GEOPHYSICAL SURVEY REPORT

Land east of Ashingdon Road, Rochford, Essex

August 2020

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Abstract

Magnitude Surveys was commissioned to assess the subsurface archaeological potential of a c.25ha area of land to the east of Ashingdon Road, Rochford, Essex. A fluxgate gradiometer survey was successfully completed across the site and no anomalies suggestive of significant archaeological activity were identified. Anomalies related to agricultural activity have been classified, with evidence of widespread, multi-phase drainage and ploughing features across the survey area. Changes in landscape are evident, as former mapping of the site identifies a ditched boundary, and ponds which have since been infilled. Anomalies of undetermined origin have been interpreted in various locations across the survey area, which likely correspond with modern day agricultural practices; however, an archaeological origin cannot be ruled out.

Contents

List of Figures

1. Introduction

1.1. Magnitude Surveys Ltd (MS) was commissioned by RPS Group on behalf of Bloor Homes to undertake a geophysical survey on a c.25ha area of land to the east of Ashingdon Road, Rochford, Essex (TQ 873 916).

1.2. The geophysical survey comprised of a quad-towed, cart-mounted GNSS-positioned fluxgate gradiometer survey. Magnetic survey is the standard primary geophysical method for archaeological applications in the UK for its ability to detect a range of different features. The technique is particularly suited for detecting fired or magnetically enhanced features, such as ditches, pits, kilns, sunken earth houses, and industrial activity (David *et al*., 2008).

1.3. The survey was conducted in line with the current best practice guidelines produced by Historic England (David et al., 2008), the Chartered Institute for Archaeologists (CIfA, 2014) and the European Archaeological Council (Schmidt et al., 2015).

1.4. It was conducted in line with a RAMS produced by MS (Magnitude Surveys, 2020).

1.5. The survey commenced on 10/08/2020 and took three days to complete.

2. Quality Assurance

2.1. Magnitude Surveys is a Registered Organisation of the Chartered Institute for Archaeologists (CIfA), the chartered UK body for archaeologists, and a corporate member of ISAP (International Society of Archaeological Prospection).

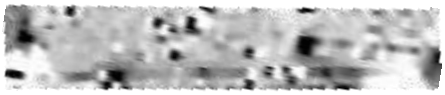
2.2. The directors of MS are involved in the cutting edge of research and the development of guidance/policy. Specifically, Dr. Chrys Harris has a PhD in archaeological geophysics from the University of Bradford, is a Member of CIfA and is the Vice-Chair of the International Society for Archaeological Prospection (ISAP); Finnegan Pope-Carter has an MSc in archaeological geophysics and is a Fellow of the London Geological Society, as well as a member of GeoSIG (CIfA Geophysics Special Interest Group); Dr. Kayt Armstrong has a PhD in archaeological geophysics from Bournemouth University, is a Member of CIfA, the Editor of ISAP News, and is the UK Management Committee representative for the COST Action SAGA; Dr. Paul Johnson has a PhD in archaeology from the University of Southampton, has been a member of the ISAP Management Committee since 2015, and is currently the nominated representative for the EAA Archaeological Prospection Community to the board of the European Archaeological Association.

2.3. All MS managers have relevant degree qualifications to archaeology or geophysics. All MS field and office staff have relevant archaeology or geophysics degrees and/or field experience.

2.4. Data collection was repeated over the same location to demonstrate the consistency and reliability of the geophysical survey. Traverse 157 is a re-collection of the area covered by Traverse 37. These are presented below:

Traverse 37:

Traverse 157:



3. Objectives

3.1. The objective of the geophysical survey was to assess the subsurface archaeological potential of the survey area.

4. Geographic Background

4.1. The survey area was located c.830m north from the centre of Rochford, Essex (Figure 1). Gradiometer survey was undertaken across two arable fields. The survey area was bounded by residential housing and Oxford Road to the north, arable fields to the east, residential housing to the south, and residential housing and Ashingdon Road to the west (Figure 2).

4.2. Survey considerations:

Survey Area	Ground Conditions	Further Notes
1	The survey area consisted of a flat arable field, which had been recently harvested.	The area was bound to the north, south and west by hedgerows. To the east the field continued beyond the survey area. Modern plough lines were visible, running northwest to southeast across the field. A number of service covers visible at the time of survey identify the location of a service.
2	The survey area consisted of a flat arable field, which had been recently harvested.	The area was bound on all sides by hedgerows. Four services covers were visible within the eastern edge of the area. An overhead powerline cable was in the north-eastern corner of the field, running southeast-northwest. Modern plough lines were visible running east to west across the field. A number of service covers visible at the time of survey identify the location of a service.

4.3. The underlying geology comprises clay, silt and sand of the London Clay Formation. Superficial deposits consist of clay and silt river terrace deposits (British Geological Survey, 2020).

4.4. The soils consist of freely draining slightly acid loamy soils (Soilscapes, 2020).

5. Archaeological Background

5.1. The following is a summary of a DBA produced by CgMs Heritage (CgMs, 2019) and provided by the client.

5.2. Within the survey area, several fragments of Roman pottery (MEX37135) were identified in the east, along with (MEX1036173)

5.3. Prehistoric activity has been identified in the form of a Palaeolithic hand axe c.590m southeast of the survey area, along with a large number of late Mesolithic flints (MEX10413), a Bronze Age token, burial pit and artefact scatter (MEX1041317), identified during a previous excavation c.290m north of the survey area. Further activity was identified in the form of a Neolithic pit c.620m southwest of the survey area (MEX1042). A previous archaeological survey c.620m southwest of the survey area identified multi-period remains (EEX56764) predominately from the prehistoric period, including a late Bronze Age field system (MEX1042224).

