SUFFOLK ARCHAEOLOGY

• A HISTORY OF EXPERTISE •

Area 8, Anglian Waste Water

Rendlesham, Suffolk

Client:
Mr Anthony Hardy, Capital Community Developments

Date:
November 2017

ESF 25912 / RLM 083
Geophysical Survey Report
SACIC Report No. 2017/097
Author: Timothy Schofield HND BSc MCIfA
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Area 8, Anglian Waste Water
Rendlesham, Suffolk
RLM 083

Geophysical Survey Report

SACIC Report No. 2017/097

Author: Timothy Schofield

Illustrator: Timothy Schofield

Editor: Rhodri Gardner

Report Date: November 2017

HER Information

Site Code:	**RLM 083**
Event Number:	**ESF 25912**
Site Name:	**Area 8, Anglian Waste Water, Rendlesham, Suffolk**
Report Number	**2017/097**
Planning Application No:	**TBC**
Date of Fieldwork:	**17th – 19th October 2017**
Grid Reference:	**TM 3370 5377**
Oasis Reference:	**297922**
Curatorial Officer:	**Faye Minter**
Project Officer:	**Timothy Schofield**
Client/Funding Body:	**Mr Anthony Hardy, Capital Community Developments**
Client Reference:	**n/a**

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

Disclaimer

Any opinions expressed in this report about the need for further archaeological work are those of Suffolk Archaeology CIC. Ultimately the need for further work will be determined by the Local Planning Authority and its Archaeological Advisors when a planning application is registered. Suffolk Archaeology CIC cannot accept responsibility for inconvenience caused to the clients should the Planning Authority take a different view to that expressed in the report.

Prepared By: Timothy Schofield
Date: November 2017

Approved By: Rhodri Gardner
Position: Director
Date: November 2017
Signed: R.V. Gardner

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Summary

In October 2017 Suffolk Archaeology Community Interest Company (SACIC) undertook a detailed fluxgate gradiometer survey on land at Area 8, Anglian Waste Water, Rendlesham, Suffolk. The survey was undertaken within a single close-cropped stubble field and covered an area of *c*. 5ha.

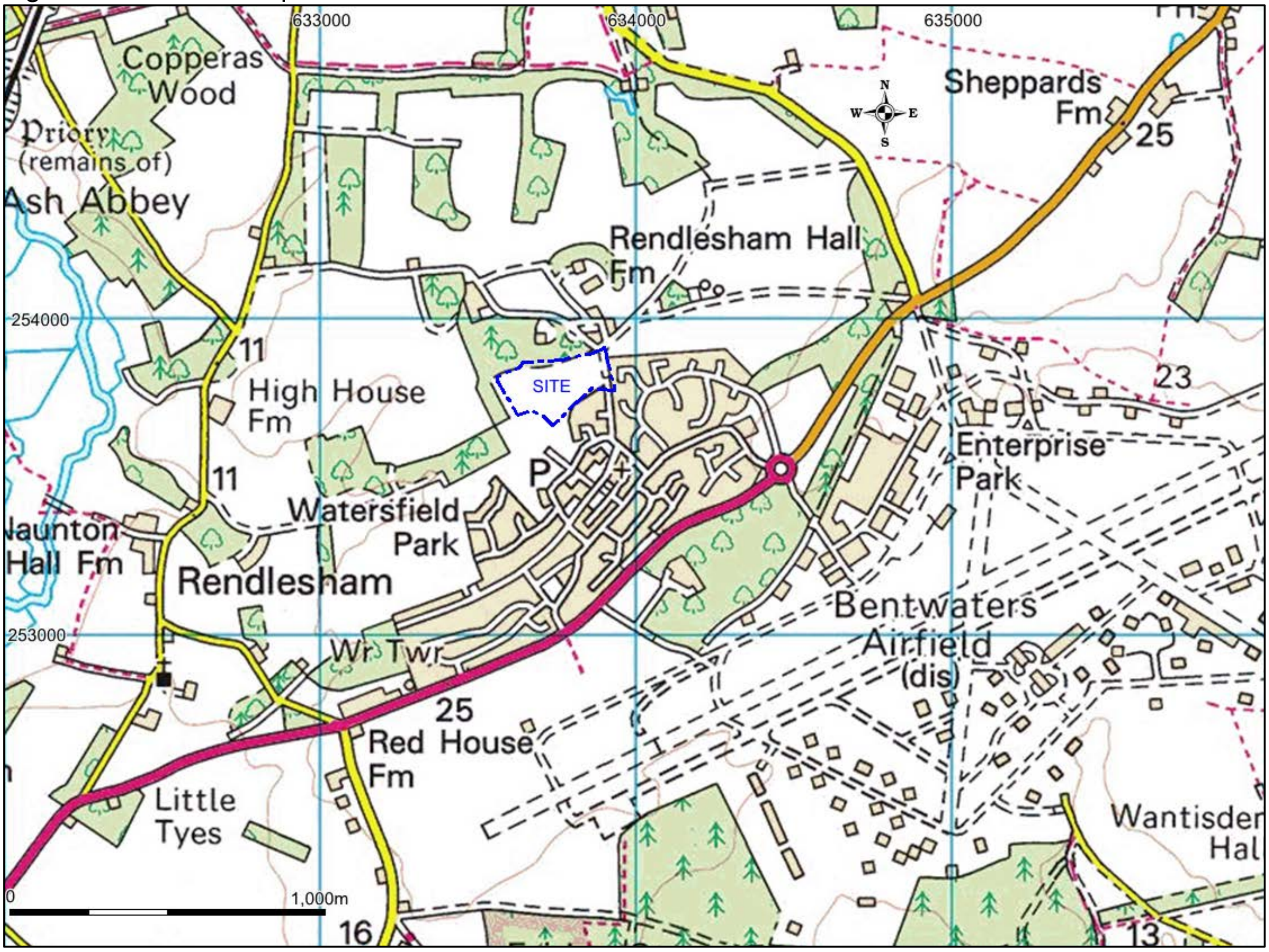
The detailed fluxgate gradiometer survey prospected a variety of geophysical anomalies, including a single potential former field boundary, five potential archaeological pits and a discrete geological anomaly. Modern ferrugenic and non-ferrous service pipe runs associated with the waste water plant were further recorded along with areas of magnetic disturbance.

