Land East of Warwick Road, Banbury

Archaeological Geophysical Survey

National Grid Reference: SP 43300 43118 (centre)

AOC Project No: 40324

Date: June 2022

AOC Archaeology Group

ARCHAEOLOGY | HERITAGE | CONSERVATION

Land East of Warwick Road

Banbury

Archaeological Geophysical Survey

On Behalf of:	**Environmental Dimension Partnership** **Tithe Barn** **Barnsley Park Estate** **Cirencester** **GL7 5EG**
National Grid Reference (NGR):	**SP 43300 43118 (centre)**
AOC Project No:	**40324**
Prepared by:	**Alistair Galt**
Illustrations by:	**Chris Sykes**
Date of survey:	**9th & 10th May 2022**
Surveyors:	**A. Galt, M. Hall, K. Hall**

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

Author: Alistair Galt & Chris Sykes	**Date: 23rd May 2022**
Quality Checked by: Susan Ovenden & James Lawton	**Date: 16th June 2022**
Report Stage: Final Version 1	**Date: 16th June 2022**

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Non-Technical Summary

AOC Archaeology Group was commissioned by Environmental Dimension Partnership to undertake an archaeological geophysical gradiometer survey on the 9th and 10th May 2022 to investigate the potential for buried archaeological remains ahead of a proposed development at Hanwell, Oxfordshire (centred at SP 43300 43118).

A total of 13 hectares were surveyed and the results of the survey have identified the following.

A possible Iron Age/Romano British settlement has been detected, with a large enclosure containing a curvilinear and a rectilinear feature, with possible pits and areas of potential industrial activity in the vicinity. However, a more recent date cannot be fully ruled out given the strength an shape of the responses on the XY trace plots.

Another rectilinear feature has been located to the west of this main concentration, as well as two elongated "U"-shaped features that vaguely resemble either funerary or tentative banjo enclosures, but such interpretations are cautious as one response has been partially obscured.

A number of linear trends, which have varying magnetic signatures, have been detected in the west of the Site and have an uncertain origin.

A former field boundary has been detected in the west of the Site.

Broad trends of ridge and furrow cultivation can be seen running east-west throughout the entire dataset and possibly also running north–south in the northwest of the Site. Weaker parallel trends have also been noted which are associated with modern ploughing.

The background level of response is moderately high with a mottled appearance which is thought to be due to natural variations in the subsoil.

An area of magnetic disturbance, most likely the result of modern activity due to the proximity of the farm buildings, were also detected.

1 Introduction

1.1 AOC Archaeology Group was commissioned by Environmental Dimension Partnership, on behalf of their client (Hollins Strategic Land) to undertake an archaeological geophysical gradiometer survey of a site at land to the east of Warwick Road, Banbury. The survey was conducted during the 9th and 10th May 2022 as part of a wider scheme of archaeological assessment in advance of the proposed development of the site.

1.2 Archaeological geophysical survey uses non-intrusive and non-destructive techniques to determine the presence or absence of anomalies likely to be caused by archaeological features, structures or deposits, as far as is reasonably possible (CIfA, 2014).

1.3 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 Site is located on land East of Warwick Road, Banbury, Oxfordshire, approximately half a kilometre south of Hanwell (NGR SP 43300 43118) and half a kilometre north of Banbury. The Site is situated across agricultural land which is located east of Warwick Road (see Figure 1).

2.2 The Site totals approximately 20.4 ha and consists of three fields. Only two of the fields (13 ha) have been surveyed as the most easterly field was unsuitable for survey due to the area in the east being removed from the scope of the survey (see Figure 2).

2.3 The ground level within the site is gently undulating and level, situated at around 108m above Ordnance Datum (aOD), sloping to 105m aOD in the southwest corner.

2.4 The site is underlain by bedrocks of the Marlstone Rock Formation – Ferruginous Limestone and Ironstone in the west of the Site and Charmouth Mudstone Formation to the east of the Site. No superficial deposits are recorded within the Site boundary (BGS, 2022).

2.5 The soils within the Site are classed as freely draining slightly acid but base-rich soils (Soilscapes, 2022).

2.6 Gradiometer survey is suggested to provide a variable response over sedimentary rocks; for example the results can be good over certain sandstones and average over mudstones and the drift / alluvium deposits may also have an effect (David *et al.* 2008, 15).

3 Archaeological Background

3.1 The archaeological background is summarised from records derived from the Heritage Gateway (Heritage Gateway, 2022) using a 500 metre search radius from the Site boundary. All references to NHLE and HER (MOX) numbers can be found on the Heritage Gateway. No Scheduled Monuments are located on the Site.

3.2 Scheduled Monuments No Scheduled Monuments are located on the Site or within the study area.

Undated Monuments

3.3 An undated lynchet aligned NNE-SSW about 500 metres to the southwest of the Site (MOX4225).

Prehistoric and Roman (8000BC-AD 410)

3.4 There are no recorded assets within the Site dating to the prehistoric period.

3.5 Approximately 100 metres to the south of the Site boundary is a series of monuments that relate to a Bronze Age ring ditch, Middle to Late Iron Age settlement, with an Early Roman droveway and late Roman industrial activity. This was confirmed with geophysics and evaluation trenching (MOX 26690). 100 metres to the south east of MOX26690 is another field system with a group of ring ditches, which may also have been used for a post medieval windmill (MOX26838). These are directly next to other later prehistoric and other modern features (MOX26898).

3.6 Approximately 150 metres to the south west of the Site is a series of features found with a geophysics survey. A large multiple ditch enclosure of a possible defensive function, as well as roundhouses, pit clusters, stock enclosures and field systems (MOX27058). Just to the south of this are a series of rectilinear field enclosures with industrial activity including 3 kiln types (MOX27003).

Early Historic and Medieval (AD 410- 1600)

3.7 No remains or artefacts from the Early Historic or medieval period have previously been identified on the Site.

3.8 50 metres to the south west of MOX26898 are a series of linear features and pit anomalies at Hanwell fields, with a mix of undated features and post-medieval finds around the area, covered by post medieval ridge and furrow (MOX12216).

3.9 200 metres to the north of the Site is Hanwell Castle park, which was described in the 17th century but otherwise has unknown origins (MOX4228). This could be related to Hanwell Castle and its associated Great Hall and other structures (MOX24082, MOX4185, NHLE 1216370,1216369).The church of St Peter is about 50 metres to the west of Hanwell Castle (MOX 4186). Medieval or post-medieval fishponds are also known to the north of Hanwell Castle (MOX4184).

3.10 To the north of Hanwell village are the remnants of Hanwell Medieval Shrunken Village (MOX4199), where earthwork platforms, house sites and linear bank indicating the site of part of the village.

3.11 A Saxon boundary ditch is recorded at Spring Farm, 500 metres to the north of the Site (MOX4249).

Post-Medieval and Modern (1600 – present)

3.12 No remains dating to the post-medieval or modern period are present within the Site.

3.13 Directly to the north of the Site is a series of earthworks that have been identified as pair of Post Medieval or 20th century quarries (MOX24553)

3.14 Near to MOX27003 is a post medieval fishpond near to Drayton Lodge, 200 metres to the southwest of the Site (MOX4187).

3.15 Number 6 Main Street Hanwell has 18th century origins, with a datestone of 1749 (MOX18533).

3.16 500 metres to the north of the Site boundary is a former Wesleyan Methodist Chapel, last used in 1963 (MOX4183).

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 (Appendix 2) and report.

5 Methodology

5.1 The geophysical survey was undertaken between 9th and 10th May 2022.

5.2 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).

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

5.4 Digital photographs of every survey parcel were taken before, during and after geophysical survey to show any changes to field conditions following the programme of works. The photos were downloaded and stored off site

5.5 The gradiometer survey was carried out using a Bartington Non-Magnetic Cart. The cart system utilises six Grad-01 fluxgate gradiometer sensors mounted upon a carbon fibre frame one metre apart, along with data logging equipment and batteries (see Appendix 3). Before each session of use, the cart system was balanced around a single set up point within the Site specifically chosen for being magnetically quiet. In balancing the machine around this point, it produces a more uniform dataset throughout and allows all data to be plotted with ease.

5.6 Data was collected using zig-zag traverses alongside a constant stream of GPS data collected through a Trimble R10 GPS, enabling the collected data to be spatially georeferenced without the need for a pre-determined grid system. The data was collected through a laptop mounted to the cart using Geomar MLGrad601 software.

5.7 A total of 13ha were surveyed using the Bartington cart.

5.8 Care was taken to attempt to avoid metal obstacles present within the survey area, such as metal fencing around hedge boundaries as gradiometer survey is affected by ‘above-ground noise’ and avoiding these improves the overall data quality and results obtained.

5.9 The data was downloaded from MLGrad601 and converted into a .xyz file in Geomar MultiGrad601 before being processed along with the GPS data in TerraSurveyor v3.0.34.10. The details of these processed can be found in Appendices 3 and 4.

5.10 Interpretations of the data were created in ArcGIS Pro and the technical terminology used to describe the identified features can be found in Appendix 5.

