

**Land east of Torr Works
Wanstrow
Somerset**

MAGNETOMETER SURVEY REPORT

for

AGRenewables Ltd

David Sabin and Kerry Donaldson

March 2013

Ref. no. 466

ARCHAEOLOGICAL SURVEYS LTD

**Land east of Torr Works
Wanstrow
Somerset**

Magnetometer Survey Report

for

AGRenewables Ltd

Fieldwork by David Sabin

Report by David Sabin BSc (Hons) MIFA and Kerry Donaldson BSc (Hons)

Survey dates – 5th & 6th March 2013

Ordnance Survey Grid Reference – **ST 71222 45186 (T1), ST 71157 44849 (T2),
ST 70908 44556 (T3) and ST 70760 44671 (T4).**

**Somerset HER
PRN 32119**

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SUMMARY

A detailed magnetometer survey was carried out by Archaeological Surveys Ltd at land east of Torr Works, Wanstrow in Somerset. The survey was conducted prior to a planning application for the construction of four wind turbines and associated infrastructure. The survey covered an area of 4.7ha, with a 1ha area centred on each turbine base and partial coverage of cable routes where they were sited away from field boundaries and tracks. The results indicate widespread magnetically variable anomalies associated with differential soil depths over the shallow solid geology within each of the survey areas. Several of the survey areas contain positive linear, rectilinear, curvilinear and discrete responses, which although may appear ditch-like and pit-like in form, cannot be confidently interpreted.

1 INTRODUCTION

1.1 Survey background

- 1.1.1 Archaeological Surveys Ltd was commissioned by AGRenewables Ltd to undertake a magnetometer survey of four areas of land east of Torr Works, within the parish of Wanstrow in Somerset. The areas have been outlined for the proposed development of four wind turbines, cable routes and associated infrastructure. The survey forms part of an archaeological assessment of the site.
- 1.1.2 The geophysical survey was carried out in accordance with a Written Scheme of Investigation (WSI) produced by Archaeological Surveys (2013). The survey and report are listed under Somerset Historic Environment Record (HER) PRN 32119.

1.2 Survey objectives and techniques

- 1.2.1 The objective of the survey was to use magnetometry to locate geophysical anomalies that may be archaeological in origin so that they may be assessed prior to development of the site. The methodology is considered an efficient and effective approach to archaeological prospection.
- 1.2.2 The survey and report generally follow the recommendations set out by: English Heritage (2008) *Geophysical survey in archaeological field evaluation*; and Institute for Archaeologists (2002) *The use of Geophysical Techniques in Archaeological Evaluations*. The work has been carried out to the Institute for Archaeologists (2011) *Standard and Guidance for Archaeological Geophysical Survey*.

1.3 *Site location, description and survey conditions*

- 1.3.1 The survey areas lie to the east of Torr Works and Leighton and north west of Cloford, and are situated within the parish of Wanstrow, Somerset. They are located within agricultural land either side of Steart's Lane, just to the north of the A361 between Frome and Shepton Mallet. The turbines are centred on OS Grid Reference ST 71222 45186 (T1), ST 71157 44849 (T2), ST 70908 44556 (T3) and ST 70760 44671 (T4). The total area covered by the survey is approximately 4.7ha with 1ha around each turbine and also coverage of parts of the cable routes away from field boundaries/tracks, see Figures 01 and 02.
- 1.3.2 Turbine 1 survey area was generally flat and located on soil that had not been cultivated since harvest. Turbines 2 – 4 surveys crossed grass used for grazing and/or cropping for feed. Turbine 2 survey area was generally flat whilst Turbines 3 and 4 sloped down gently towards the south. Parts of Turbine 1 and 4 survey areas were rutted by agricultural vehicles.
- 1.3.3 The ground conditions across the site were generally considered to be favourable for the collection of magnetometry data. Weather conditions during the survey were mainly overcast with light drizzle.

1.4 *Site history and archaeological potential*

- 1.4.1 The Somerset HER lists that there have been several archaeological investigations in the vicinity of the site and that the surrounding area contains a number of archaeological sites and findspots. This includes field systems, tracks, ditches and enclosures recorded by geophysical survey (PRN 57187/22047) and cultural material from the prehistoric, Roman, Medieval and Post-Medieval periods also located through field walking and watching briefs (PRN 14097). Tom Tivey's Hole (PRN 24774) is a natural rock shelter that lies approximately 260m south west of the site and finds include Neolithic pottery, a possible Bronze Age gold band and barbed and tanged arrow head and Roman pottery. Another rock shelter, White Woman's Hole (PRN 24776) is located 150m south west of Tom Tivey's Hole and this contained evidence for 200 counterfeit Constantinian coins, as well as forging materials and Iron Age and Roman pottery. The nearest Scheduled Monument (SO486) is an earthwork north of Stubbs Wood which lies 1.5km to the south west.
- 1.4.2 There is some potential for the geophysical survey to locate archaeological features should they exist within the survey areas. However, it is possible that natural features may also result in linear, rectilinear and discrete anomalies that can be difficult to distinguish from those with an anthropogenic origin. Similar features have been found during the previous geophysical surveys in the vicinity (PRN 57187/22047).

1.5 *Geology and soils*

- 1.5.1 The underlying solid geology across the site is Inferior Oolite with overlying head deposits in the northern part of the site (Turbine 1) (BGS, 2013).

- 1.5.2 The overlying soil across the survey area is from the Elmton 2 association and is a brown rendzinas. It consists of a shallow, well drained, brashy, calcareous, fine, loamy soil over limestone (Soil Survey of England and Wales, 1983).
- 1.5.3 Magnetometry survey carried out across similar soils has produced good results, although shallow soils over limestone and contrasting deeper soils within natural joints and cracks can often be located and these may be difficult to distinguish from anthropogenic features.

2 METHODOLOGY

2.1 *Technical synopsis*

- 2.1.1 Magnetometry survey records localised magnetic fields that can be associated with features formed by human activity. Magnetic susceptibility and magnetic thermoremnance are factors associated with the formation of localised fields. Additional details are set out below and within Appendix A.
- 2.1.2 Iron minerals within the soil may become altered by burning and the break down of biological material; effectively the magnetic susceptibility of the soil is increased, and the iron minerals become magnetic in the presence of the Earth's magnetic field. Accumulations of magnetically enhanced soils within features, such as pits and ditches, may produce magnetic anomalies that can be mapped by magnetic prospection.
- 2.1.3 Magnetic thermoremnance can occur when ferrous minerals have been heated to high temperatures such as in a kiln, hearth, oven etc. On cooling, a permanent magnetisation may be acquired due to the presence of the Earth's magnetic field. Certain natural processes associated with the formation of some igneous and metamorphic rock may also result in magnetic thermoremnance.
- 2.1.4 The localised variations in magnetism are measured as sub-units of the Tesla, which is a SI unit of magnetic flux density. These sub-units are nano Teslas (nT), which are equivalent to 10^{-9} Tesla (T).

2.2 *Equipment configuration, data collection and survey detail*

- 2.2.1 The detailed magnetic survey was carried out using Bartington Grad 601-2 gradiometers. The instruments effectively measure a magnetic gradient between two fluxgate sensors mounted vertically 1m apart. Two sets of sensors are mounted on a single frame 1m apart horizontally.
- 2.2.2 The instruments are extremely sensitive and are able to measure magnetic variation to 0.01nanoTesla (nT), with an effective resolution of 0.03nT. The data are limited to ± 100 nT when surveying with the highest sensitivity. All

readings are saved to an integral data logger for analysis and presentation.

- 2.2.3 The instruments are operated according to the manufacturer's instructions with consideration given to the local conditions. An adjustment procedure is required, prior to collection of data, in order to balance the sensors and remove the effects of the Earth's magnetic field; further adjustment is required during the survey due to instrument drift often associated with temperature change.
- 2.2.4 It can be very difficult to obtain optimum balance for the sensors due to localised magnetic vectors that may be associated with large ferrous objects, geological/pedological features, 'magnetic debris' within the topsoil and natural temperature fluctuations. Imperfect balance results in a heading error often visible as striping within the data; this can be effectively removed by software processing and generally has little effect on the data unless extreme.
- 2.2.5 The Bartington gradiometer undergoes regular servicing and calibration by the manufacturer. A current assessment of the instruments is shown in Table 1 below.

Sensor type and serial numbers	Bartington Grad - 01 – 1000 Nos. 084, 085, 242 and 396
Date of certified calibration/service	Sensors 084 and 085 - 17 th August 2012 (due Aug 2014) Sensors 242 and 396 - 14 th October 2011 (due Oct 2013)
Bandwidth	12Hz (100nT range) both sensors
Noise	<100pT peak to peak
Adjustable errors	<2nT

Table 1: Bartington fluxgate gradiometer sensor calibration results

The instruments were considered to be in good working order prior to the survey, with no known faults or defects.

- 2.2.6 Data were collected at 0.25m centres along traverses 1m apart. The survey area was separated into 40m by 40m grids (1600m²) giving 6400 measurements per grid. This sampling interval is very effective at locating archaeological features and is the recommended methodology for archaeological prospection (English Heritage, 2008).
- 2.2.7 The survey grids were centred on each turbine base, covering a 1ha area, with adjacent grids covering associated infrastructure and cable routes located away from field boundaries and tracks. The grids were set out to the Ordnance Survey OSGB36 datum using a Penmap RTK GPS. The GPS is used in conjunction with Leica's SmartNet service, where positional corrections are sent via a mobile telephone link. Positional accuracy of around 10 – 20mm is possible using the system. The instrument is regularly checked against the ETRS89 reference framework using Ordnance Survey ground marker C1ST7784 (Horton).

2.3 Data processing and presentation

2.3.1 Magnetometry data downloaded from the Grad 601-2 data logger are analysed and processed in specialist software known as ArcheoSurveyor. The software allows greyscale and trace plots to be produced for presentation and display. Survey grids are assembled to form an overall composite of data (composite file) creating a dataset of the complete survey area. Appendix C contains specific information concerning the survey and data attributes and is derived directly from ArcheoSurveyor; this should be used in conjunction with information provided by Figure 02.

