AB HERITAGE
ARCHAEOLOGICAL CONSULTANCY

# Ebnal Lodge, Shropshire

# Geophysical Survey Report

Client: ELGIN ENERGY ESCO LTD

AB Heritage Project No:10833

Date: 2/06/2016

# Ebnal Lodge, Shropshire, Geophysical Survey Report

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| **Project Number** | **10833** |
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# FIGURES

# 1. NON TECHNICAL SUMMARY

AB Heritage Limited (herein AB Heritage) were commissioned by Elgin Energy Esco Ltd to undertake a programme of geophysical survey covering c.13.5 ha, ahead of a proposed Solar development.

Overall the geophysical survey has identified some possible archaeological features [**GP 1 a-d**] that have limited potential for recovery of significant archaeological remains. The results also showed geological deposits [**GP 2**], which could have the potential to obscure archaeological features.

# 2. INTRODUCTION

## 2.1 Project Background

2.1.1 AB Heritage Limited (hereinafter AB Heritage) have been commissioned by Elgin Energy Esco Ltd to conduct a Geophysical Survey (Magnetometer Survey) covering proposed development on land at Ebnal Lodge, Shropshire (see Figure 1), prior to development of the site.

2.1.2 The purpose of the survey is to identify and map any potential surviving archaeological remains within the proposed development site.

## 2.2 Site Location & Description

2.2.1 Situated 1.2km east of Gobowen and c.2km south of St Martins the proposed development site is split into three fields. Two pasture fields lie in the north of the site, and one arable field in the south. The site is centred on national grid reference (NGR) SJ 318 341 and covers an area of c.13.5 hectares (ha).

## 2.3 Geology & Topography

2.3.1 The solid underlying geology consists of mudstone, siltstone and sandstone (British Geological Survey, 2016) and the superficial deposits are Till Devision. This form of bedrock geology is not likely to have an impact on the results of geophysical survey, though the superficial geology could mask archaeological features.

2.3.2 The topography of the proposed development site is gently sloping, rising from c.99 m above Ordnance Datum (AOD) in the south-west to c.106 m in the north-east (Elevation Finder, 2016).

# 3. AIMS & METHODOLOGY

## 3.1 Aims of Survey Works

3.1.1 Geophysical survey is a programme of non-intrusive archaeological work. The aims of this geophysical survey were to:

- Identify any geophysical anomalies of possible archaeological origin within the specified survey area;
- Accurately locate these anomalies and present the findings in map form;
- And, where possible, identify the form, function and extent of any potential remains.

## 3.2 Methodology of Survey Works Summary

*Site Specific Information*

3.2.1 A geophysical survey was undertaken covering c.13.5ha across lands at Ebnal Lodge, Shropshire.

3.2.2 The AB Heritage staff members who undertook the site were Peter Bonvoisin Joe Critchley (Archaeological Technician), Sam Burn (Site Technician).

*3.2.3* The weather conditions were dry and wet throughout the survey; these conditions had no material impact upon the survey.

*Equipment*

3.2.4 The magnetic survey equipment used was two Bartington Grad-601 (fluxgate magnetometers).Please see Appendix A, which contains a detailed methodology for the works undertaken; however, briefly, Table 1, below, shows site specific information on how the magnetometer was set up:

**Table 1: Setting Parameters of Magnetometer**

| Grid Size | 30x30 metres |
|---|---|
| Data Capture Distances | 1m x 0.25m |
| Sensors | 2 |
| Sensitivity | 0.1 nanoteslanT |

3.2.5 A Trimble Geo XR GPS was used to setup the geophysical survey. This has sub-centimetre accuracy suitable for this survey.

## 3.3 Known Constraints

3.3.1 There were no known above ground constraints noticed within the site at time of survey; however, there were roads located on the eastern and western side of the site, which could lead to magnetic disturbance within c. 5 - 10m of these features.