6 Results and Interpretation

6.1 The gradiometer survey results have been visualised as XY trace plots and greyscale images. A summary greyscale image of the processed gradiometer data is provided in Figure 3 with an accompanying summary interpretation provided in Figure 4, both at a scale of 1:2000. Archive processed greyscale plots are displayed at a scale of 1:1000, visualised at -2nT to 5nT, in Figures 5.1 to 5.3. Interpretation of the archive plots at the same scale can be found in Figures 6.1 to 6.3. A collection of minimally processed XY trace plots at a scale of 50nT per cm can be seen in Figures 7.1 to 7.3. Finally, a Figure 8 at a scale of 1:2000 shows an overview of the interpretation overlaid on the grayscale plot.

6.2 For the most part, only trends of a possible archaeological or historical origin have been assigned an anomaly number on the interpretation figures.

6.3 Anomalies that are integral to the discussion have been assigned anomaly letters which are prefixed with the area number which is detailed in Figure 2.

Archaeology

6.4 No anomalies indicating the presence of definitive archaeological remains have been identified in the dataset.

Possible Archaeology

6.5 Several strong positive linear trends have been identified in both Areas. The best defined of these is in the northwest of Area 2 (**2A**). These form what appears to be a large, roughly rectilinear enclosure of approximately 50 by 55m. Within this enclosure are possible smaller features, namely the curvilinear anomaly in the northwest (**2B**) and the rectilinear feature to the southeast (**2C**). **2A** and **2B** could be contemporary but it is impossible to ascertain this from the geophysics data alone. **2B** has a possible entrance facing east and is without interior features, although an area of magnetic disturbance (**2C**) can be seen immediately to the southwest of **2B**; as the magnetic disturbance appears to respect the shape of **2B** it seems likely to be related in some way. The square enclosure **2D** has a clear western facing entrance, a possible pit-like anomaly in the northern half, and may be bisected by **2A.** Evidence of structures cutting across each other are known from other Iron Age/Romano British sites across England and is well documented (cf. Gregory, Daniel and Brown 2013:101). However, the relative dating of these features cannot be ascertained from this dataset alone. Their shape and form suggest a tentative prehistoric or Romano-British origin, which could also relate to the site known from the HER data to the south of the Site (MOX 26690).

6.6 Linear anomalies run from **2A** to the north and south and are likely to be associated with **2A**. One of these runs directly northwards (**2E**) and is relatively short in this dataset, but it is likely to continue north into the adjacent field. The linear anomaly (**2F)** that runs southwards dog-legs to the southwest almost immediately after passing **2D**. This appears to terminate near the field boundary, but may be associated with weaker linear trends (**2G** and **2H**). Trends **2G** and **2H** appear to be associated with **2A and 2E** leading to its southwestern corner, although this is obscured by an area of highly magnetic disturbance (**2I**). **2G** could be a potential trackway, as it respects the topography of the Site and stays on a relatively flat section within Area 2, located on the plateau of the slope.

6.7 The origin of the areas of strong magnetic enhancement **2C** and **2I** is unclear as it could relate to the features described above as possible archaeology. Their location would support a theory that it was an area of ground related to one of these features, perhaps for example an area of burning, a different kind of building or platform, or industrial activity. However, it could also be unrelated to these features, although the way these areas respect the delineation of space by **2B** and **2D** suggest a likely relationship. While the context does not immediately suggest a modern origin for these areas of disturbance, it cannot be ruled out.

6.8 Two different forms of linear monuments of a similar shape have been located in both Areas 1 and 2, shaped like a “U”-shape/paperclip. Whether these two monuments are the same form and date is difficult to distinguish through geophysics alone but they would appear very similar.

6.9 The first of these can be loacted in the southeast of Area 2 (**2J**). This forms a rough “U”-shape/paperclip facing northeast and is roughly 20 by 10 metres long, although it is obscured to the north by some possible geological features, so the actual length of the feature could be longer. The

provenance of this feature is difficult to ascertain as a result, although it seems unlikely to be a result of natural causes. It is tentatively thought to be similar to funerary monuments of the prehistoric period.

6.10 A second better defined "U"-shaped/paperclip anomaly is present in Area 1, with a clear termination (**1A**). It measures roughly 15 by 85 metres in length, facing southeast. This anomaly is slightly more reminiscent of a funerary monument of a prehistoric date or tentatively part of a "banjo enclosure", although the bulb at the far end of the feature is not as large as would be expected for such an enclosure. The bulb is slightly more pronounced in **1A** than it is in **2J**, although the long length and similar shape of these features suggests that these two could be contemporary, although this is difficult to ascertain from a geophysical survey. Nonetheless the origin of these features is unlikely to be natural.

6.11 A slightly curving linear feature (**1B**) is present in the southeast of Area 1, and might connect to 2A, 2F or 2G in Area 2, although this is obscured by the field boundary. The similar characteristics of the magnetic signals of features 2A, 2F and 1B suggests a possible additional relationship between these features.

6.12 A possible rectilinear archaeological enclosure has been identified in the centre of Area 1 (**1C**). The enclosure measures approximately 17 by 26 metres and consists of strong positive responses with a possible entranceway facing towards the northwest and southwest. The eastern end of the enclosure appears to have been ploughed out, although this might also represent the true extent of the original feature.

Unclear Origins

6.13 A negatively enhanced linear trend runs north-south from the southern end of Area 1 and dog legs towards the northwest (**1D**). This linear feature appears to be cut by the ridge and furrow ploughing regime, suggesting a significant antiquity, but it may have an agricultural origin and hence its designation as unclear in origin.

6.14 A weak linear trend runs roughly north-south in the centre of Area 1 (**1E**). This does not appear to be related to the other linear anomalies already discussed above although at the southern end it tentatively forms s square shaped feature. It may have an archaeological origin, of a feature which is weakly magnetised, but a more recent agricultural or modern origin is as likely.

6.15 A broad trend that is weakly positively enhanced (**1F)** can be discerned in Area 1. It could have a natural origin as it is roughly in line with the bottom of the small valley that is present in this part of Area 1 although other origins cannot be ruled out.

6.16 A well-defined area of magnetic enhancement has been detected along the southern edge of Area 2 (**2K**). This does not correspond with an historic feature, but its location along the edge of the field could suggest a modern origin. However, an archaeological origin cannot be dismissed given the anomalies recorded elsewhere within this area.

6.17 Across both areas additional weak trends have been noted. These are likely to have natural or agricultural origins, although an archaeological origin for some of these cannot be wholly excluded.

Agricultural

6.18 The linear trend (**1G**) in the west of Area 1 corresponds with a former field boundary indicated on the OS Six Inch map of 1888-1913 and is still apparent on the OS 1:25000 mapping from 1937 - 61 (NLS, 2022).

6.19 Several strongly magnetically positive, parallel long curving linear trends running east-west are present throughout the survey area and their shape suggest a medieval origin, as the linear trends form a rough, broad "S" shape which is indicative of the ploughing regime of the time. These contribute to the

high background values of the dataset. They have been partially ploughed out, particular in Area 1. Some fainter linear trends run north-south in the north-western portion of Area 1. As these don't appear to overlie the ploughing trends running east-west, these could be contemporary, although their shape suggests a different origin.

6.20 Weaker parallel trends have also been noted which are associated with modern ploughing.

Non - Archaeology

6.21 A series of dipolar discrete areas cover the whole Site and don't conform to conventional pit-like features or other known archaeological features. They contribute to the overall high background readings of the dataset, and it seems more likely these anomalies are geological in origin, although an archaeological reason, cannot be ruled out either.

6.22 Magnetic disturbance is visible on the northern edge of the dataset in Area 1 due to the proximity of the farm buildings.

6.23 A moderate level of isolated dipolar anomalies (ferrous / iron spikes) are visible throughout the dataset which are likely modern in origin. Only the most prominent of these are noted on the interpretation.

7 Conclusion

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

7.2 Several linear trends forming possible enclosures have identified which are likely to be archaeological in origin. However, without the support of additional techniques such as LiDAR, aerial photographic evidence or HER data, they cannot be definitively confirmed as being archaeological in nature.

7.3 Given the shaping of the anomalies, it is suggested they could relate to Prehistoric, Iron Age or possibly Romano-British settlement.

7.4 The data suggests a large enclosure containing a curvilinear and a rectilinear feature, with possible pits and areas of industrial activity in the vicinity.

7.5 Another rectilinear feature has been located to the west of this main concentration, as well as two elongated "U"-shaped/paperclip shaped features that vaguely resemble funerary or banjo enclosures, but such interpretations are cautious as some responses are being partially obscured.

7.6 Numerous agricultural ploughing trends have also been identified. Strong parallel trends are consistent with medieval ridge and furrow cultivation have been detected throughout the Site. A former field boundary has also been detected.

7.7 The background level of response is moderately high with a mottled appearance which is thought to be due to natural variations in the subsoil.

