

APPENDIX 7.2

GEOPHYSICAL SURVEY



**magnitude
surveys**

**Geophysical Survey Report
of
Land North of Tollerton,
Nottinghamshire**

**For
Pegasus Group**

**On Behalf of
Vistry Home Ltd**

Magnitude Surveys Ref: MSSK1538A

June 2023



**magnitude
surveys**

3 Captain Street

Bradford

BD1 4HA

01274 926020

info@magnitudesurveys.co.uk

Report By:

Aidan Palmer MESci, Bethan Healey BSc MSc

David Taylor BA(Hons) MSc ACIfA

Report Approved By:

Finnegan Pope-Carter BSc (Hons) MSc FGS

Issue Date:

16 June 2023

Abstract

Magnitude Surveys were commissioned to assess the subsurface archaeological potential of c.53.8 of Land North of Tollerton, Nottinghamshire. A fluxgate gradiometer was successfully completed across the most of the survey area, with c.2.5ha unable to be surveyed due to waterlogged ground conditions, fences, and structures related to Nottingham City Airport. The geophysical results primarily reflect the use of the site as a former World War II airfield, RAF Tollerton, and as a current commercial airport. Anomalies associated with former structures of the airfield have been identified. Modern interference related to the current airfield has been detected, and may be obscuring any potential anomalies in proximity, if present. Additionally, anomalies of agricultural and undetermined origin have been identified. Former mapped field boundaries have been detected across the survey area, as well as ridge and furrow cultivation and modern ploughing regimes. Anomalies classified as 'Undetermined' have been detected and whilst these are most likely a result of natural processes, agricultural or modern activities, an archaeological origin cannot be ruled out.

Contents

Abstract.....	2
List of Figures	4
1. Introduction	6
2. Quality Assurance	6
3. Objectives.....	6
4. Geographic Background.....	7
5. Archaeological Background.....	9
6. Methodology.....	10
6.1. Data Collection.....	10
6.2. Data Processing.....	10
6.3. Data Visualisation and Interpretation.....	11
7. Results.....	11
7.1. Qualification.....	11
7.2. Discussion.....	12
7.3. Interpretation.....	13
7.3.1. General Statements	13
7.3.2. Magnetic Results - Specific Anomalies.....	13
8. Conclusions	14
9. Archiving	16
10. Copyright.....	16
11. References	16
12. Project Metadata	17
13. Document History	17

List of Figures

Figure 1:	Site Location	1:25,000 @ A4
Figure 2:	Location of Survey Areas	1:10,000 @ A3
Figure 3:	Total Field (Overview (West))	1:3,000 @ A3
Figure 4:	Magnetic Interpretation Over Combined Historical Maps and Satellite Imagery (Overview (West))	1:3,000 @ A3
Figure 5:	Total Field (Overview (East))	1:3,000 @ A3
Figure 6:	Magnetic Interpretation Over Combined Historical Maps and Satellite Imagery (Overview (East))	1:3,000 @ A3
Figure 7:	Magnetic Gradient (Areas 5, 6 and 11)	1:1,500 @ A3
Figure 8:	Magnetic Interpretation (Areas 5, 6 and 11)	1:1,500 @ A3
Figure 9:	XY Trace Plot (Areas 5, 6 and 11)	1:1,500 @ A3
Figure 10:	Magnetic Gradient (Areas 6, 7, and 8)	1:1,500 @ A3
Figure 11:	Magnetic Interpretation (Areas 6, 7, and 8)	1:1,500 @ A3
Figure 12:	XY Trace Plot (Areas 6, 7, and 8)	1:1,500 @ A3
Figure 13:	Magnetic Gradient (Areas 7, 8, 9, 10, and 14)	1:1,500 @ A3
Figure 14:	Magnetic Interpretation (Areas 7, 8, 9, 10, and 14)	1:1,500 @ A3
Figure 15:	XY Trace Plot (Areas 7, 8, 9, 10, and 14)	1:1,500 @ A3
Figure 16:	Magnetic Gradient (Areas 1, 2, 4, 5, 6, and 11)	1:1,500 @ A3
Figure 17:	Magnetic Interpretation (Areas 1, 2, 4, 5, 6, and 11)	1:1,500 @ A3
Figure 18:	XY Trace Plot (Areas 1, 2, 4, 5, 6, and 11)	1:1,500 @ A3
Figure 19:	Magnetic Gradient (Areas 2, 3, and 4)	1:1,500 @ A3
Figure 20:	Magnetic Interpretation (Areas 2, 3, and 4)	1:1,500 @ A3
Figure 21:	XY Trace Plot (Areas 2, 3, and 4)	1:1,500 @ A3
Figure 22:	Magnetic Gradient (Areas 3, 10, 14, and 15)	1:1,500 @ A3
Figure 23:	Magnetic Interpretation (Areas 3, 10, 14, and 15)	1:1,500 @ A3
Figure 24:	XY Trace Plot (Areas 3, 10, 14, and 15)	1:1,500 @ A3

Figure 25:	Magnetic Gradient (Areas 3, 13, 14, 15 and 16)	1:1,500 @ A3
Figure 26:	Magnetic Interpretation (Areas 3, 13, 14, 15 and 16)	1:1,500 @ A3
Figure 27:	XY Trace Plot (Areas 3, 13, 14, 15 and 16)	1:1,500 @ A3
Figure 28:	Magnetic Gradient (Areas 3, 4, 13 and 16)	1:1,500 @ A3
Figure 29:	Magnetic Interpretation (Areas 3, 4, 13 and 16)	1:1,500 @ A3
Figure 30:	XY Trace Plot (Areas 3, 4, 13 and 16)	1:1,500 @ A3



1. Introduction

- 1.1. Magnitude Surveys Ltd (MS) was commissioned by Pegasus Group in behalf of Vistry Home Ltd to undertake a geophysical survey over a c. 53.8ha area of land at Nottingham City Airport, north of Tollerton, Nottinghamshire (SK 62158 36024).
- 1.2. The geophysical survey comprised quad-towed and hand-carried GNSS-positioned fluxgate gradiometer survey. Magnetic survey is the standard primary geophysical method for archaeological applications in the UK due to 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 featured buildings (SFBs) 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, 2020) and the European Archaeological Council (Schmidt *et al.*, 2015).
- 1.4. It was conducted in line with a WSI produced by MS (Dyulgerski, 2023).
- 1.5. The survey commenced on 03/04/2023 and took 8 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 for Archaeological Prospection).
- 2.2. The directors of MS are involved in cutting edge 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 Paul Johnson has a PhD in archaeology from the University of Southampton, is a Fellow of the Society of Antiquaries of London and a Member of CifA, 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, field and office staff have degree qualifications relevant to archaeology or geophysics and/or field experience.

3. Objectives

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

4. Geographic Background

4.1. The survey area was located c. 2.4km north of Tollerton (Figure 1). Gradiometer survey was undertaken across multiple grassland fields of an active airport and fields under arable cultivation. The survey area was bordered to the west by Tollerton Lane and to the north, east, and south by arable and pasture fields (Figure 2). c. 2.5ha of land was unable to be surveyed due to fences, structures related to the airport, waterlogged ground conditions and overgrown vegetation.

4.2. Survey considerations:

Survey Area	Ground Conditions	Further Notes
1	The survey area consisted of flat grassland .	The survey area was bordered to the south by metal poles, and to the west, north, and east there was no physical boundary. Running along the west and north boundary were airport runways. Airfield equipment was present in the west and northeast of the area.
2	The survey area consisted of flat grassland.	The survey area was bordered to the north by metal poles, and to the west, south, and east there was no physical boundary. Running along the west and south boundary were airport runways. Airfield equipment was present in the east of the area.
3	The survey area consisted of flat grassland.	The survey area was bordered to the south by trees and hedgerow, to the northwest and northeast there was no physical boundary. Running along the northwest and northeast boundary were airport runways.
4	The survey area consisted of a flat mainly arable field with an area of grassland in the northern quarter.	The survey area was bordered to the east by trees, to the south by a ditch and to the west and north there was no physical boundary. Three large grassland areas were present in the centre of the survey area and were former aircraft parking spaces. Two pillbox bunkers were also present in the centre and northeast of the area.
5	The survey area consisted of flat grassland.	The survey area was bordered to the north by trees, to the west by metal poles, and to the east and south there was no physical boundary. Running along the east and south boundary were airport runways.
6	The survey area consisted of flat grassland.	The survey area was bordered to the north by a raised bank, to the east by metal poles, and to the west and south there was no physical boundary.
7	The survey area consisted of flat grassland .	The survey area was bordered to the north by a raised bank, to the west, south, and east there was no physical boundary.
8	The survey area consisted of flat grassland .	The survey area was bordered to the west by trees, to the southwest by metal fencing, and to

		the north, east, and south there was no physical boundary. In the southeast of the survey area there were planes and various airfield machinery. Running along the north, east and south of the boundary were airport runways. Running through the west of the area was a taxiway.
9	The survey area consisted of flat grassland.	The survey area was bordered to the west by metal fencing, to the south by wooden fencing and to the northeast there was no physical boundary. Running along the northeast boundary was an airport runway.
10	The survey area consisted of flat grassland.	The survey area was bordered to the north and west by wooden fencing, and to the southeast there was no physical boundary. In the north of the survey area was a pillbox bunker, and in the centre of the area was a war memorial. Running along the east boundary was airport parking.
11	The survey area consisted of flat grassland.	The survey area was bordered to the east by trees, and to the north, west, and south there was no physical boundary.
12	The survey area consisted of flat grassland .	The survey area was bordered on all sides by trees, for small sections to the west and southeast there was no physical boundary. A section to the southeast was unable to be surveyed due to boggy ground conditions.
13	The survey area consisted of overgrown flat grassland.	The survey area was bordered to the north by a drainage ditch, to the southeast by trees, and to the southwest there was no physical boundary.
14	The survey area consisted of flat grassland .	The survey area was bordered to the west by a security fence, and on all other sides there was no physical boundary. Running through the centre and along the eastern border of the survey area were airport runways. A section in the south of the survey area was unable to be surveyed due to parked aircraft.
15	The survey area consisted of an arable field that gently sloped downwards to the south.	The survey area was bordered to the west and south by roads, to the east by a drainage ditch. To the north was metal fencing, past which a large area was unable to be surveyed due to overgrown vegetation.
16	The survey area consisted of a flat arable field sloping gently southward.	The survey area was bordered to the west and south by a drainage ditch, to the northeast by intermittent vegetation, and to the northwest and east there was no physical boundary. The fields were divided by trackways.

