HARP CLOSE MEADOW, SUDBURY, SUFFOLK

DETAILED MAGNETOMETER SURVEY

Site Code: SUY 117 August 2012

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Detailed Magnetometer Survey

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August 2012

Site Code	SUY 117	**NGR**	NGR 587900 242100
Report Number	1009	**OASIS**	TBC
Approved By	Matthew Adams	**DATE** August 2012	

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CONTENTS

ABSTRACT

Detailed fluxgate gradiometer survey on land at Harp Close Meadow, Sudbury, Suffolk, recorded five discrete anomalies of potential archaeological origin. One broad weak positive linear anomaly of probable natural origin, large areas of magnetic disturbance, a plethora of dipolar 'iron-spike' anomalies and six weak linear dipolar responses indicative of service pipe trenches were also prospected.

1.0 INTRODUCTION

On the 9th and 10th of August 2012, Britannia Archaeology Ltd (BA) undertook detailed magnetometer survey on land at Harp Close Meadow, Sudbury, Suffolk (NGR 587900 242100) in advance of the construction of a residential development. The survey was undertaken on behalf of Andrew Tester of Suffolk County Council Archaeological Services, in response to a brief (dated 3rd July 2012) prepared by Sarah Poppy of Suffolk County Council Archaeology Service/Conservation Team (SCCAS/CT) on 4.5 hectares of land previously used as meadows. On both days the weather was sunny. This geophysical survey was undertaken as part of a programme of archaeological investigation with the subsequent phase being a trial trench evaluation.

2.0 SITE DESCRIPTION

Located to the north-east of the town centre of Sudbury on a dry valley overlooking the River Stour and bounded by Waldingfield Road to the south-east, housing estates to the south, west and north-east, and by Acton Lane to the north-west. Situated at 40-45m AOD on land currently used as meadows on the edge of the floodplain. The total area is 4.5 hectares on land sloping from the north-west to the south-east.

The bedrock comprises Lewes Nodular Chalk, Seaford Chalk, Newhaven Chalk, and Culver Chalk Formation when the local environment was dominated by warm chalk seas formed 71-94 million years ago in the Cretaceous Period (British Geological Society (BGS, 2012).

Superficial deposits are described as Lowestoft Formation till, deep draining fine silty clay and outwash sand and gravel. These deposits were formed during the Ice Age when glaciers scoured the landscape depositing moraines of till with the sand and gravel deposited by seasonal and post-glacial meltwaters (BGS, 2012).

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 policies also include the Babergh Development Framework Core Strategy (2011-2031) Submission Draft.

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 Babergh Development Framework Core Strategy (2011-2031) Submission Draft.

The local development framework for Babergh states the following:

- Provide support and guidance to ensure that development which may affect historic assets and ensure new development makes a positive contribution to local character and distinctiveness (section 3.3.6).

4.0 ARCHAEOLOGICAL BACKGROUND

The proposed residential development is located in an area of archaeological interest identified in the County Historic Environment Record. Located immediately to the north-east are two cropmark ring ditches (HER SUY041 and SUT042). A desk-based assessment undertaken by SCCAS (2010/203) identified moderate potential for the location of remains of prehistoric and 20th century date. The topographic setting (on a dry valley overlooking the River Stour) is favourable for occupation relating to all periods. This will be the first systematic investigation to have been undertaken on the site.

5.0 PROJECT AIMS

This specific aim of the geophysical survey and subsequent targeted trial trench evaluation is 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, chosen for its high sensitivity and rapid ground coverage. The soils and underlying geology were relatively receptive to magnetometer survey, with adequate contrast between the anomalies and the relatively low magnetic susceptibility of the silt, sand and gravel natural drift geology.

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. The geophysical surveyors noted that instrument drift was relatively minor throughout the survey.

6.3 Sampling Interval and Grid Size

The sampling interval was 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 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 grid was positioned parallel to the long axis of the field for ease of survey progression.

6.5 Data Capture

Instrument readings were recorded on an internal data logger which were downloaded to a laptop at midday and at the end of the survey. 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 field 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 metal boundary fences *etc*. Topographic details were recorded using the DGPS, they included earthworks and hollows, the remains of the temporary salesroom (no longer extant) that were mapped to aid the dataset interpretation (see Figures 1-7).

6.6 Data Presentation and Processing

Only minimal processing of the data set was undertaken:

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 -2/+2.

Raw and processed greyscale/XY trace plots were produced for comparison, ensuring that no anomalies were processed out of the original dataset. An interpretation plan characterising the anomalies then followed drawing together the evidence collated from the greyscale and XY trace plots. 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 positioned three reference stations (orange wooden stakes) in the field (Figure 2) that should be used to relocate the grid or the geophysical anomalies.