7.8 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 survey will help in determining the next stage of works as it has provided evidence that remains of an Prehistoric Iron Age Romano British or Medieval origin are most likely present on site, and has provided a number of targets for further investigation;

- 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 through survey alone;
- The survey has resulted in a comprehensive report and archive.

7.9 The geophysical survey has produced good quality gradiometer results which have successfully helped to clarify whether archaeological or uncertain remains are present across the Site. There is a high confidence level that the methodology and survey strategy chosen were appropriate to assess the archaeological potential across the Site.

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 the archaeological remains within a survey area.

9 Archive Deposition

9.1 In accordance professional standard practice an 'Online Access to the Index of archaeological investigations' ('OASIS') record will be completed for submission to the HER and Archaeological Data Service (ADS) (Appendix 2).

9.2 One digital and hard copy of the report and data will be submitted to the relevant Historic Environment Record (HER) at the Client's discretion.

9.3 A digital copy of the report and data will also be submitted to the ADS at the Client's discretion.

10 Bibliography

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11 Plates

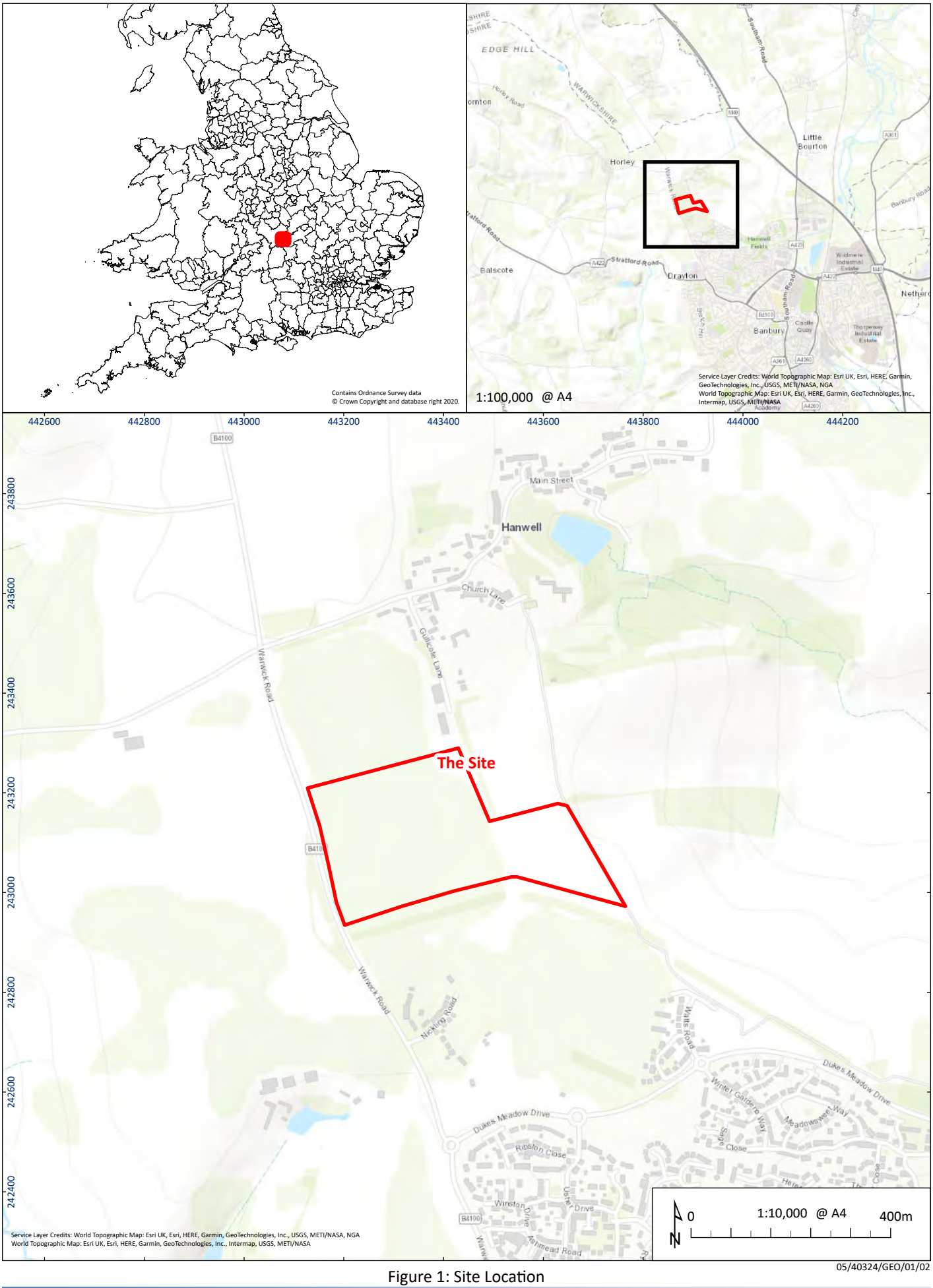
Plate 1. Area 1 - Taken from west facing east before survey

Plate 2. Area 1 - Taken from east facing north after survey

Plate 3. Area 2 - Taken from north facing south before survey

Plate 4. Area 2 - Taken facing east from west facing after survey

12 Figures



05/40324/GEO/01/02

Figure 1: Site Location

Survey Areas

Figure 02

Red Line Boundary
Bartington Cart Survey

N

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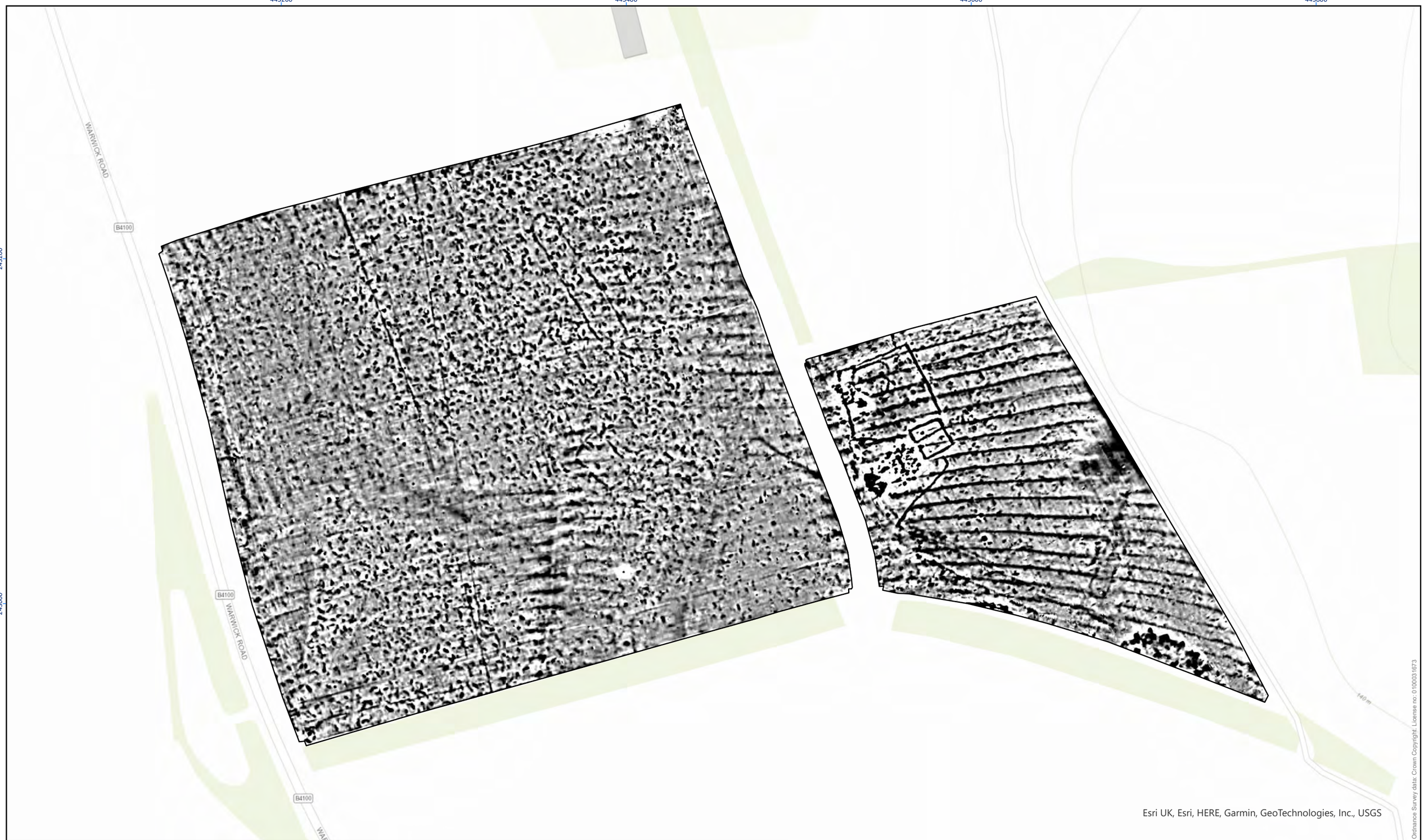

Summary Greyscale Image

Figure 03

5nT
-3nT

N

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Approved by: JL	Date: 16/06/2022

