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**Proposed Development at Blakett Drive,
Heather, Leicestershire**

Geophysical Survey Report MSSK17

For



Magnitude Surveys Ref: MSSK17

April 2016



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Abstract

Magnitude Surveys was commissioned to assess the archaeological potential of c. 7 ha of land west of Heather, Leicestershire through geophysical survey. A cart-based magnetometer survey was successfully completed and no anomalies of an archaeological or probable archaeological origin have been identified. The geophysical results primarily reflect agricultural and natural processes. Anomalies reflecting the site's agricultural usage have been identified. A number of anomalies have been detected that cannot be attributed to specific origins and are likely agricultural or natural in origin.

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1. Introduction

- 1.1. Magnitude Surveys Ltd (MS) was commissioned by Cotswold Archaeology (CA) to undertake a geophysical survey on land off Blackett Drive, Heather, Leicestershire (SK 386 109). The geophysical survey comprised:
 - 1.1.1. Hand pulled, cart-mounted fluxgate gradiometer survey.
- 1.2. The survey was conducted in line with the current best practice guidelines produced by Historic England (David et al., 2008), the Chartered Institute of Field Archaeologists (CIfA, 2014) and the European Archaeological Council (Schmidt et al., 2015).
- 1.3. The survey commenced on 29 March 2016 and took two days to complete.

2. Quality Assurance

- 2.1. Project management, survey work, data processing and report production have been carried out by qualified and professional geophysicists to standards exceeding the current best practice (CIfA, 2014; David et al., 2008, Schmidt et al., 2015).
- 2.2. Magnitude Surveys is a corporate member of ISAP (International Society of Archaeological Prospection).
- 2.3. Graeme Attwood is a Member of the Institute for Archaeologists (CIfA), the chartered UK body for archaeologists, as well as a member of GeoSIG, the CIfA Geophysics Special Interest Group.
- 2.4. 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.

3. Objectives

- 3.1. The geophysical survey aimed to assess the potential archaeological landscape of the survey area.
- 3.2. The survey forms part of the archaeological mitigation required by the planning archaeologist and shall be used to inform the location of any trenches, should they be required.

4. Geographic Background

- 4.1. The underlying geology comprises Tarporey Siltstone formation: siltstone, mudstone and sandstone with superficial glaciofluvial deposits (BGS, 2016). Historic England guidelines state the magnetic response to this type of underlying geology is variable, generally ranging from poor to good (David et al., 2008).
- 4.2. The soils consist freely draining, slightly acid loamy soils (Soilscapes, 2016).
- 4.3. Areas 1 and 2 were under brassica. Area 1 sloped gently down from east to west; whereas Area 2 was primarily flat. Area 3 was under cereal crop and generally flat with a slight slope from west to east at the eastern end of the field.

5. Archaeological Background

- 5.1. The following forms a brief summary of the archaeological background of the site and its immediate surroundings as identified through Heritage Gateway.
- 5.2. The site lies to the west of the historic centre of Heather, which is centred around the parish Church of St. John. The village contains a number of listed buildings.
- 5.3. Three find spots are denoted with the survey area on Heritage Gateway: A Roman Coin (MLE8047), an Anglo-Saxon die (MLE6225) and a medieval spindle-whorl. A scheme of field walking was undertaken to the north and west of site in 2005 this identified a number of further find spots including; prehistoric flint (MLE 20449 & 20457), Roman Pottery (MLE 20458 & 4594) and Medieval/Post medieval pottery (MLE 20447 & 20459). In a field to the North of Normanton Lane a Papal Bull was discovered (MLE 6400).
- 5.4. In the fields to the immediate west of the survey area there have been identified on aerial photographs two sets of crop marks. One set (MLE 4592) is thought to be of Iron-Age origin and the second (Pastscape 925844) are thought to be post medieval in date.

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 1000L fluxgate gradiometer | 1 m | 10 Hz reprojected to 0.125 m |

6.1.3. The magnetic data were collected using MS' bespoke hand-pulled cart system.

6.1.3.1. The cart system supports the magnetic and GPS instruments with a bespoke datalogger. The magnetic instruments comprise two Bartington Instruments 1000L fluxgate gradiometers operating in NMEA mode. Positional referencing is through a Hemisphere S320 RTK GPS outputting in NMEA mode. Corrections were made through Topcon TopNet. Data from both instruments were logged in a bespoke datalogger. Data were transferred to a laptop computer for processing.

