ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

on behalf of
CgMs Consulting

Land off Holmes Chapel Road
Congleton
Cheshire

geophysical surveys

report 2468
August 2010

Durham University

Contents

Figures

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1. Summary

The project

1.1 This report presents the results of geophysical surveys at the site of National Monument No. 13499, a long mound near Congleton, Cheshire, undertaken in order to aid the interpretation of the monument (Figure 1). The works comprised geomagnetic survey totalling *c*. 1ha over the entire mound, and targeted areas of earth electrical resistance survey and ground-penetrating radar (GPR).

1.2 The works were commissioned by CgMs Consulting and conducted by Archaeological Services Durham University.

Results

1.3 The geomagnetic survey detected two concentric anomalies, which could be interpreted as ditch circuits, at the north-west end of the mound, but no evidence of ditches flanking the entire length of the mound. A possible causeway has been detected through both circuits on their north-west side. The mound does not sit centrally within these ditch circuits. The mound and the ditches may be unrelated; if this is the case it is likely that the mound overlies the ditches.

1.4 Possible structural elements have been detected at the north-west end of the mound by both GPR and earth electrical resistance, but do not connect to the mound and as such could be unrelated.

1.5 These features outside the mound, the ditches and possible structures, could contain information to help date the mound, if it can be assumed that the ditches pre-date the mound.

1.6 The earth electrical resistance data indicates that the mound is constructed of stone elements. Further stone work continues outside the mound, perhaps unrelated to the mound itself.

1.7 A geomagnetic anomaly that may represent a possible stone kerb has been detected along the north-east edge of the mound; this would be consistent with a long barrow interpretation.

1.8 The presence of mature oak trees and their associated root action makes interpretation of other features very difficult.

1.9 No obvious chambers or voids have been detected in the geophysical survey, but the majority of the body of the mound has not been tested by either earth electrical resistance or GPR.

1.10 The concentration of dipolar magnetic anomalies and high resistance anomalies on the mound itself indicates that the mound is probably man-made and not a natural feature, although the GPR data has detected a probable slope in the natural deposits below the topsoil.

1.11 Although the presence of a possible stone revetment, and the probable man-made nature of the mound are consistent with the interpretation of the mound as a long barrow, the geophysical evidence alone cannot conclusively state that the mound at Congleton is a Neolithic long barrow. The lack of indicative features, such as flanking

ditches and chambers or voids within the mound itself, could suggest an alternative interpretation.

2. Project background

Location (Figures 1 and 2)

2.1 The survey area was located on land to the south of Holmes Chapel Road, to the west of Congleton, Cheshire (NGR centre: SJ 83036 63413). Seven surveys (one geomagnetic measuring 1ha, two earth electrical resistance totalling 975sq m and four ground penetrating radar totalling 760sq m) were undertaken over a presumed long barrow (National Monument No. 13499). Holmes Chapel Road and Loach Brook lay to the north and east; to the south was farmland and to the west was Sandy Lane.

Objective

2.3 The aim of the geophysical surveys was to shed light on the sub-surface nature of the mound by determining various physical characteristics which could indicate the presence/absence of soil-filled and stone components of the mound in order to aid interpretation.

Methods statement

2.4 The surveys have been undertaken in accordance with instructions from the client. Since the survey area encompassed a Scheduled Monument the surveys were undertaken in accordance with a licence granted by English Heritage under Section 42 of the Ancient Monuments and Areas Act 1979 (as amended by the National Heritage Act 1983).

Dates

2.5 Fieldwork was undertaken on 10th and 11th August 2010. This report was prepared for 20th August 2010.

Personnel

2.6 Fieldwork was conducted under the supervision of Duncan Hale by Edward Davies and Richie Villis. The geophysical data were processed by Richie Villis. This report was prepared by Richie Villis with illustrations by Edward Davies and edited by Duncan Hale, the Project Manager.

Archive/OASIS

2.7 The site code is **CHC10**, for **C**ongleton **H**olmes **C**hapel Road 20**10**. The survey archive will be supplied on CD to the client for deposition with the project archive in due course. Archaeological Services Durham University is registered with the **O**nline **A**cces**S** to the **I**ndex of archaeological investigation**S** project (**OASIS**). The OASIS ID number for this project is **archaeol3-81045**.

Acknowledgements

2.8 Archaeological Services Durham University is grateful for the assistance of Trefor Hughes in facilitating this scheme of works.

3. Historical and archaeological background

3.1 The survey area encompassed a large mound. The mound is scheduled as 'National Monument No. 13499 Long barrow 300m south-east of Somerford Bridge'. The mound has never been excavated or investigated.

3.2 The mound at Congleton was first included in the Scheduled Monuments register as a Neolithic Long Barrow on 25th October 1974. The location of the mound is recorded on the 1st Edition Ordnance Survey County Series 1:2500 map of Cheshire, dated 1873. Higham believes that it could perhaps be natural having 'glacial or fluvoglacial origins' (Higham 1993).

3.3 Typically long barrows consist of earthen or drystone mounds flanked by ditches. They were constructed as funerary monuments during the Early and Middle Neolithic periods, around 3400-2400 BC. Long barrows are amongst the oldest extant field monuments in the British archaeological landscape. Investigations of long barrows have shown that they were used for communal burial, often with only parts of the human remains selected for interment. Some investigated long barrow sites provide evidence for several phases of funerary monument preceding the barrow. This suggests that long barrows acted as important ritual sites for a local community over a considerable period of time. Around 500 long barrows are recorded in England, and they are one of only a handful of Neolithic structure types to survive.

3.4 Long barrows are typically found concentrated in areas such as the Cotswolds, the Wessex downs and the Yorkshire and Lincolnshire Wolds. The mound at Congleton is one of only two long barrows recorded in Cheshire.

3.5 The mound is aligned north-west/south-east and is located on a small flood plain to the west of Loach Brook. A berm flanks the long barrow on either side, but there is no evidence as yet for any flanking ditches. The sub-surface nature of the mound, has never been investigated.

3.6 The antiquity of the mound has been questioned (Mullen 2002) and there have been alternative origins and functions of the mound suggested. One of these is that the mound may be an 18th-century cattle plague burial mound.

4. Landuse, topography and geology

4.1 The mound was covered in mature deciduous trees in a pasture field.

4.2 The mound measures *c*. 110m long by 20m wide and rises *c*. 2m. An accompanying berm flanks the earthwork on each side. The mean elevation at the foot of the mound was approximately 84m OD.

