GEOPHYSICAL SURVEY REPORT 2012/53

Land at Llanlliwe, Whitland, Carmarthenshire

Client:

AC archaeology

archaeology consultants and contractors

On behalf of:

Kronos Solar GmBH

GSB Prospection

Celebrating over 25 years at the forefront of Archaeological Geophysics

GSB Survey Report No. 2012/53

Land at Llanlliwe, Whitland, Carmarthenshire

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Survey Personnel

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Dates

Fieldwork: 13 - 16 August 2012
Report: 31 August 2012

Report Approved: Dr John Gater MIfA FSA

Background Project Details

NGR	SN 181 177
Location	The survey was undertaken approximately 2km north-west of Whitland, to the north of the A40 and was bounded to the south by a railway line, the west by the River Taf and to the north and east by further agricultural fields.
HER/SMR	Dyfed HER
District	Carmarthenshire
Topography	Undulating slopes, steep to very steep in places largely sloping down from north-east to south-west.
Current Land Use	Grassland - cut
Soils	Denbigh 1 (541j): well drained fine loamy and fine silty soils over rock. Some similar soils with slowly permeable subsoils and slight seasonal water logging. Shallow soils and some bare rock locally (SSEW 1983)
Geology	Bedrock geology: bordering Didymograpatus Bifidus beds – mudstone and Tetragraptus beds - mudstone (BGS 2012)
Archaeology	A putative Roman fort (PRN 102817) and Roman road (PRN 28121-3) are thought to lie within the vicinity of the survey area. (Valentin, J. *pers.comm.)*
Survey Methods	Detailed magnetometer survey (fluxgate gradiometer)
Study Area	9ha

Aims

To locate and characterise any anomalies of possible archaeological interest within the study area. The work forms part of a wider archaeological assessment being carried out by **AC archaeology Ltd**. on behalf of **Kronos Solar GmBH**.

Summary of Results

No anomalies of clear archaeological significance were detected in the survey area; however, anomalies possibly pertaining to early field systems and a trackway were identified. Anomalies that have the appearance of strongly burnt or fired features have also been detected; however a natural origin is more likely in this case.

Areas of increased magnetic response dominate the survey results and are most likely natural in origin. There is, however, a degree of uncertainty to this interpretation. Former tributaries to the River Taf are present in the data in the form of palaeochannels.

Method

All survey grid positioning was carried out using Trimble R8 Real Time Kinematic (RTK) VRS Now dGPS equipment. The geophysical survey area is georeferenced relative to the Ordnance Survey National Grid by tying in to local detail and corrected to the survey plan provided by the client. These tie-ins are presented in Figure T1. Please refer to this diagram when re-establishing the grid or positioning trenches.

Technique	Instrument	Traverse Interval	Sample Interval
Magnetometer	Bartington Grad 601-2	1m	0.25m

Data Processing

Data processing was performed as appropriate using both in-house and commercial software packages (Geoplot) as outlined below.

Magnetic Data
Zero Mean Traverse, Step Correction (De-stagger) and Interpolation (on the Y axis).

Interpretation

When interpreting the results several factors are taken into consideration, including the nature of archaeological features being investigated and the local conditions at the site (geology, pedology, topography etc.). Anomalies are categorised by their potential origin. Where responses can be related to very specific known features documented in other sources, this is done so (for example: *Abbey Wall*, *Roman Road*). For the generic categories levels of confidence are indicated, for example: *Archaeology – ?Archaeology*. The former is used for a confident interpretation, based on anomaly definition and/or other corroborative data such as cropmarks. Poor anomaly definition, a lack of clear patterns to the responses and an absence of other supporting data reduces confidence, hence the classification *?Archaeology*. Details of the data plot formats and interpretation categories used are given in the Appendix: Technical Information at the end of the report.

General Considerations

Site conditions were mixed the ground cover, which consisted of a recently cut grass, posed little hindrance to the collection of data. However, the topography in some parts of the survey area, combined with the extreme weather conditions (strong gusting winds and very heavy rain) will have introduced a certain level of stepping and tilt errors; these have been corrected for during data processing.

1.0 Survey Results - Magnetometer Survey

1.1 Perpendicular linear positive magnetic anomalies [**1**] have been classified as *?Archaeology,* and are of a ditch-like form. The lack of any further anomalies 'within' them and no returning anomalies to the south would imply that these do not form part of the putative Roman fort (PRN 102817) and are much more likely to represent an earlier field system.

1.2 A pair of parallel linear anomalies [2] orientated approximately east-west have been detected in the north of the survey. It is not possible to say whether they are representative of the Roman road (PRN 28121-3) that is thought to have passed through this field.

1.3 A few of curvilinear positive magnetic anomalies [**3**] have been detected throughout the data set. Although the responses are of an archaeological type the lack of context or existence of any recognisable pattern only allows a classification as *?Archaeology*.

1.4 Three anomalies [**4**] in the north of the survey area have been classified as *Uncertain origin.* Although the responses are of a strength that would indicate a possible burnt or fired origin the lack of any further archaeological type responses, coupled with the magnetic strength of many of the natural responses, would suggest that a natural origin is more likely.

1.5 Large areas have been denoted as being of *Uncertain Origin – Increased Response.* These have a characteristic mottled appearance in the greyscale and are likely to be natural in origin; an anthropogenic origin such as severely plough damaged features or, in the case of [**5**], differing manuring practices cannot be ruled out. A number of trends of *Uncertain Origin* have also been noted.

1.6 Three old field boundaries [**6**] are in evidence within the data. The most prominent of these is orientated northeast-southwest and runs parallel with the present eastern boundary; the second and third boundaries are perpendicular to this. These boundaries are denoted on the 1889, 1:2500 first edition Ordnance Survey map of the area (OS, 2012)

1.7 Palaeochannels can be seen throughout the data set. These all orientate down slope towards the present River Taf and have been given the classification of *Natural*.

1.8 Modern plough marks have been detected in the east of the survey area orientated both north-south and east-west.

1.9 Smaller scale ferrous anomalies ("iron spikes") are present throughout the data, their form best illustrated in the XY trace plot. These responses are characteristic of small pieces of ferrous debris in the topsoil and are commonly assigned a modern origin. Ferrous responses adjacent to boundaries are due to metal fencing.

