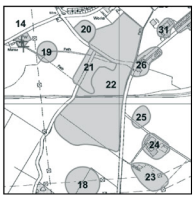
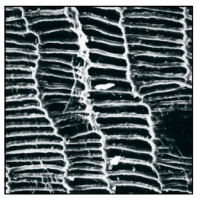
NWRR18










NORTHAMPTON WESTERN RELIEF ROAD NORTHAMPTONSHIRE

GEOPHYSICAL SURVEY

commissioned by WSP
on behalf of Northamptonshire County Council

March 2019

HEADLAND ARCHAEOLOGY

REGISTERED ORGANISATION CIfA

NORTHAMPTON WESTERN RELIEF ROAD NORTHAMPTONSHIRE

GEOPHYSICAL SURVEY

commissioned by WSP
on behalf of Northamptonshire County Council

March 2019

This report adheres to the quality standard of ISO 9001:2015

PROJECT INFO:

HA Project Code **NWRR18** / NGR **SP 7324 6486** / Parish **Church with Chapel Brampton, Boughton, Northampton** / Local Authority **Northamptonshire** / OASIS Ref. **headland5-346085**

PROJECT TEAM:

Project Manager **David Harrison** / Author **David Harrison** / Fieldwork **Mark Evans, Phoebe Utting, Richard McGregor Edwards, Ross Bishop** / Graphics **Beata Wieczorek-Oleksy, David Harrison**

Approved by **David Harrison** D Harrison.....

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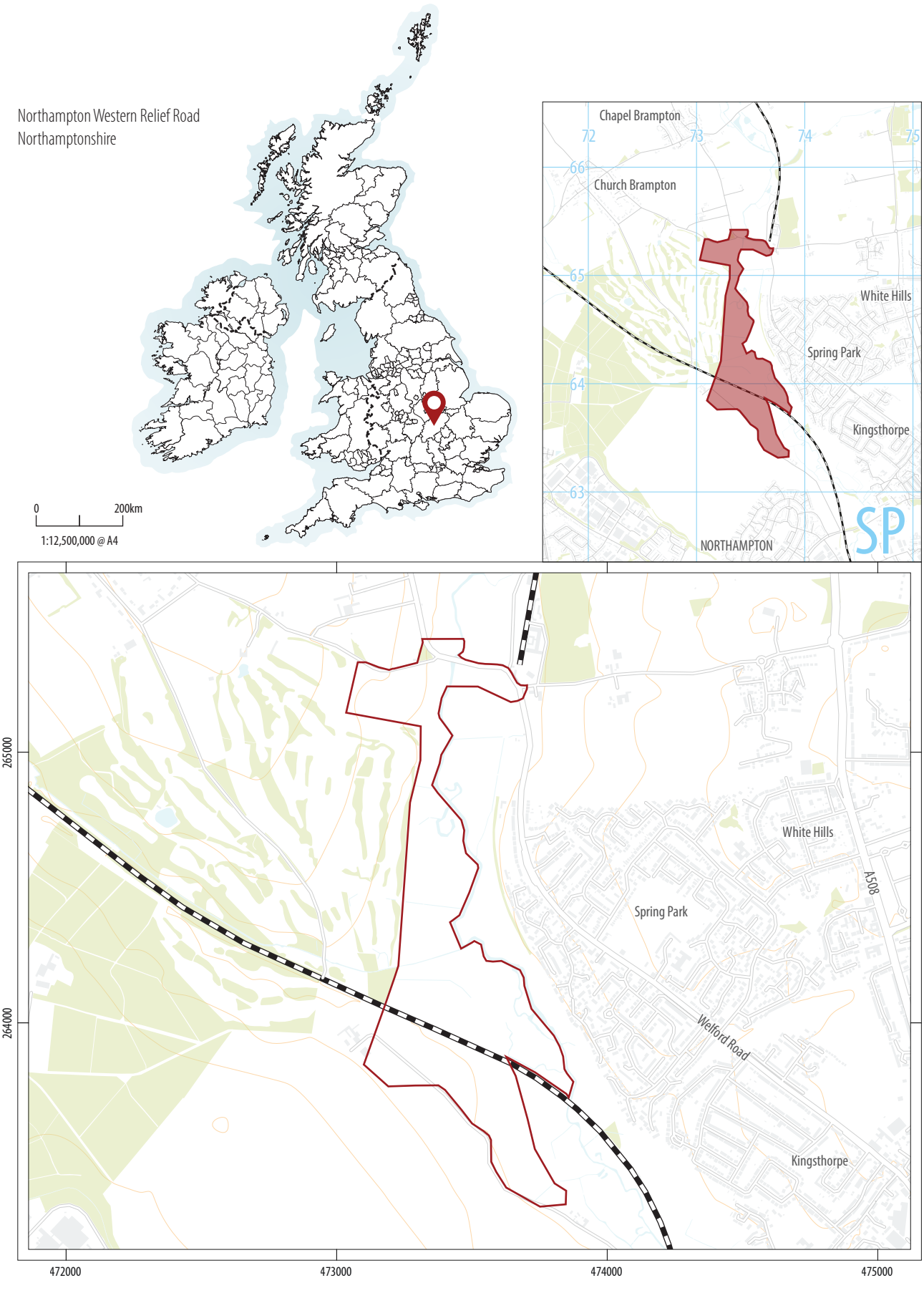
HEADLAND ARCHAEOLOGY

PROJECT SUMMARY

Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey of a 50 hectare site in the Nene Valley on the north-western periphery of Northampton, to provide information on the archaeological potential of the site in advance of the proposed Northampton Western Relief Road. The majority of the data collected over the alluvial deposits in the valley base is dominated by contrasting geological anomalies manifesting either as extremely high magnitude areas of magnetic disturbance or conversely as a flat monotone response with minimal magnetic variation. Against either of these magnetic backgrounds it may be difficult to identify any anomalies of archaeological potential, if present. However, on the north-facing side of the Nene valley, in the south of the site, a distinct area of archaeological activity has been identified comprising a complex of conjoined enclosures, ditches and ring-ditches and including a possible kiln. These anomalies are thought to be suggestive of Romano-British settlement activity and are considered to be of high archaeological potential. Some of these anomalies correspond to cropmarks recorded by the National Mapping Programme but the majority of the archaeological anomalies identified by the survey are previously unknown. Several high magnitude discrete and linear anomalies in the vicinity of the complex cannot be explained as agricultural, geological or modern in origin and, given the local context, an archaeological origin cannot be dismissed. These anomalies are ascribed moderate archaeological potential. No anomalies of archaeological potential have been identified over the majority of the site although, given the presence of alluvial deposits and the extremely variable magnetic background, isolated soil-filled features and/or areas of unenclosed settlement, if present, may not manifest in the data.

CONTENTS

LIST OF ILLUSTRATIONS



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ILLUS 1 Site location

NORTHAMPTON WESTERN RELIEF ROAD

NORTHAMPTONSHIRE

GEOPHYSICAL SURVEY

1 INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned by WSP (the Consultant), on behalf of Northamptonshire County Council, to undertake a geophysical (magnetometer) survey north-west of Northampton, where the Northampton Western Relief Road is proposed. The survey was undertaken in order to inform planning proposals by assessing the heritage potential of the geophysical survey area and, therefore the impact of any proposed development on the historic environment.

The work was undertaken in accordance with a Written Scheme of Investigation (Harrison 2018) which was sent to the Assistant Archaeological Advisor of Northamptonshire County Council, 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).

The survey was carried out between the 19th and 28th November 2018.

1.1 SITE LOCATION, TOPOGRAPHY AND LAND-USE

The Geophysical Survey Area (GSA) is located on the north-western periphery of Northampton, centred on SP 7324 6486 (Illus 1). It comprises 13 fields (F1–F13) within an irregularly-shaped parcel of land which is roughly constrained in the north by Sandy Lane and the A5199 Northampton Road, by Brampton Heath Golf Club in the west, by an access road to Grange Farm in the south and by the River Nene to the east. A railway line (The Northampton loop) passes north-west/south-east within the south of the GSA. At the time of the survey, no access was granted to F1. F2–F13 were under a mixture of pasture, recently sown and harvested cereal crops. F4 and F13 were overgrown and unsuitable for survey (Illus 2–5). A rectangular area in the south-east corner of F11 containing the demolished remains of Lodge Farm was also overgrown and unsuitable for survey.

The majority of the GSA is located on the floodplain on the western side of the River Nene and is flat being at 64m Above Ordnance Datum (AOD). F2 is generally located on an east-facing slope being at 84m AOD in the west and 64m AOD in the east with a prominent central hummock (Illus 2). F10–F12 are located on a north-east facing gradient being at 76m AOD along the southern site limit and 66m AOD along the railway line.

1.2 GEOLOGY AND SOILS

The bedrock geology mainly comprises Whitby Mudstone Formation with Northampton Sand Formation (sandstone, limestone and ironstone) recorded in the north and south of the GSA (Illus 7). Alluvial deposits (clay, silt, sand and gravel) are recorded over the lower lying valley base in the centre and east of the GSA with no superficial deposits recorded in the south or north-west (NERC 2018).

The soils are mainly classified in the Soilscape 20 association, characterised as floodplain loams and clays with naturally high groundwater. In the south and the west, the soils are classified in the Soilscape 7 Association which are characterised as freely draining base-rich soils (Cranfield University 2018).

ILLUS 2 F2, looking east

2 ARCHAEOLOGICAL BACKGROUND

The GSA is located in a rich archaeological landscape with cropmarks (Illus 7) and previous archaeological investigations indicating activity from the prehistoric period to the present day.

Features of probable prehistoric archaeological origin have been identified in aerial photographs within the south of the GSA and include a possible hut circle (Northamptonshire Historic Environment Record (NHER) Ref. MNN129850), pits (NHER MNN129851 and MNN129854), a ditch (NHER MNN129852) and enclosures (NHER MNN129849 and MNN129853). These types of features indicate settlement activity throughout this period.

Four enclosures (NHER MNN130542, MNN130549, MNN130549 and MNN130593) which are thought to be of Iron Age origin are recorded in the immediate vicinity of the GSA. The enclosures were identified through aerial photography and confirmed through trial trenching. Activity from the Roman period is also well represented in the surrounding landscape with one asset included within the GSA comprising a potential pottery kiln site (MNN6103) identified through fieldwalking. The Nene Valley was an important location for pottery production during the Roman period with pottery manufactured here found all around England. Several pottery kilns are known in the surrounding landscape. Early medieval activity is not well represented within the GSA indicating a population move away from the area, with the Late Medieval period being the most common period represented in the archaeological record. This activity mainly comprises corn and watermills positioned to harness energy from the River Nene.

3 AIMS, METHODOLOGY AND PRESENTATION

The general aim of the geophysical survey was to provide sufficient information to establish the presence/absence, character and extent of any archaeological remains within the GSA. 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:

- to provide information about the nature and possible interpretation of any magnetic anomalies identified;
- to therefore model the presence/absence and extent of any buried archaeological features; 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.

ILLUS 3 F4, looking south

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 1:20,000. Illus 2–5 are site condition photographs. Illus 6 is a 1:7,500 survey location plan showing the direction of survey as GPS swaths. Illus 7 shows the geology and National Mapping Programme (NMP) cropmark data, also at 1:7,500. Illus 8 and Illus 9 present the overall greyscale data and interpretation at the same scale. Large-scale, fully processed (greyscale) data, minimally processed (XY traceplot) data, and an accompanying interpretative plot are presented at a scale of 1:2,500 in Illus 10–21 inclusive. Larger scale (1:1,000) plots of the area of archaeological activity (AAA) are presented in Illus 22–27 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 (Harrison 2018), 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

With the exception of the overgrown conditions in F4 and F13, ground conditions were generally good Illus 2–5) contributing to a high standard of data throughout.

The survey has detected an extremely variable magnetic background throughout the lower lying parts of the GSA ranging from the dense clusters of broad and high magnitude anomalies throughout F2 and F7/F8 to the broad sinuous bands of magnetic enhancement against the low level of magnetic background variation throughout F5–F9 and F12. These anomalies are geological in origin (see Section 4.3) and may mask or obscure any low magnitude anomalies of archaeological potential, if present within the affected areas. Against these backgrounds, numerous linear and discrete anomalies have been identified and these are discussed below and cross-referenced to specific examples on the interpretive figures, where appropriate.

ILLUS 4 F11, looking north-west

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. Broad areas of magnetic disturbance have been identified at the perimeters of F10 and F11. Disturbance of this type is typical of ferrous contamination in the upper soil horizons probably relating to the demolition of Lodge Farm and modern tipping.

