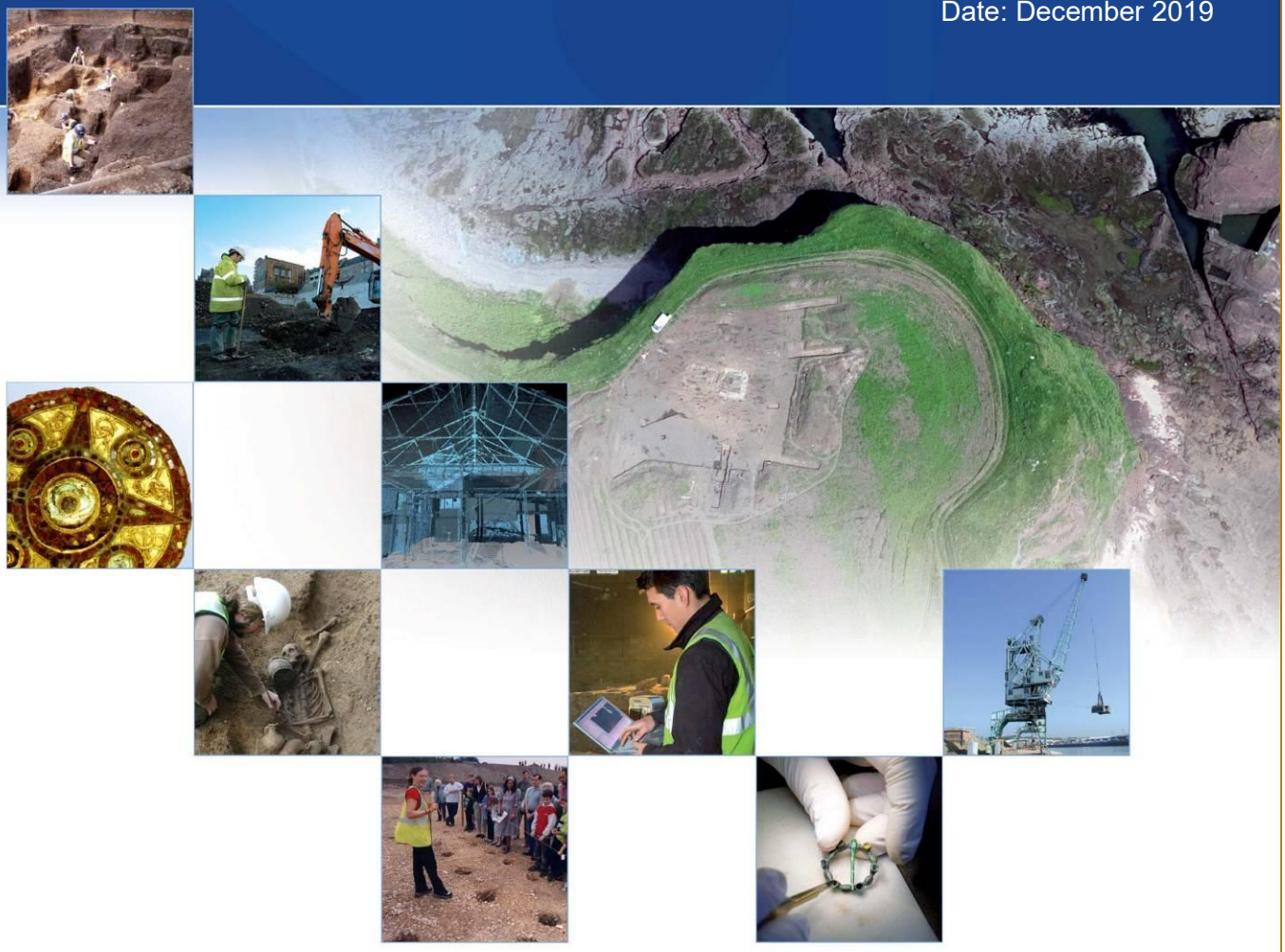
Land at Caenby Corner, Lincolnshire

Archaeological Geophysical Survey

National Grid Reference: SK 97025 89545

AOC Project No: 40074

Date: December 2019



AOC Archaeology Group

ARCHAEOLOGY | HERITAGE | CONSERVATION

Land at Caenby Corner, Lincolnshire

Archaeological Geophysical Survey

On Behalf of:	**Waterman Infrastructure & Environment Ltd.** **Merchants House,** **Wapping Road,** **Bristol,** **BS1 4RW**
National Grid Reference (NGR):	**SK 97025 89545**
AOC Project No:	**40074**
Prepared by:	**James Lawton and Alistair Galt**
Illustrations by:	**James Lawton**
Date of survey:	**11th December 2019**

This document has been prepared in accordance with AOC standard operating procedures.

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Approved by: Kimberley Teale	**Date: 02nd January 2020**
Report Stage: Final Report V2	**Date: 06th January 2020**

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Non-Technical Summary

AOC Archaeology Group was commissioned by Waterman Infrastructure and Environment Limited to undertake an archaeological geophysical gradiometer survey. The survey was undertaken to investigate the potential for buried archaeological remains on a proposed development site at Caenby Corner in Lincolnshire (NGR SK 97025 89545). A total of 2 hectares were surveyed and the results of the survey have identified the following.

No definitive archaeological remains were detected in the results.

Although a number of unclear trends were identified in the dataset, the archaeological potential of these are limited such is the amount of modern disturbance across the site. These unclear trends are most likely related to modern disturbance caused by the sites use for motorsport.

Four linear trends also visible in the dataset are likely to relate to former ridge and furrow ploughing across the site, which is noted in the HER. The appearance of these trends suggest that the furrows have been infilled with magnetically enhanced material, indicating that the site has been levelled.

Magnetic disturbance has been identified across the entire dataset, relating to the presence of small buildings and metallic fencing, and ground disturbance from the use of the area for motorsport. Its possible that hardcore material has also been used in the field, particularly in the field entrance.