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Summary Interpretation

Figure 04

- Geology/Natural
- Enhanced Magnetism (Modern)
- Linear Trend (Possible Archaeology)
- Enhanced Magnetism (Possible Archaeology)
- Ferrous/Iron Spike
- Enhanced Magnetism (Unclear Origin)
- Linear Trend (Unclear Origin)
- Trend (Archaeology)
- Linear Trend (Historic Feature)
- Trend (Possible Archaeology)
- Linear Trend (Ridge and Furrow)
- Trend (Unclear Origin)

N

0 60m

Scale: 1:2,000 @ A3

Drawing Number: 05/40324/GEO/04/01	
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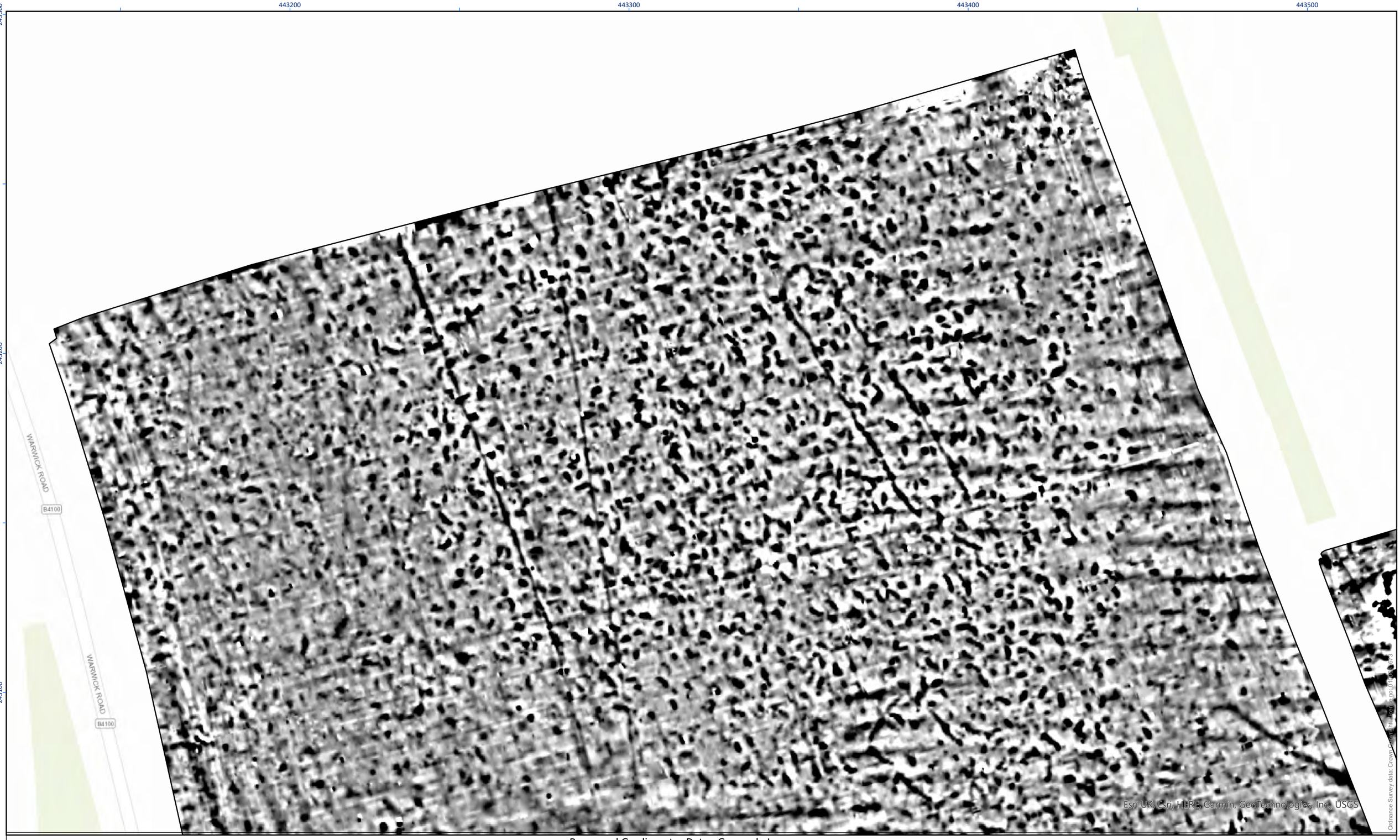
AOC Archaeology Group



Processed Gradiometer Data - Greyscale Image

Figure 5.1

5nT
-3nT

N

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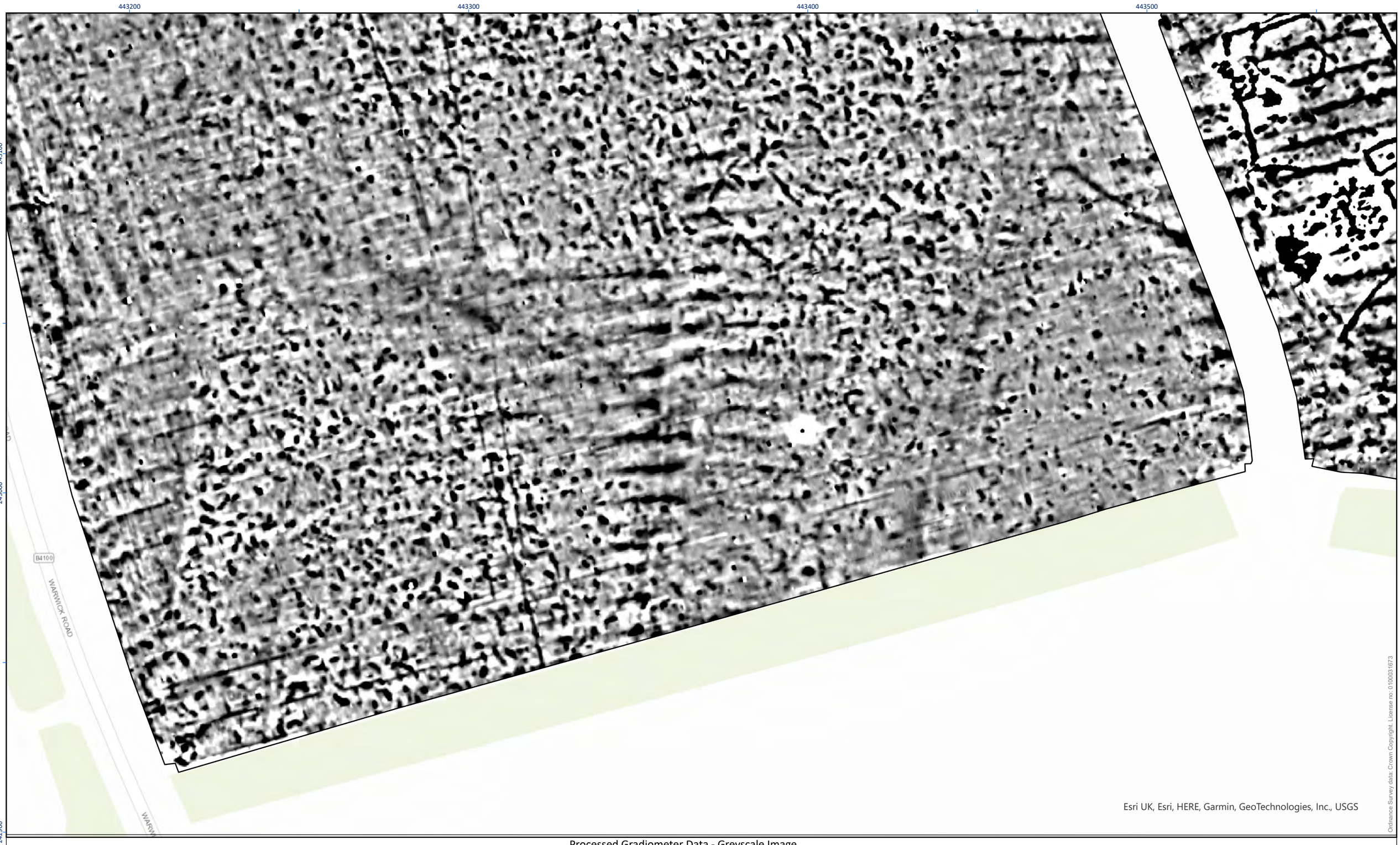
AOC Archaeology Group



