

LUTL18



# PROPOSED EAST OF LUTTERWORTH SDA, LEICESTERSHIRE

GEOPHYSICAL SURVEY

commissioned by Leicestershire County Council

January 2019



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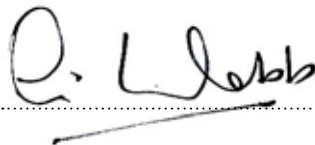
#### PROJECT INFO:

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## PROJECT SUMMARY

Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey of a 235 hectares site immediately east of Lutterworth, Leicestershire, to provide information on the archaeological potential of the site, identified as a Strategic Development Area (SDA), prior to the submission of a planning application for a proposed residential and local infrastructure development. The survey has identified eight areas of archaeological potential (AAA), in the southern and central parts of the SDA, on higher and prominent positions overlooking the River Swift and its tributary. Clusters of enclosures of differing size and morphology (some with evidence of settlement activity, including roundhouses) trackways and round barrows of likely later prehistoric and early Romano-British origin have been identified. In AAA1, AAA2, AAA4 and AAA5 the level of archaeological activity is greater than indicated from cropmarks and previous geophysical surveys, whilst the archaeological features identified in AAA3, AAA6, AAA7 and AAA8 were not previously known. The survey has also identified numerous discrete anomalies due to geological variations in the soil as well as linear trend anomalies caused by medieval and post-medieval agricultural activity over the entirety of the site. Overall, the survey has successfully evaluated the archaeological potential of the site. On the basis of the survey, the southern and central area of the SDA is assessed as of high archaeological potential, while in the north the potential is assessed as medium to low.

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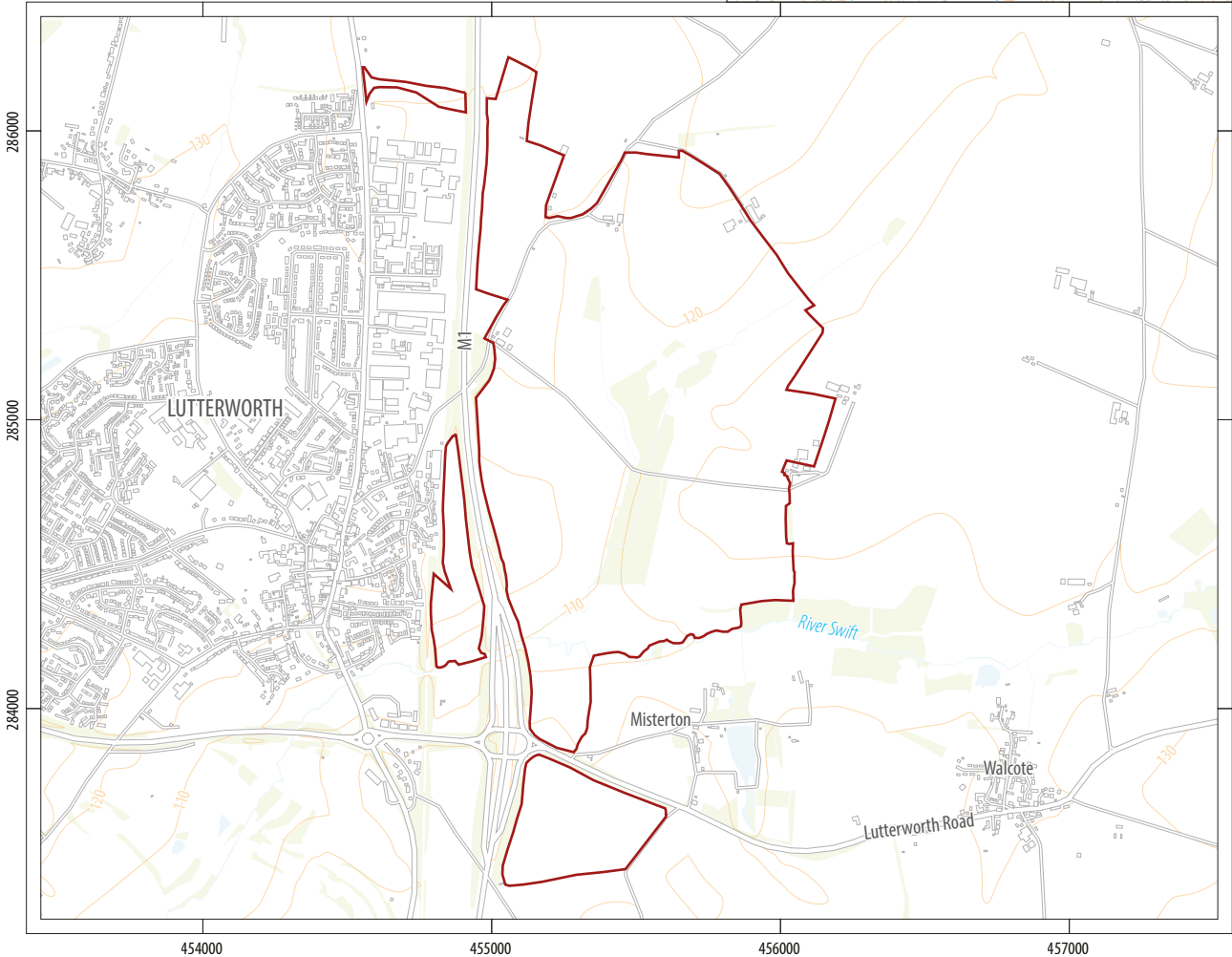
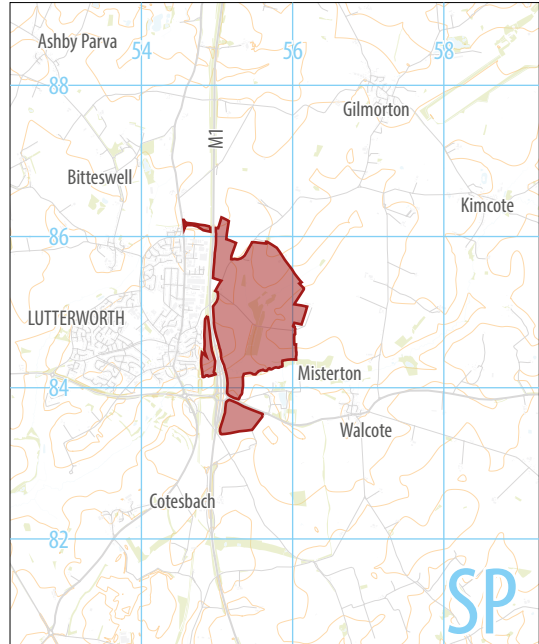
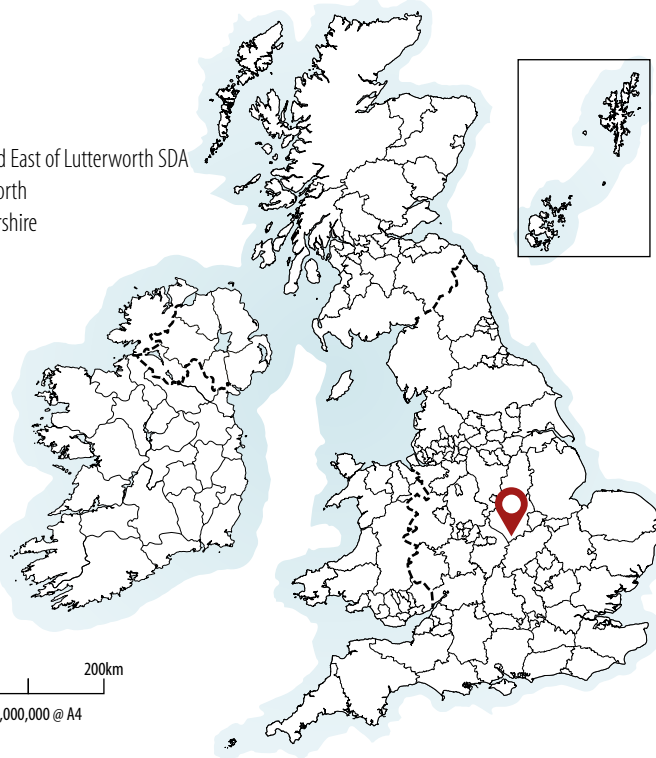
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Proposed East of Lutterworth SDA  
Lutterworth  
Leicestershire

0 200km  
1:10,000,000 @ A4



0 500m  
1:25,000 @ A4

 strategic development area boundary

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# PROPOSED EAST OF LUTTERWORTH SDA, LEICESTERSHIRE

## GEOPHYSICAL SURVEY

### 1 INTRODUCTION

Headland Archaeology was commissioned by Leicestershire County Council (the Client), to undertake a geophysical (magnetometer) survey on land east of Lutterworth, Leicestershire which is identified as an SDA being proposed for residential development with associated infrastructure. The survey was undertaken in order to support any future planning proposal by assessing the heritage potential of the SDA, therefore the impact of any proposed development on the historic environment.

The work was undertaken in accordance with a Written Scheme of Investigation (WSI) (Dyulgerski 2018), with guidance within the National Planning Policy Framework (MHCLG 2018) and in line with current best practice (Chartered Institute for Archaeologists 2016, Europae Archaeologia Consilium 2016).

#### 1.1 SITE LOCATION, TOPOGRAPHY AND LAND-USE

The SDA roughly comprises four irregularly shaped parcels of land immediately east of Lutterworth, split on either side of the M1, and centred on NGR SP 5539 8472 (Illus 1). All of the land within the SDA was in agricultural use at the time of survey (see Illus 2–4) and comprised 63 fields (F1–F63 inclusive). Thirteen fields were under arable cultivation with the remainder pasture and silage with the exception of the fields on the river floodplain which were unsuitable for survey due to dense vegetation (see Illus 6–7).

The southern area comprising of F62 and F63 is bounded to the south and west by Warren Farm and the M1, and by Lutterworth Road, the A4304, to the north. The western area comprising of

F58, F59 and F60 is bounded by the M1 to the east, Lutterworth to the west and the River Swift to the south. The north-western area comprising of F1 and F2 is bounded by Lutterworth to the south, the M1 to the east and Leicester Road, the A426, to the west. The central area comprising of the rest of the fields in the SDA is bounded by the M1 to the east, Gilmorton Road to the north, Lutterworth Road, the A4304, to the south and Thornborough Farm, Oback Farm and Lea Barn Farm to the east, with a tributary of the River Swift flowing in a north/south direction, cutting the SDA into eastern and western halves.

The SDA's topography is variable, rising from 108m Above Ordnance Datum (AOD) on either side of the watercourses in the centre of the site to 133m AOD in the detached north-western parcel of the SDA (Illus 10).

The survey was carried out between the 22nd October and 21st November 2018.

#### 1.2 GEOLOGY AND SOILS

The recorded geology of the site comprises Blue Lias Formation mudstone and sandstone, overlain by diamicton (boulder clay). The geology along the course of the River Swift and its tributaries comprise of Charmouth Formation mudstone overlain by alluvium (NERC 2018).

The soils are classified in the Soilscape 18 Association in the north being characterised as slowly permeable, seasonally wet, loams and clays. In the south of the SDA, they comprise freely draining slightly acid loamy soils in the Soilscape 6 Association (Cranfield University 2018).

## 2 ARCHAEOLOGICAL BACKGROUND

A Heritage Statement (HS) (Pratt, 2018) prepared by Cotswold Archaeology prior to the survey, identified four areas of late prehistoric activity in the south and central parts of the SDA. Air photographs show cropmarks identified as possible enclosures in F62 and F63 and ring-ditches in the fields adjacent to the south-eastern boundary of the SDA. A geophysical survey conducted in 1997 identified a settlement and an associated field system, with one curvilinear and two large rectangular enclosures in the north-west corner of F63. The HS has also noted a cropmark interpreted as a 'clothes line' enclosure in F61 directly south of the bank of the River Swift which showed linear ditches with associated smaller enclosures. In the north-western part of F49, a large circular enclosure with a diameter of 85m was discovered following its truncation by the construction of the M1. This feature has been interpreted as a livestock enclosure due to its size and lack of internal features. The fourth area of archaeological activity is located in the south-western corner of F44. Here cropmarks suggest the presence of a double-ditched sub-square enclosure, measuring 85m by 85m with associated pendant enclosures.

Fieldwalking surveys within the SDA have recovered relatively few finds of Romano-British date. However, an excavation on land south of F1 and F2 uncovered a single pit and six ditches. Sixty-two pottery sherds dating from the 1st century AD were recovered from the ditch fills.

Air photographs have also documented the widespread presence of ridge and furrow cultivation across the SDA. Given the fact that the site is part of the agricultural hinterland of the parishes of Misterton and Lutterworth evidence of medieval and post-medieval cultivation is likely.

Due to the substantial evidence for prehistoric, Roman, medieval and post-medieval archaeological activity in the SDA and the immediate environs, the HS assessed the archaeological potential as high with a high probability for previously unrecorded remains to be present.

## 3 AIMS, METHODOLOGY AND PRESENTATION

The general aim of the geophysical survey was to provide sufficient information and to establish the presence/absence, character and extent of any archaeological remains within the SDA. This will, therefore, enable an assessment to be made of the impact of the proposed development on any sub-surface archaeological remains if present.

The specific archaeological objectives of the geophysical survey were:

- › Gather sufficient information to inform the extent, condition, character and date (as far as circumstances permit) of any archaeological features and deposits within the survey area;

- › to obtain information that will contribute to an evaluation of the significance of the scheme upon cultural heritage assets; and
- › to prepare a report summarising the results of the survey.

### 3.1 MAGNETOMETER SURVEY

Magnetic survey methods rely on the ability of a variety of instruments to measure very small magnetic fields associated with buried archaeological remains. A feature such as a ditch, pit or kiln can act like a small magnet, or series of magnets, that produce distortions (anomalies) in the earth's magnetic field. In mapping these slight variations, detailed plans of sites can be obtained as buried features often produce reasonably characteristic anomaly shapes and strengths (Gaffney & Gater 2003). Further information on soil magnetism and the interpretation of magnetic anomalies is provided in Appendix 1.

The survey was undertaken using four Bartington Grad601 sensors mounted at 1m intervals (1m traverse interval) onto a rigid carrying frame. The system was programmed to take readings at a frequency of 10Hz (allowing for a 10–15cm sample interval) on roaming traverses (swaths) 4m apart. These readings were stored on an external weatherproof laptop and later downloaded for processing and interpretation. The system was linked to a Trimble R8s Real Time Kinetic (RTK) differential Global Positioning System (dGPS) outputting in NMEA mode to ensure a high positional accuracy for each data point.

MLGrad601 and MultiGrad601 (Geomar Software Inc.) software was used to collect and export the data. Terrasurveyor V3.0.32.4 (DWConsulting) software was used to process and present the data.

### 3.2 REPORTING

A general site location plan is shown in Illus 1 at a scale of 1:25,000. Illus 2 to Illus 6 inclusive are site condition photographs. Illus 7 is a 1:10,000 survey location plan showing the direction of survey as GPS swaths and photograph locations. Illus 8 and Illus 9 present the overall greyscale and interpretative plot at a scale of 1:10,000. Illus 10 presents the juxtaposition between the interpretative plot, the geological information and the major topographical contours at a scale of 1:10 000. Large-scale, fully processed (greyscale) data, minimally processed data (XY traceplot) and accompanying interpretative plots are presented at a scale of 1:2,500 in Illus 11 to Illus 34 inclusive. Larger scale (1:1000) plots of the eight areas of archaeological activity (AAA) are presented in Illus 35 to Illus 73 inclusive.

Technical information on the equipment used, data processing and magnetic survey methodology is given in Appendix 1. Appendix 2 details the survey location information and Appendix 3 describes the composition and location of the site archive. Data processing details are presented in Appendix 4. A copy of the OASIS entry (Online Access to the Index of Archaeological Investigations) is reproduced in Appendix 5.

The survey methodology, report and any recommendations comply with the Written Scheme of Investigation (Dyulgerski 2018),



ILLUS 2 F52, looking south-east

guidelines outlined by Europae Archaeologia Consilium (EAC 2016) and by the Chartered Institute for Archaeologists (Cifa 2016). All illustrations from Ordnance Survey mapping are reproduced with the permission of the controller of Her Majesty's Stationery Office (© Crown copyright).

*The illustrations in this report have been produced following analysis of the data in 'raw' and processed formats and over a range of different display levels. All illustrations are presented to most suitably display and interpret the data from this site based on the experience and knowledge of management and reporting staff.*

## 4 RESULTS AND DISCUSSION

The ground conditions were good throughout (see Illus 2–4) with the exception of some of the lower lying parts of the SDA near to the rivers which were overgrown and unsuitable for survey (see Illus 5 –6). The overall data quality is good.

In the majority of the SDA, the survey has detected a relatively homogenous magnetic background which is characterised by discrete areas of magnetic enhancement. These are caused by localised variations in the depth and composition of the soil. Against this background, numerous linear and discrete anomalies of geological, agricultural and archaeological nature have been identified. These anomalies are discussed below and cross-

referenced to specific examples on the interpretive figures, where appropriate.

In F56, F55, F57 and the northern part of F51, the survey has detected a highly elevated and speckled magnetic background that is characteristic of the recent application of 'green waste' as soil conditioner. Against this variable background a number of linear and discrete anomalies have been identified and cross-referenced, however, it should be noted that against such an artificially elevated magnetic background it is very difficult to pick potentially weaker responses.

### 4.1 FERROUS ANOMALIES

Ferrous anomalies, characterised as individual 'spikes', are typically caused by ferrous (magnetic) material, either on the ground surface or in the plough-soil. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as modern ferrous debris is common on most sites, often being present as a consequence of manuring or tipping/infilling. There is no obvious clustering to these ferrous anomalies which might indicate an archaeological origin. Far more probable is that the 'spike' responses are likely caused by the random distribution of ferrous debris in the upper soil horizons.

In F63, F61, F60, F59, F58, F46, F45, F41, F39, F39, F36, F29, F26 and F22, 13 high magnitude dipolar linear anomalies; Illus 8–10 inclusive) are identified. These anomalies are caused by buried service pipes.



**ILLUS 3** F63, looking south-east

In fields F62, F45, F43, F42, F39, F15, F9, F4 and F3 (Illus 8–10) nine areas of magnetic disturbance are due to the proximity of electric pylons and manholes.

In the south-west of F63 (see Illus 32–34) and the north-east of F30 (see Illus 20–22) two high magnitude bipolar anomalies have been detected by the survey. These anomalies are thought to be caused by a lightning strike hitting the upper soil horizons. The magnetic amplitude of the anomalies appears to decrease with distance from the central strike point.

In F47, a large area of magnetic disturbance running north/south is due to infilling/tipping.

Magnetic disturbance around the field edges is due to ferrous material within, or adjacent to the boundaries and is of no archaeological interest.

A linear band of disturbance aligned north/south along the eastern edge of F2 marks the route of a former railway line.

## 4.2 AGRICULTURAL ANOMALIES

Parallel linear trend anomalies on differing alignments, but mostly parallel or orthogonal to the current field boundaries, have been identified in all of the fields except F54, F57, F24 and F10. The slightly elongated S-shaped anomalies are indicative of the former agricultural practice of ridge and furrow cultivation. In the pasture fields, the cultivation strips still survive as slight earthworks.

In F56, F55, F57 and F51 (Illus 14–16, 26–28) extensive areas of high magnitude magnetic responses have been detected by the survey. These responses are characteristic of green waste which has been spread into the topsoil as soil conditioner. The response is not fully understood but is thought to be caused by the presence of magnetic compounds in the soil created during decomposition, and by ferrous contaminants within the waste material. Even though agricultural and possible archaeological anomalies have been detected against this background, it is possible that low magnitude anomalies (such as from an archaeological feature), if present, may be masked against this magnetic background.

A series of linear anomalies identified in F48, F45, F46 and F61 (Illus 29–31, 26–28, 23–25), oblique to the extant field boundaries and exhibiting a 'speckled' appearance, are caused by field drains. It is worth noting that according to the HS, the cropmarks on the north side of F61 suggests the existence of a 'clothes line' settlement. However, due to the speckled appearance, the low elevation, the proximity to the River Swift and the presence of field drains in the adjacent F46, a drainage system is a more plausible interpretation.

## 4.3 GEOLOGICAL ANOMALIES

Numerous low magnitude discrete anomalies are identified across the SDA. These are likely due to the variation in the depth and composition of the soils.



ILLUS 4 F2, looking north-east

Broad sinuous and curvilinear low magnitude anomalies are identified in F10 and F46 (Illus 17–19, Illus 23–25, Illus 29–31). These anomalies are interpreted as alluvial deposits caused by former tributaries connecting to the channel of the River Swift.

#### 4.4 ARCHAEOLOGICAL ANOMALIES

*Unless specified all the linear anomalies described are likely to be due to soil filled cut features, such as ditches, forming clear patterns of enclosure and land division. Against a variable magnetic background, it is difficult to confidently discriminate between discrete anomalies which may be due to archaeological features, such as pits, which may be indicative of occupational activity and those that are probably due to localised geological variation. For this reason, most of the discrete anomalies within enclosures have been ascribed a possible archaeological origin with those outside, except where the responses are particularly broad or high in magnitude, interpreted as of non-archaeological origin.*

Eight areas of archaeological activity (AAA) have been identified which are discussed below.

##### Area of Archaeological Activity 1 (AAA1) - West (Illus 53–55), East (Illus 56–58)

In AAA1 two clusters of anomalies indicative of archaeological activity have been identified that corroborate and expand on the previously identified cropmark features in F62 and F63.

In the western side of F63 a cluster of at least three rectangular enclosures (E1, E2 and E3) have been identified with a possible fourth one extending west beyond the boundary of the SDA (see Illus 53–55). E2 is the easternmost enclosure measuring approximately 37m by 45m. Within it, a 15m diameter ring-ditch (RD1) is located in the north-eastern corner of the enclosure. It is not certain whether this circular feature is a small stock enclosure or corral or perhaps a roundhouse. There are several discrete anomalies within the enclosure which may suggest human occupation, although some (or all) of these anomalies may just be due to minor variations in the composition of the topsoil. On the south side of E2, a clear break in the southern ditch indicates an entrance to the enclosure. E1 adjoins E2 to the west sharing a common central ditch. To the north of E1 and E2 a small square enclosure (E3), measuring 12m by 13m is identified. The magnetic response is particularly strong and consistent, with a break in the signal on the north side again suggesting the presence of an entrance.

One hundred and fifty metres to the north in F62 a rectangular anomaly (E4) measuring 14m by 6m with its long axis aligned south-west/north-east has been interpreted as another small enclosure.

The eastern half of F63 is dominated by a series of enclosures, of varying size and shape, and trackways. The complex is on the same basic orientation as E1, E2 and E3 150m to the west but there is no obvious connection between the two complexes. The western edge of the complex is defined by two large fields, E5 and E6. Appended to the south-western corner of E6 is a much smaller enclosure, E7, with three broadly rectangular enclosures attached to



**ILLUS 5** F64, unsuitable for survey, looking north

the eastern side of E5 (E8, E9 and E10). Vaguely triangular shaped enclosures E11 and E12 adjoin E10 and E9 respectively. One large pit type anomaly is prominent in E11. Bordering E12 along its northern edge are parallel linear discontinuous anomalies that locate ditches that probably define a trackway, TR1, that skirts around the northern side of the complex. In the eastern corner of F63, another cluster of enclosures is partly identified to the south of the trackway, TR1. Only E13 to the south-western corner of this cluster is clearly defined with ditches to all four sides. Several discrete anomalies within this complex, and in the other enclosures, have been identified as of possible archaeological origin based solely on their position within the enclosures.

#### Area of Archaeological Activity 2 (AAA2) – (Illus 59–61)

In F61 a series of linear anomalies have been identified form a loose aggregation of enclosures separated by trackways.

In the northern half of the field a single very large enclosure/field, E14, is identified. A possible very small enclosure, E15, is tentatively identified appended to the south-west corner of E14. A linear cluster of discrete anomalies aligned broadly east/west, inside E14, is interpreted as of possible archaeological origin although a geological origin is perhaps more plausible.

Further south in the field two trackways, TR2 (aligned north/south) and TR3 (aligned east/west) are the focus around which several enclosures and/or boundary ditches are appended. The most clearly defined is E16 to the western side of TR2. East of TR2 and north of TR3 is E17, with a much smaller enclosure, E18

appended to the south of TR3. Several discontinuous linear ditch type anomalies hint at further enclosure and sub-division. Several discrete anomalies have been interpreted as of archaeological potential although again a geological origin is also considered possible.

#### Area of Archaeological Activity 3 (AAA3) – (Illus 62–64)

In AAA3 a single ring ditch anomaly, RD2, with a diameter of 17m, has been identified adjacent to the western boundary of F59. It's slightly irregular shape perhaps leads to its interpretation as an enclosure rather than a round barrow.

#### Area of Archaeological Activity 4 (AAA4) – (Illus 65–67)

AAA4 covers all of F49 and contains four distinct archaeological features.

In the south-east corner of F49 a triangularly shaped enclosure, E19 has been identified. Within it, a series of curvilinear anomalies of unknown function are identified as well as a distinct line of six discrete anomalies indicative of large pits.

In the centre of the field immediately next to the western field boundary the survey has detected a ring ditch (RD3), 37m in diameter that is defined by two parallel ditches to its northern side. It is bisected by a public footpath that follows the line of a former (post-medieval) boundary in an east/west alignment. Four pit type anomalies are identified just outside the south-eastern side of the feature. Its function is not certain.





**ILLUS 6** F13, partly unsuitable for survey, looking south

North of RD3 a much larger circular anomaly is identified by the survey. Sixty metres in diameter, this feature has been truncated during the construction of the M1 and is interpreted as an enclosure (E20). Within it, two linear and two sub-square anomalies have been located perhaps locating internal division within the enclosure, while south of the outer perimeter of the enclosure a series of discrete anomalies, possible pits, run parallel with the circular ditch. A number of discrete anomalies inside the enclosure are also interpreted as of possible archaeological origin.

Ten metres directly east of E20 is a rectangular anomaly also interpreted as an enclosure, E21. The enclosure is aligned broadly east/west along its long axis, measuring 52m by 76m. No internal sub-divisions are present suggesting that E20 is more likely an animal enclosure probably; a linear ditch type anomaly appears to connect or form a barrier between, E20 and E21. Several discrete anomalies, which may be indicative of pits, have been identified in the north-western quarter of the enclosure.

#### Area of Archaeological Activity 5 (AAA5) - NW (Illus 35–Illus 37), NE (Illus 38–40), SE (Illus 41–43), SW (Illus 44–46)

AAA5 comprises four fields F41, F42, F43 and F44, covering an area of approximately 10 hectares. Within these fields, a substantial number of archaeological anomalies have been identified that corroborate and expand upon the cropmark data presented in the HS. Two large complexes of enclosures have been identified either side of a boundary/trackway. Only the larger and most prominent anomalies are described. This is clearly an area of high archaeological potential.

In the south-west corner of F44, a double-ditched square enclosure measuring 89m by 92m is identified (E22). The distance between the outer in inner ditches is 10 m with a clear break in the magnetic signal on the eastern side clearly identifying the entrance. Inside, there is a square sub-enclosure (E23A) in the south-east inner corner, measuring 18m by 19m with entrances on its western and northern side. In the centre of E22, there are three partial circular ring ditch anomalies (RD4, RD5 and RD6) measuring between 10m and 15m in diameter. These anomalies are interpreted as probable roundhouses. Within E22 there are also numerous discrete, linear and semi-circular anomalies, which are interpreted as either of possible or probable archaeological origin. The primary function of this enclosure is clearly settlement.

This enclosure (E22) is bounded on its eastern side by two parallel ditch type anomalies, TR4, which are provisionally interpreted as forming a boundary/trackway between the complex of enclosures to the north-west and south-east. The boundary is aligned south-west/north-east and follows the natural contours (Illus 10) extending at least 450m.

On the north side of E22, a linear ditch type anomaly parallel to the outer enclosure ditch and a D-shaped enclosure (E23) measuring 40m by 32m are identified. Also appended to the north-western side of TR4 are two much smaller enclosures, E24 and E25; the latter has a clear entrance on the north-eastern side.

Further to the north-west, but with no clear connection with the enclosures to the south is a much larger enclosure, E26, containing

two sub-enclosures, E27 and E28, within. Arcing around the northern side of E26 is a faint curvilinear ditch type anomaly that appears link to the southern side of E28.

On the higher ground south-east of TR4 is another complex of three conjoining enclosures, E29, E30 and E31, from west to east. The anomalies defining E29 are very low magnitude but a smaller internal enclosure, E32, can be seen in the south-western part of the enclosure. In E30 and E31 sub-circular ring ditch anomalies (probable roundhouses – RD7 and RD8) are again indicative of settlement activity with the presence of several discrete and linear anomalies supporting this interpretation.

Immediately south of this complex, other discontinuous linear and curvilinear anomalies clearly demonstrate that the archaeological activity extends beyond the three enclosures although no clear pattern can be distinguished.

Similarly, to the north-east fragmentary and low magnitude anomalies show that the activity also continues to the north. The only clearly defined feature in this area is ring ditch anomaly, RD9.

#### Area of Archaeological Activity 6 (AAA6) - North (Illus 47–49), South (Illus 50–52)

In the south of the AAA is the circular anomaly, RD11, identified in F38, that has been interpreted as a ring-ditch (RD11), 17m in diameter. Several discrete pit type anomalies have been identified within the enclosure.

South of the ring ditch three linear anomalies have been recorded, all of which are oblique to the alignment of the ploughing trends. For this reason, the anomalies are interpreted as of possible archaeological origin although an agricultural cause cannot be dismissed.

At the northern end of F36, the survey identified a ladder-like alignment of at least three rectangular enclosures, E33, E34 and E35, aligned north-east/south-west, which continues north beyond the SDA. Several linear and discrete anomalies, that have also been

interpreted as of either probable or possible archaeological origin, are identified within these three enclosures.

#### Area of Archaeological Activity 7 (AAA7)– (Illus 68–70)

In AAA7, a single anomaly of definite archaeological potential has been identified by the survey. In the western part of F15, a sub-circular ring ditch anomaly measuring 36m in diameter has been interpreted as an enclosure (RD12) with an entrance to the western side. Two low magnitude linear anomalies, one to the south and one to the east of RD12, are also ascribed some archaeological potential. A line of discrete 'spike' anomalies is also identified immediately adjacent to one of the linear anomalies. Whilst these discrete anomalies are probably modern in origin an archaeological cause should not be dismissed given the proximity of the enclosure.

#### Area of Archaeological Activity 8 (AAA8)– (Illus 71–73)

In the eastern side of F27, an irregular, broadly rectangularly shaped enclosure (E36) is identified. The enclosure is 50m by 36m in size with the long axis aligned south-east/north-west. Within it, a 13m diameter ring ditch (RD12) has been identified in the north-west corner.

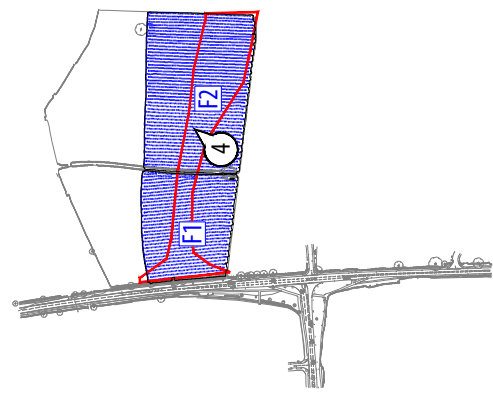
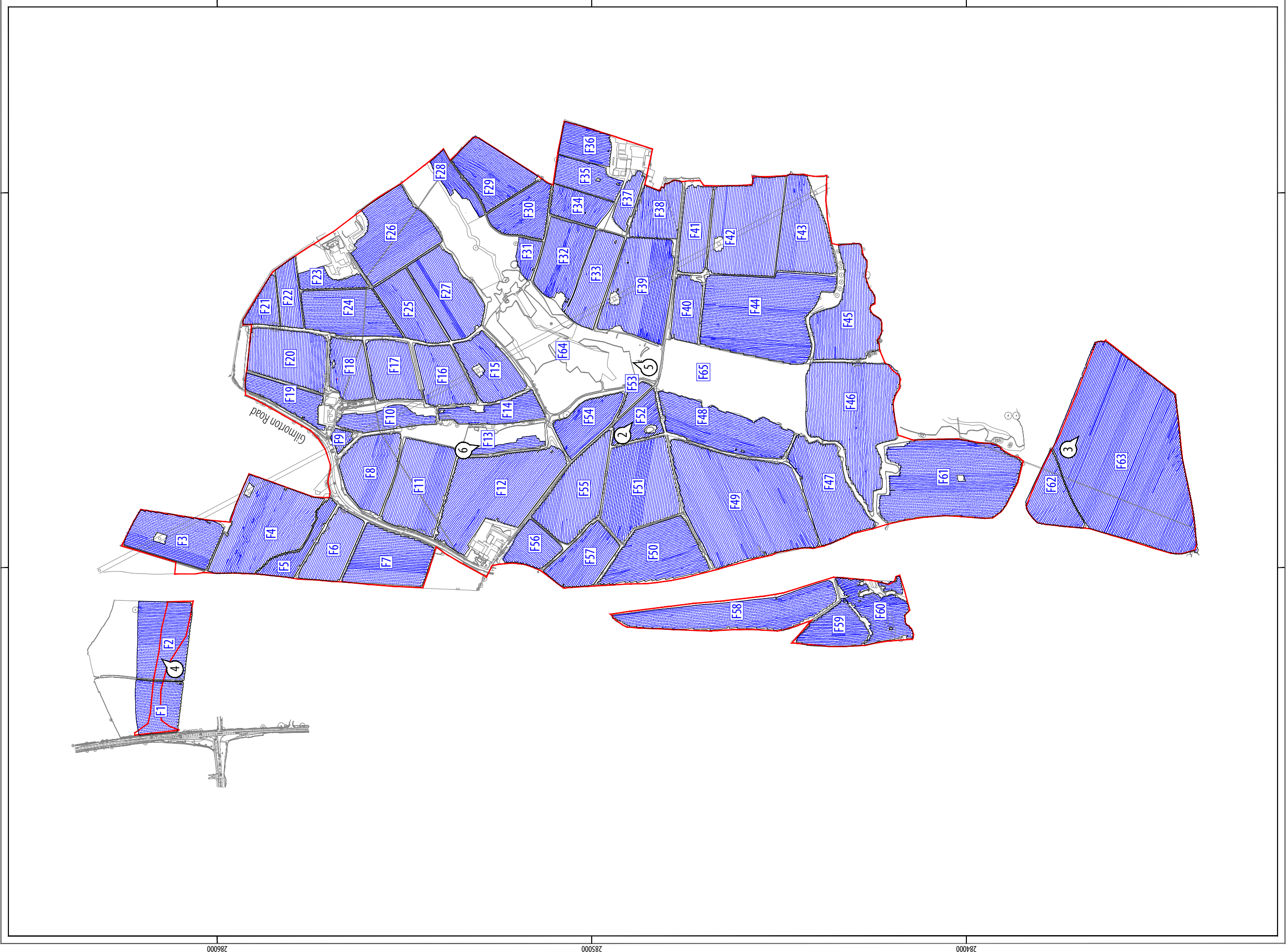
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## 5 CONCLUSION

The survey has successfully evaluated 63 fields further advancing knowledge of the archaeological potential of the SDA and providing evidence for eight areas of definite archaeological activity, ranging from isolated ring ditches to extensive areas of settlement. Four of these areas (AAA1, AAA2, AAA3 and AAA5), were previously known through the presence of cropmarks, although to a lesser extent than has been identified by the geophysical survey. The other four areas were not previously known (AAA4, AAA6, AAA7 and AAA8). With the exception of AAA8 and AAA7, all of the areas of archaeological activity are situated in the southern and central part of the site, and all of the identified archaeological areas are situated on higher ground overlooking the River Swift and its tributaries. Overall, the survey corroborates the conclusions of the HS and assesses the archaeological potential of the site as high in the southern and central areas and medium to low in the northern part of the SDA.

