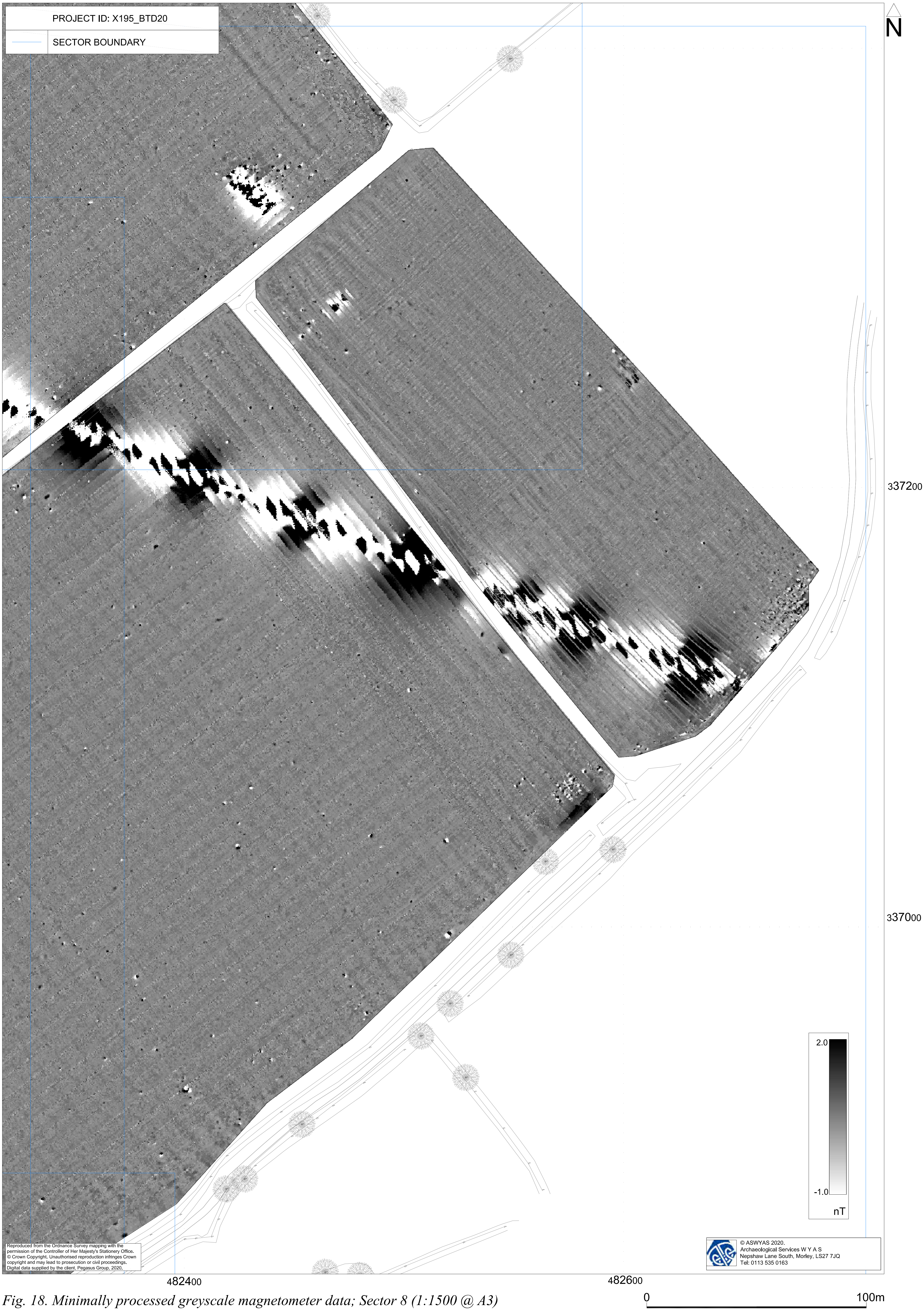

Fig. 18. Minimally processed greyscale magnetometer data; Sector 8 (1:1500 @ A3)