Processed Gradiometer Data - Greyscale Image

Figure 5.2

5nT
-3nT

N

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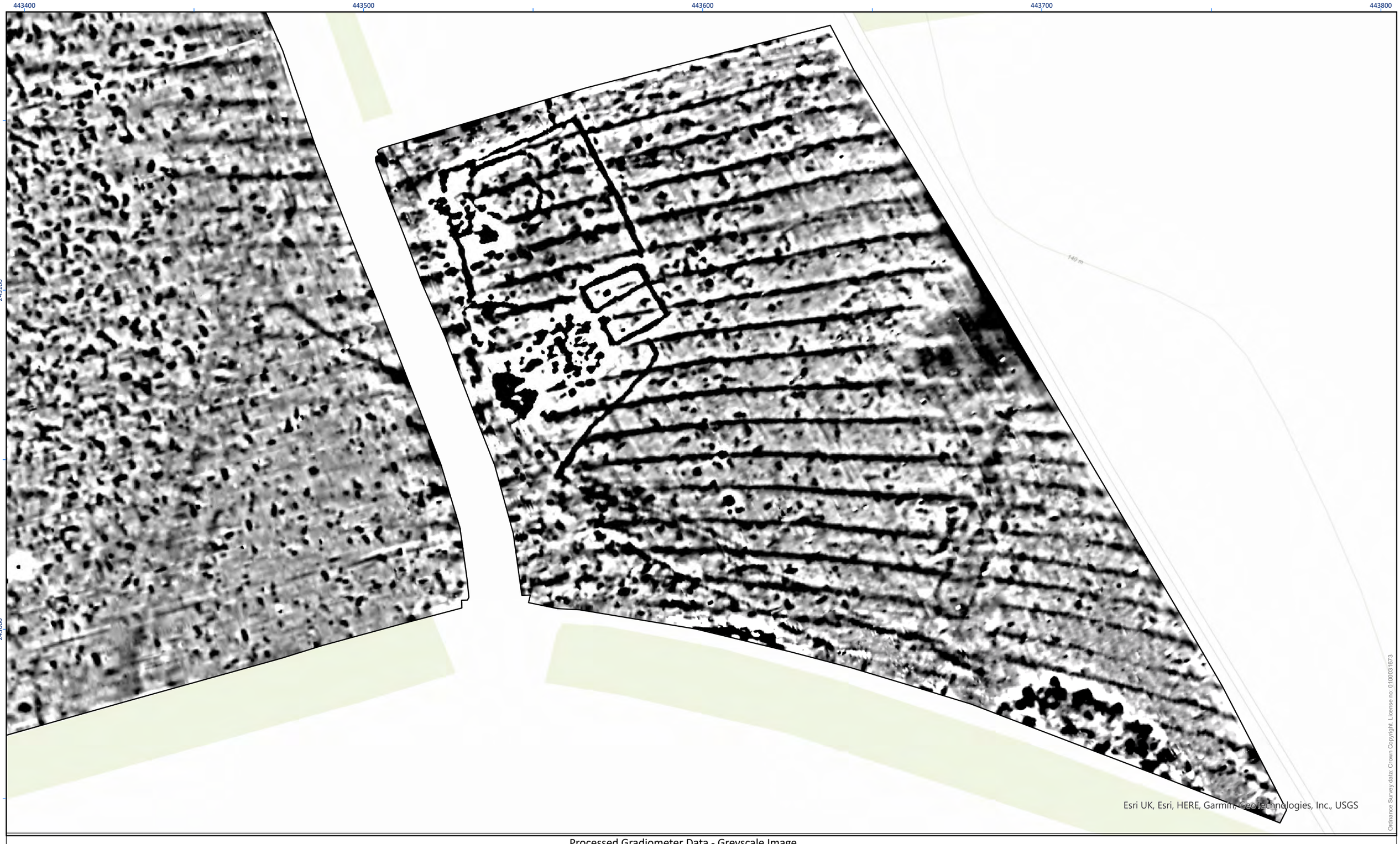
Checked by: AG	Date: 16/06/2022
Approved by: JL	Date: 16/06/2022

AOC Archaeology Group



Processed Gradiometer Data - Greyscale Image

Figure 5.3

5nT
-3nT

N

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Approved by: JL	Date: 16/06/2022

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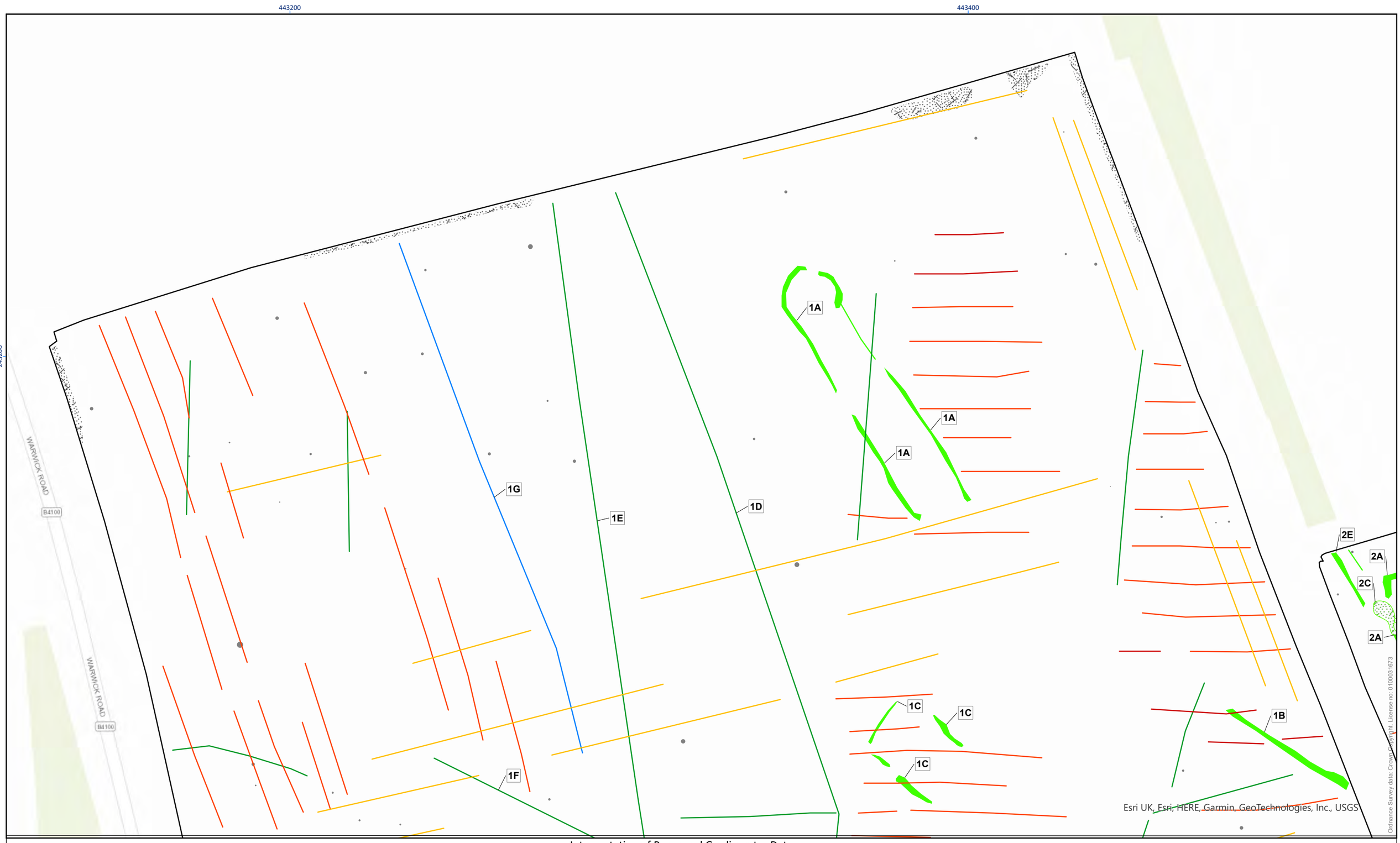

Interpretation of Processed Gradiometer Data

Figure 6.1

- Enhanced Magnetism (Modern)
- Linear Trend (Possible Archaeology)
- Enhanced Magnetism (Possible Archaeology)
- Ferrous/Iron Spike
- Trend (Archaeology)
- Linear Trend (Historic Feature)
- Linear Trend (Ploughing)
- Trend (Possible Archaeology)
- Linear Trend (Ridge and Furrow)
- Trend (Unclear Origin)

N

0 30m

Scale: 1:1,000 @ A3

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Approved by: JL	Date: 17/06/2022