6.1.3.2. A series of temporary sight markers were established in each survey area to guide the surveyor and ensure full coverage with the cart. Data were collected by traversing the survey area along the longest possible lines, to ensure that the data was efficiently collected and processed.

6.2. Data Processing

6.2.1. Bartington Instruments magnetic data were processed in bespoke in-house software produced by MS. Processing steps were limited to:

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

6.3.1. Magnetic greyscales should be viewed alongside the accompanying XY trace plots, which are available on the archive disk. XY trace plots visualise the magnitude and form of the geophysical response, aiding in anomaly interpretation.

7. Survey Considerations

| Survey Area | No. Survey Blocks | Surveyed Y/N | Ground Conditions | Further notes: |
|-------------|-------------------|--------------|---------------------------|----------------|
| 1 | 1 | Y | Brassica, slightly rutted | |
| 2 | 1 | Y | Brassica, slightly rutted | |
| 3 | 1 | Y | Cereal | |

Refer to Figure 2 for survey area locations.

8. Results

8.1. Qualification

8.1.1. *Geophysical techniques 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.*

8.2. Discussion

8.2.1. The geophysical results, both greyscale images and XY traces, were interpreted in consideration with satellite imagery (Bing, 2016; Figure 5) and historic mapping (Ordnance Survey, 6" 2nd edition c.1882-1913; Figure 6).

8.2.2. Magnetic survey has responded well to the surveys area's geological and pedological environment, detecting modern soil disturbances and anomalies associated with agricultural processes. A number of anomalies have been categorised as having an undetermined origin. Many of these Undetermined anomalies exhibit geophysical responses that are characteristic of agricultural-type anomalies. However, given their isolated nature, an archaeological origin cannot be entirely ruled out. Overwhelming magnetic responses caused by the neighbouring properties and vehicles may have masked any weaker archaeological anomalies around the edge of the survey areas, should they be present.

8.3. Interpretation

8.3.1. General Statements

8.3.1.1. Geophysical anomalies will be discussed broadly as classification types across the survey area. Only anomalies that are distinctive or unusual will be discussed individually. Specific anomalies discussed within the text have been assigned numbers, which are emboldened within square parenthesis e.g. [**1**].

8.3.1.2. **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.

8.3.1.3. **Ferrous** – A number of discrete ferrous-like anomalies have been mapped throughout both survey areas. These responses are likely to be the result of

modern metallic disturbance on or near the ground surface. Broad 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.

8.3.2. Magnetic Results - Specific Anomalies

- 8.3.2.1. **Agricultural** – Faint, parallel linear magnetic anomalies on an east-west alignment have been detected in Area 2. These are indicative of medieval ridge and furrow.
- 8.3.2.2. **Agricultural** – Ruts created by the movement of agricultural machinery around the edge of Area 1 can be seen within the data as pairs of parallel positive magnetic anomalies. Furthermore, a modern ploughing trend can be seen as faint closely spaced parallel anomalies, whose direction has been indicated with arrows.
- 8.3.2.3. **Undetermined** – A series of faint, parallel linear anomalies on a north-south alignment intersect Area 3. These anomalies may possibly represent ridge and furrow ploughing activity; however, given the limited number and extent of these anomalies, a ridge and furrow origin is not certain.
- 8.3.2.4. **Undetermined** – A negative anomaly on the western edge of area three has been classified as of Undetermined origin. It is likely that this is a tractor route or similar track. However, as none of the other sets of tramlines have manifested within the data there is a certain element of doubt with this interpretation; hence the categorisation of Undetermined.
- 8.3.2.5. **Undetermined** – A pair of weak, curvilinear, magnetic anomalies have been identified in Area 1. These anomalies, along with the discrete Undetermined anomalies along Area 1's western boundary, are likely agricultural in origin; however, given their relative isolation from other agricultural anomalies, a natural or archaeological origin cannot be entirely ruled out.

9. Conclusions

- 9.1. The geophysical survey has not identified any anomalies of archaeological or probable archaeological origin. The geophysical results primarily reflect agricultural and natural processes. Anomalies pertaining to historic and modern farming practices have been identified. A number of anomalies have been detected that cannot be attributed to specific origins due to the ambiguous nature of their geophysical responses and relative isolation. However, these anomalies are most likely agricultural in origin—although a natural or archaeological origin cannot be entirely ruled out.

10. Archiving

- 10.1. MS maintains an in-house digital archive, which is based on Schmidt and Ernenwein (2013).
- 10.2. MS contributes all reports to the ADS Grey Literature Library subject to any time embargo dictated by the client.