# 4. RESULTS

4.1.1 For the purposes of this detailed magnetic survey, results for the geophysics raw and processed data have been shown on Figures 2 and 3 respectively, with an interpretation plot shown on Figure 4.

4.1.2 Below is a factual account of the results.

## 4.2 Geophysical Survey Results

GP 1 [a-d] - Possible Archaeology

4.2.1 Within the southern half of the site there are two connected positive linears [**GP 1a**]. One of these runs in a north to south direction to a length of c.150m, while the other extends in an east to west direction, with a length of c.100m. Both linears have a reading of between 1 – 2 nanotesla nT.

4.2.2 A curvilinear [**GP 1b**] feature is located within the southern half of the site and reaches a length of c.50m, with a reading of between 1 - 3nT.

4.2.3 In the northern half of the site is a linear [**GP 1c**] was recorded running in north to south direction, with a length of c.75m and a reading of 1 - 2nT.

4.2.4 Finally, a feature [**GP 1d**] of multiple positive and negative areas in a semi-circular pattern was located in the north west of the site covering c.1,250m$^2$. This had a range of readings varying from -5nT to 12nT.

GP 2 - Geology

4.2.5 Curvilinear features present, mainly in the southern area of the site, take up a large part of the site survey and are concluded to be geological in nature.. The largest of these geological features extends from the south east corner of the site and has an overall length of c.250m and a width of c.50m. The readings for this feature were between 1 - 2nT.

GP 3 - Di-Polar

4.2.6 Multiple Di-polar features are spread across the site in amorphous pattern.

GP 4 - Magnetic Disturbance

4.2.7 Magnetic disturbance was recorded in areas across the site but in the main is located predominately along the eastern boundary of the site, adjacent to the road.

# 5. INTERPRETATIONS AND DISCUSSION

5.1.1 Interpretation of the results of geophysical survey is based on professional judgement as to the likely/probable cause of an anomaly or reading. For example, strong dipolar discrete anomalies of small size are often associated with ferrous debris or similarly magnetic debris. In addition, where a positive linear anomaly is recorded, which has a negative anomaly associated alongside either side of it, is often likely to relate to the line of a modern utility.

5.1.2 GP numbers have been used to place interpretations into categories. Below is a discussion of the results, there has also been applied a confidence rating to the features identified (See Appendix 1). As with English Heritage 2008 guidelines for geophysical survey for archaeological field evaluation, this is an acceptable additional option only on the clear understanding that such ratings are subjective and potentially fallible assessments which can only really be tested through excavation.

**Table 2: Interpretation of Geophysical Anomalies**

| AB No | Appearance | Potential Cause |
|---|---|---|
| **GP 1 A-D** | Positive/negative linears and curvlinears | Possible archaeology |
| **GP 2** | Strong negative and positive unformed features | Geological Response |
| **GP 3** | Di-Polar Anomaly | Magnetic Debris |
| **GP 4** | Magnetic Disturbance | Metallic features |

5.1.3 Some features [**GP 1a & c**] of possible archaeological origin have been identified within the site, they have a medium confidence rating to relate to past field boundaries.

5.1.4 Another feature [**GP 1b**], identified within the southern half of the site, has a low confidence to be of possible archaeological origin, based on its curvilinear form.

5.1.5 A feature [**GP 1d**] identified within the north western corner of the site has the potential to be archaeological but, based on the strong reading, is likely to be of more modern date, and may possibly relate to the site of an old pond. Overall there is a low confidence rating for this feature to be a complex archaeological feature.

5.1.6 The site is located in an area containing extensive drainage and, based on the findings of geological features [**GP 2**], there is high confidence rating that these features relate to previous water channels.

5.1.7 The majority of the site also contains Di-polar anomalies [**GP 3**], most likely due to its modern farming techniques causing metallic debris. Also magnetic disturbance [**GP 4**] was recorded along the eastern side of the site, which is likely to reflect made ground from the creation of the boundary.

# 6. CONCLUSION

6.1.1 A geophysical survey was undertaken by AB Heritage covering an area of proposed development at Ebnal Lodge, Shropshire.