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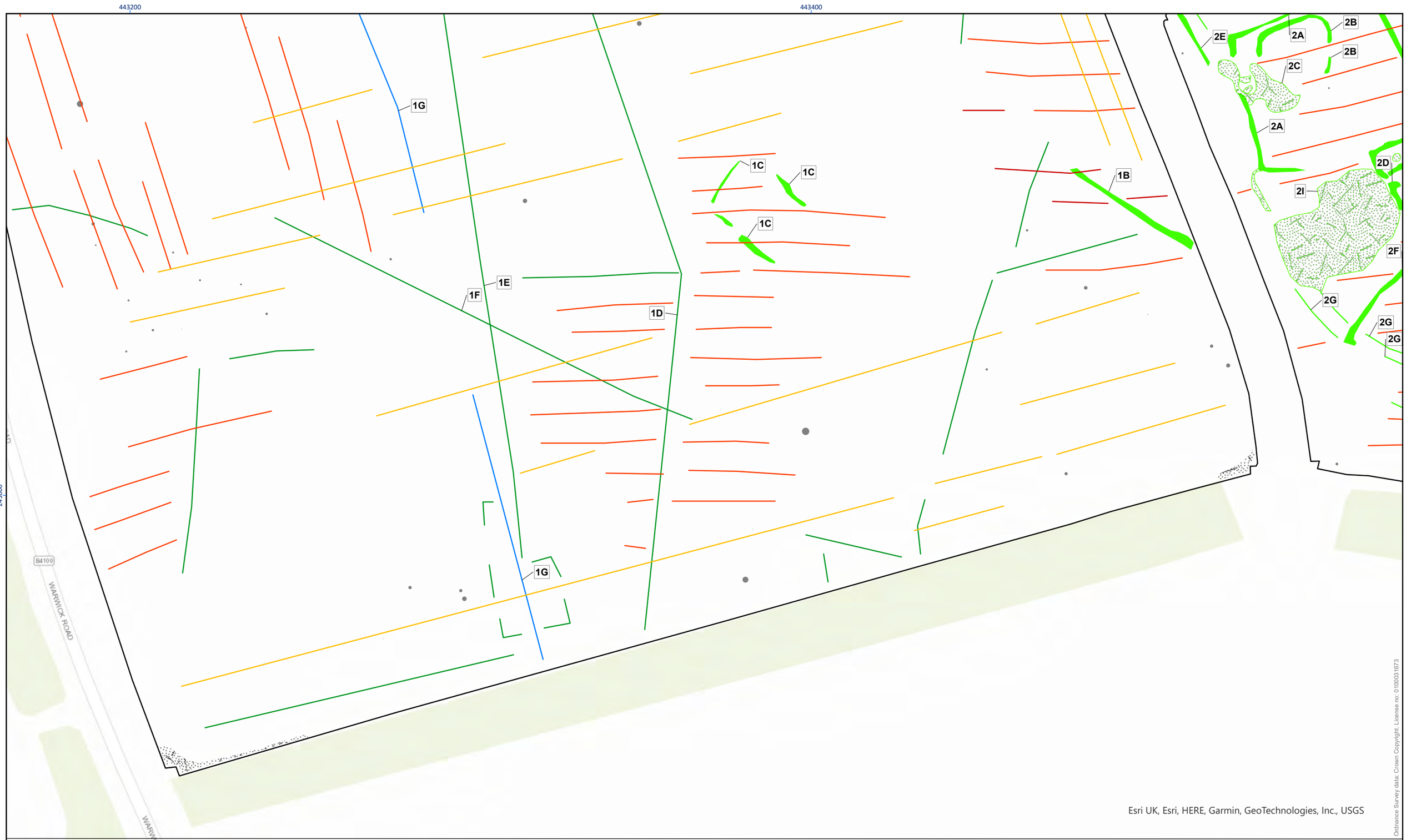

Interpretation of Processed Gradiometer Data

Figure 6.2

- Enhanced Magnetism (Modern)
- Linear Trend (Possible Archaeology)
- Enhanced Magnetism (Possible Archaeology)
- Ferrous/Iron Spike
- Trend (Archaeology)
- Linear Trend (Historic Feature)
- Linear Trend (Ploughing)
- Trend (Possible Archaeology)
- Linear Trend (Ridge and Furrow)
- Trend (Unclear Origin)

N

0 30m

Scale: 1:1,000 @ A3

Drawing Number: 05/40324/GEO/6.2/01	
Created by: SO	Date: 15/06/2022
Checked by: AG	Date: 17/06/2022
Approved by: JL	Date: 17/06/2022

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443400 443600 443800

243000

1A 1B 1C 2A 2B 2C 2D 2E 2F 2G 2H 2I 2J 2K

140 m

Esri UK, Esri, HERE, Garmin, GeoTechnologies, Inc., USGS

Interpretation of Processed Gradiometer Data

Figure 6.3

- Geology/Natural
- Enhanced Magnetism (Modern)
- Linear Trend (Possible Archaeology)
- Enhanced Magnetism (Possible Archaeology)
- Ferrous/Iron Spike
- Enhanced Magnetism (Unclear Origin)
- Linear Trend (Unclear Origin)
- Trend (Archaeology)
- Linear Trend (Ploughing)
- Trend (Possible Archaeology)
- Linear Trend (Ridge and Furrow)
- Trend (Unclear Origin)

N

0 30m

Scale: 1:1,000 @ A3

Drawing Number: 05/40324/GEO/6.3/01	
Created by: SO	Date: 15/06/2022
Checked by: AG	Date: 17/06/2022
Approved by: JL	Date: 17/06/2022

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443200

443400

243200

WARWICK ROAD

B4100

WARWICK ROAD

B4100

Esri UK, Esri, TomTom, Garmin, FAO, NOAA, USGS, ...

Minimally Processed Gradiometer Data - XY Trace

Figure 7.1

50nT

-50nT

N

0 30m

Scale: 1:1,000 @ A3

Drawing Number: 05/40324/GEO/7.1/01	
Created by: SO	Date: 15/06/2022
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Approved by: JL	Date: 16/06/2022

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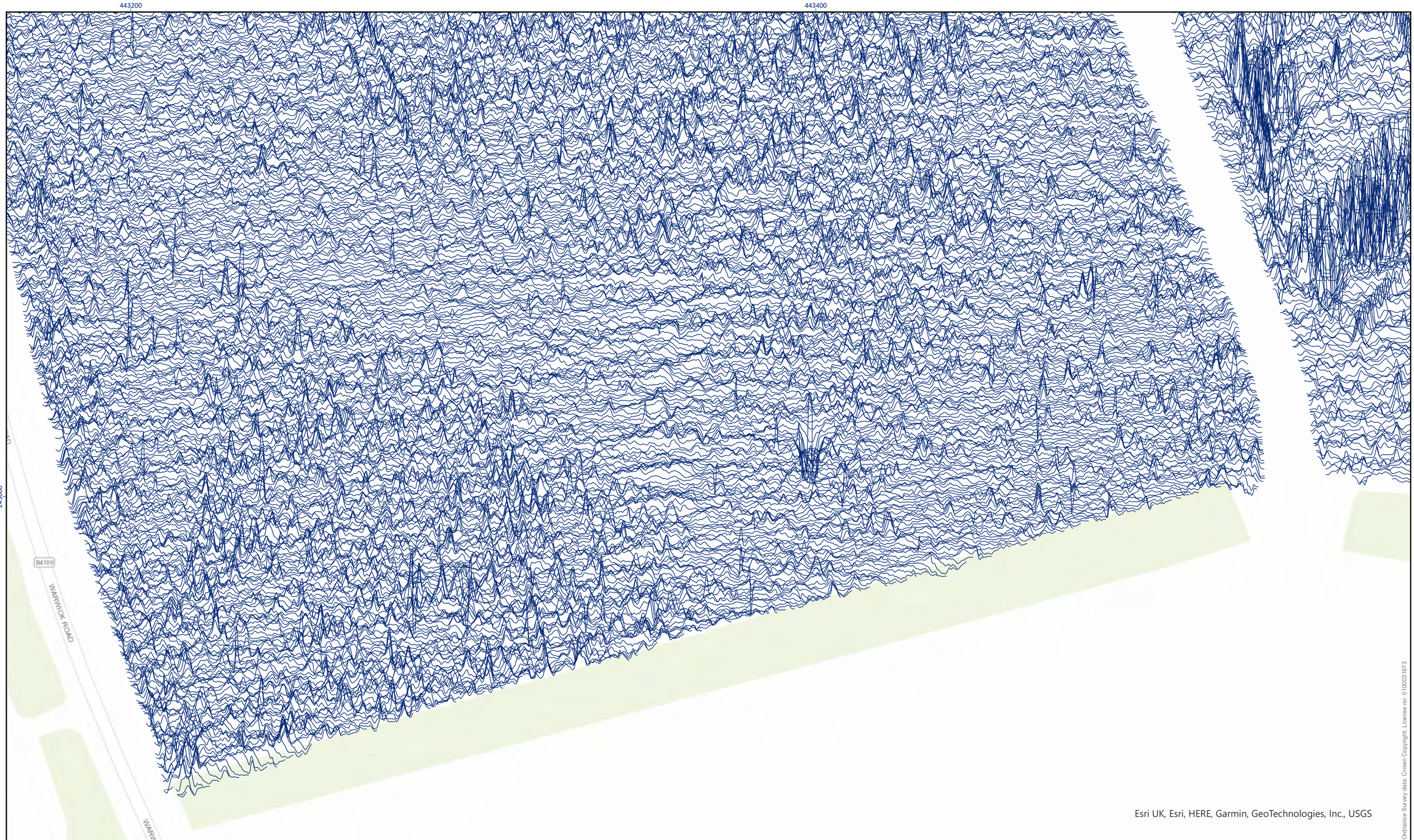

Minimally Processed Gradiometer Data - XY Trace

Figure 7.2

50nT
-50nT

N

0 30m

Scale: 1:1,000 @ A3

Drawing Number: 05/40324/GEO/7.2/01	
Created by: SO	Date: 15/06/2022
Checked by: AG	Date: 16/06/2022
Approved by: JL	Date: 16/06/2022

