BRLS20

LAND SOUTH OF LOWER STONDON, BEDFORDSHIRE

GEOPHYSICAL SURVEY REPORT

commissioned by Rainier Developments Ltd

April 2020

HEADLAND ARCHAEOLOGY

REGISTERED ORGANISATION CIfA

LAND SOUTH OF LOWER STONDON, BEDFORDSHIRE

GEOPHYSICAL SURVEY REPORT

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This report adheres to the quality standard of ISO 9001:2015

PROJECT INFO:

HA Project Code **BRLS20** / NGR **TL 1668 3474** / Parish **Stondon** / Local Authority **Central Bedforshire** / OASIS Ref. **headland5-391481**

PROJECT TEAM:

Project Manager **David Harrison** / Author **David Harrison** / Fieldwork **Peter Heykoop, Ross Bishop** / Graphics **Julia Bastek-Michalska, Rafael Maya Torcelly, Sam Harrison**

Approved by **David Harrison** D Harrison.....

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part of the RSK Group

REGISTERED ORGANISATION CIfA

PROJECT SUMMARY

Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey of a 5 hectare site on land south of Lower Stondon, to inform planning proposals for a new residential development. No anomalies of clear archaeological potential have been identified. The survey has detected several dipolar anomalies consistent with modern activity including a twentieth century farm track and adjacent small structure, two buried service pipes and extant telegraph poles. Two small and localised areas of high magnitude anomalies have been identified which may be due to archaeological activity such as pits and spreads of enhanced material but, in the absence of any coherent archaeological pattern, these are assessed as of low archaeological potential. Elsewhere, on the basis of the geophysical survey, the site is assessed as having very low archaeological potential, corroborating the results of the Archaeological and Heritage Assessment (EDP forthcoming).

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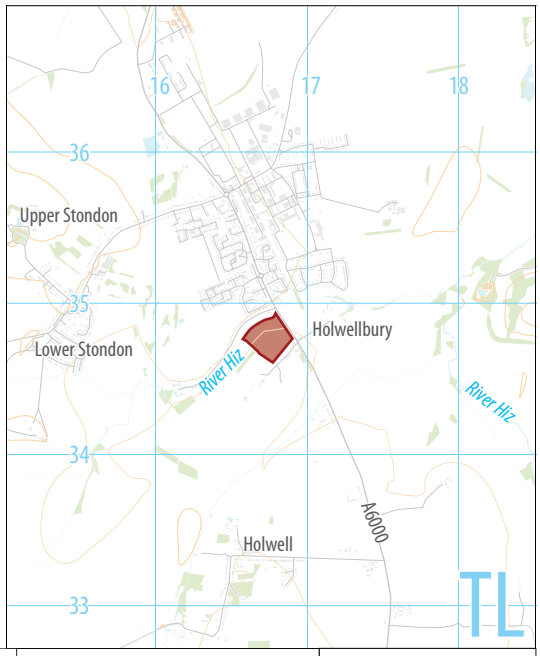
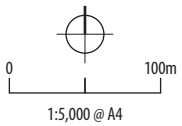
Land south of Lower Stondon
Bedfordshire





proposed development area

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ILLUS 1 Site location

LAND SOUTH OF LOWER STONDON, BEDFORDSHIRE

GEOPHYSICAL SURVEY REPORT

1 INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned by Rainier Developments Ltd (the Client), to undertake a geophysical (magnetometer) survey on land south of Lower Stondon to inform planning proposals for a new residential development. The results of the survey will inform future archaeological strategy at the site., if required.

The survey was undertaken in order to assess the impact of the proposed development on the historic environment. It was undertaken in accordance with an Archaeological Written Scheme of Investigation (WSI) (Harrison 2020), which was submitted to and approved by Martin Oake (Development Archaeologist at Central Bedfordshire Council), with guidance within the National Planning Policy Framework (MHCLG 2019) and in line with current best practice (Chartered Institute for Archaeologists 2014, Europae Archaeologia Consilium 2016).

1.1 SITE LOCATION, TOPOGRAPHY AND LAND-USE

The Proposed Development Area (PDA) comprises a single sub-square block of land on the south-eastern periphery of Lower Stondon, centred on TL 1668 3474 (Illus. 1). It is bounded to east by the A600 Bedford Road, to the north by a brook, to the south by hedgerows and is open to farmland to the west.

