

WFSN17



PARK 38, LAND OFF CARTWRIGHT LANE, SOUTH NORMANTON, DERBYSHIRE

GEOPHYSICAL SURVEY

commissioned by Q+A Planning
on behalf of Limes Developments Ltd

May 2018

PARK 38, LAND OFF CARTWRIGHT LANE, SOUTH NORMANTON, DERBYSHIRE

GEOPHYSICAL SURVEY

commissioned by Q+A Planning
on behalf of Limes Developments Ltd

May 2018

© 2018 by Headland Archaeology (UK) Ltd

This report contains OS data and digital data supplied by Q&A Planning. Ordnance Survey © Crown copyright and database right 2018.

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

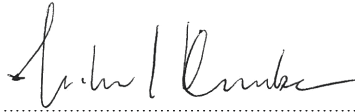
PROJECT INFO:

HA Project Code **WFSN17** / NGR **SK 45984 57436** / Parish **South Normanton** / Local Authority **Bolsover District Council** / OASIS Ref. **headland5-316512**

PROJECT TEAM:

Project Manager **Mike Kimber** / Author **Alistair Webb** / Fieldwork **Krasimir Dyulgerski, Ross Bishop** / Graphics **David Harrison, Julia Bastek-Michalska**

Approved by **Mike Kimber**



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



PROJECT SUMMARY

Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey, covering approximately 12 hectares, within several fields north off Cartwright Lane, South Normanton, to inform planning proposals for a hybrid retail, leisure and hotel development with associated parking and landscaping. A recently completed desk-based assessment identified several buildings, structures and earthworks, mostly associated with 19th century coal extraction, which were assessed as of historical interest. The geophysical survey has identified anomalies consistent with the former mining and has defined the extent of the former colliery workings, the spread of demolition material and mine waste and the possible location of one of the mine shafts. Other anomalies are indicative of post-medieval and modern ploughing, former tracks and boundaries, geological boundaries and topography. In addition linear ditch type anomalies have been identified, predominantly in the southern half of the site. The alignment of these anomalies (at 45 degrees to the current field layout) could indicate a much earlier system of land division and on this basis these anomalies have been interpreted as of possible archaeological interest. Overall the site is assessed as having a low to moderate archaeological potential based on the results of the survey.

CONTENTS

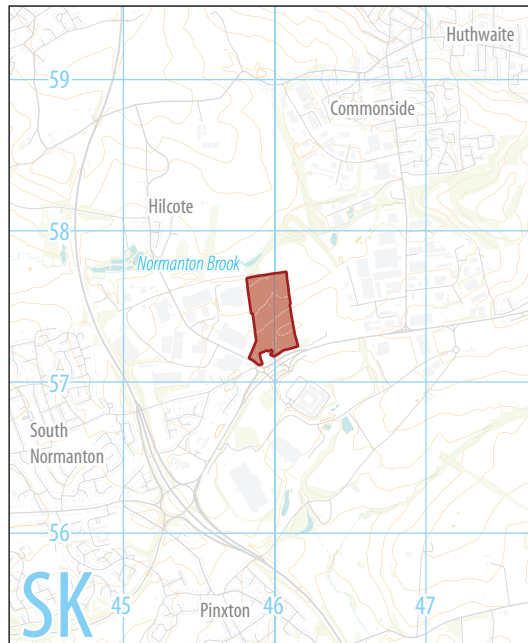
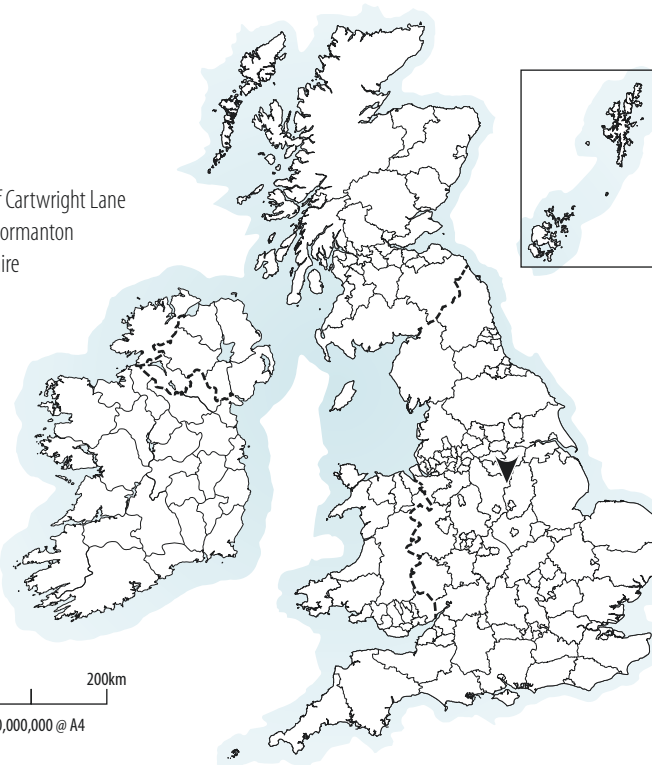
1	INTRODUCTION	1
	1.1 SITE LOCATION, LAND-USE AND TOPOGRAPHY	1
	1.2 GEOLOGY AND SOILS	1
2	ARCHAEOLOGICAL BACKGROUND	1
3	AIMS, METHODOLOGY AND PRESENTATION	2
	3.1 MAGNETOMETER SURVEY	2
	3.2 REPORTING	3
4	RESULTS AND DISCUSSION	3
	4.1 FERROUS AND MODERN ANOMALIES	4
	4.2 GEOLOGICAL ANOMALIES	4
	4.3 POSSIBLE ARCHAEOLOGICAL ANOMALIES	4
5	CONCLUSION	5
6	REFERENCES	5
7	APPENDICES	19
	APPENDIX 1 MAGNETOMETER SURVEY	19
	APPENDIX 2 SURVEY LOCATION INFORMATION	20
	APPENDIX 3 GEOPHYSICAL SURVEY ARCHIVE	20
	APPENDIX 4 DATA PROCESSING	20
	APPENDIX 5 OASIS DATA COLLECTION FORM: ENGLAND	21

