



RESERVOIR SITE 2, CAPEL ST ANDREW, SUFFOLK

DETAILED MAGNETOMETER SURVEY



Report Number: 1083

January 2015



RESERVOIR SITE 2, CAPEL ST ANDREW, SUFFOLK

Detailed Magnetometer Survey

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Site Code	BUT 089	NGR	TM 365 503
Planning Ref.	-	OASIS	britanni1-201284
Approved By	Dan McConnell	DATE	January 2015



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ABSTRACT

In January 2015, Britannia Archaeology Ltd undertook a detailed fluxgate gradiometer survey over c.2.36 hectares of land at Reservoir Site 2, Capel St Andrew, Suffolk, in one agricultural field, covering the footprint of a proposed agricultural reservoir.

The survey was successful in recording a fairly wide range of anomalies, some of which have a potential archaeological origin. A series of parallel and perpendicular positive linear anomalies interpreted as ditches forming enclosures (potentially a ladder-type settlement), that are in close proximity to and respecting eight positive discretas (potential rubbish pits) and one area of burning.

Four positive linear trends are likely to be the remains of backfilled post-medieval field boundaries and narrow weak positive linear trends record the presence of a probable modern land drainage system. Extant wheel ruts recorded within the dataset as negative and positive parallel linear trends did cause a degree of difficulty when interpreting the data to the south-west of the large hollow. One weak dipolar curvilinear trend potentially records the presence of a service trench run.

A broad range of the anomaly types should be further ground-tested to test the interpretations given within this report. The main focus of any further work however should be on the anomalies that have been interpreted as being of a potential archaeological origin.



1.0 INTRODUCTION

On Tuesday 20th January 2015 Britannia Archaeology Ltd (BA) undertook detailed fluxgate gradiometer survey over c.2.36 hectares of land to the north of Capel St Andrew and to the south of Butley, Suffolk (NGR TM 365 503) in one agricultural field to cover the proposed footprint of an agricultural reservoir (Figure 1).

This survey was commissioned by Rhodri Gardener of Suffolk County Council Archaeological Service/Field Team. The weather was predominantly sunny with overcast periods and sleet-fall in the second half of the day, following a relatively long period of precipitation.

2.0 SITE DESCRIPTION

The site is located in one agricultural field to the south of Woodbridge Road and to the west of Church Road, it slopes down from the north at 20m AOD to south the at 15m AOD.

The bedrock comprises Chillesford Clay, a sedimentary deposit formed approximately 2 million years ago in the Quaternary Period when the local environment was dominated by shallow seas with mainly siliciclastic sediments deposited as mud, silt, sand and gravel (BGS, 2015).

At the time of writing no superficial deposits were described for this area (BGS, 2015).

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) which replaces Planning Policy Statement 5: Planning for the Historic Environment (PPS5, DCLG 2010). The relevant local planning policy is the *Suffolk Coastal Local Plan; incorporating First and Second Amendments* (March 2006) which is due to be replaced with the *Suffolk Coastal Local Development Framework* in the near future.

3.1 National Planning Policy Framework (NPPF, DCLG March 2012)

The NPPF recognises that 'heritage assets' are an irreplaceable resource and planning authorities should conserve them in a manner appropriate to their significance when considering development. It requires developers to record and advance understanding of the significance of any heritage assets to be lost (wholly or in part) in a manner proportionate to their importance and the impact, and to make this evidence (and any archive generated) publicly accessible. The key areas for consideration are:

- The significance of the heritage asset and its setting in relation to the proposed development;



- The level of detail should be proportionate to the assets' importance and no more than is sufficient to understand the potential impact of the proposal on their significance;
- Significance (of the heritage asset) can be harmed or lost through alteration or destruction, or development within its setting. As heritage assets are irreplaceable, any harm or loss should require clear and convincing justification;
- Local planning authorities should not permit loss of the whole or part of a heritage asset without taking all reasonable steps to ensure the new development will proceed after the loss has occurred;
- Non-designated heritage assets of archaeological interest that are demonstrably of equivalent significance to scheduled monuments, should be considered subject to the policies for designated heritage assets.

3.2 *Suffolk Coastal District Council (Policy AP7. 31st March 2006)*

The local plan for the Suffolk Coastal District deals with development on archaeological sites in section AP7, this states the following:

In considering planning applications, outline or detailed, for development that might affect sites that are known or are likely to contain archaeological remains, the Council will require the following. Where necessary, these should be preceded by a professional archaeological assessment as to the likelihood that remains might be encountered and their importance.

- a field evaluation in those cases where the assessment suggests that important archaeological remains may exist but it is unable to be precise about their nature or extent. The field evaluation shall be carried out by an approved archaeological contractor in accordance with a specification agreed with the Council;
- the preservation of archaeological remains in situ where the assessment and/or field evaluation indicate that the remains are important. Even where lesser remains exist, consideration must be given to the desirability of preserving them in situ;
- adequate arrangements for "preservation by record" - a recording of the archaeological remains that would be lost in the course of works for which permission is being sought - in those cases where arguments in favour of the development outweigh the significance of the remains;
- Development that would adversely affect a Scheduled Ancient Monument, its setting or remains will not be permitted.

