SUFFOLK ARCHAEOLOGY

• A HISTORY OF EXPERTISE •

Proposed Reservoir Knights Farm

Harkstead, Suffolk

Client:
Andrew Hawes

Date:
March 2018

HRK 097
Geophysical Survey Report
SACIC Report No. 2018/023
Author: Timothy Schofield HND BSc MCIfA

Proposed Reservoir, Knights Farm
Harkstead, Suffolk
HRK 097

Geophysical Survey Report

SACIC Report No. 2018/23

Author: Timothy Schofield

Illustrator: Timothy Schofield

Editor: Stuart Boulter

Report Date: March 2018

HER Information

Site Code:	**HRK 097**
Site Name:	**Proposed Reservoir, Knights Farm, Harkstead, Suffolk**
Report Number	**2018/23**
Planning Application No:	**DC/18/00373**
Date of Fieldwork:	**5th – 6th March 2018**
Grid Reference:	**TM 2020 3418**
Oasis Reference:	**310031**
Curatorial Officer:	**Rachael Abraham**
Project Officer:	**Timothy Schofield**
Client/Funding Body:	**Andrew Hawes**

Digital report submitted to Archaeological Data Service:
http://ads.ahds.ac.uk/catalogue/library/greylit

Prepared By: Timothy Schofield
Date: March 2018

Approved By: Stuart Boulter
Position: Senior Project Manager
Date: March 2018
Signed:

Contents

List of Figures

List of Appendices

Summary

In March 2018 Suffolk Archaeology Community Interest Company (SACIC) undertook a detailed fluxgate gradiometer survey on land set aside for a proposed agricultural reservoir at Knights Farm, Harkstead, Suffolk. A total area of 2.75ha was prospected for archaeologically derived anomalies within the cut line of the proposed reservoir.

The detailed fluxgate gradiometer survey recorded a narrow range of geophysical anomalies, indicative of archaeological pits, geological anomalies and a thermoremanent response. The results of the non-intrusive survey reveal a low potential for magnetic anomalies of an archaeological origin.

1. Introduction

The proposed reservoir and bunds will occupy a total area of *c.*2.85ha; however, topsoil stripping and subsequent excavation will only be undertaken in the central reservoir area with bunds built up from the existing ground level. Suffolk Archaeology Community Interest Company (hereafter SACIC) were contracted to carry out the geophysical survey within the central cut line, an area totalling 2.40 hectares, all within a single arable field, at Knights Farm, Harkstead, Suffolk (Fig. 1).

SACIC were commissioned to undertake the project by Andrew Hawes in March 2018, prior to determination of the planning application, in accordance with paragraph 128, 129 and 141 of the National Planning Policy Framework.

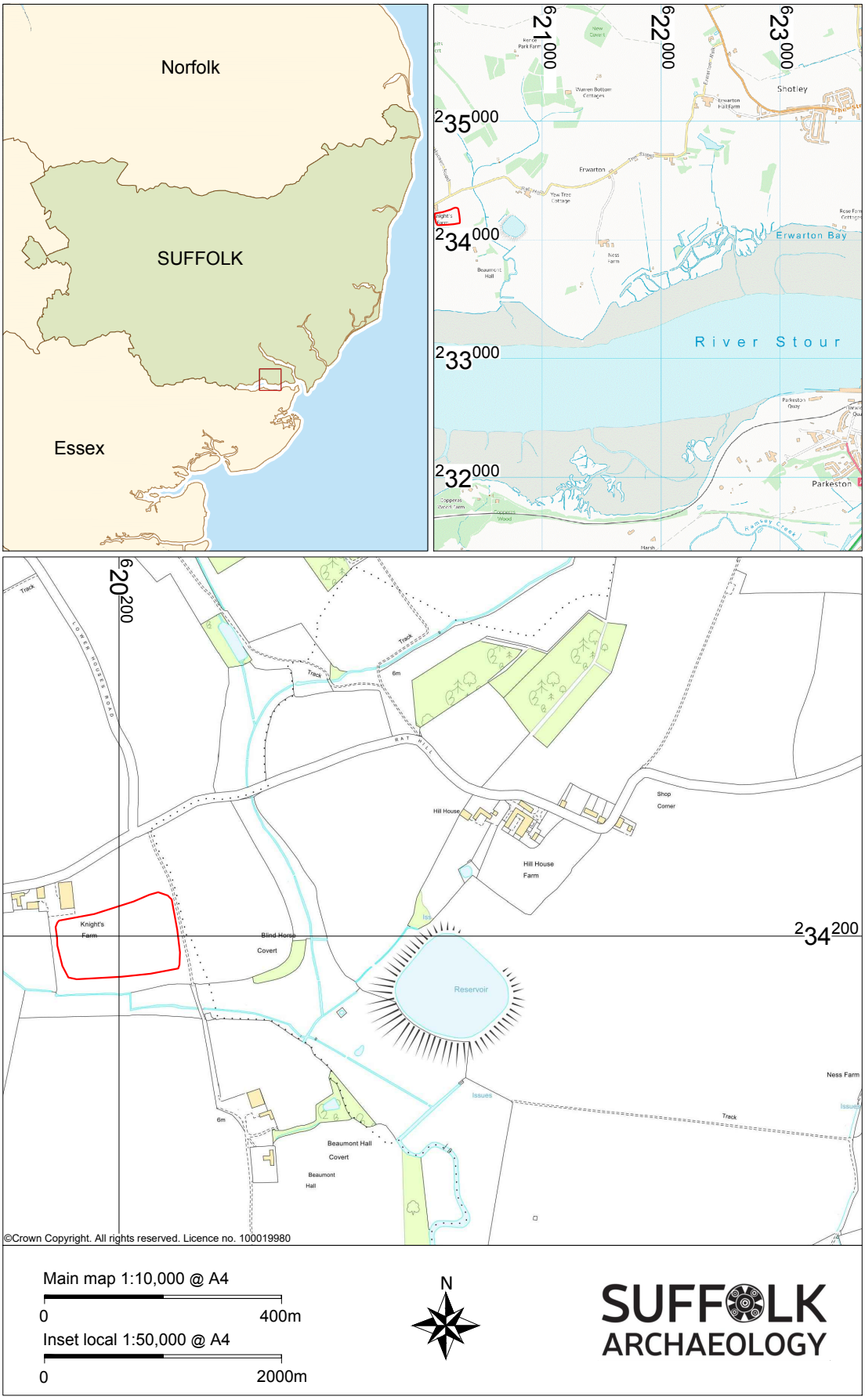

Figure 1. Site location showing site (red)

2. Geology and topography

The site lies within an arable landscape, located *c*.1.6km to the southeast of the settlement of Harkstead, in the southern half of a single field at TM 2020 3418. It is bounded on its eastern border by a farm track, to the west and south by hedgerows and The Street runs along the northern boundary (Fig.1).

The field slopes down from its northeastern corner at 12m above Ordnance Datum (AOD) to 4m AOD in the southwestern corner. Bedrock geology is sedimentary in nature, consisting of Thames Group clay, silt and sand, formed between 56 and 33.9 million years ago during the Palaeogene period. This is overlain by sedimentary superficial deposits of Lowestoft Formation sand and gravel, formed between 480 to 423 thousand years ago in the Quaternary Period (BGS 2018).

3. Archaeology and historical background

The geophysical survey was required by Suffolk County Council Archaeological Service (hereafter SCCAS), to inform the archaeological evaluation brief for the proposed agricultural reservoir. A background search of the records reveals that the site of the proposed reservoir is located within a fairly rich prehistoric to post-medieval landscape. A potential Bronze Age ring ditch (HRK 065) located within undated enclosures (HRK 066) has been recorded 450m to the north of Knights Farm. Potential Bronze Age, Iron Age and Roman enclosure systems (HRK 007, 072, 073) have also been identified 750m to the west at Nether Hall. Recorded 1000m to the east are a series of enclosure type cropmarks, thought to be prehistoric, Roman and post-medieval in date (ARW 014, 055). At Beaumont Hall 550m to the southeast (HRK 019 and 030), an undated square enclosure and ditch-type cropmarks are identified. A wide trackway has been recorded on aerial photography of unknown date (HRK 065), 300m to the south. A series of undated small ring ditches are recorded as cropmarks (HRK 034) at Sparrow Hall 630m to the southwest of the proposed reservoir, along with post-medieval field boundary enclosures (HRK 035).

An examination of the Ordnance Survey (OS) maps held by SACIC revealed a field boundary running from south to north in the western quarter of the site that was present in 1885, remaining in place until its removal sometime after the survey for the 1958 OS map edition. No other cartographic features were worthy of note.

4. Methodology

Instrument type

A Bartington DualGRAD 601-2 fluxgate gradiometer was employed to undertake the detailed geophysical survey; the weather, ground and geological soil conditions were found to be suitable.

Instrument calibration and settings

One hour was allocated to allow the instruments' sensors to reach optimum operating temperature before the survey commenced each day. The weather was wet and overcast, ground conditions were challenging with soft underfoot conditions, following heavy snowfall that had recently melted. Instrument sampling intervals were set to 0.25m along 1m traverses (four readings per metre).

Survey grid layout

The detailed survey was undertaken within 20m grids (Fig. 2, blue grid), orientated northeast to southwest and geolocated employing a Leica Viva GS14 Smart Rover RTK GLONASS/GPS, allowing an accuracy of +/- 0.03m. Data were converted to National Grid Transformation OSTN15.

Data capture

Detailed fluxgate gradiometer survey data points were recorded on an internal data logger that were downloaded and checked for quality at midday and in the evening, allowing grids to be re-surveyed if necessary. A pro-forma survey sheet was completed to allow data composites to be created. Data were filed in unique project folders and backed-up onto an external storage device and then a remote server in the evening.