A high magnitude linear anomaly (SP1; see Illus 10–12) aligned north/south across F2 locates a buried service pipe. A second service pipe is identified as a dipolar linear anomaly (SP2; see Illus 16–18) aligned north-west/south-east across F10.

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

4.2 AGRICULTURAL ANOMALIES

Analysis of historical Ordnance Survey (OS) mapping indicates that the pattern of land division within the GSA has changed since the publication of the first edition OS map in 1885, with the removal of eight field boundaries to facilitate larger fields. Only three of these former boundaries (FB1–FB3; see Illus 10–12 and Illus 16–18) have been detected by the survey as faint linear anomalies. The anomalies are caused by infilled ditches.

Closely-spaced parallel linear trend anomalies within F2 and F10–F12 are typical of modern ploughing with the more widely-spaced parallel linear anomalies in F8/F11 more typical of field drains.

4.3 GEOLOGICAL ANOMALIES

As mentioned, the valley base is dominated by contrasting geological anomalies ranging from dense clusters of extremely high magnitude and broad anomalies (e.g. F2 and F7/F8) to a homogenous magnetic background with minimal magnetic variation but containing broad, sinuous bands of magnetic enhancement (e.g. F5–F9 and F12). The clusters of extremely high magnitude anomalies are thought to be caused by near-surface variation in the sandstone, limestone and ironstone within the Northampton Sand bedrock. The homogenous magnetic background is caused by alluvial silts, clays, sands and gravels deposited during periods of seasonal flooding and infilling former river channels. In the west of F2, the south-west of F8 and F10–F12, where no superficial deposits are recorded, a moderate level of magnetic background variation has been detected manifesting in the data as a plethora of low magnitude discrete anomalies. These are likely to be due to localised variation in the depth and composition of soils.

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,

ILLUS 5 F12, looking north-east

except where the responses are particularly broad or high in magnitude, interpreted as of non-archaeological origin.

A distinct Area of Archaeological Activity (AAA1) has been identified within F10–F12, centred on the site of Lodge Farm (SP 7340 6378), and comprising a complex of conjoined enclosures, ditches and ring-ditches and including a possible kiln. The area is located on a gentle north-facing gradient, slightly elevated above the River Nene floodplain to the north. It extends over 4ha and probably continues beyond the southern limit of the GSA, as suggested by the cropmark data.

North-west of Lodge Farm, AAA1 includes at least two ring-ditches (RD1 and RD2) with a third possible ring-ditch (RD3?) identified adjacent to the Grange Farm access track in the east of F10 (Illus 22–24). The magnetic background throughout F10 and the south of F11 is particularly variable with closely-spaced ploughing trends and frequent ferrous contaminants making confident interpretation of low magnitude and/or discrete anomalies difficult. Any of these anomalies could be due to spreads of archaeological material or plough-damaged archaeological remains and are interpreted as an Area of Archaeological Potential (AAP1). North-west of AAP1 a clearly-defined high magnitude square anomaly, K1, exhibits an XY trace response (Illus 23) which is characteristic of intense heating/burning and is interpreted as a possible kiln. Several pottery kilns are known in the surrounding landscape.

A linear anomaly within the broad area of magnetic disturbance in the west of F10 locates the eastern extent of a square enclosure, E1, which is recorded as a cropmark. The northern extent of a second enclosure, E2, is identified as a rectilinear anomaly in the south-west of F11. A north/south linear cropmark in the centre of F10 has been clearly identified as a fragmentary linear cropmark, D1, probably being due to a soil-filled ditch. A second linear anomaly, D2, aligned north-west/south-east along the contours in the north of F11 is interpreted as a possible ditch.

South-east of Lodge Farm, AAA1 is more clearly defined, comprising a complex of at least 12 conjoined enclosures (E3–E14) over a 1ha area (Illus 25–27). Numerous discrete and short linear anomalies within the interior of the enclosures are suggestive of settlement activity. A ring-ditch, RD4, is identified within the west of the complex.

4.5 POSSIBLE ARCHAEOLOGICAL ANOMALIES

Anomalies interpreted as being of possible archaeological origin are caused by soil-filled features such as pits or ditches or by spreads of magnetically enhanced material within the upper soil horizons. Whilst these anomalies do not manifest in any coherent archaeological pattern, they are either located near to areas of known archaeology, or cannot be satisfactorily interpreted as either modern, agricultural or geological in origin. On this basis, these anomalies are interpreted as potentially archaeological in origin. These include the localised cluster of anomalies towards the west of F8 and the broader cluster of high magnitude anomalies, AAP2, on higher ground in the south-east of F12 (Illus 19–21).

5 CONCLUSION

The survey has successfully evaluated the site and has identified a distinct area of archaeological activity along the southern site limit comprising a complex of conjoined enclosures, ditches and ring-ditches and including a possible kiln. These anomalies are suggestive of Romano-British settlement activity and are considered to be of high archaeological potential. Some of the anomalies correspond to

cropmarks recorded by the National Mapping Programme but the majority of the archaeological anomalies identified by the survey are previously unknown. Several high magnitude discrete and linear anomalies in the vicinity of the complex cannot be explained as agricultural, geological or modern in origin and, given the local context, an archaeological origin cannot be dismissed. These anomalies are ascribed moderate archaeological potential. The data collected over the alluvial deposits in along the valley base is dominated by contrasting geological anomalies manifesting either as extremely high magnitude areas of magnetic disturbance or conversely as a flat monotone response with minimal magnetic variation. Against either of these magnetic backgrounds it may be difficult to identify isolated soil-filled features and/or areas of unenclosed settlement, if present.

6 REFERENCES

Chartered Institute for Archaeologists (CIfA) 2016 ***Standard and guidance for archaeological geophysical survey*** (Reading) http://www.archaeologists.net/sites/default/files/CIfAS%26GGeophysics_2.pdf accessed 10 December 2018

Cranfield University 2018 ***Cranfield Soil and Agrifood Institute Soilscapes http://www.landis.org.uk/soilscapes/ accessed 10 December 2018***

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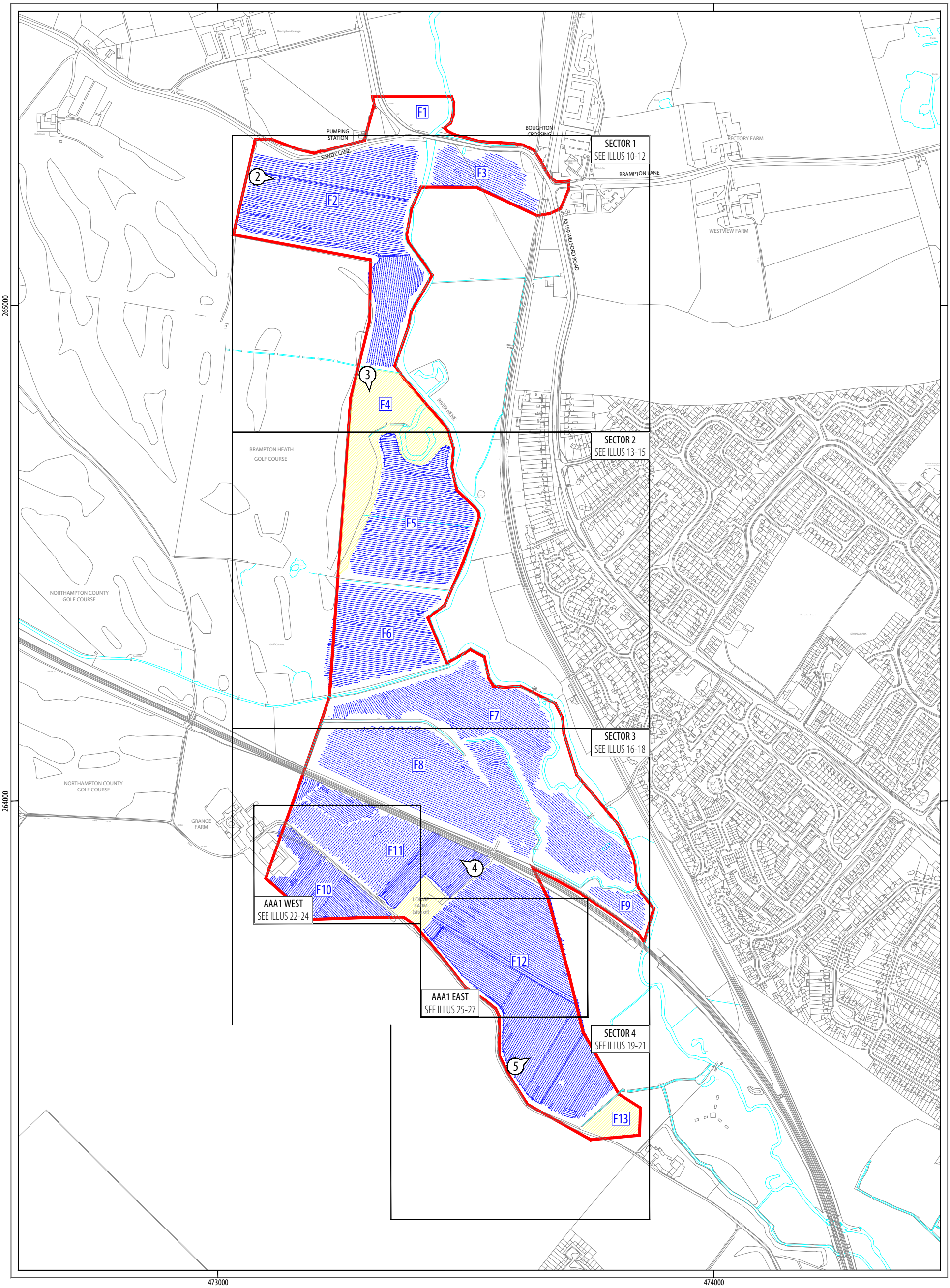
Ministry of Housing, Communities and Local Government (MHCLG) 2018 ***National Planning Policy Framework*** https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/740441/National_Planning_Policy_Framework_web_accessible_version.pdf accessed 10 December 2018



geophysical survey area
area unsuitable for survey
GPS swaths
location and direction of ILLUS 2-5

0 200m
1:7,500 @ A3

PROJECT NWRR18
Northampton Western Relief Road
CLIENT WSP on behalf of Northamptonshire County Council

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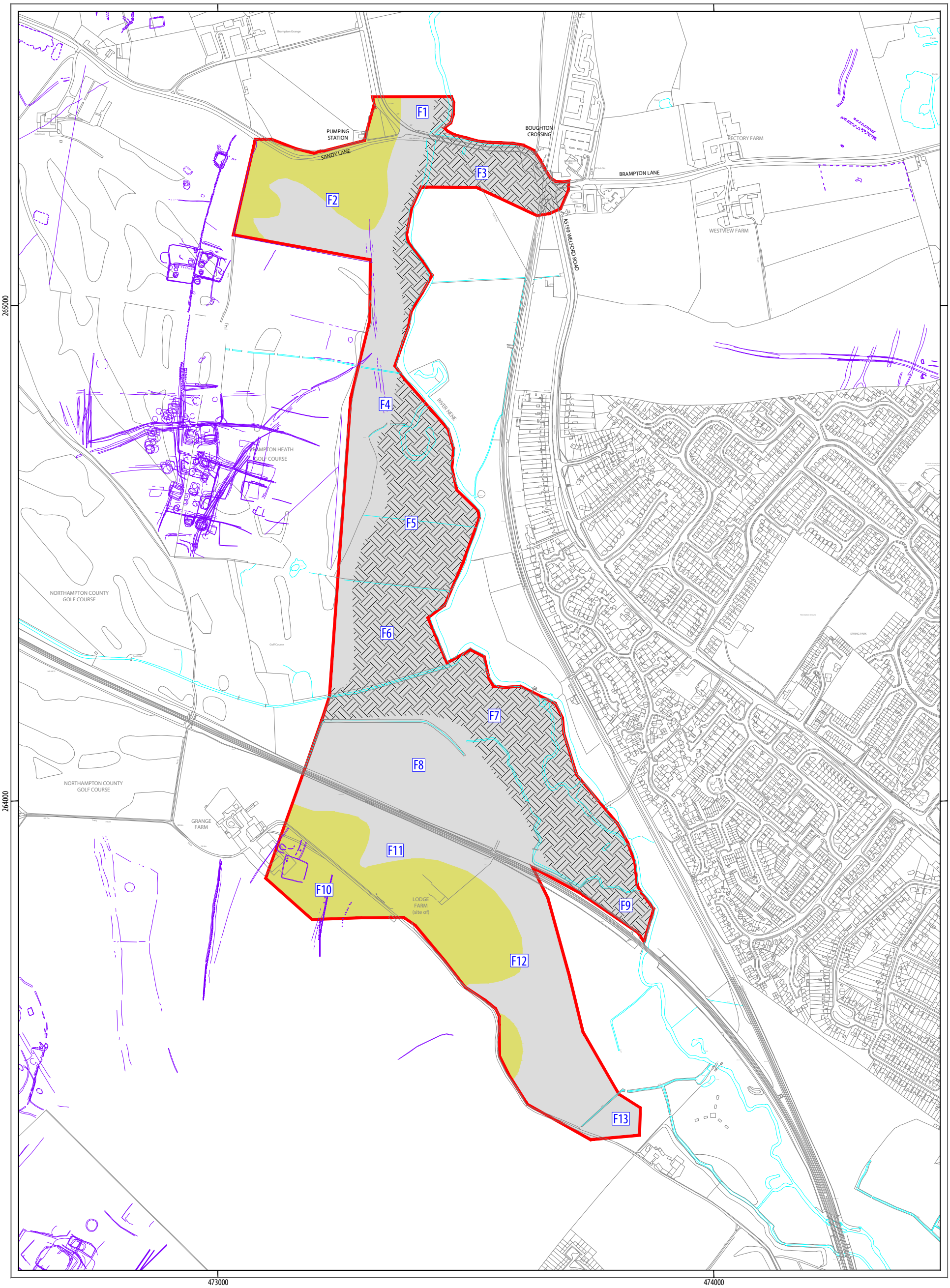
ILLUS 6 Survey location showing GPS swaths