4.0 ARCHAEOLOGICAL BACKGROUND

The preferred location of the agricultural reservoir was surveyed previously in 2014 by Britannia Archaeology Ltd (Schofield, T. P. 2014), anomalies indicative of a substantial medieval settlement on the fringes of The Green in Capel St Andrew were recorded;



therefore this site was deemed to be too archaeologically rich to construct the reservoir. The second proposed reservoir site is located 1.5km to the north of the previous survey over an area comprising c.2.36 hectares, Britannia Archaeology Ltd undertook detailed fluxgate gradiometer survey here in January 2015.

5.0 PROJECT AIMS

The geophysical survey was required to inform the location of the subsequent trial trench evaluation which will ground-truth the results recorded by the fluxgate gradiometer. Suffolk County Council Archaeological Service will be undertaking the trial trench evaluation and will prepare a separate written scheme of investigation.

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

6.2 Instrument Calibration

One hour was allowed in the morning for the magnetometers sensors to settle before the start of the first grid. The instrument was zeroed after every three to five grids to minimise the effect of sensor drift. An area with a relatively low magnetic reading was chosen to calibrate the instrument; this same point was used to zero the sensors throughout the survey providing a common zero point. The survey was undertaken during sunny periods which caused a degree of sensor drift and the characteristic parallel traverse 'striping' that is 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 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 $\pm 0.1\text{m}$ employing a Leica Viva Glonass Smart Rover GS08 real time kinetic (RTK) survey system. Data were converted to the National Grid Transformation OSTN02 and the instrument was regularly tested using stations with known ETRS89 coordinates. The grids were positioned on a north-east to south-west alignment (Figure 1).



6.5 Data Capture

Instrument readings were recorded on an internal data logger that were downloaded to a laptop at midday followed by a second download at the end of the survey. The grid order was recorded on a BA pro-forma to aid in the creation of the data composites. Data were filed in job specific folders. These data composites were checked for quality on site by BA, allowing grids to be re-surveyed if necessary. The data were backed up onto an external storage device in the office and finally a remote server at the end of the day.

6.6 Data Presentation and Processing

Data are presented in both raw and processed data plots in greyscale format (Figures 2 and 3). An XY trace plot of the processed data has also been included (Figure 4).

The raw data 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: 4.00 standard deviations;
Display Clipping: +/- 3 standard deviations.

Processed Data:

De-stripe: Median Sensors: 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 v2.5.16.0 and will be stored in this format as raw data. The software used to process the data and produce the composites was also DW Consulting's Archeosurveyor v2.5.16.0. Datasets were exported into AutoCAD and placed onto the local survey grid. Interpretation plots were then produced using AutoCAD.

6.8 Grid Restoration

Britannia Archaeology Ltd did not position any reference stations within the field, three virtual geo-referenced survey stations are presented in Figure 1 that will allow the survey grid and anomalies to be accurately targeted.



7.0 RESULTS & DISCUSSION

Isolated dipolar ('iron spike') responses (yellow hatched circles) were present throughout the dataset and record the presence of ferrous material deposited within the topsoil. It is possible that some may relate to buried archaeological artefacts or equally introduced during episodes of manuring.

One slightly curving weak dipolar linear anomaly (grey hatching) is present in the north-east of the dataset that is possibly indicative of a modern service trench run that runs out of the survey area to the north, and into the large possible quarry hollow to the south.

A plethora of narrow positive and negative linear and curvilinear anomalies (cyan lines) are present throughout the dataset running north-east to south-west and perpendicular. These delineate the location of c.0.30m deep and wide wheel ruts that were present across the site and are particularly clustered to the south-west of the large hollow. Evidence of ground disturbance was witnessed by the surveyors in this area.

A series of evenly spaced narrow weak positive linear anomalies (green lines), the majority of which run north-west to south-east across the dataset, are most likely to have been caused by the presence of buried ceramic land drains.

Four weak positive linear anomalies (blue hatching) orientated north-west to south-east are likely to demarcate backfilled remnant field boundaries, one of which was backfilled between the printing of the 1957-58 and 1974-76 Ordnance Survey Maps (Figure 5). All are aligned on similar orientations to the existing field boundaries, and are probably of at least post-medieval construction.

One thermo-remnant response (magenta hatching) is located centre-north of the dataset. It is recorded respecting a positive linear anomaly (red hatching) and is also nearby a cluster of discrete anomalies (orange hatching). It is likely to be an area of burning, a large burnt pit or potentially relating to industrial activity (possibly a kiln, hearth or furnace).

Nine positive discrete anomalies (orange hatching) have been recorded, eight of which are clustered near to the perpendicular positive linear anomalies (red hatching). These discretely are likely to relate to material that has a positive magnetic reading and are commonly interpreted as potential archaeological rubbish pits.

Eleven parallel and perpendicular positive linear and curvilinear anomalies (red hatching) have been recorded in the dataset, the majority of which are present in the central portion of the plot. They are all approximately aligned on a north to south orientation, which is notably slightly different to the layout of the existing field boundaries. Many of these anomalies appear to respect one another and together with their orientations, it would appear that they are from a similar phase of enclosure building activity that may prove to be a settlement.



