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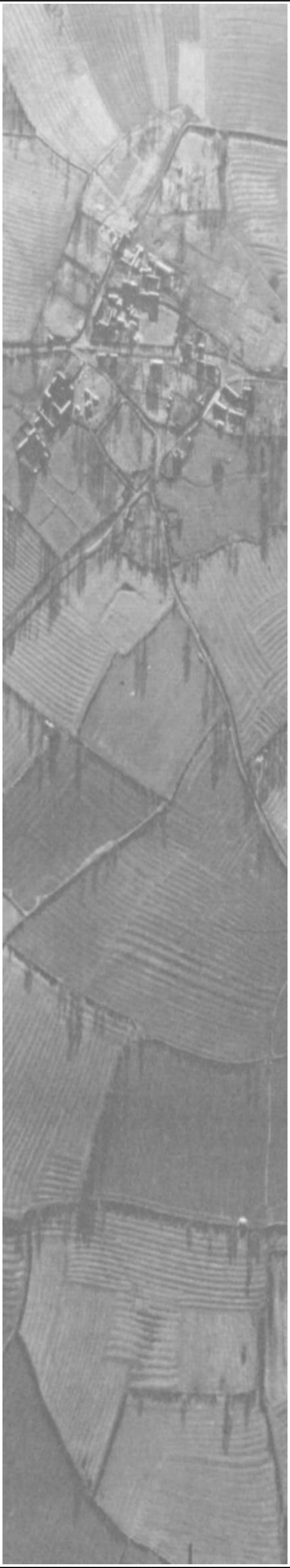

Land at Harnhill
Driffield/Preston
Gloucestershire

MAGNETOMETER SURVEY REPORT

for

Aura Power Ltd

Kerry Donaldson & David Sabin

October 2022

Ref. no. J927

ARCHAEOLOGICAL SURVEYS LTD

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Driffield/Preston
Gloucestershire

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Aura Power Ltd

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Report checked by David Sabin
Primary archive location - Archaeological Surveys Ltd, Yatesbury, Wiltshire

Survey dates – 21st, 22nd, 25th, 26th & 27th July 2022
Ordnance Survey Grid Reference – **SP 06110 00880**

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It is a Registered Organisation with the Chartered Institute for Archaeologists.

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SUMMARY

A geophysical survey, comprising detailed magnetometry was carried out by Archaeological Surveys Ltd within a single 47ha field at Harnhill, within the parishes of Driffield and Preston in Gloucestershire. The results indicate the presence of a number of prehistoric features including a rectilinear enclosure with an internal smaller enclosure situated at the eastern edge of the site. In the north is a large, square enclosure with an internal U-shaped enclosure and a single small ring ditch. To the west is a circular enclosure and further south west is another small ring ditch. A stone-lined drain is also located within a shallow valley in the southern part of the site and this could also have archaeological potential. The site also contains a large number of positive linear and discrete anomalies and while some may relate to further cut features it is likely that many relate to naturally formed anomalies. There are widespread natural features as well as numerous land drains, ridge and furrow and a number of formerly mapped land boundaries.

1 INTRODUCTION

1.1 Survey background

1.1.1 Archaeological Surveys Ltd was commissioned by Aura Power Ltd, to undertake a magnetometer survey of an area of land at Harnhill within the parishes of Driffield and Preston near Cirencester, Gloucestershire. The site was outlined for a proposed development of Witpit Solar Farm and the survey formed part of an archaeological assessment.

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 Geophysical survey can provide useful information on the archaeological potential of a site; however, the outcome of any survey relies on a number of factors and as a consequence results can vary. The success in meeting the aims and objectives of a survey is, therefore, often impossible to predetermine.

1.3 Standards, guidance and recommendations for the use of this report

1.3.1 Archaeological Surveys Ltd is a Registered Organisation with the Chartered Institute for Archaeologists and both company directors are Members of the Chartered Institute for Archaeologists (MCIfA) and have therefore been assessed for their technical competence and ethical suitability and abide by the CIfA Codes of Conduct. The survey and report follow the recommendations set out by: European Archaeological Council (2015) *Guidelines for the Use of Geophysics in Archaeology;* Institute for Archaeologists (2002) *The use of Geophysical Techniques in Archaeological Evaluations.* The work has been carried out to the Chartered Institute for Archaeologists (2014) (updated 2020) *Standard and Guidance for Archaeological Geophysical Survey.*

1.3.2 Archaeological Surveys Ltd provide a detailed geophysical survey report and it is recommended that where possible the contents should be considered in full. The Summary provides a brief overview of the results with more detail available in the Discussion and/or Conclusion. The *List of anomalies* within the Results provides a detailed assessment of the anomalies within separate categories which can be useful in inferring a level of confidence to the interpretation. Quality and factors influencing the interpretation of anomalies is also set out within the results.

1.3.3 It is recommended that the full report should always be considered when using data and interpretation plots; where this is not possible, in the field for example, the abstraction and interpretation plots should retain their colour coding and be used with a corresponding legend.

1.3.4 Where targeting of anomalies by excavation is to be carried out, care should be taken to place trenches over solid lines or features visible on the abstraction and interpretation plots. Archaeological Surveys abstraction and interpretation avoids the use of dashed or dotted line formats, and broken or fragmented lines used in interpretive plots may well correspond closely with truncation of archaeological features.

1.4 Site location, description and survey conditions

1.4.1 The site is located to the west of Waterton Lane, Harnhill, 1km north west of Driffield and 1km east of Preston near Cirencester in Gloucestershire. It is centred on Ordnance Survey National Grid Reference (OS NGR) SP 06110 00880, see Figs 01 and 02.

1.4.2 The geophysical survey covers approximately 47ha within a single arable field that had been recently harvested at the time of survey.

1.4.3 The ground conditions across the site were generally considered to be favourable for the collection of magnetometry data. Weather conditions during the survey were dry and sunny.

1.5 Site history and archaeological potential

1.5.1 The eastern and northern part of the site contain cropmark evidence for two possible Iron Age to Romano-British rectilinear enclosures (Gloucestershire HER no: 3077). Towards the central, south western part of the site is a small ring ditch measuring 8m in diameter (HER no: 37902) with an undated field boundary or trackway situated to the west (HER no:37901). Further cropmarks to the north west of the site have revealed evidence for further enclosures (HER no: 2027) and a possible Bronze Age dispersed barrow cemetery and linear ditches have been recorded to the south west of the site (HER no: 3068).

1.5.2 The location of the enclosures and ring ditch within the site indicates that there is a high potential for the geophysical survey to locate archaeological features.

1.6 Geology and soils

1.6.1 The underlying geology across the majority of the site is Forest Marble limestone, with a ring of Forest Marble mudstone in the central northern part of the site and a small zone of Cornbrash Formation limestone in the north (BGS, 2022).

1.6.2 The overlying soil across the southern half of the site is from the Sherborne association (343d) and is a brown rendzina. It consists of a shallow, well drained, brashy soil over limestone. The soil in the north and the far south eastern corner is from the Evesham 1 association which is a calcareous pelosol and it consists of a slowly permeable, calcareous clayey soil (Soil Survey of England and Wales, 1983).

1.6.3 Magnetometry carried out over similar geology and soil has produced good results although at times it can be difficult to distinguish anomalies with an anthropogenic origin from those with a natural origin. The site is, therefore, considered suitable for magnetic survey.

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 (also known as thermoremanence) are factors associated with the formation of localised fields.

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). Additional details are set out in 2.2 below and within Appendix A.

2.2 Equipment configuration, data collection and survey detail

2.2.1 The detailed magnetic survey was carried out using a SENSYS MAGNETO® MX V3 cart-based system with 7 fluxgate gradiometers spaced 0.5m apart with readings recorded at 100Hz when towed using an ATV (c0.10-0.20m). Each sensor is not zeroed in the field as the vertical axis alignment is precisely fixed leaving sensor offsets that are removed during data processing. The fixing of the vertical alignment ensures the sensors are not unduly influenced by localised magnetic fields and that the vertical component of a magnetic anomaly is measured. The gradiometers have a measurement range of ±8000nT, although the recorded range is ±3000nT, and resolution is around 0.1nT. They are linked to a Leica GS10 RTK GNSS with data recorded by SENSYS MonMX software on a rugged notebook computer system.

2.2.2 Due to the fixed offsets within the fluxgate sensors, as a result of the manufacturing and tensioning process, the survey data do not provide a visually useful dataset until a zero median traverse algorithm is applied. It is recognised that this has the potential to affect some anomalies detrimentally by removing linear features orientated parallel to survey transects. However, this has not been noted as a particular problem with the system due to the high resolution data collection, generally long length of traverses and variability within the magnetic characteristics of a linear anomaly.

2.2.3 Data are collected along a series of parallel survey transects to achieve 100% coverage of the surveyable land. The length of each transect is variable and relates to the size of the survey area and other factors including ground conditions. A visual display allows accurate placing of transects and helps maintain the correct separation between adjacent traverses. Data are not collected within fixed grids and data points are considered to be random even though the data are collected in a systematic manner covering all accessible areas (Aspinall, Gaffney and Schmidt, 2009).

2.2.4 Fluxgate sensors are highly sensitive to temperature change and this manifests as drift during the course of a survey. This can be particularly noticeable during the morning as temperatures rise and the equipment warms or cools. Sensor drift within the course of a traverse will appear as a line trending from negative to positive after processing with a zero median traverse algorithm. To remove the potential for temperature drift, data were collected after a 20 minute stabilisation period and traverses were limited to a time of generally <100s.

2.3 Data processing and presentation

2.3.1 Magnetic data collected by the SENSYS MAGNETO® MX V3 cart-based system are initially prepared using SENSYS MAGNETO®DLMGPS software. The software effectively allocates a geographic position for each data point and can compensate for fixed offsets present within the FGM650 sensors. The offsets are positive or negative values present on all fluxgate gradiometer sensors. Some systems use manual or electronic balancing to effectively zero the sensors; however, this is a short term measure that is prone to drift through temperature changes and vibration and can easily be incorrectly set due to localised magnetic fields. The FGM650 sensors are very accurately aligned to the vertical magnetic gradient and are highly stable showing negligible drift on long traverses. The offset values are removed using TerraSurveyor software.

2.3.2 Survey tracks are analysed and georeferenced raw data (UTM Z30N) are then exported in ASCII format for further analysis and display within TerraSurveyor. The removal of the offset values (compensation) of the sensors is also carried out in TerraSurveyor using a zero median traverse function. Data are then considered to be minimally processed. Note: without the zero median traverse function it is not possible to create a meaningful data plot as all sensors have a different offset value. Although a zero median traverse algorithm can remove anomalies aligned with the survey tracks, in practice this rarely occurs due to the use of long traverses, high resolution measurement and variability within the magnetic susceptibility of long linear features.

2.3.3 The minimally processed data are collected between limits of ±3000nT and clipped for display at ±3nT. Data are interpolated to a resolution of effectively 0.5m between tracks and 0.15m along each survey track.

2.3.4 Additional data processing has been carried out in the form of both low pass and high pass filtering. Low pass filtering effectively removes high frequency variation along a traverse that has been caused by uneven ground and associated vibration. High pass filtering effectively removes low frequency variation along a traverse that has been caused by large magnetic bodies, cultivation or rapid temperature change. Data treated to additional processing have been compared to unprocessed data to ensure that no significant anomalies have been removed.

2.3.5 Appendix C contains metadata concerning the survey and data attributes and is derived directly from TerraSurveyor. Reference should be made to Appendix B for further information on processing.

2.3.6 A TIF file is produced by TerraSurveyor software along with an associated world file (.TFW) that allows automatic georeferencing (OSGB36 datum) when using GIS or CAD software. The main form of data display used in the report is the minimally processed greyscale plot. With regard to the SENSYS MAGNETO® MX V3, minimally processed data are considered by the manufacturer to be data that are compensated by SENSYS MAGNETO DLMGPS software, see 2.3.1 and 2.3.2. Note: traceplots are not considered to be appropriate as they do not provide an accurate or useful assessment of the magnetic anomalies due to the very high density of data collection. In addition, traceplots cannot be meaningfully plotted against base mapping and in areas of complexity traces may be lost or highly confused. Traceplots may be used to demonstrate characteristic magnetic profiles across discrete features where it is considered beneficial.

2.3.7 The raster images are combined with base mapping using ProgeCAD Professional 2021, creating DWG (2018) file formats. All images are externally referenced to the CAD drawing in order to maintain good graphical quality. The CAD plots are effectively georeferenced facilitating relocation of features using GNSS, resection method, etc.