- 4.3. The underlying geology comprises Mudstone of the Branscombe Mudstone Formation across the east of the survey area, to the west the underlying geology comprises Sandstone of the Arden Sandstone Formation. The superficial deposits comprises Lacustrine Clay, Silt, and Sand deposits near the eastern boundary of the survey area, a small band of Diamicton is also present

in the north of the survey area covering parts of areas 5, 6, 11, and 12. The rest of the survey area no superficial deposits are present (British Geological Survey, 2023).

- 4.4. The soils consist of slightly acid loamy and clayey soils with impeded drainage across most of the survey area, A thin band of loamy and clayey floodplain soils with naturally high groundwater runs along the eastern survey area boundary (Soilscales, 2023).

5. Archaeological Background

- 5.1. An archaeology and built heritage assessment of the survey area was conducted in 2023 by Pegasus Group (Pegasus, 2023).
- 5.2. No prehistoric or Romano-British activity is recorded within the survey area.
- 5.3. A possible Neolithic long barrow is recorded c.810m north of the survey area (MNT17289). The possible barrow site has been inferred from cropmarks, identified on historical aerial photographs.
- 5.4. An undated enclosure, tentatively interpreted as a possible prehistoric settlement site, has been identified via cropmarks, c.435m west-south-west of the survey area (MNT787). Two intersecting linear features of uncertain nature or date are recorded to the south of the enclosure (MNT788).
- 5.5. No early medieval or medieval archaeological features are recorded within the survey area.
- 5.6. A possible moated manor site is recorded at Tollerton, c.185m south of the survey area (MNT13025). A rectangular enclosure, representing a probable moat, with overflow channel, has been identified on aerial photographs (MNT789), and it is recorded that earthworks were present before being levelled by a farmer in the 1950s/60s. A possible medieval trackway and drainage system have also been identified within the area (MNT9147) (Pegasus, 2023).
- 5.7. Ridge and furrow is identified as being visible on aerial photographs, adjacent to the eastern boundary of the possible moated site. An area of further ridge and furrow is recorded c.140m west (MNT1118). Possible building platforms are recorded at the south-eastern extent of this area of ridge and furrow (MNT1117).
- 5.8. The possible site of the medieval St James' Chapel is recorded at Bassingfield, c.880m north of the survey area (MNT13005, and MNT757). The chapel is recorded in documentary sources, and its location is inferred from field name evidence, with 'Chapel Yard' being recorded at the identified location. However, no evidence relating to the site or chapel has been found during field investigation, so its recorded location remains tentative.
- 5.9. Three further areas of undated but potentially medieval ridge and furrow are recorded in the wider vicinity of the site (refs. MNT7574, MNT7569, and MNT7568).
- 5.10. No post-medieval archaeological remains are recorded within the survey area.
- 5.11. Historical map regression demonstrates that the survey area was in use as agricultural land until the 1930's, at which point a grass civilian aerodrome was founded on the land. In 1938 this was turned into a Royal Air Force training school. During the Second World War, the airfield was

upgraded with three metalled runways, hangars, barracks, stores and training buildings. A set of pillbox defences which surrounded the airfield were also built during this period, six of these are situated within the survey area (Pegasus, 2023).

- 5.12. In 1956, the airfield returned to private use, and by the end of the 20th century, many of the military buildings had been decommissioned (Pegasus, 2023).

6. Methodology

6.1. Data Collection

6.1.1. 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.

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

6.1.3. 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

6.1.4. The magnetic data were collected using MS' bespoke quad-towed cart system and hand-carried GNSS-positioned system.

6.1.4.1. MS' cart and hand-carried 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.

6.1.4.2. 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.

6.1.4.3. 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.

6.2. Data Processing

6.2.1. Magnetic data were processed in bespoke in-house software produced by MS. Processing steps conform to the EAC and Historic England guidelines for 'minimally

enhanced data' (see Section 3.8 in Schmidt *et al.*, 2015: 33 and Section IV.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.

6.3. Data Visualisation and Interpretation

- 6.3.1. This report presents the gradient of the sensors' total field data as greyscale images, as well as the total field data from the 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 (Figure 9, 12, 15, 18, 21, 24, 27, and 30). XY trace plots visualise the magnitude and form of the geophysical response, aiding anomaly interpretation.
- 6.3.2. Geophysical results have been interpreted using greyscale images and XY traces in a layered environment, overlaid against open street maps, satellite imagery, historical maps, LiDAR data, and soil and geology maps. Google Earth (2023) was also consulted, to compare the results with recent land use.
- 6.3.3. 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 from further work, in order to constantly improve our knowledge and service.

7.2. Discussion

- 7.2.1. The geophysical results are presented in combination with satellite imagery and historical maps (Figures 4 and 6).
- 7.2.2. The fluxgate gradiometer survey has responded well to the environment of the survey area. Magnetic disturbance from modern activity, primarily from the sites current use as an airport, may have obscured weaker, more ephemeral anomalies, if present. The geophysical survey has primarily detected anomalies of agricultural, modern, and undetermined origins.
- 7.2.3. Modern activity has been identified across the survey area, which reflect the former use of the site as a WW2 RAF airfield, and Nottingham aerodrome. In Area 4, 14 and 16, large spreads of magnetically enhanced material correspond with former runway structures and pillboxes visible on historical OS mapping (Figures 4 & 6). In Area 14, a rectilinear dipolar anomaly and in Area 8 a curvilinear anomaly have been identified (Figures 14 and 23). These are of anthropogenic origin and interpreted as an unmapped former building or structure related to the airbase. In Area 11 a spread of magnetically enhanced material forms a rectilinear band (Figure 8). This does not correspond to any mapped features, but the size and morphology and similar response to mapped features indicates this is likely related to airfield structures.
- 7.2.4. Evidence of agricultural activity has been identified throughout the survey area in the form of mapped field boundaries, which are visible on historical OS mapping (Figures 4 and 6). Weakly positive linear anomalies have also been identified across the survey area as ridge and furrow cultivation. These are regularly spaced and display multiple orientations and are visible in satellite imagery as cropmarks.
- 7.2.5. Several linear, curvilinear, and circular anomalies have been identified and classified as 'Undetermined' (Figures 8, 11, 14, 20, 23, 26, 29). These anomalies lack any distinctive morphology or corroborative evidence to make a more confident interpretation.
- 7.2.6. In Area 8 a series of discrete anomalies orientated in a linear arrangement have been detected. The anomalies have a magnetic signal indicative of pit-like features with magnetically enhanced fill. Due to the linear alignment, a possible pit alignment interpretation is possible. However due to its location, next the airfields perimeter a modern origin is also likely.

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 dipolar anomalies are likely to be the result of isolated pieces of modern ferrous debris on or near the ground surface.
- 7.3.1.3. **Ferrous/Debris (Spread)** – A ferrous/debris spread refers to a concentration of multiple discrete, dipolar anomalies usually resulting from highly magnetic material such as rubble containing ceramic building materials and ferrous rubbish.
- 7.3.1.4. **Magnetic Disturbance** – The strong anomalies produced by extant metallic structures, typically including fencing, pylons, vehicles and service pipes, have been classified as ‘Magnetic Disturbance’. These magnetic ‘haloes’ will obscure weaker anomalies relating to nearby features, should they be present, often over a greater footprint than the structure causing them.
- 7.3.1.5. **Undetermined** – Anomalies are classified as Undetermined when the origin of the geophysical anomaly is ambiguous and there is no supporting contextual evidence to justify 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 distinct from those caused by ferrous sources.

7.3.2. Magnetic Results - Specific Anomalies

- 7.3.2.1. **Modern** – Multiple anomalies that vary in both size and signal have been identified and classified as ‘Modern’, where they correspond with former airport structures visible on historical OS mapping (Figures 4, 6, 8, 14, 17, 20, 23, 26). Anomalies identified correlate with runways, roads, and possible buildings or hangars. These features typically have a strong dipolar signal which could potentially mask weaker anomalies of anthropological origin, if present. On the eastern side of the area three distinct keyhole shaped anomalies have been detected. They measure c.70m in length each and culminate in a spherical anomaly c. 40m in diameter [4a, 4b, and 4c]. Also visible in satellite imagery these anomalies indicate the location of aircraft parking areas and would have been protected by “pill boxes” during the war, the remnants of one of which is still present [4b] (Figures 4, 6, 20, 29). Strong annular and rectilinear anomalies [8b and 14a] have been detected and interpreted as being anthropogenic in origin due to their rectilinear morphology, and strong dipolar magnetic signal. These anomalies are most likely relate to unmapped former airfield buildings or features that have since been demolished (Figures 14 and 23). A rectilinear band of highly ferrous material [11a] has been detected (Figure 8). This reflects the response seen in relation to former mapped runways in other areas of the

site, and its morphology suggests an anthropogenic origin. As such, this has been interpreted as a demolished former airfield structure.

7.3.2.2. Agricultural (Strong, Weak, and Spread) – Across the survey area, multiple linear and curvilinear anomalies have been identified (Figures 8, 11, 14, 17, 20, 23, 26) which correspond with former field boundaries visible on historical OS mapping, pre-dating the airfield. Some of these anomalies, such as in Area 5 and 6 are apparent as spreads of strongly enhanced material, where the material of dismantled boundaries may have been ploughed out or scattered (Figures 7, 8, 10 & 11).

7.3.2.3. Agricultural (Trend) – In Area 6, a series of weak linear anomalies, oriented northeast to southwest, have been identified (Figures 8 & 11). These correlate with modern ploughing regimes visible on satellite imagery (Figure 6).

7.3.2.4. Ridge and Furrow (Trend) – Weak linear anomalies have been identified throughout most of the survey area, which are most prominent in the Total Field data (Figures 3 & 5). These anomalies are consistent with ridge and furrow cultivation, and are spaced around 7-9m apart. They have multiple orientations, predominantly northwest to southeast and northeast to southwest, with some regimes cross-cutting. These are also visible in satellite data as cropmarks (Figures 4 & 6).