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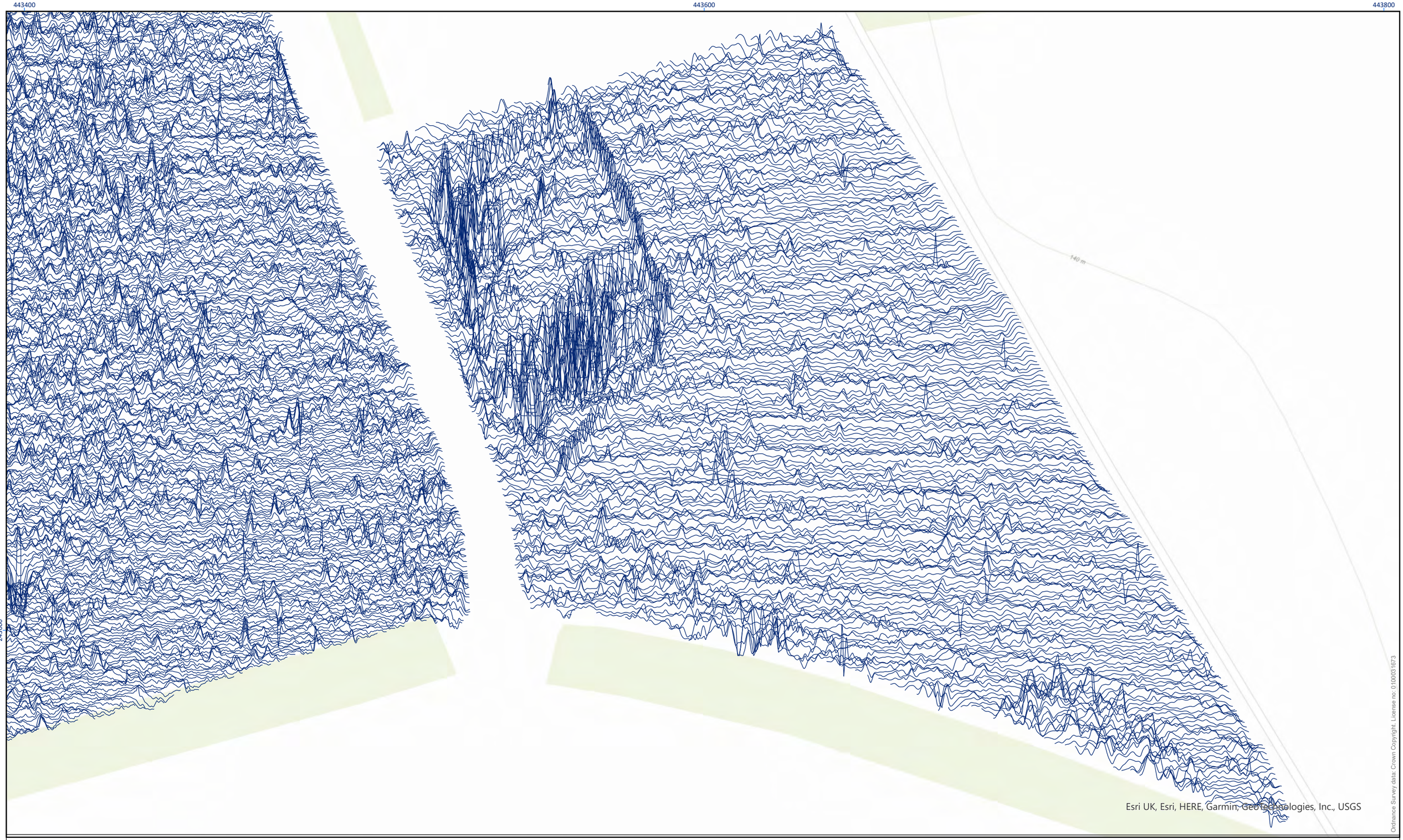

Minimally Processed Gradiometer Data - XY Trace

Figure 7.3

50nT

-50nT

N

0 30m

Scale: 1:1,000 @ A3

Drawing Number: 05/40324/GEO/7.3/01	
Created by: SO	Date: 15/06/2022
Checked by: AG	Date: 16/06/2022
Approved by: JL	Date: 16/06/2022

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443200 443400 443600 443800

243200 243000

Summary Interpretation with Greyscale Underlay

Figure 08

5nT
-3nT

- Geology/Natural
- Enhanced Magnetism (Modern)
- Linear Trend (Possible Archaeology)
- Enhanced Magnetism (Possible Archaeology)
- Ferrous/Iron Spike
- Enhanced Magnetism (Unclear Origin)
- Linear Trend (Unclear Origin)
- Trend (Archaeology)
- Linear Trend (Historic Feature)
- Trend (Possible Archaeology)
- Linear Trend (Ridge and Furrow)
- Trend (Unclear Origin)

N

0 60m

Scale: 1:2,000 @ A3

Drawing Number: 05/40324/GEO/08/01	
Created by: SO	Date: 17/06/2022
Checked by: AG	Date: 17/06/2022
Approved by: JL	Date: 17/06/2022

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Appendix 1: Characterisation of Anomalies

Gradiometer survey

Anomaly	Type of Anomaly
1A	Linear trend - Possible Archaeology
1B	Linear trend - Possible Archaeology
1C	Linear trend - Possible Archaeology
1D	Linear trend - Unclear
1E	Linear trend - Unclear
1F	Linear trend - Unclear
1G	Linear trend – Historic Feature
2A	Linear trend – Possible Archaeology
2B	Linear trend – Possible Archaeology
2C	Enhanced Magnetism – Possible Archaeology
2D	Linear trend – Possible Archaeology
2E	Linear trend – Possible Archaeology
2F	Linear trend – Possible Archaeology
2G	Linear trend – Possible Archaeology
2H	Linear trend – Possible Archaeology
2I	Enhanced Magnetism – Possible Archaeology
2J	Linear trend – Possible Archaeology
2K	Enhanced Magnetism – Unclear Origin

Appendix 2: Survey Metadata

Oasis ID: aocarcha1-505821

Field	Description
Surveying Company	AOC Archaeology
Data collection staff	Alistair Galt, Marguerite Hall, Kris Hall
Client	AXIS PED
Site name	Land to the East of Warwick Road, Banbury
County	Oxfordshire
NGR	SP 43300 43118
Land use/ field condition	Wheat crop
Duration	09/5/22 - 10/5/22
Weather	Sunny
Survey type	Gradiometer Survey
Instrumentation	Bartington cart survey: Bartington Non-Magnetic Cart, three Bartington Grad 601-2, Trimble R10 GNSS System
Area covered	Approx 13ha
Download software	MLGrad601
Processing software	Geomar, MultiGrad601 and TerraSurveyor
Visualisation software	ArcGIS Pro
Geology	Marlstone Rock Formation – Ferruginous Limestone and Ironstone , Charmouth Mudstone Formation (BGS, 2022)
Soils	Freely draining slightly acid but base-rich soils (Soilscapes, 2022)
Scheduled Ancient Monument	No
Known archaeology on site	None
Historical documentation/ mapping on site	None
Report title	Land East of Warwick Road, Banbury: Archaeological Geophysical Survey
Project number	40324
Report Author	Alistair Galt
Quality Checked by	James Lawton

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 topsoil 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 or thick layers of alluvium or till. All magnetic geophysical surveys must therefore take the effects of background geological and geomorphological conditions into account.

Bartington Non-Magnetic Cart Instrumentation and Software

AOC Archaeology's cart-based surveys are carried out using a Bartington Non-Magnetic Cart. The cart enables multiple traverses of data to be collected at the same time, increasing the speed at which surveys may be carried out and offers the benefits of reduced random measurement noise and rapid area coverage (Schmidt et al 2015, 60-62, David et al. 2008, 21).

The cart uses a configuration of six Grad-01-1000L sensors mounted upon a carbon fibre frame along with three DL601 dataloggers and two BC601 battery cassettes. The sensors are normally positioned at 1m intervals on a horizontal bar, with the datalogger taking readings at 10Hz along each traverse, though this can be altered to increase / reduce resolution if required. The data is georeferenced via a Trimble R10 Real Time Kinematic (RTK) VRS Now GNSS GPS which streams data throughout survey and allows the data to be recorded relative to a WGS1984 UTM coordinate system.

The gradiometer data is collected through Geomar MLGrad601 software on a laptop in real-time during the survey. The data is downloaded and converted into a .xyz file in Geomar MultiGrad601 before being processed along with the GPS data in TerraSurveyor v3.0.34.10 (see Appendix 4 for a summary of the processes used in Geoplot to create final data plots).

