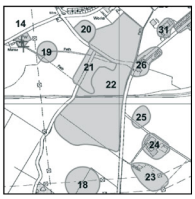
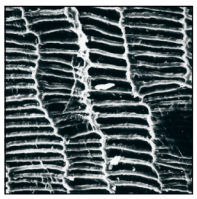
JOHL17










LAND EAST OF JUNCTION 1, M69, LEICESTERSHIRE

GEOPHYSICAL SURVEY

commissioned by EDP
on behalf of IM Properties Development Ltd

May 2018

HEADLAND ARCHAEOLOGY

REGISTERED ORGANISATION CIfA

LAND EAST OF JUNCTION 1, M69, LEICESTERSHIRE

GEOPHYSICAL SURVEY

commissioned by EDP
on behalf of IM Properties Development Ltd

May 2018

This report adheres to the quality standard of ISO 9001:2008

PROJECT INFO:

HA Project Code **JOHL17** / NGR **SP 4431 9075** / Parish **Burbage** / Local Authority **Leicestershire** / OASIS Ref. **headland5-315189**

PROJECT TEAM:

Project Manager **David Harrison** / Author **David Harrison** / Fieldwork **David Harrison, Mark Evans, Nick Adams, Ross Bishop** / Graphics **Caroline Norrman, David Harrison, Julia Bastek-Michalska**

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

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

HEADLAND ARCHAEOLOGY

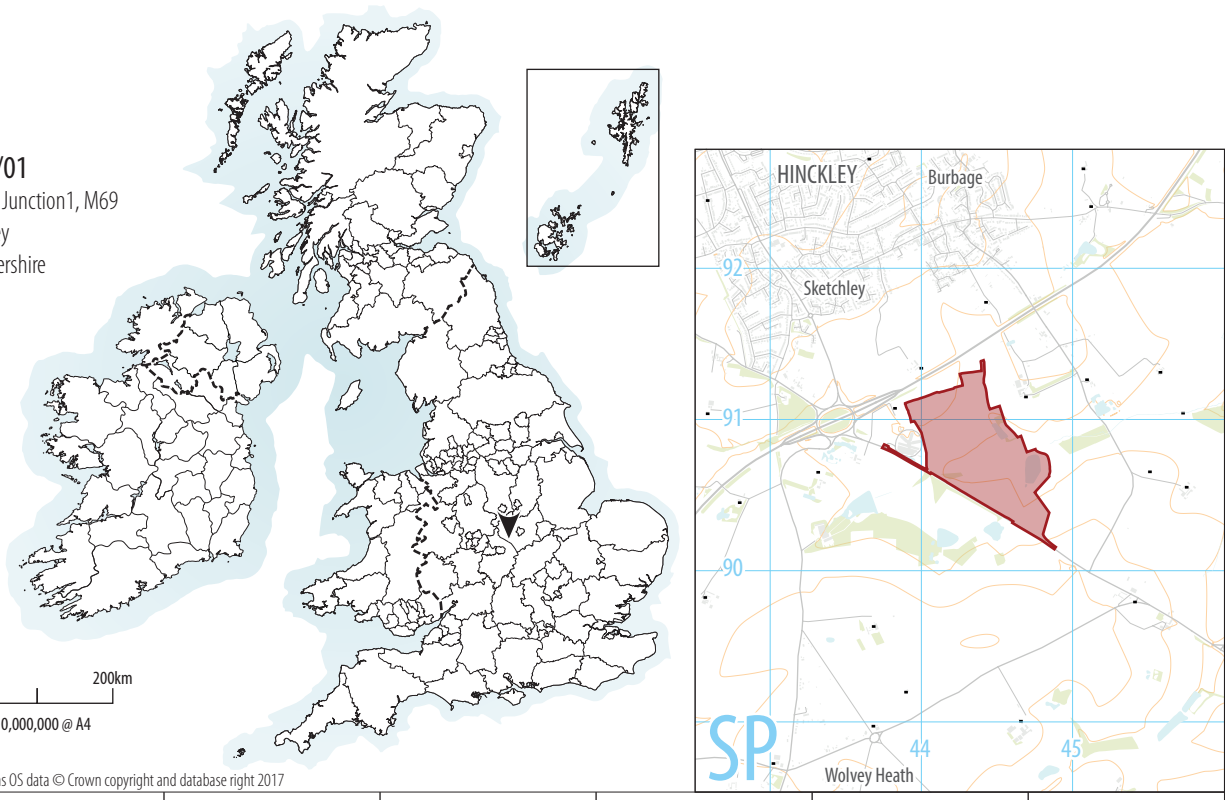
PROJECT SUMMARY

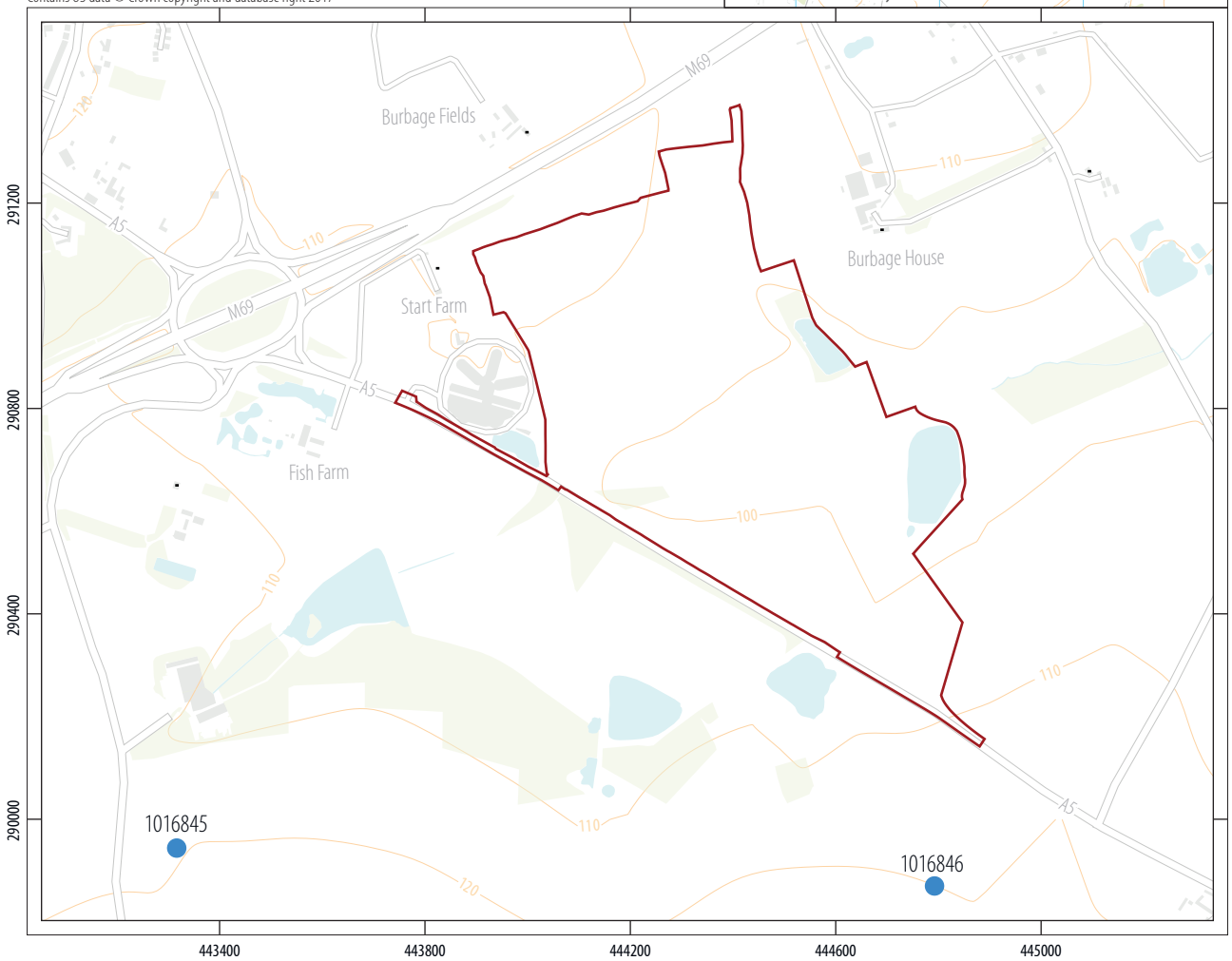
Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey of a 55 hectare site immediately east of Junction 1 of the M69 to inform planning proposals for a proposed employment development, to include a distribution warehouse and associated infrastructure. The survey has successfully evaluated the site identifying an area of clear archaeological potential in the more elevated north-western part of the site. The area comprises anomalies suggestive of a curving ditch, probably the eastern extent of an enclosure, as well as several rectilinear anomalies appended to the eastern side of a linear ditch. These anomalies are likely to locate Romano-British and possibly earlier prehistoric buried remains. No anomalies of definite archaeological potential have been identified alongside the A5 Watling Street, a Roman road which runs along the south-eastern site boundary, although a possible ring-ditch has been located and is ascribed a moderate archaeological potential. Elsewhere, anomalies have been identified which reflect the post-medieval agricultural landscape including ridge and furrow cultivation, field drains and former field boundaries. An area of localised magnetic disturbance locates the remains of a post-medieval or modern barn. With the exception of the area of archaeological activity in the north-west of the site, and the possible ring-ditch close to Watling Street, no anomalies of likely archaeological potential have been identified. It is notable, however, that all of the archaeological anomalies are located on higher ground over localised superficial deposits of Dunsmore Gravel. No anomalies of clear archaeological potential have been identified on the lower parts of the site overlying the prevailing Oadby Member deposits.

CONTENTS

LIST OF ILLUSTRATIONS

JOHL/01
land at Junction1, M69
Hinckley
Leicestershire





HEADLAND ARCHAEOLOGY
NORTH
Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 1 Site location

LAND EAST OF JUNCTION 1, M69, LEICESTERSHIRE

GEOPHYSICAL SURVEY

1 INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned by EDP (The Consultant), on behalf of IM Properties Development Ltd (The Client), to undertake a geophysical (magnetometer) survey of land to the east of Junction 1 of the M69, Leicestershire, where an employment development is being proposed. The survey was carried out in order to inform planning proposals by assessing the heritage potential of the proposed development area (PDA) and therefore the impact of the proposed development on the historic environment.

