Proposed Nuclear Power Station Wylfa, Anglesey

Archaeological Evaluation:
Geophysical Survey, Interim Report

Ymddiriedolaeth Archaeolegol Gwynedd
Gwynedd Archaeological Trust

Proposed Nuclear Power Station Wyfla, Anglesey

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Geophysical survey, Interim report

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ARCHAEOLOGICAL EVALUATION: Geophysical Survey (G2096)

1.0 INTRODUCTION

Two programmes of geophysical survey have been carried out at the location of the proposed Nuclear Power Station, Wylfa, Ynys Môn for Horizon Nuclear Power. The site of the proposed Nuclear Power Station is located adjacent to the existing Wylfa 'A' power station and currently encompasses a 166.1 hectare area of coastline and agricultural plots, buildings and residential areas, centred on SH35459328 (Fig. 1).

The first was a multiplatform survey conducted by Fugro Aperio Ltd. This included a vertical magnetic gradiometer (VMD) component suitable for archaeological prospection. Gwynedd Archaeological Trust was contracted by Fugro to provide archaeological interpretation of this survey.

Gwynedd Archaeological Trust (GAT) were subsequently asked by Horizon Nuclear Power to carry out a programme of targeted archaeological evaluation (geophysics: high and standard resolution magnetometer survey) to further investigate the results of the multiplatform survey. A series of surveys were carried out in 14 areas mostly of approximately 1ha. The areas were located in the western half of the proposed development area (centred on NGR SH34559272) and targeted specific geophysical anomalies identified during the Fugro multiplatform survey stage as well as two possible prehistoric burnt mound sites identified during the GAT watching brief of geotechnical test pitting (GAT report 994, 2011).

Individual reports were produced for the interpretation of the VMD data (GAT Report 936, 2011) and for the first phase of the targeted geophysical evaluation (GAT Report 987, 2011). The current report combines the second phase of the targeted geophysical evaluation with the results from the two previous reports.

1.1 Requirements

A detailed brief has not been prepared for the GI Programme by Gwynedd Archaeological Planning Service (GAPS; Ref.: D1315). However, at this stage, GAPS has requested that "an extensive programme of evaluation will be required **prior to** determining the appropriateness of the (planning) proposals and before a suitable mitigation strategy can be devised" (GAPS ref.: 0805ab01/D1315). The current archaeological evaluation programme will form part of the "extensive programme of evaluation". GAPS have also stated that the aim of the targeted geophysical evaluation is to evaluate the initial *Fugro* survey results within the targeted areas.

2.0 BACKGROUND

2.1 Assessment

GAT completed an archaeological baseline assessment of the proposed Nuclear Power Station development area in March 2010 (GAT Report **842**). An updated baseline report was produced including the results of the phase evaluation (GAT Report 999 version 1.0)

The report summarised that there are no known buried archaeological features of prehistoric or Roman date within the study area. However, developments elsewhere on Ynys Môn (including the construction of the A55 dual carriageway) have revealed sites for which there was no previous evidence. There are a number of sites in the vicinity of the study area which indicate the presence of people in prehistoric and Roman times. There is, therefore, reasonable potential for the discovery of

archaeological sites within the study area.

Medieval settlement is known from documentary evidence, but no settlements have been located. Some of these may lie underneath later farms and cottages, but others may have become deserted and not rebuilt, leaving potential for the survival of medieval buried archaeology.

Several post-medieval farms and cottages have been demolished in the 20th century. Whilst there are no or few upstanding remains at these sites, there is good potential for the survival of archaeological evidence which can provide additional information on the nature and date of the settlement. There is some cross-over between standing buildings and buried archaeology, particularly where, as at Cestyll, Wylfa and Tre'r Gof, there are sites of demolished buildings alongside standing buildings. In addition there is always the potential for buried archaeology to be preserved alongside or under later buildings.

The agricultural landscape of dispersed settlement preserves elements that have evolved over centuries, in particular the patterns of roads, footpaths and farm boundaries. This is illustrated by the map evidence and is pertinent to the geophysical surveys. A Carreglwyd and Berw estate survey from c.1780 (Fig 2) shows a series of small fields to the west of Wylfa. This was soon superseded and much of the present field system was in place by the time the first Ordnance Survey manuscript was produced in the 1820s (Fig. 3). There is little remaining earthwork evidence of the former field system and it appears that most early surface features were removed during the land improvements associated with the establishment of the modern field system. There have been few changes since the Ordnance Survey County Series maps of 1889 and 1924. Figures 4 and 5 show the 1889 edition, the 1924 is not included as it is almost identical. It should be noted that some surviving features such as the current road, some boundaries and Cafnan house can be recognised on the early estate survey. Comparison to recent maps indicates that the estate survey is semi-diagrammatic and not an accurate scaled map.

The majority of surviving buildings and field systems are of 19th century date. This agricultural landscape was partly overlain in the late 19th and early 20th centuries by the construction of larger houses and gardens, but late 20th century change means this impact is less evident today. The gardens at Cestyll are one of the most significant surviving elements from this period. Wylfa 'A' physically dominates the landscape, and caused many changes to it. The study area is now largely defined and managed as a result of the construction of the power station. The landscaping designed by Sylvia Crowe, and the nature trails through the woodland, are important elements within this.

3.0 METHODOLOGY

3.1 Horizon Nuclear Power a multiplatform survey/ground investigation programme

A geophysical survey of the current development zone was carried out by Fugro Aperio Ltd for Horizon Nuclear Power (Fig.6). This was carried out as part of an initial multiplatform survey/ground investigation programme of works. GAT monitored all relevant intrusive investigation works (inc. test pitting and trenching), and also provided an archaeological interpretation of the results of the Vertical Magnetic Dipole (VMD) component of the multiplatform survey. It should be noted that a further area of survey located to the south of the present area is still to be completed and will be presented in an updated version of this report.

The VMD survey used a pair of Caesium vapour magnetometers with a 1m traverse interval on a **GEEP** (**G**eophysical **E**xploration **E**quipment **P**latform) multiplatform survey sled towed by an all-terrain-vehicle. The survey results were presented to GAT as a grey-scale plot clipped to +-15nT. An interpretation plan and table of non-ferrous and non-geological magnetic gradient anomalies was produced (Fig. 6). Two further area of survey are currently awaiting completion and will be incorporated into a revised version of this report.

Each anomaly was assigned a number, interpreted and the level of confidence of the interpretation was recorded as follows:

H – High, the anomaly can be recognized from its shape or form as a recognizable site type.
M- Medium, the anomaly can be provisionally allocated to a site type or more general category.
L- Low- Amorphous and weak anomalies that cannot be provisionally allocated to a site type.

The interpretation of archaeological anomalies depends on recognising the morphology of a feature in plan. Some archaeological anomalies can be identified with a high degree of confidence, e.g. the distinctive outline of a Roman fort. Most anomalies cannot however be interpreted with a high level of certainty. Linear ditches could be assigned to many periods and functions and very weak anomalies, for example those produced by prehistoric settlement and cemeteries can be difficult to distinguish from natural subsoil variations and periglacial features. There are therefore often several possible interpretations. Alternative interpretations are therefore noted in the table along with level of confidence. A cross reference to anomalies in the targeted surveys carried out by GAT is also included in the table.

Each anomaly was also assigned a category of importance. The criteria are based upon those used by the Welsh Assembly Government (WAG) when considering sites for protection as scheduled ancient monuments, as set out in the Welsh Assembly circular 60/96.

Category A - Sites of National Importance.

This category includes Scheduled Ancient Monuments and Listed Buildings of grade II* and above, as well as those sites that would meet the requirements for scheduling (ancient monuments) or listing (buildings) or both.

Sites that are scheduled or listed have legal protection, and it is recommended that all Category A sites remain preserved and protected *in situ*.

Category B - Sites of Regional Importance

This category includes grade II Listed Buildings and sites which would not fulfil the criteria for scheduling, but which are nevertheless of particular importance within the region. Preservation *in situ* is the preferred option for Category B sites, but if damage or destruction cannot be avoided, appropriate detailed recording might be an acceptable alternative.

Category C - Sites of District or Local Importance

These sites are not of sufficient importance to justify a recommendation for preservation if threatened, but nevertheless merit adequate recording in advance of damage or destruction.

Category D - Minor and Damaged Sites

These are sites, which are of minor importance, or are so badly damaged that too little remains to justify their inclusion in a higher category. For these sites rapid recording either in advance or during destruction, should be sufficient.

Category E - Sites needing further investigation

Sites, the importance of which is as yet undetermined and which will require further work before they can be allocated to categories A-D, are temporarily placed in this category, with specific recommendations for further evaluation. By the end of the assessment there should be no sites remaining in this category, unless they will not be affected by the proposed works. This category is particularly relevant to geophysical anomalies, many of which cannot be identified with certainty without additional assessment. In such cases the category can be shown with a potential range of importance e.g. E (A-C).

Category F – Non archaeological site

The interpretation of geophysical surveys usually requires all anomalies to be transcribed in order to demonstrate that the results have been completely assessed. Many anomalies are however caused by non-archaeological features such as geology, modern services (pipe trenches, buried cables etc.) and agricultural topsoil variations caused by recent ploughing and vehicle ruts. In Tables 1 and 2 these are assigned to a separate category *Category F – Non archaeological site.* This is not a WAG category as categories A to E specifically apply to archaeological sites. It is expected that all anomalies that can be reliably assigned to category F will be discounted from any further assessment.

Specific anomalies were targeted by Fugro based on the results of the survey programme (mainly using the results of the Time Domain Electromagnetic (EM61) survey designed to detect obstructions and metal contamination) and a series of hand dug trial pits were located across the development zone. These were monitored by GAT and suspected prehistoric burnt mound activity was identified in two of these test pits (TP62A and TP76B) by GAT as part of the watching brief phase. A provisional description is supplied below.

TP62A: This test pit was located at NGR SH35189282 on a hillside sloping down to the SE and measured 0.5m in depth, and 0.03m x 0.37m in diameter. The test pit included a compact, black deposit of clay-silt-charcoal matrix surrounding fire cracked and reddened stones <0.05m in diameter, interpreted as burnt mound material. The feature was preserved in situ and not excavated within the confines of the test pit.

TP76B: This test pit was located at NGR SH34629264, located on ground which slopes down to a boggy area to the south. The test pit included a 0.8m thick deposit of friable black, clay-silt/charcoal matrix surrounding fire cracked and reddened stones <0.1m in diameter. A sample was taken of the burnt material, and a written and photograph record was made of the exposed section. The rest of the feature survives *in situ.*

3.2 Targeted Fluxgate Gradiometer Survey

The VMD survey covered a very large area in a relatively short time that would not have been practical using hand-held equipment. The technique has a theoretical resolution of 1.0m x c.0.25m. In practice the results were less clear, reducing the effective spatial resolution and making weak anomalies difficult to detect. The survey resolved large-scale linear anomalies and provided a general assessment of the archaeological potential of the study area. It was not however capable of resolving small (sub 5m) and weak (sub c.2nT) features with any certainty. Several areas of interest were

therefore targeted with hand-held fluxgate gradiometer surveys, initially at high resolution (0.5m traverse interval x 0.25m sample interval) and then at standard resolution (1.0 m traverse interval x 0.25m sample interval)

The survey was carried out in a series of 20m grids, which were tied into the Ordnance Survey grid using a Trimble GPS system to an accuracy of 30mm. The surveys were conducted using a Bartington Grad 601-2 Dual Sensor fluxgate gradiometer. The surveys in areas 4 and 5 were carried out at high resolution (0.5m traverse interval x 0.25m sample interval) and all other areas at standard resolution (1.0 m traverse interval x 0.25m sample interval). High resolution survey is much slower than standard and for this reason, standard resolution is usually used for large-area archaeological prospection. Both the high resolution and standard resolution surveys showed greatly increased levels of detail compared to the multi-platform VMD results. There was however, only a slight increase in clarity in the high resolution survey when compared with standard resolution data. After consultation with *Horizon* and GAPS it was decided to survey the remaining areas at standard resolution. Smaller areas could be re-surveyed at high resolution if more fine detail was required.

3.2.1 Instrumentation

The Bartington Grad 601-2 dual Fluxgate Gradiometer uses a pair of Grad-01-100 sensors. These are high stability fluxgate gradient sensors with a 1.0m separation between the sensing elements, giving a strong response to deeper anomalies.

The instrument detects variations in the earth's magnetic field caused by the presence of iron in the soil. This is usually in the form of weakly magnetised iron oxides which tend to be concentrated in the topsoil. Features cut into the subsoil and backfilled or silted with topsoil therefore contain greater amounts of iron and can therefore be detected with the gradiometer. This is a simplified description as there are other processes and materials which can produce detectable anomalies. The most obvious is the presence of pieces of iron in the soil or immediate environs which usually produce very high readings and can mask the relatively weak readings produced by variations in the soil. Strong readings are also produced by archaeological features such as hearths or kilns because fired clay acquires a permanent thermo-remnant magnetic field upon cooling. This material can also get spread into the soil leading to a more generalised magnetic enhancement around settlement sites.

Not all surveys can produce good results as anomalies can be masked by large magnetic variations in the bedrock or soil or high levels of natural background "noise" (interference consisting of random signals produced by material within the soil). In some cases, there may be little variation between the topsoil and subsoil resulting in undetectable features.

The Bartington Grad 601 is a hand held instrument and readings can be taken automatically as the operator walks at a constant speed along a series of fixed length traverses. The sensor consists of two vertically aligned fluxgates set 1.0m apart. Their Mumetal cores are driven in and out of magnetic saturation by an alternating current passing through two opposing driver coils. As the cores come out of saturation, the external magnetic field can enter them producing an electrical pulse proportional to the field strength in a sensor coil. The high frequency of the detection cycle produces what is in effect a continuous output.

The gradiometer can detect anomalies down to a depth of approximately one metre. The magnetic variations are measured in nanoTeslas (nT). The earth's magnetic field strength is about 48,000 nT; typical archaeological features produce readings of below 15nT although burnt features and iron objects can result in changes of several hundred nT. The instrument is capable of detecting changes as low as 0.1nT.

3.2.2 Data Collection

The gradiometer includes an on-board data-logger. Readings in the surveys are taken along parallel traverses of one axis of a 20m x 20m grid. The traverse interval is 0.5m. Readings are logged at intervals of 0.25m along each traverse.

3.2.3 Data presentation

The data is transferred from the data-logger to a computer where it is compiled and processed using ArchaeoSurveyor 2 software. The data is presented as a grey-scale plot where data values are represented by modulation of the intensity of a grey scale within a rectangular area corresponding to the data collection point within the grid. This produces a plan view of the survey and allows subtle changes in the data to be displayed. This is supplemented by an interpretation diagram showing the main features of the survey with reference numbers linking the anomalies to descriptions in the written report. It should be noted that the interpretation is based on the examination of the shape, scale and intensity of the anomaly and comparison to features found in previous surveys and excavations etc. In some cases the shape of an anomaly is sufficient to allow a definite interpretation e.g. a Roman fort. In other cases all that can be provided is the most likely interpretation. The survey will often detect several overlying phases of archaeological remains and it is not usually possible to distinguish between them. Weak and poorly defined anomalies are most susceptible to misinterpretation due to the propensity for the human brain to define shapes and patterns in random background 'noise'. An assessment of the confidence of the interpretation is given in the text.

3.2.4 Data Processing

The data is presented with a minimum of processing although corrections are made to compensate for instrument drift and other data collection inconsistencies. High readings caused by stray pieces of iron, fences, etc are usually modified on the grey scale plot as they have a tendency to compress the rest of the data. The data is however carefully examined before this procedure is carried out as kilns and other burnt features can produce similar readings. The data on some noisy or very complex sites can benefit from 'smoothing'. Grey-scale plots are always somewhat pixellated due to the resolution of the survey. This at times makes it difficult to see less obvious anomalies. The readings in the plots can therefore be interpolated thus producing more but smaller pixels and a small amount of low pass filtering can be applied. This reduces the perceived effects of background noise thus making anomalies easier to see. Any further processing would be noted in relation to the individual plot.

4.0 RESULTS

4.1 The multi-platform VMD results

The VMD data were presented by Fugro as a grey-scale plot (Fig. 5). This was interpreted by GAT (Fig. 6) and presented as a table summarising the results. An updated version is included below (Table 1). The information has been updated to include information from the trial-trenching and targeted geophysics. This feedback of information allowed some anomalies to be reinterpreted and provided a better understanding of the likely interpretation of some of the other anomalies due to added information about the geology, general levels of modern disturbance and the character of buried archaeology in the area.

Table 1. The VMD results

Anomaly Number	Interpretation	Confidence	Importance	Alternative Interpretation	Confidence	Importance	x-ref to GAT
A-01	Former field	M	E(D)	Modern	M	E(D)	

	boundary, unclear as aligned with geophys traverse direction			disturbance, possibly a track or even a data gathering artefact			
A-02	Modern disturbance associated with pipeline	M	F	Former field boundary or enclosure bank.	L	E(C-D)	
A-03	Minor feature, probably agriculture or fragments of former field boundaries shown on 1889/1924 OS County Series maps	M	E(C-D)				
A-04	Minor features, probably agriculture or fragments of former field boundaries shown on 1889/1924 OS County Series maps	M	E(C-D)				
A-05	Roughly concentric circular anomalies. Modem disturbance associated with Wylfa A construction	H	F				80
A-06	Modern surface track	H	F				61
A-07	Minor feature, probably agricultural	M	F				
A-08	Narrow trench, probably modern carrying a pipe or cable	H	F				
A-09	Narrow trench, probably modern carrying a pipe or cable	H	E(F)	Possibly a narrow ditch forming an enclosure with A-13	L	E(B-D)	62
A10	Double parallel anomaly, probably former field boundary shown on 1889/1924 OS County Series maps	H	E(C-D)	Narrow double feature, probably modern trench carrying a pipe or cable.	L	E(F)	
A-11	Meandering feature, probably agricultural or pipe trench	M	E(F)	Possibly a narrow ditch, former boundary or enclosure	L	E(C-D)	
A-12	Meandering	M	F	Possibly a	L	C-D	

	feature, probably agricultural or pipe trench, continuation of A-11			narrow ditch, former boundary or enclosure			
A-13	Narrow curvilinear trench, possibly modern carrying a pipe or cable	H	E(F)	Possibly a narrow ditch forming an enclosure with A-09	L	E(B-D)	59
A14	Faint curvilinear features with some additional associated noise. Natural subsoil/bedrock variation	H	F				60
A-15	Small discrete circular anomaly, either natural or a processing artefact	M	E(F)	Small round barrow, prehistoric or Roman. Possible but unlikely	L	E(A-B)	
A-16	Parallel anomalies, modern ploughing as opposed to medieval ridge and furrow	H	E(D)	The central (NW – SE) wider anomaly could be a former field boundary shown on 1889/1924 OS County Series maps	M	E(C-D)	
A-17	Modern surface track, continuation of A-06	H	F				56
A-18	Former field boundary shown on 1889 OS map	H	C-D				
A-19	Long curvilinear feature, possibly a former trackway	M	E(B-C)	Modern disturbance	M	E(F)	45
A-20	Mound visible on 1948 aerial photograph, natural feature	M	F				40
A-21	Mound visible on 1948 aerial photograph, natural feature	M	F				41
A-22	Widely spaced parallel linear anomalies, poss. former field boundary	M	E(C-D)	Agriculture or modern disturbance	M	E(F)	
A-23	Parallel linear anomalies, former field boundary	M	E(C-D)	Agriculture or modern disturbance	M	E(F)	
A-24	Faint linear anomaly, drainage or former boundary	M	E(C-D)				71
A-25	Strong roughly circular anomaly	M	E(A-B)	Geology or modern	M	E(F)	69