Data software, processing and presentation

The site had a fairly high magnetic background signature, despite this the anomalies contrasted well with the local magnetic field. Good quality raw survey data was collected and minimal data processing was required. Datasets were composited and processed using DW Consulting's Terrasurveyor v.3.0.33.6; raw grid files, composites and raster graphic plots will be stored and archived in this format. Minimal processing algorithms were undertaken on the raw (Figs. 3 – 4) and processed datasets (Fig. 5); data schedules are presented in Appendix 1.

Data composites were exported as raster images into AutoCAD. An interpretation plan based on the combined results of the raw, processed and xy trace plots (Figs. 3 – 5) has been produced (Fig. 6).

Survey grid restoration

Three virtual survey grid stations were placed on survey grid nodes along the baselines of the survey grid, this will allow the geophysical anomalies to be retargeted during any subsequent evaluation trenching (Fig. 2).

5. Results and discussion

Ground conditions were found to be heavy underfoot due to the recent melting snow, despite this data was collected without incident. The relic field boundary depicted on the 1882 OS map and digitised in Figure 2, was not recorded by the magnetometer, possibly due to a lack of magnetic contrast. It would be very difficult to identify in the survey data if it was a ditch that had been sequentially backfilled using the same excavated material. It is possible that this boundary was in fact a hedge line, which the gradiometer would struggle to prospect.

Isolated dipolar responses (grey spots) were extremely common throughout the survey area, likely to be caused by magnetic or ferrous objects recorded within the topsoil. It is most probable that these artefacts are of a modern origin, introduced during manuring events, however it is also possible that they represent archaeological artefacts lost within the ploughsoil.

One area of magnetic disturbance (grey hatching) recorded in the southwestern corner of the dataset is thought to have been caused by magnetic material present within the field boundary.

Many broad positive diffuse linear anomalies (green hatching) indicative of natural magnetic changes within the geological horizon were prospected during the survey. These anomalies are thought to be natural channels, infilled during flood events, river course changes, glacial retreat and melting, which have deposited magnetic salts and minerals, and humic material.

A series of broad negative diffuse anomalies (cyan hatching) where recorded that are likely to be of a geological origin. In this instance the material left behind after the flood events or during glacial retreat has a low (negative) magnetic susceptibility compared with the average background signature.

Eleven strong discrete positive anomalies (orange hatching) indicative of archaeological pits were prospected across the survey area. A modern or natural origin however, cannot be ruled out.

One very strong thermoremanent response (magenta hatching) prospected in the southern half of the survey area could be archaeologically derived and is indicative of an area of burning, potentially a fire pit, hearth, kiln or a large magnetic object.

6. Conclusion

The archaeological potential of the site was expected to be high, however the gradiometer recorded only a narrow range of geophysical anomalies. Those with a broad, irregular form are likely to be geological channels that have been infilled by alluvial and fluvial processes associated with the River Stour and retreating glaciers. Air photographs taken in the fields immediately surrounding the site reveal cropmarks that appear to be of a similar geological origin (www.google.com/earth/).

Anomalies most likely to be archaeologically derived include those indicative of pits and a single thermoremanent response. It is possible that low contrast magnetic anomalies

remain undetected below the ploughsoil, therefore, it would be prudent to target the full range of anomalies recorded, using targeted evaluation trial trenching to assess the interpretations given within this report. Areas of low magnetic susceptibility should also be further targeted to assess whether archaeological features remain unrecorded.

7. Archive deposition

The paper and digital archive will be kept at the SACIC office in Needham Market, before deposition in the Suffolk County Council Stores in Bury St Edmunds.

8. Acknowledgements

The fieldwork was carried out by Cameron Bate and Catherine Douglas, and directed by Catherine Douglas. Project management was undertaken by Rhodri Gardner. The report and illustrations were created by Tim Schofield, and the report was edited by Stuart Boulter.

9. Bibliography

Ayala, G., et al, 2004, *Geoarchaeology; Using Earth Sciences to Understand the Archaeological Record.* English Heritage.

Brown, N., and Glazebrook, J, (eds), 2000, *Research and Archaeology: A Framework for the Eastern Counties, 2. Research Agenda and Strategy.* East Anglian Archaeology Occasional Paper No. 8.

Chartered Institute for Archaeologists, 2014, *Standard and Guidance for Archaeological Geophysical Survey.*

Clark, A. J., 1996, *Seeing Beneath the Soil, Prospecting Methods in Archaeology.* BT Batsford Ltd. London.

David, A., *et al*, 2014, *Geophysical Survey in Archaeological Field Evaluation*. Historic England.

Gaffney, C., Gater. J., and Ovenden, S., 2002, *The Use of Geophysical Techniques in Archaeological Evaluations.* IFA Technical Paper No.6.

Gaffney, C., and Gater. J., 2003, *Revealing the Buried Past, Geophysics for Archaeologists.* Tempus Publishing Ltd.

Historic England, 2015, *Management of Research in the Historic Environment (MoRPHE)*.

Gurney, D., 2003, *Standards for Field Archaeology in the East of England.* East Anglian Archaeology Occasional Paper 14.

Medlycott, M. (ed), 2011, *Research and Archaeology Revisited: A revised framework for the East of England.* East Anglian Archaeology Occasional Paper 24.

Schmidt, A., 2001, *Geophysical Data in Archaeology: A Guide to good Practice.* Archaeology Data Service. Oxbow books.

Schmidt, A., et al, 2015, *EAC Guidelines for the use of Geophysics in Archaeology; Questions to ask and Points to Consider*. EAC Guidelines 2.

SCCAS, 2010, *Deposition of Archaeological Archives in Suffolk.*

SCCAS, 2011, *Requirements for a Geophysical Survey*.

Witten, A. J., 2006, *Handbook of Geophysics and Archaeology.* Equinox Publishing Ltd. London.

Websites

British Geological Survey, 2018, http://mapapps.bgs.ac.uk/geologyofbritain/home.html

Google Earth Pro, 2018, https://www.google.com/earth/

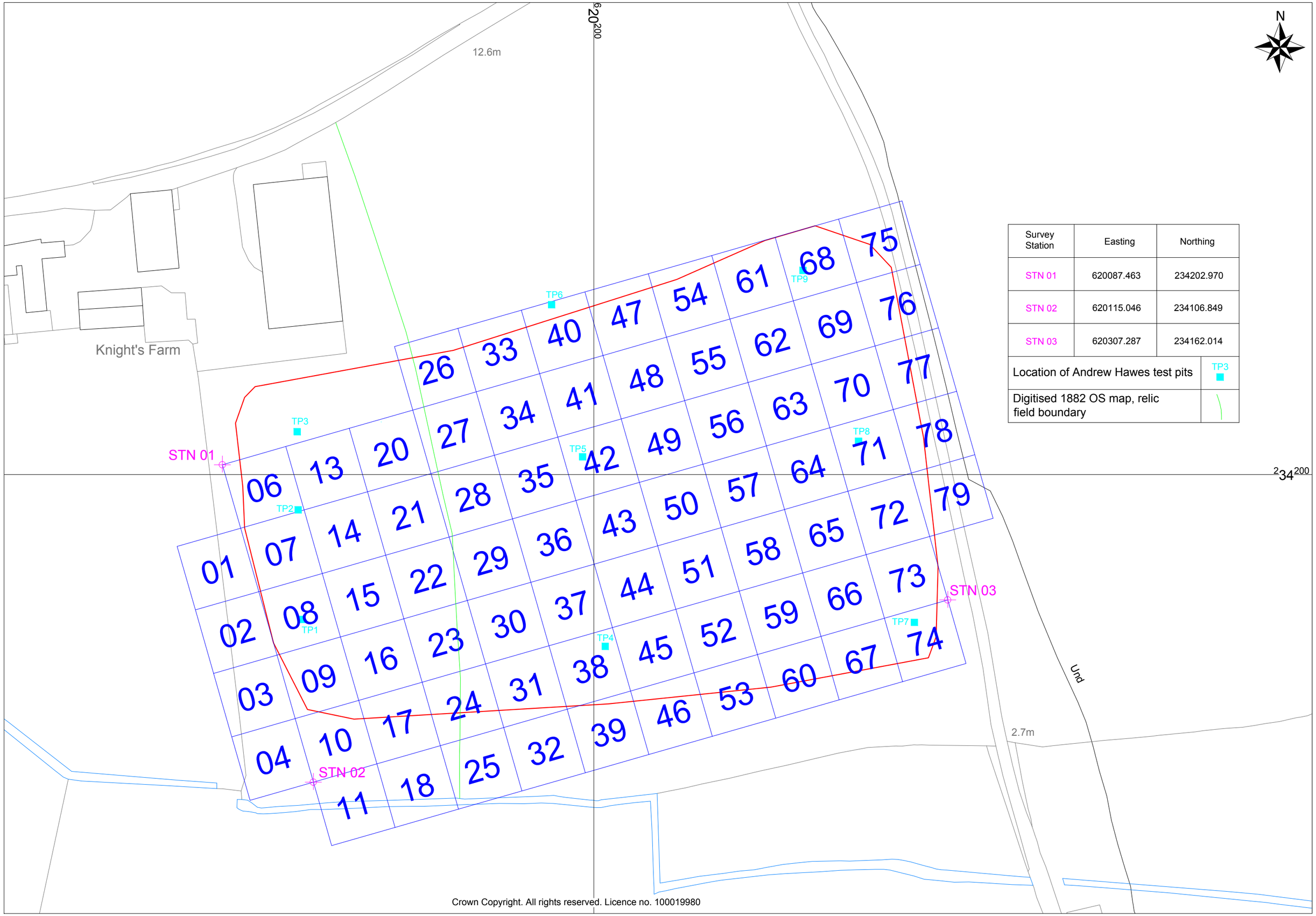

Figure 2. Survey grid, georeferencing information, test pit location, digitised cartographic features