1 Introduction

1.1 AOC Archaeology Group was commissioned by Waterman Infrastructure and Environment Limited to undertake an archaeological geophysical gradiometer survey of a site at Caenby Corner, Lincolnshire, as part of a wider scheme of archaeological assessment in advance of a proposed development of the site.

1.2 The survey was carried out to provide information on the extent and significance of potential buried archaeological remains within the proposed development site.

2 Site Location and Description

2.1 The proposed development site (hereafter 'the Site') is located on land east of Caenby Corner Raceway and north of the A631 in Lincolnshire, centred at NGR SK 97025 89545 (see Figure 1).

2.2 The site covers approximately 2 hectares (ha) across a single pasture field that is primarily agricultural fields and a former autograss racing circuit (see Figure 2). The site is situated on a gentle slope, ranging from approximately 46m aOD (above Ordnance Datum) in the north, sloping down towards the south-east to approximately 39m aOD.

2.3 The bedrock recorded geology within the site consists of the Rutland Formation - Argillaceous rocks with subordinate sandstone and limestone; there are no superficial deposits recorded in this location (BGS, 2019). The bedrock geology is overlain by shallow lime-rich soils (Soilscapes, 2019).

2.4 Gradiometer survey is suggested to provide a good response over limestones, especially over Jurassic limestone bedrocks (David *et al.* 2008, 15). The data collected across this site supports this conclusion, and the magnetically noisy background of the dataset is likely the result of modern activity on the site, rather than geology.

3 Archaeological Background

3.1 The archaeological background below is drawn from a feasibility assessment of the Site, undertaken in 2019 (Waterman, 2019). All references to Waterman IDs, Lincolnshire HER records and National Heritage List for England (NHLE) records can be found in the appendix of the feasibility assessment.

Designated Heritage Assets

3.2 A review of the NHLE records shows there are no World Heritage Sites, Scheduled Monuments, Conservation Areas, Registered Parks and Gardens or Registered Battlefields within the Site or 500m study area.

3.3 There is one Listed Building within the study area; The Grade II Listed post-medieval barn at Spital Almshouse [H1] approximately 490m to the north-west of the Site.

Non-Designated Heritage Assets

3.4 There is 1 known non-designated heritage assets recorded by the LHER within the Site; a medieval "Ridge and Furrow" field system [M13].

Prehistoric

3.5 A possible site of a prehistoric round barrow [M12] is situated approximately 220m to the south west of the Site.

Roman

3.6 Roman activity is predominantly situated along the north-south aligned Ermine Street [M5] approximately 280m to the west of Site at its closest point, in the form of findspots [M8 and M9] to the south-west.

Medieval

3.7 An early medieval (Anglo-Saxon) barrow [M4] is situated approximately 460m to the south of Site.

3.8 The site of the shrunken medieval village of 'Spital in the Street' and St. Edmunds Hospital [M7] are approximately 315m to the north-west of the Site at their closest point.

Post-medieval

3.9 Post-medieval activity is predominantly marked by ditches [M3] approximately 300m to the south-west of the Site, and the locally listed Georgian park of Norton Place approximately 455m to the north of the Site.

3.10 The 4 undated non-designated assets comprise of the possibly prehistoric roadway junction at Caenby Corner [M11] and undated ditches [M10] approximately 290m and 430m to the west of the Site, a burnt deposit and posthole [M14] and possible remains of a ditch, several pits or a ring ditch [M18] approximately 180m and 350m to the south-west respectively.

4 Aims

4.1 The aim of the geophysical survey was to identify any potential archaeological anomalies that would enhance the current understanding of the archaeological resource within the proposed survey area.

4.2 Specifically the aims of the gradiometer survey were;

- To locate, record and characterise any surviving sub-surface archaeological remains within the survey area
- To help determine the next stage of works as per the client's instruction
- To provide an assessment of the potential significance of any identified archaeological remains in a local, regional and (if relevant) national context
- To produce a comprehensive site archive and report.

5 Methodology

5.1 All geophysical survey work was carried out in accordance with recommended good practice specified in the EAC guideline documents published by Historic England (Schmidt et al. 2016) and the Chartered Institute for Archaeologists Standard and Guidance for archaeological geophysical survey (2014).

5.2 Parameters were selected that were suitable for the prospective aims of the survey and in accordance with recommended professional good practice (Schmidt et al. 2016).

5.3 The gradiometer survey was carried out using Bartington Grad601-2 fluxgate gradiometers (see Appendices 2 and 3). Data was collected on an east-west alignment using zig-zag traverses, with a sample interval of 0.25m and a traverse interval of 1m. A total of 26 full or partial 30m by 30m grids were surveyed within the specified area, totalling an area of approximately 1.55ha.

5.4 Attention was taken to avoid metal obstacles present within the survey area during data collection using gradiometers. Gradiometer survey is affected by 'above-ground noise' such as metal objects and avoiding these improves the overall data quality and results obtained.

5.5 The gradiometer data were downloaded using Bartington Grad601 PC Software v313 and processed using Geoscan Geoplot v4.0. The details of these processes can be found in Appendices 4 and 5. Data processing, storage and documentation were carried out in accordance with the good practice specifications detailed in the guidelines issued by the Archaeology Data Service (Schmidt and Ernenwein, 2009).

5.6 Interpretations of the data were created as layers in AutoCAD LT 2009 / GIS and the technical terminology used to describe the identified features can be found in Appendix 6.

6 Results and Interpretation

6.1 The gradiometer survey results have been visualised as greyscale plots, with the minimally processed data plotted at -1nT to 2nT in Figure 3. The processed data is also plotted at -1nT to 2nT and can be seen in Figure 4. An interpretation of the data can be seen in Figure 5 and an individual characterisation of the identified anomalies follows this in Appendix 1.