2.3.2 Only minimal processing is carried out in order to enhance the results of the survey for display. Raw data are always analysed, as processing can modify anomalies. The following schedule sets out the data and image processing used in this survey:

- clipping of the raw data at $\pm 30\text{nT}$ to improve greyscale resolution,
- clipping of processed data at $\pm 3\text{nT}$ to enhance low magnitude anomalies,
- de-stagger is used to enhance linear anomalies,
- zero median/mean traverse is applied in order to balance readings along each traverse.

Reference should be made to Appendix B for further information on the specific processes carried out on the data. Appendix C metadata includes details on the processing sequence used for each survey area.

2.3.3 An abstraction and interpretation is offered for all geophysical anomalies located by the survey. A brief summary of each anomaly, with an appropriate reference number, is set out in list form within the results (Section 3) to allow a rapid and objective assessment of features within each survey area.

2.3.4 The main form of data display prepared for this report is the greyscale plot. Both 'raw' and 'processed' data have been shown followed by an abstraction and interpretation plot at an overall scale of 1:3000 (A3), with additional processed and abstraction plots for each turbine at a scale of 1:1000 (A3). Anomalies are abstracted using colour coded points, lines and polygons. All plots are scaled to landscape A3 for paper printing.

2.3.5 Graphic raster images in bitmap format (.BMP) are initially prepared in ArcheoSurveyor. Regardless of survey orientation, data captured along each traverse are displayed and processed by ArcheoSurveyor from left to right. Prior to displaying against base mapping, raster graphics require a rotation of 118° anticlockwise for Turbine 1, 57° anticlockwise for Turbine 2, 55° anticlockwise for Turbine 3, and 68° anticlockwise for Turbine 4, to restore north to the top of the image upon insertion into AutoCAD.

2.3.6 The raster images are combined with base mapping using ProgeCAD Professional 2009 and AutoCAD LT 2007, creating DWG file formats. All images are externally referenced to the CAD drawing in order to maintain

good graphical quality. Quality can be compromised by rotation of graphics in order to allow the data to be orientated with respect to grid north; this is considered acceptable as the survey results are effectively georeferenced allowing relocation of features using GPS, resection method etc.

- 2.3.7 A digital archive is produced with this report, see Appendix D below. The main archive is held at the offices of Archaeological Surveys Ltd.

3 RESULTS

3.1 *General assessment of survey results*

- 3.1.1 The detailed magnetic survey was carried out over a total of four survey areas covering approximately 4.7ha.
- 3.1.2 Magnetic anomalies located can be generally classified as positive and negative anomalies of an uncertain origin, linear anomalies of an agricultural origin, anomalies with a natural origin, areas of magnetic debris and strong discrete dipolar anomalies relating to ferrous objects. Anomalies have been numbered and are listed below (3.4).

3.2 *Statement of data quality*

- 3.2.1 Data are considered representative of the magnetic anomalies present within the site. There are no significant defects within the dataset.
- 3.2.2 Strong anomalies caused by the underlying geology are widespread within all of the survey areas. It is unlikely that these have obscured anomalies of archaeological potential and may demonstrate that cut features of anthropogenic origin could potentially create strongly contrasting magnetic anomalies.

3.3 *Data interpretation*

- 3.3.1 The list of sub-headings below attempts to define a number of separate categories that reflect the range and type of features located during the survey. A basic explanation of the characteristics of the magnetic anomalies is set out for each category in order to justify interpretation, a basic key is indicated to allow cross referencing to the abstraction and interpretation plot. CAD layer names are included to aid reference to associated digital files (.dwg/.dxf). Sub-headings are then used to group anomalies with similar characteristics for each survey area.





Report sub-heading CAD layer names and plot colour	Description and origin of anomalies
<p>Anomalies with an uncertain origin</p> <p>AS-ABST MAG POS LINEAR UNCERTAIN AS-ABST MAG NEG LINEAR UNCERTAIN AS-ABST MAG POS DISCRETE UNCERTAIN</p> 	<p>The category applies to a range of anomalies where <u>there is not enough evidence to confidently suggest an origin</u>. Anomalies in this category <u>may well be related to archaeologically significant features, but equally relatively modern features, geological/pedological features and agricultural features should be considered</u>. Positive anomalies are indicative of magnetically enhanced soils that may form the fill of 'cut' features or may be produced by accumulation within layers or 'earthwork' features; soils subject to burning may also produce positive anomalies. Negative anomalies are produced by material of comparatively low magnetic susceptibility such as stone and subsoil.</p>
<p>Anomalies with an agricultural origin</p> <p>AS-ABST MAG AGRICULTURAL</p> 	<p>The anomalies are often linear and form a series of parallel responses or are parallel to extant land boundaries. Where the response is broad, former ridge and furrow is likely; narrow response is often related to modern ploughing.</p>
<p>Anomalies associated with magnetic debris</p> <p>AS-ABST MAG DEBRIS AS-ABST MAG STRONG DIPOLAR</p> 	<p>Magnetic debris often appears as areas containing many small dipolar anomalies that may range from weak to very strong in magnitude. It often occurs where there has been dumping or ground make-up and is related to magnetically thermoremanent materials such as brick or tile or other small fragments of ferrous material. This type of response is occasionally associated with kilns, furnace structures, or hearths and <u>may therefore be archaeologically significant</u>. It is also possible that the response may be caused by natural material such as certain gravels and fragments of igneous or metamorphic rock. Strong discrete dipolar anomalies are responses to ferrous objects within the topsoil.</p>
<p>Anomalies with a natural origin</p> <p>AS-ABST MAG NATURAL FEATURES</p> 	<p>Naturally formed magnetic anomalies are caused by localised variability in the magnetic susceptibility of soils, subsoils and other drift or solid geologies. Anomalies may be amorphous, linear or curvilinear and may appear 'fluvial' or discrete; the latter are <u>almost impossible to distinguished from pit-like anomalies with an anthropogenic origin</u>. Fluvial, glacial and periglacial processes may be responsible for their formation within drift material and subsoil. Igneous and metamorphic activity can lead to anomalies within more solid geology.</p>

Table 2: List and description of interpretation categories

3.4 List of anomalies – Turbine 1

Turbine centred on OS NGR 371222 145186, see Figure 06.

Anomalies with an uncertain origin

(1) – Positive linear anomalies appear to form a rectilinear feature. It is possible that this relates to a cut feature with archaeological potential; however, it is not possible to rule out a natural origin for the anomaly.

(2) – A positive linear anomaly extends across the central part of the survey area with a north north west to south south east orientation. It is possible that this relates to a ditch-like feature; however, a natural origin should be considered.

(3) – A number of positive and negative linear anomalies are oriented west south west to east north east. It is not possible to determine if these have an anthropogenic or natural origin.

(4) – The survey area contains a number of short curvilinear and linear anomalies. Although it is possible that these relate to ditch-like features, a natural origin cannot be ruled out.

(5) – Discrete positive anomalies appear to relate to pit-like features. It is not possible to determine if these are anthropogenic or natural in origin.

Anomalies with a natural origin

(6) – Patches of magnetically variable response are evident primarily in the north eastern corner of the survey area.

Anomalies associated with magnetic debris

(7) – Strong discrete dipolar anomalies are likely to indicate ferrous objects within the topsoil. All the survey areas contain these anomalies to varying degrees.

3.5 List of anomalies – Turbine 2

Turbine centred on OS NGR 371157 144849, see Figure 07.

Anomalies with a natural origin

(8) – The survey area contains widespread magnetically variable anomalies which are responses to differential soil depth across the underlying bedrock.

Anomalies with an agricultural origin

(9) – A series of parallel linear anomalies indicates the plough trend across the site.

3.6 List of anomalies – Turbine 3

Turbine centred on OS NGR 370908 144556, see Figure 08.

Anomalies with an uncertain origin

(10) – Positive linear, curvilinear and discrete anomalies are evident within the north western and southern parts of the survey area. It is possible that these relate to

ditch-like and pit-like features; however, a natural origin should also be considered.

Anomalies with a natural origin

(11) – Extending across the central part of the survey area and oriented south west to north east, is a band of magnetically variable response which is likely to relate to naturally formed features.

Anomalies with an agricultural origin

(12) – Parallel linear anomalies extend across the survey area and appear to relate to agricultural activity.

3.7 List of anomalies – Turbine 4

Turbine centred on OS NGR 370760 144671, see Figure 09.

Anomalies with an uncertain origin

(13) – Two parallel linear anomalies extend across the survey area with a north north east to south south west orientation. These anomalies may relate to ditch-like features, although a natural or agricultural origin is also possible.

Anomalies with a natural origin

(14) – The majority of the survey area contains magnetically variable responses that relate to naturally formed features within the underlying bedrock.

Anomalies associated with magnetic debris

(15) – Magnetic debris can be seen across most of the survey area, with a slightly denser cluster in the south western corner of the site. It is likely to relate to ferrous and other magnetically thermoremanent material that has been spread across the site.

4 CONCLUSION

4.1.1 The detailed magnetometer survey located widespread naturally formed anomalies within each of the survey areas. The survey area surrounding Turbine 1 contained a number of positive linear, rectilinear, curvilinear and discrete responses that may relate to ditch-like and pit-like features. The morphology of these anomalies is unclear and several appear to extend beyond the limit of the surveyed area. Given the widespread evidence for

naturally formed anomalies any interpretation is tentative, and it cannot be confidently stated as to whether they are anthropogenic or natural in origin.

- 4.1.2 Several positive anomalies were also located within areas surrounding Turbines 3 and 4, but these were also classified as uncertain in origin due to their uncharacteristic and poorly defined morphology.

5 REFERENCES

Archaeological Surveys, 2013. *Land east of Torr Works, Wanstrow, Somerset, Geophysical Survey Written Scheme of Investigation*. Unpublished typescript document.

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Appendix A – basic principles of magnetic survey

Iron minerals are always present to some degree within the topsoil and enhancement associated with human activity is related to increases in the level of magnetic susceptibility and thermoremanent material.