1. Introduction

On the 17th, 18th and 19th October 2017 a detailed fluxgate gradiometer survey covering *c*. 5 hectares within a single field at Area 8, Anglian Waste Water, Suffolk (Fig.1) was undertaken by Suffolk Archaeology Community Interest Company (SACIC).

The geophysical survey was requested by Suffolk County Council Archaeological Services/Conservation Team (SCCAS/CT), in accordance with paragraphs 128, 129 and 141 of the National Planning Policy Framework. Suffolk Archaeology CIC were commissioned to undertake the project by Mr Anthony Hardy of Capital Community Developments.

Figure 1. Location map



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2. Geology and topography

The site lies within former parkland belonging to the 18th - 19th century Rendlesham Hall (TM 3370 5377), in a single five-hectare field currently under arable cultivation. It slopes gently from 27m in the northwest to 24m Above Ordnance Datum in the southeast.

The bedrock geology consists of Chillesford Church sand formed up to 2 million years ago in the Quaternary Period when the local environment was dominated by shallow seas depositing detrital fine-grained deposits (BGS 2017).

Superficial deposits are described as Lowestoft Formation Diamicton, formed up to 2 million years ago in the Quaternary Period during ice age conditions, where deposits of a glacigenic origin were created by the actions of the ice and interglacial meltwaters (BGS 2017).

3. Archaeology and historical background

A geophysical survey is required by Faye Minter of SCCAS/CT, in order to inform an archaeological evaluation brief for the proposed development site.

The survey area lies in an agricultural field that was the former park (RLM 022) of Rendlesham Hall (RLM 021) built in the 18th century and updated in the 19th century. During the Second World War the Hall was taken over by the armed services who left the building in such a poor state of repair that it was demolished in 1939. Previous archaeological investigations, 860m to the west (RLM 030) have revealed several phases of clay extraction, dating from the Roman to medieval periods, medieval and post-medieval ditches were further recorded here. Prehistoric and Roman features were identified during trial trenching at RLM 035, 870m to the west. A suspected Anglo-Saxon cemetery (RLM 006) lies 730m to the southwest. An Iron Age pottery scatter (RLM 010) is recorded 570m to the southwest. A single undated rectilinear enclosure

(RLM 028) is identified 790m to the west on aerial photographs. Archaeological monitoring undertaken in 2005 on the Rendlesham pumping main replacement (RLM 033) located on the boundary of the site and running 500m to the east, revealed no archaeological features.

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 overcast interspersed with occasional periods of blue skies and heavy showers. 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 GS08+ 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 relatively low background magnetic signature allowing the anomalies to contrast with the superficial geology. 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 (Fig. 3) and processed datasets (Figs. 4 – 5); 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 geophysical anomalies to be accurately targeted (Fig. 2).

5. Results and discussion

A fairly narrow range of anomalies were recorded during the survey (Figs. 3 – 6). One positive linear anomaly (red hatching) orientated northwest to southeast, aligned with the current field boundary configuration, was prospected in the northern half of the dataset. It is likely to be the remains of a backfilled former field boundary subdivision.

Five positive discrete anomalies (orange hatching) indicative of pit-type anomalies were recorded within the survey area. The majority of which are in the northeast corner of the field. A single positive discrete anomaly is recorded directly to the north of the geological anomaly (green hatching).

A single broad positive discrete anomaly (green hatching) has been prospected in the centre of the dataset and to the south of a positive discrete anomaly. Its weak, broad and slightly irregular nature suggests that it is likely to be of a geological derivation.

A series of dipolar linear trends (dark blue lines) on a variety of alignments are likely to record the locations of ferrous service pipes, which are potentially linked to the Anglian Waste Water plant located immediately adjacent to the north.

One broad strong positive linear trend (cyan line) delineates the location of a service pipe trench that adjoins the ferrous service pipes, it is likely to be of a concrete or similar non-ferrous construction.

There are many areas of magnetic disturbance (grey hatching) located throughout the dataset that are probably derived from modern groundworks associated with the construction of the pipe trenches. Ferrous material has been recorded on and in the boundary and dumps of magnetic material have further been deposited within the field.

A plethora of ‘iron spike’ anomalies (grey spots) were recorded throughout the dataset, indicating that ferrous debris had been deposited within the ploughsoil during manuring events and construction activity.

6. Conclusion

The geophysical survey results indicate that the site has a low archaeological potential, with most anomalies deriving from modern service pipe trenching and their associated groundworks. A single weak broad geological anomaly, areas of magnetic disturbance and isolated dipolar ‘iron spike’ anomalies were further prospected.

One linear anomaly indicative of a former field boundary could be of an archaeological origin or may prove to be a backfilled ditch used in modern agriculture. Five discrete positive anomalies may prove to be archaeological pits, however a geological or modern origin cannot be ruled out.