LIST OF ILLUSTRATIONS

ILLUS 1 SITE LOCATION	VIII
ILLUS 2 FIELD 4, LOOKING NORTH	2
ILLUS 3 FIELD 6, LOOKING SOUTH	3
ILLUS 4 SURVEY LOCATION SHOWING GPS SWATHS (1:2,500)	7
ILLUS 5 SURVEY LOCATION OVERLYING THE 1888–1913 SIX INCH OS MAP AND SHOWING DERBYSHIRE HER DARA (1:2,500)	9
ILLUS 6 SURVEY LOCATION CONTOURS AND BEDROCK GEOLOGY (1:2,500)	11
ILLUS 7 PROCESSED GREYSCALE MAGNETOMETER DATA (1:2,000)	13
ILLUS 8 XY TRACE PLOT OF MINIMALLY PROCESSED MAGNETOMETER DATA (1:2,000)	15
ILLUS 9 INTERPRETATION OF MAGNETOMETER DATA (1:2,000)	17

Park 38
 Land off Cartwright Lane
 South Normanton
 Derbyshire

0 200km
 1:10,000,000 @ A4



0 100m
 1:5,000 @ A4

 proposed development area



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

PARK 38, LAND OFF CARTWRIGHT LANE, SOUTH NORMANTON, DERBYSHIRE

GEOPHYSICAL SURVEY

1 INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned by Q+A Planning Ltd on behalf of Limes Developments Ltd (the client), to undertake a geophysical (magnetometer) survey of land to the north of Cartwright Lane, South Normanton, Derbyshire where the client is preparing a hybrid planning application for the demolition of existing buildings and dwellings and the construction of retail and leisure units and hotel with associated infrastructure and landscaping.

The work was undertaken in accordance with a Written Scheme of Investigation (Harrison, 2017) submitted to, and approved by Steve Baker, Derby and Derbyshire Development Control Archaeologist, the archaeological advisor to Bolsover District Council, 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 on December 20 and 21st 2017.

1.1 SITE LOCATION, LAND-USE AND TOPOGRAPHY

The proposed development area (PDA) occupies a roughly rectangular block of land covering approximately 14 hectares, centred at NGR 445984 357436, to the north of the A38 (Alfreton Road), adjacent to the Carter Lane East/Berristow Lane/Cartwright Lane roundabout (see Illus 1). The PDA comprises an area of derelict and overgrown land together with Berristow Farm, including a farmhouse and numerous sheds and outbuildings. The survey was restricted to the agricultural land to the north of the farm, an area

of approximately 12 hectares, which comprised twelve fields under permanent pasture (see Illus 2 and Illus 3); Field 5 had been subdivided into smaller paddocks.

The PDA is undulating with an elevation between 120m Above Ordnance Datum (AOD) and 145m AOD with the highest ground forming a ridge aligned broadly south-west/north-east across the centre of the PDA. This ridge corresponds with a sandstone outcrop (see Illus 4).

1.2 GEOLOGY AND SOILS

The underlying bedrock geology comprises Pennine Middle Coal Measures Formation, a mixture of siltstone, mudstone and sandstone. An outcrop of sandstone is recorded across the middle of the site which corresponds with a ridge of higher ground (see Illus 4). There are no recorded superficial deposits (NERC 2017).

The soils are classified in the Soilscape 17 association, characterised as slowly permeable, seasonally wet acid loams and clays (Cranfield University 2017).

2 ARCHAEOLOGICAL BACKGROUND

The information below is abstracted from an Archaeological Desk-Based Assessment (Headland Archaeology 2017) of the PDA.

The assessment found that there are buildings of mostly 20th century date and earthworks in the PDA (although not necessarily within the survey area) which are of historic interest being shown on the first edition Ordnance Survey and in one case on the tithe map of 1843.