geophysical survey area

NMP cropmark data

BEDROCK GEOLOGY

Whitby Mudstone Formation - mudstone

Northampton Sand Formation - sandstone, limestone and ironstone

SUPERFICIAL DEPOSITS

Alluvium - clay, silt, sand and gravel

0 200m

1:7,500 @ A3

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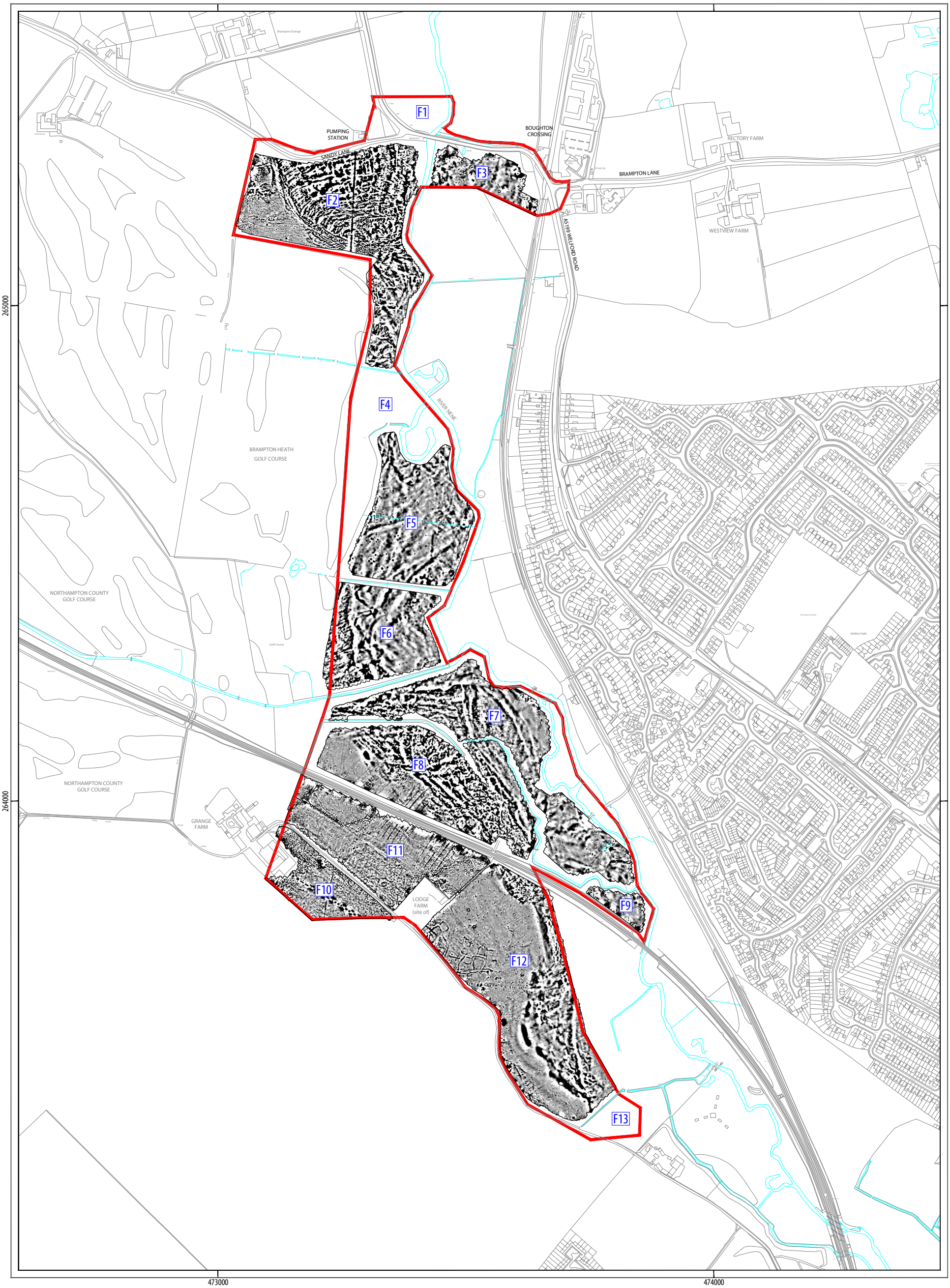
ILLUS 7 Survey location showing geology and NMP cropmark data



geophysical survey area

nT
-1.0
2.0

0
200m
1:7,500 @ A3

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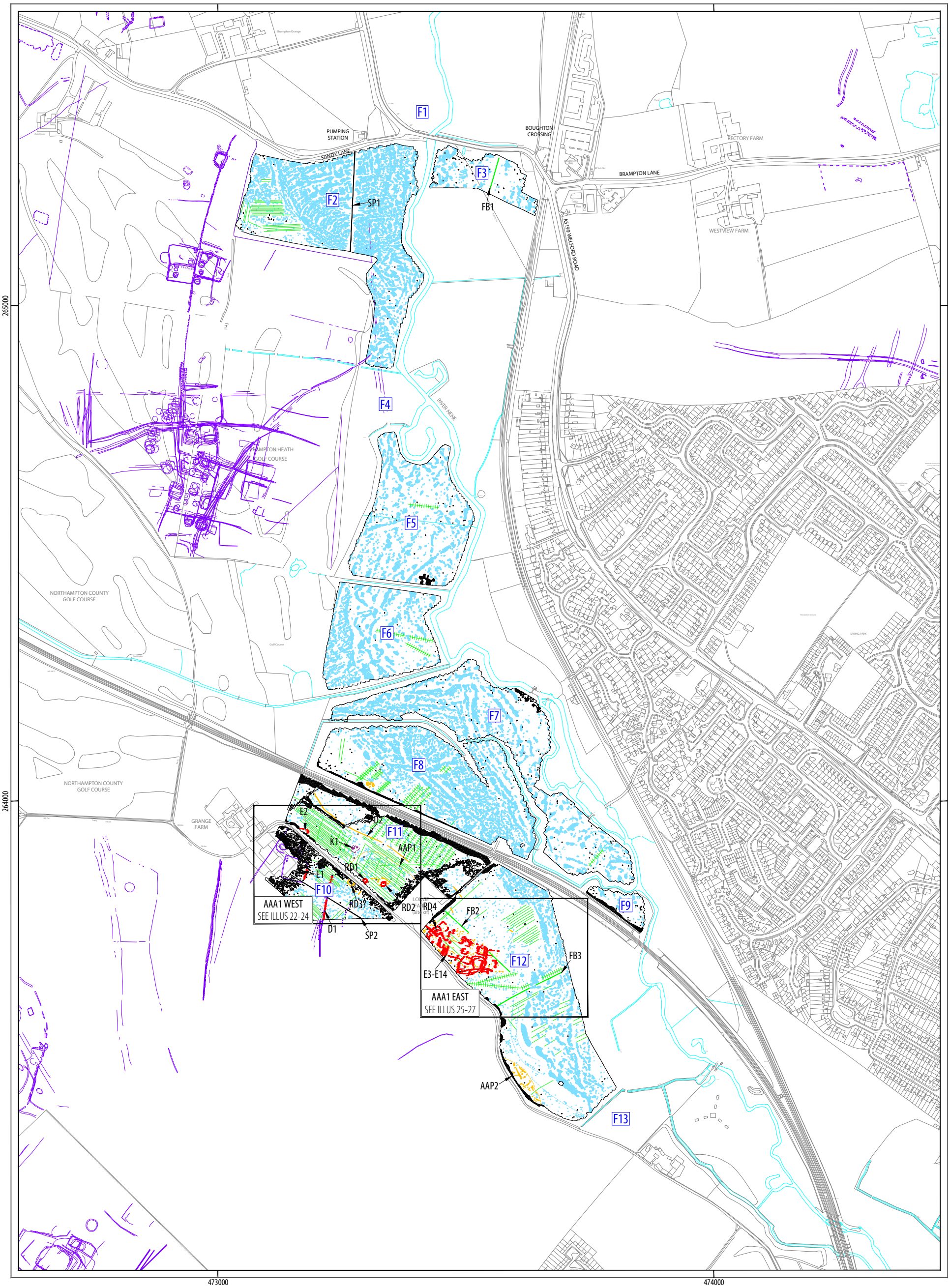
ILLUS 8 Processed greyscale magnetometer data



NMP cropmark data

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
dipolar linear	service pipe
linear trend	agricultural
linear trend	field drain

TYPE OF ANOMALY	INTERPRETATION
linear	former field boundary
linear	geological variation
magnetic enhancement	geology
magnetic enhancement	burning?/industrial?
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

ABBREVIATIONS

AAA	area of archaeological activity		
AAP	area of archaeological potential		
D	ditch	K	kiln
E	enclosure	RD	ring-ditch
FB	former boundary	SP	service pipe

0 200m
1:7,500 @ A3

PROJECT NWRR18 Northampton Western Relief Road
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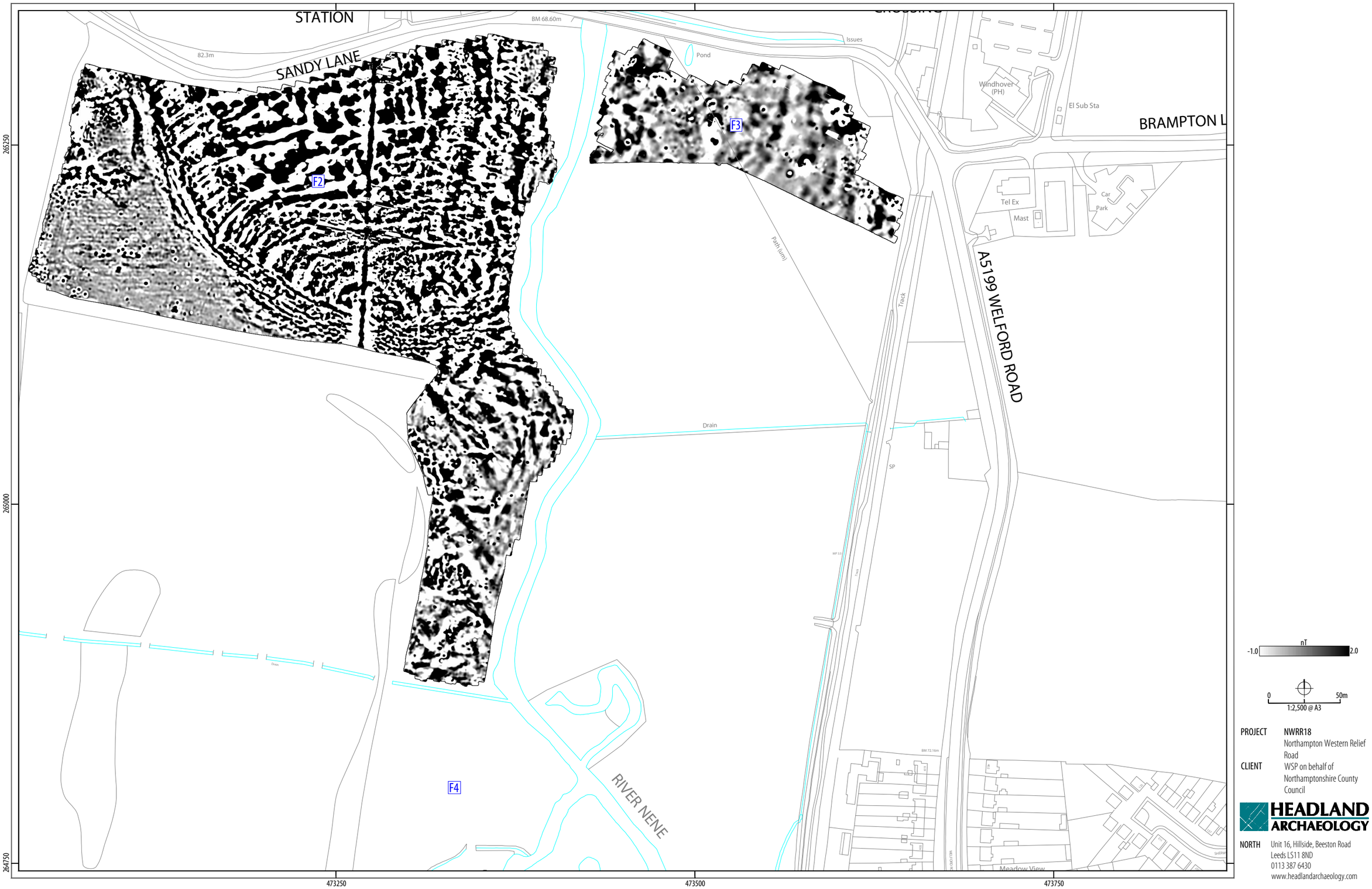
ILLUS 9 Interpretation of magnetometer data