4.3 The underlying solid geology of the area comprises Triassic strata of the Sidmouth Mudstone Formation, which are overlain by Devensian glaciofluvial deposits of sands and gravels.

5. Geophysical survey

Standards

5.1 The surveys and reporting were conducted in accordance with English Heritage guidelines, *Geophysical survey in archaeological field evaluation* (David, Linford & Linford 2008); the Institute for Archaeologists Technical Paper No.6, *The use of geophysical techniques in archaeological evaluations* (Gaffney, Gater & Ovenden

2002); and the Archaeology Data Service *Geophysical Data in Archaeology: A Guide to Good Practice* (Schmidt 2002).

Technique selection

5.2 Geophysical survey enables the relatively rapid and non-invasive identification of sub-surface features of potential archaeological significance and can involve a suite of complementary techniques such as magnetometry, earth electrical resistance, ground-penetrating radar, electromagnetic survey and topsoil magnetic susceptibility survey. Some techniques are more suitable than others in particular situations, depending on site-specific factors including the nature of likely targets; depth of likely targets; ground conditions; proximity of buildings, fences or services and the local geology and drift.

5.3 In this instance, based on accepted knowledge of other Neolithic long barrows, it was considered likely that cut features such as ditches and pits would be present on the site, and that other types of feature such as stone or timber chambers and other components may also be present.

5.4 Given the anticipated depth and nature of targets and the non-igneous geological environment of the study area, a suite of three geophysical techniques was considered appropriate in this instance: geomagnetic survey (fluxgate gradiometry), earth electrical resistance survey and ground-penetrating radar (GPR) survey.

5.5 Fluxgate gradiometry involves the use of hand-held magnetometers to detect and record anomalies in the vertical component of the Earth's magnetic field, which are caused by variations in soil magnetic susceptibility or permanent magnetisation; such anomalies can reflect, for example, ferrous, stone, brick and soil-filled features. Electrical resistance survey is ideal for detecting stone features such as walls, paths and culverts, but can also detect soil-filled features, depending on ground conditions at the time of survey. When a small electrical current is injected through the earth it encounters resistance which can be measured. Since resistance is linked to moisture content and porosity, stone and brick features will give relatively high resistance values while soil-filled features, which retain more moisture, will provide relatively low resistance values. GPR generates a short high-frequency radar pulse which is transmitted into the ground via an antenna; the energy is reflected by buried interfaces and the return signal is received by a second antenna. The amplitude of the return signal relates to the electromagnetic responses of different sub-surface materials and conditions, which can be features of archaeological interest. The time which elapses between the transmission and return of energy to the surface can be used to provide depth information.

Field methods

5.6 A 30m grid was established across the mound for the geomagnetic survey; 20m grids were established at either end of the mound for the earth electrical resistance survey. Four different areas were established for the GPR survey, measuring 20m x 12m, 10m x 12m, 20m x 8m and 16m x 15m. These were all tied-in to known, mapped Ordnance Survey points using a Trimble Pathfinder Pro XRS global positioning system with real-time correction (Figure 2).

5.7 Measurements of vertical geomagnetic field gradient were determined using Bartington Grad601-2 dual fluxgate gradiometers. A zig-zag traverse scheme was employed and data were logged in 30m grid units. The instrument sensitivity was nominally 0.03nT, the sample interval was 0.25m and the traverse interval was 1.0m, thus providing 3,600 sample measurements per 30m grid unit.

5.8 Measurements of earth electrical resistance were determined using Geoscan RM15D resistance meters with a mobile twin probe separation of 0.5m. A zig-zag traverse scheme was employed and data were logged in 20m grid units. The instrument sensitivity was set to 0.1ohm, the sample interval to 0.5m and the traverse interval to 1.0m, thus providing 800 sample measurements per 20m grid unit.

5.9 Geomagnetic and earth electrical resistance data were downloaded on site into a laptop computer for initial processing and storage and subsequently transferred to a desktop computer for processing, interpretation and archiving.

5.10 The GPR survey was conducted using a Malå Ramac X3M radar unit with 250MHz antenna. Returned energy wavelets were recorded from many depths in the ground to produce a series of reflections generated at one location, called a reflection trace. Data traces were logged at 0.1m intervals along traverses 0.5m apart. Within each rectangular grid, two sets of data were collected along two sets of perpendicular traverses which were then combined to form one dataset per grid.

Data processing

5.11 Geoplot v.3 software was used to process the geomagnetic and earth electrical resistance data and to produce both continuous tone greyscale images and trace plots of the raw (minimally processed) data. The greyscale images and interpretations are presented in Figures 3 - 4; the trace plots are provided in Figure 8. In the greyscale images, positive magnetic/high resistance anomalies are displayed as dark grey and negative magnetic/low resistance anomalies as light grey. Palette bars relate the greyscale intensities to anomaly values in nanoTesla for the geomagnetic data and ohm for the earth electrical resistance data.

5.12 The following basic processing functions have been applied to the geomagnetic data:

clip	clips data to specified maximum or minimum values; to eliminate large noise spikes; also generally makes statistical calculations more realistic
zero mean traverse	sets the background mean of each traverse within a grid to zero; for removing striping effects in the traverse direction and removing grid edge discontinuities
destagger	corrects for displacement of geomagnetic anomalies caused by alternate zig-zag traverses
despike	locates and suppresses iron spikes in gradiometer data
interpolate	increases the number of data points in a survey to match sample and traverse intervals; in this instance the data have been interpolated to 0.25m x 0.25m intervals

5.13 The following basic processing functions have been applied to the resistance data:

despike	locates and suppresses spikes in data due to poor contact resistance
interpolate	increases the number of data points in a survey to match sample and traverse intervals; in this instance the data have been interpolated to 0.25m x 0.25m intervals

Interpretation: anomaly types

5.14 Colour-coded geophysical interpretation plans are provided. Three types of geomagnetic anomaly have been distinguished in the data:

positive magnetic	regions of anomalously high or positive magnetic field gradient, which may be associated with high magnetic susceptibility soil-filled structures such as pits and ditches
negative magnetic	regions of anomalously low or negative magnetic field gradient, which may correspond to features of low magnetic susceptibility such as wall footings and other concentrations of sedimentary rock or voids
dipolar magnetic	paired positive-negative magnetic anomalies, which typically reflect ferrous or fired materials (including fences and service pipes) and/or fired structures such as kilns or hearths

5.15 Two types of resistance anomaly have been distinguished in the data:

high resistance	regions of anomalously high resistance, which may reflect foundations, tracks, paths and other concentrations of stone or brick rubble
low resistance	regions of anomalously low resistance, which may be associated with soil-filled features such as pits and ditches

Interpretation: features

5.16 A colour-coded archaeological interpretation plan is provided (Figure 7).

5.17 Small, discrete dipolar magnetic anomalies have been detected in the survey area. These almost certainly reflect items of near-surface ferrous and/or fired debris, such as horseshoes and brick fragments, and in most cases have little or no archaeological significance. A sample of these is shown on the geophysical interpretation plan, however, they have been omitted from the archaeological interpretation plan and the following discussion.

