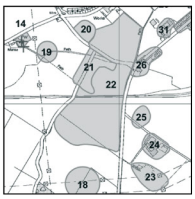
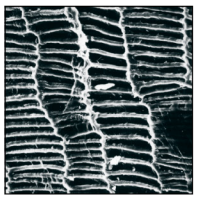
BSFW19










BISHAMPTON SOLAR FARM, BISHAMPTON, WORCESTERSHIRE

GEOPHYSICAL SURVEY REPORT

PLANNING REF. 19/01287/PA

commissioned by Dulas Ltd

March 2020

HEADLAND ARCHAEOLOGY

REGISTERED ORGANISATION CIfA

BISHAMPTON SOLAR FARM, BISHAMPTON, WORCESTERSHIRE

GEOPHYSICAL SURVEY REPORT

PLANNING REF. 19/01287/PA

commissioned by Dulas Ltd

March 2020

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

PROJECT INFO:

HA Project Code **BSFW19** / NGR **SP 0015 5106** / Parish **Bishampton** / Local Authority **Wychavon District Council** / OASIS Ref. **headland5-388185**

PROJECT TEAM:

Project Manager **David Harrison** / Author **David Harrison** / Fieldwork **Ben Tipton, Glyn Sheldrick, Michail-Athanasios Kaikas, Richard McGregor Edwards** / Graphics **Beata Wieczorek-Oleksy, David Harrison, Eleanor Winter**

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

Headland Archaeology Yorkshire & North
Unit 16 | Hillside | Beeston Rd | Leeds LS11 8ND
t 0113 387 6430
e yorkshireandnorth@headlandarchaeology.com
w www.headlandarchaeology.com

HEADLAND ARCHAEOLOGY

part of the RSK Group

REGISTERED ORGANISATION CIfA

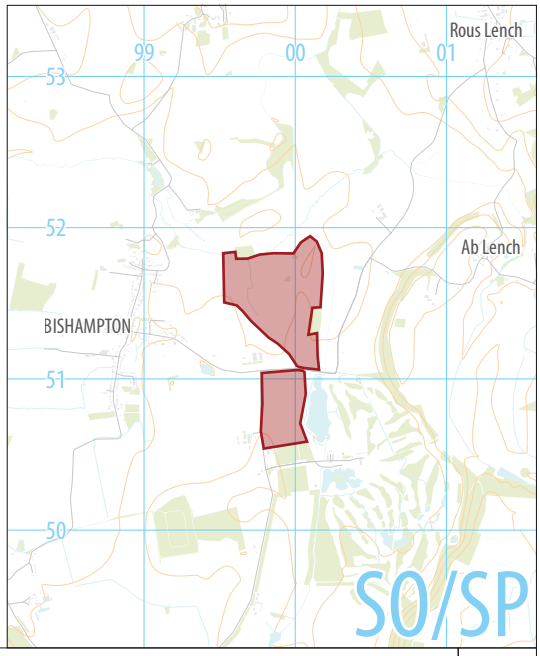
PROJECT SUMMARY

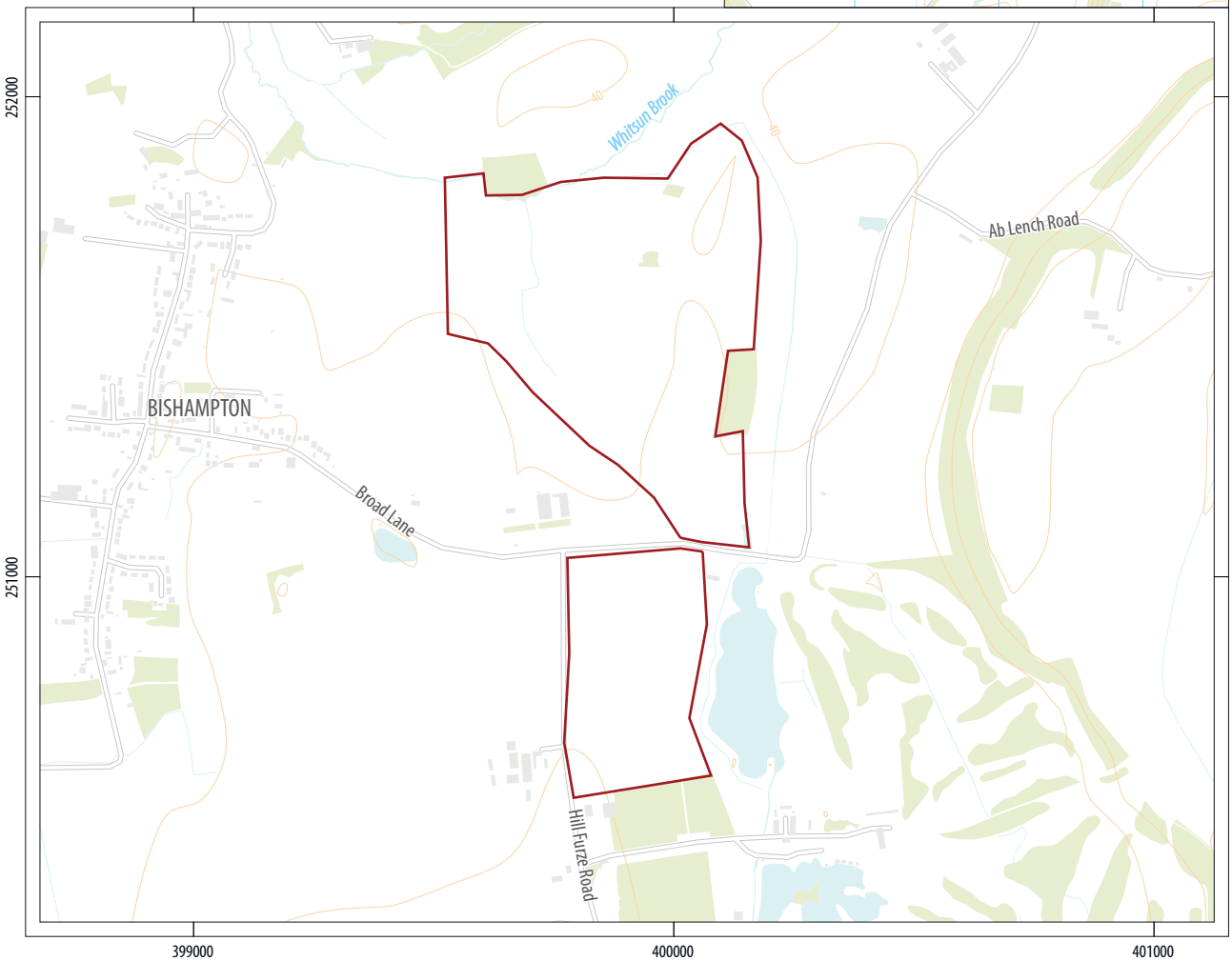
Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey covering 48 hectares on land east of Bishampton, Worcestershire to inform a planning application (ref 19/01287/PA) for a proposed solar farm. The survey has identified two distinct areas of archaeological activity, in the north-east corner and in the south of the proposed development area (PDA) comprising ditched enclosures. The northernmost site comprises a single triangular enclosure, whereas the southern site is more complex, comprising several interconnecting and overlapping rectangular enclosures which may be suggestive of multi-phase activity. Both sites are likely to be due to small-scale settlement activity and are assessed as of high archaeological potential. No clear archaeological anomalies have been identified elsewhere on the site although scattered isolated discrete and linear anomalies may be indicative of further archaeological activity within the PDA, perhaps being due to soil-filled pits and ditches. These anomalies are ascribed a moderate archaeological potential. Anomalies indicative of ridge and furrow cultivation have been identified throughout the site. These may be of local historical interest but are not thought to be of any archaeological significance. Therefore, on the basis of the geophysical survey, the majority of the PDA is assessed as of low to moderate archaeological potential with locally very high potential ascribed to the two identified areas of archaeological activity.

CONTENTS

LIST OF ILLUSTRATIONS

Bishampton Solar Farm
Worcester
Worcestershire





0 300m
1:15,000 @ A4

proposed development area

HEADLAND ARCHAEOLOGY
Headland Archaeology Yorkshire & North
Unit 16 | Hillside | Beeston Rd | Leeds LS11 8ND
t 0113 387 6430
e yorkshireandnorth@headlandarchaeology.com
w www.headlandarchaeology.com

ILLUS 1 Site location

BISHAMPTON SOLAR FARM, BISHAMPTON, WORCESTERSHIRE

GEOPHYSICAL SURVEY REPORT

1 INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned by Dulas Ltd (the Client) to undertake a geophysical survey on land east of Bishampton, Worcestershire, to inform a planning application (ref 19/01287/PA) for a proposed solar farm. The survey was undertaken in order to assess the impact of the proposed development on the historic environment. The results of the survey will inform future archaeological strategy at the site.