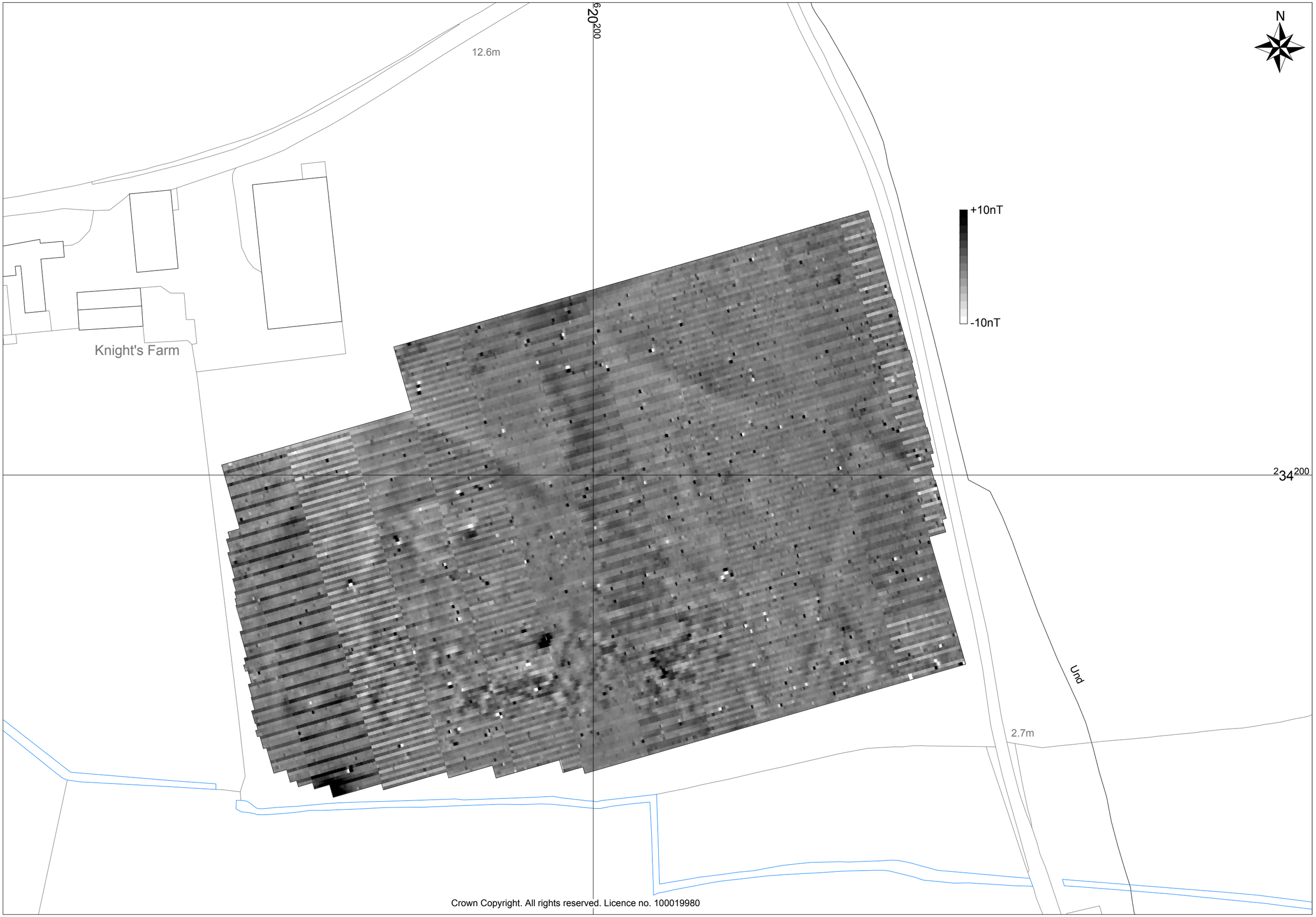

Figure 3. Raw magnetometer greyscale plot

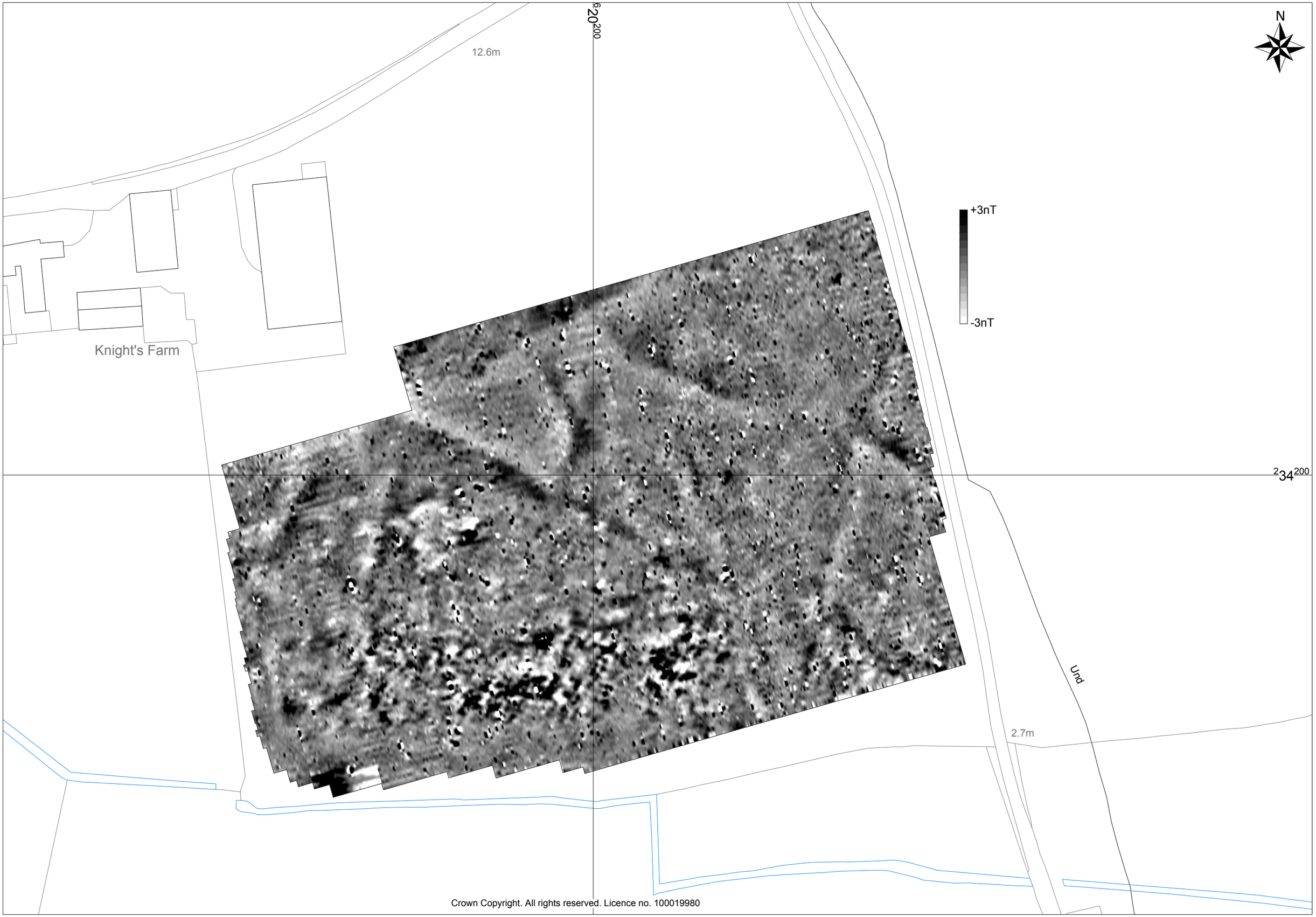

Figure 4. Processed magnetometer greyscale plot

Figure 5. Processed magnetometer xy trace plot

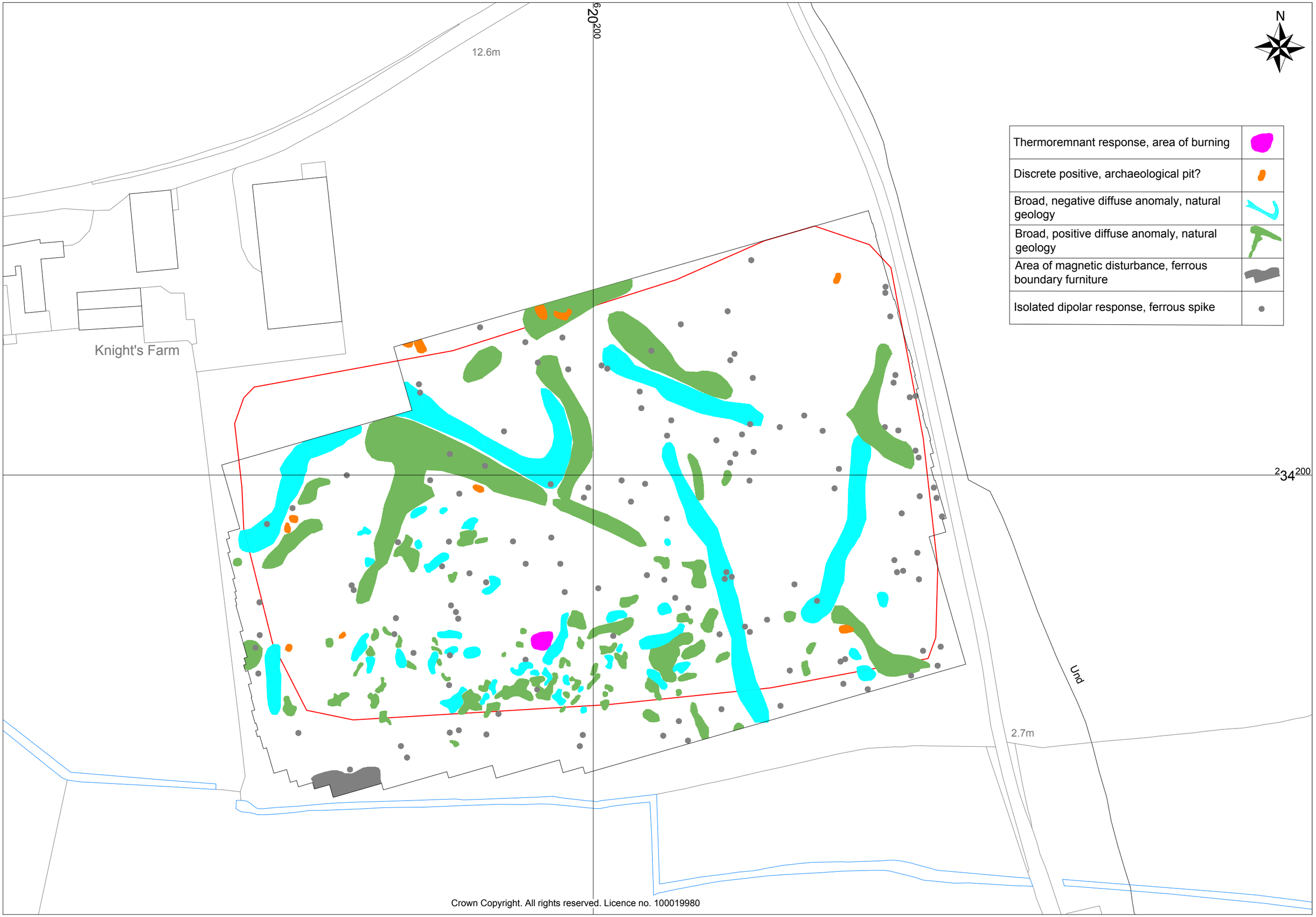

Figure 6. Interpretation plot of magnetometer anomalies

Appendix 1. Metadata sheets

Survey Grids

Source Grids: 76	
1	Col:0 Row:2 grids\01.xgd
2	Col:0 Row:3 grids\02.xgd
3	Col:0 Row:4 grids\03.xgd
4	Col:0 Row:5 grids\04.xgd
5	Col:1 Row:1 grids\06.xgd
6	Col:1 Row:2 grids\07.xgd
7	Col:1 Row:3 grids\08.xgd
8	Col:1 Row:4 grids\09.xgd
9	Col:1 Row:5 grids\10.xgd
10	Col:1 Row:6 grids\11.xgd
11	Col:2 Row:1 grids\13.xgd
12	Col:2 Row:2 grids\14.xgd
13	Col:2 Row:3 grids\15.xgd
14	Col:2 Row:4 grids\16.xgd
15	Col:2 Row:5 grids\17.xgd
16	Col:2 Row:6 grids\18.xgd
17	Col:3 Row:1 grids\20.xgd
18	Col:3 Row:2 grids\21.xgd
19	Col:3 Row:3 grids\22.xgd
20	Col:3 Row:4 grids\23.xgd
21	Col:3 Row:5 grids\24.xgd
22	Col:3 Row:6 grids\25.xgd
23	Col:4 Row:0 grids\26.xgd
24	Col:4 Row:1 grids\27.xgd
25	Col:4 Row:2 grids\28.xgd
26	Col:4 Row:3 grids\29.xgd
27	Col:4 Row:4 grids\30.xgd
28	Col:4 Row:5 grids\31.xgd
29	Col:4 Row:6 grids\32.xgd
30	Col:5 Row:0 grids\33.xgd
31	Col:5 Row:1 grids\34.xgd
32	Col:5 Row:2 grids\35.xgd
33	Col:5 Row:3 grids\36.xgd
34	Col:5 Row:4 grids\37.xgd
35	Col:5 Row:5 grids\38.xgd
36	Col:5 Row:6 grids\39.xgd
37	Col:6 Row:0 grids\40.xgd
38	Col:6 Row:1 grids\41.xgd
39	Col:6 Row:2 grids\42.xgd
40	Col:6 Row:3 grids\43.xgd
41	Col:6 Row:4 grids\44.xgd
42	Col:6 Row:5 grids\45.xgd
43	Col:6 Row:6 grids\46.xgd
44	Col:7 Row:0 grids\47.xgd
45	Col:7 Row:1 grids\48.xgd
46	Col:7 Row:2 grids\49.xgd
47	Col:7 Row:3 grids\50.xgd
48	Col:7 Row:4 grids\51.xgd
49	Col:7 Row:5 grids\52.xgd
50	Col:7 Row:6 grids\53.xgd
51	Col:8 Row:0 grids\54.xgd
52	Col:8 Row:1 grids\55.xgd
53	Col:8 Row:2 grids\56.xgd
54	Col:8 Row:3 grids\57.xgd
55	Col:8 Row:4 grids\58.xgd
56	Col:8 Row:5 grids\59.xgd
57	Col:8 Row:6 grids\60.xgd
58	Col:9 Row:0 grids\61.xgd
59	Col:9 Row:1 grids\62.xgd
60	Col:9 Row:2 grids\63.xgd
61	Col:9 Row:3 grids\64.xgd
62	Col:9 Row:4 grids\65.xgd
63	Col:9 Row:5 grids\66.xgd
64	Col:9 Row:6 grids\67.xgd
65	Col:10 Row:0 grids\68.xgd
66	Col:10 Row:1 grids\69.xgd

67 Col:10 Row:2 grids\70.xgd
68 Col:10 Row:3 grids\71.xgd
69 Col:10 Row:4 grids\72.xgd
70 Col:10 Row:5 grids\73.xgd
71 Col:10 Row:6 grids\74.xgd
72 Col:11 Row:0 grids\75.xgd
73 Col:11 Row:1 grids\76.xgd
74 Col:11 Row:2 grids\77.xgd
75 Col:11 Row:3 grids\78.xgd
76 Col:11 Row:4 grids\79.xgd

Survey grids not used: 05, 12, & 19, (magnetic noise from steel barn)

Raw Data

Filename	Harkstead 1 Raw.xcp
Description	
Instrument Type	Grad 601 (Gradiometer)
Units	nT
Direction of 1st Traverse	90 deg
Collection Method	ZigZag
Sensors	2 @ 1.00 m spacing.
Dummy Value	2047.5
Dimensions	
Composite Size (readings)	960 x 140
Survey Size (meters)	240 m x 140 m
Grid Size	20 m x 20 m
X Interval	0.25 m
Y Interval	1 m
Stats	
Max	100.00
Min	-100.00
Std Dev	2.71
Mean	0.57
Median	0.46
Composite Area	3.36 ha
Surveyed Area	2.7518 ha
Program	
Name	TerraSurveyor
Version	3.0.33.6

Raw Data Schedule

Processes:
1 Display Clip -10 +10

Processed Data

Filename	Harkstead 1 Pro.xcp
Description	
Instrument Type	Grad 601 (Gradiometer)
Units	nT
Direction of 1st Traverse	90 deg
Collection Method	ZigZag
Sensors	2 @ 1.00 m spacing.
Dummy Value	2047.5
Dimensions	
Composite Size (readings)	960 x 140
Survey Size (meters)	240 m x 140 m