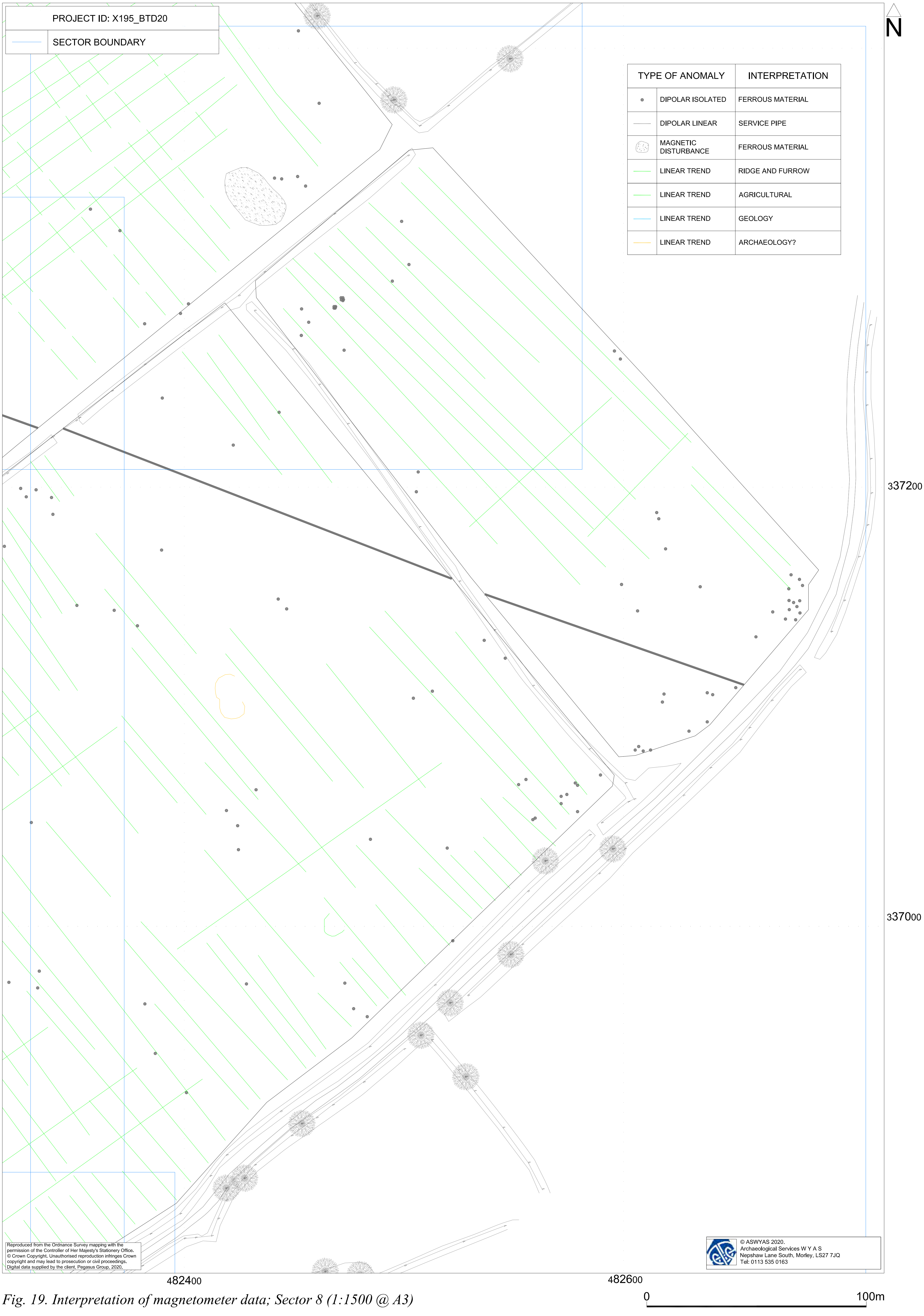

Fig. 19. Interpretation of magnetometer data; Sector 8 (1:1500 @ A3)

Fig. 20. Minimally processed greyscale magnetometer data; Sector 9 (1:1500 @ A3)