Archaeology

6.2 No responses indicating the presence of definitive archaeological remains have been located in the Site.

Unclear Origins

6.3 Trends have been identified across the dataset which have unclear origins. Anomalies of this kind are described as being of a linear / curvilinear form which are composed of a weak or different change in magnetic values. Coupled with poor patterning, the anomalies are difficult to interpret, and it is unclear whether they have an archaeological origin.

6.4 Five curved trends are visible in the north of the dataset (**C1**). These are small weak positive anomalies, which appear to have no correlation with any other features in the area. Although an archaeological origin is possible, the large amount of modern activity in the area suggests that more recent origins are more likely.

6.5 A couple of small linear trends have been identified in the south of the dataset (**C2**). These are weakly positive trends that are either formed by agricultural ploughing or relate to modern disturbances.

6.6 Further magnetically weak trends are noted in the centre of the dataset which also have unclear origins and are likely to be modern (**C3**).

Agricultural

6.7 There are four north south linear trends which potentially relate to form ridge and furrow. These trends are enhanced by magnetic disturbance which suggests that these could be filled in furrows with more magnetic infill to the ridges surrounding.

Non-archaeology

6.8 Areas of concentrated dipolar anomalies are scattered across a large portion of the dataset. The irregular patterning of the trends is likely to denote a modern origin. The field was very likely to have been used as a "pit-stop area" for the Caenby Corner Raceway, so these responses could represent activity related to motor sports, such as hardcore and discarded motor parts.

6.9 Modern aerial photography indicates that the modern car tracks align in the same direction as some of these broad trends, indicating they may be related. This includes an area of ground that enters the raceway in the west of the dataset, which has a similar appearance in the dataset.

6.10 Further magnetic disturbance is visible along the field boundaries in the west and north-east of the site and are likely to relate to the site hut building and the trailer respectively. There are also fences present on the Site that are reflected in the dataset; there is one dipolar anomaly that matches the position of a fence running parallel to the road in the centre of the dataset, and some strong dipolar anomalies correspond with harris fencing sections in the north-west and west of the dataset.

6.11 Across the data set there is a large quantity of isolated dipolar anomalies (ferrous / iron spikes). These are commonly caused by ferrous or highly magnetic material on the surface or within the topsoil of the site and it is likely that modern activity has created a high level of background 'noise' within the data set.

7 Conclusion

7.1 The gradiometer survey has not identified any anomalies or features of a definitive archaeological nature.

7.2 A number of unclear linear and curvilinear trends were identified in the dataset, but due to their poor strength and patterning only a tentative interpretation can be formed as to their origin. The presence of modern disturbance across the site indicated these trends could also have a modern origin.

7.3 Several areas of magnetic disturbance were also detected across a large portion of the dataset, most likely relating to modern disturbance from the former motor racing circuit.

7.4 The archaeological background suggests a potential for remains of a medieval date in the form of a field system made up of ridge and furrow ploughing. A number of trends possibly relating to ridge and furrow were identified in the dataset, however their visibility is hampered due to the large quantity of modern disturbance across the Site.

7.5 In assessing the results of the geophysical survey against the specific aims set out in section 4;

- The survey has succeeded in locating, recording and characterising surviving sub-surface remains within the Site, though more remains may be present that are not suitable for detection through magnetometry. The remains cannot be definitively classed as 'archaeological' until further investigation has been undertaken, as the true nature of anomalies cannot be defined through geophysical survey alone;
- The survey will help in determining the next stage of works as it has provided evidence that the Site has been affected by modern activity, therefore limiting the archaeological potential;
- It is not possible to provide an assessment of the potential significance of the identified remains in a local, regional or national context as it has not been possible to definitively characterise the nature of the anomalies identified during the survey;
- The survey has resulted in a comprehensive report and archive.

8 Statement of Indemnity

8.1 Although the results and interpretation detailed in this report have been produced as accurately as possible, it should be noted that the conclusions offered are a subjective assessment of collected data sets.

8.2 The success of a geophysical survey in identifying archaeological remains can be heavily influenced by several factors, including geology, seasonality, field conditions and the properties of the features being detected. Therefore, the geophysical interpretation may only reveal certain archaeological features and not produce a complete plan of all of the archaeological remains within a survey area.

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Plate 1. Site before survey looking north