Appendix 4: Summary of Data Processing

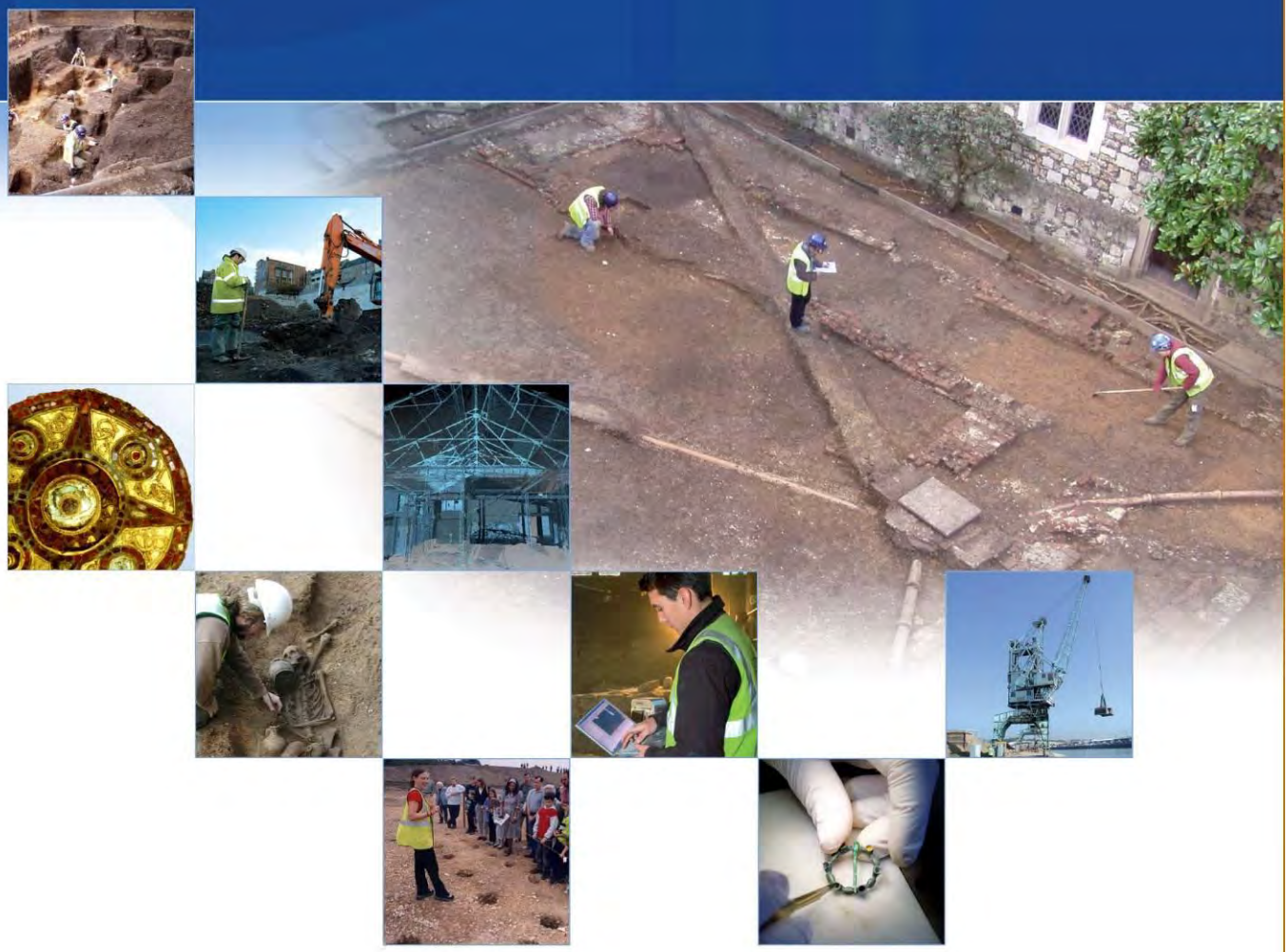
Process	Effect
Clip	Limits data values to within a specified range
De-spike	Removes exceptionally high readings in the data that can obscure the visibility of archaeological features. In resistivity survey, these can be caused by poor contact of the mobile probes with the ground. In gradiometer survey, 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.
Discard Overlap (TerraSurveyor)	Removes datapoints which occur too closely together and can cause digital artefacts in the data which are caused by the overlapping of parallel traverses.
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.
Filter (MAGNETO)	Much like a zero mean traverse, it resets the median value of each point to zero, in order to address the effect of striping in the data and counteract edge effects. In MAGNETO the individual values take into account the value of all uncorrected points within a certain distance to create its own median.
GPS Filter (MAGNETO)	Used to either remove or reduce the appearance of constant and reoccurring features that are not consistent with the GPS signal in use by the cart system.
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.
Remove Turns (TerraSurveyor)	Uses analysis of the direction of travel derived from the GNSS data to break continuous streams of data into individual traverses.
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.

Processing Steps

Bartington Cart survey	
Process	**Extent**
Base Settings	Interval 0.121m, Track Radius 1.06m
Discard Overlap	Threshold Distance 0.4m, Minimum Track 5, Newest
Despike	Mean Diameter 7 Threshold 3
Destripe	Median Traverse absolute -10 to 10
Clip	-30/30

Appendix 5: Technical Terminology

Type of Anomaly	Description
Archaeology	*Interpretation is supported by the presence of known archaeological remains or by other forms of evidence such as HER records, LiDAR data or cropmarks identified through aerial photography.*
Trend	Linear / curvilinear / rectilinear anomalies either characterised by an increase or decrease in values compared to the magnetic background.
Area of enhanced magnetism	A zone of enhanced magnetic responses over a localised area. These anomalies do not have the high dipolar response which are manifested in an 'iron spike' anomaly and likely have a relationship with nearby archaeological trends.
Pit	An anomaly composed of an increase in magnetic values with a patterning on the XY trace plot that is pit-like in appearance.
Possible Archaeology	*Trends are likely to have an archaeological origin, however without supporting evidence from known archaeological remains, HER records, LiDAR or aerial photography, they can only be classed as having a possible archaeological origin.*
Trend	Linear / curvilinear / rectilinear anomalies either characterised by an increase or decrease in values compared to the magnetic background.
Area of enhanced magnetism	A zone of enhanced magnetic responses over a localised area. These anomalies do not have the high dipolar response which are manifested in an 'iron spike' anomaly but lacks definitive records to be classed as being archaeological.
Pit-like anomaly	An anomaly composed of an increase in magnetic values with a patterning on the XY trace plot that is pit-like in appearance.
Burnt area	An anomaly with a patterning on the XY trace plot that is suggestive of industrial activity such as a kiln or hearth.
Unclear Origin	*Trends are magnetically weak, fractured or isolated and their context is difficult to ascertain. Whilst an archaeological origin is possible, an agricultural, geological or modern origin is also likely.*
Trend	Linear / curvilinear / rectilinear anomalies which are composed of a weak or different change in magnetic values. The trends do not appear to form a patterning that is suggestive of archaeological remains, such as enclosures or trackways.
Area of enhanced magnetism	A zone of enhanced magnetic responses which lack context for a conclusive interpretation. They do not appear to have a relationship with nearby trends of an archaeological origin. Can often be caused by areas of former woodland, geological variations or agricultural activity.
Agricultural	*Trends associated with agricultural activity, either historical or modern.*
Old Field Boundary	These isolated long linear anomalies, most often represented as a negative or fractured magnetic trend, relate to former field boundaries when their positioning is cross referenced with historical mapping.
Historical Features	Features observed on historical mapping that correspond with anomalies or trends in the data. Areas of enhanced magnetism could relate to former buildings, trackways, quarries or ponds.
Ridge and Furrow / Rig and Furrow	A series of regular linear or curvilinear anomalies either composed of an increased or decreased magnetic response compared to background values. The wide regular spacing between the anomalies is consistent with that of a ridge and furrow / rig and furrow ploughing regime. The anomalies often present as a positive 'ridge' trend adjacent to a negative 'furrow' trend.
Ploughing Trends	A series of regular linear anomalies either composed of an increased or decreased magnetic response compared to background values. Anomalies seen parallel to field edges are representative of headlands caused by ploughing.
Field Drainage	A series of magnetic linear anomalies of an indeterminate date, usually with a regular or herringbone patterning.
Non - Archaeology	*Trends which are likely to have derived from non-archaeological processes or activities.*
Geology / Natural	An area of enhanced magnetism that is composed of irregular weak increases or decreases in magnetic values compared with background readings. It is likely to indicate natural variations in soil composition or reflect variations in the bedrock or superficial geology.
Possible Modern Service	Anomalies of a linear form often composed of contrasting high positive and negative dipolar values. Such anomalies usually signify a feature with a high level of magnetisation and are likely to belong to modern activity such as pipes or modern services.
Magnetic Disturbance	A zone of highly magnetic disturbance that has been caused by or is a reflection of modern activity, such as metallic boundary fencing, gateways, roads, boreholes, adjacent buildings, rubbish at field edges or a spread of green waste material.
Isolated Dipolar Anomalies / Ferrous (iron spikes) and Ferrous Zones	A response caused by ferrous materials on the ground surface or within the subsoil, which causes a 'spike' in the data representing a rapid variation in the magnetic response. These generally represent modern material often re-deposited during manuring.



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