2.0 Conclusions

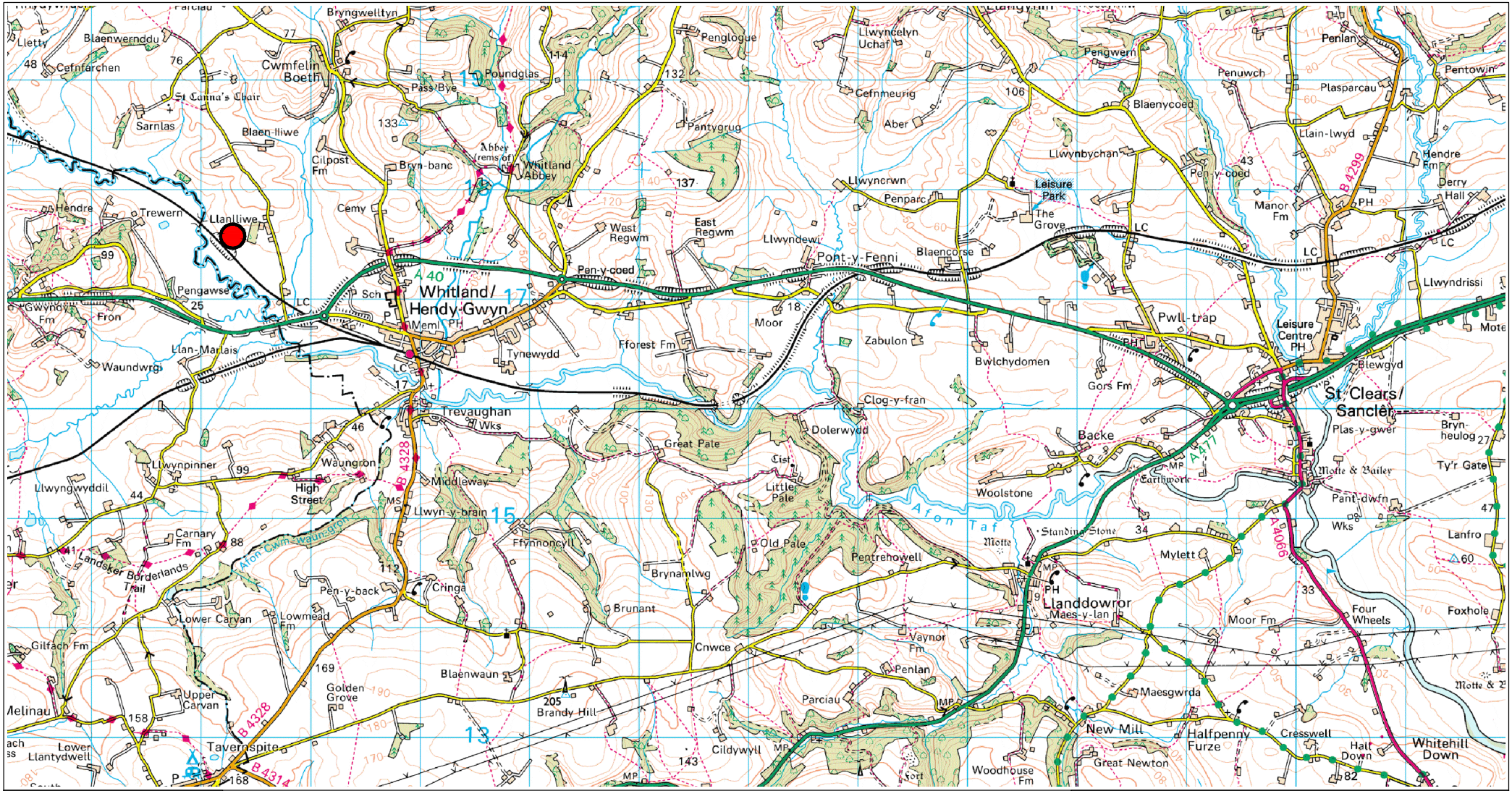
2.1 No anomalies have been detected that have a definitive archaeological character and form. There are several clusters of responses that have archaeological potential, in the form of earlier field systems and potential burnt or fired features. Field boundaries marked on 19th century mapping have also be identified.

2.2 Large areas of the survey are dominated by areas of increased response. These are not thought to be anthropogenic, although their archaeological potential cannot be entirely ruled out; however a natural origin is far more likely.

2.3 Former palaeochannels have been detected across the survey area, which almost certainly represent earlier tributaries to the River Taf

References

BGS 2012	British Geological Survey, Geology of Britain Viewer http://mapapps.bgs.ac.uk/geologyofbritain/home.html 1:50,000 scale geology, centred on 218056,217719 accessed 21/08/2012
OS 2012	http://www.old-maps.co.uk 1899, 1:2500, Carmarthenshire, centred on 218056,217719 accessed 20/08/2012
SSEW 2011	*Soils of England and Wales. Sheet 2, Wales*. Soil Survey of England and Wales. 1983.



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Project: 2012/53 Land at Llanlliwe, Whitland Carmarthenshire