7.3.2.5. Undetermined (Weak) – Multiple linear and curvilinear anomalies have been identified across the survey area and have been classified as 'Undetermined' (Figures 8, 11, 14, 20, 23, 26, 29). These anomalies vary in size and orientation and do not correspond to any features visible on historical maps or satellite imagery. While they are likely of agricultural or modern origin, an archaeological interpretation cannot be ruled out. In Area 8, (Figure 14) a series of positive discrete anomalies orientated in a linear arrangement have been identified [8a]. These features could be a result of a deep service and their alignment with the current runway may suggest a modern origin. However, the individual morphology and regular linear proximity of the anomalies, together with the discrete response, may also suggest that they are part of a larger pit alignment – though these are uncommon and normally found in the south and south east of the United Kingdom. As the origin of these anomalies cannot be confidently interpreted without further corroboration, they have been categorised as 'Undetermined'.

8. Conclusions

8.1. A fluxgate gradiometer survey was successfully completed across the survey area. The geophysical survey has detected a range of different types of anomalies of agricultural, modern, and undetermined origins. Extensive modern and ferrous anomalies were present across the survey area that may have obscured weaker, more ephemeral features, if present.

8.2. Anomalies associated with the operational use of the airfield by the RAF during World War II and more recent civilian and commercial airport infrastructure have been identified across the

survey area. These correspond to historical cartographic evidence and satellite imagery and include possible former buildings.

- 8.3. Evidence of historical agricultural activity has been identified throughout the survey area in the form of former mapped field boundaries, in addition to linear trends likely relating to ridge and furrow and modern ploughing regimes.
- 8.4. Anomalies of an undetermined origin have been identified across the survey area. These are most likely of agricultural, natural, or modern origin; however, an archaeological origin cannot be ruled out.



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 any dictated time embargoes.

10. Copyright

- 10.1. Copyright and 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

British Geological Survey, 2023. Geology of Britain. Tollerton, Nottinghamshire.

[<http://mapapps.bgs.ac.uk/geologyofbritain/home.html/>]. Accessed 11/04/2023.

Chartered Institute for Archaeologists, 2020. Standards and guidance for archaeological geophysical survey. ClfA.

David, A., Linford, N., Linford, P. and Martin, L., 2008. Geophysical survey in archaeological field evaluation: research and professional services guidelines (2nd edition). Historic England.

Dyulgerski, K., 2023. Written Scheme of Investigation for a Geophysical Survey at Land North of Tollerton, Nottinghamshire.

Google Earth, 2023. Google Earth Pro V 7.1.7.2606.

Olsen, N., Toffner-Clausen, L., Sabaka, T.J., Brauer, P., Merayo, J.M.G., Jorgensen, J.L., Leger, J.M., Nielsen, O.V., Primdahl, F., and Risbo, T., 2003. Calibration of the Orsted vector magnetometer. Earth Planets Space 55: 11-18.

Schmidt, A. and Ernenwein, E., 2013. Guide to good practice: geophysical data in archaeology (2nd edition). Oxbow Books: Oxford.

Schmidt, A., Linford, P., Linford, N., David, A., Gaffney, C., Sarris, A. and Fassbinder, J., 2015. Guidelines for the use of geophysics in archaeology: questions to ask and points to consider. EAC Guidelines 2. European Archaeological Council: Belgium.

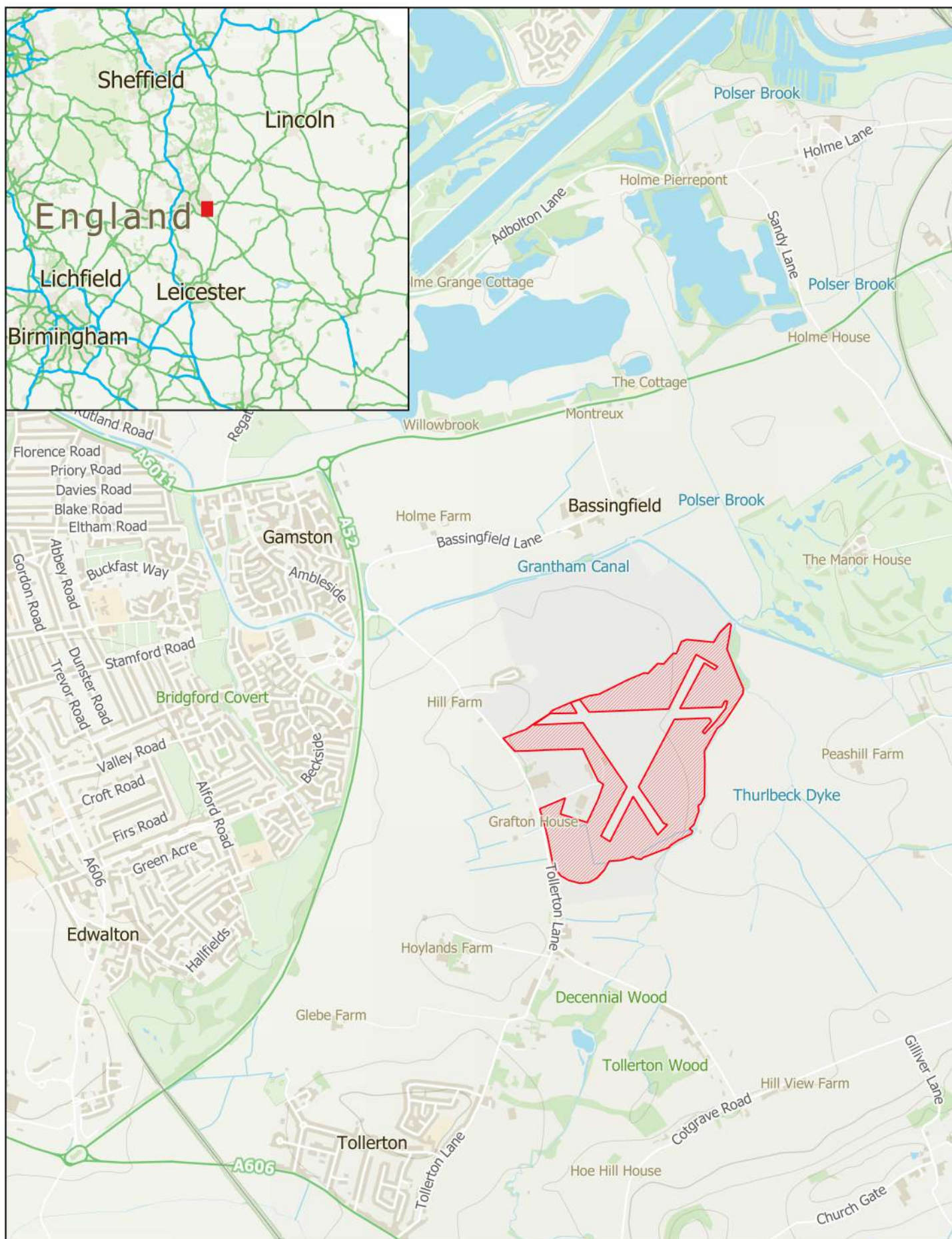
Soilscapes, 2023. Tollerton, Nottinghamshire. Cranfield University, National Soil Resources Institute. [<http://landis.org.uk>]. Accessed 11/04/2023.

12. Project Metadata

MS Job Code	MSSK1538
Project Name	Land North of Tollerton, Nottinghamshire
Client	Pegasus Group
Grid Reference	SK 62158 36024
Survey Techniques	Magnetometry
Survey Size (ha)	53.8ha (Magnetometry)
Survey Dates	03/04/2023 – 12/04/2023
Project Lead	Krasimir Dyulgerski BA MRes
Project Officer	Krasimir Dyulgerski BA MRes
HER Event No	TBC
OASIS No	N/A
S42 Licence No	N/A
Report Version	1.0

13. Document History

Version	Comments	Author	Checked By	Date
0.1	Initial draft for Project Lead to Review	AP	KD	20 April 2023
0.2	Corrections from Project Lead	BH	KD	25 April 2023
0.3	Corrections from Project Lead	DT	KD	29 April 2023
0.4	Report For Director Sign Off	MS	FPC	18 May 2023
0.5	Archaeological Background Added	SO	KD	09 June 2023
1.0	Issued as Final	KD	KD	16 June 2023