5.4. Roman activity has been identified as an early Roman Sestertius recovered c.570m west of the survey area (MEX37133). Previous excavations identified multi-period remains (EEX56562), largely from the Roman period c.290m north of the survey area, including a rectilinear enclosure system, cremation cemetery and refuse pits (MEX1041317), along with a trackway and spread of pottery (MEX41217).

5.5. Saxon and Medieval activity has been identified in the wider environs in the form of a number of Saxon burials c.890m to the southeast of the survey area (MEX43251). Rochford Medieval core is located c.700m to the south of the survey area (MEX37648). Previous excavation identified medieval remains c.620m southwest of the survey area (EEX56764), including a ditch, a field system and a pit along with Medieval pottery (MEX1042224).

6. Methodology

6.1. Magnetometer surveys are generally the most cost effective and suitable geophysical technique for the detection of archaeology in England. Therefore, a magnetometer survey should be the preferred geophysical technique unless its use is precluded by any specific survey objectives or the site environment. For this site, no factors precluded the recommendation of a standard magnetometer survey. Geophysical survey therefore comprised the magnetic method as described in the following section.

6.2.Data Collection

6.2.1. Geophysical prospection comprised the magnetic method as described in the following table.

6.2.2. Table of survey strategies:

Method	Instrument	Traverse Interval	Sample Interval
Magnetic	Bartington Instruments Grad-13 Digital Three-Axis Gradiometer	1m	200Hz reprojected to 0.125m

6.2.3. The magnetic data were collected using MS' bespoke quad-towed cart system GNSS-positioned system.

6.2.3.1. MS' cart system was comprised of Bartington Instruments Grad 13 Digital Three-Axis Gradiometers. Positional referencing was through a multi-channel, multi-constellation GNSS Smart Antenna RTK GPS outputting in NMEA mode to ensure high positional accuracy of collected measurements. The RTK GPS is accurate to 0.008m + 1ppm in the horizontal and 0.015m + 1ppm in the vertical.

6.2.3.2. Magnetic and GPS data were stored on an SD card within MS' bespoke datalogger. The datalogger was continuously synced, via an in-field Wi-Fi unit, to servers within MS' offices. This allowed for data collection, processing and visualisation to be monitored in real-time as fieldwork was ongoing.

6.2.3.3. A navigation system was integrated with the RTK GPS, which was used to guide the surveyor. Data were collected by traversing the survey area along the longest possible lines, ensuring efficient collection and processing.

6.3.Data Processing

6.3.1. Magnetic data were processed in bespoke in-house software produced by MS. Processing steps conform to Historic England's standards for "raw or minimally processed data" (see sect 4.2 in David et al., 2008: 11).

Sensor Calibration – The sensors were calibrated using a bespoke in-house algorithm, which conforms to Olsen et al. (2003).

Zero Median Traverse – The median of each sensor traverse is calculated within a specified range and subtracted from the collected data. This removes striping effects caused by small variations in sensor electronics.

Projection to a Regular Grid – Data collected using RTK GPS positioning requires a uniform grid projection to visualise data. Data are rotated to best fit an orthogonal grid projection and are resampled onto the grid using an inverse distance-weighting algorithm.

Interpolation to Square Pixels – Data are interpolated using a bicubic algorithm to increase the pixel density between sensor traverses. This produces images with square pixels for ease of visualisation.

6.4.Data Visualisation and Interpretation

6.4.1. This report presents the gradient of the sensors' total field data as greyscale images, as well as the total field data from the upper and/or lower sensors. The gradient of the sensors minimises external interferences and reduces the blown-out responses from ferrous and other high contrast material. However, the contrast of weak or ephemeral anomalies can be reduced through the process of calculating the gradient. Consequently, some features can be clearer in the respective gradient or total field datasets. Multiple greyscale images of the gradient and total field at different plotting ranges have been used for data interpretation. Greyscale images should be viewed alongside the XY trace plot (Figures 8 and 11). XY trace plots visualise the magnitude and form of the geophysical response, aiding in anomaly interpretation.

6.4.2. Geophysical results have been interpreted using greyscale images and XY traces in a layered environment, overlaid against open street maps, satellite imagery, historic maps, LiDAR data, and soil and geology maps. Google Earth (2020) was consulted as well, to compare the results with recent land usages.

6.4.3. Geodetic position of results - All vector and raster data have been projected into OSGB36 (ESPG27700) and can be provided upon request in ESRI Shapefile (.SHP) and Geotiff (.TIF) respectively. Figures are provided with raster and vector data projected against OS Open Data.

7. Results

7.1.Qualification

7.1.1. Geophysical results are not a map of the ground and are instead a direct measurement of subsurface properties. Detecting and mapping features requires that said features have properties that can be measured by the chosen technique(s) and that these properties have sufficient contrast with the background to be identifiable. The interpretation of any identified anomalies is inherently subjective. While the scrutiny of the results is undertaken by qualified, experienced individuals and rigorously checked for quality and consistency, it is often not possible to classify all anomaly sources. Where possible an anomaly source will be identified along with the certainty of the interpretation. The only way to improve the interpretation of results is through a process of comparing excavated results with the geophysical reports. MS actively seek feedback on their reports as well as reports of further work in order to constantly improve our knowledge and service.