5.18 Two concentric curvilinear positive magnetic anomalies have been detected at either side of the mound at the north-west end. These are likely to reflect soil-filled ditch features (**A**), possibly with a causeway at their north-west side. The outer of the two anomalies corresponds to the outer edge of the berm at the north of the mound. These features are also apparent as areas of anomalously low electrical resistance and can be seen in time-slices of the GPR data, which indicates that one of these may lie 0.7-0.9m below ground level (Figure 5). The mound does not sit centrally within these ditch circuits. The ditches are not detected where the mound is. If the mound and the ditch circuits are unrelated then it is likely that the mound overlies the ditches.

5.19 A weak linear negative magnetic anomaly has been detected along the north-east edge of the base of the mound. This could reflect the presence of a stone kerb or revetment (**B**) along the edge of the mound.

5.20 In the earth electrical resistance surveys at both the north-west and south-east ends of the mound areas of anomalously high resistance have been detected. The relatively high intensity of these anomalies is likely to reflect the presence of stone (**E**), rather than natural gravels, at each end of the mound. Some of this may be structural. The GPR data also detected anomalies in these areas. At the north-east end high resistance anomalies have been detected beyond the limit of the mound.

5.21 The areas of high resistance at both ends of the mound correspond to the slope of the barrow, possibly reflecting structural stone (**E**) in the composition of the mound. This would be consistent with other long barrows which have been found to be drystone constructed.

5.22 The roughly square area of high electrical resistance just to the north-west of the mound, on the berm between the mound and the ditches, corresponds to an anomaly seen in the time-slices and profiles of the GPR data. An approximately 4m x 3m feature has been identified, at a depth of around 0.75m – 1m (Figure 5). This could represent a stone built structure (**C**). If the structural element of this is thin upright slabs of stone this may explain why it has not been identified in the geomagnetic data. This feature is located outside of the mound, between the geomagnetically identified ditches, and may not be associated with the mound itself.

5.23 The rectilinear high resistance anomaly detected in the centre of the north-west survey could also represent a stone structure (**G**), however there is no supporting evidence from either the GPR or geomagnetic data.

5.24 Two possible ditches (**D**) have been detected in the GPR data against the base of the mound at its north corner. These correspond to an area of low electrical resistance.

5.25 A positive magnetic anomaly has been detected in the south corner of the survey area; an area of low electrical resistance was also detected in the vicinity. This would suggest a soil-filled feature (**F**).

5.26 A number of linear, curvilinear and rectilinear weak positive magnetic anomalies have been detected across the survey area. These may reflect soil-filled archaeological features, such as ditches and gullies, but the weak and diffuse nature of many of these and the number of trees on the mound may mean these are natural features related to root action. The GPR data has detected a number of near-surface anomalies that may also relate to root action.

5.27 A sloping reflective surface has been identified in the GPR data at the north-west of the mound (Figures 5 and 6). This is likely to reflect a slope in the natural sub-surface deposits (**H**), which would be consistent with Higham's interpretation of the mound forming naturally (Higham 1993). The high concentration of dipolar magnetic anomalies detected across the mound, most evident in the trace plot of geomagnetic data (Figure 8), and the anomalously high resistance (**E**) detected on the mound itself, would suggest that the mound is not natural.

6. Conclusions

6.1 Geomagnetic, earth electrical resistance and ground penetrating radar surveys were undertaken over a possible Neolithic Long Barrow on land to the south-west of Holmes Chapel Road, near Congleton, Cheshire.

6.2 The geomagnetic survey detected two concentric anomalies, which could be interpreted as ditch circuits, at the north-west end of the mound, but no evidence of ditches flanking the entire length of the mound. A possible causeway has been detected through both circuits on their north-west side. The mound does not sit centrally within these ditch circuits. The mound and the ditches may be unrelated; if this is the case it is likely that the mound overlies the ditches.

6.3 Possible structural elements have been detected at the north-west end of the mound by both GPR and earth electrical resistance; these could reflect features such as a stone chamber or entrance to the long barrow, but do not connect to the mound and as such could be unrelated.

6.4 These features outside the mound, the ditches and possible structures, could contain information to help date the mound, if it can be assumed that the ditches pre-date the mound.

6.5 The earth electrical resistance data indicates that the mound is constructed of stone elements. Further stone work continues outside the mound, perhaps unrelated to the mound itself.

6.6 A geomagnetic anomaly that may represent a possible stone kerb has been detected along the north-east edge of the mound; this would be consistent with a long barrow interpretation.

6.7 The presence of mature oak trees and their associated root action makes interpretation of any possible timber features very difficult.

6.8 No obvious chambers or voids have been detected in the geophysical survey, but the majority of the body of the mound has not been tested by either earth electrical resistance or GPR. Further survey over the body of the mound may shed light on any possible structural components of the monument.

6.9 The GPR data has detected a probable slope in the natural deposits below the topsoil at the north-west of the mound which would be consistent with Higham's interpretation that the mound formed naturally. However the concentration of dipolar magnetic anomalies and high resistance anomalies on the mound itself indicates that the mound is probably man-made and not a natural feature.

6.10 Although the presence of a possible stone revetment, and the probable man-made nature of the mound are consistent with the interpretation of the mound as a long barrow, the geophysical evidence alone cannot conclusively state that the mound at Congleton is a Neolithic long barrow. The lack of indicative features, such as flanking ditches and chambers or voids within the mound itself, could suggest an alternative interpretation.