Grid Size	20 m x 20 m
X Interval	0.25 m
Y Interval	1 m
Stats	
Max	101.59
Min	-102.25
Std Dev	2.21
Mean	0.12
Median	0.00
Composite Area	3.36 ha
Surveyed Area	2.7518 ha
Program	
Name	TerraSurveyor
Version	3.0.33.6

Processed Data Schedule

Processes:
1 DeStripe Median Sensors: All
2 Display Clip -3 +3
3 Graduated Shade

Appendix 2. Technical data

Detailed magnetometer survey

Detailed magnetometer survey is the most commonly employed archaeological geophysical prospection method in Britain; sensitive sensors can cost-effectively cover large areas of ground, rapidly recording anomalies that are indicative of cultural settlement activity. These anomalies can then be further investigated by field archaeologists to quantify a form and function. The magnetometer is a passive instrument that detects both permanent thermoremanent and temporary magnetic responses.

Thermoremanent Magnetism

When a material containing iron oxides, for example clay, is heated above the Curie point, weakly magnetic compounds transform in to highly magnetic oxides that can be detected by the sensors of a magnetometer (Clark, 1996). For instance, the iron oxide haematite has a Curie temperature of 675 Celsius and magnetite 565 Celsius. Once these temperatures are reached, the oxides become demagnetised, on cooling their magnetic properties become permanently re-magnetised and align in the direction of the Earth's magnetic field (Gaffney and Gater, 2003). Over time the direction of the Earth's magnetic field changes allowing these directional differences to be detected by the magnetometer.

Strongly heated features such as hearths, kilns or furnaces frequently reach the Curie temperature and become permanently magnetised. These permanent magnetic responses are some of the strongest cultural features that can be recorded.

Temporary Magnetism

Magnetic susceptibility is the ease with which a magnetic field can pass through a material, therefore the higher the material's magnetic susceptibility, the stronger the induced magnetic field will be. Temporary magnetisation occurs within material that is magnetically susceptible, this material acquires its own local magnetic field that combines with the Earth's magnetic field causing an anomaly to stand out from the background noise (Clark, 1996). These anomalies are subtler in nature, being derived from material that has been magnetically enhanced by cultural activity which has become concentrated into features over time. Anomalies that have temporary

magnetisation include backfilled pits, ditches, field systems, occupation areas, land drains, remnant and existing field boundaries (David *et al*, 2014).

The key to a successful survey is having good contrast between the magnetic susceptibility of an archaeological feature with the surrounding superficial deposits. If there is no discernible difference between the two mediums it may be unlikely that the magnetometer will successfully prospect the feature. Archaeological features can also be masked by high magnetically susceptible topsoil, or deep overlying subsoil and colluvial deposits.

Ferrous anomalies

Ferrous objects are a common source of permanent magnetism, usually isolated with a strong dipolar signature. Some of these responses may have an archaeological derivation, however they are probably more indicative of modern iron objects introduced through manuring or lost within the topsoil.

