LAND AT LANWADES PARK, KENTFORD, SUFFOLK

DETAILED MAGNETOMETER SURVEY

Report Number: 1058

May 2014

LAND AT LANWADES PARK, KENTFORD, SUFFOLK

DETAILED MAGNETOMETER SURVEY

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May 2014

Site Code	MUN 052	**NGR**	TL 6986 6645
Planning Ref.	-	**OASIS**	-
Approved By	Matt Adams	**DATE**	May 2014

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CONTENTS

ABSTRACT

Detailed fluxgate gradiometer survey was undertaken by Britannia Archaeology Ltd in one field (c.2.50 hectares) on the 22nd May 2014. Despite the sites potential for encountering anomalies of possible prehistoric origin, only a single are of magnetic enhancement may be of an archaeological derivation.

Isolated dipolar responses were most numerous throughout the dataset and have probably been caused by the presence of modern ferrous cultural debris introduced into the topsoil through loss. Two areas of magnetic disturbance were recorded in the dataset, located in the south-western corner of the field and surrounding the extant brick foul water pumping station.

Two negative linear trends recorded running from the north-eastern corner of the pumping station to the north-eastern corner of the field are likely to delineate the location of non-ferrous service pipe runs.

Two weak positive and one weak negative linear trend all orientated north-west to south-east have been recorded running the length of the field, they are indicative of agricultural strip fields or relic field boundaries.

One area of magnetic enhancement that is circular or curvilinear is potentially of an archaeological origin, however a modern derivation cannot be ruled out.

Further targeted trial trenching to ground- test the hypotheses given in this report would be prudent.

1.0 INTRODUCTION

On the 22nd May 2014 Britannia Archaeology Ltd (BA) undertook a detailed fluxgate gradiometer survey over *c.*2.5 hectares on one field laid to pasture in advance of a proposed new housing development and associated groundwork's at Lanwades Park, Kentford, Suffolk (TL 6986 6645).

The survey was commissioned by Mark Hinman of Pre-Construct Archaeology in response to a design brief issued by Suffolk County Council Archaeology Service/Conservation Team (SCCAS/CT), (Tipper. J, dated 11/04/2013).

2.0 SITE DESCRIPTION

The site is located to the south of Bury Road and to the west of Jeddah Way in Kentford, Suffolk, in one field given over to pasture. It lies at a height of between 30 – 35m AOD, bordered to the north, east and west by field boundaries and to the south by the Animal Health Trust site.

Bedrock geology is described as Holywell Nodular and New Pit Chalk Formation formed approximately 89 to 100 million years ago in the Cretaceous Period when the local environment was dominated by warm chalk seas (BGS, 2014).

At the time of writing no superficial deposits had been recorded at this location (BGS 2014).

3.0 PLANNING POLICIES

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

The large size of the proposed development has not been the subject of any previous systematic archaeological investigation and recording work. However the area is known to be topographically favourable for early occupation from all periods and overlooks the valley of the River Kennett.

5.0 PROJECT AIMS

A non-intrusive field survey by geophysical prospection was undertaken to determine the extent and significance of any surviving subsurface anomalies, to be followed by a subsequent trial trench evaluation. The aims and objectives (Brief, Section 3) are laid out as follows:

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

3.2 A systematic fluxgate gradiometer survey is to be undertaken across the proposed development site, 3.60 ha. in area.

3.3 A scale plan showing the proposed location of the geophysical survey should be included in the WSI and the detailed trench design must be approved by SCCAS/CT before fieldwork begins.

The trial trench evaluation phase of site work is to be undertaken by Pre-Construct Archaeology who will prepare a Written Scheme and trench design informed by the results of the geophysical survey.

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 was relatively low, and therefore it was relatively simple to locate 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 in overcast conditions interspersed with occasional rain and long periods of sunshine which caused a degree of sensor drift, and the characteristic parallel traverse 'striping' that is prevalent throughout the raw dataset (Figure 2).

6.3 Sampling Interval and Grid Size

The sampling interval was set at 0.25m along 1m traverse intervals, providing 4 readings a metre, the magnetometer survey was undertaken 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 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-west to south-east alignment (Figure 1).