	20m diam, central feature. Thermoremnant feature possible kiln			disturbance			
A-26	Faint linear anomaly, drainage or former boundary	M	E(C-D)				72
A-27	Two linear anomalies with right angle turn. Enclosure or boundary ditches	M	E(B-D)	Agriculture or modern disturbance	L	E(F)	46
A-28	Linear anomaly. Agriculture or modern disturbance	M	E(D)				
A-29	Linear anomaly. Agriculture or modern disturbance	M	E(D)				
A-30	Former boundary and footpath shown on 1889 OS map	H	C-D				
A-31	Former track from Tyddyn Du	H	C				
A-32	Former boundary and drain shown on 1889 OS map	H	C-D				82
A-33	Geology	H	F				86
A-34	Narrow linear anomaly, probably a 18th or 19th century boundary	H	D				83
A-35	Narrow linear anomaly, possibly a drain or early boundary	M	E(C-D)	Agriculture or modern disturbance	M	F	84
A-36	Oval anomaly, recent disturbance	M	E(F)	Unknown archaeological feature	L	E(B-D)	
A-37	Linear anomaly possibly former boundary	M	E(C-D)	Modern disturbance	M	E(F)	
A-38	Geology or modern disturbance	H	F				31
A-39	Linear anomaly, possibly former boundary or drainage	M	E(C-D)	Modern feature	L	E(F)	
A-40	Large oval anomaly, quarry pit	M	E(C-D)	Modern disturbance	M	E(F)	
A-41	Modern disturbance poss. former access track	M	E(F)	Curvilinear anomaly possibly part of former boundary or enclosure	L	E(C-D)	
A-42	Modern disturbance	M	E(F)	Curvilinear anomaly possibly part of former boundary	M	E(C-D)	

				or enclosure			
A-43	Modern disturbance poss. former access track	M	F				
A-44	Linear anomaly, possibly former boundary or drainage	M	E(C-D)				
A-45	Former boundary shown on 1889 and 1924 Ordnance Survey County Series maps	H	C-D				
A-46	Two linear anomalies, probably modern drainage or agriculture	H	F				
A-47	Linear anomaly, crosses modern boundaries, post-medieval field boundary	M	E(C-D)	Drain	M	E(F)	
A-48	Former field boundary shown on 1889 and 1924 Ordnance Survey County Series maps	H	C-D				
A-49	Former field boundary shown on 1889 and 1924 Ordnance Survey County Series maps	H	C-D				
A-50	Former field boundary possible continuation of A-49	H	C-D				
A-51	Weak linear anomaly, possible former field boundary	M	E(C-D)				
A-52	Double parallel linear anomaly, former trackway	M	E(C-D)	Linear anomaly, possibly former double ditched boundary	M	E(C-D)	
A-53	Linear anomaly crosses current field system possibly former early boundary	M	E(C-D)				
A-54	Ferrous and linear anomaly modern services	H	F				
A-55	Former field boundary shown on 1889 and 1924 Ordnance Survey County Series	H	C-D				

	maps						
A-56	Former field boundary shown on 1889 and 1924 Ordnance Survey County Series maps	H	C-D				
A-57	Linear anomaly possibly former boundary or drain	M	E(C-D)				
A-58	Former field boundary shown on 1889 and 1924 Ordnance Survey County Series maps	H	C-D				
A-59	Curvilinear anomaly, drainage channel	M	D				
A-60	Curvilinear anomaly, drainage channel, continuation of A-59	M	D				
A-61	Linear anomaly, former boundary or drain	M	E(C-D)				
A-62	Plough scarring, prob. modern	H	F				
A-63	Field drains	H	F				
A-64	Field drains	H	F				
A-65	Linear anomaly, former boundary or drain	M	E(C-D)				
A-66	Linear anomaly, former boundary	M	E(C-D)				
A-67	Circular anomaly, 40m diameter. Prehistoric enclosure or settlement	M	E(A-B)	Modern disturbance	L	E(F)	
A-68	Area of noise, possible activity associated with A-67	M	E(A-B)	Modern disturbance or landscaping	L	E(F)	
A-69	Linear anomaly, former boundary or enclosure, poss. associated with A-67	M	E(A-B)	Modern disturbance or landscaping	L	E(F)	
A-70	Modern dumping	H	F				
A-71	Weak circular anomaly, 40m diameter. Prehistoric enclosure or settlement	M	E(A-B)	Modern disturbance	M	E(F)	
A-72	Linear anomaly, former trackway	M	E(C-D)	Linear anomaly, former boundary	M	E(C-D)	

	from Wylfa house						
A-73	Parallel anomalies, modern drainage or ploughing	H	F				
A-74	Parallel anomalies, modern drainage or ploughing	H	F				
A-75	Linear anomaly, former boundary, part of current field system	M	E(C-D)				
A-76	Group of linear anomalies and increased noise. Early boundaries and poss. trackway (see A-72)	M	E(B-C)	Modern disturbance	L	E(F)	
A-77	Linear anomaly, former boundary	M	E(C-D)				
A-78	Circular anomaly, modern disturbance	M	E(F)	Circular anomaly, 40m diameter. Prehistoric enclosure or settlement	L	E(A-B)	
A-79	Broken and forking linear, former trackway, from Wylfa (house) shown on 1889 and 1924 Ordnance Survey County Series maps	H	B-D	Modern disturbance	L	F	
A-80	A series of linear anomalies at approx right-angles. Medieval or post-medieval field system	M	E(B-D)	Modern drainage	L	E(F)	
A-81	Faint linear anomalies, probably ploughing or drainage	L	E(D)				
A-82	Data artefact?	M	F	Modern services / drain	L	F	
A-83	Fragmentary double linear anomaly, former trackway	M	E(D)	Modern erosion	L	E(F)	
A-84	Former field boundary shown on 1889 and 1924 Ordnance Survey County Series maps	H	C-D				
A-85	Two curvilinear anomalies, former boundaries, poss. prehistoric or medieval	M	E(B-C)	Modern disturbance	L	E(F)	

A-86	Linear and right-angled anomalies. Medieval or post-medieval settlement/buildings	M	E(A-C)	Geology or modern disturbance	L	E(F)	
A-87	Curvilinear anomaly, modern disturbance	M	E(F)	Curvilinear anomaly, prehistoric or medieval enclosure or settlement	L	E(A-B)	
A-88	Linear anomaly, part of a field system shown on 1780 Carreglwyd estate map	M	E(B-C)				
A-89	Footpath shown on 1889 and 1924 Ordnance Survey County Series maps	H	C				
A-90	Linear anomaly, part of a field system shown on 1780 Carreglwyd estate map	H	B-C				17
A-91	Curvilinear anomaly, modern disturbance	H	F				20
A-92	Linear anomaly, part of a field system predating current 18th/19th century system	M	E(B-C)	Modern agricultural features or disturbance	L	E(F)	
A-93	Linear anomaly, probably geological	H	F				
A-94	Possible terracing, medieval or prehistoric field system	M	E(B-C)	Modern drainage or agricultural features	M	E(F)	
A-95	Former field boundary shown on 1889 and 1924 Ordnance Survey County Series maps	H	C-D				
A-96	Former field boundary shown on 1889 and 1924 Ordnance Survey County Series maps	H	C-D				25
A-97	Linear anomaly, part of a field system predating current 18th/19th century system	M	E(B-C)	Modern agricultural features or disturbance	L	E(F)	
A-98	Linear anomaly,	M	E(B-C)	Modern	L	E(F)	

	part of a field system predating current 18th/19th century system			agricultural features or disturbance			
A-99	Rectangular and ferrous or thermo-remnant anomaly, Enclosure and building unknown date	L	E(B-D)	Geology	M	E(F)	
A-100	Area of increased noise, post medieval or modern landscaping	M	E(C-D)	Geology	L	E(F)	
A-101	Double linear anomaly, probably vehicle erosion	M	F				
A-102	Linear anomaly, part of a field system possibly medieval	M	E(B-C)	Modern agricultural features or disturbance	L	E(F)	11
A-103	Geology	H	F				13
A-104	Linear anomaly, part of a field system, possibly as shown on 1780 Carreglwyd estate map	M	E(B-C)				7
A-105	Linear anomaly, part of a field system, possibly as shown on 1780 Carreglwyd estate map	M	E(B-C)				
A-106	Linear anomaly, part of a field system, possibly as shown on 1780 Carreglwyd estate map	M	E(B-C)				8
A-107	Geology	H	F				12
A-108	Geology	H	F				14
A-109	Geology	H	F				
A-110	Linear anomaly, part of a field system predating the map evidence	M	E(B-D)	Modern agricultural features or disturbance	L	E(F)	
A-111	Linear anomaly, part of a field system possibly shown on 1780 Carreglwyd estate map	M	E(B-C)	Modern agricultural features or disturbance	L	E(F)	
A-112	Linear anomaly, part of a field system predating current 18th/19th century system	M	E(B-C)	Modern agricultural features or disturbance	L	E(F)	

A-113	Linear anomaly, part of a field system predating current 18th/19th century system	M	E(B-C)	Modern agricultural features or disturbance	L	E(F)	
A-114	Modern drainage	M	F	Barn shown on 1780 estate map	L	E(B-C)	
A-115	Two linear anomalies, part of a field system predating the map evidence	M	E(B-C)	Modern agricultural features or disturbance	L	E(F)	
A-116	Modern disturbance or land drains down W side of fields	M	F				
A-117	Linear anomaly, part of a field system predating the map evidence	M	E(B-C)	Modern agricultural features or disturbance	L	E(F)	
A-118	Linear anomaly, part of a field system predating the map evidence	M	E(B-C)	Modern agricultural features or disturbance	L	E(F)	
A-119	Palaeochannel or other natural sub-soil feature	M	F				
A-120	Linear anomaly, part of a field system possibly shown on 1780 Carreglwyd estate map	M	E(B-C)	Modern agricultural features or disturbance	L	E(F)	6
A-121	Former field boundary shown on 1889 and 1924 Ordnance Survey County Series maps	H	C-D				5
A-122	Linear anomaly, part of a field system predating the map evidence	M	E(B-C)	Modern agricultural features or disturbance	L	E(F)	
A-123	Linear anomaly, part of a field system predating the map evidence	M	E(B-C)	Modern agricultural features or disturbance	L	E(F)	
A-124	Linear anomaly, part of a field system shown on 1780 Carreglwyd estate map	M	E(B-C)				
A-125	Area of increased noise, former pond or marsh	H	D				4
A-126	Linear anomaly, possibly part of a field system shown on 1780 Carreglwyd estate	M	E(B-C)	Modern agricultural features or disturbance	L	E(F)	

	map						
A-127	Linear anomaly, part of a field system predating current 18th/19th century system	M	E(B-C)	Modern agricultural features or disturbance	L	E(F)	
A-128	Linear anomaly, former field boundary	M	E(C-D)				
A-129	Parallel anomalies, modern drainage or ploughing	H	F				
A-130	Linear anomaly, probably geological	H	F				100
A-131	Linear anomaly, probably geological	H	F				101
A-132	Irregular anomaly, probably geological	H	F				132
A-133	Trackway or modern erosion	H	C-D				
A-134	Linear anomaly and parallel anomalies, probably a field boundary and ploughing. It appears to predate the1780 Carreglwyd estate map. Possibly a medieval field system including strip fields or ridge and furrow	H	B-D				90
A-135	Trackway or modern erosion	H	C-D				100
A-136	A series of linear anomalies, probably field drains post-dating removal of boundary A-95	H	F				
A-137	Curvilinear anomaly, perhaps part of a ditched enclosure, date unknown	M	E (B-D)				
A-138	A Former field boundary shown on 1889 and 1924 Ordnance Survey County Series maps	H	C-D				
A-139	Former field /rectangular enclosure shown on 1889 and 1924	H	C-D				

	Ordnance Survey County Series maps						
A-140	Narrow linear anomalies, probably drainage	M	E(C-F)				
A-141	Linear anomaly, former ditch or trench for services	M	E(C-F)				
A-142	Narrow linear anomalies, probably drains	M	E(C-F)				
A-143	Former field boundary	M	E(C-D)				
A-144	Parallel anomalies, modern drainage or ploughing	H	F				
A-145	Parallel anomalies, modern drainage or ploughing	H	F				
A-146	Parallel anomalies, modern drainage or ploughing	H	F				

The results are discussed in conjunction with the targeted surveys in section 5 *Synthesis and Conclusions*, below.

4.2 The Targeted Fluxgate Gradiometer Surveys

Fourteen areas were surveyed (Fig. 8). Most comprised 1 ha sample areas although four complete fields ranging from 0.6ha to 4.7ha were surveyed (Fig. 8). The total survey area was 17.8ha. The results for each area are summarised and discussed in this section. A table listing all anomalies, their interpretation, confidence, importance scores and cross reference with the Fugro anomalies is also included.

4.2.1 Area 1

Area 1 (SH 34629263): targeted *Fugro* test TP76B (location of suspected prehistoric burnt mound). The south of the survey area was level and very wet with sloping ground to the north and a large mound, probably bedrock, at the western limit. It was bisected by a field boundary.

Survey results (Figs 9 and 10)

The suspected burnt mound produced a strong anomaly (1) consistent with a thermoremnant feature suggesting that the interpretation was correct. A second area of possible thermoremnant anomalies (2) was detected on the end of the raised bedrock mound. This was investigated by trial trenching and found to be a patch of manganese panning (which may also contain iron oxides) and light root burning. The edge of a further area of strong anomalies (3) was detected in the north-west corner of the survey. This appears to be a little more diffuse and given its position on a slope, is best interpreted as being of geological origin. The south-west corner of the survey is dominated by a large irregular anomaly (4) that corresponds to a wet area in the fields. This appears to be the remains of a drained and possibly infilled pond. A former field boundary shown on 1889 and 1924 Ordnance Survey County Series maps produced a faint linear anomaly; this was confirmed by trial trenching (5). A wide and diffuse linear anomaly (6) initially interpreted as a former boundary from the *Fugro* data (A-120) appears to be of geological origin.

4.2.2 Area 2

Area 2 (SH34559282): targeted *Fugro* anomalies A102, A104, A106 and A107; these anomalies had been interpreted by GAT as part of a field system predating the current 18th/19th century system. The survey area consisted of an area of pasture sloping from the east down to the edge of an area of mounds that are presumed to be grassed-over bedrock.

Survey results (Figs 11 and 12)

The survey detected a series of well-defined linear anomalies best interpreted as field boundaries (7-11). Anomalies 7 and 8 correspond to *Fugro* anomalies A104 and A106. These along with anomalies 9 and 10 appear to be part of a former field system predating those shown on the 1820 and 1889 OS maps. Anomaly 11 respects these field boundaries and is probably part of the same system. These fields appear to be typical smaller enclosures that predate the larger fields produced during estate improvements in the late 18th or early 19th century. The boundaries may therefore relate to those shown on the 1780s Carreglwyd Estate survey (Fig. 7). A detailed correlation is not possible due to the diagrammatic nature of the map. This area of the survey contains many features and may correspond to part of the estate map around field 6 that appears to contain a small building or farmstead (see Fig. 33 for location).

The south-eastern end of anomaly 7 was targeted by a trial trench but no archaeological feature was found. These geophysical anomalies are mostly very clear but the portion that was evaluated produced only a faint anomaly. This was a negative anomaly suggesting a ploughed-out bank and it may only have survived as a subtle change in the topsoil that would not have easily been detected in the trial trench.

Three wider, diffuse, positive anomalies (12, 13 and 14) are most likely to be the result of the underlying geology but could alternatively have been interpreted as the ploughed-down remains of lynchets from an early prehistoric or medieval field system. These were targeted with a trial trench confirming their geological origin.

Part of a curvilinear feature (15) was detected close to the north-west corner of the survey. This was not detected by the *Fugro* survey. The anomaly does not correspond to any of the mounds at the base of the slope and required further evaluation. This was targeted with a trial trench but no features cut into the subsoil were identified. It therefore appears that the anomaly was a result of changes in the topsoil, indicating modern disturbance. A further narrow, linear anomaly (16) was also not seen in the trial trench indicating that this too was modern disturbance. The entire survey is criss-crossed with narrow linear anomalies (shown as dashed lines on the interpretation plan) which do not respect the earlier field boundaries and are therefore the result of modern ploughing. Several faint circular anomalies also dashed lines on the plan also appear to be natural or agricultural subsoil features.

4.2.3 Area 3

Area 3 (SH 34739292) targeted *Fugro* anomaly A91. This anomaly had been interpreted as a semi-circular anomaly on top of a rounded natural hill, possibly part of a circular prehistoric enclosure or settlement.

Survey results (Figs 13 and 14)

This area contained further former field boundaries predating those shown on the 1820 and 1889 OS maps (17, 18 and 19). These appear to be boundaries to fields 16, 23 and 18 shown on the 1780s Carreglwyd Estate survey (Fig. 7) Feature 19 is a faint parallel double anomaly with a spacing of 5m perhaps indicating a former trackway was incorporated into the boundary.

Feature 19 was investigated by a trial trench and no archaeological feature was found. The anomaly is faint but undoubtedly present and its linear parallel form indicates that it is not a natural feature. It is possible that it has been ploughed away to the point that it only exists as a change in the topsoil. The trench section was, however, carefully inspected and nothing was visible. The contrary evidence makes it difficult to draw any firm conclusions about this feature.

A curvilinear anomaly (20, *Fugro Aperio* A91) intersects anomaly 19. This appears to be a ditch, possibly with a gap in the eastern side. This was initially interpreted as possibly being prehistoric.

Trial trenching, however, revealed it to be a shallow modern cut, possibly a very deep wheel rut. No other features apart from a strong, probably recent, ferrous anomaly (21) and a small area of disturbance (22) could be seen in the vicinity of the feature.

4.2.4 Area 4

Area 4 (SH35179283): targeted *Fugro* test pit TP62A (location of suspected prehistoric burnt mound). The survey area was in a field sloping to the east.

Survey results (Figs 15 and 16)

The survey detected a strong magnetic anomaly (23) that is presumed to be the possible burnt mound that was discovered in the test pit. The anomaly is consistent with a thermoremnant feature. It appears, however, to be principally produced by in-situ burning with a fairly consistent positive and negative response across the feature. Burnt mounds sometimes produce mass of randomly orientated responses due to the presence of randomly orientated magnetically-enhanced heat-affected stones. This feature does not exhibit this effect.

A second similar thermoremnant (24) anomaly was detected a few metres to the south-east. This was investigated by trial trench 8 and was found to be a root bole with associated burning.

Both anomalies lie on the line of a double linear anomaly (25, Fugro A-96) that indicates the line of a former field boundary; this was confirmed by trial trenching. The boundary is still visible as a low earthwork and the map regression shows that it was still in place in 1924. This also suggests a late origin for features 23 and 24, which could be interpreted as bonfires dating from the removal of the hedgerow and not burnt mounds.

Two further linear positive anomalies, 26 and 27, are probably the result of drains or subdivisions of the former fields. A similar negative anomaly 28 is probably a further drainage feature.

Less well-defined linear anomalies 29 and 30 are probably a result of ploughing.

4.2.5 Area 5

Area 5 (SH35579288): targeted *Fugro* anomaly A-338. This feature had been interpreted as either modern disturbance or a ditched enclosure possibly prehistoric in origin. The survey area was in level slightly uneven pasture.

Survey results (Figs 17 and 18)

The survey revealed a complex series of anomalies. The irregular character of anomalies 31 to 34, one of which is *Fugro* anomaly A-338, suggest that they are not archaeological in origin and are a result of landscaping or other subsoil changes. Trial trenching suggested that they were the result of shattered bedrock close to the surface. The field has clearly been heavily cultivated and possibly landscaped and is criss-crossed with fine linear anomalies (shown as dotted lines on the interpretation) consistent with several phases of deep ploughing. There are also numerous linear anomalies (35-40) best interpreted as drains or service trenches on the eastern side of the survey. A stone-filled pit cut into the subsoil was discovered during subsequent trial trenching. This did not produce an anomaly on the geophysical survey.

4.2.6 Areas 6 and 8

Areas 6, 8 and 10 were adjoining but crossed by three field boundaries. They were all surveyed as one large area and the alignment was slightly altered from the original specifications to allow a better fit into the field system. All features to be targeted by the survey were still within the survey area. Area 10 was in a different field and is examined separately; areas 6 and 8 were in the same fields and contained anomalies in common and are therefore interpreted together. The two areas investigated VMD anomalies A-20 and A-21, two possibly natural mounds, along with A-19 and A-27, two possible former boundaries. The areas were also crossed by A-06 and A-17 a modern haul-road.

Survey results (Figs 19 and 20)

The survey detected weak anomalies across most of the areas caused by variations in the bedrock or subsoil. Anomalies 41 and 42 (Fugro A-20 and A-21) correspond to mounds in the field and appear to be entirely natural. Further weak anomalies 43 and 44 also appear to be bedrock. The latter can be seen in the field and is partially covered by a field clearance cairn. A series of fragmentary linear anomalies 45 to 48 (including Fugro A-19 and A-20) are either former boundaries or modern disturbance. Narrow linear anomalies 49 to 55 all appear to be the result of ploughing or vehicle erosion. The wide linear anomaly (56, Fugro A-06 and A-17) crossing the survey area is a modern haul road and anomaly 57 is modern ferrous. Two moderately well defined circular anomalies (58) could be small prehistoric features but are most likely to be a result of natural subsoil variations.

4.2.7 Area 7

This area investigated two curvilinear anomalies Fugro A-13/A-09 and A-14. The area also contained several large modern ferrous objects, including a steel tower, that produced large magnetic anomalies.

Survey Results (Figs 22 and 22)

The linear Fugro anomaly A-13 and associated anomaly A-09 (59/62) was confirmed as being a narrow cut feature. There are no strong ferrous signals associated with it so it probably does not contain a major cable although copper cabling from the environmental monitoring station or an alkathene pipe are still possibilities. It could however, also be interpreted as a former boundary. Fugro A-14 appears to be rutting (60) running from the haul road (61). Small linear anomalies (63) are probably agricultural or modern disturbance. A square anomaly (64) with a small central feature could again be recent disturbance but could alternatively be interpreted as a small enclosure containing a cut feature such as an early medieval funerary enclosure. The remaining anomalies 65 to 68 are all the result of modern ferrous structures in the field.

4.2.8 Area 9

This area targeted a strong circular anomaly Fugro A-25 along with two linear anomalies A-24 and A-26. The area was in a field sloping from south to north with no surface features.

Survey Results (Figs 23 and 24)

The circular feature (69, Fugro A-25) was found to be oval with dimensions of 25m x 23m. The strength of the anomaly, in the range of +-100nT, indicates significant magnetic enhancement but is not high enough to suggest a buried iron object. The most likely interpretation is an igneous geological feature but it could alternatively be interpreted as a large thermoremnant feature such as a kiln. It is surrounded by an area of increased noise (70) with a NE to SW orientation (Fugro A-26). Reasonably well-defined linear features (71 and 72) pass to the north and south of it. These are best interpreted as drains or boundaries. An area of noise (73) at the south is probably geological and a ferrous anomaly (74) on the west side of the survey was produced by nearby buildings. A series of oval faint anomalies (75) are probably geological but could be archaeological features.

4.2.9 Area 10

This area targeted a ‘blank’ area in the Fugro survey in order to see if the higher resolution survey could detect any smaller or weaker features.

Survey Results (Figs 19 and 20)

The field contained a variety of parallel linear anomalies that probably indicate ploughing and landscaping. Features 76 and 77 are typically produced by deep ploughing. Feature 78 appears to be recent disturbance and is cut by what appears to be a recent haul road (79) or area of deep disturbance. It is presumed that these features date from the construction phase of Wylfa A. No anomalies of archaeological significance were detected.

4.2.10 Area 11

This area was designed to investigate a series of anomalies that had been interpreted as disturbance dating from the construction of Wylfa A (Fugro A-05).

Survey Results (Figs 25 and 26)

Only part of the area was available for survey because the topsoil from the works compound and nearby haul roads was being stored in a number of bunds around the edge of the field. It was also overgrown and very uneven suggesting substantial recent disturbance. The survey detected the edge of concentric circles of what appear to be disturbance dating from the construction of Wylfa A (80). A buried HV Cable (81) cuts the south-west corner of the survey.

4.2.11 Area12

The Fugro survey identified anomalies interpreted as a former boundary and drain shown on the 1889 OS map (A-32) along with three linear drains or boundaries (A-33 to A35) and a former track.

Survey Results (Figs 27 and 28)

Linear anomalies 82 and 83 (A-33 and- A34) have a similar character and therefore part of the field system shown on the 1889 OS map although 83 had probably been removed by this time. Linear 84 appears to be another boundary. It is a negative anomaly suggesting a ploughed-out bank. An area of parallel anomalies (85 and A-31) are best interpreted as an area of rutting, possibly a former trackway. An underground environmental monitoring cable also runs on this alignment. A diffuse linear anomaly (86) is typical of geological interference. Two small non-ferrous anomalies (87) at the east of the survey may be archaeological cut features such as pits or graves but could alternatively be interpreted as modern disturbance or natural features. A buried HV cable (88) crosses the centre of the survey.

4.2.12 Area 13

This field contained VMD anomalies suggesting a medieval field system (A-134). The survey area comprised a single field sloping from south to north with occasional low outcroppings of bedrock. A small area at the north could not be surveyed because it was very boggy.