8.0 CONCLUSION

This detailed fluxgate gradiometer survey was successful in recording a fairly wide range of anomalies, some of which have a potential archaeological origin. The results reveal a series of parallel and perpendicular positive linear anomalies interpreted as ditches forming enclosures (potentially a ladder-type settlement), that are in close proximity to and respecting eight positive discrettes (potential rubbish pits) and one area of burning.

Four positive linear trends are likely to be the remains of backfilled post-medieval field boundaries and narrow weak positive linear trends record the presence of a probable modern land drainage system. Extant wheel ruts recorded within the dataset as negative and positive parallel linear trends did cause a degree of difficulty when interpreting the data to the south-west of the large hollow. One weak dipolar curvilinear trend potentially records the presence of a service trench run.

A broad range of the anomaly types should be further ground-tested to test the interpretations given within this report. The main focus of any further work however should be on the anomalies that have been interpreted as being of a potential archaeological origin.

9.0 PROJECT ARCHIVE AND DEPOSITION

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

10.0 ACKNOWLEDGEMENTS

Britannia Archaeology Ltd would like to thank Dr Rhodri Gardener of SCCAS for commissioning the project.



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Cartographic Sources

Ordnance Survey County Series: Suffolk. 1904. 1:2500.

Ordnance Survey County Series: Suffolk. 1905. 1:10560.

Ordnance Survey Plan. 1957-58. 1:10560.

Ordnance Survey Plan. 1974-76. 1:2500.

Ordnance Survey Plan. 1977-83. 1:10000.



APPENDIX 1 METADATA SHEETS

Raw Data

Filename	Capel St Andrew 2R.xcp
Description	
Instrument Type	Grad 601-2 (Gradiometer)
Units	nT
Surveyed by	TPS/DPM on 1/20/2015
Assembled by	TPS on 1/20/2015
Direction of 1st Traverse	45 deg
Collection Method	ZigZag
Sensors	2 @ 1.00 m spacing.
Dummy Value	32702.00
Dimensions	
Composite Size (readings)	1600 x 100
Survey Size (meters)	400.00m 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	11.50
Min	-10.91
Std Dev	2.01
Mean	0.28
Median	0.30
Composite Area	4.00 ha
Surveyed Area	2.41 ha
Program	
Name	ArcheoSurveyor
Version	2.5.16.0

Processed Data

Filename	Capel St Andrew 2P.xcp
Description	
Instrument Type	Grad 601-2 (Gradiometer)
Units	nT
Surveyed by	TPS/DPM on 1/20/2015
Assembled by	TPS on 1/20/2015
Direction of 1st Traverse	45 deg
Collection Method	ZigZag
Sensors	2 @ 1.00 m spacing.
Dummy Value	32702.00
Dimensions	
Composite Size (readings)	1600 x 100
Survey Size (meters)	400.00m 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	2.49
Min	-2.33
Std Dev	0.96
Mean	0.02
Median	0.00
Composite Area	4.00 ha
Surveyed Area	2.41 ha
Program	
Name	ArcheoSurveyor
Version	2.5.16.0



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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.



APPENDIX 3 OASIS FORM

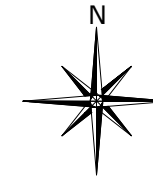
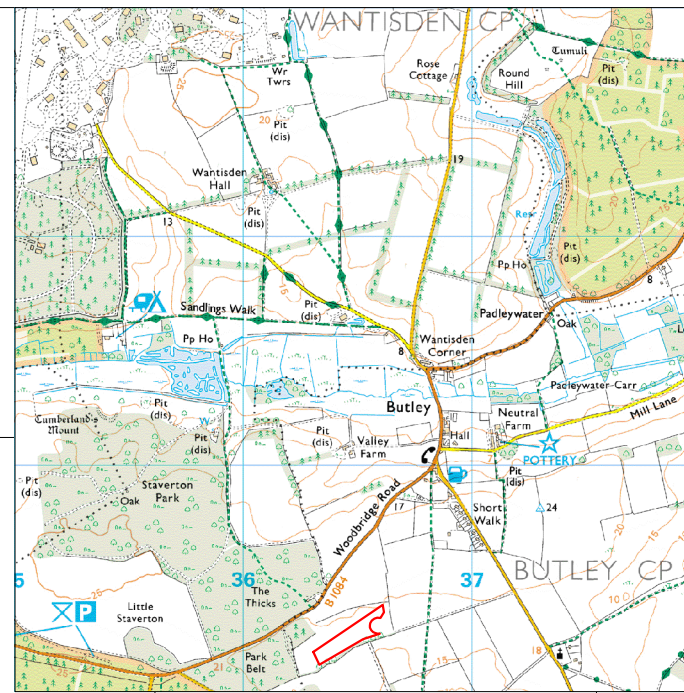
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Project details