7.0 RESULTS

The results reveal five discrete positive anomalies, one broad weak positive linear anomaly, six weak dipolar linear responses, large areas of magnetic disturbance and multiple dipolar isolated responses (Figure 7).

Five discrete positive anomalies were present, four of which were on the higher ground to the west and one towards the northern corner of the site. These positive discrete anomalies could be of archaeological origin and are commonly indicative of rubbish pits. However, they could be of modern derivation or naturally occurring patches of higher magnetically susceptible soil.

The broad weakly positive linear anomaly located close to the south-eastern corner is likely to be of natural derivation and may relate to a localised change in the superficial geology, it could also be bank material of archaeological origin.

Six weak dipolar linear responses were recorded within the dataset, that are probable service pipe trench runs. Inspection chambers present across the site appear to demarcate the routes. The three located to the west probably served the salesroom that was once present to the north of the tarmac road.

The most numerous anomalies were the dipolar isolated responses ('iron-spike') that are present throughout the dataset. This ferrous material is likely to have been introduced into the topsoil over the years, the site is still used regularly by dog walkers and fetes were once held here.

Areas of magnetic disturbance are also abundant throughout the dataset, predictably many are located nearby the site boundaries. One of these areas is located over an extant earthwork that is probably of modern origin, possibly relating to a fly tipping episode. The other smaller areas of magnetic disturbance may also have been caused by the dumping of rubbish, or equally could demarcate previous fire events.

8.0 DISCUSSION & CONCLUSION

The magnetic susceptibility background level of the superficial geology was relatively low allowing the Bartington DualGrad 601-2 fluxgate gradiometer to perform fairly well. However some of the areas of magnetic disturbance could have potentially masked weaker archaeological anomalies that may exist below.

The site does have some archaeological potential with the five discrete anomalies worthy of further investigation. It may also be prudent to investigate the broad linear anomaly, target trenches on areas of low magnetic susceptibility (blank areas) and also the smaller areas of magnetic disturbance to discover whether they are of archaeological origin.

9.0 ACKNOWLEDGEMENTS

Britannia Archaeology would like to thank Jo Caruth and Andrew Tester of SCCAS for funding the project and for their help and support throughout.

We are also grateful for the advice of Sarah Poppy of SCCAS/CT.

10.0 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.

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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). Kilns, hearths, baked clay and ovens can reach temperatures of the Curie point, and are the strongest responses apart from large iron objects that can be detected. Cultural anomalies that can be detected by the magnetometers include occupation areas, pits, ditches, furnaces, sunken feature buildings, ridge and furrow field systems and ritual sites (David, 2011). Modern ferrous service pipes, field drainage pipes, removed field boundaries, perimeter fences and field boundaries can also be recorded.

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 reads the local magnetic field. Both of the 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 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 direction of traverse should be east to west, optimising the instruments data quality.

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 magnetic linear 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. Curvilinear trends can also be recorded and are indicative of archaeological structures such as drip-gullies.