ILLUS 2 Field 4, looking north

The PDA was previously the site of South Normanton Colliery (see Illus 5), which was accessed by a track or tramway which still survives as an earthwork. Other earthworks within the PDA include an inclined plane and a probable spoil heap, both of which are considered to be of historic interest; an evaluation trench across the inclined plane in advance of a neighbouring development found a stone base to the tramway. The proposed development will impact on these identified heritage assets which are considered to be of low importance.

The assessment concluded that 'construction activities within the PDA also have the potential to impact on any currently unidentified below ground remains that may be present within the site. Such remains could be of prehistoric or Roman date and would most likely be of low importance, although they could contribute to regional research objectives. The extent of previous disturbance as a result of mining activity is not known and there is potential that waste material from the deep shaft mining was distributed across the PDA and could obscure and possibly damage or preserve evidence of earlier activity'.

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 survey area. 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 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



ILLUS 3 Field 6, looking south

frame. The system was programmed to take readings at a frequency of 10Hz (allowing for a 10–15cm sample interval) on roaming traverses (swaths – see Illus 6) 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 1:5,000. Illus 2 and Illus 3 are site condition photographs. Illus 4 is a 1:2,500 scale survey location plan showing contours and bedrock geology whilst Illus 5 displays the Derbyshire HER data within the site overlain on an early Ordnance Survey map base, also at 1:2,500. The GPS swaths and field numbers are shown on Illus 6. The fully processed (greyscale) data, minimally processed data (XY traceplot) and an accompanying interpretative plot are presented at a scale of 1:2,000 in Illus 7 to 9 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 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 very good (see Illus 2 and Illus 3) and consequently the overall quality of the data collected was good throughout.

The data exhibits a very variable magnetic background across the central and northern parts of the survey area due to the level of disturbance primarily as a consequence of the 19th century mining and the recent demolition of several structures. Against this

background other anomalies have been identified and these 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. There is no obvious clustering to these discrete 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.

Three linear dipolar anomalies (Illus 8 – SP1, SP2 and SP3) are due to sub-surface pipes.

High magnitude linear anomaly (Illus 8 – FT1) locates the continuation of an extant track accessing the site from Normanton Brook Road. FT2, of similar magnitude, possibly marks the continuation of the trackway/tramway accessing the former colliery from the south.

Magnetic disturbance around field edges is due to ferrous material within or close to the adjacent field boundaries, tracks or extant structures, and is of no archaeological interest. h2]

A single large area of magnetic disturbance (Illus 8 – AD1) across the southern quarter of F2, to the south of the FT1, corresponds with the former location of South Normanton Colliery and is caused by the sub-surface remains of the mine and shaft and material which has been used to infill the site during remediation, probably from the dismantled colliery structures. No definite outline of specific buildings can be discerned but the location of one of the mine shafts has tentatively been identified and the possibility that there are other in-situ remains cannot be discounted.

Immediately north of FT1 is another area of magnetic disturbance (Illus 8 – AD2). The responses here are slightly less intense than over the colliery site but still of very high magnitude. This disturbance is almost certainly also caused by demolition material, or perhaps mining spoil, from the colliery.

A third, smaller, area of magnetic disturbance (Illus 8 – MD3) in the north-eastern corner of F6 is probably due to the demolished remains of Winter/Wincobank Farm.

AGRICULTURAL ANOMALIES

Analysis of historic OS mapping indicates that the current field boundaries have changed very little since the production of the tithe map in 1843. There has been some minor modification of the boundary between F2 and F3 where an arcing band of trees has been planted replacing the formerly straight boundary shown on the historic mapping. No trace of the former boundary can be seen

due to the extremely high magnitude responses recorded over the site of the former colliery.

The only other change is along the southern edge of F1 where the formerly straight side (as shown on the 1843 tithe map) has been replaced by a slightly curving boundary which was recorded on the 1884 Ordnance Survey mapping and which is still extant today. Linear anomalies FB1 locates the original mid-19th century boundary.

Throughout the PDA slightly curving closely spaced linear anomalies are recorded aligned broadly north/south parallel with the long axis of the current field system. These anomalies are most clearly visible in F4 and F5 but are identified across most parts of the PDA and are due to ridge and furrow cultivation. In F6 the anomalies extend across the tithe map boundary suggesting that the ploughing post-dates 1843.

Parallel linear trend anomalies, aligned north-west/south-east in F3 and F2, oblique to the alignment of the current field layout and to the direction of cultivation, are probably field drains. Other isolated linear trends are also interpreted as of likely agricultural origin.

4.2 GEOLOGICAL ANOMALIES

Three broad, parallel anomalies (GB1, 2 and 3) correlate with, and are caused by, the geological boundary between the two differing variants of Pennine Middle Coal Measures Formation bedrock (see Illus 4) and by the accumulation of soil along breaks of slope; the alignment of the anomalies exactly matches the contours (see Illus 4).

4.3 POSSIBLE ARCHAEOLOGICAL ANOMALIES

Several linear anomalies have been identified none of which can be definitely interpreted as of agricultural, modern or geological origin. There is no obvious pattern to these anomalies, which are distributed across all parts of the PDA and therefore they have been interpreted as of possible archaeological origin, perhaps soil-filled ditches (D), although non-archaeological causes are also considered equally plausible.