## 6 REFERENCES

- Chartered Institute for Archaeologists (CIfA) 2016 *Standard and guidance for archaeological geophysical survey* (Reading) [http://www.archaeologists.net/sites/default/files/CIfA%26GGeophysics\\_2.pdf](http://www.archaeologists.net/sites/default/files/CIfA%26GGeophysics_2.pdf) accessed 10 December 2018
- Cranfield University 2018 *Cranfield Soil and Agrifood Institute Soilscales* <http://www.landis.org.uk/soilscales/> accessed 10 December 2018
- Dyulgierski K 2018 *Land east of Lutterworth, Leicestershire; Written Scheme of Investigation for Geophysical Survey* [unpublished client document] Headland Archaeology Ref LUTL18
- Europae Archaeologia Consilium 2016 EAC *Guidelines for the use of Geophysics in Archaeology*, Archaeolingua 2016
- Gaffney C & Gater J (2003) *Revealing the Buried Past: Geophysics for Archaeologists* Stroud
- Ministry of Housing, Communities and Local Government (MHCLG) 2018 *National Planning Policy Framework* [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/740441/National\\_Planning\\_Policy\\_Framework\\_web\\_accessible\\_version.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/740441/National_Planning_Policy_Framework_web_accessible_version.pdf) accessed 10 December 2018
- Pratt E 2017 *East of Lutterworth Strategic Development Area, Harborough District, Leicestershire; Heritage Statement* [unpublished client report] Cotswold Archaeology Ref 17604



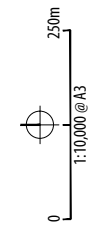
- geophysical survey area
- GPS swath
- location and direction of ILLUS 2-6

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ILLUS 7 Survey location showing GPS swaths and photo locations



■ geophysical survey area  
■ area unsuitable for survey

-2.0f  
 nT  
 3.0

0  
 250m  
 1:10,000 @ A3

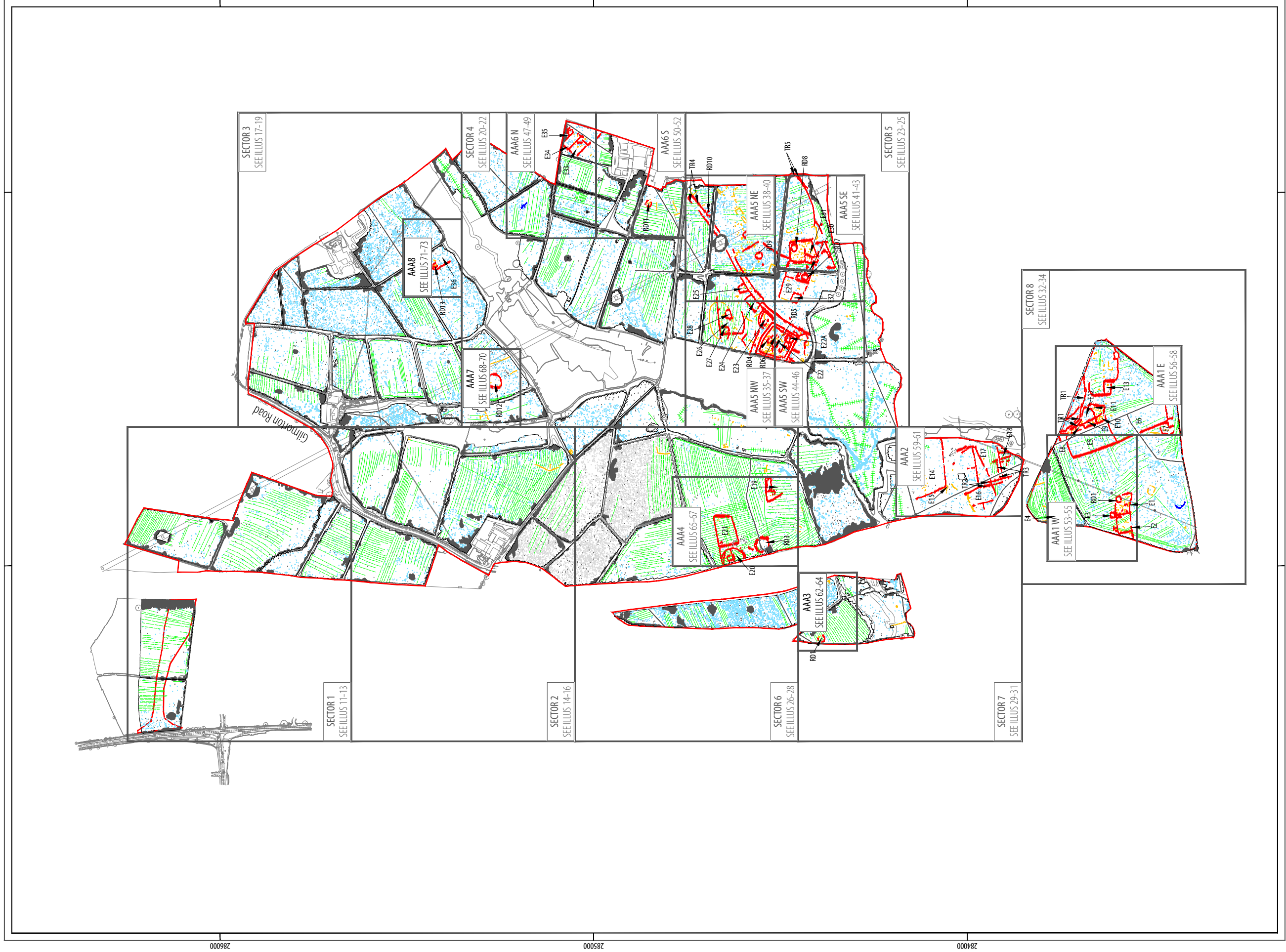
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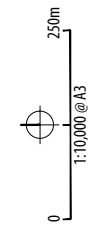
ILLUS 8 Overall greyscale magnetometer data



TYPE OF ANOMALY	INTERPRETATION
• dipolar isolated	ferrous material
• magnetic disturbance	ferrous material
— dipolar linear	service pipe
— linear trend	ridge and furrow
— linear trend	agricultural
— linear trend	field drain

TYPE OF ANOMALY	INTERPRETATION
• magnetic disturbance	green waste
• magnetic enhancement	geology
• magnetic enhancement	LIRM
• magnetic enhancement	archaeology?
• magnetic enhancement	archaeology

INTERPRETATION



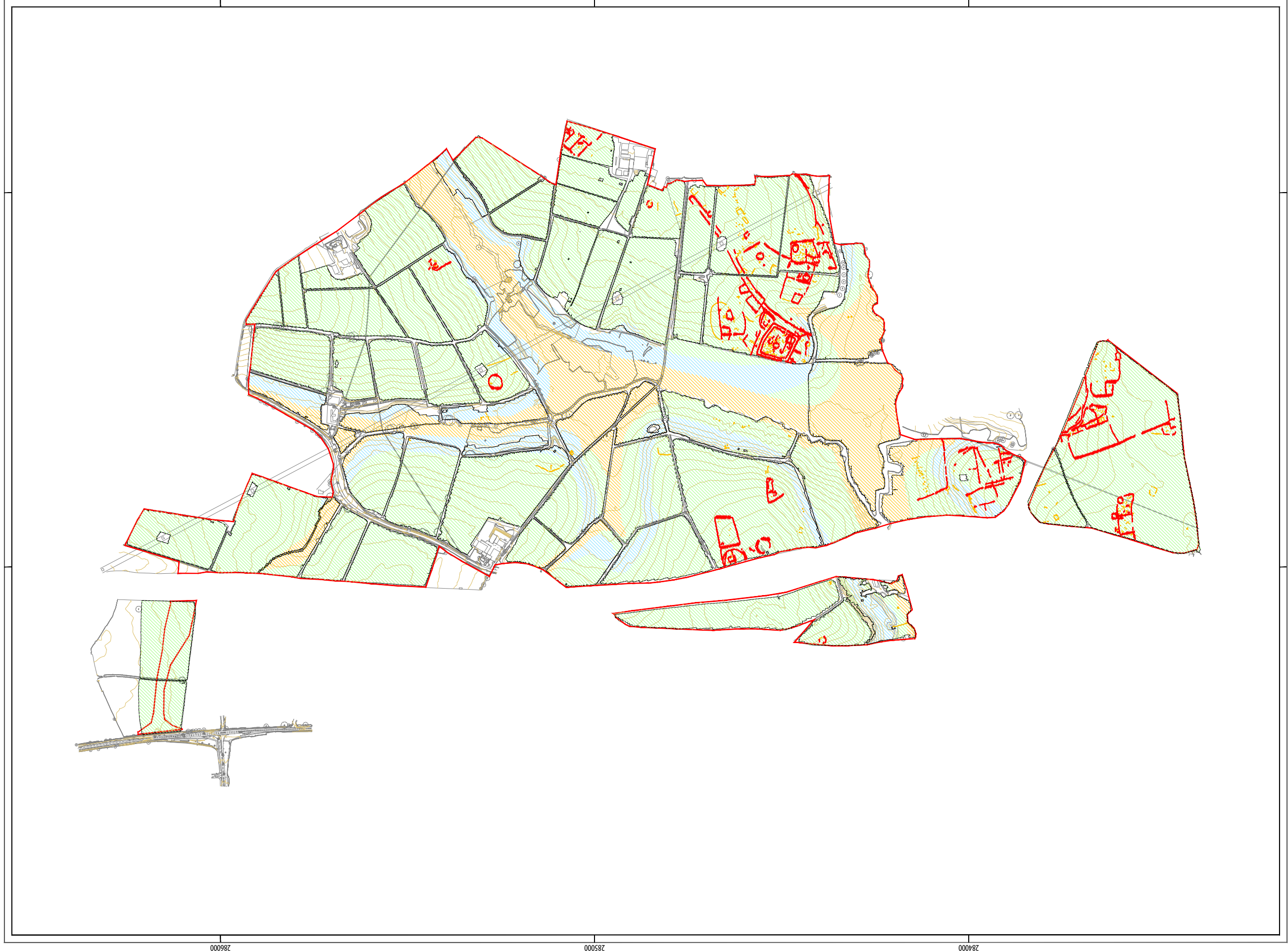
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ILLUS 9 Overall interpretation of magnetometer data

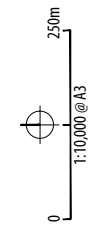


- geophysical survey area
- Till- Diamicton
- Alluvium- Clay, Silt, Sand, and Gravel
- Shawell Sand and Gravel- Sand and Gravel

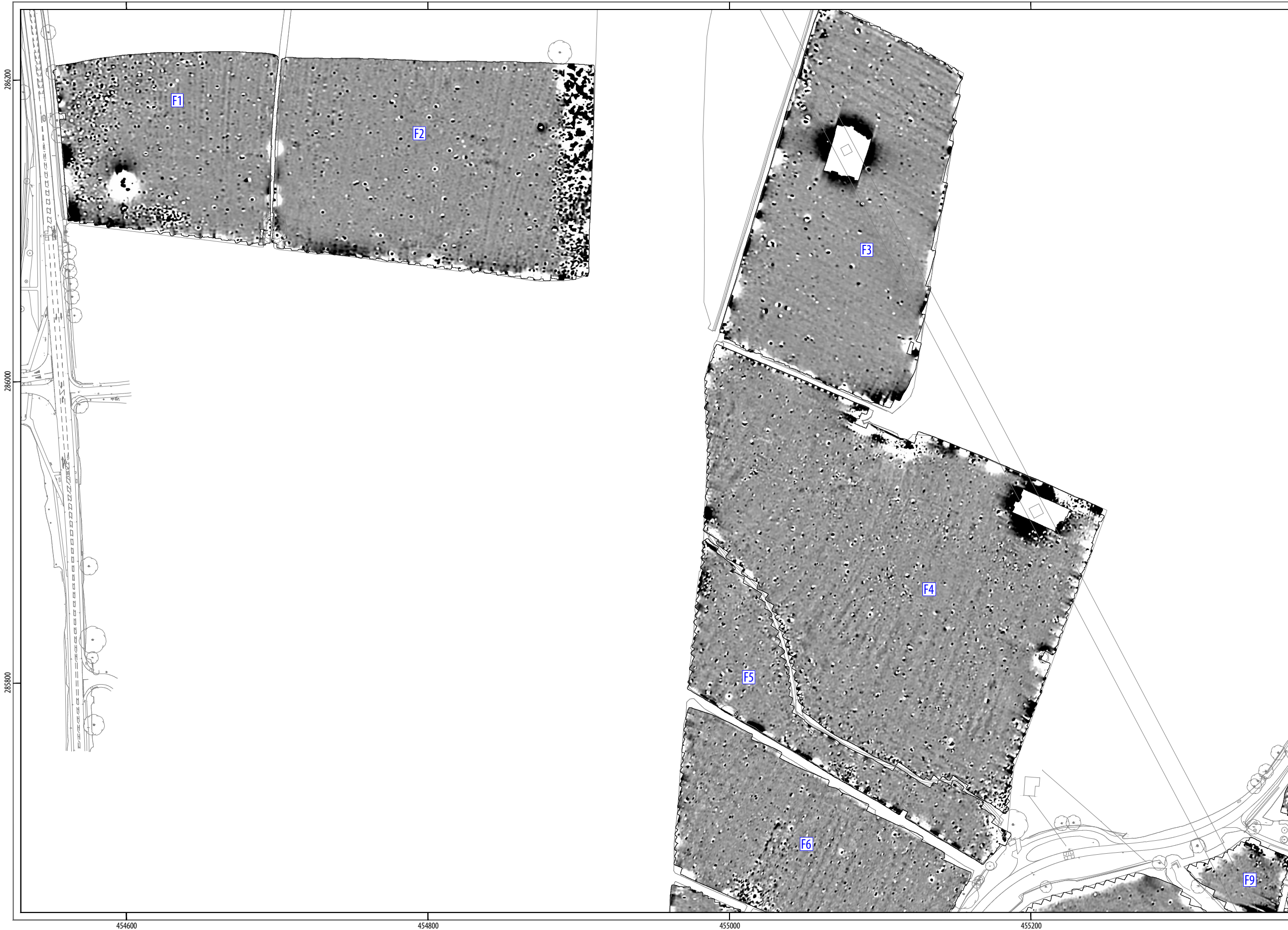
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ILLUS 10 Survey location showing geology (after BGS), major contours, and archaeological interpretation



286200

286000

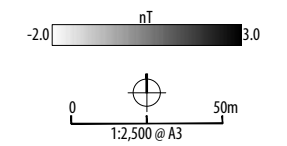
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454600

454800

455000

455200



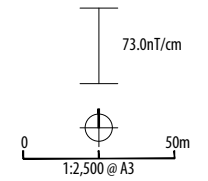
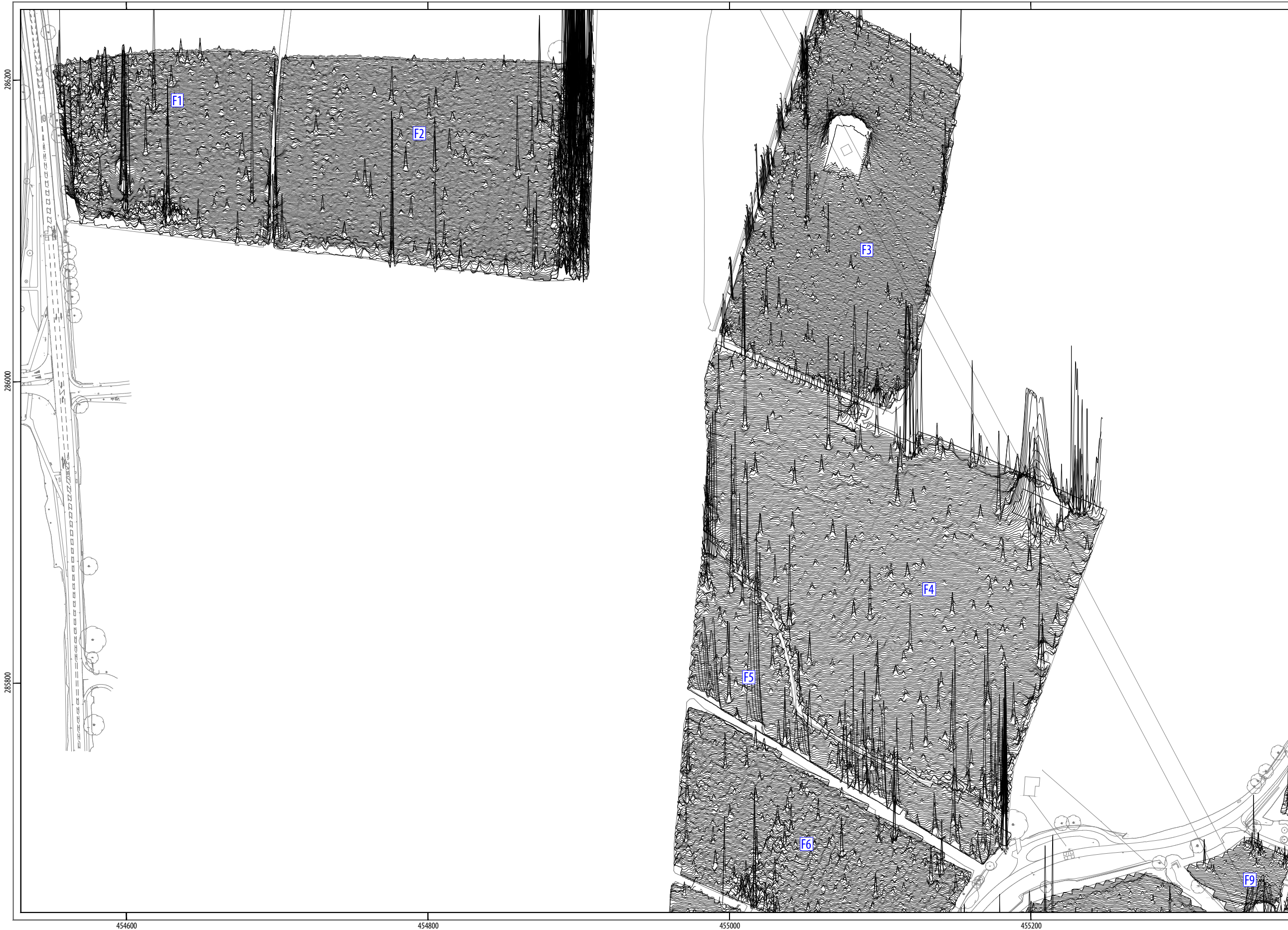
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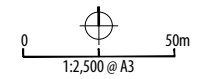


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ILLUS 12 XY trace plot of minimally processed magnetometer data; Sector 1



TYPE OF ANOMALY	INTERPRETATION
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● magnetic disturbance	ferrous material
— linear trend	ridge and furrow
— linear trend	agricultural
● magnetic enhancement	geology



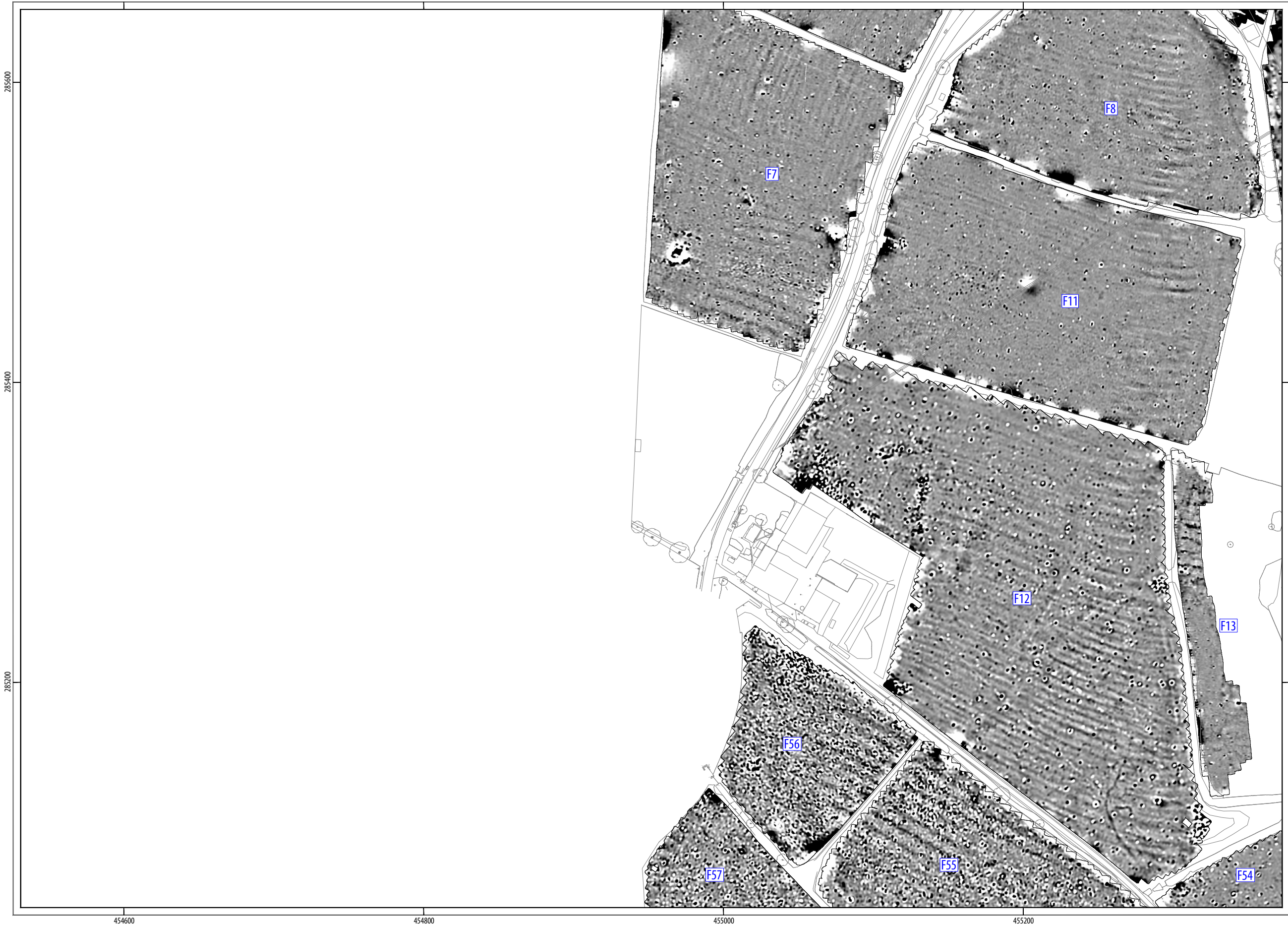
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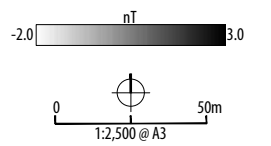
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ILLUS 13 Interpretation of magnetometer data; Sector 1



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285400  
285200

454600 454800 455000 455200

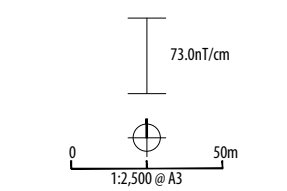
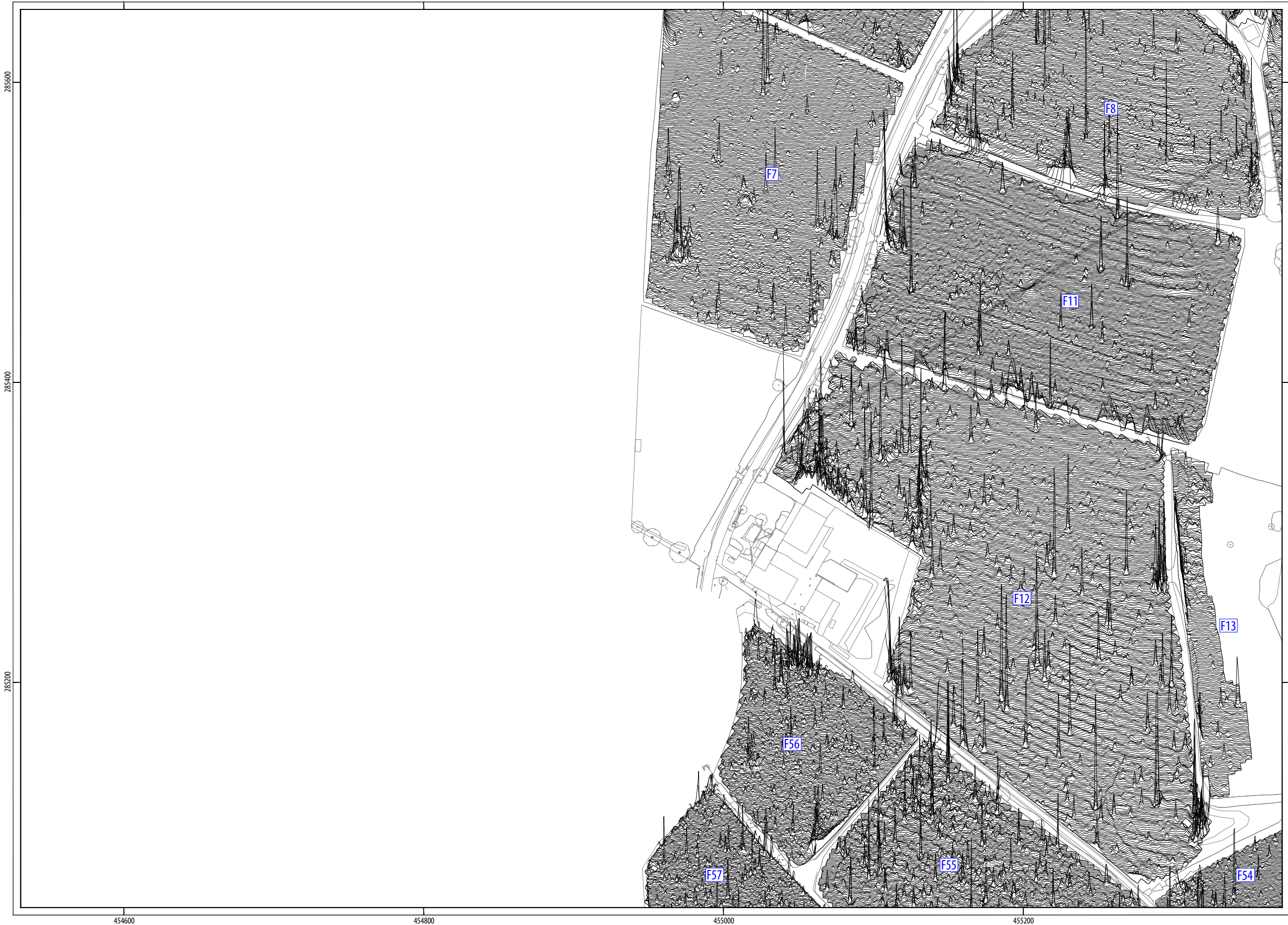


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ILLUS 14 Processed greyscale magnetometer data; Sector 2



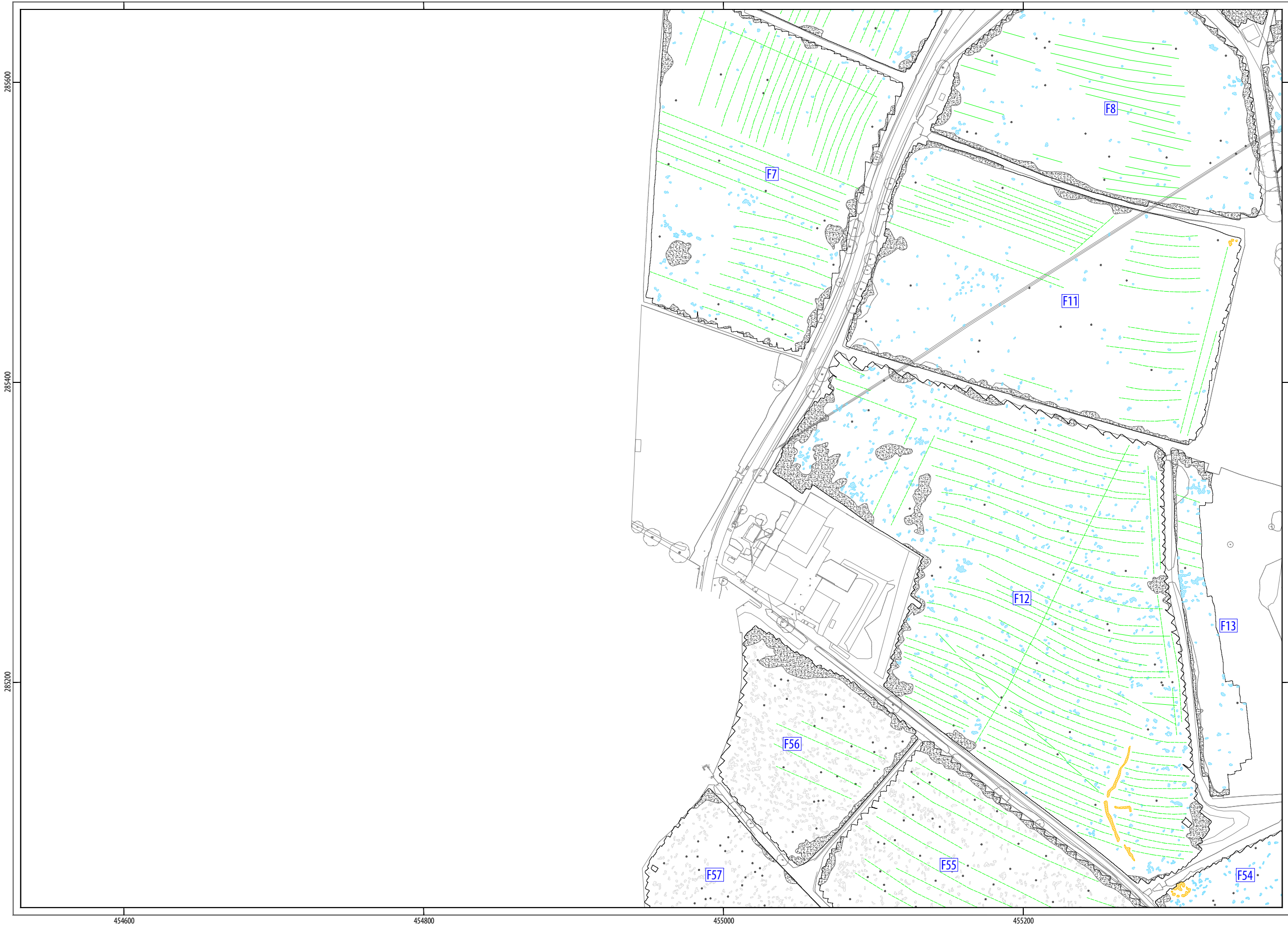
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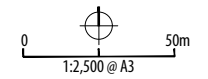


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ILLUS 15 XY trace plot of minimally processed magnetometer data; Sector 2



TYPE OF ANOMALY	INTERPRETATION
• dipolar isolated	ferrous material
• magnetic disturbance	ferrous material
— dipolar linear	service pipe
— linear trend	ridge and furrow
• magnetic enhancement	geology
• magnetic enhancement	archaeology?
• magnetic disturbance	green waste



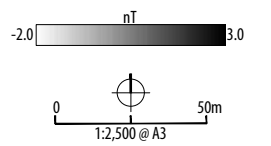
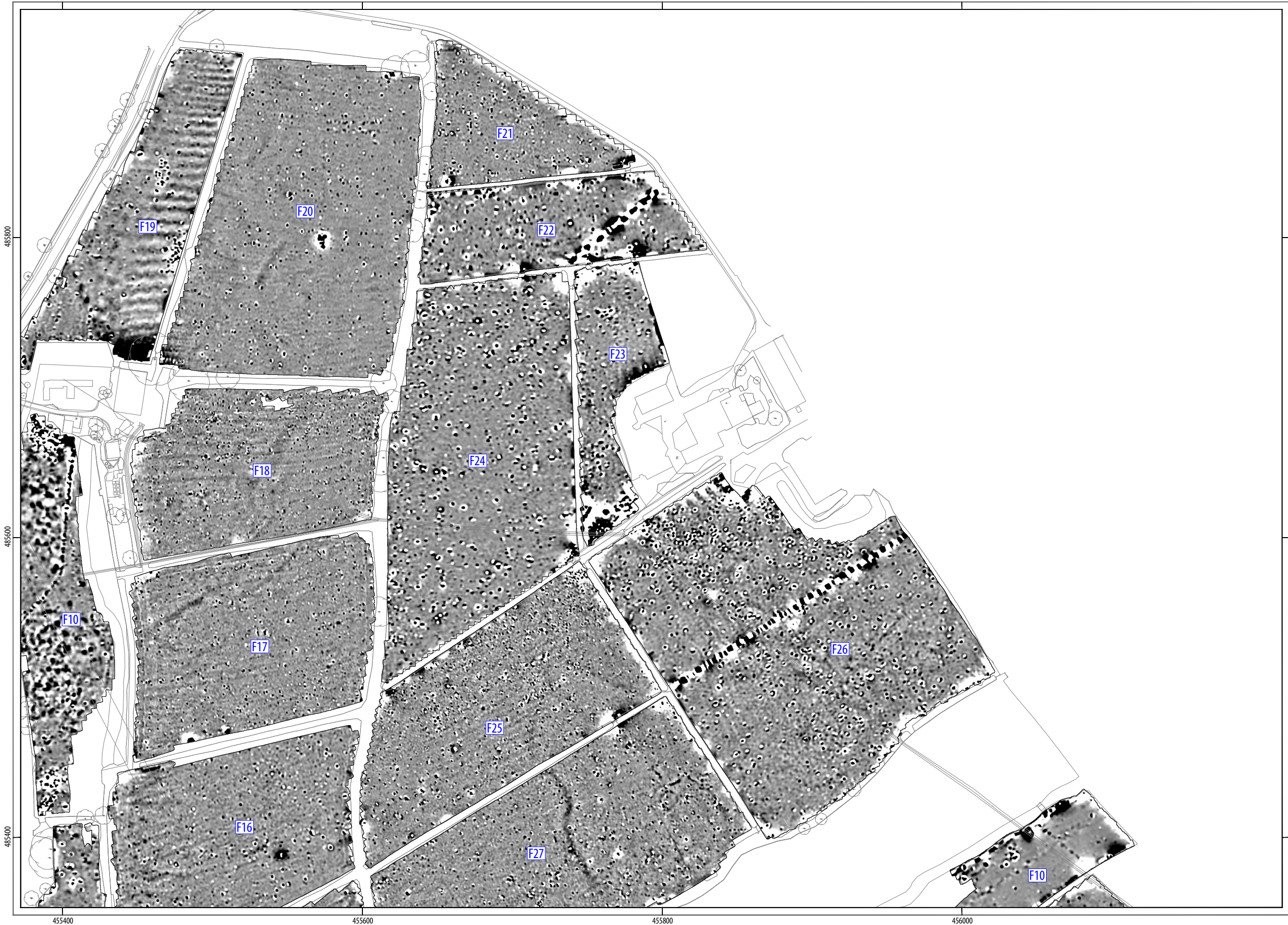
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ILLUS 16 Interpretation of magnetometer data; Sector 2