7.2.Discussion

7.2.1. The geophysical results are presented in consideration with satellite imagery and historic maps (Figure 5).

7.2.2. A fluxgate gradiometer survey has been successfully completed across the survey area, highlighting a variable magnetic background. Variations corresponding with changes in superficial and surface soil materials have produced more magnetically enhanced bands of sediment (see section 4.3 & 4.4) distributed according to minor topographic variations and potential seasonal flooding (prior to drainage installation). No anomalies suggestive of significant archaeological activity have been identified; however, in the case of a number of discrete undetermined anomalies within Area 1, an archaeological origin should not be completely discounted (Figure 5).

7.2.3. Widespread agricultural activity is evidenced by an almost orthogonal pattern of ploughing and drainage. Former field boundaries identified on tithe mapping may suggest multiple phases of cultivation across the survey area, with changes in plough orientation occurring with the removal or addition of land divisions. Although likely relating to various eras of cultivation, the difference between agricultural trends and drainage features is hard to establish as they may at one point have been one of the same, with drainage ditches forming the boundary between fields and or changes in

crop. Variations in magnetic signal have helped interpret some drainage features and may likely identify culverts and or French drains made of stone.

7.2.4. Tithe mapping also identifies former landscape features, which are no longer visible on the surface. Two ponds identified from these mapping sources are understood to have been infilled as they are no longer visible on the surface. Tithe mapping has been used as a supplementary source of information, as although it highlights these features, their precise location remains uncertain.

7.2.5. Various sources of modern interference have been identified, generally located along or within close proximity to field edges, they relate to modern residential or service related features. An alignment of service covers identified at the time of survey (See section 4.2) are likely to correspond with the location of a service line. An approximate course for this feature has been inferred, with a line of best fit through these metal covers (Figure 5). Other disturbances appear from former pylon foundation pits and fencing from residential property to the north, south, and west of the survey area.

7.3.Interpretation

7.3.1. General Statements

7.3.1.1. Geophysical anomalies will be discussed broadly as classification types across the survey area. Only anomalies that are distinctive or unusual will be discussed individually.

7.3.1.2. **Ferrous (Spike)** – Discrete ferrous-like, dipolar anomalies are likely to be the result of isolated modern metallic debris on or near the ground surface.

7.3.1.3. **Ferrous/Debris (Spread)** – A ferrous/debris spread refers to a concentrated deposition of discrete, dipolar ferrous anomalies and other highly magnetic material.

7.3.1.4. **Magnetic Disturbance** – The strong anomalies produced by extant metallic structures along the edges of the field have been classified as 'Magnetic Disturbance'. These magnetic 'haloes' will obscure the response of any weaker underlying features, should they be present, often over a greater footprint than the structure they are being caused by.

7.3.1.5. **Undetermined** – Anomalies are classified as Undetermined when the anomaly origin is ambiguous through the geophysical results and there is no supporting or correlative evidence to warrant a more certain classification. These anomalies are likely to be the result of geological, pedological or agricultural processes, although an archaeological origin cannot be entirely ruled out. Undetermined anomalies are generally not ferrous in nature.

7.3.2. Magnetic Results - Specific Anomalies

7.3.2.1. **Agricultural (Weak)** – A discontinuous weakly enhanced linear anomaly, corresponding closely with a field boundary visible on tithe mapping has been identified **[2a].** Oriented northwest – south east and generally north -south, the slightly di-polar signature exhibited may identify a drainage component to this

boundary feature, otherwise suggestive of a former ditched boundary. The feature appears separated by an infilled pond [**2b**], recorded on the tithe map. A similar, more-discrete infilled pond is noted in Area 1 adjacent to the eastern boundary [**1a**]. Both pond features show a weakly enhanced magnetic signature. This sort of enhancement with low contrast to the surrounding magnetic background suggests the infill material is natural to its surroundings.

7.3.2.2. **Agricultural Trend** – Across the survey area three distinctive orientations of agricultural trends can be seen (Figure 5). Across both Areas 1 and 2 weakly enhanced linear trends consistent with cultivation visible on satellite mapping (Figure 6) have been interpreted. Extending southwards from the northern boundary of Area 1 several further closely-spaced agricultural trends have been categorised. These do not follow the same orientation as more contemporary, extant agricultural practices; however, their spacing and signature are similar, and they align with former boundaries noted on tithe mapping, suggesting presence of a historical agricultural regime.

7.3.2.3. **Drainage Trend** – Identified within Area 1 two drainage features [**1b**] identify a negative magnetic enhancement. This sort of signal is typical of a stone lined or French drain. The difference in width of the anomalies may indicate a distinction between a major culvert or a tributary drain. Oriented diagonally through the centre of Area 2, a large, positively enhanced linear feature corresponds with a modern field drainage system [**2c**] (Figure 11). Differing from other anomalies interpreted as drainage features across the survey area, this exhibits a greater positive enhancement, suggestive of a more substantial drainage feature, possibly constructed from fired materials such as ceramic pipe. The anomaly appears to terminate at the northern boundary, with a ditch and the western boundary with modern housing which may tie in to further residential servicing. The southern terminus of this feature is obscured by magnetic disturbances, likely emanating from residential property along this boundary.

7.3.2.4. **Natural (Weak)** – Several amorphous bands of positive, weakly enhanced material are noted within Area 2 (Figure 5). Corresponding with drift geological patterns, these bands highlight a transportation and subsequent deposition of fine-grained material (See section 4.3 & 4.4), likely resulting from a flooding event.