Perhaps of greatest potential are two intersecting linear anomalies, D1 (aligned north-west/south-east) and D2 (aligned south-west/north-east), which are clearly visible in F4 and F5. These anomalies are aligned oblique to the field boundaries and direction of ploughing and could be caused by soil filled ditches, perhaps forming part of an earlier system of field division.

The remaining linear anomalies are shorter and lower in magnitude linear anomalies and include D3, aligned east/west which looks to continue to extend from F11 (the west of Berristow Farm) into F5, and D4 and D5 (in F6 and F3 respectively) which are both on the same alignment as D2.

The remaining anomalies are all in F5 and comprise the parallel anomalies D6 in the south-east corner of the PDA and D7 and D8 which again are on similar alignments as D2 and D1 respectively.

Whilst all of the anomalies described above have been interpreted as potentially archaeological this interpretation is considered to be tentative and they could equally be interpreted as agricultural, perhaps field drains.

5 CONCLUSION

The survey has successfully evaluated the PDA revealing the extent of 19th century mining activity, the demolished remains of a former farmhouse, evidence of post-medieval/modern ploughing and other recent agricultural activity and geological boundaries. The presence of in-situ below ground remains from the South Normanton Colliery cannot be discounted.

In addition several linear anomalies of uncertain origin have been identified. As a non-archaeological origin cannot be confidently stated, the possibility that they may be of archaeological potential cannot either be discounted. This, together with the presence of archaeological cropmarks in the immediate vicinity, has led to the interpretation of these anomalies as of possible archaeological origin, being caused by soil filled ditches forming the truncated remains of a (possibly Iron Age/Roman) field system which predates the current layout. However, it is acknowledged that this interpretation is tentative.

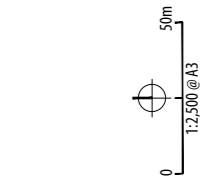
On the basis of the geophysical survey, the PDA is assessed as having a low to moderate archaeological potential.

6 REFERENCES

- Chartered Institute for Archaeologists (CIfA) 2014 *Standard and guidance for archaeological geophysical survey* (Reading) http://www.archaeologists.net/sites/default/files/CIfAS&Geophysics_1.pdf accessed 8 January 2018
- Cranfield University 2017 *Cranfield Soil and Agrifood Institute Soilscales* <http://www.landis.org.uk/soilscales/> accessed 8 January 2018
- 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 8 January 2018
- English Heritage 2008 *Geophysical Survey in Archaeological Field Evaluation: Research and Professional Services Guidelines* (2nd edn) <http://content.historicengland.org.uk/images-books/publications/geophysical-survey-in-archaeological-field-evaluation/geophysics-guidelines.pdf> accessed 8 January 2018
- Gaffney C & Gater J (2003) *Revealing the Buried Past: Geophysics for Archaeologists* Stroud
- Harrison D (2017) *PARK 38 (Land off Cartwright Lane), South Normanton, Derbyshire. Written Scheme of Investigation for Geophysical Survey* [unpublished client document] Ref WFSN17
- Natural Environment Research Council (NERC) 2017 *British Geological Survey* <http://www.bgs.ac.uk/> accessed 8 January 2018



- ▭ proposed development area
- ⊙ location and direction of ILLUS 2-3
- Pennine Middle Coal Measures Formation - mudstone, siltstone and sandstone
- Pennine Middle Coal Measures Formation - sandstone