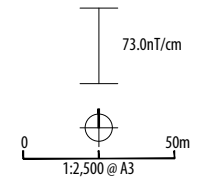
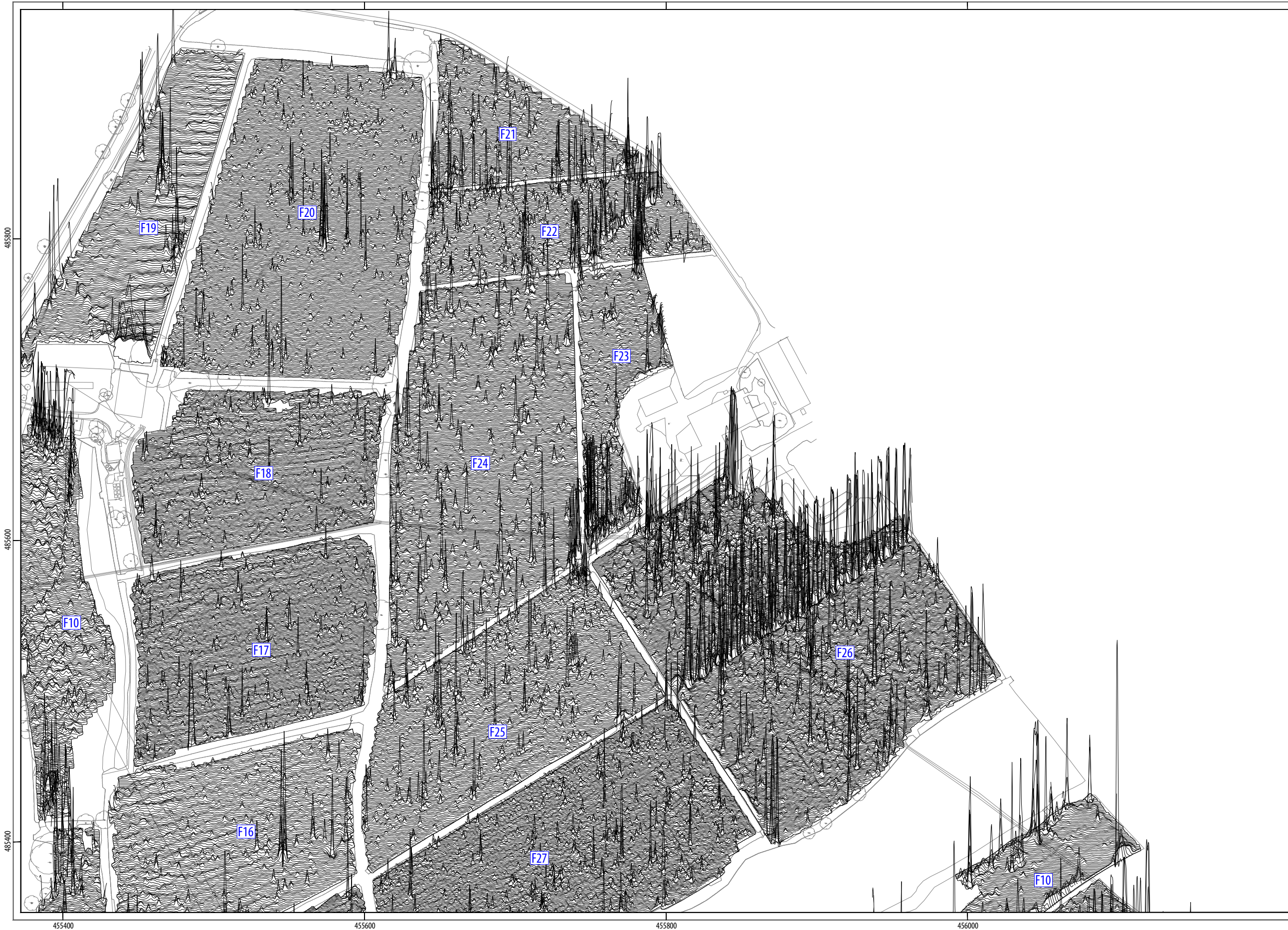


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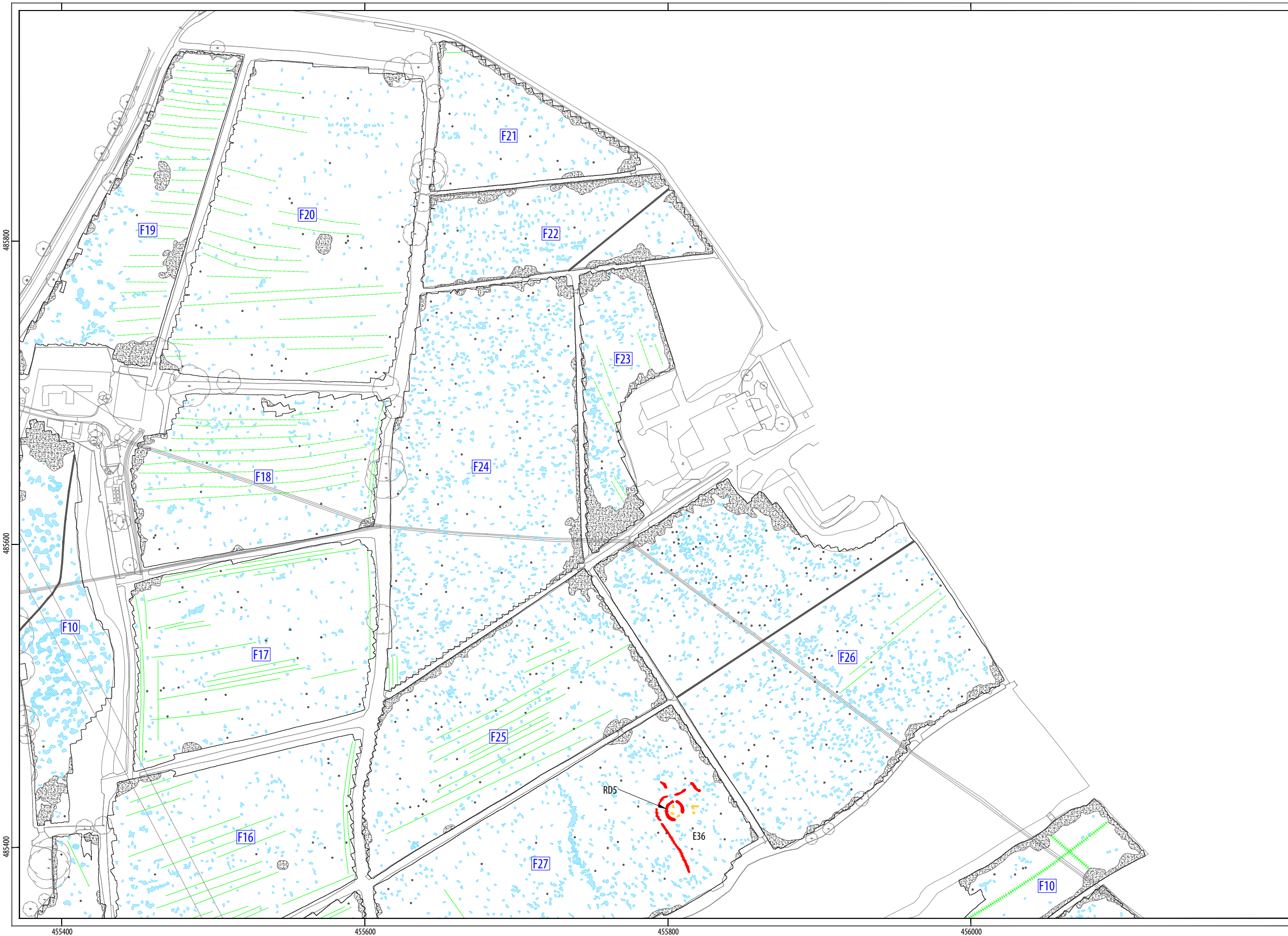
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ILLUS 18 XY trace plot of minimally processed magnetometer data; Sector 3



TYPE OF ANOMALY	INTERPRETATION
• dipolar isolated	ferrous material
● magnetic disturbance	ferrous material
— dipolar linear	service pipe
— linear trend	ridge and furrow
— linear trend	agricultural
— linear trend	field drain
⊕ magnetic enhancement	geology
⊗ magnetic enhancement	archaeology?
● magnetic enhancement	archaeology



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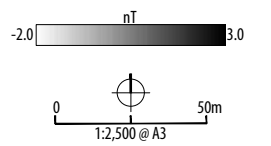
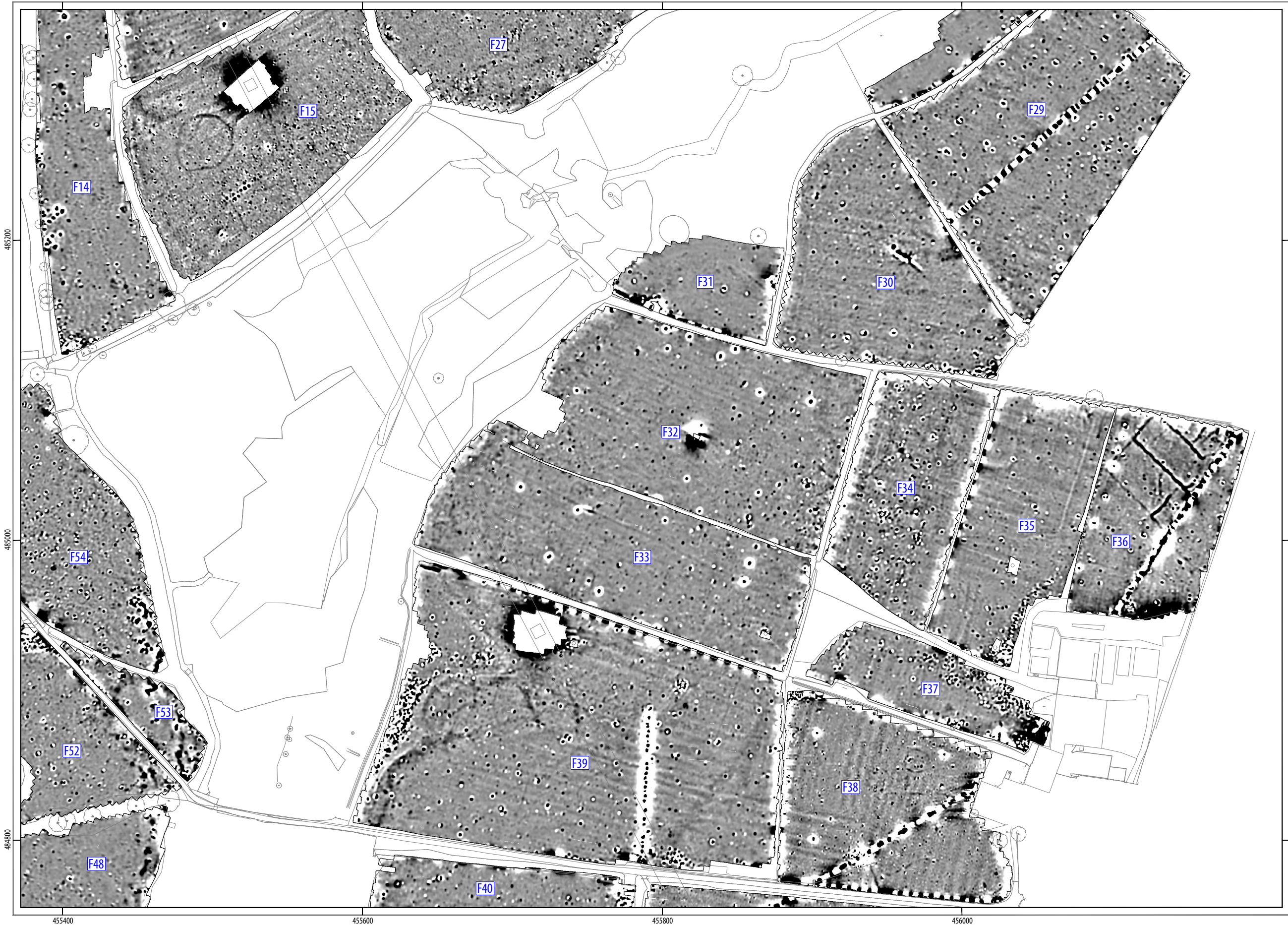
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ILLUS 19 Interpretation of magnetometer data; Sector 3



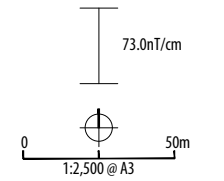
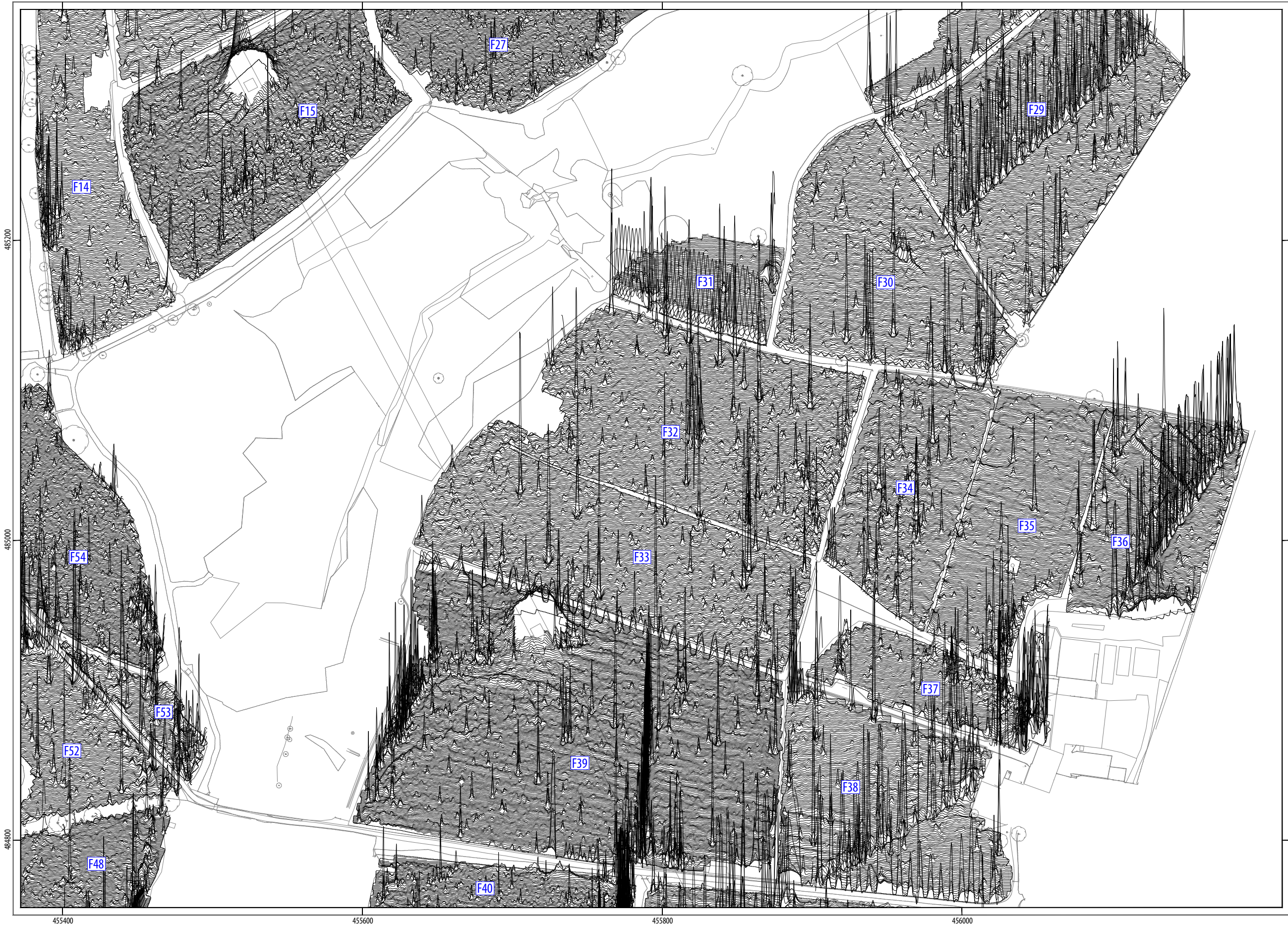


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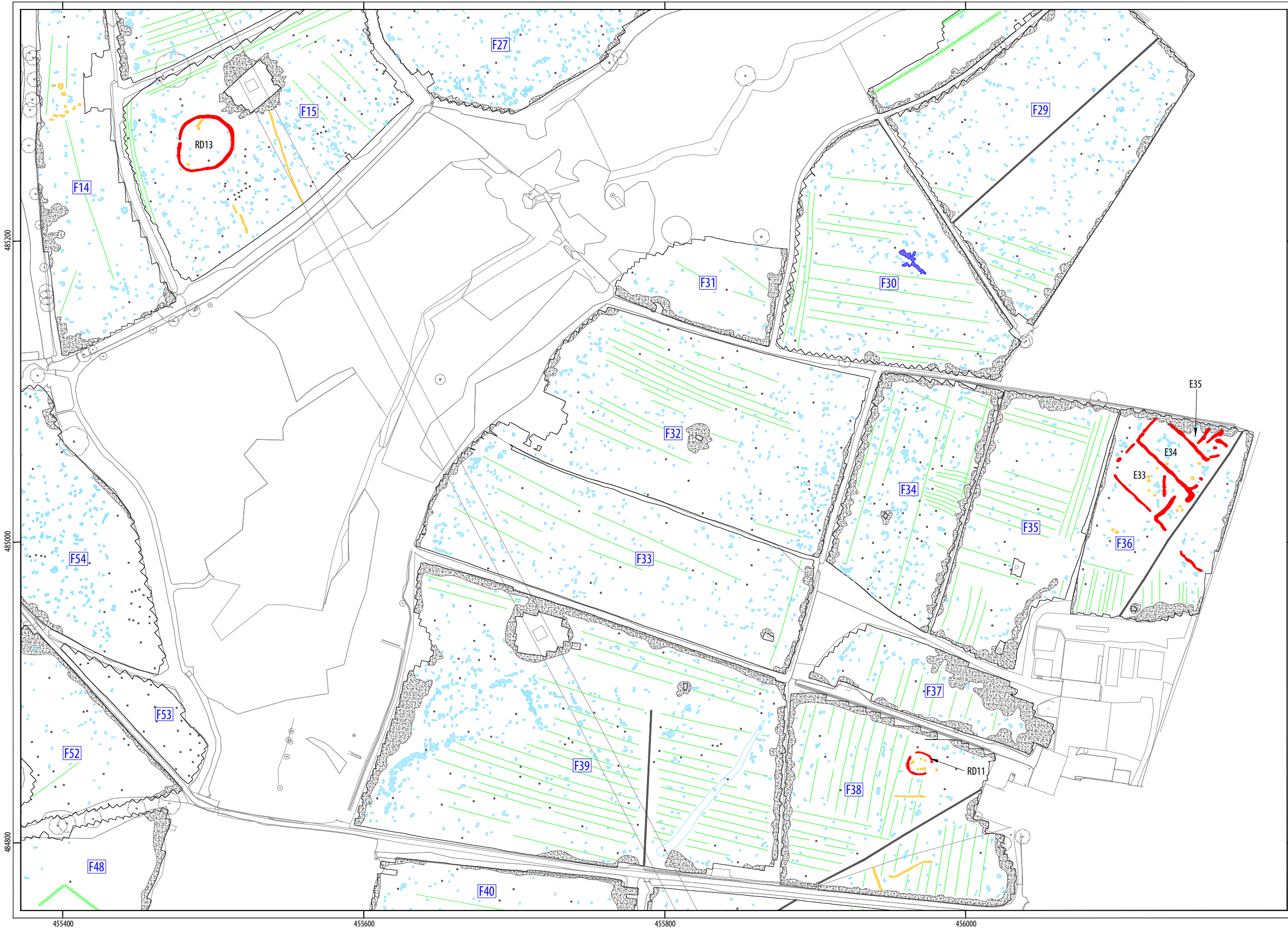
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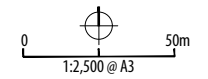


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ILLUS 21 XY trace pot of minimally processed magnetometer data; Sector 4



TYPE OF ANOMALY	INTERPRETATION
● dipolar isolated	ferrous material
● magnetic disturbance	ferrous material
— dipolar linear	service pipe
— linear trend	ridge and furrow
— linear trend	agricultural
— linear trend	field drain
● magnetic enhancement	geology
● magnetic enhancement	archaeology?
● magnetic enhancement	archaeology
● magnetic enhancement	LIRM



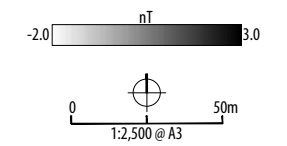
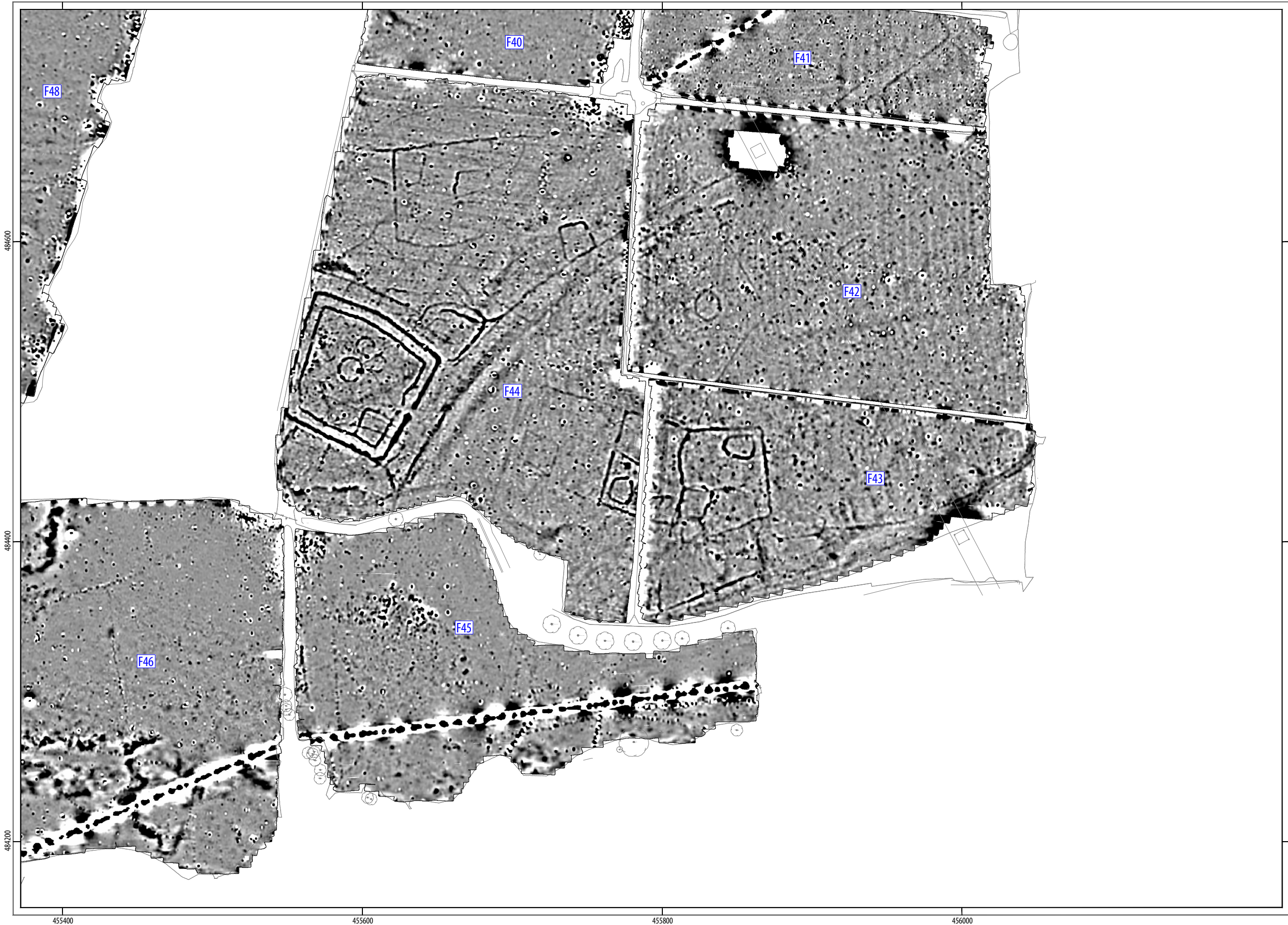
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ILLUS 22 Interpretation of magnetometer data; Sector 4

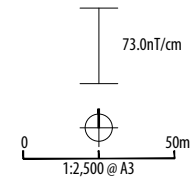
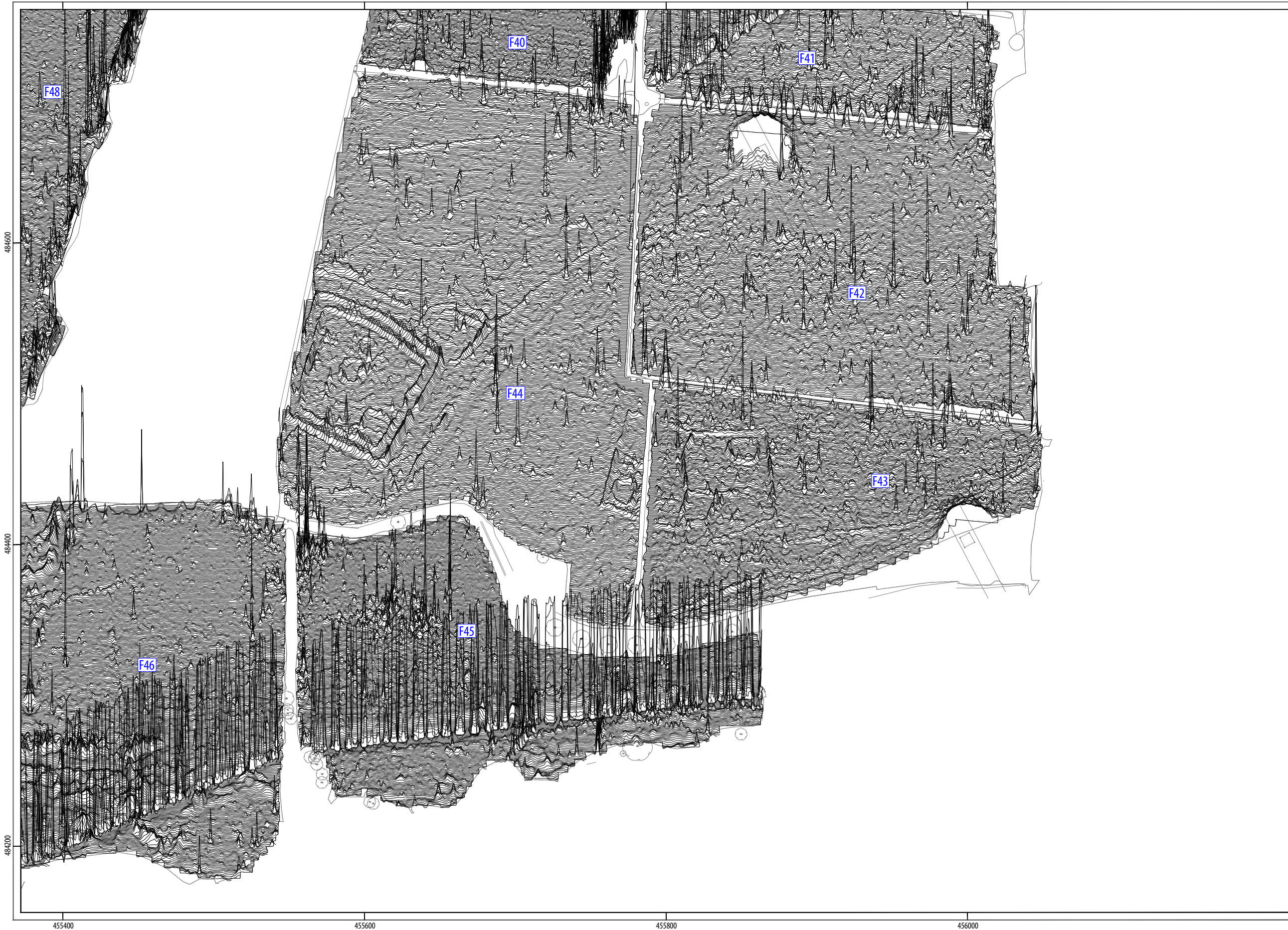


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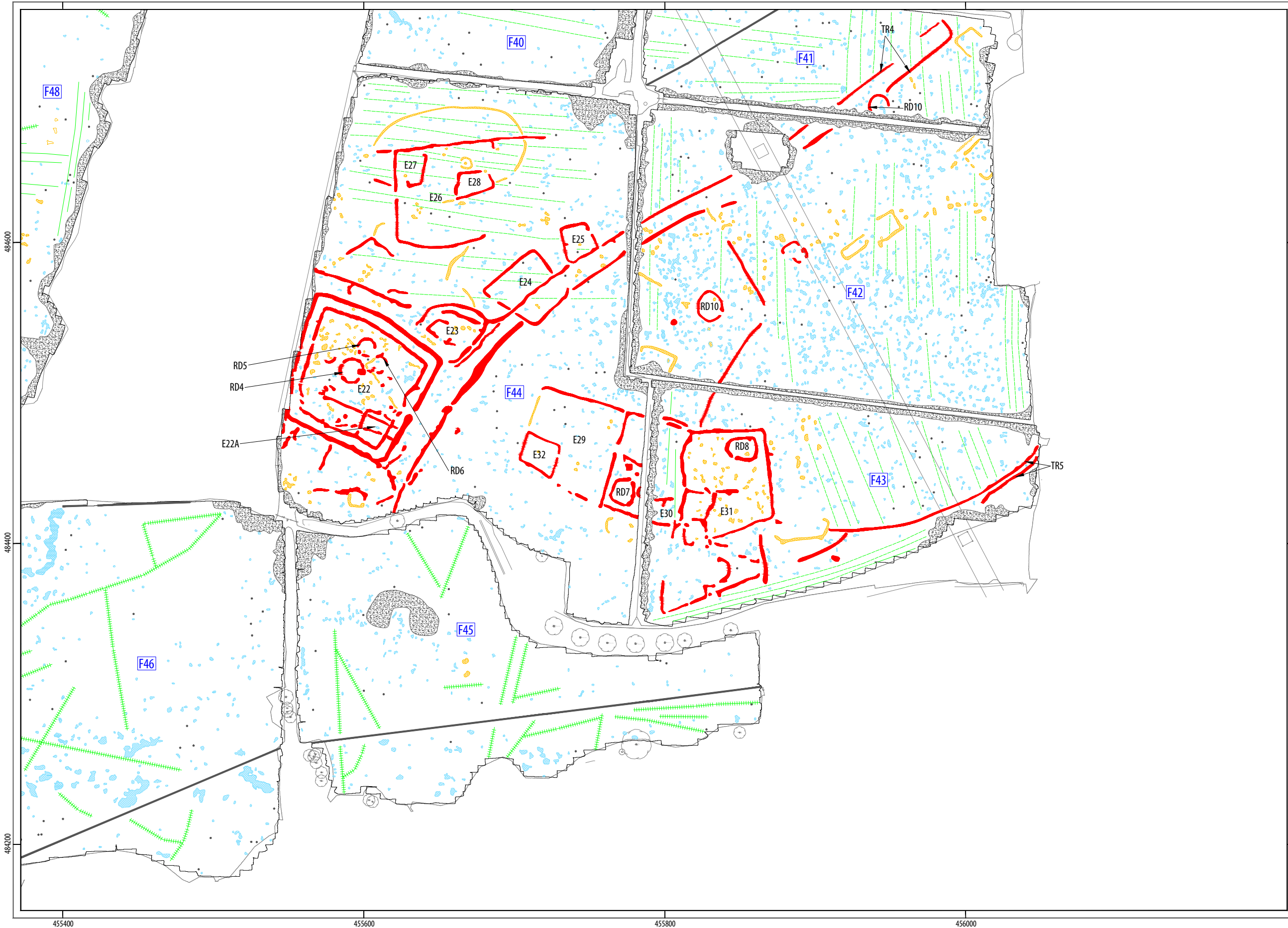
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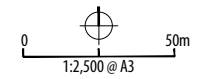


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ILLUS 24 XY trace plot of minimally processed magnetometer data; Sector 5



TYPE OF ANOMALY	INTERPRETATION
• dipolar isolated	ferrous material
● magnetic disturbance	ferrous material
— dipolar linear	service pipe
— linear trend	ridge and furrow
— linear trend	agricultural
— linear trend	field drain
● magnetic enhancement	geology
● magnetic enhancement	archaeology?
● magnetic enhancement	archaeology