7.3.2.5. **Undetermined (Weak) –** A discrete, horse-shoe shaped anomaly [**1c**] identified within Area 1 (Figure 8) has been classified as undetermined. This anomaly does not identify with any of the nearby agricultural activity, either ploughing or drainage related. The extent of the anomaly is too discrete for it to be considered natural or drift related and such a geological feature would be unlikely to form in such an environment. The anomaly may represent a cultivation trend, from tractor movement which is not visible on satellite mapping; however, an archaeological origin cannot be entirely ruled out.

7.3.2.6. **Service –** Several discrete dipolar anomalies have been identified running parallel to the eastern boundary of both Areas 1 and 2. Extant on site, corresponding with service covers, it is inferred they correspond to a sub-surface service line, relating to the residential properties to the north and south of the survey area. The exact orientation and extent of the service is unknown; however, a predicted line has been produced.

8. Conclusions

8.1. A fluxgate gradiometer survey has been successfully undertaken across the site, variations in the near surface geology have produced broad bands of river terrace deposits, associated with flooding which have aided with the interpretation of a range of discrete, ephemeral drainage features. Tithe maps have helped with the interpretation of the survey area; however, the location of anomalies corresponding with these maps is dubious.

8.2. The survey area reflects a predominantly agricultural setting, with variations in cultivation orientation, layout and usage, over time. Historic mapping shows differences in field layout with boundaries corresponding to similar mapped features.

8.3. Variations in drainage features throughout the survey area relate closely to changes in landscape and agricultural practise. A former boundary identifies drainage characteristics which may highlight a ditch line, whereas other more enhanced features associate closer with either stone lined /French drains or clay fired drainage.

8.4. Discrete, undetermined anomalies within the survey area differentiate from the general agricultural and geological landscape, sharing few similarities in signal strength, form or location. It is possible; however, they represent some unmapped surface feature present at the time of survey or even archaeological activity.

9. Archiving

9.1. MS maintains an in-house digital archive, which is based on Schmidt and Ernenwein (2013). This stores the collected measurements, minimally processed data, georeferenced and un-georeferenced images, XY traces and a copy of the final report.

9.2. MS contributes reports to the ADS Grey Literature Library upon permission from the client, subject to the any dictated time embargoes.

10. Copyright

10.1. Copyright and the intellectual property pertaining to all reports, figures, and datasets produced by Magnitude Services Ltd. is retained by MS. The client is given full licence to use such material for their own purposes. Permission must be sought by any third party wishing to use or reproduce any IP owned by MS.

11. References

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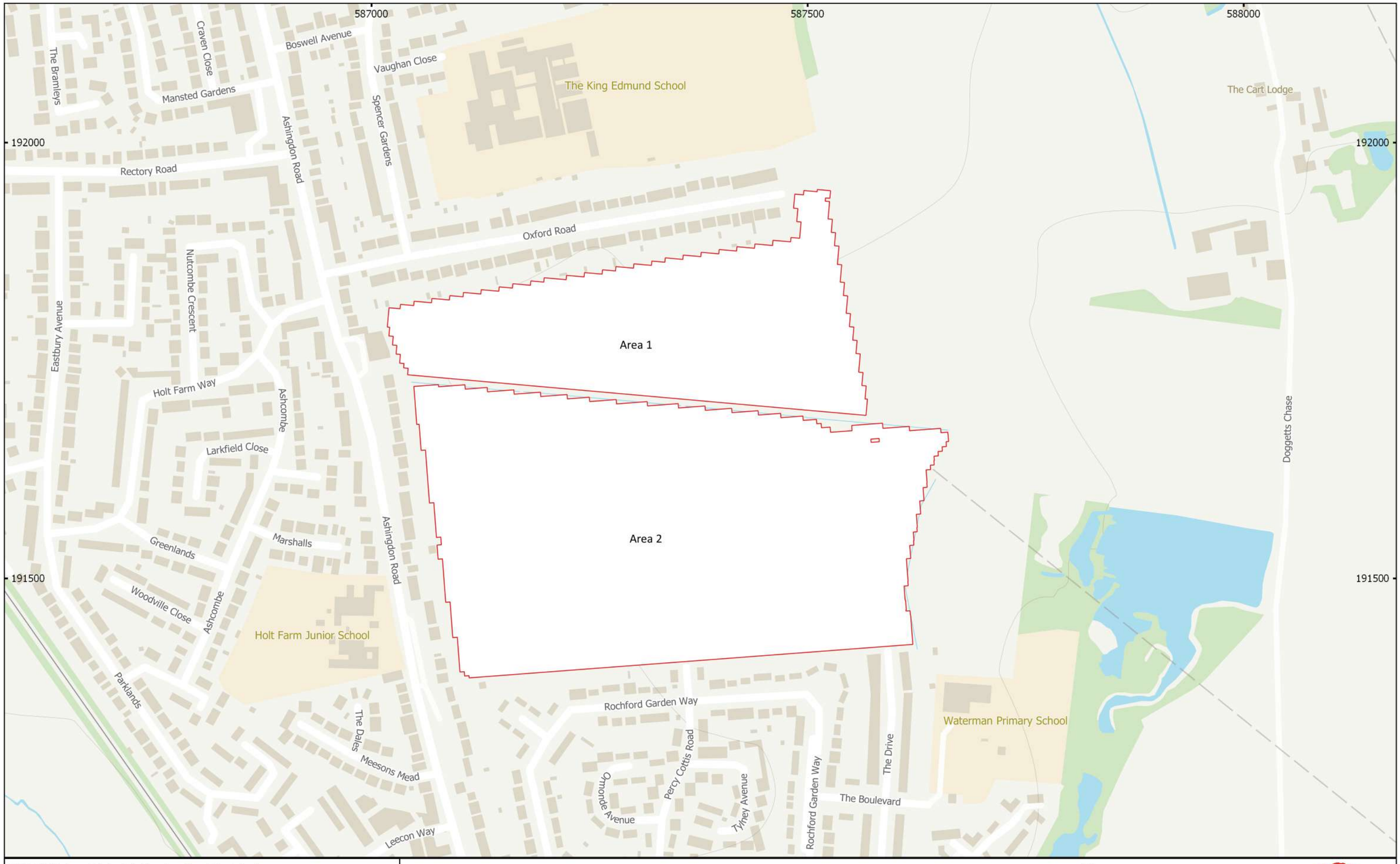
12. Project Metadata

