Geophysical Survey Report

of

Land north of Pretoria Road

Ibstock, Leicestershire

For

Orion Heritage Ltd

On Behalf Of

Lightsource Renewable Energy

Magnitude Surveys Ref: MSSK268

April 2018

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Abstract

Magnitude Surveys was commissioned to assess the subsurface archaeological potential of a c. 8ha area of land north of Pretoria Road, Ibstock, Leicestershire. A fluxgate gradiometer survey was successfully completed and no anomalies of a probable or possible archaeological origin have been identified. The geophysical results reveal a relatively quiet area, with evidence for agricultural activity on site demonstrated by ephemeral ploughing trends, field drains, an infilled pond and a former field boundary. Modern activity, such as fencing and overhead powerlines, have had a minimal impact on the results.

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1. Introduction

1.1. Magnitude Surveys Ltd (MS) was commissioned by Orion Heritage Ltd on behalf of Lightsource Renewable Energy to undertake a geophysical survey on a c.8ha area of land north of Pretoria Road, Ibstock, Leicestershire (SK 4292 1054).

1.2. The geophysical survey comprised hand-carried GNSS-positioned fluxgate gradiometer survey.

1.3. The survey was conducted in line with the current best practice guidelines produced by Historic England (David et al., 2008), the Chartered Institute for Archaeologists (CIfA, 2014) and the European Archaeological Council (Schmidt et al., 2015).

1.4. The survey commenced on 28 March 2018 and took 2 days to complete.

2. Quality Assurance

2.1. The survey was conducted in line with the current best practice guidelines produced by Historic England (David et al., 2008), the Chartered Institute for Archaeologists (2014) and the European Archaeological Council (Schmidt et al., 2015).

2.2. Magnitude Surveys is a Registered Organisation of the Chartered Institute for Archaeologists (CIfA), the chartered UK body for archaeologists, and a corporate member of ISAP (International Society of Archaeological Prospection).

2.3. Director Graeme Attwood is a Member of CIfA, as well as the Secretary of GeoSIG, the CIfA Geophysics Special Interest Group. Director Finnegan Pope-Carter is a Fellow of the London Geological Society, the chartered UK body for geophysicists and geologists, as well as a member of GeoSIG, the CIfA Geophysics Special Interest Group. Director Chrys Harris has a PhD in archaeological geophysics from the University of Bradford and is the Vice-Chair of the International Society for Archaeological Prospection.

2.4. All MS managers have relevant degree qualifications to archaeology or geophysics. All MS field and office staff have relevant archaeology or geophysics degrees and/or field experience.

3. Objectives

3.1. The geophysical survey aimed to assess the subsurface archaeological potential of the survey area.

4. Geographic Background

4.1. The site is located c. 2km east from the centre of the village of Ibstock, which lies c. 16.7km NW from Leicester (Figure 1). Survey was undertaken across three continuous arable fields, bounded by Pretoria Road to the south, a private track to the north, and further arable fields to the west (Figure 2).

4.2. Survey considerations:

Survey Area	Ground Conditions	Further Notes
1	Arable, very slight slope upwards to the west.	Bounded by hedgerows to the east, west and south, and a ditched boundary to the north.
2	Arable, very slight slope upwards to the east and west.	Bounded by hedgerows to the east, west and south, wire fence to the south, and ditched boundary to the north.
3	Arable, very slight slope upwards to the east. Depression to the southern border.	Bounded by hedgerows to the west and north-east, wire fence to the south, and ditch boundary to the north-west. A tree was located to the south-western corner. Overhead cables ran NW-SE across the western half of this area.

4.3. The underlying geology comprises sedimentary bedrock of mudstone Edwalton Member throughout Area 3, south of Area 2 and south of Area 1; sedimentary bedrock of sandstone from Cotgrave Sandstone Member across the north of Area 2 and centre of Area 1; and sedimentary bedrock of mudstone from Gunthorpe Member to the north of Area 1. Only superficial deposits across Area 3 have been recorded as diamicton from Oadby Member (British Geological Survey, 2018).