The PDA is sited on a gentle north facing gradient being at between 55m Above Ordnance Datum (AOD) in the south and 46m AOD in the north. At the time of the survey, the field had been recently drilled (Illus 2).

The survey was carried out on the 27th March 2020.

1.2 GEOLOGY AND SOILS

The bedrock geology comprises Woburn Sands Formation (sandstone) and is overlain by Lowestoft Formation (diamicton) (NERC 2019).

The soil is classified in the Soilscape 9 Association, characterised as lime-rich loams and clays with impeded drainage (Cranfield University 2019).

2 ARCHAEOLOGICAL BACKGROUND

An Archaeological and Heritage Assessment (EDP forthcoming) has established that the PDA has

> *'a low potential to contain archaeological remains from any period, other than 'negligible' value remains related to medieval and later farming practices.'*

3 AIMS, METHODOLOGY AND PRESENTATION

The general aim of the geophysical survey was to provide enough information to establish the presence/absence, character and extent of any archaeological remains within the PDA. This will therefore enable an assessment to be made of the impact of the proposed development on any sub-surface archaeological remains, if present.

ILLUS 2 PDA, looking north-west

The specific archaeological objectives of the geophysical survey were:

- to gather enough information to inform the extent, condition, character and date (as far as circumstances permit) of any archaeological features and deposits within the PDA;
- to obtain information that will contribute to an evaluation of the significance of the scheme upon cultural heritage assets; and
- to prepare a report summarising the results of the survey.

3.1 MAGNETOMETER SURVEY

Magnetic survey methods rely on the ability of a variety of instruments to measure very small magnetic fields associated with buried archaeological remains. A feature such as a ditch, pit or kiln can act like a small magnet, or series of magnets, that produce distortions (anomalies) in the earth's magnetic field. In mapping these slight variations, detailed plans of sites can be obtained as buried features often produce reasonably characteristic anomaly shapes and strengths (Gaffney & Gater 2003). Further information on soil magnetism and the interpretation of magnetic anomalies is provided in Appendix 1.

The survey was undertaken using four Bartington Grad601 sensors mounted at 1m intervals (1m traverse interval) onto a rigid carrying frame. The system was programmed to take readings at a frequency of 10Hz (allowing for a 10–15cm sample interval) on roaming traverses (swaths) 4m apart. These readings were stored on an external weatherproof laptop and later downloaded for processing and interpretation. The system was linked to a Trimble R8s Real Time Kinetic (RTK) differential Global Positioning System (dGPS) outputting in NMEA mode to ensure a high positional accuracy for each data point.

MLGrad601 and MultiGrad601 (Geomar Software Inc.) software was used to collect and export the data. Terrasurveyor V3.0.35.1 (DWConsulting) software was used to process and present the data.

3.2 REPORTING

A general site location plan is shown in Illus 1 at a scale of 1:5,000. Illus 2 is a site condition photograph. Illus 3 is a 1:1,500 survey location plan showing the direction of survey as GPS swaths. Large-scale, fully processed (greyscale) data, minimally processed data (XY trace plot) and an interpretative plot are presented at a scale of 1:1,500 in Illus 4 to Illus 6 inclusive.

Technical information on the equipment used, data processing and magnetic survey methodology is given in Appendix 1. Appendix 2 details the survey location information and Appendix 3 describes the composition and location of the site archive. Data processing details are presented in Appendix 4. A copy of the OASIS entry (Online Access to the Index of Archaeological Investigations) is reproduced in Appendix 5.

The survey methodology, report and any recommendations comply with the Written Scheme of Investigation (Harrison 2020), guidelines outlined by Europae Archaeologia Consilium (EAC 2016) and by the Chartered Institute for Archaeologists (ClfA 2014). All illustrations from Ordnance Survey (OS) mapping are reproduced with the permission of the controller of Her Majesty's Stationery Office (Ó Crown copyright).

The illustrations in this report have been produced following analysis of the data in 'raw' and processed formats and over a range of different display levels. All illustrations are presented to most suitably display and interpret the data from this site based on the experience and knowledge of management and reporting staff.