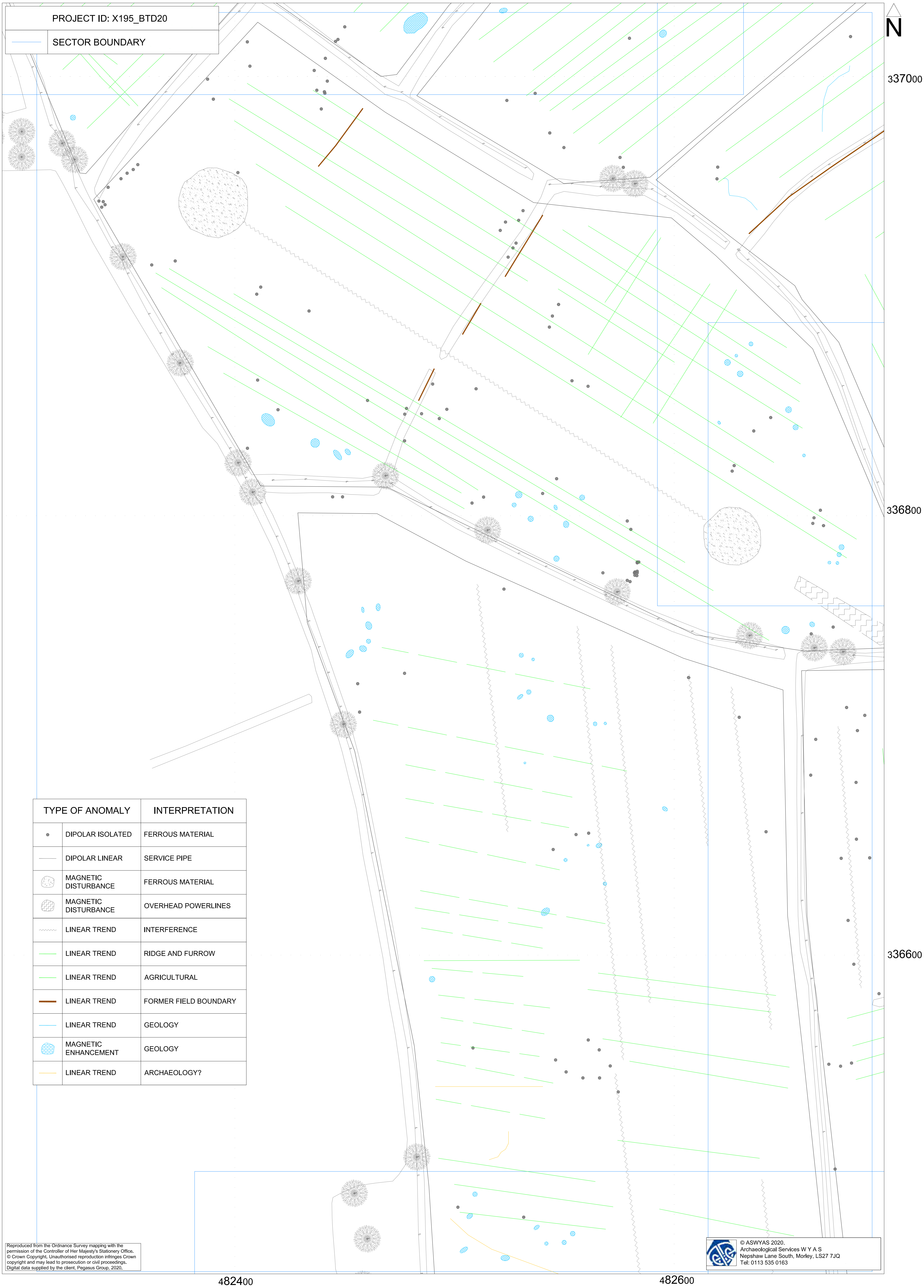

Fig. 21. Interpretation of magnetometer data; Sector 9 (1:1500 @ A3)

Fig. 22. Minimally processed greyscale magnetometer data; Sector 10 (1:1500 @ A3)

