Geophysical Survey Report

of

Land at High Street, Wrestlingworth

For

Archaeology Collective

On Behalf Of

Dyason Developments Ltd

Magnitude Surveys Ref: MSTL542

HER Event Number: To be issued when submitted to HER

September 2019

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Draft 1.1	Corrections from line manager.	Hans Whitefield BA (Hons) MSc	Hans Whitefield BA (Hons) MSc	Finnegan Pope-Carter BSc (Hons) MSc FGS	11 September 2019
Draft 1.2	Corrections from Project Manager	Hans Whitefield BA (Hons) MSc	Hans Whitefield BA (Hons) MSc	Finnegan Pope-Carter BSc (Hons) MSc FGS	12 September 2019
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Abstract

Magnitude Surveys was commissioned to assess the subsurface archaeological potential of a c. 7.8 ha area of land at High Street Wrestlingworth. A fluxgate gradiometer survey was successfully completed across the site. The geophysical results are characterised by evidence of field systems of a possibly medieval date. Anomalies related to historical agricultural use have been detected and interpreted as ridge and furrow as well as possible boundary walls and ditches and possibly house platforms. Several responses that may be associated with the core of the medieval shrunken village are also present. The impact of modern activity on the results in generally limited and detected as ferro-magnetic spreads and a cricket pitch.

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1. Introduction

1.1. Magnitude Surveys Ltd (MS) was commissioned by Archaeology Collective on behalf of Dyason Developments Ltd to undertake a geophysical survey on a c. 7.8 ha area of land off the High Street, Wrestlingworth, Central Bedfordshire (TL 25579 47381).

1.2. The geophysical survey comprised quad-towed cart-mounted GNSS-positioned fluxgate gradiometer survey.

1.3. The survey was conducted in line with the current best practice guidelines produced by Historic England (David et al., 2008), the Chartered Institute for Archaeologists (CIfA, 2014) and the European Archaeological Council (Schmidt et al., 2015).

1.4. It was conducted in line with a Written Scheme of Investigation produced by MS (2019).

1.5. The survey commenced on 2nd September 2019 and took two days to complete.

2. Quality Assurance

2.1. Magnitude Surveys is a Registered Organisation of the Chartered Institute for Archaeologists (CIfA), the chartered UK body for archaeologists, and a corporate member of ISAP (International Society of Archaeological Prospection).

2.2. Director Dr. Chrys Harris is a Member of CIfA, has a PhD in archaeological geophysics from the University of Bradford and is the Vice-Chair of ISAP. Director Finnegan Pope-Carter is a Fellow of the London Geological Society, the chartered UK body for geophysicists and geologists, as well as a member of GeoSIG, the CIfA Geophysics Special Interest Group. Reporting Analyst Dr. Kayt Armstrong has a PhD in archaeological geophysics from Bournemouth University, is the Vice Conference Secretary and Editor of ISAP News for ISAP, and is the UK Management Committee representative for the COST Action SAGA.

2.3. All MS managers have relevant degree qualifications to archaeology or geophysics. All MS field and office staff have relevant archaeology or geophysics degrees and/or field experience.

3. Objectives

3.1. The objective of this geophysical survey was to assess the subsurface archaeological potential of the survey area.

4. Geographic Background

4.1. The site is located c.250m south-west from Wrestlingworth (Figure 1). Survey was undertaken across two fields under pasture. The site is bounded by Potton Road to the north, High Street and housing to the east, and arable land and Water End farm to the south, and more arable land to the west (Figure 2).

4.2. Survey considerations:

Survey Area	Ground Conditions	Further Notes
1	Grassland (pasture). Gentle slope downwards from south to north. Ridge and furrow were visible on an approximately north-east to south-west orientation.	Bounded to the north and west by hedgerows and wire fencing, to the east by hedgerows and wooden fencing, and to the south by a temporary electric fence. Telegraph poles and associated cables ran along the northern boundary and across the south-east corner.
2	Grassland (pasture). Steep downward slope from north-west to south-east.	Bounded to the north by a temporary electric fence, to the west and south by hedgerows and wire fencing, and to the east by wooden fencing. Telegraph poles and associated cables ran north-east to south-west across the northern half of the area.

4.3. The underlying geology comprises mudstone of the Gault formation. The superficial geology is made up of diamicton deposited during the last glacial period (British Geological Survey, 2019).