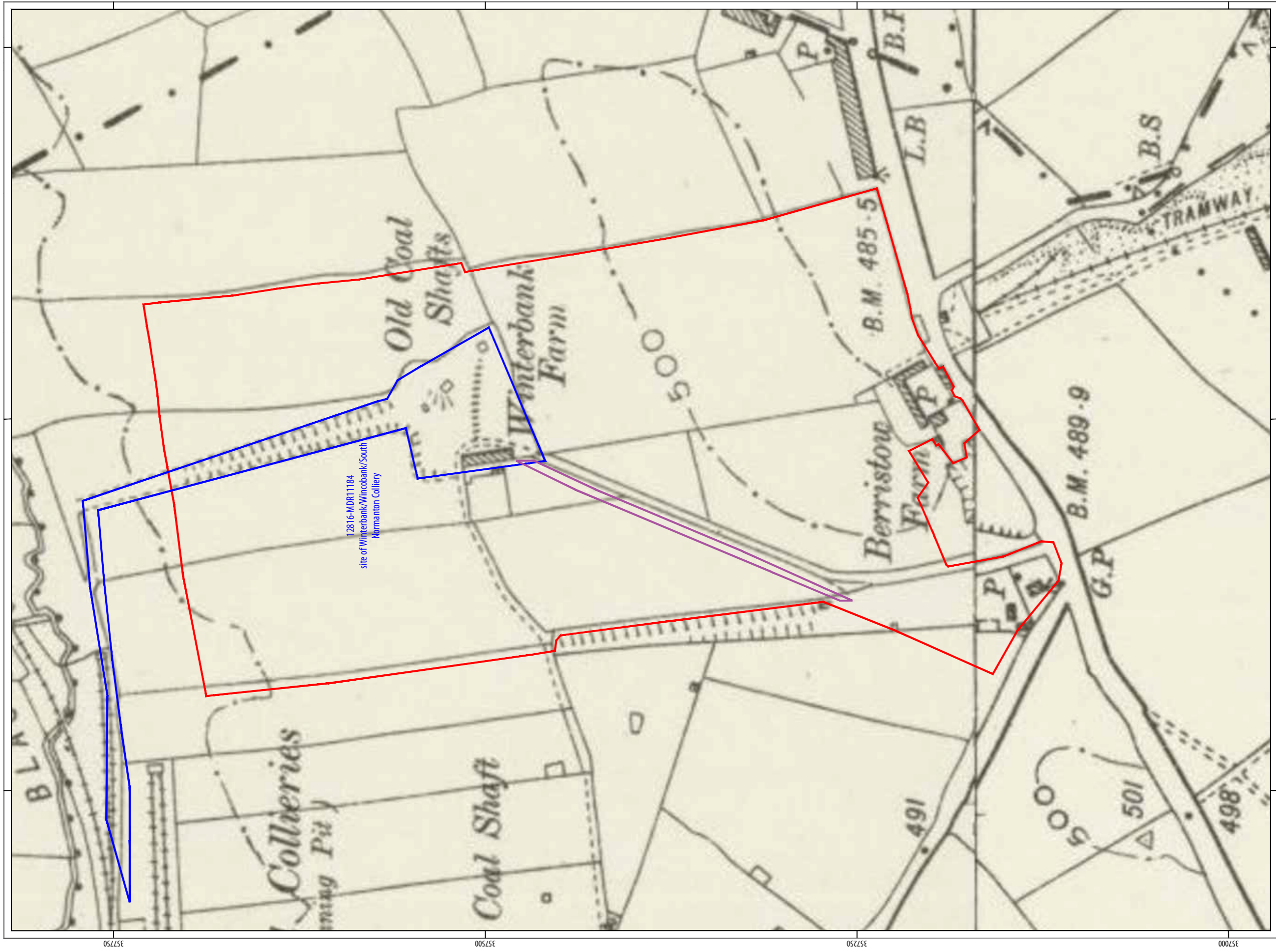


PROJECT
 WFSN17
 PARK 38
 Land off Cartwright Lane
 South Normanton
 Derbyshire
 Q&A Planning

CLIENT
 Q&A Planning

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

ILLUS 4 Survey location showing GPS swaths (1:2,500)