Discrete anomalies

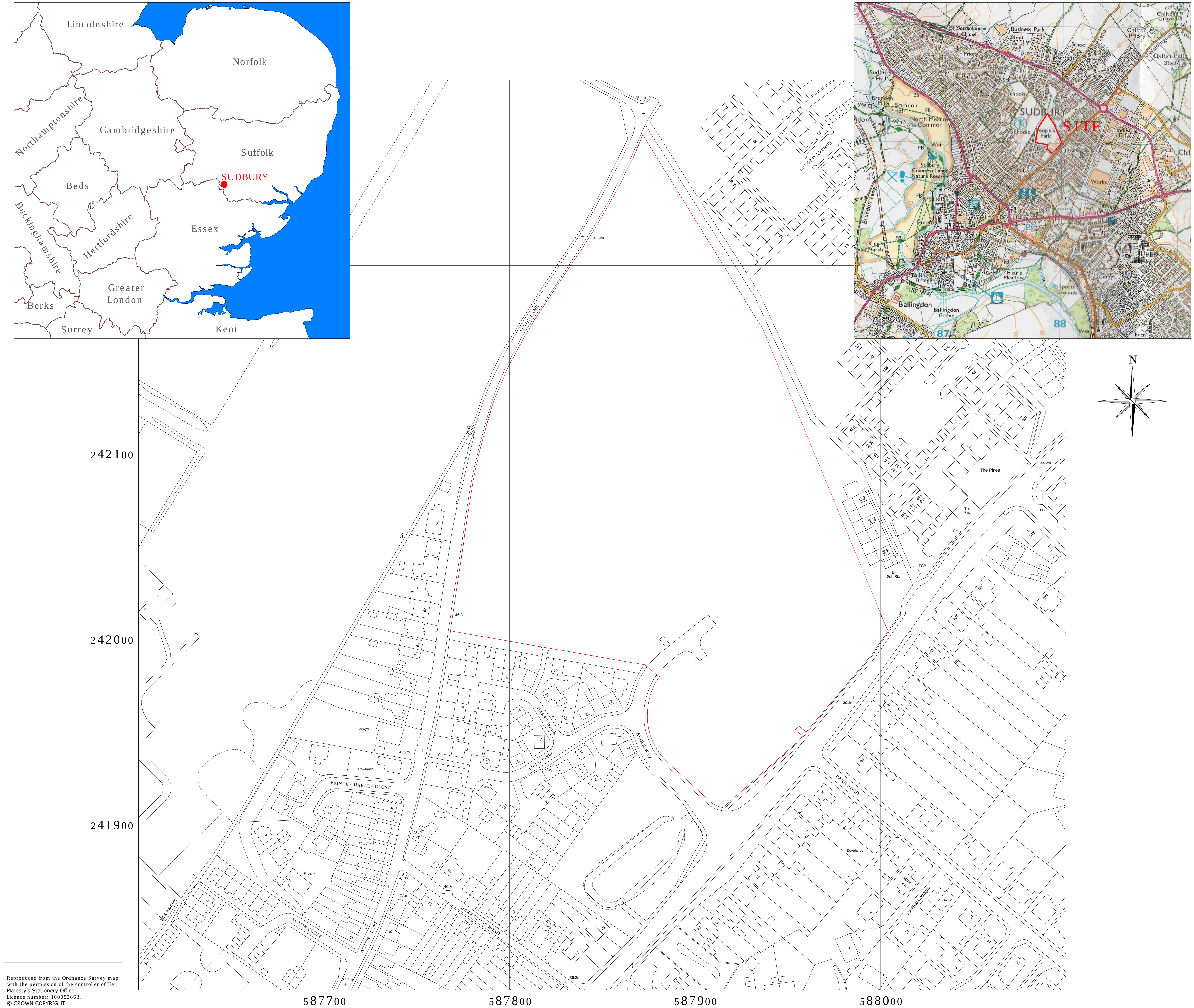
Discrete anomalies appear as increased positive responses present within a localised area. They are caused by a general increase in the amount of magnetic iron oxides present within the humic back-fill of for example a rubbish pit.

'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.



Site Boundary

NGR: 587900 242100	REPORT NUMBER: 1009

PROJECT: HARP CLOSE MEADOW, SUDBURY, SUFFOLK

CLIENT: ANDREW TESTER

DESCRIPTION: SITE LOCATION PLAN

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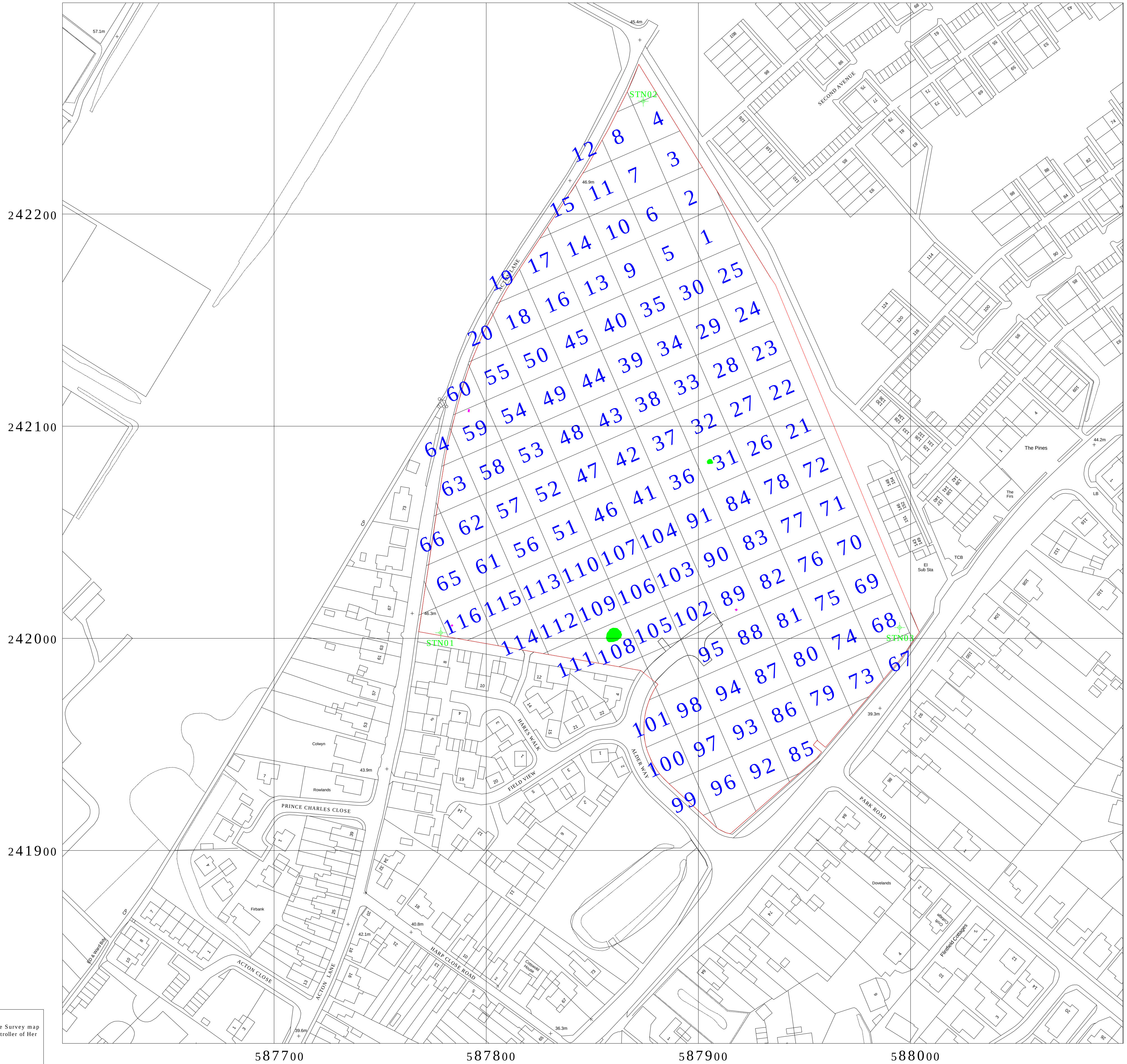
PLOT:	APPROVED:	VERSION:
A3	MCA	01