4.4. The soils consist of lime-rich loamy and clayey soils with slightly impeded drainage (Soilscapes, 2019).

5. Archaeological Background

5.1. The following is a summary of Monument Reports and Event/Activity Reports produced by Central Bedfordshire Council the Archaeology Collective (2019a; 2019b). The following summarises the Historic Environment Records of the site and the surrounding area (1km radius) following a search of Heritage Gateway (2019).

5.2. Within the survey area, several standing earthworks have been identified. The southern portion of Area 2 has the remains of a possible trackway flanked by extant ditches of possible medieval date (Central Bedfordshire Council 2019b). Ridge and furrow are present on a north-south orientation dating from between 1066 and 1539. These are possibly related to a portion of the shrunken medieval village. Furthermore, local tradition holds that this field was home to a moated manor (Central Bedfordshire Council 2019a).

5.3. Trial trenching undertaken 300 metres to the south-east of the site uncovered a small assemblage of medieval pottery, along with several discrete but non-descript ditches and pits (Central Bedfordshire Council 2019a). It is suggested that this area was on the peripheries of any medieval site, and that the core of medieval activity was further north and west.

5.4. Further medieval activity in the form of ridge and furrow is present 249m to the north (Heritage Gateway 2019). This system of ridge and furrow was identified by aerial photography and is on an east-west orientation.

6. Methodology

6.1.Data Collection

6.1.1. Geophysical prospection comprised the magnetic method as described in the following table.

6.1.2. Table of survey strategies:

Method	Instrument	Traverse Interval	Sample Interval
Magnetic	Bartington Instruments Grad-13 Digital Three-Axis Gradiometer	1m	200Hz reprojected to 0.125m

6.1.3. The magnetic data were collected using MS' bespoke quad-towed cart system.

6.1.3.1. MS' cart system was comprised of Bartington Instruments Grad 13 Digital Three-Axis Gradiometers. Positional referencing was through a multi-channel, multi-constellation GNSS Smart Antenna RTK GPS outputting in NMEA mode to ensure high positional accuracy of collected measurements. The RTK GPS is accurate to 0.008m + 1ppm in the horizontal and 0.015m + 1ppm in the vertical.

6.1.3.2. Magnetic and GPS data were stored on an SD card within MS' bespoke datalogger. The datalogger was continuously synced, via an in-field Wi-Fi unit, to servers within MS' offices. This allowed for data collection, processing and visualisation to be monitored in real-time as fieldwork was ongoing.

6.1.3.3. A navigation system was integrated with the RTK GPS, which was used to guide the surveyor. Data were collected by traversing the survey area along the longest possible lines, ensuring efficient collection and processing.

6.2.Data Processing

6.2.1. Magnetic data were processed in bespoke in-house software produced by MS. Processing steps conform to Historic England's standards for "raw or minimally processed data" (see sect 4.2 in David et al., 2008: 11).

Sensor Calibration – The sensors were calibrated using a bespoke in-house algorithm, which conforms to Olsen et al. (2003).

Zero Median Traverse – The median of each sensor traverse is calculated within a specified range and subtracted from the collected data. This removes striping effects caused by small variations in sensor electronics.

Projection to a Regular Grid – Data collected using RTK GPS positioning requires a uniform grid projection to visualise data. Data are rotated to best fit an orthogonal grid projection and are resampled onto the grid using an inverse distance-weighting algorithm.

Interpolation to Square Pixels – Data are interpolated using a bicubic algorithm to increase the pixel density between sensor traverses. This produces images with square pixels for ease of visualisation.

6.3.Data Visualisation and Interpretation

6.3.1. This report presents the gradient of the sensors' total field data as greyscale images, as well as the total field data from the lower sensors. The gradient of the sensors minimises external interferences and reduces the blown-out responses from ferrous and other high contrast material. However, the contrast of weak or ephemeral anomalies can be reduced through the process of calculating the gradient. Consequently, some features can be clearer in the respective gradient or total field datasets. Multiple greyscale images at different plotting ranges have been used for data interpretation. Greyscale images should be viewed alongside the XY trace plot (Figure 8). XY trace plots visualise the magnitude and form of the geophysical response, aiding in anomaly interpretation.