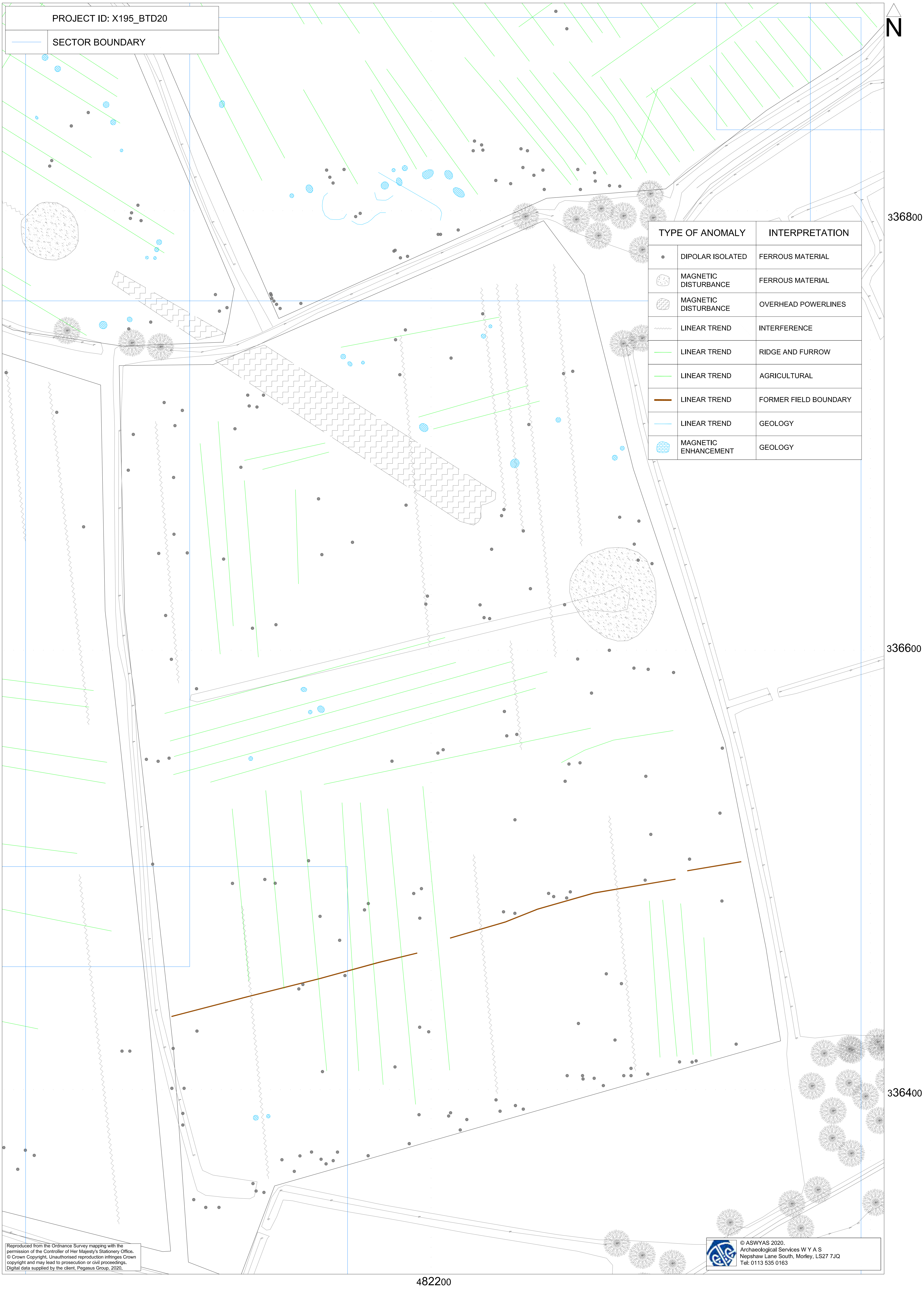

Fig. 23. Interpretation of magnetometer data; Sector 10 (1:1500 @ A3)