4.4. The soils consist of slightly acid loamy and clayey soils with impeded drainage (Soilscapes, 2018).

5. Archaeological Background

5.1. The following section summarises the archaeological background of the site and the immediate surrounding area following a search of Heritage Gateway (2018).

5.2. Multi-period prehistoric findspots (MLW10595) and an Iron Age site (MLE10594) are recorded c.500 south-west from site. Neolithic findspots were identified c.100m west from site.

5.3. A possible Roman site is recorded to the south-west of site (MLE10581), with further Roman findspots (MLW18788) c. 100m to the west.

5.4. Anglo-Saxon (MLE10582 and MLE10596) findspots are also recorded to the south-west of site and c. 500m to the south-west, respectively.

5.5. The Ibstock Colliery Mineral Railway (MLE16167), in disuse since the late 1950's, ran along the northern boundary of the site. This former railway is visible on historic and modern OS mapping. Ellistown Collieries, Brick Pipe and Fireclay Works (MLE21762) are recorded c.500m east from site.

5.6. Historic maps since 1880's depict the site as a number of enclosed fields, with a number of boundaries subdividing the present-day layout until 1975. A small pond is recorded to the south-east of Area 1, since 1883 until the 1960 OS Plan.

6. Methodology

6.1. Data Collection

6.1.1. Geophysical prospection comprised the magnetic method as described in the following table.

6.1.2. Table of survey strategies:

Method	Instrument	Traverse Interval	Sample Interval
Magnetic	Bartington Instruments Grad-13 Digital Three-Axis Gradiometer	1m	200Hz reprojected to 0.125m

6.1.3. The magnetic data were collected using MS' bespoke hand-carried GNSS-positioned system.

6.1.3.1. MS' hand-carried system was comprised of Bartington Instruments Grad 13 Digital Three-Axis Gradiometers. Positional referencing was through a Hemisphere S321 GNSS Smart Antenna RTK GPS outputting in NMEA mode to ensure high positional accuracy of collected measurements. The Hemisphere S321 GNSS Smart Antenna is accurate to 0.008m + 1ppm in the horizontal and 0.015m + 1ppm in the vertical.

6.1.3.2. Magnetic and GPS data were stored on an SD card within MS' bespoke datalogger. The datalogger was continuously synced, via an in-field Wi-Fi unit, to servers within MS' offices. This allowed for data collection, processing and visualisation to be monitored in real-time as fieldwork was ongoing.

6.1.3.3. A navigation system was integrated with the RTK GPS was used to guide the surveyor. Data were collected by traversing the survey area along the longest possible lines, ensuring efficient collection and processing.

6.2. Data Processing

6.2.1. Magnetic data were processed in bespoke in-house software produced by MS. Processing steps conform to Historic England's standards for "raw or minimally processed data" (see sect 4.2 in David et al., 2008: 11).

Sensor Calibration – The sensors were calibrated using a bespoke in-house algorithm, which conforms to Olsen et al. (2003).

Zero Median Traverse – The median of each sensor traverse is calculated within a specified range and subtracted from the collected data. This removes striping effects caused by small variations in sensor electronics.

Projection to a Regular Grid – Data collected using RTK GPS positioning requires a uniform grid projection to visualise data. Data are rotated to best fit an orthogonal grid

projection and are resampled onto the grid using an inverse distance-weighting algorithm.

Interpolation to Square Pixels – Data are interpolated using a bicubic algorithm to increase the pixel density between sensor traverses. This produces images with square pixels for ease of visualisation.

6.3. Data Visualisation and Interpretation

6.3.1. This report presents the gradient of the sensors' total field data as greyscale images. The gradient of the sensors minimises external interferences and reduces the blown-out responses from ferrous and other high contrast material. However, the contrast of weak or ephemeral anomalies can be reduced through the process of calculating the gradient. Consequently, some features can be clearer in the respective gradient or total field datasets. Multiple greyscale images at different plotting ranges have been used for data interpretation. Greyscale images should be viewed alongside the XY trace plot (Figure 7). XY trace plots visualise the magnitude and form of the geophysical response, aiding in anomaly interpretation.