- 10.3. 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.

11. Copyright

- 11.1. 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.

12. References

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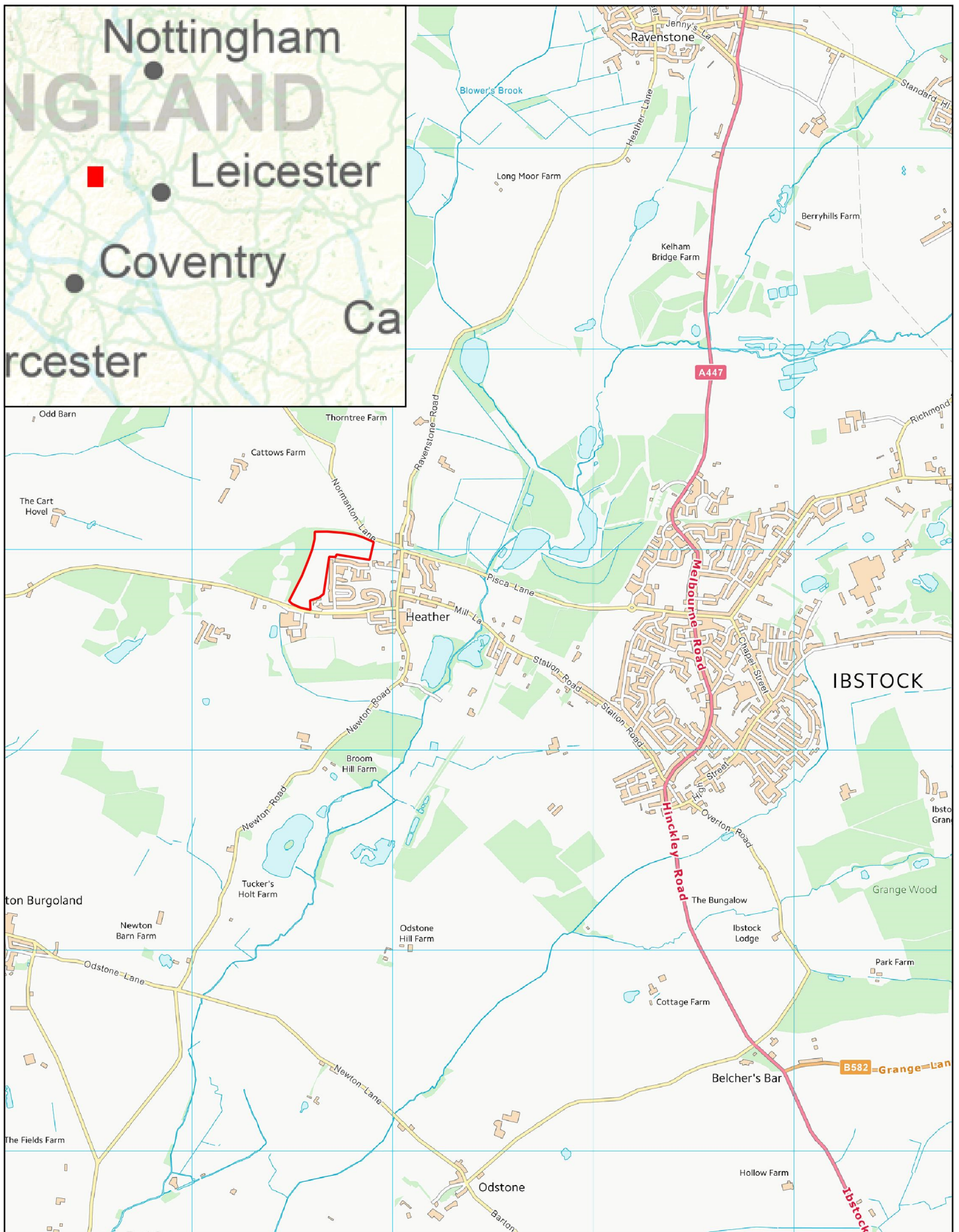