7. Sources

David, A, Linford, N, & Linford, P, 2008 *Geophysical Survey in Archaeological Field Evaluation*. English Heritage

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Figure 1: Site location

site location

0 2.5km
scale 1:50 000 for A4 plot

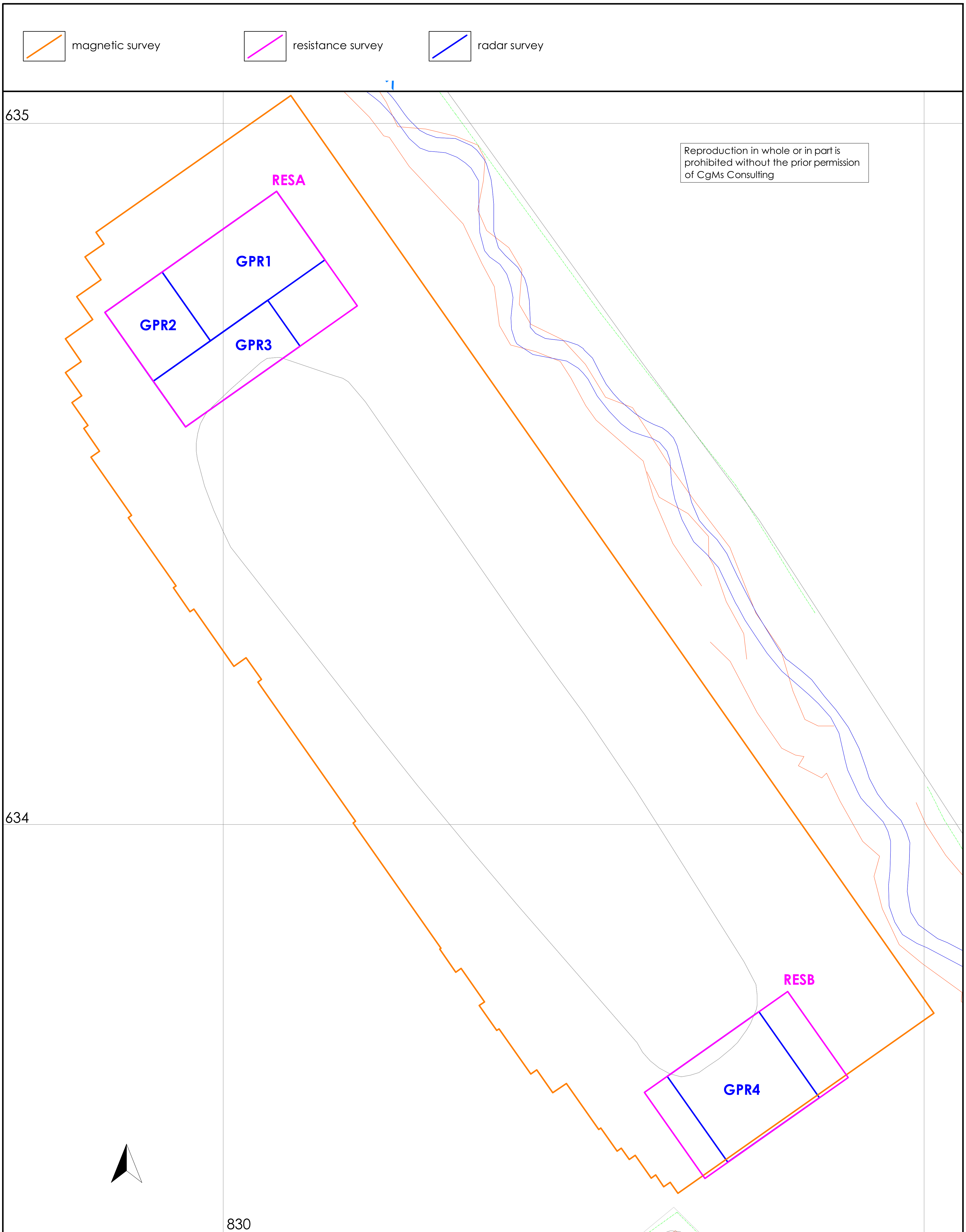

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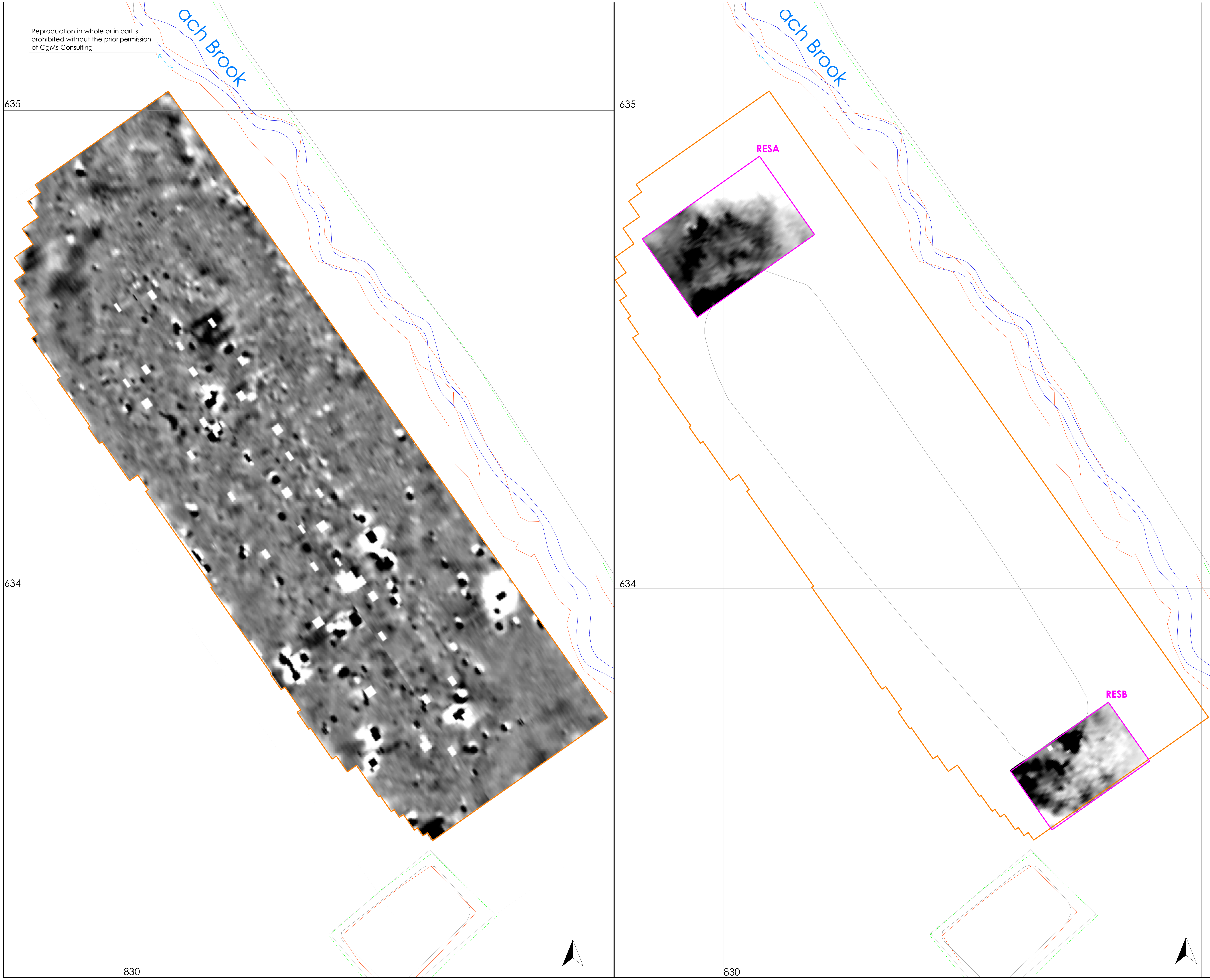
Figure 2: Survey areas