6.3.2. Geophysical results have been interpreted using greyscale images and XY traces in a layered environment, overlaid against open street maps, satellite imagery, historic maps, LiDAR data, and soil and geology maps. Google Earth (2018) was consulted as well, to compare the results with recent land usages.

7. Results

7.1. Qualification

7.1.1. Geophysical results are not a map of the ground and are instead a direct measurement of subsurface properties. Detecting and mapping features requires that said features have properties that can be measured by the chosen technique(s) and that these properties have sufficient contrast with the background to be identifiable. The interpretation of any identified anomalies is inherently subjective. While the scrutiny of the results is undertaken by qualified, experienced individuals and rigorously checked for quality and consistency, it is often not possible to classify all anomaly sources. Where possible an anomaly source will be identified along with the certainty of the interpretation. The only way to improve the interpretation of results is through a process of comparing excavated results with the geophysical reports. MS actively seek feedback on their reports as well as reports of further work in order to constantly improve our knowledge and service.

7.2. Discussion

7.2.1. The geophysical results are presented in consideration with satellite imagery (Figure 5) and historic maps (Figure 6).

7.2.2. The fluxgate gradiometer survey has revealed a relatively quiet magnetic background, with modern interferences generally limited to the peripheries of the fields. No anomalies of a possible or probable archaeological origin have been identified. The geophysical results primarily reflect anomalies associated with modern and agricultural

activity. A former field boundary and an in-filled pond, both recorded on historic maps, have been detected, along with ephemeral agricultural trends and field drains.

7.3. Interpretation

7.3.1. General Statements

7.3.1.1. Geophysical anomalies will be discussed broadly as classification types across the survey area. Only anomalies that are distinctive or unusual will be discussed individually.

7.3.1.2. **Undetermined** – Anomalies are classified as Undetermined when the anomaly origin is ambiguous through the geophysical results and there is no supporting or correlative evidence to warrant a more certain classification. These anomalies are likely to be the result of geological, pedological or agricultural processes, although an archaeological origin cannot be entirely ruled out. Undetermined anomalies are generally not ferrous in nature.

7.3.1.3. **Ferrous (Discrete/Spread)** – Discrete ferrous-like, dipolar anomalies are likely to be the result of modern metallic disturbance on or near the ground surface. A ferrous spread refers to a concentrated deposition of these discrete, dipolar anomalies. Broad dipolar ferrous responses from modern metallic features, such as fences, gates, neighbouring buildings and services, may mask any weaker underlying archaeological anomalies should they be present.

7.3.2. Magnetic Results - Specific Anomalies

7.3.2.1. **Agricultural** – A circular anomaly has been recorded to the south-east of Area 1. The signal is characteristic of a deposition or infilling of strong, densely packed, ferrous and other highly magnetic material. This correlates with a former pond denoted on historic maps (see 5. Archaeological Background) and has been categorized as 'Agricultural (Spread)'. A number of magnetically enhanced anomalies, in a discrete alignment, have been recorded to the west of Area 3. These are well correlated with the former field boundary (see Figure 6) and have been classified as 'Agricultural (Strong)' and 'Agricultural (Weak)', reflecting the different magnitude of the measured signal. A series of faint, linear trends have been recorded running east-west across Area 1, and NW-SE to the north of Area 2. These are characteristic of different ploughing regimes and related arable activity on site.

7.3.2.2. **Drains** – A distinct patterning of parallel, linear responses has been recorded running east-west towards the eastern edge of Area 1, where a drainage feature is recorded on OS plans (Figure 4). The morphology of the signal is indicative of land drains, potentially constructed of fired material. Another isolated drain has been recorded to the north-west of the same area, an a sub east-west orientation.

7.3.2.3. **Service** – The overhead powerline running through the western half of Area 3 has produced a minor magnetic disturbance.