6.3.2. Geophysical results have been interpreted using greyscale images and XY traces in a layered environment, overlaid against open street maps, satellite imagery, historic maps, LiDAR data, and soil and geology maps. Google Earth (2019) was consulted as well, to compare the results with recent land usages.

6.3.3. Geodetic position of results - All vector and raster data have been projected into OSGB36 (ESPG27700) and can be provided upon request in ESRI Shapefile (.SHP) and Geotiff (.TIF) respectively. Figures are provided with raster and vector data projected against OS Open Data.

7. Results

7.1.Qualification

7.1.1. Geophysical results are not a map of the ground and are instead a direct measurement of subsurface properties. Detecting and mapping features requires that said features have properties that can be measured by the chosen technique(s) and that these properties have sufficient contrast with the background to be identifiable. The interpretation of any identified anomalies is inherently subjective. While the scrutiny of the results is undertaken by qualified, experienced individuals and rigorously checked for quality and consistency, it is often not possible to classify all anomaly sources. Where possible an anomaly source will be identified along with the certainty of the interpretation. The only way to improve the interpretation of results is through a process of comparing excavated results with the geophysical reports. MS actively seek feedback on their reports as well as reports of further work in order to constantly improve our knowledge and service.

7.2.Discussion

7.2.1. The geophysical results are presented in consideration with historic maps (Figure 6) and earthwork survey (Figure 8).

7.2.2. The fluxgate gradiometer survey has responded well to the environment of the survey area. The geophysical data is characterised by agricultural activity in the form of ridge and furrow as well as former systems of land division. Several areas of ferrous debris and magnetic disturbance due to fence lines are present. An area of highly magnetic responses most likely related to a modern cricket pitch were in the northeast of the survey.

7.2.3. An area of potentially dense archaeology has been identified on the southern boundary of the site. It is possible that this relates to the medieval settlement of Wrestlingworth but cannot be confirmed by the magnetic data alone.

7.2.4. At least 5 orientations of ridge and furrow as well as possible ploughing headlands connected to historic agriculture have been identified in the magnetic data. A number of possible drainage features have been identified; although this interpretation is tenuous owing to a large number of other signals associated with agriculture in close proximity.

7.3.Interpretation

7.3.1. General Statements

7.3.1.1. Geophysical anomalies will be discussed broadly as classification types across the survey area. Only anomalies that are distinctive or unusual will be discussed individually.

7.3.1.2. **Magnetic Disturbance** – The strong anomalies produced by extant metallic structures along the edges of the field have been classified as ‘Magnetic Disturbance’. These magnetic ‘haloes’ will obscure the response of any weaker

underlying features, should they be present, often over a greater footprint than the structure they are being caused by.

7.3.1.3. **Ferrous (Spike)** – Discrete ferrous-like, dipolar anomalies are likely to be the result of isolated modern metallic debris on or near the ground surface.

7.3.1.4. **Ferrous/Debris (Spread)** – A ferrous/debris spread refers to a concentrated deposition of discrete, dipolar ferrous anomalies and other highly magnetic material.

7.3.1.5. **Undetermined** – Anomalies are classified as Undetermined when the anomaly origin is ambiguous through the geophysical results and there is no supporting or correlative evidence to warrant a more certain classification. These anomalies are likely to be the result of geological, pedological or agricultural processes, although an archaeological origin cannot be entirely ruled out. Undetermined anomalies are generally not ferrous in nature.

7.3.2. Magnetic Results - Specific Anomalies

7.3.2.1. **Archaeology Possible (Strong)**– The south-eastern extreme of Area 2 is dominated by several rectilinear and discrete anomalies [**2a**] (Figure 5). These strong positive features are most explicit in the gradient (Figure 4). This location has been suggested by previous investigations as the location of the medieval settlement core; however, the density of these responses and their proximity to the edge of the survey area inhibits any definitive interpretation.

7.3.2.2. **Archaeology Possible (Strong)** – A ring like anomaly [**2b**] 10 m in diameter is visible at the south-eastern extreme of Area 2 (Figure 5). This strong negative response is most explicit in the gradient (Figure 4). This feature may be stone as evidenced by its negative magnetic signature.