6.1.2 The purpose of this work was to understand the potential for any archaeological remains to survive within the site, and, where possible, identify the form, function and extent of any potential remains.

6.1.3 Overall the survey identified limited potential for the recovery of significant archaeological remains. Some of the possible archaeological features identified [**GP 1a & c**] are likely to relate to previous field boundaries, while other features [**GP 1d**] are likely to have more modern origins (and possibly relate to the site of an old pond).

6.1.4 However, a curvilinear feature [**GP 1b**], identified in the southern half of the site, has unknown archaeological potential. Although, based on form limited surrounding features and known evidence, there is a low confidence it is of significant archaeological interest.

6.1.5 The site is also located on an area of varying geology [**GP 2**], most likely related to previous waterways within the site. This could mask archaeological features in these areas.

# 7. ARCHIVE

7.1.1 The Site Archive will contain the following, as a minimum:

**Table 3: Site Archive Data**

| Archive | Format |
|---|---|
| Raw Geophysical Data files | XYZ and Text |
| Processed geophysical data files | JPEG, BMAP |
| Archaeological Interpretation | Shape Files ARC GIS |
| Final Report | PDF |
| Final Images | PDF |

7.1.2 A physical and digital archive will be stored in a suitable format at AB Heritage Limited offices in Taunton, Somerset.

# 8. REFERENCES

BGS (British Geological Society) 2015. *Geology of Britain viewer.* http://mapapps.bgs.ac.uk/geologyofbritain/home.html.

CIFA, 2014.*Standard and Guidance for archaeological geophysical survey.*

Cranfield Soil and Agrifood Industry, 2015. *Soilscapes viewer*, http://www.landis.org.uk/soilscapes/

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Schmidt, A. 2002. *Geophysical Data in Archaeology: a Guide to Good Practice.* Oxford. Oxbow.

# Appendix 1 Technical Information on Geophysical Survey

## FLUXAGTE MAGNETOMETRY SURVEY

The magnetic survey is carried out using a fluxgate gradiometer, which is a passive instrument consisting of two sensors mounted vertically 1m apart. The instrument is carried about 30cm above the ground surface and the top sensor measures the Earth's magnetic field, whilst the lower sensor measures the same field but is also more affected by any localised buried field. The difference between the two sensors will relate to the strength of a magnetic field created by a buried feature, if no field is present the difference will be close to zero as the magnetic field measured by both sensors will be the same.

Factors affecting the magnetic survey may include soil type, local geology, previous human activity, disturbance from modern services etc.

*Survey equipment*

The Bartington Grad 601-2 dual magnetic gradiometer is capable of surveying to an accuracy of 0.1 nanotesla (nT).

*Sample interval and depth of scan*

The magnetometer data is collected in 30mx30m grids at a resolution of 1m x 0.25m. This sample density is recommended for site evaluation (English Heritage, 2008). This equates to 3600 points per 30mx30m grid. The magnetometer has a typical depth of penetration of 0.5m to 1.0m. This would be increased if strongly magnetic objects are buried within the site.

*Data capture*

The readings are logged continually by the data logger during the survey, which is then downloaded on site to a site laptop. At the end of each job, data is transferred to the office PC's for processing and presentation.

This 'regular xy' data is then downloaded into specialist data processing software, at user defined sample intervals (in this case 1 m by 0.25 m). This is processed as standard magnetometer data.

Processing

*Standard Raw Magnetometer data processing consists of:*

**Zero mean Traverse-** This process sets the background mean of each traverse within each grid to zero, the operation allows for the removal of striping effects.

**Destagger-** The collection of geophysical data can lead to errors with time due to a slight variation in speed of traverses or time lag within the collection of data. The process corrects the errors of stagger within the data.

*Non-Standard Magnetometer processing:*

**Interpolation-** The results of greyscale geophysical data can sometimes appear blocky in nature. Interpolation is a process which calculates and inserts values between existing data to give a smoother grey scale image.