The survey was undertaken in accordance with an Archaeological Written Scheme of Investigation (WSI) (Harrison 2019) which was submitted to, and approved by, Aidan Smyth, Wychavon District Council Archaeologist, 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 two blocks of land either side of Broad Lane, approximately 1km east of Bishampton, centred on SP 0015 5106 (Illus 1). The northernmost block comprises six arable fields (F1–F6) which are bound to the south by Broad Lane, to the south-west by a public footpath, by Whitsun Brook to the north and by a tributary of the brook to the west. The southern block comprises a single rectangular field (F7) between Broad Lane in the north and Hayes Farm in the south.

Generally, the topography varies between 50m Above Ordnance Datum (AOD) in the south and 36m AOD in the north. More locally the land rises in the east of the PDA to form a low north/south band of slightly elevated ground.

The survey was carried out between the 14th and 16th January 2019.

1.2 GEOLOGY AND SOILS

The bedrock geology comprises Mercia Mudstone. No superficial deposits are recorded over the majority of the PDA although alluvium (clay, silt, sand and gravel) is recorded in the north and west (NERC 2019).

The soils are mostly classified in the Soilscape 8 Association, characterised as loams and clays with impeded drainage. In the north of the PDA the soils are classified in the Soilscape 20 Association, characterised as floodplain clays with naturally high groundwater (Cranfield University 2019).

2 ARCHAEOLOGICAL BACKGROUND

No detailed archaeological background is known at the time of writing. However, a cropmark enclosure is recorded in the south-east corner of F7 on the Worcestershire Historic Environment Record (HER), and ridge and furrow cultivation is recorded in the north.

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

ILLUS 2 F2 (west), looking north

enable an assessment to be made of the impact of the proposed development on any sub-surface archaeological remains, if present.

The specific archaeological objectives of the geophysical survey were:

- to provide information about the nature and possible interpretation of any magnetic anomalies identified;
- to therefore determine the likely presence/absence and extent of any buried archaeological features; and
- to produce a comprehensive site archive and report.

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 1:15,000. Illus 2–4 are site condition photographs. Illus 5 is a 1:5,000 survey location plan showing the direction of survey as GPS swaths. Illus 6 and Illus 7 present the overall greyscale and interpretation plots at the same scale. Large scale (1:2,500) fully processed (greyscale) data, minimally processed (XY trace plot) data and interpretation plots are presented in Illus 8 to Illus 13. Large scale (1:1,000) plots of the two Areas of Archaeological Activity (AAA) are presented in Ilus 14 to Illus 19 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 2019), guidelines outlined by Europae Archaeologia Consilium (EAC 2016) and by the Chartered Institute for Archaeologists (CIfA 2014). All illustrations from Ordnance Survey (OS) mapping are reproduced with the permission of the controller of Her Majesty's Stationery Office (© Crown copyright).

ILLUS 3 F2 (east), looking north

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 good throughout the PDA and have contributed to a high standard of data throughout. The magnetic background is homogenous across the majority of the PDA being visible as a monotone greyscale with frequent small discrete anomalies. However, in the west of F2 the magnetic background is extremely variable being characterised by a dense concentration of amorphous high magnitude anomalies. This background corresponds to alluvial superficial deposits which are recorded by the British Geological Survey (BGS) and is caused by the presence of magnetic sands, silts and gravels. Against these backgrounds several anomalies have been identified and cross-referenced to specific examples on the interpretation figures.

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.

Larger 'spike' anomalies, TP, correspond to telegraph poles carrying overhead cables.

Localised areas of magnetic disturbance (BP1–BP3, Illus 8–13) in F1, F2 and F5, correspond to ponds which are depicted on the first edition Ordnance Survey (OS) map (1885). The disturbance is caused by the magnetic properties of the material used to backfill the former ponds (brick, tile etc).

The broad area of magnetic disturbance (TR1, Illus 11–13) in the south-east of F1 is caused by an animal feeding trough.

In the south of F1, a localised area of magnetic enhancement (B1, Illus 8–10) corresponds to a small building which is also shown on the first edition map. The magnetic anomalies are due to the presence of demolition material/rubble in the topsoil.

Magnetic disturbance along the field edges is due to the presence of ferrous material within and adjacent to the field boundaries and is of no archaeological interest.

4.2 AGRICULTURAL ANOMALIES

Analysis of historical OS maps indicates that the layout and division of land within the PDA has undergone several changes since the publication of the first edition OS map with the removal of several field boundaries to facilitate larger fields. Two of these former field boundaries have been detected north of Broad Lane as curvilinear anomalies (FB1 and FB2, Illus 8–10). The anomalies are caused by the

ILLUS 4 F7, looking south

contrast between the soil-fill of a ditch and the surrounding soils. Former field boundaries in F7 have not been detected by the survey, perhaps having been removed by later ploughing.

The medieval and post-medieval practice of ridge and furrow cultivation is identified across the PDA as a series of broadly-spaced, slightly curvilinear anomalies. The anomalies are caused by the magnetic contrast between the soil-fill of the furrows and the former ridges. Ridge and furrow is recorded in the north of the PDA on the Worcestershire HER.

Linear anomalies in F1, F2 and F6, mostly oblique to the surrounding field boundaries, are thought to be due to land drains.

4.3 GEOLOGICAL ANOMALIES

As mentioned, a relatively homogenous magnetic background is recorded over the majority of the PDA characterised by numerous small discrete anomalies against a flat, monotone greyscale background. These are thought to be caused by localised variation in the depth and composition of the topsoil. The dense concentration of high magnitude anomalies in the west of F2 corresponds to the presence of superficial deposits recorded by the British Geological Survey. The anomalies are caused by the presence of alluvium (clay, silt, sand and gravel) deposited during episodes of inundation from the adjacent Whitsun Brook.

4.4 POSSIBLE ARCHAEOLOGICAL ANOMALIES

A cluster of linear and rectilinear anomalies (D1–D4, Illus 8–10) in the north of F1 cannot be confidently interpreted as either modern, geological or agricultural in origin and therefore an archaeological origin should be considered. The anomalies may be due to infilled ditches.

Three isolated high magnitude discrete anomalies (P1–P3, Illus 8–10) within F4/F5 are larger and notably higher in magnitude than the ubiquitous discrete geological anomalies. For this reason, these anomalies are ascribed a possible archaeological origin and they may locate isolated pits.

In the south of F6 a clear high magnitude sub-square anomaly (P4, Illus 11–13) may be of interest, perhaps locating a large pit. However, it is equally plausible that the anomaly is modern in origin. Perhaps being due to an infilled pond or clay extraction pit.

An irregular curvilinear anomaly (D5, Illus 11–13) has been identified in the south-east corner of F7 in the vicinity of a cropmark enclosure which is recorded on the Worcestershire HER. The anomaly is at the limit of the survey area and no clear pattern is discernible, but it is possible that it is caused by a soil-filled ditch.

4.5 ARCHAEOLOGICAL ANOMALIES

Unless specified all the linear anomalies described are likely to be due to soil filled cut features, such as ditches, forming clear patterns of enclosure and land division. Against a variable magnetic background, it is difficult to confidently discriminate between discrete anomalies which may be due to archaeological features, such as pits, which may be indicative of occupational activity and those that are probably due to localised geological variation. For this reason, most of the discrete anomalies within enclosures have been ascribed a possible archaeological origin with those outside, except where the responses are particularly broad or high in magnitude, interpreted as of non-archaeological origin.

Two distinct areas of archaeological activity (AAA) have been identified 885m apart, in slightly elevated positions in the east of the PDA. These are assessed as of high archaeological potential and are discussed below.

AAA1 (Illus 14–16)

In the north-east corner of F2 a clear triangular enclosure is identified, centred on SP 0013 5185, and corresponding closely to the contours of the field. The enclosure measures 75m east/west and 90m north/south. A well-defined gap in the south-east of the enclosure is likely to locate an entrance. At least two sub-circular internal features and a linear ditch-type anomaly are identified in the north and the south-west of the enclosure which locate internal divisions or cells, perhaps for settlement activity.

A low magnitude rectilinear anomaly, D6, extends east/west from the south-west corner of the enclosure and is caused by an infilled ditch. The anomaly is clearly oblique to the surrounding ridge and furrow anomalies and may locate an appended enclosure or annex.

AAA2 (Illus 17–19)

AAA2 locates a complex of linear and rectilinear anomalies towards the north of F7 (centred on SP 9998 5088), over an area which extends 100m north/south and 86m east/west. The complex comprises several small adjoining rectilinear enclosures on a north/south alignment. The density of anomalies increases in the south of the complex with some criss-crossing almost certainly suggestive of multi-phase settlement activity. Towards the north of AAA2 the anomalies are lower in magnitude and less clear although two faint parallel linear anomalies, D7 and D8, are identified extending northwards on the same alignment as the enclosure complex. These are caused by ditches and may locate part of an outlying field system. It is unclear whether AAA2 locates the actual position of the cropmark enclosure which is recorded on the Worcestershire HER or whether it represents a new, previously unknown site.