The work was undertaken in accordance with a Written Scheme of Investigation (Headland Archaeology 2017) which was submitted to and approved by the Consultant, and with guidance contained in the National Planning Policy Framework (DCLG 2012). All work was undertaken in line with current best practice (Chartered Institute for Archaeologists 2014, English Heritage 2008).

The survey was carried out in two stages to allow for differing harvesting regimes on August 1st and August 2nd and between August 16th and August 18th 2017.

1.1 SITE LOCATION, LAND-USE AND TOPOGRAPHY

The PDA comprises six fields (F1–F6) within an irregularly-shaped block of agricultural land to the east of Junction 1 of the M69 and south of Hinckley, Leicestershire, centred at SP 4431 9075 (see Illus 1). It is bound to the north by narrow fields bordering the M69, to the east by a minor watercourse with pastoral fields beyond, to the west by Hinckley Island Hotel and to the south-west by the A5 Watling Street. The site is bisected east/west by the Soar Brook, a tributary of the River Soar.

At the time of the survey, F2, F5 an F6 had been recently harvested, whereas F1, F3 and F4 were under permanent grazed pasture (see Illus 2–6).

The topography rises gently from the Soar Brook at 97m AOD (AOD) to 113m AOD in the north-west corner and 109m AOD in the south. Survey was restricted by overgrown vegetation and wild bird cover on either side of the Soar Brook (see Ilus 3), by trees within the centre of F3 and a lake in the east of Field 4. Of the 55ha PDA, 44ha were available for survey.

1.2 GEOLOGY AND SOILS

The underlying bedrock geology comprises Mercia Mudstone. This is mainly overlain by Oadby Member Diamicton although localised deposits of Dunsmore Gravel are recorded towards the north-west of the PDA and along the south-western boundary. Alluvial deposits are recorded along the course of the Soar Brook and the small watercourse forming the north-eastern site boundary (see Illus 8; NERC 2017).

The soils are classified in the Soilscape 8 association being characterised as slightly acid loams and clays with impeded drainage (Cranfield University 2017).

2 ARCHAEOLOGICAL BACKGROUND

Baseline information collected by the Consultant (EDP 2017) has identified that there are no previously recorded designated or non-designated heritage assets within the PDA.

A ploughed-out burial mound is recorded as a scheduled monument (Historic England List Entry 1016846) some 300m south of the PDA. A second scheduled monument (1016845), also a burial mound, is recorded 1km to the south-west (see Illus 1).

ILLUS 2 Field 1, looking east **ILLUS 3** Field 2 (south), looking north-east **ILLUS 4** Field 2, looking north-west

A number of prehistoric artefacts are recorded from within the site and its immediate environs, as well as numerous cropmarks and the adjacent Watling Street Roman Road suggesting a general moderate potential for activity of a prehistoric and/or Roman date.

3 AIMS, METHODOLOGY AND PRESENTATION

The general aim of the geophysical survey was to provide sufficient 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.

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 model the presence/absence and extent of any buried archaeological features; 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

ILLUS 5 Field 3, looking north **ILLUS 6** Field 5, looking north

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 and 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 V3.0.32.4 (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 1:14,000. Illus 2-6 inclusive are site condition photographs. Illus 7 is a 1:5000 scale survey location plan showing the GPS swath data. The geology data is shown in Illus 8 overlying the six inch Ordnance Survey (OS) map (1888-1913), also at 1:5000. The processed greyscale data and an overall interpretation plot are also presented at 1:5,000 on Illus 9 and Illus 10 with the possible archaeological anomalies and probable

archaeological anomalies shown overlying the Dunsmore Gravels on Illus 11. Detailed data plots of the fully processed data (greyscale), the minimally processed data (XY traceplot) and an accompanying interpretative plot, are presented at a scale of 1:2,500 in Illus 12 to Illus 17 inclusive, with more detailed (1:1,000) plots of the area of archaeological activity (AAA) in Illus 18 to Illus 20 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 (Headland Archaeology 2017) and guidelines outlined by Historic England (English Heritage 2008) and by the Chartered Institute for Archaeologists (CIfA 2014). All illustrations from Ordnance Survey mapping are reproduced with the permission of the controller of Her Majesty's Stationery Office (© 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

The ground conditions across the PDA were good and the overall quality of the data collected was good throughout. The survey has detected a variable magnetic background across the PDA reflecting localised variations in the depth and composition of the soils and the superficial deposits from which they derive. Against this background, numerous anomalies have been identified. Those anomalies with modern, agricultural or geological origins are discussed first followed by those anomalies with a possible or probable archaeological cause. All are discussed below and cross-referenced to specific anomalies on the interpretative drawings, 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 consequence of manuring or tipping/infilling. Two large ferrous spikes (BH1 and BH2 see Illus 15-17) within F5 are caused by capped bore holes.

Four high magnitude dipolar linear anomalies (SP1-SP4) locate buried pipes. SP1 (see Illus 12-14), aligned north/south within the north-west of F2 runs between a backfilled pond (PD1) and the site of Start Barn (B1) which is depicted on early OS maps. SP2–SP4 (see Illus 15–17) are likely to locate buried water pipes. Two non-dipolar high magnitude linear anomalies (CU1 and CU2) are thought to locate culverts. CU1 (see Illus 12-14) is aligned north/south within the north of F3 and extends from a former spring which is shown at its northern limit on the 1964 OS map. CU2 (see Illus 15–17) is located along the southern boundary of F3 and is clearly a culverted section of the Soar Brook. A localised area of high magnitude magnetic disturbance, B2, at the western end of CU2, corresponds to a small square structure which is shown on the 1964 OS map. The disturbance is caused by rubble and ferrous contamination within the topsoil.

A vague alignment of ferrous spikes (TR1 see Illus 15-17) aligned north-east/south-west in the north of F5, corresponds to a farm track which is shown on the first edition OS map (1888). The spikes are caused by ferrous material (e.g. brick, tile, clinker etc.) within the surface of the track.

Magnetic disturbance around the field edges is due to ferrous material within or close to the adjacent field boundaries and is of no archaeological interest. Along the route of the A5 Watling Street the continual flow of traffic during the course of the survey manifests in the data as short dipolar anomalies.

4.2 AGRICULTURAL ANOMALIES

Analysis of historic OS mapping indicates that the division and layout of land within the PDA has changed considerably over the last 130 years with the removal of several field boundaries to facilitate larger arable fields. Five of these former boundaries (FB1-FB5) have been detected by the survey in F2 and F5, manifesting as faint and discontinuous linear anomalies. The anomalies are thought to be caused by the contrast between the soil-fill of a former boundary ditch and the surrounding soils. The discontinuous nature of the anomalies may suggest low magnetic contrast in the prevailing soils, or that the former boundaries have been partially removed by subsequent ploughing.

Numerous parallel trend anomalies have been identified across the PDA. Slightly curvilinear, broadly-spaced parallel trend anomalies have been recorded throughout F2, aligned both east/west and north/south. These anomalies are caused by the medieval and post-medieval practice of ridge and furrow cultivation. More closely-spaced parallel linear trends across F2 are caused by modern cultivation.

The regular pattern of linear anomalies across F5 is characteristic of field drains.

4.3 GEOLOGICAL ANOMALIES

As discussed, a variable magnetic background has been identified across the PDA resulting in a plethora of discrete anomalies and short curvilinear trends. These are caused by localised variations in the depth and composition of the soils and the superficial deposits from which they derive. The anomalies coalesce into broader areas of enhancement either side of the Soar Brook. This is likely to be due to localised areas of clay, silt, sand and gravel within the alluvial superficial deposits.

4.4 QUARRYING ANOMALIES

Immediately south of the Sour Brook, within the north of F5, a broad and amorphous area of high magnitude magnetic enhancement (Q1 see Illus 15–17) has been identified. It is possible that the enhancement is caused by magnetically enhanced material backfilled into a former quarry. However, there is no historical evidence of extraction here and the anomaly, being low-lying and close to the Soar Brook, may equally be caused by alluvial material deposited during episodes of seasonal flooding.

4.5 ARCHAEOLOGICAL AND POSSIBLE ARCHAEOLOGICAL ANOMALIES

A clear area of archaeological activity (AAA1) has been identified in the north-west of F2. The area comprises a curving anomaly at the north-western site boundary which is thought to locate the eastern extent of a ditched enclosure (E1 see Illus 18-20). A gap in the anomaly may locate an entrance. Discrete anomalies within the enclosure, which are broader and of a higher magnitude than the discrete geological anomalies described above, have been interpreted as of possible archaeological origin. It is however, impossible to be confident of discriminating between geological anomalies and those which may be caused by archaeological features, such as pits or areas of burning, against this background.

Located 80m east of E1, a linear anomaly (D1) has been identified aligned north-west/south-east. The anomaly is 270m in length and it is notable that it appears to terminate at the interface between the underlying superficial deposits of Oadby Member -diamicton and Dunsmore Gravel (see Illus 11). It is possible that there is insufficient contrast in the soils overlying the diamicton for the ditch, if present, to manifest in the magnetic dataset. A large rectilinear enclosure (E2) is appended to the eastern side of D1, centred at SP 4414 9094, and measuring 100 east/west and at least 100m north/south. Fragmented linear and rectilinear anomalies within the interior of E2 form at least a further four enclosures (E3–E6).

Few anomalies of archaeological potential have been identified beyond the enclosure boundaries although isolated high magnitude anomalies (P1 and D1) to the east of the enclosures may locate an isolated pit and a ditch respectively.

A fragmented curvilinear anomaly, RD1, is identified in the west of F5, perhaps locating a ring-ditch. This interpretation is given credence considering the two scheduled burial mounds within 1km and also the close proximity of the anomalies to Watling Street Roman road. However, the anomaly is fragmented and may simply be caused by agricultural activity along the field edge. Other discrete anomalies along the course of Watling Street may be of interest, but are generally isolated and of low magnitude, and on this basis are ascribed a likely geological origin.