Bartington DualGRAD 601-2 Fluxgate Gradiometers

Fluxgate gradiometers are the most commonly employed class of instrument in the UK. Two 1m sensitive sensors are affixed to a frame mounted 1m apart in a vertical plane and harnessed to the trunk of a geophysical surveyor or attached to a cart. Each sensor contains two fluxgate magnetometers with a 1m vertical separation. The sensor above records the Earth's magnetic field (magnetic background) while the sensor below records the local magnetic field. The two sensors need aligning before recording can begin and a zero station is located in an area with low magnetic variation for this purpose. After the sensors have been aligned, the survey can begin. When differences in the magnetic field strength occur between the two vertical magnetometers within each sensor, a positive or negative reading is recorded that is relative to the magnetic background of the zero station. Positive anomalies include pits, ditches and agricultural furrows. Negative anomalies commonly prospected include earthwork embankments, land drains and geological features.

Sensors are normally mounted to a height of 0.30m above the surface, and can detect to a depth of between one and two metres below the ground. The first survey traverse is commonly undertaken in an east to west direction.

Magnetic Anomalies

Isolated dipolar responses

Isolated dipolar responses are commonly recorded throughout a dataset and are usually indicative of modern ferrous material deposited within the topsoil horizon. In some instances, the anomalies may be of an archaeological derivation. They are isolated, strong and dipolar in character.

Areas of magnetic disturbance

These anomalies are usually caused by building demolition rubble, ferrous boundaries, slag waste dumps, modern buried rubbish, pylons and services. Strong and dipolar in character, they are commonly recorded over a wide area.

Linear trends

Linear trends can be either positive or negative magnetic responses depending on the nature of the material present within the feature. If the anomaly is broad and weak, it is more likely to be of geological origin. Stronger positive linear trends are more likely to be of archaeological derivation, caused by settlement activity washing rich humic, charcoal and fired deposits into a feature. Negative linear trends are more commonly associated with bank deposits or land drains, with the less magnetically susceptible superficial deposits deposited at the top of the feature. Curvilinear trends are usually of archaeological origin, commonly interpreted as ring ditches or drip-gullies.

Discrete anomalies

Discrete anomalies can either be positive or negative in nature recorded within a localised area. Those that are positive are more likely to be of an archaeological origin, with negative discrete anomalies more commonly interpreted as natural geological variations.

Thermoremanent responses

These responses are caused by the heating of material containing iron to above the Curie temperature, they are strong and discrete in nature. In Britain high positive readings are recorded to the south of the anomaly with high negative readings recorded to the north.

Appendix 3. OASIS form

OASIS DATA COLLECTION FORM: England

Printable version

OASIS ID: suffolka1-310031

Project details

Project name	Proposed Reservoir, Knights Farm, Harkstead, Suffolk, Geophysical Survey
Short description of the project	In March 2018 Suffolk Archaeology Community Interest Company (SACIC) undertook a detailed fluxgate gradiometer survey on land set aside for a proposed agricultural reservoir at Knights Farm, Harkstead, Suffolk. A total area of 2.75ha was prospected for anomalies of an archaeological derivation within the cut line of the proposed reservoir. The detailed fluxgate gradiometer survey recorded a narrow range of geophysical anomalies, indicative of a geological anomalies, archaeological pits, geological anomalies and a thermoremanent response. The results of the non-intrusive survey reveal a low potential for magnetic anomalies of an archaeological origin.
Project dates	Start: 05-03-2018 End: 06-03-2018
Previous/future work	No / Yes
Any associated project reference codes	R2018_023 - Contracting Unit No.
Any associated project reference codes	HRK 097 - 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	ANOMALIES INDICATIVE OF ARCHAEOLOGICAL PITS Uncertain
Monument type	ANOMALIES INDICATIVE OF A BURNT FEATURE Uncertain
Significant Finds	NONE None
Methods & techniques	"Geophysical Survey"
Development type	Farm Reservoir
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Pre-application
Solid geology (other)	Thames Group Clay, Silt and Sand
Drift geology (other)	Lowestoft Formation Sands and Gravels
Techniques	Magnetometry

Project location

Country	England

Site location	SUFFOLK BABERGH HARKSTEAD Knights Farm, Harkstead, Suffolk
Study area	2.75 Hectares
Site coordinates	TM 2020 3418 51.961860492404 1.205547641771 51 57 42 N 001 12 19 E Point
Height OD / Depth	Min: 4m Max: 12m

Project creators

Name of Organisation	Suffolk Archaeology CIC
Project brief originator	Local Authority Archaeologist and/or Planning Authority/advisory body
Project design originator	Rachael Abraham
Project director/manager	Rhodri Gardner
Project supervisor	Tim Schofield
Project supervisor	Catherine Douglas
Type of sponsor/funding body	Developer
Name of sponsor/funding body	Andrew Hawes

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","Survey","Text"
Paper Archive recipient	Suffolk HER
Paper Contents	"Survey"
Paper Media available	"Plan","Report","Survey ","Unpublished Text"

Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	Proposed Reservoir, Knights Farm, Harkstead, Suffolk, Geophysical Survey Report
Author(s)/Editor(s)	Schofield, T. P.
Other bibliographic details	R2018/023
Date	2018
Issuer or publisher	Suffolk Archaeology CIC
Place of issue or publication	Needham Market
Description	A4 bound report with A3 fold-out figures.

URL	www.suffolkarchaeology.co.uk
Entered by	Tim Schofield (tim.schofield@suffolkarchaeology.co.uk)
Entered on	13 March 2018

OASIS:

Appendix 4. Written scheme of investigation

SUFFOLK ARCHAEOLOGY

• A HISTORY OF EXPERTISE •

Proposed Reservoir, Knights Farm

Harkstead, Suffolk

Client:
Andrew Hawes

Date:
February 2018

HRK 097
Written Scheme of Investigation and Risk Assessment – Geophysical Survey
Author: Tim Schofied HND BSc MCIfA

Contents

List of Figures

Appendices

Project details

Planning Application No:	TBC
Curatorial Officer:	TBC (SCCAS/CT)
Grid Reference:	TM 2020 3418
Area:	*c.* 2.40ha
HER Event No/Site Code:	HRK 097
OASIS Reference:	310031
Project Start date:	22nd February 2018
Project Fieldwork Duration:	*c.* 2 days
Client/Funding Body:	Andrew Hawes
SACIC Project Manager:	Tim Schofield
SACIC Project Officer:	Tim Schofield
SACIC Job Code:	TBC

1. Introduction

- A program of geophysical survey is required on the site of a proposed farm reservoir, at Knights Farm, Harkstead, Suffolk (Fig. 1), prior to determination of the planning application, in accordance with paragraph 128, 129 and 141 of the National Planning Policy Framework.
- The work is required by the archaeological adviser to the Local Planning Authority (LPA), of Suffolk County Council Archaeological Service/Conservation Team (SCCAS/CT).
- The proposed reservoir, including bunds, occupies an area of *c.* 2.85ha, however Suffolk Archaeology Community Interest Company (SACIC) has been informed that the development will only involve topsoil stripping and subsequent excavation within the central reservoir area, with the bunds simply being built up from existing ground level.
- Suffolk Archaeology have been contracted to carry out a *c.* 2.40ha survey of the central area that will be subjected to ground disturbance by the development. This Written Scheme of Investigation (WSI) details how the survey will meet the requirements as laid out in the SCCAS/CT geophysical survey guidelines (SCCAS/CT 2017), and has been submitted to SCCAS/CT for approval on behalf of the LPA. It provides the basis for measurable standards and will be adhered to in full, unless otherwise agreed with SCCAS/CT.
- It should be noted that the geophysical survey is only a first stage in a potential program of works. This WSI covers the geophysical survey only. Any further stages of archaeological work that are required in relation to the proposed development after the survey will be specified by SCCAS/CT, and will require new documentation (Brief and WSI) and estimate of costs. Such works could have considerable time and cost implications for the development and the client is advised to consult with SCCAS/CT as to their obligations following receipt of the geophysical survey report.

