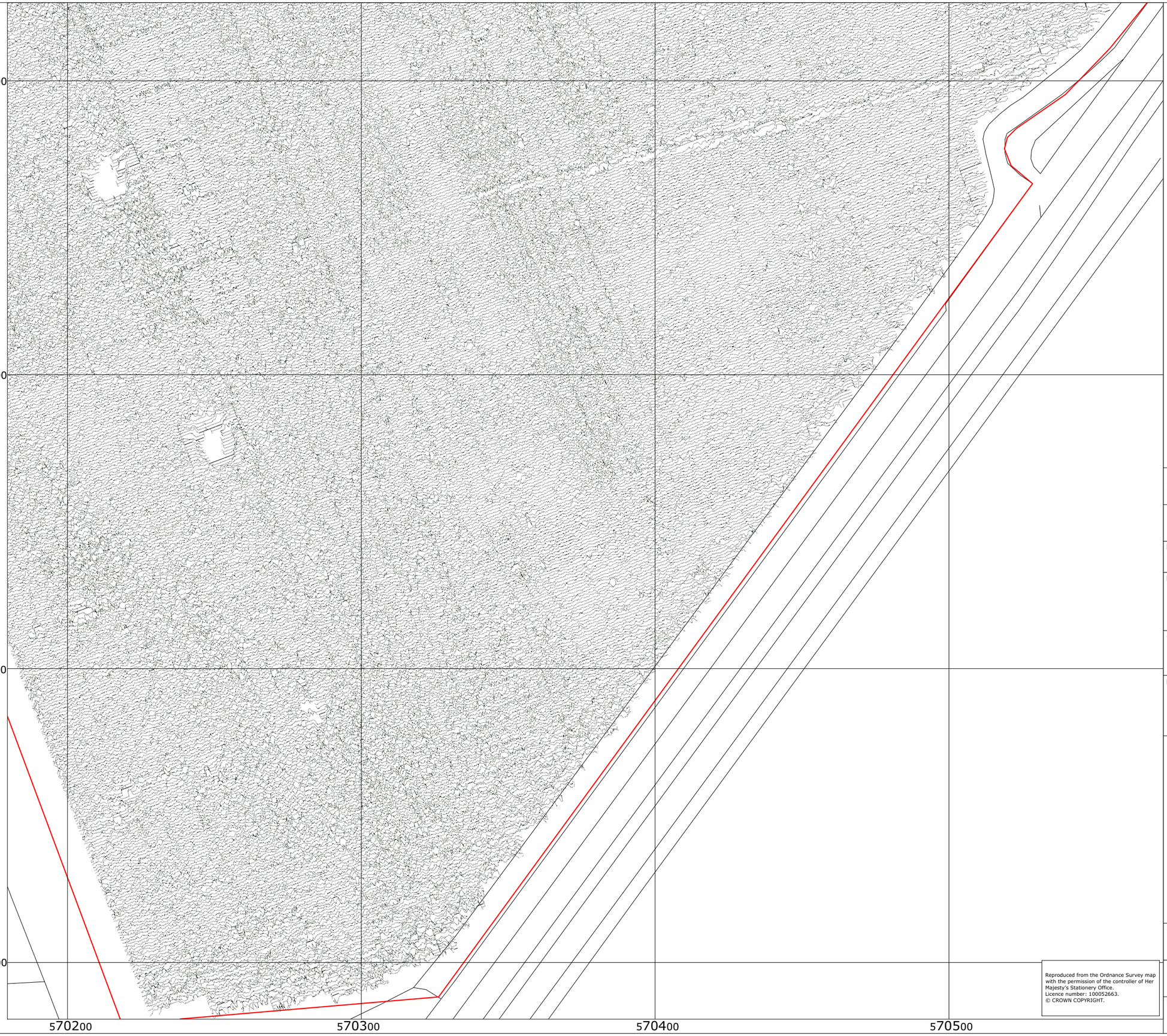
DATE: NOV 2012	AUTHOR: TPS	FIGURE: 4A



19 nT/cm	Scale Interval
	Site Boundary

NGR: 5704 2716	REPORT NUMBER: 1008

PROJECT:
LAND AT BAY FARM, RED LODGE, SUFFOLK

CLIENT:
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DESCRIPTION:
RAW CORRECTED MAGNETOMETER XY TRACE PLOT

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PLOT:	APPROVED:	VERSION:
A3	MCA	01
DATE: NOV 2012	AUTHOR: TPS	FIGURE: 4B