DATE:	AUTHOR:	FIGURE:
AUG 2012	TPS	01



N

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Extant Earthwork

Inspection Chamber

Site Boundary

NGR: 587900 242100

REPORT NUMBER: 1009

PROJECT: HARP CLOSE MEADOW, SUDBURY, SUFFOLK

CLIENT: ANDREW TESTER

DESCRIPTION: SITE GRID & REFERENCING

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PLOT: A3

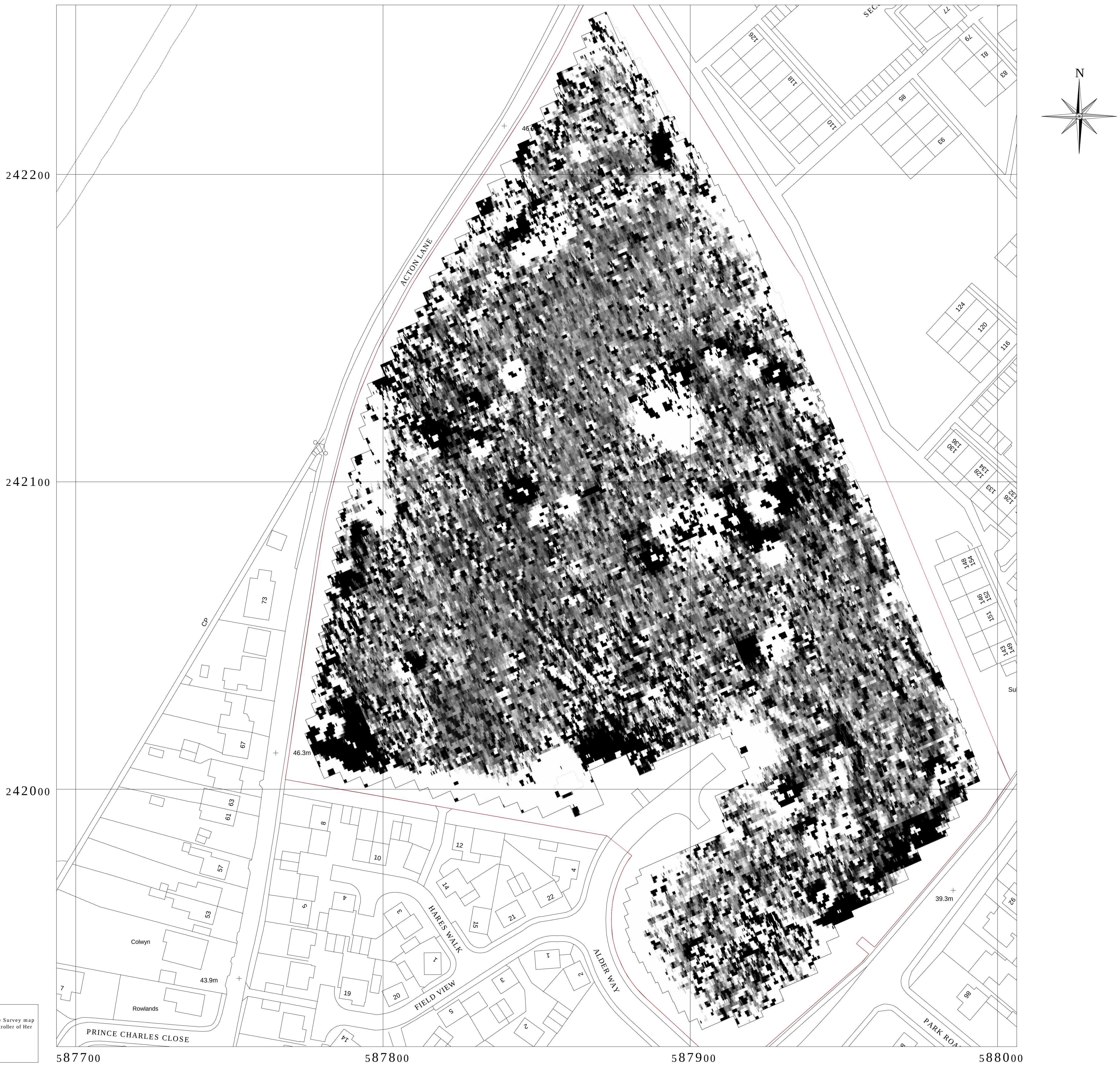