12816-MDR11184
site of Winterbank/Wincobank/South
Normanton Colliery

proposed development area
Derbyshire HER data
tramway identified in DBA

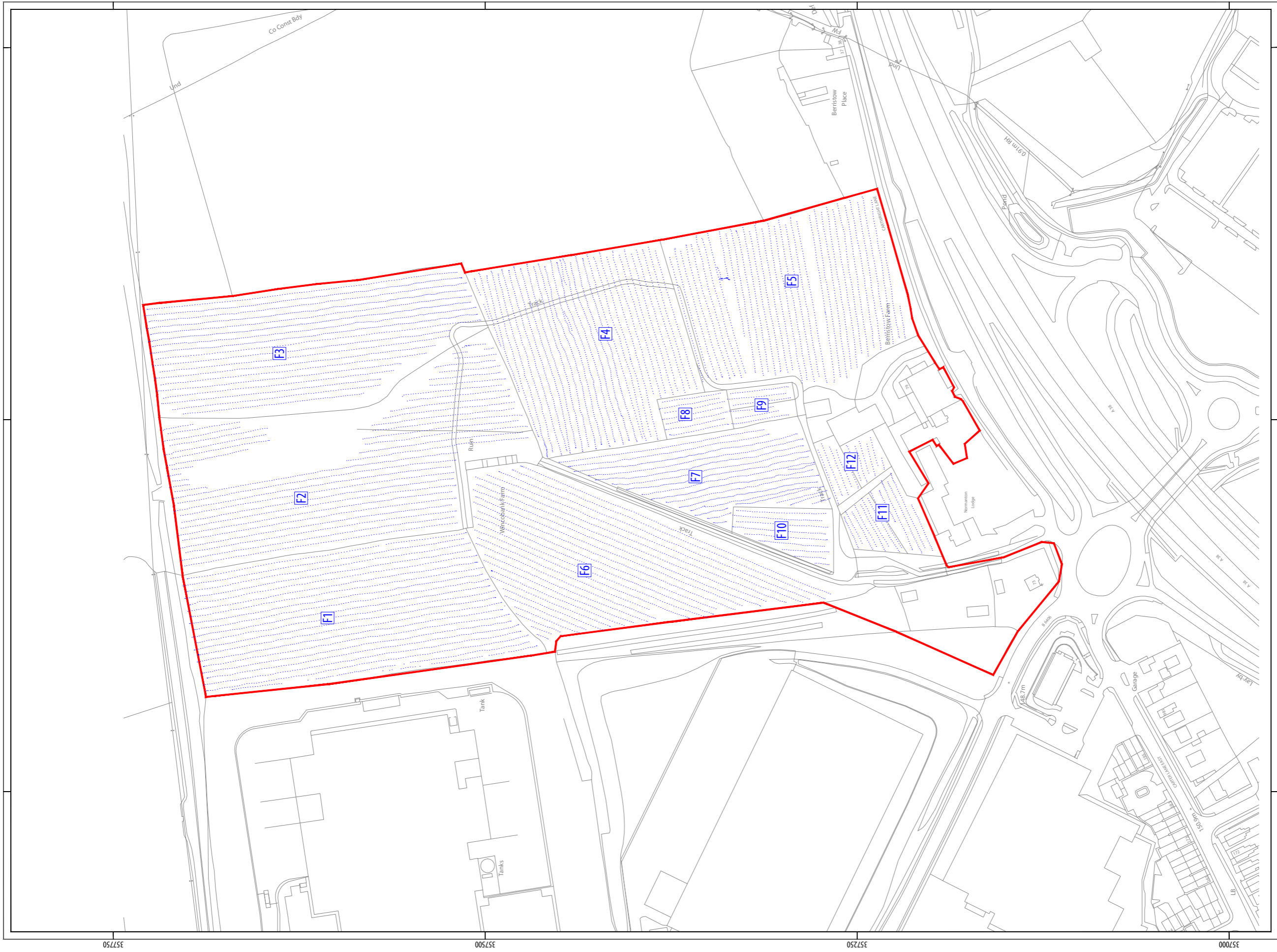


PROJECT
WFSN17
PARK 38
Land off Cartwright Lane
South Normanton
Derbyshire
Q&A Planning

CLIENT
Leeds LS11 8ND
0113 387 6490
www.headlandarchaeology.com



ILLUS 5 Survey location overlying the 1888–1913 six inch OS map and showing Derbyshire HER data (1:2,500)



 proposed development area
 GPS swaths

44600

44650

446250

PROJECT WFSN17
 PARK 38
 Land off Cartwright Lane
 South Normanton
 Derbyshire

CLIENT Q&A Planning

HEADLAND
ARCHAEOLOGY

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

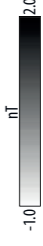


ILLUS 6 Survey location contours and bedrock geology (1:2,500)