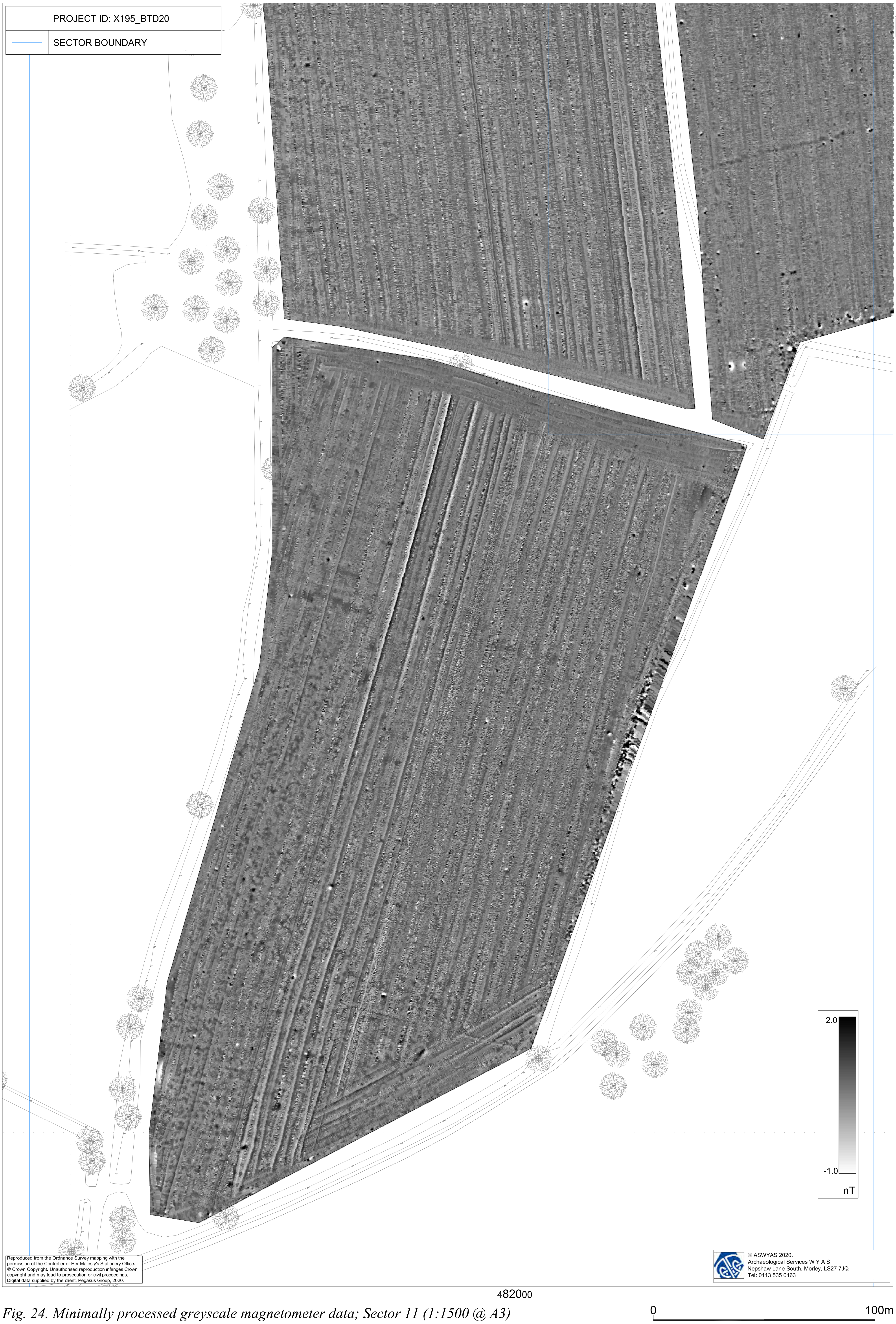

Fig. 24. Minimally processed greyscale magnetometer data; Sector 11 (1:1500 @ A3)