Plate 2. Unsurveyable area to the west of the Site

Plate 3. Site after survey facing north

Plate 4. Site after survey facing south

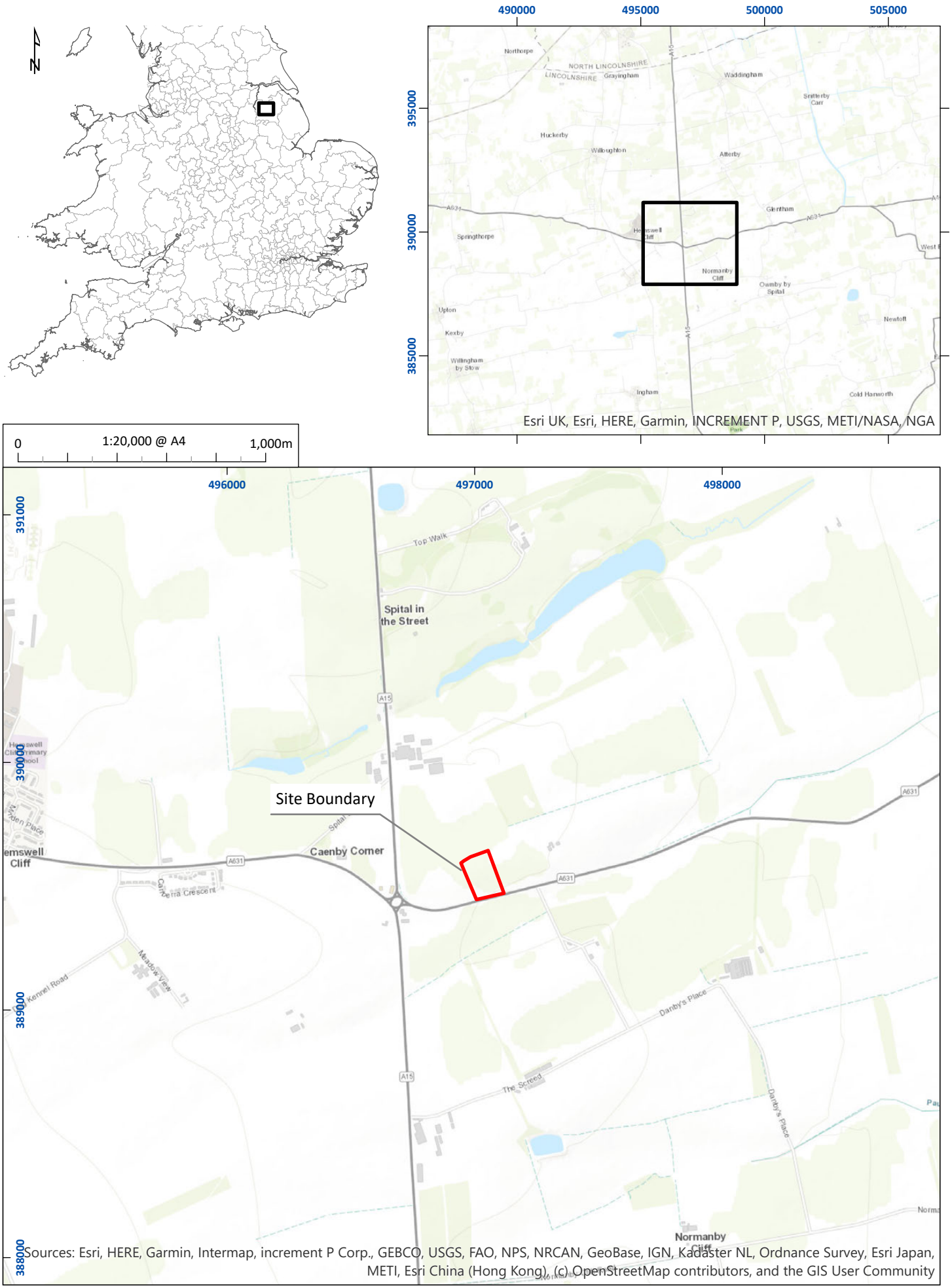

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Figure 1: Site location plan

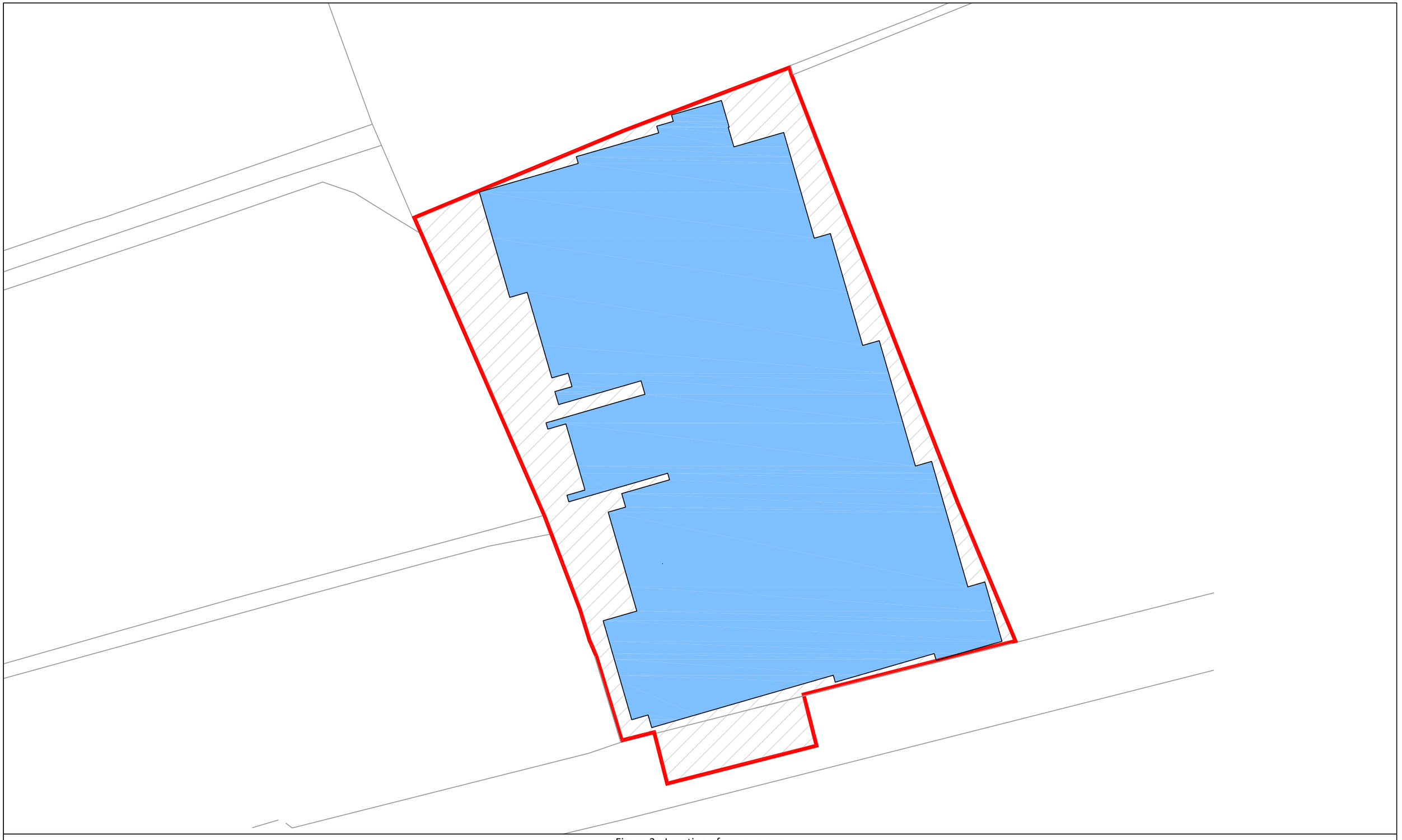

Figure 2 - Location of survey areas

Figure 2

Area Surveyed

Area Not Surveyed

N

0 40m

1:1000 at A3

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Drawn by/Checked by:	JL / KT
Date created:	06 / 01 / 2020