2.3.8 An abstraction and interpretation is drawn and plotted for all geophysical anomalies located by the survey. Anomalies are abstracted using colour coded points, lines and polygons. All plots are scaled to landscape A3 for paper printing. Appendix E sets out CAD layer names with colour and graphic content for each interpretation category, see 3.3.

2.3.9 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 the survey area.

2.3.10 The abstraction and interpretation procedure has been supported by analysis of a digital terrain model plot derived from the Environment Agency's LiDAR data. Shaded relief plots and contours are created using Surfer 15 (Azimuth:135, Altitude:45, Z factor:10), (Fig 19).

2.3.11 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 approximately 47ha within a single arable field.

3.1.2 Magnetic anomalies located can be generally classified as positive responses of archaeological potential, positive and negative anomalies of an uncertain origin, anomalies associated with land management, linear anomalies of an agricultural origin, anomalies with a natural origin, strong discrete dipolar anomalies relating to ferrous objects and strong multiple dipolar linear anomalies relating to buried services or pipelines.

3.1.3 Anomalies located within each survey area have been numbered and are described in 3.4 to 3.7 below. The area covers 47ha in total and has been split into four sections, south east, north east, north west and south west within the report.

3.2 Statement of data quality and factors influencing the interpretation of anomalies

3.2.1 Data are considered representative of the magnetic anomalies present within the site.

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 general explanation of the characteristics of the magnetic anomalies is set out for each category in order to justify interpretation, see Table 1.

Interpretation category	Description and origin of anomalies
Anomalies with archaeological potential	Anomalies have the characteristics (mainly morphological) of a range of archaeological features such as pits, ring ditches, enclosures, etc. The category is used where there is a high level of confidence which may be due to additional supporting information where morphology is unclear or uncharacteristic.
Anomalies with an uncertain origin	The category applies to a range of anomalies where there is not enough evidence to confidently suggest an origin. Anomalies in this category may well be related to archaeologically significant features, but equally relatively modern features, geological/pedological features and agricultural features should be considered. Morphology may be unclear or uncharacteristic and there may be a lack of additional supporting information. 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.
Anomalies relating to land management	Anomalies are mainly linear and may be indicative of the magnetically enhanced fill of cut features (i.e. ditches). The anomalies may be long and/or form rectilinear elements and they may relate to topographic features or be visible on early mapping. Associated agricultural anomalies (e.g. headlands, plough marks and former ridge and furrow) may support the interpretation. Land drains can appear in a classic herringbone pattern of interconnected multiple dipolar linear anomalies, or as parallel linear anomalies. The multiple dipolar response indicates ceramic land drains.
Anomalies with an agricultural origin	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. This category does not include agricultural features of early date or considered to be of archaeological potential (e.g. animal stockades, enclosures, farmsteads, etc).
Anomalies associated with magnetic debris	Strong discrete dipolar anomalies are responses to ferrous objects within the topsoil.
Anomalies with a modern origin	Buried services may produce characteristic multiple dipolar anomalies dependant upon their construction.
Anomalies with a natural origin	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 almost impossible to distinguish from pit-like anomalies with an anthropogenic origin. 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.

Table 1: List and description of interpretation categories

3.4 *List of anomalies - south east*

Centred on OS NGR 406290 200700, see Figs 07 – 09.

Anomalies of archaeological potential

(1 & 2) – A positive rectilinear anomaly (1) relates to the eastern part of an enclosure. It contains a smaller, L-shaped feature (2) just on the eastern edge of the survey area. The northern part of the enclosure ditch has been truncated by a water pipe (see Figs 10 – 12).

Anomalies with an uncertain origin

(3) – A broad, positive responses could relate to a former broad boundary feature.

(4) – A number of positive linear anomalies has a north north west to south south east orientation. It is not possible to determine if they relate to cut, ditch-like features, or if they are associated with land drainage or if they have an association with natural joints and cracks within the underlying geology.

(5) A number of positive linear anomalies can be seen in the south eastern corner of the survey area. They may relate to cut, ditch-like features.

(6) – A group of positive responses and a negative curvilinear anomaly is located in the southern part of the site. The positive responses could indicate pit-like features, the negative a response to rock.

(7) – A group of elongated pit-like anomalies could relate to further naturally formed pits or tree throws (11), however their elongated form could indicate anthropogenic activity.

Anomalies associated with land management

(8) – Positive linear anomalies relate to field boundaries mapped during the 19th and removed during the 20th centuries.

(9) – A herringbone formation of positive linear anomalies is a response to land drains.

Anomalies with an agricultural origin

(10) – Parallel linear anomalies relate to ridge and furrow.

Anomalies with a natural origin

(11 & 12) – Discrete positive responses (11) and linear anomalies (12) relate to

natural pits and soil-filled joints and cracks within the underlying limestone geology.

3.5 List of anomalies - north east

Centred on OS NGR 406280 200975, see Figs 10 – 12.

Anomalies of archaeological potential

(13 & 14) – A positive rectilinear anomaly (13) relates to an enclosure with dimensions of approximately 170m by 145m. There are several gaps along the perimeter with one in the northern side and south eastern corner that appear to be entrances. The western side is much narrower (0.6-1m) and weaker (0.5-1nT)than on the northern and western sides which is 1.3-2.5m wide and has a response of 3-11nT. It contains an internal enclosure with a curvilinear northern end (14) and some evidence of internal divisions. A small, ring ditch (15) in the south western corner.

(15) – Positive curvilinear anomalies appear to relate to a ring ditch feature with a diameter of 10-11m situated within the south western part of the enclosure (13). The anomaly is likely to relate to an Iron Age round house.

Anomalies with an uncertain origin

(16) – A number of positive linear and rectilinear anomalies can be seen within the northern part of the enclosures (13 & 14). It is possible that they relate to cut features, however they could relate to further naturally formed soil-filled features within the underlying geology.

(17) – A large pit-like feature and small similar responses nearby lies just to the west of enclosure (13) and they could relate to cut features, however a natural origin is also possible.

(18) – A number of linear anomalies can be seen to the south of (13). It is not clear if they are natural or anthropogenic features.

(19) – Towards the north eastern corner of the survey area are a number of discrete, positive anomalies. Although it is possible that they could relate to naturally formed features, they have a response of up to 15nT, which is much stronger to the majority of the natural features at 1nT, and an anthropogenic origin is possible.

Anomalies with a natural origin

(20) – A large zone of magnetically variable responses can be seen extending through the north eastern part of the site. This appears to relate to variations in the underlying geology and in places it appears to have been disturbed by ridge and furrow.

Anomalies with a modern origin

(21) – A strong, multiple dipolar, linear anomaly extends through the survey area and it relates to a buried pipe or service.

3.6 List of anomalies - north west

Centred on OS NGR 405870 201040, see Figs 12 – 15.

Anomalies of archaeological potential

(22) – A weakly positive curvilinear anomaly relates to a sub-circular enclosure with dimensions of up to 42m by 37m. It appears that it may extend to the east of anomaly (23), but this is not well defined.

Anomalies with an uncertain origin

(23) – A fragmented positive linear anomaly with a similar response to anomalies (24) could relate to a cut, ditch-like feature, however a natural origin cannot be ruled out.

(24) – A number of positive linear anomalies can be seen in the western part of the survey area. Some are fragmented, and associated with pit-like responses, others more continuously linear. Such anomalies could relate to ditch-like features, but a natural origin is also possible.

(25) – The north western part of the site contains a large number of pit-like anomalies. They differ from the majority of pit-like features within the rest of the site in that they have a response of 10-20nT which could indicate that there is some association with burnt material. There is however no coherent layout to the anomalies, although one appears to be contained within the confines of the sub-circular enclosure (23), but the majority lie outside.

Anomalies associated with land management

(26) – A number of positive linear and rectilinear anomalies relate to formerly mapped field boundaries.

Anomalies with a natural origin

(27) – A large zone of amorphous, discrete and linear anomalies can be seen in the north western part of the survey area. The morphology indicates an association with soil-filled natural features within the underlying geology.

3.7 List of anomalies - south west

Area centred on OS NGR 406100 200840, see Figs 16 – 18.

Anomalies of archaeological potential

(28) – A positive curvilinear anomaly is situated in the south western part of the site. It has an outer diameter of approximately 12m and may have an entrance on the south eastern side, although this may be associated with truncation by ridge and furrow.

Anomalies with an uncertain origin

(29) – A positive linear anomaly appears to have been truncated by anomaly (31). It could relate to a cut feature but lies only in a shallow combe associated with naturally formed anomalies.

(30) – A small area of magnetic enhancement could relate to further naturally formed features, however it appears to be associated with a shallow surface depression and an association with quarrying is possible.

Anomalies associated with land management

(31) – A negative linear anomaly is located in the south western part of the site and relates to a stone-lined drain that has been partially excavated by burrowing animals in places.

Anomalies with a natural origin

(32) – A zone containing numerous and widespread discrete positive responses can be seen in the south western part of the site. This corresponds to where the land slopes to a shallow combe in the south west and the anomalies relate to numerous naturally formed pits.

4 CONCLUSION

4.1.1 The geophysical survey located two rectilinear enclosures in the eastern and northern parts of the site along with a small, curvilinear enclosure and two small ring ditches which are all likely to relate to prehistoric features. The site also contains widespread naturally formed features within the underlying limestone geology, as well as numerous land drains, ridge and furrow and a number of formerly mapped field boundaries indicating that the single 47ha field was once sub-divided into at least 12 separate land parcels during the 19th and early 20th centuries.

5 REFERENCES

Aspinall, A., Gaffney, C. and Schmidt, A. 2009. *Magnetometry for Archaeologists*. Lanham (US), AltaMira Press.

British Geological Survey, 2022. *Geology Viewer, [online]* available from https://geologyviewer.bgs.ac.uk [accessed 10/8/2022].

Chartered Institute for Archaeologists, 2014 (updated 2020). *Standard and Guidance for archaeological geophysical survey*. CIfA, University of Reading.

European Archaeological Council, 2015. *EAC Guidelines for the Use of Geophysics in Archaeology: Questions to Ask and Points to Consider.* Europae Archaeologia Consilium and Association Internationale sans But Lucratif, Belgium.

Historic England, 2018. Geophysical Survey Advice [online] available from https://historicengland.org.uk/advice/technical-advice/archaeological-science/geophysics/ [accessed July 2018].

Institute for Archaeologists, 2002. *The use of Geophysical Techniques in Archaeological Evaluations*. IfA Paper No. 6. IfA, University of Reading.

Schmidt, A., 2013. *Geophysical Data in Archaeology: A Guide to Good Practice.* Oxbow Books.

Soil Survey of England and Wales, 1983. *Soils of England and Wales, Sheet 5 South West England.*

Paul, S. (ed), 2018. *Gloucestershire Archaeological Archive Standards. A Countywide Standard for the Creation, Compilation and Transfer of Archaeological Archives in Gloucestershire.* Version 1b. South West Museum Development Programme.

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 thermoremnant 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. Thermoremnant 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. Thermoremnant features include ovens, hearths, and kilns. In addition thermoremnant 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 SENSYS gradiometer is a passive instrument consisting of two fluxgate sensors mounted vertically 65cm apart. The instrument is carried about 10-20cm 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 magnetic field. The difference between the two sensors will relate to the strength of the magnetic field created by the buried feature.

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. Different ranges are applied to data in order to determine the most suitable for anomaly abstraction and display.

High Pass Filter

Removes low frequency anomalies within the data that are not considered to be archaeologically significant and may be natural in origin. A window passes over the data, the mean of all the data within the window is subtracted from the centre value. The size of the window is adjusted as is the weighting which may be uniform or Gaussian. The process is used to improve the visibility of anomalies of interest.

Low Pass Filter

Removes high frequency anomalies or 'noise' within datasets and provides a smoother output. A window passes over the data, the mean of all the data within the window is used to replace the centre value. The size of the window is adjusted as is the weighting. The process is used to improve the visibility of anomalies of interest.

Zero Median/Mean Traverse

The median (or mean) of data from 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 differences between the offset values of the gradiometer sensors. The process can remove archaeological features that run along a traverse but with the high resolution datasets created by the Sensys FGM650 sensors and the method of data collection this has not been a notable problem. In fact, the removal of offsets using software avoids carrying out a balancing procedure on site, which inevitably can never be done in magnetically clean conditions and results in improperly aligned fluxgate sensors and/or electronic adjustment values.