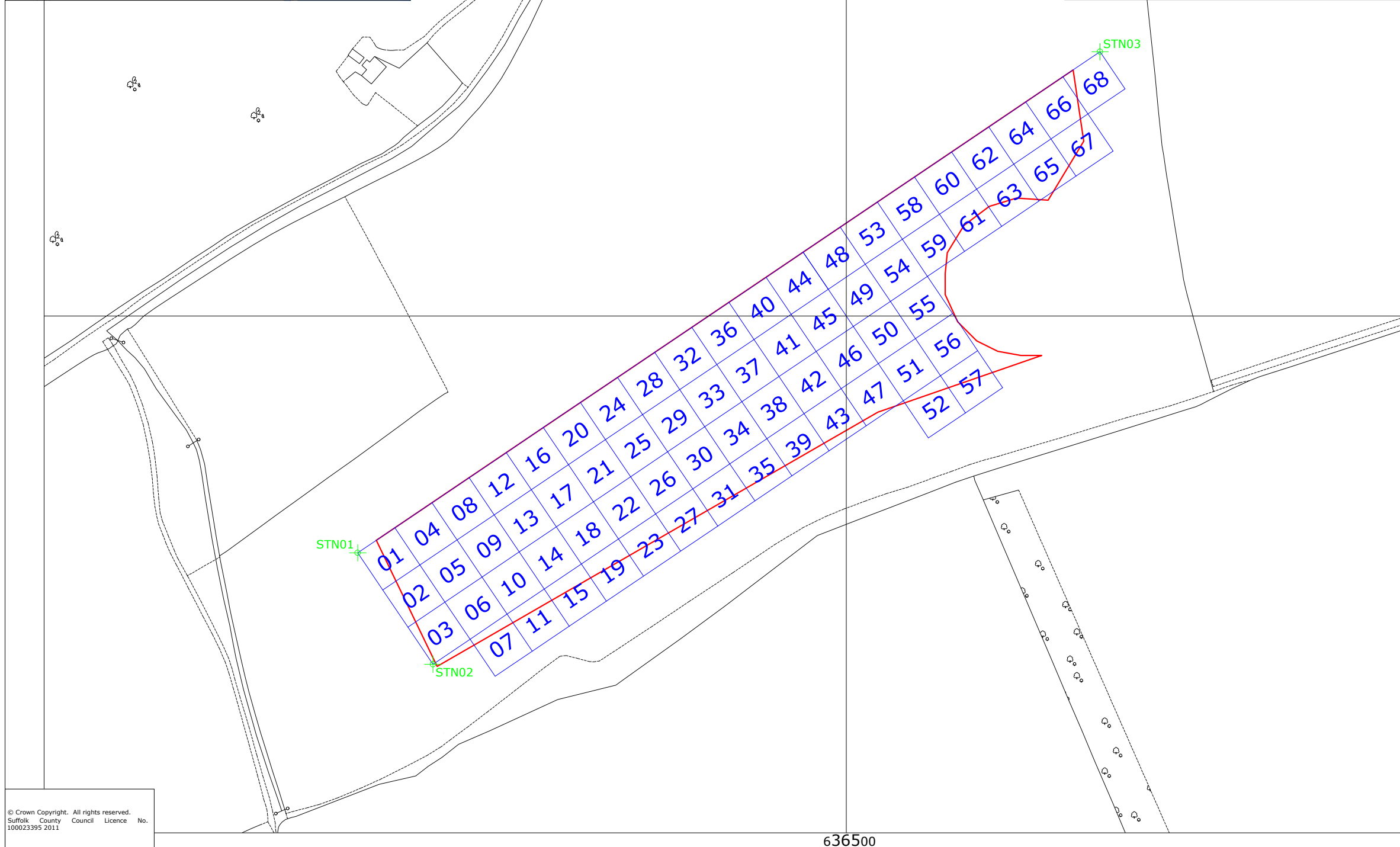
Project name	Reservoir Site 2, Capel St Andrew, Suffolk; Detailed Magnetometer Survey.
Short description of the project	<p>In January 2015, Britannia Archaeology Ltd undertook a detailed fluxgate gradiometer survey over c.2.36 hectares of land at Reservoir Site 2, Capel St Andrew, Suffolk, in one agricultural field, covering the footprint of a proposed agricultural reservoir. The survey was successful in recording a fairly wide range of anomalies, some of which have a potential archaeological origin. A series of parallel and perpendicular positive linear anomalies interpreted as ditches forming enclosures (potentially a ladder-type settlement), that are in close proximity to and respecting eight positive disretes (potential rubbish pits) and one area of burning. Four positive linear trends are likely to be the remains of backfilled post-medieval field boundaries and narrow weak positive linear trends record the presence of a probable modern land drainage system. Extant wheel ruts recorded within the dataset as negative and positive parallel linear trends did cause a degree of difficulty when interpreting the data to the south-west of the large hollow. One weak dipolar curvilinear trend potentially records the presence of a service trench run. A broad range of the anomaly types should be further ground-tested to test the interpretations given within this report. The main focus of any further work however should be on the anomalies that have been interpreted as being of a potential archaeological origin.</p>
Project dates	Start: 20-01-2015 End: 20-01-2015
Previous/future work	No / Not known
Any associated project reference codes	P1077B - Contracting Unit No. BUT 089 - Sitecode
Type of project	Field evaluation
Site status	None
Current Land use	Cultivated Land 3 - Operations to a depth more than 0.25m
Monument type	NONE None
Significant Finds	NONE None
Methods & techniques	""Geophysical Survey""
Development type	Agricultural Reservoir
Prompt	Direction from Local Planning Authority - PPS
Position in the planning process	Pre-application
Solid geology (other)	Chillesford Clay
Drift geology	Unknown
Techniques	Magnetometry
Project location	
Country	England
Site location	SUFFOLK SUFFOLK COASTAL BUTLEY Reservoir Site 2, Capel St Andrew, Suffolk
Study area	2.36 Hectares
Site coordinates	TM 365 503 52.0998063907 1.45352794254 52 05 59 N 001 27 12 E Point
Height OD /Depth	Min: 15.00m Max: 20.00m
Project creators	
Name of Organisation	Britannia Archaeology Ltd
Project brief originator	Consultant