Magnetic susceptibility is an induced magnetism within a material when it is in the presence of a magnetic field. This can be thought of as effectively permanent due to the presence of the Earth's magnetic field.

Thermoremanent magnetism occurs when ferrous material is heated beyond a specific temperature known as the Curie Point. Demagnetisation occurs at this temperature with re-magnetisation by the Earth's magnetic field upon cooling.

Enhancement of magnetic susceptibility can occur in areas subject to burning and complex fermentation processes on biological material; these are frequently associated with human settlement. Thermoremanent features include ovens, hearths, and kilns. In addition thermoremanent material such as tile and brick may also be associated with human activity and settlement.

Silting and deliberate infilling of ditches and pits with magnetically enhanced soil can create an area of enhancement compared with surrounding soils and subsoils into which the feature is cut. Mapping enhanced areas will produce linear and discrete anomalies allowing an assessment and characterisation of hidden subsurface features.

It should be noted that areas of negative enhancement can be produced from material having lower magnetic properties compared to the topsoil. This is common for many sedimentary bedrocks and subsoils which were often used in the construction of banks and walls etc. Mapping these 'negative' anomalies may also reveal archaeological features.

Magnetic survey or magnetometry can be carried out using a fluxgate gradiometer and may be referred to as gradiometry. The gradiometer is a passive instrument consisting of two fluxgate sensors mounted vertically 1m apart. The instrument is carried about 30cm above the ground surface and the upper sensor measures the Earth's magnetic field as does the lower sensor but this is influenced to a greater degree by any localised buried field. The difference between the two sensors will relate to the strength the magnetic field created by the buried feature. If no enhanced feature is present the field measured by both sensors will be similar and the difference close to zero.

There are a number of factors that may affect the magnetic survey and these include soil type, local geology and previous human activity. Situations arise where magnetic disturbance associated with modern services, metal fencing, dumped waste material etc., obscures low magnitude fields associated with archaeological features.

Appendix B – data processing notes

Clipping

Minimum and maximum values are set and replace data outside of the range with those values. Extreme values are removed improving colour or greyscale contrast associated with data values that may be archaeologically significant. It has been found that clipping data to ranges between $\pm 5\text{nT}$ and $\pm 1\text{nT}$ often improves the appearance of features associated with archaeology. Different ranges are applied to data in order to determine the most suitable for anomaly abstraction and display.

Zero Median/Mean Traverse

The median (or mean) of each traverse is calculated ignoring data outside a threshold value, the median (or mean) is then subtracted from the traverse. The process is used to equalise slight differences between the set-up and stability of gradiometer sensors and can remove striping. The process can remove archaeological features that run along a traverse so data analysis is also carried out prior its application.

De-stagger

Compensates for small positional errors within data collection by shifting the position of the readings along each traverse by a specified amount. Data lost at the end of each traverse are extrapolated from adjacent value in the same row.

Deslope

Corrects for striping and distortion caused by metal objects/services etc.. The process calculates a curve based on a polynomial best fit mathematical function for each traverse. This curve is then subtracted from the actual data.

Edge Match

Calculates the mean of the 2 lines (rows or columns) of data either side of the edge to match. It then subtracts the difference between the means from all datapoints in the selected area.

FFT (Fast Fourier Transform) spectral filtering

A mathematical process used to determine the frequency components of a traverse. Repetitive features, such as plough marks, produce characteristic spectral zones that can be suppressed allowing greyscale images to appear clearer.

Appendix C – survey and data information

Turbine 1 raw magnetometer data

COMPOSITE
 Filename: J466-mag-t1-raw.xcp
 Instrument Type: Bartington (Gradiometer)
 Units: nT
 Surveyed by: on 07/03/2013
 Assembled by: on 07/03/2013
 Direction of 1st Traverse: 45 deg
 Collection Method: ZigZag
 Sensors: 2 @ 1.00 m spacing.
 Dummy Value: 32702

Dimensions
 Composite Size (readings): 640 x 120
 Survey Size (meters): 160 m x 120 m
 Grid Size: 40 m x 40 m
 X Interval: 0.25 m
 Y Interval: 1 m

Stats
 Max: 30.00
 Min: -30.00
 Std Dev: 2.03
 Mean: 0.67
 Median: 0.44
 Composite Area: 1.92 ha
 Surveyed Area: 1.1612 ha

PROGRAM
 Name: ArcheoSurveyor
 Version: 2.5.19.3

Processes: 2
 1 Base Layer
 2 Clip from -30.00 to 30.00 nT

Source Grids: 10
 1 Col:0 Row:1 grids\01.xgd
 2 Col:1 Row:0 grids\02.xgd
 3 Col:1 Row:1 grids\03.xgd
 4 Col:1 Row:2 grids\04.xgd
 5 Col:2 Row:0 grids\05.xgd
 6 Col:2 Row:1 grids\06.xgd
 7 Col:2 Row:2 grids\07.xgd
 8 Col:3 Row:0 grids\08.xgd
 9 Col:3 Row:1 grids\09.xgd
 10 Col:3 Row:2 grids\10.xgd

Turbine 1 processed magnetometer data

COMPOSITE
 Filename: J466-mag-t1-proc.xcp

Stats
 Max: 3.35
 Min: -3.58
 Std Dev: 1.05
 Mean: 0.05
 Median: 0.00
 Composite Area: 1.92 ha
 Surveyed Area: 1.16 ha

Processes: 5
 1 Base Layer
 2 Clip from -30.00 to 30.00 nT
 3 DeStripe Median Traverse: Grids: All
 4 Clip from -3.00 to 3.00 nT
 5 De Stagger: Grids: All Mode: Both By: -1 intervals

Turbine 2 raw magnetometer data

COMPOSITE
 Filename: J466-mag-t2-raw.xcp
 Instrument Type: Bartington (Gradiometer)
 Units: nT
 Surveyed by: on 07/03/2013
 Assembled by: on 07/03/2013
 Direction of 1st Traverse: 45 deg
 Collection Method: ZigZag
 Sensors: 2 @ 1.00 m spacing.
 Dummy Value: 32702

Dimensions
 Composite Size (readings): 640 x 120
 Survey Size (meters): 160 m x 120 m
 Grid Size: 40 m x 40 m
 X Interval: 0.25 m
 Y Interval: 1 m

Stats
 Max: 30.00
 Min: -30.00

Std Dev: 1.94
 Mean: 0.67
 Median: 0.55
 Composite Area: 1.92 ha
 Surveyed Area: 1.1613 ha

Processes: 3
 1 Base Layer
 2 Move (Area: Top 0, Left 480, Bottom 101, Right 615) to X 0, Y 20
 3 Clip from -30.00 to 30.00 nT

Source Grids: 10
 1 Col:0 Row:1 grids\01.xgd
 2 Col:1 Row:0 grids\02.xgd
 3 Col:1 Row:1 grids\03.xgd
 4 Col:1 Row:2 grids\04.xgd
 5 Col:2 Row:0 grids\05.xgd
 6 Col:2 Row:1 grids\06.xgd
 7 Col:2 Row:2 grids\07.xgd
 8 Col:3 Row:0 grids\08.xgd
 9 Col:3 Row:1 grids\09.xgd
 10 Col:3 Row:2 grids\10.xgd

Turbine 2 processed magnetometer data

COMPOSITE
 Filename: J466-mag-t2-proc.xcp

Stats
 Max: 3.00
 Min: -3.00
 Std Dev: 1.39
 Mean: 0.09
 Median: 0.00
 Composite Area: 1.92 ha
 Surveyed Area: 1.1613 ha

Processes: 5
 1 Base Layer
 2 Move (Area: Top 0, Left 480, Bottom 101, Right 615) to X 0, Y 20
 3 Clip from -30.00 to 30.00 nT
 4 DeStripe Median Traverse: Grids: All
 5 Clip from -3.00 to 3.00 nT

Turbine 3 raw magnetometer data

COMPOSITE
 Filename: J466-mag-t3-raw.xcp
 Instrument Type: Bartington (Gradiometer)
 Units: nT
 Surveyed by: on 06/03/2013
 Assembled by: on 06/03/2013
 Direction of 1st Traverse: 45 deg
 Collection Method: ZigZag
 Sensors: 2 @ 1.00 m spacing.
 Dummy Value: 32702

Dimensions
 Composite Size (readings): 640 x 120
 Survey Size (meters): 160 m x 120 m
 Grid Size: 40 m x 40 m
 X Interval: 0.25 m
 Y Interval: 1 m

Stats
 Max: 30.00
 Min: -30.00
 Std Dev: 2.01
 Mean: 0.79
 Median: 0.71
 Composite Area: 1.92 ha
 Surveyed Area: 1.2414 ha

Processes: 2
 1 Base Layer
 2 Clip from -30.00 to 30.00 nT

Source Grids: 11
 1 Col:0 Row:0 grids\01.xgd
 2 Col:0 Row:1 grids\02.xgd
 3 Col:1 Row:0 grids\03.xgd
 4 Col:1 Row:1 grids\04.xgd
 5 Col:1 Row:2 grids\05.xgd
 6 Col:2 Row:0 grids\06.xgd
 7 Col:2 Row:1 grids\07.xgd
 8 Col:2 Row:2 grids\08.xgd
 9 Col:3 Row:0 grids\09.xgd
 10 Col:3 Row:1 grids\10.xgd
 11 Col:3 Row:2 grids\11.xgd

Turbine 3 processed magnetometer data

COMPOSITE

Filename: J466-mag-t3-proc.xcp

Stats

Max: 3.00
 Min: -3.00
 Std Dev: 1.10
 Mean: 0.07
 Median: 0.00
 Composite Area: 1.92 ha
 Surveyed Area: 1.2414 ha

Processes: 4

- 1 Base Layer
- 2 Clip from -30.00 to 30.00 nT
- 3 DeStripe Median Traverse: Grids: All
- 4 Clip from -3.00 to 3.00 nT

Min: -30.00

Std Dev: 3.86

Mean: 0.22

Median: -0.13

Composite Area: 1.44 ha

Surveyed Area: 1.0807 ha

Processes: 2

- 1 Base Layer
- 2 Clip from -30.00 to 30.00 nT

Source Grids: 9

- 1 Col:0 Row:0 grids\01.xgd
- 2 Col:0 Row:1 grids\02.xgd
- 3 Col:0 Row:2 grids\03.xgd
- 4 Col:1 Row:0 grids\04.xgd
- 5 Col:1 Row:1 grids\05.xgd
- 6 Col:1 Row:2 grids\06.xgd
- 7 Col:2 Row:0 grids\07.xgd
- 8 Col:2 Row:1 grids\08.xgd
- 9 Col:2 Row:2 grids\09.xgd

Turbine 4 raw magnetometer data

COMPOSITE

Filename: J466-mag-t4-raw.xcp

Instrument Type: Bartington (Gradiometer)

Units: nT

Surveyed by: on 06/03/2013

Assembled by: on 06/03/2013

Direction of 1st Traverse: 45 deg

Collection Method: ZigZag

Sensors: 2 @ 1.00 m spacing.