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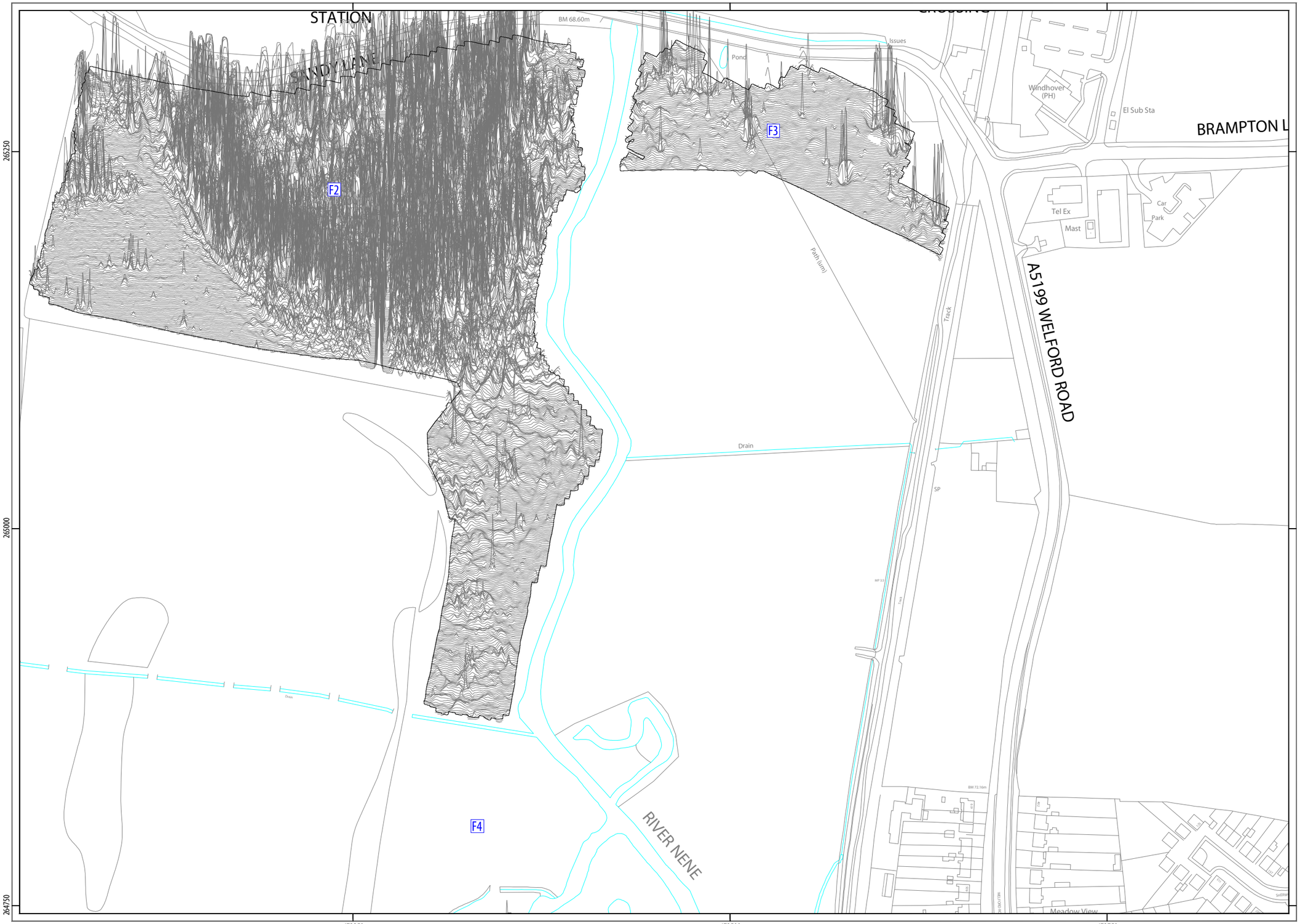
ILLUS 10 Processed greyscale magnetometer data; Sector 1



100.0nT/cm

0 50m

1:2,500 @ A3

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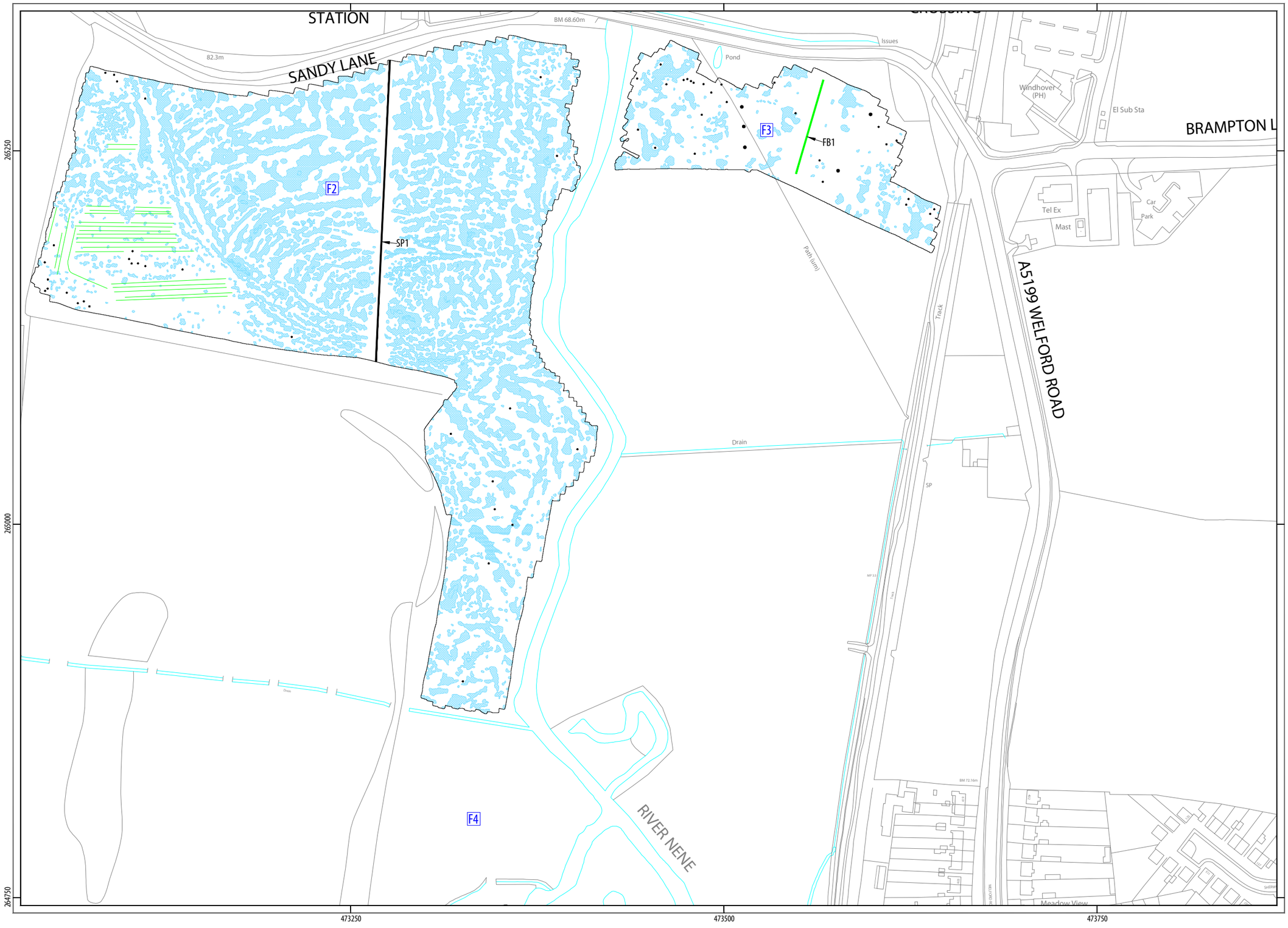
ILLUS 11 XY trace plot of minimally processed magnetometer data; Sector 1



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
dipolar linear	service pipe
linear trend	agricultural
linear	former field boundary
magnetic enhancement	geology

ABBREVIATIONS

FB former boundary

SP service pipe

0 50m

1:2,500 @ A3

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ILLUS 12 Interpretation of magnetometer data; Sector 1

BRAMPTON HEATH
GOLF COURSE

F4

F5

F6

F7

Golf Course

264500

264250

473250

473500

473750

-1.0 nT 2.0

0 50m
1:2,500 @ A3

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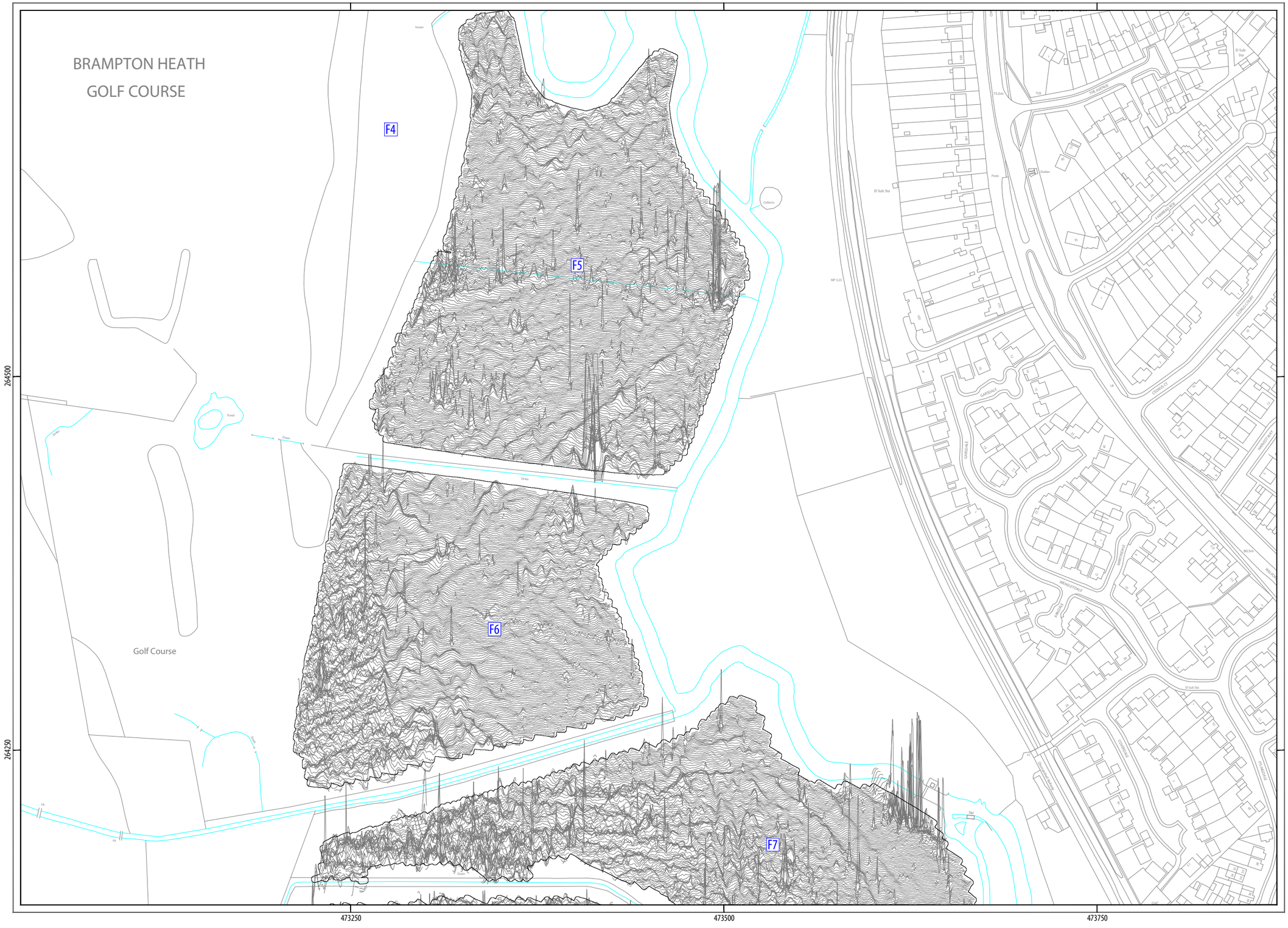
ILLUS 13 Processed greyscale magnetometer data; Sector 2