Survey Results (Figs 29 and 30)

The principal feature in this survey is an extensive former field system (90 and probably 91 and 92) comprising a series of negative anomalies probably indicating ploughed-out banks. The triangular former field at the south corresponds to a level area at the top of the present field. It contains anomalies (93) running parallel to the former boundary suggesting either ridge and furrow or medieval strip fields. The former field appears to be cut by the modern road suggesting that it predates it and therefore forms part of an early field system. There also appears to be a small rectangular enclosure in its northern corner, possibly an animal pen (94). A series of parallel linear anomalies (95) leading to a wider anomaly in the centre of the survey are best interpreted as modern vehicle erosion. Three modern ferrous objects; a buried cable (99) and two borehole caps (97 and 98) produced large anomalies. Two bands of magnetic geology 100 and 101 cross the area. Other, weaker subsoil/bedrock anomalies were also detected (102 and 103).

4.2.13 Area 14

This area re-examined another blank area in the original VMD survey. It comprised a single field crossed by a modern haul road.

Survey Results (Figs 31 and 32)

The haul road produced a strong anomaly (104) but the most striking feature of the survey is a diagonal division across the centre of the field. This is marked by a linear anomaly (105) and the gradiometer results to the north-west are fairly noisy with possible areas of disturbance (106 and 107) while those to the south-east show very little variation. This could indicate that the field was originally divided into two and only one half has been ploughed. Other possibilities are that soil from the Wylfa A construction has been spread cross half of the field or that the change is the result of a natural variation in the subsoil. Five diffuse anomalies (108-111) are the result of magnetic bedrock and an iron pipe (112) runs along the southern edge of the survey area. The higher resolution survey revealed more detail but did not discover any further archaeological features.

Table 2: Geophysical anomalies detected in the targeted surveys

Anomaly Number	Interpretation	Confidence	Importance	Alternative Interpretation	Confidence	Importance	Cross ref. to Fugro
1	Burnt Mound	M	E(B)				
2	Mineral Panning/root burning	H	F				
3	Geology	M	E(F)	Thermoremnant archaeological feature	L	E (A-D)	
4	Edge of former pond or marsh	H	C				
5	Former field boundary shown on 1889 and 1924 Ordnance Survey County Series maps	H	C				A-121
6	Geology	H	F				A-120
7	Field boundary, possibly part of a field system shown on 1780 Carreglwyd estate map	M	E(B-C)				A-104
8	Field boundary, possibly part of a field system shown on 1780 Carreglwyd estate map	M	E(B-C)				A-106
9	Field boundary, possibly part of a field system shown on 1780 Carreglwyd estate map	M	E(B-C)				
10	Former field boundary or drain	M	E(C-D)	Agricultural disturbance	M	E(F)	
11	Former field boundary or drain	M	E(C-D)	Agricultural disturbance	M	E(F)	A-102
12	Geology	H	F				A-107
13	Geology	H	F				A-103
14	Geology	H	F				A-108
15	Geology or modern disturbance	H	F				
16	Geology or modern disturbance	H	F				
17	Field boundary, part of a field system shown on 1780 Carreglwyd estate map	H	E(B-C)				A-90
18	Field boundary, double bank, possibly part of a field system shown on 1780 Carreglwyd estate map	M	E(B-C)				
19	Field boundary, part of a field system shown on 1780 Carreglwyd estate map	H	E(B-C)				

20	Modern curvilinear cut. Possibly rut from earthmover	H	F				A-91
21	Modern ferrous	H	F				
22	Unknown noise, probably geological	M	D-F				
23	Fire dating from removal of hedge line	M	E(F)	Burnt mound	L	E(B-C)	
24	Tree-bole and fire	H	F				
25	Former field boundary, removed in 20th century	H	D				A-96
26	Former boundary or drain	H	D-F				
27	Former boundary or drain	H	D-F				
28	Former boundary or drain	M	E(D-F)				
29	Plough scarring	H	F				
30	Number not used						
31	Geology	H	F				
32	Geology	H	F				
33	Geology	H	F				
34	Geology	H	F				
35	Linear feature probably modern agricultural	M	D-F				
36	Linear feature probably modern agricultural	M	D-F				
37	Linear feature probably modern agricultural	M	D-F				
38	Linear feature probably modern agricultural	M	D-F				
39	Linear feature probably modern agricultural	M	D-F				
40	Linear feature probably modern agricultural	M	D-F				
41	Geology	H	F				A-21
42	Geology	H	F				A-20
43	Geology	H	F				
44	Geology	H	F				
45	Field boundary, part of a field system predating the current field system	M	E(B-D)				A-19

46	Field boundary, part of a field system predating the current field system	M	B-D				A-27
47	Possibly part of a former field boundary	L	E(C-D)	Linear feature probably modern agricultural	M	D-F	
48	Possibly part of a former field boundary	L	E(C-D)	Linear feature probably modern agricultural	M	D-F	
49	Linear feature probably modern agricultural	M	D-F				
50	Linear feature probably modern agricultural	M	D-F				
51	Field boundary, part of a field system predating the current field system	M	E(B-D)				
52	Linear feature probably modern agricultural	M	D-F				
53	Modern ploughing	H	F				
54	Modern ploughing	H	F				
55	Modern ploughing	H	F				
56	Modern haul road	H	F				A-17
57	Modern ferrous	H	F				
58	Natural Subsoil features	M	E(F)	Prehistoric ring cairns or barrows	L	E(A-B)	
59	Cable, environmental monitoring	M	E(F)	Ditched enclosure (with 62)	L	E(B-C)	A-13
60	Modern disturbance	H	F				A-14
61	Modern Haul road	H	F				A-06
62	Cable, environmental monitoring	M	E(F)	Ditched enclosure (with 59)	L	E(B-C)	A-09
63	Field boundary, part of a field system predating the current field system	L	E(B-D)	Linear feature modern agricultural	M	E(D-F)	
64	Modern disturbance	M	E(F)	Medieval funerary enclosure	L	E(A-B)	
65	Modern ferrous mast	H	F				
66	Modern ferrous	H	F				
67	Modern ferrous pylon	H	F				
68	Modern ferrous/cable	H	F				
69	Strong roughly circular anomaly 20m diam., central feature. Thermoremnant feature	M	E(A-B)	Geology or modern disturbance	M	E(F)	

	possible kiln						
70	Cut for 69	M	E(A-B)	Geology or modern disturbance	M	E(F)	
71	Linear feature, either boundary or drain	M	E(C-D)				
72	Linear feature, either boundary or drain	M	E(C-D)				
73	Geology	H	F				
74	Modern ferrous	H	F				
75	Faint oval anomalies, possibly geological	M	E(F)	Archaeological cut features	M	E(A-D)	
76	Parallel linear anomalies modern ploughing or landscaping	H	F				
77	Parallel linear anomalies modern ploughing	H	F				
78	Modern disturbance	H	F				
79	Modern trackway or vehicle erosion	H	F				
80	Modern disturbance	H	F				A-05
81	Buried HV cable	H	F				
82	Former field boundary shown on 1889 and 1924 Ordnance Survey County Series maps	H	C				
83	Former field boundary probably a subdivision of current field system	H	C				
84	Negative linear anomaly perhaps an early field boundary	M	E(C)	Stone lined culvert/drain	M	E(D)	
85	Modern disturbance	H	F				
86	Geology	H	F				
87	Faint oval anomalies, possibly geological	M	E(F)	Archaeological cut features	M	E(F)	
88	Buried HV cable	H	F				
89	Number not used						
90	A series of linear anomalies indicating former field system. This predates the field system shown on 1780 Carreglwyd estate map. Possibly medieval	H	B				

91	Probably a continuation of Feature 90	M	E(B)	Modern disturbance	L	E(F)	
92	Probably a continuation of Feature 90	M	E(B)	Modern disturbance	L	E(F)	
93	Parallel linear anomalies respecting boundary 90. Possibly medieval strip fields	M	E(B)	Ridge and furrow	M	E(C)	
94	A small subdivision in the corner of feature 90. Former pen or small plot	M	E(B)				
95	Parallel narrow linear anomalies, probably modern vehicle erosion	M	F				
96	Parallel narrow linear anomalies probably ploughing	H	F				
97	Modern ferrous	H	F				
98	Modern ferrous	H	F				
99	Modern pipe/cable	H	F				
100	Geology	H	F				
101	Geology	H	F				
102	Geology	H	F				
103	Geology	H	F				
104	Modern haul road	H	F				
105	Linear anomaly marking edge of an area of increased noise. Former boundary	M	E(D)	Geological feature or edge of soil spread from Wylfa A	M	E(F)	
106	Area of increased noise, possibly modern disturbance	M	F				
107	Area of increased noise, possibly modern disturbance	M	F				
108	Geology	H	F				
109	Geology	H	F				
110	Geology	H	F				

5. SYNTHESIS AND CONCLUSIONS

5.1 The Assessment process

The VMD survey produced a basic assessment of the archaeological potential of the majority of the proposed development area. It successfully identified large-scale archaeological anomalies but could

not resolve finer details. The targeted geophysical surveys added information to parts of the VMD survey. Standard resolution (1.0m x 0.25m) survey revealed additional details of the VMD anomalies as well as detecting further weak or small-scale archaeological features. This allowed better interpretation of the targeted anomalies and in particular allowed some potential archaeological features to be reclassified as geological or modern disturbance. The refinement of the interpretation of these areas also indirectly allowed a better assessment of the wider survey. Further information was added to the interpretation by the results of the trial trenching. This, in particular, allowed modern disturbance to be interpreted as such with a fairly high degree of certainty.

Not all areas of the country can produce useful magnetic geophysics surveys. Results from Anglesey have ranged from unusable to very good, mostly as a result of the extremely complex pattern of geology and soils across the island. The results from Wylfa show a small amount of interference from igneous bedrock but this has not compromised the effectiveness of the survey. Archaeological features produced fairly weak anomalies but this has been offset by low levels of background noise, resulting in an effective survey that has detected a wide range of archaeology. The most common features that were detected were former field boundaries and modern disturbance. Earlier archaeology was relatively sparse but a potential burnt mound and two possible prehistoric defended enclosures were also detected. It should however be noted that a geophysical survey can never be assumed to have detected all archaeological features. This was clearly demonstrated by the discovery of a large stone covered drain in a trial trench in geophysical area 1 that produced no discernable anomaly.

The trial trenching introduced an extra degree of caution to the interpretation of some anomalies due to the amount of unpredictable disturbance caused by the construction of Wylfa A. A good example of this was an anomaly interpreted as a potential prehistoric hilltop enclosure (A-91). This was found to be a modern cut possibly caused by a piece of heavy machinery driving around the top of a hill in wet conditions and causing a deep rut. This produced an anomaly, and in some ways a subsoil feature, similar to that produced by a prehistoric enclosure. This was an unusual occurrence and should not unduly influence the interpretation of the rest of the survey but does add an extra degree of uncertainty to some areas.

The most common type of potential site found throughout the survey was former field boundaries. Two ditched boundaries were targeted by the trial trenches and both of these were correctly identified from the geophysical survey data. Two very faint potential boundaries, one of which was almost certainly the slight remnants of a ploughed-out bank, were not found in the trial trenches. The reason for this is not entirely clear, although it is possible that they only survived as subtle changes in the topsoil. The overall patterns of the boundaries particularly on the higher resolution targeted data make their interpretation as artificial features fairly certain.

5.2 Historical themes

Features from many historical periods were identified during the survey. The findings are summarised on Fig. 33. The geophysical anomalies are colour-coded according to potential period and important sites are highlighted. All geological anomalies have been discounted. The development area is also divided into a series of zones, which are also used in the Baseline Assessment Report, that reflect its historical land use and modern disturbance levels.

The surveys identified two potential prehistoric site types, burnt mounds and defended enclosures or settlements. The possibility of burnt mounds (Bronze Age sites, usually found near a water source, usually interpreted as cooking sites) was introduced by the discovery of extensive amounts of burnt material in two small test pits excavated by Fugro. It should be noted that the pits were not large enough to assess the overall morphology of the features. Both features produced magnetic anomalies consistent with burnt features, although not necessarily burnt mounds and two further similar anomalies were also identified (Fig. 10, features 1 and 2 and Fig. 16, features 23 and 24). The additional anomalies were both investigated with test pits and shown to be a result of root burning and mineral panning i.e. both are relatively modern agricultural features. One potential burnt mound and one of the additional features (Fig 16 features 23 and 24) were also found to be on the line of a former field boundary in a dry sloping field. This suggests that both are the result of fires dating from the removal of a hedgerow within the last century. The remaining potential burnt mound lies in a wet hollow next to a former pond and may have been correctly identified. Two probable prehistoric defended enclosures (Fig. 07, A-67 and A-71) were identified on the eastern side of the survey. Anomaly A-67 is located on the top of a rounded hill, a typical location for this site type. Further

features (A68 and A69) to the south may also be associated with the enclosure. Many comparable sites have been recorded on Anglesey and across North Wales (e.g. Smith and Hopewell 2006, Hopewell and Smith 2007)

Former field boundaries were detected across all of the proposed development area. These are generally not visible as earthworks and it appears that most surface features were levelled during land improvements during the establishment of the current 18th or early 19th century field system. The map evidence also shows that some former boundaries were subdivisions of the current field system, indicating that, as would be expected in fairly intensively cultivated land, further land improvement has occurred in the 19th and 20th centuries.

A complex pattern of fields was detected on the west side of the survey, to the west and south-west of Tan-yr-allt (Zone A, Fig. 33). This area historically comprises the holdings of Cafnan, a farm on the western border of the survey. The map evidence for this area is good, allowing the development of the field system to be traced. The four areas of targeted survey (1, 2, 3 and 13, see Figs 9-14 and 29-30) were particularly useful here, revealing many details that were not visible on the VMD results. The earliest fields predate the boundaries shown on the 1780s estate map (Fig. 2) and there appears to be evidence of strip fields or ridge and furrow to the north of the road (Fig 30, feature 9). It is likely that these early boundaries relate to the medieval township of Cafnan. Some of the boundaries can be recognised on the estate map, which is not an accurate scale drawing and has previously been difficult to interpret. This has allowed some of the details on the map including two possible buildings to be more accurately located on the ground, although their precise positions are still open to conjecture. The area around targeted geophysical surveys 2 and 3 appears to be particularly complex and has not yet been fully resolved. The more complex boundaries in this area could indicate a focus of activity including settlement. This area is indicated on Fig. 33. The geophysical and map evidence emphasises the length of occupation around Cafnan indicating surviving features from the medieval period onwards.

The trial trenching indicates that the geophysics has detected some features that have been almost entirely ploughed-out and may only survive as gradual changes in the topsoil. This may mean that good quality geophysical survey may be the only way to record some features in this area.

Occasional fragments of potentially early boundaries (i.e. predating the 19th century map evidence) were detected across most of the rest of the survey (Zones E, C, K, L, and F) but there are no signs of extensive survival of early field systems comparable to the area around Cafnan. This could be a result of more intensive agriculture across these areas destroying early evidence or may indicate that some areas were unenclosed prior to the 18th century. Some features, such as the former trackway to Wylfa house can be identified, demonstrating there is potential for the survival of relatively slight archaeological features. No early boundaries or other archaeological anomalies were identified in Zone D. This area may not have been enclosed until the establishment of the current field system.

Geophysical anomalies were also detected across the whole of the survey area that cannot be reliably assigned to a particular site type or period, again emphasising the potential for the survival of archaeology across the whole area.

Extensive disturbance from the construction of Wylfa A was detected by the geophysical survey. This is particularly obvious in the fields to the south of the power station which appear to contain the remains of concrete foundations (Zone H). Similar disturbance was also detected immediately to the north of Wylfa A. A lower level of disturbance, apparently consisting of the deposition of topsoil along with areas of rutting and subsequent landscaping was detected to the east and south of the visitor's centre (Zones C and E). This will have decreased the archaeological potential of the two zones but evidence from the geophysical survey and trial trenching indicate that there is still potential for the survival of archaeological remains in this area.

5.3 Overall Archaeological Potential

The geophysical survey has been successful at providing a basic assessment of the potential for survival of archaeological features across the survey area. The area of highest potential appears to be at the west in the area around Cafnan where there is a high potential for the survival of medieval and later field systems and possibly associated settlement. The eastern and northern parts of the survey detected a lower concentration of archaeological features indicating a generally lower potential

although some small areas containing possible prehistoric sites could contain features of importance. The disturbed areas to the east and south of Wylfa A appear to have a relatively low potential.

6.0 BIBLIOGRAPHY

6.1 Manuscript sources

National Library of Wales
Carreglwyd Mss
M Broadhead Evans Mss
NLW B/Misc Vols/7 [c.1780] Survey of Carreglwyd and Berw Estates, The Property of Holland Griffith Esq.

Ordnance Survey
2" manuscript map of Anglesey c. 1830
1" first edition of Anglesey
25" County Series 1889
25" County Series 1924

6.2 Published sources

Hopewell, D. and Smith, G. 2007 Defended Enclosures Survey: Threat Related Assessment of Cropmarks on the Llyn Peninsula and Anglesey 2007-8 *Archaeology in Wales*

Smith, G. and Hopewell, D. 2006 Pan-Wales Survey of Defended Enclosures: Geophysical Evaluation *Archaeology in Wales*

6.3 Unpublished Sources

Davidson, A., 2010. Proposed Nuclear Power Station at Wylfa, Anglesey, North Wales. GAT report 842.

Cooke, R., 2011. Proposed Nuclear Power Station at Wylfa, Anglesey, North Wales, Archaeological Assessment NPDUK. GAT report 966.

Cooke, R., 2011. Proposed Nuclear Power Station at Wylfa, Anglesey, North Wales, Archaeological Assessment Areva. GAT report 967.

Davidson, J., 2011. Proposed Nuclear Power Station, Wylfa, Ynys Mon. Archaeological Watching Brief: Ground Investigation Works. GAT report 994.

Hopewell, D., 2011. Preliminary outline interpretation of potential archaeological magnetic gradient anomalies in Phase 1 area, Wylfa. GAT report 936.

Hopewell, D., 2011. Proposed Nuclear Power Station, Wylfa, Ynys Mon. Archaeological Evaluation: Targeted Geophysics. GAT report 987.

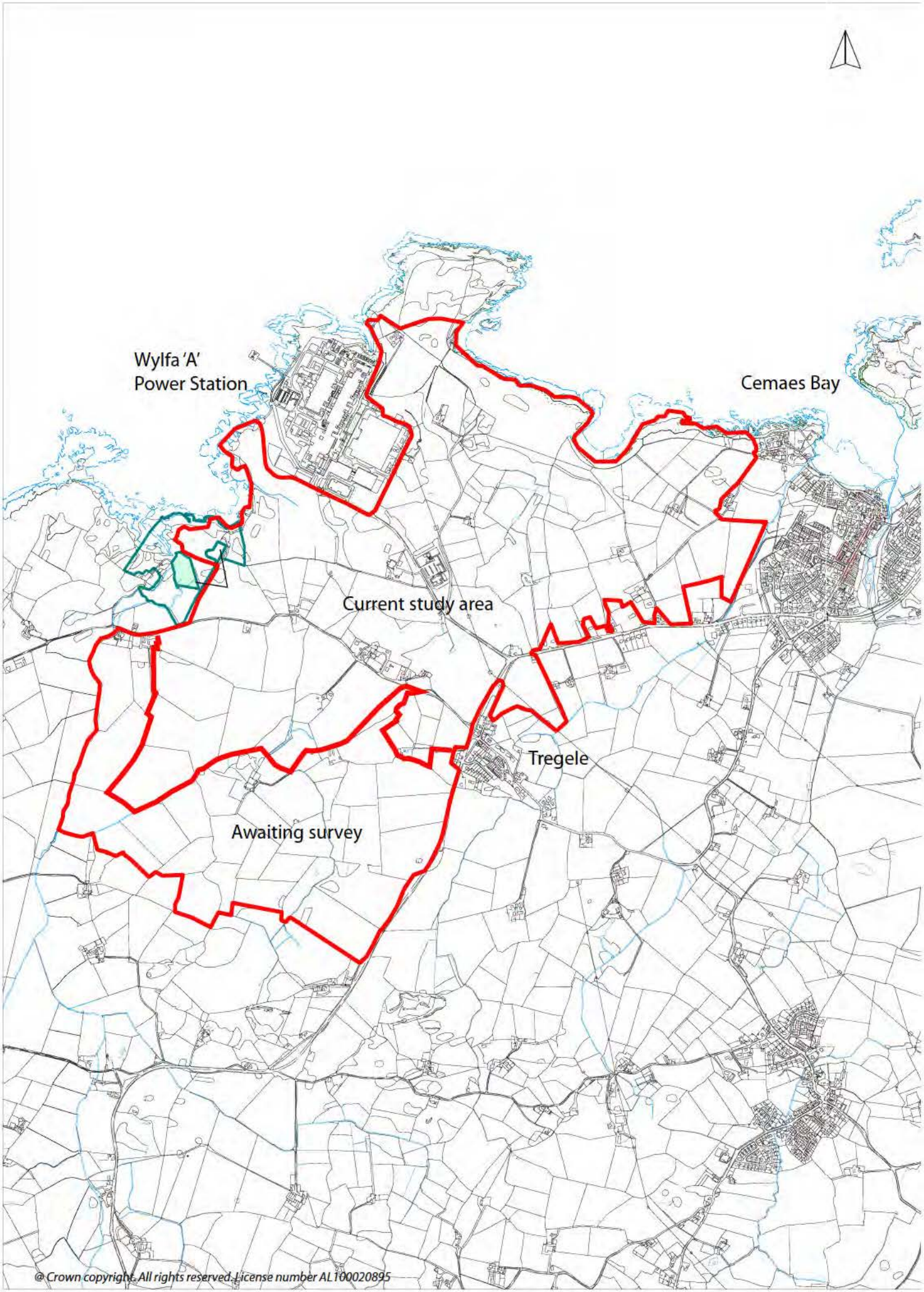
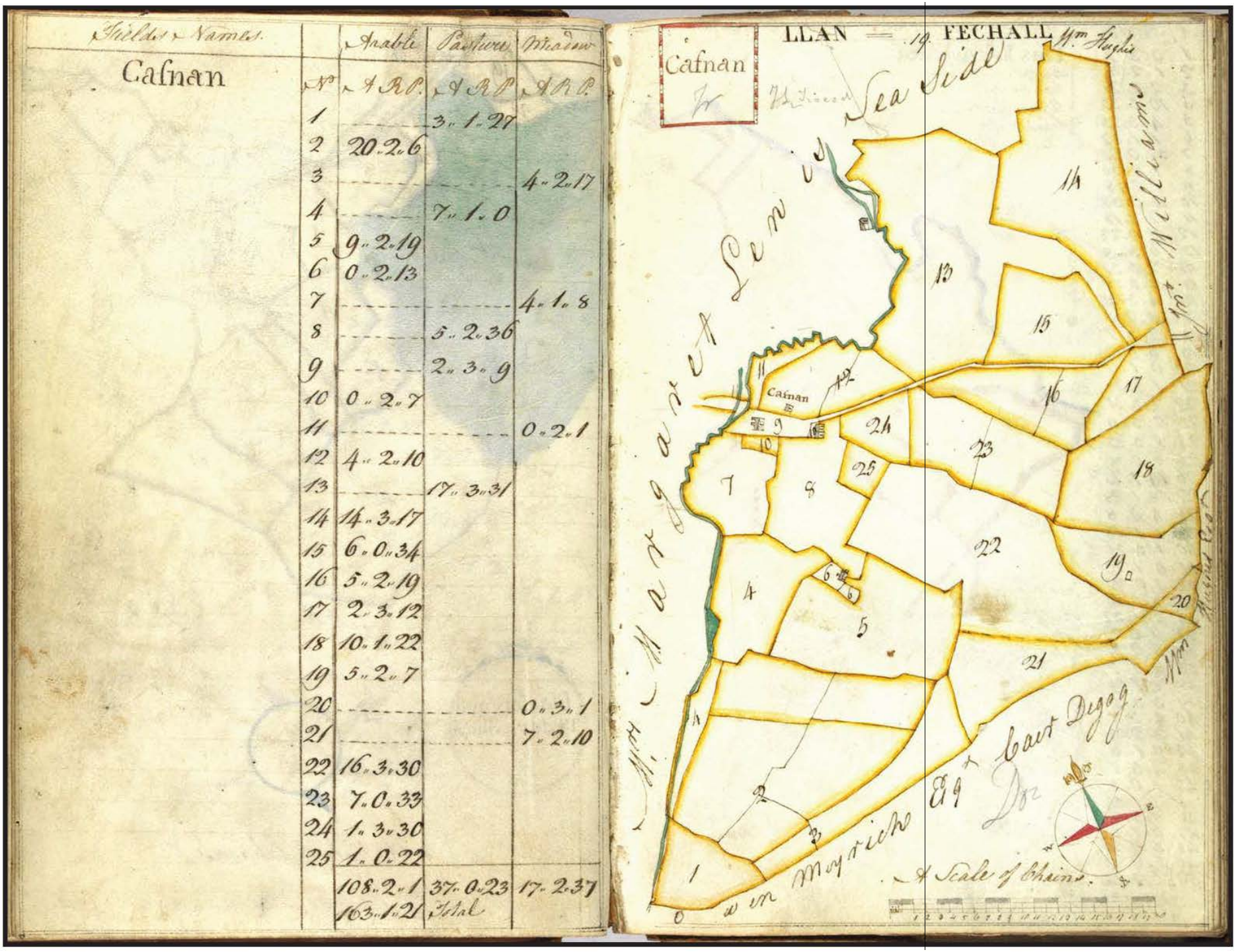