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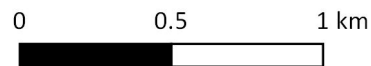
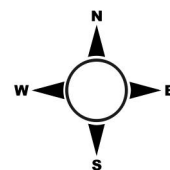
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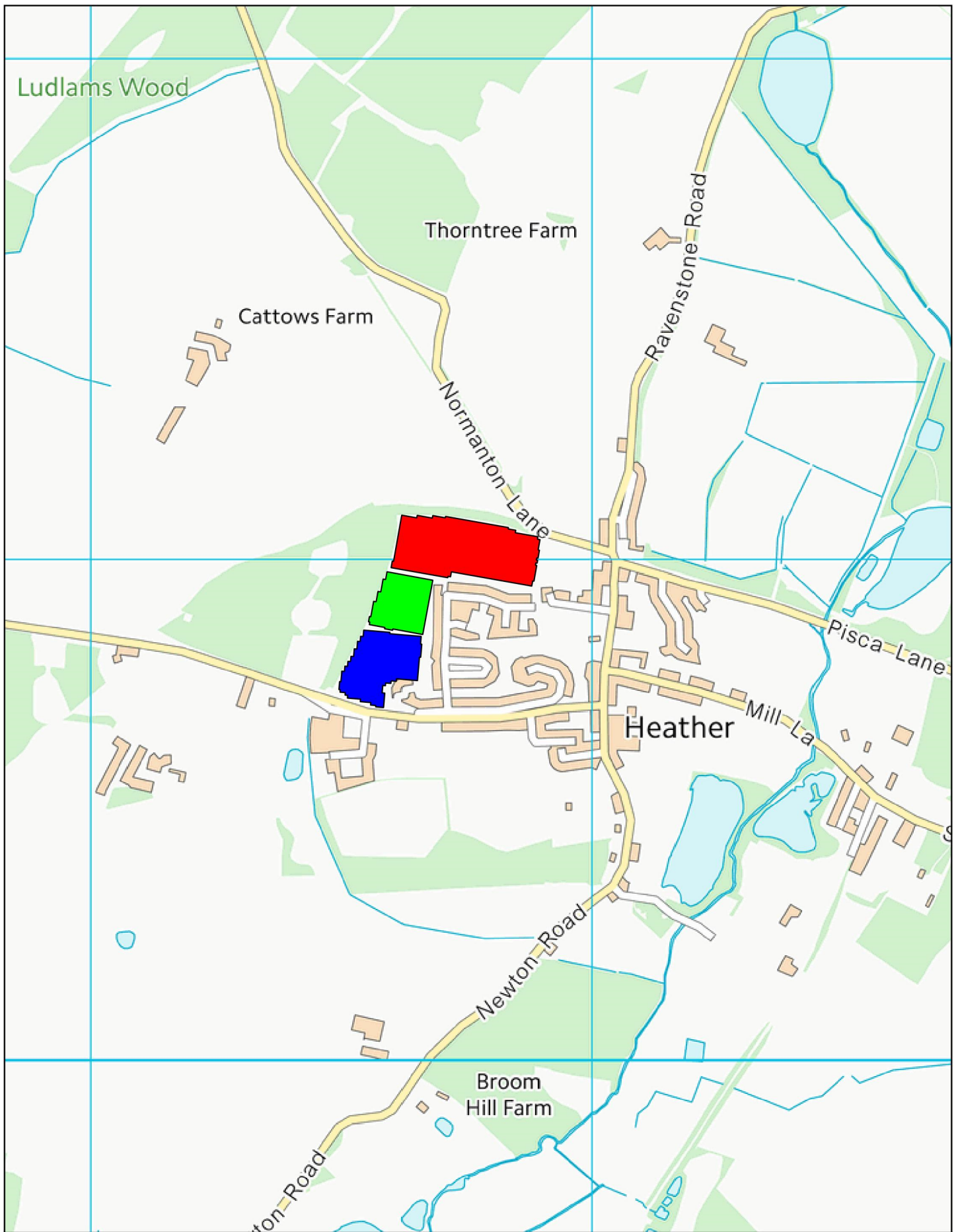