Five large ferrous spikes identified in the north-east of the complex do not correspond to any surface feature or any features shown on historical OS mapping, However, the spikes are most likely modern in origin and are therefore of no archaeological interest.

5 CONCLUSION

The survey has successfully evaluated the geophysical survey area and has identified two distinct areas of archaeological activity, in the north-east corner and in the south of the proposed development area (PDA) comprising ditched enclosures. The northernmost site comprises a single triangular enclosure, whereas the southern site is more complex, comprising several interconnecting and overlapping rectangular enclosures which may be suggestive of multi-phase activity. Both sites are likely to be due to small-scale settlement activity and are assessed as of high archaeological potential. No clear archaeological anomalies have been identified elsewhere on the site although scattered isolated discrete and linear anomalies may be indicative of further archaeological activity within the PDA, perhaps being due to soil-filled pits and ditches. These anomalies are ascribed a moderate archaeological potential. Anomalies indicative of ridge and furrow cultivation have been identified throughout the site. These may be of local historical interest but are not thought to be of any archaeological significance. Therefore, on the basis of the geophysical survey, the majority of the PDA is assessed as of low to moderate archaeological potential with locally very high potential ascribed to the two identified areas of archaeological activity.

6 REFERENCES

Chartered Institute for Archaeologists (ClfA) 2014 ***Standard and guidance for archaeological geophysical survey*** (Reading) http://www.archaeologists.net/sites/default/files/ClfAS%26GGeophysics_2.pdf accessed 28 January 2020

Cranfield University 2019 ***Cranfield Soil and Agrifood Institute Soilscapes*** http://www.landis.org.uk/soilscapes/ accessed 28 January 2020

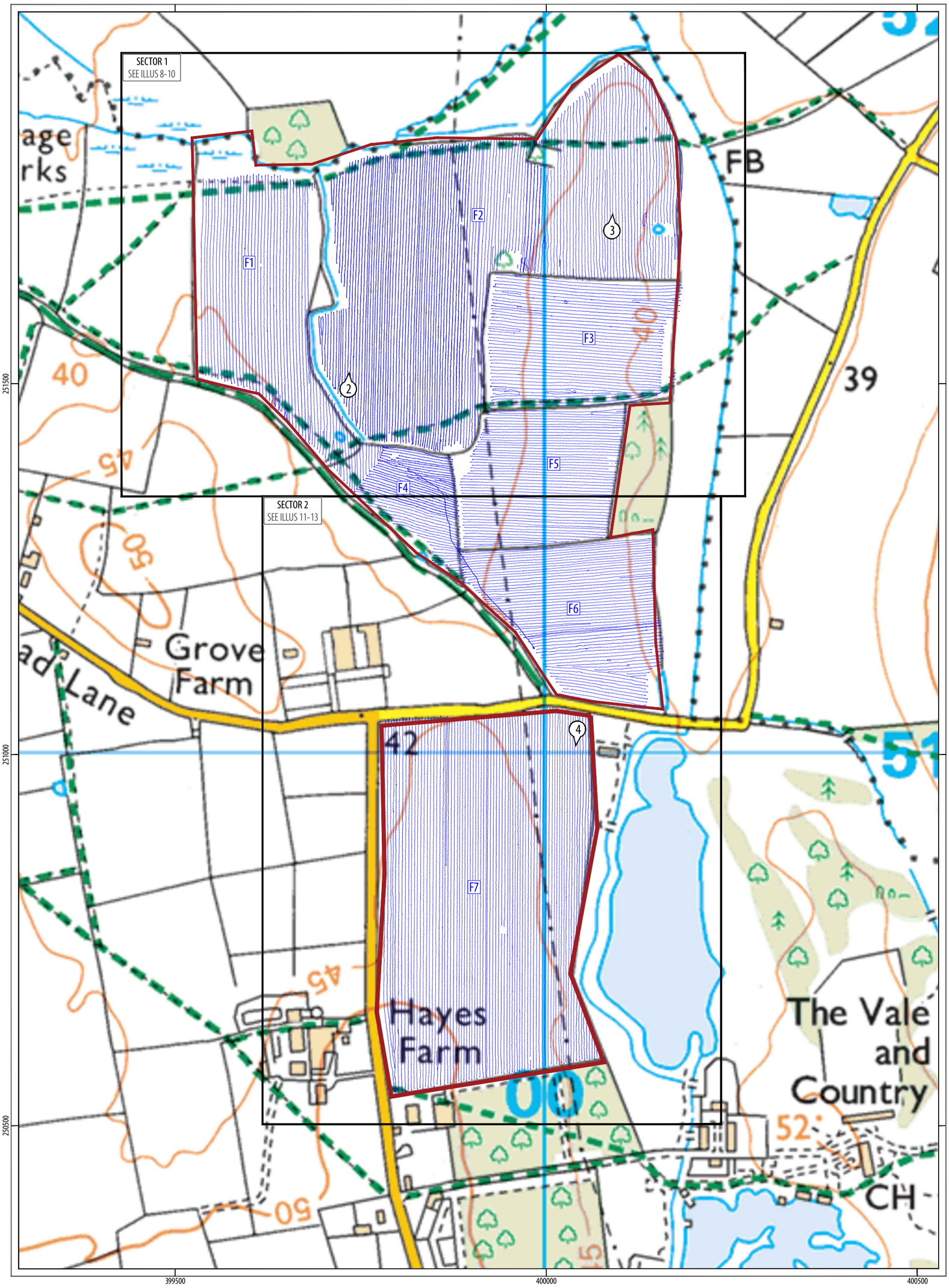
Europae Archaeologia Consillium (EAC) 2016 ***EAC Guidelines for the Use of Geophysics in Archaeology: Question to Ask and Points to Consider*** (Namur, Belgium) http://www.old.europeanarchaeological-council.org/files/eac_guidelines_2_final.pdf accessed 28 January 2020

Gaffney C & Gater J 2003 ***Revealing the Buried Past: Geophysics for Archaeologists*** Stroud

Ministry of Housing, Communities and Local Government MHCLG) 2019 ***National Planning Policy Framework*** https://assers.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/81017/NPPF_Feb_2019_revised.pdf accessed 28 January 2020

Harrison D 2019 ***Bishampton Solar Farm, Worcestershire; Written Scheme of investigation for Geophysical Survey*** [unpublished client document] Headland Archaeology Ref BSFW19

Natural Environment Research Council (NERC) 2019 ***British Geological Survey*** http://www.bgs.ac.uk/ accessed 28 January 2020