446000

445750

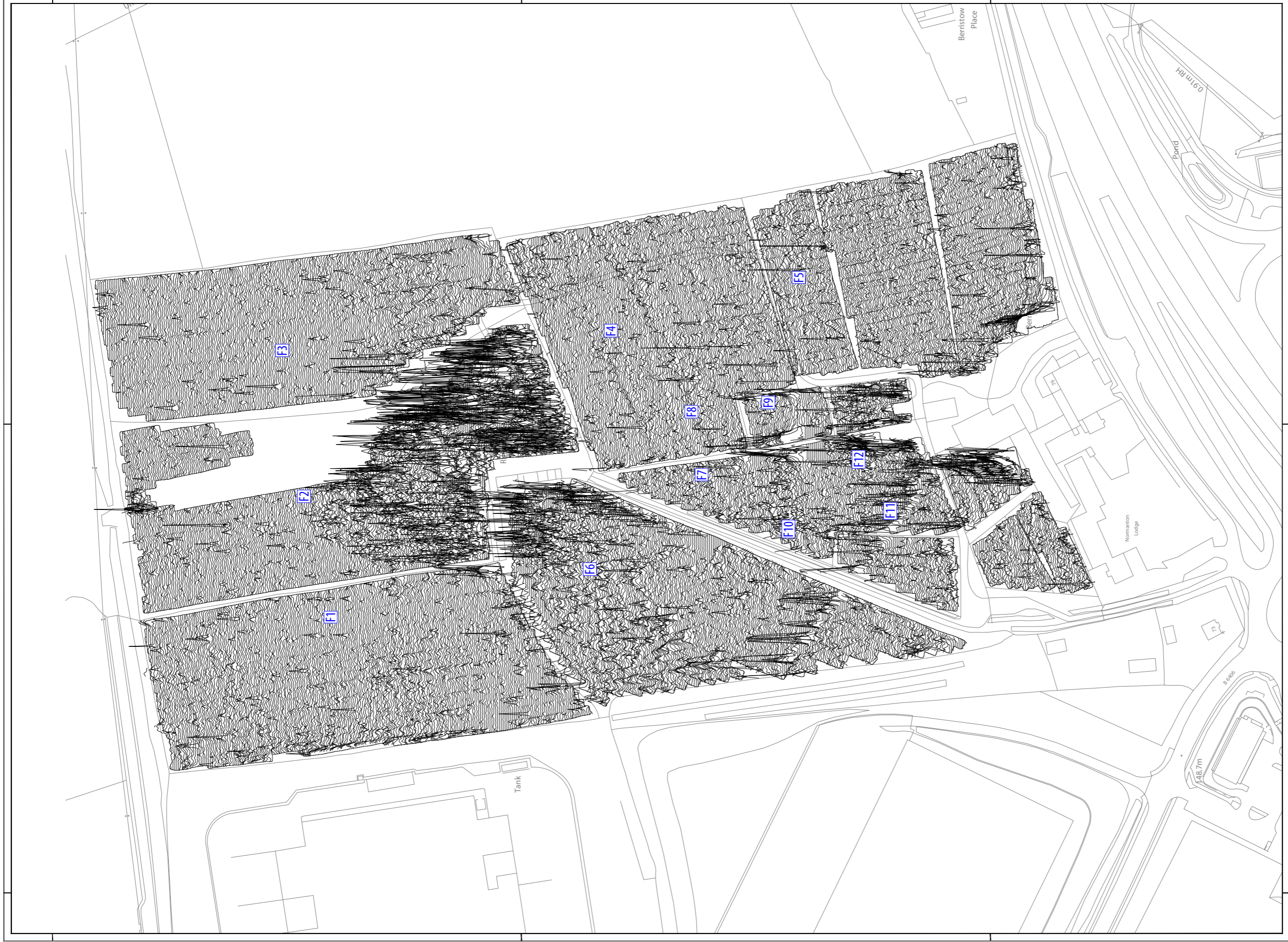


**HEADLAND
ARCHAEOLOGY**
NORTH
Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6490
www.headlandarchaeology.com

PROJECT
WFSN17
PARK 38
Land off Cartwright Lane
South Normanton
Derbyshire
Q&A Planning

CLIENT

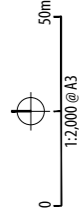




446000

445750

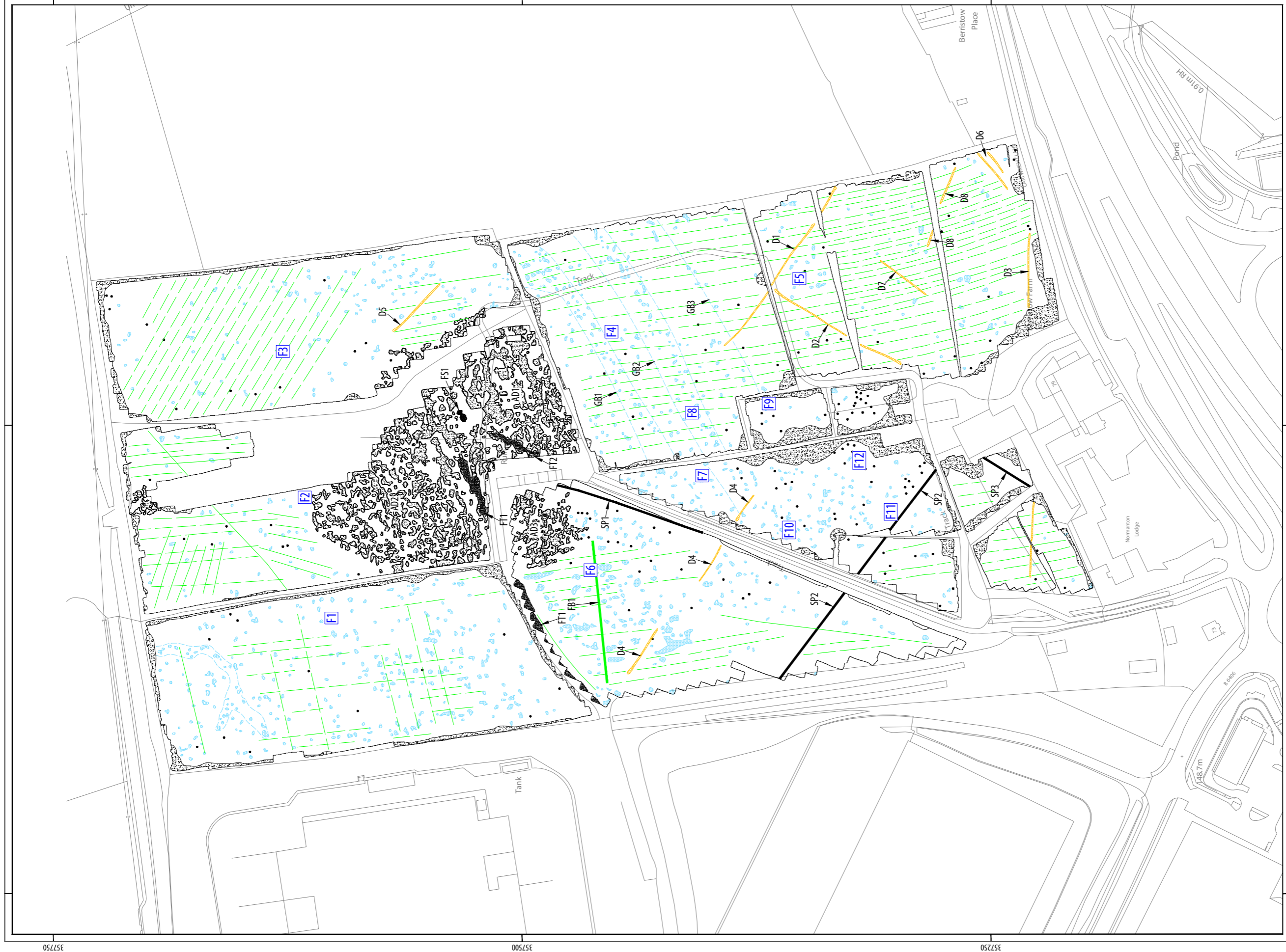
55.0m/cm



PROJECT WFSN17
PARK 38
Land off Carwright Lane
South Normanton
Derbyshire
CLIENT Q&A Planning