APPROVED: MCA

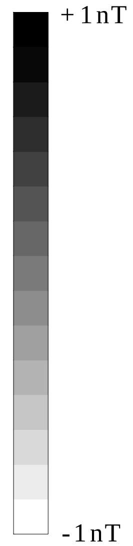
VERSION: 01

DATE: AUG 2012

AUTHOR: TPS

FIGURE: 02





Site Boundary

NGR: 587900 242100

REPORT NUMBER: 1009

PROJECT: HARP CLOSE MEADOW, SUDBURY, SUFFOLK

CLIENT: ANDREW TESTER

DESCRIPTION: RAW CORRECTED GREYSCALE PLOT

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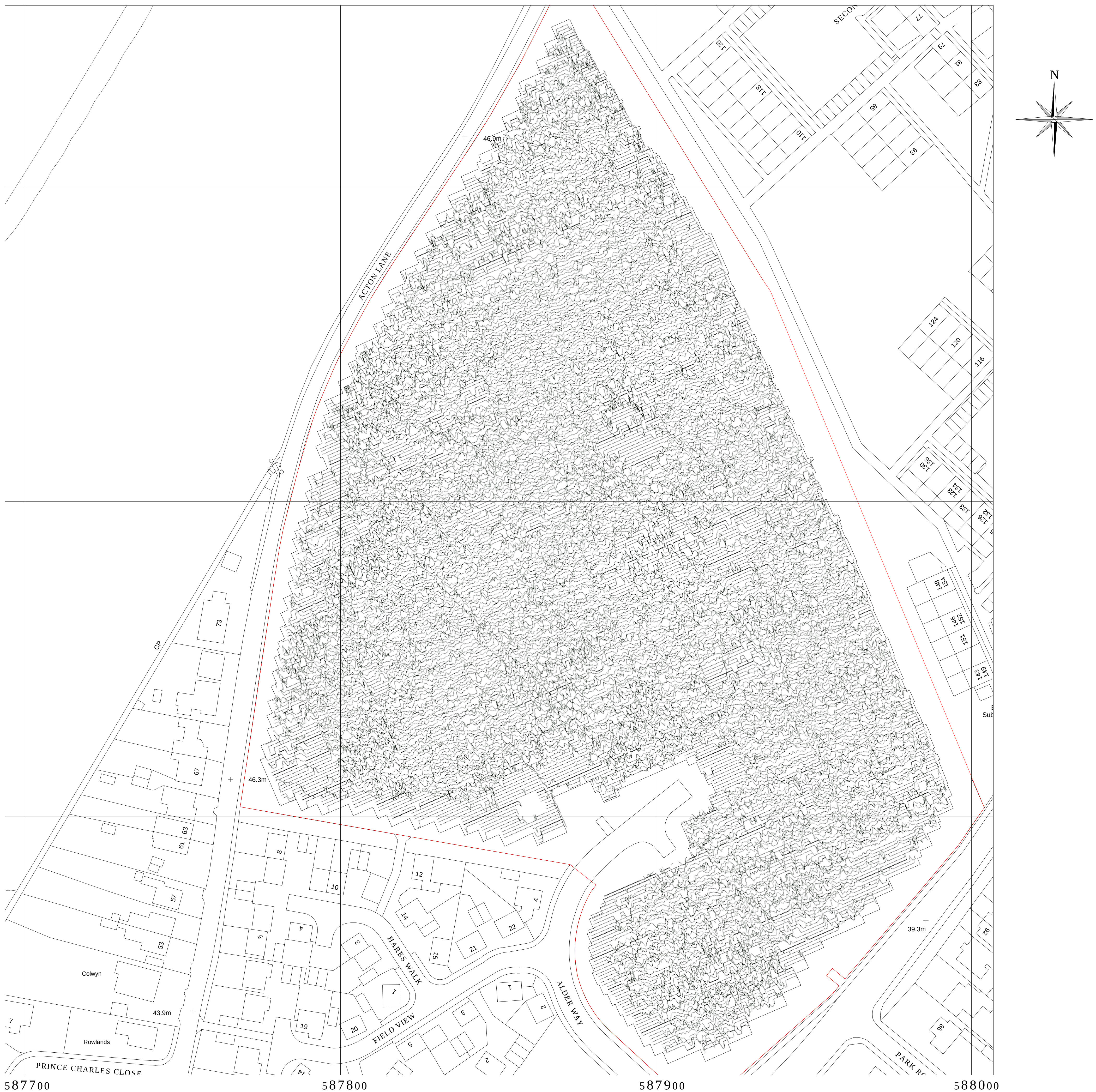