7.3.2.3. **Archaeology Probable (Weak)** – Two parallel linear anomalies [**2c**] are on a south-west to north-east orientation in the southern portion of Area 2 (Figure 5). These signals are weakly positive, but most apparent in the magnetic gradient (Figure 4). They are approximately 100 m in length 1 m to 2 m in width and approximately 20 m apart. A 17 m long continuation may be located further east [**2d**]. Two ditches have been recorded in the location by earthwork survey and HER records (Figure 8) (Central Bedfordshire County Council 2019b). Furthermore, these possible ditches appear to respect the more complex features identified at **2a** supporting the interpretation that these may be archaeological, rather than ridge and furrow.

7.3.2.4. **Agricultural (Weak)** – Several weak linear anomalies [**2e**] are present in the south-east portion of Area 2 (Figure 5). The most prominent linear anomaly is on a north-west to south-east alignment. The gradient data shows a clear positive response 98 m in length and 2.5 m wide (Figure 4). Two further parallel linear features 25 m long and 1.5 m wide are on a south-west to north-east alignment are visible. Further anomalies on a north-south orientation extend

roughly 65 m to the south. Despite not being highly regular in these are likely to be drainage features.

7.3.2.5. **Agricultural (Weak)** – A further group of linear anomalies [**2f**] are in the eastern portion of Area 2 (Figure 5). These weak positive anomalies extend c. 95 m from the north-east to south-west and c. 95 m north to south in the gradient data (Figure 4). These anomalies are a possible series of land drains conforming to a typical herringbone pattern. They may or may not be related to the anomalies at **2e**.

7.3.2.6. **Archaeology Probable (Weak)** – The boundary between Area 1 and 2 has several recti-linear [**1a**,**2g**,**2h**] anomalies. These are visible in the gradient data as weak positive anomalies, covering area of c. 120 m east to west and north to west. An upstanding earthwork corresponds with the location of **1a** (Figure 8) and suggests that the anomalies may be built up field boundaries, possibly former walls or hedge lines. The number of anomalies and their differing orientation at **2g** suggests that there may be multiple phases of activity possibly a trackway. These features may be related to medieval activity in the area, as the numerous ridge and furrow systems seem to respect the possible boundaries.

7.3.2.7. **Archaeology Possible (Strong)** – A group of semi-rectangular [**1b,1c**,**1d**] anomalies is clustered on the north-east edge of Area 1 (Figure 5). These anomalies are most explicit in the gradient as strong positive responses bordered by negative magnetic signal (Figure 4). The least continuous of the anomalies [**1b**] is 15m long and 15m wide. The clearest anomaly [**1c**] has two components and is roughly 10m by 11m. The northern most anomaly [**1d**] is 10m by 15m. The roughly rectangular shape of these features and the strength of their responses suggests they may be house platforms. This is further supported by their position outside of the areas of historic agricultural activity.

7.3.2.8. **Archaeology Possible (Weak)** – Two anomalies [**1e** and **1f**] both 20 m in length and 2 m wide are visible on a very rough east-west alignment before turning south for an additional 10 m (Figure 5). They are visible in the gradient data as weak positive anomalies before they intersect an area of ferrous debris (Figure 4). They are likely to continue to the south [**1g**] for another 40 m. They may be ditch-like features, and their funnel like appearance is suggestive of a possible track or drove way.

7.3.2.9. **Modern** – A rectilinear area of 10 very strong positive responses [**1h**] and a negative halo 38 m long and 25 m wide is present in the centre of Area 1 (Figure 5). There is also a central area of magnetic enhancement in the centre of the anomalies. These features are readily apparent in both the gradient and total field data due to their ferrous nature (Figure 3,4). These responses are most likely related to a former cricket ground attested to in the area in Ordnance Survey maps around 1980.

7.3.2.10. **Agricultural (Weak)** – Two parallel curvilinear anomalies [**1i**] traverse the north end of Area 1 (Figure 5). These weakly positive anomalies are clearest in the gradient data (Figure 4). The anomalies are 190 m long and between 3 m and 5 m wide. These anomalies are indicative of agricultural activity, namely plough headlands, related to the ridge and furrow visible in both aerial photographs and magnetic data.

8. Conclusions

8.1. A fluxgate gradiometer survey has successfully been undertaken across the site. The geophysical survey has detected a range of anomalies of archaeological and agricultural origin. The underlying geology has not significantly contributed to the signals detected in the magnetic data. Modern interference is limited to the western edge and south-west corner of the site but has not impaired the collection or interpretation of magnetic data. A group of strong ferrous responses has been attributed to the presence of a former cricket pitch that was on the site in the 1980s.