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 Tim Schofield and Cameron Bate and directed by Tim Schofield. Project management was undertaken by Rhodri Gardner. The report and illustrations were created by Tim Schofield, editing was carried out by Rhodri Gardner.

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STN 02	633920.470	253796.324
STN 03	633606.084	253736.647

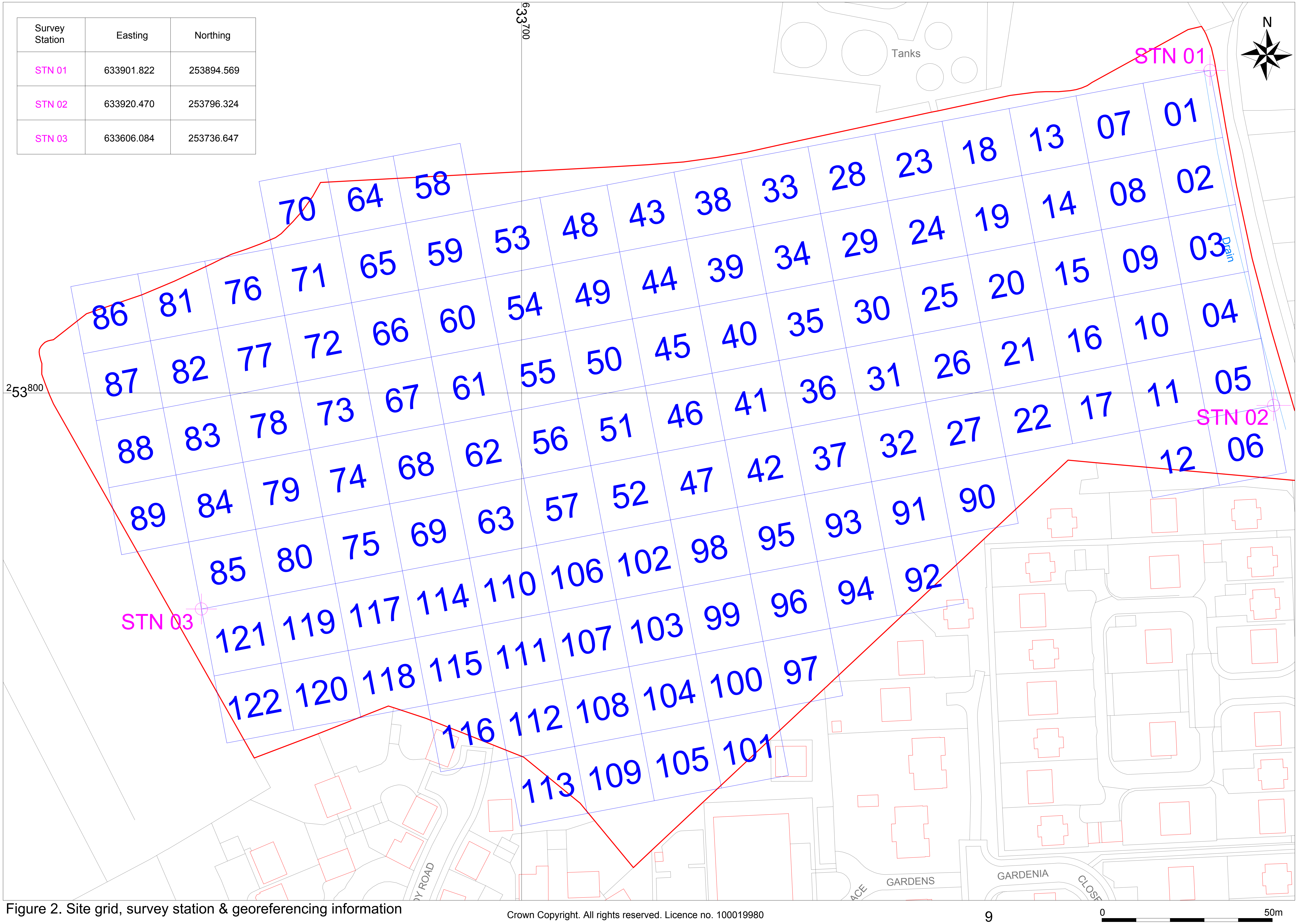

Figure 2. Site grid, survey station & georeferencing information

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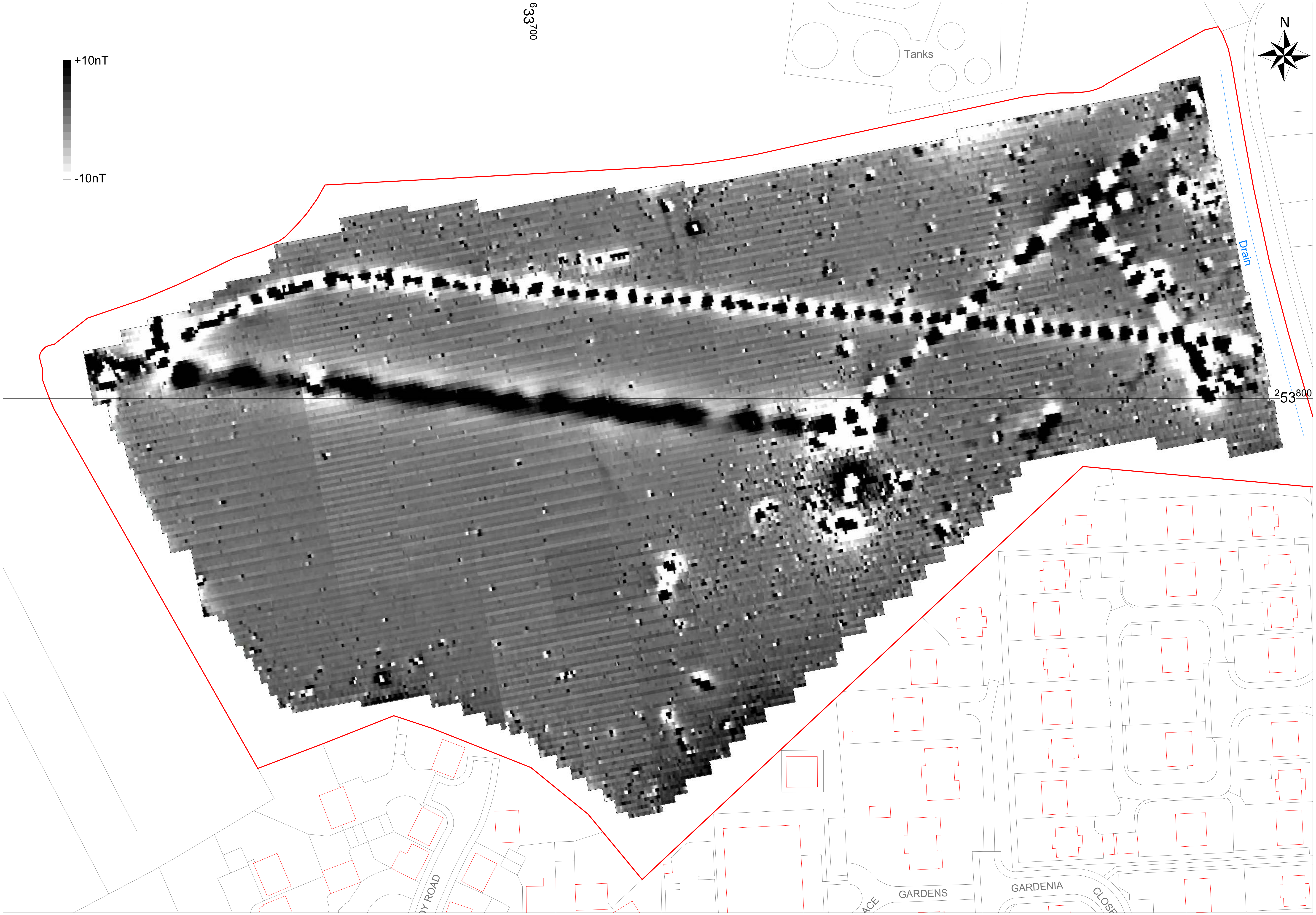

Figure 3. Raw magnetometer greyscale plot

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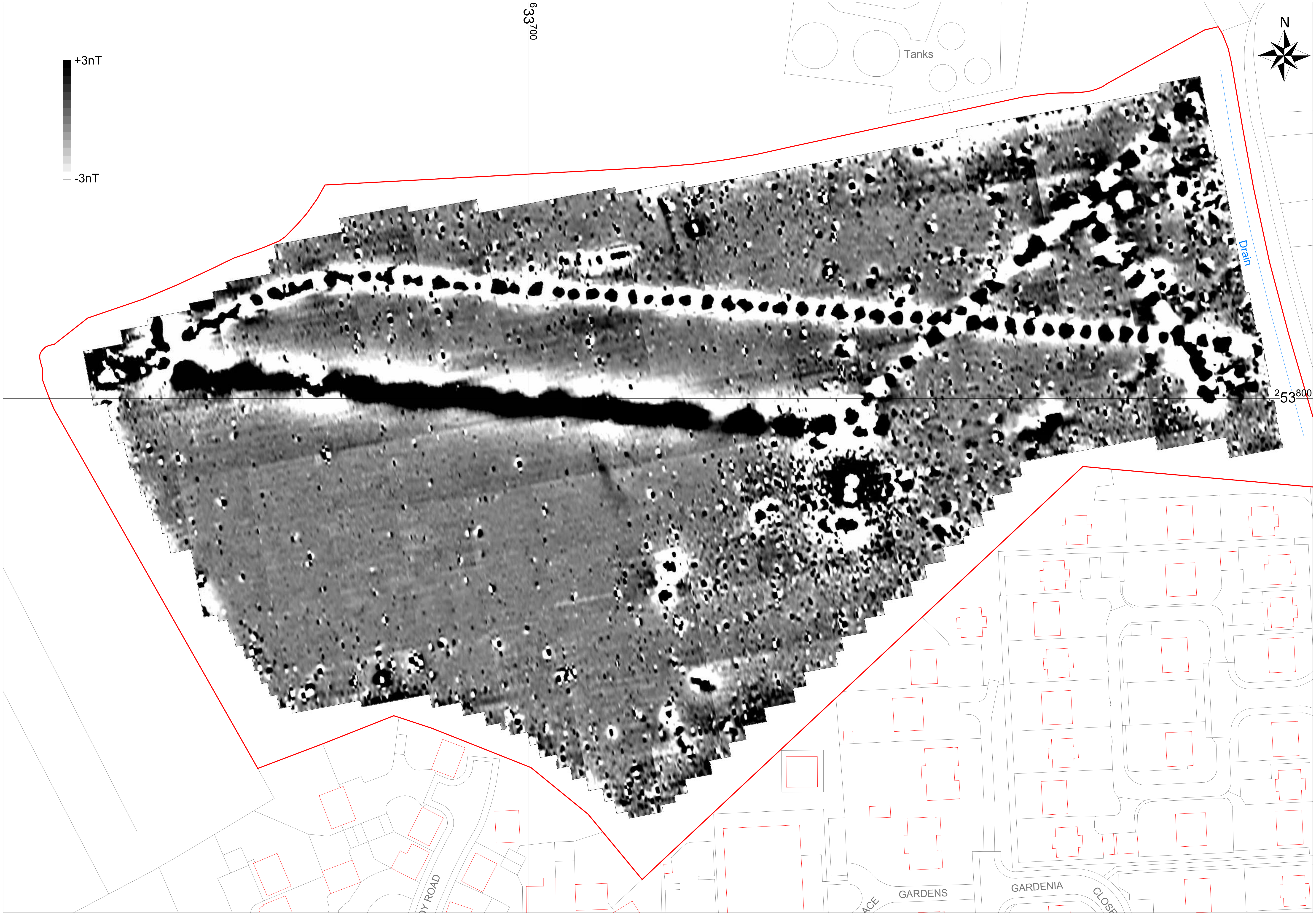