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	Site Boundary

NGR: 587900 242100

REPORT NUMBER: 1009

PROJECT:
HARP CLOSE MEADOW, SUDBURY, SUFFOLK

CLIENT:
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DESCRIPTION:
RAW CORRECTED XY TRACE PLOT

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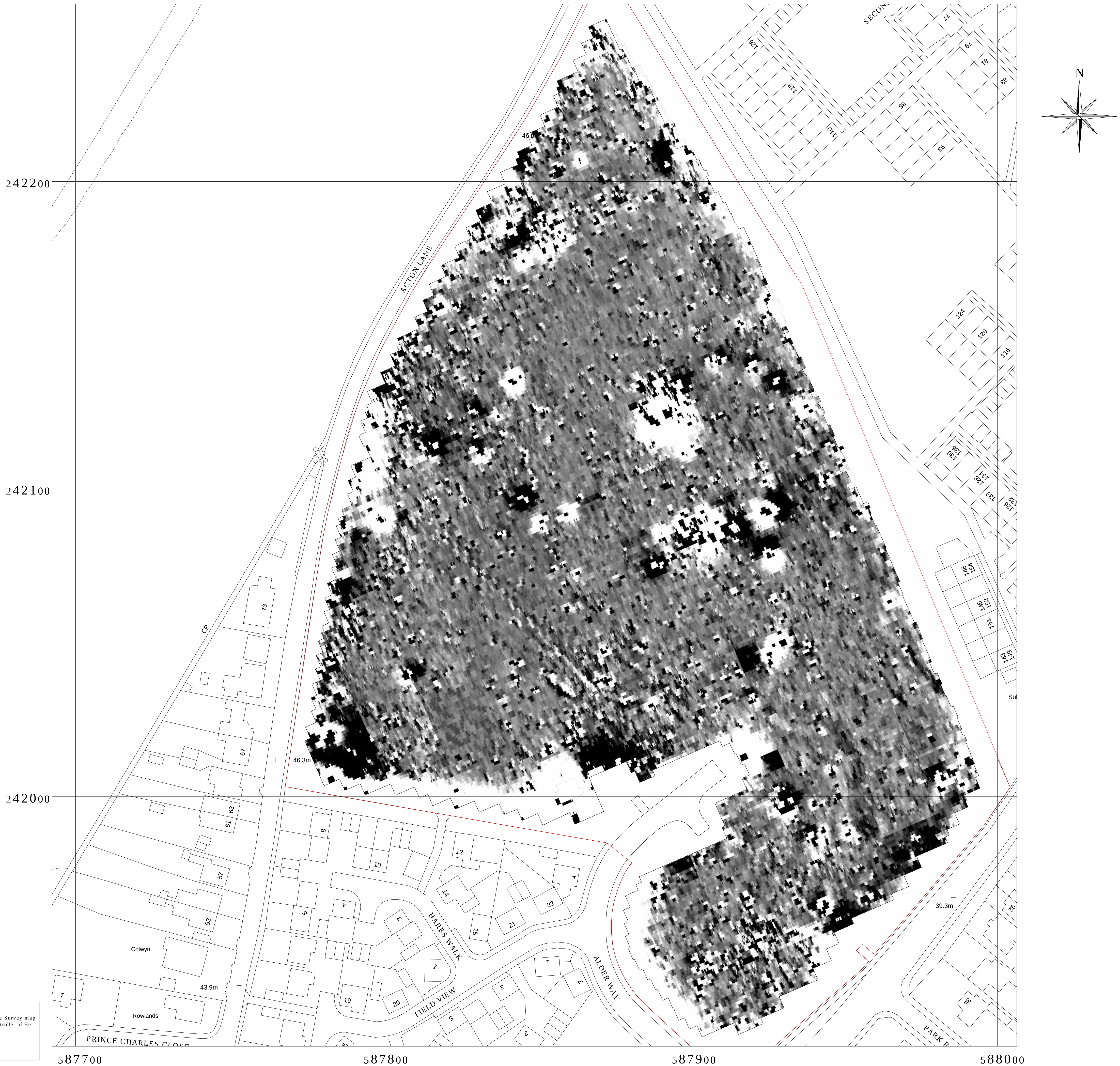

