Geophysical Survey Report

of

Melton, Suffolk

For

Christchurch Property Company Limited

Magnitude Surveys Ref: MSTM671

OASIS Reference: magnitud1-516429

HER Event Number: MTN109

June 2023

Unit 17, Commerce Court

Challenge Way

Bradford

BD4 8NW

01274 926020

info@magnitudesurveys.co.uk

Report By:

Leanne Swinbank BA ACIfA

Report Approved By:

Dr Paul S. Johnson BA MA PhD

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Abstract

Magnitude Surveys was commissioned to assess the subsurface archaeological potential of a c. 5.7ha area of land at Melton, Suffolk. A fluxgate gradiometer survey was successfully completed across the survey area. The geophysical survey has primarily detected anomalies related to the agricultural use of the survey area as well as anomalies reflecting natural variations. No anomalies suggestive of significant archaeological features have been identified. Anomalies related to agricultural use have been detected and interpreted as current and former plough directions and a former historic trackway. Natural variations have been identified as textural variation across the dataset due to the interface between underlying geologies. Topographic changes have also produced anomalies with natural origins suggesting they may be the result of colluvial processes. The impact of modern activity on the results in generally minimal detected as magnetic disturbance at the perimeters of the survey area.

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1. Introduction

1.1. Magnitude Surveys Ltd (MS) was commissioned by RPS on behalf of Christchurch Property Company Limited to undertake a geophysical survey on a c.5.7ha area of land at Melton, Suffolk (TM 28646 51337).

1.2. The geophysical survey comprised hand-carried 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. The survey was conducted in line with a WSI produced by MS (2020).

1.5. The survey commenced on 18 May 2020 and was completed the same day.

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. The directors of MS are involved in the cutting edge of research and the development of guidance/policy. Specifically, Dr. Chrys Harris has a PhD in archaeological geophysics from the University of Bradford, is a Member of CIfA and is the Vice-Chair of the International Society for Archaeological Prospection (ISAP); Finnegan Pope-Carter has an MSc in archaeological geophysics and is a Fellow of the London Geological Society, as well as a member of GeoSIG (CIfA Geophysics Special Interest Group); Dr. Kayt Armstrong has a PhD in archaeological geophysics from Bournemouth University, is a Member of CIfA, the Editor of ISAP News, and is the UK Management Committee representative for the COST Action SAGA; Dr. Paul Johnson has a PhD in archaeology from the University of Southampton, has been a member of the ISAP Management Committee since 2015, and is currently the nominated representative for the EAA Archaeological Prospection Community to the board of the European Archaeological Association.

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 survey area was located c.960m north-northeast of Melton, Suffolk (Figure 1). Survey was undertaken across a single field under a combination of arable and pasture land. The survey area was bounded by further fields and housing to the north, the B1438 to the east, housing and gardens to the south, and fields and St Audrys Road to the west (Figure 2).

4.2. Survey considerations:

Survey Area	Ground Conditions	Further Notes
1	Mostly flat area, with a topographic depression in the northeast. The majority of the area was cultivated into unplanted potato furrows, and some grassland in the northeast, though it was evident the grassland had also been previously cultivated. The ridge dividing the two sections prevented a small section of survey as did a group of trees in the southeast.	Bounded by hedges and a public footpath to the north; by hedges and adjacent roads to the east and south; the field continued to the west. A ridge divided the northeast grass section of the field from the arable land. Survey traverses could not always directly follow in line with the potato furrows which may have caused some streaks in the data.

4.3. The underlying geology comprises sand of the Crag formation. Superficial deposits comprise diamicton of the Lowestoft formation and sand and gravel of the Lowestoft formation in the southeast (British Geological Survey, 2020).

4.4. The soils consist slightly acid loamy and clayey soils with impeded drainage across the majority of the site, and freely draining slightly acid sandy soils in the northeast corner (Soilscapes, 2020).