Appendix C – survey and data information

Filename: J927-mag-proc.xcp
Description: Imported as Composite from: all.asc
Instrument Type: Sensys DLMGPS
Units:
UTM Zone: 30U
Survey corner coordinates (X/Y):OSGB36
Northwest corner: 405636.29, 201268.32 m
Southeast corner: 406604.49, 200437.72 m
Collection Method: Randomised
Sensors: 5
Dummy Value: 32702
Dimensions
Survey Size (meters): 968 m x 831 m
X&Y Interval: 0.2 m
Source GPS Points: Active: 19011655, Recorded: 19011655

Stats
Max: 3.00
Min: -3.00
Std Dev: 1.00
Mean: 0.05
Median: 0.00
Composite Area: 80.419 ha
Surveyed Area: 46.875 ha

GPS based Proce5
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to UTM).
3 DeStripe Median Traverse:
4 Clip from -5.00 to 5.00
5 Clip from -3.00 to 3.00

PROGRAM
Name: TerraSurveyorPre
Version: 3.0.36.24
Filename: J927-mag-proc-hpf-lpf

Stats
Max: 3.00
Min: -3.00
Std Dev: 0.87
Mean: 0.06
Median: 0.00

GPS based Proce6
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to UTM).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 500
5 Clip from -3.00 to 3.00
6 Lo pass Uniform (median) filter: Window dia: 18

Appendix D – digital archive

Archaeological Surveys Ltd hold the primary digital archive at their offices in Wiltshire. 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.

A copy of the report in PDF/A format will be supplied to the Gloucestershire Historic Environment Record, together with a DXF of the survey boundary. In order to comply with the Gloucestershire Archaeological Archive Standards (Paul, 2018) the data will be archived with the Archaeology Data Service (ADS) and the report uploaded to Online AccesS to the Index of archaeological investigationS (OASIS) in the formats stated below for archiving:

Archive contents:

File type	Naming scheme	Description
Data	J927-magasc J927-mag-raw.xcp J927-mag-proc.xcp J927-mag-proc-hpf-lpf.xcp	Raw data as ASCII CSV TerraSurveyor raw data TerraSurveyor minimally processed data TerraSurveyor filtered data
Graphics	J927-mag-**[area number/name]**-proc.tif	Image in TIF format
Drawing	J927-**[version number]**.dwg	CAD file in 2018 dwg format
Report	J927 report.odt	Report text in LibreOffice odt format

Table 2: Archive metadata

Appendix E – CAD layers for abstraction and interpretation plots

The table below sets out Archaeological Surveys Ltd CAD layer names with associated colours and graphical content. Where CAD files are available layers may be extracted for further CAD/GIS use. Note: hatched polygon boundaries are contained within layers with the RGB colour code 254, 255, 255 (near white) in order to prevent their visibility.

Report sub-heading and associated CAD layer names	Colour with RGB index		Layer content
Anomalies with archaeological potential			
AS-ABST MAG POS CURVILINEAR RING DITCH		Magenta 255,0,255	Polyline or polygon (solid)
AS-ABST MAG NEG LINEAR ARCHAEOLOGY		127,0,255	Line, polyline or polygon (solid)
AS-ABST MAG POS RECTILINEAR ENCLOSURE DITCH		127,0,255	Line, polyline or polygon (solid)
AS-ABST MAG POS CURVILINEAR ENCLOSURE DITCH		51,0,204	Line, polyline or polygon (solid)
Anomalies with an uncertain origin			
AS-ABST MAG POS LINEAR UNCERTAIN		255,127,0	Line, polyline or polygon (solid)
AS-ABST MAG NEG LINEAR UNCERTAIN		Blue 0,0,255	Line, polyline or polygon (solid)
AS-ABST MAG POS DISCRETE UNCERTAIN		255,127,0	Solid donut, point or polygon (solid)
AS-ABST MAG POS UNCERTAIN		255,127,0	Polygon (cross hatched ANSI37)
Anomalies relating to land management			
AS-ABST MAG BOUNDARY		127,0,0	Line, polyline or polygon (solid or cross hatched ANSI37)
AS-ABST MAG LAND DRAIN		Cyan 0,255,255	Line or polyline
Anomalies with an agricultural origin			
AS-ABST MAG RIDGE AND FURROW		0,127,63	Line, polyline or polygon (cross hatched ANSI37)
Anomalies associated with magnetic debris			
AS-ABST MAG DEBRIS		132, 132, 132	Polygon (cross hatched ANSI37)
AS-ABST MAG STRONG DIPOLAR		132, 132, 132	Solid donut, point or polygon (solid)
Anomalies with a modern origin			
AS-ABST MAG DISTURBANCE		132, 132, 132	Polygon (hatched ANSI31)
AS-ABST MAG SERVICE		132, 132, 132	Line or polyline
Anomalies with a natural origin			
AS-ABST MAG NATURAL FEATURES		204,178,102	Polygon (stipple)

Table 3: CAD layering

Appendix F – copyright and intellectual property

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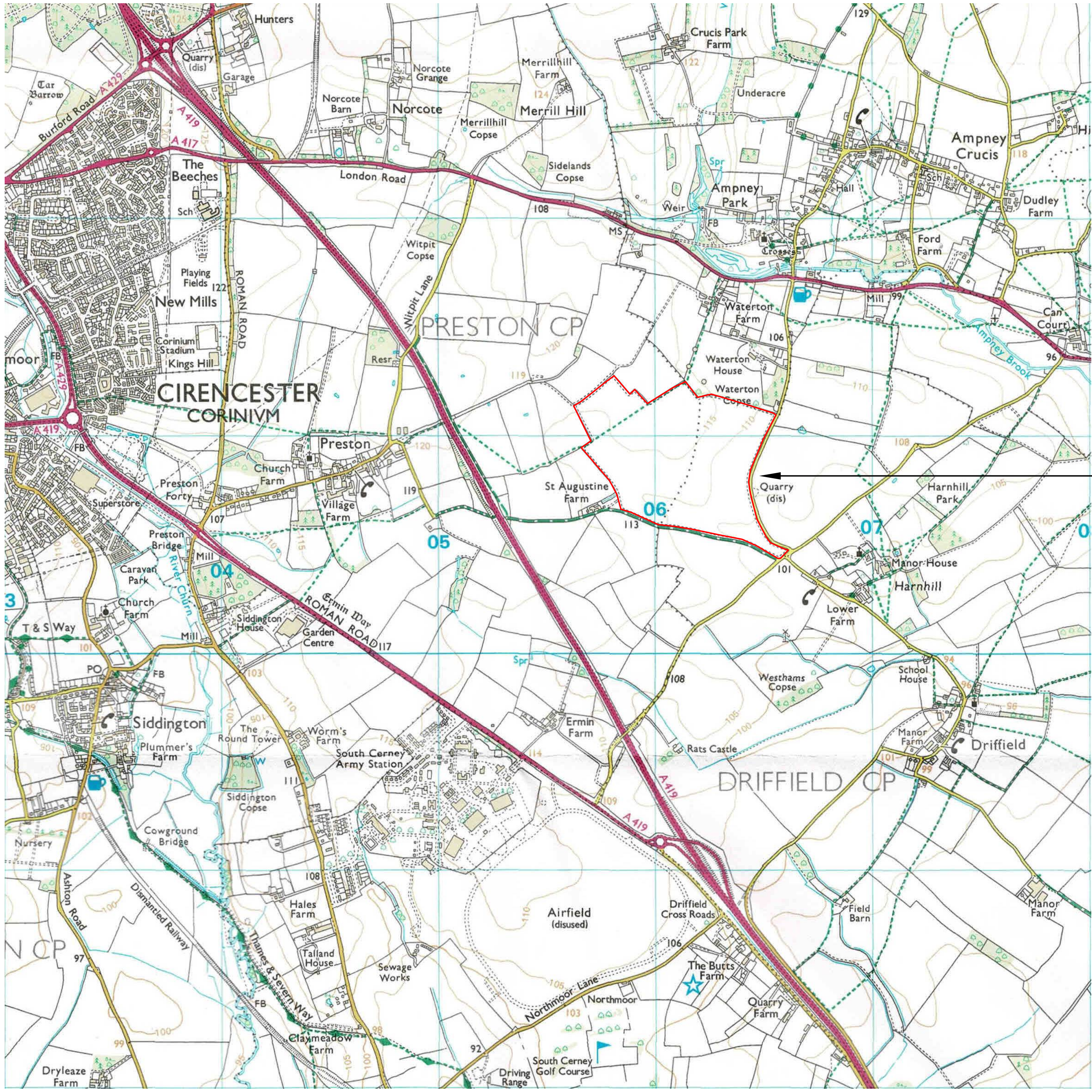
Geophysical Survey
Land at Harnhill
Driffield/Preston
Gloucestershire

Map of survey area

N



Survey location

● Survey location

Site centred on OS NGR
SP 06110 00880

SCALE 1:25 000

0m 500m 1000m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 01

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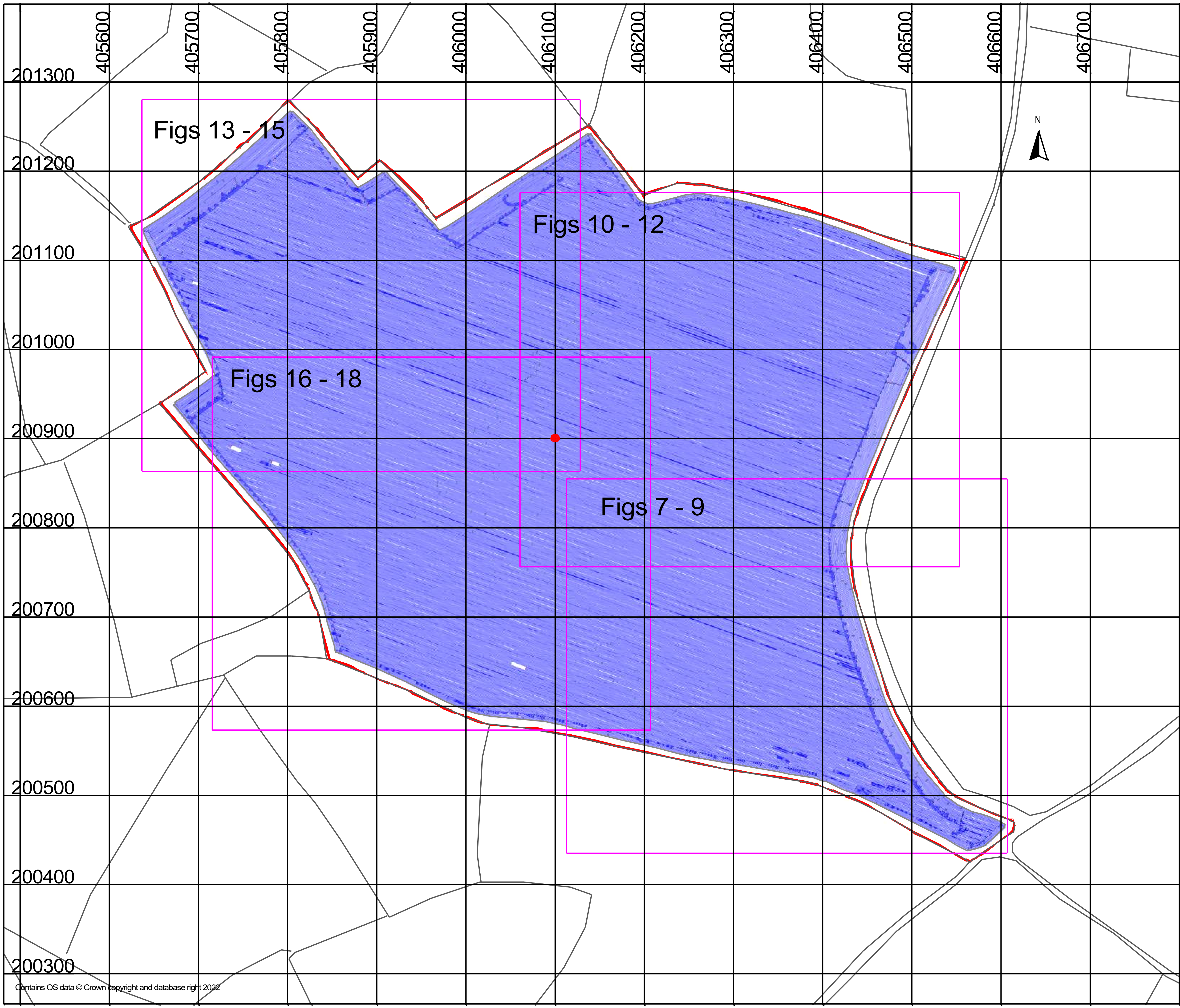

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Geophysical Survey
Land at Harnhill
Driffield/Preston
Gloucestershire