Dummy Value: 32702

Dimensions

Composite Size (readings): 480 x 120

Survey Size (meters): 120 m x 120 m

Grid Size: 40 m x 40 m

X Interval: 0.25 m

Y Interval: 1 m

Stats

Max: 30.00

Turbine 4 processed magnetometer data

COMPOSITE

Filename: J466-mag-t4-proc.xcp

Stats

Max: 3.00

Min: -3.00

Std Dev: 1.62

Mean: 0.08

Median: 0.00

Composite Area: 1.44 ha

Surveyed Area: 1.0807 ha

Processes: 4

- 1 Base Layer
- 2 Clip from -30.00 to 30.00 nT
- 3 DeStripe Median Traverse: Grids: All
- 4 Clip from -3.00 to 3.00 nT

Appendix D – digital archive

Archaeological Surveys Ltd hold the primary digital archive at their offices in Wiltshire (see inside cover for address). Data are backed-up onto an on-site data storage drive and at the earliest opportunity data are copied to CD ROM for storage on-site and off-site.

Surveys are reported on in hardcopy (recycled paper) using A4 for text and A3 for plots (all plots are scaled for A3). A copy of the report will be sent to the Somerset HER and uploaded to Oasis.

This report has been prepared using the following software on a Windows XP platform:

- ArcheoSurveyor version 2.5.19.3 (geophysical data analysis),
- ProgeCAD Professional 2009 (report graphics),
- AutoCAD LT 2007 (report figures),
- OpenOffice.org 3.0.1 Writer (document text),
- PDF Creator version 0.9 (PDF archive).

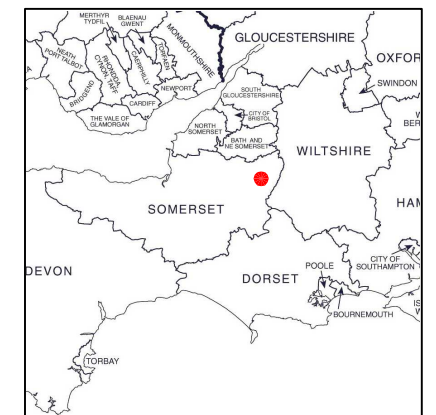
Digital data produced by the survey and report include the following files:

- ArcheoSurveyor grid and composite files for all geophysical data,
- CSV files for raw and processed composites,
- geophysical composite file graphics as Bitmap images,
- AutoCAD DWG files in 2000 and 2007 versions,
- report text as OpenOffice.org ODT file,
- report text as Word 2000 doc file,
- report text as rich text format (RTF),
- report text as PDF,
- PDFs of all figures.

Geophysical Survey Land east of Torr Works Wanstrow Somerset

Map of survey area

Reproduced from OS Explorer map no.142 1:25 000
by permission of Ordnance Survey on behalf of The
Controller of Her Majesty's Stationery Office.
© Crown copyright. All rights reserved.
Licence number 100043739.



● Survey location

Site centred on OS NGR
ST 710 448

SCALE 1:25 000



SCALE TRUE AT A3



Survey locations

**Geophysical Survey
Land east of Torr Works
Wanstrow
Somerset**

Survey location

Grid coordinates based on Ordnance Survey
OSGB36 datum

Grids set out using RTK GPS with Leica
SmartNet correction data RTCMv2 format
OSTN02 transformation

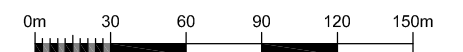
Survey grid size = 40m

→ Survey start and traverse direction

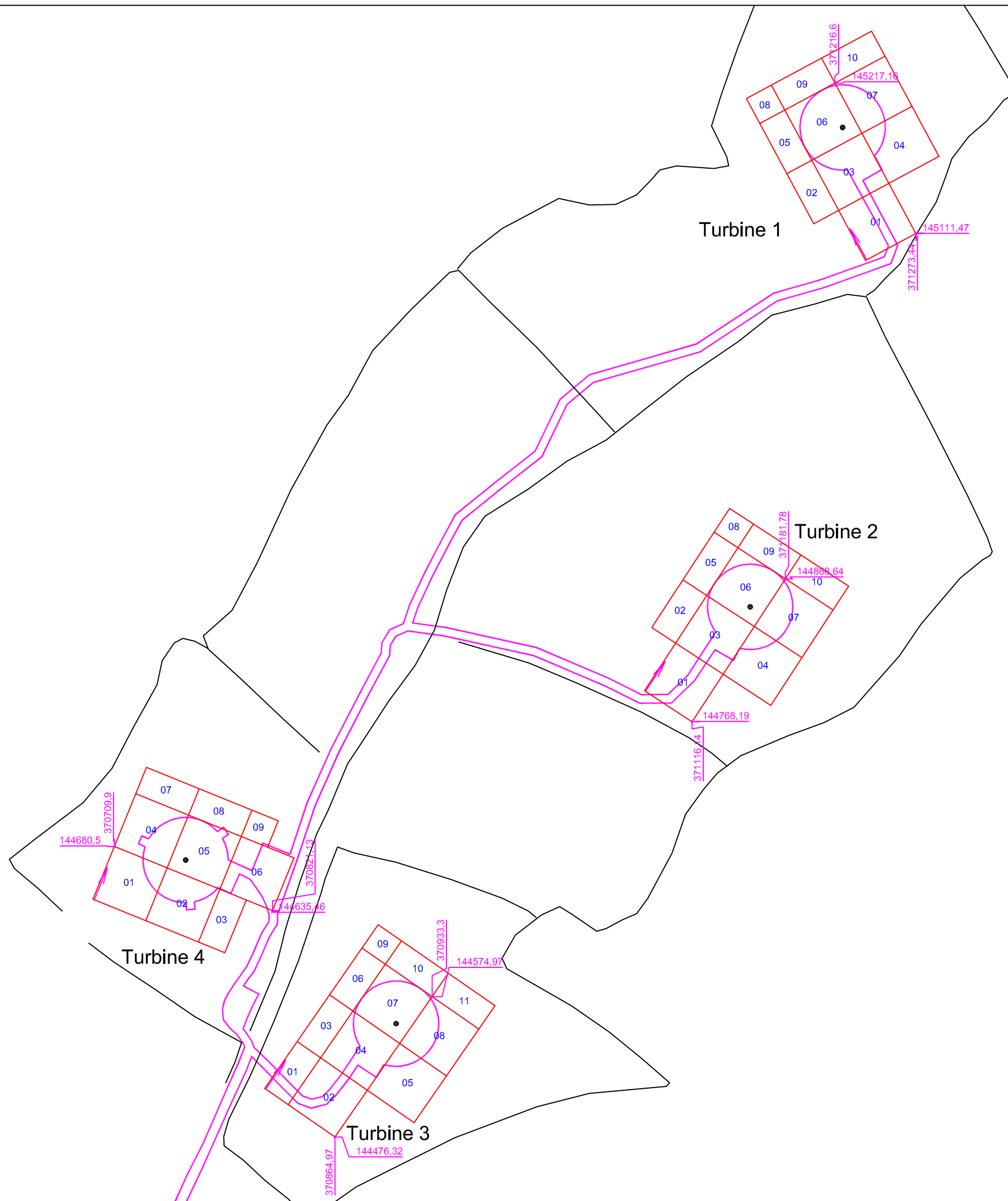
01 Grid reference number and filename

- Turbine 1 - 371222 145186
- Turbine 2 - 371157 144849
- Turbine 3 - 370908 144556
- Turbine 4 - 370760 144671

SCALE 1:3000

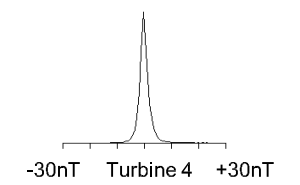
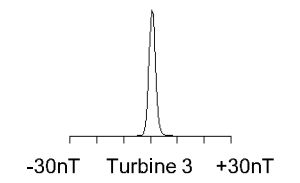
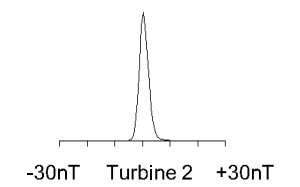
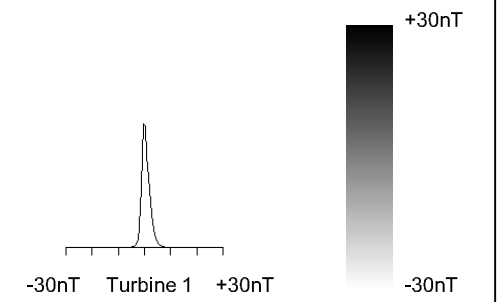