4 RESULTS AND DISCUSSION

Ground conditions were very good throughout the PDA contributing to a high standard of data collection. The survey has detected a moderate level of background magnetic variation which is characterised by frequent, evenly dispersed, discrete low magnitude anomalies. This is likely due to the depth and composition of the topsoil and the superficial deposits from which they derive. Against this background several anomalies have been identified and cross-referenced to specific examples on the interpretation figure (Illus 6), where appropriate.

4.1 FERROUS AND MODERN ANOMALIES

Ferrous anomalies, characterised as individual 'spikes', are typically caused by ferrous (magnetic) material, either on the ground surface or in the plough-soil. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as modern ferrous debris is common on most sites, often being present as a result of manuring or tipping/infilling. There is no obvious clustering to these ferrous anomalies which might indicate an archaeological origin. Far more probable is that the 'spike' responses are likely caused by the random distribution of ferrous debris in the upper soil horizons.

Isolated large spike anomalies (TP) within the centre of the dataset are due to the presence of telegraph poles carrying overhead lines.

A clear band of dipolar anomalies is identified aligned north-east/south-west across the centre of the PDA. The band of anomalies corresponds to a former farm track which is shown on the 1977 Ordnance Survey (OS) map. The anomalies are due to the remnants of the former track in the topsoil. Within the band of anomalies, a high magnitude dipolar linear anomaly (SP1) locates a buried service pipe on the same orientation. A second dipolar linear pipe anomaly (SP2) is identified on a north-west/south-east alignment just beyond the southern limit of the PDA.

On the south-eastern side of the former farm track a large spike (B1) corresponds to a small structure which is also depicted on the 1977 OS map and is probably due to the in situ foundations of a small farm building.

Magnetic disturbance around the field edges is due to ferrous material within, or adjacent to the boundaries and is of no archaeological interest.

4.2 AGRICULTURAL ANOMALIES

Low magnitude parallel linear trend anomalies, aligned north-west/south-east, and parallel with the surrounding field boundaries, are typical of modern ploughing.

Two linear trends in the south of the dataset, but beyond limit of the PDA, are characteristic of modern land drains with both likely to drain into SP2.

4.3 POSSIBLE ARCHAEOLOGICAL ANOMALIES

Two small and localised clusters of high magnitude anomalies (relative to the magnetic background) have been identified in the north and the south corners of the PDA. These anomalies could conceivably be archaeological in origin, perhaps being due to pits and spreads of enhanced material. However, no coherent pattern is discernible, and, in the absence of any other supporting evidence, these anomalies are assessed as of low archaeological potential. A geological origin is considered equally plausible.

5 CONCLUSION

The survey has successfully evaluated the geophysical survey area and has not identified any anomalies of clear archaeological potential. Several dipolar anomalies have been detected which are consistent with modern activity including a twentieth century farm track and adjacent small structure, two buried service pipes and extant telegraph poles. Two small and localised areas of high magnitude anomalies have been identified which may be due to archaeological activity such as pits and spreads of enhanced material but, in the absence of any coherent archaeological pattern, these are assessed as of low archaeological potential. Elsewhere, on the basis of the geophysical survey, the site is assessed as of very low archaeological potential, corroborating the results of the Archaeological and Heritage Assessment (EDP forthcoming).

6 REFERENCES

Chartered Institute for Archaeologists (CIfA) 2014 ***Standard and guidance for archaeological geophysical survey*** (Reading) http://www.archaeologists.net/sites/default/files/CIfAS%26GGeophysics_2.pdf accessed 31 March 2020

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Natural Environment Research Council (NERC) 2018 ***British Geological Survey*** http://www.bgs.ac.uk/ accessed 31 March 2020