proposed development area
GPS swaths
location and direction of ILLUS 2-9

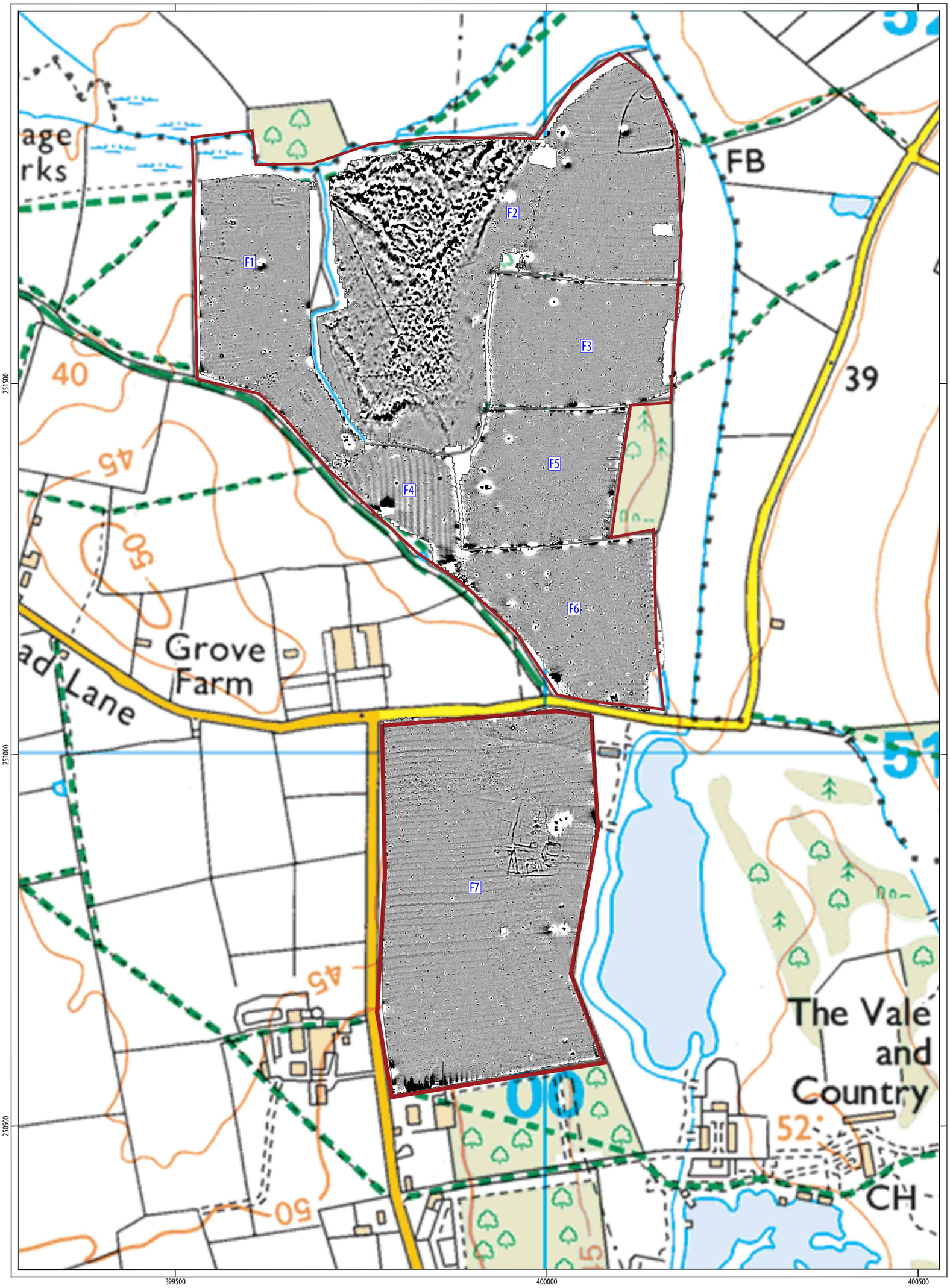
0 100m
1:5,000 @ A3

PROJECT BSFW19
Bishampton Solar Farm
Bishampton
Worcestershire

CLIENT Dulas Ltd

HEADLAND ARCHAEOLOGY
Headland Archaeology Yorkshire & North
Unit 16 | Hillside, Beeston Road | Leeds LS11 8ND
t 0113 387 6430
e yorkshireandnorth@headlandarchaeology.com
w www.headlandarchaeology.com

ILLUS 5 Survey location showing GPS swaths (1:5,000)



proposed development area

nT
-1.0 2.0

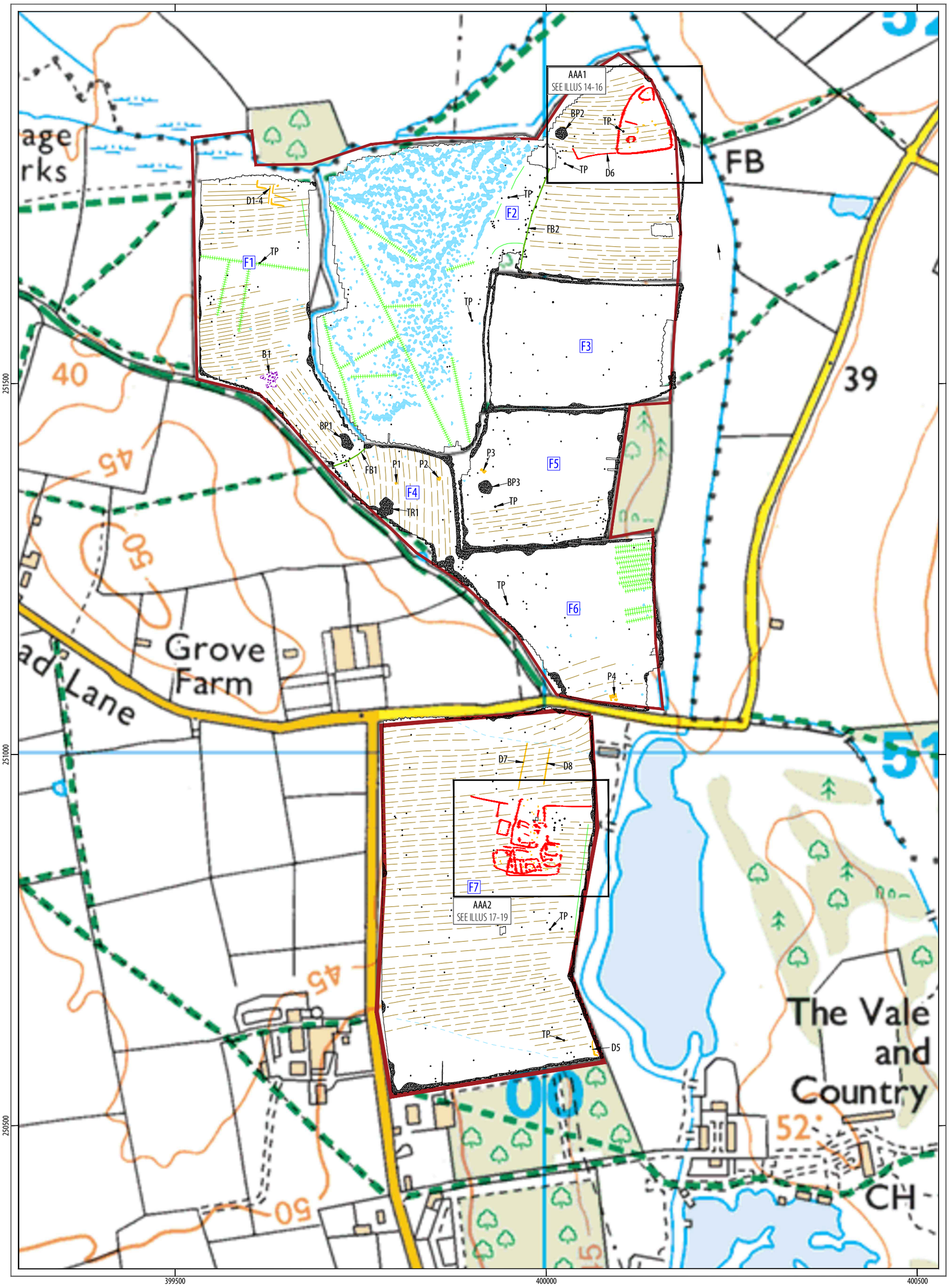
0 100m
1:5,000 @ A3

PROJECT BSFW19
Bishampton Solar Farm
Bishampton
Worcestershire

CLIENT Dulas Ltd

HEADLAND ARCHAEOLOGY
Headland Archaeology Yorkshire & North
Unit 16 | Hillside, Beeston Road | Leeds LS11 8ND
t 0113 387 6430
e yorkshireandnorth@headlandarchaeology.com
w www.headlandarchaeology.com

ILLUS 6 Processed greyscale magnetometer data (1:5,000)



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
magnetic disturbance	former building
linear trend	ridge and furrow
linear trend	agricultural
linear trend	field drain

TYPE OF ANOMALY	INTERPRETATION
linear	former field boundary
linear trend	geological variation
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

ABBREVIATIONS			
AAA	area of archaeological activity		
B	building	TP	telegraph pole
BP	backfilled pond	TR	trough
D	ditch		
FB	former boundary		
P	pit		