5. Archaeological Background

5.1. The following section summarises the archaeological background of the survey area and the surrounding area (1km radius) following a search of Heritage Gateway (2020).

5.2. Prehistoric activity has been recorded in the form of numerous findspots of flint scatters, burnt flints, flakes and lithic scatters the majority of which have not been dated to a specific prehistoric period; these findspots are located c.400m- 800m around the survey area (MSF10525, MSF10523, MSF10515, MSF10516, MSF10520). However, a lithic scatter c. 580m southeast of the survey has been dated to the Neolithic period (MSF10517).

5.3. Iron Age activity has been recorded in the form of an Iron Age gold stater coin findspot (MDF20177) c. 530m west of the survey area, and flint-gritted pottery (MSF10518) c.730m to the southeast. Roman activity is limited to Roman metal finds (MSF3528) which were not in-situ on an allotment c. 680m east of the survey area; Roman pottery scatter (MSF10510) located c. 670m east, and a Roman coin findspot (MSF3526) c. 1km to the east.

5.4. Evidence of Saxon activity includes inhumation burials (390149) located c.800m northeast of the survey area, and an amulet (MSF16299) found at St Andrews church c.980m east of the survey area. The core of medieval Melton (MSF25767) was located 500m south of the survey area and numerous findspots of medieval pottery have been recorded within and around Melton (MSF10524, MSF10521, MSF10522), some of which has been dated to the 13th-14th century (MSF10530).

5.5. A post-medieval cemetery is located just 150m west of the survey area which is now disused (MSF10503).

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 hand-carried GNSS-positioned system.

6.1.3.1. MS' hand-carried 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 upper and/or 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 7). 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 (2020) 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 satellite imagery and historic maps (Figure 6).

7.2.2. The fluxgate gradiometer survey has generally responded well to the environment of the survey area; however, the presence of deep potato furrows has produced faint data artefacts evident as streaking within the dataset, the most significant of these has been digitised and categorised as “Data Artefact” (Figure 5). No anomalies suggestive of significant archaeological activity have been detected. The geophysical survey has primarily detected agricultural activity as well as natural variations. The natural variations are reflective of topographic change, and the interfaces between the sand of the Crag formation and the Lowestoft formation (see section 4.3), due to the different levels of iron oxides within the deposits. The impact of modern activity is present as magnetic disturbance at the perimeters of the survey area related to adjacent fencing.

7.2.3. Agricultural activity has been identified in the form of two directions of ploughing, both considered to be relatively modern in origin, and areas of repeated tractor movement which cuts across these ploughing regimes. A former historic trackway has also been detected.

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. **Agricultural** – A linear anomaly has been detected crossing the southern half of the survey area on east-west alignment, this is most visible within the total field dataset (Figure 3). The linear anomaly is abutted by two diagonally aligned anomalies with similar levels of weak magnetic enhancement (Figure 5). These anomalies do not correspond with any features recorded on available historic maps, however they do correspond with a possible trackway visible on 1945 aerial photography (Google Earth, 2020). At least two directions of cultivation have been identified in the magnetic dataset, one aligned northeast to southwest corresponds with the current ploughing regime; the northwest to southeast ploughing regime is also likely modern in origin as indicated by satellite images from 2007 (Google Earth, 2020). Evidence of repeated tractor movement has been detected at the perimeter of the field, as well as separating what was grassland at the time of survey (in the northeast, see section 4.2) from the arable area.

7.3.2.2. **Natural** – Broad amorphous anomalies in the north of the survey area correspond with a topography depression (see section 4.2), as well as differential drainage visible on satellite imagery (Figure 6). These broad positively magnetically enhanced anomalies may be the result of colluvial processes. The magnetic data also has clear textual shifts visible within the magnetic background. The recorded geology of the area being a combination of Crag formations sand (which is relatively enhanced due to the presence of iron oxides), and Lowestoft formation sands and gravels (which are generally more chalk-based) explains the mottled and varying levels of background enhancement.