6.5 Data Capture

Instrument readings were recorded on an internal data logger that were downloaded to a laptop at lunchtime and then also at the end of the day. The grid order was recorded on a BA pro-forma to aid in the creation of the data composites. Data were filed in job specific folders. These data composites were checked for quality on site by BA, allowing

grids to be re-surveyed if necessary, (grids 34 – 39 were re-surveyed becoming grids 52 – 57 due to a zeroing error). The data were backed up onto an external storage device in the office and finally a remote server at the end of the day. A five metre exclusion zone was left between the boundaries and the survey area to reduce the amount of field boundary magnetic disturbance, which slightly reduced the area available.

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: 1.00 standard deviation.
Display Clipping: +/- 3 standard deviations.

Processed Data:
De-spike: X diameter = 3, Y diameter = 3, Threshold = 1, centre value=mean, replace with = mean;
De-stripe: Median Traverse: All;
Data Clipping: 1.00 standard deviation;
Display Clipping: +/- 3 standard deviations.

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

6.7 Software

Raw data were downloaded using DW Consulting's Archeosurveyor v2.0 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 v2.0. Datasets were exported into AutoCAD and placed onto the local survey grid. Interpretation plots were then produced using AutoCAD.

6.8 Grid Restoration

Britannia Archaeology Ltd positioned no reference stations within the field however the grids can be relocated using the geo-referenced stations presented in Figure 1; these co-ordinates can also enable the accurate targeting of the geophysical anomalies.

7.0 RESULTS & DISCUSSION

Isolated dipolar ('iron spike') were particularly numerous throughout the dataset and record the presence of modern ferrous cultural debris introduced into the topsoil, rather than resulting from the presence of buried archaeological artefacts. These responses (yellow hatched circles) seem to be fairly evenly spaced throughout the field with no apparent concentration, potentially related to ferrous material associated with equinery.

Two areas of magnetic disturbance (yellow hatching) were recorded during the survey, the first is located in the south-western corner and may delineate a service pipe or be caused by a ferrous water trough or the iron fence and gate in the corner of the field. The second surrounds an extant foul water brick-built pumping station also close to the south-western corner of the field.

Two negative linear trends (blue lines) have been recorded running from the north-eastern corner of the brick-built pumping station to the north-eastern corner of the field. It is likely that these are foul water service pipe runs associated with the pumping station. These pipes are also likely to be present on the western side of the pumping station, 'dummy' readings were inputted here because of the magnetic nature of the structure. The pipes are non-ferrous in nature, possibly back-filled in reverse stratigraphic sequence with the less magnetically susceptible superficial geology as the upper fill and the topsoil in the base. Alternatively it may have been backfilled with hogging or gravel. Caution should be exercised when excavating below ground level over these anomalies and also on the western side of the pumping station.

Two weak positive linear trends (green lines) were recorded in the dataset, orientated north-west to south-east on a parallel course with the existing field boundaries. A weak negative linear trend (cyan line) on a similar alignment but further to the west was also recorded, all of these anomalies are indicative of relic agricultural boundaries or possibly furrows that are also delineated by extant cropmarks and earthworks in the field.

One area of magnetic enhancement (magenta hatching) is perhaps the most intriguing of the anomalies recorded in the dataset. It is roughly circular or potentially curvi-linear in plan and is of possible archaeological origin, however a modern derivation cannot be ruled out.

8.0 CONCLUSION

The underlying superficial geology has a relatively low background magnetic susceptibility, providing for good clarity between anomalies and the average background reading. Despite the potential for recording anomalies of a potential archaeological origin, only one area of magnetic enhancement of potential archaeological origin was recorded that is worthy of further targeted investigation. It would be prudent to further evaluate the anomalies indicative of agricultural ditches, to ground-test the hypotheses given in this report. Areas devoid of anomalies could also be further investigated to test whether features containing leached-out and non-humic fills (and therefore undetectable by gradiometer) are present.

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 Mark Hinman of Pre-Construct Archaeology for commissioning the project, and to Dr Jess Tipper of Suffolk County Council Archaeological Service/Conservation Team for his advice throughout.