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

ILLUS 8 XY trace plot of minimally processed magnetometer data (1:2,000)



<p>TYPE OF ANOMALY</p> <ul style="list-style-type: none"> ● dipolar isolated ● magnetic disturbance — dipolar linear — linear trend — linear trend — linear 	<p>INTERPRETATION</p> <ul style="list-style-type: none"> ferrous material ferrous material service pipe ridge and furrow agricultural former field boundary 	<p>TYPE OF ANOMALY</p> <ul style="list-style-type: none"> — linear ● magnetic enhancement ● magnetic enhancement 	<p>INTERPRETATION</p> <ul style="list-style-type: none"> geology geology archaeology? 	<p>ABBREVIATIONS</p> <ul style="list-style-type: none"> AD area of magnetic disturbance D ditch FB former field boundary FS former shaft FT former trackway GB geological boundary SP service pipe 	<p>PROJECT</p> <p>WFSN17 PARK 38 Land off Cartwright Lane South Normanton Derbyshire</p> <p>CLIENT</p> <p>Q&A Planning</p>	<p>HEADLAND ARCHAEOLOGY</p> <p>NORTH Unit 16, Hillside, Beeston Road Leeds LS11 8ND 0113 387 6430 www.headlandarchaeology.com</p>
--	--	--	---	--	--	--

ILLUS 9 Interpretation of magnetometer data (1:2,000)

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.

APPENDIX 4 DATA PROCESSING

The gradiometer data has been presented in this report in processed greyscale, minimally 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 (no de-striping has been applied to the minimally processed greyscale data). The XY trace data has also been clipped to remove extreme values and to improve data contrast.

The processed data has also been interpolated to project the data onto a regular grid. 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.

APPENDIX 5 OASIS DATA COLLECTION FORM: ENGLAND

OASIS ID: headland5-316512

Project details	
Project name	PARK 38, LAND OFF CARTWRIGHT LANE, SOUTH NORMANTON, DERBYSHIRE
Short description of the project	Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey, covering approximately 12 hectares, within several fields north off Cartwright Lane, South Normanton, to inform planning proposals for a hybrid retail, leisure and hotel development with associated parking and landscaping. A recently completed desk-based assessment identified several buildings, structures and earthworks, mostly associated with 19th century coal extraction, which were assessed as of historical interest. The geophysical survey has identified anomalies consistent with the former mining and has defined the extent of the former colliery workings, the spread of demolition material and mine waste and the possible location of one of the mine shafts. Other anomalies are indicative of post-medieval and modern ploughing, former tracks and boundaries, geological boundaries and topography. In addition linear ditch type anomalies have been identified, predominantly in the southern half of the site. The alignment of these anomalies (at 45 degrees to the current field layout) could indicate a much earlier system of land division and on this basis these anomalies have been interpreted as of possible archaeological interest. Overall the site is assessed as having a low to moderate archaeological potential based on the results of the survey.
Project dates	start: 20-12-2017 end: 21-12-2017
Previous/future work	No / Yes
Any associated project reference codes	WFSN17 - Contracting Unit No.
Type of project	Field evaluation
Site status	None
Current Land use	Grassland Heathland 5 - Character undetermined
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	Extensive green field commercial development (e.g. shopping centre, business park, science park, etc.)
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Pre-application
Solid geology (other)	Pennine Coal Measures
Drift geology (other)	None
Techniques	Magnetometry
Project location	
Country	England
Site location	DERBYSHIRE BOLSOVER SOUTH NORMANTON Park 38, Land off Cartwright Lane, South Normanton
Study area	12 Hectares
Site coordinates	SK 45984 57436; 53.111829304639-1.312953273768 53 06 42 N 001 18 46 W Point
Project creators	
Name of Organisation	Headland Archaeology
Project brief originator	Q and A Planning
Project design originator	Headland Archaeology
Project director/manager	Kimber, M
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	Park 38, Land off Cartwright Lane, South Normanton; Geophysical Survey
Author(s)/Editor(s)	Webb, A.
Date	2018
Issuer or publisher	Headland Archaeology
Place of issue or publication	Leeds
Description	PDF [A]
Entered by	David Harrison (david.harrison@headlandarchaeology.com)
Entered on	8 May 2018



© 2018 by Headland Archaeology (UK) Ltd

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 | Ivyford 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