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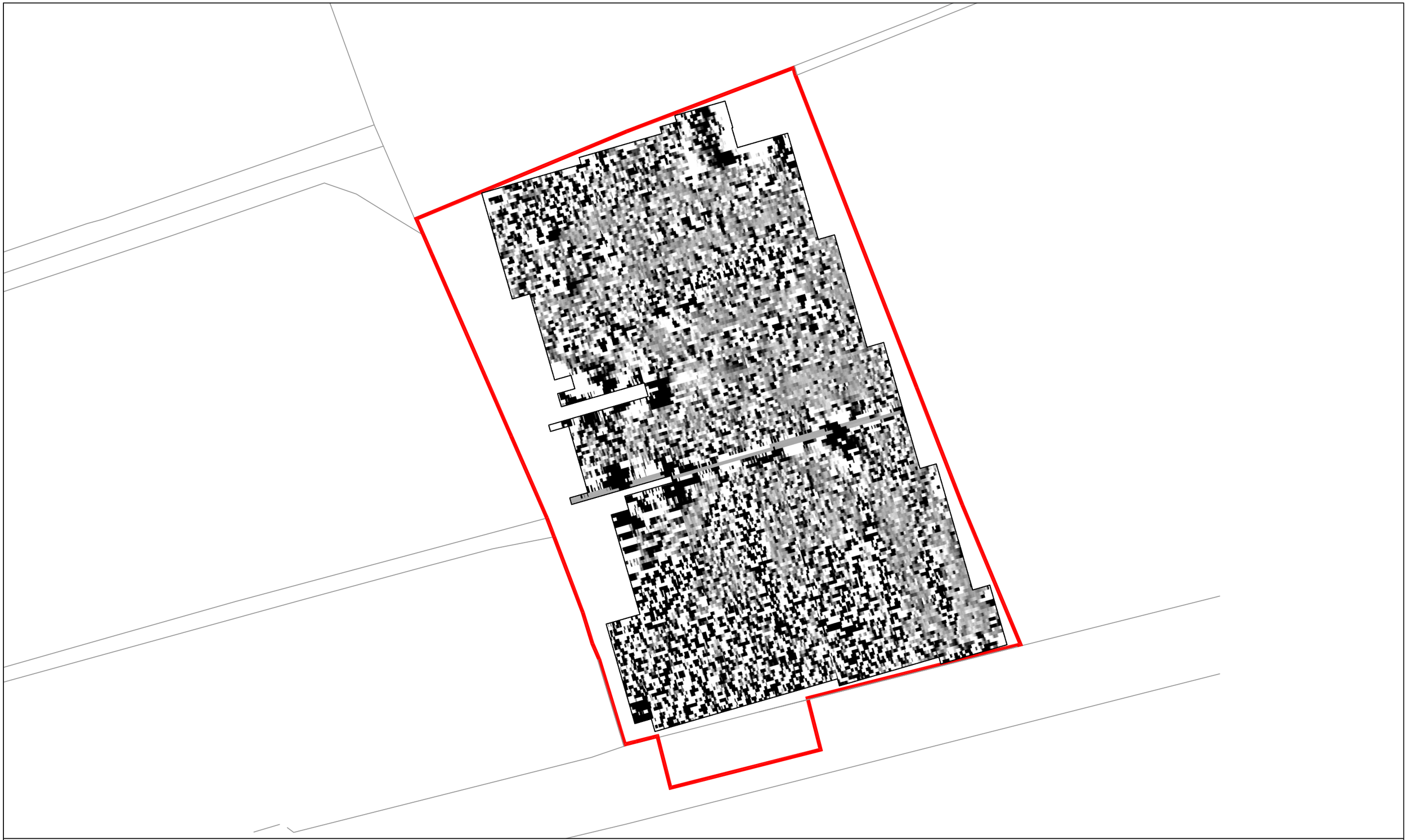

Figure 3 - Minimally processed gradiometer survey results - greyscale plot

Figure 3

Greyscale +2nT -1nT

N

0 40m

1:1000 at A3

Drawing No:	05/40074/GEO/F3/V02
Drawn by/Checked by:	JL / KT
Date created:	06 / 01 / 2020