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APPENDIX 1 METADATA SHEETS

Raw Data

Filename	Ken 1 Raw.xcp
Description	
Instrument Type	Grad 601-2 (Gradiometer)
Units	nT
Surveyed by	MB/TPS on 5/22/2014
Assembled by	TPS on 5/22/2014
Direction of 1st Traverse	90 deg
Collection Method	ZigZag
Sensors	2 @ 1.00 m spacing.
Dummy Value	32702.00
Dimensions	
Composite Size (readings)	480 x 180
Survey Size (meters)	120.00m x 180.00 m
Grid Size	20.00 m x 20.00 m
X Interval	0.25 m
Y Interval	1.00 m
Stats	
Max	5.70
Min	-5.57
Std Dev	1.82
Mean	0.11
Median	0.14
Composite Area	2.16 ha
Surveyed Area	1.59 ha
Program	
Name	ArcheoSurveyor
Version	2.5.16.0

Processed Data

Filename	Ken 1 Pro.xcp
Description	
Instrument Type	Grad 601-2 (Gradiometer)
Units	nT
Surveyed by	MB/TPS on 5/22/2014
Assembled by	TPS on 5/22/2014
Direction of 1st Traverse	90 deg
Collection Method	ZigZag
Sensors	2 @ 1.00 m spacing.
Dummy Value	32702.00
Dimensions	
Composite Size (readings)	480 x 180
Survey Size (meters)	120.00m x 180.00 m
Grid Size	20.00 m x 20.00 m
X Interval	0.25 m
Y Interval	1.00 m
Stats	
Max	5.37
Min	-5.14
Std Dev	1.42
Mean	0.06
Median	0.00
Composite Area	2.16 ha
Surveyed Area	1.59 ha
Program	
Name	ArcheoSurveyor
Version	2.5.16.0

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5	Col:0	Row:4	grids\02.xgd
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APPENDIX 2 – TECHNICAL DETAILS

Magnetometer Survey

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

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

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

Fluxgate Gradiometers

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

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

Magnetic Anomalies

Linear trends

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

Discrete anomalies

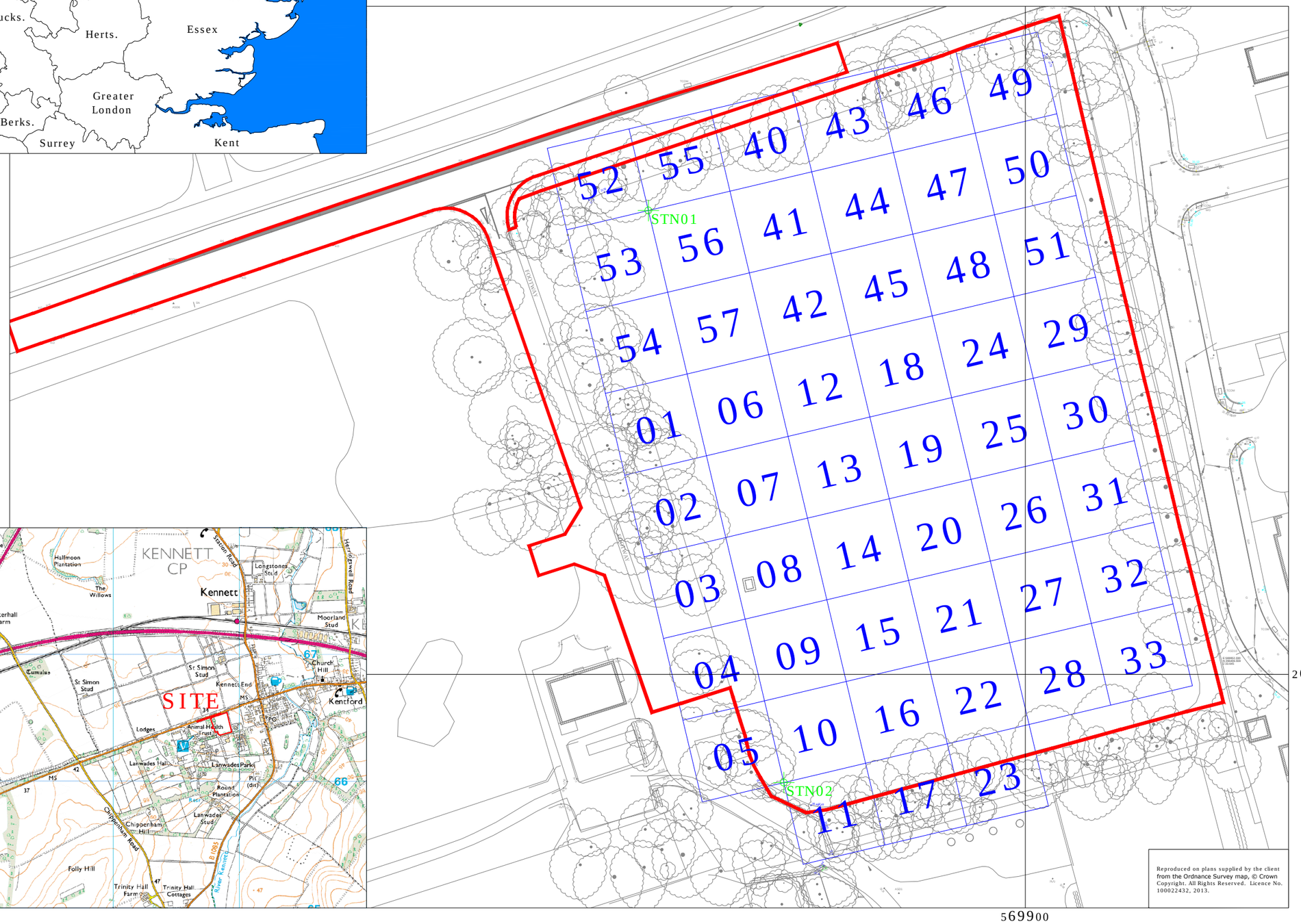
Discrete anomalies appear as increased positive responses present within a localised area. They are caused by a general increase in the amount of magnetic iron oxides present within the humic back-fill of for example a rubbish pit.