Title: Site Location Diagram

Drawn by: CES

Figure 1

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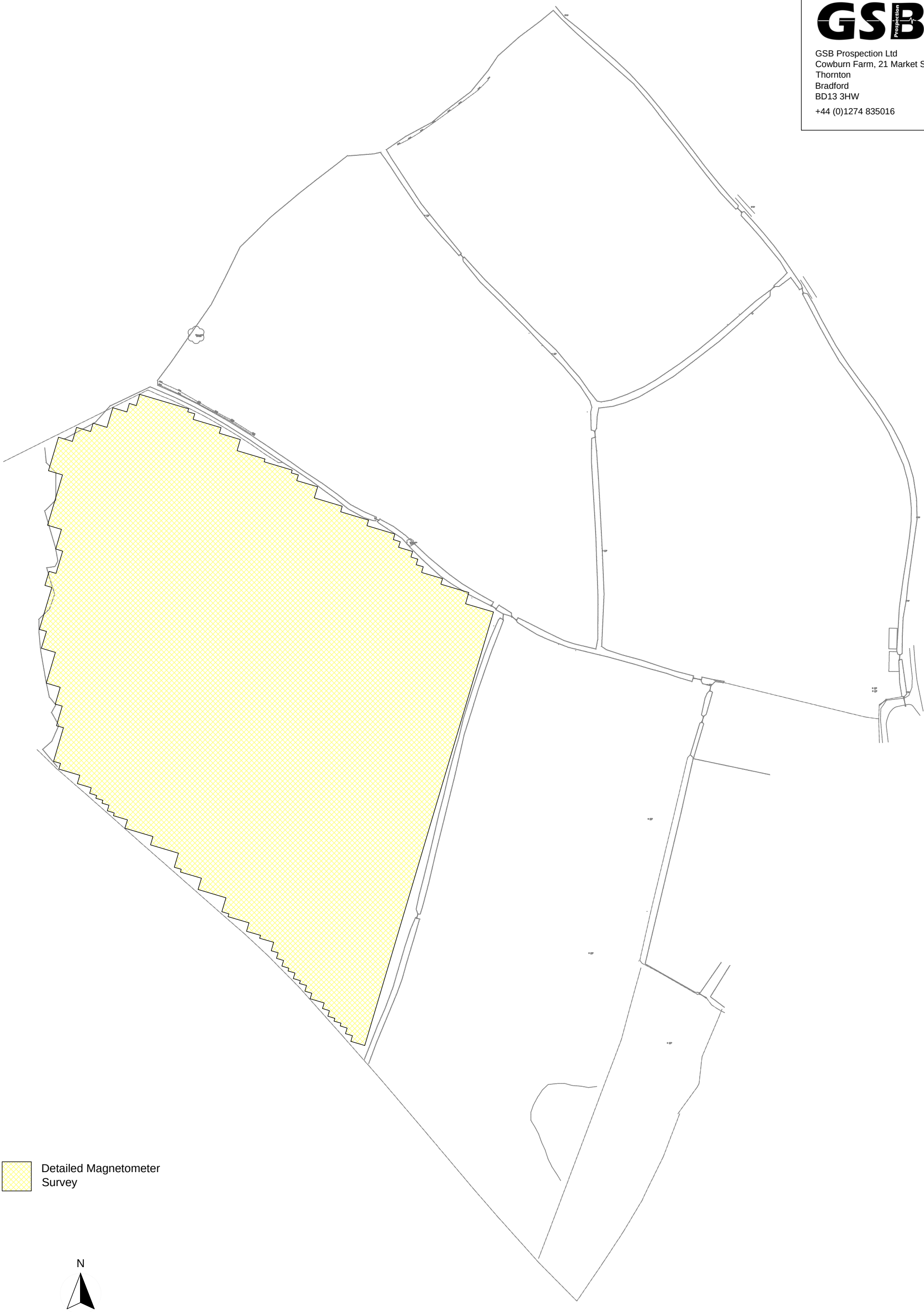

Detailed Magnetometer Survey

N

0 metres 100

1:2500 @ A3

Project: 2012/53 Land at Llanlliwe, Whitland, Carmarthenshire	**Title:** Location of Survey Area	Based on a site survey plan provided by the client. Reproduced with permission.	Drawn by: CES	**Figure 2**

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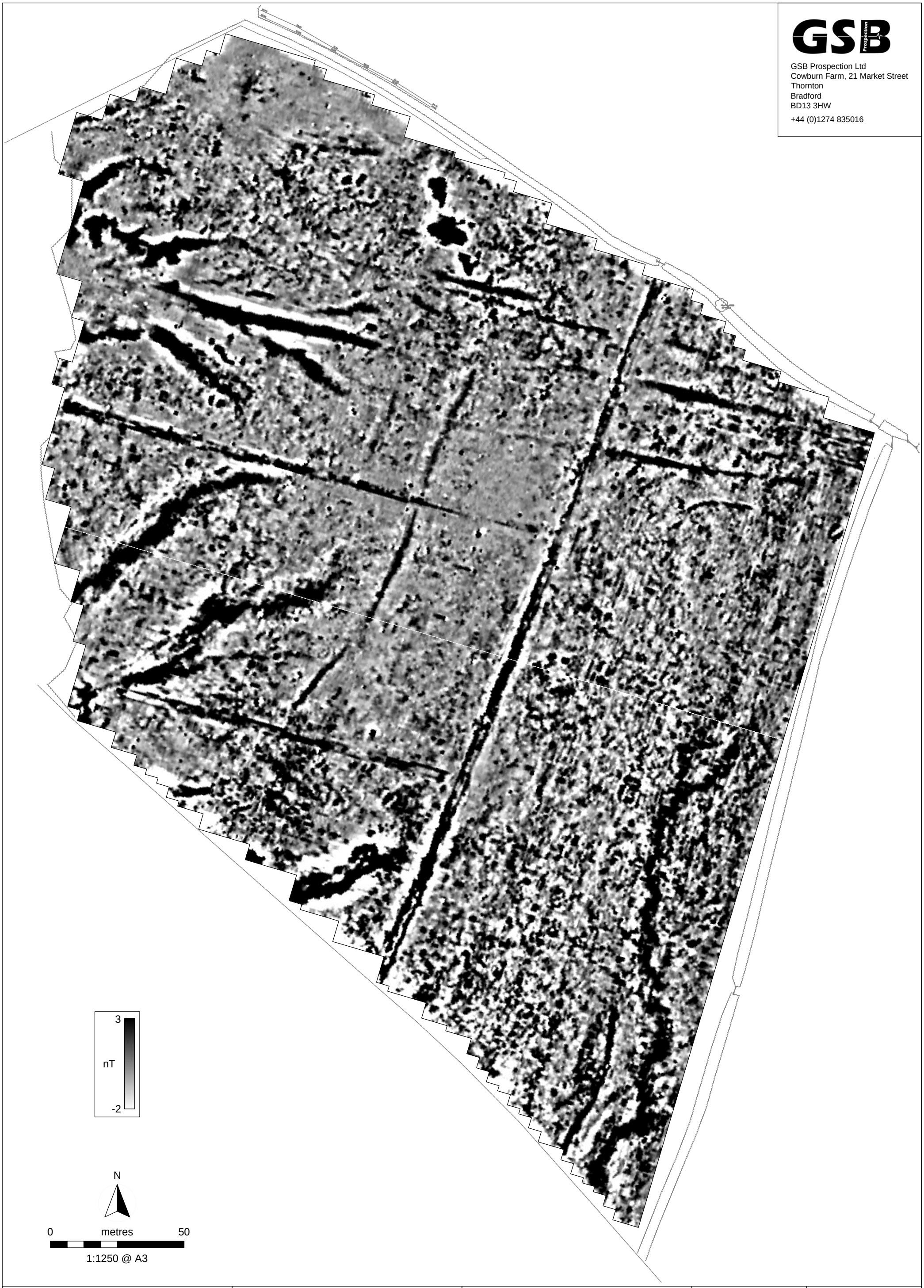