Figure 4. Processed magnetometer greyscale plot

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0 50m

Figure 5. Processed magnetometer xy trace plot

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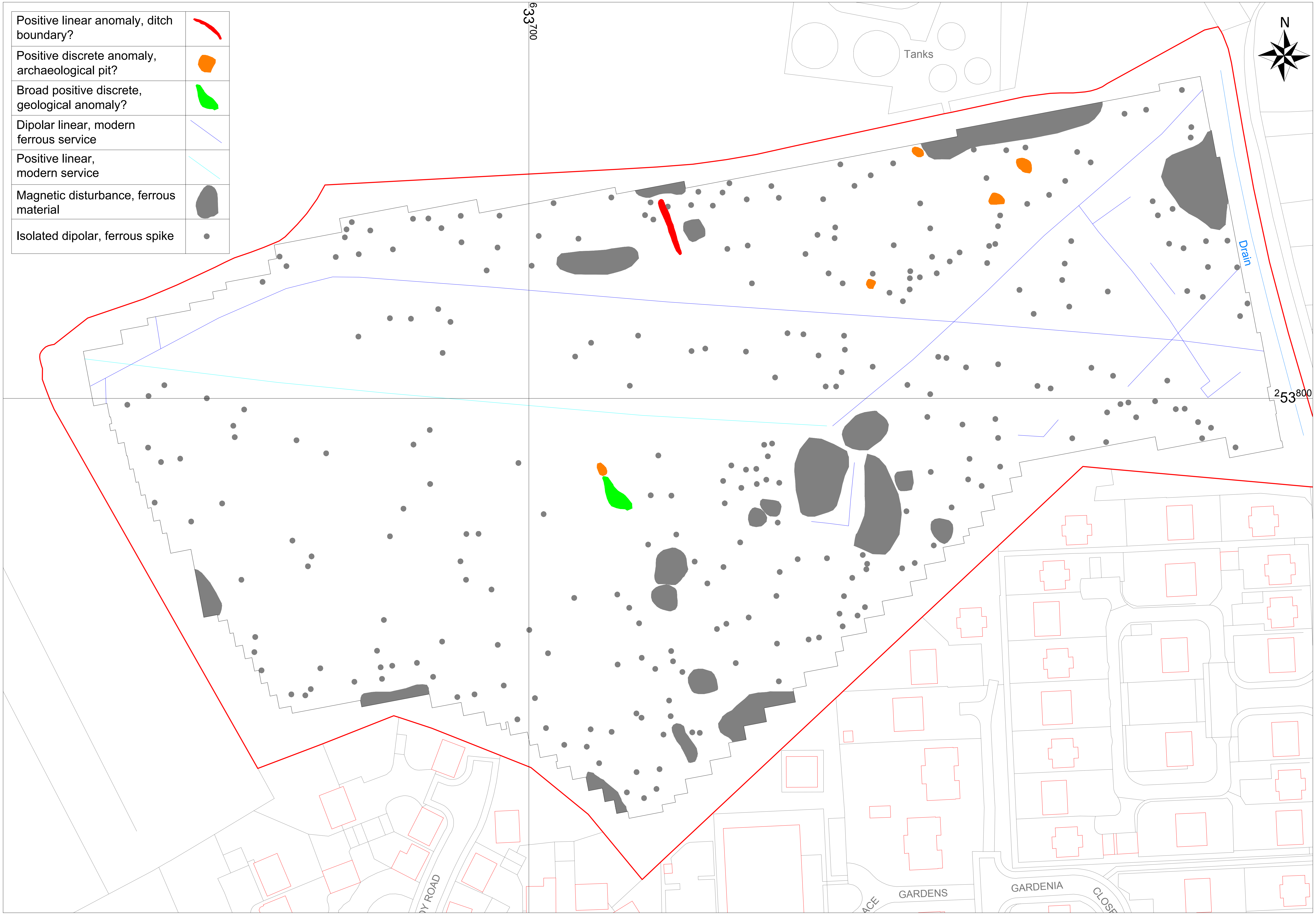

Figure 6. Interpretation plot of magnetometer anomalies

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Appendix 1. Metadata sheets

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Y Interval	1 m
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Std Dev	15.50
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Surveyed Area	4.2136 ha
Program	
Name	TerraSurveyor
Version	3.0.33.6