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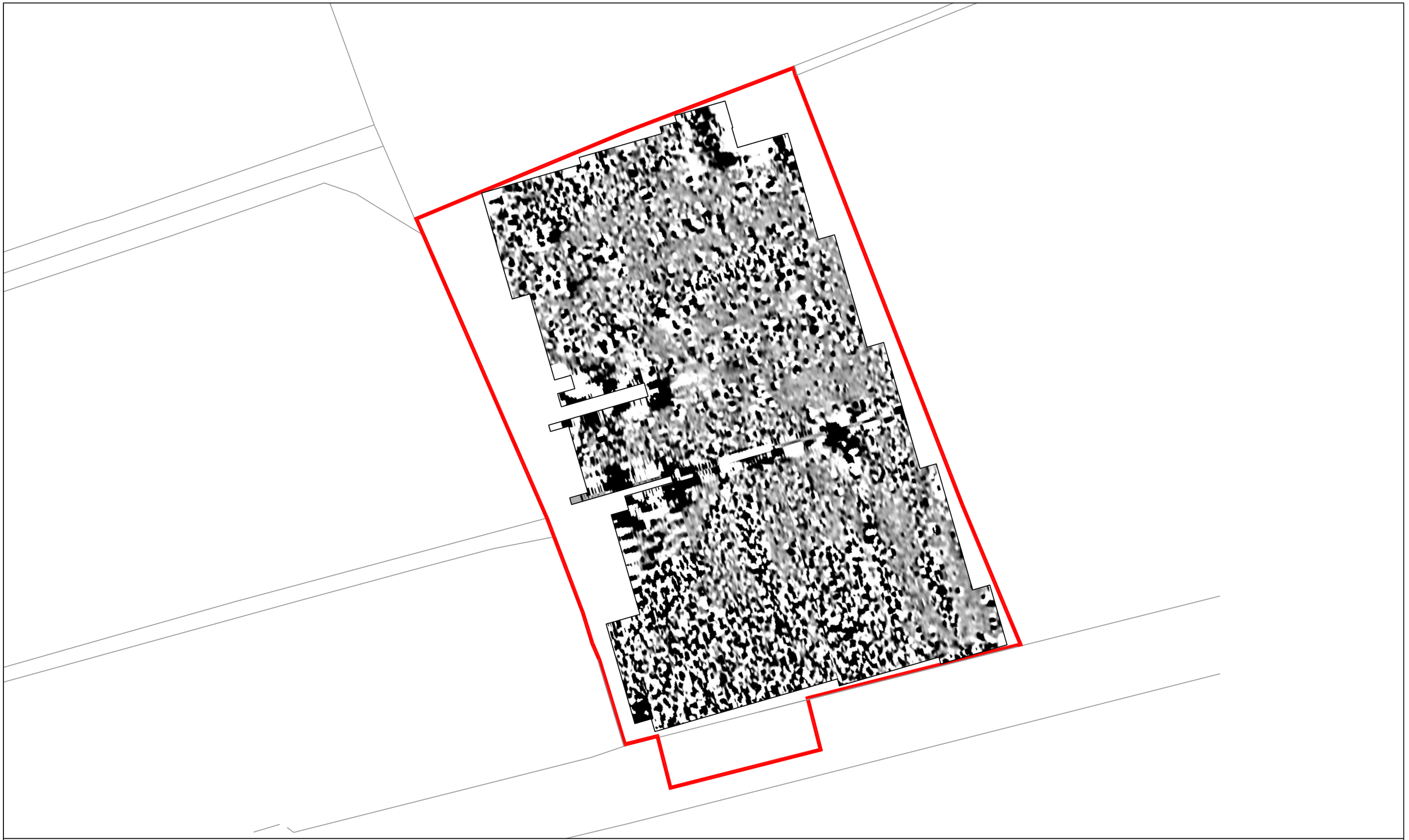

Figure 4 - Processed gradiometer survey results - greyscale plot

Figure 4

Greyscale +2nT -1nT

N

0 40m

1:1000 at A3

Drawing No:	05/40074/GEO/F4/V02
Drawn by/Checked by:	JL / KT
Date created:	06 / 01 / 2020

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Figure 5 - Interpretation of gradiometer survey results

Figure 5

Trend (Unclear Origin)
Linear Trend (Ploughing)
Area of Disturbance (Modern)
Ferrous / Iron Spike

N
0
40m
1:1000 at A3

Drawing No:	05/40074/GEO/F5/V02
Drawn by/Checked by:	JL / KT
Date created:	06 / 01 / 2020

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Appendix 1: Characterisation of Identified Anomalies

Gradiometer survey

Site Specific Anomaly Code: **C**

Anomaly	Type of Archaeology
C1	Curvilinear trends (unclear)
C2	Linear trends (unclear)
C3	Linear trends (unclear)

Appendix 2: Survey Metadata

Field	Description
Surveying Company	AOC Archaeology
Data collection staff	Alistair Galt, Nick Hannon, Sacha O'Connor
Client	Waterman Infrastructure and Environment Ltd
Site name	Caenby Corner
County	Lincolnshire
NGR	SK 97025 89545
Land use/ field condition	Pasture/recreational
Duration	11/12/2019
Weather	Overcast
Survey type	Gradiometer Survey
Instrumentation	Trimble GXOR system Bartington Grad 601-2
Area covered	Hand-held: Approx 1.55 ha (26 full and partial grids)
Download software	Grad601 PC Software v313
Processing software	Hand-held: Geoplot v4.0
Visualisation software	AutoCAD LT 2009
Geology	Rutland Formation - Argillaceous rocks with subordinate sandstone and limestone (BGS, 2019)
Soils	Shallow lime-rich soils (Soilscapes, 2019)
Scheduled Ancient Monument	No
Known archaeology on site	Potential Ridge and Furrow
Historical documentation/ mapping on site	None
Report title	Land at Caenby Corner, Lincolnshire: Archaeological Geophysical Survey
Project number	40074
Report Author	James Lawton
Report approved by	Kimberley Teale

Appendix 3: Archaeological Prospection Techniques, Instrumentation and Software Utilised

Gradiometer survey

Gradiometer surveys measure small changes in the earth's magnetic field. Archaeological materials and activity can be detected by identifying changes to the magnetic values caused by the presence of weakly magnetised iron oxides in the soil (Aspinall *et al.*, 2008, 23; Sharma, 1997, 105). Human inhabitation often causes alterations to the magnetic properties of the ground (Aspinall et al, 2008, 21). There are two physical transformations that produce a significant contrast between the magnetic properties of archaeological features and the surrounding soil: the enhancement of magnetic susceptibility and thermoremnant magnetization (Aspinall *et al.*, 2008, 21; Heron and Gaffney 1987, 72).

Ditches and pits can be easily detected through gradiometer survey as the top soil is generally suggested to have a greater magnetisation than the subsoil caused by human habitation. Areas of burning or materials which have been subjected to heat commonly also have high magnetic signatures, such as hearths, kilns, fired clay and mudbricks (Clark 1996, 65; Lowe and Fogel 2010, 24).

It should be noted that negative anomalies can also be useful for characterising archaeological features. If the buried remains are composed of a material with a lower magnetisation compared to the surrounding soil, the surrounding soil will consequently have a greater magnetization, resulting in the feature in question displaying a negative signature. For example; stone materials of a structural nature that are composed of sedimentary rocks are considered non-magnetic and so will appear as negative features within the dataset.