8. Conclusions

8.1. A fluxgate gradiometer survey has successfully been undertaken across the survey area. No anomalies suggestive of significant archaeological features were identified. The geophysical survey has detected anomalies of agricultural and natural origin. The underlying geology of sand of the Crag formation and superficial geology of the Lowestoft formation has created textual variation across the dataset due to the varying levels of iron oxides producing varying magnetic enhancement. Topographic changes in the north have also produced anomalies with natural origins possibly the result of colluvial processes. Modern activity has not significantly impacted the survey area being limited to magnetic disturbance related to perimeter fencing.

8.2. Agricultural activity has been detected in the form of ploughing regimes, repeated tractor movement, and a former historic trackway which once divided the field.

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.

11. References

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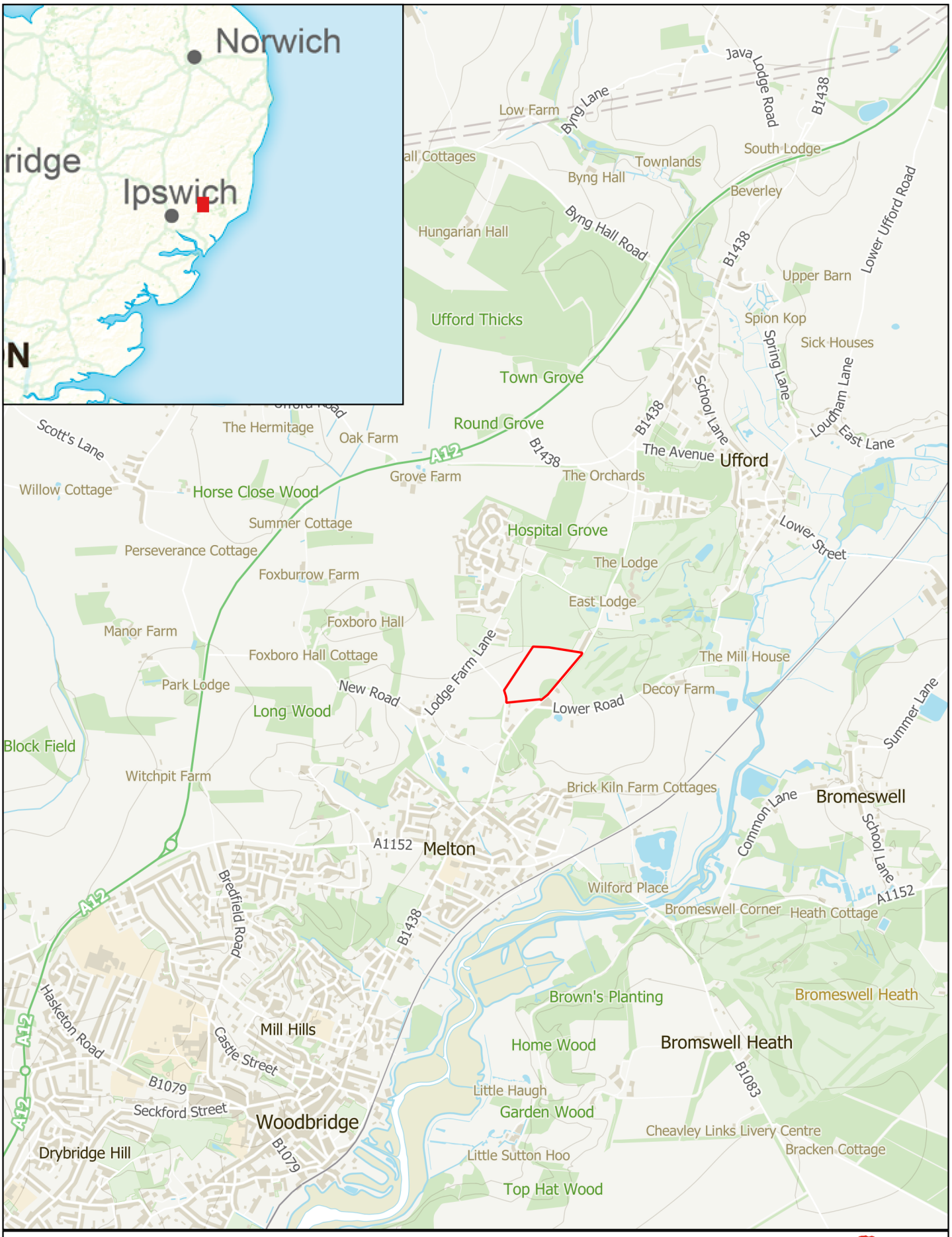
12. Project Metadata