Referencing information

Referencing grid to OSGB36 datum at 100m intervals

- 406200 200900
- Survey tracks
- Survey track start
- Survey track stop

SCALE 1:4000

0m 40 80 120 160 200m

KTD | DJS | FIG 02

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Gloucestershire

Greyscale plot of minimally processed magnetometer data

SCALE 1:4000

0m 40 80 120 160 200m

KTD | DJS | FIG 03

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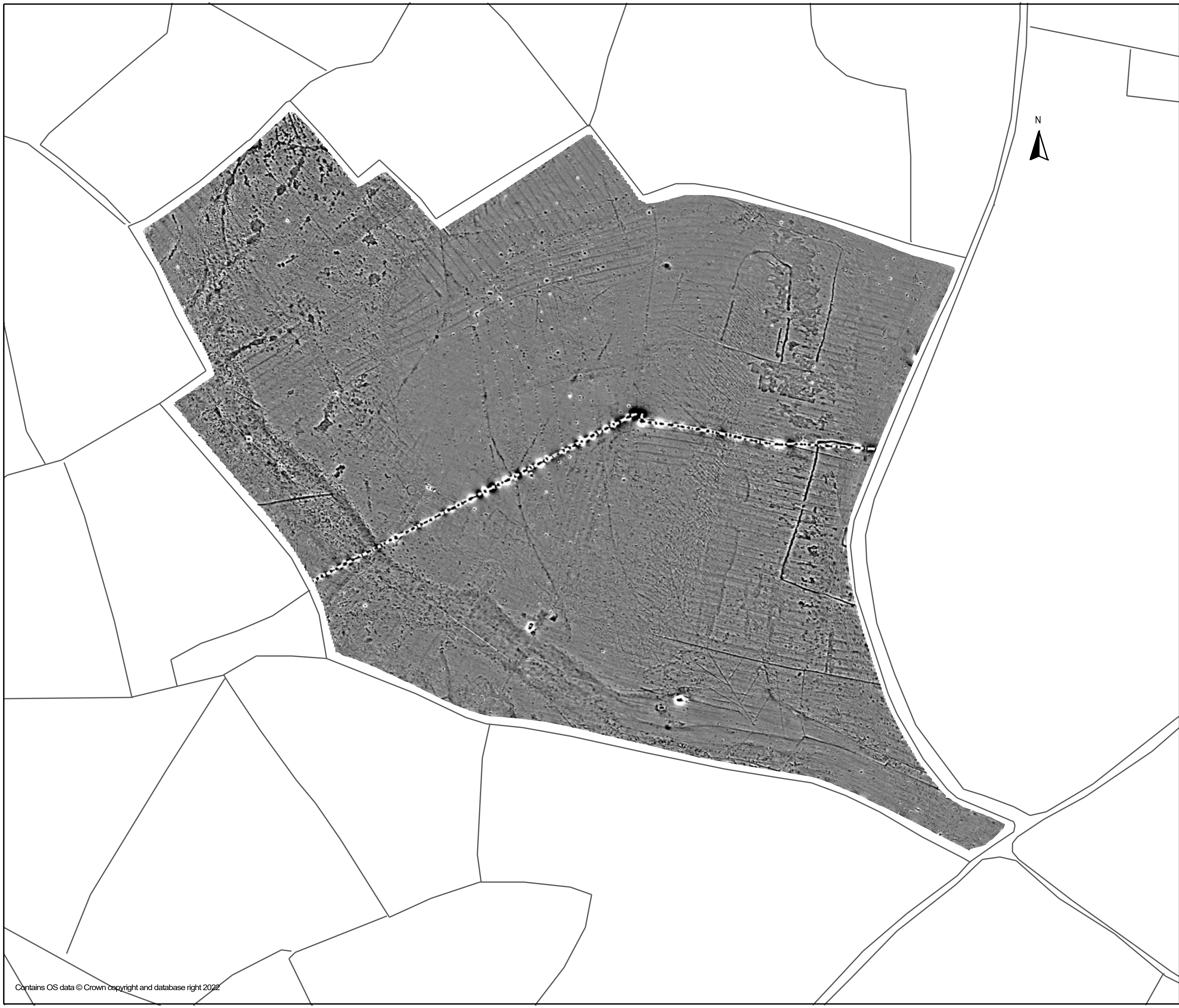
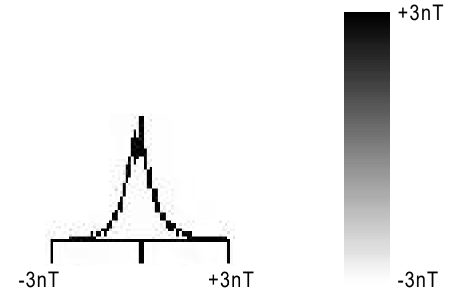
Driffield/Preston
Gloucestershire

Greyscale plot of filtered magnetometer data





SCALE 1:4000

0m 40 80 120 160 200m

KTD	DJS	FIG 04

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Gloucestershire

Abstraction and interpretation of magnetic anomalies

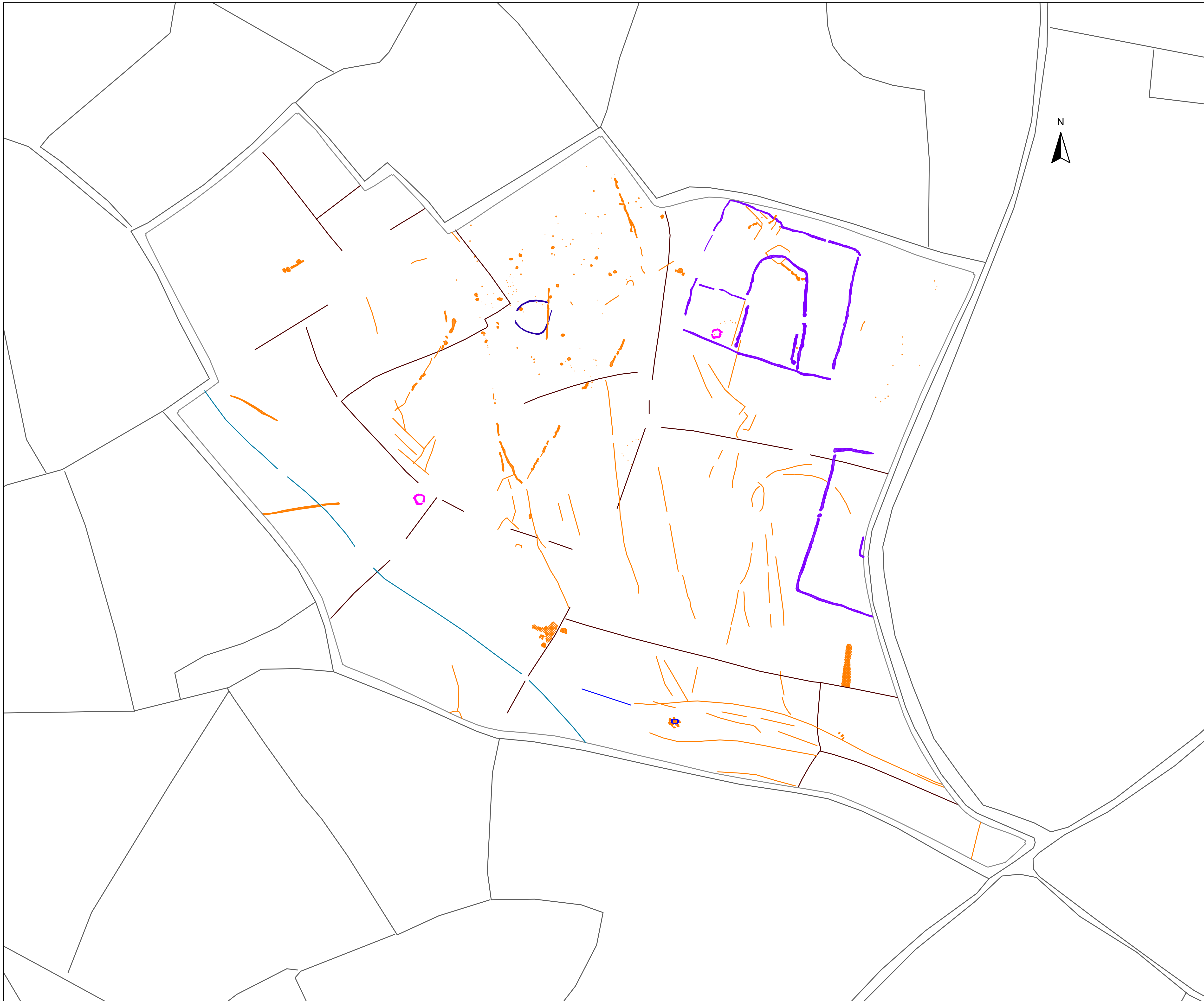
- Positive rectilinear/curvilinear anomaly - enclosure ditch
- Positive curvilinear anomaly - enclosure ditch
- Positive curvilinear anomaly - ring ditch
- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - ridge and furrow
- Positive/weak multiple dipolar linear anomaly - land drain
- Positive linear anomaly - former field boundary
- Negative linear anomaly - material of low magnetic susceptibility
- Negative linear anomaly - stone-lined drain
- Positive linear anomaly - of natural origin
- Discrete positive response - pit-like feature of natural origin
- Discrete positive response - possible pit-like feature
- Positive anomaly - magnetically enhanced material
- Variable magnetic response - of natural origin
- Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - pipeline / cable / service
- Strong dipolar anomaly - ferrous object

SCALE 1:4000

0m 40 80 120 160 200m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 05



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Geophysical Survey
Land at Harnhill
Driffield/Preston
Gloucestershire

Abstraction and interpretation of archaeological, boundaries & uncertain magnetic anomalies

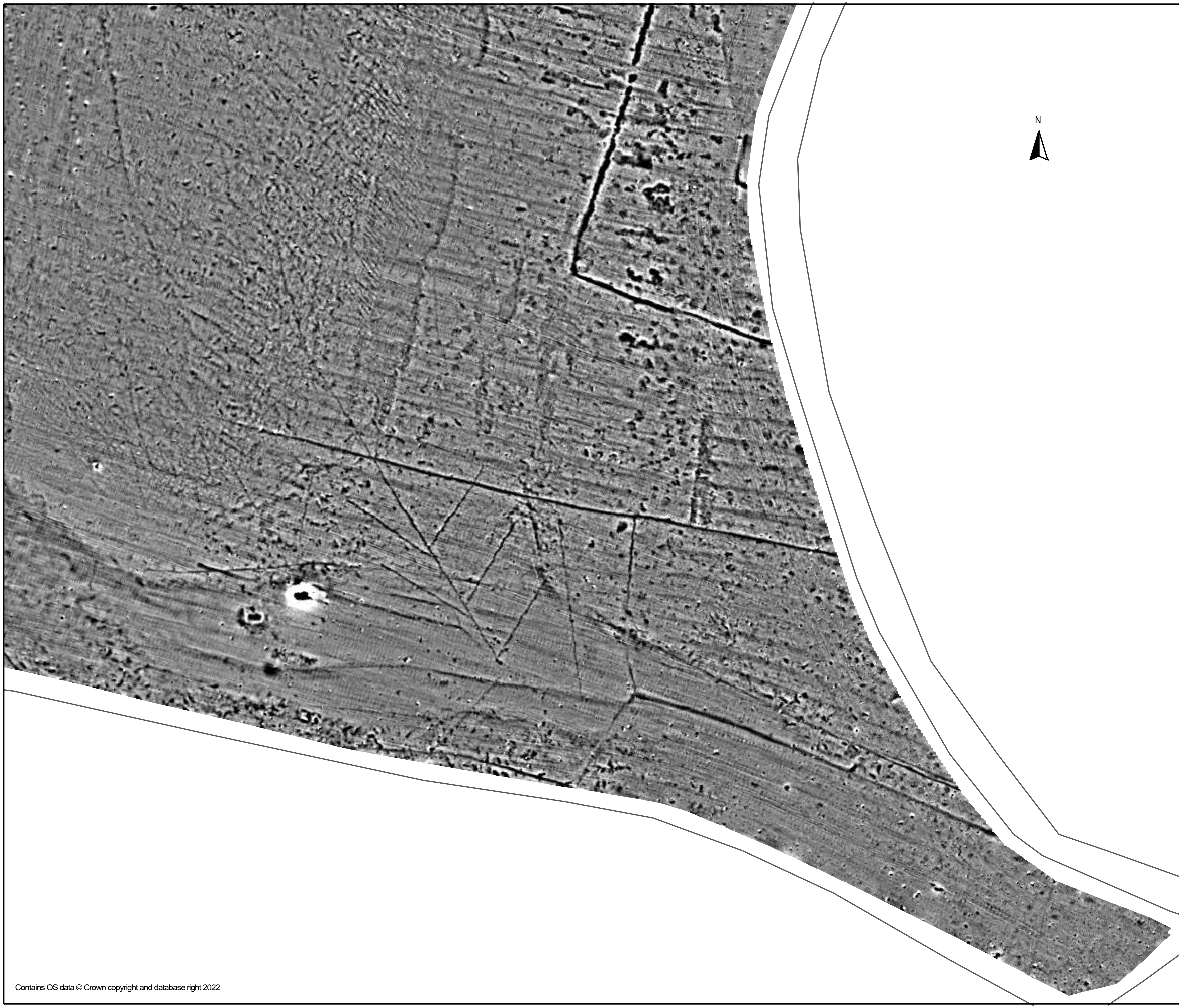
- Positive rectilinear/curvilinear anomaly - enclosure ditch
- Positive curvilinear anomaly - enclosure ditch
- Positive curvilinear anomaly - ring ditch
- Positive linear anomaly - possible ditch-like feature
- Positive linear anomaly - former field boundary
- Negative linear anomaly - material of low magnetic susceptibility
- Negative linear anomaly - stone-lined drain
- Discrete positive response - possible pit-like feature
- Positive anomaly - magnetically enhanced material