MS Job Code	MSTQ733
Project Name	Land East of Ashingdon Road, Rochford
Client	RPS Group
Grid Reference	TQ873916
Survey Techniques	Magnetometry
Survey Size (ha)	25ha (Magnetometry)
Survey Dates	2020-08-10 to 2020-08-13
Project Lead	Frederick Salmon BSc FGS ACIfA
Project Officer	Frederick Salmon BSc FGS ACIfA
HER Event No	N/A
OASIS No	N/A
S42 Licence No	N/A
Report Version	Final

13. Document History

Version	Comments	Author	Checked By	Date
0.1	Initial draft for Project Lead to Review	AL, CN, AP	FS	18 August 2020
0.2	Corrections for Director Sign off	FS	PSJ	21 August 2020
Final	Minor Corrections from the client	FS	N/A	02 September 2020

MSTQ733 - Land East of Ashingdon Road, Rochford
Figure 1 - Site Location
1:25,000 @ A4



MSTQ733 - Land East of Ashingdon Road, Rochford
Figure 2 - Location of Survey Areas
1:4,000 @ A3

Survey Extents

magnitude surveys

192000 586800 587000 587200 587400 587600 587800 192000

191800 191800

191600 191600

191400 191400

Area 1

Area 2

Rectory Road
Spencer Gardens
Ashingdon Road
Oxford Road
Nuttcombe Crescent
Holt Farm Way
Ashcombe
Larkfield Close
Wheatley Close
Marshalls
Greenlands
Woodville Close
Holt Farm Junior School
Rochford Garden Way
Percy Cottis Road
The Drive
Tylney Avenue
The Dales
Meesons Mead
Parklands
Waterman Primary School

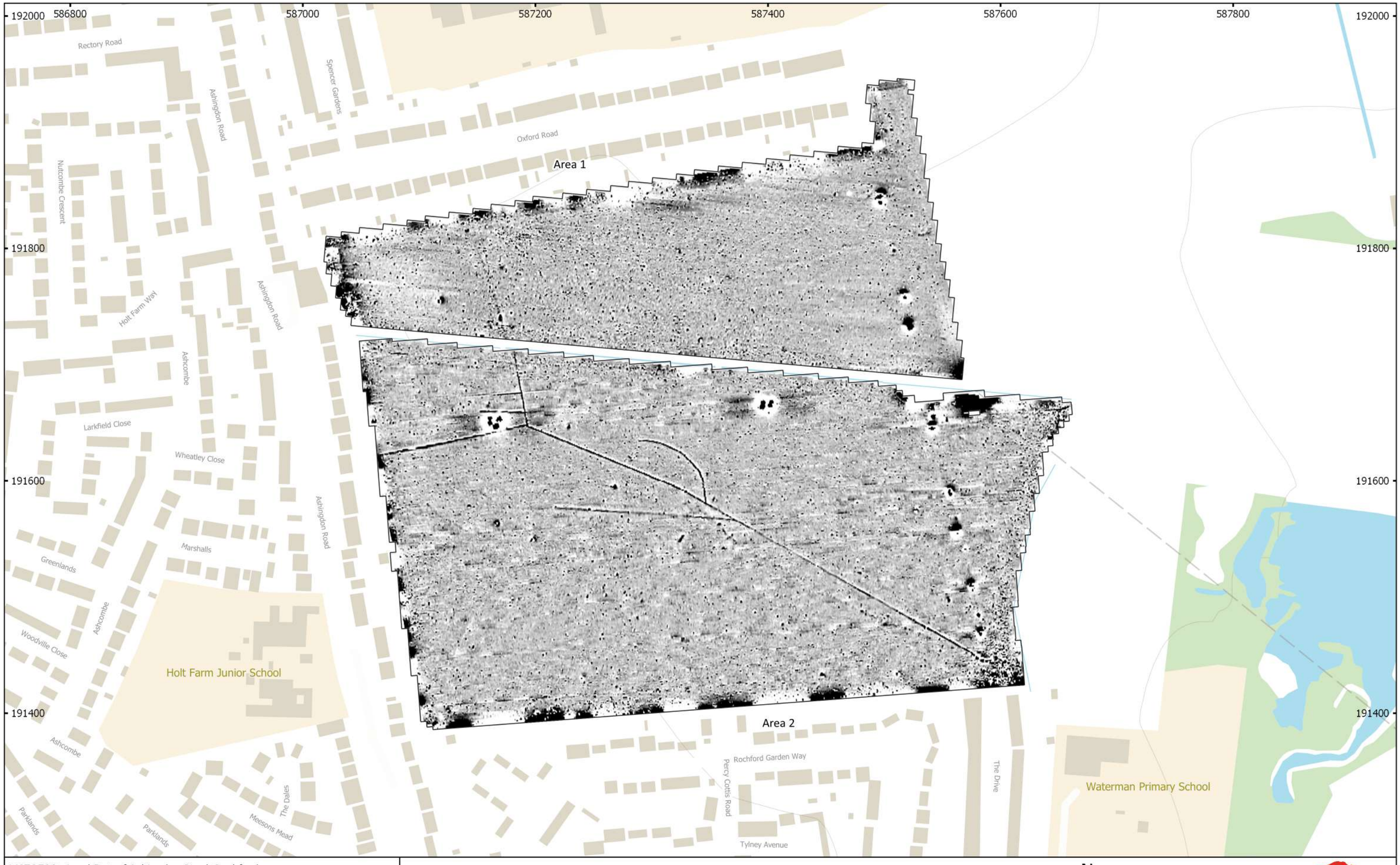
MSTQ733 - Land East of Ashingdon Road, Rochford
Figure 3 - Magnetic Total Field (Lower Sensor) Overview
1:3,000 @ A3