Project: 2012/53 Land at Llanlliwe, Whitland, Carmarthenshire	**Title:** Magnetometer Survey - Greyscale Plot	Based on a site survey plan provided by the client. Reproduced with permission.	Drawn by: CES	**Figure 3**

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4
2
1
1
6
3
6
5
3

?Archaeology
(discrete anomaly / trend)

Uncertain Origin
(discrete anomaly / trend / area of increased response)

Old Field Boundary

Natural

Plough

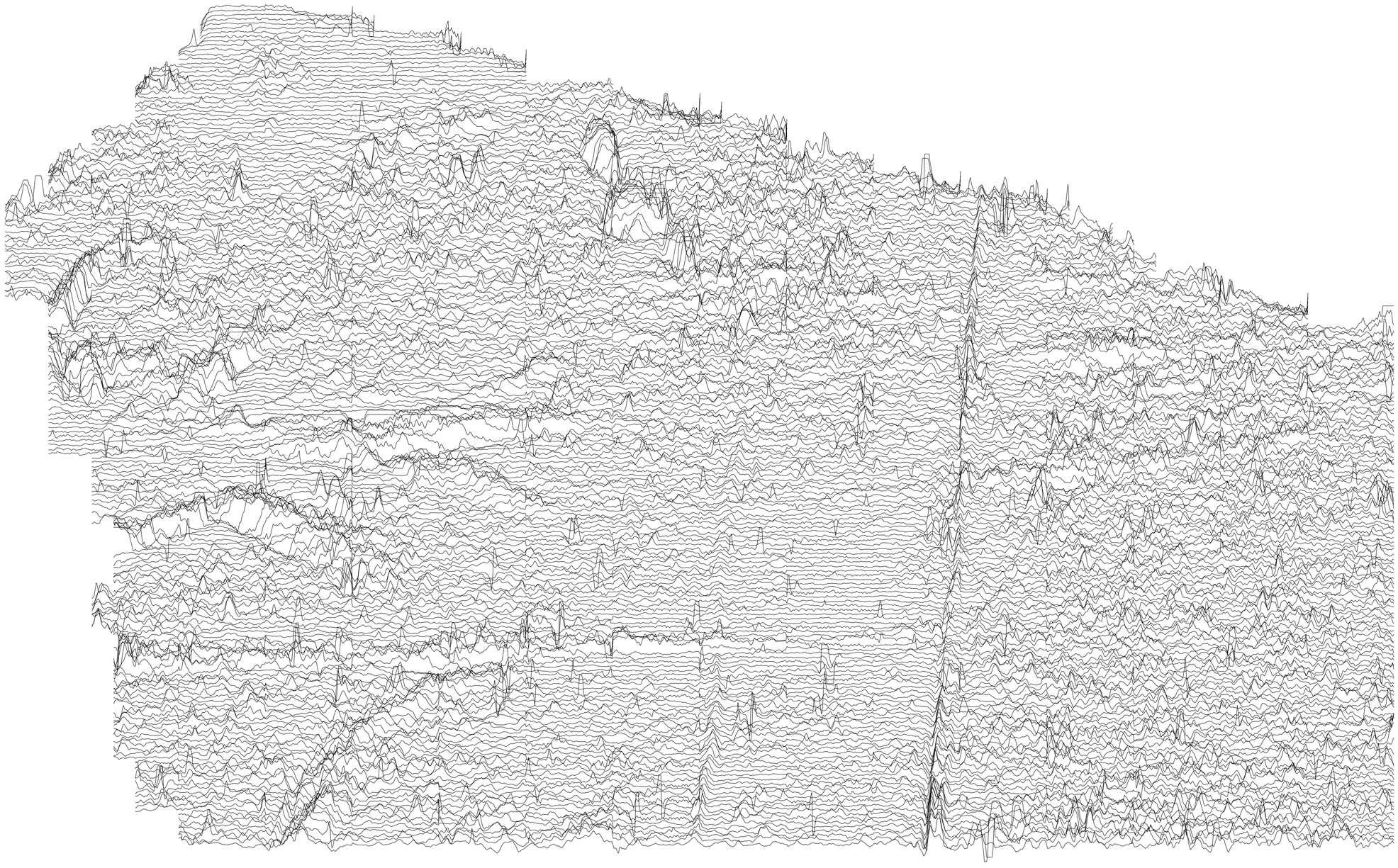
Ferrous

N

0 metres 50

1:1250 @ A3

Project: 2012/53 Land at Llanlliwe, Whitland, Carmarthenshire	**Title:** Magnetometer Survey - Interpretation	Based on a site survey plan provided by the client. Reproduced with permission.	Drawn by: CES	**Figure 4**