SCALE 1:4000

0m 40 80 120 160 200m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 06



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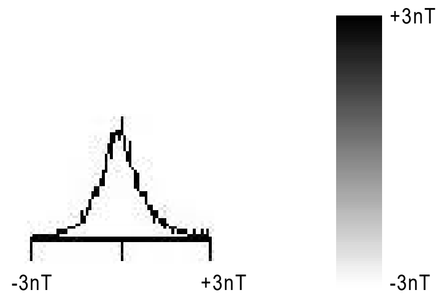
Geophysical Survey
Land at Harnhill
Driffield/Preston
Gloucestershire

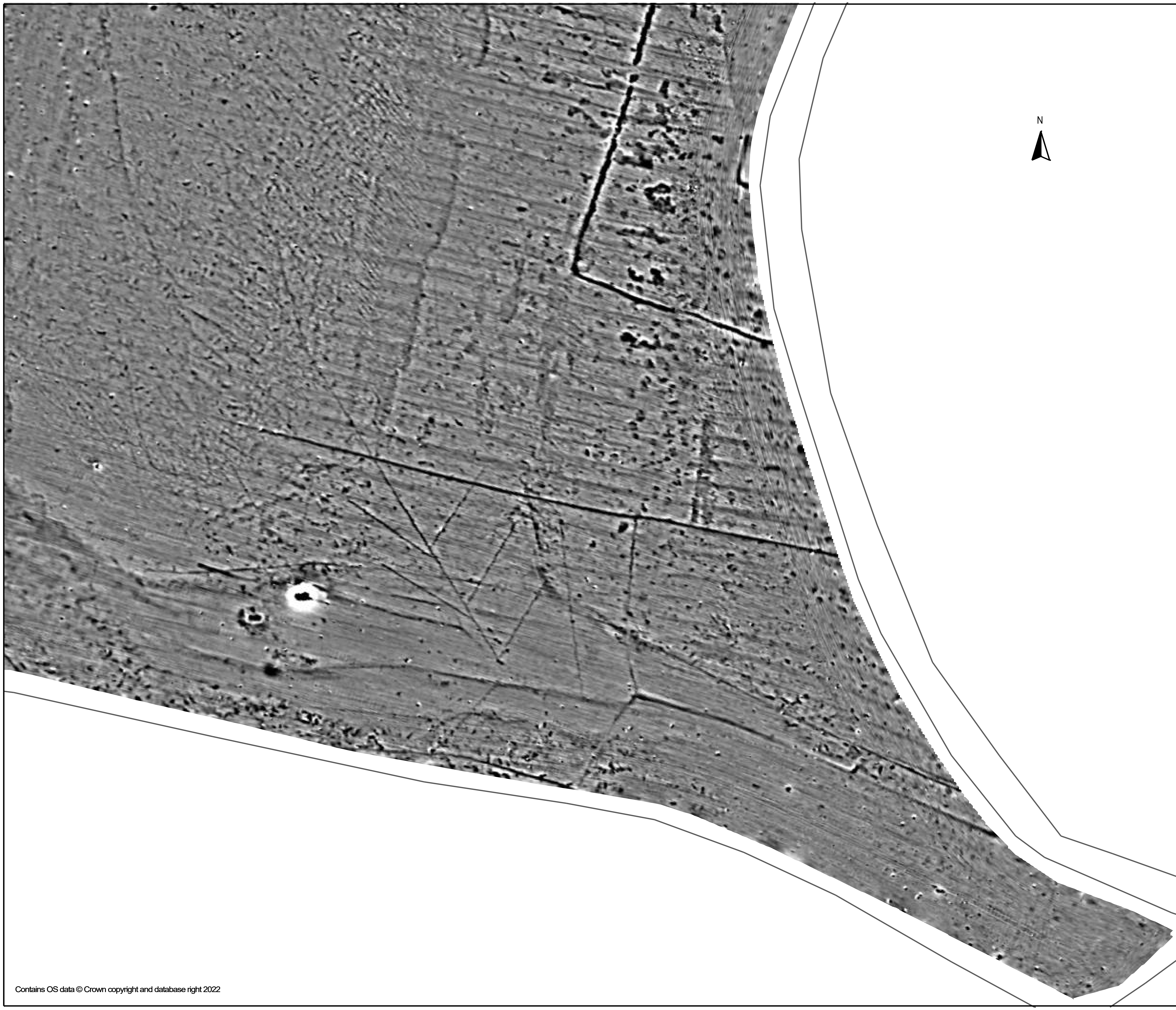
Greyscale plot of minimally processed magnetometer data - south east



SCALE 1:1500

0m 10 20 30 40 50m

KTD	DJS	FIG 07



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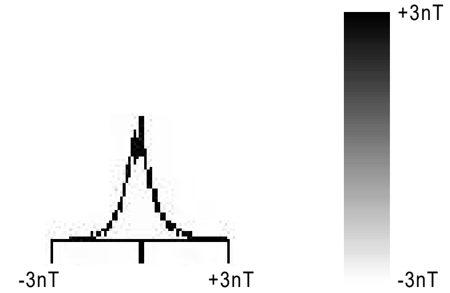
Gloucestershire

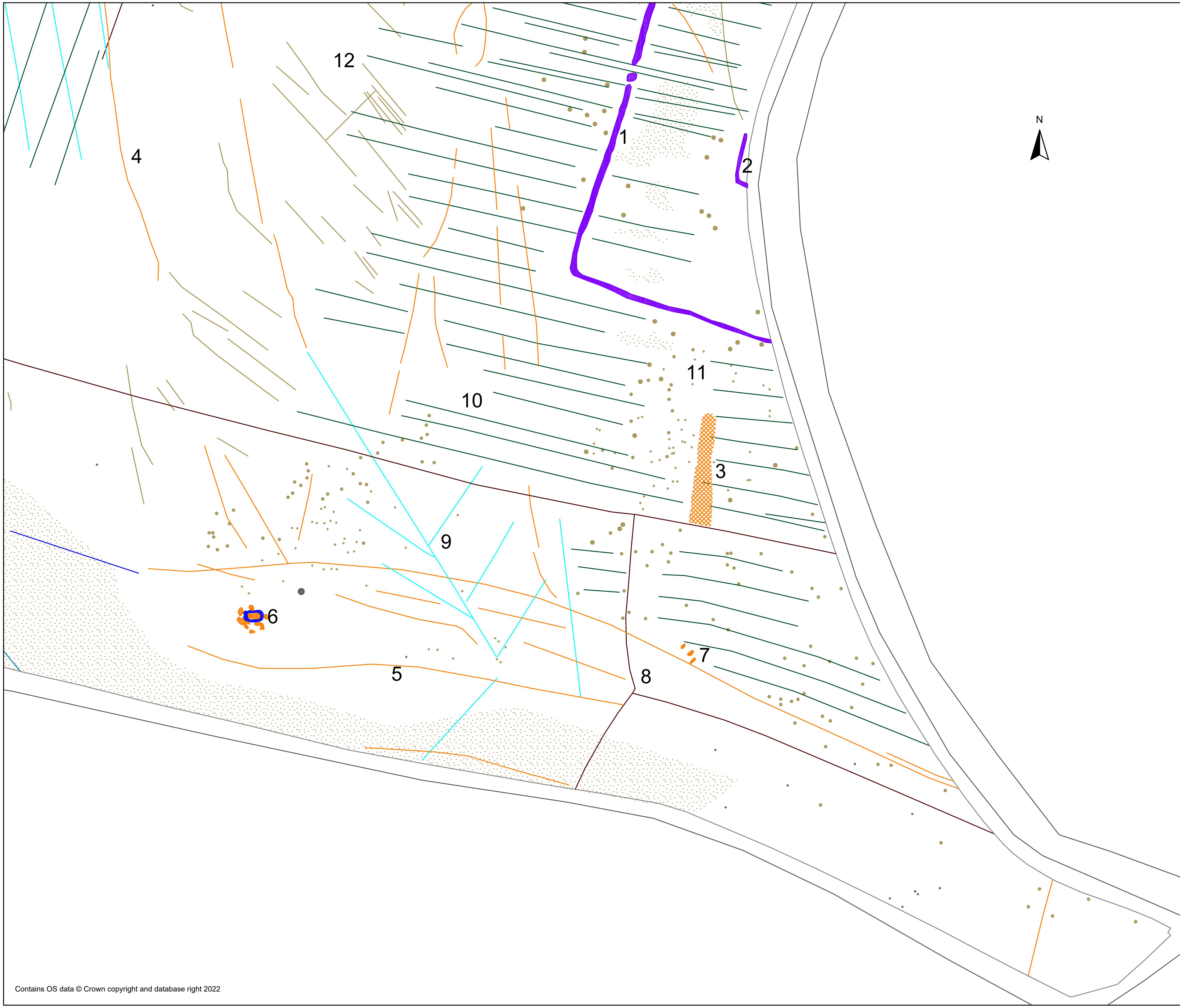
Greyscale plot of filtered magnetometer data - south east



SCALE 1:1500

0m 10 20 30 40 50m

KTD	DJS	FIG 08



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Driffield/Preston
Gloucestershire

Abstraction and interpretation of magnetic anomalies - south east

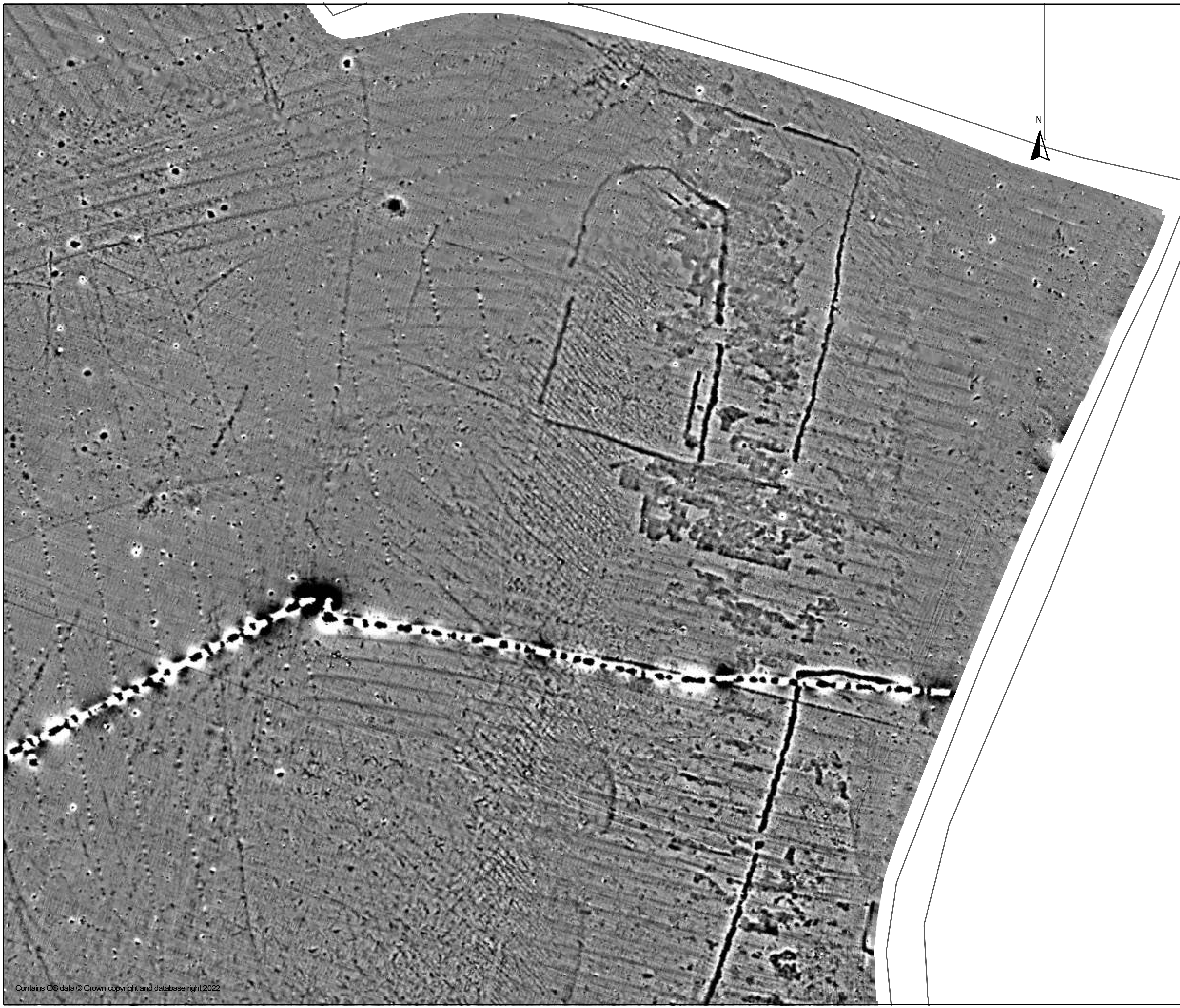
- Positive rectilinear anomaly - enclosure ditch
- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - ridge and furrow
- Positive/weak multiple dipolar linear anomaly - land drain
- Positive linear anomaly - former field boundary
- Negative linear anomaly - material of low magnetic susceptibility
- Positive linear anomaly - of natural origin
- Discrete positive response - pit-like feature of natural origin
- Discrete positive response - possible pit-like feature
- Positive anomaly - magnetically enhanced material
- Variable magnetic response - of natural origin
- Strong dipolar anomaly - ferrous object