8. Conclusions

8.1. A fluxgate gradiometer survey has been successfully conducted across the site. The survey has revealed a quiet magnetic background, with minimal interference from modern sources. No anomalies of a possible or probable archaeological origin have been identified.

8.2. Agricultural activity in the form of ploughing trends have been recorded across the site. Field drains have been identified in the westernmost field, along with an infilled former pond. The remnants of a former field boundary have been detected towards the east of site.

8.3. Modern activity on the site have had a limited effect the on the results. Adjacent fencing and overhead powerlines are the primary sources, along with scattered ferrous debris.

9. Archiving

9.1. MS maintains an in-house digital archive, which is based on Schmidt and Ernenwein (2013). This stores the collected measurements, minimally processed data, georeferenced and un-georeferenced images, XY traces and a copy of the final report.

9.2. MS contributes reports to the ADS Grey Literature Library upon permission from the client, subject to the any dictated time embargoes.

9.3. Whenever possible, MS has a policy of making data available to view in easy to use forms on its website. This can benefit the client by making all of their reports available in a single repository, while also being a useful resource for research. Should a client wish to impose a time embargo on the availability of data, this can be achieved in discussion with MS.

10. Copyright

10.1. Copyright and the intellectual property pertaining to all reports, figures, and datasets produced by Magnitude Services Ltd. is retained by MS. The client is given full licence to use such material for their own purposes. Permission must be sought by any third party wishing to use or reproduce any IP owned by MS.

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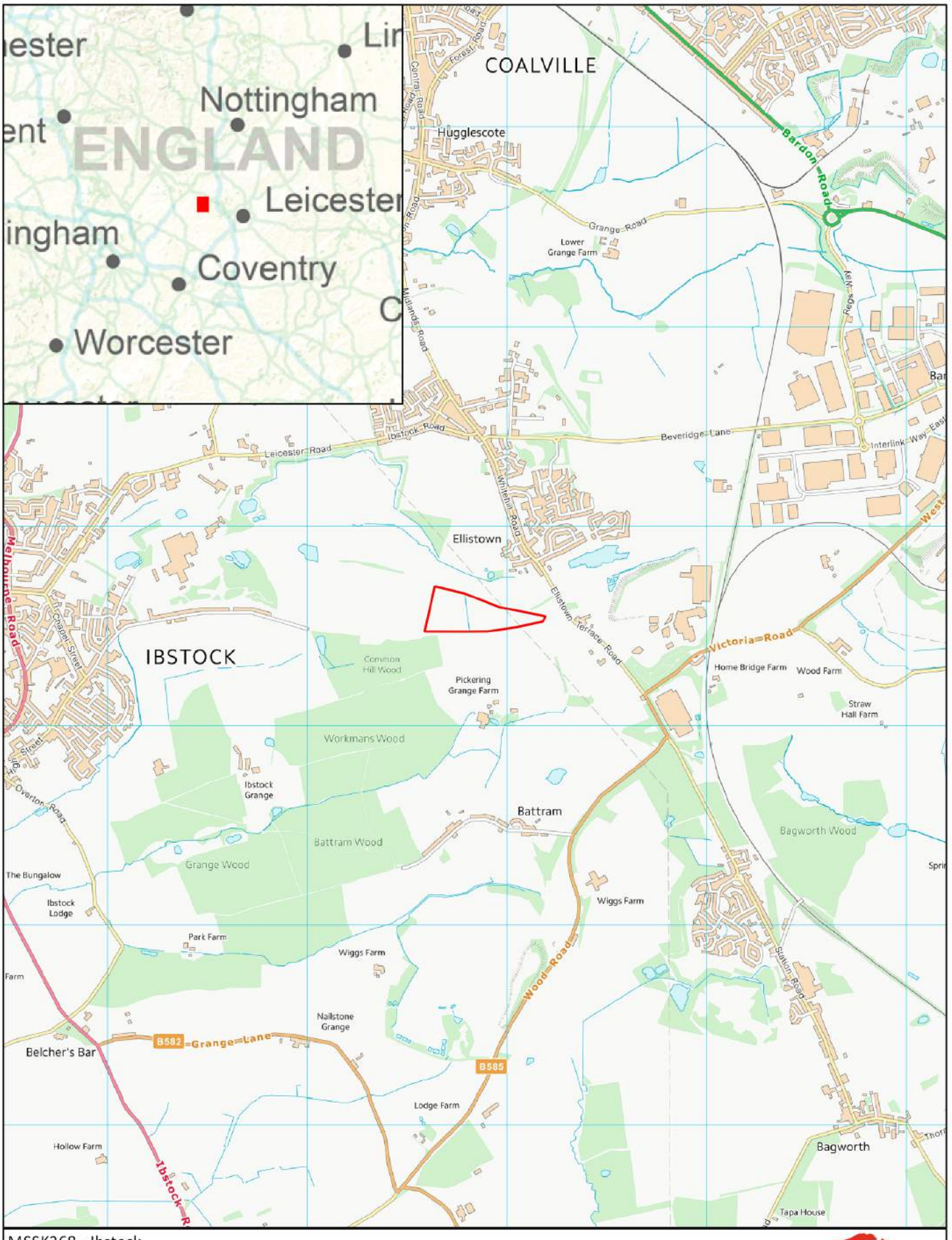