SCALE TRUE AT A3

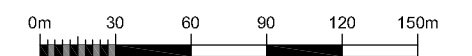


**Geophysical Survey
Land east of Torr Works
Wanstrow
Somerset**

**Greyscale plot of raw
magnetometer data**

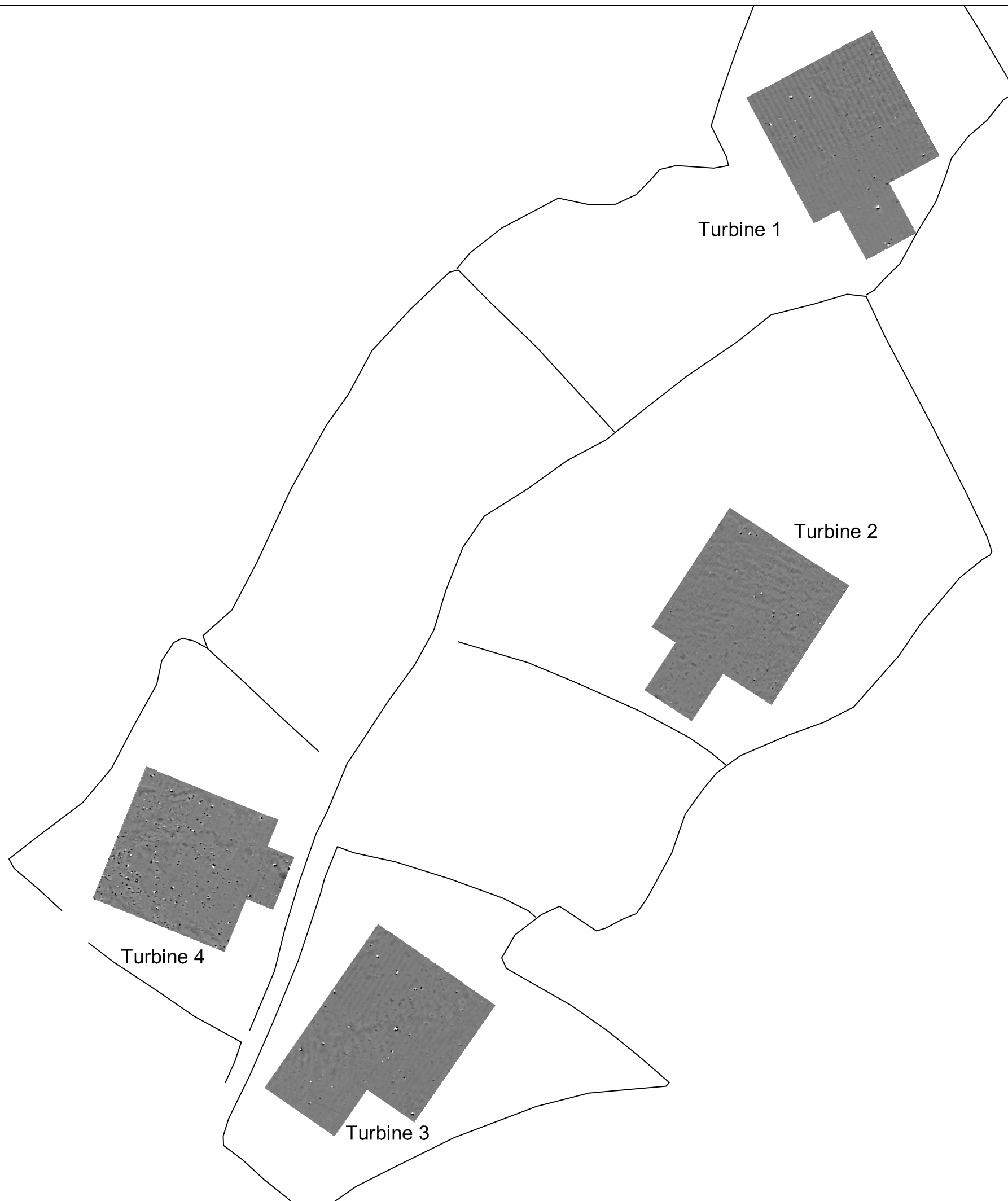


SCALE 1:3000



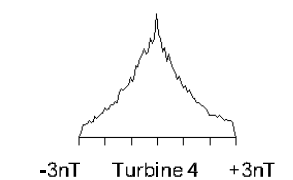
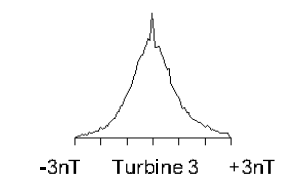
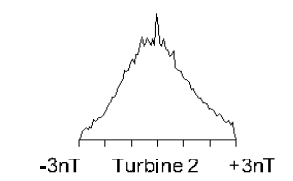
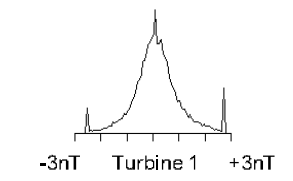
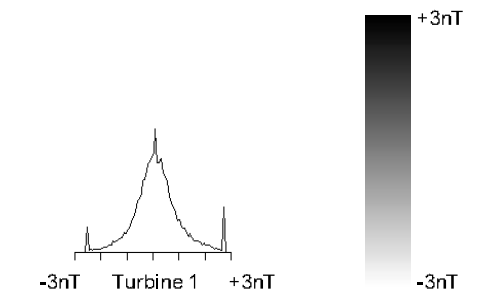
SCALE TRUE AT A3

FIG 03

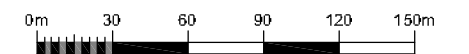


**Geophysical Survey
Land east of Torr Works
Wanstrow
Somerset**

**Greyscale plot of processed
magnetometer data**



SCALE 1:3000










SCALE TRUE AT 0

FIG 04

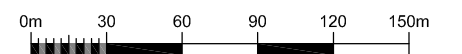


**Geophysical Survey
Land east of Torr Works
Wanstrow
Somerset**

**Abstraction and interpretation of
magnetometer anomalies**

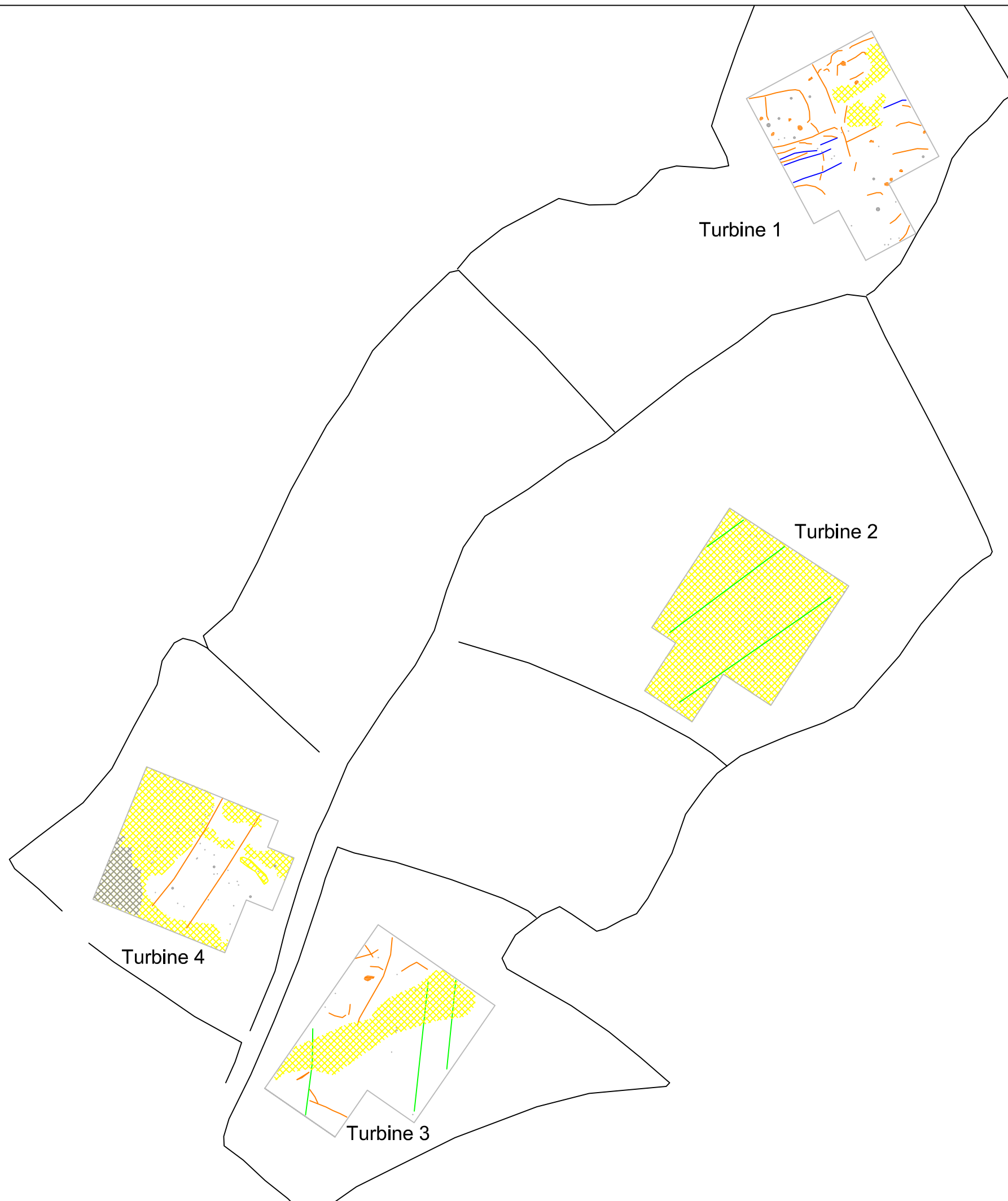
-  Positive linear anomaly - possible ditch-like feature
-  Linear anomaly - of agricultural origin (trend only)
-  Negative linear anomaly - material of low magnetic susceptibility
-  Discrete positive response - possible pit-like feature
-  Variable magnetic response - of natural origin
-  Magnetic debris - spread of magnetically thermoremanent/ferrous material
-  Strong dipolar anomaly - ferrous object