SCALE 1:1500

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 09



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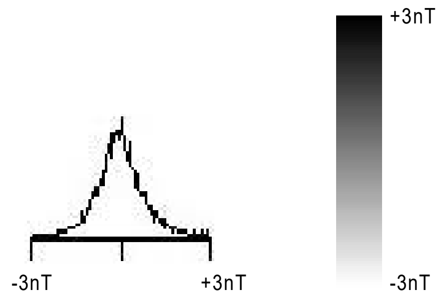
Driffield/Preston
Gloucestershire

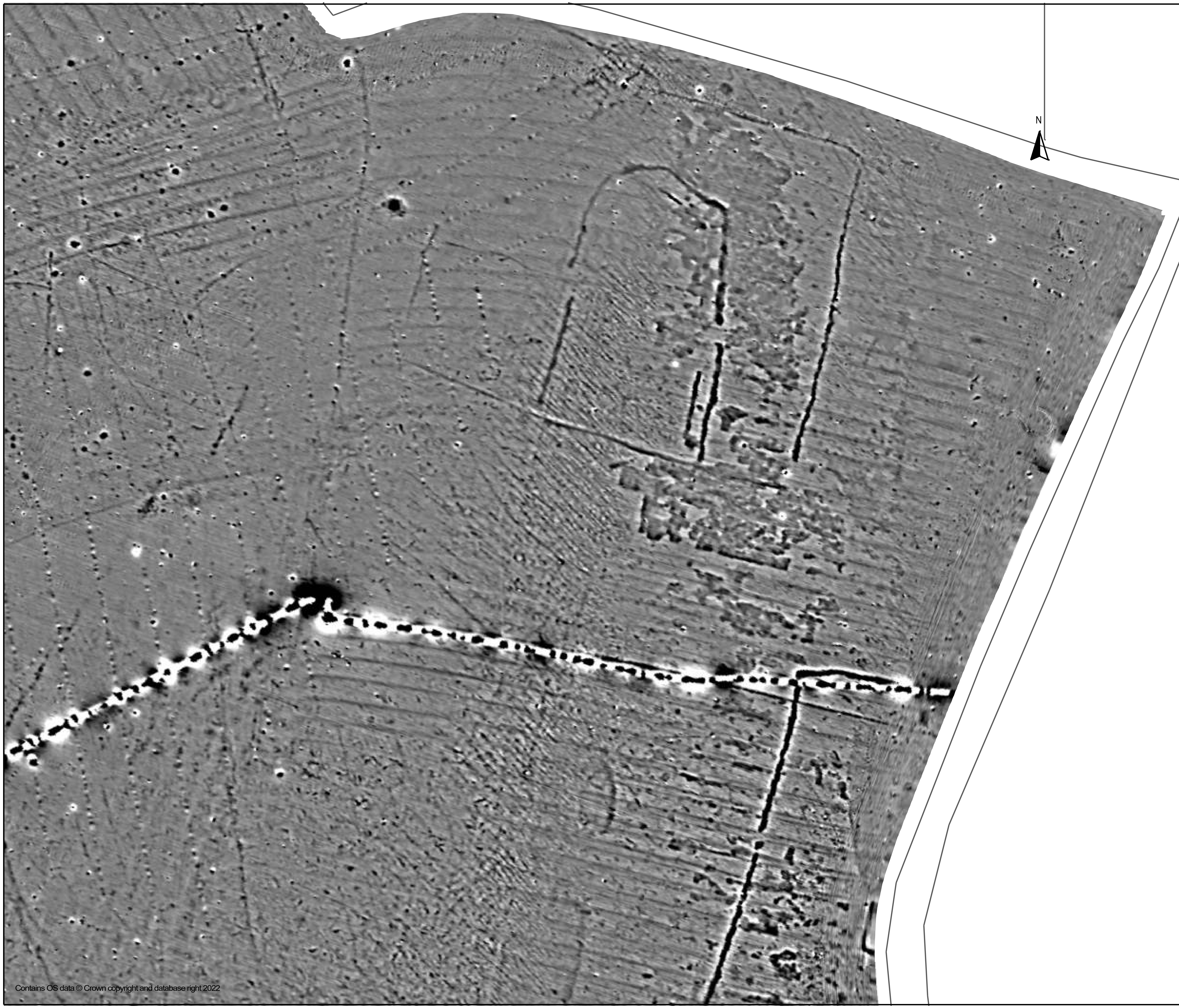
Greyscale plot of minimally processed magnetometer data - north east



SCALE 1:1500

0m 10 20 30 40 50m

KTD	DJS	FIG 10



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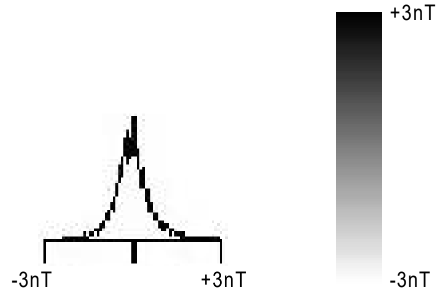
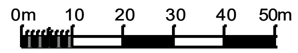
Driffield/Preston
Gloucestershire

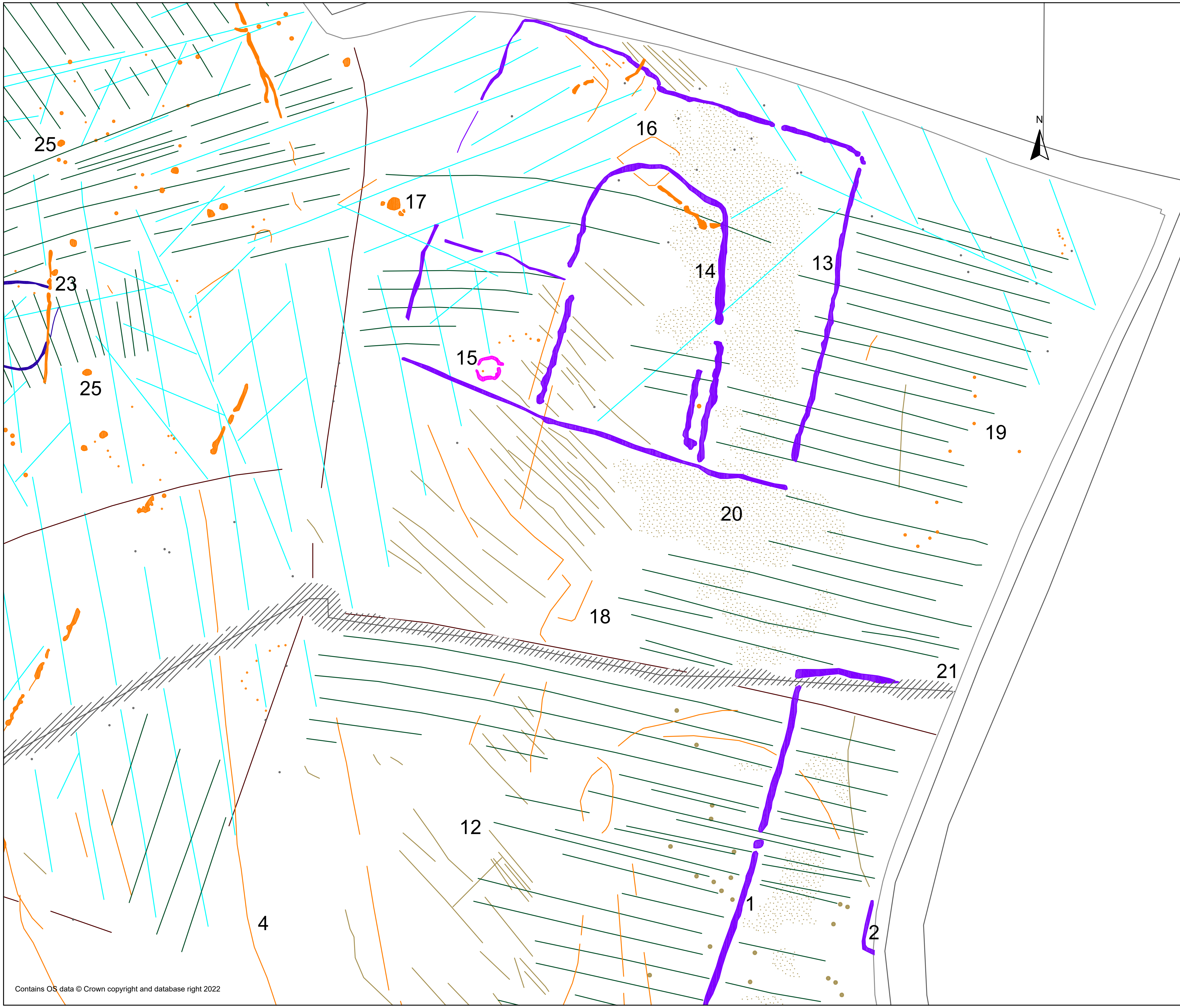
Greyscale plot of
filtered magnetometer data



SCALE 1:1500



KTD	DJS	FIG 11



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Abstraction and interpretation of magnetic anomalies - north east