5 CONCLUSION

The survey has successfully evaluated the proposed development area, identifying an area of clear archaeological potential in the more elevated north-western part of the site. The area comprises a curving ditch, probably the eastern extent of an enclosure, as well as several rectilinear anomalies appended to the eastern side of a linear ditch. These anomalies are likely to locate Romano-British and possibly earlier prehistoric buried remains. No anomalies of definite archaeological potential have been identified alongside the A5 Watling Street, a Roman road which runs along the south-eastern site boundary, although a possible ring-ditch has been located and is ascribed a moderate archaeological potential. Elsewhere, anomalies have been identified which reflect the post-medieval agricultural landscape including ridge and furrow cultivation, field drains and former field boundaries. An area of localised magnetic disturbance locates the remains of a post-medieval or modern barn. With the exception of the area of archaeological activity in the north-west of the site, and the possible ring-ditch close to Watling Street, no anomalies of likely archaeological potential have been identified. It is notable, however, that all of the archaeological anomalies are located on localised superficial deposits of Dunsmore Gravel with no anomalies of archaeological potential identified over the prevailing Oadby Member deposits. It is possible that there is insufficient magnetic contrast within the soils overlying the Oadby diamicton for archaeological features to manifest as magnetic anomalies and therefore, archaeological features may extend beyond the Dunsmore Gravel deposits.

6 REFERENCES

Chartered Institute for Archaeologists (CIfA) 2014 ***Standard and guidance for archaeological geophysical survey*** (Reading) http://www.archaeologists.net/sites/default/files/CIfAS&GGeophysics_1.pdf accessed 6 September 2017

Cranfield University 2017 ***Cranfield Soil and Agrifood Institute Soilscapes*** www.landis.org.uk/soilscapes/ accessed 6 September 2017

Department of Communities and Local Government (DCLG) 2012 ***National Planning Policy Framework*** https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf accessed 6 September July 2017

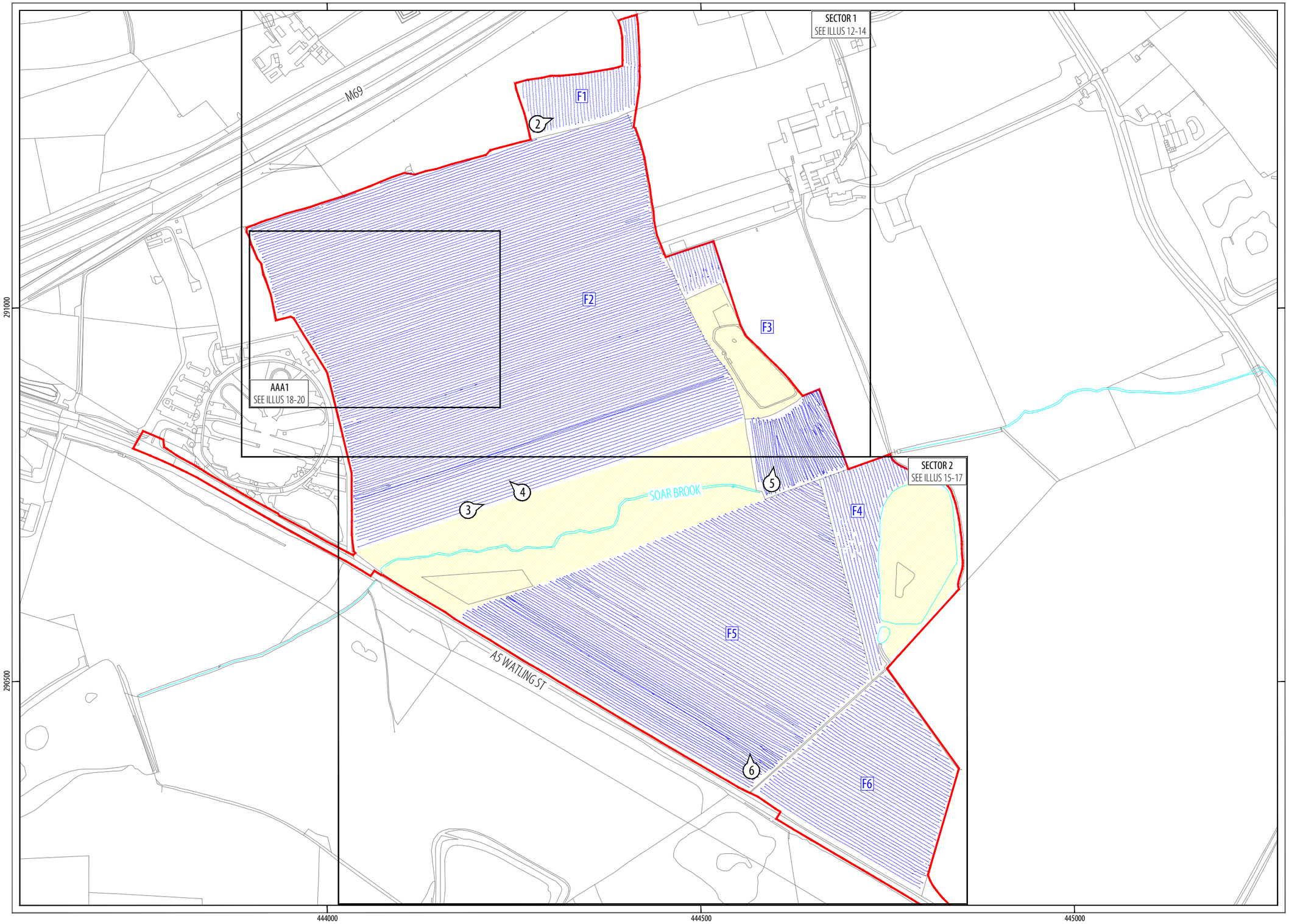
EDP 2017 ***Land at Junction 1, M69, Leicestershire: Archaeological and Heritage Assessment*** [unpublished client document] Ref EDP3594_01c

English Heritage 2008 ***Geophysical Survey in Archaeological Field Evaluation: Research and Professional Services Guidelines*** (2nd edition) http://content.historicengland.org.uk/images-books/publications/geophysical-survey-in-archaeological-field-evaluation/geophysics-guidelines.pdf accessed 6 September 2017

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

Headland Archaeology 2017 ***Land east of Junction 1, M69, Leicestershire: Written Scheme of Investigation for Geophysical Survey*** [unpublished client document] Headland Archaeology Ref JOHL/01

Natural Environment Research Council (NERC) 2017 ***British Geological Survey*** http://www.bgs.ac.uk/ accessed 6 September 2017



proposed development area
GPS swaths
area unsuitable for survey
location and direction of ILLUS 2-6

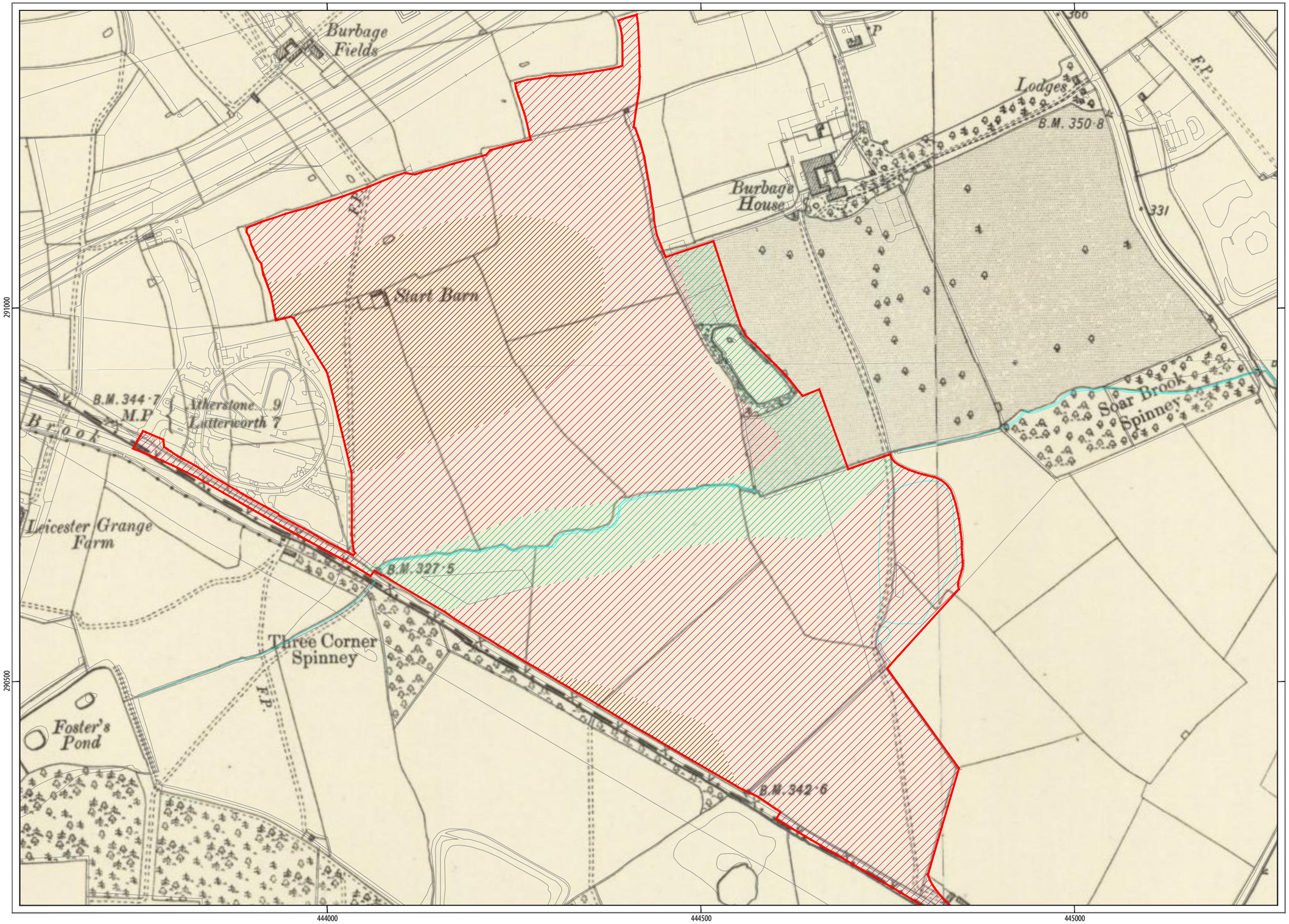
N
0 100m
scale 1:5,000 @ A3

PROJECT JOHL/01
Land east of Junction 1 M69
Leicestershire

CLIENT IM Properties Development Ltd

HEADLAND ARCHAEOLOGY
NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 7 Survey location showing GPS swaths (1:5000)



proposed development area
Oadby Member - diamicton
Alluvium - clay, silt, sand and gravel
Dunsmore Gravel - sand and gravel