MSSK1538: Land North of Tollerton, Nottinghamshire

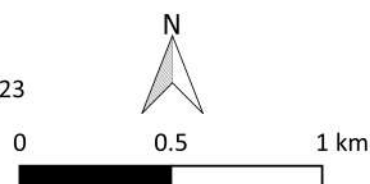
Figure 1 - Site Location

1:25,000 @ A4

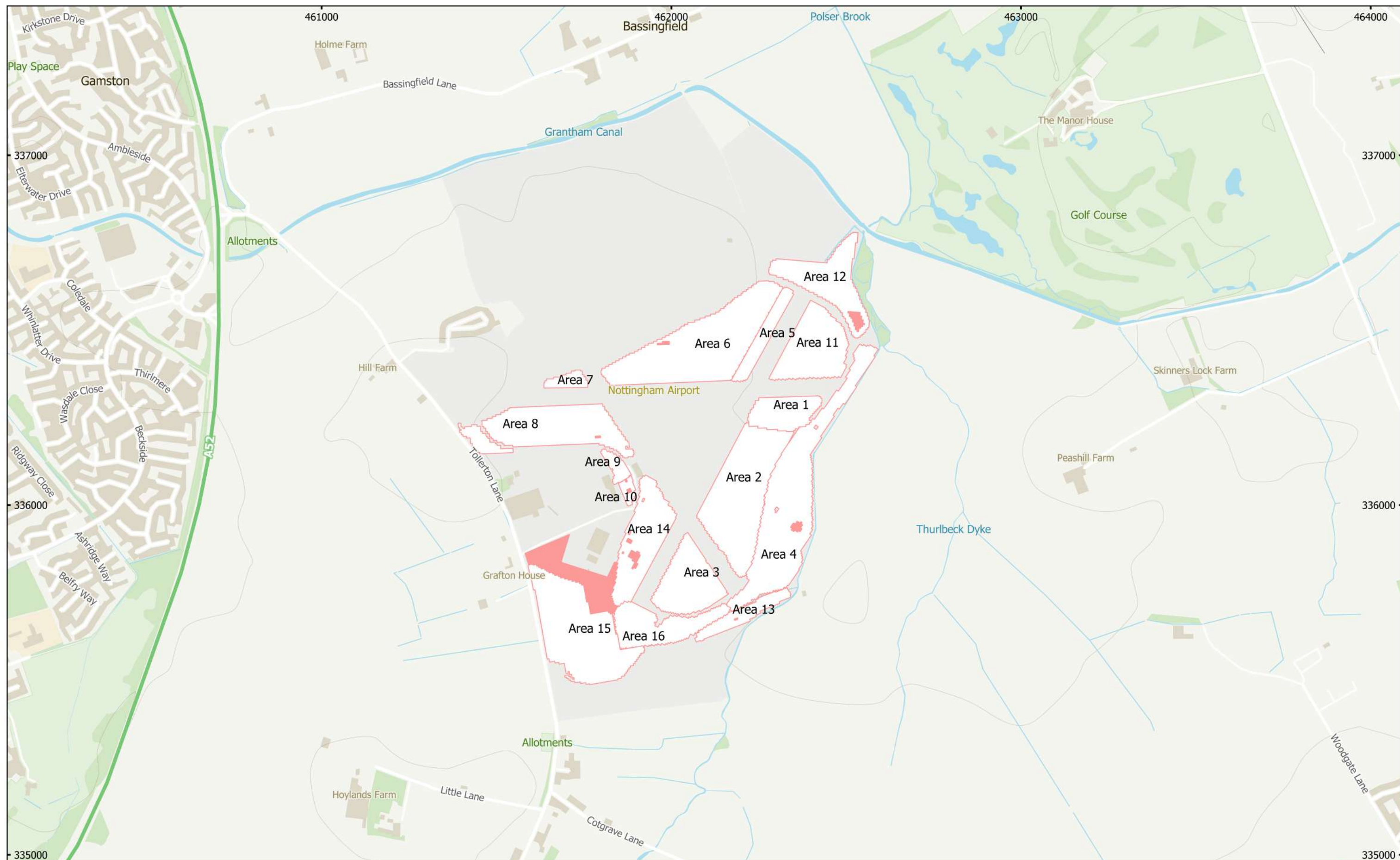
Copyright Magnitude Surveys Ltd 2023

Contains Ordnance Survey data © Crown Copyright and database right 2023

 Site Boundary

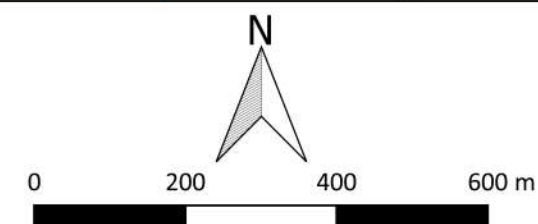


magnitude
surveys



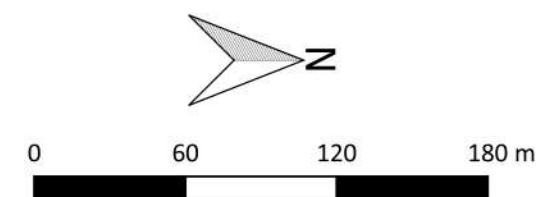
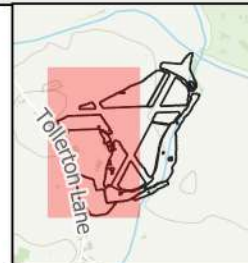
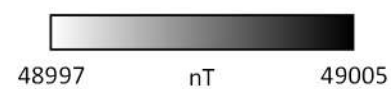
MSSK1538: Land North of Tollerton, Nottinghamshire
 Figure 2 - Location of Survey Areas
 1:10,000@ A3
 Copyright Magnitude Surveys Ltd 2023
 Contains Ordnance Survey data © Crown Copyright and database right 2023

- Survey Extent
- Unserved Areas





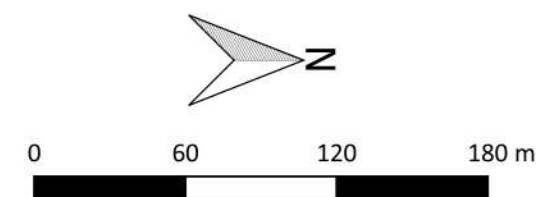
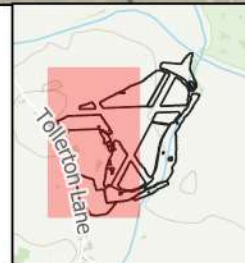
MSSK1538: Land North of Tollerton, Nottinghamshire
 Figure 3 - Total Field (Overview (West))
 1:3,000 @ A3
 Copyright Magnitude Surveys Ltd 2023
 Contains Ordnance Survey data © Crown Copyright and database right 2023





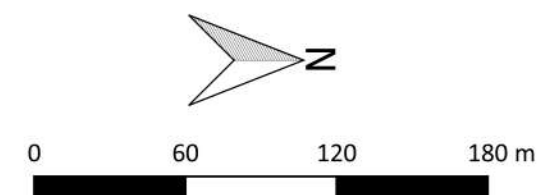
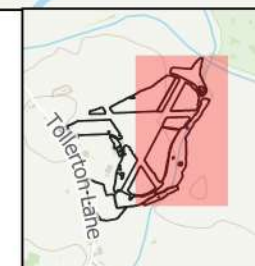
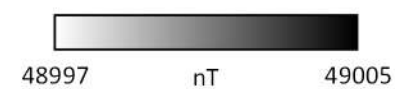
MSSK1538: Land North of Tollerton, Nottinghamshire
 Figure 4 - Magnetic Interpretation Over Combined Historical Maps and Satellite Imagery(Overview (West))
 1:3,000 @ A3
 Copyright Magnitude Surveys Ltd 2023
 Contains historical mapping © CLS Data 2023: Ordnance Survey, 6" 2nd edition c. 1882-1913
 Contains Satellite Imagery © 2023 Google Satellite

- | | | |
|-----------------------|----------------------------|--------------------------|
| Agricultural (Spread) | Ferrous/Debris (Spread) | Service |
| Agricultural (Strong) | Undetermined (Weak) | Ridge and Furrow (Trend) |
| Agricultural (Weak) | Industrial/Modern (Spread) | Drainage Feature |
| Magnetic Disturbance | Industrial/Modern | Ferrous (Spike) |



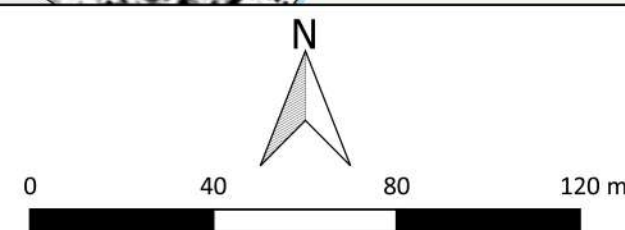
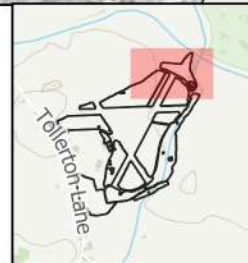
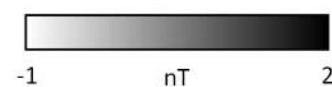


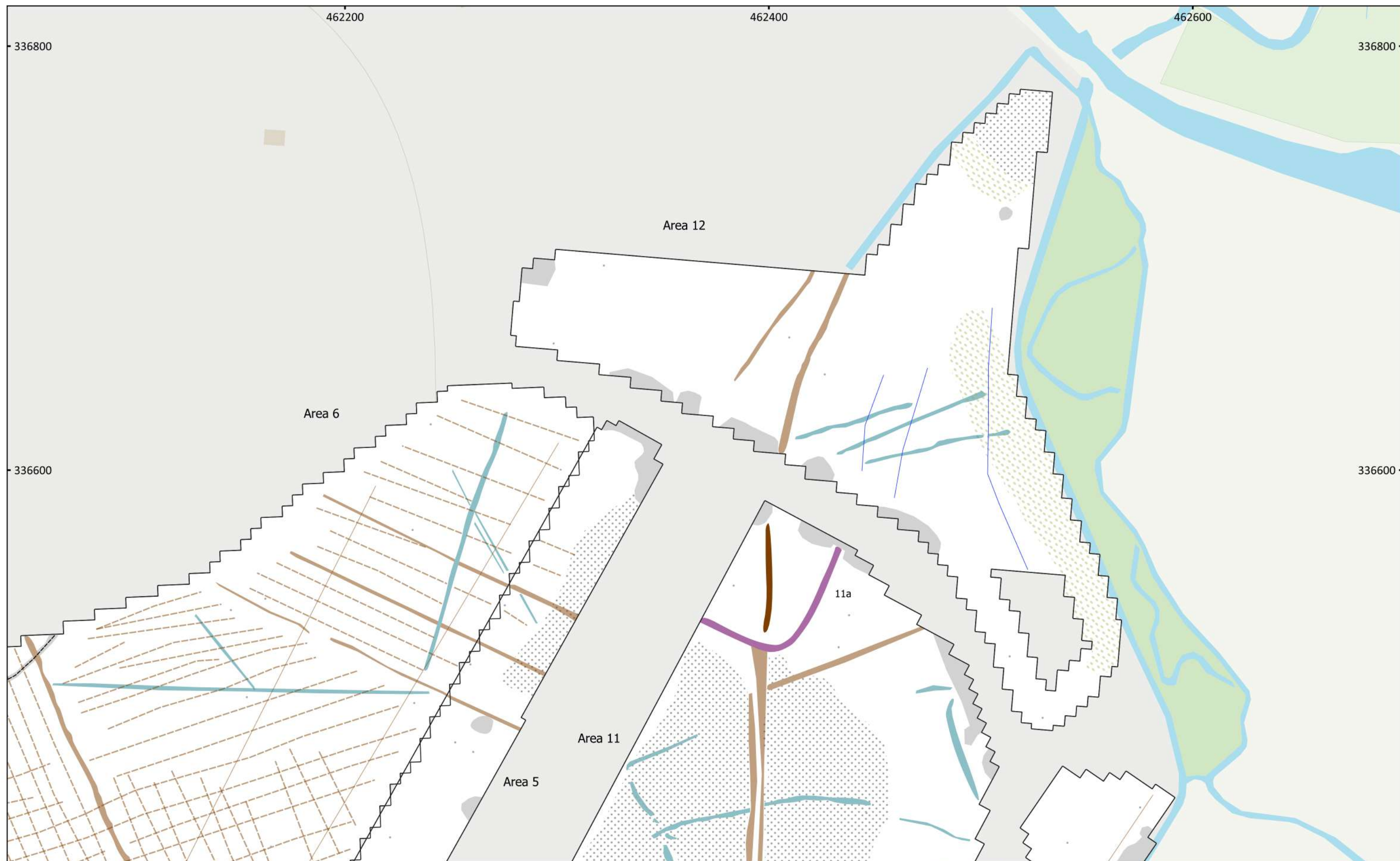
MSSK1538: Land North of Tollerton, Nottinghamshire
 Figure 5 - Total Field (Overview (East))
 1:3,000 @ A3
 Copyright Magnitude Surveys Ltd 2023
 Contains Ordnance Survey data © Crown Copyright and database right 2023