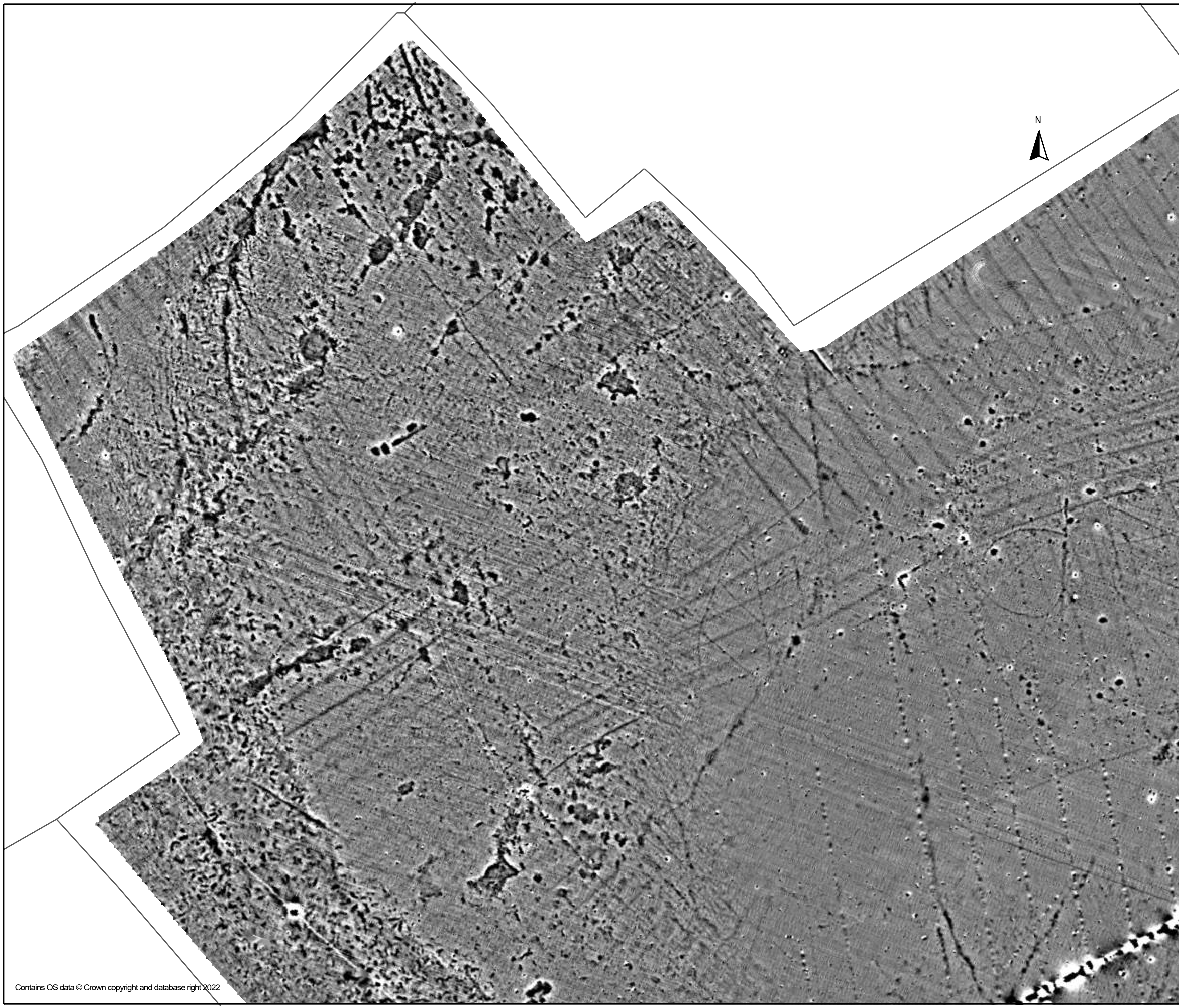
- Positive curvilinear/rectilinear anomaly - enclosure ditch
- Positive curvilinear anomaly - ring ditch
- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - ridge and furrow
- Positive/weak multiple dipolar linear anomaly - possible land drain
- Positive linear anomaly - former field boundary
- Positive linear anomaly - of natural origin
- Discrete positive response - possible pit-like feature
- Variable magnetic response - of natural origin
- Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - pipeline / cable / service
- Strong dipolar anomaly - ferrous object

SCALE 1:1500

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 12



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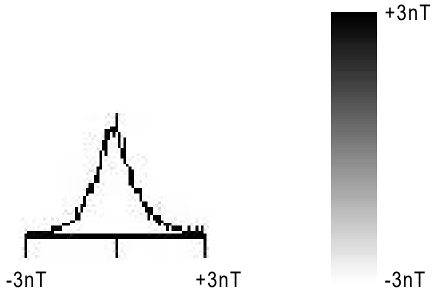
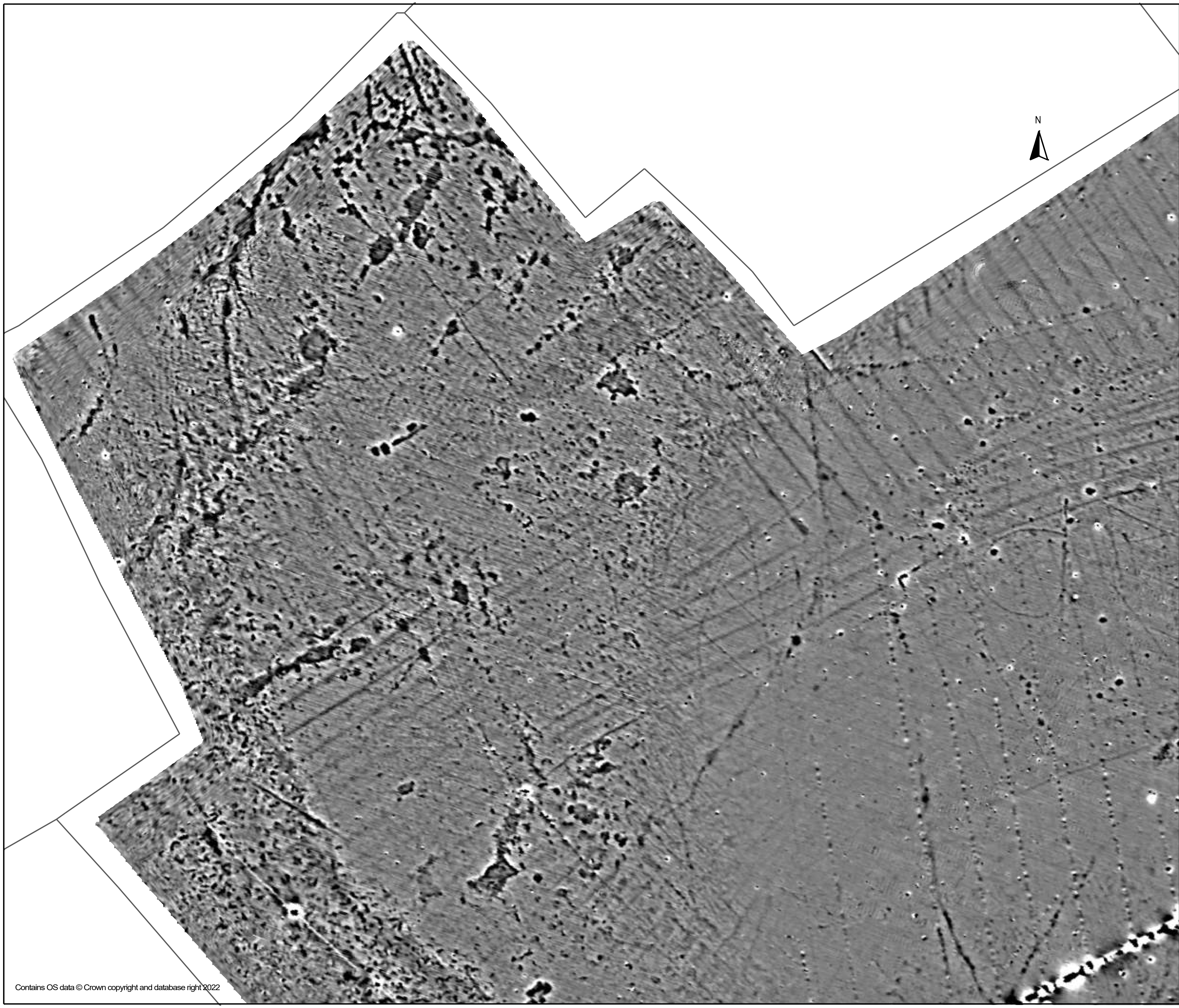
Greyscale plot of minimally processed magnetometer data - north west



SCALE 1:1500

0m 10 20 30 40 50m

KTD | DJS | FIG 13



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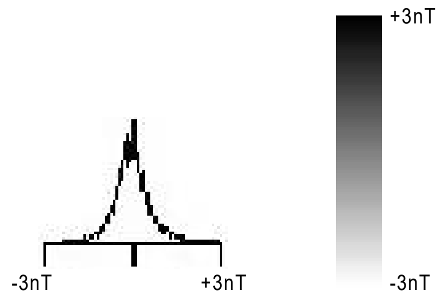
Driffield/Preston
Gloucestershire

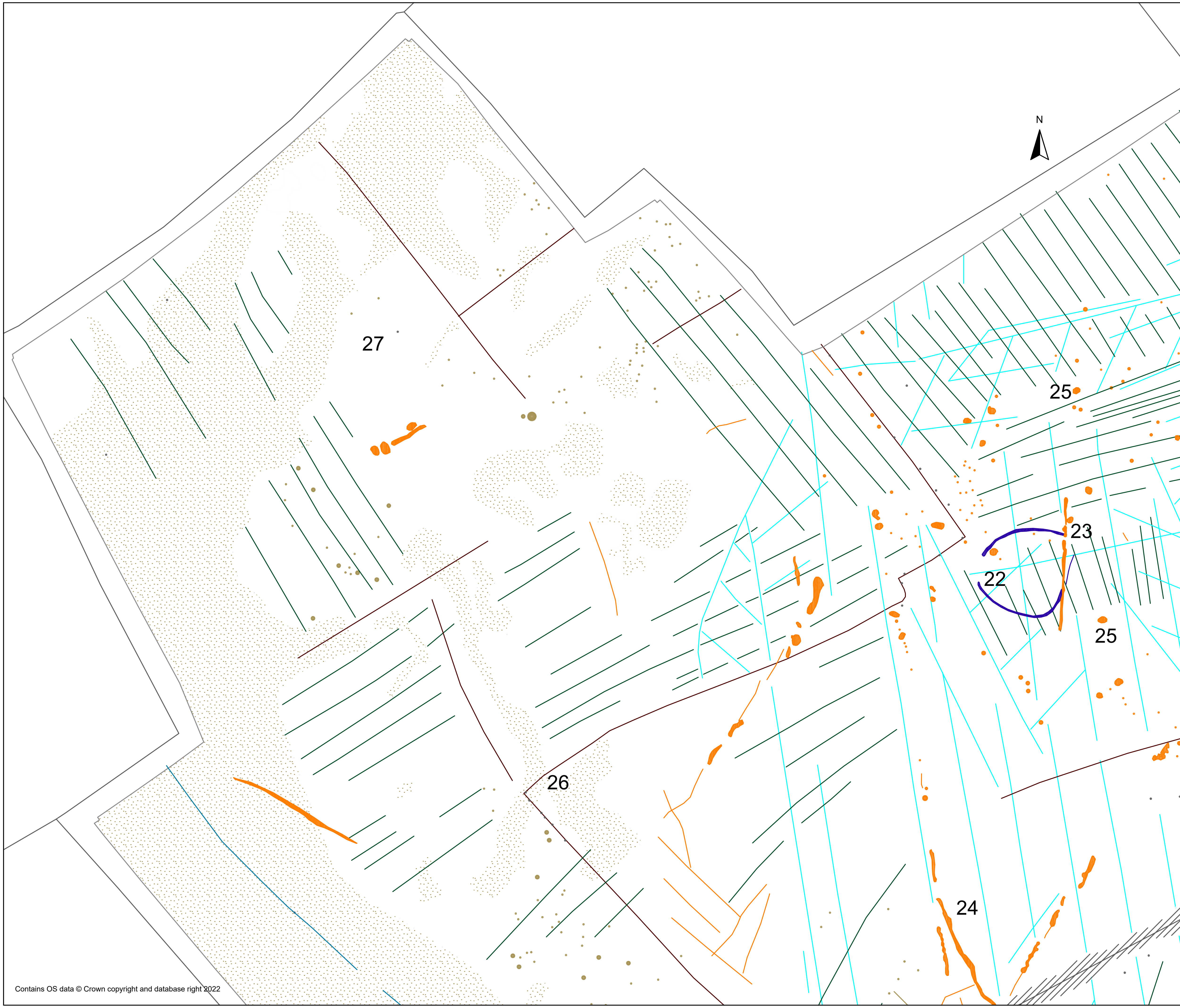
Greyscale plot of filtered magnetometer data