N
0 100m
scale 1:5,000 @ A3

PROJECT JOHL/01
Land east of Junction 1 M69
Leicestershire

CLIENT IM Properties Development Ltd

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 8 Survey location showing superficial geology overlying six inch OS map (1888-1913) (1:5000)

proposed development area

nT
-1.0 2.0

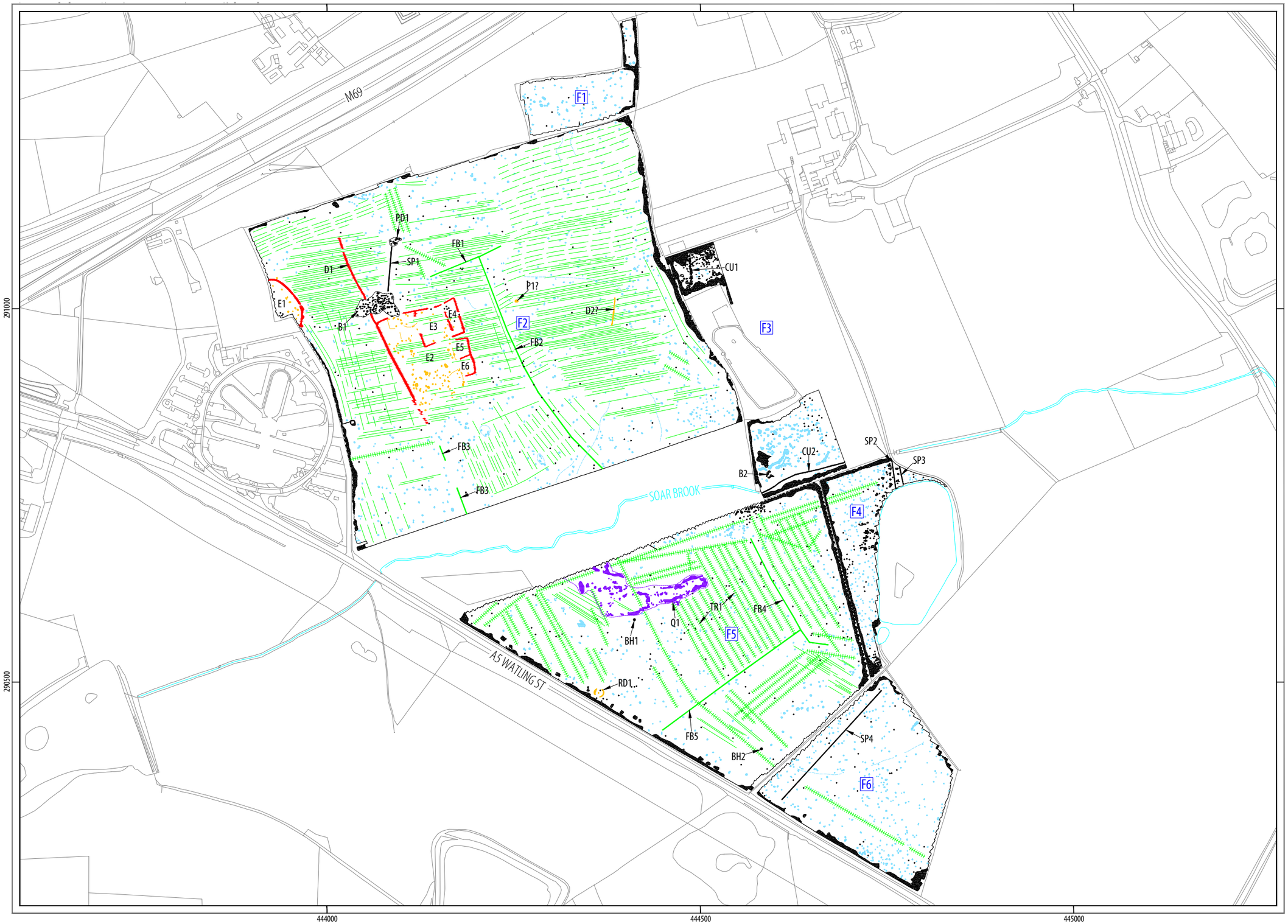
N
0 100m
scale 1:5,000 @ A3

PROJECT JOHL/01
Land east of Junction 1 M69
Leicestershire

CLIENT IM Properties Development Ltd

HEADLAND ARCHAEOLOGY
NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 9 Overall processed greyscale magnetometer data (1:5,000)



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

ABBREVIATIONS

B	building
BH	bore-hole
CU	culvert
D	ditch
E	enclosure
FB	former boundary
P	pit
PD	pond
Q	quarry
RD	ring-ditch
SP	service pipe
TR	trackway

N

0 100m

scale 1:5,000 @ A3

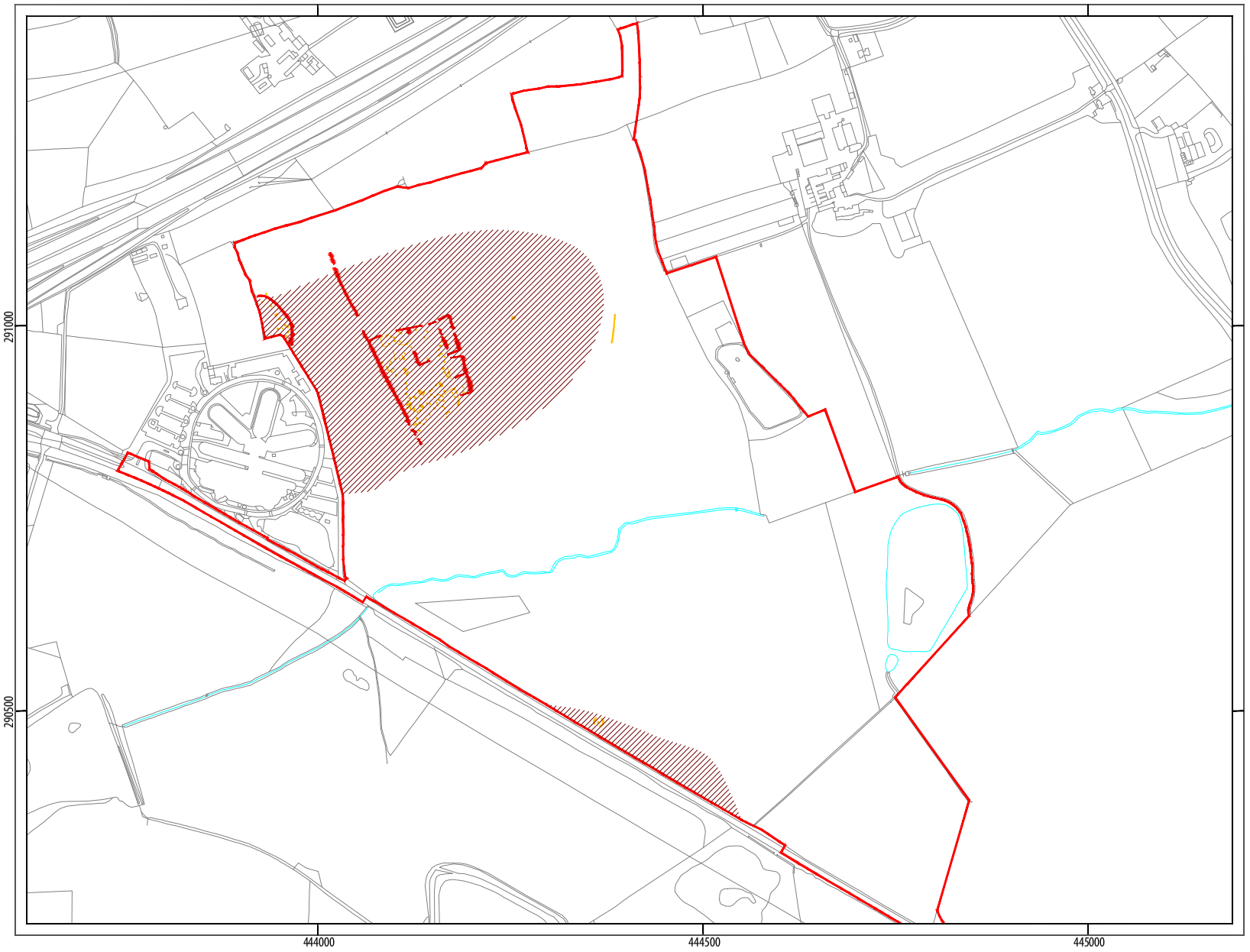
PROJECT JOHL/01
Land east of Junction 1 M69
Leicestershire

CLIENT IM Properties Development Ltd

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 10 Overall interpretation of magnetometer data (1:1,500)



proposed development area

Dunsmore Gravel - sand and gravel

TYPE OF ANOMALY	INTERPRETATION
linear trend	archaeology?
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