8.2. A significant system of land division has been identified in the magnetic data. The substantial number of ridge and furrow systems in the area, as well as the recorded earthworks (Central Bedfordshire Council 2019a; 2019b) suggest that this activity may date to the medieval period.

8.3. The responses at the southern end of the site are possibly related to settlement. Previous excavation reports suggest that the medieval core of Wrestlingworth was located in this area; however, it is not definitive that the anomalies detected are of this period (Central Bedfordshire 2019a). The similar anomalies at the northern end of the site may be of a similar origin, as they are respected by the historic agricultural activity.

9. Archiving

9.1. MS maintains an in-house digital archive, which is based on Schmidt and Ernenwein (2013). This stores the collected measurements, minimally processed data, georeferenced and un-georeferenced images, XY traces and a copy of the final report.

9.2. MS contributes reports to the ADS Grey Literature Library upon permission from the client, subject to the any dictated time embargoes.

10. Copyright

10.1. Copyright and the intellectual property pertaining to all reports, figures, and datasets produced by Magnitude Services Ltd. is retained by MS. The client is given full licence to use such material for their own purposes. Permission must be sought by any third party wishing to use or reproduce any IP owned by MS.

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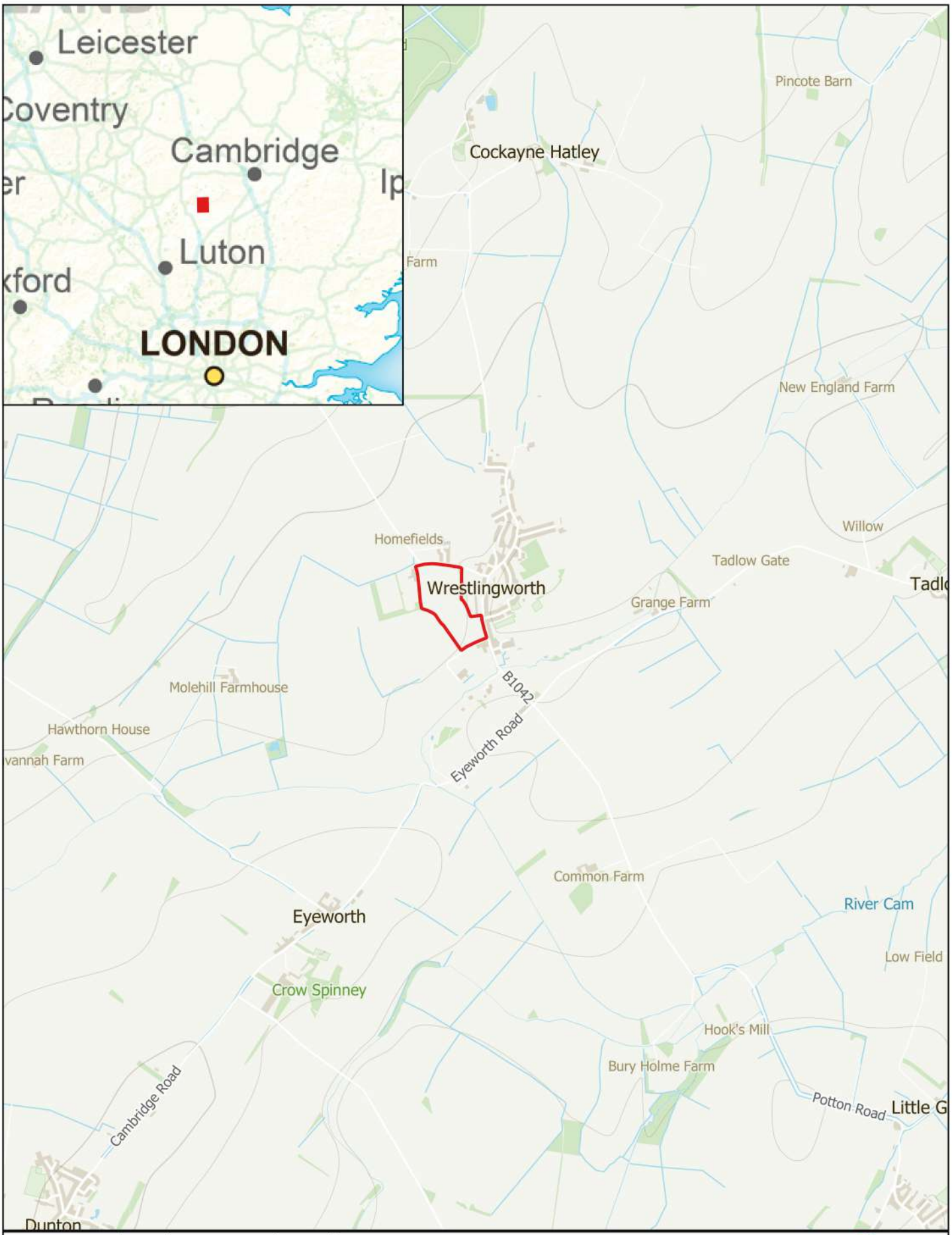