Processes

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Processed Data

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Units	nT
Direction of 1st Traverse	90 deg
Collection Method	ZigZag
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Dummy Value	2047.5
Dimensions	
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Survey Size (meters)	340 m x 220 m
Grid Size	20 m x 20 m
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Y Interval	1 m
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Median	0.00
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Surveyed Area	4.2135 ha
Program	
Name	TerraSurveyor
Version	3.0.33.6

Processes

Display Clip -3 +3

Graduated Shade

Destripe Median Sensors; All

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: suffolka1-297922

Project details

Project name	Area 8 Anglian Waste Water, Rendlesham, Suffolk; Detailed Geophysical Survey
Short description of the project	In October 2017 Suffolk Archaeology Community Interest Company (SACIC) undertook a detailed fluxgate gradiometer survey on land at Area 8, Anglian Waste Water, Rendlesham, Suffolk. The survey covered an area of c. 5ha that was prospected for anomalies of an archaeological derivation within a single field, over an area of close cropped stubble. The detailed fluxgate gradiometer survey prospected a variety of geophysical anomalies, including a single potential former field boundary, 5 potential archaeological pits, a discrete geological anomaly. Modern ferrugenic and non-ferrous service pipe runs associated with the waste water plant were further recorded during the survey along with areas of magnetic disturbance.
Project dates	Start: 17-10-2017 End: 19-10-2017
Previous/future work	No / Yes
Any associated project reference codes	ESF 25912 - HER event no.
Any associated project reference codes	RLM 083 - 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 RUBBISH PITS Uncertain
Monument type	ANOMALIES INDICATIVE OF A FIELD BOUNDARY Uncertain
Significant Finds	NONE None
Methods & techniques	"Geophysical Survey"
Development type	Housing estate
Prompt	Direction from Local Planning Authority - PPS
Position in the planning process	Pre-application
Solid geology (other)	Chillesford Church Sand
Drift geology (other)	Lowestoft Formation Diamicton
Techniques	Magnetometry

Project location

Appendix 4. Written scheme of investigation

SUFFOLK ARCHAEOLOGY

• A HISTORY OF EXPERTISE •

Area 8 Anglian Waste Water

Rendlesham, Suffolk

Client:
Mr Anthony Hardy, Capital Community Developments

Date:
October 2017

ESF 25912 / RLM 083
Written Scheme of Investigation and Risk Assessment – Geophysical Survey

Author: Timothy Schofield HND BSc MCIfA

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Project details

Planning Application No:	TBC
Curatorial Officer:	TBC (Suffolk CC Archaeological Service)
Grid Reference:	TM 3370 5377
Area:	5ha
HER Event No/Site Code:	ESF 25912 / RLM 083
OASIS Reference:	297922
Project Start date:	17th October
Project Fieldwork Duration:	*c*. 3 days
Client/Funding Body:	Anthony Hardy
SACIC Project Manager:	Tim Schofield
SACIC Project Officer:	Tim Schofield
SACIC Job Code:	RLM ARE 001

1. Introduction

- A program of geophysical survey is required to the south of the Anglian Waste Water plant at Rendlesham, Suffolk (Fig. 1), prior to determination of a planning application in accordance with paragraph 128, 129 and 141 of the National Planning Policy Framework.
- The work is required to inform the archaeological brief, an archaeological adviser to the Local Planning Authority (LPA) from Suffolk County Council Archaeological Service (SCCAS) is to be confirmed.
- The development occupies an area of *c.* 5ha and Suffolk Archaeology (SACIC) have been contracted to carry out the geophysical survey. This Written Scheme of Investigation (WSI) details how the survey will meet the requirements as laid out in the SCCAS geophysical survey guidelines (SCCAS 2017), and has been submitted to SCCAS 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.
- 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, 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 as to their obligations following receipt of the geophysical survey report.