SCALE 1:3000








SCALE TRUE AT A3

FIG 05

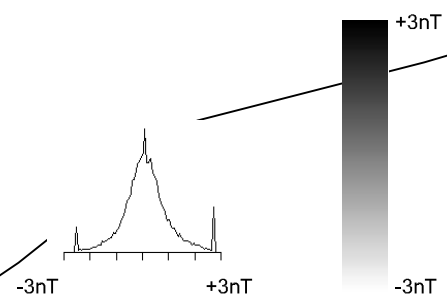
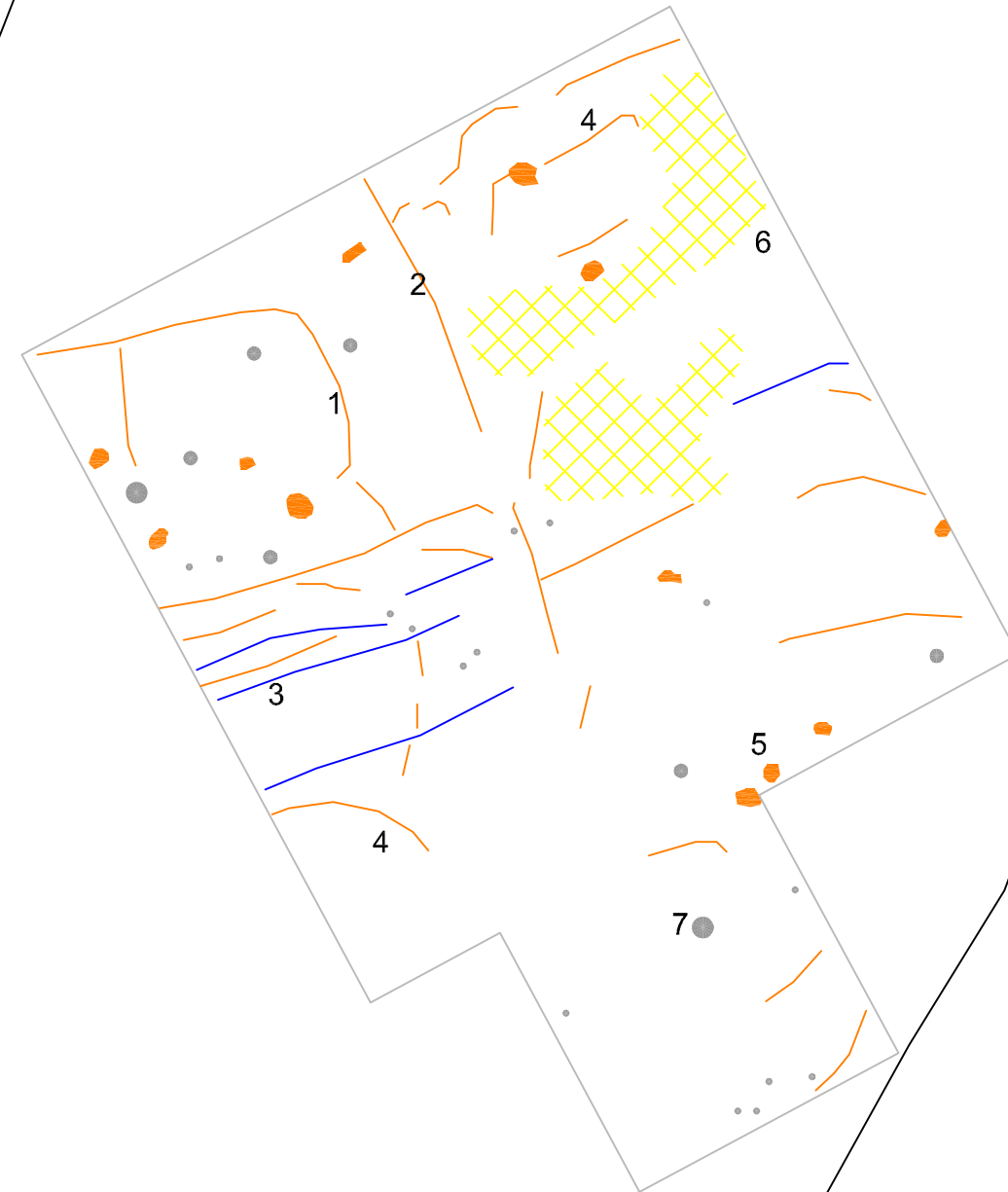
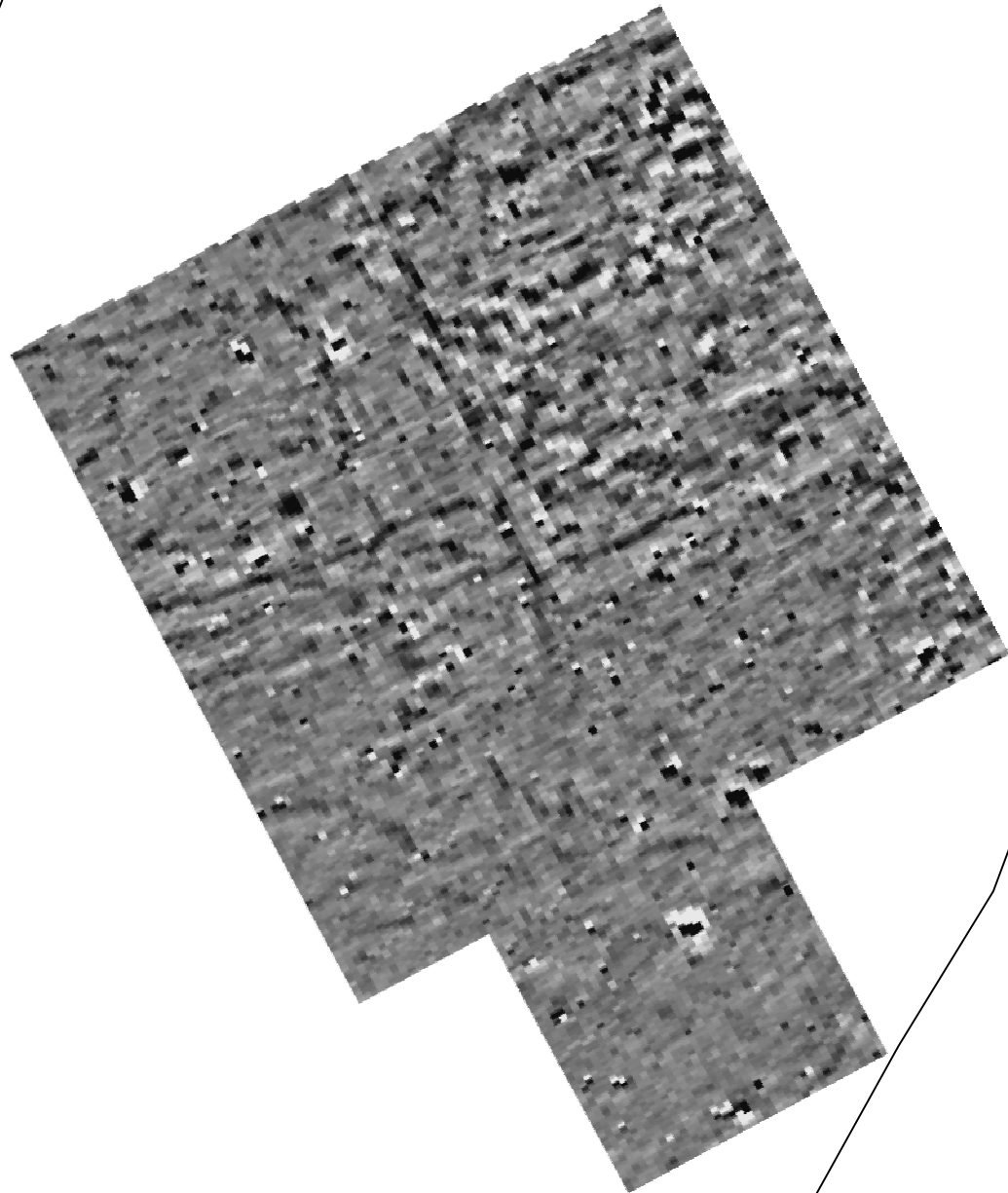


**Geophysical Survey
Land east of Torr Works
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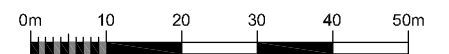
**Abstraction and interpretation of
magnetometer anomalies -
Turbine 1**

-  Positive linear anomaly - possible ditch-like feature
-  Negative linear anomaly - material of low magnetic susceptibility
-  Discrete positive response - possible pit-like feature
-  Variable magnetic response - of natural origin
-  Strong dipolar anomaly - ferrous object