48,997 nT 49,005

N

0 50 100 150 m

magnitude surveys



MSTQ733 - Land East of Ashingdon Road, Rochford
Figure 4 - Magnetic Gradient Overview
1:3,000 @ A3

-1 nT 2

N

0 50 100 150 m

magnitude surveys

MSTQ733 - Land East of Ashingdon Road, Rochford
Figure 5 - Magnetic Interpretation Overview
1:3,000 @ A3

- Agricultural (Weak)
- Natural (Weak)
- Magnetic Disturbance
- Ferrous/Debris (Spread)
- Undetermined (Weak)
- Agricultural (Trend)
- Service
- Drainage Feature
- Ferrous (Point)

N

0 50 100 150 m

magnitude surveys

192000
587000
587500
192000
191500
191500
Area 1
Area 2
G.P
39
Holt Farm
P
B.P
37
F.P.

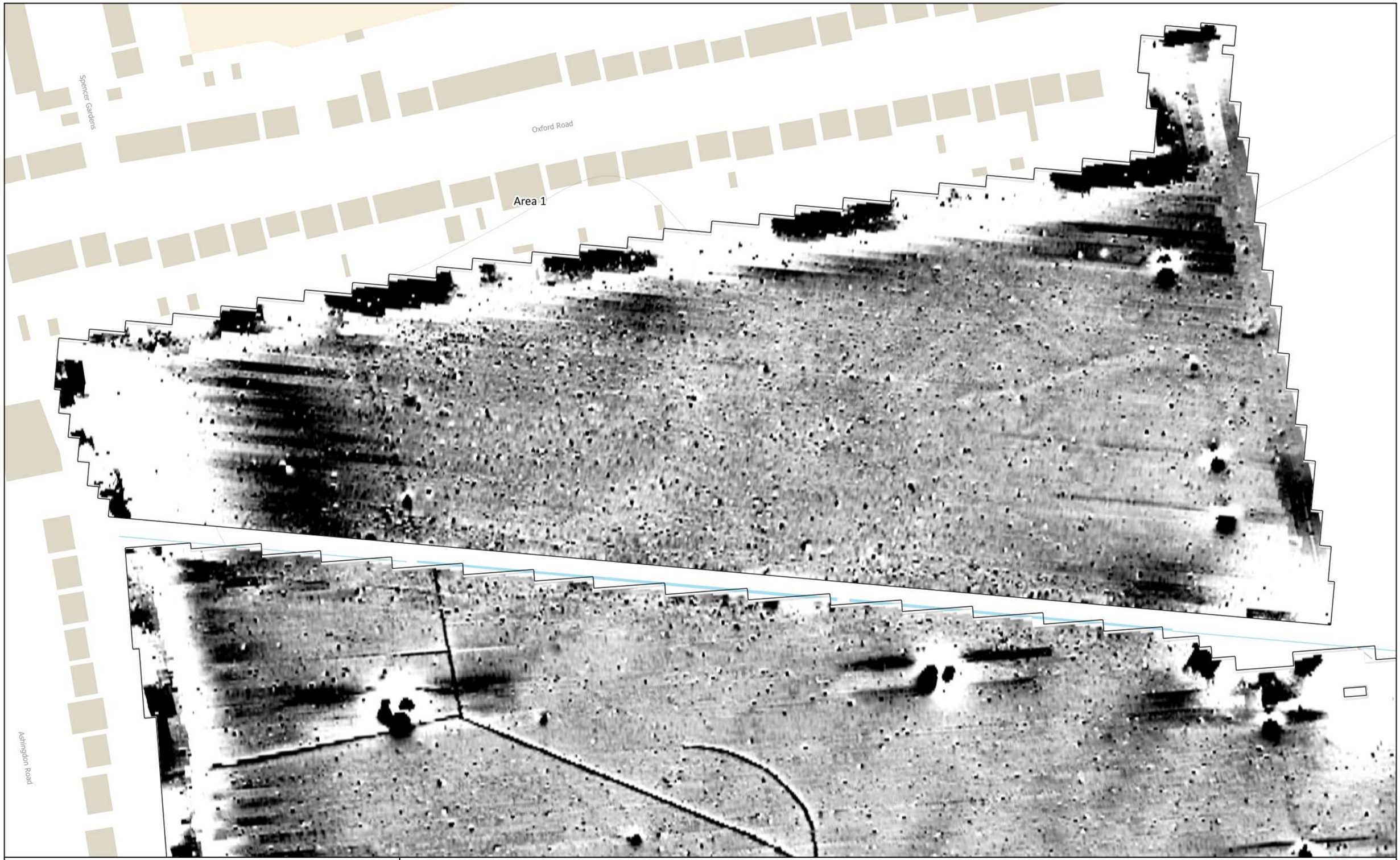
MSTQ733 - Land East of Ashingdon Road, Rochford
Figure 6 - Magnetic Interpretation Over Historic maps and Satellite Imagery
1:3,000 @ A3