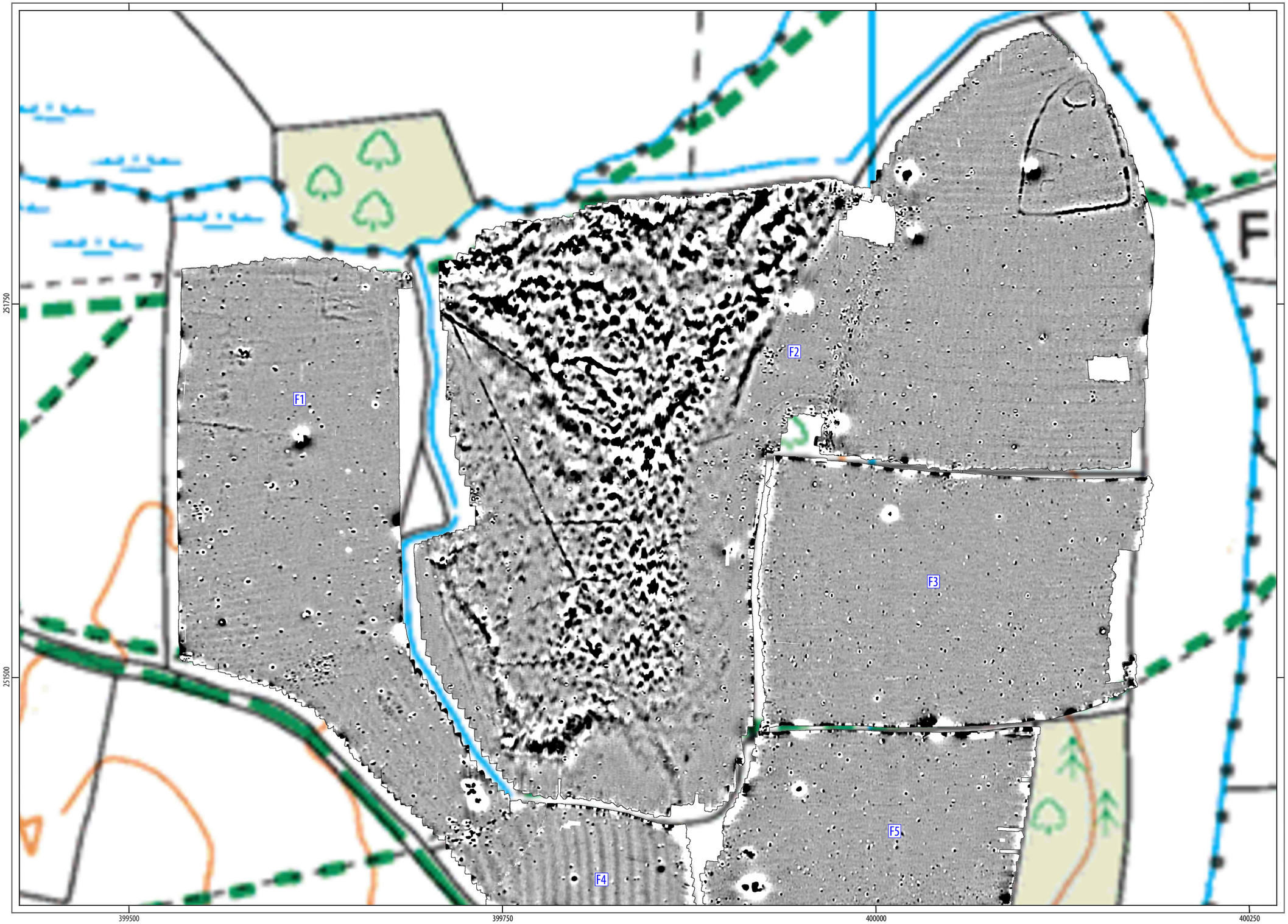
0 100m
1:5,000 @ A3

PROJECT BSFW19
Bishampton Solar Farm
Bishampton
Worcestershire

CLIENT Dulas Ltd

HEADLAND ARCHAEOLOGY
Headland Archaeology Yorkshire & North
Unit 16 | Hillside, Beeston Road | Leeds LS11 8ND
t 0113 387 6430
e yorkshireandnorth@headlandarchaeology.com
w www.headlandarchaeology.com

ILLUS 7 Interpretation of magnetometer data (1:5,000)



PROJECT BSFW19
Bishampton Solar Farm
Bishampton
Worcestershire
CLIENT Dulas Ltd

HEADLAND ARCHAEOLOGY
Headland Archaeology Yorkshire & North
Unit 16 | Hillside, Beeston Road | Leeds LS11 8ND
t 0113 387 6430
e yorkshireandnorth@headlandarchaeology.com
w www.headlandarchaeology.com

ILLUS 8 Processed greyscale magnetometer data; Sector 1 (1:2,500)

35.0nT/cm

0 50m

1:2,500 @ A3

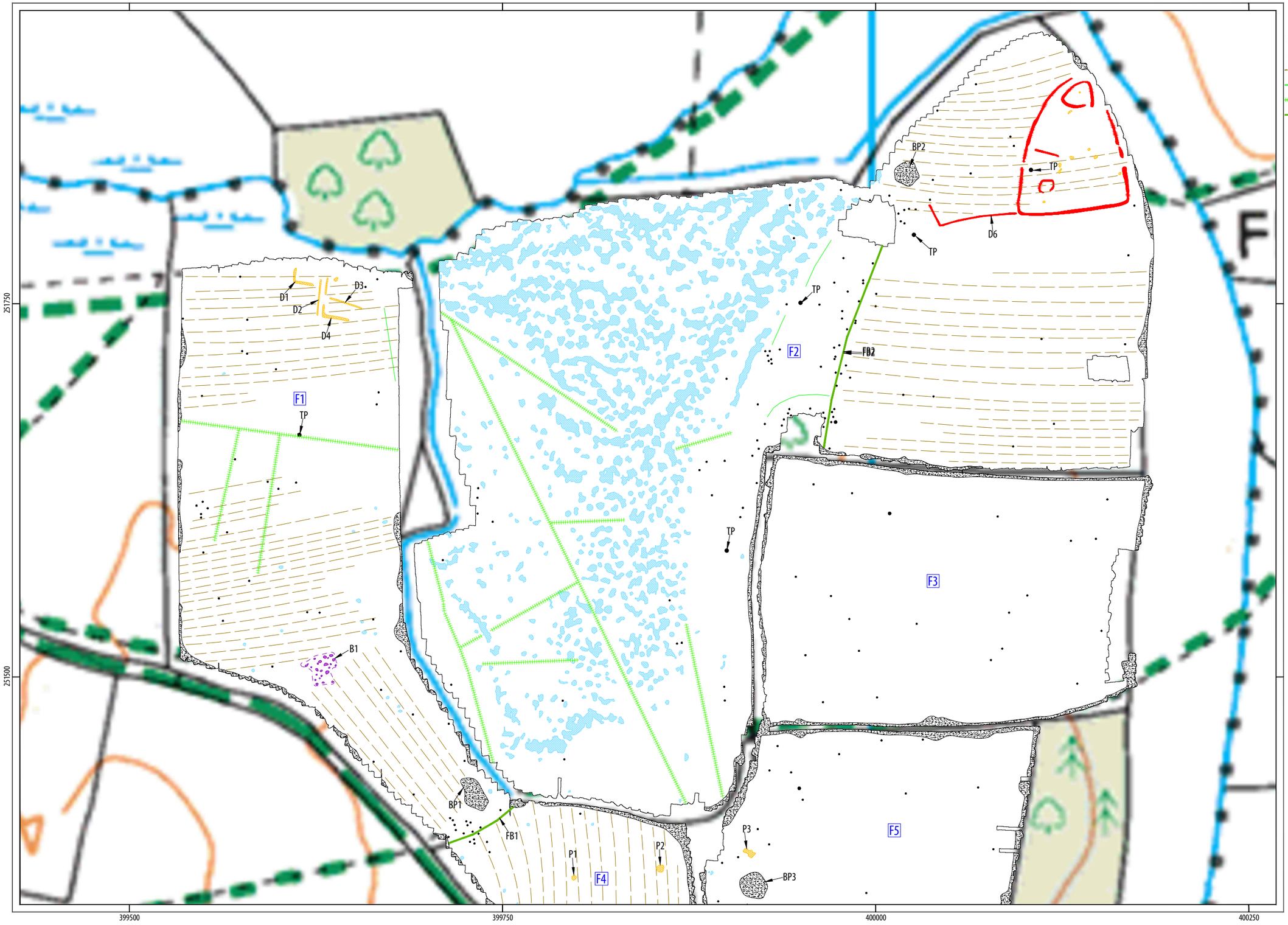
PROJECT BSFW19
Bishampton Solar Farm
Bishampton
Worcestershire

CLIENT Dulas Ltd

HEADLAND ARCHAEOLOGY

Headland Archaeology Yorkshire & North
Unit 16 | Hillside, Beeston Road | Leeds LS11 8ND
t 0113 387 6430
e yorkshireandnorth@headlandarchaeology.com
w www.headlandarchaeology.com

ILLUS 9 XY trace plot of minimally processed magnetometer data; Sector 1 (1:2,500)



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
magnetic disturbance	former building
linear trend	ridge and furrow
linear trend	agricultural
linear trend	field drain
linear	former field boundary
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

ABBREVIATIONS

AAA	area of archaeological activity
B	building
BP	backfilled pond
D	ditch
FB	former boundary
P	pit
Q	quarry
TP	telegraph pole
TR	trough

0 50m
1:2,500 @ A3

PROJECT BSFW19
Bishampton Solar Farm
Bishampton
Worcestershire

CLIENT Dulas Ltd

HEADLAND ARCHAEOLOGY
Headland Archaeology Yorkshire & North
Unit 16 | Hillside, Beeston Road | Leeds LS11 8ND
t 0113 387 6430
e yorkshireandnorth@headlandarchaeology.com
w www.headlandarchaeology.com

ILLUS 10 Interpretation of magnetometer data; Sector 1 (1:2,500)

nT
-1.0 2.0

0 50m
1:2,500 @ A3

PROJECT BSFW19
Bishampton Solar Farm
Bishampton
Worcestershire

CLIENT Dulas Ltd

HEADLAND ARCHAEOLOGY
Headland Archaeology Yorkshire & North
Unit 16 | Hillside, Beeston Road | Leeds LS11 8ND
t 0113 387 6430
e yorkshireandnorth@headlandarchaeology.com
w www.headlandarchaeology.com

ILLUS 11 Processed greyscale magnetometer data; Sector 2 (1:2,500)