100.0nT/cm

0 50m

1:2,500 @ A3

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Northampton Western Relief Road

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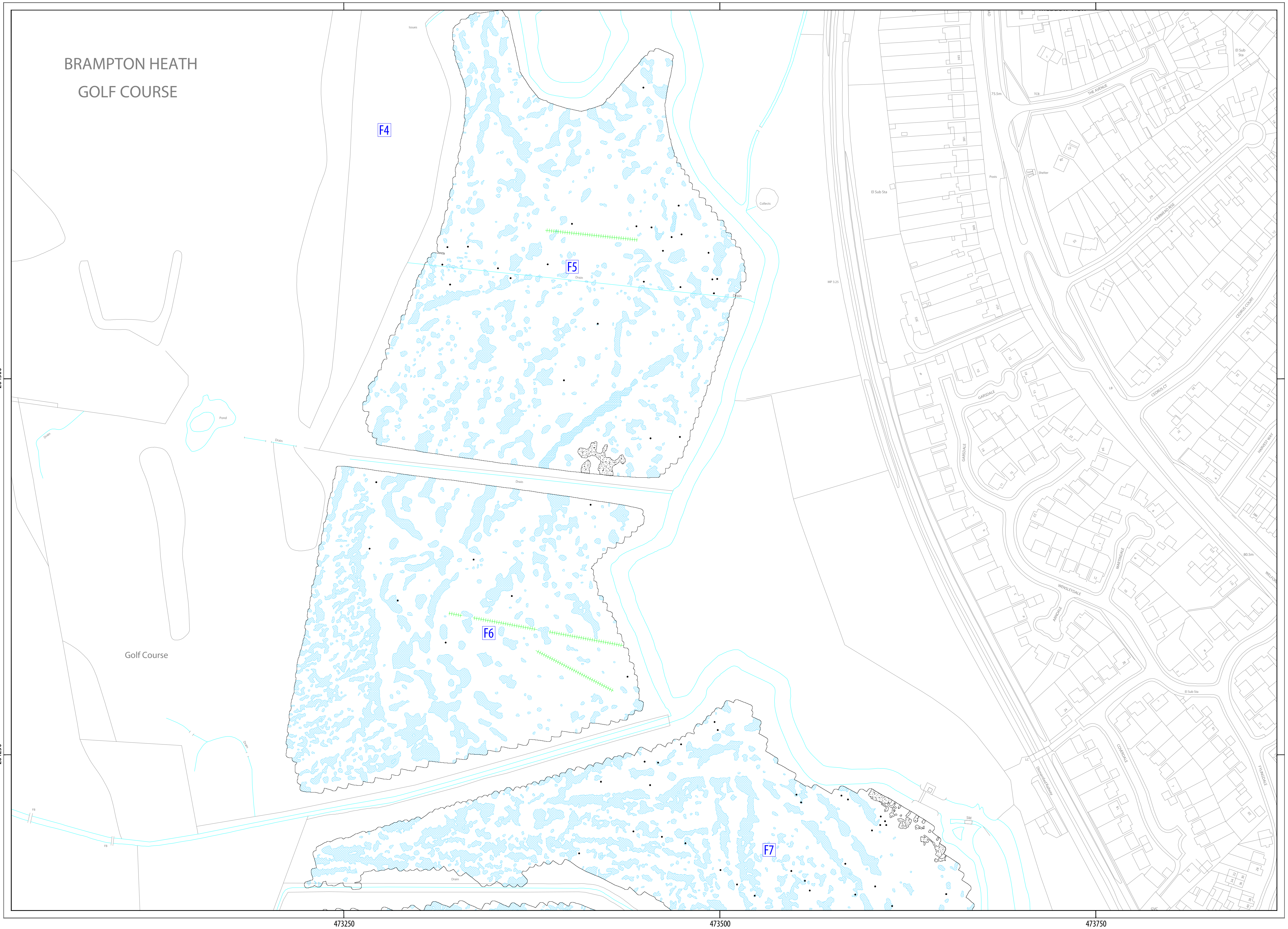
ILLUS 14 XY trace plot of minimally processed magnetometer data; Sector 2



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	field drain
magnetic enhancement	geology

0 50m
1:2,500 @ A3

PROJECT NWRR18
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ILLUS 15 Interpretation of magnetometer data; Sector 2

nT
-1.0 2.0

0 50m
1:2,500 @ A3

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Northampton Western Relief Road

CLIENT WSP on behalf of Northamptonshire County Council

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ILLUS 16 Processed greyscale magnetometer data; Sector 3

F8
F7
F11
F10
LODGE
FARM
(site of)
F12
F9
264000
263750
473250
473500
473750
100.0nT/cm
0
50m
1:2,500 @ A3
PROJECT NWRR18
Northampton Western Relief Road
CLIENT WSP on behalf of Northamptonshire County Council
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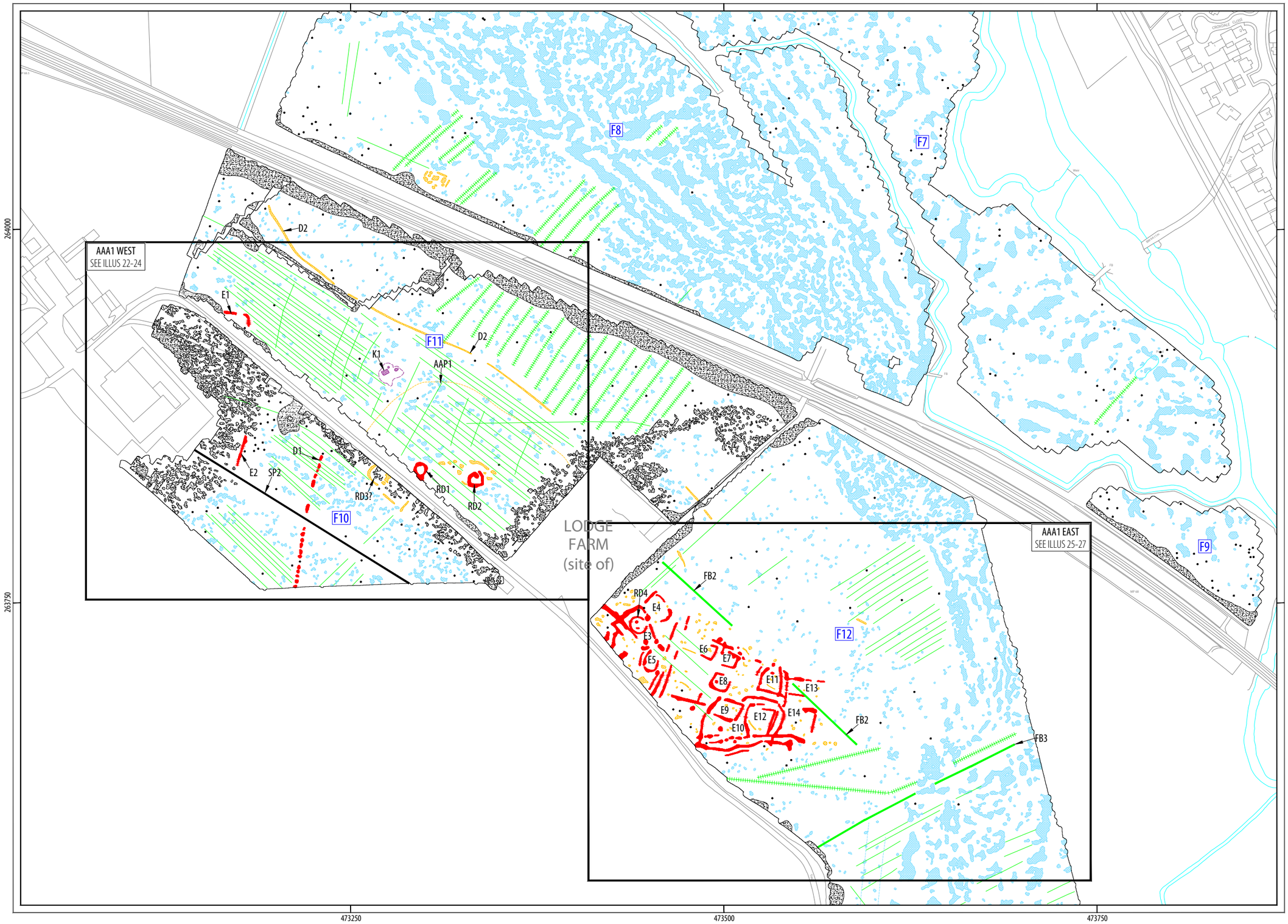
ILLUS 17 XY trace plot of minimally processed magnetometer data; Sector 3



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
dipolar linear	service pipe
linear trend	agricultural
linear trend	field drain
linear	former field boundary
linear	geological variation
magnetic enhancement	geology
linear trend	archaeology?
magnetic enhancement	burning?/industrial?
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

ABBREVIATIONS

AAA area of archaeological activity
AAP area of archaeological potential
D ditch
E enclosure
FB former boundary
K kiln
RD ring-ditch
SP service pipe

0 50m
1:2,500 @ A3

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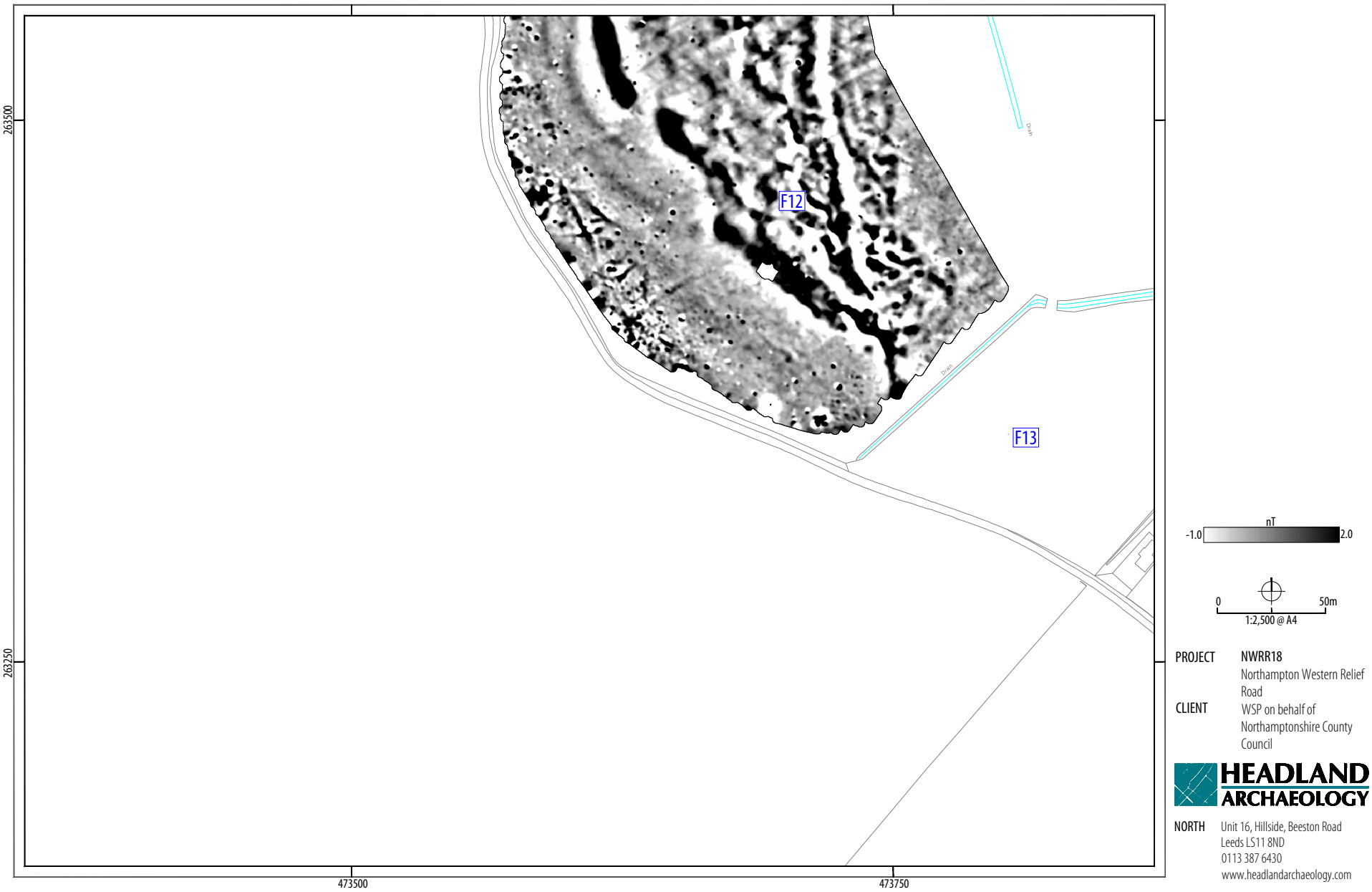
ILLUS 18 Interpretation of magnetometer data; Sector 3