19 nT/cm	Scale Interval
	Site Boundary

NGR: 5704 2716

REPORT NUMBER: 1008

PROJECT:
LAND AT BAY FARM, RED LODGE, SUFFOLK

CLIENT:
RICHARD PIKE ASSOCIATES

DESCRIPTION:
RAW CORRECTED MAGNETOMETER XY TRACE PLOT

BRITANNIA ARCHAEOLOGY LTD

4 THE MILL, CLOVERS COURT,SUFFOLK
IP14 1RB

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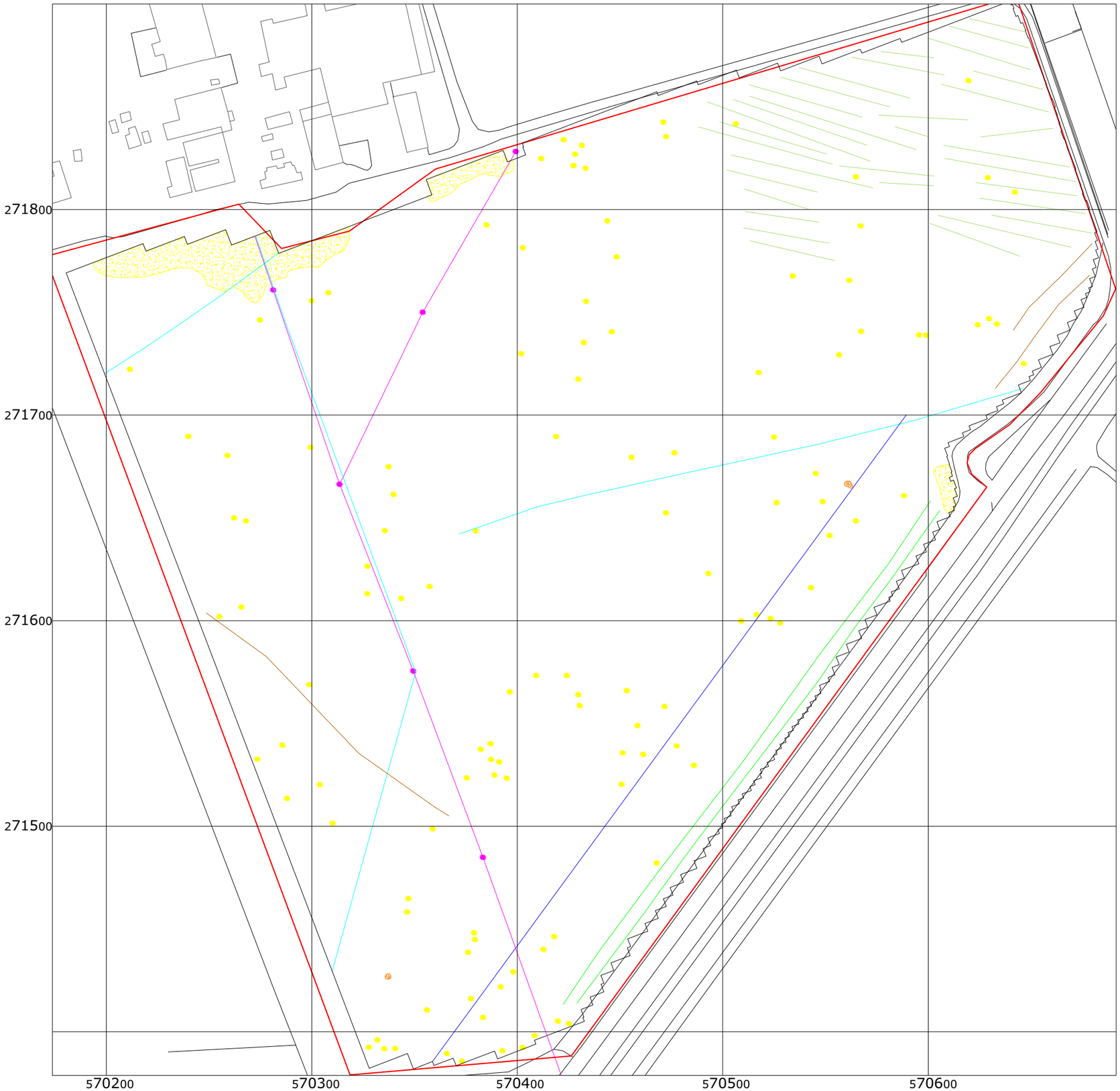
SCALE: 1:1250 (0 – 50m)

PLOT:	APPROVED:	VERSION:
A3	MCA	01
DATE: NOV 2012	AUTHOR: TPS	FIGURE: 4C



N

	Positive Discrete Anomaly, Archaeology?
	Broad Positive Linear Anomaly, Strip Fields?
	Weak Negative Linear, Agricultural?
	Weak Positive Linear, Agricultural?
	Broad Positive Linear Anomaly, A11 Easement?
	Positive Linear Anomaly, Service Run
	Area of Magnetic Disturbance, Ferrous Material
	Dipolar Anomaly, Ferrous Material
	Electricity Pole & Cable
	Site Boundary

NGR: 5704 2716

REPORT NUMBER: 1008

PROJECT:
LAND AT BAY FARM, RED LODGE, SUFFOLK

CLIENT:
RICHARD PIKE ASSOCIATES

DESCRIPTION:
INTERPRETATION PLOT OF MAGNETOMETER DATA

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SCALE: 1:2000 (0 – 80m)

PLOT:	APPROVED:	VERSION:
A3	MCA	01
DATE: NOV 2012	AUTHOR: TPS	FIGURE: 5