Figure 1: Location of Study Area 1:18,000



Fields Names.		Arable	Pasture	Waste
Cafnan	No	A R P.	A R P.	A R P.
	1		3 . 1 . 28	
	2	20 . 2 . 6		
	3			4 . 2 . 17
	4		7 . 1 . 0	
	5	9 . 2 . 19		
	6	0 . 2 . 13		
	7			4 . 1 . 8
	8		5 . 2 . 36	
	9		2 . 3 . 9	
	10	0 . 2 . 7		
	11			0 . 2 . 1
	12	4 . 2 . 10		
	13		17 . 3 . 31	
	14	14 . 3 . 17		
	15	6 . 0 . 34		
	16	5 . 2 . 19		
	17	2 . 3 . 12		
	18	10 . 1 . 22		
	19	5 . 2 . 7		
	20			0 . 3 . 1
	21			7 . 2 . 10
	22	16 . 3 . 30		
	23	7 . 0 . 33		
	24	1 . 3 . 30		
	25	1 . 0 . 22		
		108 . 2 . 1	37 . 0 . 23	17 . 2 . 37
		163 . 1 . 21	Total	

Figure 7: Cafnan from ***Survey of Carreglwyd a Berw Estates - The Property of Holland Griffith Esq. (c.1780)*** (NLW B/Misc Vol.7)

Figure 3: Ordnance Survey 2 inch manuscript *c.* 1820's

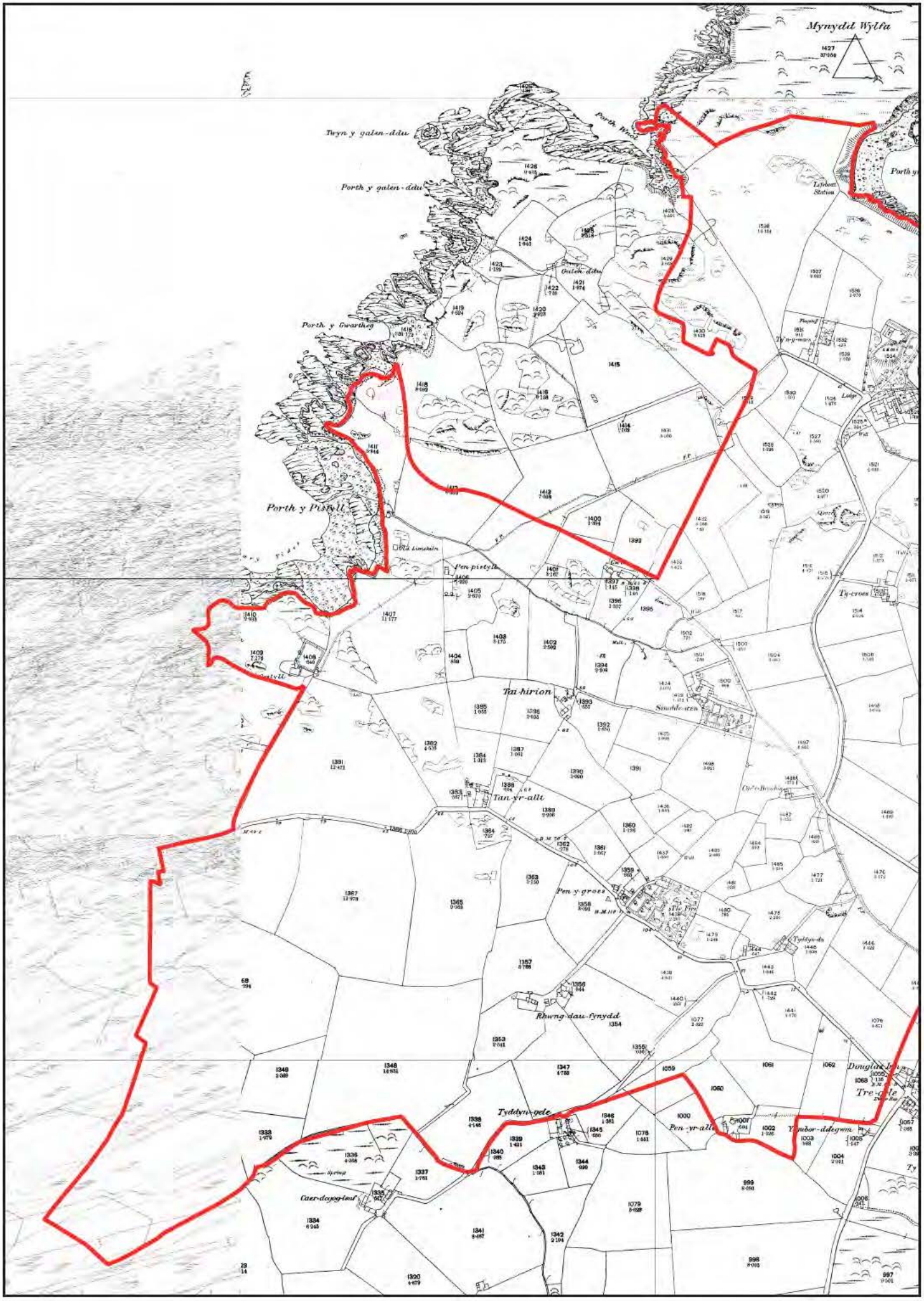


Figure 4: Wylfa west 1889. Ordnance Survey, Anglesey County Series, XX.2, XX.6, XXI.0. Scale 1:8,000

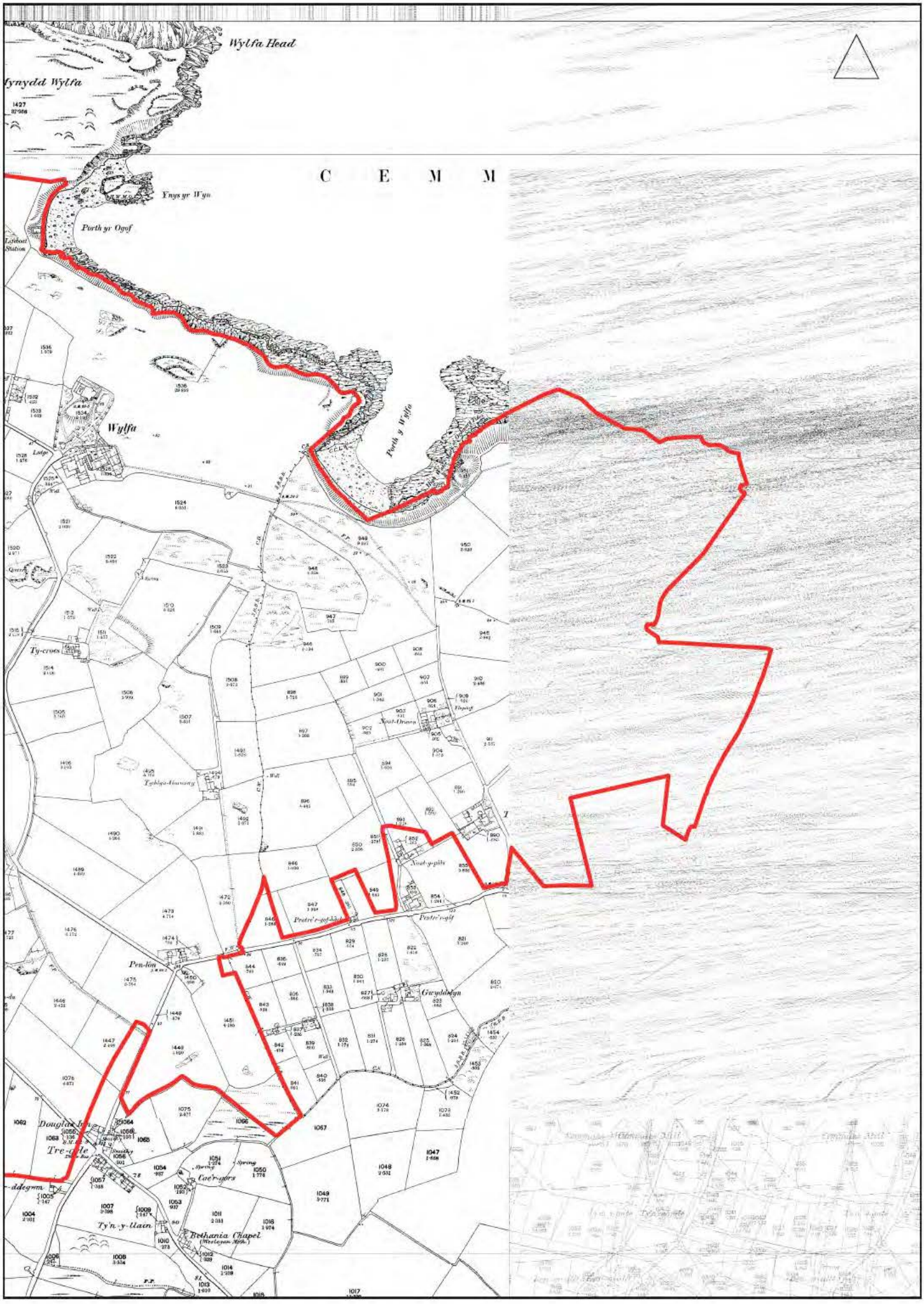
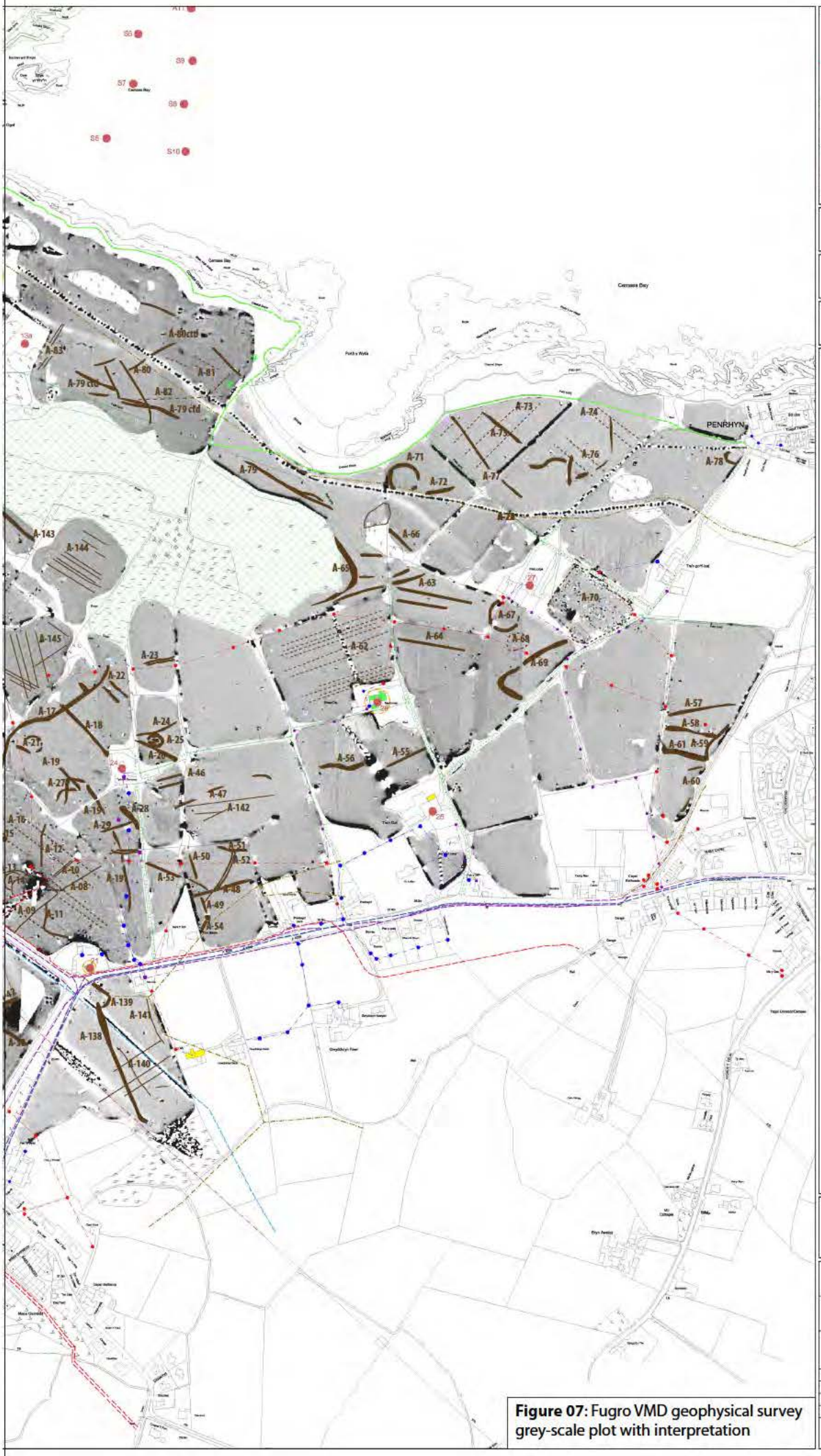


Figure 5: Wylfa east 1889. Ordnance Survey, Anglesey County Series, XX.3, XX.7, XXI.1. Scale 1:8,000


NO INTRUSIVE
WORK IN THIS AREA
Tregele
Wylfa Power Station

Figure 06: Fugro VMD geophysical survey grey-scale plot


MODERN FERROUS
NO INTRUSIVE WORK IN THIS AREA
Wylfa Power Station
Tregele



Magnetic Gradient

Phase I Area (Red)
Phase 2 Area (Blue)
SSSI
Parks & Gardens of Historic Interest
Local Nature Reserve
R.C. Bunker
AONB
Heritage Coastline
Public Footpaths
Isle of Anglesey Coastal Path
Underground HV Cables
Overhead HV Cables
Possible route of buried HV cables (conflicting information on source drawings)
Redundant cables for A stn contruction wks
Underground LV Cables
Overhead LV Cables
Street lights and cables
Welsh Water Sewer
Welsh Water Rising Main
Temporary 24" Surface Water Drain
Welsh Water Potable Water
Redundant Water main
Welsh Water - Towns Water to A Station
BT Underground Cables
BT Overhead Cables
Proposed 2009 Boreholes & Trial Pits
Areas of Potential Made Ground
Visitor Centre Foul Drainage
Dwellings: Definitely Unoccupied
Dwellings: Unknown Occupancy
Dwellings: Definitely Occupied
Dwellings: Undergoing demolition studies
Environmental Monitoring Station
Possible Environmental Monitoring Station
Env. Monitoring Cable (Underground)
Env. Monitoring Cable (Overground)
S10 Archeological sites
TP-## Fugro Proposed Phase 2 inspection pits

1. DRAWING REPRODUCED FROM HNP AUTOCAD FILE wbx000[cpl_A0 View.dwg
2. IMPORTANT NOTE: INFORMATION CONTAINED IN THIS DRAWING IS INTENDED FOR GENERAL GUIDANCE ONLY. NO GUARANTEE IS GIVEN OF ITS ACCURACY AND IT SHOULD NOT BE RELIED UPON AS COMPREHENSIVE IN THE EVENT OF EXCAVATIONS OR OTHER WORKS. SERVICES MAY BE BURIED AT VARIOUS DEPTHS AND MAY DEVIATE FROM THE MARKED ROUTE.

CLIENT: HORIZON NUCLEAR POWER

PROJECT: WYB0755 - WYLFA GEOPHYSICAL & ARCHAEOLOGICAL INVESTIGATION

TITLE: PRELIMINARY MAGNETIC GRADIENT RESULTS COLOUR SHADED

INTERP. BY: -	DATE:		DRAWN BY: GH	DATE:	18/03/2011
CHECKED BY: TH	DATE:	15/04/2011	APPROVED BY: BE	DATE:	18/03/2011
PROJECT No.: 23602			FOS 9602 12C		
CAD FILE NAME: FOS 9602 12C - MAG GRAD CR.dwg					
PLOTTED DRAWING SIZE: A0 (1189 x 841)					

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Tel: +44 (0)870 4201 400 Fax: +44 (0)870 4201 460
Email: info@fugro-appro.com www.fugro-appro.com