**Greyscale plot of processed
magnetometer data - Turbine 1**






SCALE 1:1000



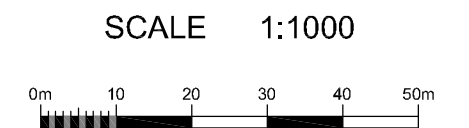
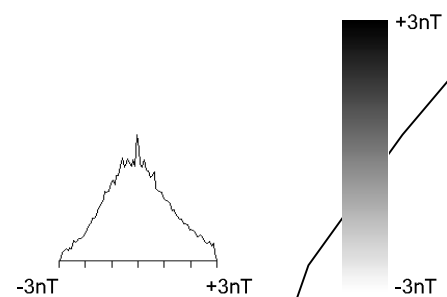
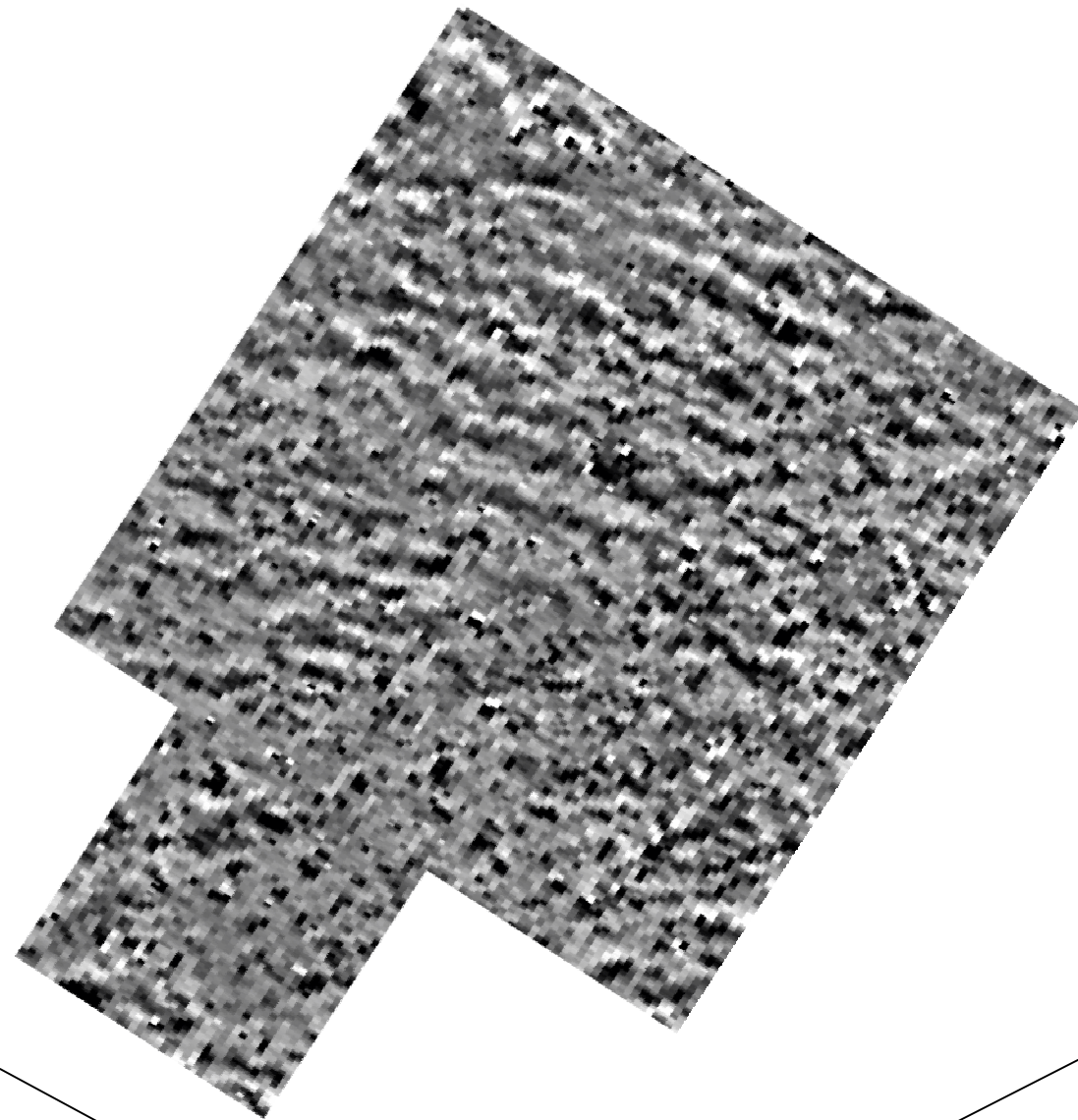
SCALE TRUE AT A3

**Geophysical Survey
Land east of Torr Works
Wanstrow
Somerset**

**Abstraction and interpretation of
magnetometer anomalies -
Turbine 2**

-  Linear anomaly - of agricultural origin (trend only)
-  Variable magnetic response - of natural origin
-  Strong dipolar anomaly - ferrous object






**Greyscale plot of processed
magnetometer data - Turbine 2**



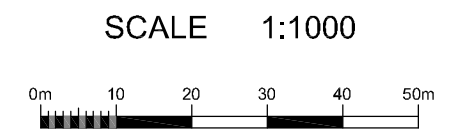
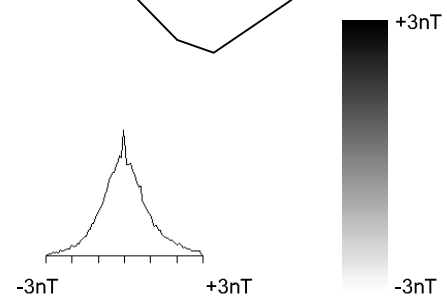
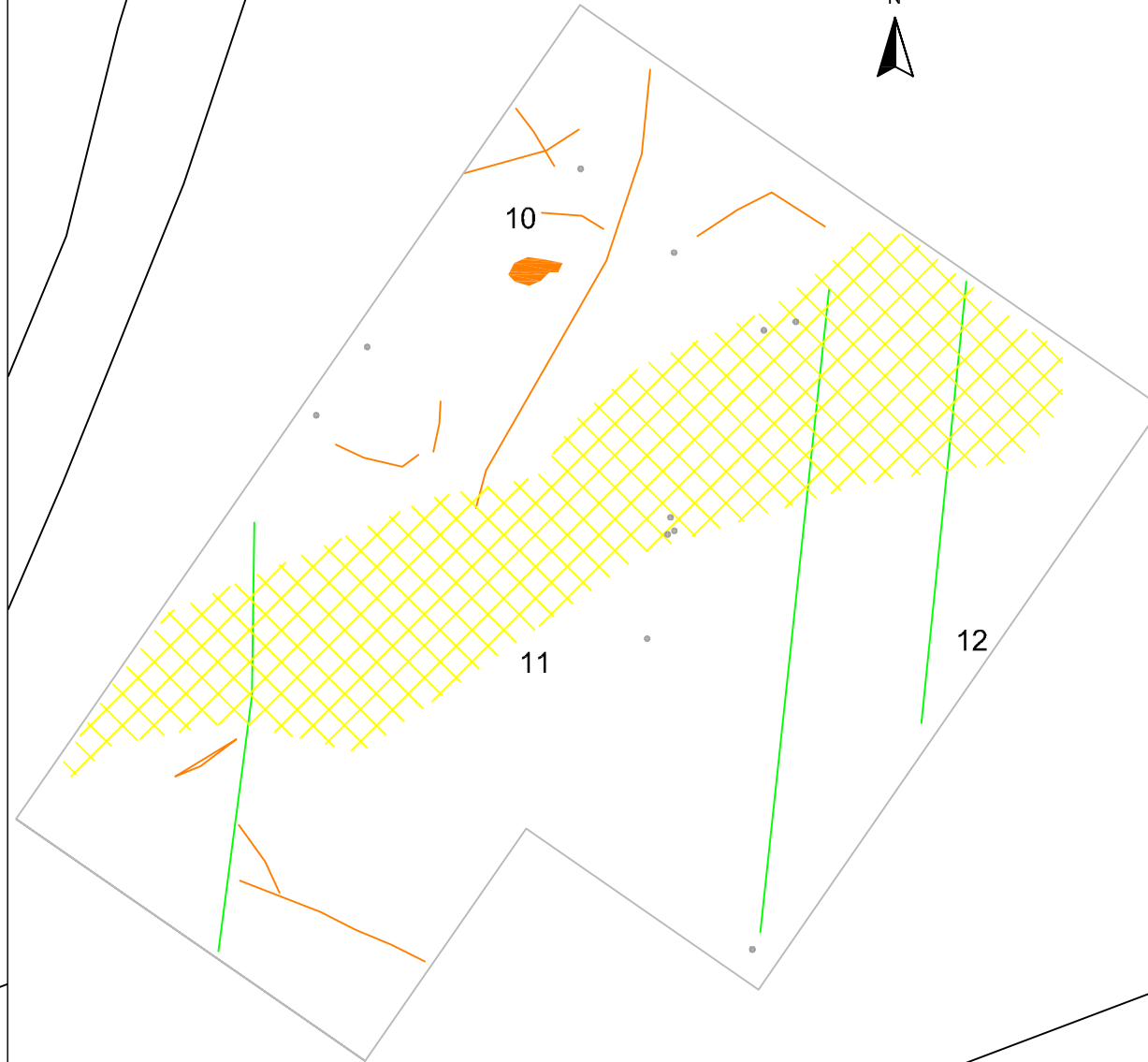
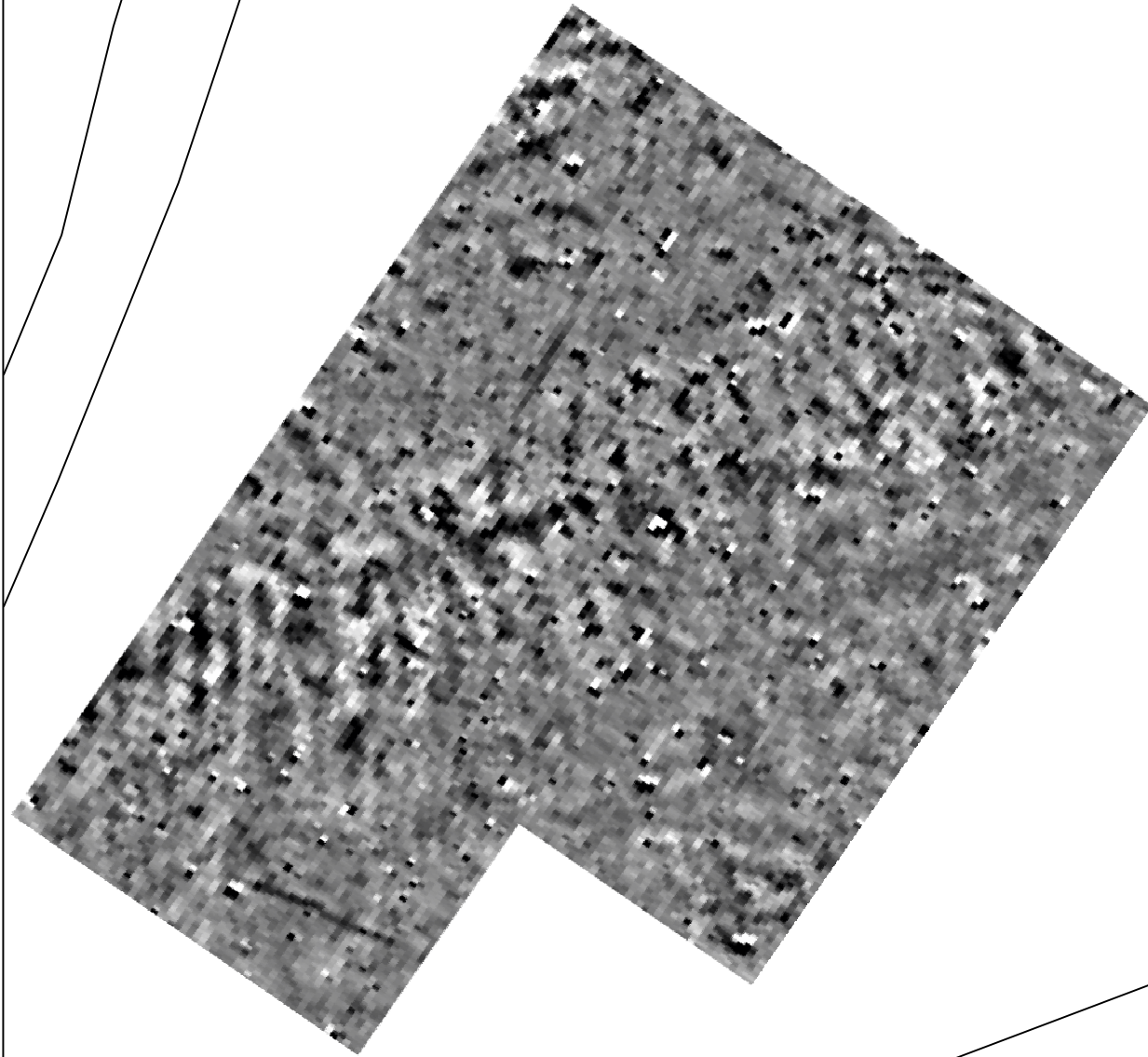
SCALE TRUE AT A3