Project design originator	Timothy Schofield
Project director/manager	Timothy Schofield
Project supervisor	Timothy Schofield
Type of sponsor/funding body	Archaeological Contractor
Name of sponsor/funding body	Suffolk County Council Archaeological Service
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"
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Entered on	19 February 2015



STATION	EASTING	NORTHING
01	636281.805	250194.267
02	636315.365	250144.531
03	636613.388	250417.992



	Survey Grid Location
	Site Boundary

NGR: TM 3650 5030	REPORT NUMBER: 1083
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PROJECT:
RESERVOIR SITE 2, CAPEL ST ANDREW, SUFFOLK

CLIENT:


DESCRIPTION:
SITE, SURVEY GRID & GEOREFERENCING INFORMATION PLAN

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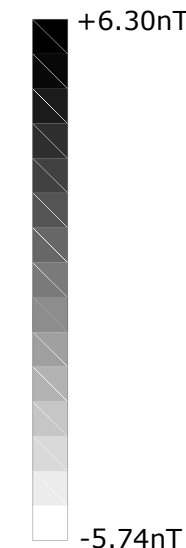
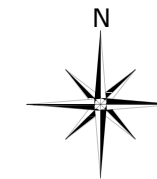
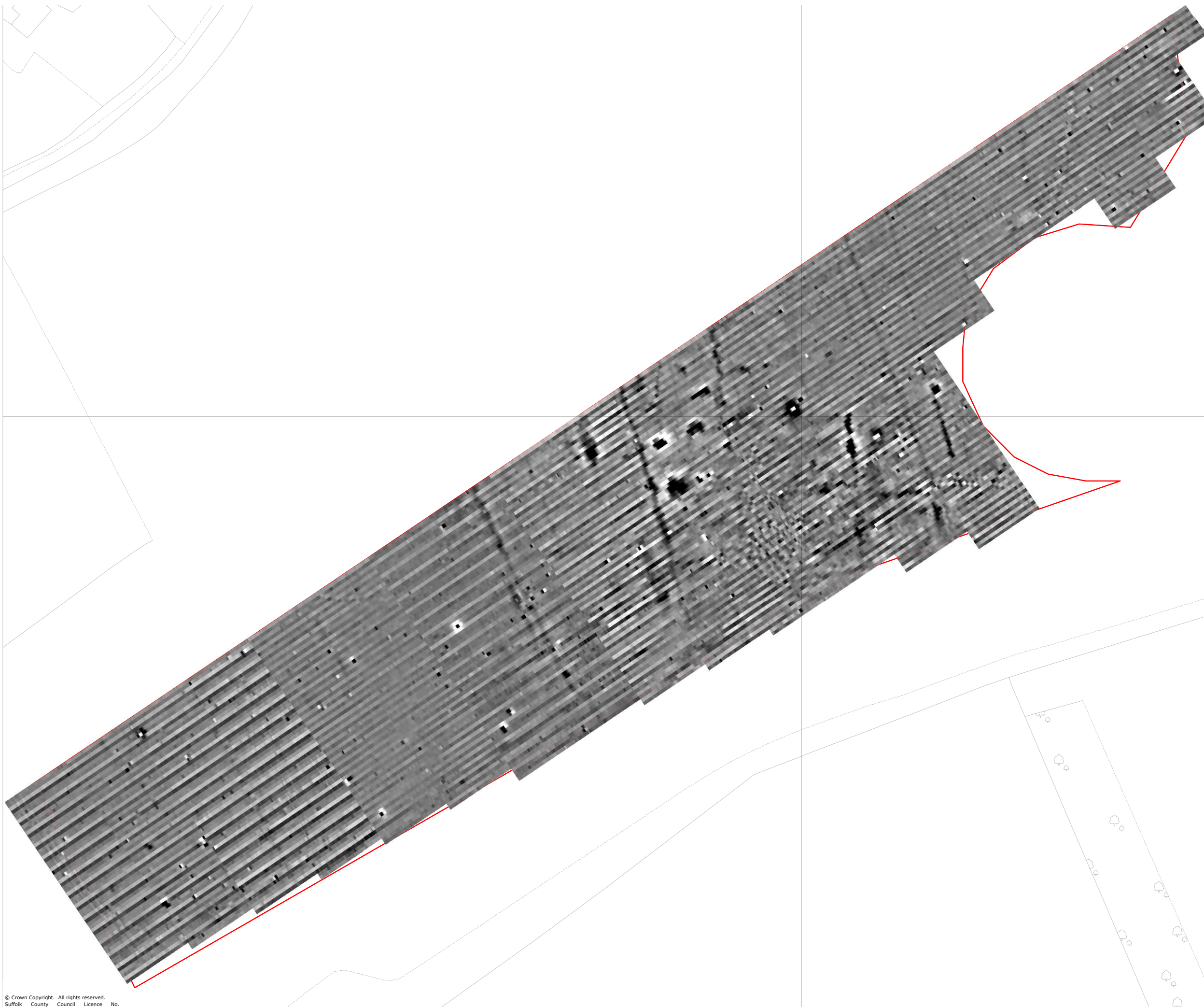