N

0 200m

scale 1:7,500 @ A4

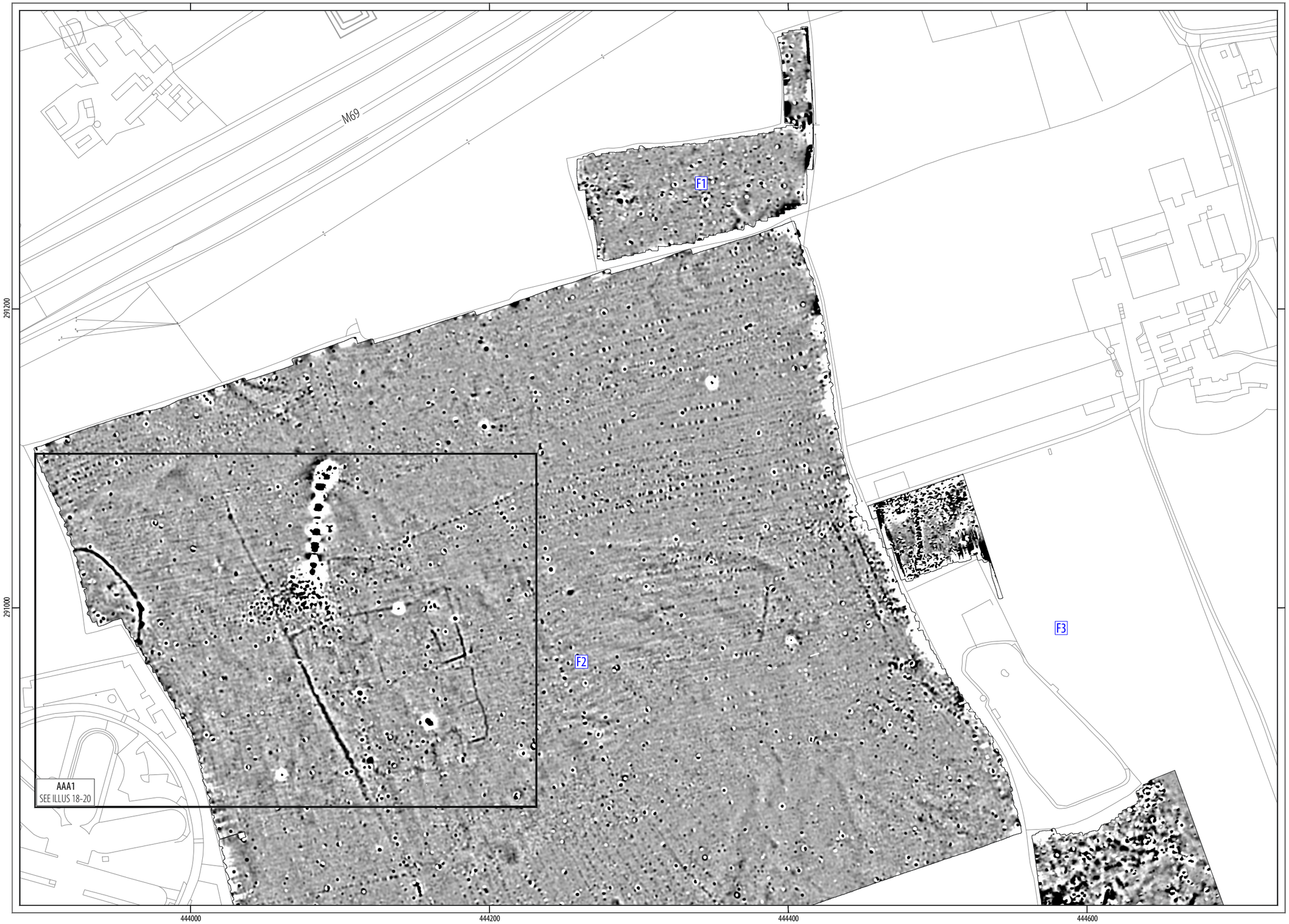
PROJECT JOHL/01
Land east of Junction 1 M69
Leicestershire

CLIENT IM Properties Development Ltd

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 11 Archaeological anomalies showing Dunsmore Gravel deposits (1:7,500)



nT
-1.0
2.0

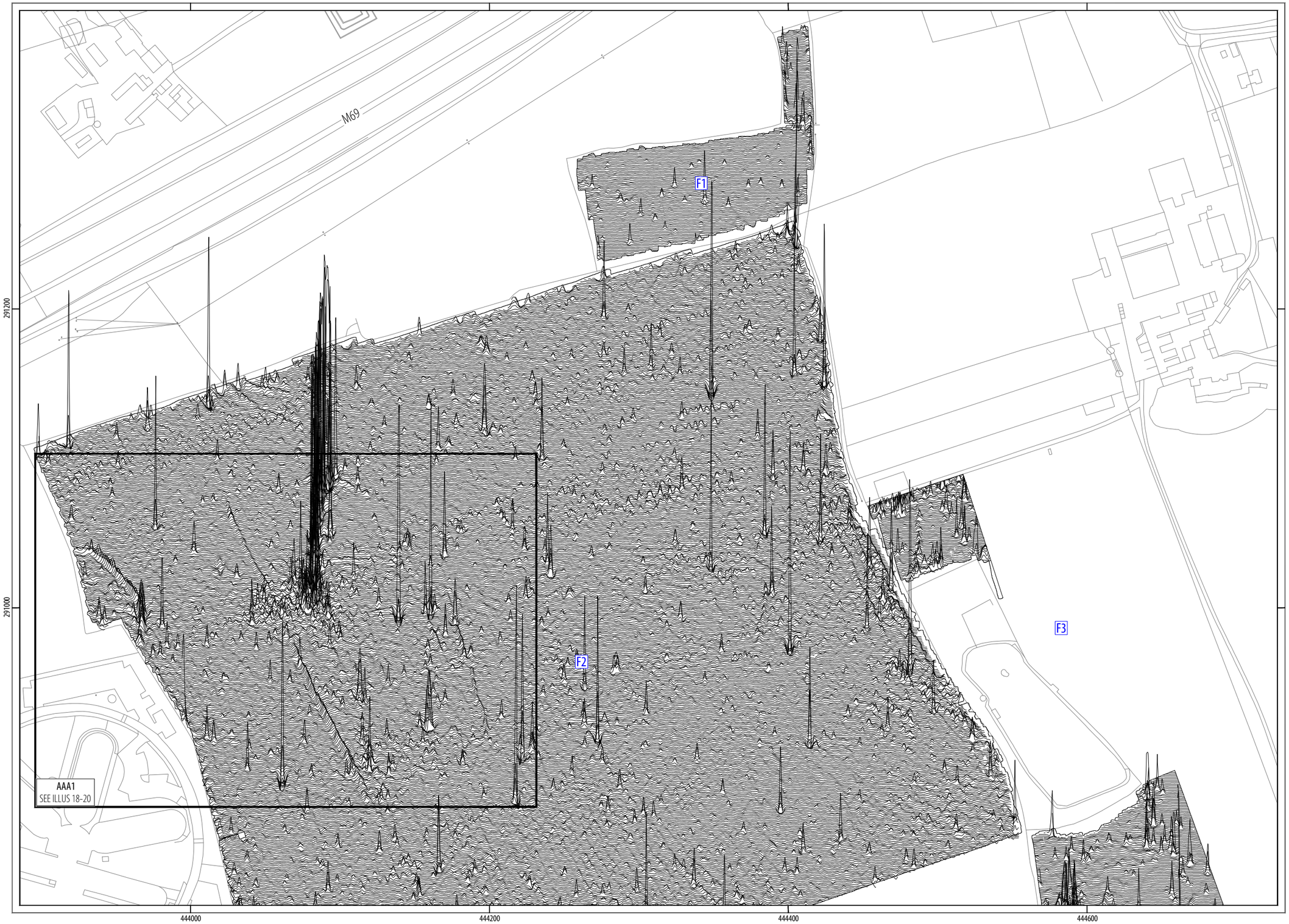
N
0
50m
scale 1:2,500 @ A3

PROJECT JOHL/01
Land east of Junction 1 M69
Leicestershire

CLIENT IM Properties Development Ltd

HEADLAND ARCHAEOLOGY
NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 12 Processed greyscale magnetometer data; Sector 1 (1:2,500)



40.0nT/cm

N

0 50m

scale 1:2,500 @ A3

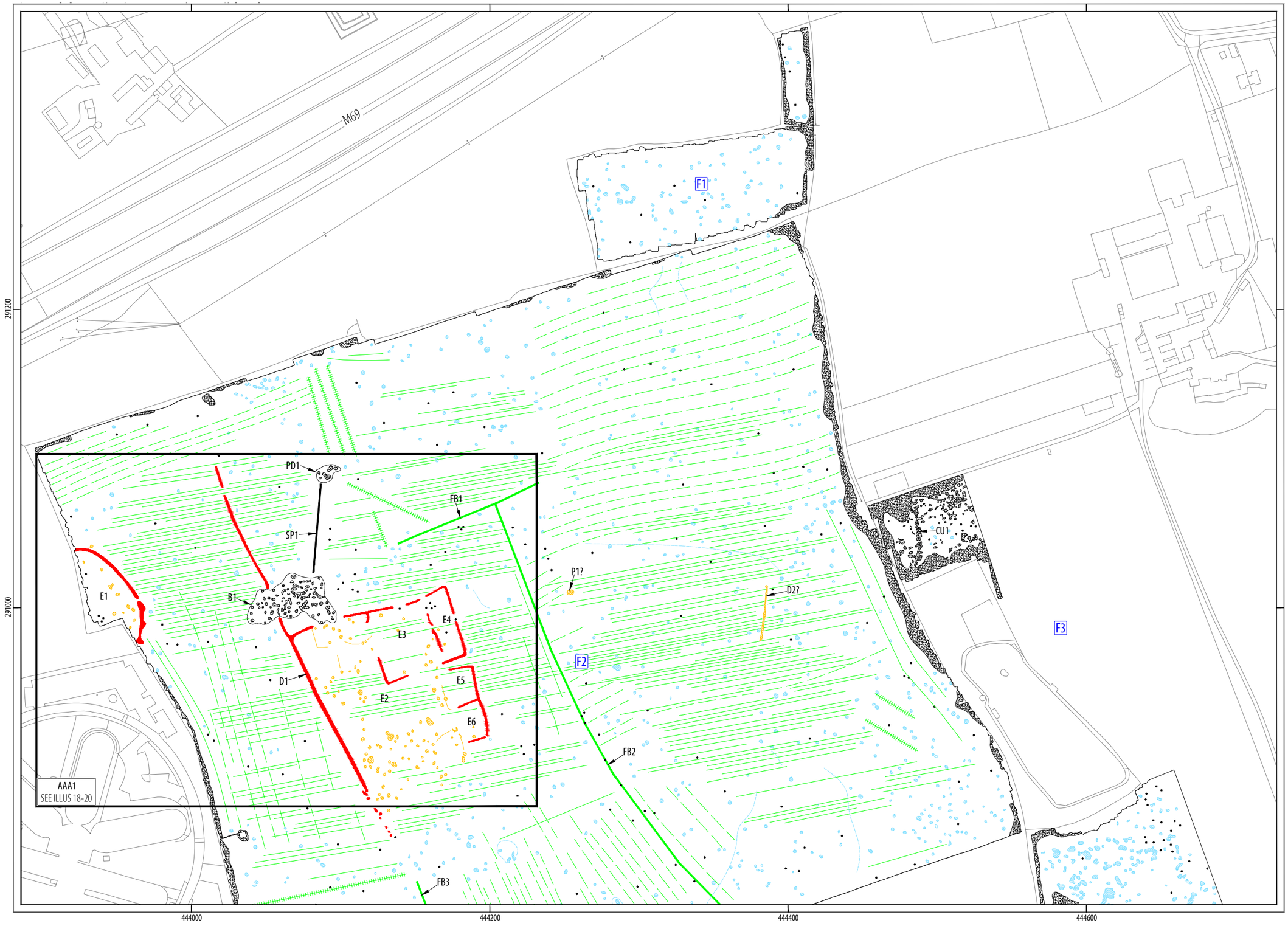
PROJECT JOHL/01
Land east of Junction 1 M69
Leicestershire