**Clipping** – The clipping process will clip extreme values from the data set and increase the contrast in the data values closer to the mean. As most data within a data set is concentrated around the

mean clipping can produce a better visualisation of standard data sets, particularly very weak signals that tend to be lost in a myriad of grey shades.

Some degree of heading error is inevitable when using a fluxgate gradiometer with such an acute sensitivity to the direction of travel in bi directional manner i.e. zigzag traverses. The error displays as a series of alternating lighter and darker stripes in the traverse direction and the function asses and corrects the mean for each line of data to bring them in to the same mean range and remove any visible artefacts.

Display of data

**Greyscale-**This is display takes a range of reading and divides into a set number of classes. Each class is represented by a specific shade of grey and the higher the positive reading the darker the grey.

**Colour-** Colour can be applied to Greyscale plots to show high and low data collection points in a more direct way.

**XY Trace Plot-** Data is represented by a line, which is incremented along the Y axis. This produces a stepped effect, thus the data can be viewed to show a possible shaping of a feature. Typically features are clipped to limit odd readings.

Assigned ranges can be adjusted to give the best display of the data.

Some degree of heading error is inevitable when using a fluxgate gradiometer with such an acute sensitivity to the direction of travel in bi directional manner i.e. zigzag traverses. The error displays as a series of alternating lighter and darker stripes in the traverse direction and the function asses and corrects the mean for each line of data to bring them in to the same mean range and remove any visible artefacts.

## GPS METHODOLOGY

An RTK GPS (Real-time Kinematic Global Positioning System) can locate a point on the ground to sub-cm accuracy, a far greater accuracy than a standard GPS unit. An RTK system uses a base station receiver and a number of mobile units (rovers). The base station takes measurements from satellites in view and then broadcasts them along with its known position to the rover receivers. The rover receiver also collects measurements from the satellites in view and processes them with the base station data. The rover then computes its location relative to the base.

During such a survey a Trimble GeoXR Differential Global Positioning System (dGPS), capable of Real Time Kinematic (RTK) is used to set out a nominal grid prior to the survey. This increases the accuracy and efficiency of the survey. The data is then downloaded from the unit on the day, using a USB stick.

## CONFIDENCE RATING OF INTERPRETATION

Categories for interpretations when there is corroborative evidence from mapping/desk based or excavation data can be assigned to magnetic anomalies (for example, Utility, Road, Wall, etc.) and where appropriate, such interpretations will be applied.

**Table 2: Table of Confidence with interpretation**

| Interpretation Confidence | Evidence |
|---|---|
| High | Backed by mapping/desk based work/ excavation. A clear feature with a clear form. |
| Medium | A feature which has an unclear structure though has grouped potential or associated potential. |
| Low | Unknown provenance entirely based on form. |