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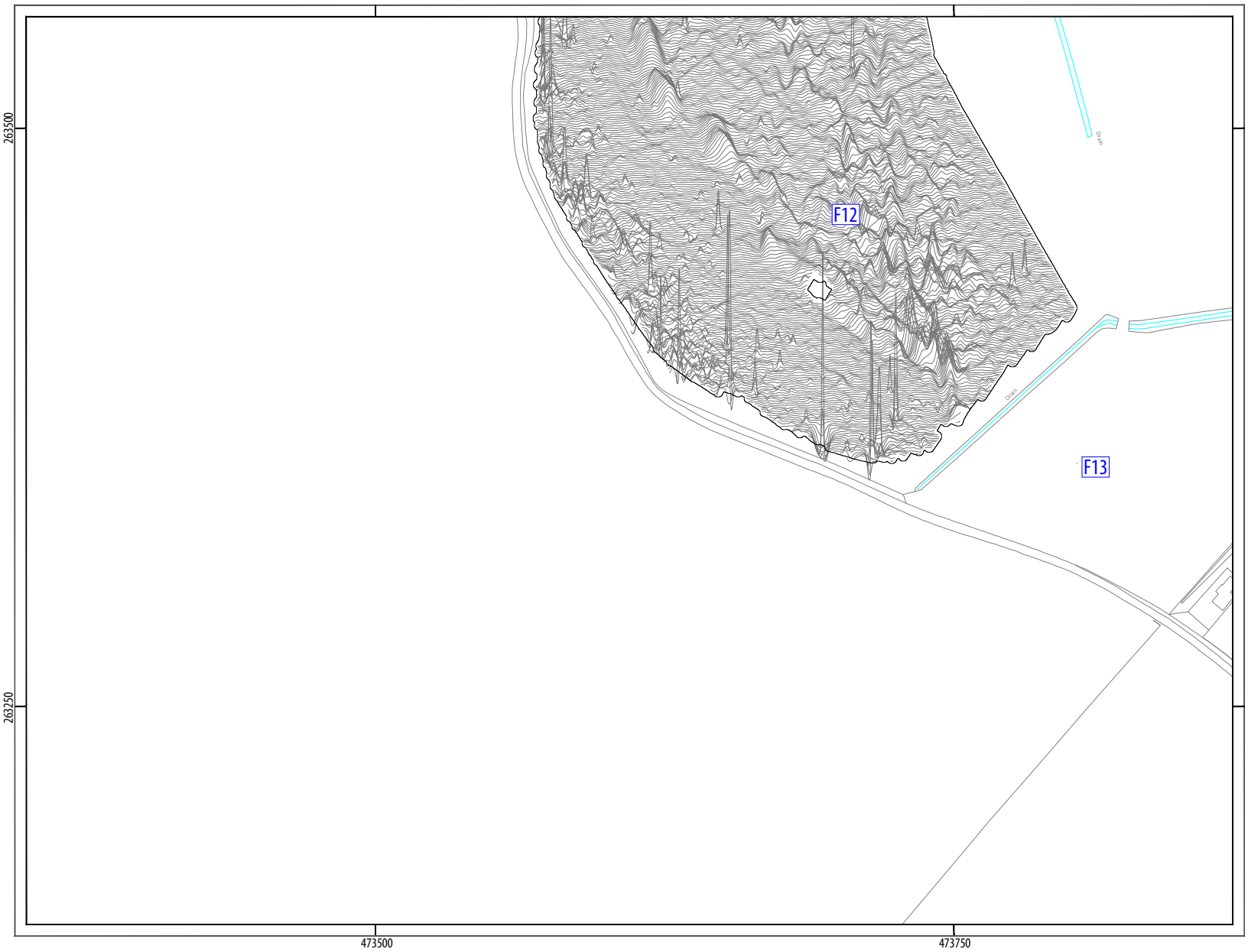
ILLUS 19 Processed greyscale magnetometer data; Sector 4



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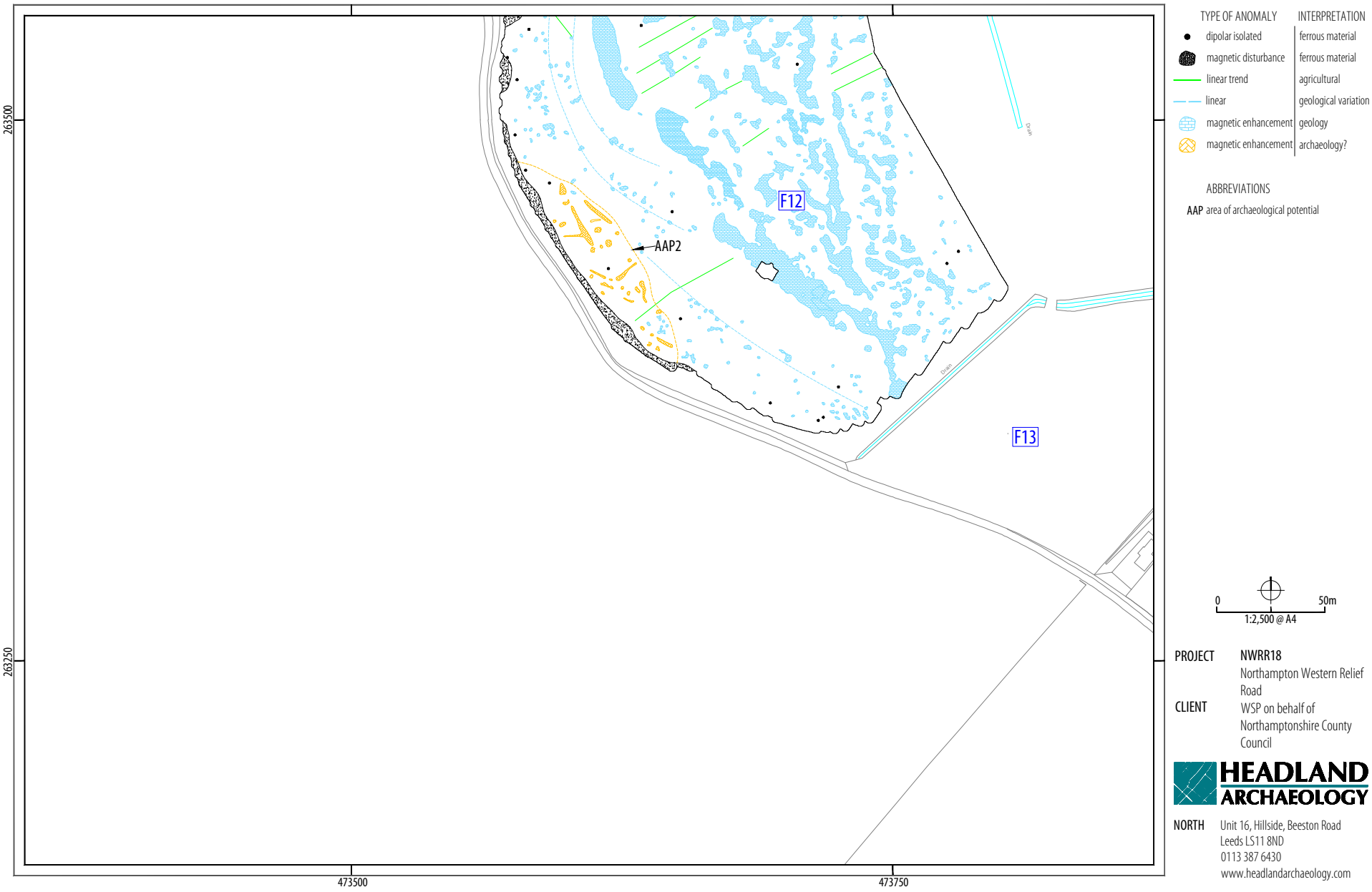
ILLUS 20 XY trace plot of minimally processed magnetometer data; Sector 4



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	agricultural
linear	geological variation
magnetic enhancement	geology
magnetic enhancement	archaeology?

ABBREVIATIONS

AAP area of archaeological potential

0 50m

1:2,500 @ A4

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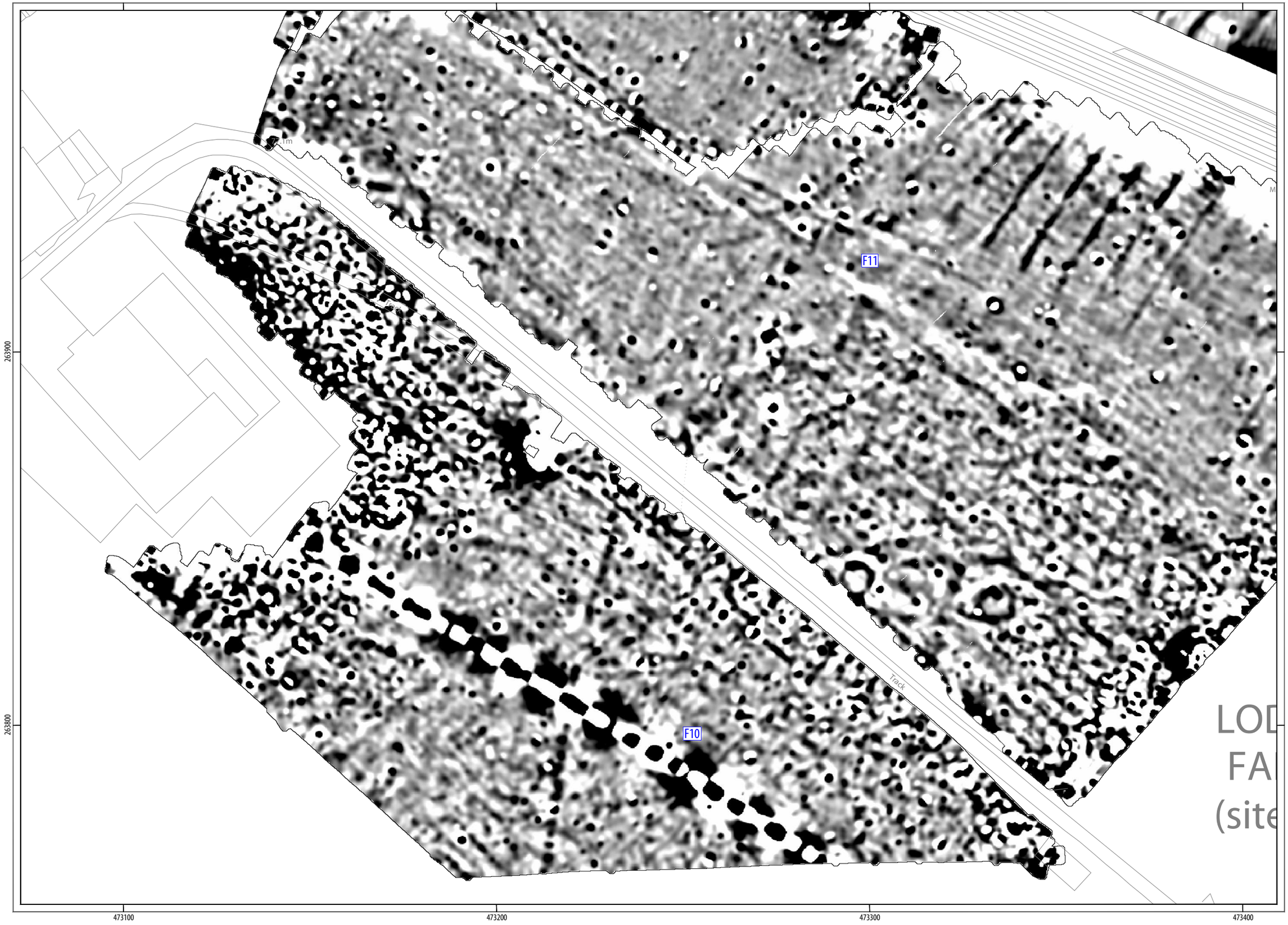
ILLUS 21 Interpretation of magnetometer data; Sector 4