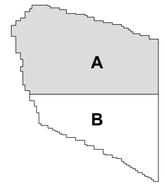
N

0 metres 20

1:500 @ A1

15 nT

Y axis plot scale: 15nT/cm
Clip levels: +/-15nT



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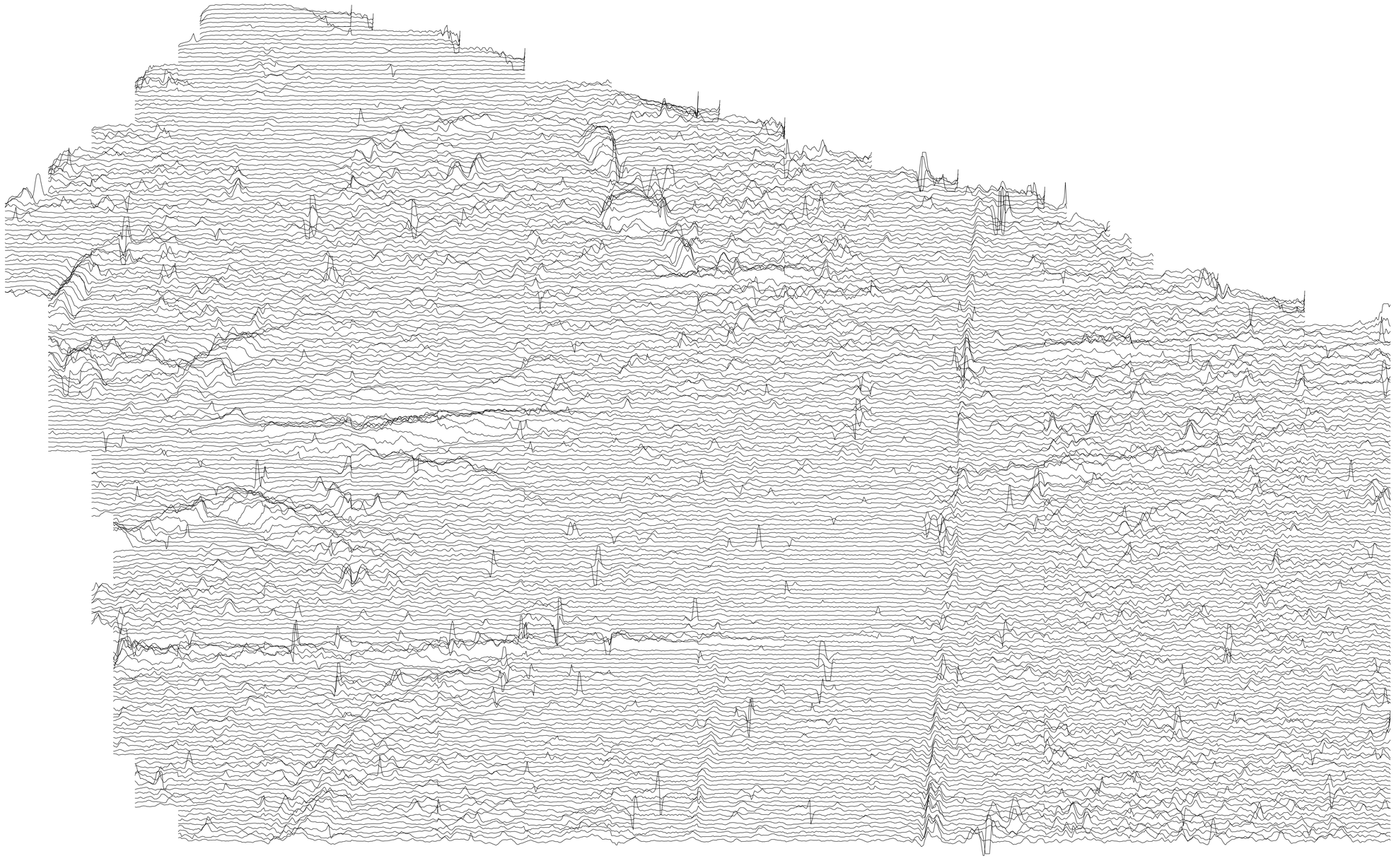
Title: Magnetic Data - Area A: XY Trace Plot

Drawn by: CES

Figure A1



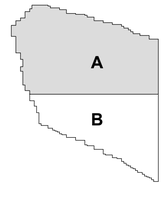
N

0 metres 20

1:500 @ A1

30 nT

Y axis plot scale: 30nT/cm
Clip levels: +/-30nT



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Carmarthenshire

Title: Magnetic Data - Area A:
XY Trace Plot

Drawn by: CES

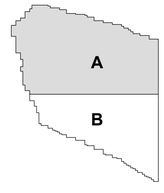
Figure A2

N

0 metres 20

1:500 @ A1

2
nT
-1



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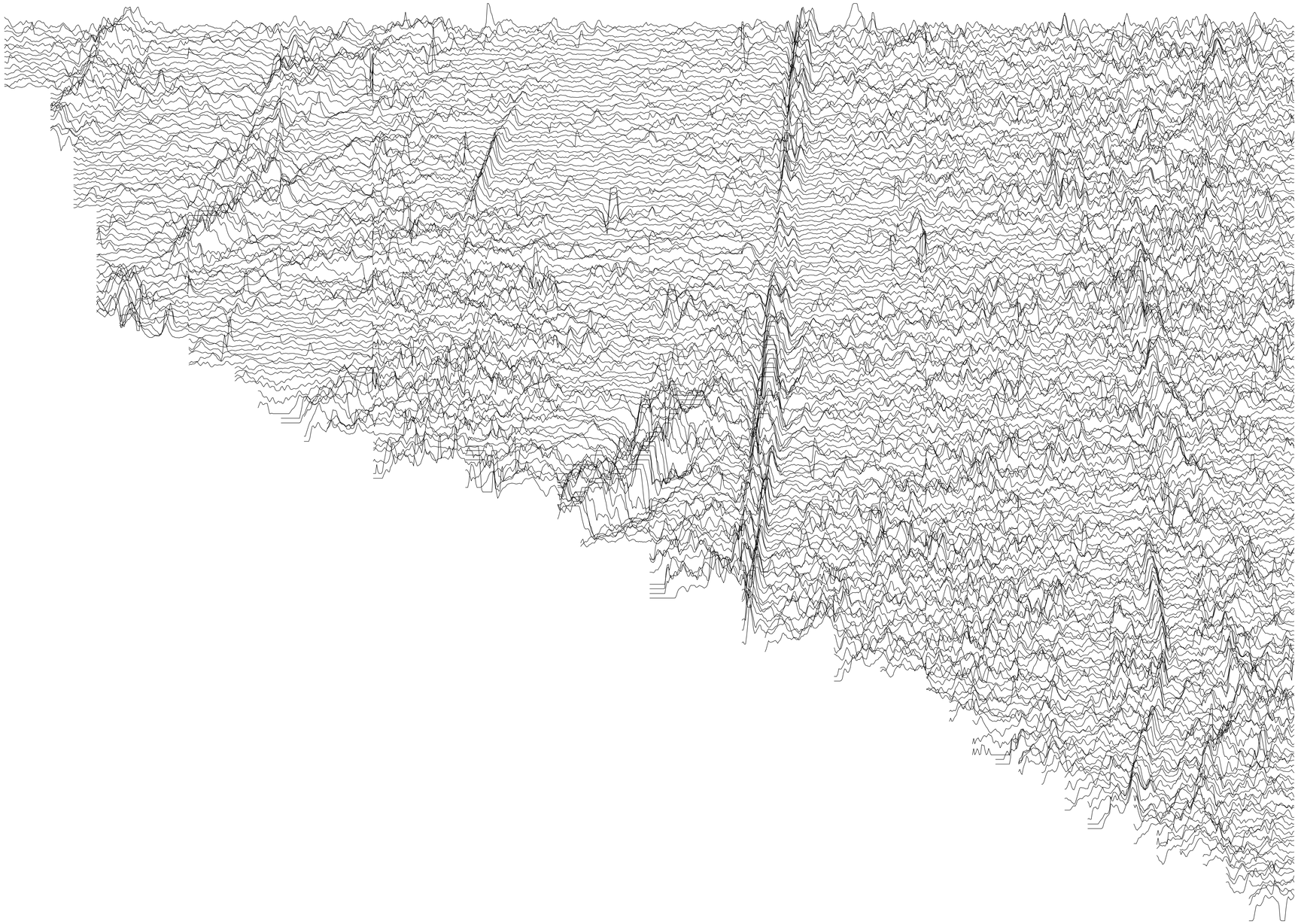
Title:	Magnetic Data - Area A: Greyscale Plot
Drawn by: CES	**Figure A3**