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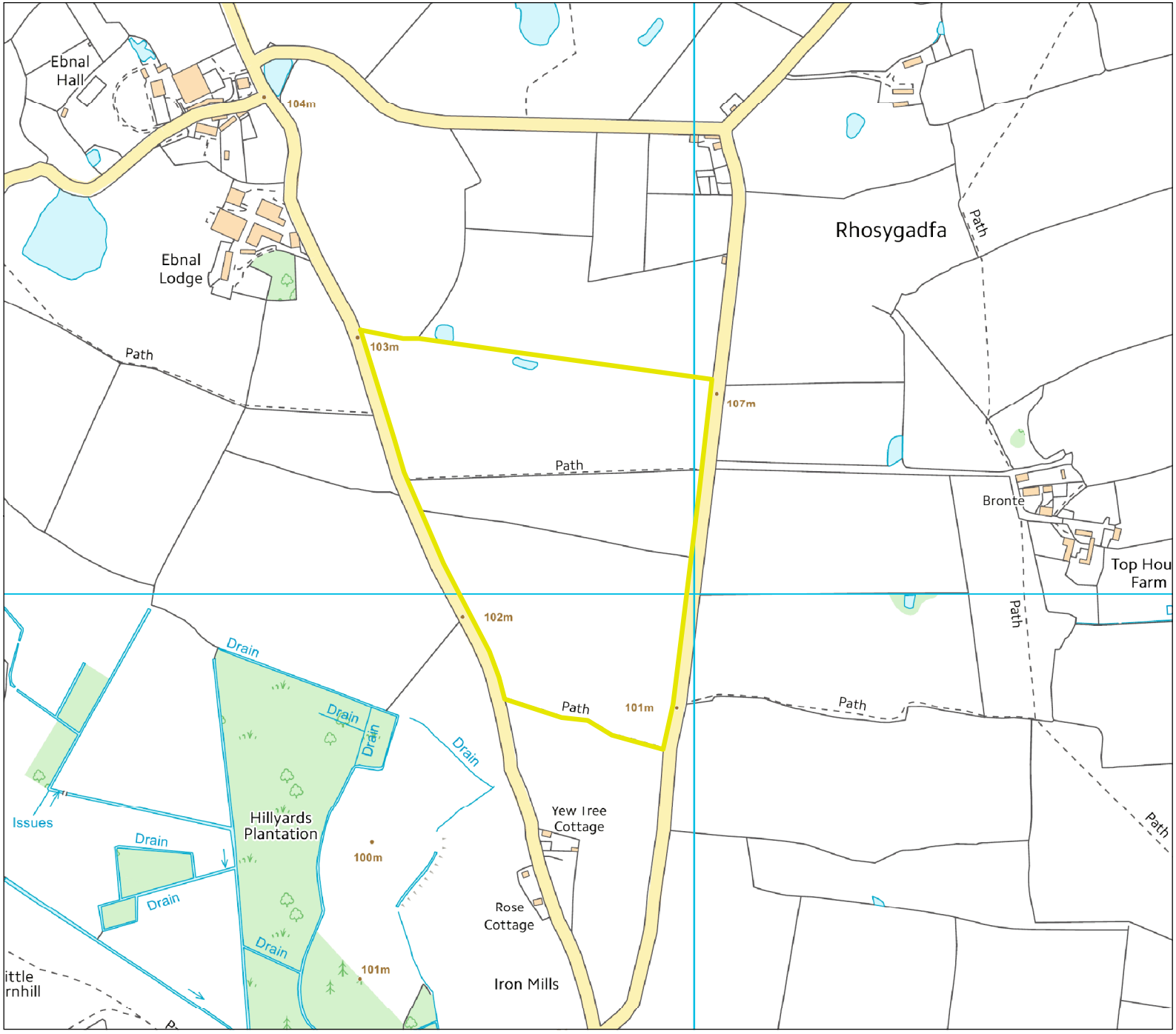




Legend

Site Boundary


Figure 1: Site Location

Project: Land at Ebnal Lodge

| Date: 03/05/16 | Job Number: 10833 |
|---|---|
| Drawn by: ZE | Approved by: DD |

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N

Legend

Site Boundary

+1.5

Plotting Perameters

-1.5

Figure 2: Raw Geophysical Data

Project: Ebnal Lodge

| Date: 24/05/16 | Job Number: 10833 |
|---|---|
| Drawn by: ZE | Approved by: GR |

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0 62.5 125 250 m


N

Legend

Site Boundary

+3

Plotting Perameters

-3

Figure 3: Processed Geophysical Data

Project: Ebnal Lodge

| Date: 24/05/16 | Job Number: 10833 |
|---|---|
| Drawn by: ZE | Approved by: GR |