MSSK17 - Geophysical Survey at Heather, Leicestershire
 Figure 1 - Site Location
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 Survey Area



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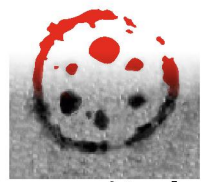
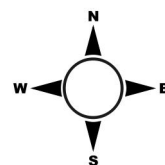
Figure 2 - Location of survey areas

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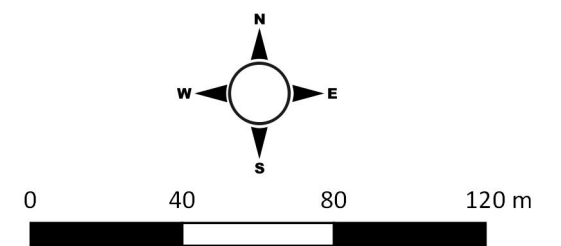
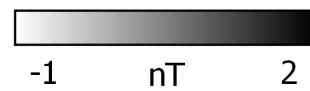
 Area 1  Area 2  Area 3



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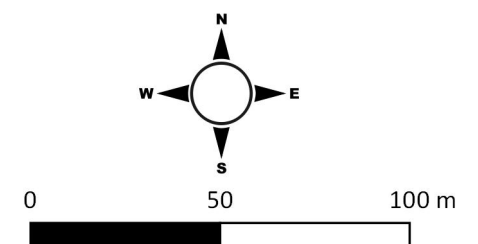
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Figure 3 - Magnetic Greyscale - Overview
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 Figure 4 - Magnetic Interpretation -Overview
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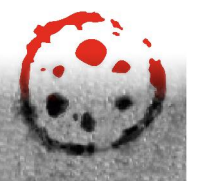
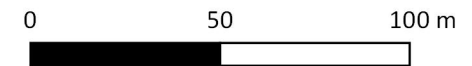
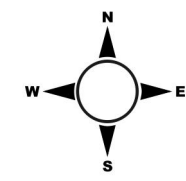
- | | | |
|---|--|--|
|  Undetermined (Strong) |  Agricultural (Weak Signal) |  Direction of modern plough |
|  Undetermined (Weak) |  Ferrous (Dipolar) |  Ferrous (Spike) |
|  Undetermined (Spread) |  Agricultural | |