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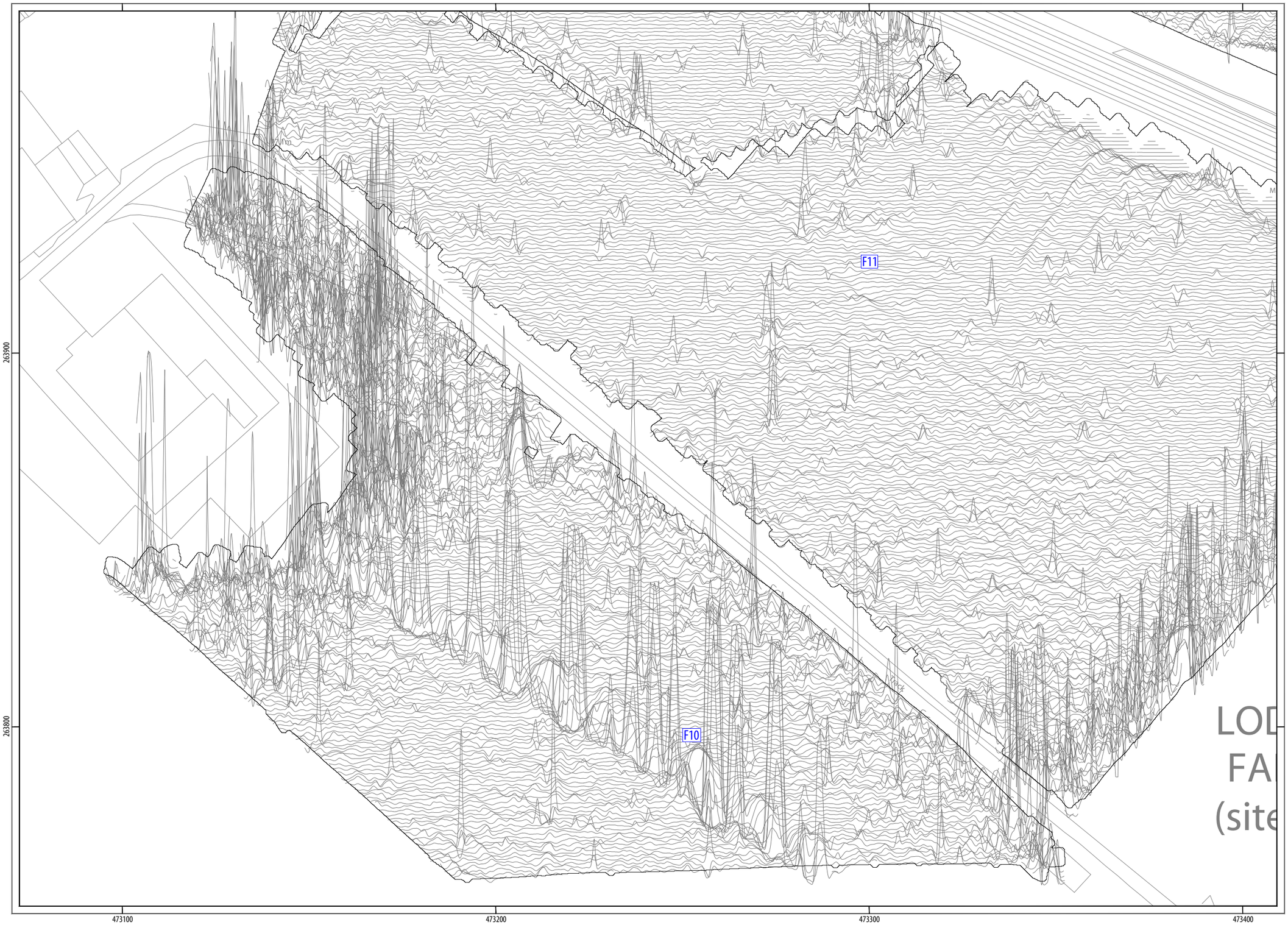
ILLUS 22 Processed greyscale magnetometer data; AAA1 (west)



ILLUS 23 XY trace plot of minimally processed magnetometer data; AAA1 (west)

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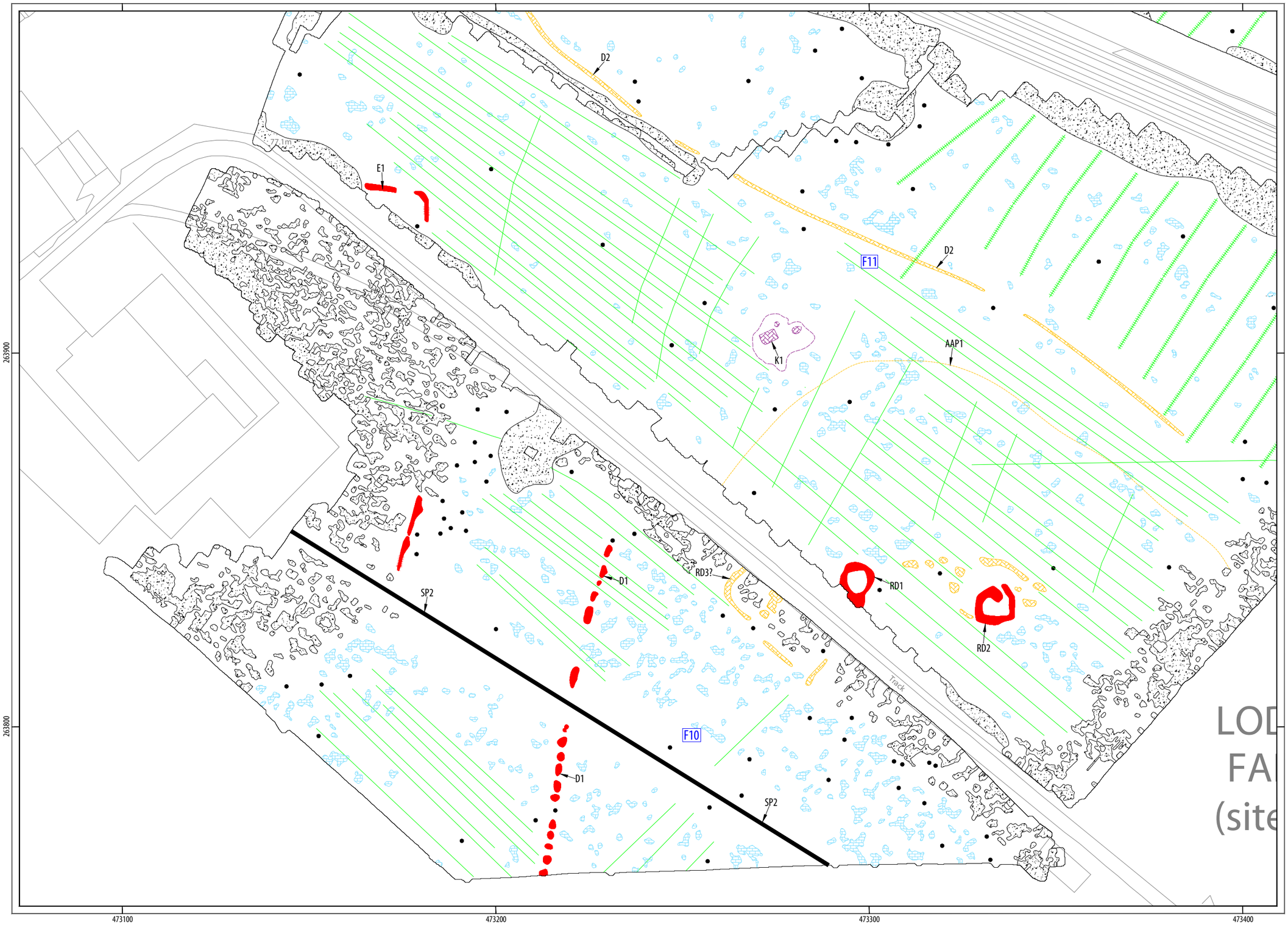

TYPE OF ANOMALY | INTERPRETATION

dipolar isolated	ferrous material
magnetic disturbance	ferrous material
dipolar linear	service pipe
linear trend	agricultural
linear trend	field drain
magnetic enhancement	geology
magnetic enhancement	burning?/industrial?
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

ABBREVIATIONS

- **AAP** area of archaeological potential
- **D** ditch
- **E** enclosure
- **FB** former boundary
- **K** kiln
- **RD** ring-ditch
- **SP** service pipe

0 25m
1:1,000 @ A3

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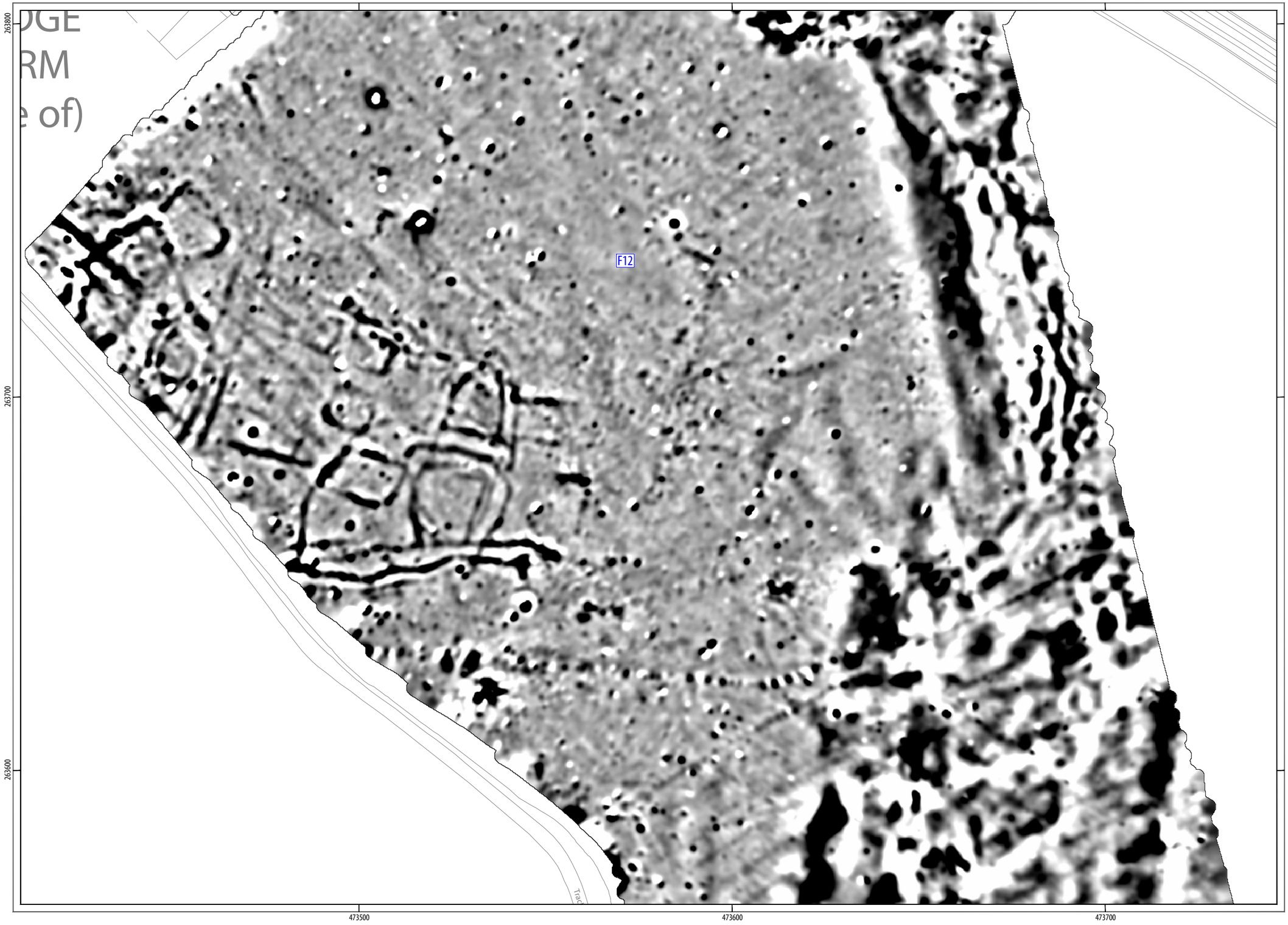
ILLUS 24 Interpretation of magnetometer data; AAA1 (west)