magnetic survey

-2 nT 2

resistance survey

RESA

200 ohm 400

RESB

150 ohm 300

0 25m

scale 1:500 for A2 plot

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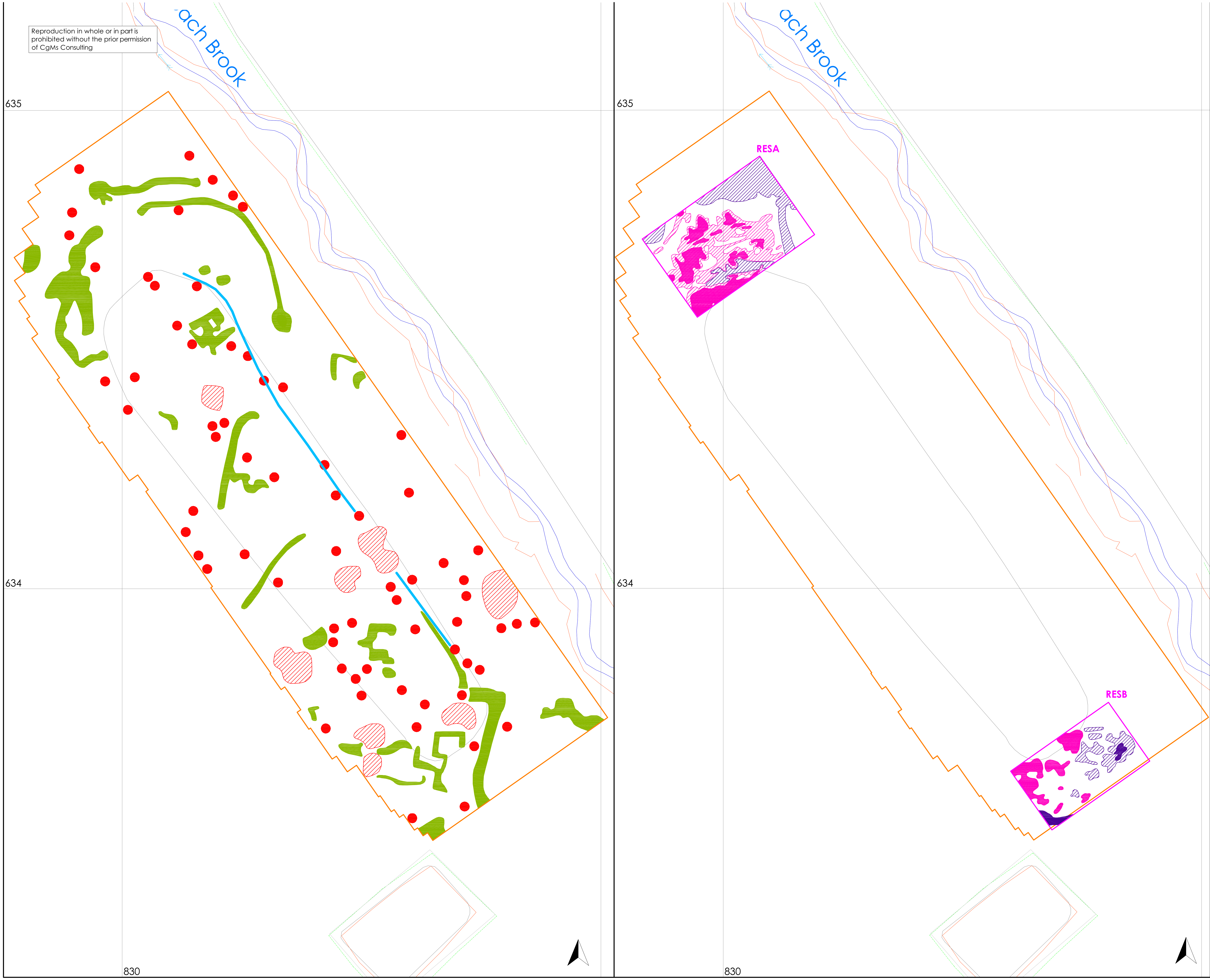
Figure 3: Geophysical surveys



- magnetic survey
- resistance survey
- dipolar magnetic anomaly
- positive magnetic anomaly
- negative magnetic anomaly
- high resistance anomaly
- low resistance anomaly