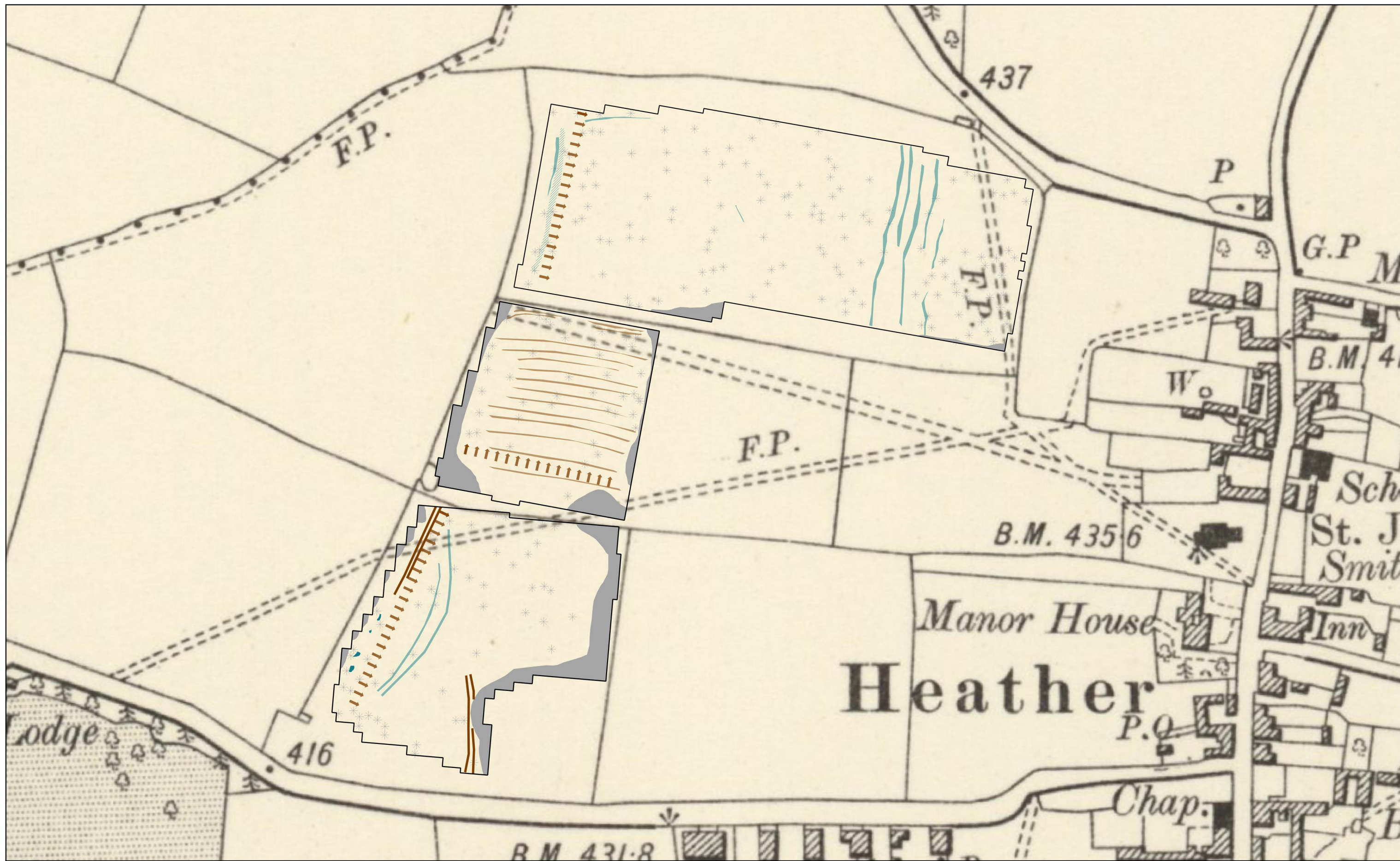


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 Figure 5 - Magnetic Interpretation - satellite imagery
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 Satellite Imagery Copyright Bing Maps 2016









- | | | | | | |
|---|-----------------------|---|----------------------------|---|----------------------------|
|  | Undetermined (Strong) |  | Agricultural (Weak Signal) |  | Direction of modern plough |
|  | Undetermined (Weak) |  | Ferrous (Dipolar) |  | Ferrous (Spike) |
|  | Undetermined (Spread) |  | Agricultural | | |

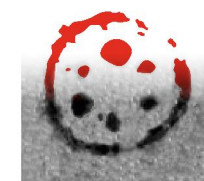
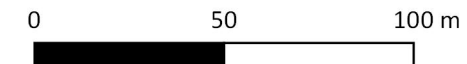
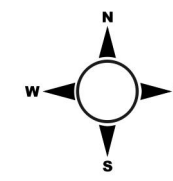


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 Figure 6 - Magnetic Interpretation - historic mapping
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 Historic mapping Ordnance Survey, 6" 2nd edition c.1882-1913. National
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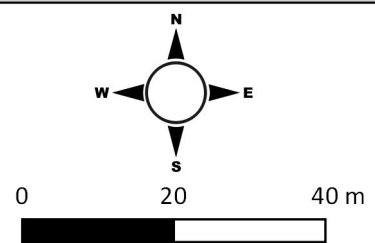
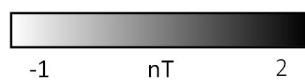
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|---|-----------------------|---|----------------------------|---|----------------------------|
|  | Undetermined (Strong) |  | Agricultural (Weak Signal) |  | Direction of modern plough |
|  | Undetermined (Weak) |  | Ferrous (Dipolar) |  | Ferrous (Spike) |
|  | Undetermined (Spread) |  | Agricultural | | |



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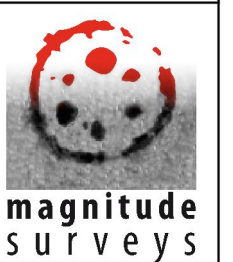
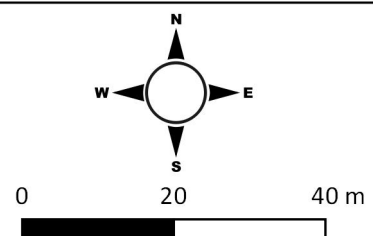
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Figure 7 - Magnetic Greyscale
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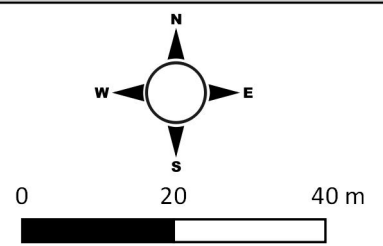
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- | | | | |
|---|----------------------------|---|-----------------|
|  | Undetermined (Strong) |  | Arrow line |
|  | Undetermined (Weak) |  | Agricultural |
|  | Undetermined (Spread) |  | Ferrous (Spike) |
|  | Agricultural (Weak Signal) | | |
|  | Ferrous (Dipolar) | | |



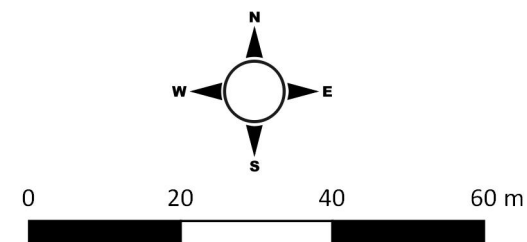
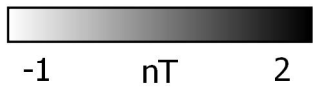