CLIENT IM Properties Development Ltd

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 13 XY trace plot of minimally processed magnetometer data; Sector 1 (1:2,500)



TYPE OF ANOMALY / INTERPRETATION

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

ABBREVIATIONS

B	building
CU	culvert
D	ditch
E	enclosure
FB	former boundary
P	pit
PD	pond
SP	service pipe

N

0 50m

scale 1:2,500 @ A3

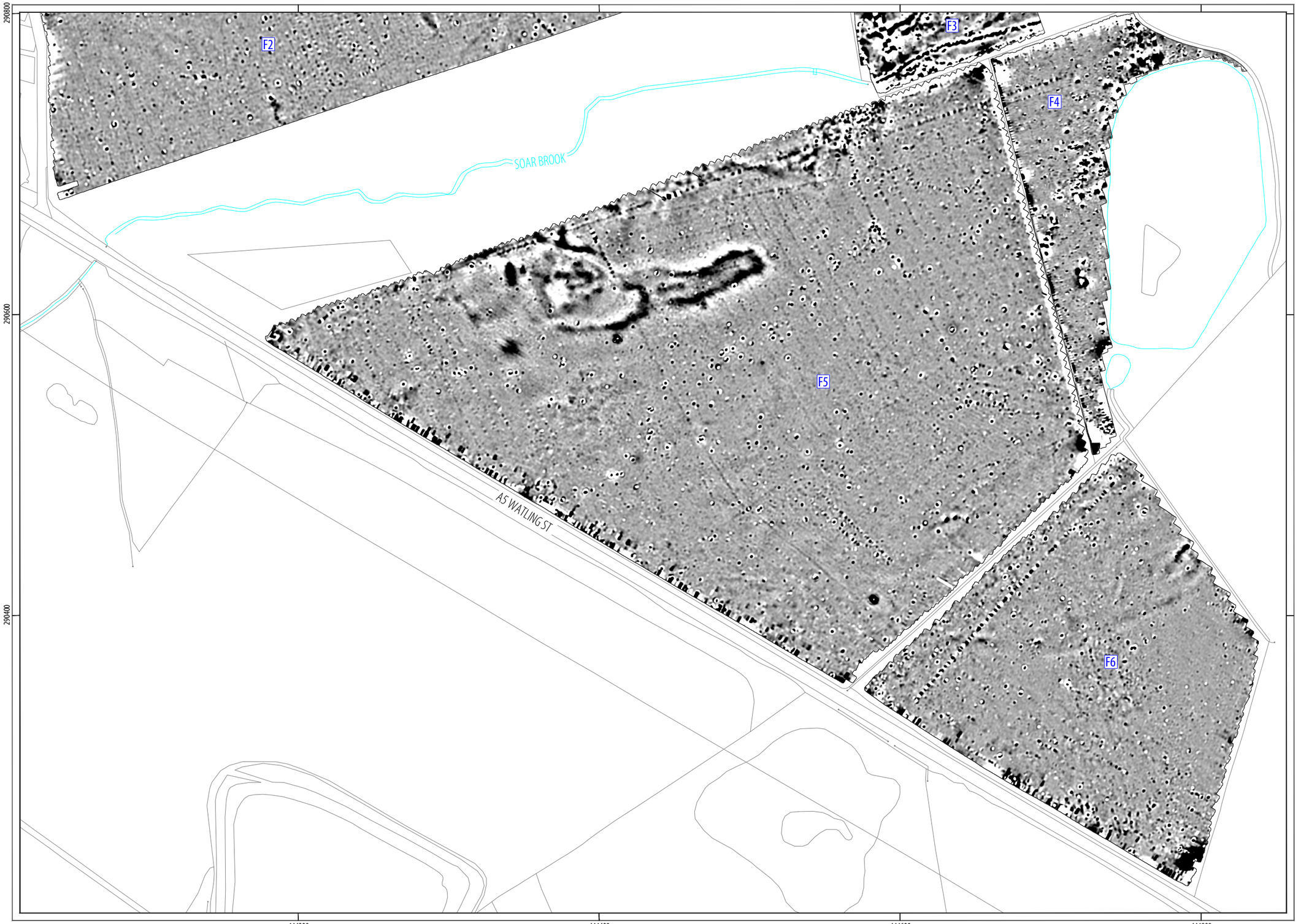
PROJECT JOHL/01
Land east of Junction 1 M69
Leicestershire

CLIENT IM Properties Development Ltd

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 14 Interpretation of magnetometer data; Sector 1 (1:2,500)



nT
-1.0
2.0

N
0
50m
scale 1:2,500 @ A3

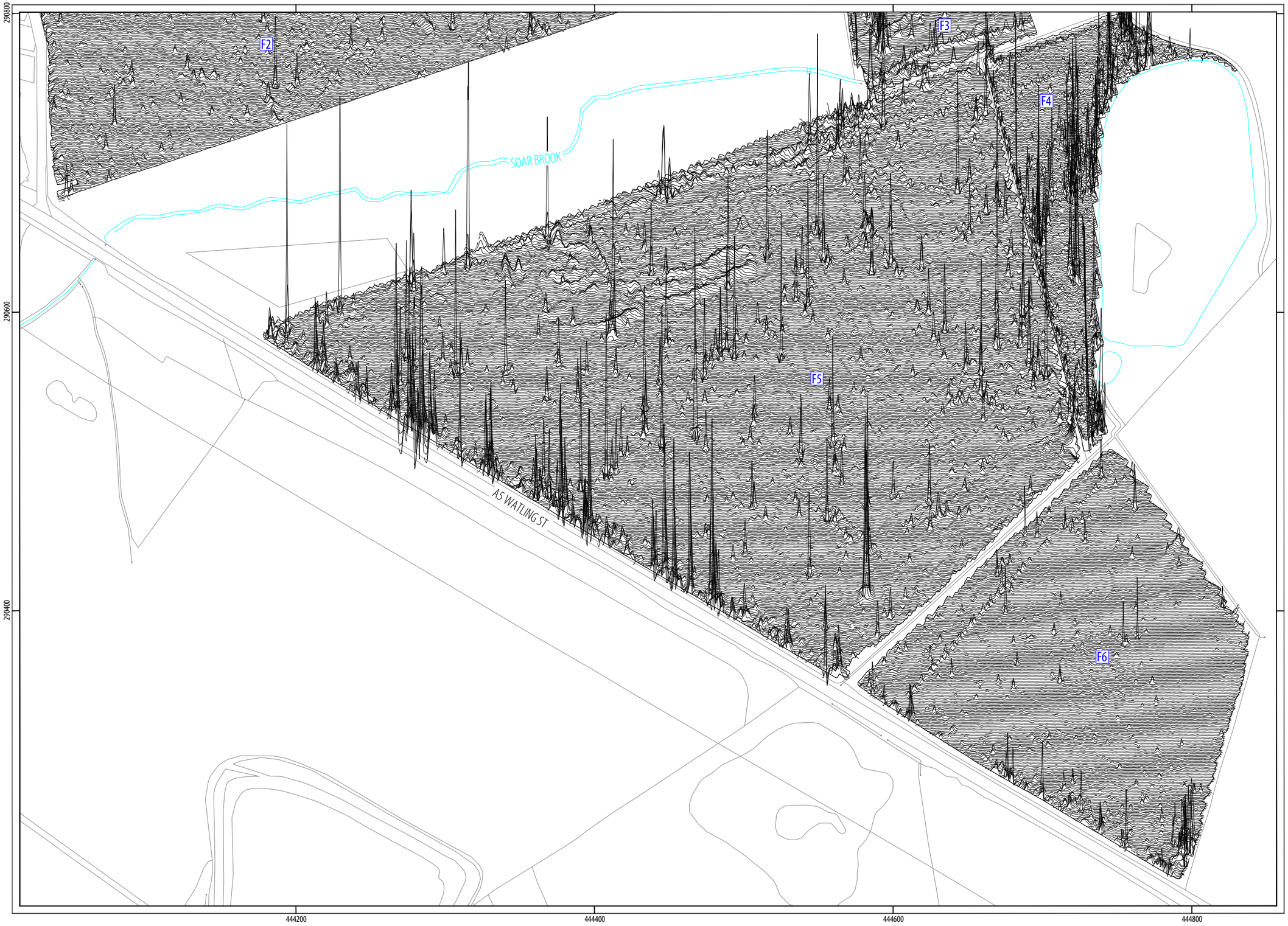
PROJECT JOHL/01
Land east of Junction 1 M69
Leicestershire