0 25m
scale 1:500 for A2 plot

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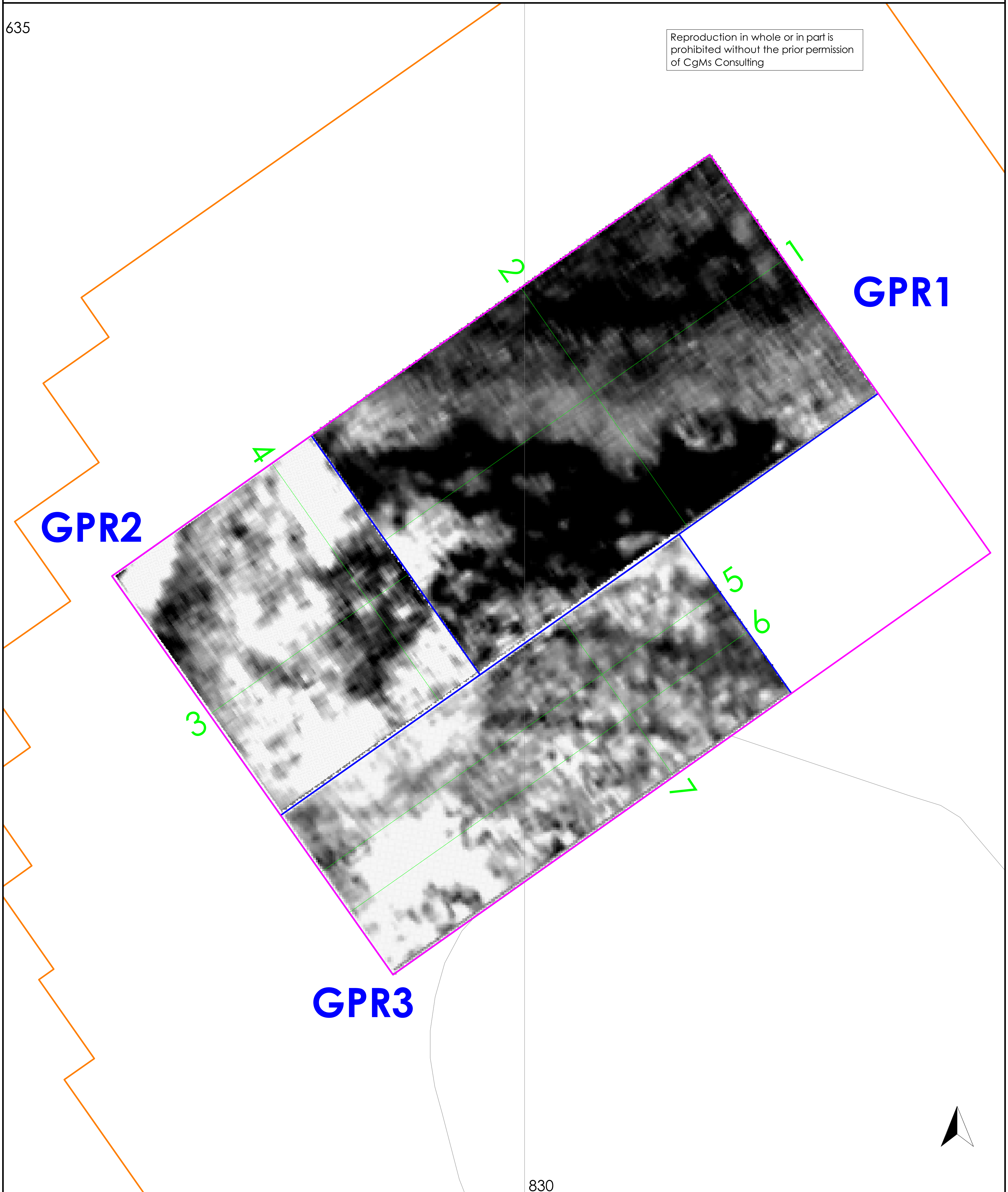
Figure 4: Geophysical interpretations

magnetic survey
resistance survey
radar survey
profile (see figure 6)



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0 7.5m
scale 1:150 for A3 plot

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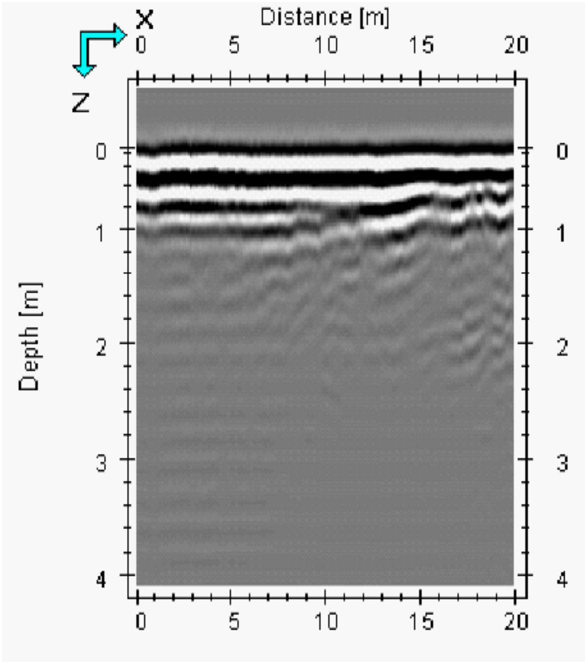
Figure 5: GPR time-slice at 0.8m, Areas GPR1, GPR2 and GPR3

GPR1

1



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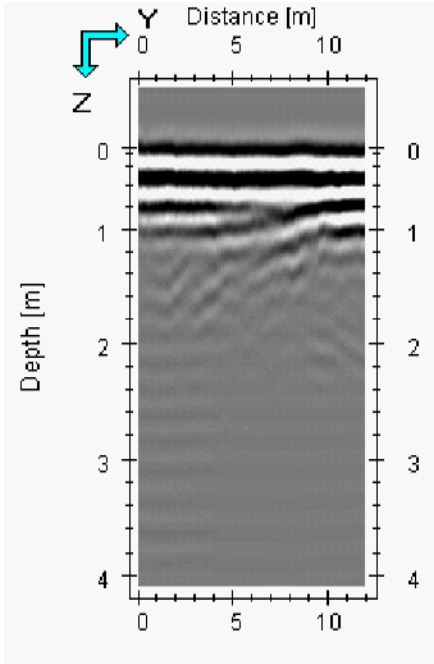
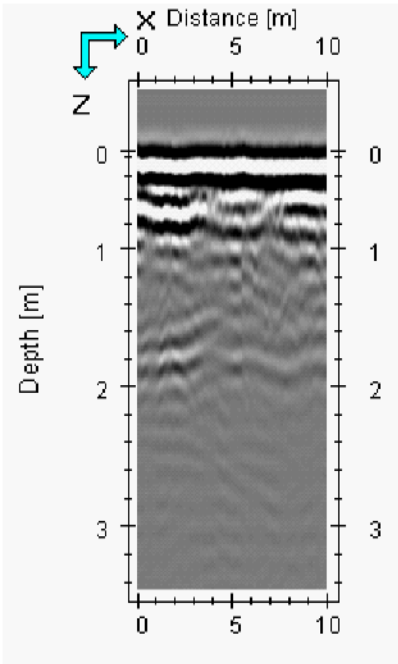