35.0nT/cm

0 50m

1:2,500 @ A3

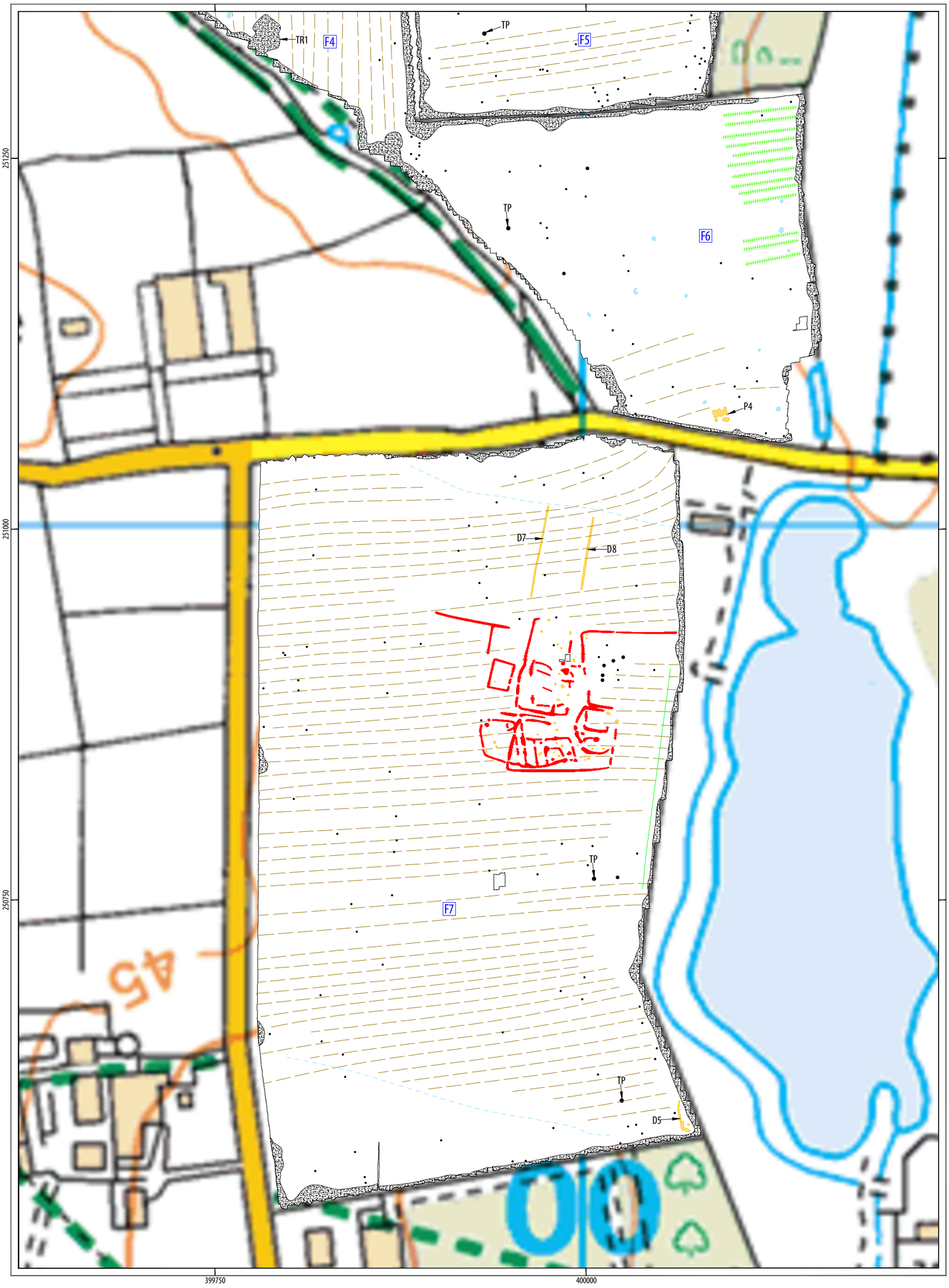
PROJECT BSFW19
Bishampton Solar Farm
Bishampton
Worcestershire

CLIENT Dulas Ltd

HEADLAND ARCHAEOLOGY

Headland Archaeology Yorkshire & North
Unit 16 | Hillside, Beeston Road | Leeds LS11 8ND
t 0113 387 6430
e yorkshireandnorth@headlandarchaeology.com
w www.headlandarchaeology.com

ILLUS 12 XY trace plot of minimally processed magnetometer data; Sector 2 (1:2,500)



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	ridge and furrow
linear trend	agricultural
linear trend	field drain
linear	former field boundary

TYPE OF ANOMALY	INTERPRETATION
linear trend	geological variation
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

ABBREVIATIONS	
D	ditch
P	pit
TP	telegraph pole
TR	trough

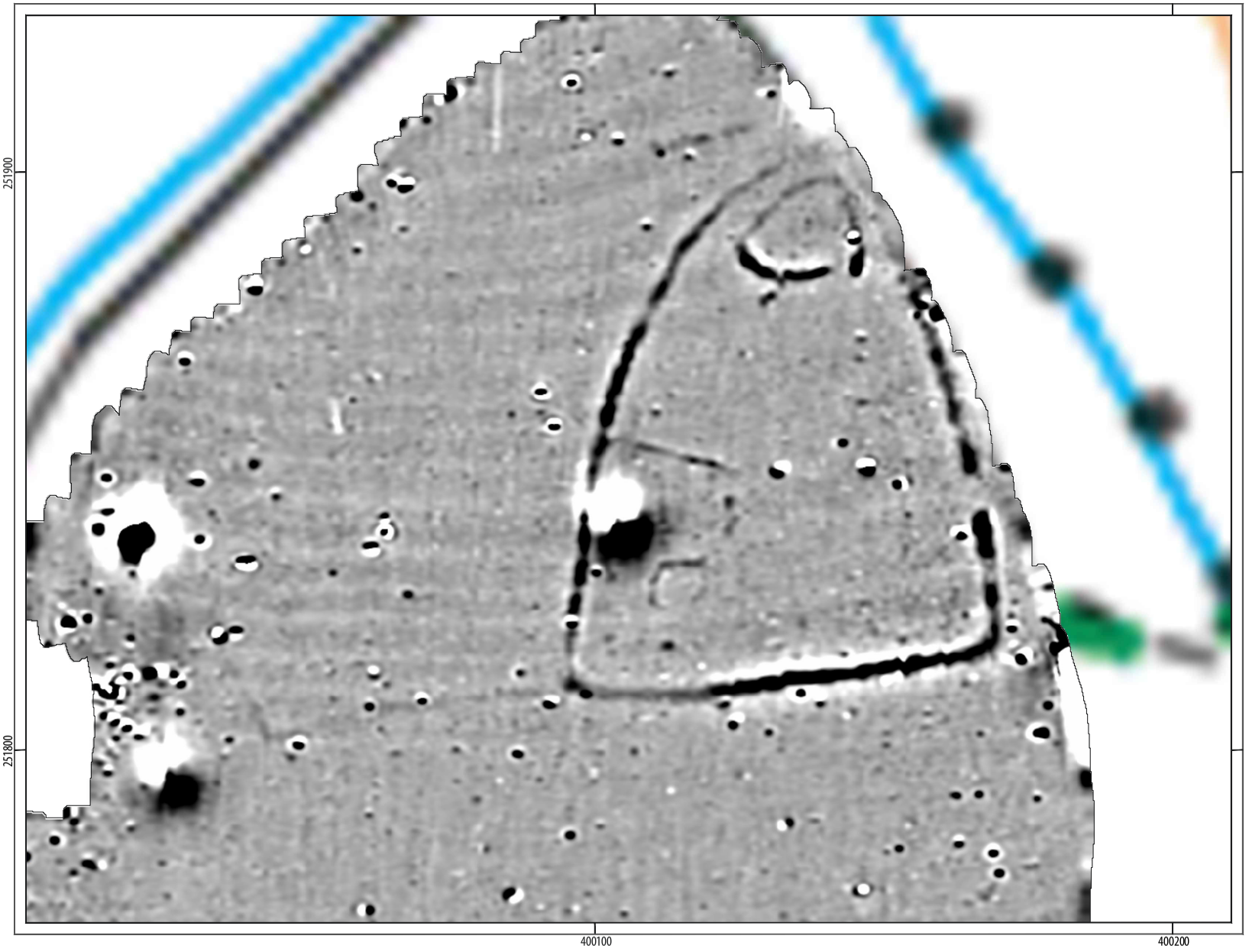
0 50m
1:2,500 @ A3

PROJECT BSFW19
Bishampton Solar Farm
Bishampton
Worcestershire

CLIENT Dulas Ltd

HEADLAND ARCHAEOLOGY
Headland Archaeology Yorkshire & North
Unit 16 | Hillside, Beeston Road | Leeds LS11 8ND
t 0113 387 6430
e yorkshireandnorth@headlandarchaeology.com
w www.headlandarchaeology.com

ILLUS 13 Interpretation of magnetometer data; Sector 2 (1:2,500)