proposed development area
GPS swaths
location and direction of ILLUS 2

0 50m
1:1,500 @ A3

PROJECT BRLS20
Land south of Lower Stondon
Central Bedfordshire

CLIENT Rainier Developments Ltd

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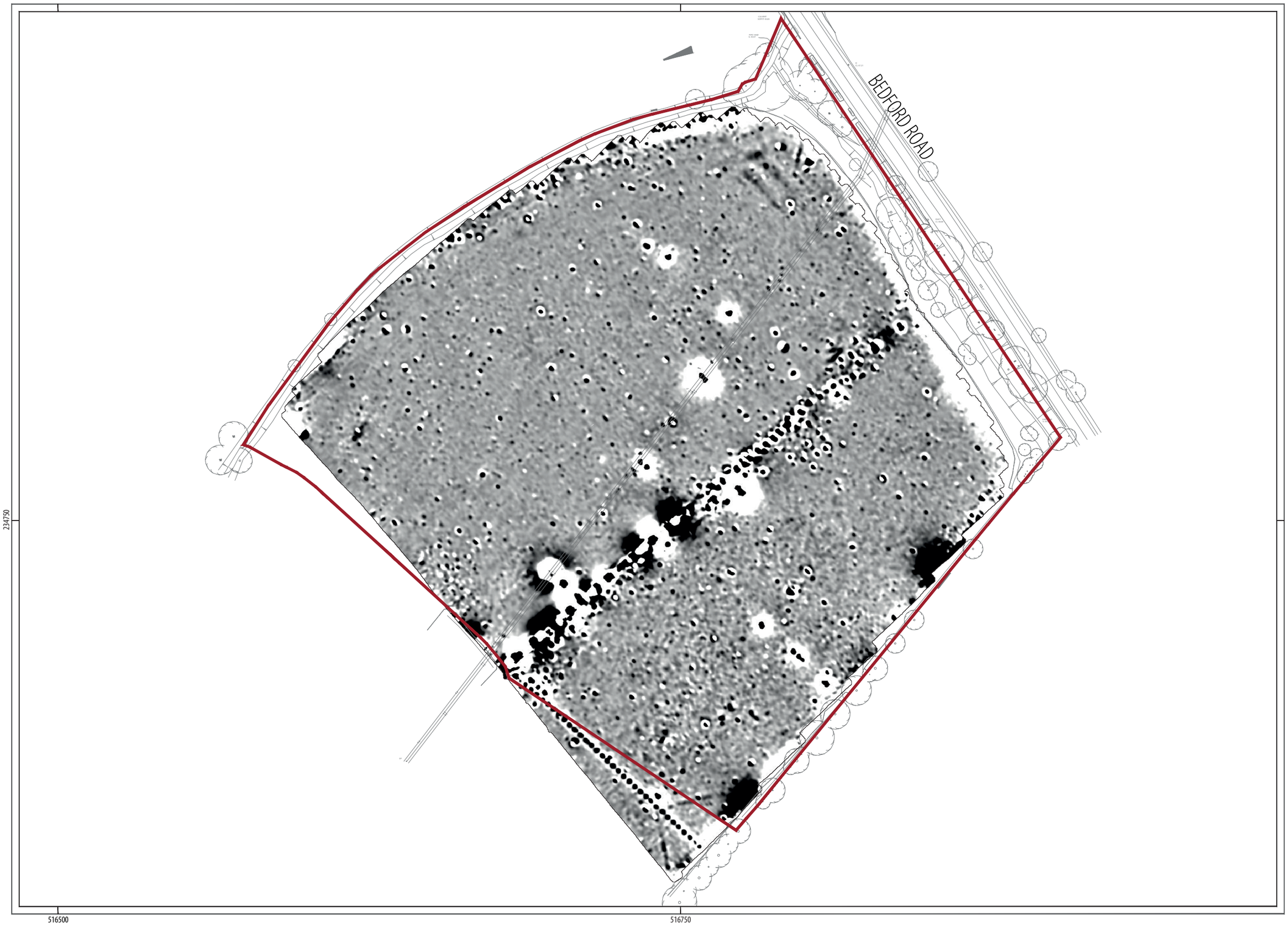
ILLUS 3 Survey location showing GPS swaths (1:1,500)