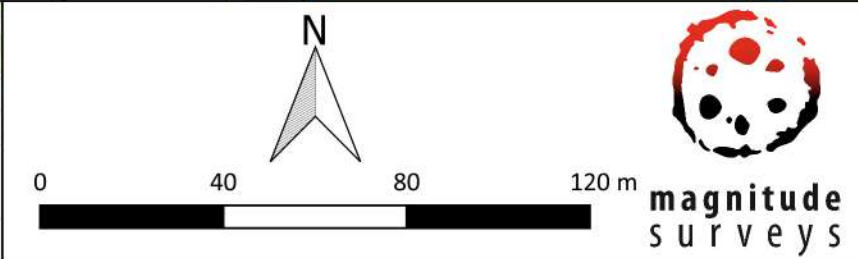
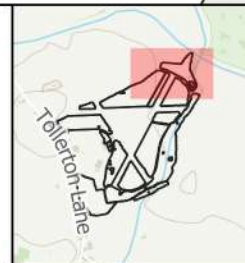
MSSK1538: Land North of Tollerton, Nottinghamshire
Figure 7 - Magnetic Gradient (Areas 5, 6, 11, and 12)
1:1,500 @ A3
Copyright Magnitude Surveys Ltd 2023
Contains Ordnance Survey data © Crown Copyright and database right 2023

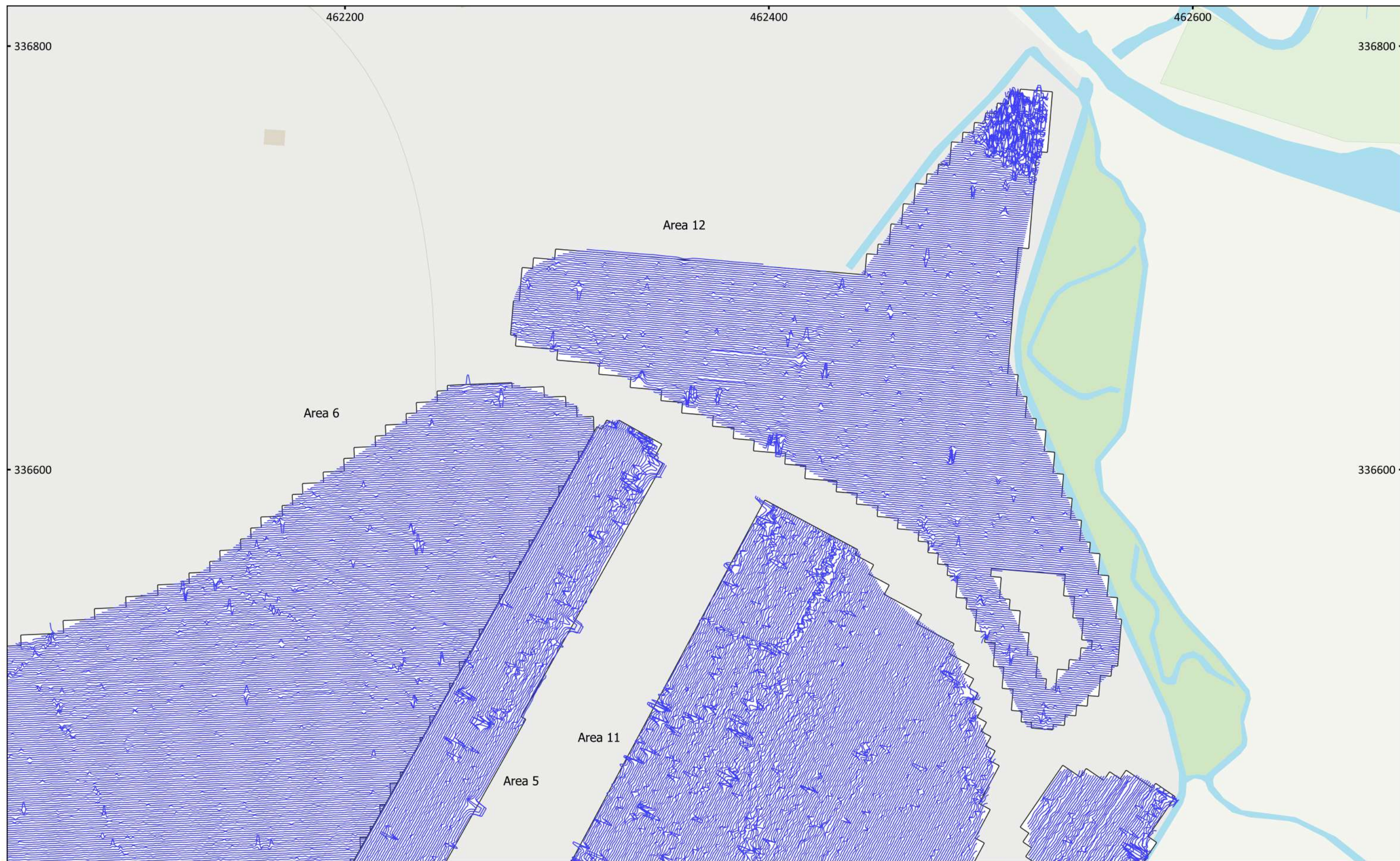




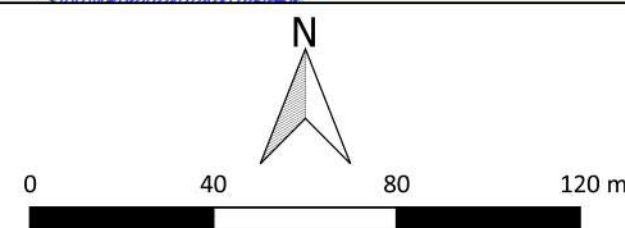
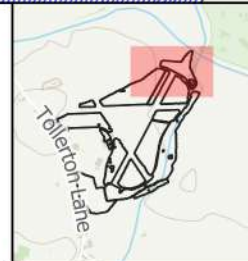
MSSK1538: Land North of Tollerton, Nottinghamshire
 Figure 8 - Magnetic Interpretation (Areas 5, 6, 11, and 12)
 1:1,500 @ A3
 Copyright Magnitude Surveys Ltd 2023
 Contains Ordnance Survey data © Crown Copyright and database right 2023

- | | | |
|-----------------------|----------------------------|--------------------------|
| Agricultural (Spread) | Ferrous/Debris (Spread) | Service |
| Agricultural (Strong) | Undetermined (Weak) | Ridge and Furrow (Trend) |
| Agricultural (Weak) | Industrial/Modern (Spread) | Drainage Feature |
| Magnetic Disturbance | Industrial/Modern | Ferrous (Spike) |



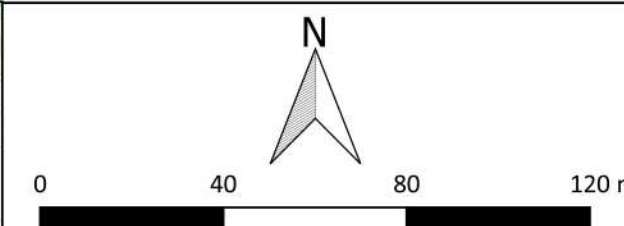
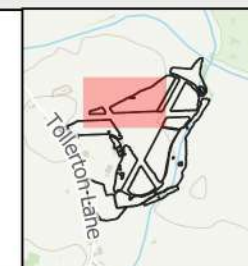
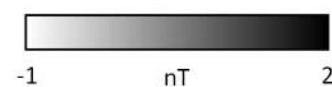