Figure 07: Fugro VMD geophysical survey grey-scale plot with interpretation

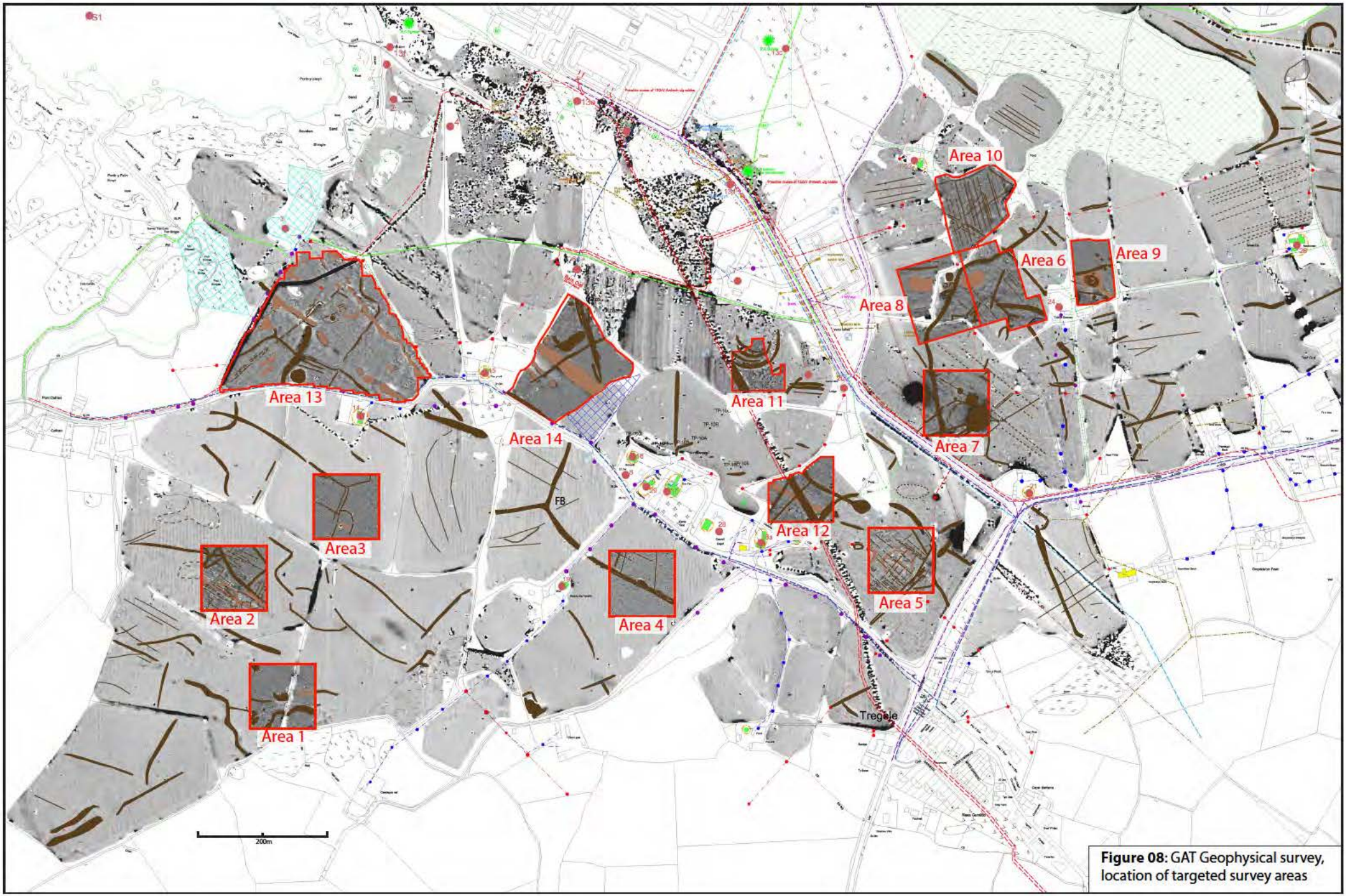


Figure 08: GAT Geophysical survey, location of targeted survey areas

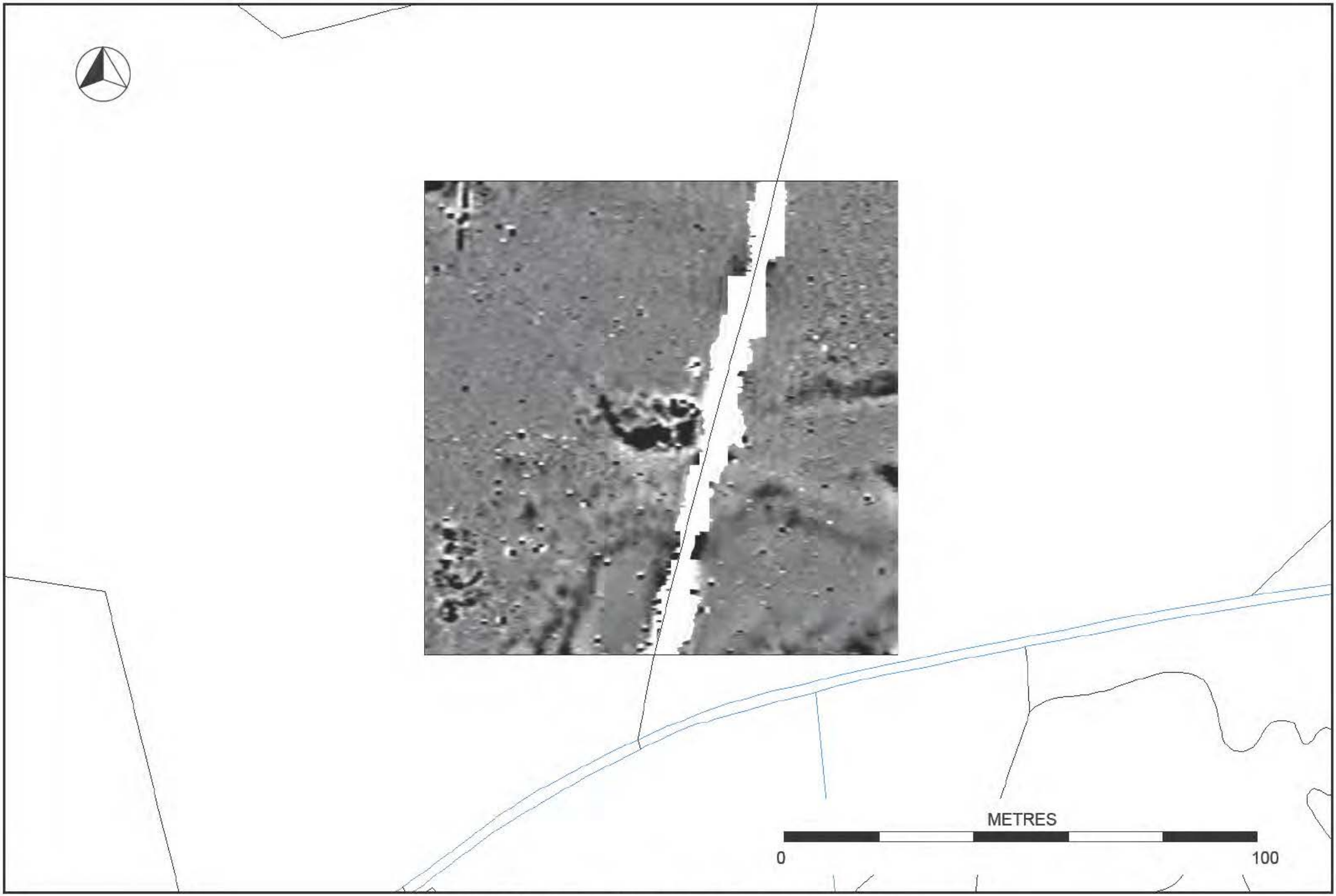


Figure 9: Standard resolution gradiometer survey of Area 1

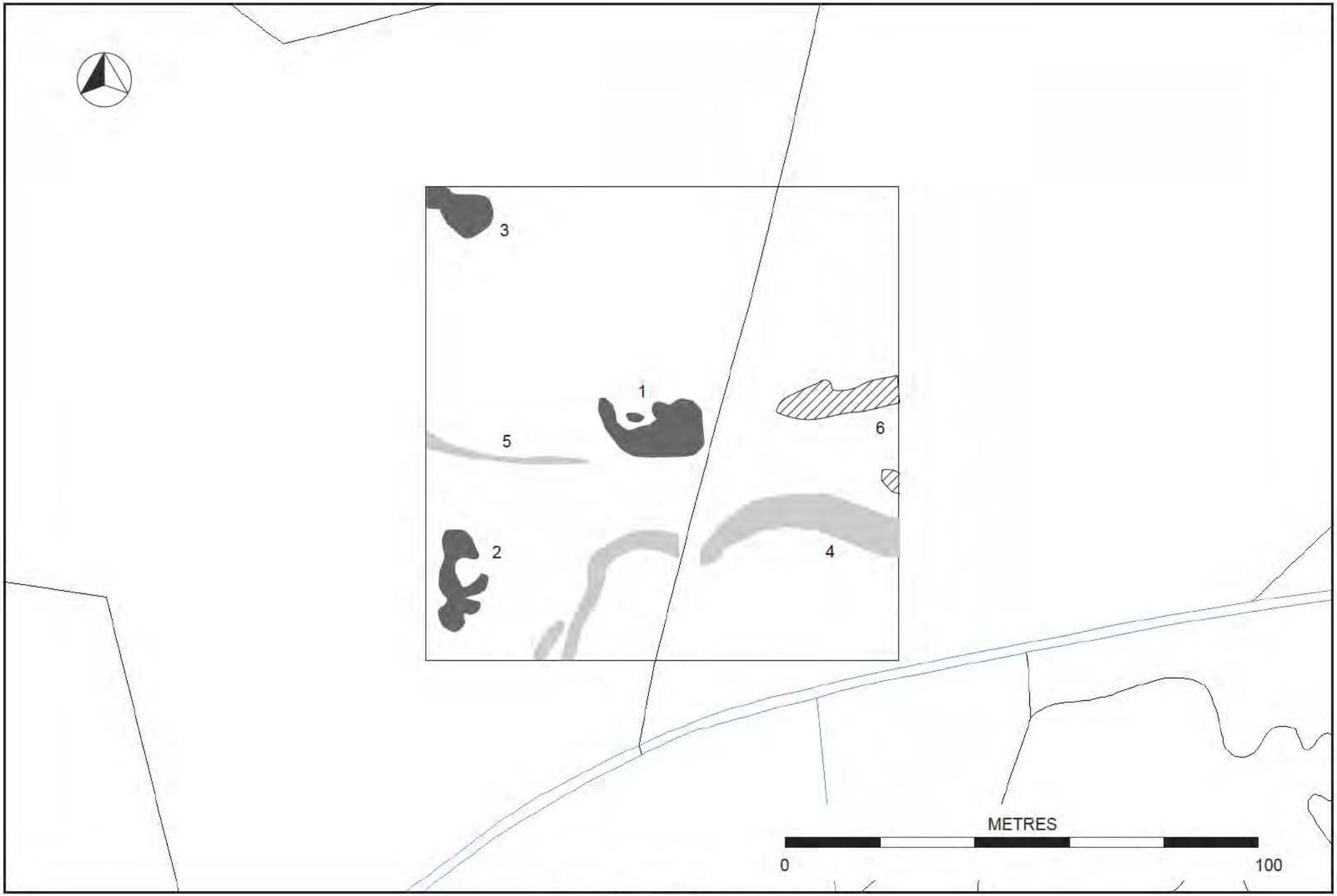


Figure 10 : Area 1, interpretation

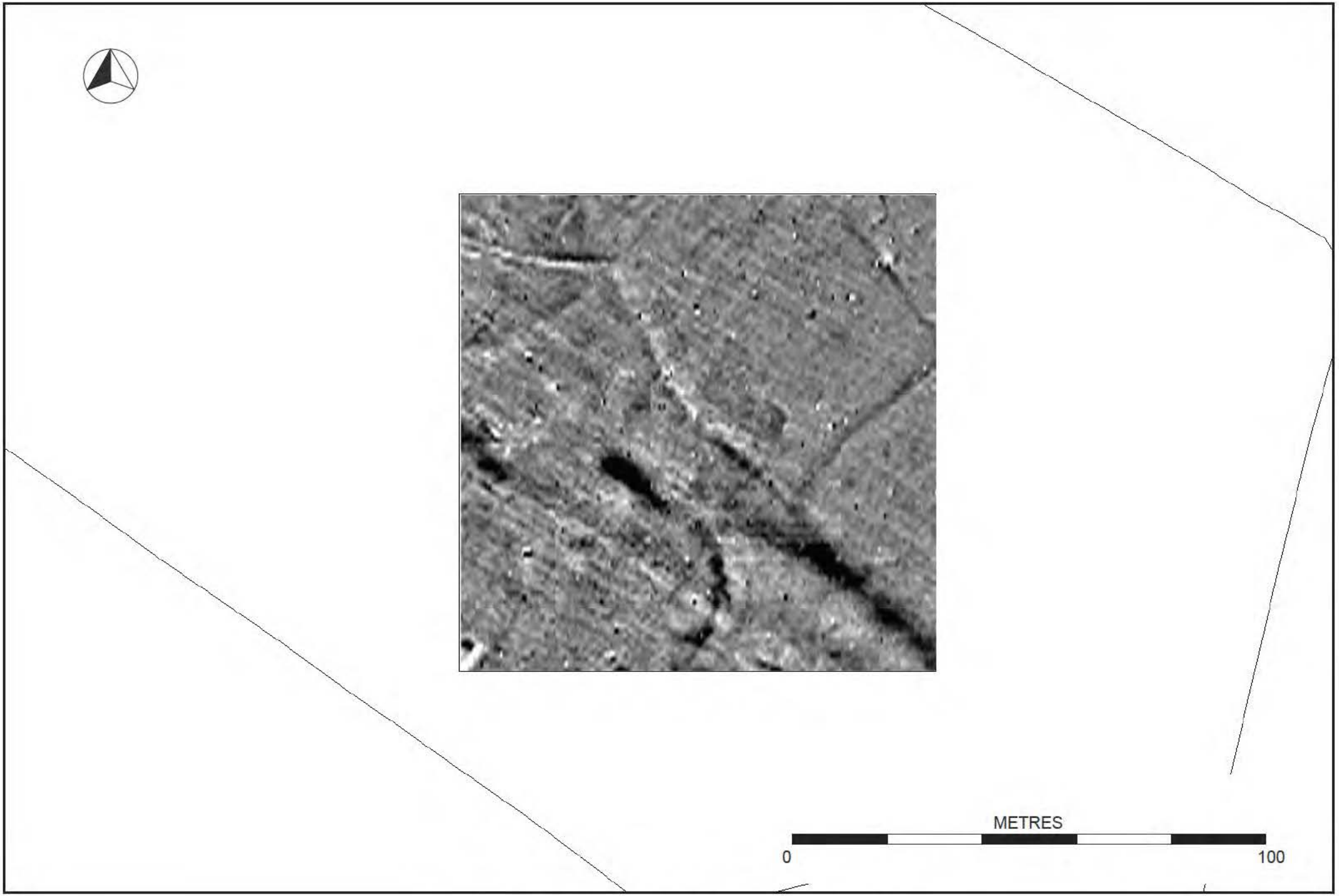
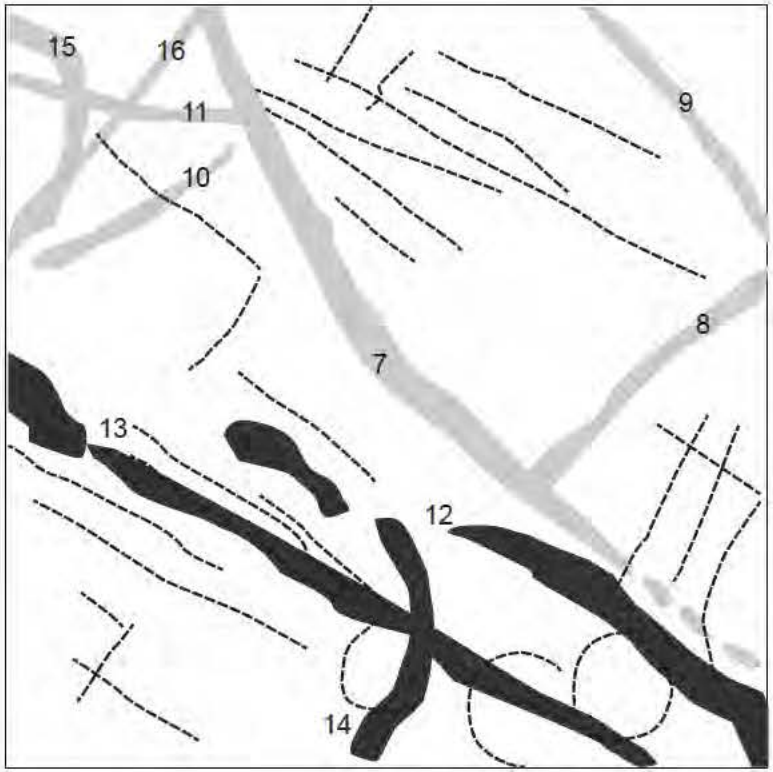