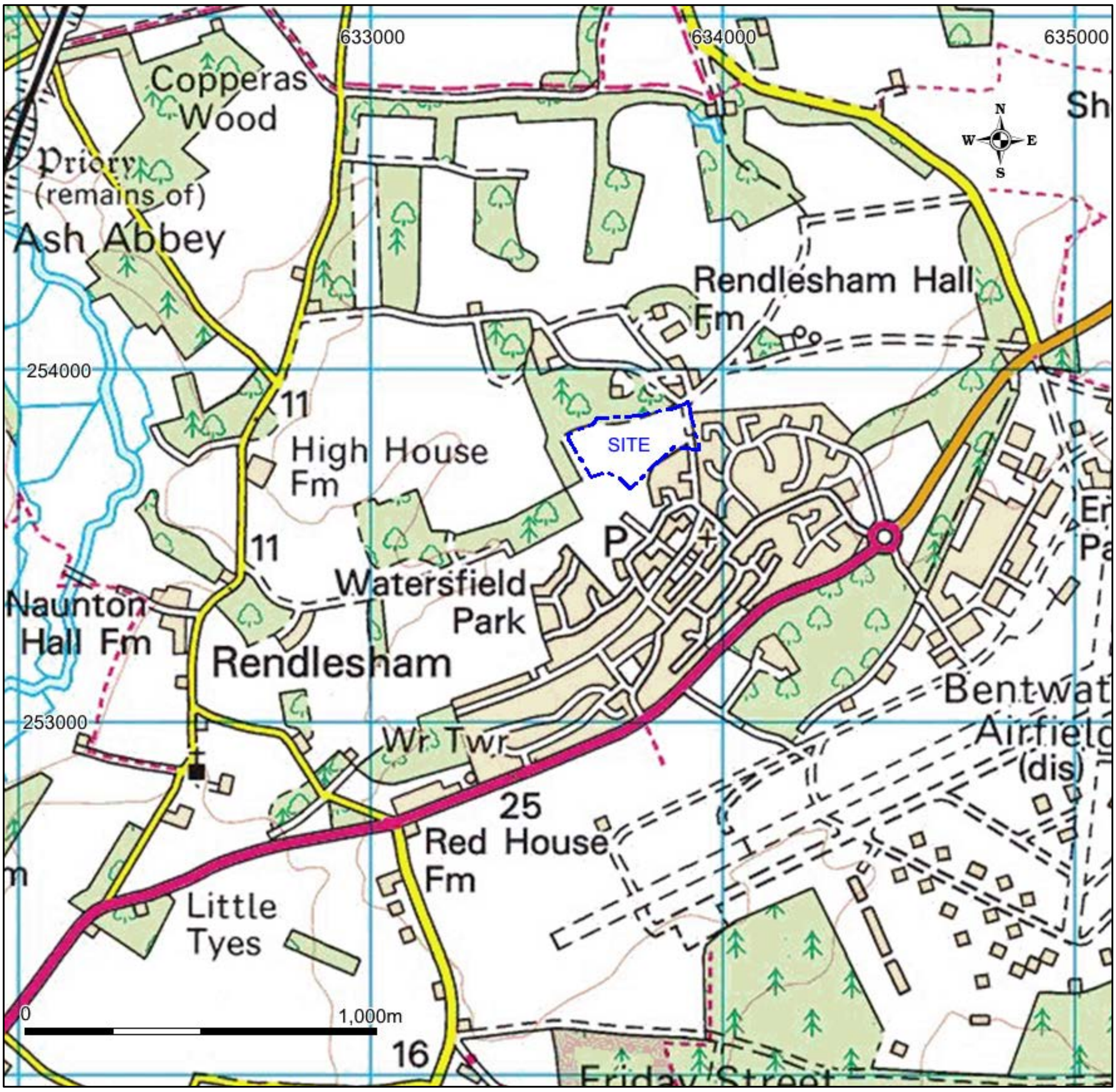

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Figure 1. Location map

2. The Site

- The site lies within the former park of the 18th and 19th century Rendlesham Hall (TM 3370 5377), comprising a single five-hectare field that is currently under arable cultivation. It slopes gently from 27m in the northwest to 24m Above Ordnance Datum in the southeast.
- The bedrock geology consists of Chillesford Church sand formed 2 million years ago in the Quaternary Period when the local environment was dominated by shallow seas depositing detrital fine-grained deposits (BGS 2017). Superficial deposits are described as Lowestoft Formation Diamicton, formed up to 2 million years ago in the Quaternary Period during ice age conditions, where deposits of a glacigenic origin were created by the actions of the ice and its interglacial meltwaters (BGS 2017).

3. Archaeological and Historical Background

The survey area lies in an agricultural field that was the former park (RLM 022) of Rendlesham Hall (RLM 021) built in the 18th century and updated in the 19th century. During the Second World War the Hall was taken over by the armed services, who in turn left the building in such a poor state of repair that it was finally demolished in 1939.

Previous archaeological investigations 860m to the west (RLM 030) have revealed several phases of clay extraction pit, dating from the Roman to medieval periods, medieval and post-medieval ditches were also recorded at this site. Prehistoric and Roman features were identified during trial trenching at RLM 035, 870m to the west. A suspected Anglo-Saxon cemetery (RLM 006) lies 730m to the southwest. An Iron Age pottery scatter (RLM 010) is recorded 570m to the southwest of site. A single undated rectilinear enclosure (RLM 028) is identified 790m to the west on aerial photographs. Archaeological monitoring undertaken on the Rendlesham pumping main replacement (RLM 033) located on the boundary of the site, then running 500m to the east in 2005, revealed no archaeological features.

4. Project Objectives

- A systematic fluxgate gradiometer survey is to be undertaken across a single field to prospect for anomalies of a potential archaeological derivation.