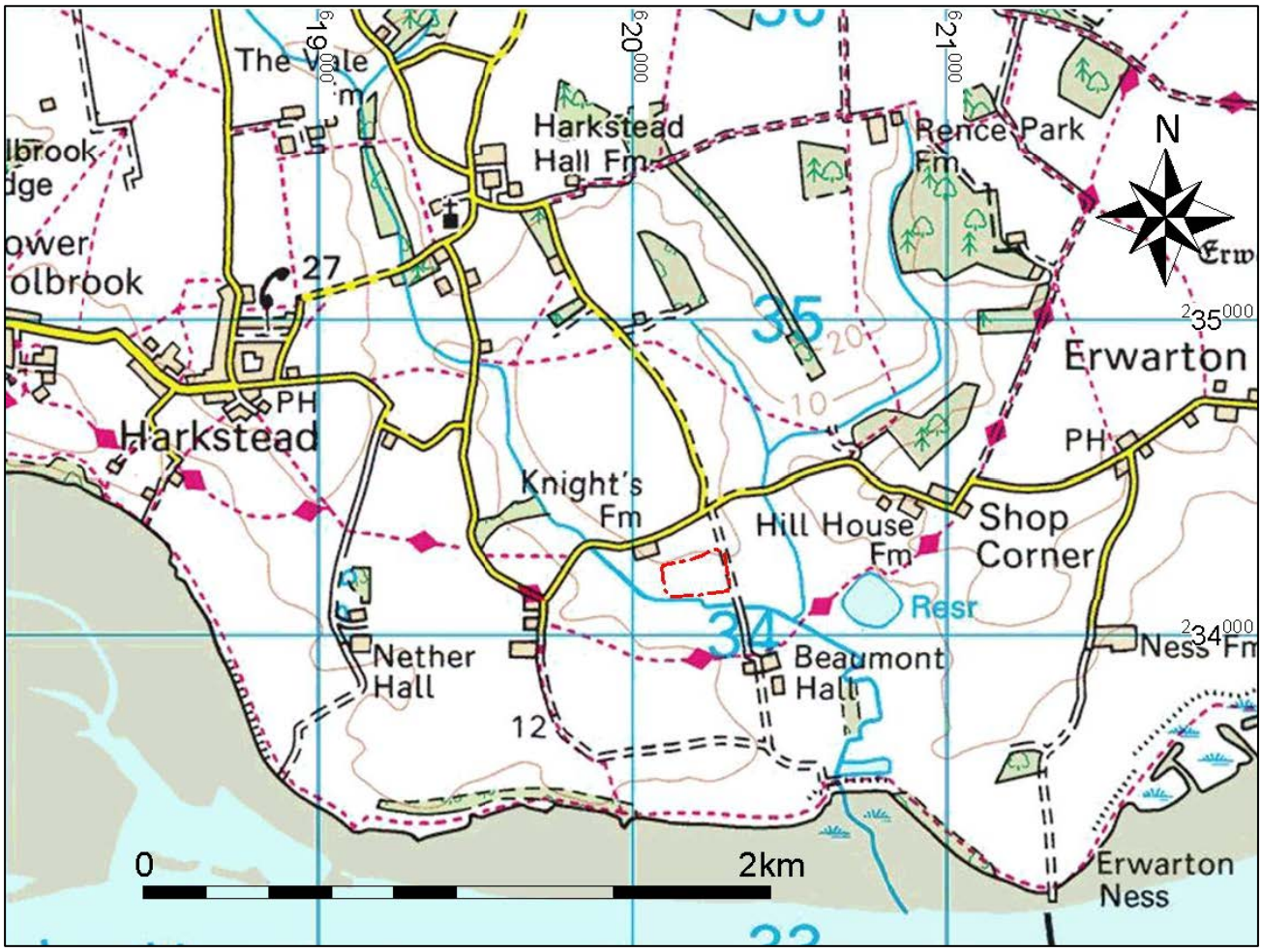

Figure 1. Location map

2. The Site

- The site lies within an arable landscape, located *c*. 1.6km to the southeast of the settlement of Harkstead, in the southern half of a single field at TM 2020 3418. It is bounded on its eastern border by a farm track, to the west and south by hedgerows and The Street runs along the northern boundary (Fig.1).
- The field slopes down from its northeastern corner at 12m above Ordnance Datum (AOD) to 4m AOD in the southwestern corner.
- The bedrock geology is sedimentary in nature consisting of Thames Group clay, silt and sand, formed between 56 and 33.9 million years ago during the Palaeogene period. This is overlain by sedimentary superficial deposits of Lowestoft Formation sand and gravel, formed up to 480 to 423 thousand years ago in the Quaternary Period (BGS 2018).

3. Archaeological and Historical Background

- The geophysical survey is required by SCCAS/CT in order to inform the archaeological evaluation brief for the proposed agricultural reservoir.
- The site is set within a single agricultural field.
- A full search of the Suffolk Historic Environment Record has been commissioned and will be used within the survey report. A brief look on the heritage gateway has revealed that the proposed reservoir is located within a fairly rich prehistoric to post-medieval landscape. A potential Bronze Age ring ditch (HRK 065) located within undated enclosures (HRK 066) has been recorded 450m to the north of Knights Farm. Potential Bronze Age, Iron Age and Roman enclosure systems (HRK 007, 072, 073) have also been identified 750m to the west at Nether Hall. Recorded 1000m to the east are a series of enclosure type cropmarks, thought to be prehistoric, Roman and post-medieval in date (ARW 014, 055). At Beaumont Hall 550m to the southeast (HRK 019 and 030), an undated square enclosure and ditch-type cropmarks are identified. A wide trackway has been recorded on aerial photography of unknown date (HRK 065), 300m to the south. A series of undated small ring ditches are recorded as cropmarks (HRK 034) at Sparrow Hall 630m to the southwest of the proposed reservoir, along with post-medieval field boundary enclosures (HRK 035).

- An initial examination of historic mapping held by SACIC has been made. The Ordnance Survey (OS) maps from 1885 until 1958 reveal a field boundary running from south to north in the western quarter of the site, this field boundary appears to have been removed some time after the 1958 OS map publication.

4. Project Objectives

- A systematic fluxgate gradiometer survey is to be undertaken across all areas of the proposed reservoir site where groundworks will be carried out.

Figure 2. Proposed geophysical survey grid (dark blue), cut line (red)

5. Geophysical Survey Method Statement

5.1. Management

- The project will be managed by SACIC Project Officer Tim Schofield in accordance with the principles of *Management of Research Projects in the Historic Environment* (MoRPHE, Historic England 2015).
- SCCAS/CT will be given five days' notice of the commencement of the fieldwork and arrangements made for a SCCAS/CT site visit if required.
- Full details of project staff are given in section 6 below.

5.2. Project preparation

- An event number and site code have been obtained from the SCCAS/CT HER Officer and will be included on all future project documentation. An HER search has been requested.
- An OASIS online record has been initiated and key fields in details, location and creator forms have been completed.
- A Risk Assessment for the project has been completed.

5.3. Fieldwork

- Fieldwork standards will be guided by 'Standards for Field Archaeology in the East of England', EAA Occasional Papers 14, and the Chartered Institute for Archaeology's (CIfA) paper 'Standard and Guidance for archaeological geophysical survey', December 2014.
- The fieldwork will be carried out by members of SACIC led by Project Officer Tim Schofield. The fieldwork team will be drawn from a pool of suitable staff at SACIC.
- The project requires the survey of *c*. 2.40 hectares over the proposed development area (Fig. 2). The survey area is based on a cut plan provided by the client, minor modifications to the survey area may need to be made onsite to respect any areas of disturbance/contamination or other obstacles.

- The outline of the survey area ensures that a 5-10m exclusion zone can be maintained from surrounding field boundaries in order to minimise the amount of associated magnetic disturbance.

Instrument type and set-up

- The site will be surveyed using a Bartington Dual-Grad 601-2 which has high sensor sensitivity combined with rapid ground coverage. Good contrast between the magnetic susceptibility of a feature's fill (charcoal rich or humic deposits providing the best soil medium) and the local magnetic background signature of the superficial deposits will be important in achieving successful survey results.
- Best practice dictates that sensors will be secured on the same side of the instrument until the completion of the survey, and sensor heights equalised to achieve a consistent elevation across the area. The instrument will be switched on and left for at least 20 minutes before the survey of the first grid to allow the sensors to reach a suitable operating temperature.
- A zero station with low magnetic susceptibility shall be prospected within the field to allow the correction of diurnal sensor drift. This unique station will be employed throughout the survey providing a common calibration location.

Sampling interval and grid size

- The 20m survey grid will be set-out using a Leica Viva Glonass Smart Rover GS14 to the Ordnance Survey OSGB36, converted to the National Grid Transformation OSTN15 datum that has an accuracy of +/- 0.03m. Regular testing of the instruments accuracy will be undertaken employing stations with known ETRS89 coordinates. All raw data recorded by the GPS will be uploaded to the project folder, suitably labelled and kept as part of the project archive.
- A 1m traverse interval and 0.25m sample interval will be utilised.

Data capture and archiving

- A pro-forma survey sheet will be completed each day; unique grid numbers will be

allocated to enable a data composite to be created. Instrument readings will be recorded on the internal data logger and downloaded to a laptop at midday and also in the evening, this will allow the data to be checked for quality on site and for grids to be re-surveyed if required.

- Data will be filed in project specific folders separated into daily datasets. The daily datasets will be combined into a single composite on completion of the fieldwork.
- Data will be stored in project specific folders that will be downloaded onto a laptop and then backed-up onto an external server in the evening of each day.
- Metadata sheets will be completed and inserted into the report as an appendix.
- All on-site derived site data will be entered onto a digital (Microsoft Access) SACIC database compatible with the Suffolk HER.

Data processing and presentation

- Raw survey data will be collected to a high standard to enable only minimal processing of the datasets to be required. Typically, these algorithms comprise zero median sensor. The data will also be clipped at a suitable level to enable the anomalies to be presented with best clarity.
- Raw and processed greyscale plots and xy trace plots of the datasets shall be exported from Terrasurveyor into AutoCAD.
- An interpretation plan based on the combined interpretations of the raw, processed and xy trace plots will be produced using AutoCAD. All figures shall be georeferenced within the National Grid and printed at an appropriate scale.

Software

- The software used to process the data will be DW Consulting's Terrasurveyor v3.0.33.6. Images will be exported from Terrasurveyor into a geo-referenced grid within an AutoCAD drawing. Interpretation plans of the anomalies will then be digitised using AutoCAD.

5.4. Report

- The report will be commensurate with the results of the fieldwork and will be consistent with the principles of Management of Research Projects in the Historic Environment (MoRPHE, Historic England, 2015), Geophysical survey in Field Evaluation (Historic England, 2008) and the Standard and Guidance for Archaeological Geophysical Survey (Chartered Institute for Archaeologists, 2014), containing the following: a summary, description of the project background, site location, survey methodology, detailed description of the nature, location and extent of anomalies, discussion of the anomalies, impact assessment, site potential and possible further work. Scaled raw, processed, xy data plans and an interpretation plan will also be included.
- The report will include a summary in the established format for inclusion in the annual *'Archaeology in Suffolk'* section of the Proceedings of the Suffolk Institute of Archaeology and History.
- A copy of this Written Scheme of Investigation will be included as an appendix in the report.
- Metadata sheet tables will form one of the appendices within the report.
- A technical data sheet will be included as an appendix.
- The report will include a copy of the completed project OASIS form as an appendix.
- An unbound draft copy of the report will be submitted to SCCAS/CT for approval within 6 months of completion of fieldwork.