'Iron spike' anomalies

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

Areas of magnetic disturbance

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



N

STATION	EASTING	NORTHING
01	569810.201	266510.471
02	569842.487	266374.245

Survey Grid Location

Site Boundary

NGR: TL 6986 6645

REPORT NUMBER: 1058

PROJECT:
LAND AT LANWADES PARK,
KENTFORD, SUFFOLK

CLIENT: PCA PRE-CONSTRUCT ARCHAEOLOGY

DESCRIPTION:
SITE, SURVEY GRID &
REFERENCING INFORMATION PLAN

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SCALE: 1:1000 (0 – 50m)

PLOT:	APPROVED:	VERSION:
A3	MCA	01
DATE:	AUTHOR:	FIGURE:
MAY 2014	TPS	01

N

+5.70nT

-5.57nT

Site Boundary

NGR: TL 6986 6645

REPORT NUMBER: 1058

PROJECT:
LAND AT LANWADES PARK,
KENTFORD, SUFFOLK

CLIENT: PCA PRE CONSTRUCT ARCHAEOLOGY

DESCRIPTION:
RAW MAGNETOMETER
GREYSCALE PLOT

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SCALE: 1:1000 (0 – 50m)

PLOT:	APPROVED:	VERSION:
A3	MCA	01

DATE:	AUTHOR:	FIGURE:
MAY 2014	TPS	02

Site Boundary

NGR: TL 6986 6645

REPORT NUMBER: 1058

PROJECT:
LAND AT LANWADES PARK,
KENTFORD, SUFFOLK

CLIENT: PCA PRE-CONSTRUCT ARCHAEOLOGY

DESCRIPTION:
PROCESSED MAGNETOMETER
GREYSCALE PLOT

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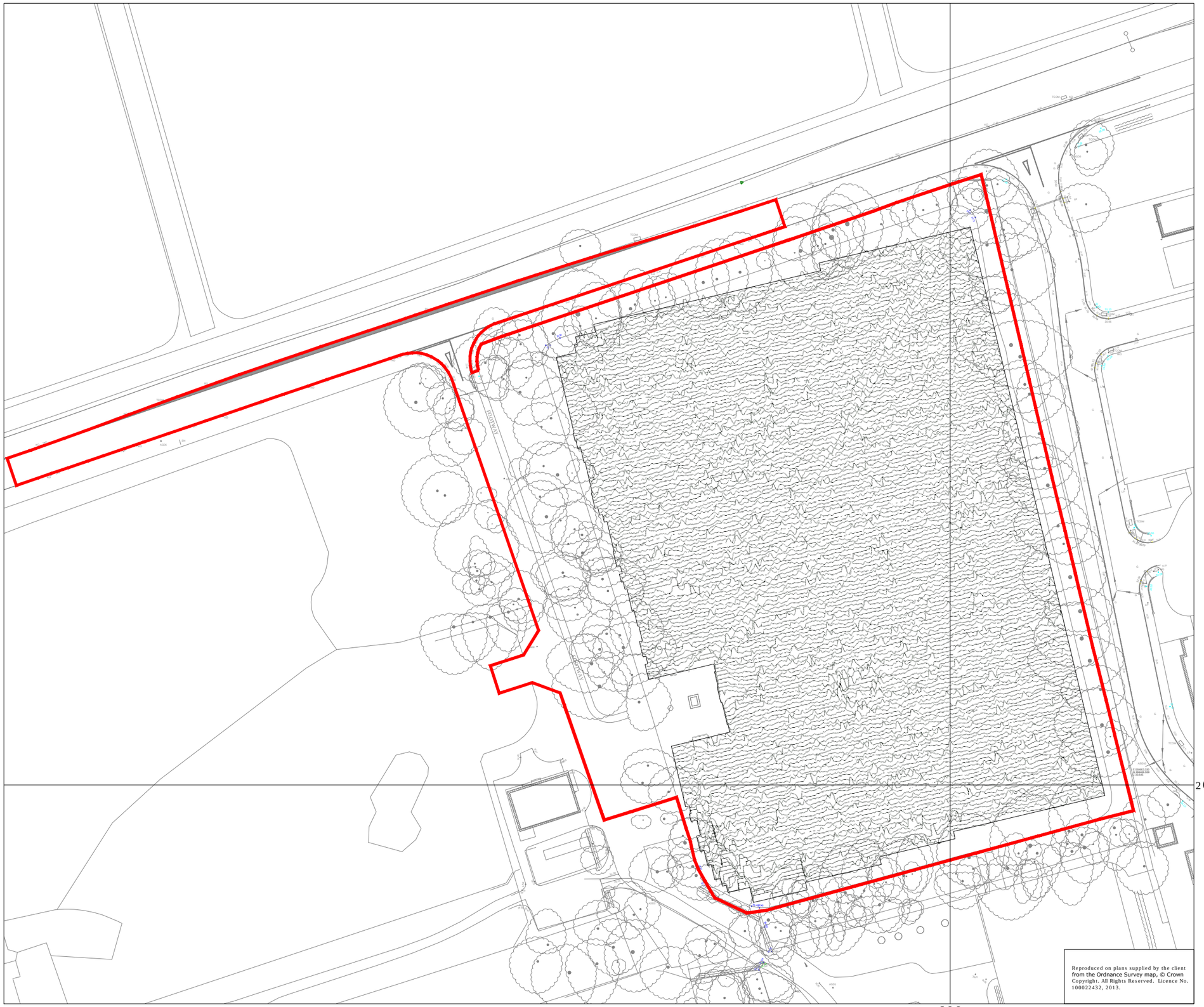
SCALE: 1:1000 (0 – 50m)

PLOT:	APPROVED:	VERSION:
A3	MCA	01
DATE:	AUTHOR:	FIGURE:
MAY 2014	TPS	03



41nT/cm	Scale Interval
	Site Boundary

NGR: TL 6986 6645

REPORT NUMBER: 1058

PROJECT:

LAND AT LANWADES PARK,
KENTFORD, SUFFOLK

CLIENT: PCA PRE-CONSTRUCT ARCHAEOLOGY

DESCRIPTION:

PROCESSED MAGNETOMETER
XY TRACE PLOT

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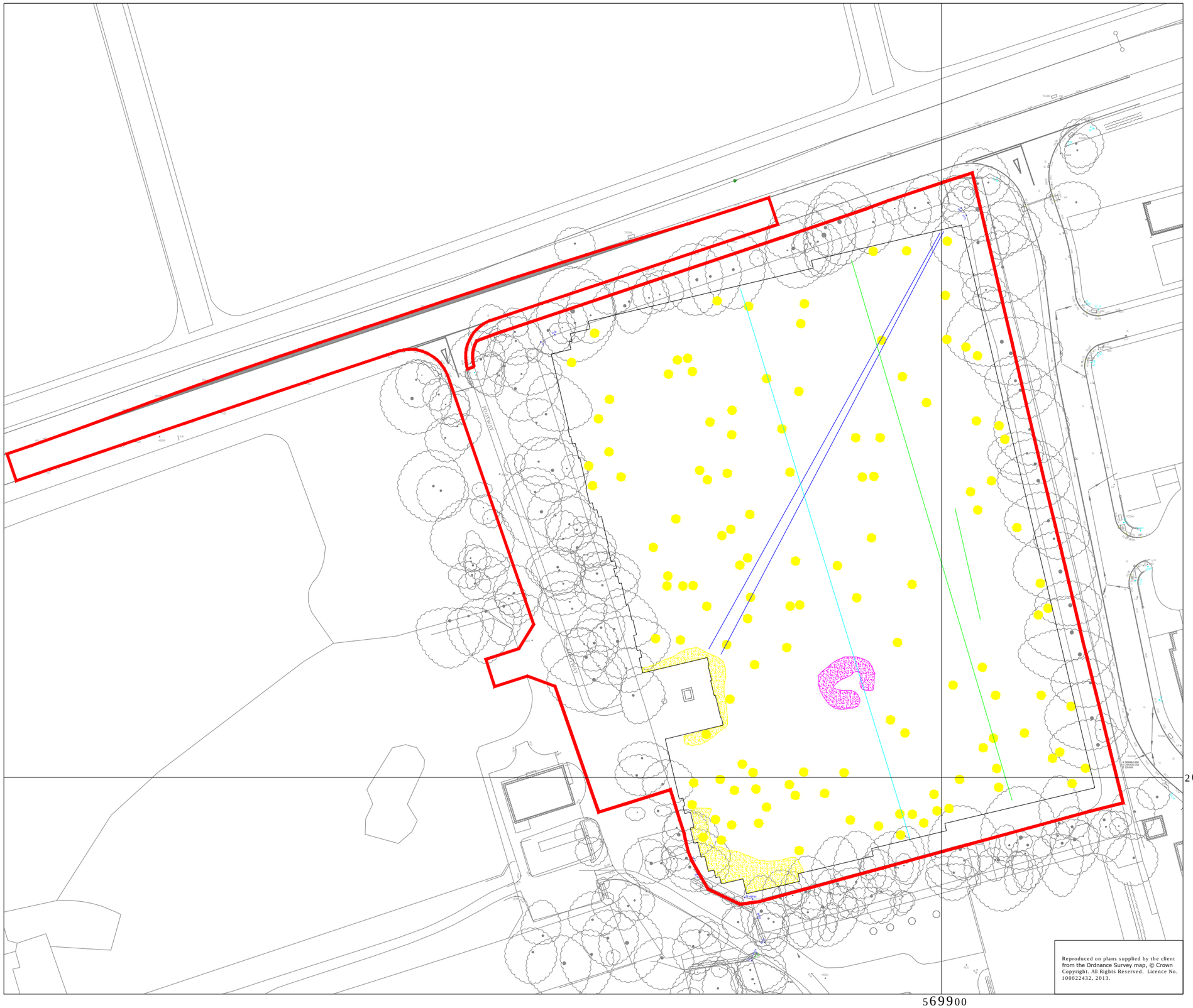
SCALE: 1:1000 (0 – 50m)

PLOT:	APPROVED:	VERSION:
A3	MCA	01
DATE:	AUTHOR:	FIGURE:
MAY 2014	TPS	04



	Area of Magnetic Enhancement, Archaeology?
	Weak Negative Linear Trend Agricultural.
	Weak Positive Linear Trend, Agricultural.
	Negative Linear Trend, Service Trench Run
	Area of Magnetic Disturbance
	Isolated Dipolar Response
	Site Boundary

NGR: TL 6986 6645

REPORT NUMBER: 1058

PROJECT:

LAND AT LANWADES PARK, KENTFORD, SUFFOLK

CLIENT: PCA PRE-CONSTRUCT ARCHAEOLOGY

DESCRIPTION:

INTERPRETATION PLOT OF MAGNETOMETER DATA

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SCALE: 1:1000 (0 – 50m)

PLOT:	APPROVED:	VERSION:
A3	MCA	01
DATE:	AUTHOR:	FIGURE:
MAY 2014	TPS	05