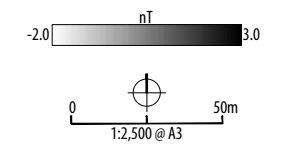
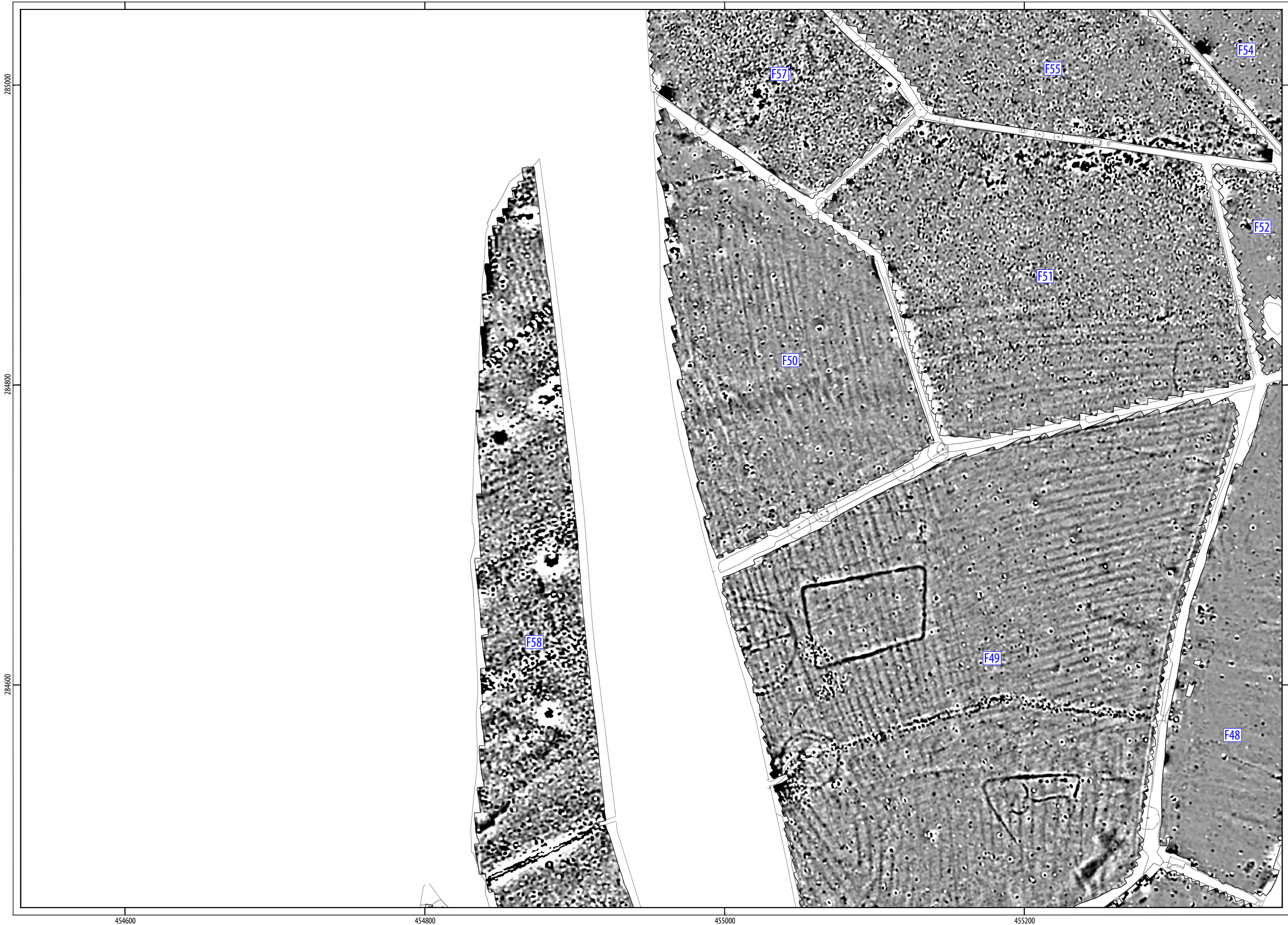
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ILLUS 25 Interpretation of magnetometer data; Sector 5

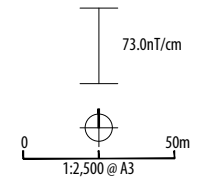
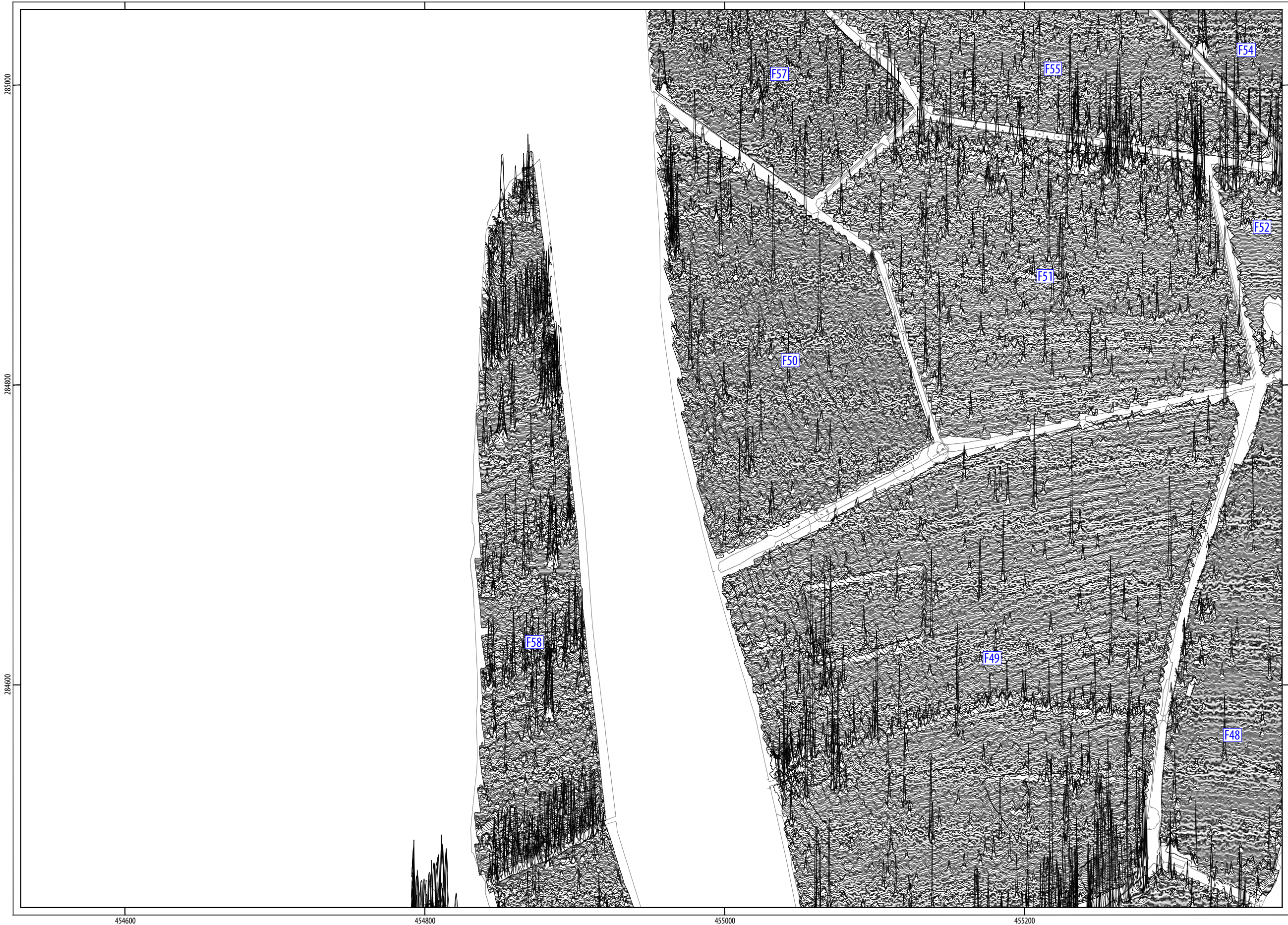


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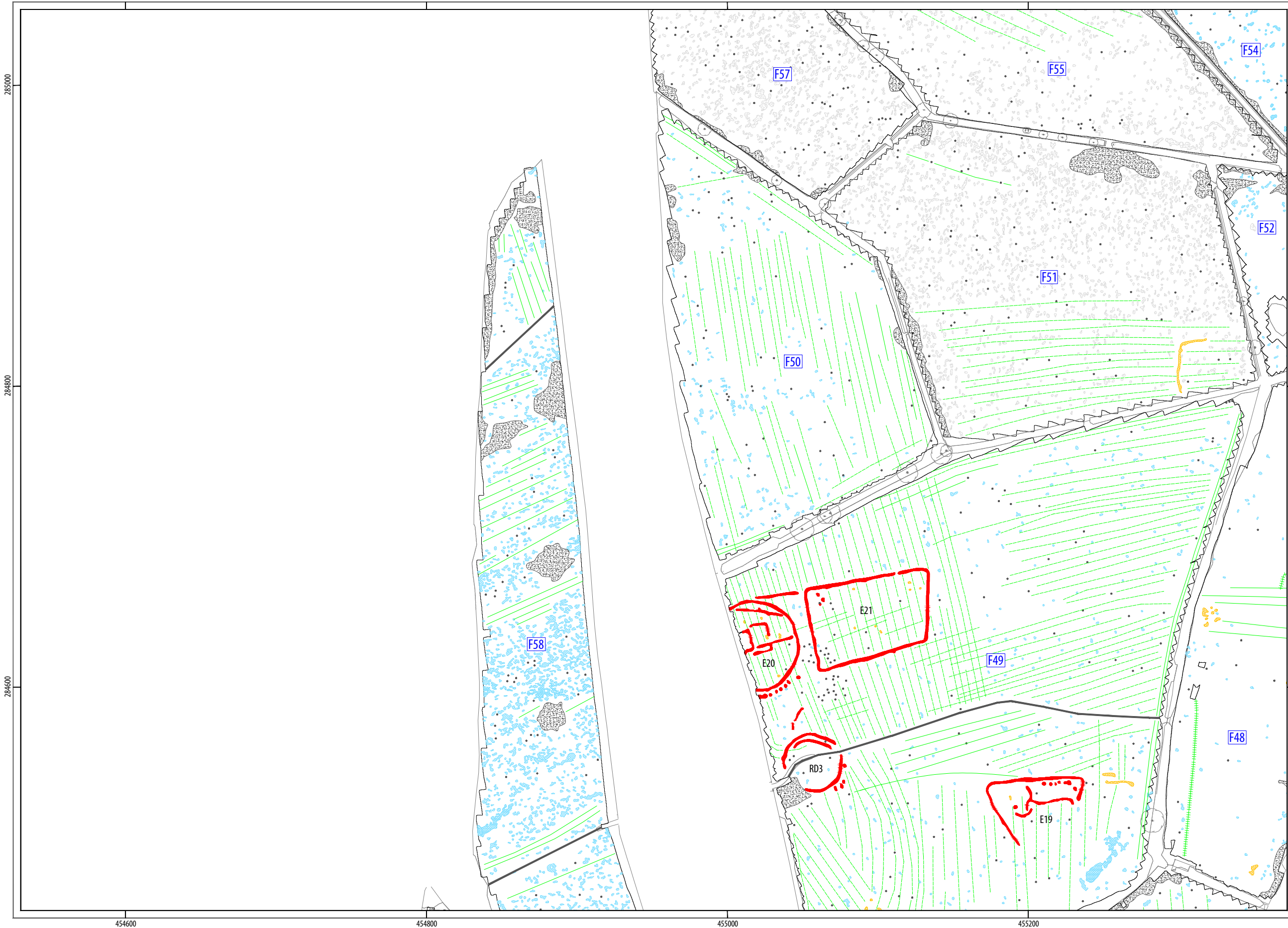
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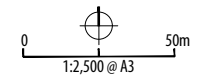
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ILLUS 27 XY trace plot of minimally processed magnetometer data; Sector 6





TYPE OF ANOMALY	INTERPRETATION
• dipolar isolated	ferrous material
• magnetic disturbance	ferrous material
— dipolar linear	service pipe
• magnetic disturbance	green waste
— linear trend	ridge and furrow
— linear trend	agricultural
— linear trend	field drain
• magnetic enhancement	geology
• magnetic enhancement	archaeology?
• magnetic enhancement	archaeology



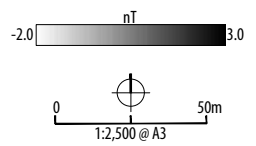
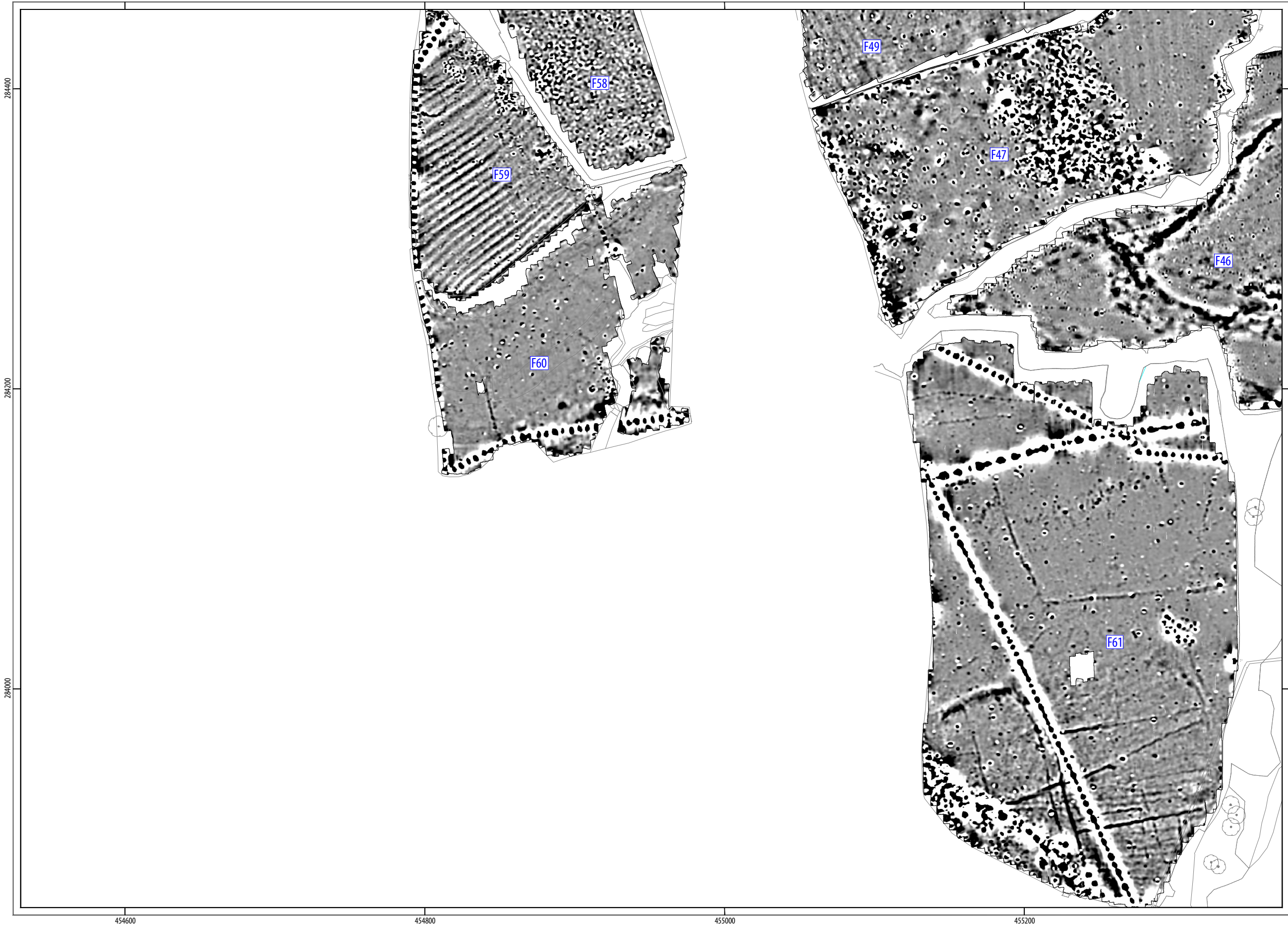
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ILLUS 28 Interpretation of magnetometer data; Sector 6

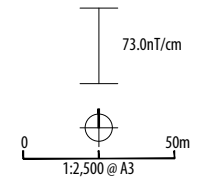
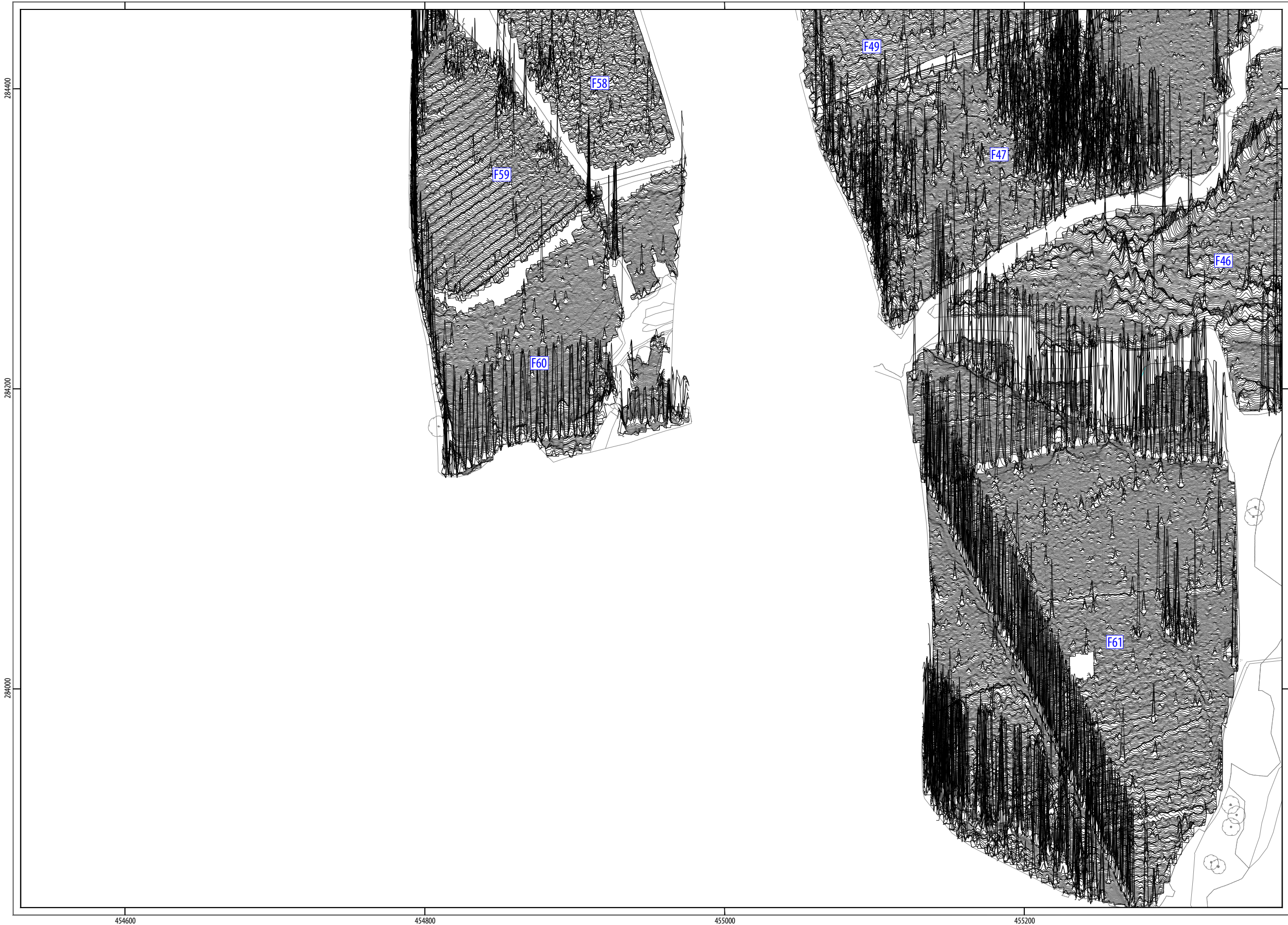


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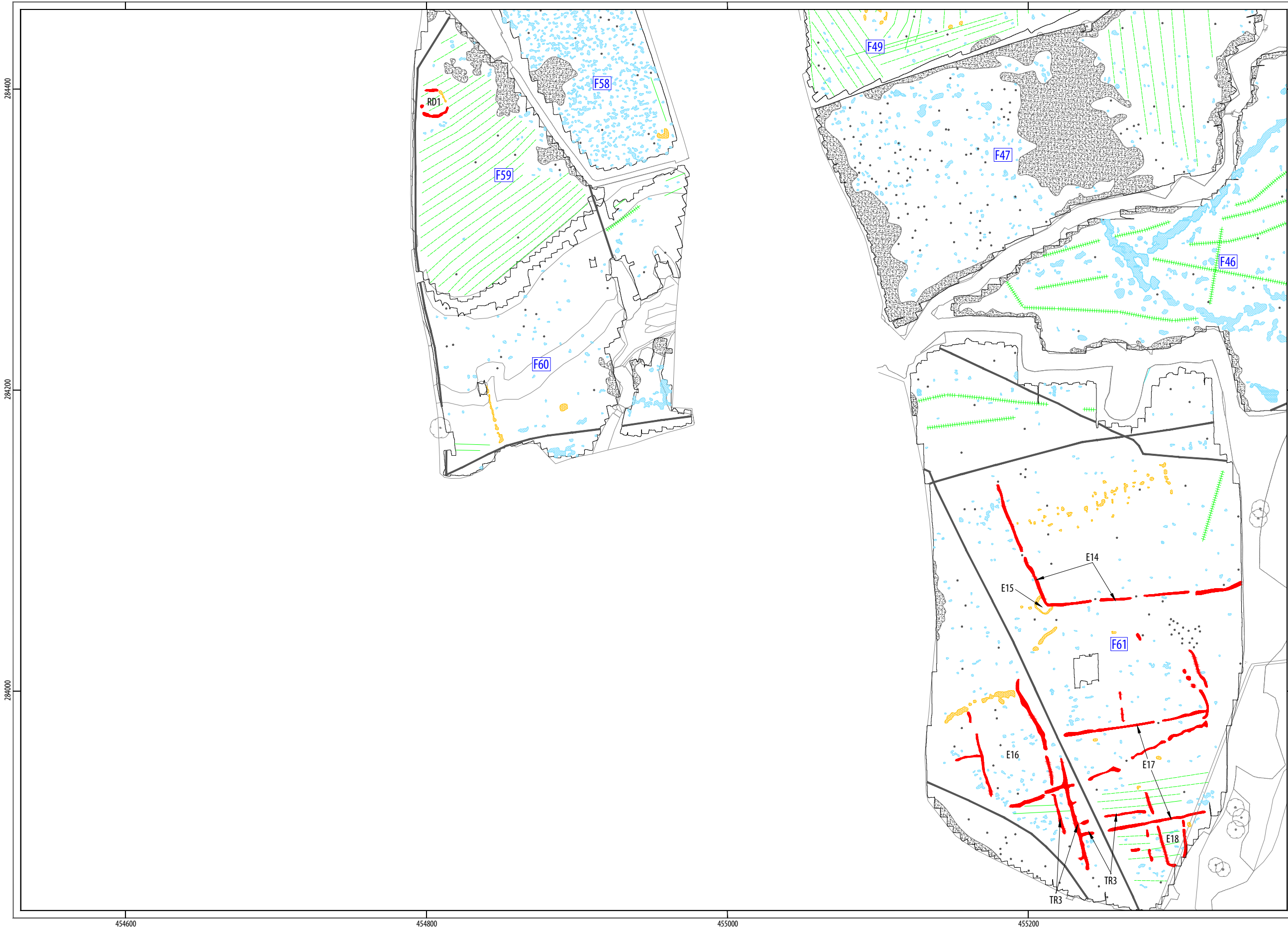
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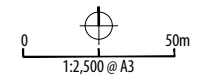


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ILLUS 30 XY trace plot of minimally processed magnetometer data; Sector 7



TYPE OF ANOMALY	INTERPRETATION
• dipolar isolated	ferrous material
• magnetic disturbance	ferrous material
— dipolar linear	service pipe
— linear trend	ridge and furrow
— linear trend	agricultural
— linear trend	field drain
• magnetic enhancement	geology
• magnetic enhancement	archaeology?
• magnetic enhancement	archaeology

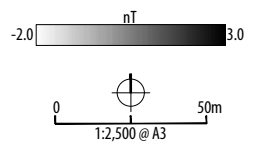
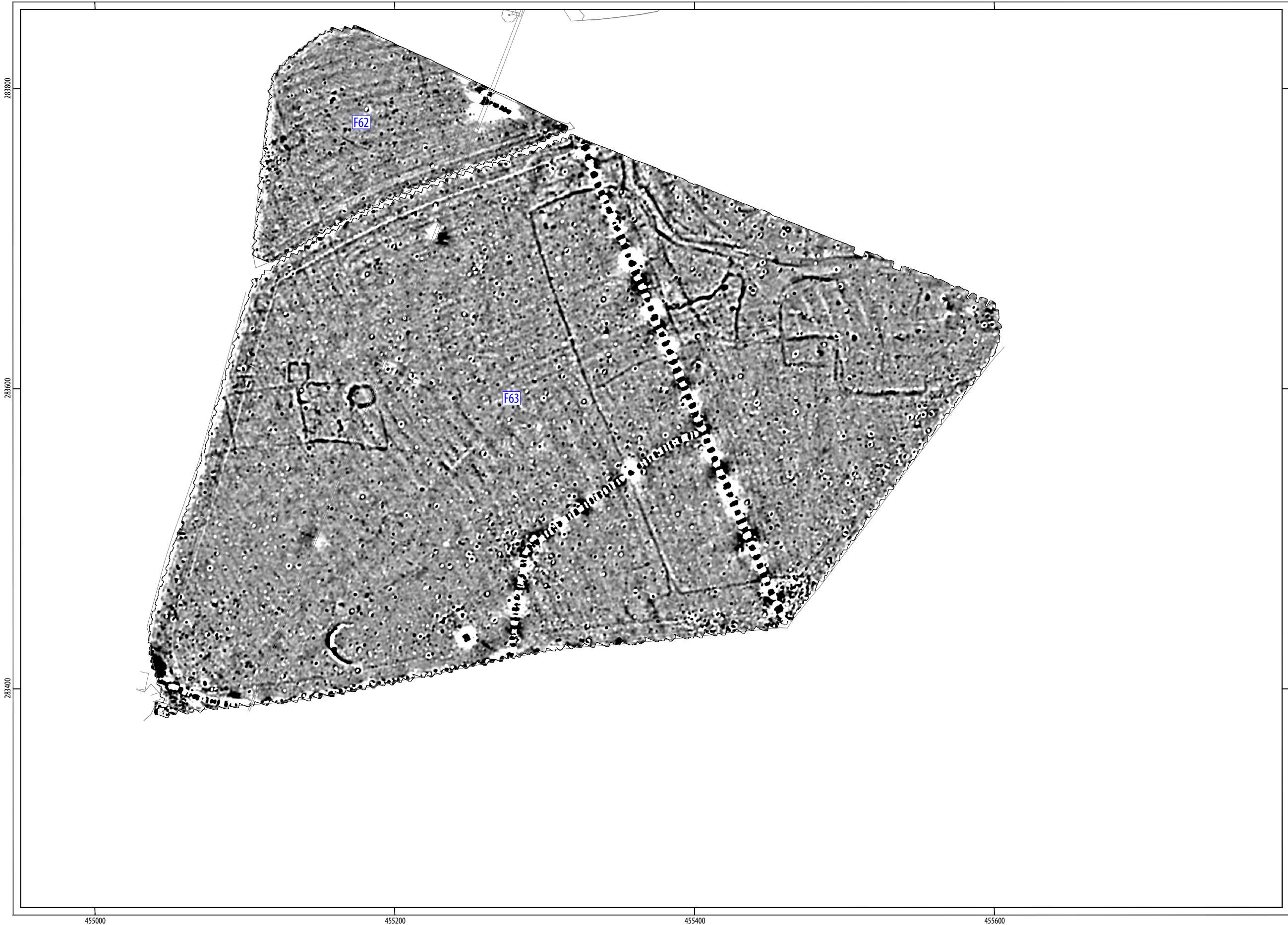


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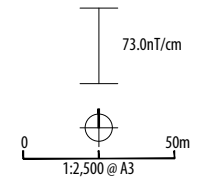
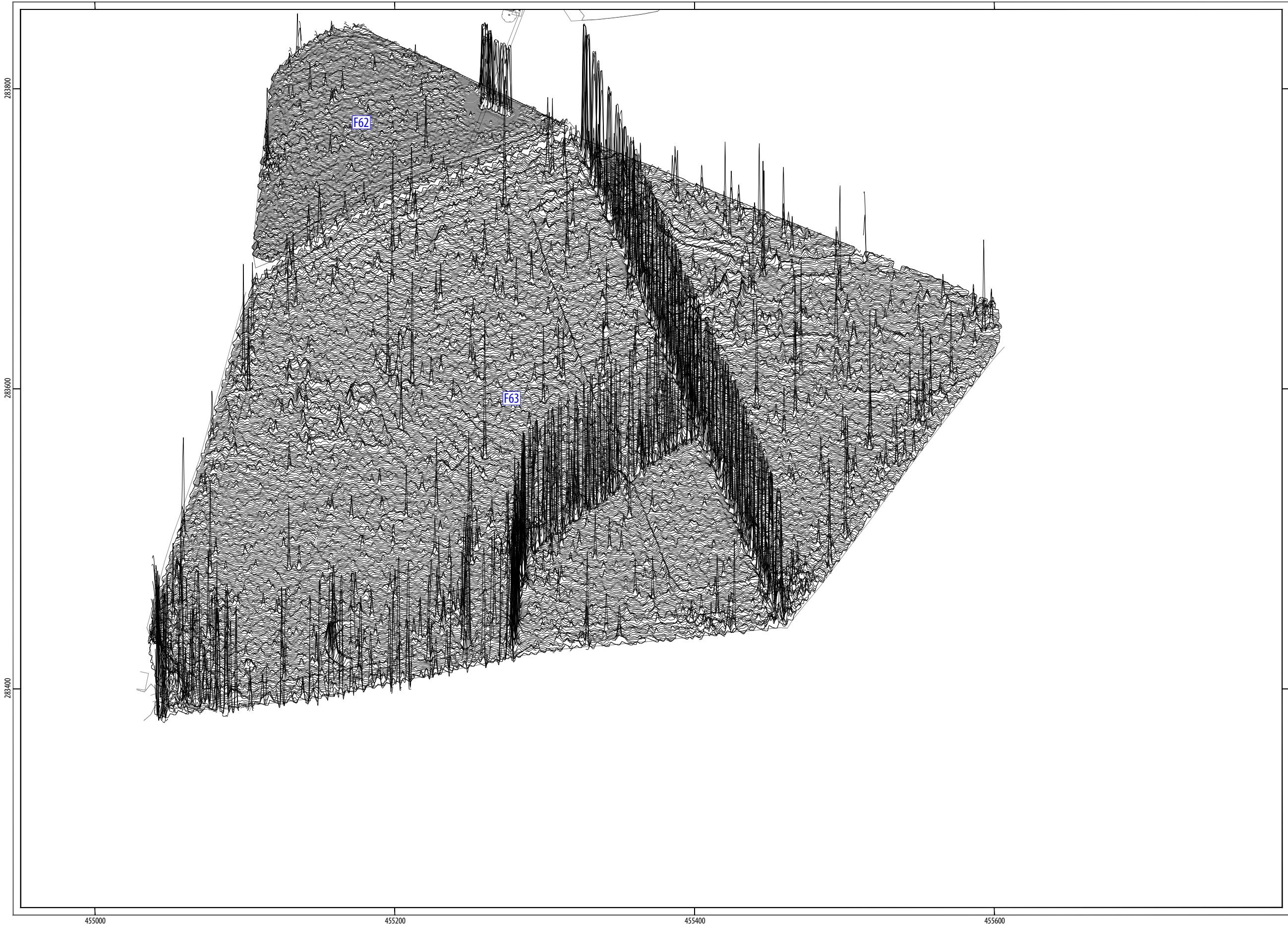


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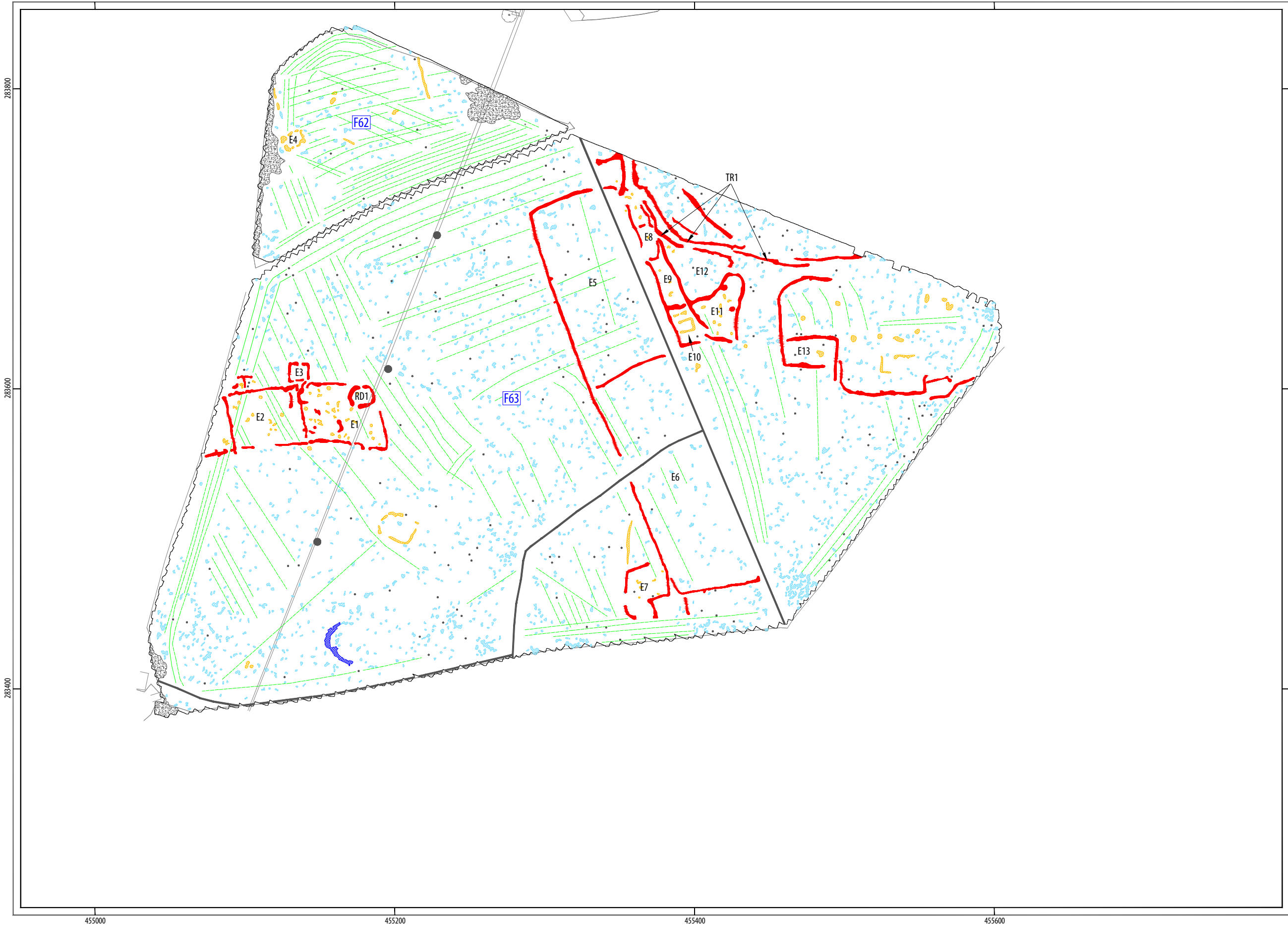
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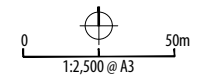