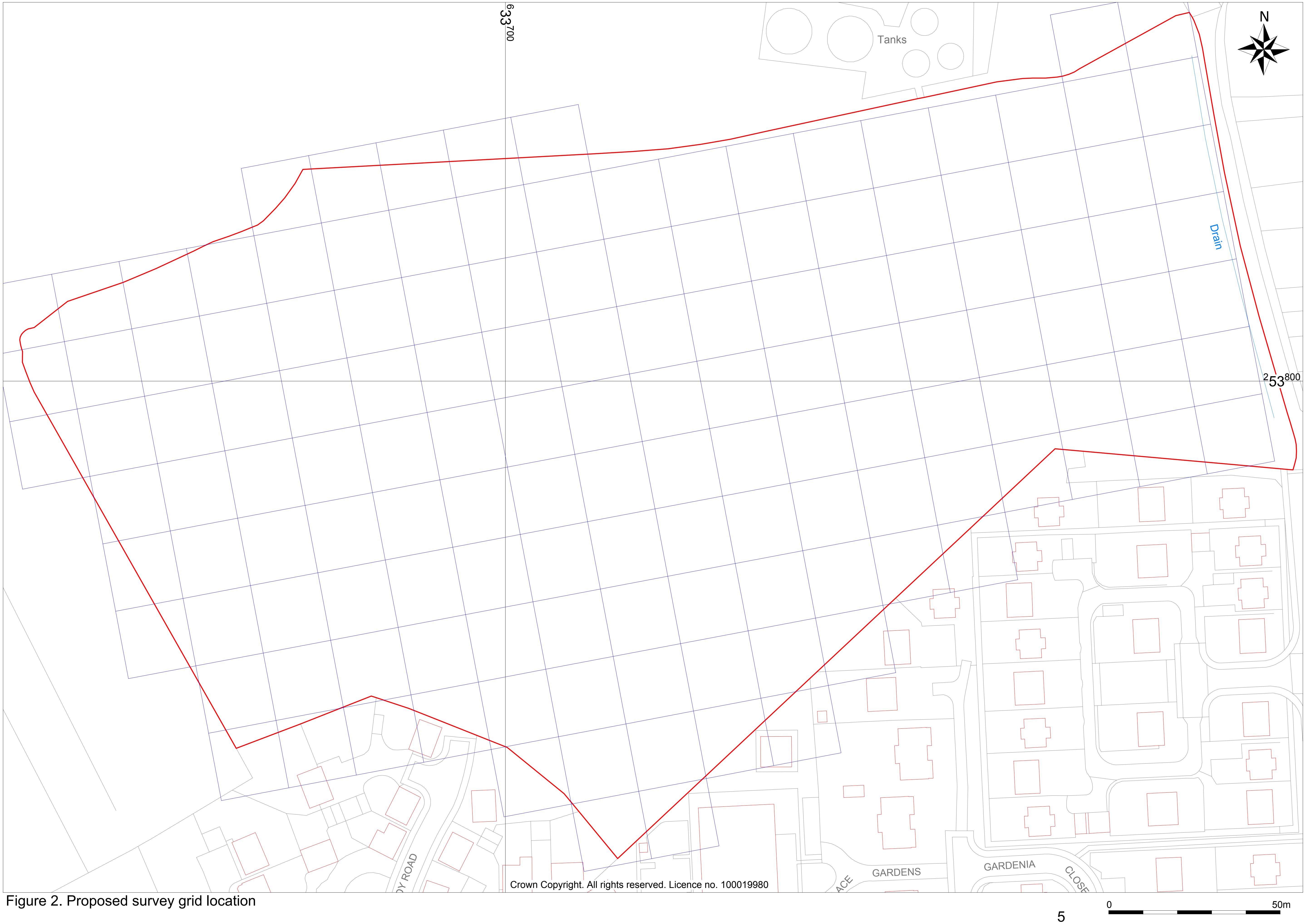

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Figure 2. Proposed survey grid location

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 will be given five days' notice of the commencement of the fieldwork and arrangements made for a SCCAS 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 HER Officer and will be included on all future project documentation. An HER search has been requested.
- An OASIS online record has been initiated (297922) 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*. 5 hectares over the proposed development area (Fig. 2). 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 GS08+ 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 may comprise de-spike and zero mean 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 v3.0.32.4. 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 plots 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 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 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 (SCCAS 2017).
- The project costing includes a sum to meet SCCAS archive charges. A form transferring ownership of the archive to SCCAS 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, they will be expected to either nominate another suitable depository approved by SCCAS.

5.6. Bibliography

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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.

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

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

Websites

British Geological Survey 2017

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 Santo	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:

Suffolk Archaeology Community Interest Company is committed to ensuring the health, safety and welfare of its employees, and it will, so far as is reasonably practicable, establish procedures and systems necessary to implement this commitment and to comply with its statutory obligations on health and safety. Our Personnel are informed of their responsibilities to ensure they take all reasonable precautions, to ensure the safety, health and welfare of those that are likely to be affected by the acts and emissions of our organisations undertakings.

Suffolk Archaeology Community Interest Company understands our duty to identify the significant hazards that may be created by our undertakings and to risk assess these accordingly to ensure that suitable and effective controls are implemented to minimise risk to a suitable level as far as is reasonably practicable.

We also acknowledge our duty, so far as is reasonably practicable:

- *To provide a safe working environment for our workforce, fulfil our statutory commitments and actively manage and supervise health and safety at work;*
- *To identify the risks associated with our business activities and ensure suitable and sufficient control measures are in place.*
- *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 adequately maintained.*
- *To provide suitable storage and ensure safe handling of Hazardous substances.*
- *To ensure that all workers are competent to undertake their daily work activities by providing all relevant information and training, consideration will also be given to any employees who do not have English as a first language.*
- *To prevent accidents and cases of work related ill health by ensuring a robust reporting and investigation system is in place.*
- *To liaise and communicate effectively regarding health and safety matters when working on other persons premises.*
- *To ensure that there is an effective system of induction, training, communication and supervision to other persons visiting or working on our premises.*
- *To have access to competent advice, this will be provided by Agility UK (Training and Consultancy) Ltd. Who will assists us in the continuous improvement in our health and safety 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 arrangements effective.*

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 via a field entrance to the west of Friston Hall. 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	Rendlesham Surgery, 6 Acer Road, IP12 2GA	01502 722326
Location of nearest A&E	Ipswich Hospital, Heath Road, Ipswich, IP4 5PD	01473 712233
Environment Agency	Customer Services Line (8am to 6pm)	03708 506 506
	24 hour Emergency Hotline	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	Anthony Hardy	
Client Agent		
Site landowner		

Archaeological contacts

Curator	Rachael Abraham	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.

Geophysical Survey Risk Assessments

A pre-site inspection and assessment has been made of the site and the following SACIC Risk Assessments apply to the project and are included below.

SACIC GSRA1	Manual handling and outdoor working
SACIC GSRA2	Use of hand tools and instrumentation

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	10/10/17	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	10/10/17	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

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