CLIENT IM Properties Development Ltd

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 15 Processed greyscale magnetometer data; Sector 2 (1:2,500)



40.0nT/cm

N

0 50m

scale 1:2,500 @ A3

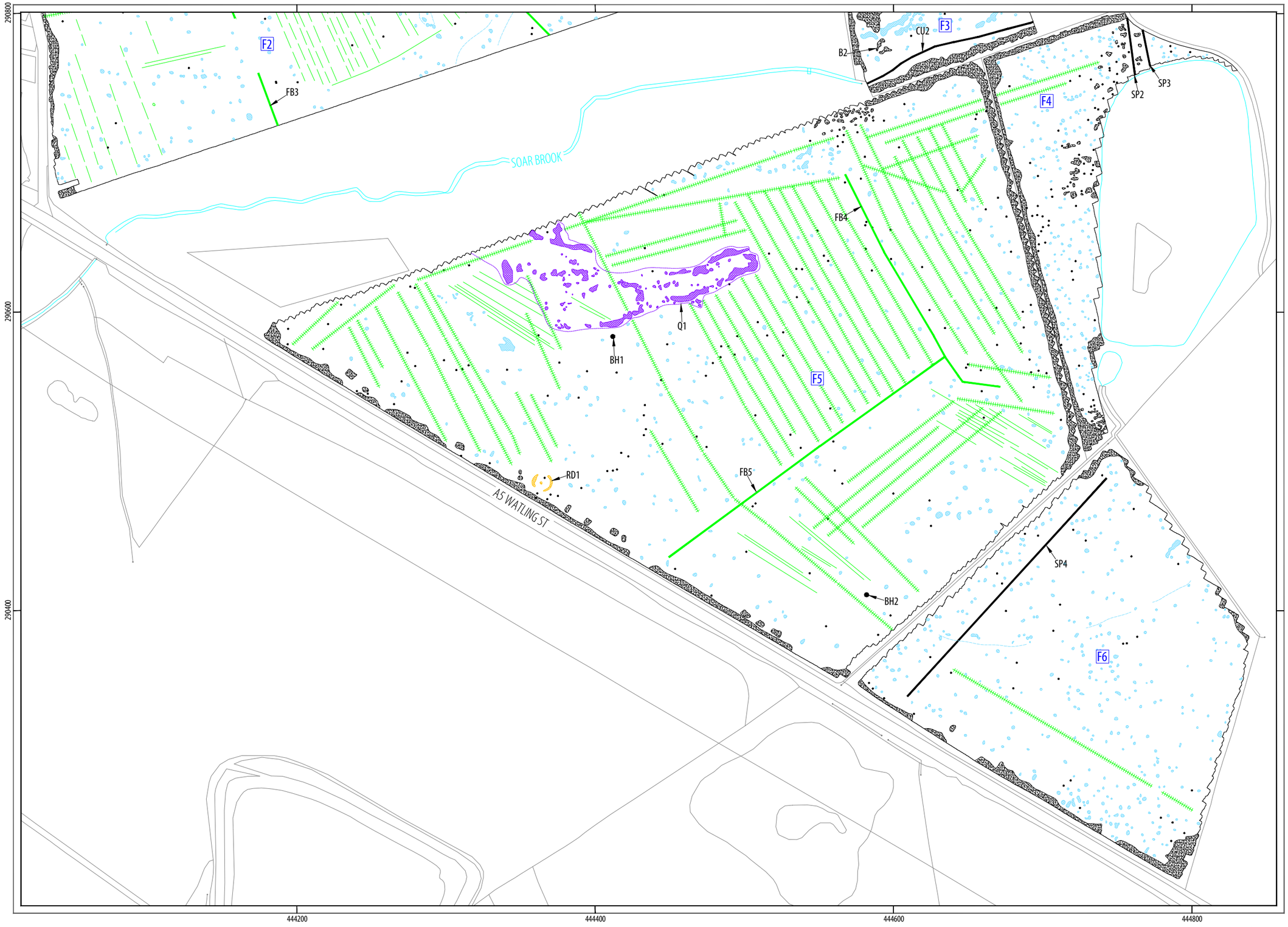
PROJECT JOHL/01
Land east of Junction 1 M69
Leicestershire

CLIENT IM Properties Development Ltd

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 16 XY trace plot of minimally processed magnetometer data; Sector 2 (1:2,500)



TYPE OF ANOMALY / INTERPRETATION

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

ABBREVIATIONS

B	building
BH	bore-hole
CU	culvert
FB	former boundary
Q	quarry
RD	ring-ditch
SP	service pipe
TR	trackway

N

0 50m

scale 1:2,500 @ A3

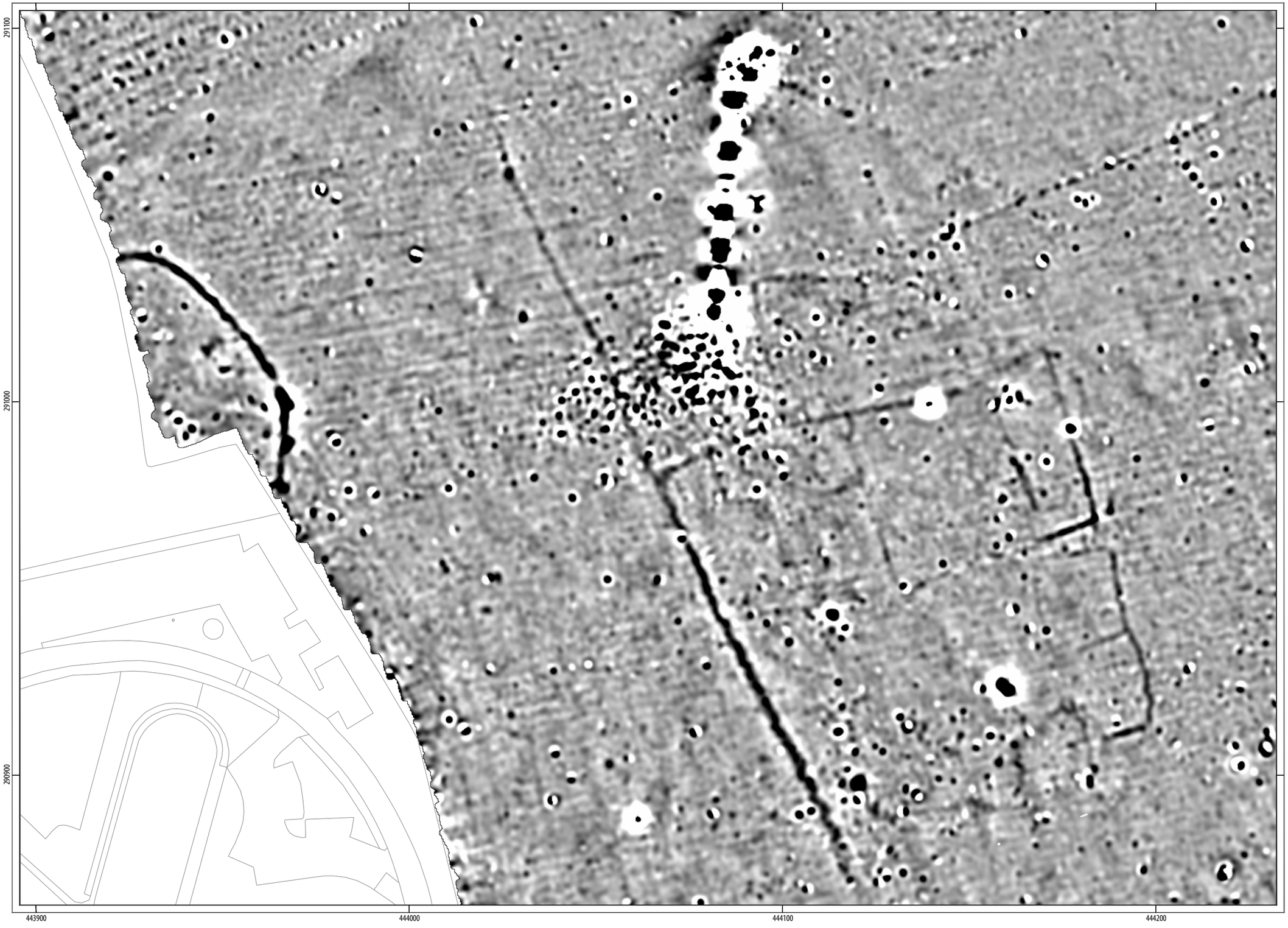
PROJECT JOHL/01
Land east of Junction 1 M69
Leicestershire

CLIENT IM Properties Development Ltd

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 17 Interpretation of magnetometer data; Sector 2 (1:2,500)