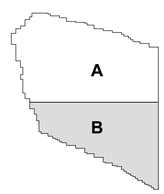
N

0 metres 20

1:500 @ A1

15 nT

Y axis plot scale: 15nT/cm
Clip levels: +/-15nT



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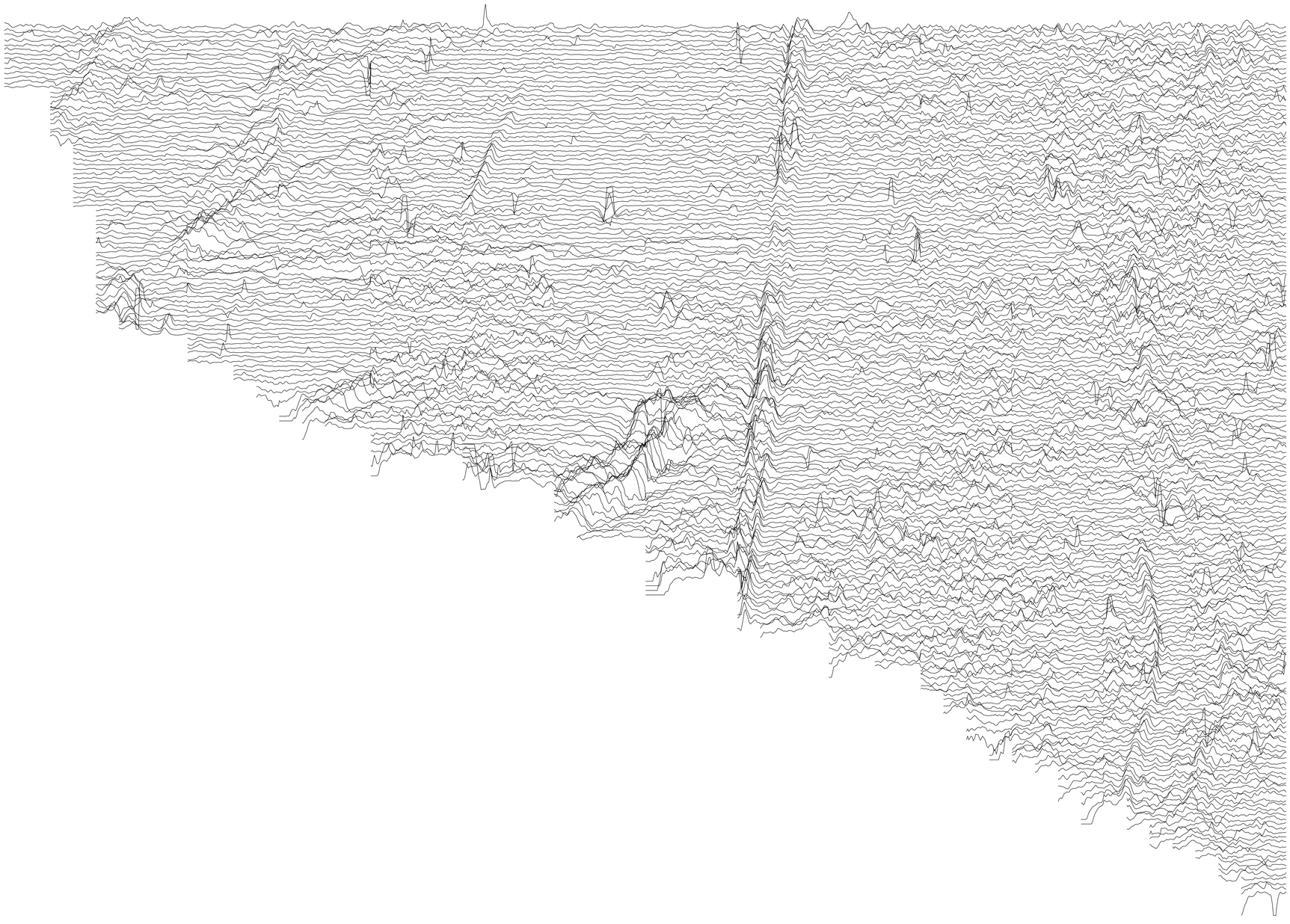
Title: Magnetic Data - Area B: XY Trace Plot