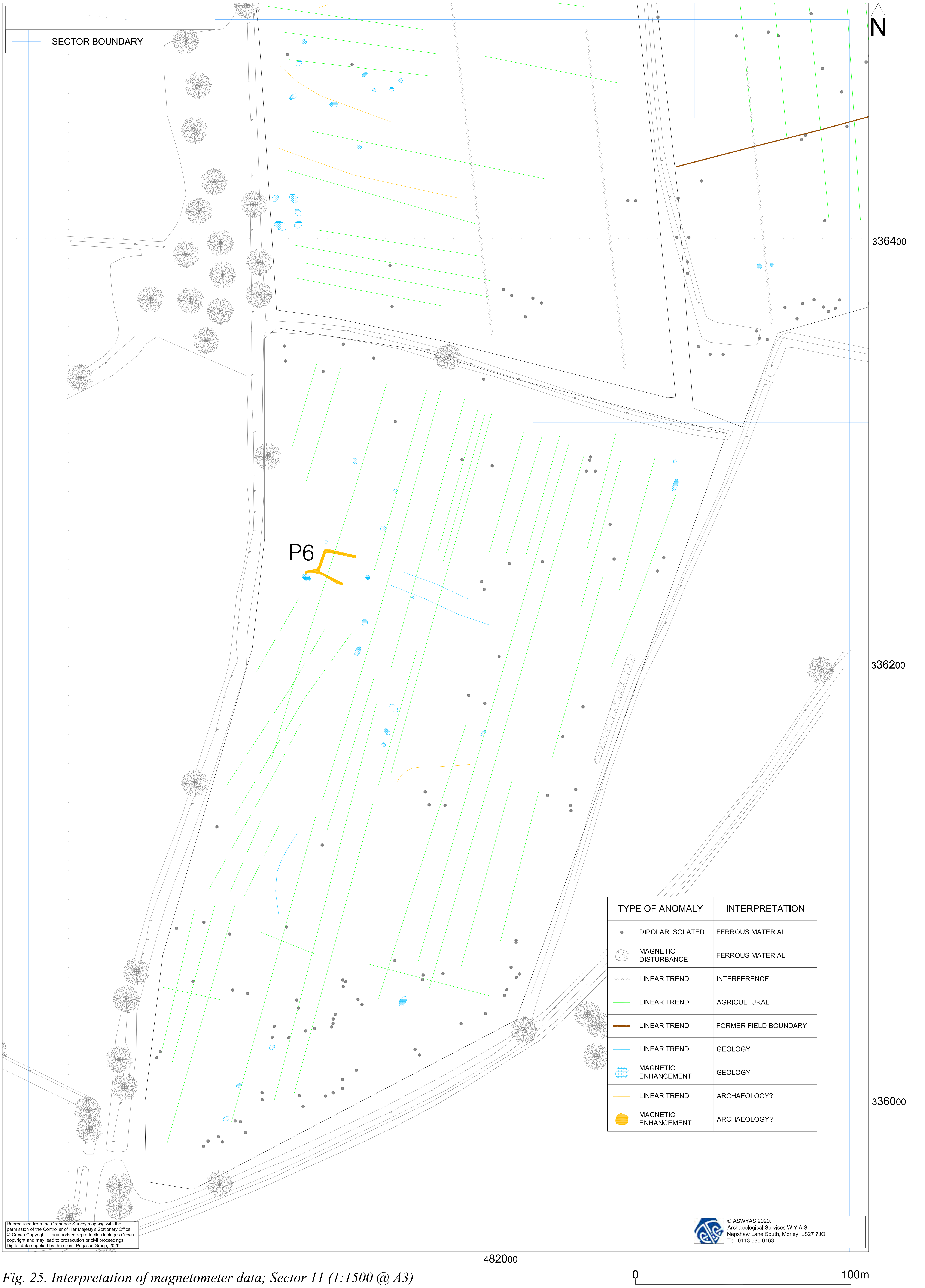

Fig. 25. Interpretation of magnetometer data; Sector 11 (1:1500 @ A3)

Plate 1. General view of Field 1, looking east

Plate 2. General view of Field 2, looking south

Plate 3. General view of Field 4, looking southeast

Plate 4. General view of Field 5, looking east

Plate 5. General view of Field 6, looking east

Plate 6. General view of Field 7, looking south

Plate 7. General view of Field 8, looking north

Plate 8. General view of Field 9, looking north

Plate 9. General view of Field 11, looking northwest

Plate 10. General view of Field 12, looking north

Plate 11. General view of Field 13, looking northwest

Plate 12. General view of Field 14, looking northwest

Plate 13. General view of Field 15, looking south

Plate 14. General view of Field 16, looking north

Appendix 1: Magnetic survey - technical information

Magnetic Susceptibility and Soil Magnetism

Iron makes up about 6% of the Earth's crust and is mostly present in soils and rocks as minerals such as maghaemite and haemetite. These minerals have a weak, measurable magnetic property termed magnetic susceptibility. Human activities can redistribute these minerals and change (enhance) others into more magnetic forms. Areas of human occupation or settlement can then be identified by measuring the magnetic susceptibility of the topsoil because of the attendant increase (enhancement) in magnetic susceptibility. If the enhanced material subsequently comes to fill features, such as ditches or pits, localised isolated and linear magnetic anomalies can result whose presence can be detected by a magnetometer (fluxgate gradiometer).