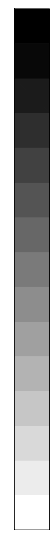

Site Boundary

NGR: 587900 242100

REPORT NUMBER: 1009

PROJECT: HARP CLOSE MEADOW, SUDBURY, SUFFOLK

CLIENT: ANDREW TESTER

DESCRIPTION: PROCESSED GREYSCALE PLOT

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PLOT: A3

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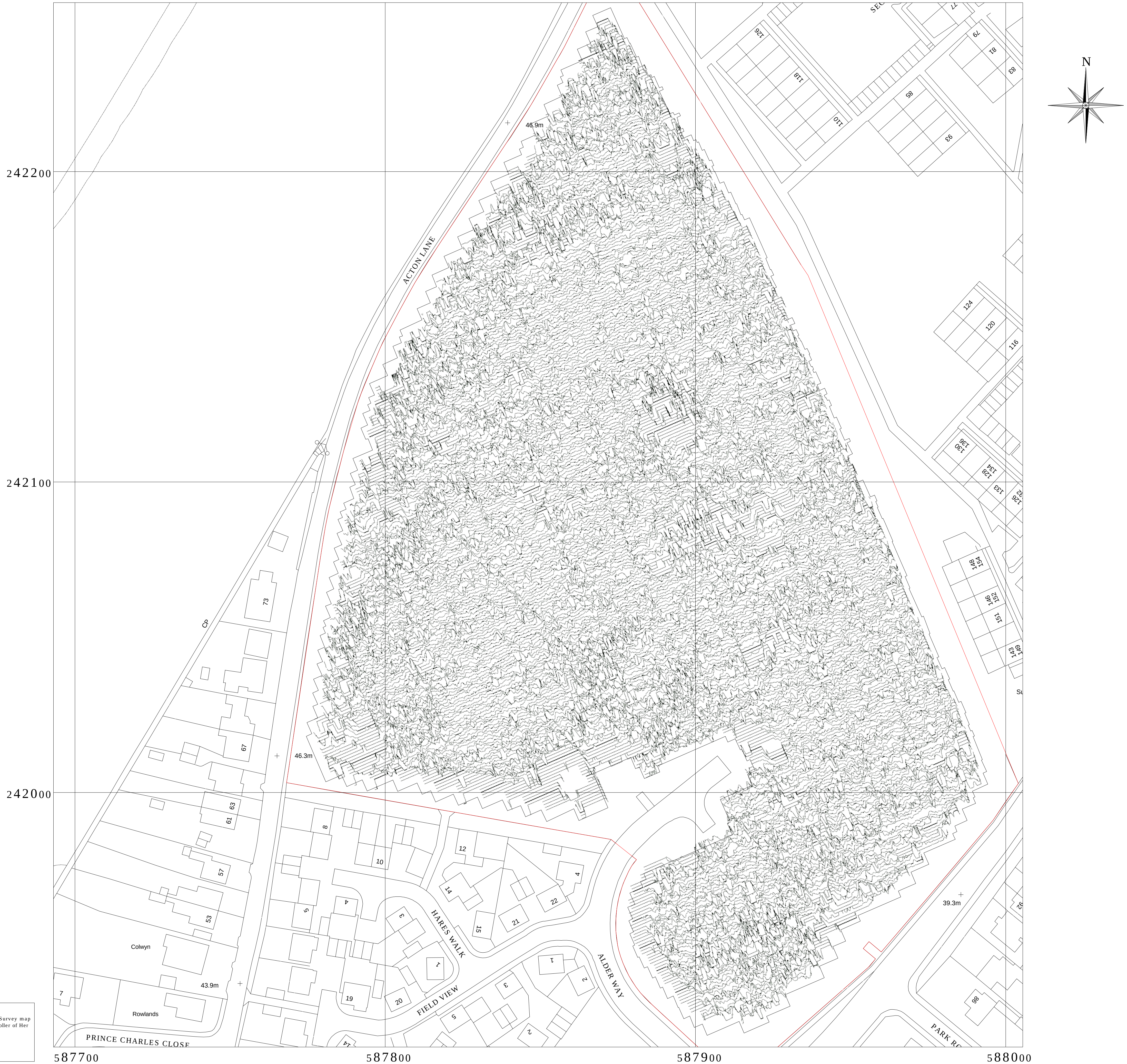
AUTHOR: TPS