SCALE 1:1500

0m 10 20 30 40 50m

KTD	DJS	FIG 14



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Gloucestershire

Abstraction and interpretation of magnetic anomalies - north west

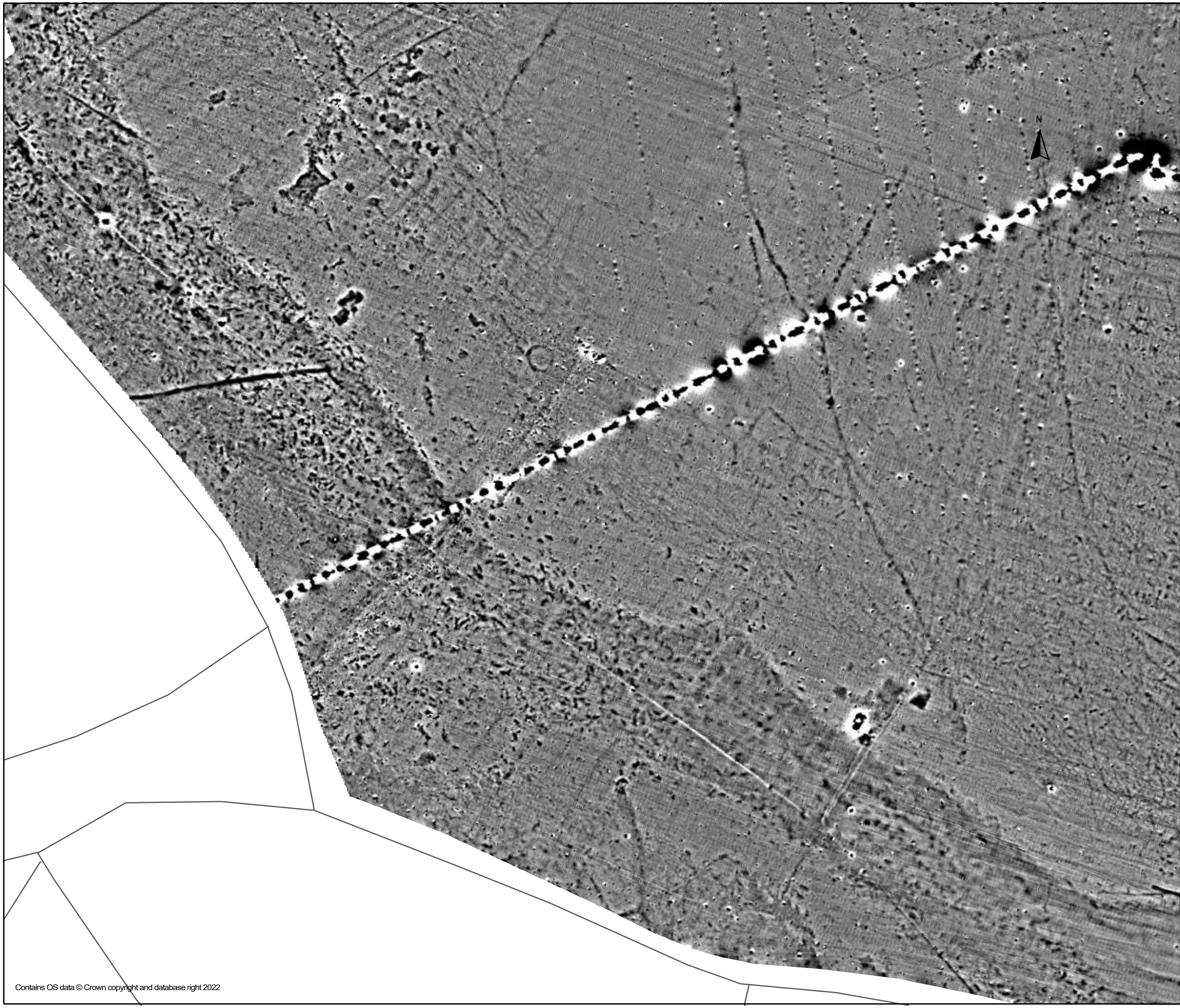
- Positive curvilinear anomaly - enclosure ditch
- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - ridge and furrow
- Positive/weak multiple dipolar linear anomaly - possible land drain
- Positive linear anomaly - former field boundary
- Discrete positive response - possible pit-like feature
- Discrete positive response - of natural origin
- Variable magnetic response - of natural origin
- Strong dipolar anomaly - ferrous object

SCALE 1:1500

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 15



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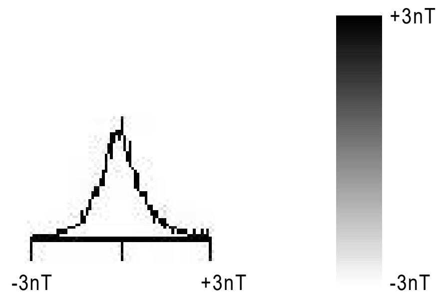
Gloucestershire

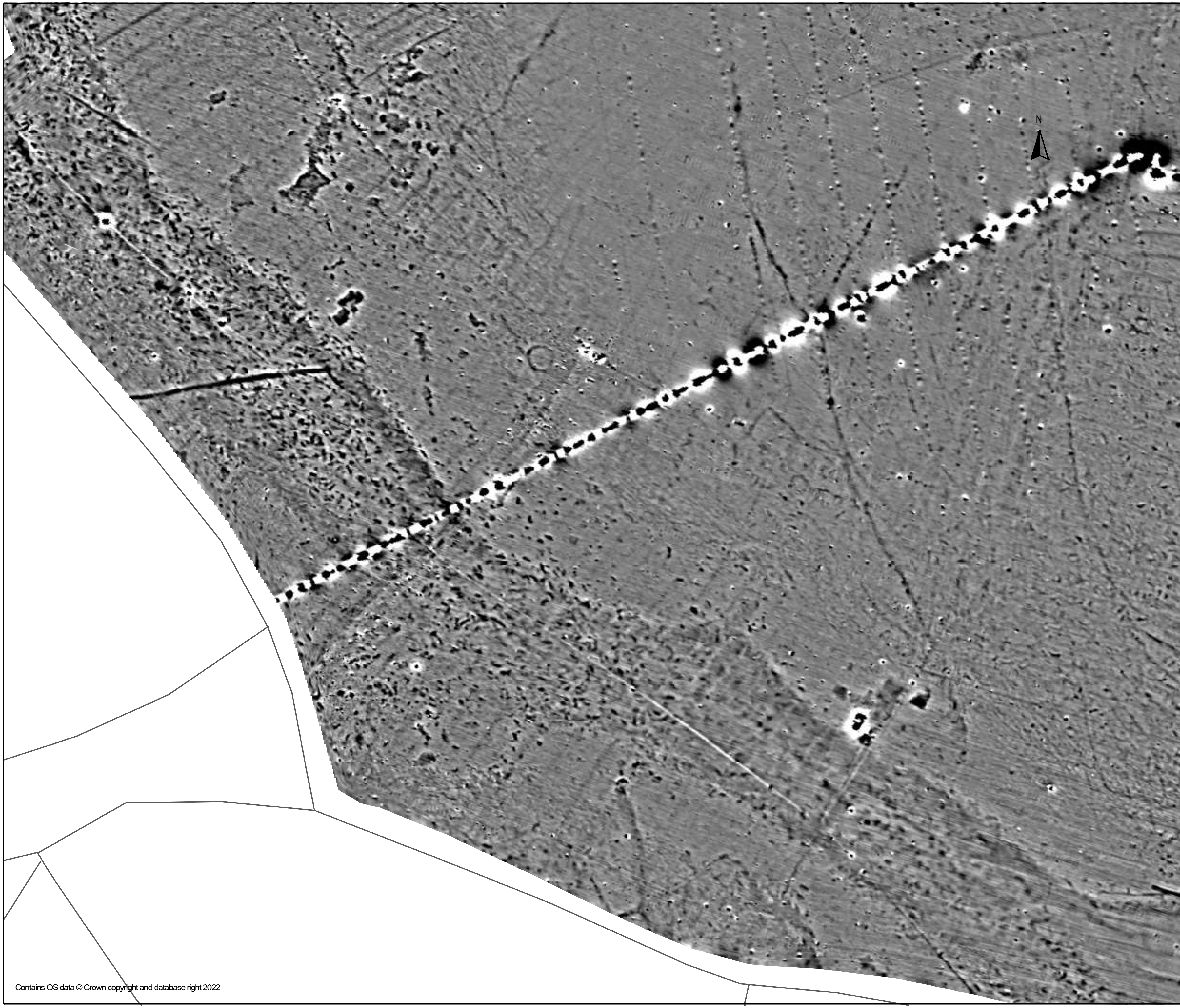
Greyscale plot of minimally processed magnetometer data - south west



SCALE 1:1500

0m 10 20 30 40 50m

KTD	DJS	FIG 16



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Land at Harnhill
Driffield/Preston
Gloucestershire

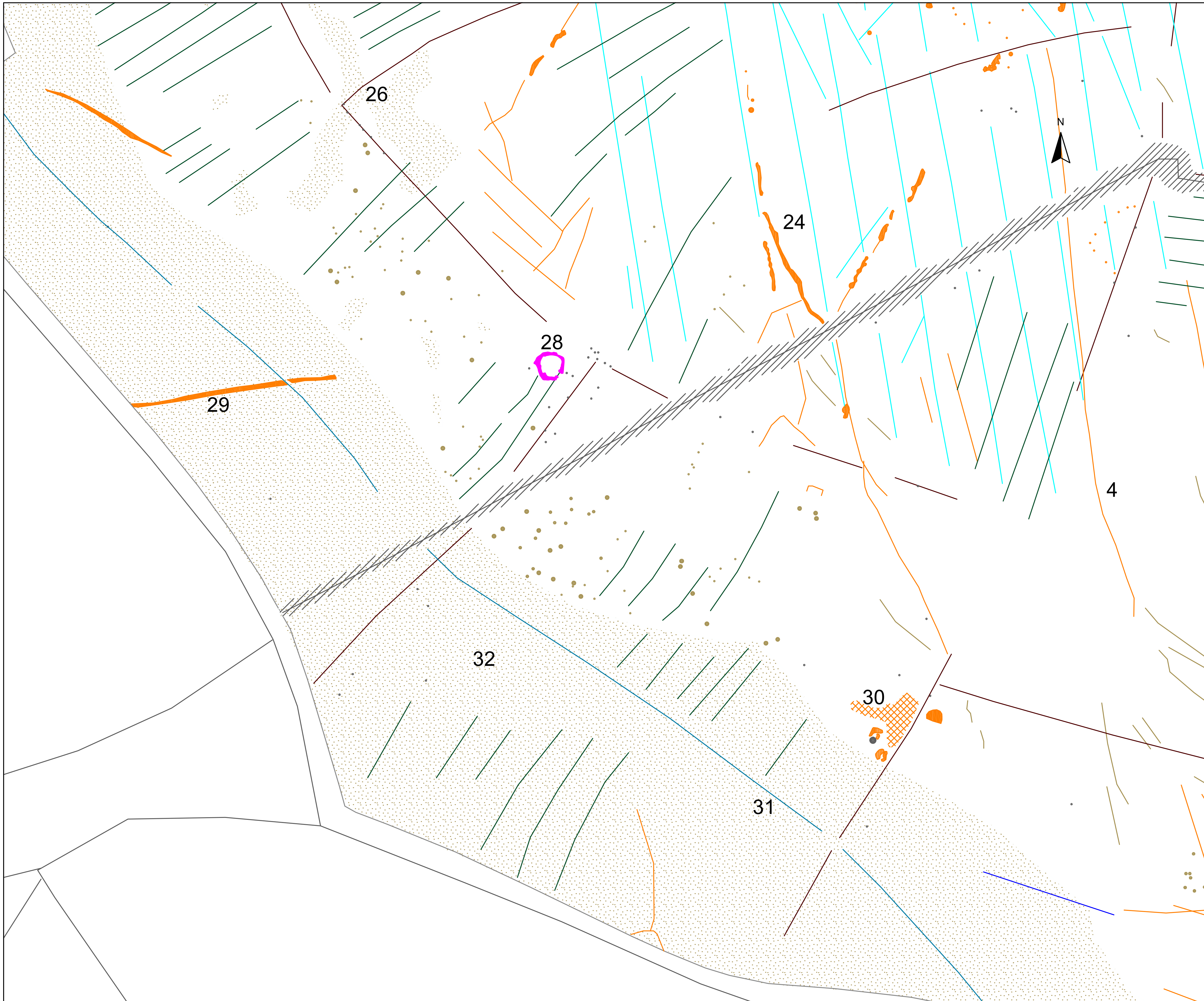
Greyscale plot of filtered magnetometer data - south west

+3nT
-3nT
-3nT +3nT

SCALE 1:1500

0m 10 20 30 40 50m

KTD	DJS	FIG 17



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Abstraction and interpretation of magnetic anomalies - south west

- Positive curvilinear anomaly - ring ditch
- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - ridge and furrow
- Positive/weak multiple dipolar linear anomaly - possible land drain
- Positive linear anomaly - former field boundary
- Negative linear anomaly - stone-lined drain
- Negative linear anomaly - of uncertain origin
- Discrete positive response - of natural origin
- Discrete positive response - possible pit-like feature
- Positive anomaly - magnetically enhanced material
- Variable magnetic response - of natural origin
- Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - pipeline / cable / service
- Strong dipolar anomaly - ferrous object

SCALE 1:1500

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 18

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Digital Terrain Model

Derived from Environment Agency's LiDAR data 1m resolution

SCALE 1:5000

0m 100 200m

KTD	DJS	FIG 19