Contains historic maps: Ordnance Survey, 6" 2nd edition c.1882-1913 © National Library of Scotland
Contains Satellite Imagery © 2020 Bing Satellite

Agricultural (Weak)
Natural (Weak)
Magnetic Disturbance
Ferrous/Debris (Spread)
Undetermined (Weak)
Agricultural (Trend)
Service
Drainage Feature
Ferrous (Point)

N
0 50 100 150 m

magnitude surveys



MSTQ733 - Land East of Ashingdon Road, Rochford
Figure 7 - Magnetic Total Field (Lower Sensor)
1:1,500 @ A3

48,997 nT 49,005

N

0 50 100 150 m

magnitude surveys

Spencer Gardens

Oxford Road

Area 1

Ashingdon Road

MSTQ733 - Land East of Ashingdon Road, Rochford
Figure 8 - Magnetic Gradient North
1:1,500 @ A3

-1 nT 2

N

0 50 100 150 m

magnitude surveys

Spencer Gardens

Oxford Road

Area 1

1c

1a

1b

1b

2c

Ashingdon Road

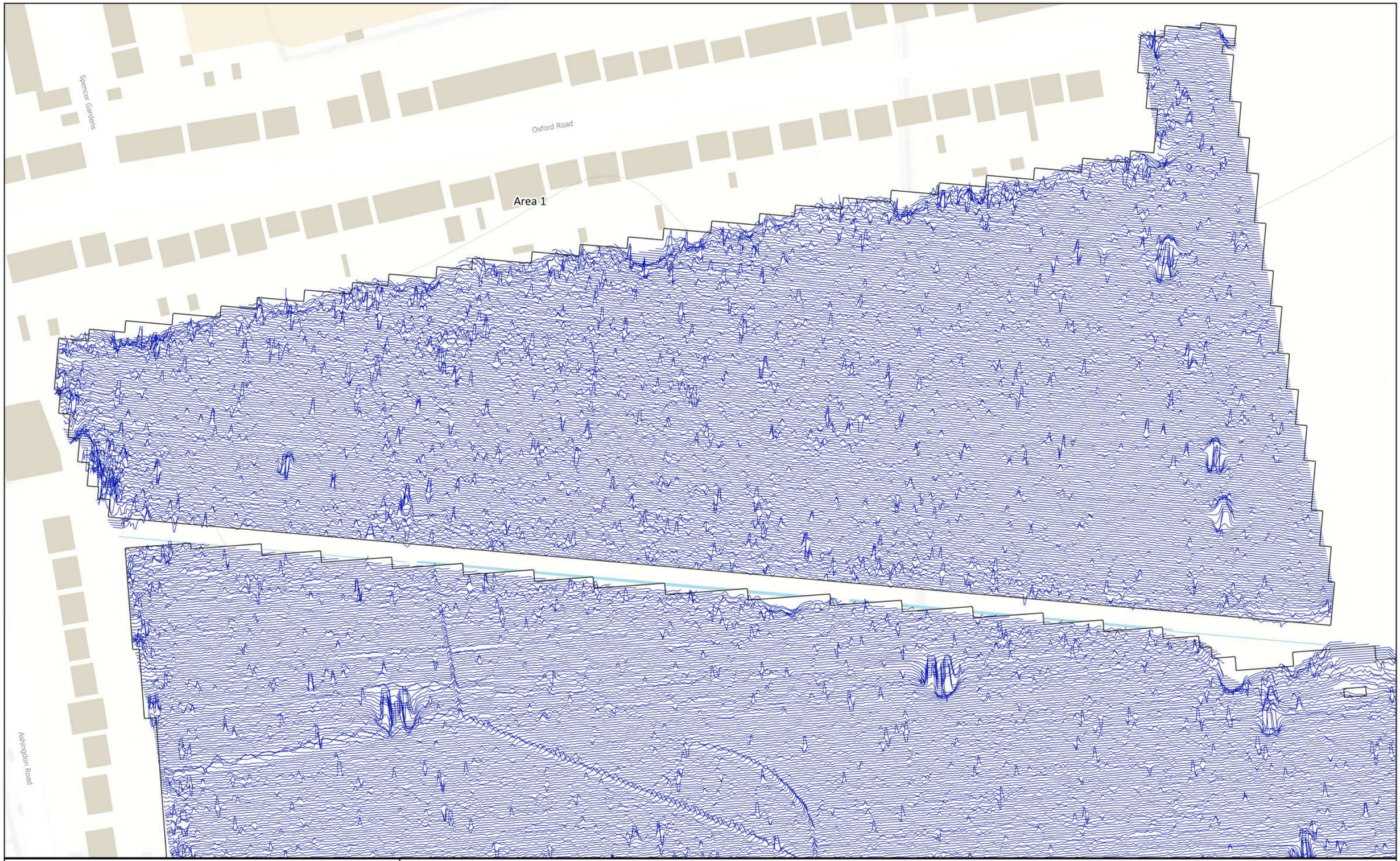
MSTQ733 - Land East of Ashingdon Road, Rochford
Figure 9 - Magnetic Interpretation (North)
1:1,500 @ A3

- Agricultural (Weak)
- Natural (Weak)
- Magnetic Disturbance
- Ferrous/Debris (Spread)
- Undetermined (Weak)
- Agricultural (Trend)
- Service
- Drainage Feature
- Ferrous (Point)