Drawn by: CES

Figure A4



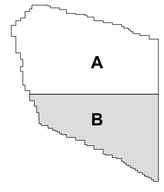
N

0 metres 20

1:500 @ A1

30 nT

Y axis plot scale: 30nT/cm
Clip levels: +/-30nT



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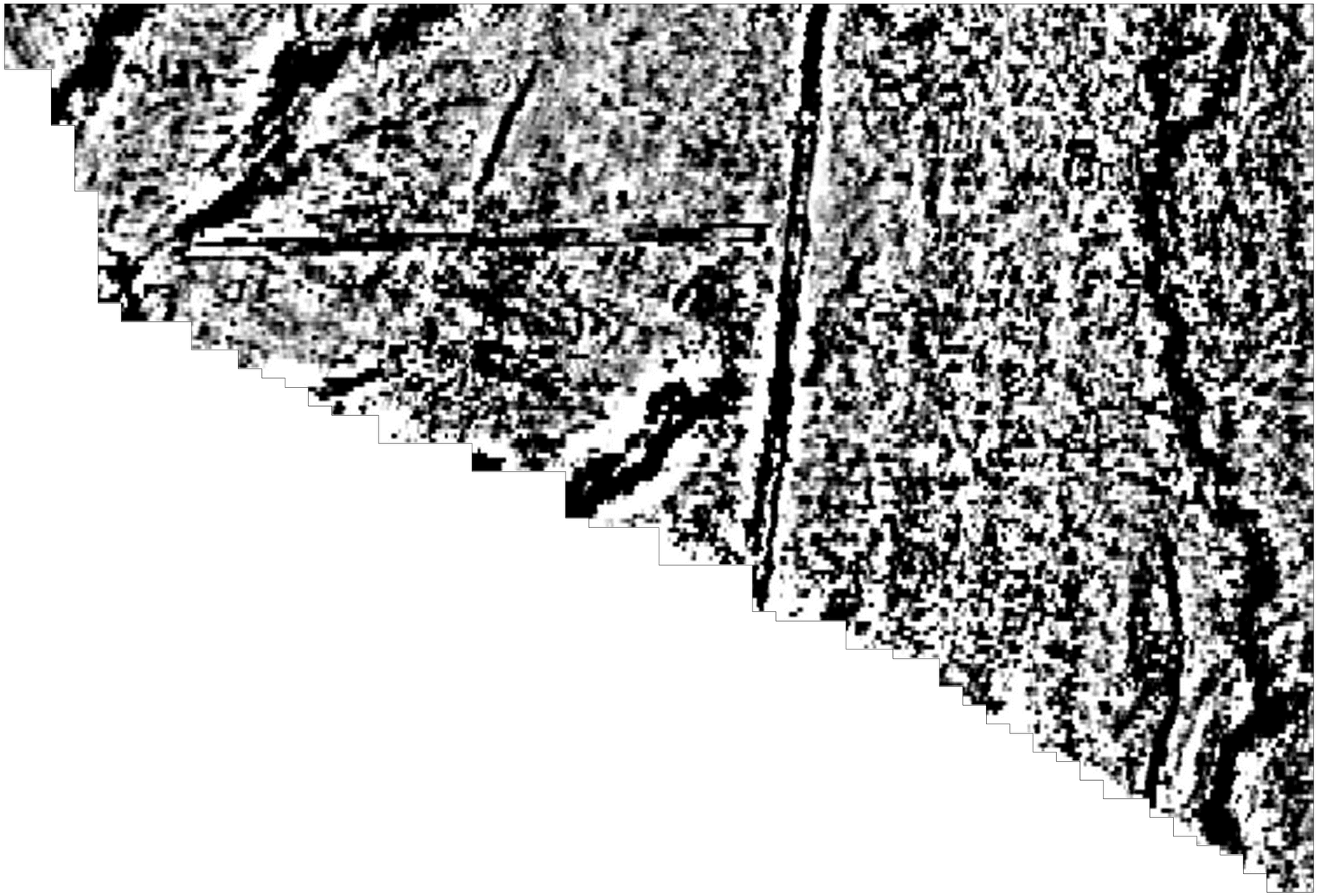
Project: 2012/53 Land at Llanlliwe, Whitland Carmarthenshire

Title: Magnetic Data - Area B: XY Trace Plot

Drawn by: CES

Figure A5

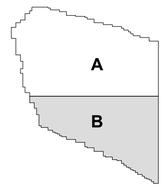


N

0 metres 20

1:500 @ A1

2
nT
-1



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Title: Magnetic Data - Area B: Greyscale Plot

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Figure A6

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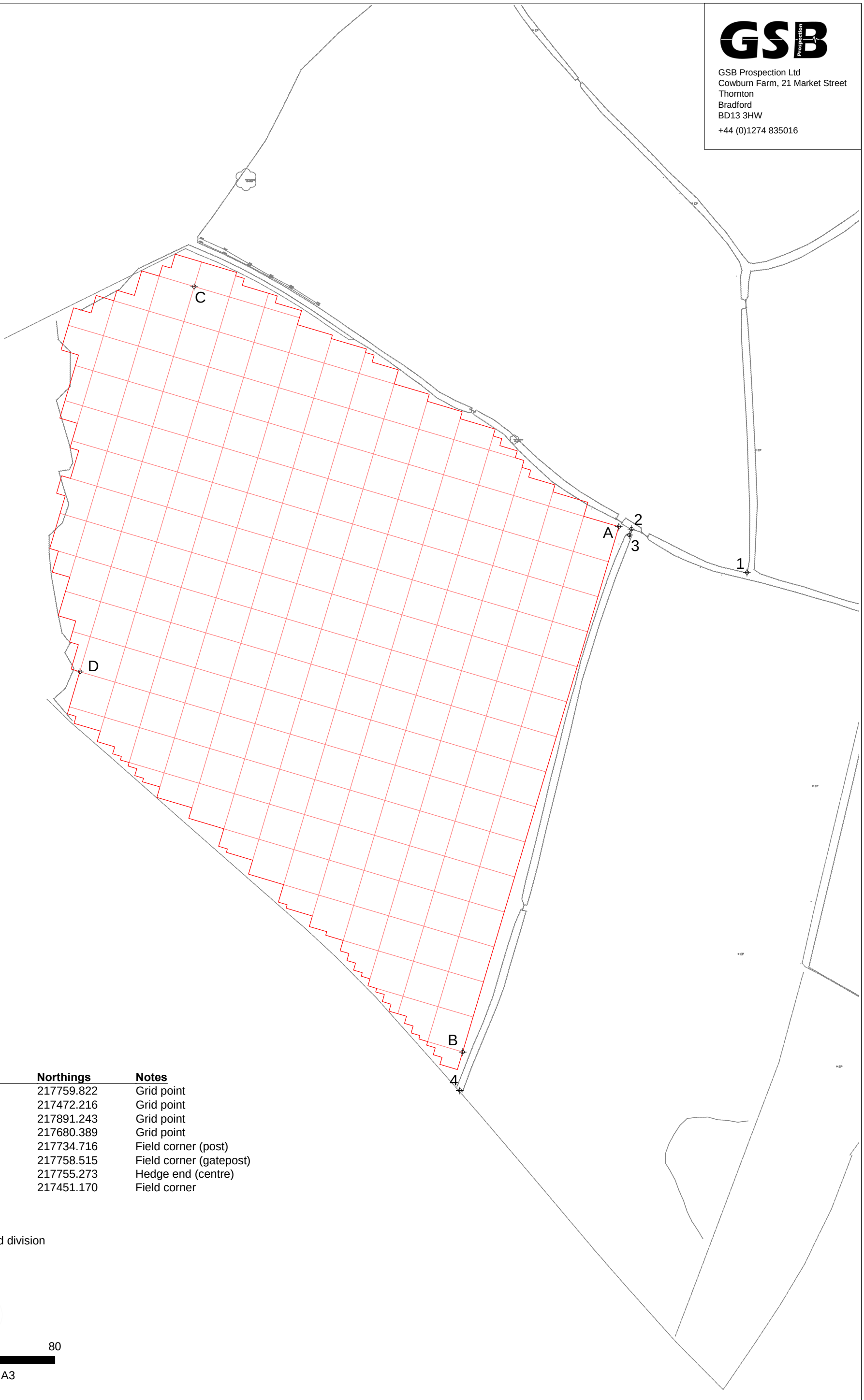