GPR2

3



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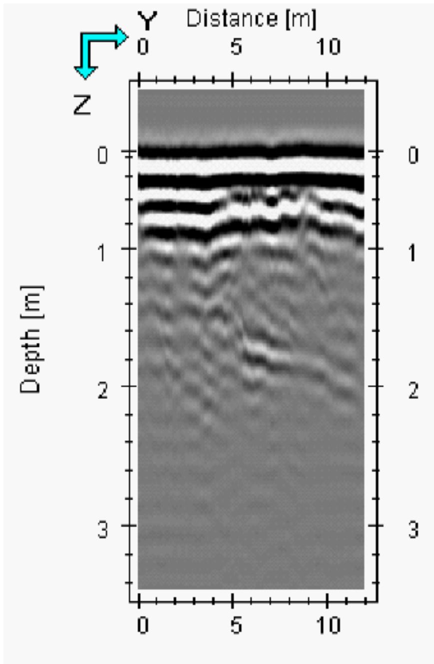
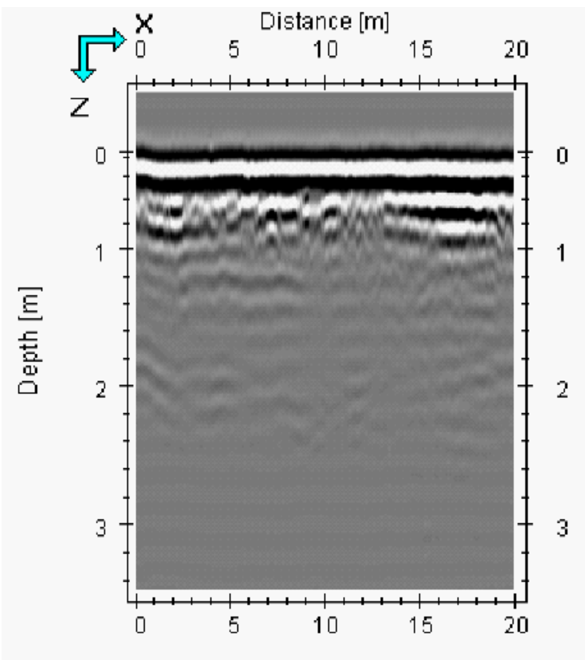


GPR3

5



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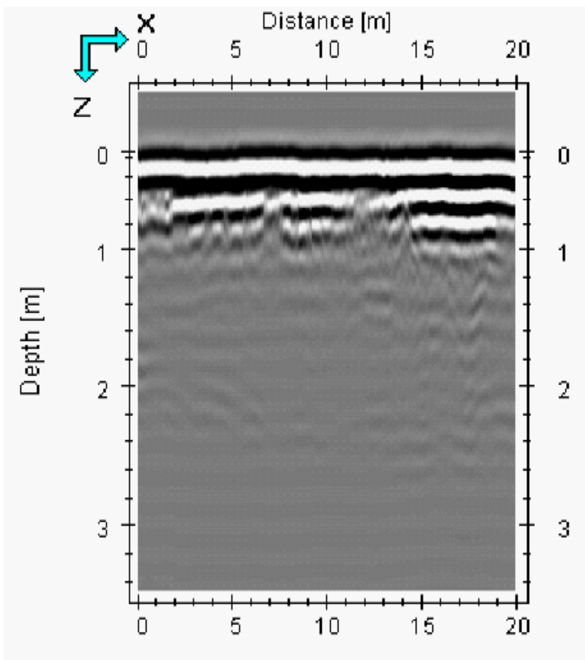

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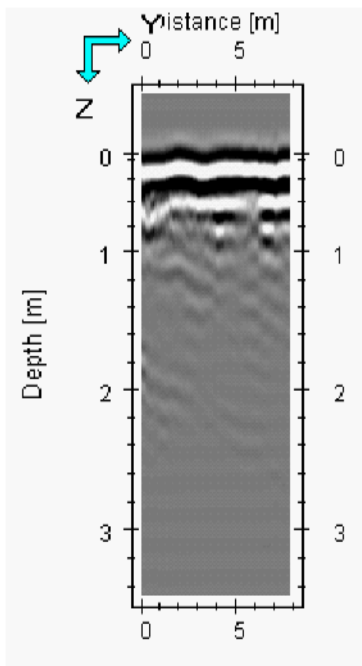

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0 20m
scale 1:400 for A3 plot