proposed development area

nT
-1.0
2.0

0
50m
1:1,500 @ A3

PROJECT BRLS20
Land south of Lower Stondon
Central Bedfordshire

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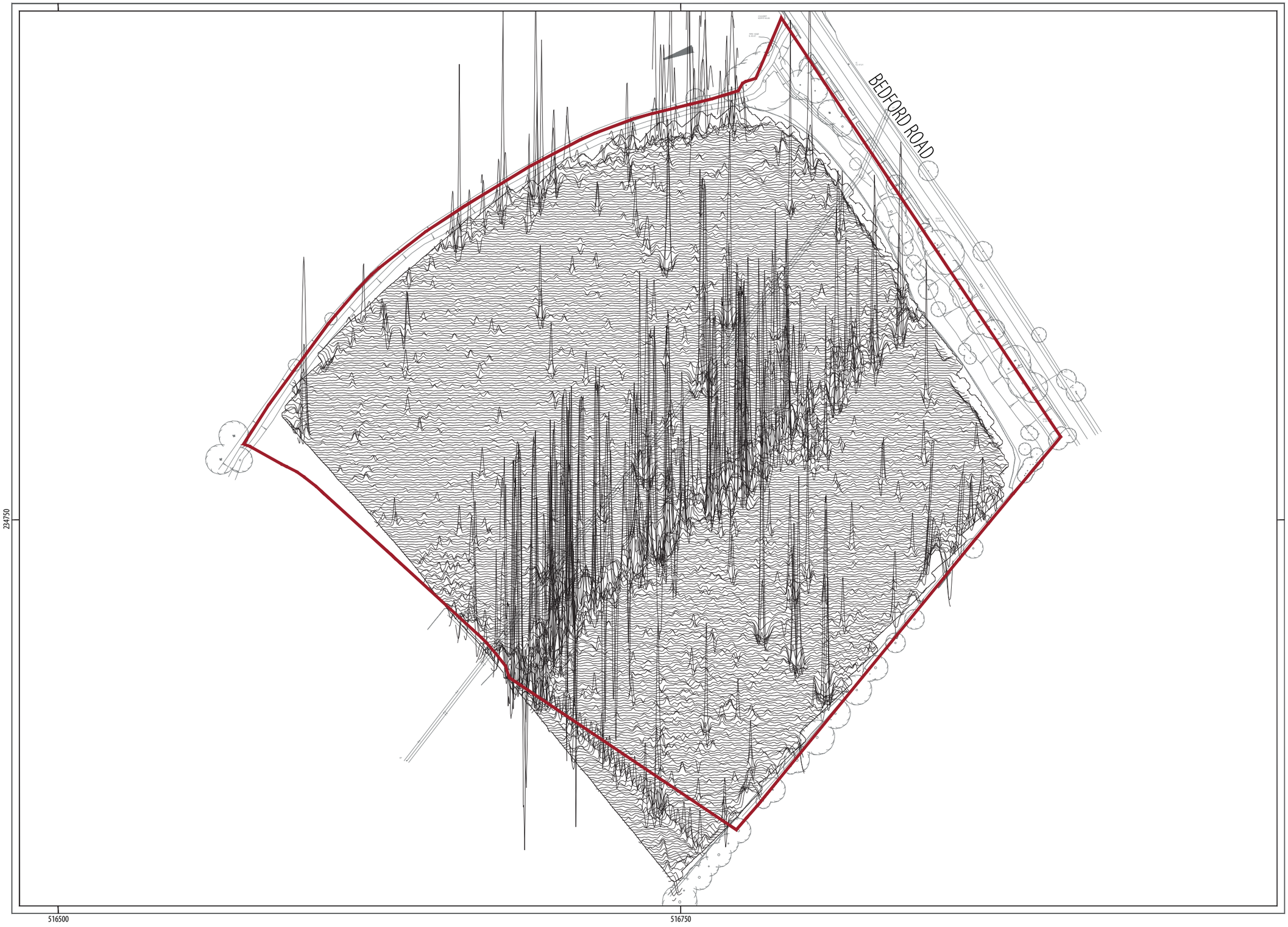
ILLUS 4 Processed greyscale magnetometer data (1:1,500)



proposed development area

25.0nT/cm

0 50m

1:1,500 @ A3

PROJECT BRLS20
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ILLUS 5 XY trace plot of minimally processed magnetometer data (1:1,500)

proposed development area

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
dipolar linear	service pipe
magnetic disturbance	former building
linear trend	agricultural
linear trend	field drain
magnetic enhancement	archaeology?/geology

ABBREVIATIONS

B building
SP service pipe
TP telegraph pole

0 50m
1:1,500 @ A3

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ILLUS 6 Interpretation of magnetometer data (1:1,500)