**Geophysical Survey
Land east of Torr Works
Wanstrow
Somerset**

**Abstraction and interpretation of
magnetometer anomalies -
Turbine 3**

-  Positive linear anomaly - possible ditch-like feature
-  Linear anomaly - of agricultural origin (trend only)
-  Discrete positive response - possible pit-like feature
-  Variable magnetic response - of natural origin
-  Strong dipolar anomaly - ferrous object

**Greyscale plot of processed
magnetometer data - Turbine 3**









SCALE TRUE AT A3

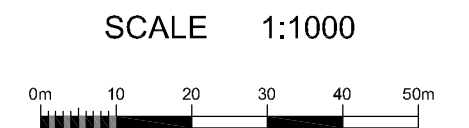
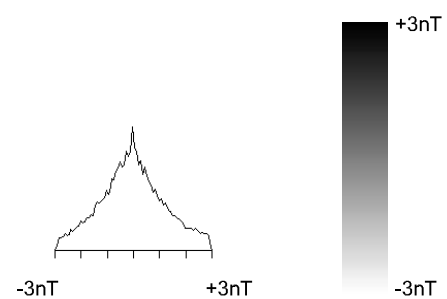
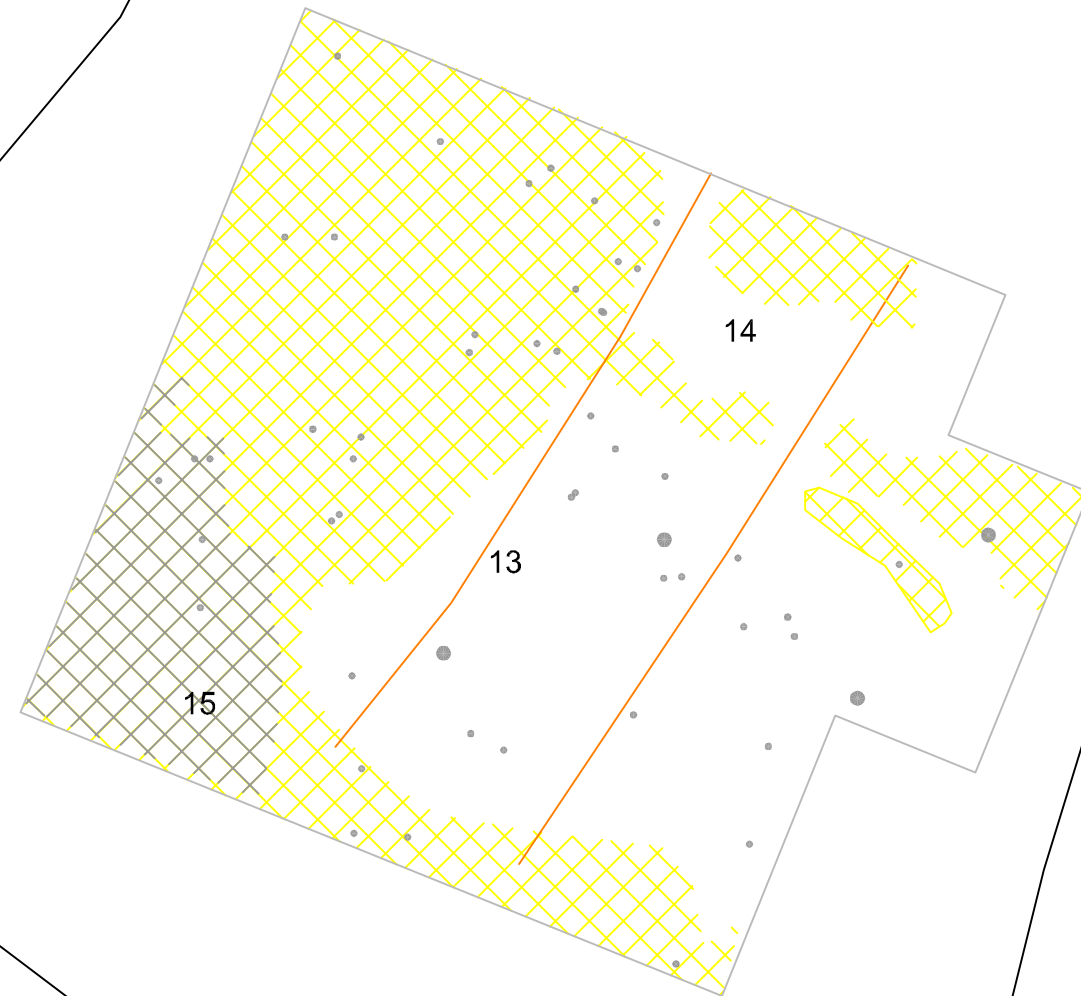
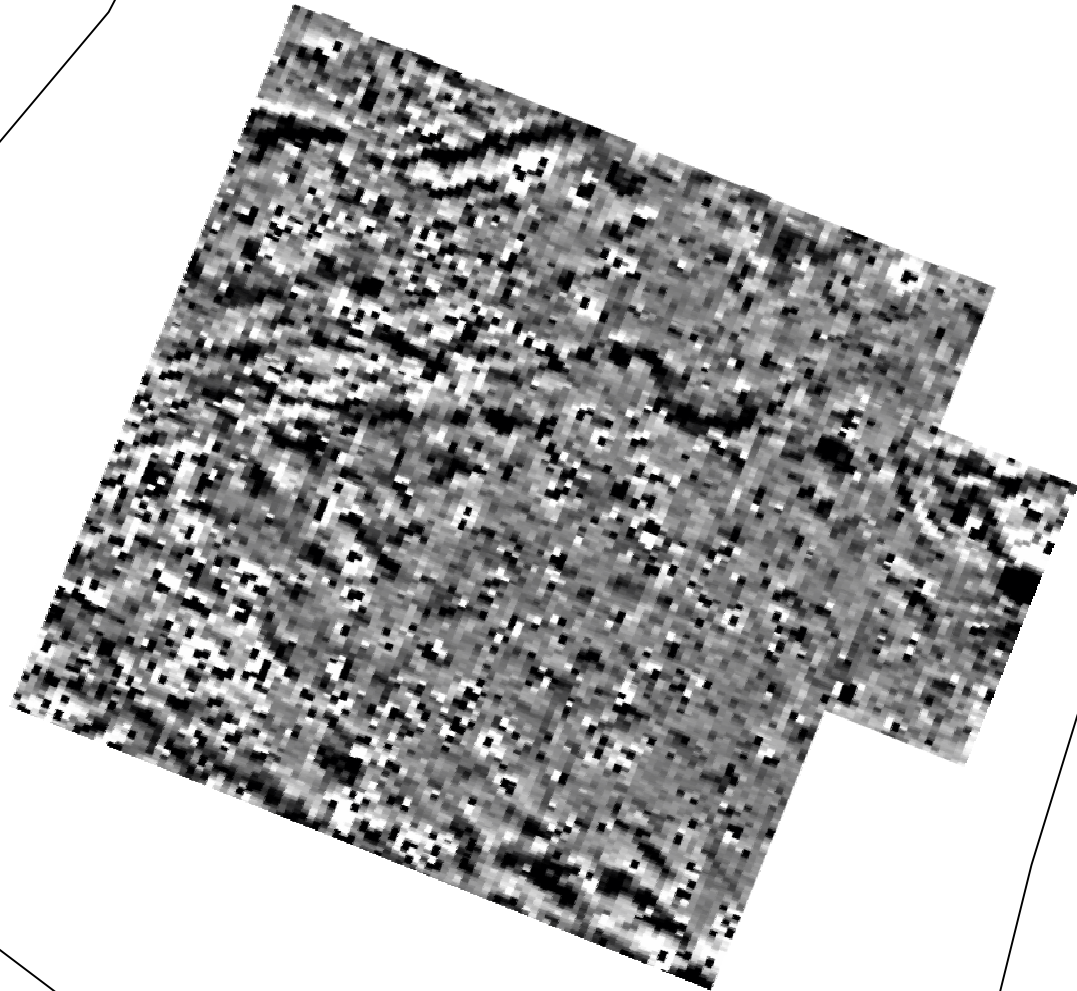
FIG 08

**Geophysical Survey
Land east of Torr Works
Wanstrow
Somerset**

**Abstraction and interpretation of
magnetometer anomalies -
Turbine 4**

-  Positive linear anomaly - possible ditch-like feature
-  Linear anomaly - of agricultural origin (trend only)
-  Discrete positive response - possible pit-like feature
-  Variable magnetic response - of natural origin
-  Magnetic debris - spread of magnetically thermoremnant/ferrous material
-  Strong dipolar anomaly - ferrous object

Greyscale plot of processed magnetometer data - Turbine 4



SCALE TRUE AT A3