MS Job Code	MSTM671
Project Name	Melton, Suffolk
Client	RPS
Grid Reference	TM 28646 51337
Survey Techniques	Magnetometry
Survey Size (ha)	5.7
Survey Dates	18/05/2020
Project Lead	Julia Cantarano Ingénieur PCIfA
Project Officer	N/A
HER Event No	MTN109
OASIS No	magnitud1-516429
S42 Licence No	N/A
Report Version	1.1

13. Document History

Version	Comments	Author	Checked By	Date
0.1	Initial draft for Project Lead to Review	LS	JC	20 May 2020
0.2	Incorporation of line manager comments	LS	PSJ	26 May 2020
1.0	Adding Client Name and Issuing as Final	N/A	JC	27 May 2020
1.1	Adding HER Event Number and OASIS Record	KD	KD	06 June 2023



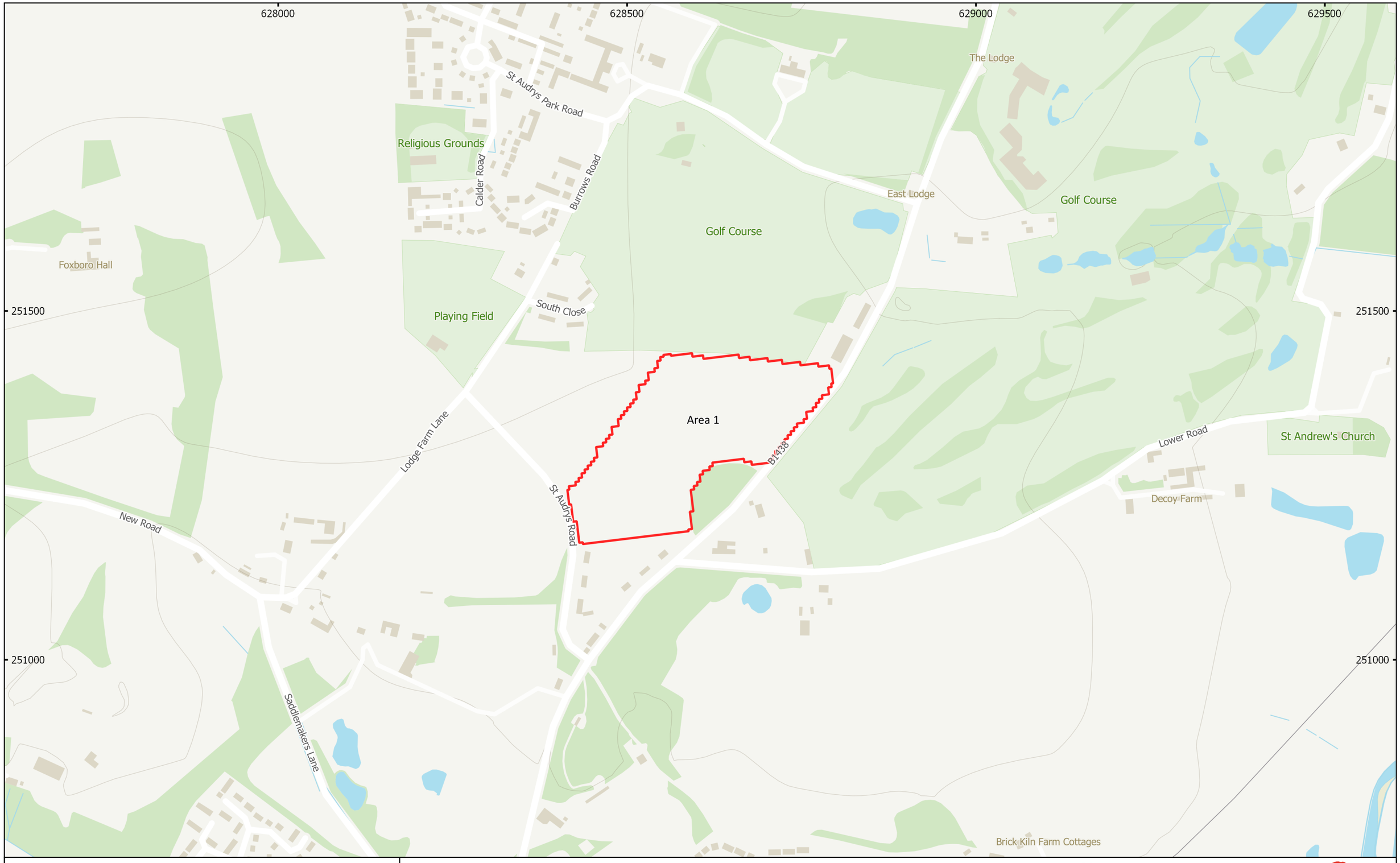
MSTM671 - Melton, Suffolk
Figure 1 - Site Location
1:25,000 @ A4