Ferrous objects - i.e. iron and its alloys - are strongly magnetic and are typically detected as high-value peaks in gradiometer survey data, though it is not usually possible to determine whether these relate to archaeological or modern objects.

Although gradiometer surveys have been successfully carried out in all areas of the United Kingdom, the effectiveness of the technique is lessened in areas with complex geology, particularly where igneous and metamorphic bedrock is present. All magnetic geophysical surveys must therefore take the effects of background geological and geomorphological conditions into account.

Gradiometer survey instrumentation

AOC Archaeology's gradiometer surveys are carried out using Bartington Grad601-2 magnetic gradiometers. The Grad601-2 is a high-stability fluxgate magnetic gradient sensor, which uses a 1m sensor separation. The detection resolution is from 0.03 nT/m to 0.1nT/m, depending on the sensor parameters selected, making the Grad601-2 an ideal instrument for prospective survey of large areas as well as detailed surveys of known archaeology. The instrument stores the data collected on an on-board data-logger, which is then downloaded as a series of survey grids for processing.

Gradiometer survey software

Following the survey, gradiometer data is downloaded from the instrument using Grad601 PC Software v313. Survey grids are then assembled into composites and enhanced using a range of processing techniques using Geoscan Geoplot v3.0 / v4.0 (see Appendix 4 for a summary of the processes used in Geoplot and Appendix 5 for a list of processes used to create final data plots).

Appendix 4: Summary of Processes used in Geoplot

Process	Effect
Clip	Limits data values to within a specified range
De-spike	Removes exceptionally high readings in the data that can obscure the visibility of archaeological features. In resistivity survey, these can be caused by poor contact of the mobile probes with the ground. In gradiometer survey, these can be caused by highly magnetic items such as buried ferrous objects.
De-stagger	Corrects a misalignment of data when the survey is conducted in a zig-zag traverse pattern.
Edge Match	Counteracts edge effects in grid composites by subtracting the difference between mean values in the two lines either side of the grid edge.
High pass filter	Removes low-frequency, large scale detail in order to remove background trends in the data, such as variations in geology.
Interpolate	Increases the resolution of a survey by interpolating new values between surveyed data points, creating a smoother overall effect.
Low Pass filter	Uses a Gaussian filter to remove high-frequency, small scale detail, typically for smoothing the data.
Periodic Filter	Used to either remove or reduce the appearance of constant and reoccurring features that distort other anomalies, such as plough lines.
Wallis filter	Applies a locally adaptive contrast enhancement filter.
Zero Mean Grid	Resets the mean value of each grid to zero, in order to counteract grid edge discontinuities in composite assemblies.
Zero Mean Traverse	Resets the mean value of each traverse to zero, in order to address the effect of striping in the data and counteract edge effects.