7 APPENDICES

APPENDIX 1 MAGNETOMETER SURVEY

Magnetic susceptibility and soil magnetism

Iron makes up about 6% of the earth's crust and is mostly present in soils and rocks as minerals such as maghaemite and haematite. These minerals have a weak, measurable magnetic property termed magnetic susceptibility. Human activities can redistribute these minerals and change (enhance) others into more magnetic forms so that by measuring the magnetic susceptibility of the topsoil, areas where human occupation or settlement has occurred can be identified by virtue of the attendant increase (enhancement) in magnetic susceptibility. If the enhanced material subsequently comes to fill features, such as ditches or pits, localised isolated and linear magnetic anomalies can result whose presence can be detected by a magnetometer (fluxgate gradiometer).

In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of topsoils, subsoils and rocks into which these features have been cut, which causes the most recognisable responses. This is primarily because there is a tendency for magnetic ferrous compounds to become concentrated in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected.

The magnetic susceptibility of a soil can also be enhanced by the application of heat. This effect can lead to the detection of features such as hearths, kilns or areas of burning.

Types of magnetic anomaly

In the majority of instances anomalies are termed 'positive'. This means that they have a positive magnetic value relative to the magnetic background on any given site. However some features can manifest themselves as 'negative' anomalies that, conversely, means that the response is negative relative to the mean magnetic background.

Where it is not possible to give a probable cause of an observed anomaly a '?' is appended.

It should be noted that anomalies interpreted as modern in origin might be caused by features that are present in the topsoil or upper layers of the subsoil. Removal of soil to an archaeological or natural layer can therefore remove the feature causing the anomaly.

The types of response mentioned above can be divided into five main categories that are used in the graphical interpretation of the magnetic data:

Isolated dipolar anomalies (iron spikes) [h5] These responses are typically caused by ferrous material either on the surface or in the topsoil. They cause a rapid variation in the magnetic response giving a characteristic 'spiky' trace. Although ferrous archaeological artefacts could produce this type of response, unless there is supporting evidence for an archaeological interpretation, little emphasis is normally given to such anomalies, as modern ferrous objects are common on rural sites, often being present as a consequence of manuring.

Areas of magnetic disturbance [h5] These responses can have several causes often being associated with burnt material, such as slag waste or brick rubble or other strongly magnetised/fired material. Ferrous structures such as pylons, mesh or barbed wire fencing and buried pipes can also cause the same disturbed response. A modern origin is usually assumed unless there is other supporting information.

Lightning-induced remnant magnetisation (LIRM) LIRM anomalies are thought to be caused in the near surface soil horizons by the flow of an electrical currents associated with lightning strikes. These observed anomalies have a strong bipolar signal which decreases with distance from the spike point and often appear as linear or radial in shape.

Linear trend [h5] This is usually a weak or broad linear anomaly of unknown cause or date. These anomalies are often caused by agricultural activity, either ploughing or land drains being a common cause.

Areas of magnetic enhancement/positive isolated anomalies [h5] Areas of enhanced response are characterised by a general increase in the magnetic background over a localised area whilst discrete anomalies are manifest by an increased response (sometimes only visible on an XY trace plot) on two or three successive traverses. In neither instance is there the intense dipolar response characteristic exhibited by an area of magnetic disturbance or of an 'iron spike' anomaly (see above). These anomalies can be caused by infilled discrete archaeological features such as pits or post-holes or by kilns. They can also be caused by pedological variations or by natural infilled features on certain geologies. Ferrous material in the subsoil can also give a similar response. It can often therefore be very difficult to establish an anthropogenic origin without intrusive investigation or other supporting information.

Linear and curvilinear anomalies [h5] Such anomalies have a variety of origins. They may be caused by agricultural practice (recent ploughing trends, earlier ridge and furrow regimes or land drains), natural geomorphological features such as palaeochannels or by infilled archaeological ditches.

APPENDIX 2 SURVEY LOCATION INFORMATION

An initial survey base station was established using a Trimble VRS differential Global Positioning System (dGPS). The magnetometer data was georeferenced using a Trimble RTK differential Global Positioning System (Trimble R8s model).