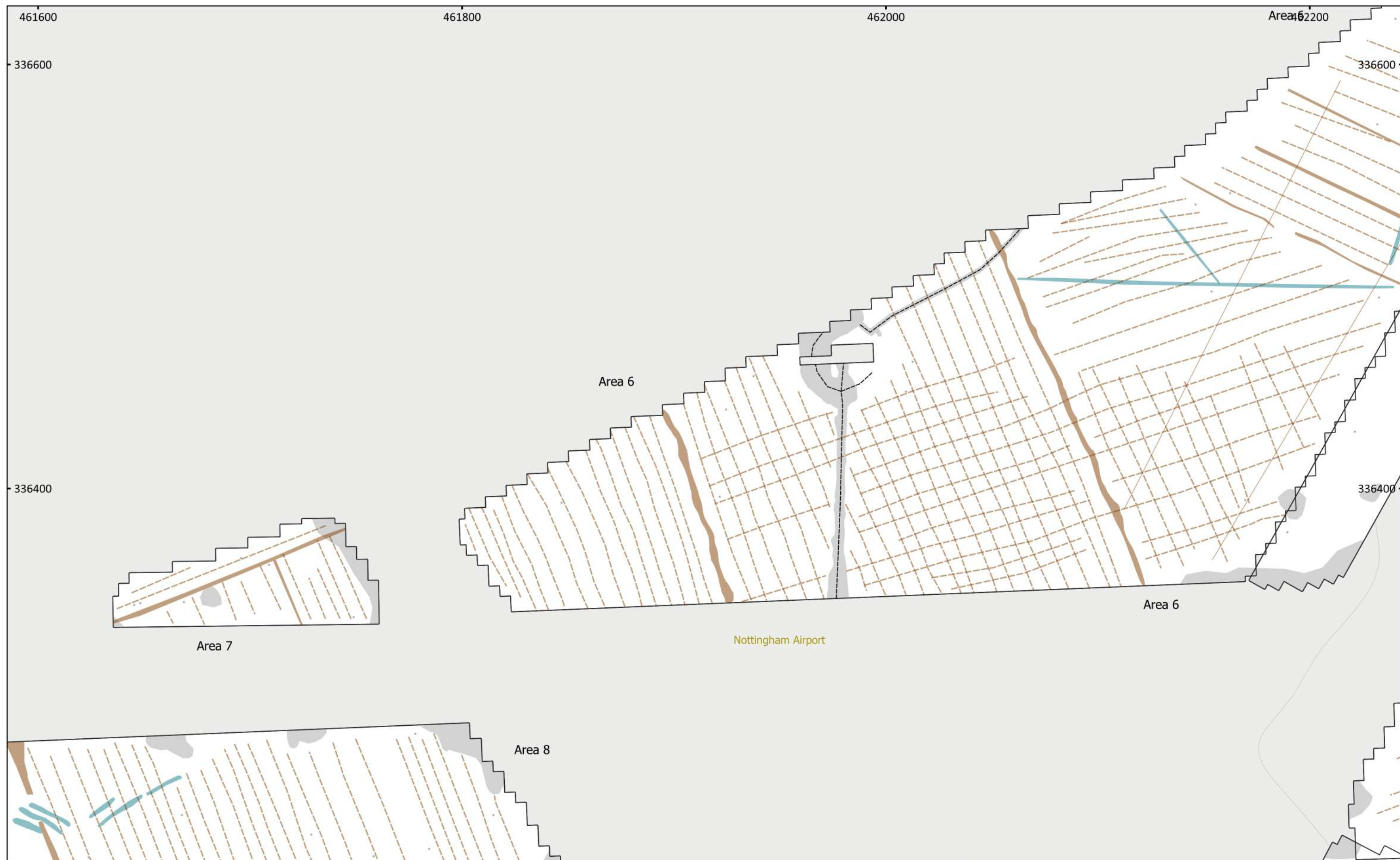
MSSK1538: Land North of Tollerton, Nottinghamshire
Figure 9 - XY Trace Plot (Areas 5, 6, 11, and 12)
30nT/cm at 1:1,500 @ A3
Copyright Magnitude Surveys Ltd 2023
Contains Ordnance Survey data © Crown Copyright and database right 2023





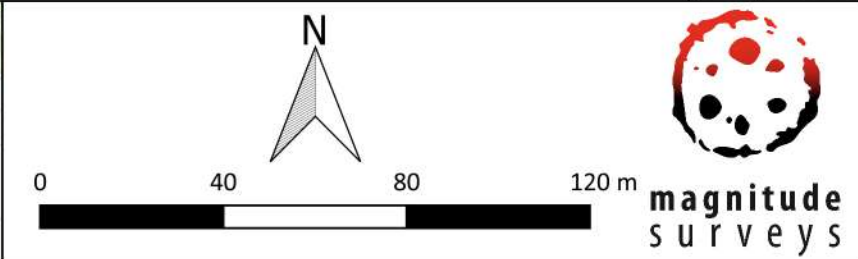
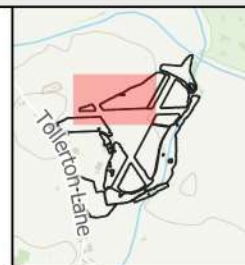
MSSK1538: Land North of Tollerton, Nottinghamshire
 Figure 10 - Magnetic Gradient (Areas 6, 7, and 8)
 1:1,500 @ A3
 Copyright Magnitude Surveys Ltd 2023
 Contains Ordnance Survey data © Crown Copyright and database right 2023

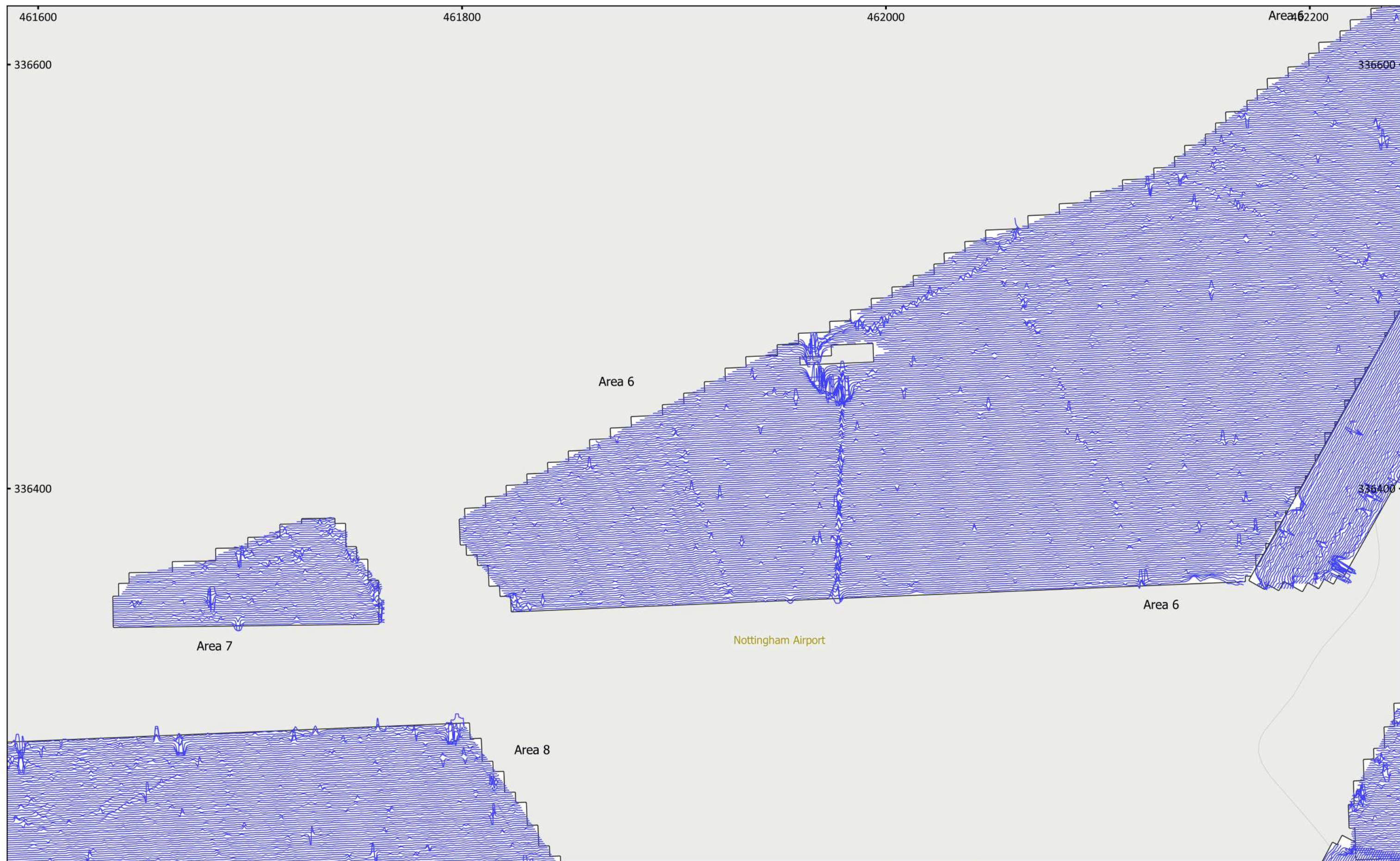




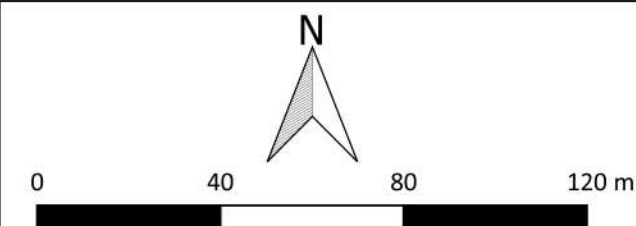
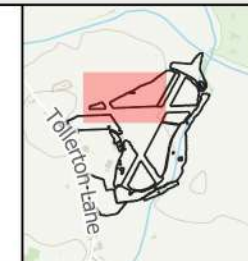
MSSK1538: Land North of Tollerton, Nottinghamshire
 Figure 11 - Magnetic Interpretation (Areas 6, 7, and 8)
 1:1,500 @ A3
 Copyright Magnitude Surveys Ltd 2023
 Contains Ordnance Survey data © Crown Copyright and database right 2023

- | | | |
|-----------------------|----------------------------|--------------------------|
| Agricultural (Spread) | Ferrous/Debris (Spread) | Service |
| Agricultural (Strong) | Undetermined (Weak) | Ridge and Furrow (Trend) |
| Agricultural (Weak) | Industrial/Modern (Spread) | Drainage Feature |
| Magnetic Disturbance | Industrial/Modern | Ferrous (Spike) |



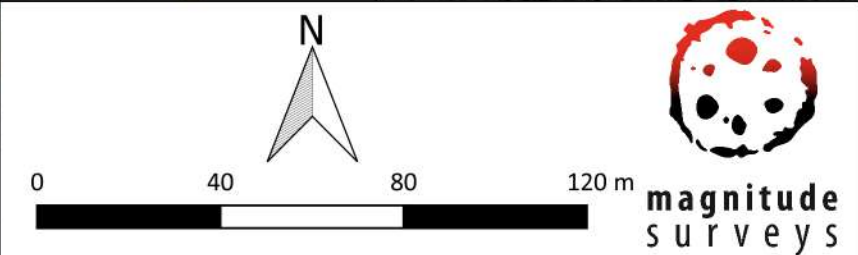
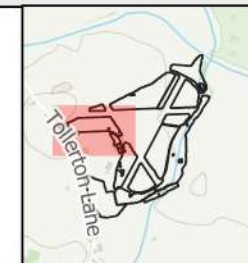
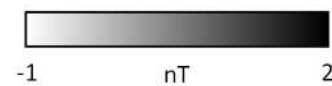