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SCALE: 1:2000	
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PLOT: A3	APPROVED: MCA	VERSION: 01
DATE: JAN 2015	AUTHOR: TPS	FIGURE: 01



250300

 Site Boundary

NGR: TM 3650 5030 REPORT NUMBER: 1083

PROJECT:
RESERVOIR SITE 2, CAPEL ST
ANDREW, SUFFOLK

CLIENT:


DESCRIPTION:
RAW MAGNETOMETER
GREYSCALE PLOT

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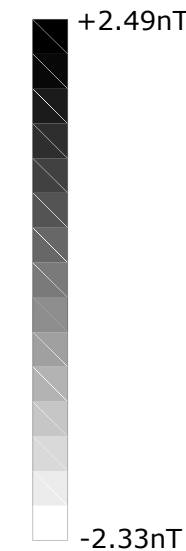
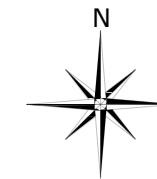
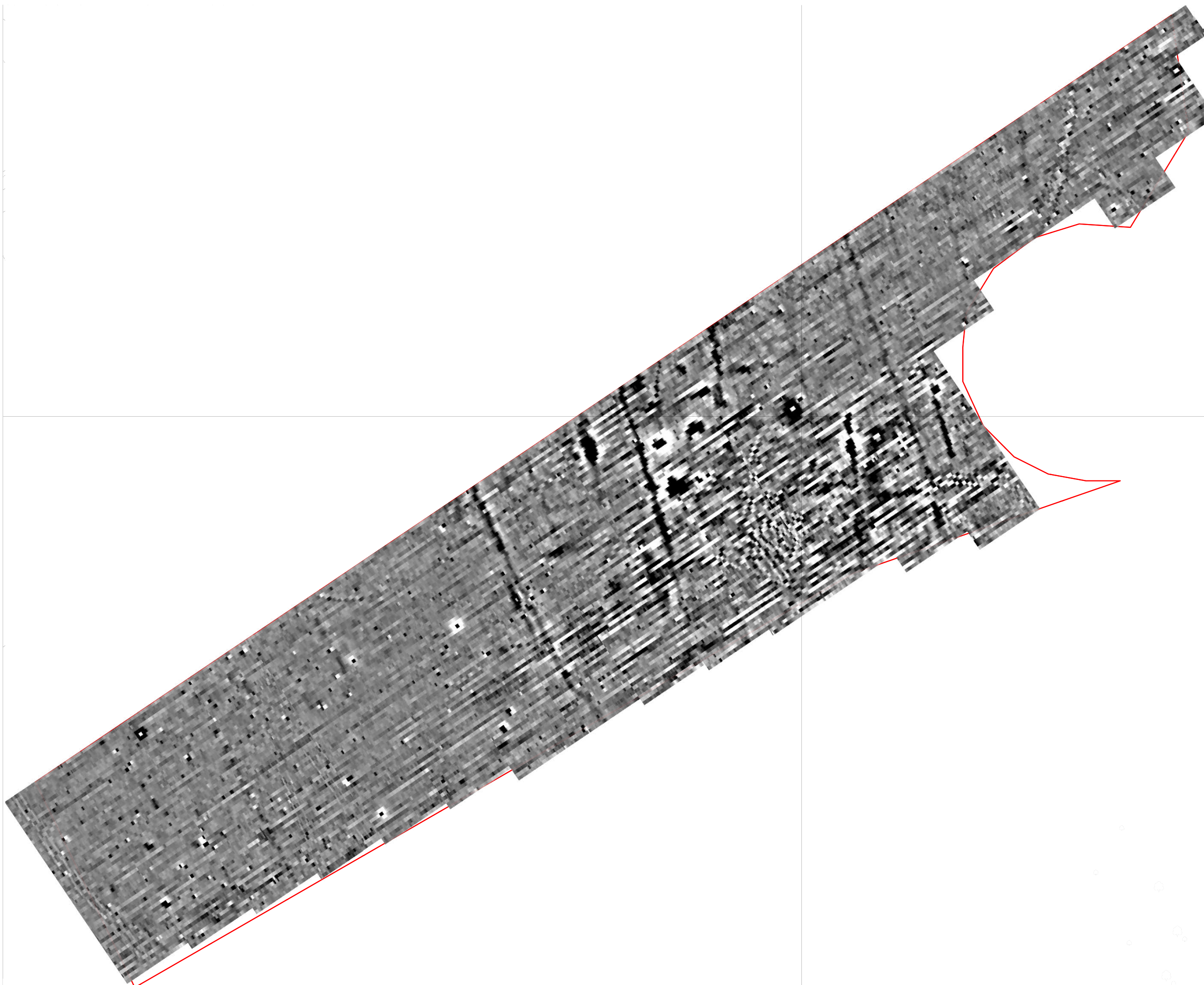
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SCALE: 1:1000 0 50m