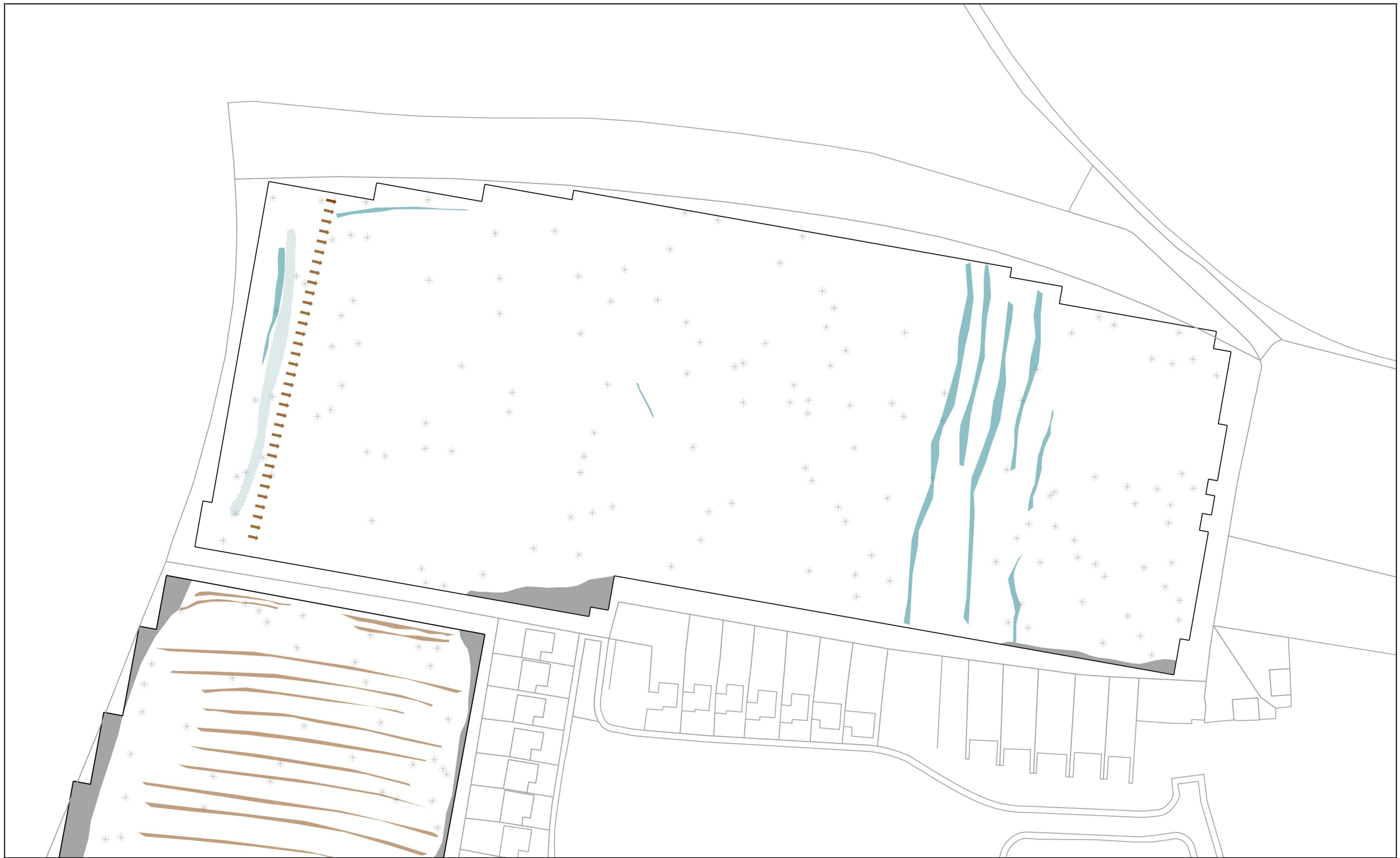
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Figure 9 - Magnetic XY Trace
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XY Trace 15nT per cm @ 1:1000