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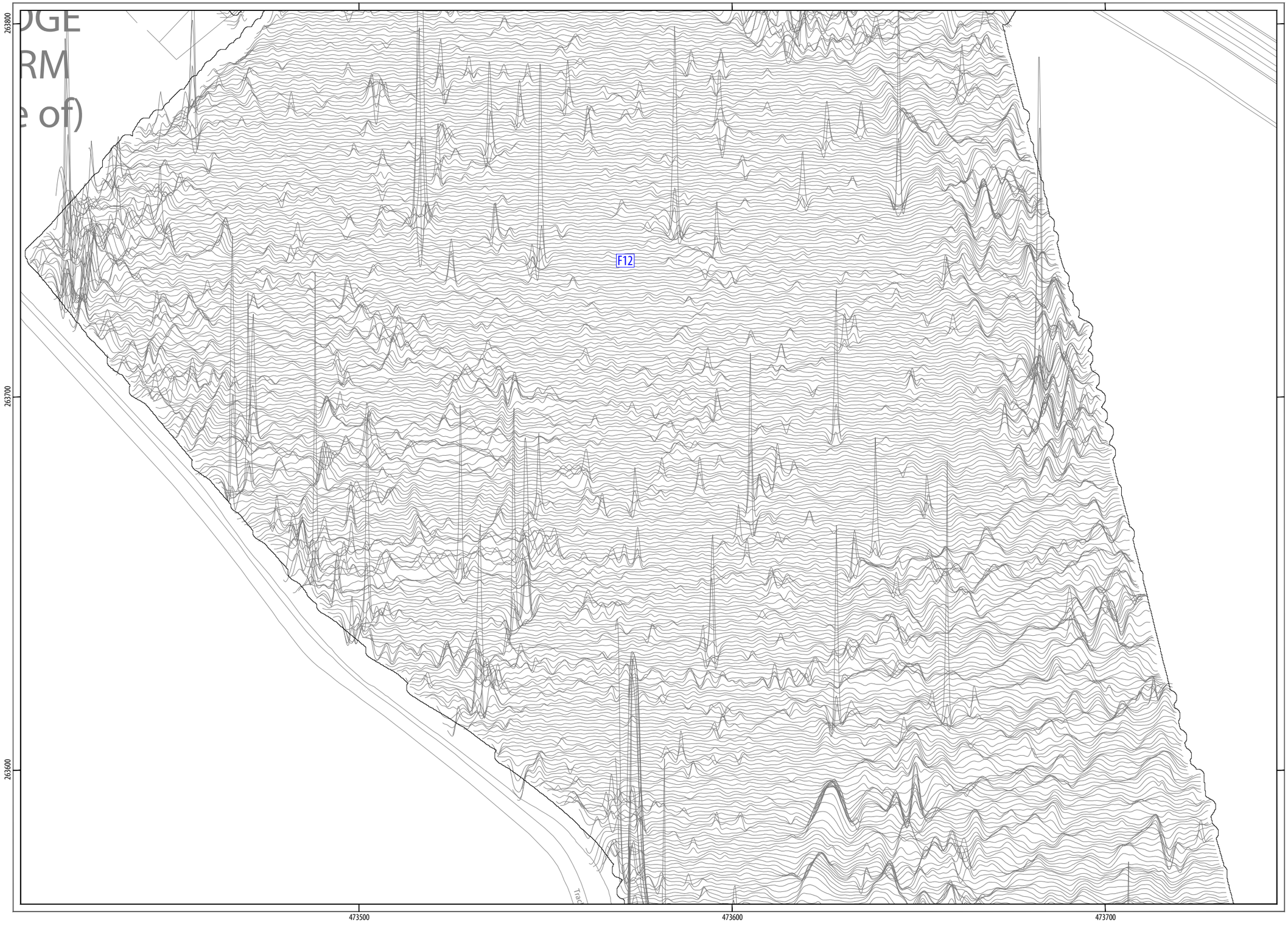
ILLUS 25 Processed greyscale magnetometer data; AAA1 (east)



40.0nT/cm

0 25m

1:1,000 @ A3

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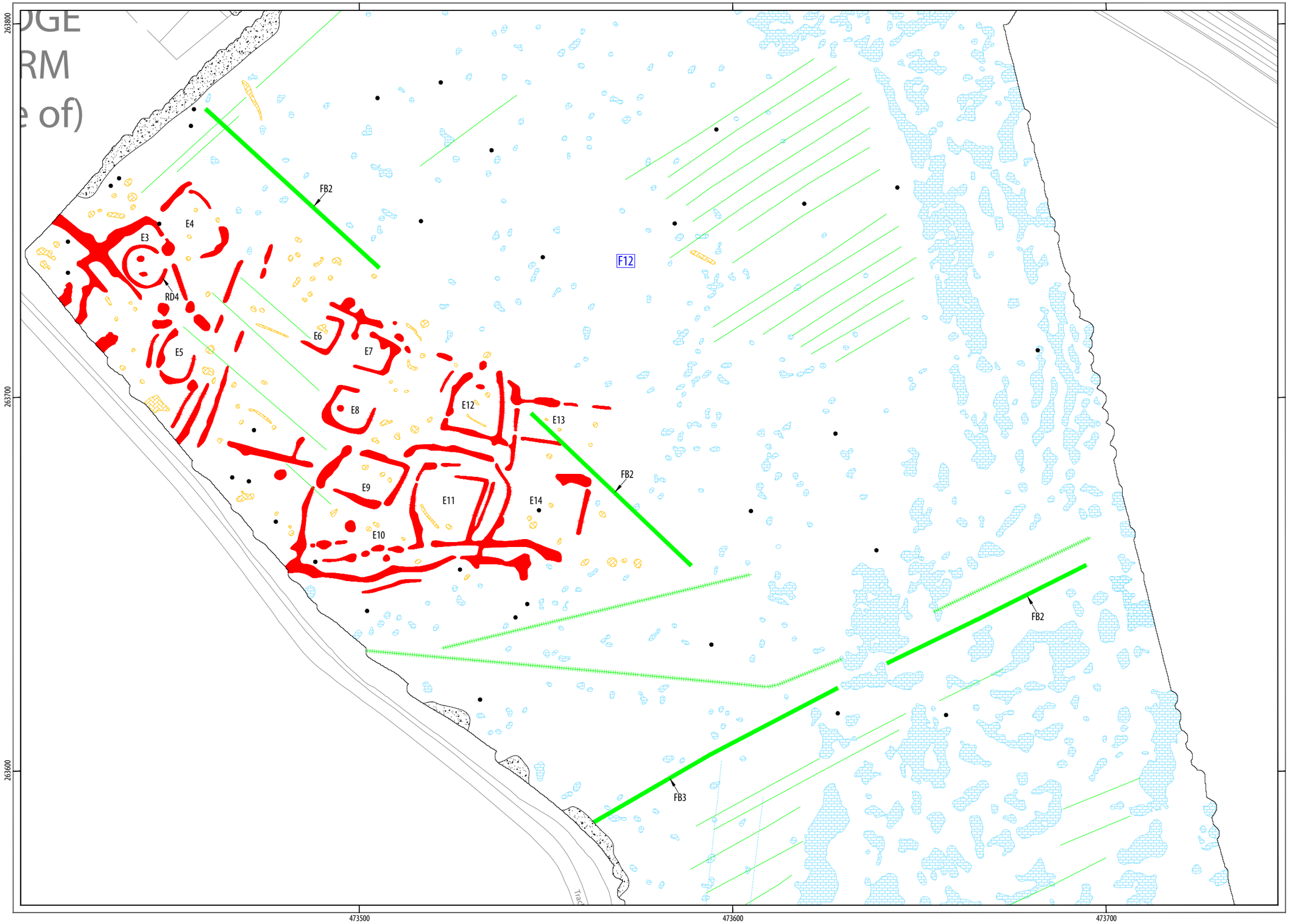
ILLUS 26 XY trace plot of minimally processed magnetometer data; AAA1 (east)



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	agricultural
linear trend	field drain
linear	former field boundary
linear	geological variation
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

ABBREVIATIONS

D	ditch
E	enclosure
FB	former boundary
K	kiln
RD	ring-ditch
SP	service pipe

0 25m
1:1,000 @ A3

PROJECT NWRR18
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ILLUS 27 Interpretation of magnetometer data; AAA1 (east)

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.

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 associate 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). The data will be stored in an indexed archive and migrated to new formats when necessary.

APPENDIX 4 ADATA 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

OASIS ID: headland5-346085

PROJECT DETAILS	
Project name	Northampton Western Relief Road
Short description of the project	Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey of a 50 hectare site in the Nene Valley on the north-western periphery of Northampton, to provide information on the archaeological potential of the site in advance of the proposed Northampton Western Relief Road. The majority of the data collected over the alluvial deposits in the valley base is dominated by contrasting geological anomalies manifesting either as extremely high magnitude areas of magnetic disturbance or conversely as a flat monotone response with minimal magnetic variation. Against either of these magnetic backgrounds it may be difficult to identify any anomalies of archaeological potential, if present. However, on the north-facing side of the Nene valley, in the south of the site, a distinct area of archaeological activity has been identified comprising a complex of conjoined enclosures, ditches and ring-ditches and including a possible kiln. These anomalies are thought to be suggestive of Romano-British settlement activity and are considered to be of high archaeological potential. Some of these anomalies correspond to cropmarks recorded by the National Mapping Programme but the majority of the archaeological anomalies identified by the survey are previously unknown. Several high magnitude discrete and linear anomalies in the vicinity of the complex cannot be explained as agricultural, geological or modern in origin and, given the local context, an archaeological origin cannot be dismissed. These anomalies are ascribed moderate archaeological potential. No anomalies of archaeological potential have been identified over the majority of the site although, given the presence of alluvial deposits and the extremely variable magnetic background, isolated soil-filled features and/or areas of unenclosed settlement, if present, may not manifest in the data.
Project dates	Start: 19-11-2018 End: 28-11-2018
Previous/future work	No / Yes
Any associated project reference codes	NWRR18 - 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 None
Monument type	N/A None
Significant Finds	N/A None
Significant Finds	N/A None
Methods & techniques	"Geophysical Survey"
Development type	Road scheme (new and widening)
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Not known / Not recorded
Solid geology (other)	Whitby Mudstone; Northampton Sand Formation
Drift geology	ALLUVIUM
Techniques	Magnetometry

PROJECT LOCATION	
Country	England
Site location	NORTHAMPTONSHIRE NORTHAMPTON NORTHAMPTON Northampton Western Relief Road
Study area	50 Hectares
Site coordinates	SP 7324 6486 52.27660920646 -0.926399494293 52 16 35 N 000 55 35 W Point

PROJECT CREATORS	
Name of Organisation	Headland Archaeology
Project brief originator	WSP
Project design originator	Headland Archaeology
Project director/manager	Harrison, D
Project supervisor	Bishop, R
Project supervisor	Evans, M
Type of sponsor/funding body	Developer

PROJECT ARCHIVES	
Physical Archive Exists?	No
Digital Archive recipient	In house
Digital Contents	"Survey"
Digital Media available	"Geophysics"
Paper Archive Exists?	No

PROJECT BIBLIOGRAPHY 1	
Publication type	Grey literature (unpublished document/manuscript)
Title	Northampton Western Relief Road, Northamptonshire; Geophysical Survey
Author(s)/Editor(s)	Harrison, D.
Date	2019
Issuer or publisher	Headland Archaeology
Place of issue or publication	Leeds
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Entered by	David Harrison (david.harrison@headlandarchaeology.com)
Entered on	18 March 2019

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