FIGURE: 05



12 nT/cm	Scale Interval
	Site Boundary

NGR: 587900 242100

REPORT NUMBER: 1009

PROJECT:

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CLIENT:

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DESCRIPTION:

PROCESSED XY TRACE PLOT

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DATE:	AUTHOR:	FIGURE:
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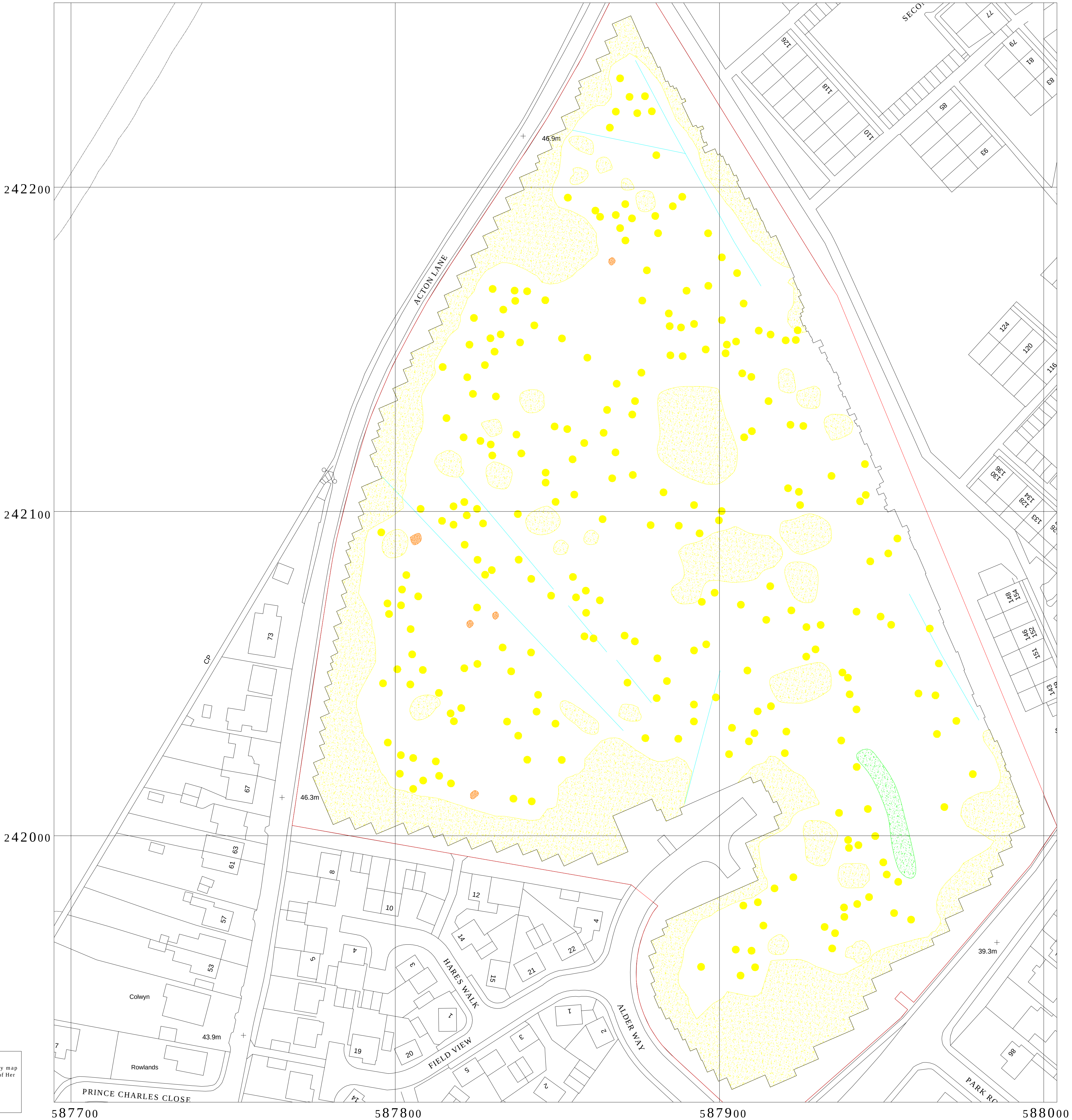

Positive Discrete Anomaly, Archaeology?
Very Weak Dipolar Linear Anomaly, Service Run
Area of Magnetic Disturbance, Ferrous Material
Dipolar Anomaly, Ferrous Material
Broad Weak Positive Linear Anomaly, Natural?
Site Boundary

NGR: 587900 242100

REPORT NUMBER: 1009

PROJECT: HARP CLOSE MEADOW, SUDBURY, SUFFOLK

CLIENT: ANDREW TESTER

DESCRIPTION: INTERPRETATION OF MAGNETOMETER ANOMALIES

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PLOT: A3	APPROVED: MCA	VERSION: 01
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