Figure 11. Standard resolution gradiometer survey of Area 2



METRES

0 100

Figure 12: Area 2, interpretation

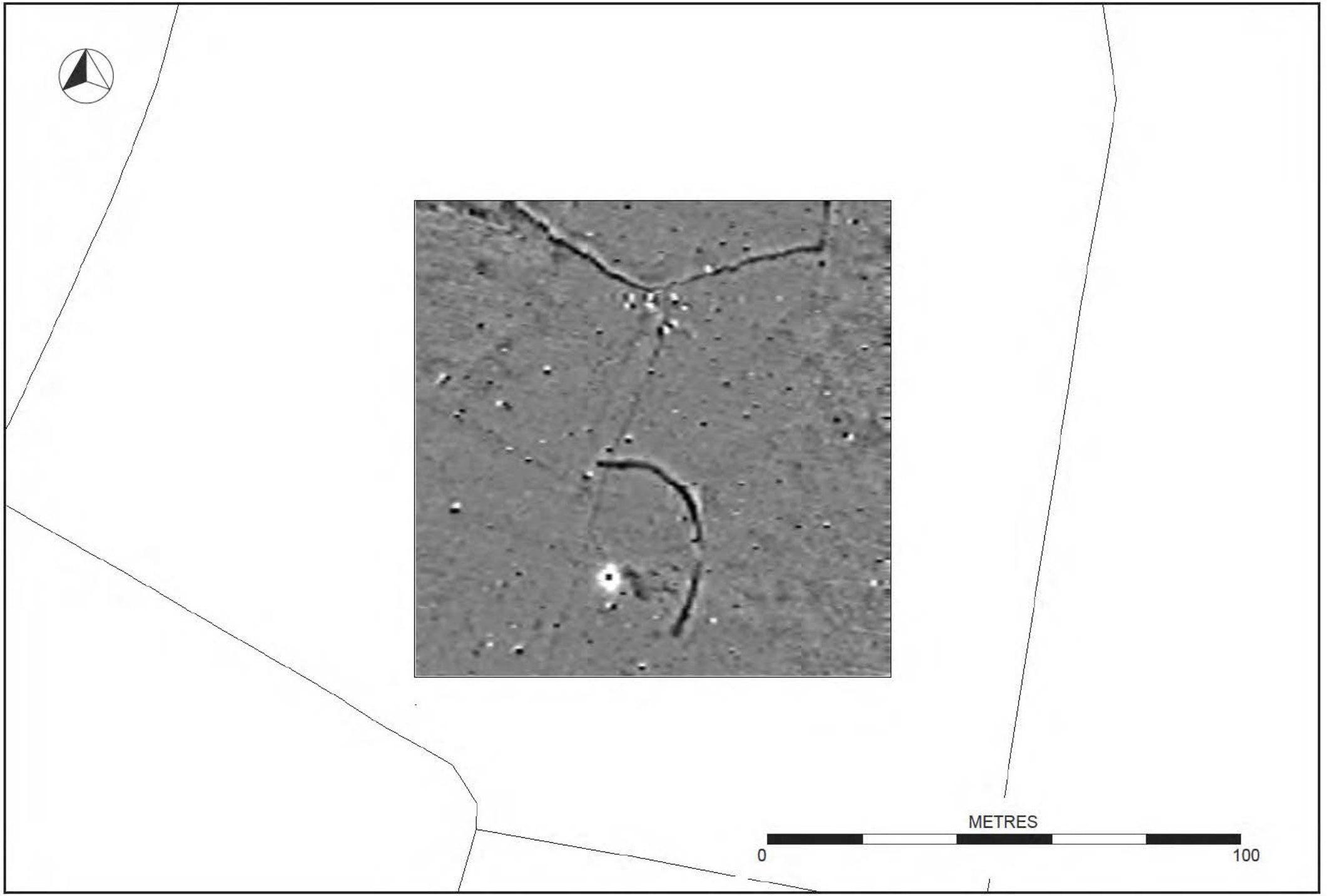


Figure 13: Standard resolution gradiometer survey of Area 3

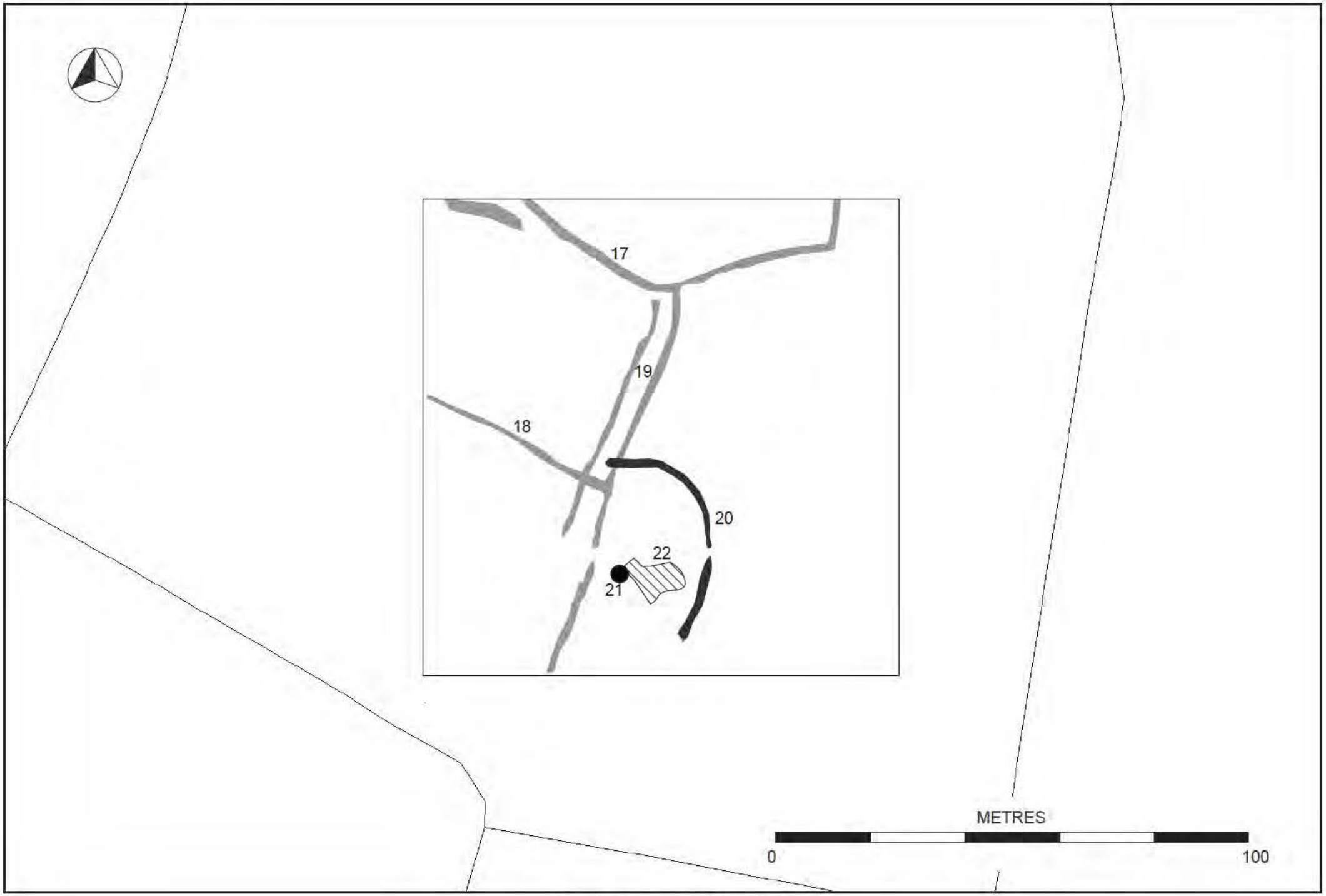


Figure 14: Area 3, interpretation

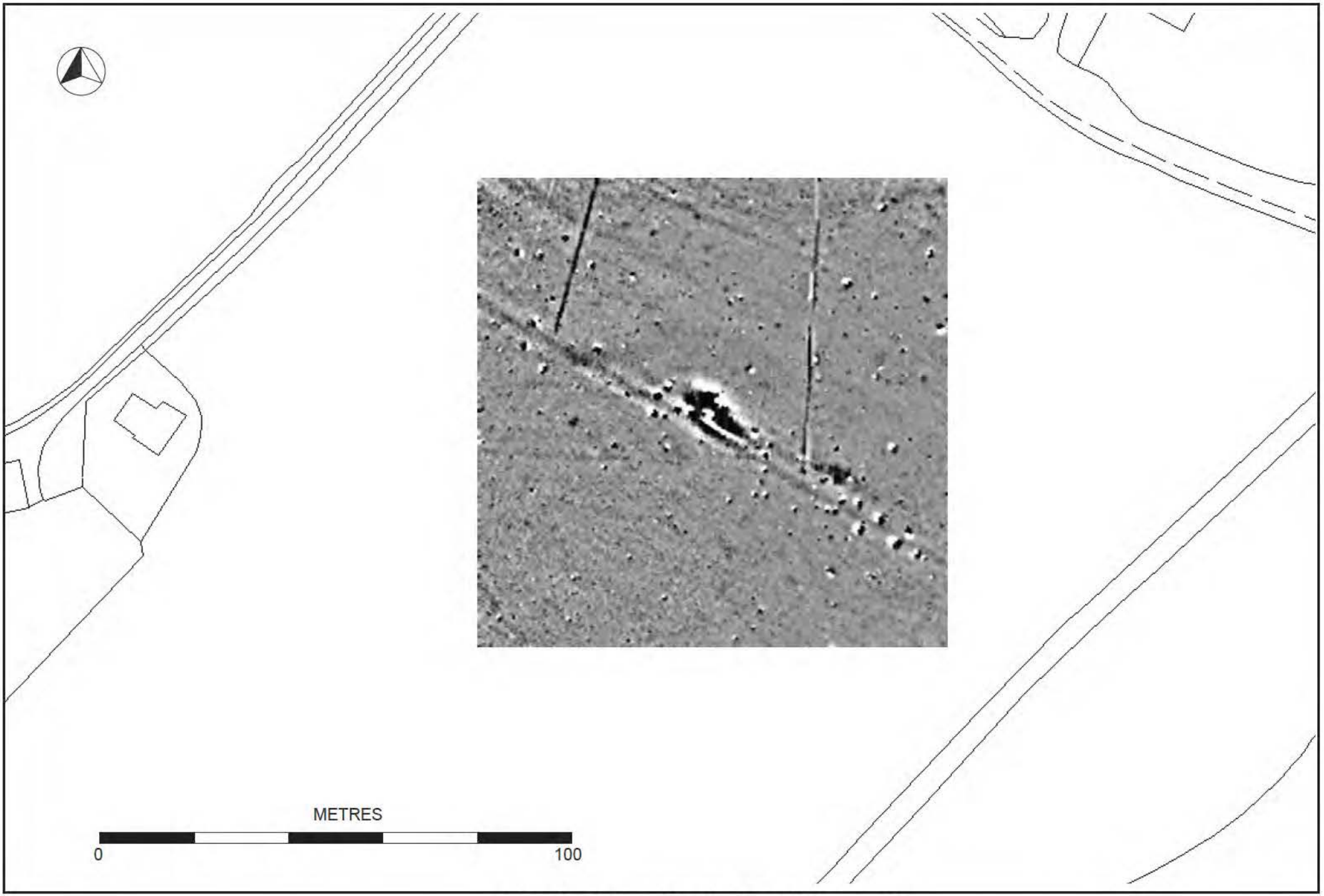


Figure 15: High resolution gradiometer survey of Area 4

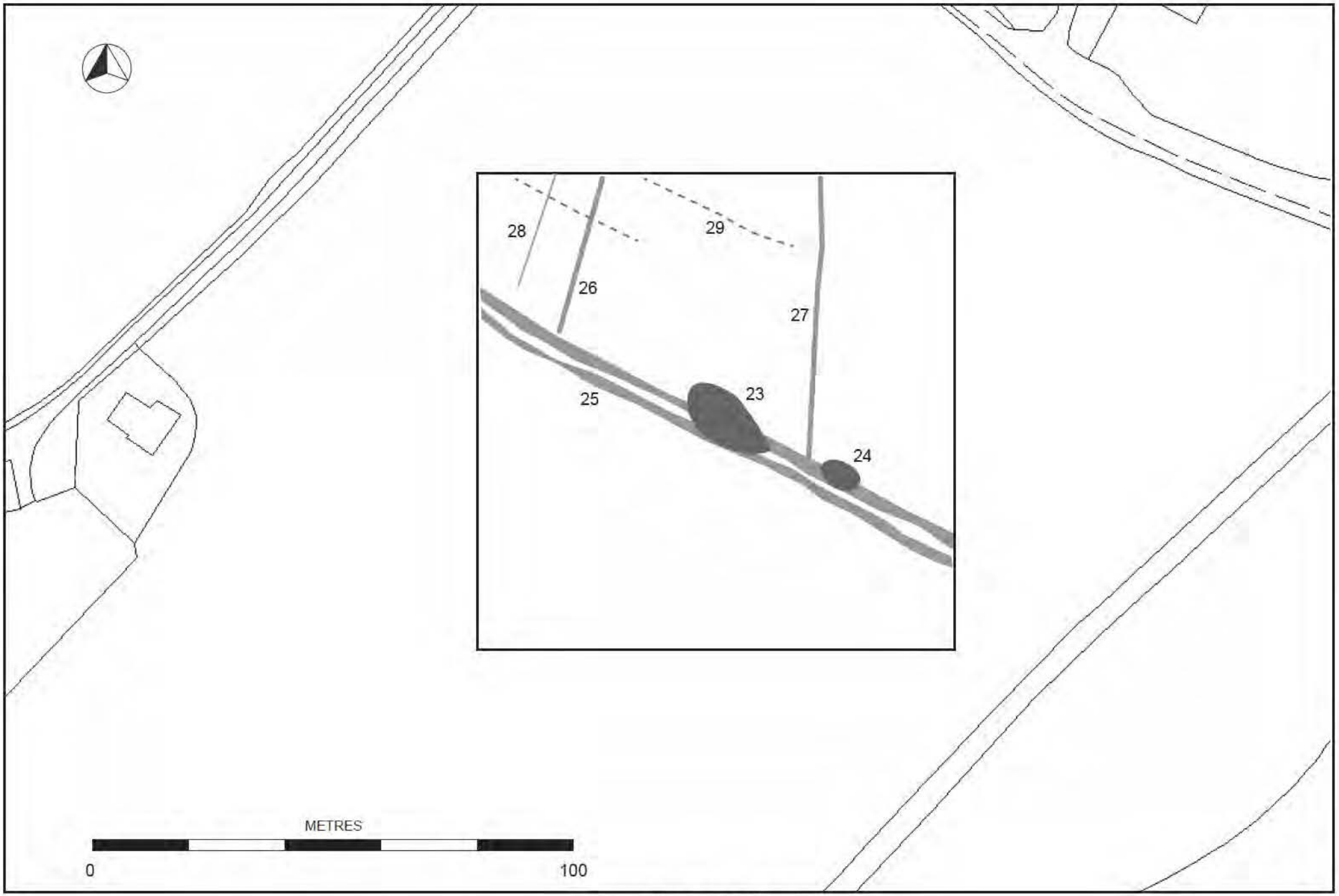


Figure 16: Area 4, interpretation

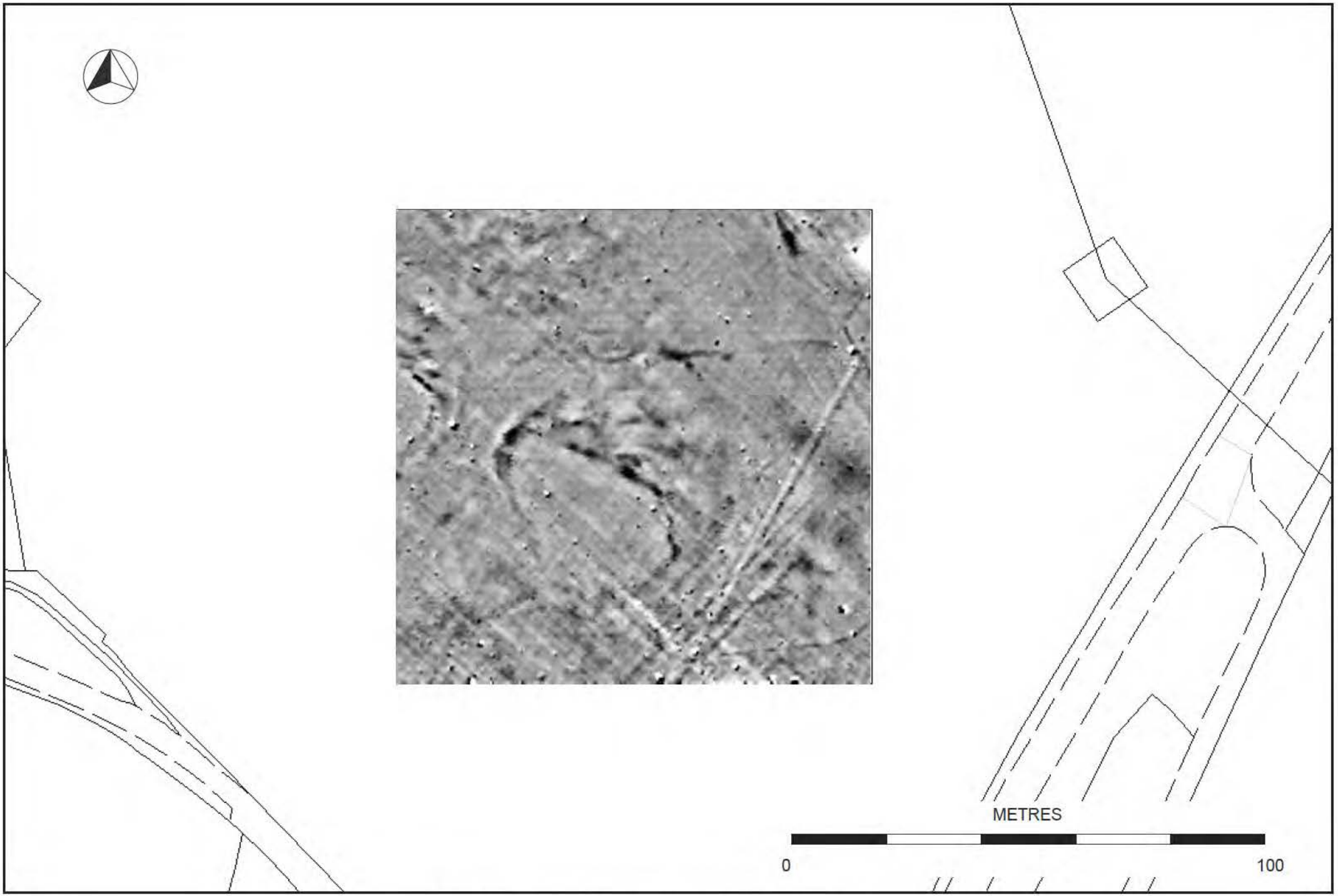


Figure 17: High resolution gradiometer survey of Area 5

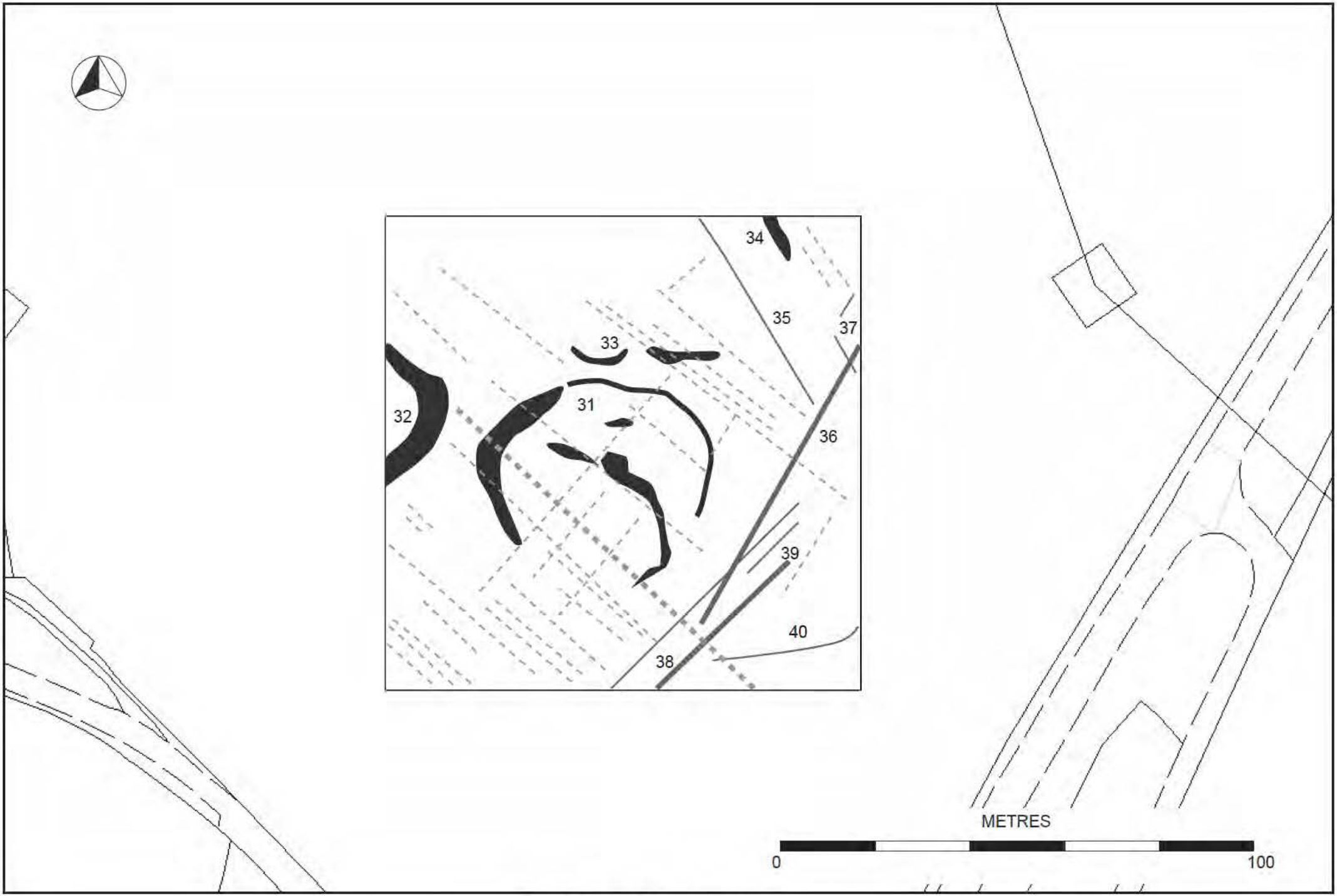


Figure 18: Area 5, interpretation

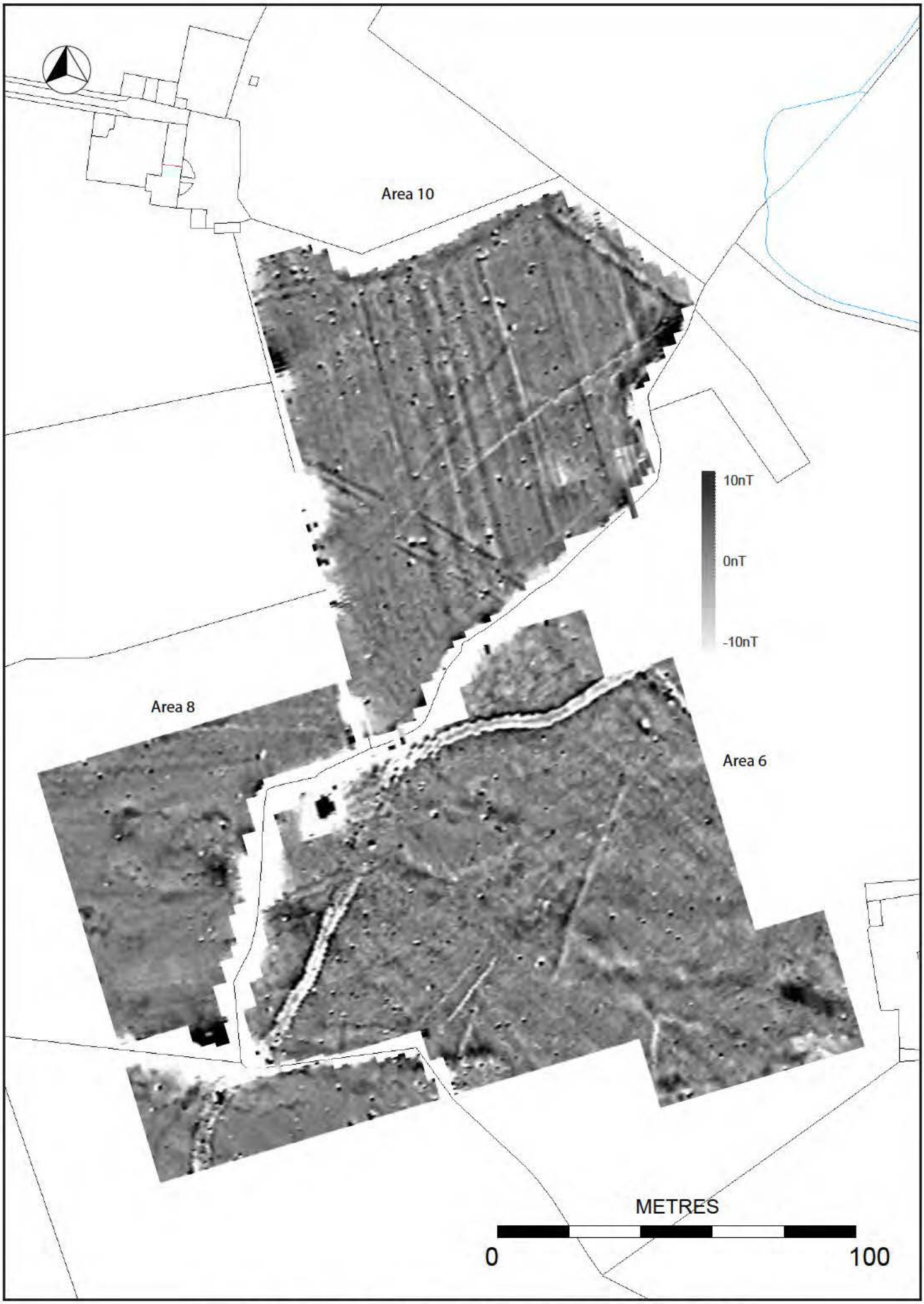