MSTL542 - Land at High Street, Wrestlingworth
Figure 1 - Site Location
1:25,000 @ A4

Site Boundary

N

0 0.5 1 km

magnitude surveys

525000

526000

Homefields

Victoria Close

Braggs Lane

Butcher's Lane

High Street

Church Lane

Area 1

Wrestlingworth

St Peter's Church

Wrestlingworth Church Of England (Voluntary Controlled) Lower School

Play Space

Area 2

B1042

Water End

247000

247000

MSTL542 - Land at High Street, Wrestlingworth
Figure 2 - Location of Survey Areas
1:4,000 @ A3

Survey Extents

Unsurveyable Area

N

0 100 200 300 m

magnitude surveys

247500

247250

Wrestlingworth

B1042

Church Lane

525750

525750

Area 2

Area 1

Water End

525500

525500

MSTL542 - Land at High Street, Wrestlingworth
Figure 3 - Magnetic Total Field Lower Sensor
1:1,500 @ A3

-48,997 nT 49,005

N

0 50 100 150 m

magnitude surveys

247500

247250

Wrestlingworth

B1042

Church Lane

525750

525750

Area 2

Area 1

Water End

525500

525500

MSTL542 - Land at High Street, Wrestlingworth
Figure 4 - Magnetic Gradient
1:1,500 @ A3