5.5. Project archive

- On approval of the report a printed and bound copy will be lodged with the Suffolk HER. A digital .pdf file will also be supplied, together with a digital and fully georeferenced vector plan showing the application area and survey location, compatible with MapInfo software.
- The online OASIS form for the project will be completed and a .pdf version of the report uploaded to the OASIS website for online publication by the Archaeological Data Service. A paper copy of the form will be included in the project archive.

- A second bound copy of the report will be included with the project archive.
- A digital .pdf copy of the approved report will be supplied to the client, together with our final invoice for outstanding fees. Printed and bound copies will be supplied to the client on request.
- The project archive, consisting of all paper and digital records, will be deposited in the SCCAS/CT Archaeological Store at Bury St Edmunds within 6 months of completion of fieldwork. The project archive will be consistent with MoRPHE (Historic England, 2015) and ICON guidelines. The project archive will also meet the requirements of SCCAS/CT (SCCAS/CT 2017).
- The project costing includes a sum to meet SCCAS/CT archive charges. A form transferring ownership of the archive to SCCAS/CT will be completed and included in the project archive.
- If the client, on completion of the project, does not agree to deposit the archive with, and transfer to, SCCAS/CT, they will be expected to either nominate another suitable depository approved by SCCAS/CT.

5.6. Bibliography

Ayala, G., et al., 2004, *Geoarchaeology; Using Earth Sciences to Understand the Archaeological Record.* English Heritage.

Brown, N., and Glazebrook, J, (eds), 2000, *Research and Archaeology: A Framework for the Eastern Counties, 2. Research Agenda and Strategy.* East Anglian Archaeology Occasional Paper No. 8.

Chartered Institute for Archaeologists, 2014, *Standard and Guidance for Archaeological Geophysical Survey.*

Clark, A. J., 1996, *Seeing Beneath the Soil, Prospecting Methods in Archaeology.* BT Batsford Ltd. London.

David, A., *et al.*, 2014, *Geophysical Survey in Archaeological Field Evaluation*. Historic England.

Gaffney, C., Gater. J., and Ovenden, S., 2002, *The Use of Geophysical Techniques in Archaeological Evaluations.* IFA Technical Paper No.6.

Gaffney, C., and Gater. J., 2003, *Revealing the Buried Past, Geophysics for Archaeologists.* Tempus Publishing Ltd.

Historic England, 2015, *Management of Research in the Historic Environment (MoRPHE)*.

Gurney, D., 2003, *Standards for Field Archaeology in the East of England.* East Anglian Archaeology Occasional Paper No 14.

Medlycott, M. (Ed)., 2011, *Research and Archaeology Revisited: A revised framework for the East of England.* EAA Occasional Paper 24.

Schmidt, A., 2001, *Geophysical Data in Archaeology: A Guide to good Practice.* Archaeology Data Service. Oxbow books.

Schmidt, A., et al., 2015, *EAC Guidelines for the use of Geophysics in Archaeology; Questions to ask and Points to Consider*. EAC Guidelines 2.

SCCAS, 2017, *Deposition of Archaeological Archives in Suffolk.*

SCCAS, 2017, *Requirements for a Geophysical Survey*.

Witten, A. J., 2006, *Handbook of Geophysics and Archaeology.* Equinox Publishing Ltd. London.

Websites

British Geological Survey 2018

http://mapapps.bgs.ac.uk/geologyofbritain/home.html

6. Project Staffing

6.1. Management

SACIC Manager	Dr Rhodri Gardner
SACIC Project Manager	John Craven

6.2. Fieldwork

The fieldwork team will be derived from the following pool of SACIC staff.

Name	Job Title	First Aid	Other skills/qualifications
Tim Schofield	Project Officer	Yes	Geophysical Surveyor
Catherine Douglas	Project Officer	Yes	Geophysical Surveyor
Cameron Bate	Project Assistant	No	Geophysical Surveyor
Rui Oliveira	Project Assistant	No	Geophysical Surveyor
Filipe Santos	Project Assistant	No	Geophysical Surveyor

6.3. Report production

The production of the site report, graphics and submission of the project archive will be carried out by Tim Schofield.

Appendix 1. Health and Safety

1. Introduction

The project will be carried out following the SACIC Health and Safety Management System at all times. The SACIC Health and Safety Policy Statement reads as follows:

SuffolkArchaeologyCommunityInterestCompanyiscommittedtoensuringthehealth,safetyandwelfare ofitsemployees,anditwill,sofarasisreasonablypracticable,establishproceduresandsystemsnecessary to implement this commitment and to comply with its statutory obligations on health and safety. Our Personnelareinformedoftheirresponsibilitiestoensuretheytakeallreasonable precautions,toensure the safety, health and welfare of those that are likely to be affected by the acts and emissions of our organisationsundertakings.

SuffolkArchaeology CommunityInterestCompany understandsourdutytoidentifythesignificanthazards thatmaybecreatedbyourundertakingsandtoriskassessttheseaccordinglytoensurethatsuitableand effectivecontrolsareimplementedtominimiserisktoasuitablelevelasfarasisreasonablypracticable.

Wealsoacknowledgeourduty,sofarasisreasonablypracticable:

- *Toprovideasafeworkingenvironmentforourworkforce,fulfilourstatutorycommitments andactivelymanageandsupervisehealthandsafetyatwork;*
- *Toidentifytherisksassociatedwithourbusinessactivitiesandensure suitableandsufficient controlmeasuresareinplace.*
- *Ensure regular consultation with our employees on matters which affect their health and Safety.*
- *To ensure that all plant and equipment used by our employees is fit for purpose and adequatelymaintained.*
- *Toprovidesuitablestorageandensuresafehandlingof Hazardoussubstances.*
- *Toensurethatallworkersarecompetenttoundertaketheirdailyworkactivitiesbyproviding allrelevantinformationandtraining,considerationwillalsobegiventoany employeeswho donothaveEnglishasafirstlanguage.*
- *Topreventaccidentsandcasesofworkrelatedillhealthbyensuringarobustreportingand investigationsystemisinplace.*
- *Toliaiseandcommunicateeffectivelyregardinghealthandsafetymatters whenworkingon otherpersonspremises.*
- *To ensure that there is an effective system of induction, training, communication and supervisiontootherpersonsvisitingorworkingonourpremises.*
- *To have access to competent advice, this will be provided by Agility UK (Training and Consultancy)Ltd.Whowillassistsusinthecontinuousimprovementinourhealthandsafety performance and management through regular review and revision of this policy; and to provide suitable resources required to make this policy and our Health and Safety arrangementseffective.*

2. Specific project issues

Introduction

All SACIC staff will be aware that they have a responsibility to:

- Take care of their own health and safety and that of others who may be affected by what they do, or fail to do, at work.
- Follow safe systems of work and other precautions identified in the project risk assessments.
- Report any changes to personal circumstances that may affect their ability to work safely.
- Report potential hazards, incidents and near misses to the Project Officer/supervisor.

A pre-site inspection has been made of the site and applicable SACIC Risk Assessments for the project are included below.

All SACIC staff are experienced in working on a variety of archaeological sites and permanent staff all hold a CSCS (Construction Skills Certification Scheme) card. All staff have been shown the SACIC Health and Safety Manual, copies of which are held at the SACIC office in Needham Market. All staff will read the site WSI and Risk Assessments and receive a site safety induction from the Project Officer prior to starting work. All staff will be issued with appropriate PPE.

From time to time it may be necessary for site visits by other SACIC staff, external specialists, SCCAS/CT staff or other members of the public. All such staff and visitors will be issued with the appropriate PPE and will undergo the required inductions.

Site staff, official visitors and volunteers are all covered by SACIC insurance policies. SACIC also has professional negligence insurance. Copies of these policies are available on request.

Welfare facilities

Due to the limited nature of the project, it is proposed that SACIC staff will work from their vehicle and travel to public facilities if required. A vehicle will be on site at all times.

First Aid

A member of staff with the First Aiders at Work qualification will be on site at all times. A First Aid kit and a fully charged mobile will also be in vehicle/on site at all times.

Site access and security

Access to the site is along the farm track off The Street that is located along the eastern edge of the field. The site is private arable land, bounded by hedgerows, but is open to general access.

Contaminated ground

Details of any ground contamination have not been provided by the client. If any such is identified then groundworks will cease until adequate safety and environmental precautions are in place.

Advice will be sought from HSE and relevant authorities if required concerning any of these issues.

Hazardous Substances

No hazardous substances are specifically required in order to undertake the archaeological works.

Underground services

Details of known services have not been provided by the client.

Overhead Powerlines

No overhead powerlines cross the site.

Personal Protective Equipment (PPE)

The following PPE is issued to all site staff as a matter of course. Additional PPE will be provided if deemed necessary.

- Hard Hat (to EN397).
- High Visibility Clothing (EN471 Class 2 or greater).
- Safety Footwear (EN345/EN ISO 20346 or greater – to include additional penetration-resistant midsole).

- Gloves (to EN388).
- Eye Protection (safety glasses to at least EN 166 1F).

SACIC Environment Policy

Suffolk Archaeology is committed to the sustainable management of the local and global environment to support local communities and growth in our local economy. We will strive to reduce our carbon emissions, to protect and enhance the natural and historic environment and to tackle the issues of a changing climate. In delivering our services, we are committed to meeting all relevant regulatory, legislative and other requirements, and to the continual improvement of our environmental performance.

We will endeavour to:

- Prevent environmental pollution and minimise waste;
- Reduce our carbon emissions;
- Continually improve our energy efficiency and reduce our use of resources;
- Reduce the impact of vehicle travel by our employees;
- Implement sustainable procurement practices where possible;
- Enhance biodiversity, conserve distinctive landscapes and protect the historic environment.

All existing and new SACIC subcontractors are issued annually with an Environmental Guidance Note For Contractors.

On site the SACIC Project Officer will monitor environmental issues and will alert staff to possible environmental concerns. In the event of spillage or contamination, e.g. from plant or fuel stores, EMS reporting and procedures will be carried out in consultation with the SACIC EMS Officer.