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ILLUS 33 XY trace plot of minimally processed magnetometer data; Sector 8



TYPE OF ANOMALY	INTERPRETATION
• dipolar isolated	ferrous material
••• magnetic disturbance	ferrous material
— dipolar linear	service pipe
— linear trend	ridge and furrow
— linear trend	agricultural
○ magnetic enhancement	geology
○ magnetic enhancement	archaeology?
● magnetic enhancement	archaeology
○ magnetic enhancement	LIRM

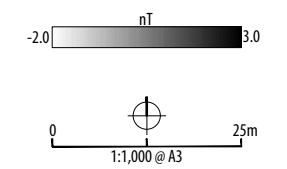


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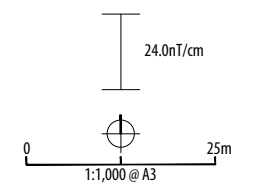
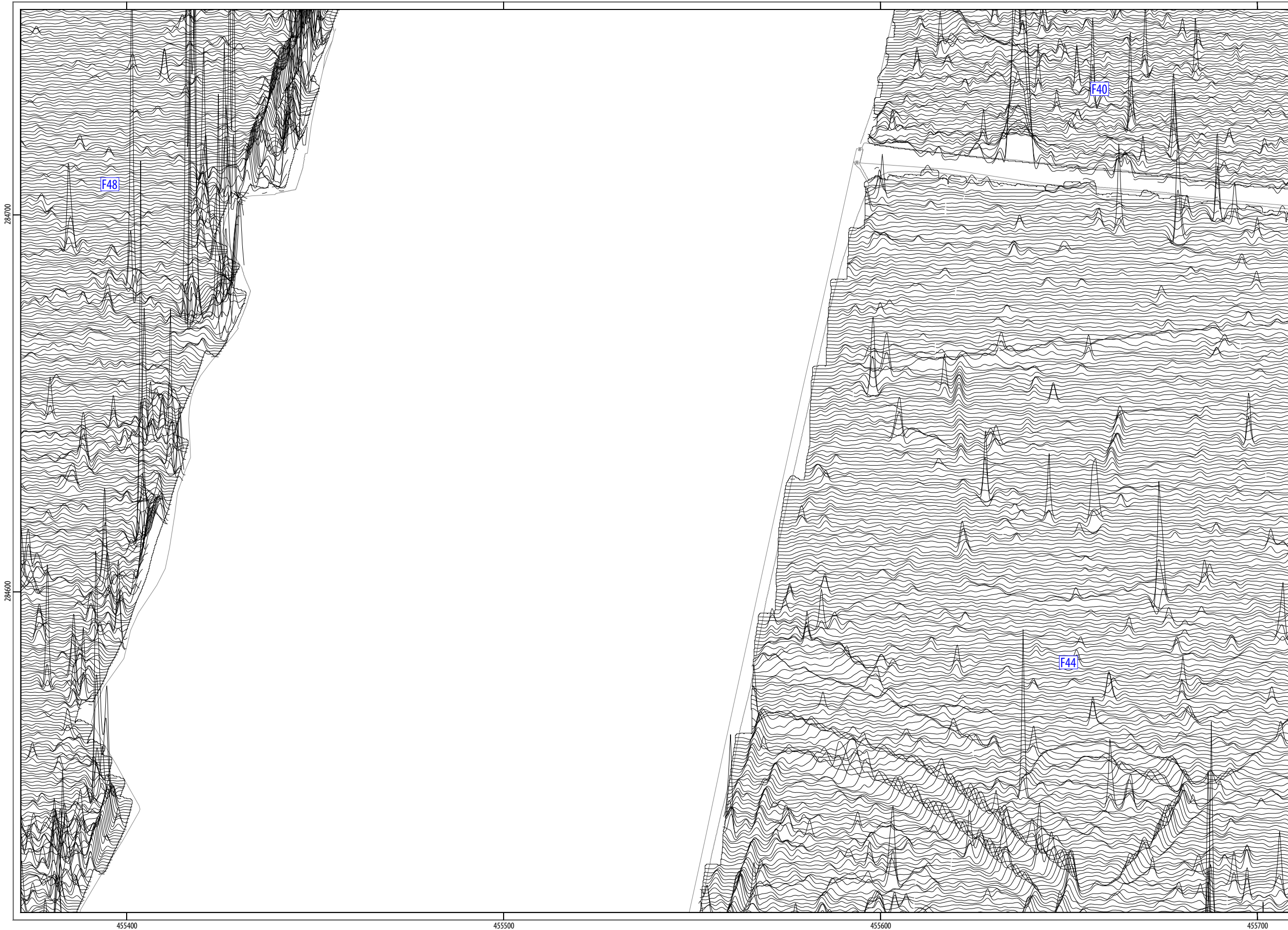
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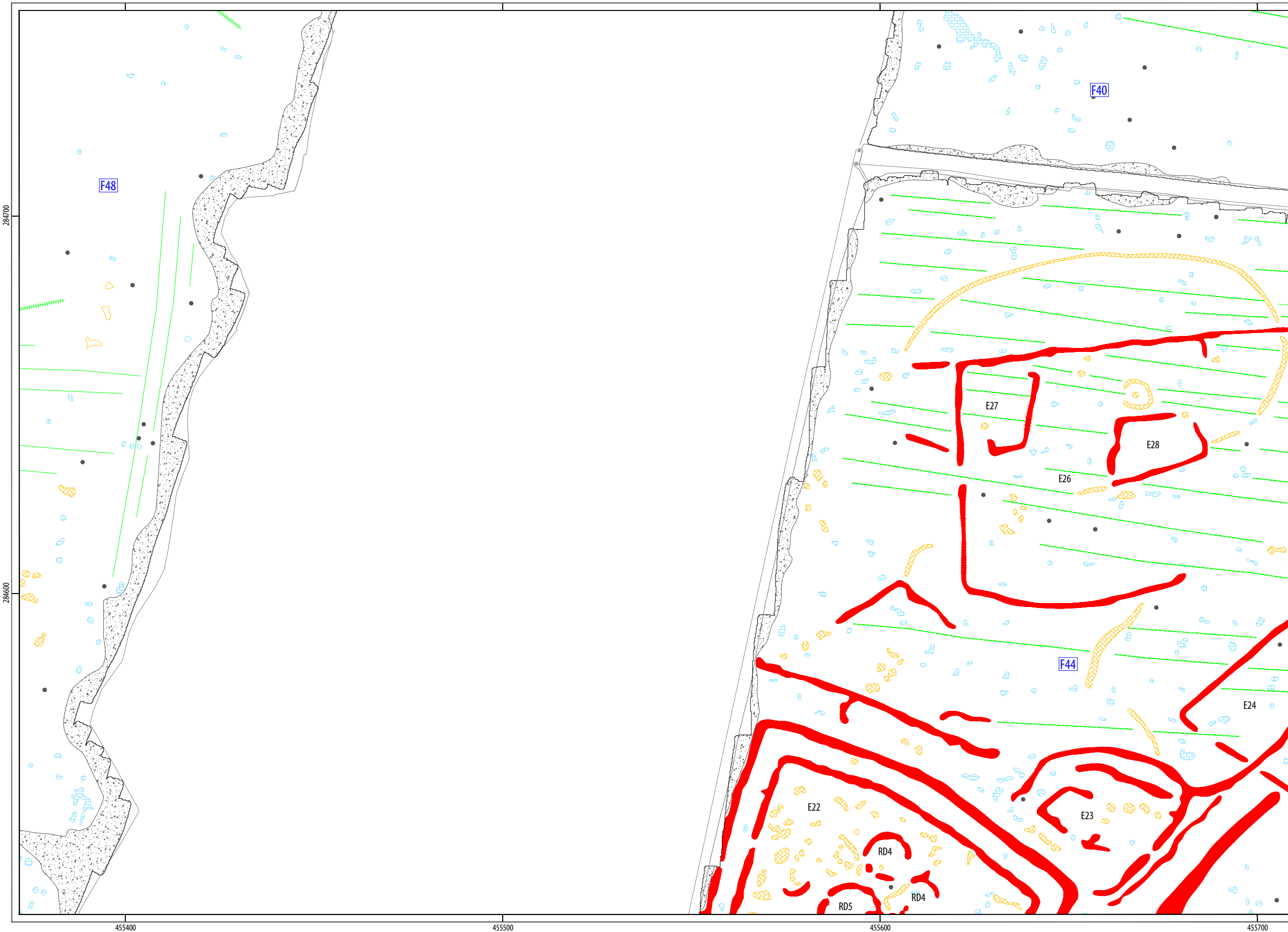


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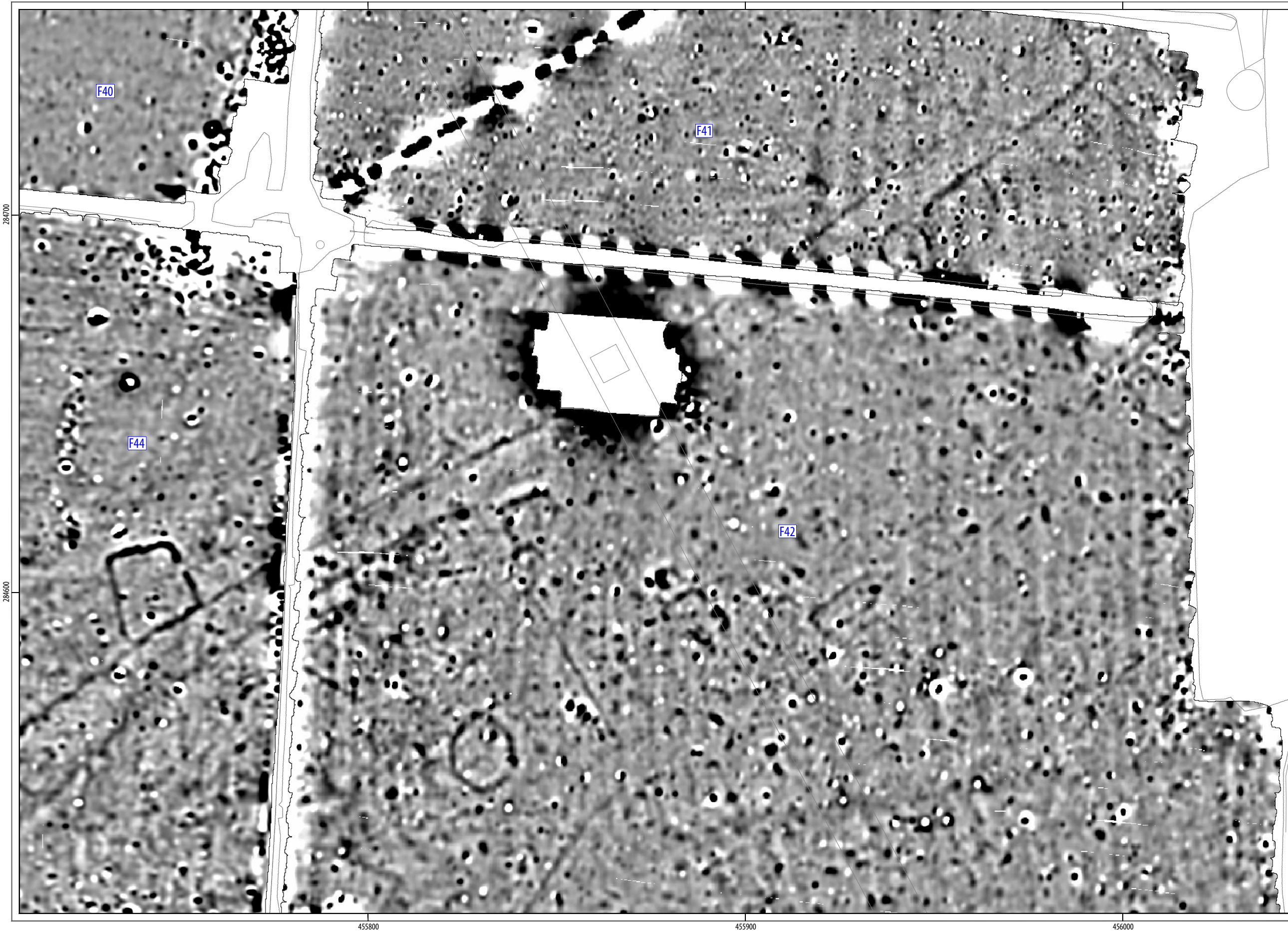
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ILLUS 37 Interpretation of magnetometer data; AAAS NW



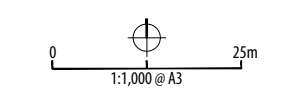
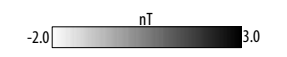
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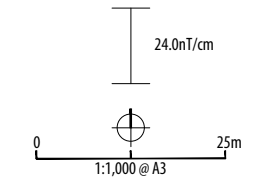
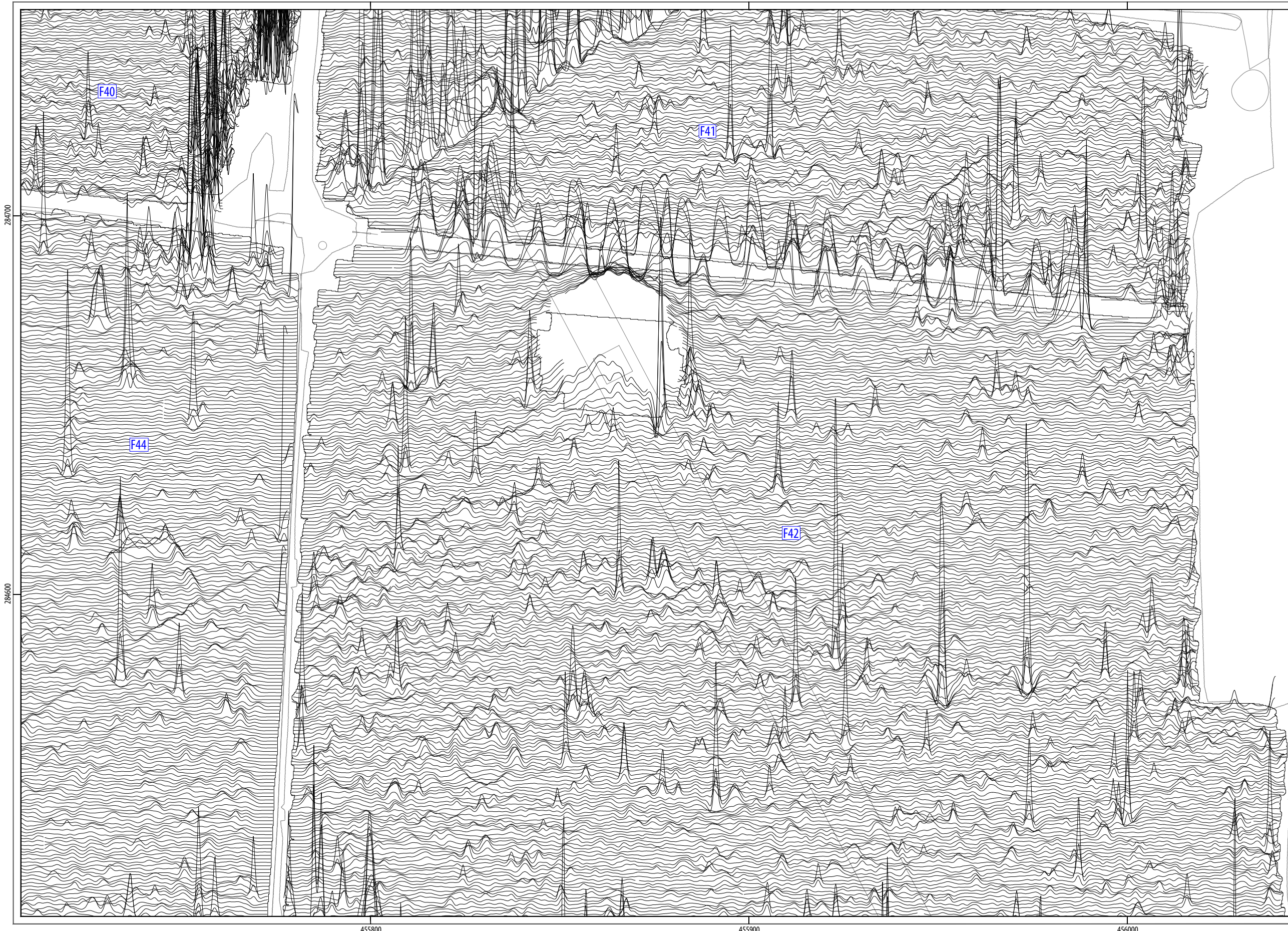


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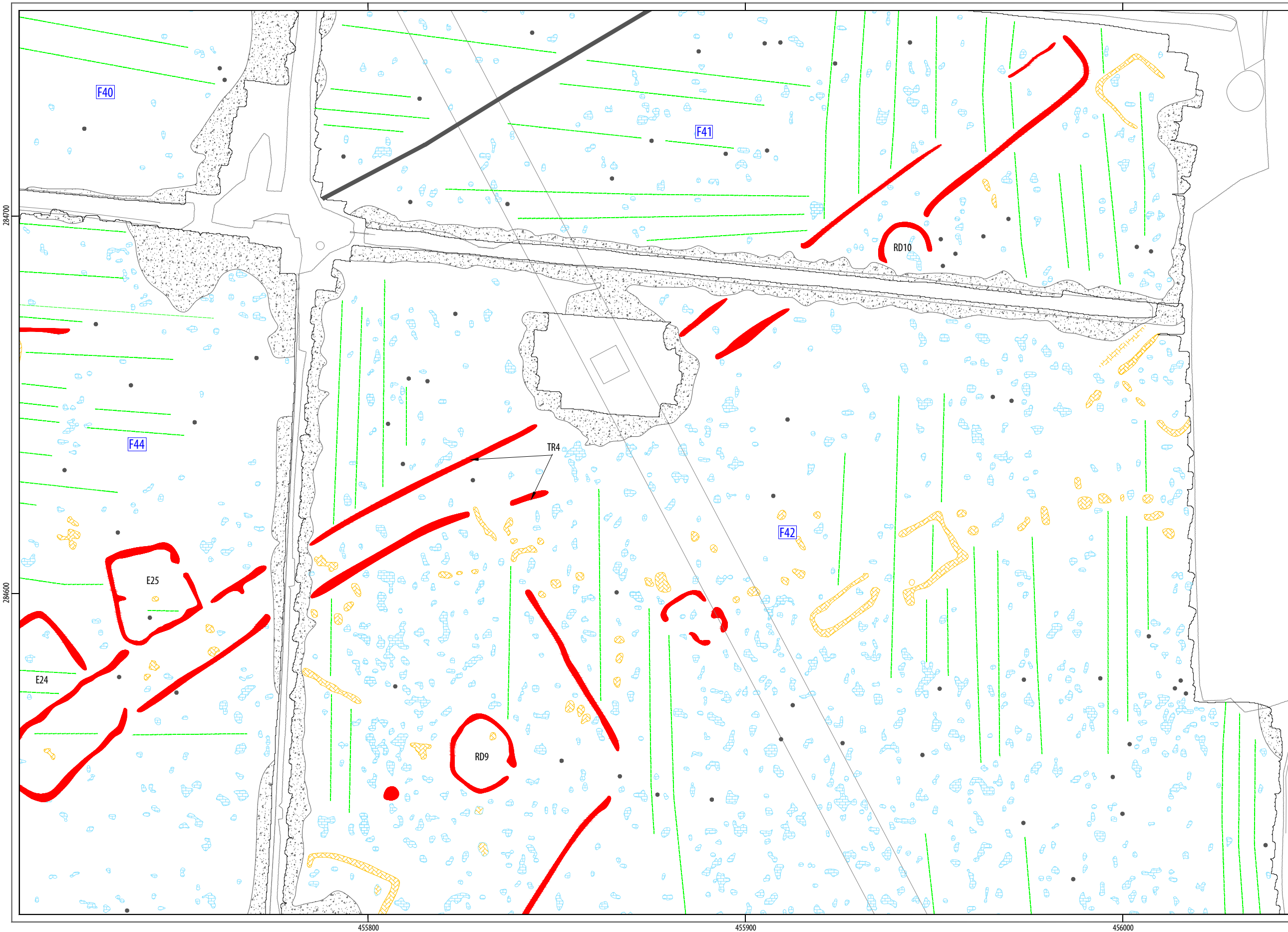
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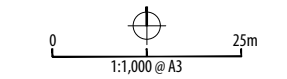


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ILLUS 39 XY trace plot of minimally processed magnetometer data; AAA1 NE



TYPE OF ANOMALY	INTERPRETATION
• dipolar isolated	ferrous material
• magnetic disturbance	ferrous material
— dipolar linear	service pipe
— linear trend	ridge and furrow
• magnetic enhancement	geology
• magnetic enhancement	archaeology?
• magnetic enhancement	archaeology

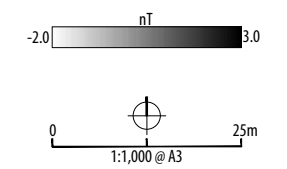


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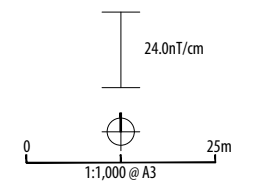
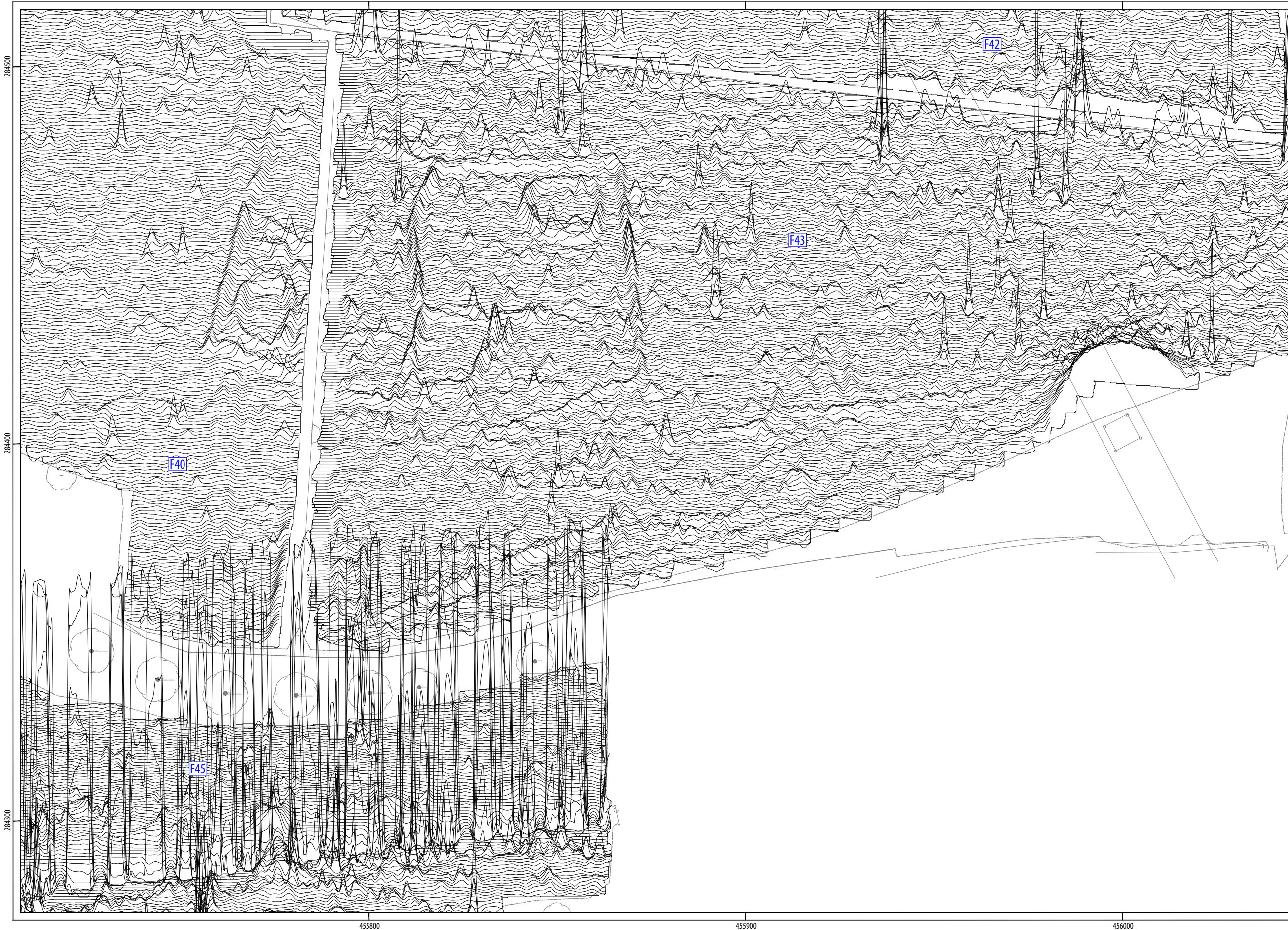
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ILLUS 41 Processed greyscale magnetometer data; AAA5 SE



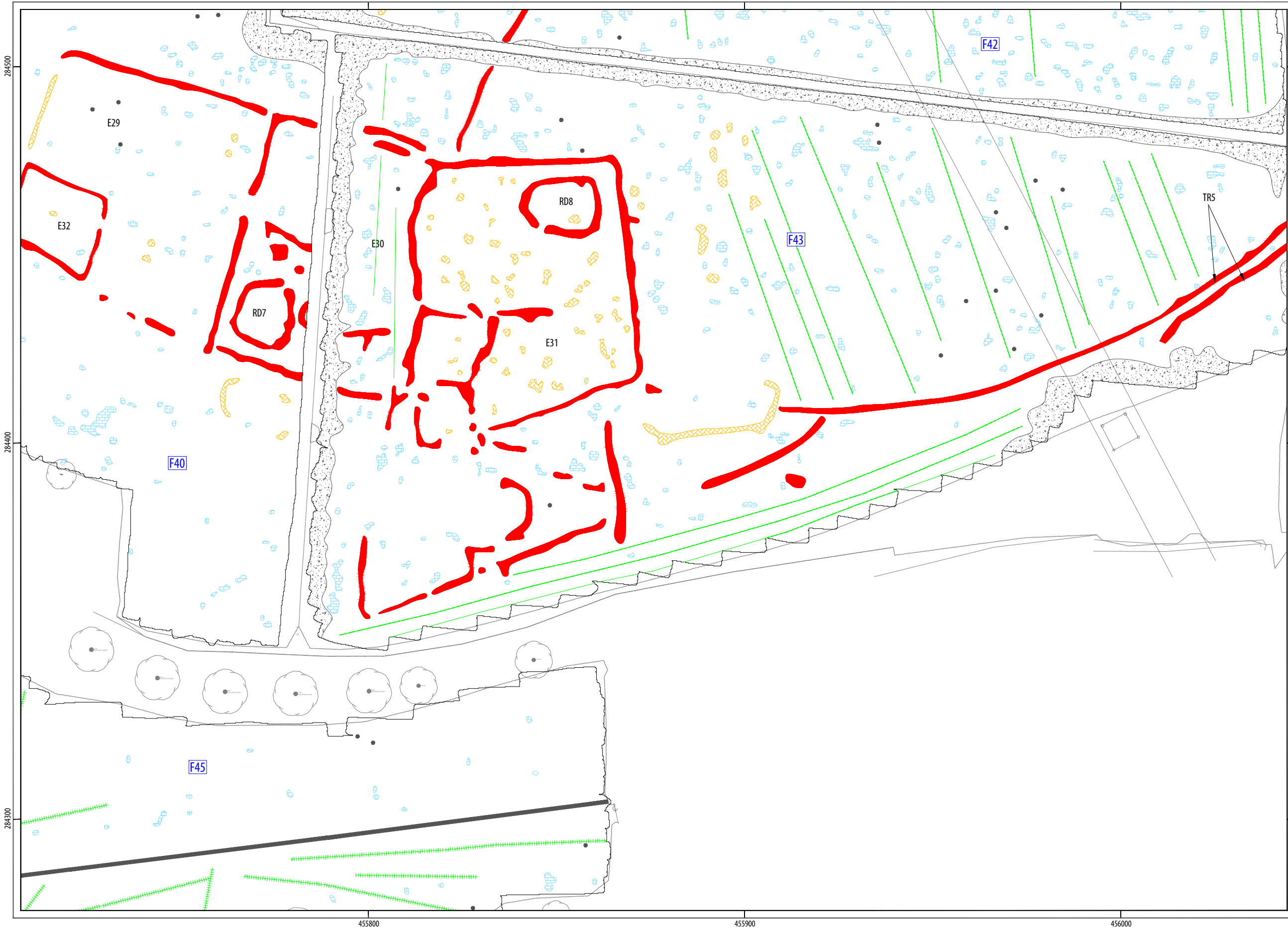
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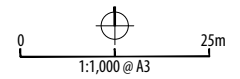


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ILLUS 42 XY trace plot of minimally processed magnetometer data; AAA1 SE



TYPE OF ANOMALY	INTERPRETATION
• dipolar isolated	ferrous material
• magnetic disturbance	ferrous material
— dipolar linear	service pipe
— linear trend	ridge and furrow
— linear trend	agricultural
— linear trend	field drain
• magnetic enhancement	geology
• magnetic enhancement	archaeology?
• magnetic enhancement	archaeology



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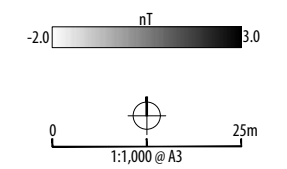
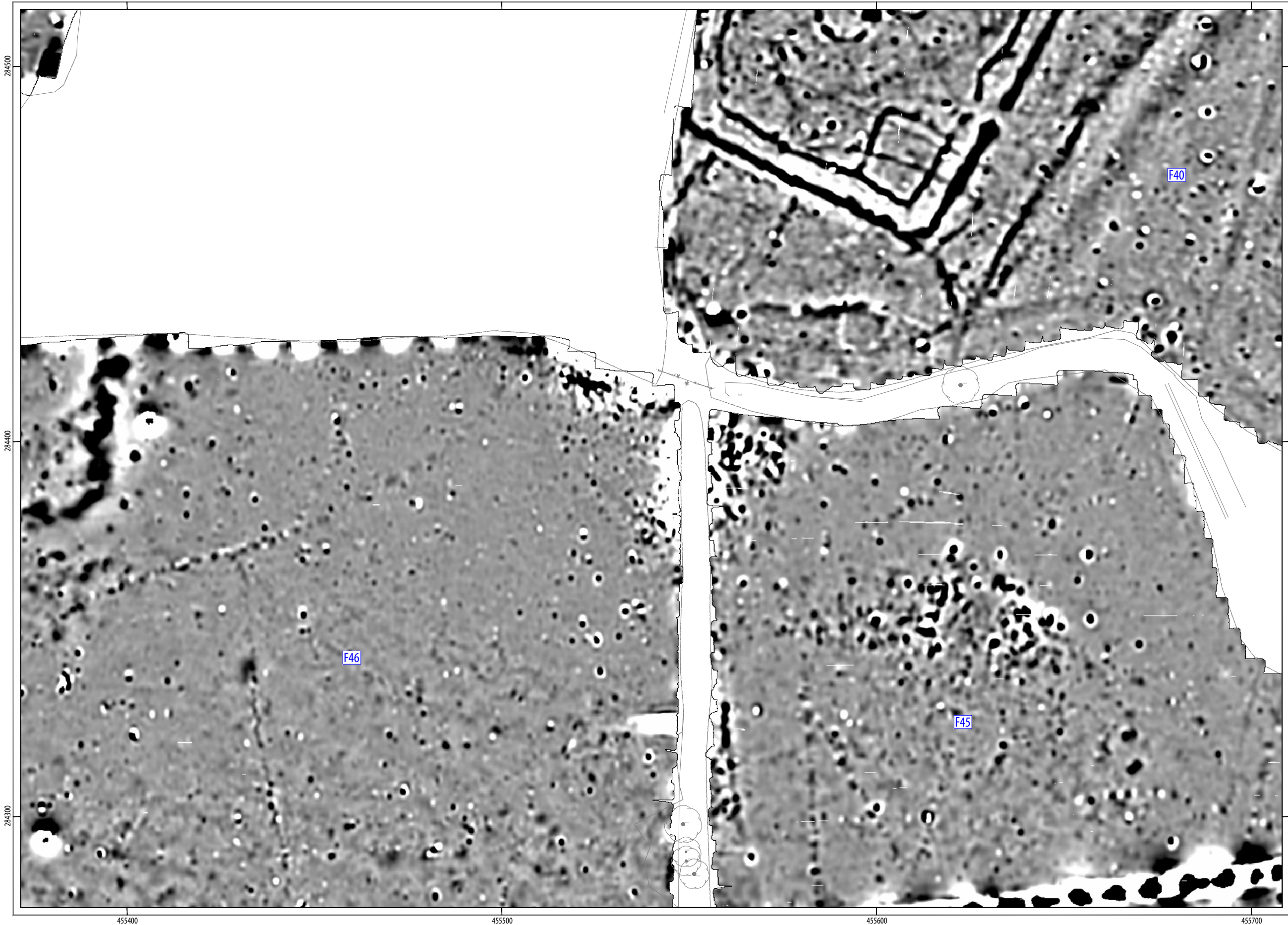
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ILLUS 43 Interpretation of magnetometer data; AAAS SE