0 62.5 125 250 m

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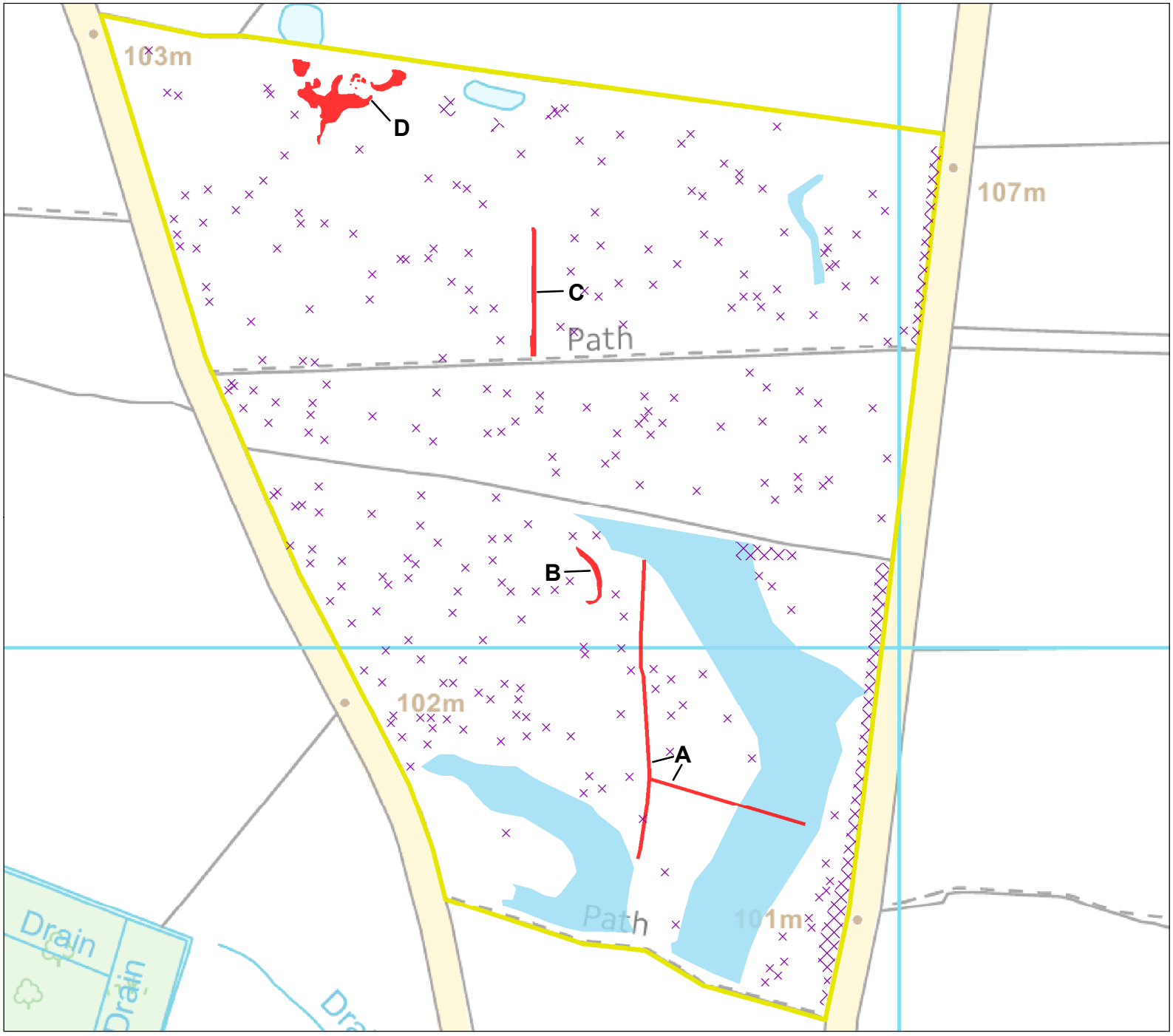


Legend

- Possible Archaeology [GP1]
- Possible Geology [GP2]
- Di-Polar Anomalies [GP3]
- Magnetic Disturbance [GP4]
- Site Boundary



Figure 4: Interpretation of Geophysical Data

Project: Ebnal Lodge

| Date: 06/06/16 | Job Number: 10833 |
|---|---|
| Drawn by: ZE | Approved by: GR |

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