The client and/or landowner has not informed SACIC of any environmental constraints upon the development area but none are expected as the site is wholly within arable agricultural use

All rubbish will be bagged and removed either to areas designated by the client or returned to SACIC for disposal.

3. Project Contacts

SACIC

SACIC Manager	Dr Rhodri Gardner	01449 900120
SACIC Project Manager	John Craven	01449 900121
SACIC Finds Dept	Richenda Goffin	01449 900129
SACIC H&S	John Craven	01449 900121
SACIC EMS	Jezz Meredith	01449 900124
SACIC Outreach Officer	Alex Fisher	01449 900125

Emergency services

Local Police		101
Local GP	Holbrook Surgery, The Street, Holbrook, IP9 2QS	01473 328263
Location of nearest A&E	Ipswich Hospital, Heath Road, Ipswich, IP4 5PD	01473 702033
Environment Agency	Customer Services Line (8am to 6pm) 24 hour Emergency Hotline	03708 506 506 0800 807060
Essex and Suffolk Water	24 hour Emergency Hotline	0845 782 0999
National Gas Emergency Service	Gas emergency hotline	0800 111 999
UK Power Networks	East England electricity emergency hotline	0800 783 8838
Anglian Water	24 hour Emergency Hotline	08457 145 145

Client contacts

Client	Andrew Hawes	
Client Agent		
Site landowner		

Archaeological contacts

Curator	TBC (SCCAS/CT)	01284 741232
Consultant		
EH Regional Science Advisor	Dr Zoe Outram	01223 582707

4. Geophysical Technical Information

Detailed magnetometer survey

Detailed magnetometer survey is the most commonly employed archaeological geophysical prospection method in Britain, sensitive sensors can cost-effectively cover large areas of ground, rapidly recording anomalies that are indicative of cultural settlement activity. These anomalies can then be further investigated by field archaeologists to quantify a form and function. The magnetometer is a passive instrument that detects both permanent thermoremanent and temporary magnetic responses.

Thermoremanent Magnetism

When a material containing iron oxides, for example clay, is heated above the Curie point, weakly magnetic compounds transform in to highly magnetic oxides that can be detected by the sensors of a magnetometer (Clark). For instance the iron oxide haematite has a Curie temperature of 675 Celsius and magnetite 565 Celsius. Once these temperatures are reached, the oxides become demagnetised, on cooling their magnetic properties become permanently re-magnetised and align in the direction of the Earth's magnetic field (Gaffney and Gater). Over time the direction of the Earth's magnetic field changes allowing these directional differences to be detected by the magnetometer.

Strongly heated features such as hearths, kilns or furnaces frequently reach the Curie temperature and become permanently magnetised. These permanent magnetic responses are some of the strongest cultural features that can be recorded.

Temporary Magnetism

Magnetic susceptibility is the ease with which a magnetic field can pass through a material, therefore the higher the materials magnetic susceptibility, the stronger the induced magnetic field will be. Temporary magnetisation occurs within material that is magnetically susceptible, this material acquires its own local magnetic field that combine with the Earth's magnetic field causing an anomaly to stand out from the background noise (Clark). These anomalies are more subtle in nature, being derived from material that has been magnetically enhanced by cultural activity and become concentrated into features over time. Anomalies that have temporary magnetisation include backfilled pits, ditches, field systems, occupation areas, land drains, remnant and existing field

boundaries (David, 2011).

The key to a successful survey is having good contrast between the magnetic susceptibility of an archaeological feature with the surrounding superficial deposits. If there is no discernible difference between the two mediums it may be unlikely that the magnetometer will successfully prospect the feature. Archaeological features can also be masked by high magnetically susceptible topsoil, or deep overlying subsoil and colluvial deposits.

Ferrous anomalies

Ferrous objects are a common source of permanent magnetism, usually isolated with a strong dipolar signature. Some of these responses may have an archaeological derivation, however they are probably more indicative of modern iron objects introduced through manuring or lost within the topsoil.

Bartington DualGRAD 601-2 Fluxgate Gradiometers

Fluxgate gradiometers are the most commonly employed class of instrument in the UK. Two 1m sensitive sensors are affixed to a frame mounted 1m apart in a vertical plane and harnessed to the trunk of a geophysical surveyor or attached to a pulled cart. Each sensor contains two fluxgate magnetometers with 1m vertical separation. The sensor above records the Earth's magnetic field (magnetic background) while the sensor below records the local magnetic field. The two sensors need aligning before recording can begin, a zero station is located in an area with low magnetic variation for this purpose. After the sensors have been aligned, the survey can begin. When differences in the magnetic field strength occur between the two vertical magnetometers within each sensor, a positive or negative reading is recorded that is relative to the magnetic background of the zero station. Positive anomalies include pits, ditches and agricultural furrows. Negative anomalies commonly prospected include earthwork embankments, land drains and geological features.

Sensors are normally mounted to a height of 0.30m above the surface, and can detect to a depth of between one and two metres below the ground. The first survey traverse is commonly undertaken in an east to west direction.

Magnetic Anomalies

Isolated dipolar responses

Isolated dipolar responses are commonly recorded throughout a dataset and are usually indicative of modern ferrous material deposited within the topsoil horizon. In some instances the anomalies may be of an archaeological derivation. They are isolated, strong and dipolar in character.

Areas of magnetic disturbance

These anomalies are usually caused by building demolition rubble, ferrous boundaries, slag waste dumps, modern buried rubbish, pylons and services. Strong and dipolar in character, they are commonly recorded over a wide area.

Linear trends

Linear trends can be either positive or negative magnetic responses depending on the nature of the material present within the feature. If the anomaly is broad and weak, it is more likely to be of geological origin. Stronger positive linear trends are more likely to be of archaeological derivation, caused by settlement activity washing rich humic, charcoal and fired deposits into a feature. Negative linear trends are more commonly associated with bank deposits or land drains, with the less magnetically susceptible superficial deposits deposited at the top of the feature. Curvilinear trends are usually of archaeological origin, commonly interpreted as ring ditches or drip-gullies.

Discrete anomalies

Discrete anomalies can either be positive or negative in nature recorded within a localised area. Those that are positive are more likely to be of an archaeological origin, with negative discrete anomalies more commonly interpreted as natural geological variations.

Thermoremanent responses

These responses are caused by the heating of material containing iron to above the Curie temperature, they are strong and discrete in nature, in Britain high positive readings are recorded to the south of the feature, and high negative readings are recorded to the north.

SUFFOLK ARCHAEOLOGY

• A HISTORY OF EXPERTISE •

Geophysical Survey Risk Assessments

Apre -siteinspectionandassessmenthasbeenmadeofthesiteandthefollowing SACIC RiskAssessmentsapplytotheprojectandare includedbelow.

SACIC GSRA1	Manualhandlingandoutdoorworking
SACIC GSRA2	Useofh andtoolsandinstrumentation

Geophysical Survey Risk Assessment 1 Manual handling and outdoor working

Activity	Location	Hazard	Risks	Persons affected	Initial risk	Control measures	Residual risk	Name	Date	Rescue procedures
Manual handling of survey instruments and working outdoors.	Various.	Extremes of heat, cold and wet weather. Trip hazards.	Hypothermia, heat stroke, sunburn. Minor injuries. Carrying heavy equipment for prolonged periods.	All field staff.	9	All staff provided with appropriate clothing for weather conditions. No staff to work alone in extreme conditions. Regular sweep for trip hazards.	2	T Schofield	23/02/18	First Aid if required. Call emergency services if necessary.

	Likelihood				
Severity	1	2	3	4	5
1	1	2	3	4	5
2	2	4	6	8	10
3	3	6	9	12	15
4	4	8	12	16	20
5	5	10	15	20	25

Initial Risk
Residual Risk

Likelihood	Severity	Risk (likelihood x severity)
1. Highly unlikely	1. Slight inconvenience	1-5 Low
2. May occur but very rarely	2. Minor injury requiring first aid	
3. Does occur but only rarely	3. Medical attention required	6-12 Medium
4. Occurs from time to time	4. Major injury leading to hospitalisation	
5. Likely to occur often	5. Fatality or serious injury leading to disablement	13-25 High

Geophysical Survey Risk Assessment 2 Use of hand tools and survey instruments

Activity	Location	Hazard	Risks	Persons affected	Initial risk	Control measures	Residual risk	Name	Date	Rescue procedures
Surveying, setting out and use of small hand tools and marker canes.	Various.	Splinters from poorly maintained equipment, trip hazards from unused equipment, trip hazards from uneven ground, some heavy lifting, tape winding.	Minor injuries.	All field staff.	8	Ensure all tools in serviceable condition. Careful policing of temporarily unused equipment (e.g. no discarded hand tools, hand tapes pegged down). Ensure all tools and instrumentation carried appropriately.	4	T Schofield	23/02/18	First Aid if required. Call emergency services if necessary.

	Likelihood				
Severity	1	2	3	4	5
1	1	2	3	4	5
2	2	4	6	8	10
3	3	6	9	12	15
4	4	8	12	16	20
5	5	10	15	20	25

Initial Risk
Residual Risk

Likelihood	Severity	Risk (likelihood x severity)
1. Highly unlikely	1. Slight inconvenience	1-5 Low
2. May occur but very rarely	2. Minor injury requiring first aid	
3. Does occur but only rarely	3. Medical attention required	6-12 Medium
4. Occurs from time to time	4. Major injury leading to hospitalisation	
5. Likely to occur often	5. Fatality or serious injury leading to disablement	13-25 High

Suffolk Archaeology CIC
Unit 5 | Plot 11 | Maitland Road | Lion Barn Industrial Estate
Needham Market | Suffolk | IP6 8NZ

Rhodri.Gardner@suffolkarchaeology.co.uk
01449 900120

www.suffolkarchaeology.co.uk

www.facebook.com/SuffolkArchCIC

www.twitter.com/suffolkarchcic