PLOT: A3 APPROVED: MCA VERSION: 01


DATE: JAN 2015 AUTHOR: TPS FIGURE: 02

636500



250300

636500

 Site Boundary

NGR: TM 3650 5030 REPORT NUMBER: 1083

PROJECT:
RESERVOIR SITE 2, CAPEL ST
ANDREW, SUFFOLK

CLIENT:


DESCRIPTION:
PROCESSED MAGNETOMETER
GREYSCALE PLOT

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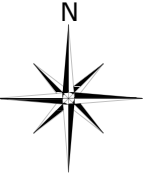
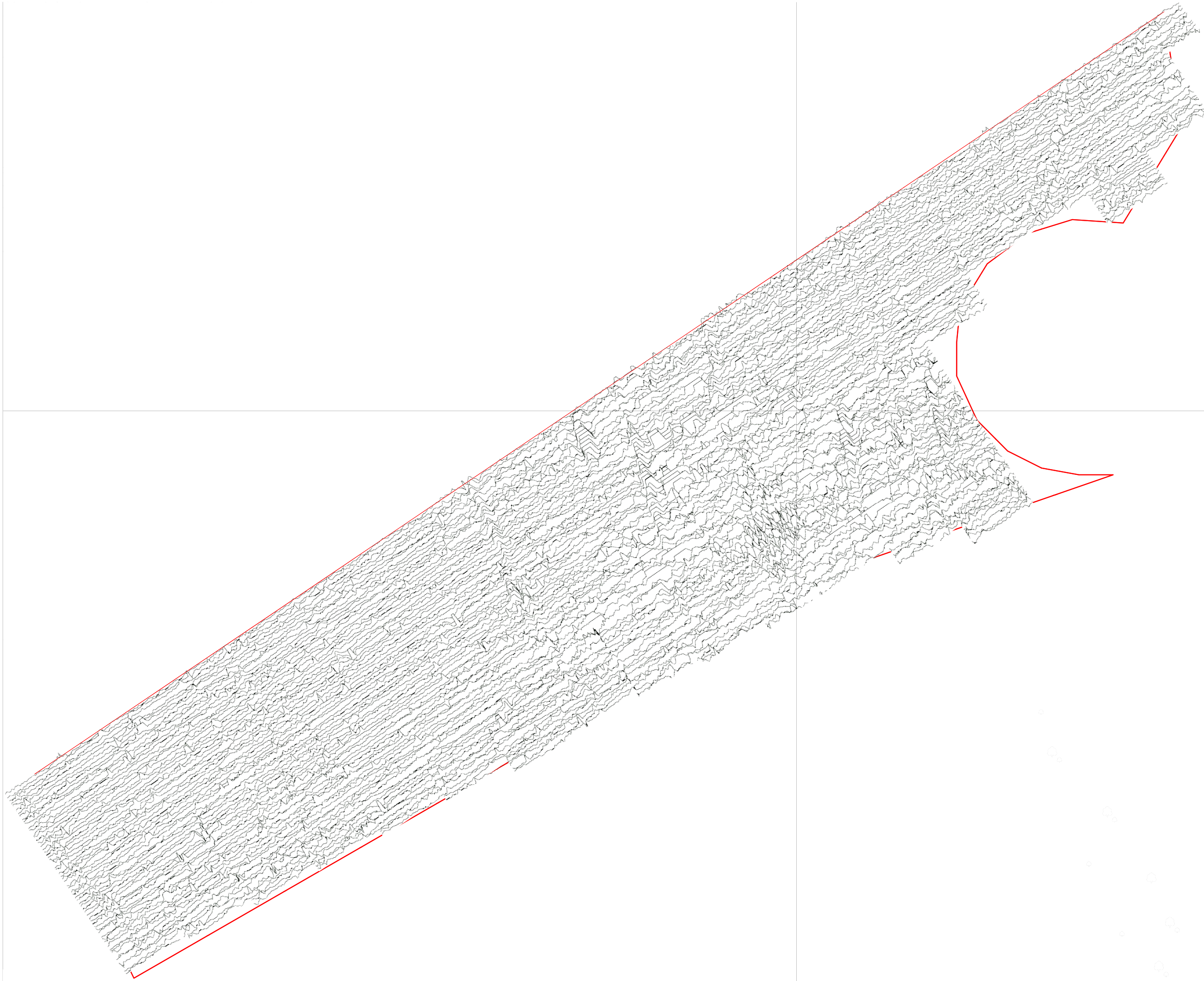
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SCALE: 1:1000 0 50m

PLOT: A3 APPROVED: MCA VERSION: 01

DATE: JAN 2015 AUTHOR: TPS FIGURE: 03



250300

31nT/cm	Scale Interval
	Site Boundary

NGR:	TM 3650 5030	REPORT NUMBER:	1083
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PROJECT:
RESERVOIR SITE 2, CAPEL ST
ANDREW, SUFFOLK