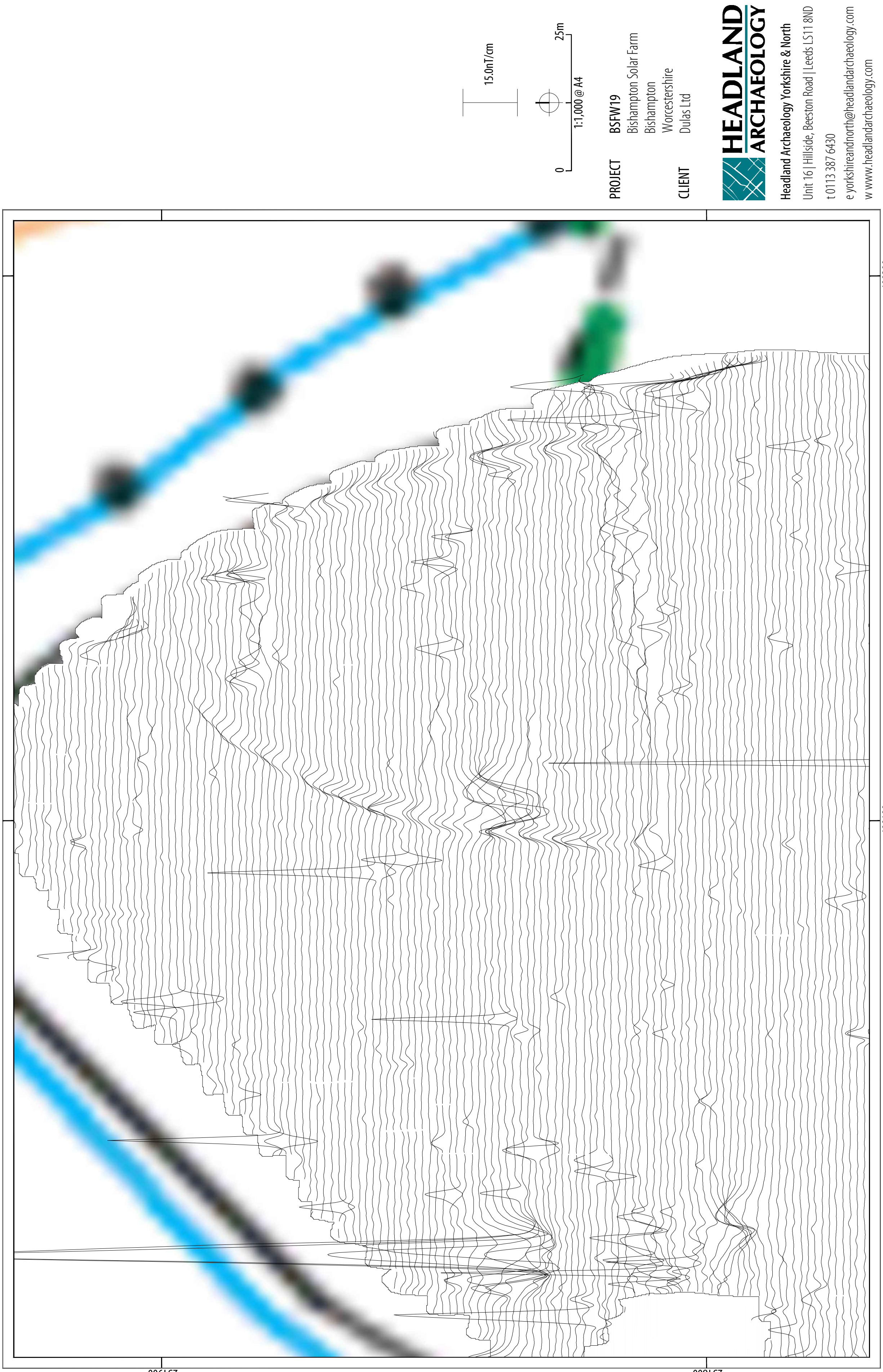
PROJECT BSFW19
Bishampton Solar Farm
Bishampton
Worcestershire

CLIENT Dulas Ltd

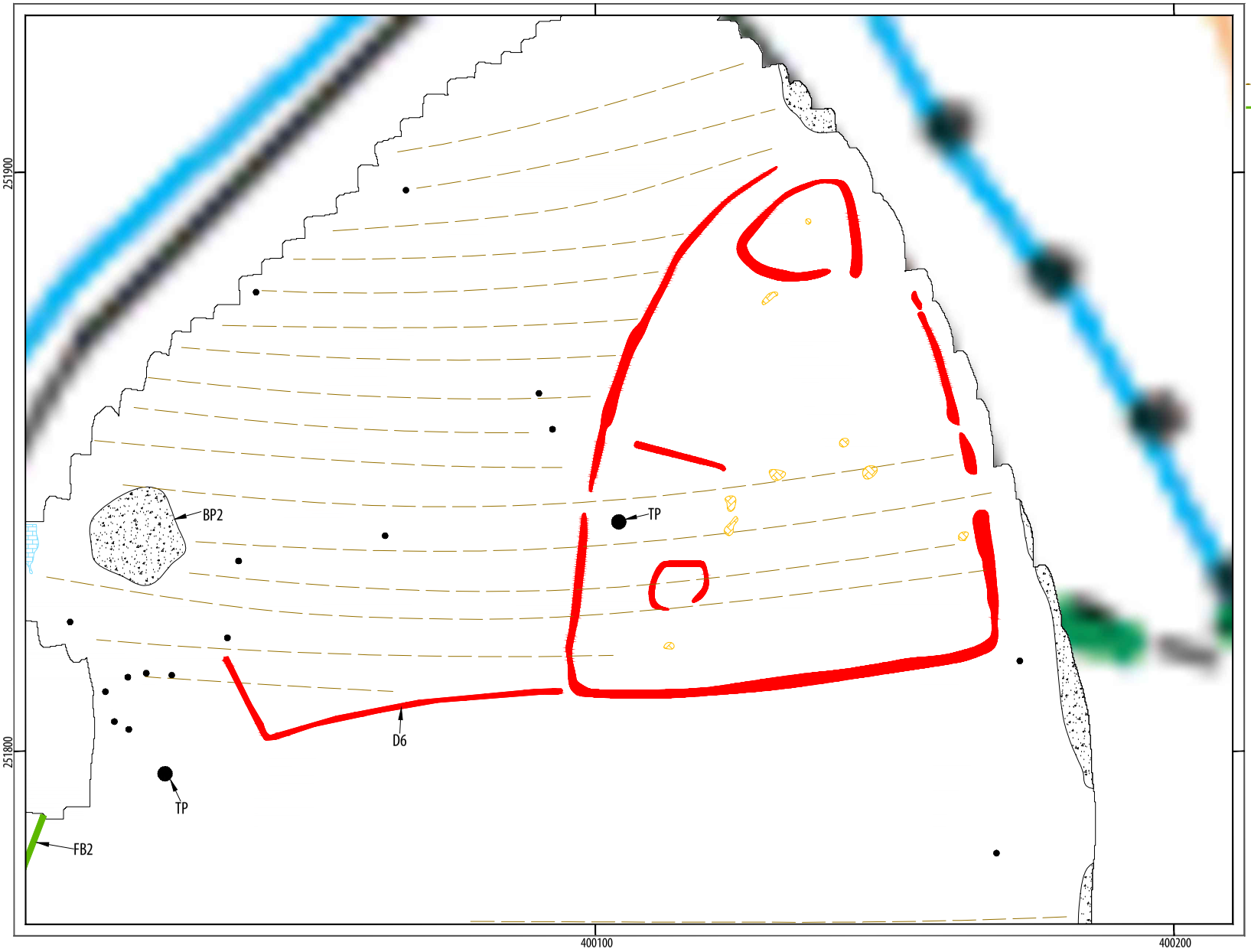
HEADLAND ARCHAEOLOGY

Headland Archaeology Yorkshire & North
Unit 16 | Hillside, Beeston Road | Leeds LS11 8ND
t 0113 387 6430
e yorkshireandnorth@headlandarchaeology.com
w www.headlandarchaeology.com

ILLUS 14 Processed greyscale magnetometer data; AAA1 (1:1,000)



ILLUS 15 XY trace plot of minimally processed magnetometer data; AAA1 (1:1,000)



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	ridge and furrow
linear	former field boundary
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