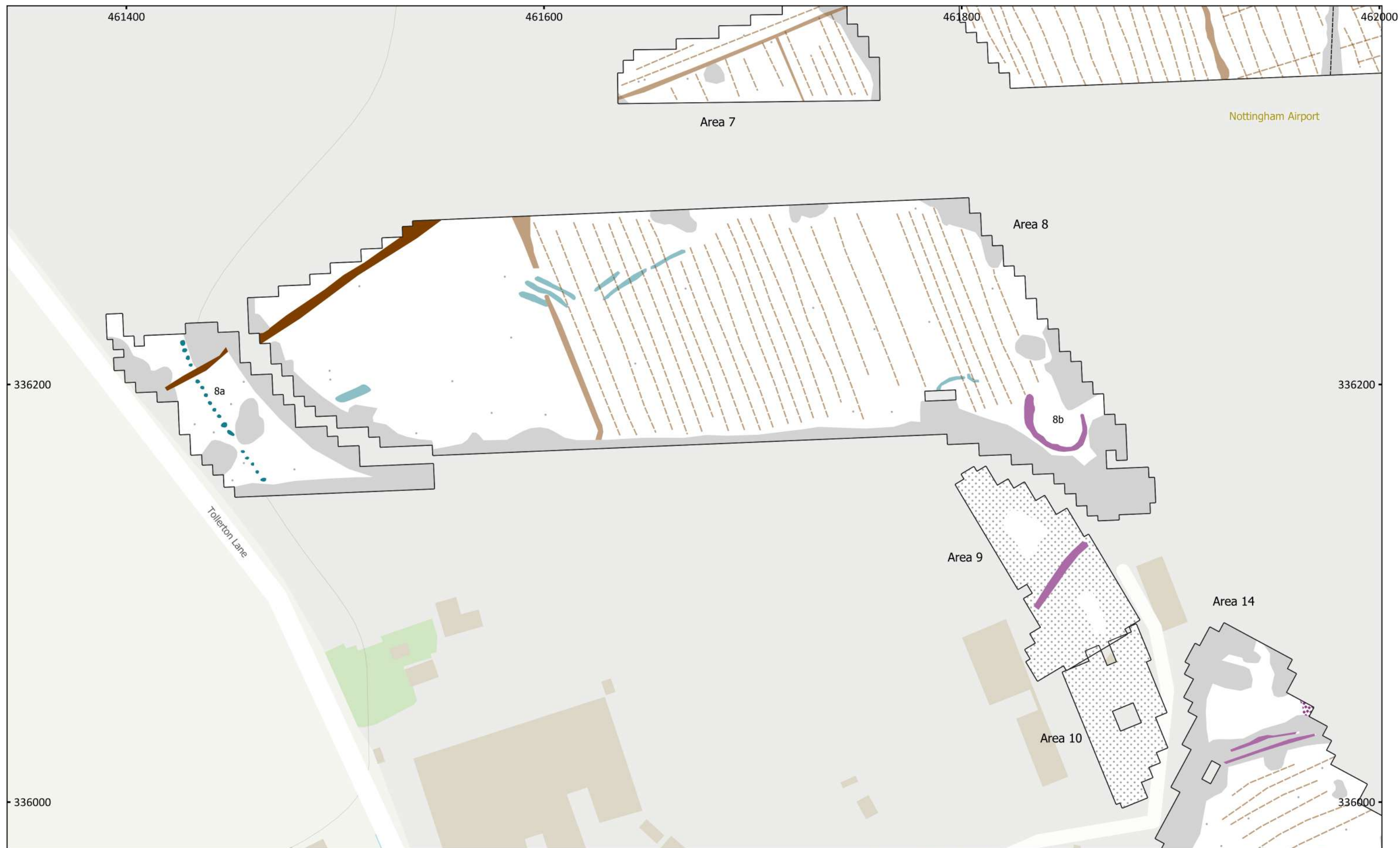
MSSK1538: Land North of Tollerton, Nottinghamshire
Figure 12 - XY Trace Plot (Areas 6, 7, and 8)
30nT/cm at 1:1,500 @ A3
Copyright Magnitude Surveys Ltd 2023
Contains Ordnance Survey data © Crown Copyright and database right 2023





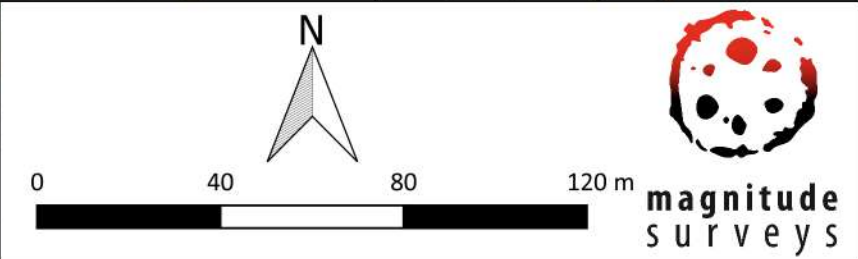
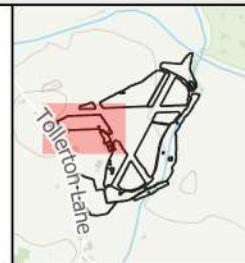
MSSK1538: Land North of Tollerton, Nottinghamshire
Figure 13 - Magnetic Gradient (Areas 7, 8, 9, 10 and 14)
1:1,500 @ A3
Copyright Magnitude Surveys Ltd 2023
Contains Ordnance Survey data © Crown Copyright and database right 2023

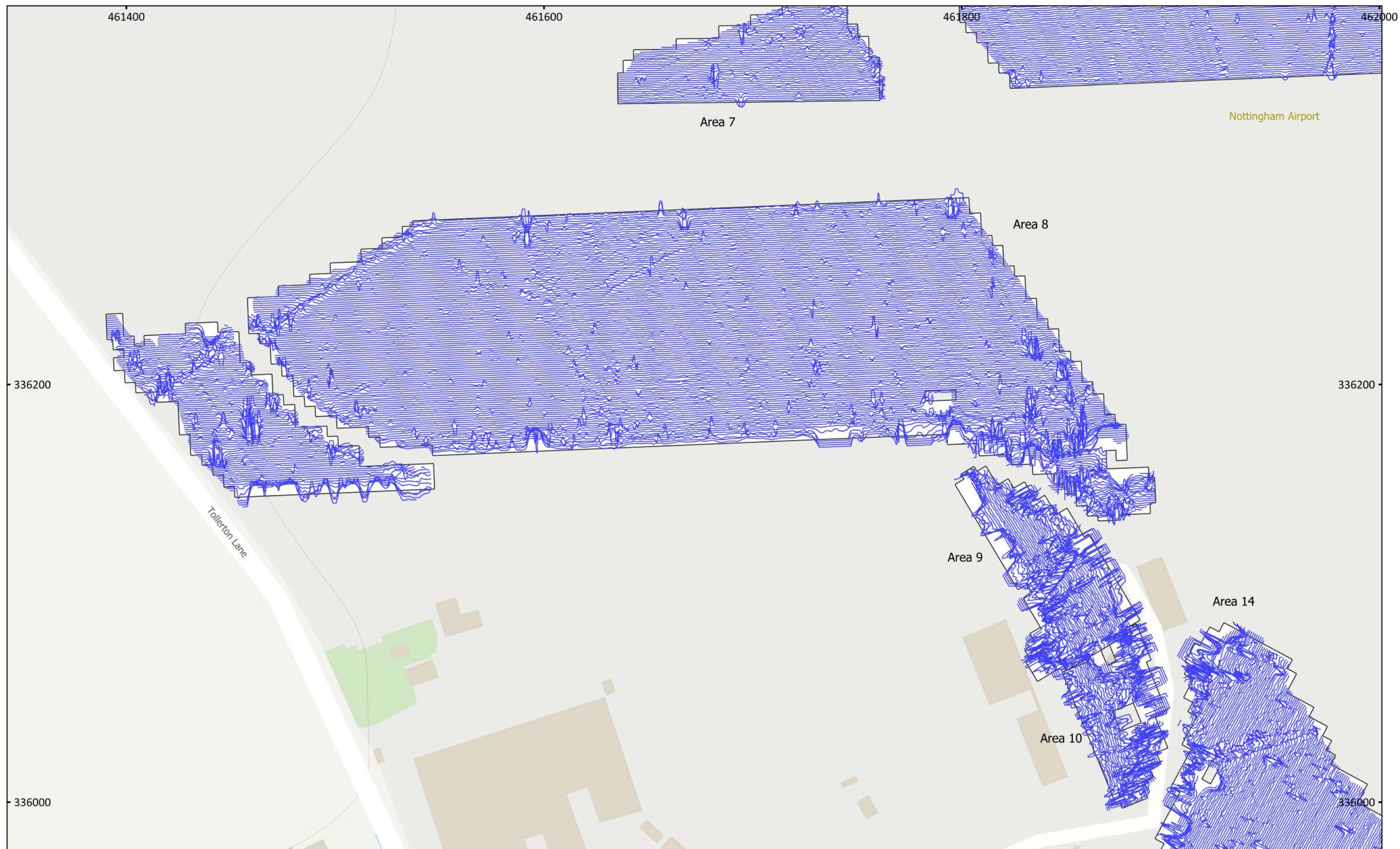




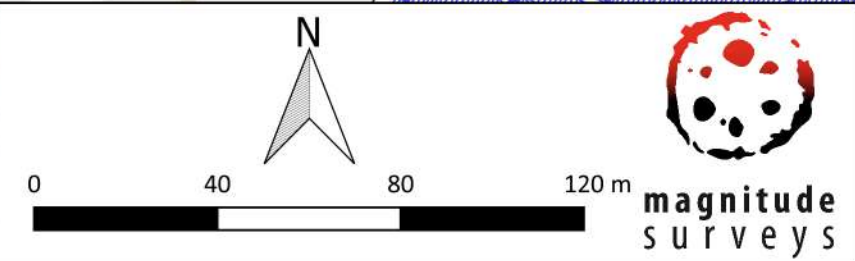
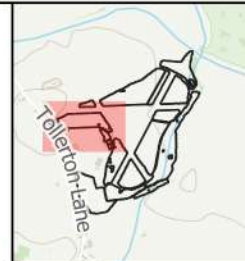
MSSK1538: Land North of Tollerton, Nottinghamshire
 Figure 14 - Magnetic Interpretation (Areas 7, 8, 9, 10 and 14)
 1:1,500 @ A3
 Copyright Magnitude Surveys Ltd 2023
 Contains Ordnance Survey data © Crown Copyright and database right 2023