N

0 50 100 150 m

magnitude surveys



MSTQ733 - Land East of Ashingdon Road, Rochford
Figure 10 - XY Trace Plot (North)
30nT/cm at 1:1,500 @ A3

N

0 50 100 150 m

magnitude surveys

Area 2

Percy Cottis Road

Rochford Garden Way

The Drive

MSTQ733 - Land East of Ashingdon Road, Rochford
Figure 11 - Magnetic Total Field (Lower Sensor)
1:1,500 @ A3

48,997 nT 49,005

N

0 50 100 150 m

magnitude surveys

Area 2

Percy Cottis Road

Rochford Garden Way

The Drive

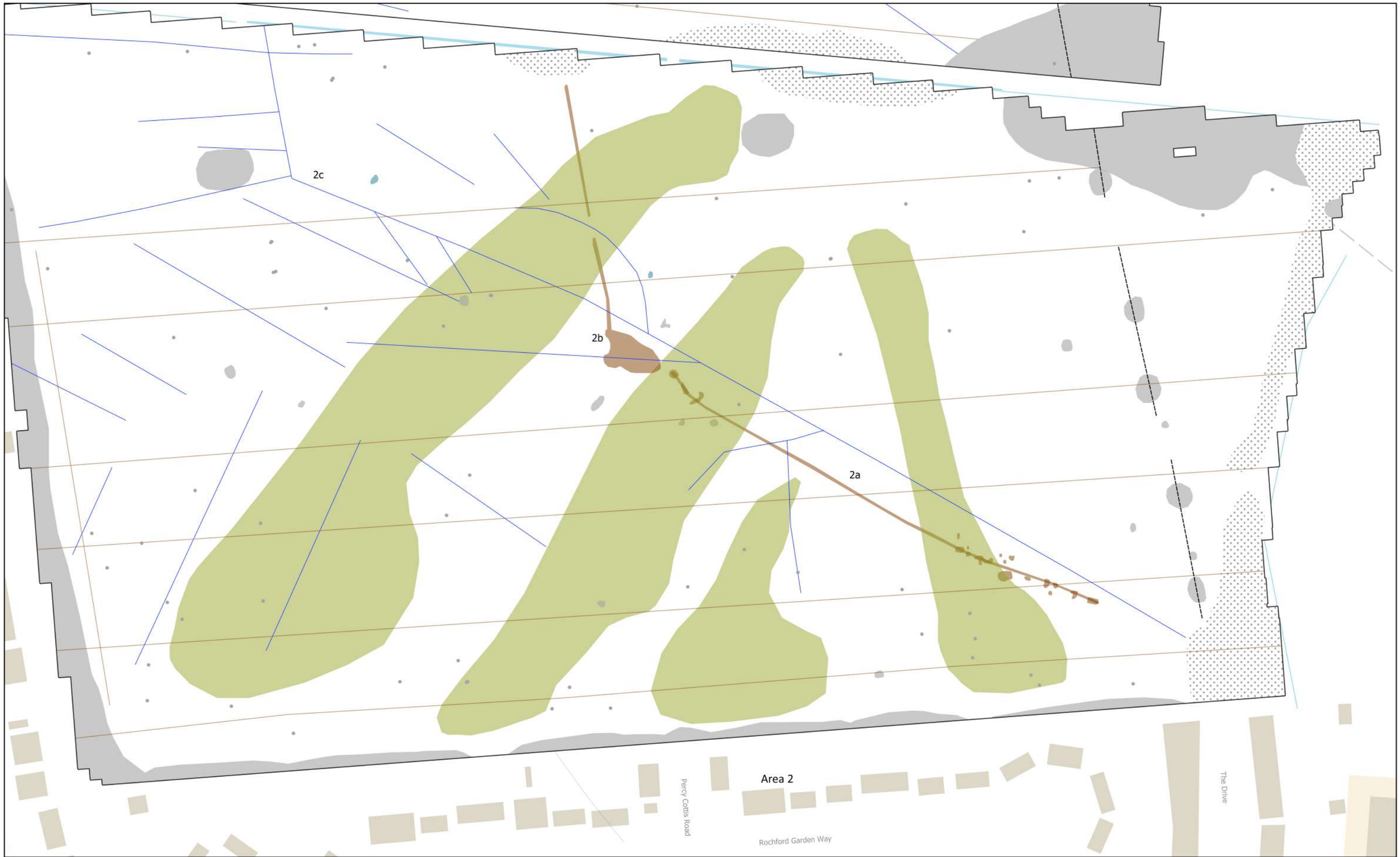
MSTQ733 - Land East of Ashingdon Road, Rochford
Figure 12 - Magnetic Gradient North
1:1,500 @ A3

-1 nT 2

N

0 50 100 150 m

magnitude surveys



MSTQ733 - Land East of Ashingdon Road, Rochford
Figure 13 - Magnetic Interpretation (South)
1:1,500 @ A3

- Agricultural (Weak)
- Natural (Weak)
- Magnetic Disturbance
- Ferrous/Debris (Spread)
- Undetermined (Weak)
- Agricultural (Trend)
- Service
- Drainage Feature
- Ferrous (Point)

N

0 50 100 150 m

magnitude surveys

Area 2

Percy Cottis Road

Rochford Garden Way

The Drive

MSTQ733 - Land East of Ashingdon Road, Rochford
Figure 14 - XY Trace Plot (South)
30nT/cm at 1:1,500 @ A3

N

0 50 100 150 m

magnitude surveys

MAKING
COMPLEX
EASY

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