MSSK268 - Ibstock
Figure 1 - Site Location
1:25,000 @ A4

Site Boundary

N

0 0.5 1 km

magnitude surveys

442000

449000

311000

311000

Ellistown

Tehill Road

Ellistown Terrace Road

Area 1

Area 2

Area 3

Common Hill Wood

Pickering Grange Farm

310000

310000

MSSK268 - Land north of Pretoria Road, Ibstock, Leicestershire
Figure 2 - Location of Survey Areas
1:5000 @ A3

Survey Extent

N

0 100 200 300 m

magnitude surveys

442600
442800
443000
443200
310600
310400

Area 1

Area 2

Area 3

MSSK268 - Land north of Pretoria Road, Ibstock, Leicestershire
Figure 3 - Magnetic Gradient
1:1600 @ A3

-1 nT 2

N

0 50 100 150 m

magnitude surveys

442600
442800
443000
443200
310600
310400

Area 1

Area 2

Area 3

MSSK268 - Land north of Pretoria Road, Ibstock, Leicestershire
Figure 4 - Magnetic Interpretation
1:1600 @ A3

Agricultural (Strong)
Agricultural (Weak)
Agricultural (Spread)
Agricultural (Trend)
Field Drain
Ferrous (Dipolar)
Ferrous (Spread)
Service

N

0 50 100 150 m

magnitude surveys

442500

443000

Area 1

Area 2

Area 3

310500

310500

MSSK268 - Land north of Pretoria Road, Ibstock, Leicestershire
Figure 5 - Magnetic Interpretation Over Satellite Imagery
1:3000 @ A3

- Agricultural (Strong)
- Agricultural (Weak)
- Agricultural (Spread)
- Agricultural (Trend)
- Field Drain
- Ferrous (Dipolar)
- Ferrous (Spread)
- Service

N

0 50 100 150 m

magnitude surveys

MSSK268 - Land north of Pretoria Road, Ibstock, Leicestershire
Figure 6 - Magnetic Interpretation Over Historic Maps
1:3000 @ A3

Contains historic maps: Ordnance Survey, 6" 2nd edition c. 1882-1913 © National Library of Scotland

- Agricultural (Strong)
- Agricultural (Weak)
- Agricultural (Spread)
- Agricultural (Trend)
- Field Drain
- Ferrous (Dipolar)
- Ferrous (Spread)
- Service

N

0 50 100 150 m

magnitude surveys

442600
442800
443000
443200
310600
310400

Area 1

Area 2

Area 3

MSSK268 - Land north of Pretoria Road, Ibstock, Leicestershire
Figure 7 - XY Trace Plot
32nT/cm at 1:1600 @ A3

N

0 50 100 150 m

magnitude surveys