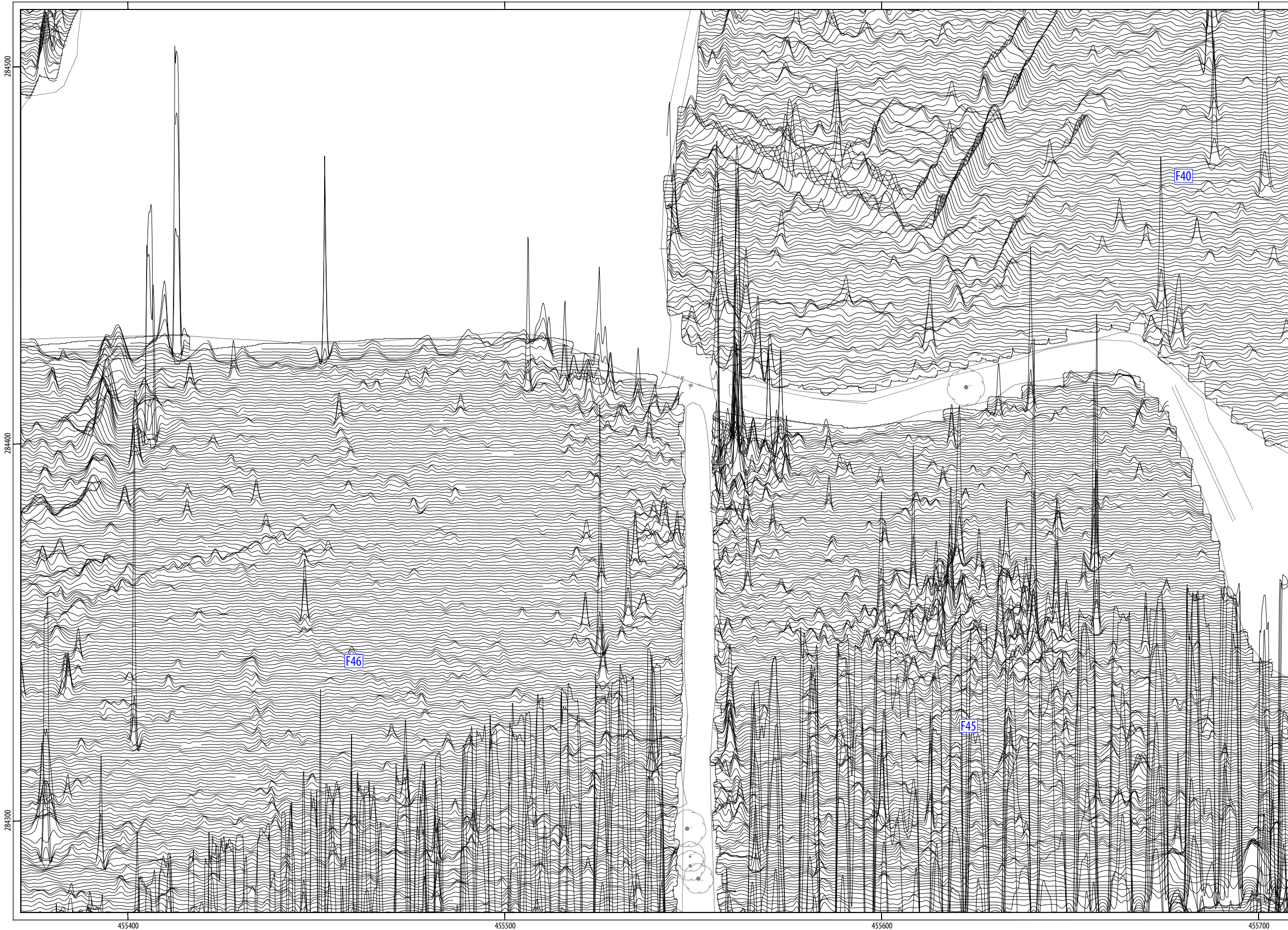


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284500

284400

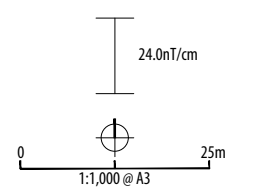
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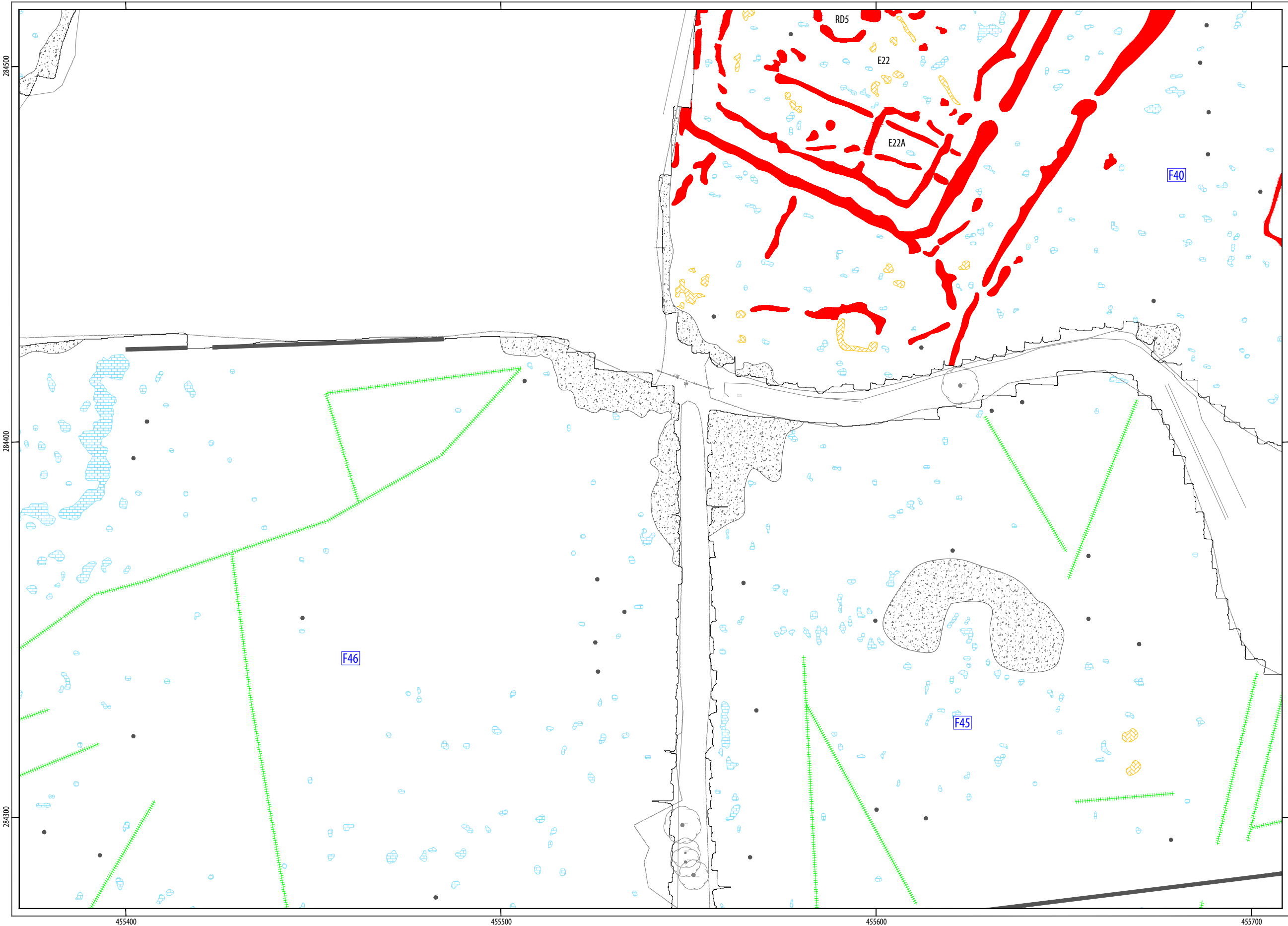
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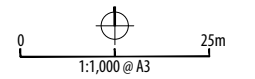


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ILLUS 45 XY trace plot of minimally processed magnetometer data; AAA1 SW



TYPE OF ANOMALY	INTERPRETATION
• dipolar isolated	ferrous material
● magnetic disturbance	ferrous material
— dipolar linear	service pipe
— linear trend	field drain
⊕ magnetic enhancement	geology
⊗ magnetic enhancement	archaeology?
● magnetic enhancement	archaeology



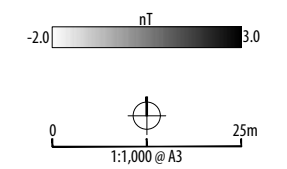
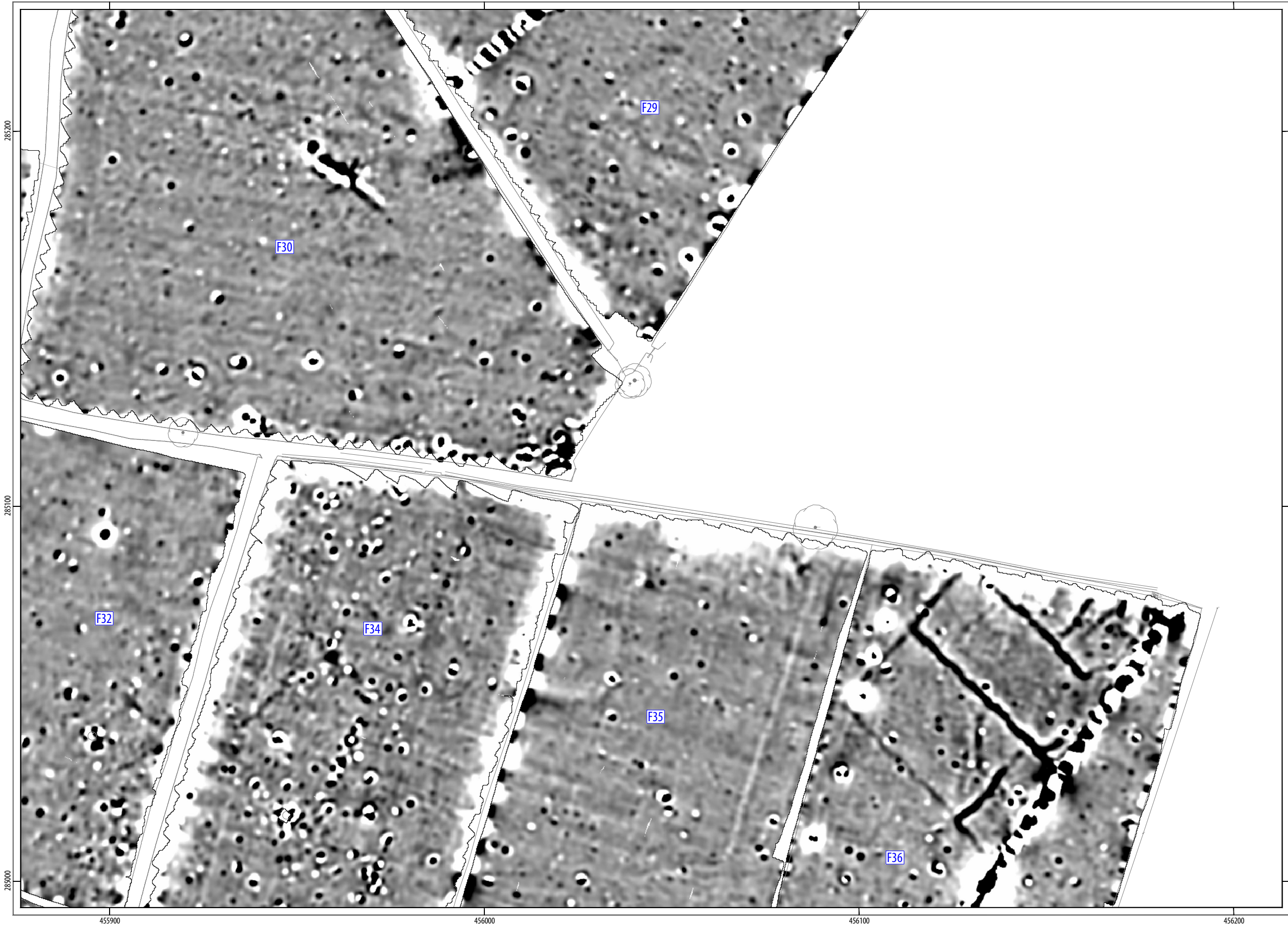
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ILLUS 46 Interpretation of magnetometer data; AAAS SW



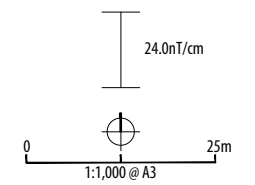
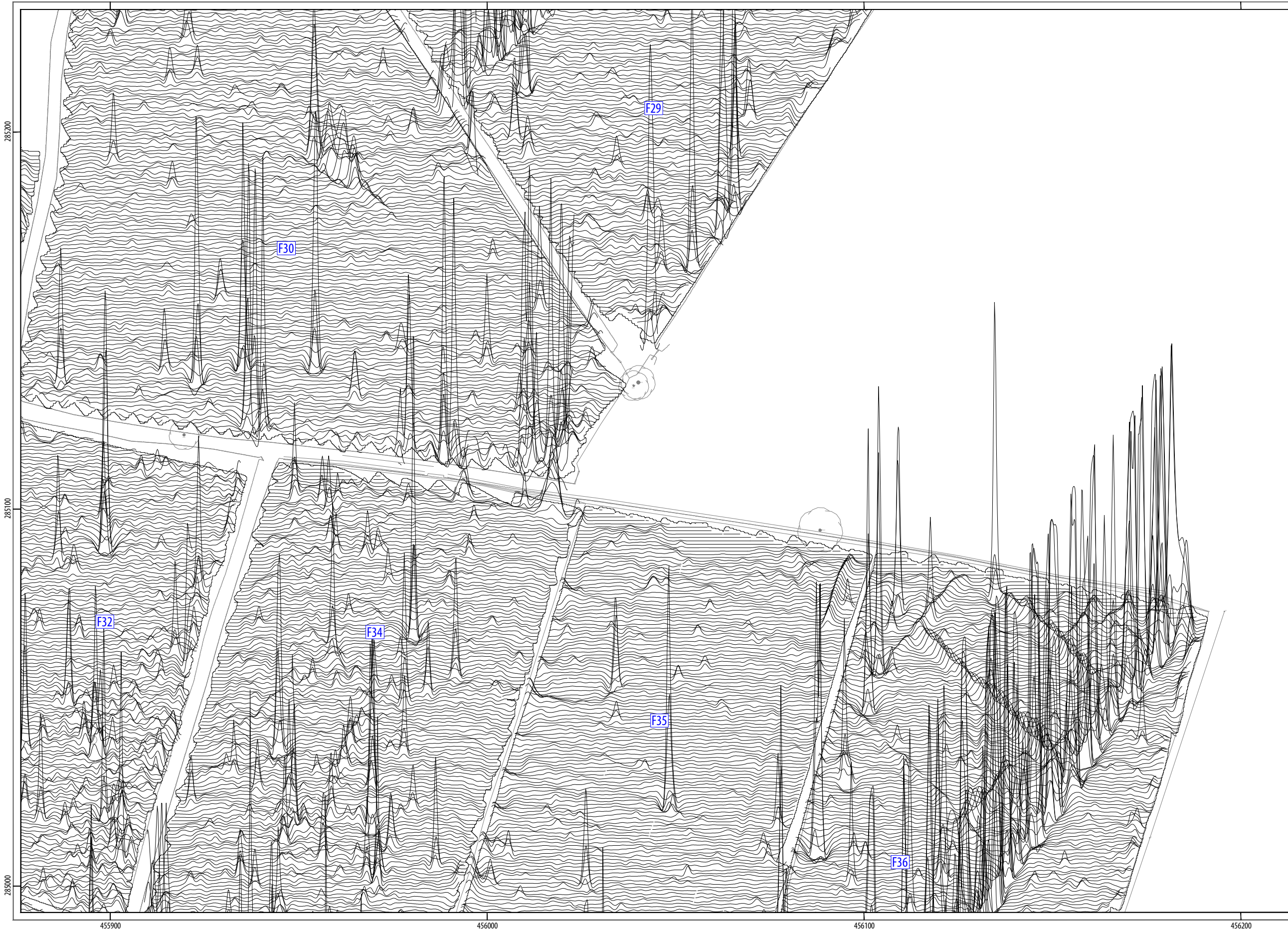
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ILLUS 47 Processed greyscale magnetometer data; AAA6 N



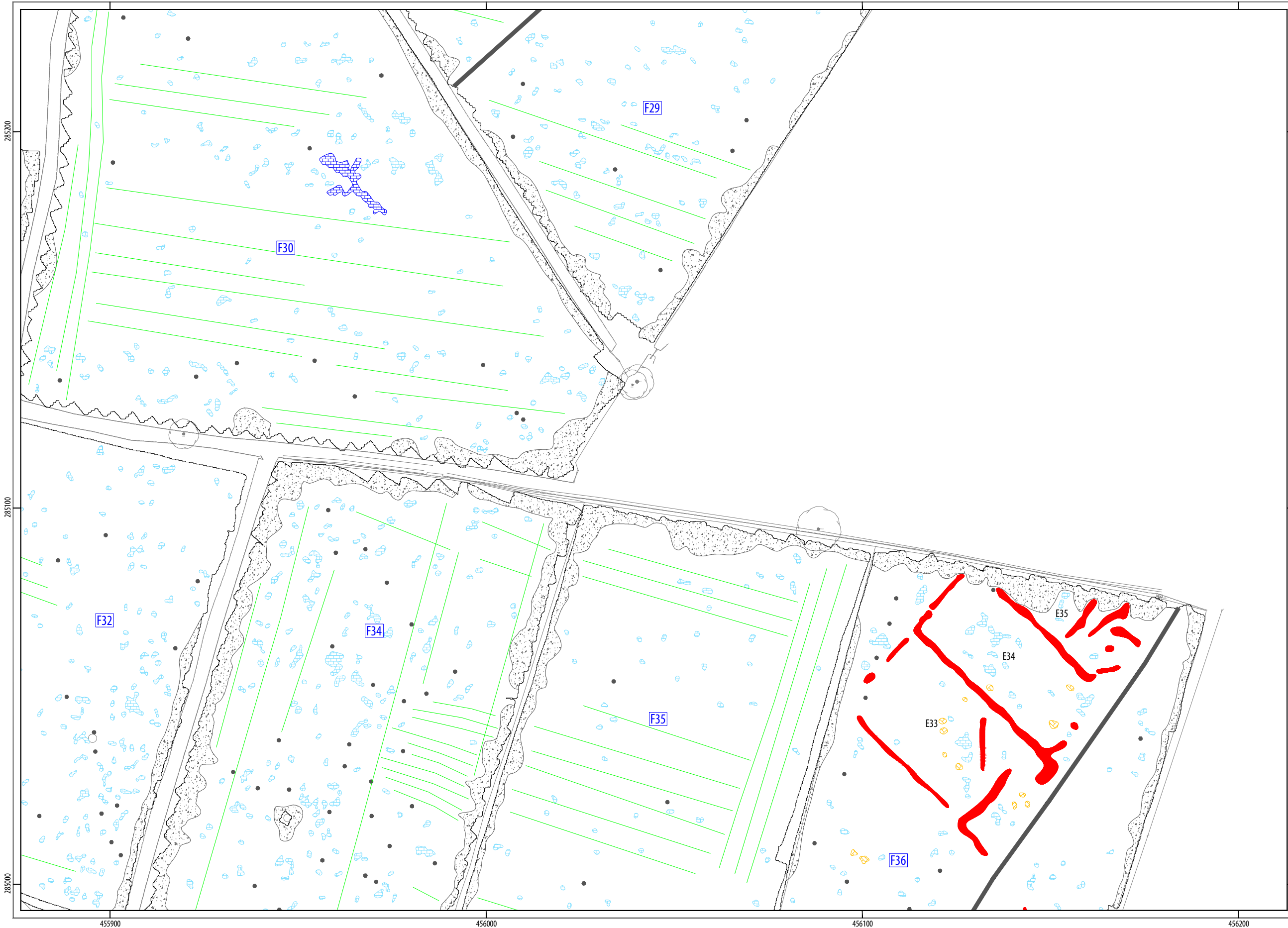
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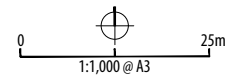


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ILLUS 48 XY trace plot of minimally processed magnetometer data; AAA2 N



TYPE OF ANOMALY	INTERPRETATION
• dipolar isolated	ferrous material
● magnetic disturbance	ferrous material
— dipolar linear	service pipe
— linear trend	agricultural
■ magnetic enhancement	geology
■ magnetic enhancement	archaeology?
■ magnetic enhancement	archaeology
■ magnetic enhancement	LIRM



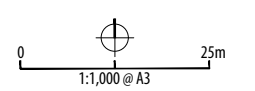
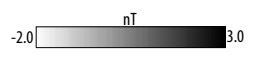
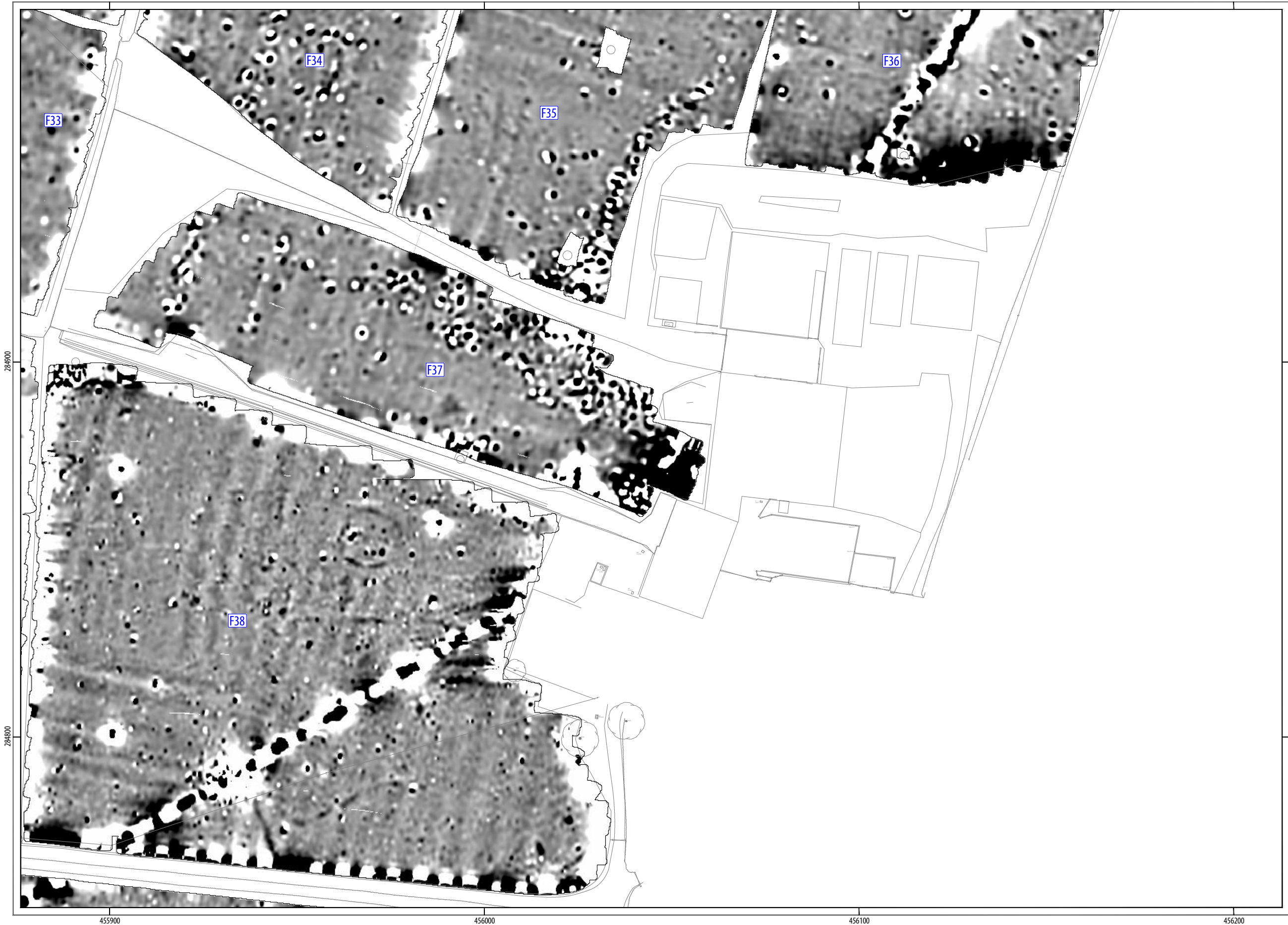
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ILLUS 49 Interpretation of magnetometer data; AAA6 N

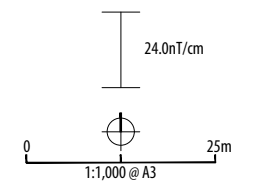
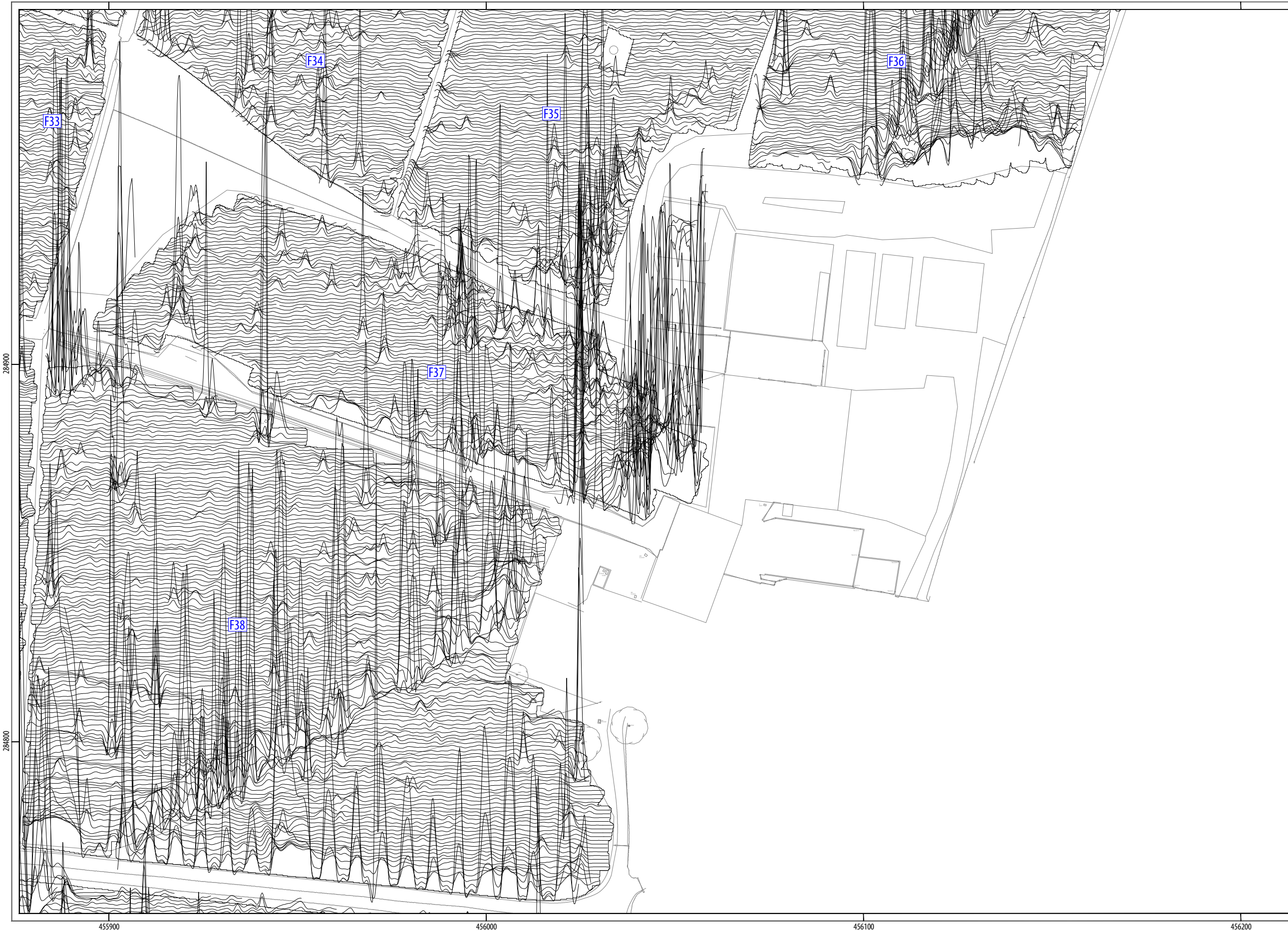


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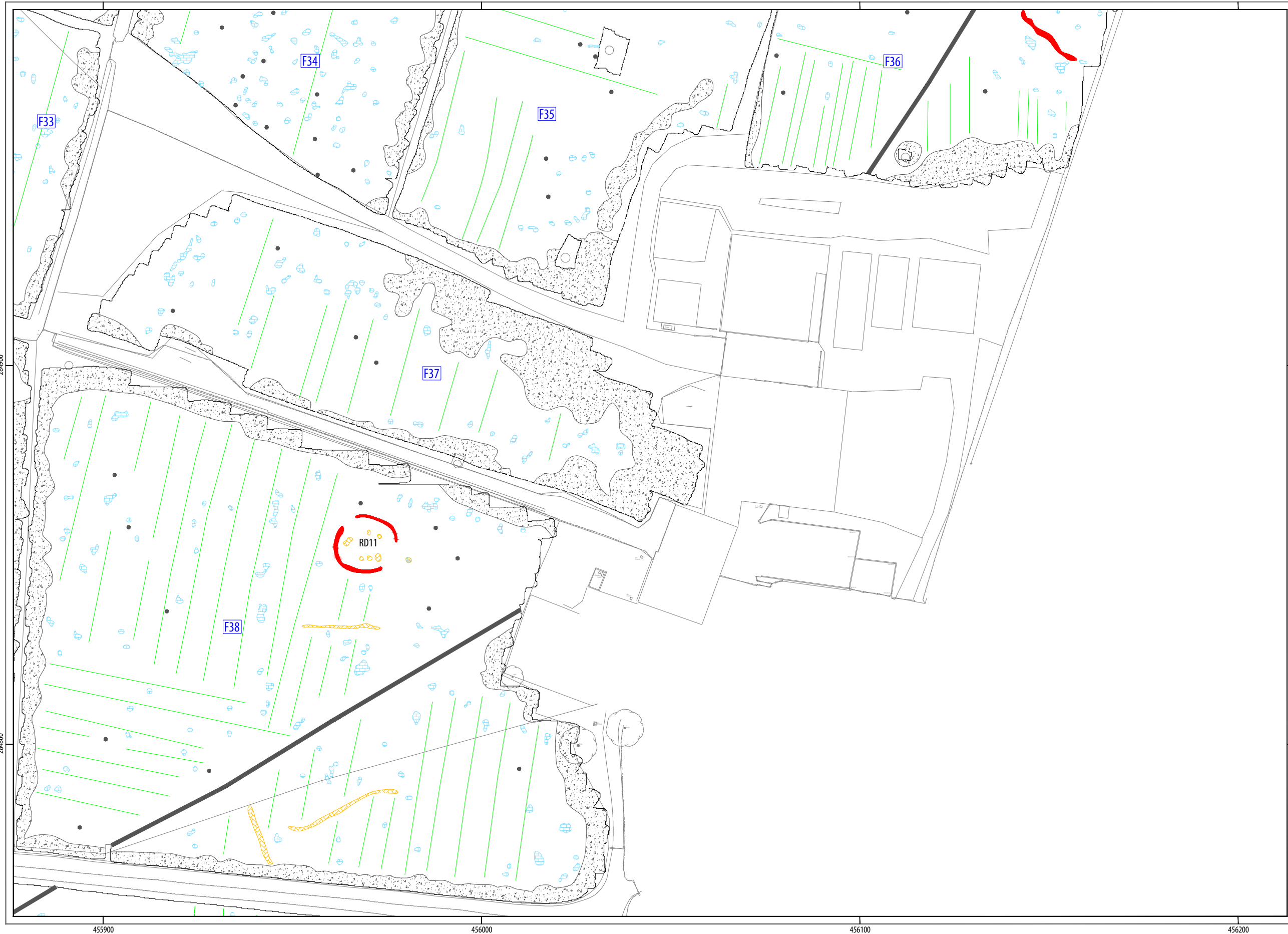
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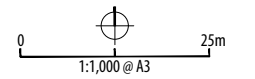


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TYPE OF ANOMALY	INTERPRETATION
• dipolar isolated	ferrous material
• magnetic disturbance	ferrous material
— dipolar linear	service pipe
— linear trend	ridge and furrow
— linear trend	agricultural
■ magnetic enhancement	geology
■ magnetic enhancement	archaeology?
■ magnetic enhancement	archaeology