In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of topsoils, subsoils and rocks into which these features have been cut, which causes the most recognisable responses. This is primarily because there is a tendency for magnetic ferrous compounds to become concentrated in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected. The magnetic susceptibility of a soil can also be enhanced by the application of heat and the fermentation and bacterial effects associated with rubbish decomposition. The area of enhancement is usually quite large, mainly due to the tendency of discard areas to extend beyond the limit of the occupation site itself, and spreading by the plough.

Types of Magnetic Anomaly

In the majority of instances anomalies are termed 'positive'. This means that they have a positive magnetic value relative to the magnetic background on any given site. However some features can manifest themselves as 'negative' anomalies that, conversely, means that the response is negative relative to the mean magnetic background.

Where it is not possible to give a probable cause of an observed anomaly a '?' is appended.

It should be noted that anomalies interpreted as modern in origin might be caused by features that are present in the topsoil or upper layers of the subsoil. Removal of soil to an archaeological or natural layer can therefore remove the feature causing the anomaly.

The types of response mentioned above can be divided into five main categories that are used in the graphical interpretation of the magnetic data:

Isolated dipolar anomalies (iron spikes)

These responses are typically caused by ferrous material either on the surface or in the topsoil. They cause a rapid variation in the magnetic response giving a characteristic 'spiky' trace. Although ferrous archaeological artefacts could produce this type of response, unless there is supporting evidence for an archaeological interpretation, little emphasis is normally given to such anomalies, as modern ferrous objects are common on rural sites, often being present as a consequence of manuring.

Areas of magnetic disturbance

These responses can have several causes often being associated with burnt material, such as slag waste or brick rubble or other strongly magnetised/fired material. Ferrous structures such as pylons, mesh or barbed wire fencing and buried pipes can also cause the same disturbed response. A modern origin is usually assumed unless there is other supporting information.

Linear trend

This is usually a weak or broad linear anomaly of unknown cause or date. These anomalies are often caused by agricultural activity, either ploughing or land drains being a common cause.

Areas of magnetic enhancement/positive isolated anomalies

Areas of enhanced response are characterised by a general increase in the magnetic background over a localised area whilst discrete anomalies are manifest by an increased response on two or three successive traverses. In neither instance is there the intense dipolar response characteristic exhibited by an area of magnetic disturbance or of an 'iron spike' anomaly (see above). These anomalies can be caused by infilled discrete archaeological features such as pits or post-holes or by kilns. They can also be caused by pedological variations or by natural infilled features on certain geologies. Ferrous material in the subsoil can also give a similar response. It can often therefore be very difficult to establish an anthropogenic origin without intrusive investigation or other supporting information.

Linear and curvilinear anomalies

Such anomalies have a variety of origins. They may be caused by agricultural practice (recent ploughing trends, earlier ridge and furrow regimes or land drains), natural geomorphological features such as palaeochannels or by infilled archaeological ditches.

Methodology: Gradiometer Survey

The main method of using the fluxgate gradiometer for commercial evaluations is referred to as ***detailed survey*** and requires the surveyor to walk at an even pace carrying the instrument within a grid system. A sample trigger automatically takes readings at predetermined points, typically at 0.25m intervals, on traverses 1m apart. These readings are stored in the memory of the instrument and are later dumped to computer for processing and interpretation.

During this survey an eight channel Sensys MX V3 system containing eight FGM650 sensors was used which was towed across the area using an ATV. Readings were taken every 20MHz (between 0.05 and 0.1m). Data was be recorded onto a device, using a Carlson GNSS Smart antenna, for centimetre accuracy. These readings were stored in the memory of the instrument and downloaded for processing and interpretation

The gradiometer data have been presented in this report in processed greyscale format. The data in the greyscale images have been interpolated and selectively filtered to remove the effects of drift in instrument calibration and other artificial data constructs and to maximise the clarity and interpretability of the archaeological anomalies.