ABBREVIATIONS

BP	backfilled pond
D	ditch
FB	former boundary
TP	telegraph pole

0 25m
1:1,000 @ A4

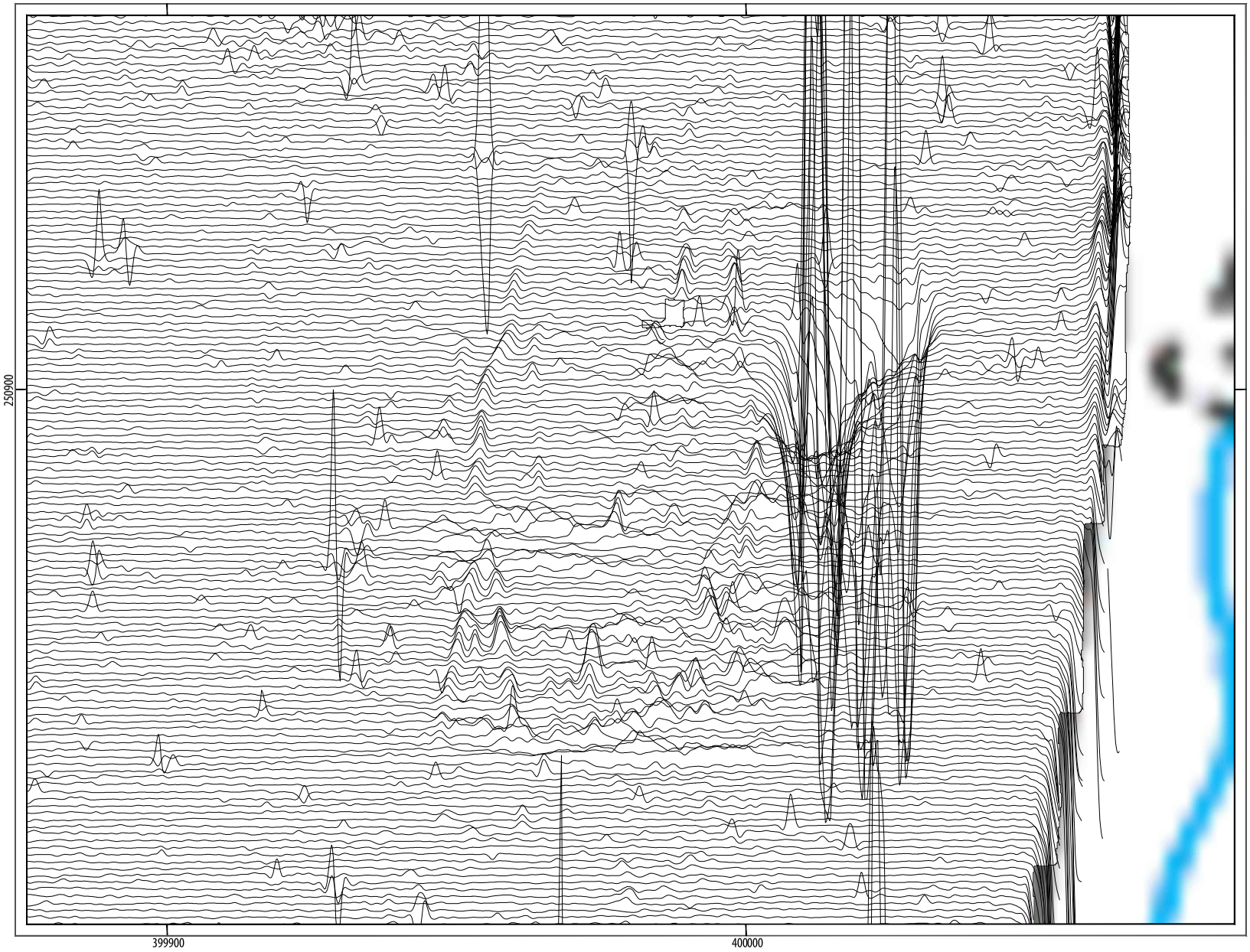
PROJECT BSFW19
Bishampton Solar Farm
Bishampton
Worcestershire

CLIENT Dulas Ltd

HEADLAND ARCHAEOLOGY
Headland Archaeology Yorkshire & North
Unit 16 | Hillside, Beeston Road | Leeds LS11 8ND
t 0113 387 6430
e yorkshireandnorth@headlandarchaeology.com
w www.headlandarchaeology.com

ILLUS 16 Interpretation of magnetometer data; AAA1 (1:1,000)

ILLUS 17 Processed greyscale magnetometer data; AAA2 (1:1,000)



15.0nT/cm

0 25m

1:1,000 @ A4

PROJECT BSFW19
Bishampton Solar Farm
Bishampton
Worcestershire

CLIENT Dulas Ltd

HEADLAND ARCHAEOLOGY

Headland Archaeology Yorkshire & North
Unit 16 | Hillside, Beeston Road | Leeds LS11 8ND
t 0113 387 6430
e yorkshireandnorth@headlandarchaeology.com
w www.headlandarchaeology.com

ILLUS 18 XY trace plot of minimally processed magnetometer data; AAA2 (1:1,000)

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	ridge and furrow
linear trend	agricultural
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

ABBREVIATIONS

D ditch

0 25m

1:1,000 @ A4

PROJECT BSFW19
Bishampton Solar Farm
Bishampton
Worcestershire

CLIENT Dulas Ltd

HEADLAND ARCHAEOLOGY

Headland Archaeology Yorkshire & North
Unit 16 | Hillside, Beeston Road | Leeds LS11 8ND
t 0113 387 6430
e yorkshireandnorth@headlandarchaeology.com
w www.headlandarchaeology.com

ILLUS 19 Interpretation of magnetometer data; AAA2 (1:1,000)

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) 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 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 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 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 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: headland5-388185

PROJECT DETAILS	
Project name	Bishampton Solar Farm, Bishampton, Worcestershire
Short description of the project	Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey covering 48 hectares on land east of Bishampton, Worcestershire to inform a planning application (ref 19/01287/PA) for a proposed solar farm. The survey has identified two distinct areas of archaeological activity, in the north-east corner and in the south of the proposed development area (PDA) comprising ditched enclosures. The northernmost site comprises a single triangular enclosure, whereas the southern site is more complex, comprising several interconnecting and overlapping rectangular enclosures which may be suggestive of multi-phase activity. Both sites are likely to be due to small-scale settlement activity and are assessed as of high archaeological potential. No clear archaeological anomalies have been identified elsewhere on the site although scattered isolated discrete and linear anomalies may be indicative of further archaeological activity within the PDA, perhaps being due to soil-filled pits and ditches. These anomalies are ascribed a moderate archaeological potential. Anomalies indicative of ridge and furrow cultivation have been identified throughout the site. These may be of local historical interest but are not thought to be of any archaeological significance. Therefore, on the basis of the geophysical survey, the majority of the PDA is assessed as of low to moderate archaeological potential with locally very high potential ascribed to the two identified areas of archaeological activity.
Project dates	Start: 14-01-2020 End: 16-01-2020
Previous/future work	No / Yes
Any associated project reference codes	BSFW19 – Contracting Unit No.
Any associated project reference codes	19/01287/PA – Planning Application No.
Type of project	Field evaluation
Site status	None
Current Land use	Cultivated Land 4 – Character Undetermined
Monument type	None
Monument type	None
Significant Finds	None
Significant Finds	None
Methods & techniques	"Geophysical Survey"
Development type	Solar Farm
Prompt	National Planning Policy Framework – NPPF
Position in the planning process	Between deposition of an application and determination
Solid geology (other)	Mercia Mudstone
Drift geology	Alluvium
Techniques	Magnetometry
PROJECT LOCATION	
Country	England
Site location	Worcestershire, Wychavon, Bishampton, Biahampton Solar Farm
Study area	48 Hectares
Site coordinates	SP 0015 5106 52.157409695967 -1.997807111146 52 09 26 N 001 59 52 W Point
PROJECT CREATORS	
Name of Organisation	Headland Archaeology
Project brief originator	Local Planning Authority (with/without advice from County/District Archaeologist)
Project design originator	Headland Archaeology

Project director/manager	David Harrison
Project supervisor	Richard McGregor Edwards
Type of sponsor/funding body	Developer

PROJECT ARCHIVES

Physical Archive Exists?	No
Digital Archive recipient	In house
Digital Contents	"none"
Digital Media available	"Geophysics"
Paper Archive Exists?	No

PROJECT BIBLIOGRAPHY 1

Publication type	Grey literature (unpublished document/manuscript)
Title	Bishampton Solar Farm, Bishampton, Worcestershire; Geophysical Survey Report
Author(s)/Editor(s)	David Harrison
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	9 March 2020

part of the RSK Group

Headland Archaeology Scotland
13 Jane Street
Edinburgh EH6 5HE
t 0131 467 7705
e scotland@headlandarchaeology.com

Headland Archaeology Yorkshire & North
Unit 16 | Hillside | Beeston Rd
Leeds LS11 8ND
t 0113 387 6430
e yorkshireandnorth@headlandarchaeology.com

Headland Archaeology South & East
Building 68C | Wrest Park | Silsoe
Bedfordshire MK45 4HS
t 01525 861 578
e southandeast@headlandarchaeology.com

Headland Archaeology Midlands & West
Unit 1 | Clearview Court | Twyford Rd
Hereford HR2 6JR
t 01432 364 901
e midlandsandwest@headlandarchaeology.com

Headland Archaeology North West
Fourways House | 57 Hilton Street
Manchester M1 2EJ
t 0161 236 2757
e northwest@headlandarchaeology.com

www.headlandarchaeology.com