Figure 19: Areas 6, 8 and 10 fluxgate gradiometer survey, grey-scale plot

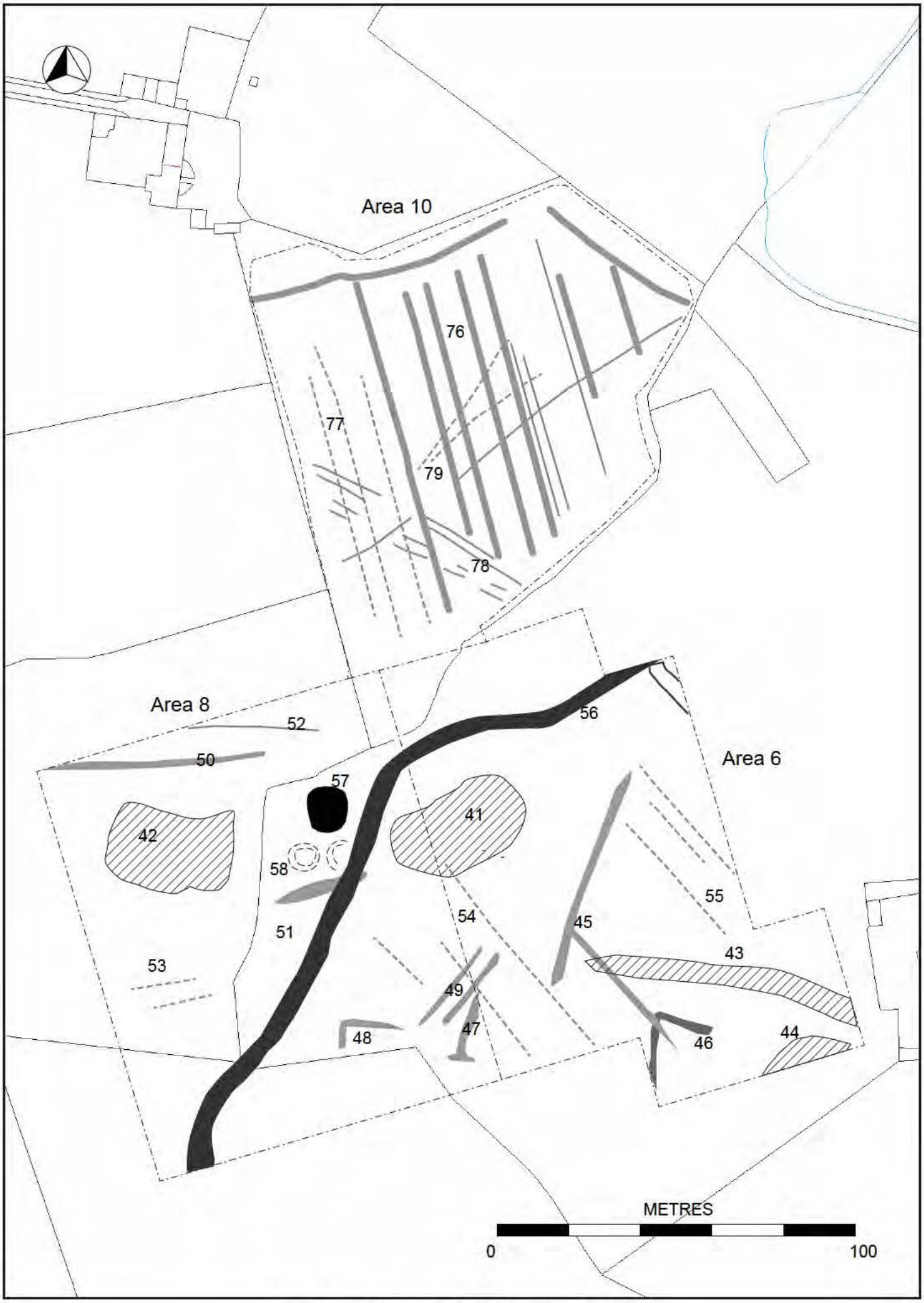


Figure 20 Areas 6, 8 and 10, interpretation diagram

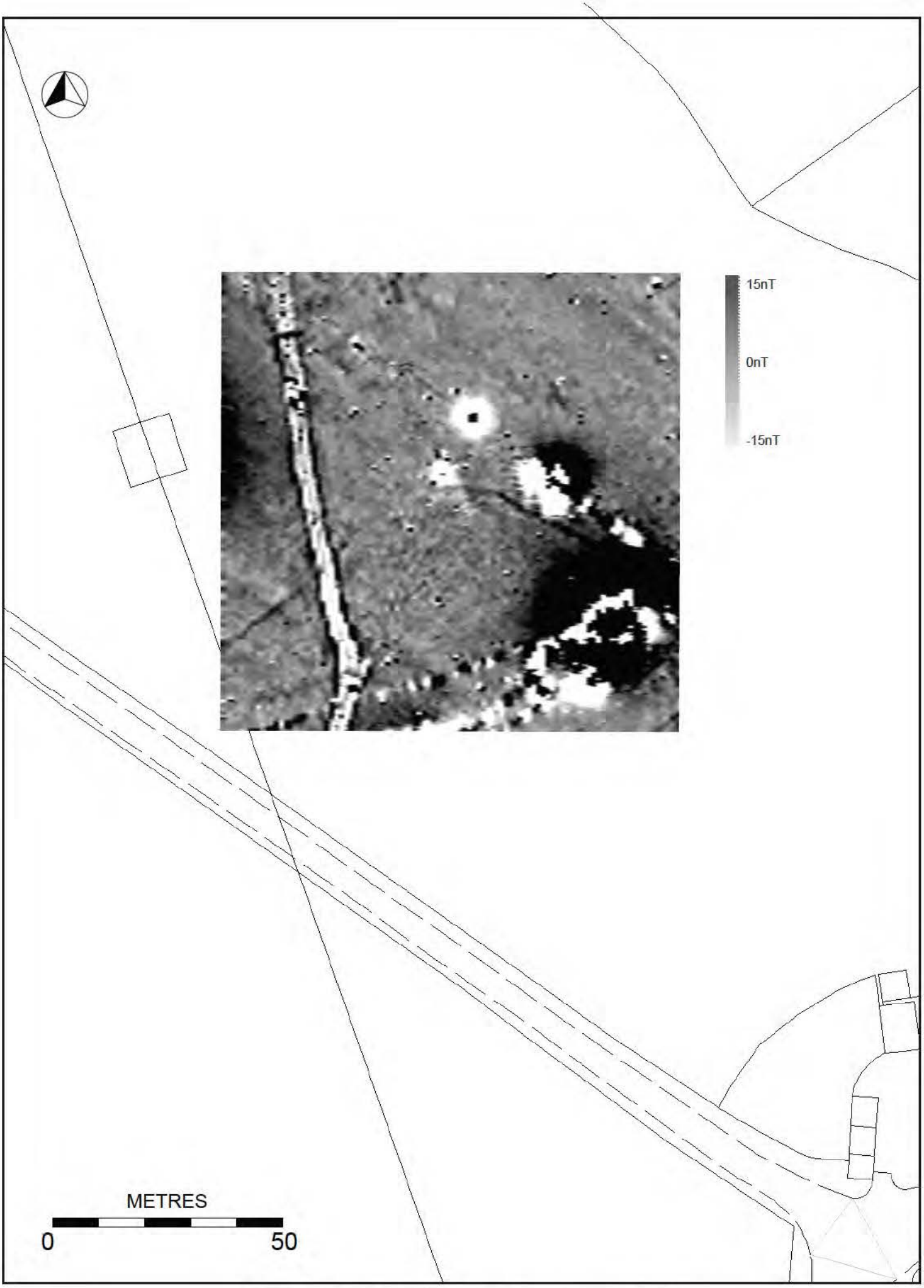


Figure 21: Area 7 fluxgate gradiometer survey, grey-scale plot

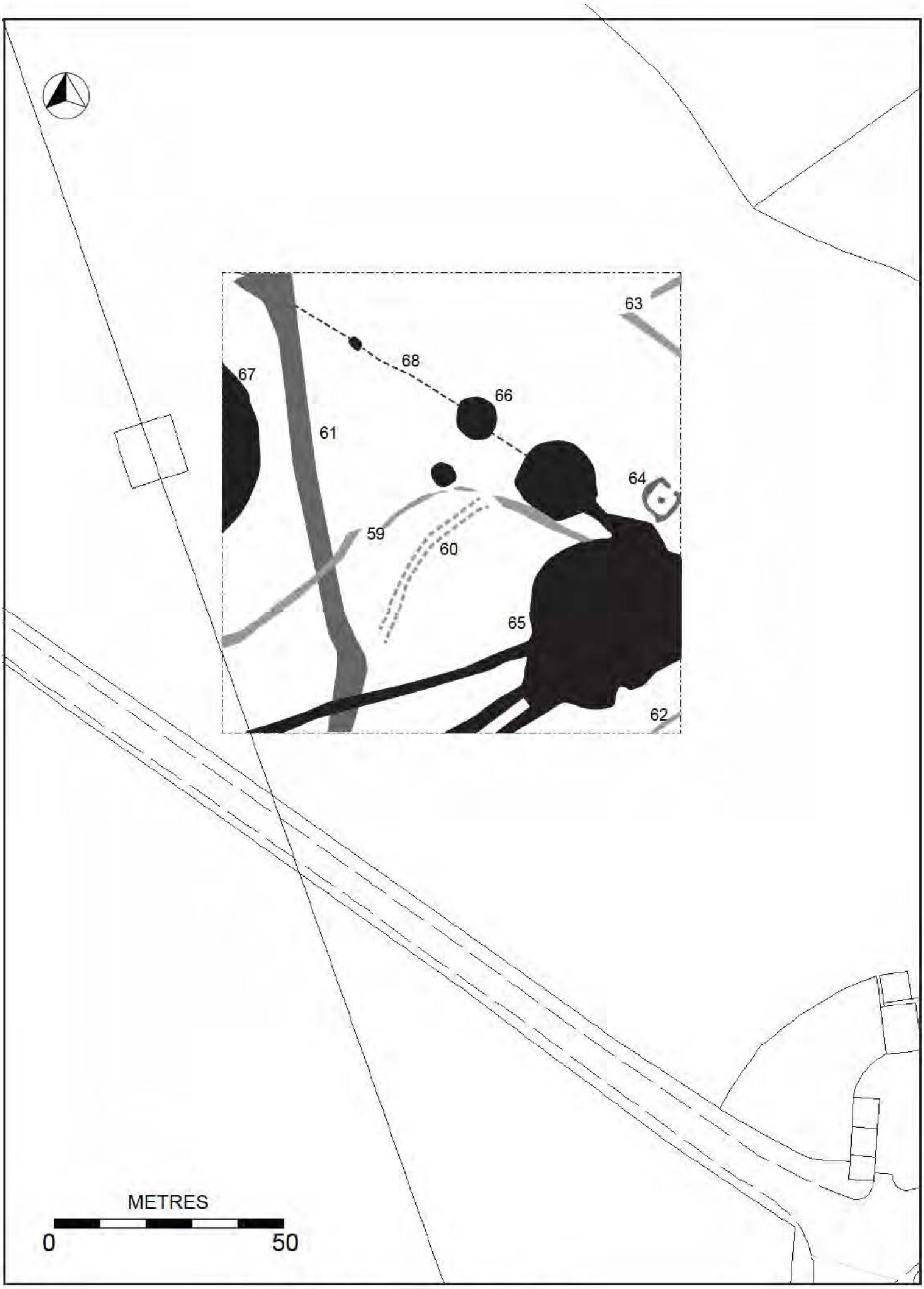


Figure 22: Area 7 interpretation diagram

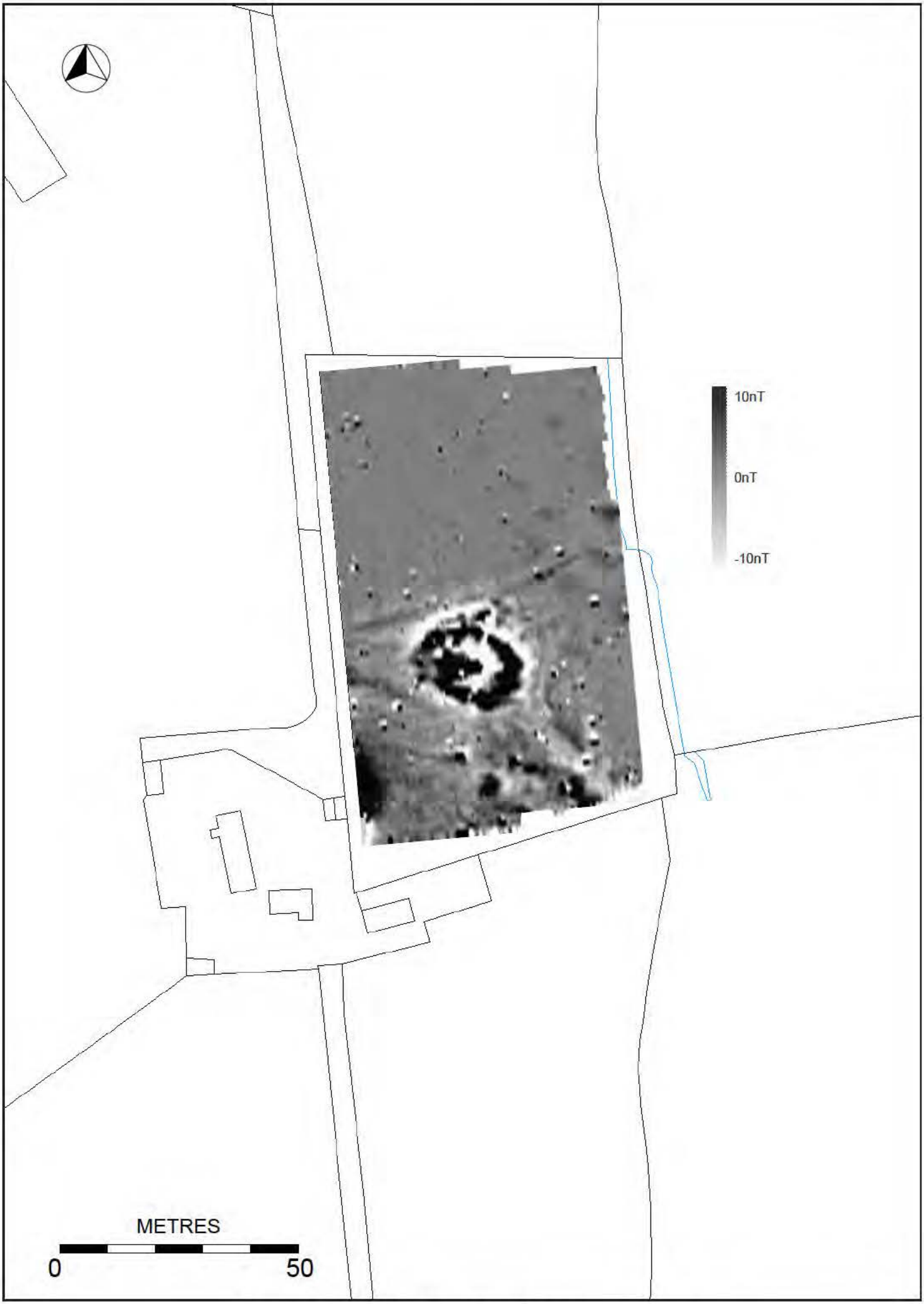


Figure 23: Area 9 fluxgate gradiometer survey, grey-scale plot

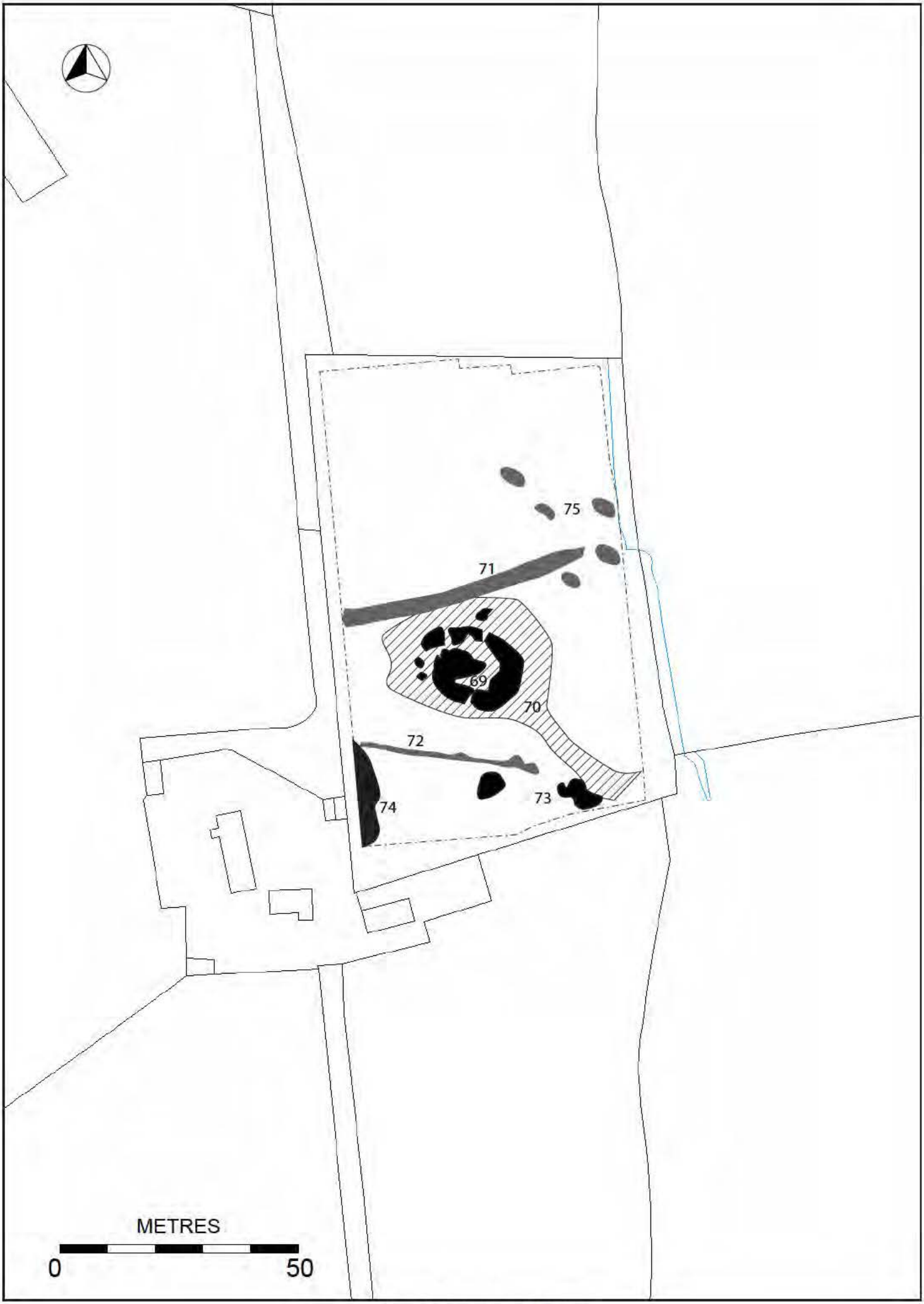


Figure 22: Area 9 interpretation diagram

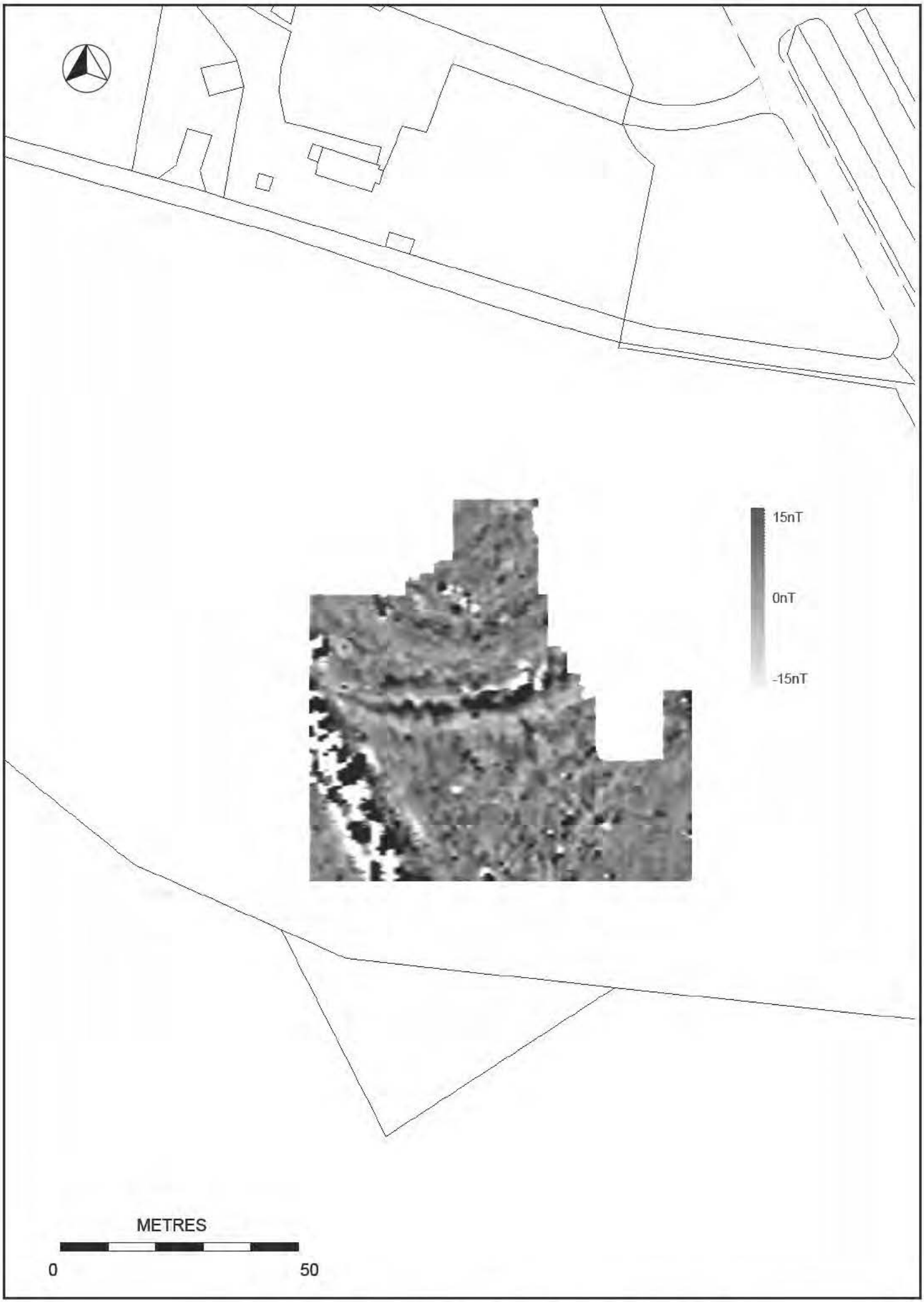


Figure 25: Area 11 fluxgate gradiometer survey, grey-scale plot

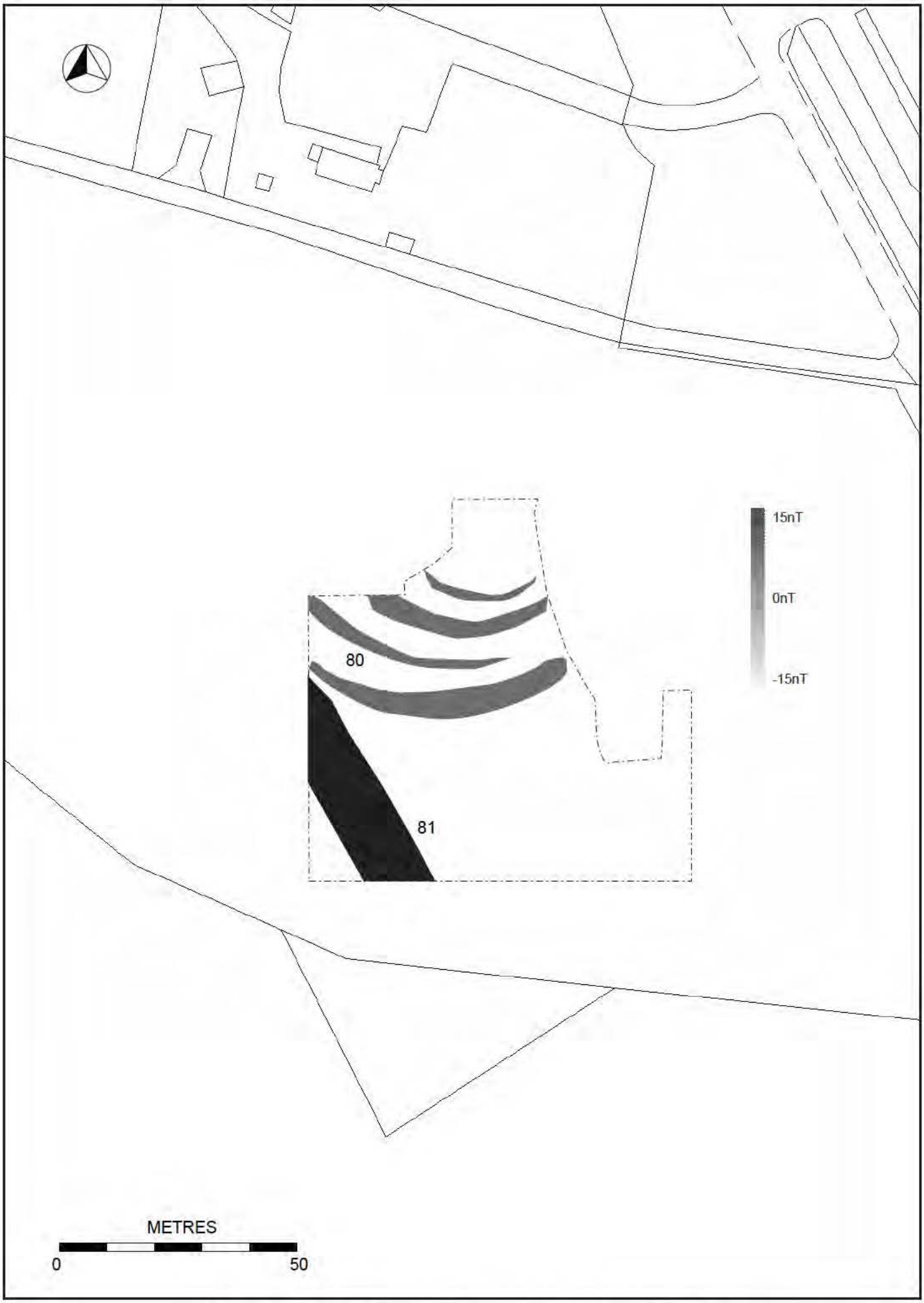


Figure 26: Area 11 fluxgate gradiometer survey, interpretation diagram