CLIENT:



DESCRIPTION:
PROCESSED MAGNETOMETER
XY TRACE PLOT

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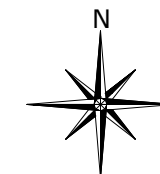
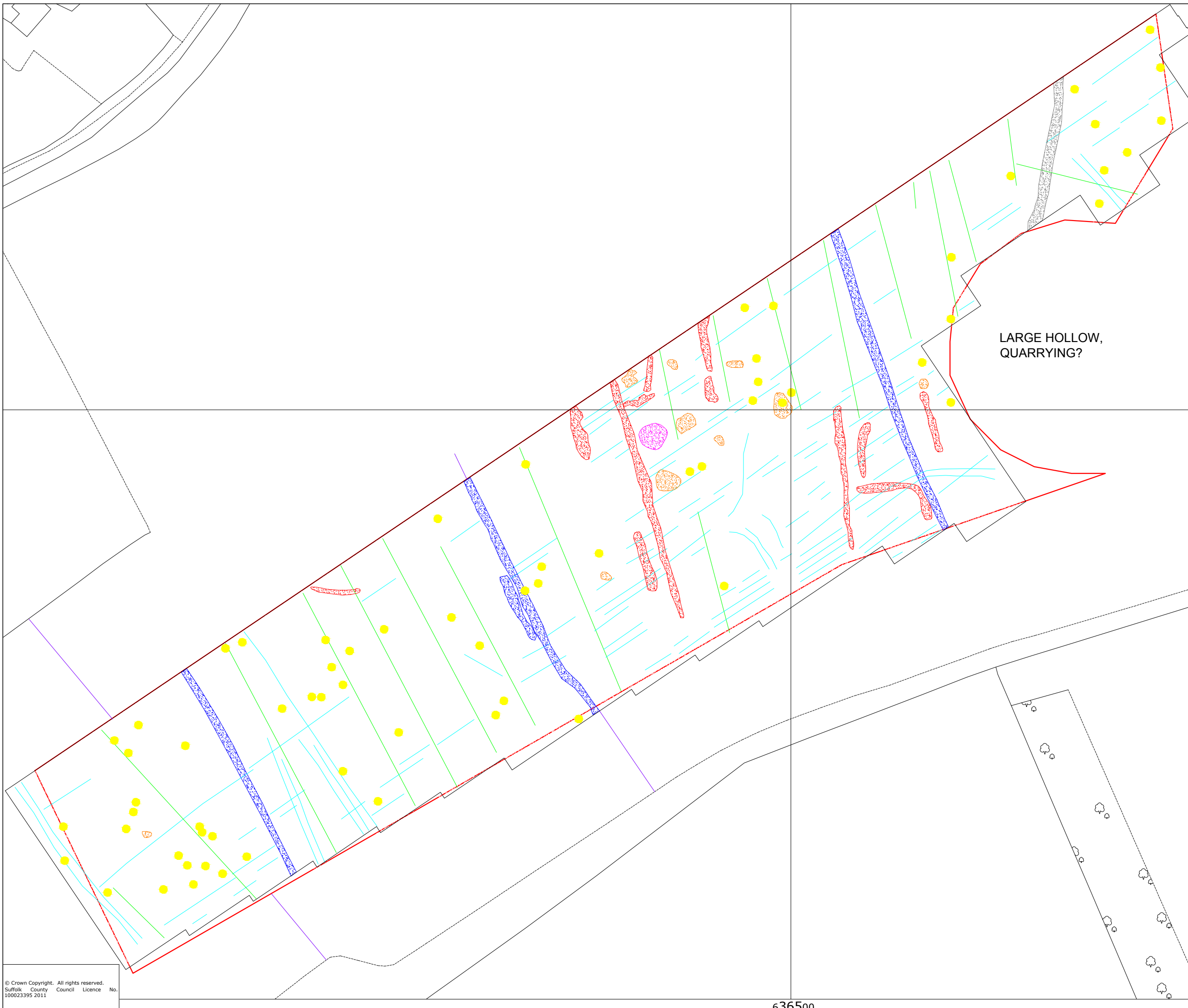
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PLOT:	APPROVED:	VERSION:
A3	MCA	01

DATE:	AUTHOR:	FIGURE:
JAN 2015	TPS	04

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	Positive Linear Anomaly, Archaeology
	Positive Discrete Anomaly, Archaeology
	Thermo-remnant Response, Area Of Burning
	Weak Positive Linear Anomaly, Remnant Field Boundary
	Narrow Weak Positive Linear Anomalies, Land Drains
	Narrow Negative & Positive Linear Anomalies, Wheel Ruts
	Weak Dipolar Linear Anomaly, Modern Service Trench?
	Isolated Dipolar Responses

250300

	Digitised Field Boundaries, OS Map 1957-58
	Site Boundary

NGR: TM 3650 5030	REPORT NUMBER: 1083
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PROJECT:
RESERVOIR SITE 2, CAPEL ST ANDREW, SUFFOLK

CLIENT:

DESCRIPTION:
INTERPRETATION PLOT OF MAGNETOMETER ANOMALIES

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