N

0 0.5 1 km

Site Boundary

magnitude surveys



MSTM671 - Melton, Suffolk
Figure 2 - Location of Survey Area
1:5,000 @ A3

Survey Extent

N

0 100 200 300 m

magnitude surveys

628400
628600
628800
251400
251200
Lodge Farm Lane
St Audrys Road
B1438
Lower Road
Area 1

MSTM671 - Melton, Suffolk
Figure 3 - Magnetic Total Field
1:1,500 @ A3

48,997 nT 49,005

N

0 25 50 75 m

magnitude surveys

628400
628600
628800
251400
251400
251200
251200
Lodge Farm Lane
St Audrys Road
B1438
Lower Road
Area 1

MSTM671 - Melton, Suffolk
Figure 4 - Magnetic Gradient
1:1,500 @ A3

-1 nT 2

N

0 25 50 75 m

magnitude surveys

628400
628600
628800
251400
251200
Lodge Farm Lane
St Audry's Road
B1438
Lower Road
Area 1

MSTM671 - Melton, Suffolk
Figure 5 - Magnetic Interpretation
1:1,500 @ A3

Agricultural (Weak)
Natural (Strong)
Natural (Weak)
Natural (Zone)
Magnetic Disturbance
Data Artefact
Agricultural (Trend)
Natural (Trend)
Ferrous Spike

N

0 25 50 75 m

magnitude surveys

628000 628200 628400 628600 628800 629000

251600 251400 251200 251000

Area 1

South Lodge
East Lodge
Block's Barn
Sand Pi
Upper Melton
Terrace
Lodge Farm
Rectory
The Lodge
B.M. 77.16
Lodge
P
74
83
92
80

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Figure 6 - Magnetic Interpretation over Satellite Imagery and Historic Maps
1:3,000 @ A3

Agricultural (Weak)
Natural (Strong)
Natural (Weak)
Natural (Zone)
Magnetic Disturbance
Data Artefact
Agricultural (Trend)
Natural (Trend)
Ferrous Spike

N

0 50 100 150 m

magnitude surveys

628400
628600
628800
251400
251400
Area 1
Lodge Farm Lane
St Audry's Road
B1438
Lower Road
251200
251200

MSTM671 - Melton, Suffolk
Figure 7 - XY Trace Plot
30nT/cm at 1:1,500 @ A3

N

0 25 50 75 m

magnitude surveys