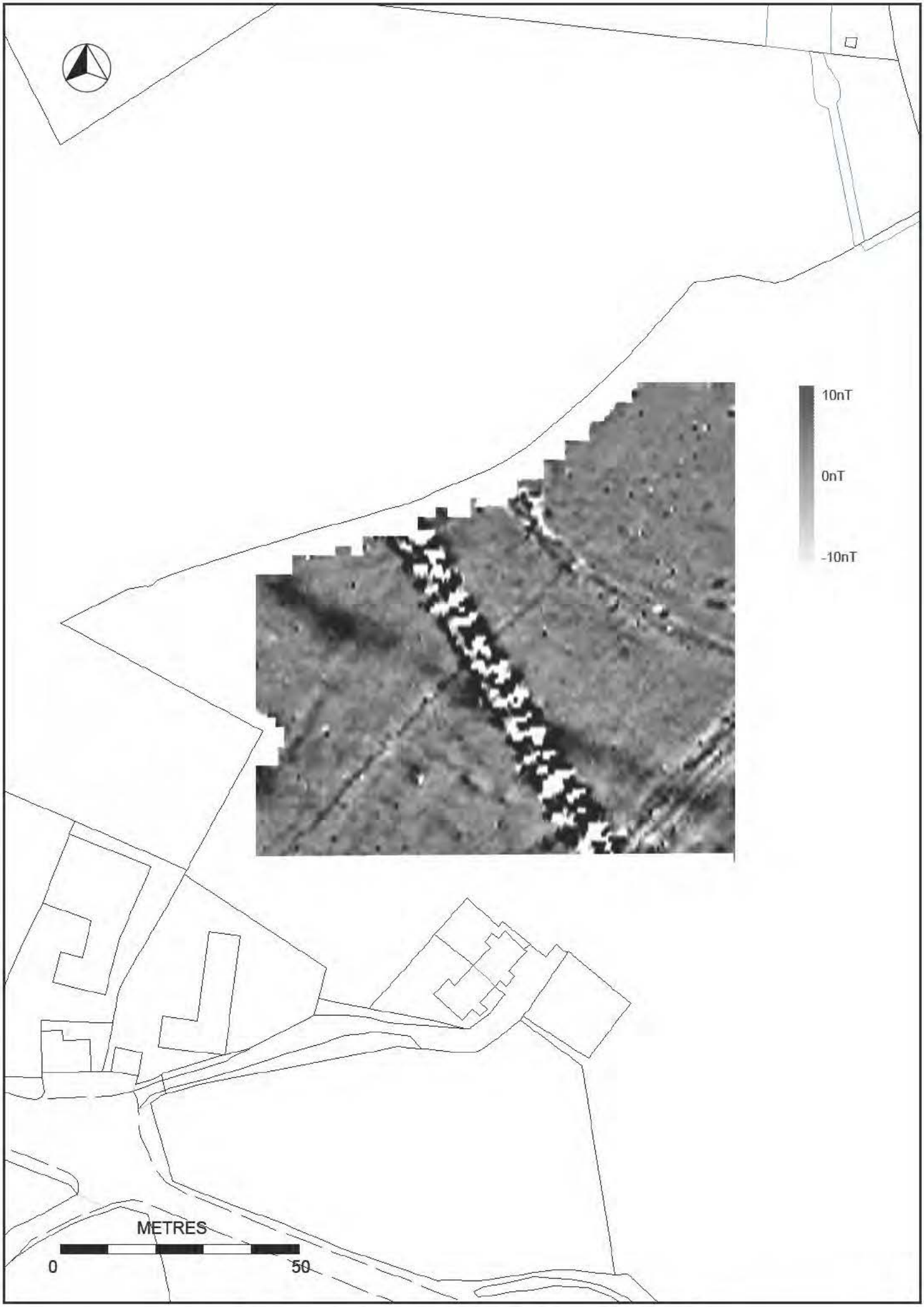


Figure 27: Area 12 fluxgate gradiometer survey, grey-scale plot

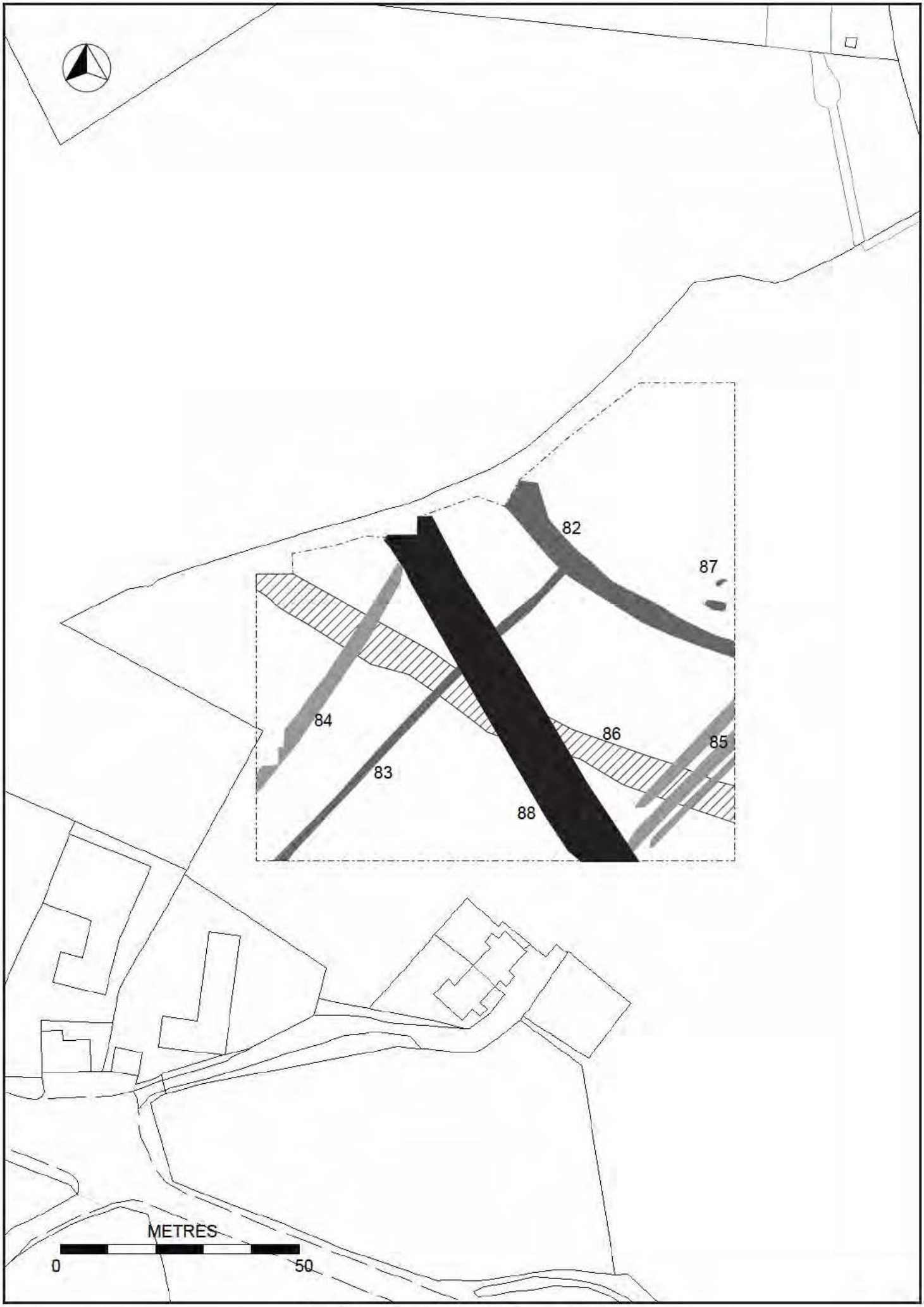


Figure 28: Area 12 interpretation diagram

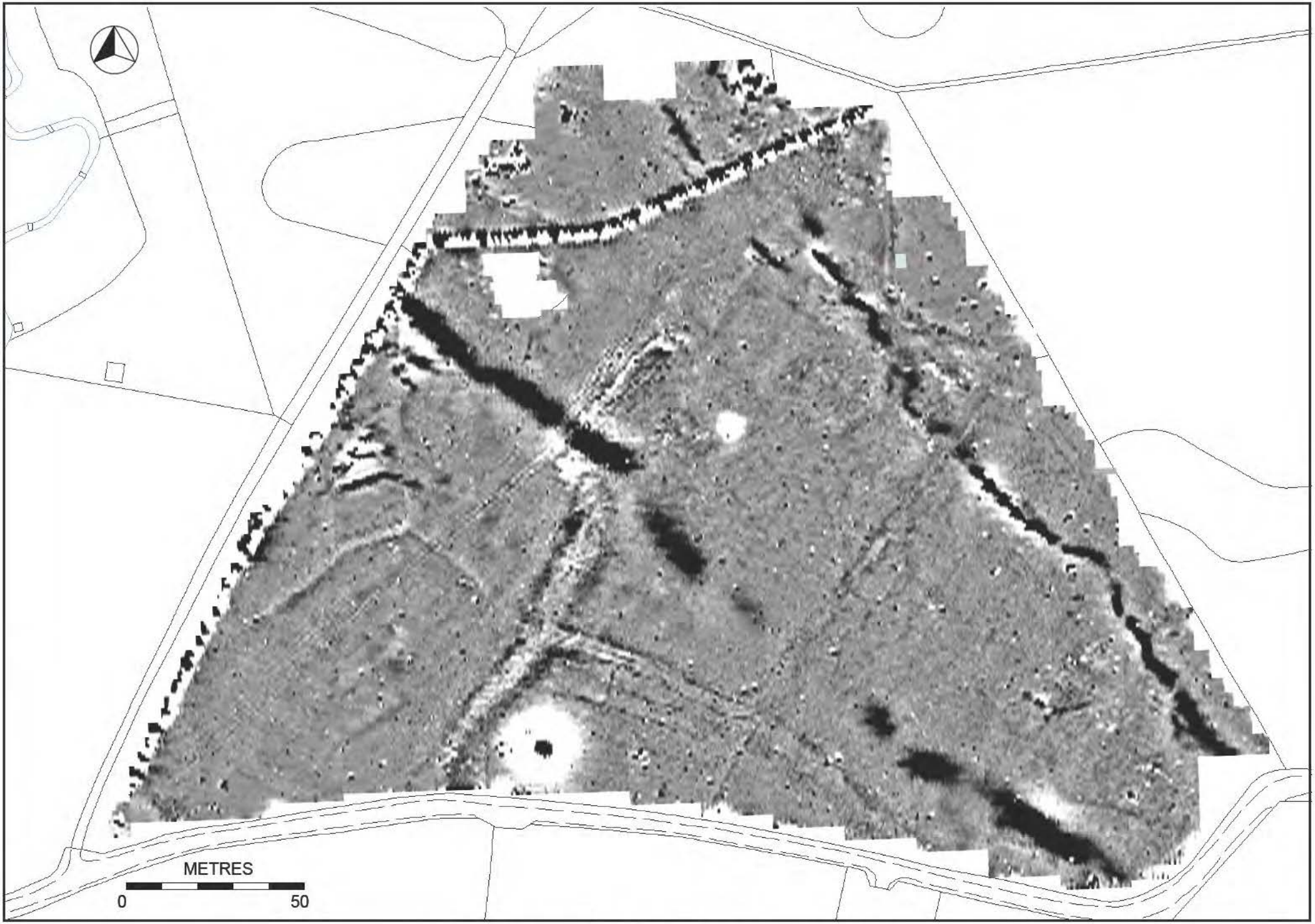


Figure 29: Area 13 fluxgate gradiometer survey, grey-scale plot

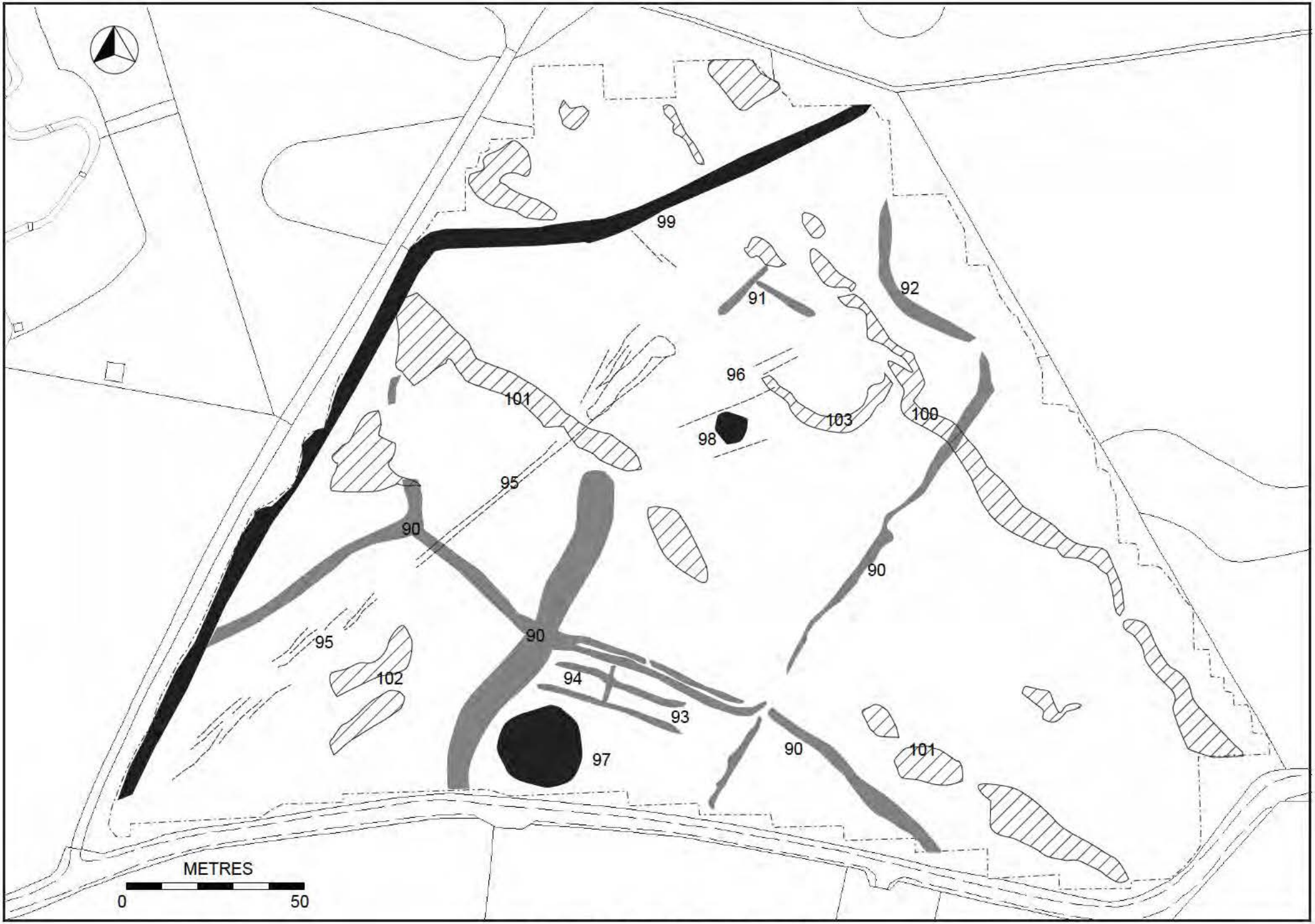


Figure 32: Area 13 interpretation plan

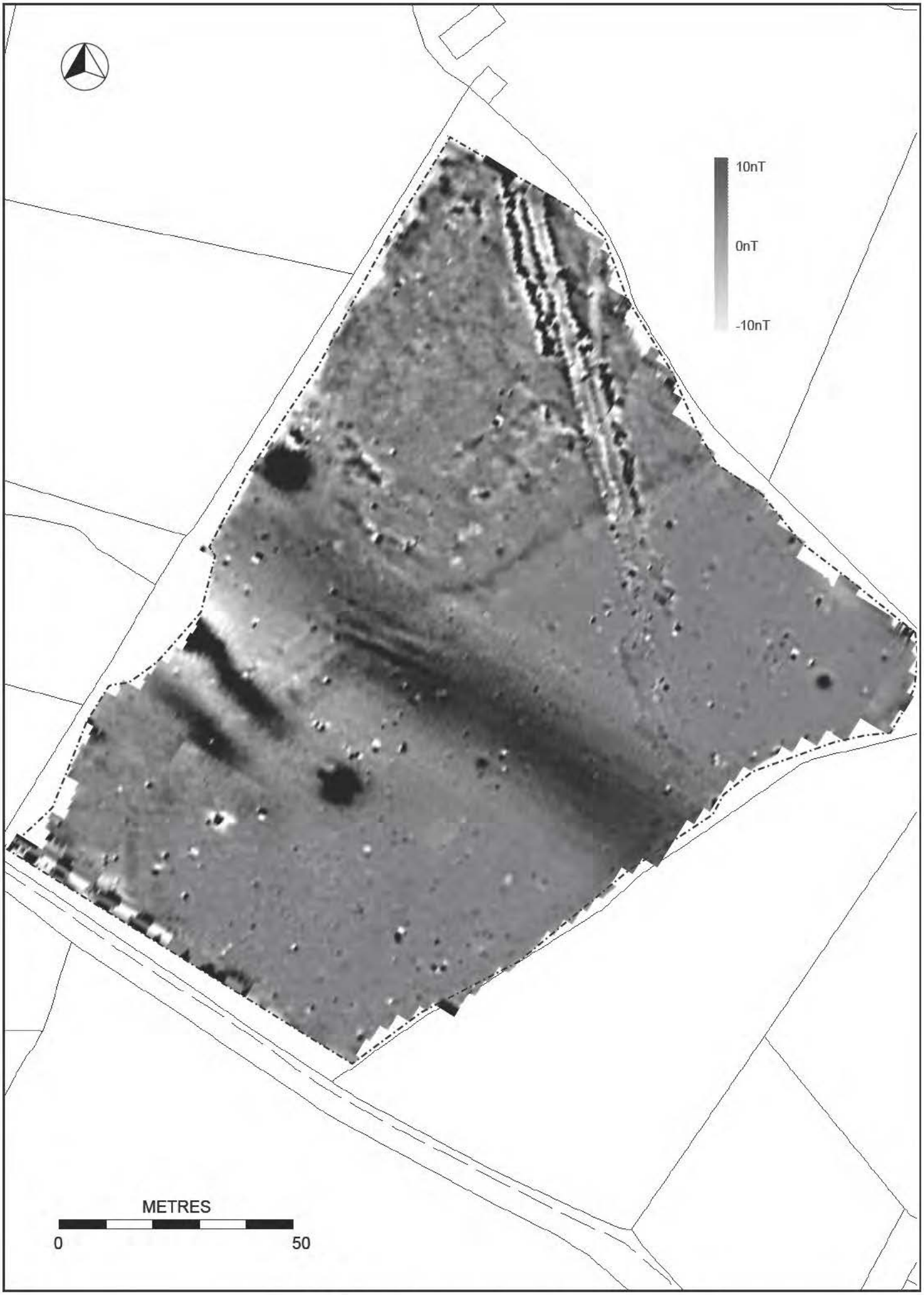


Figure 31: Area 14 fluxgate gradiometer survey, grey-scale plot

Figure 32: Area 14 interpretation diagram

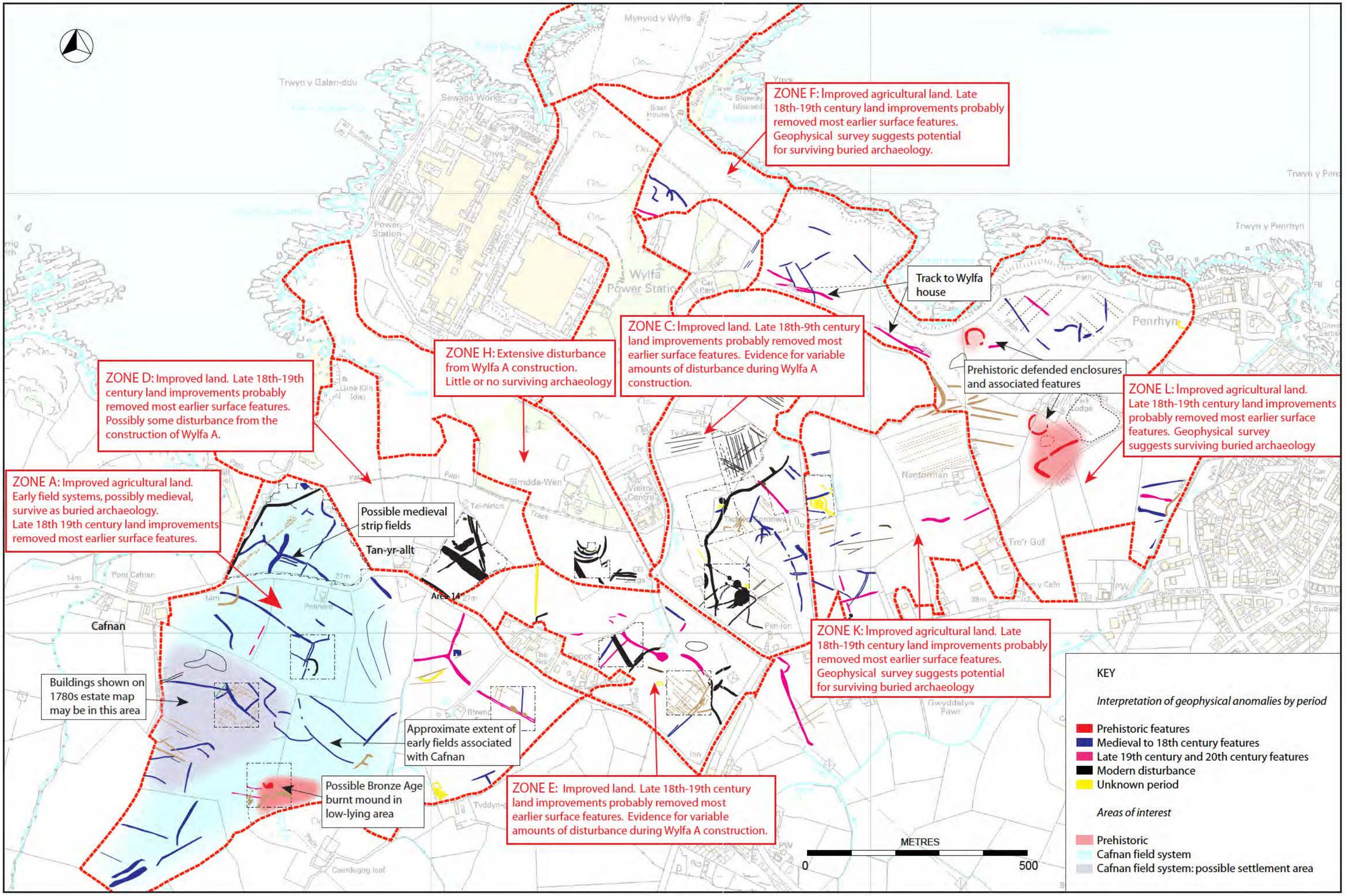


Figure 33: Zonal historical themes and geophysical anomalies by period

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