-1.0 nT 2.0

N

0 25m

scale 1:1,000 @ A3

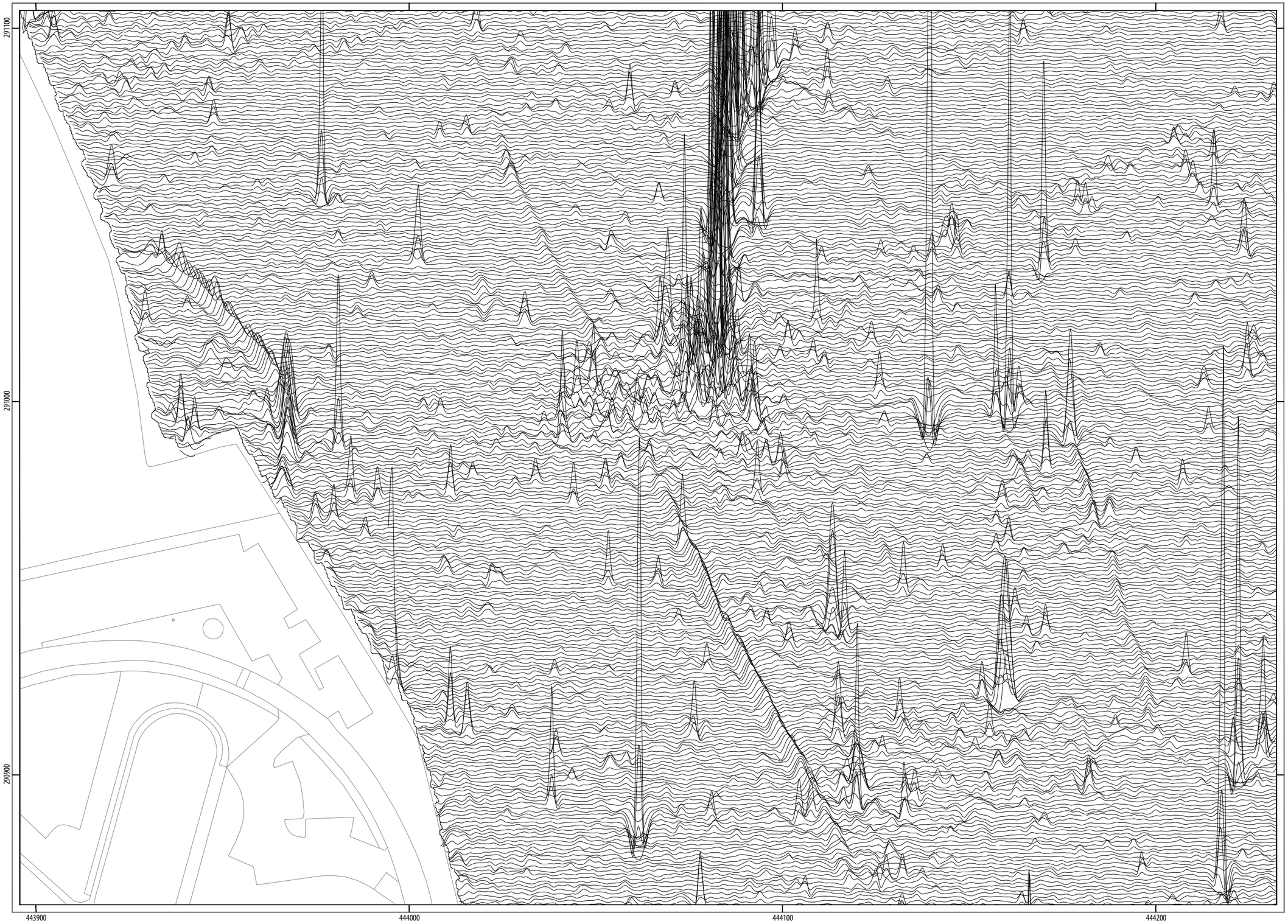
PROJECT JOHL/01
Land east of Junction 1 M69
Leicestershire

CLIENT IM Properties Development Ltd

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 18 Processed greyscale magnetometer data; AAA1 (1:1,000)



10.0nT/cm

N

0 25m

scale 1:1,000 @ A3

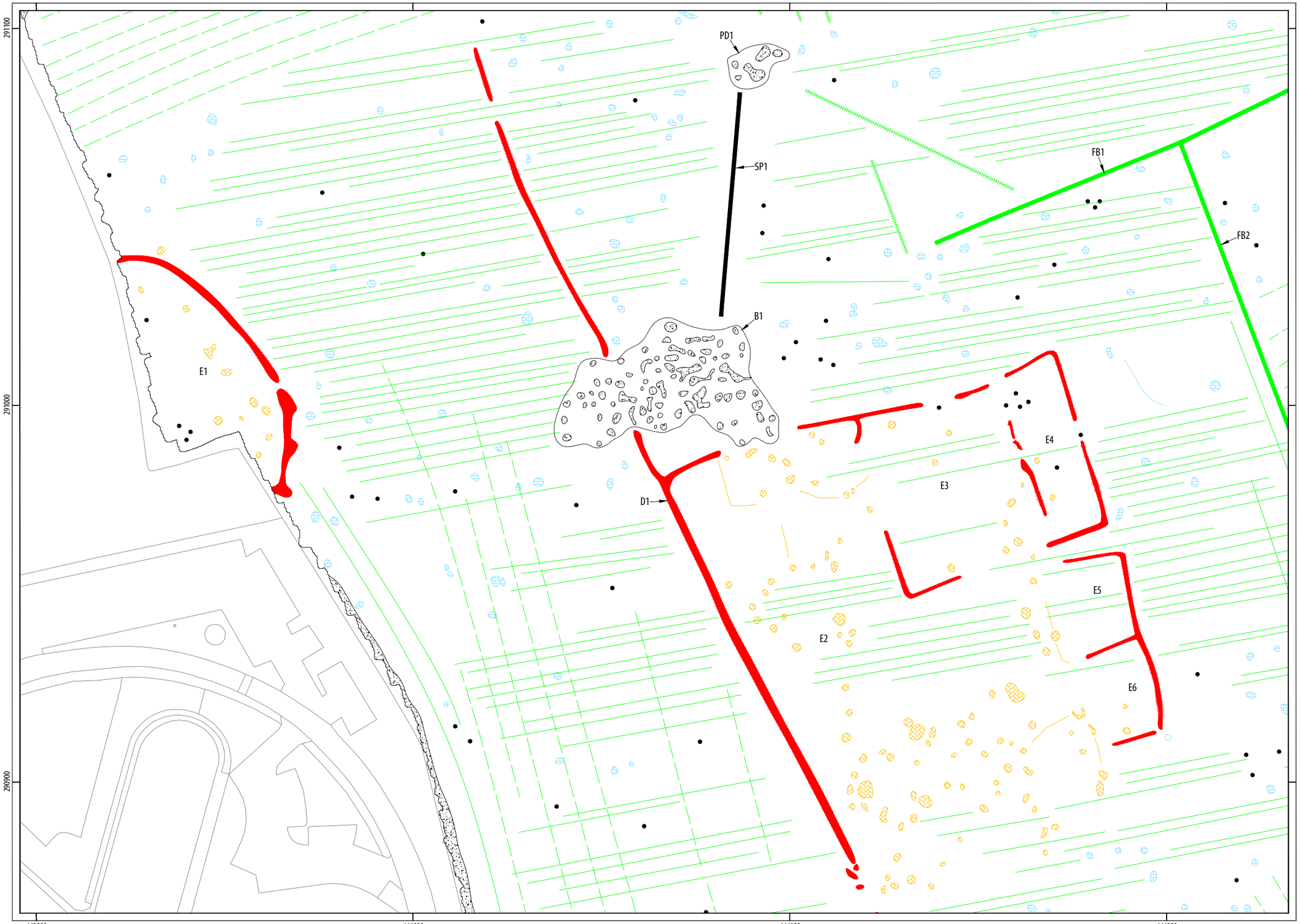
PROJECT JOHL/01
Land east of Junction 1 M69
Leicestershire

CLIENT IM Properties Development Ltd

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 19 XY trace plot of minimally processed magnetometer data; AAA1 (1:1,000)



TYPE OF ANOMALY / INTERPRETATION

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

ABBREVIATIONS

B	building
D	ditch
E	enclosure
FB	former boundary
PD	pond
SP	service pipe

N

0 25m

scale 1:1,000 @ A3

PROJECT JOHL/01
Land east of Junction 1 M69
Leicestershire

CLIENT IM Properties Development Ltd

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 20 Interpretation of magnetometer data; AAA1 (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.

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. In addition, the raw data will be deposited with the Archaeology Data Service (ADS) in accordance with Devon County Council's Specification for Geophysical Survey.

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: headland5-315189

Project details	
Project name	Land East of Junction 1, M69, Leicestershire
Short description of the project	Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey of a 112 hectare site, immediately north of the A69 at Throckley, west of Newcastle, to inform planning proposals for a proposed opencast coal and fireclay mine. The survey has successfully evaluated the site identifying a plethora of anomalies the overwhelming majority of which are consistent with post-medieval coal mining including former waggonways, coal pits and shafts. Numerous anomalies due to agricultural activity, including ridge and furrow cultivation, modern ploughing and field drains are also common throughout the site. The varying magnetic background across the survey area reflects changes in the underlying superficial deposits. A few anomalies of uncertain origin have been interpreted as of possible archaeological origin including one possible enclosure at the northern end of the site which corresponds with a cropmarks. Other cropmarks have not been identified in the data. An irregular pattern of linear anomalies in the south-eastern quarter of the site may locate the remnants of possible prehistoric enclosures although this interpretation is tentative and a geological origin is considered to be equally likely. On the basis of the magnetic survey the site is assessed as of low to moderate archaeological potential mostly centred on the waggonways and the cropmarks/anomalies at the northern end of the site.
Project dates	Start: 01-08-2017 End: 18-08-2017
Previous/future work	Not known / Not known
Any associated project reference codes	JOHL/01 - Sitecode
Type of project	Field evaluation
Site status	None
Current Land use	Cultivated Land 3 - Operations to a depth more than 0.25m
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	Rural commercial
Prompt	Direction from Local Planning Authority - PPG16
Position in the planning process	Not known / Not recorded
Solid geology (other)	Mercia Mudstone
Drift geology (other)	Oadby Member Diamicton
Techniques	Magnetometry
Project location	
Country	England
Site location	LEICESTERSHIRE OADBY AND WIGSTON OADBY Land East of Junction 1, M69, Leicestershire
Study area	55 Hectares
Site coordinates	SP 444747 290509 51.957732254519 -1.352701973427 51 57 27 N 001 21 09 W Point
Project creators	
Name of Organisation	Headland Archaeology
Project brief originator	Consultant
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	"Survey"
Digital Media available	"Geophysics"
Paper Archive Exists?	No
Project bibliography 1	
Publication type	Grey literature (unpublished document/manuscript)
Title	Land East of Junction 1, M69, Leicestershire
Author(s)/Editor(s)	David Hasrrison
Date	2017
Issuer or publisher	Headland Archaeology
Place of issue or publication	Leeds
Description	A4 Bound Report
Entered by	Grahame Appleby (grahame.appleby@leicester.gov.uk)
Entered on	23 April 2018

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
Unit 16 | Hillside | Beeston Rd | Leeds LS11 8ND
t 0113 387 6430
e north@headlandarchaeology.com

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

www.headlandarchaeology.com