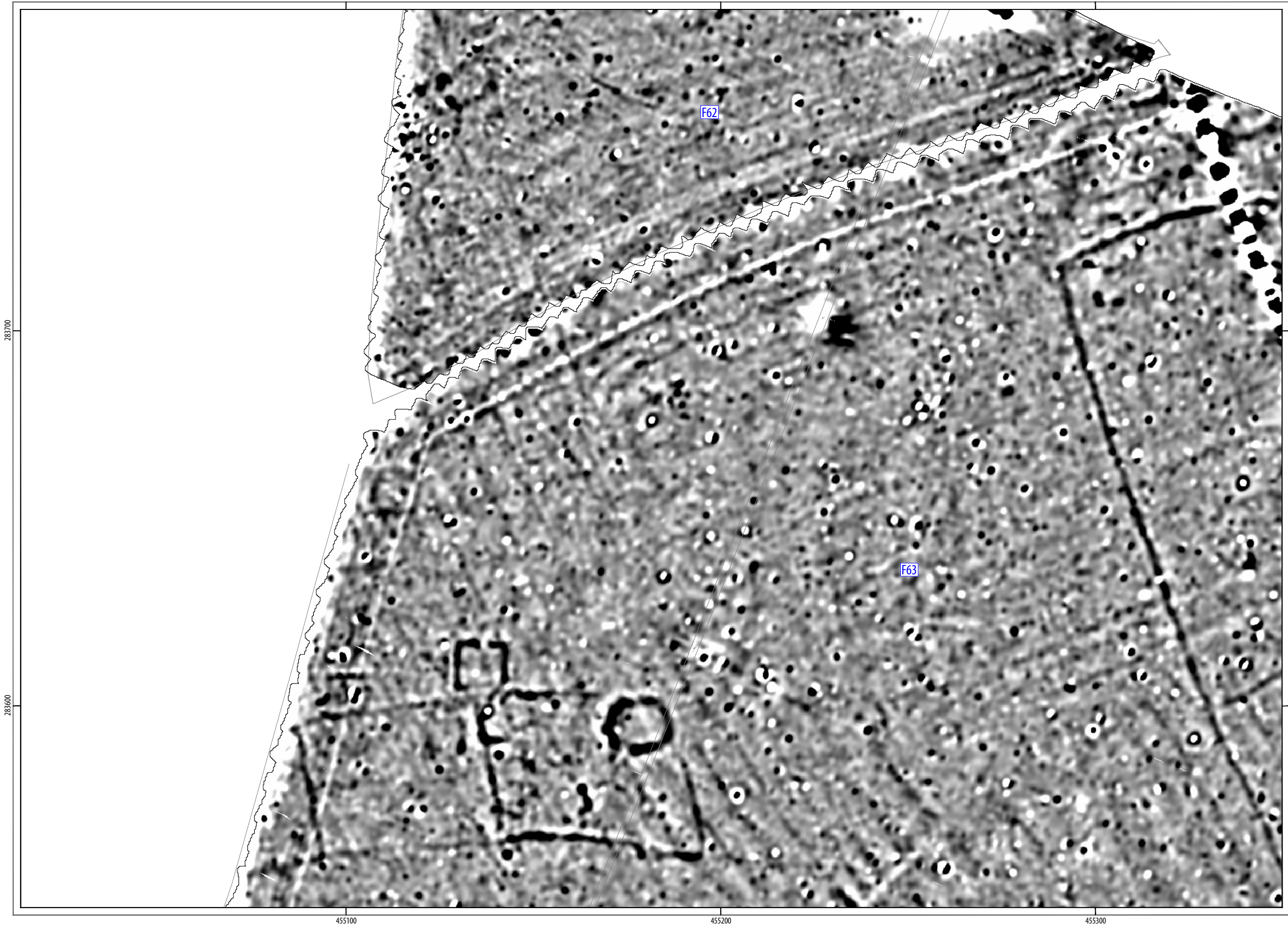
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ILLUS 52 Interpretation of magnetometer data; AAA6 S



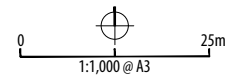
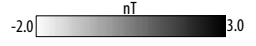
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455300

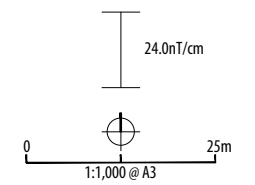
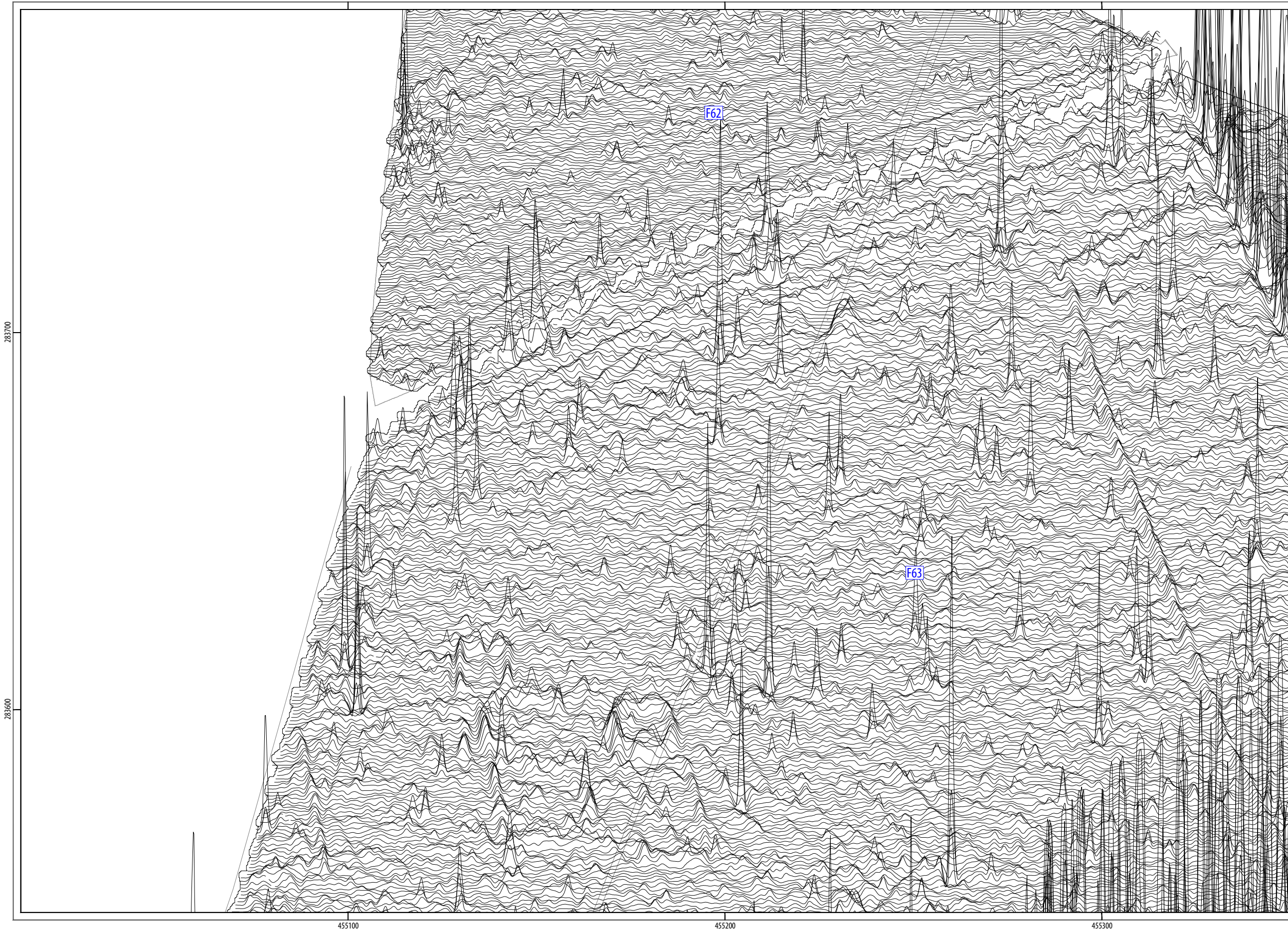


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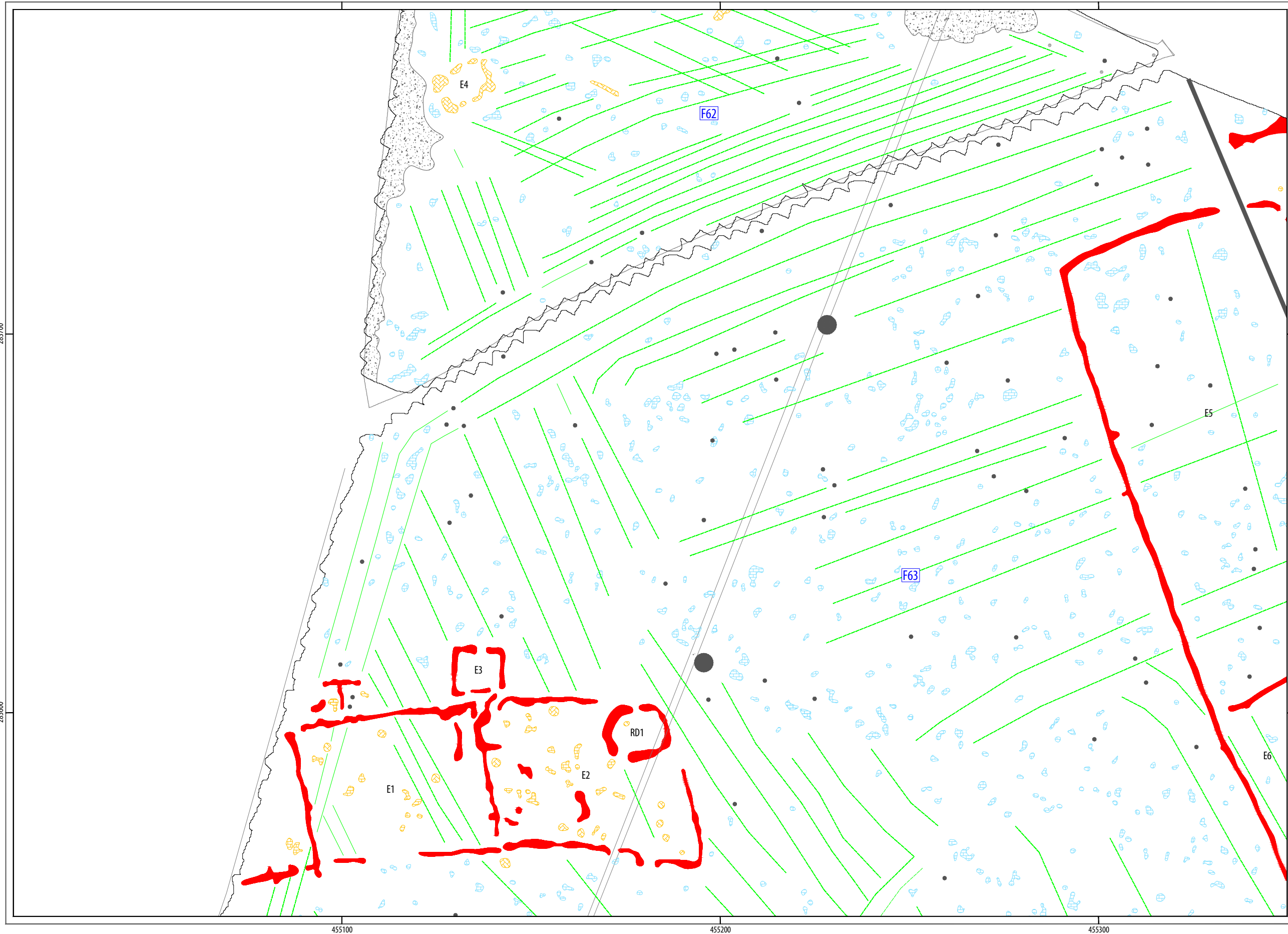
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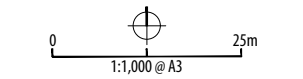


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ILLUS 54 XY trace plot of minimally processed magnetometer data; AAA3 W



TYPE OF ANOMALY	INTERPRETATION
• dipolar isolated	ferrous material
● magnetic disturbance	ferrous material
— dipolar linear	service pipe
— linear trend	ridge and furrow
— linear trend	agricultural
■ magnetic enhancement	geology
■ magnetic enhancement	archaeology?
■ magnetic enhancement	archaeology



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283700

283600

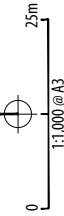
283500

455400

455500



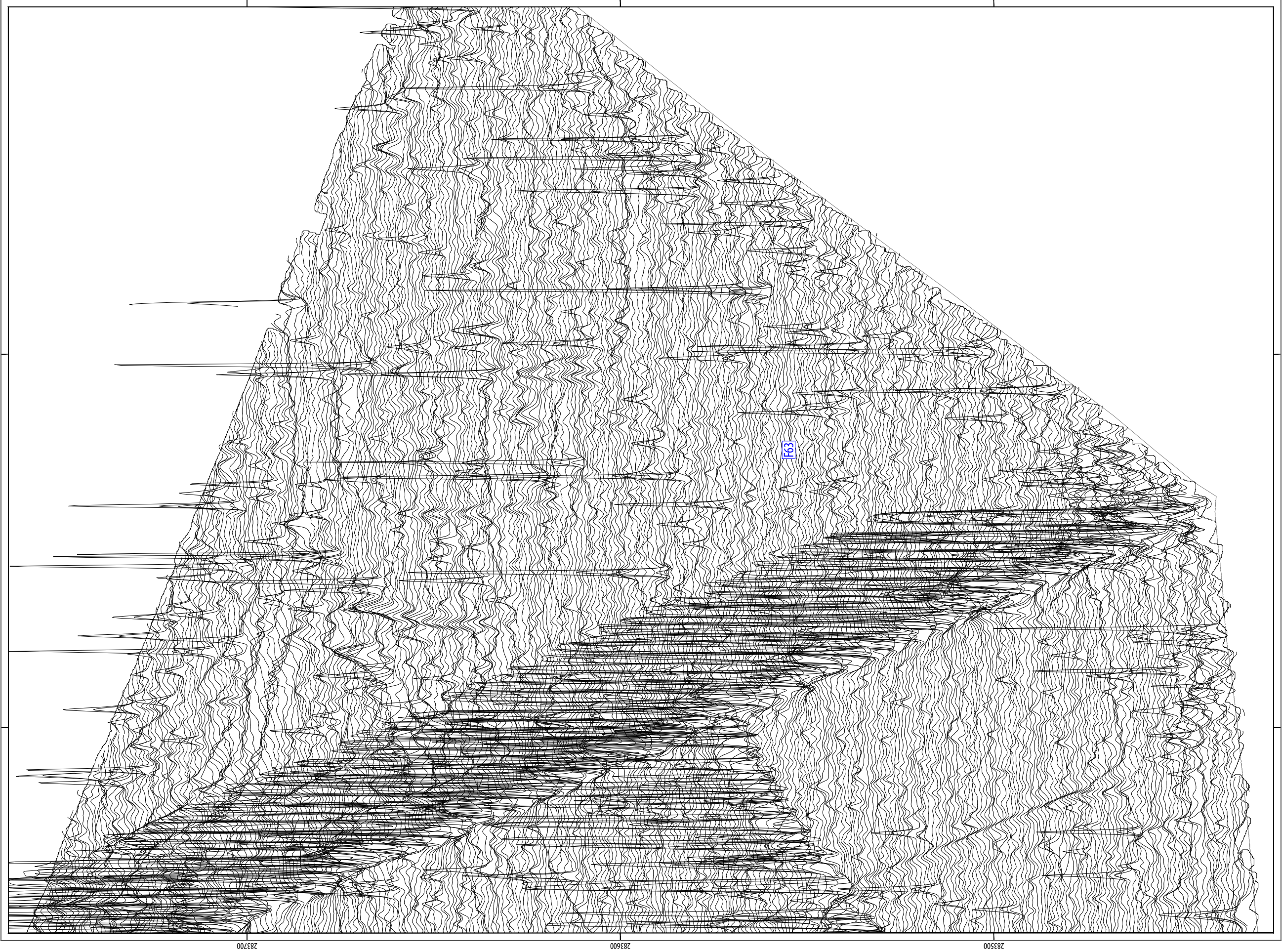
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455400

455300

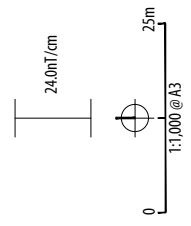


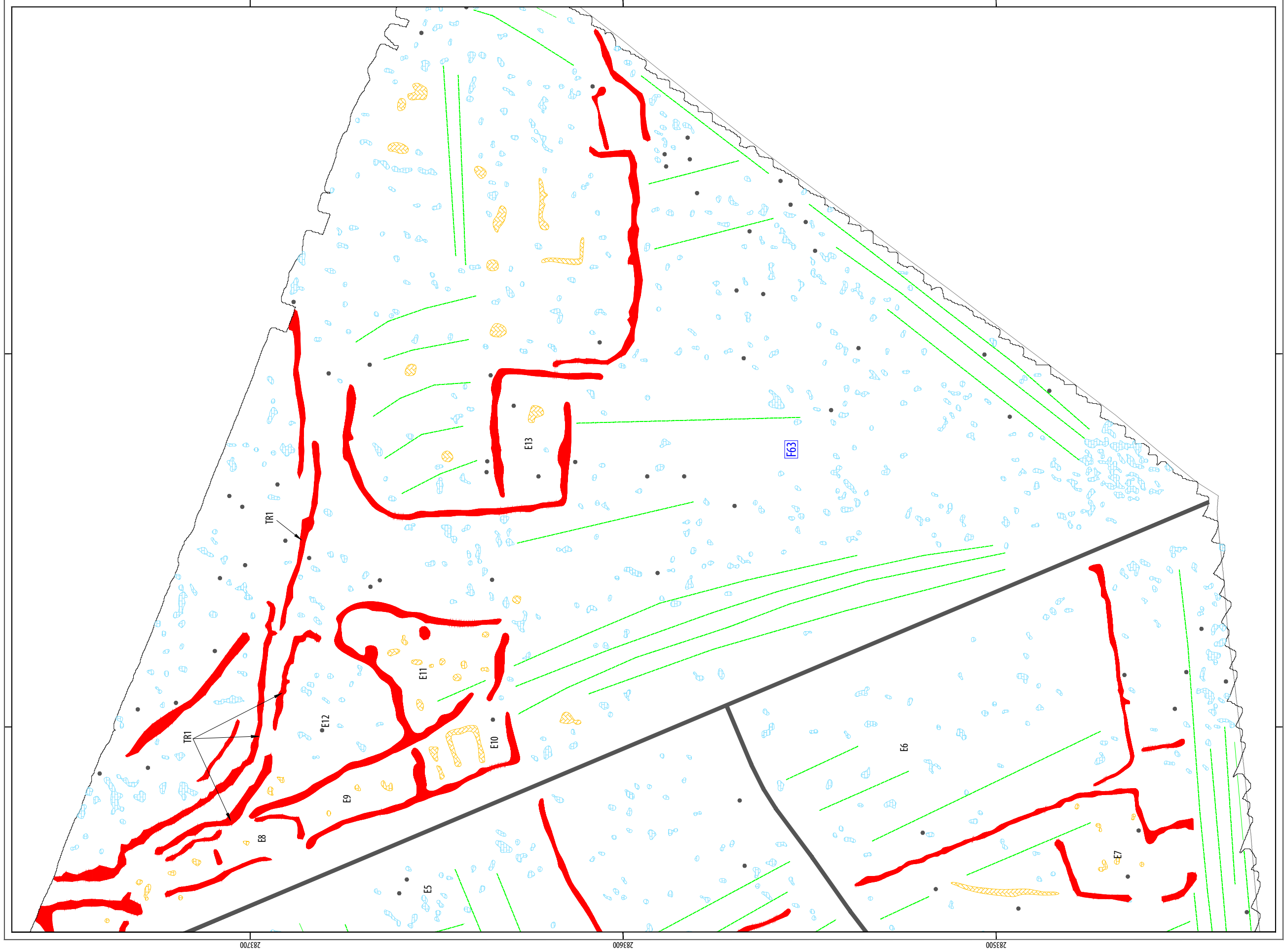
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455400

455300

283700

283600

283500

0 25m  
1:1,000 @ A3

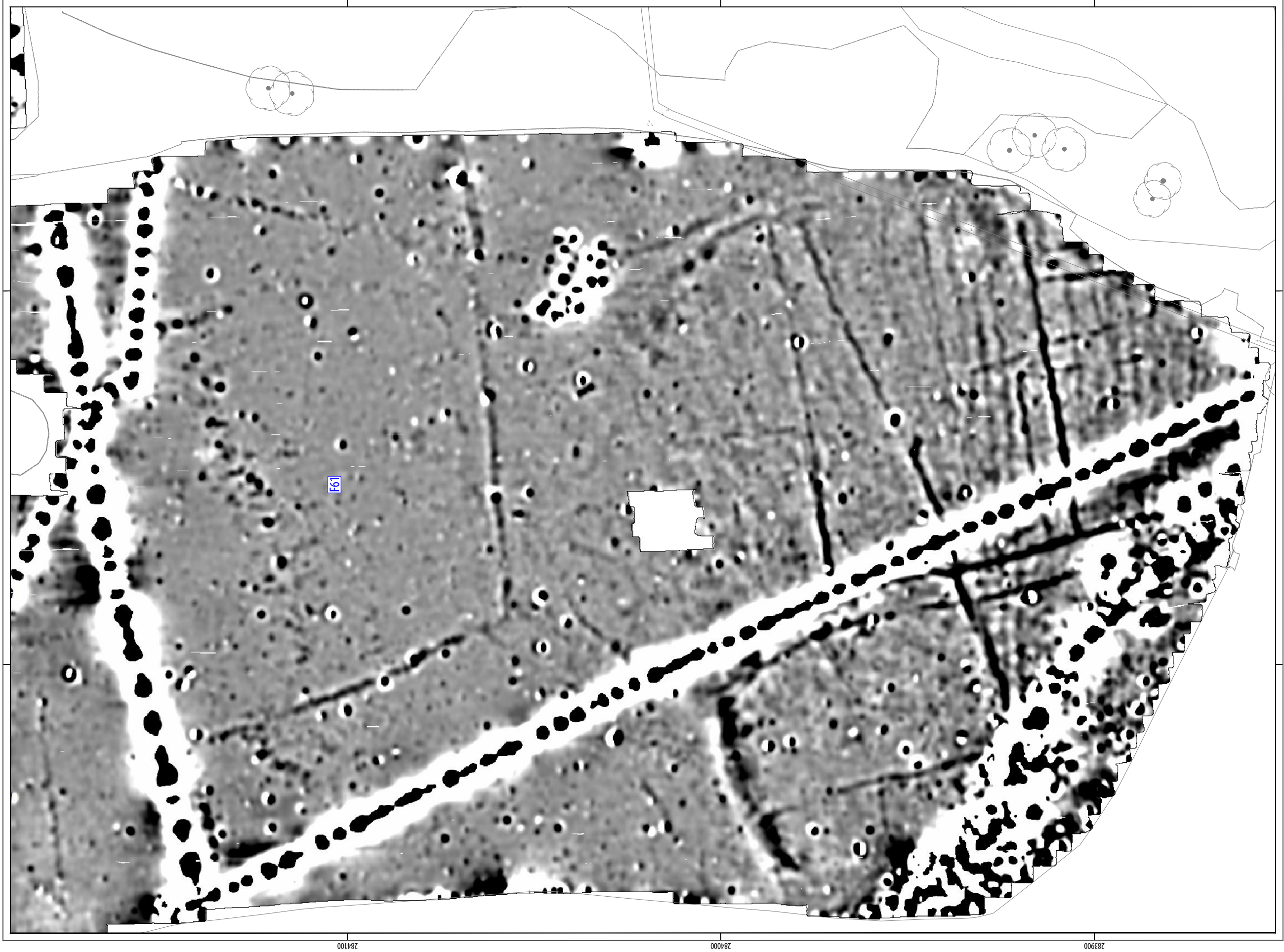
TYPE OF ANOMALY	INTERPRETATION	TYPE OF ANOMALY	INTERPRETATION
• dipolar isolated	ferrous material	● magnetic enhancement	archaeology
■ magnetic disturbance	ferrous material		
— dipolar linear	service pipe		
— linear trend	ridge and furrow		
● magnetic enhancement	geology		
● magnetic enhancement	archaeology?		

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ILLUS 58 Interpretation of magnetometer data: AAA1 E



455300

455200

284100 284000 283900

0 25m  
1:1,000 @ A3

0 -2.0 nT 3.0

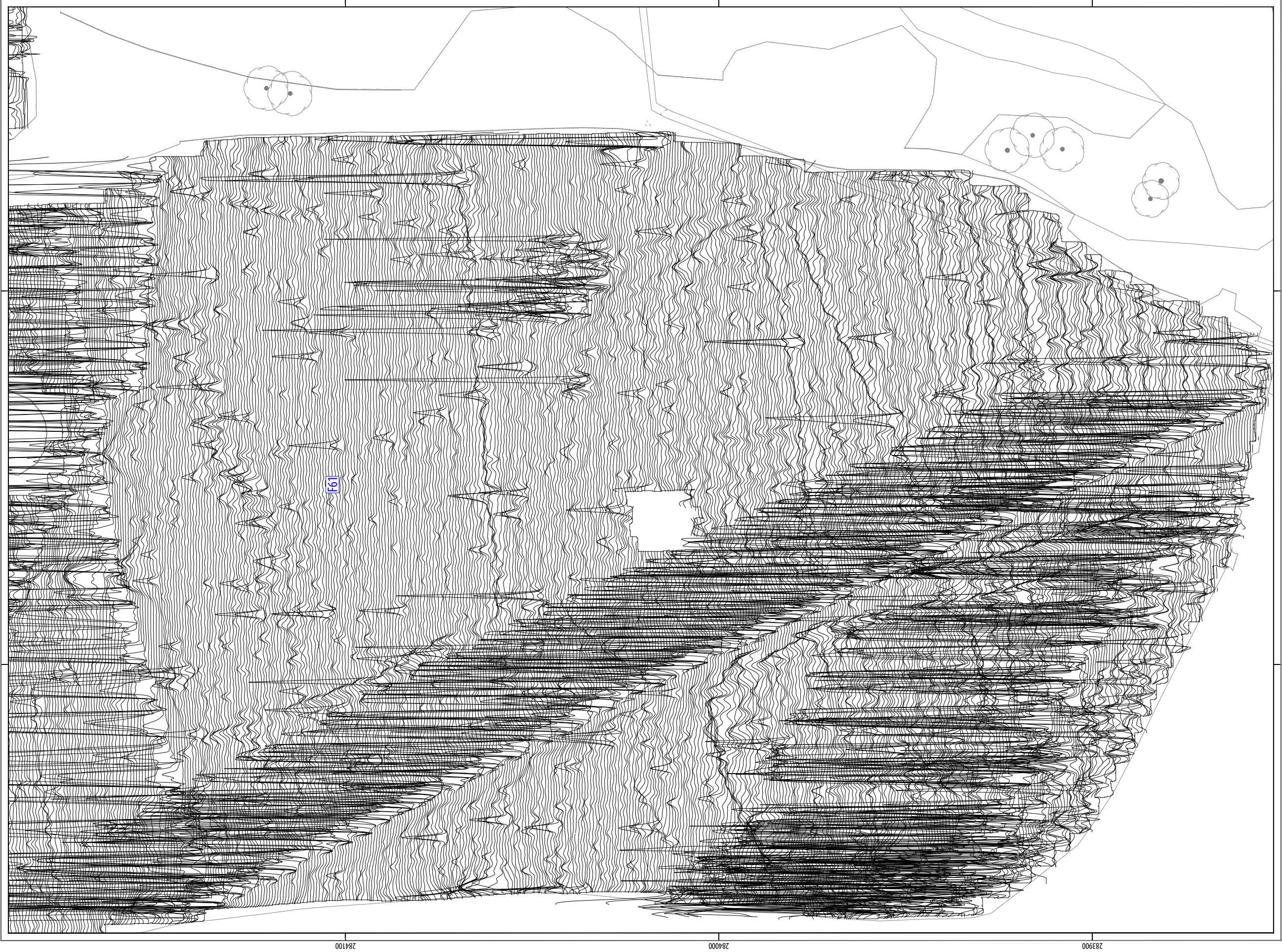
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F61

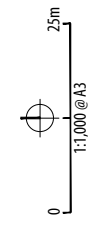
284100

284000

283900

455200

455300

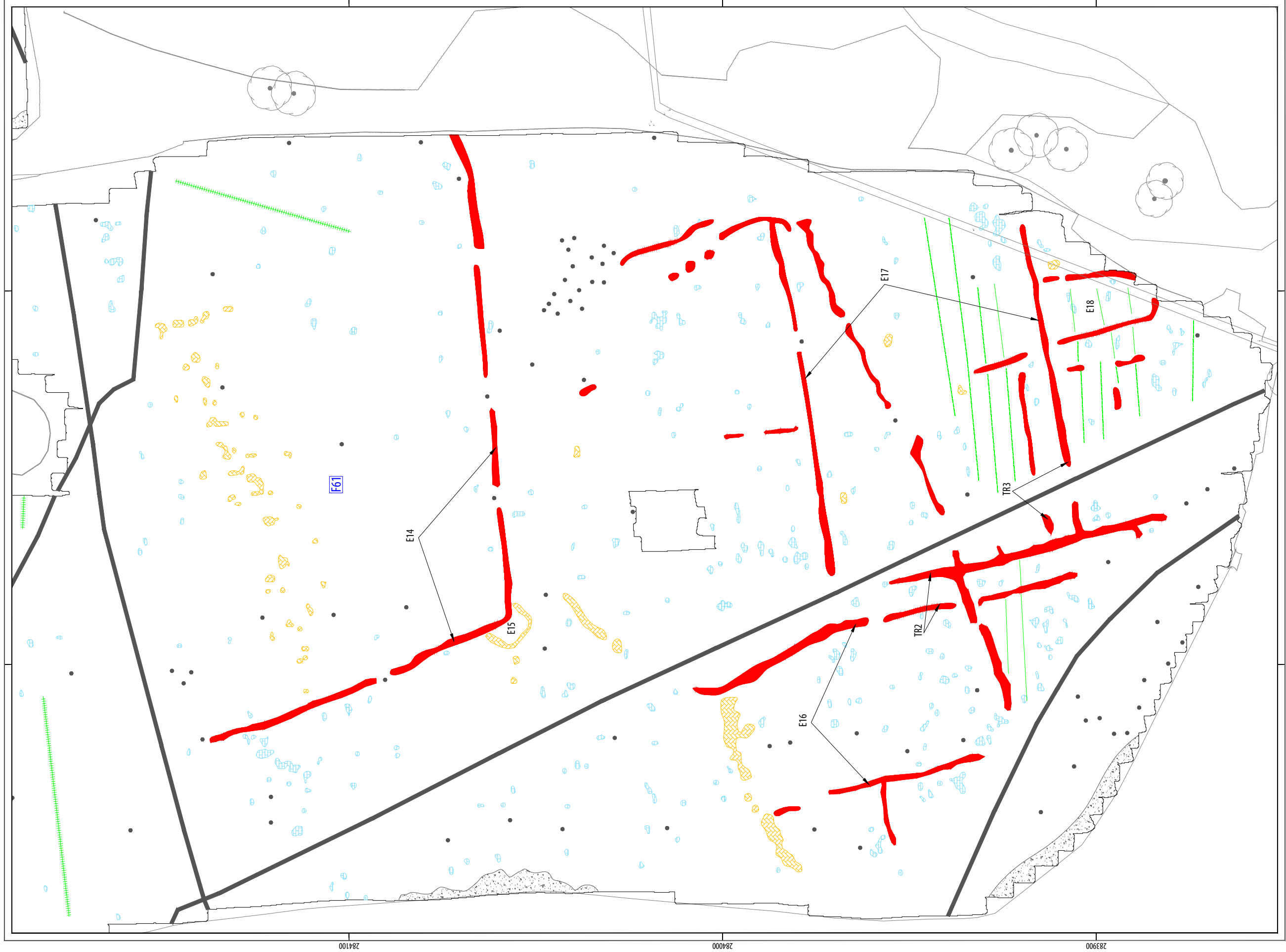


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**ILLUS 61 Interpretation of magnetometer data: AAA2**

TYPE OF ANOMALY	INTERPRETATION	TYPE OF ANOMALY	INTERPRETATION
• dipolar isolated	ferrous material	● magnetic enhancement	archaeology
● magnetic disturbance	ferrous material	■	
— dipolar linear	service pipe		
— linear trend	ridge and furrow		
● magnetic enhancement	geology		
● magnetic enhancement	archaeology?		