-1 nT 2

N

0 50 100 150 m

magnitude surveys

247500

247250

Wrestlingworth

B1042

Church Lane

Water End

525750

525750

525500

525500

1a

1b

1c

1d

1e

1f

1g

1h

1i

2a

2b

2c

2d

2e

2f

2g

2h

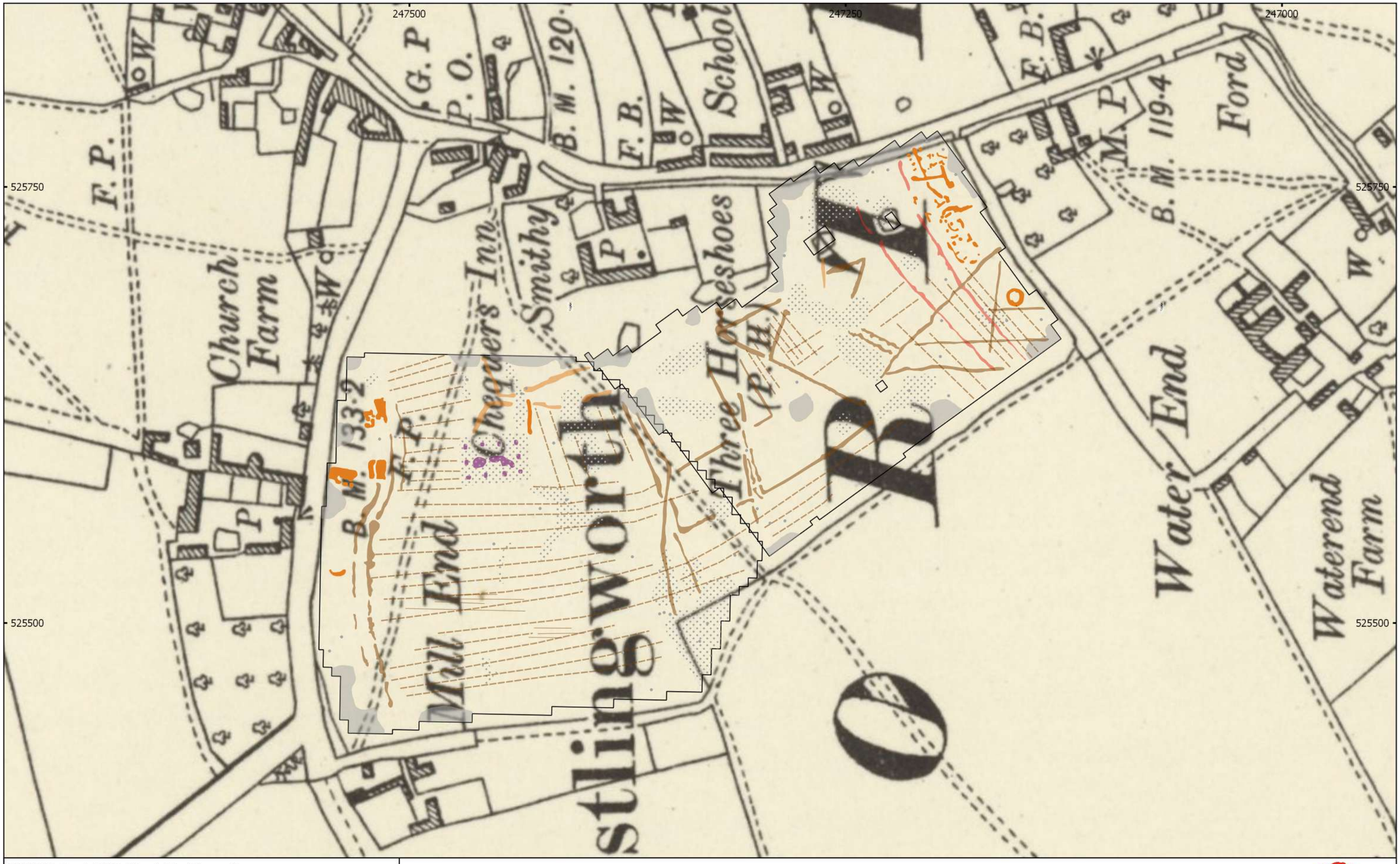
MSTL542 - Land at High Street, Wrestlingworth
Figure 5 - Magnetic Interpretation
1:1,500 @ A3

- Agricultural (Trend)
- Ridge and Furrow (Trend)
- Agricultural (Weak)
- Archaeology Possible (Strong)
- Archaeology Possible (Weak)
- Archaeology Probable (Weak)
- Magnetic Disturbance
- Ferrous/Debris (Spread)
- Modern
- Ferrous Point

N

0 50 100 150 m

magnitude surveys



MSTL542 - Land at High Street, Wrestlingworth
Figure 6 - Magnetic Interpretation Over Historic Maps
1:2,000 @ A3

Contains historic maps: Ordnance Survey, 6" 2nd edition c. 1882-1913 © National Library of Scotland

- Agricultural (Trend)
- Ridge and Furrow (Trend)
- Agricultural (Weak)
- Archaeology Possible (Strong)
- Archaeology Possible (Weak)
- Archaeology Probable (Weak)
- Magnetic Disturbance
- Ferrous/Debris (Spread)
- Modern
- Ferrous Point

N

0 50 100 150 m

magnitude surveys

247500

247250

Wrestlingworth

B1042

Church Lane

Water End

525750

525750

525500

525500

MSTL542 - Land at High Street, Wrestlingworth
Figure 7 - XY Trace Plot
30nT/cm at 1:1,500 @ A3

N

0 50 100 150 m

magnitude surveys

247500

247250

Wrestlingworth

B1042

Church Lane

Water End

525750

525750

525500

525500

MSTL542 - Land at High Street, Wrestlingworth
Figure 8 - Magnetic Interpretation over Earthwork Survey
1:1,500 @ A3

- Agricultural (Trend)
- Ridge and Furrow (Trend)
- Agricultural (Weak)
- Archaeology Possible (Strong)
- Archaeology Possible (Weak)
- Archaeology Probable (Weak)
- Magnetic Disturbance
- Ferrous/Debris (Spread)
- Modern
- Ferrous Point

N

0 50 100 150 m

magnitude surveys