Temporary sight markers were laid out using a Trimble VRS differential Global Positioning System (Trimble R8s model) to guide the operator and ensure full coverage. The accuracy of this dGPS equipment is better than 0.01m.

The survey data were then super-imposed onto a base map provided by the client to produce the displayed block locations. However, it should be noted that Ordnance Survey positional accuracy for digital map data has an error of 0.5m for urban and floodplain areas, 1.0m for rural areas and 2.5m for mountain and moorland areas. This potential error must be considered if coordinates are measured off hard copies of the mapping rather than using the digital coordinates.

Headland Archaeology cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party.

APPENDIX 3 GEOPHYSICAL SURVEY ARCHIVE

The geophysical archive comprises an archive disk containing the raw data in XYZ format, a raster image of each greyscale plot with associate world file, and a PDF of the report.

The project will be archived in-house in accordance with recent good practice guidelines (http://guides.archaeologydataservice.ac.uk/g2gp/Geophysics_3). The data will be stored in an indexed archive and migrated to new formats when necessary.

APPENDIX 4 DATA PROCESSING

The gradiometer data has been presented in this report in processed greyscale and minimally processed XY trace plot format.

Data collected using RTK GPS-based methods cannot be produced without minimal processing of the data. The minimally processed data has been interpolated to project the data onto a regular grid and de-striped to correct for slight variations in instrument calibration drift and any other artificial data.

A high pass filter has been applied to the greyscale plots to remove low frequency anomalies (relating to survey tracks and modern agricultural features) in order to maximise the clarity and interpretability of the archaeological anomalies.

The data has also been clipped to remove extreme values and to improve data contrast.

APPENDIX 5 OASIS DATA COLLECTION FORM: ENGLAND

OASIS ID: headland5-391481

PROJECT DETAILS	
Project name	Land south of Lower Stondon, Bedfordshire
Short description of the project	Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey of a 5 hectare site on land south of Lower Stondon, to inform planning proposals for a new residential development. No anomalies of clear archaeological potential have been identified. The survey has detected several dipolar anomalies consistent with modern activity including a twentieth century farm track and adjacent small structure, two buried service pipes and extant telegraph poles. Two small and localised areas of high magnitude anomalies have been identified which may be due to archaeological activity such as pits and spreads of enhanced material but, in the absence of any coherent archaeological pattern, these are assessed as of low archaeological potential. Elsewhere, on the basis of the geophysical survey, the site is assessed as having very low archaeological potential, corroborating the results of the Archaeological and Heritage Assessment (EDP forthcoming).
Project dates	Start: 27-03-2020 End: 27-03-2020
Previous/future work	No / Not known
Any associated project reference codes	BRLS20 - Contracting Unit No
Type of project	Field evaluation
Site status	None
Monument type	N/A None
Monument type	N/A None
Significant Finds	N/A None
Significant Finds	N/A None
Methods & techniques	'Geophysical Survey'
Development type	Housing estate
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Pre-application
Solid geology (other)	Woburn Sands Formation
Drift geology	Boulder clay and morainic drift
Techniques	Magnetometry
PROJECT LOCATION	
Country	England
Site location	Bedfordshire Mid Bedfordshire Stondon, land south of Lower Stondon
Study area	5 hectares
Site coordinates	TL 1668 3474 51.998391772501–0.300214354815 51 59 54 N 000 18 00 W Point
PROJECT CREATORS	
Name of Organisation	Headland Archaeology
Project brief originator	The Environmental Dimension Partnership
Project design originator	Headland Archaeology
Project director/manager	Harrison, D
Project supervisor	Bishop, R
Type of sponsor/funding body	Developer
PROJECT ARCHIVES	
Physical Archive Exists?	No
Digital Archive recipient	In-house

Digital Contents	'other'
Digital Media available	'Geophysics'
Paper Archive Exists?	No

PROJECT BIBLIOGRAPHY 1

Publication type	Grey literature (unpublished document/manuscript)
Title	Land south of Lower Stondon, Bedfordshire; Geophysical Survey Report
Author(s)/Editor(s)	Harrison, D
Date	2020
Issuer or publisher	Headland Archaeology
Place of issue or publication	Leeds
Description	PDF[A]
Entered by	David Harrison (david.harrison@headlandarchaeology.com)
Entered on	7 April 2020

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