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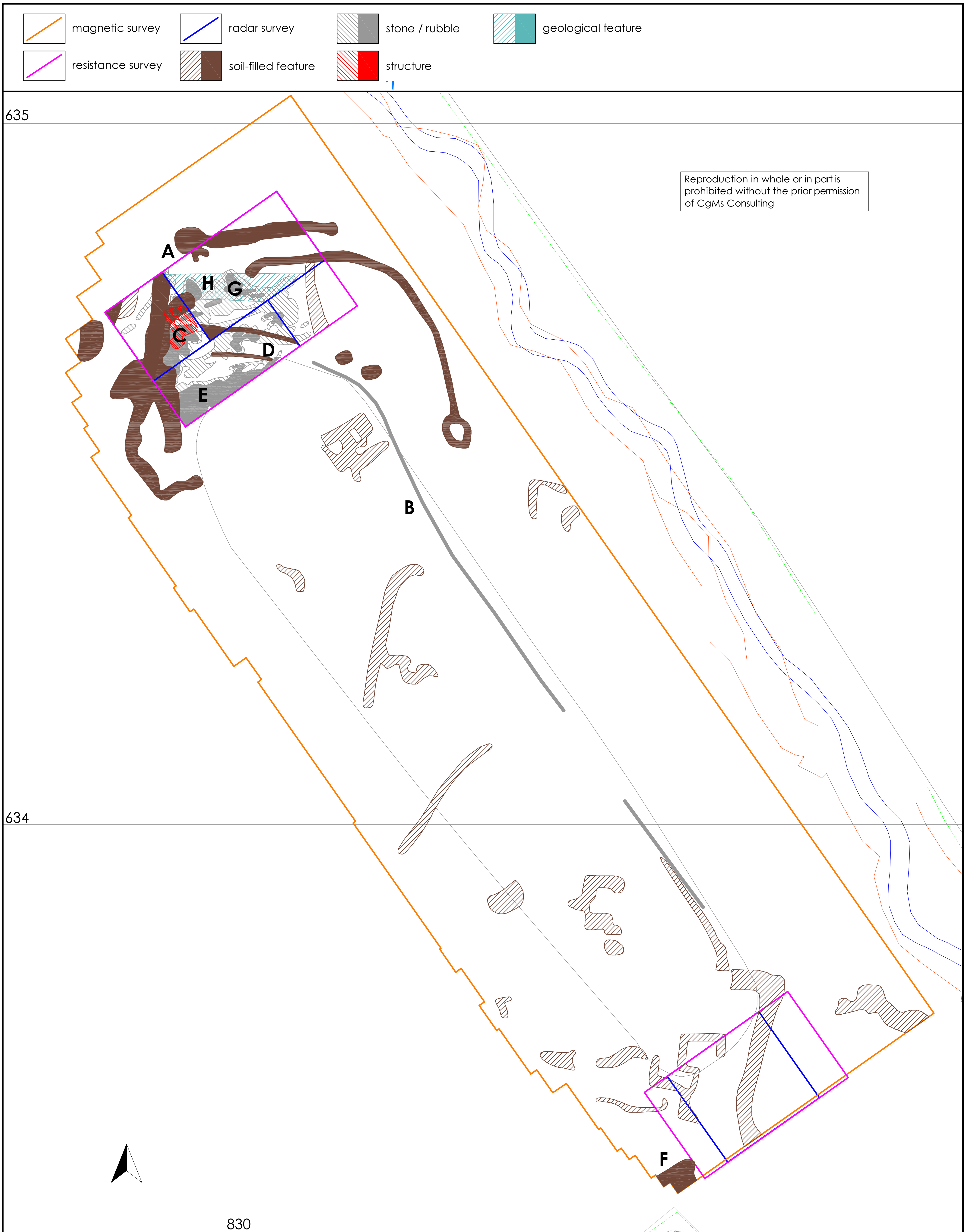
Figure 6: Profiles of GPR data



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0 25m
scale 1:500 for A3 plot

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Figure 7: Archaeological interpretations

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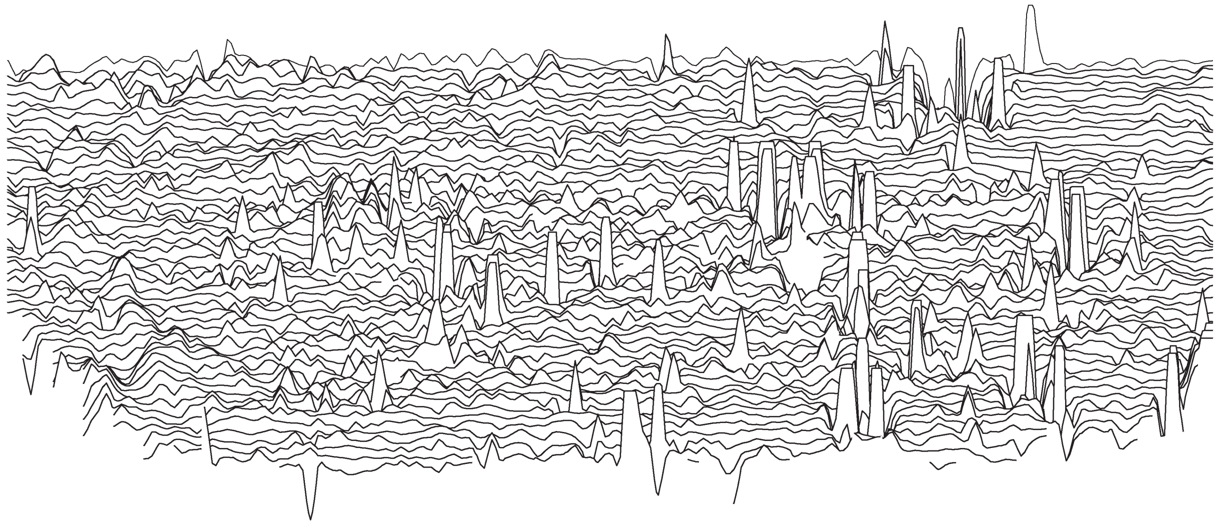
Figure 8:
Trace plots of geomagnetic data

Magnetic area 1

6.90nT/cm

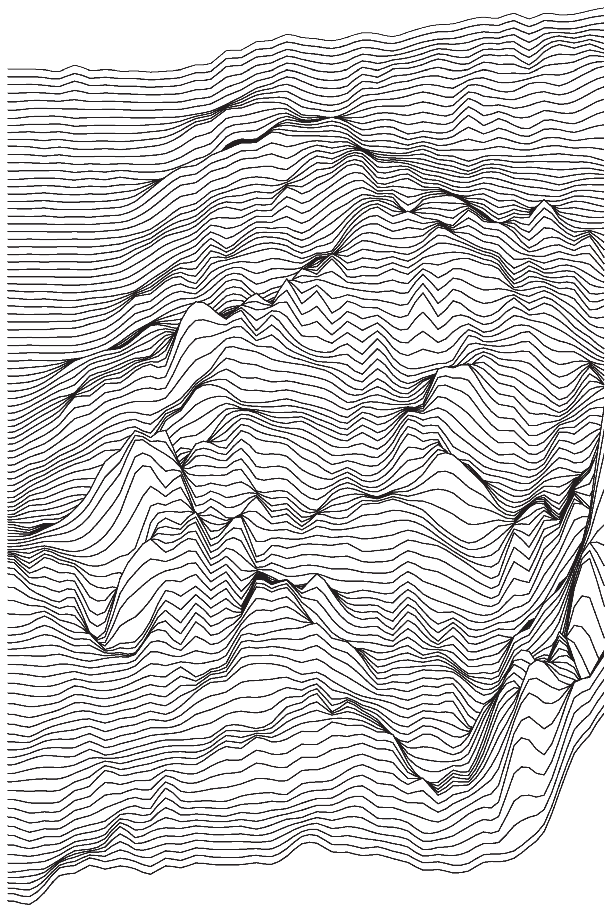
0 50m
scale 1:1000



Resistance area A

0.04 = 146.90 nT/cm

0 10m
scale 1:250



Resistance area B

0.075 = 228.10 ohm/cm

0 10m
scale 1:250