Appendix 2: Survey location information

An initial survey station was established using a Trimble VRS differential Global Positioning System (Trimble R6 model). The data was geo-referenced using the geo-referenced survey station with a Trimble RTK differential Global Positioning System (Trimble R6 model). The accuracy of this equipment is better than 0.01m. The survey grids were then super-imposed onto a base map provided by the client to produce the displayed block locations. However, it should be noted that Ordnance Survey positional accuracy for digital map data has an error of 0.5m for urban and floodplain areas, 1.0m for rural areas and 2.5m for mountain and moorland areas. This potential error must be considered if co-ordinates are measured off hard copies of the mapping rather than using the digital co-ordinates.

Archaeological Services WYAS cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party.

Appendix 3: Geophysical archive

The geophysical archive comprises:-

- an archive disk containing compressed (WinZip 8) files of the raw data, report text (Microsoft Word 2000), and graphics files (Adobe Illustrator CS2 and AutoCAD 2008) files; and
- a full copy of the report.

At present the archive is held by Archaeological Services WYAS although it is anticipated that it may eventually be lodged with the Archaeology Data Service (ADS). Brief details may also be forwarded for inclusion on the English Heritage Geophysical Survey Database after the contents of the report are deemed to be in the public domain (i.e. available for consultation in the Leicestershire Historic Environment Record).

Appendix 4: Oasis form

OASIS DATA COLLECTION FORM: England

Printable version

OASIS ID: archaeol11-405580

Project details

Project name	Belvoir Solar Farm, Bottesford
Short description of the project	A geophysical (cart-based magnetometer) survey was undertaken on approximately 134 hectares of land located to the south of Bottesford, Leicestershire. Anomalies of a possible archaeological origin have been detected including a ring ditch, sub-rectangular enclosures, linear features and pit-like responses. Medieval ridge and furrow cultivation have also been detected along with former field boundaries and modern ploughing. Geological responses can be seen throughout whilst ferrous responses are associated with modern debris, pylons and overhead power cables. Based on the geophysical survey and interpretation of the results the archaeological potential of the site is medium to high in the northwest and low elsewhere.
Project dates	Start: 07-09-2020 End: 25-09-2020
Previous/future work	No / Not known
Any associated project reference codes	BTD20 - Sitecode
Any associated project reference codes	MLE3405 - SM No.
Any associated project reference codes	MLE3404 - SM No.
Type of project	Field evaluation
Monument type	RING DITCH Bronze Age
Monument type	ENCLOSURE Iron Age
Significant Finds	RING DITCH Bronze Age
Significant Finds	ENCLOSURE Uncertain
Methods & techniques	"Geophysical Survey"
Development type	Solar
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Not known / Not recorded

Solid geology	MAGNESIAN LIMESTONE
Drift geology	GLACIAL SAND AND GRAVEL
Techniques	Magnetometry

Project location

Country	England
Site location	LEICESTERSHIRE MELTON BOTTESFORD Belvoir Solar Farm, Bottesford
Study area	134 Hectares
Site coordinates	SK 8212 3748 52.928120250839 -0.778228936658 52 55 41 N 000 46 41 W Point
Height OD / Depth	Min: 39m Max: 49m

Project creators

Name of Organisation	Archaeological Services WYAS
Project brief originator	Pegasus Group
Project design originator	Pegasus Group
Project director/manager	E Brunning
Project supervisor	C. Sykes

Project archives

Physical Archive Exists?	No
Digital Archive recipient	Pegasus Group
Digital Contents	"Survey"
Digital Media available	"Geophysics","Images raster / digital photography","Survey","Text"
Paper Archive Exists?	No

Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	Belvoir Solar Farm, Bottesford
Author(s)/Editor(s)	Brunning, E
Date	2020
Issuer or publisher	ASWYAS
Place of issue or publication	Leeds
Description	A4 report with A3 figures

Entered by	Emma Brunning (emma.brunning@aswyas.com)

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