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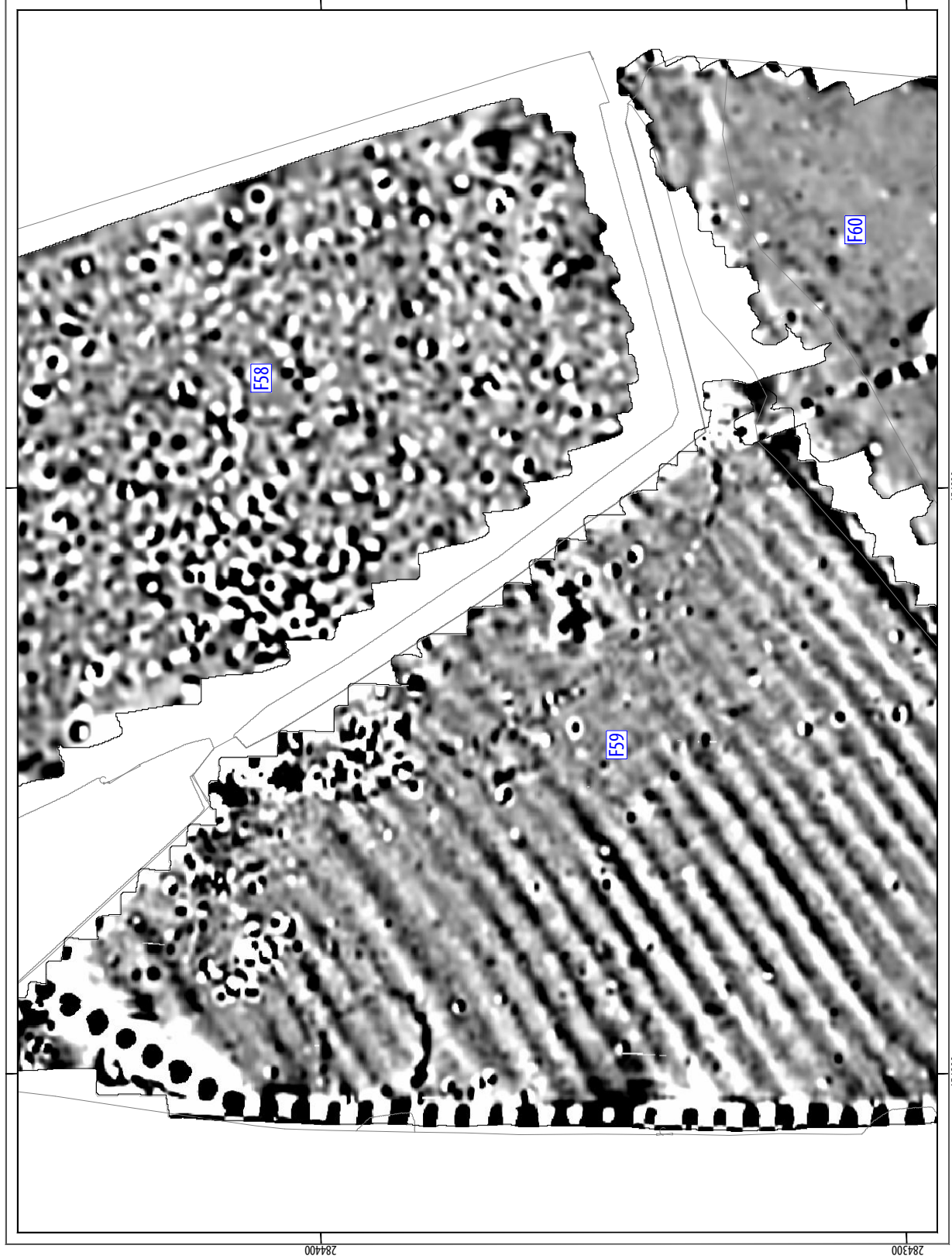
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**NORTH**

Scale: 1:1,000 @ A3  
 0 25m

ILLUS 61 Interpretation of magnetometer data: AAA2



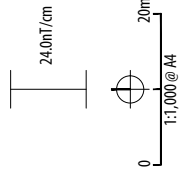
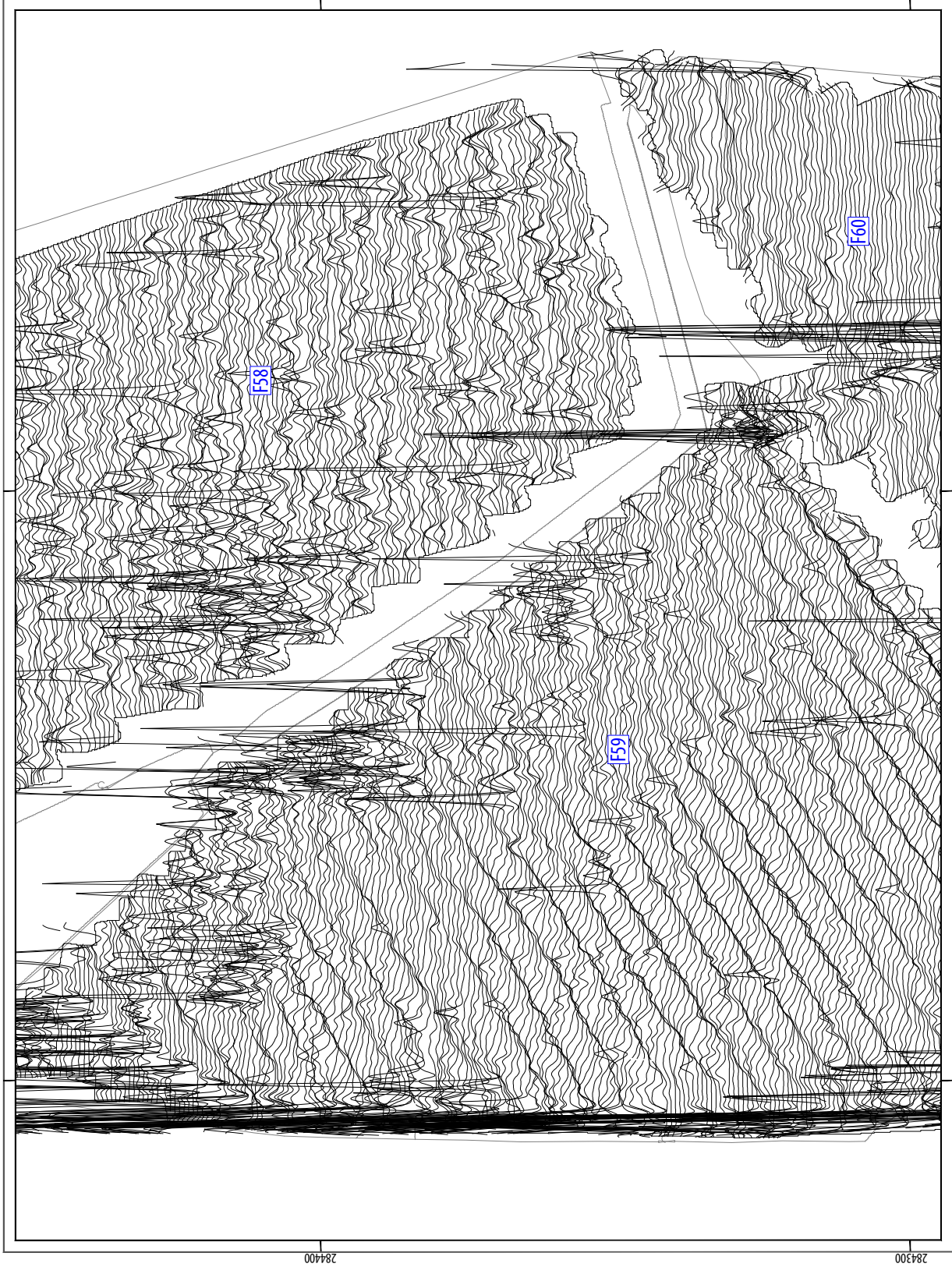
ILLUS 62 Processed greyscale magnetometer data; AAA3

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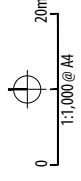
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ILLUS 63 XY trace plot of minimally processed magnetometer data; AA45

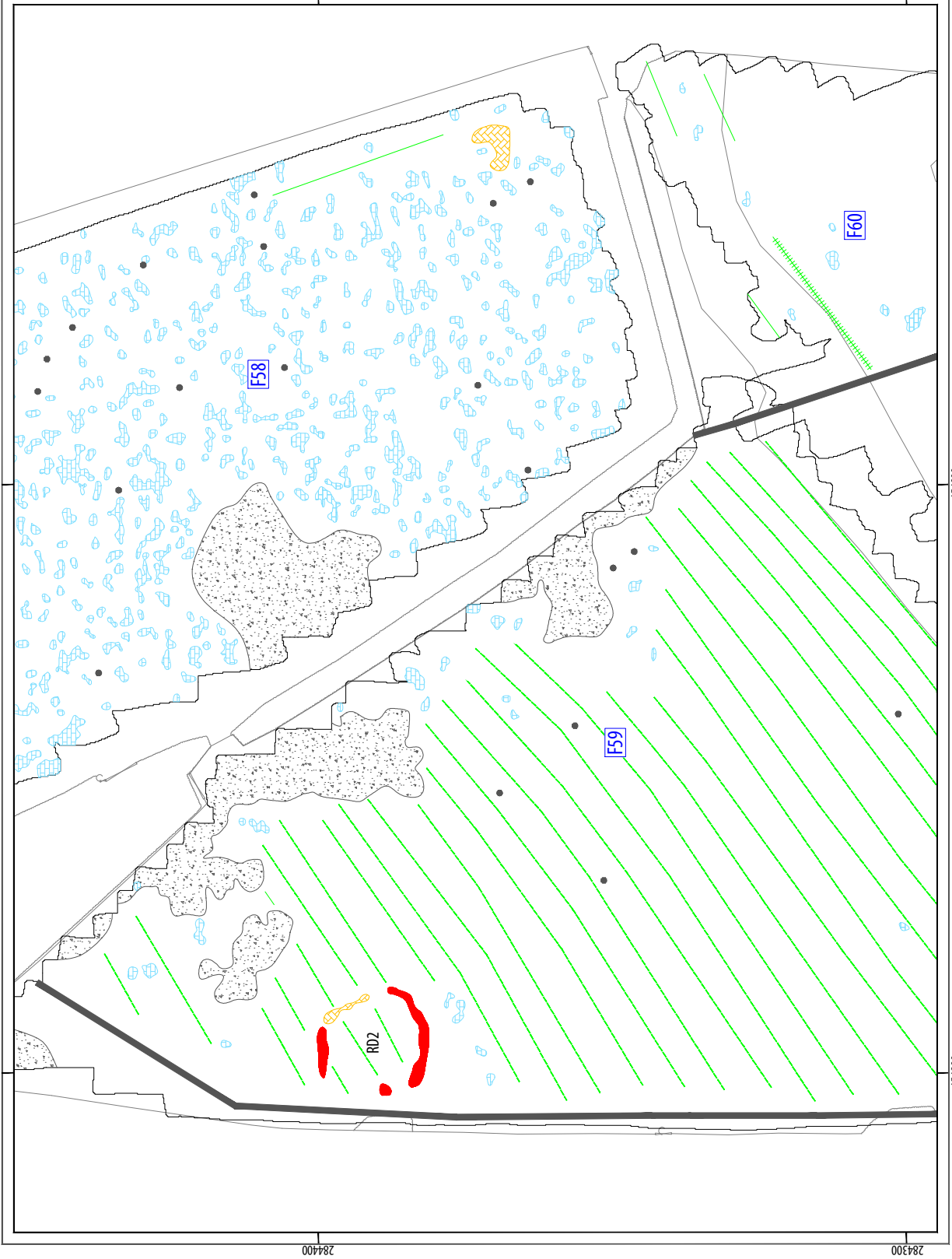
TYPE OF ANOMALY	INTERPRETATION
●	ferrous material
●	ferrous material
—	service pipe
—	ridge and furrow
—	agricultural
—	field drain
—	geology
—	archaeology?
—	archaeology
●	dipolar isolated
●	magnetic disturbance
—	dipolar linear
—	linear trend
—	linear trend
—	linear trend
—	magnetic enhancement
—	magnetic enhancement
—	magnetic enhancement



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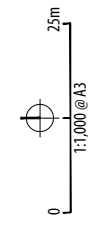
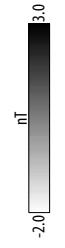


ILLUS 64 Interpretation of magnetometer data; AAA3



284700 284600 284500

455100 455200



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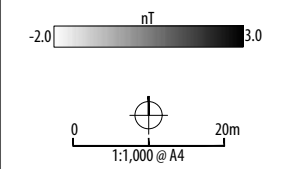
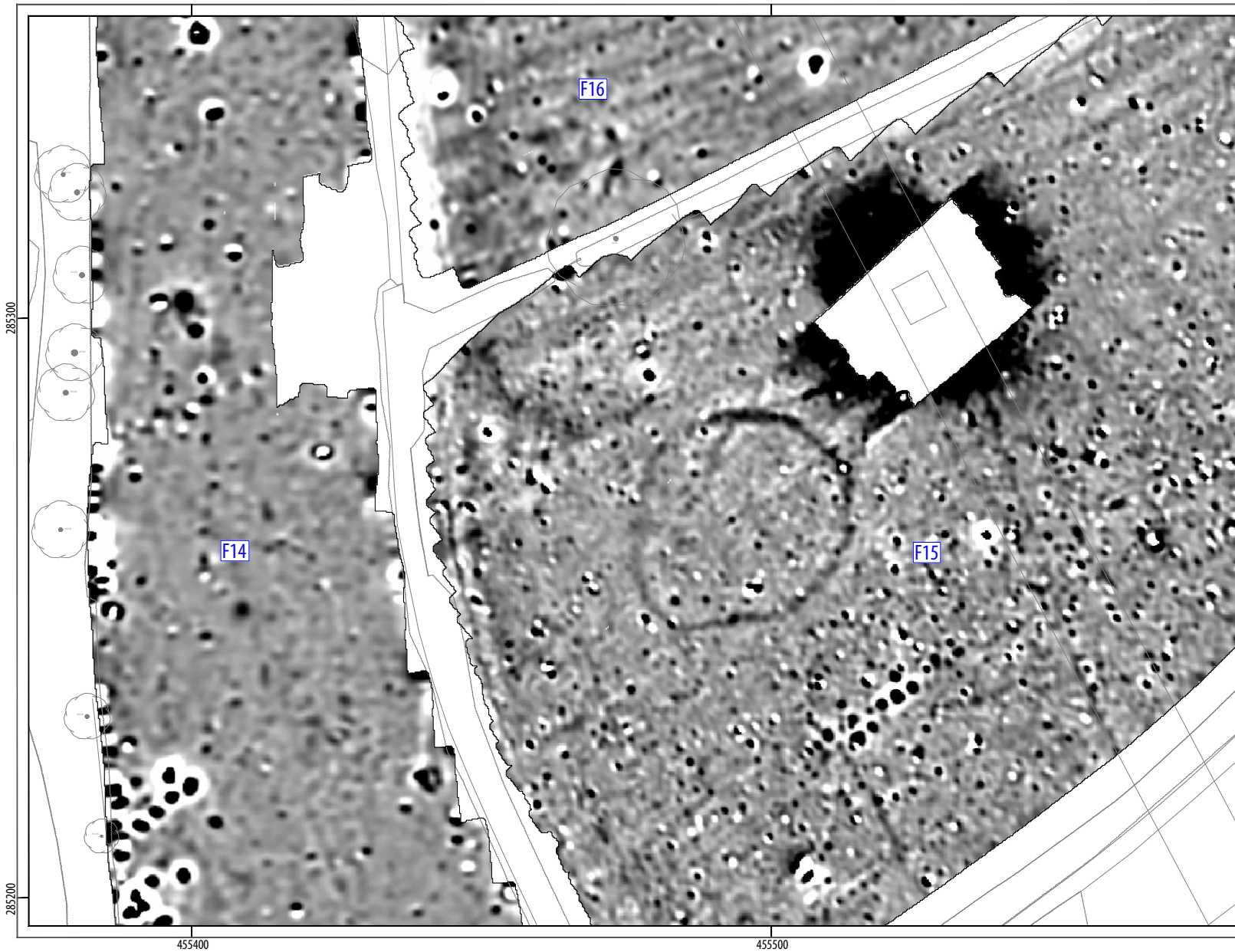
ILLUS 66 XY trace plot of minimally processed magnetometer data; AAA6



TYPE OF ANOMALY	INTERPRETATION	TYPE OF ANOMALY	INTERPRETATION
● dipolar isolated	ferrous material	● magnetic enhancement	geology
■ magnetic disturbance	ferrous material	■ magnetic enhancement	archaeology?
— dipolar linear	service pipe	● magnetic enhancement	archaeology
— magnetic disturbance	green waste		
— linear trend	ridge and furrow		
— linear trend	agricultural		

ILLUS 67 Interpretation of magnetometer data: AAA4





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ILLUS 68 Processed greyscale magnetometer data; AAA7



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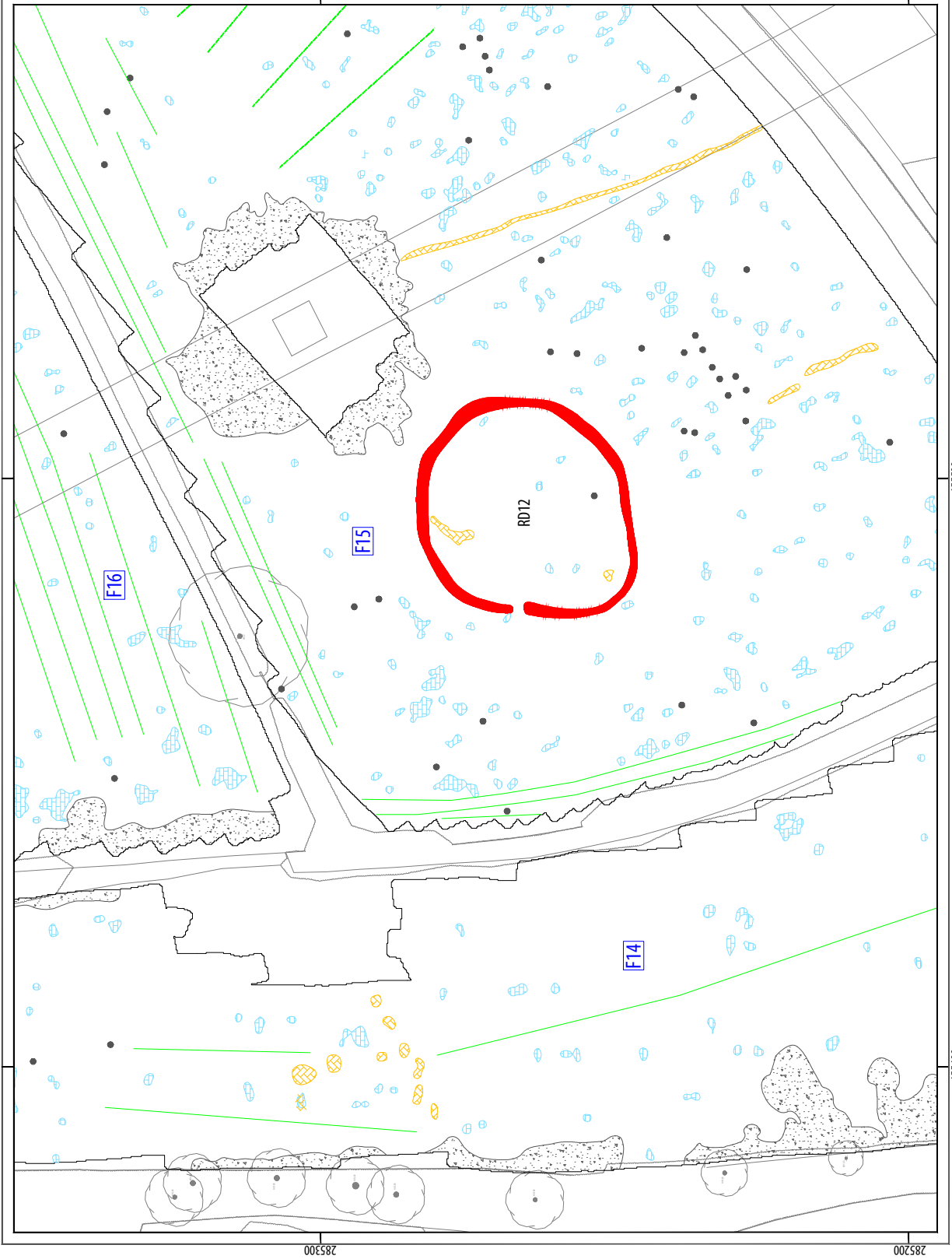
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ILLUS 69 XY trace plot of minimally processed magnetometer data; AAA7

TYPE OF ANOMALY	INTERPRETATION
●	ferrous material
●	ferrous material
—	ridge and furrow
—	agricultural
—	geology
—	archaeology?
—	archaeology
●	dipolar isolated
●	magnetic disturbance
—	linear trend
—	linear trend
—	magnetic enhancement
—	magnetic enhancement
—	magnetic enhancement



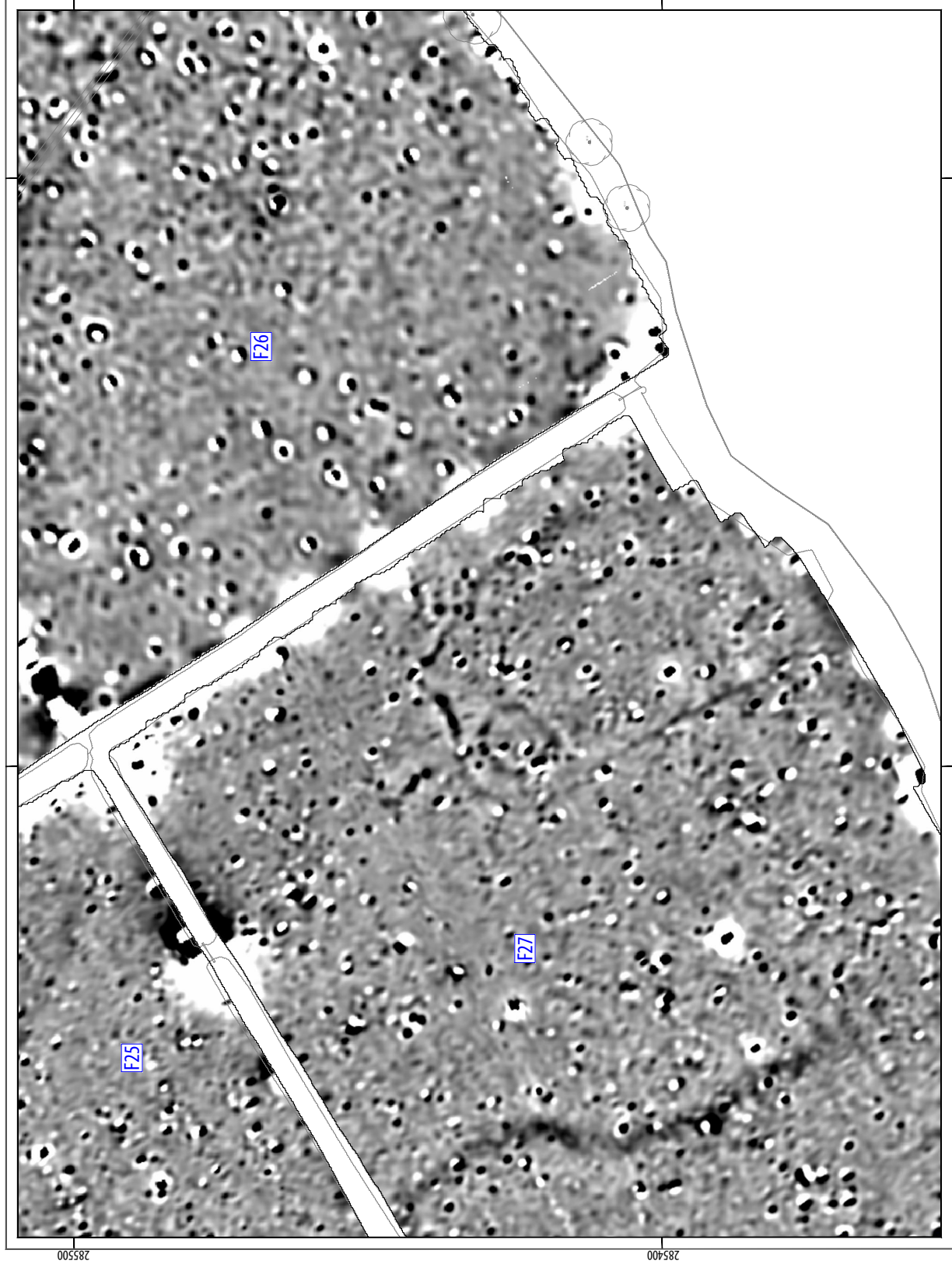
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ILLUS 70 Interpretation of magnetometer data; AAA7



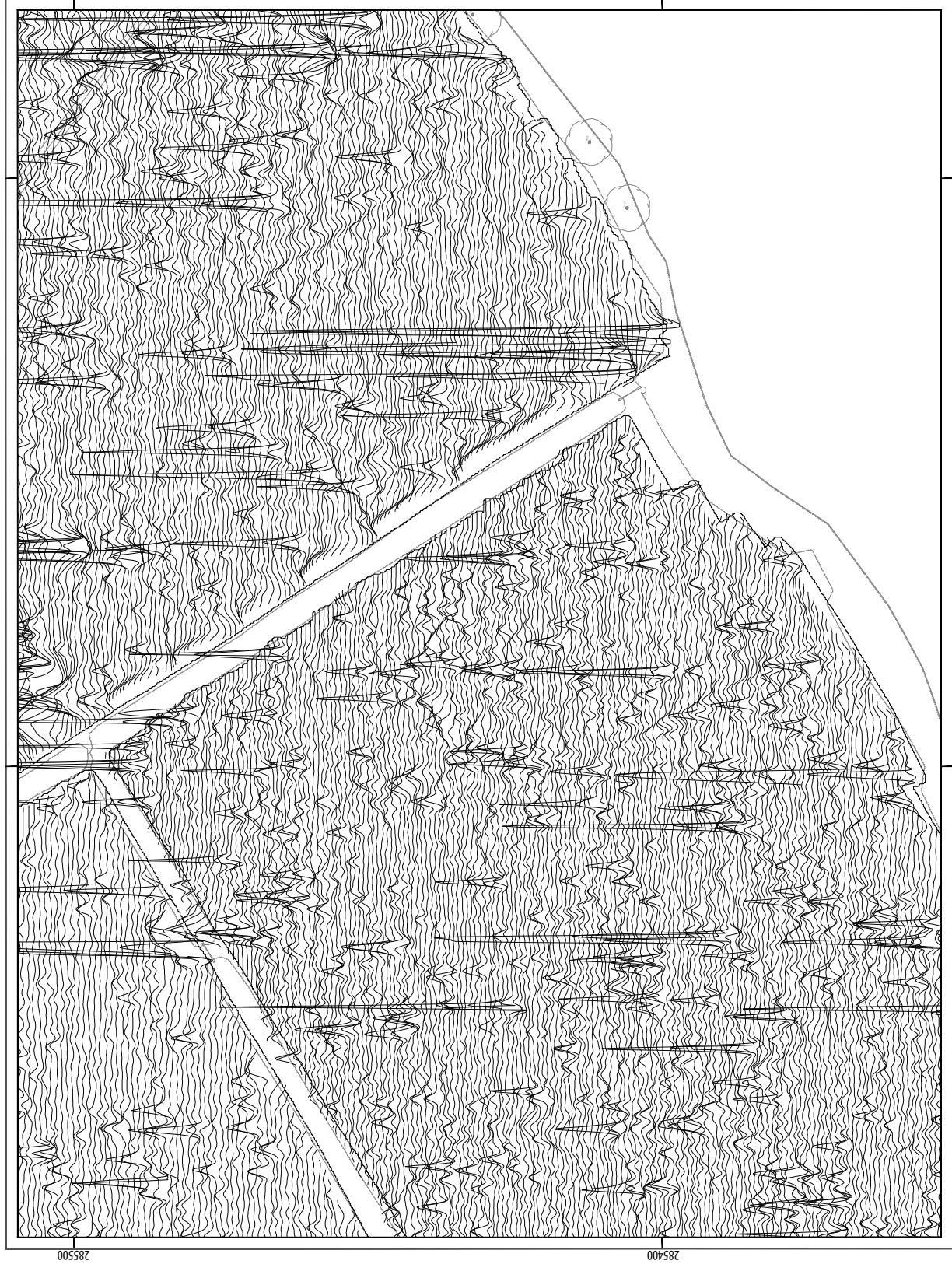
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ILLUS 71 Processed greyscale magnetometer data; AAA8



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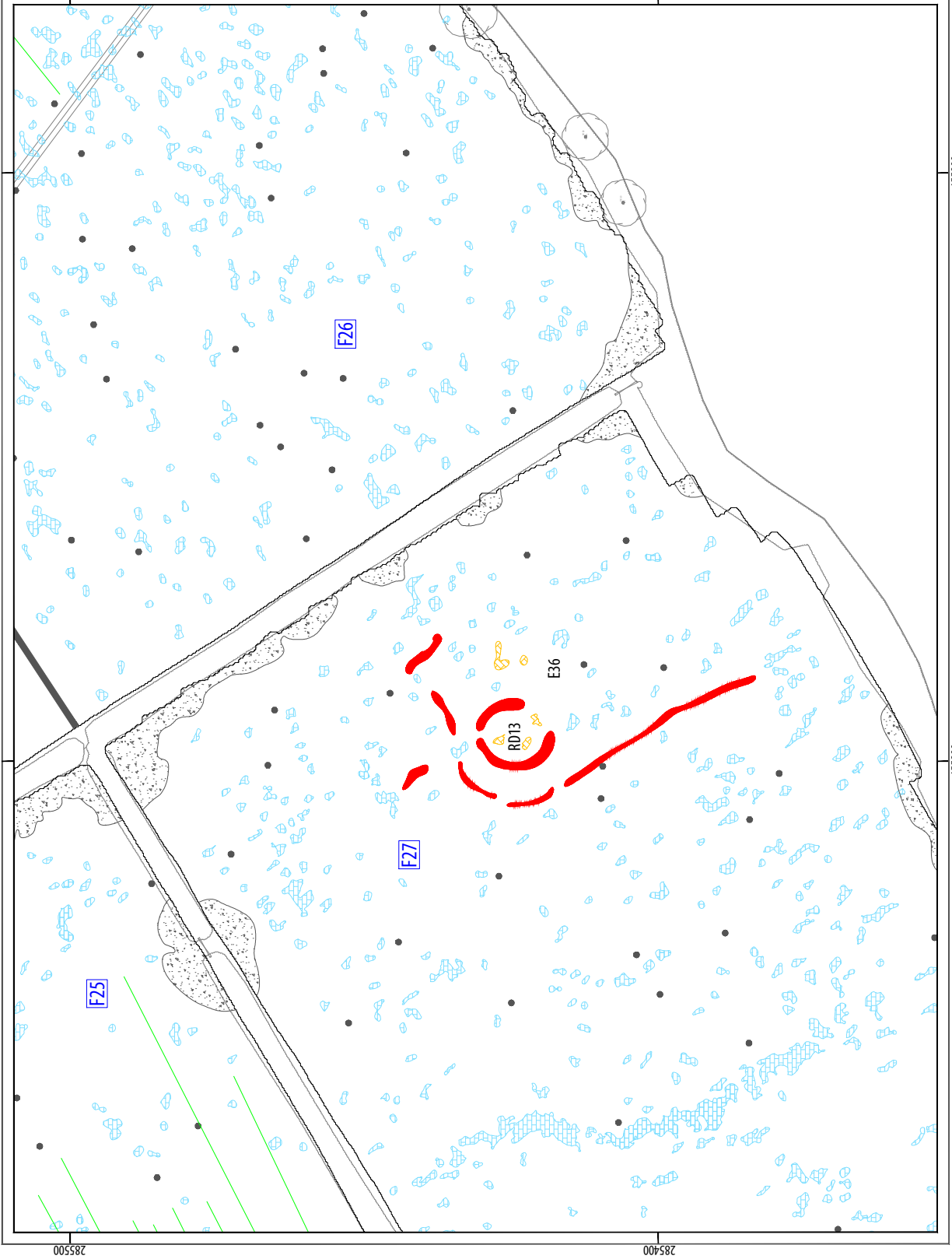
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ILLUS 72 XY trace plot of minimally processed magnetometer data; AA48

TYPE OF ANOMALY	INTERPRETATION
●	ferrous material
●	ferrous material
—	service pipe
—	agricultural
—	geology
—	archaeology?
—	archaeology
●	dipolar isolated
●	magnetic disturbance
—	dipolar linear
—	linear trend
—	magnetic enhancement
—	magnetic enhancement
—	archaeology?
—	archaeology



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## 7 APPENDICES

### APPENDIX 1 MAGNETOMETER SURVEY

#### *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 haematite. 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 so that by measuring the magnetic susceptibility of the topsoil, areas, where human occupation or settlement has occurred, can be identified by virtue 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. This effect can lead to the detection of features such as hearths, kilns or areas of burning.

#### *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.

**Lightning-induced remnant magnetisation (LIRM)** LIRM anomalies are thought to be caused in the near surface soil horizons by the flow of electrical currents associated with lightning strikes. These observed anomalies have a strong bipolar signal which decreases with distance from the spike point and often appear as linear or radial in shape.

**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 (sometimes only visible on an XY trace plot) 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.

## APPENDIX 2 SURVEY LOCATION INFORMATION

An initial survey base station was established using a Trimble VRS differential Global Positioning System (dGPS). The magnetometer data was georeferenced using a Trimble RTK differential Global Positioning System (Trimble R8s model).

Temporary sight markers were laid out using a Trimble VRS differential Global Positioning System (Trimble R8s model) to guide the operator and ensure full coverage. The accuracy of this dGPS equipment is better than 0.01m.

The survey data 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 coordinates are measured off hard copies of the mapping rather than using the digital coordinates.

*Headland Archaeology cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party.*

## APPENDIX 3 GEOPHYSICAL SURVEY ARCHIVE

The geophysical archive comprises an archive disk containing the raw data in XYZ format, a raster image of each greyscale plot with associated world file, and a PDF of the report.

The project will be archived in-house in accordance with recent good practice guidelines ([http://guides.archaeologydataservice.ac.uk/g2gp/Geophysics\\_3](http://guides.archaeologydataservice.ac.uk/g2gp/Geophysics_3)). The data will be stored in an indexed archive and migrated to new formats when necessary.

## APPENDIX 4 DATA PROCESSING

The gradiometer data has been presented in this report in processed greyscale and minimally processed XY trace plot format.

Data collected using RTK GPS-based methods cannot be produced without minimal processing of the data. The minimally processed data has been interpolated to project the data onto a regular grid and de-striped to correct for slight variations in instrument calibration drift and any other artificial data.

A high pass filter has been applied to the greyscale plots to remove low frequency anomalies (relating to survey tracks and modern agricultural features) in order to maximise the clarity and interpretability of the archaeological anomalies.

The data has also been clipped to remove extreme values and to improve data contrast.



## APPENDIX 5 OASIS DATA COLLECTION FORM: ENGLAND

PROJECT DETAILS	
Project name	Proposed East of Lutterworth SDA
Short description of the project	Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey of a 235 hectare site immediately east of Lutterworth, Leicestershire, to provide information on the archaeological potential of the site, identified as a Strategic Development Area (SDA), prior to the submission of a planning application for a proposed residential and local infrastructure development. The survey has identified eight areas of archaeological potential (AAA), in the southern and central parts of the SDA, on higher and prominent positions overlooking the River Swift and its tributary. Clusters of enclosures of differing size and morphology (some with evidence of settlement activity, including roundhouses) trackways and round barrows of likely later prehistoric and early Romano-British origin have been identified. In AAA1, AAA2, AAA4 and AAA5 the level of archaeological activity is greater than indicated from cropmarks and previous geophysical surveys, whilst the archaeological features identified in AAA3, AAA6, AAA7 and AAA8 were not previously known. The survey has also identified numerous discrete anomalies due to geological variations in the soil as well as linear trend anomalies caused by medieval and post-medieval agricultural activity over the entirety of the site. Overall, the survey has successfully evaluated the archaeological potential of the site. On the basis of the survey the southern and central area of the SDA is assessed as of high archaeological potential, while in the north the potential is assessed as medium to low.
Project dates	Start: 22-10-2018 End: 21-11-2018
Previous/future work	No / Not known
Any associated project reference codes	LUTL18 - Contracting Unit No.
Type of project	Field evaluation
Site status	None
Current Land use	Cultivated Land 4 - Character Undetermined
Current Land use	Grassland Heathland 5 - Character undetermined
Monument type	N/A Uncertain
Monument type	N/A None
Significant Finds	N/A None
Methods & techniques	"Geophysical Survey"
Development type	Housing estate
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Pre-application
Solid geology (other)	Blue Lias Formation - mudstone and sandstone
Drift geology	BOULDER CLAY AND MORAINIC DRIFT/ ALLUVIUM
Techniques	Magnetometry
PROJECT LOCATION	
Country	England
Site location	LEICESTERSHIRE HARBOROUGH LUTTERWORTH Proposed East of Lutterworth SDA
Study area	235 Hectares
Site coordinates	SP 5539 8472 52.457245887449 -1.184743072822 52 27 26 N 001 11 05 W Point
PROJECT CREATORS	
Name of Organisation	Headland Archaeology
Project brief originator	Leicester County Council
Project design originator	Headland Archaeology
Project director/manager	Webb, A.
Project supervisor	Dyulgierski, K.
Type of sponsor/funding body	County Council

PROJECT ARCHIVES	
Physical Archive Exists?	No
Digital Archive recipient	In house
Digital Contents'	'Survey'
Digital Media available	"Geophysics","Survey","Text"
Paper Archive Exists?	No
PROJECT BIBLIOGRAPHY 1	
Publication type	Grey literature (unpublished document/manuscript)
Title	Proposed east of Lutterworth SDA, Lutterworth, Leicestershire
Author(s)/Editor(s)	Webb, A.
Date	2019
Issuer or publisher	Headland Archaeology
Place of issue or publication	Leeds
Description	PDF[A]
Entered by	David Harrison (david.harrison@headlandarchaeology.com)
Entered on	14 January 2019





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