Point	Eastings	Northings	Notes
A	218329.464	217759.822	Grid point
B	218244.079	217472.216	Grid point
C	218097.251	217891.243	Grid point
D	218034.715	217680.389	Grid point
1	218399.556	217734.716	Field corner (post)
2	218336.311	217758.515	Field corner (gatepost)
3	218335.204	217755.273	Hedge end (centre)
4	218242.492	217451.170	Field corner

20m grid division

N

0 metres 80

1:2000 @ A3

Project: 2012/53 Land at Llanlliwe, Whitland, Carmarthenshire	**Title:** Tie-in Diagram	Based on a site survey plan provided by the client. Reproduced with permission.	Drawn by: CES	**Figure T1**

Appendix - Technical Information: Magnetometer Survey

Instrumentation: Geoscan FM36/256 and Bartington *Grad*601-2

Both the Geoscan and Bartington instruments operate in a gradiometer configuration which comprises two fluxgate sensors mounted vertically a set distance apart; on the Geoscan instruments this is 0.5m, on the Bartington, 1m. The fluxgate gradiometer suppresses any diurnal or regional effects. The instruments are carried by hand, with the bottom sensor approximately 0.1-0.3m from the ground surface. At each survey station, the difference in the magnetic field between the two fluxgates is measured in nanoTesla (nT). The sensitivity of the instrument can be adjusted; for most archaeological surveys the most sensitive range (0.1nT) is used. Generally, features up to 1m deep may be detected by this method. Having two gradiometer units mounted laterally with a separation of 1000mm, the Bartington instrument can collect two lines of data per traverse.

Data Processing

Zero Mean Traverse	This process sets the background mean of each traverse within each grid to zero. The operation removes striping effects and edge discontinuities over the whole of the data set.
Step Correction (Destagger)	When gradiometer data are collected in 'zig-zag' fashion, stepping errors can sometimes arise. These occur because of a slight difference in the speed of walking on the forward and reverse traverses. The result is a staggered effect in the data, which is particularly noticeable on linear anomalies. This process corrects these errors.
Interpolation	When geophysical data are presented as a greyscale, each data point is represented as a small square. The resulting plot can sometimes have a 'blocky' appearance. The interpolation process calculates and inserts additional values between existing data points. The process can be carried out with points along a traverse (the x axis) and/or between traverses (the y axis) and results in a smoother greyscale image.

Display

XY Trace Plot	This involves a line representation of the data. Each successive row of data is equally incremented in the Y axis, to produce a stacked profile effect. This display may incorporate a hidden-line removal algorithm, which blocks out lines behind the major peaks and can aid interpretation. The advantages of this type of display are that it allows the full range of the data to be viewed and shows the shape of the individual anomalies. The display may also be changed by altering the horizontal viewing angle and the angle above the plane.
Greyscale/ Colourscale Plot	This format divides a given range of readings into a set number of classes. Each class is represented by a specific shade of grey, the intensity increasing with value. All values above the given range are allocated the same shade (maximum intensity); similarly all values below the given range are represented by the minimum intensity shade. Similar plots can be produced in colour, either using a wide range of colours or by selecting two or three colours to represent positive and negative values. The assigned range (plotting levels) can be adjusted to emphasise different anomalies in the data-set.
3D Surface Plot	This is similar to the XY trace, but in 3 dimensions. Each data point of a survey is represented in its relative position on the x and y axes and the data value is represented in the z axis. This gives a digital terrain, or topographic effect.

Interpretation Categories

In certain circumstances (usually when there is corroborative evidence from desk based or excavation data) very specific interpretations can be assigned to magnetic anomalies (for example, *Roman Road, Wall,* etc.) and where appropriate, such interpretations will be applied. The list below outlines the generic categories commonly used in the interpretation of the results.

Archaeology	This term is used when the form, nature and pattern of the response are clearly or very probably archaeological and /or if corroborative evidence is available These anomalies, whilst considered anthropogenic, could be of any age.
?Archaeology	These anomalies exhibit either weak signal strength and / or poor definition, or form incomplete archaeological patterns, thereby reducing the level of confidence in the interpretation. Although the archaeological interpretation is favoured, they may be the result of variable soil depth, plough damage or even aliasing as a result of data collection orientation.
Increased Magnetic Response	An area where increased fluctuations attest to greater magnetic enhancement of the soils, but no specific patterns can be discerned in the data and no visual indications on the ground surface hint at a cause. They may have some archaeological potential, suggesting damaged archaeological deposits.
Industrial / Burnt-Fired	Strong magnetic anomalies that, due to their shape and form or the context in which they are found, suggest the presence of kilns, ovens, corn dryers, metal-working areas or hearths. It should be noted that in many instances modern ferrous material can produce similar magnetic anomalies.
Old Field Boundary	Anomalies that correspond to former boundaries indicated on historic mapping, or which are clearly a continuation of existing land divisions.
Ridge & Furrow	Parallel linear anomalies whose broad spacing suggests ridge and furrow cultivation. In some cases the response may be the result of more recent agricultural activity.
Ploughing	Parallel linear anomalies or trends with a narrower spacing, sometimes aligned with existing boundaries, indicating more recent cultivation regimes.
Natural	These responses form clear patterns in geographical zones where natural variations are known to produce significant magnetic distortions. Smaller, isolated responses which do not form such obviously 'natural' patterns but which are, nonetheless, likely to be natural in origin may be classified as *?Natural*.
Uncertain Origin	Anomalies which stand out from the background magnetic variation, yet whose form and lack of patterning gives little clue as to their origin. Often the characteristics and distribution of the responses straddle the categories of *? Archaeology* and *?Natural* or (in the case of linear responses) *?Archaeology* and *?Ploughing*; occasionally they are simply of an unusual form.
Magnetic Disturbance	Broad zones of strong dipolar anomalies, commonly found in places where modern ferrous or fired materials (e.g. brick rubble) are present. They are presumed to be modern.
Ferrous	This type of response is associated with ferrous material and may result from small items in the topsoil, larger buried objects such as pipes, or above ground features such as fence lines or pylons. Ferrous responses are usually regarded as modern. Individual burnt stones, fired bricks or igneous rocks can produce responses similar to ferrous material.

Where appropriate some anomalies will be further classified according to their form (positive or negative) and relative strength and coherence (trend: weak and poorly defined).

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forefront of archaeological geophysics

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