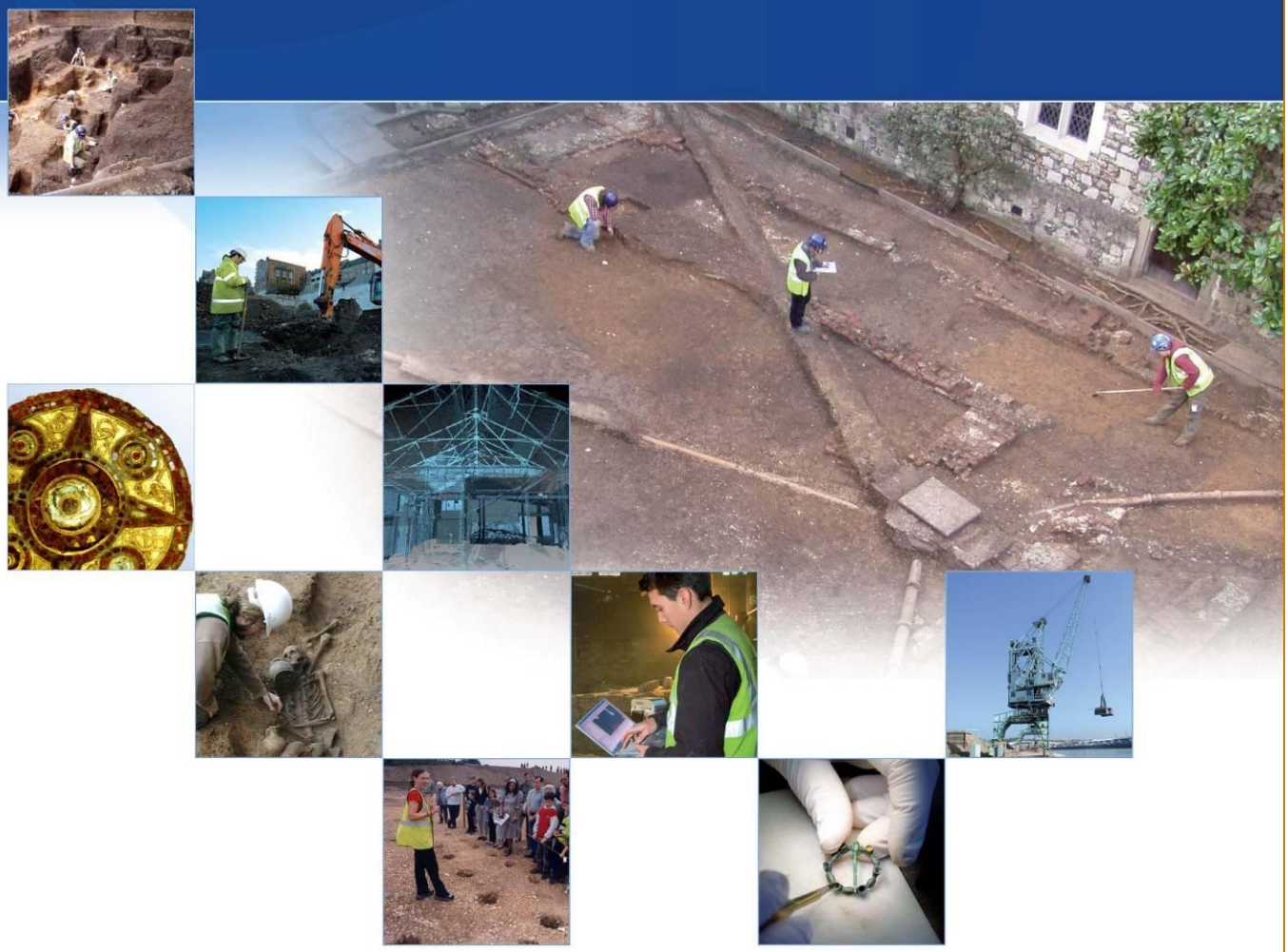
Appendix 5: Survey Processing Steps

Gradiometer survey	
Process	**Extent**
Zero Mean Traverse	All LMS =on, threshold -5 to 5
De-spike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
De-stagger	All grids dir Shift = 2 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Expand –SinX/X x2
Raw Palette Scale	Grey08 Min= -1nT Max= 2nT
Palette Scale	Grey08 Min= -1nT Max= 2nT

Appendix 6: Technical Terminology

Type of Anomaly	Description
Archaeology	
Archaeology - Trend	These are made up of linear / curvilinear / rectilinear anomalies and are either characterised by an increase or decrease in values compared to the magnetic background. This evidence is normally supported by the presence of archaeological remains and is confirmed by other forms of evidence such as HER records and aerial photography.
Archaeology - Area of enhanced magnetism	This is characterised by a general increase and decrease of magnetic responses over a localised area and does not appear as having a linear form. These anomalies do not have the high dipolar response which are manifested in an 'iron spike' anomaly. This anomaly may be supported by the known location of a former building, or other forms of evidence such as HER records and aerial photography.
Archaeology - Pit	An anomaly composed of an increase in magnetic values with a patterning on the XY trace plot that is suggestive of buried remains, such as the infill of a pit. This evidence is normally supported by the presence of archaeological remains and is confirmed by other forms of evidence such as HER records and aerial photography.
Possible Archaeology	
Archaeology? – Trend	Anomalies of a linear / curvilinear / rectilinear form either composed of an increased or decreased signal compared to magnetic background values. It is possible these anomalies belong to archaeological remains, but poor patterning or weaker response values makes interpretation difficult. Where historical records are present, the anomalies would appear to be weak or inconclusive.
Archaeology? - Area of enhanced magnetism	Anomalies with an increase or decrease in magnetic values compared with the magnetic background over a localised area. Poor patterning or weak signal changes creates difficulty in defining the origin of the anomaly and so interpretation is only tentative. The anomaly lacks definitive records to confirm its origin as being archaeological. Such areas could indicate the presence of buried rubble relating to fallen structures, or instead denote modern material from either quarrying or agricultural activity. On certain geologies these anomalies could be caused by in-filled natural features.
Archaeology? – Pit	An anomaly composed of an increase in magnetic values with a patterning on the XY trace plot that is suggestive of buried remains, such as the infill of a pit, but is isolated in its location and association with other features.
Unclear Origin	
Linear Trend	Anomalies of a linear / curvilinear form which are composed of a weak or different change in magnetic values. Coupled with poor patterning, the anomaly is difficult to interpret and it is unclear whether it has an archaeological origin.
Area of enhanced magnetism	An area of enhanced magnetic readings which consist of a variety of increased and decreased magnetic values compared with background readings, but lack sufficient patterning or context for a conclusive interpretation. It is likely that these readings are caused by modern disturbances, but interpretation is tentative.

Agricultural	
Linear Trend (Old Field Boundary)	These isolated long linear anomalies, most often represented as a negative magnetic trend, are likely to relate to former field boundaries. The magnetic signal may appear inconsistent but when the positioning is cross referenced with historic mapping, it is confirmed as a former field boundary.
Linear Trend (Old Field Boundary?)	These isolated long linear anomalies, most often represented as a negative magnetic trend, are likely to relate to former field boundaries. The positioning is not supported by historic mapping, but is often confirmed with adjacent ploughing patterns.
Linear Trend (Ridge and Furrow / Rig and Furrow)	A series of regular linear anomalies either composed of an increased or decreased magnetic response compared to background values. The width between the anomalies is consistent with that of a Ridge and Furrow ploughing regime, which is normally wider than conventional ploughing methods.
Linear Trend (Conventional ploughing)	A series of regular linear anomalies either composed of an increased or decreased magnetic response compared to background values. The regular patterning is likely to denote the presence of ploughing, however isolated trends can occasionally be observed that follow the orientation of ploughing trends seen elsewhere in the area. Anomalies seen adjacent to field edges are representative of headlands caused by ploughing.
Linear Trend (Field drainage)	A series of linear anomalies of an indeterminate date, usually with a regular or herringbone patterning and regular spacing. These are likely to represent agricultural activity such as land drainage.
Non - Archaeology	
Geology / Natural	An area of disturbance that is composed of irregular significant increases or decreases in magnetic values compared with background readings and is likely to indicate natural variations in soil composition or geology.
Linear Trend (possible modern service)	Anomalies of a linear form often composed of contrasting high positive and negative values. Such anomalies usually signify a feature with a high level of magnetisation and are likely to belong to modern activity such as pipe lines or modern services.
Disturbed Area (modern disturbance?)	An area of disturbance that is likely to be caused by modern activity and is characterised by significant increases or decreases in magnetic values compared with background readings.
Isolated Dipolar Anomalies / Ferrous (iron spikes)	A response normally caused by ferrous materials on the ground surface or within the top soil, which causes a ‘spike’ representing a rapid variation in the magnetic response. These are generally not assessed to be archaeological when surveying on rural sites, and generally represent modern material often re-deposited during manuring.



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