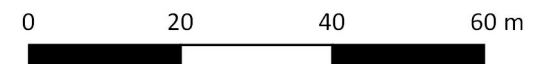
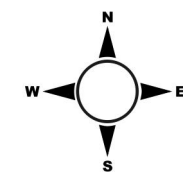
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Figure 10 - Magnetic Greyscale
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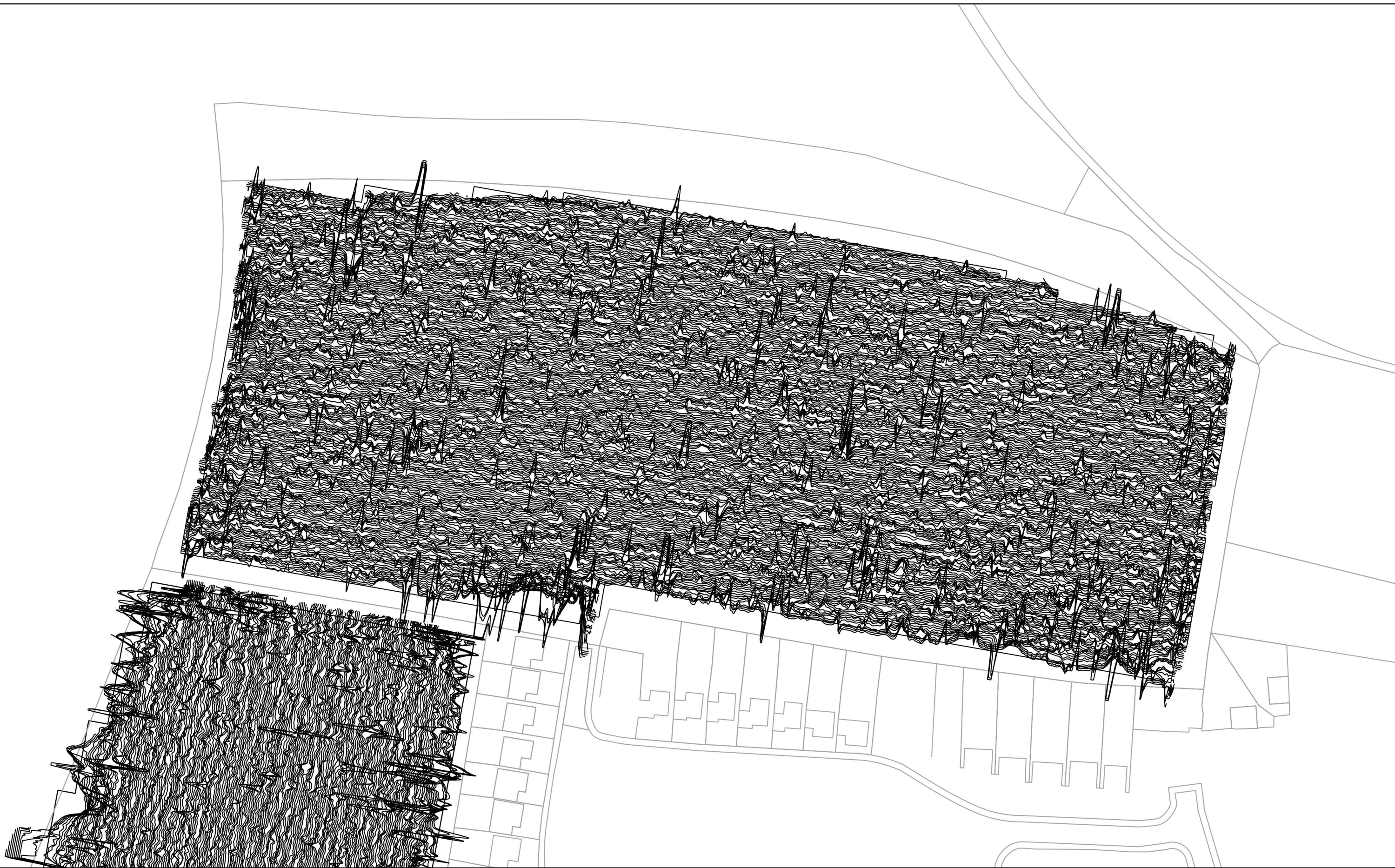


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 Figure 11 - Magnetic Interpretation
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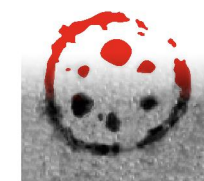
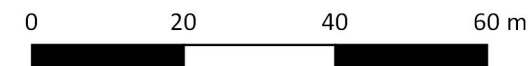
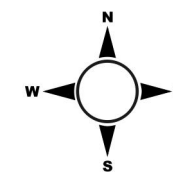
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|---|--|--|
|  Undetermined (Weak) |  Agricultural (Weak Signal) |  Direction of modern plough |
|  Undetermined (Spread) |  Ferrous (Dipolar) |  Ferrous (Spike) |



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XY Trace 15nT per cm @ 1:1000



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