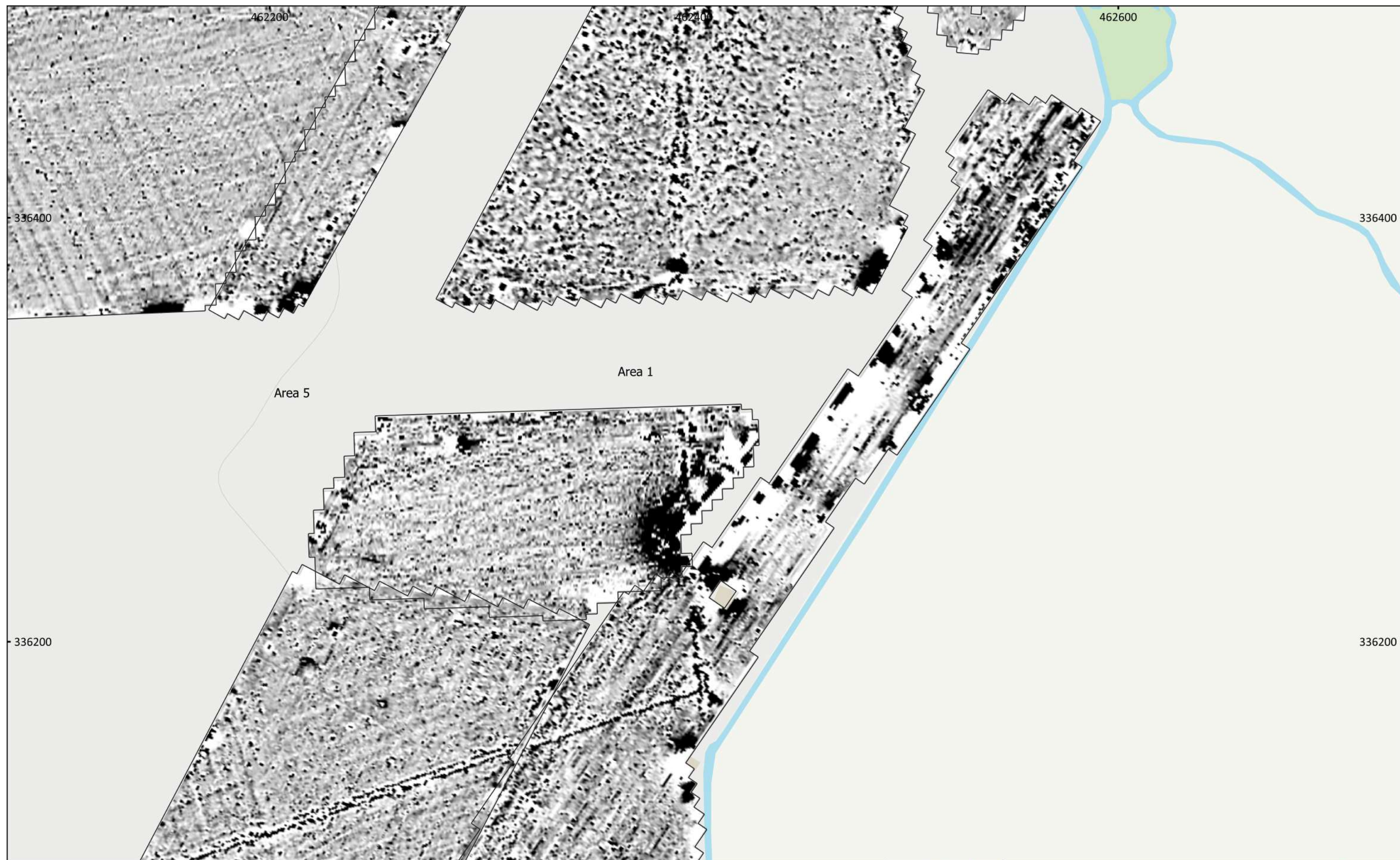
- | | | |
|-----------------------|----------------------------|--------------------------|
| Agricultural (Spread) | Ferrous/Debris (Spread) | Service |
| Agricultural (Strong) | Undetermined (Weak) | Ridge and Furrow (Trend) |
| Agricultural (Weak) | Industrial/Modern (Spread) | Drainage Feature |
| Magnetic Disturbance | Industrial/Modern | Ferrous (Spike) |



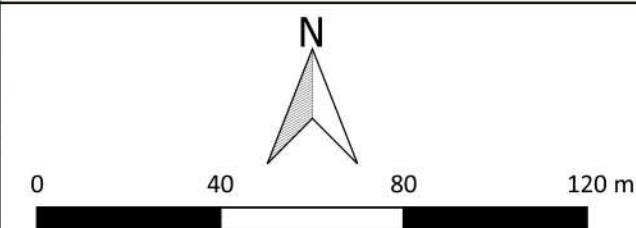
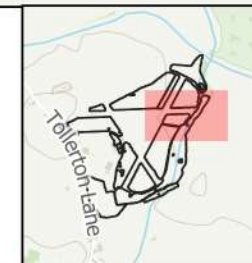
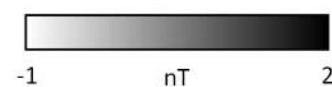


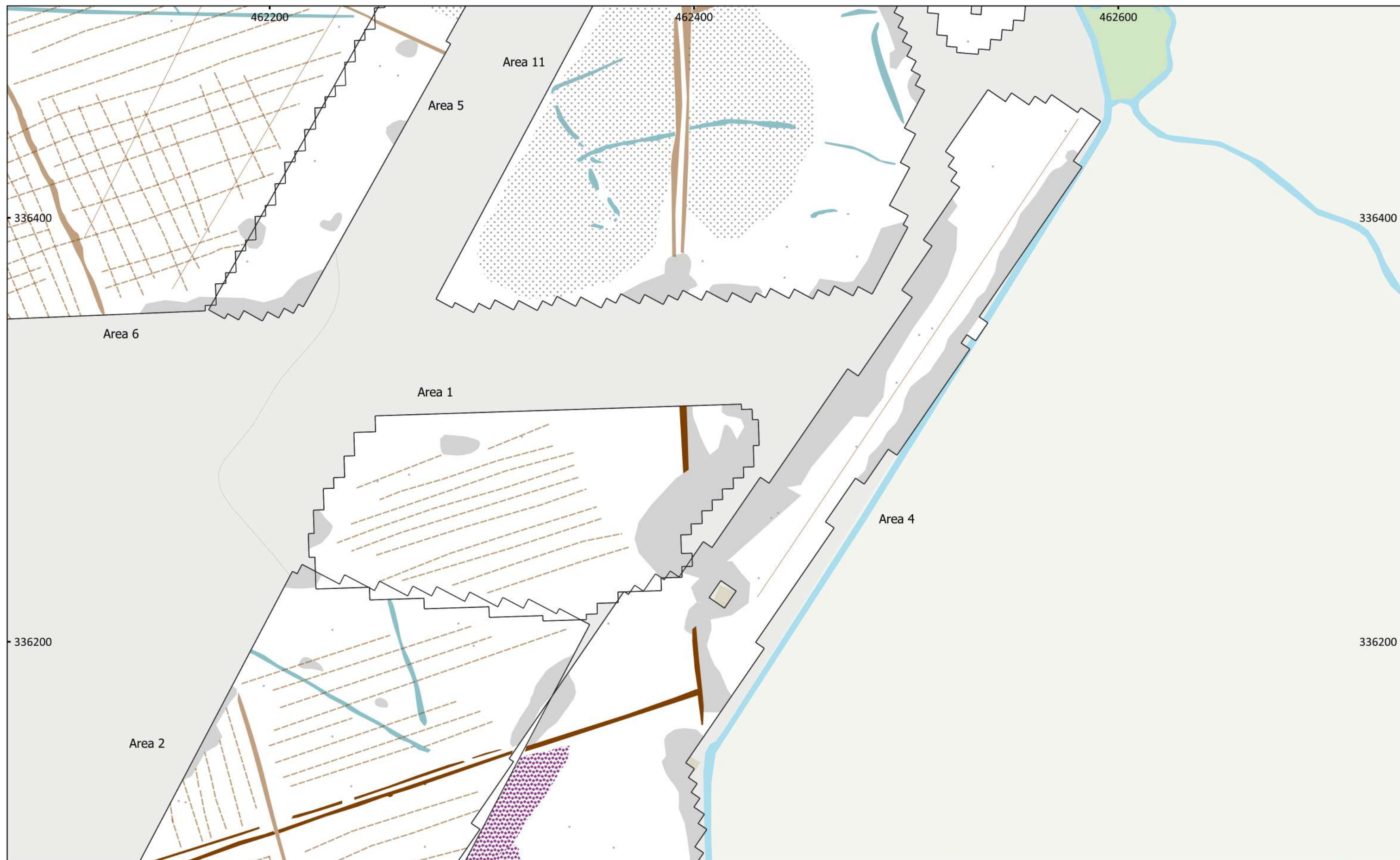
MSSK1538: Land North of Tollerton, Nottinghamshire
 Figure 15 - XY Trace Plot (Areas 7, 8, 9, 10 and 14)
 30nT/cm at 1:1,500 @ A3
 Copyright Magnitude Surveys Ltd 2023
 Contains Ordnance Survey data © Crown Copyright and database right 2023





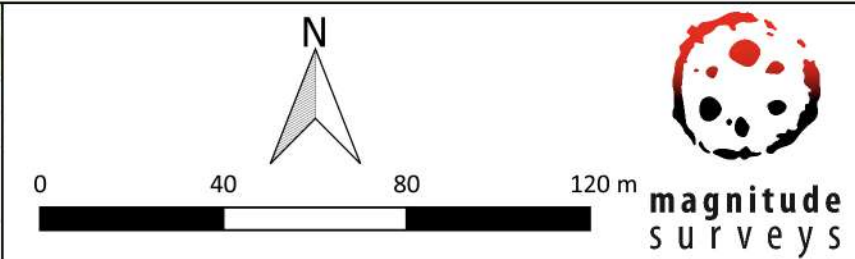
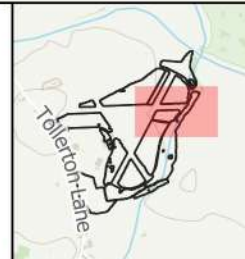
MSSK1538: Land North of Tollerton, Nottinghamshire
 Figure 16 - Magnetic Gradient (Areas 1, 2, 4, 5, 6, and 11)
 1:1,500 @ A3
 Copyright Magnitude Surveys Ltd 2023
 Contains Ordnance Survey data © Crown Copyright and database right 2023

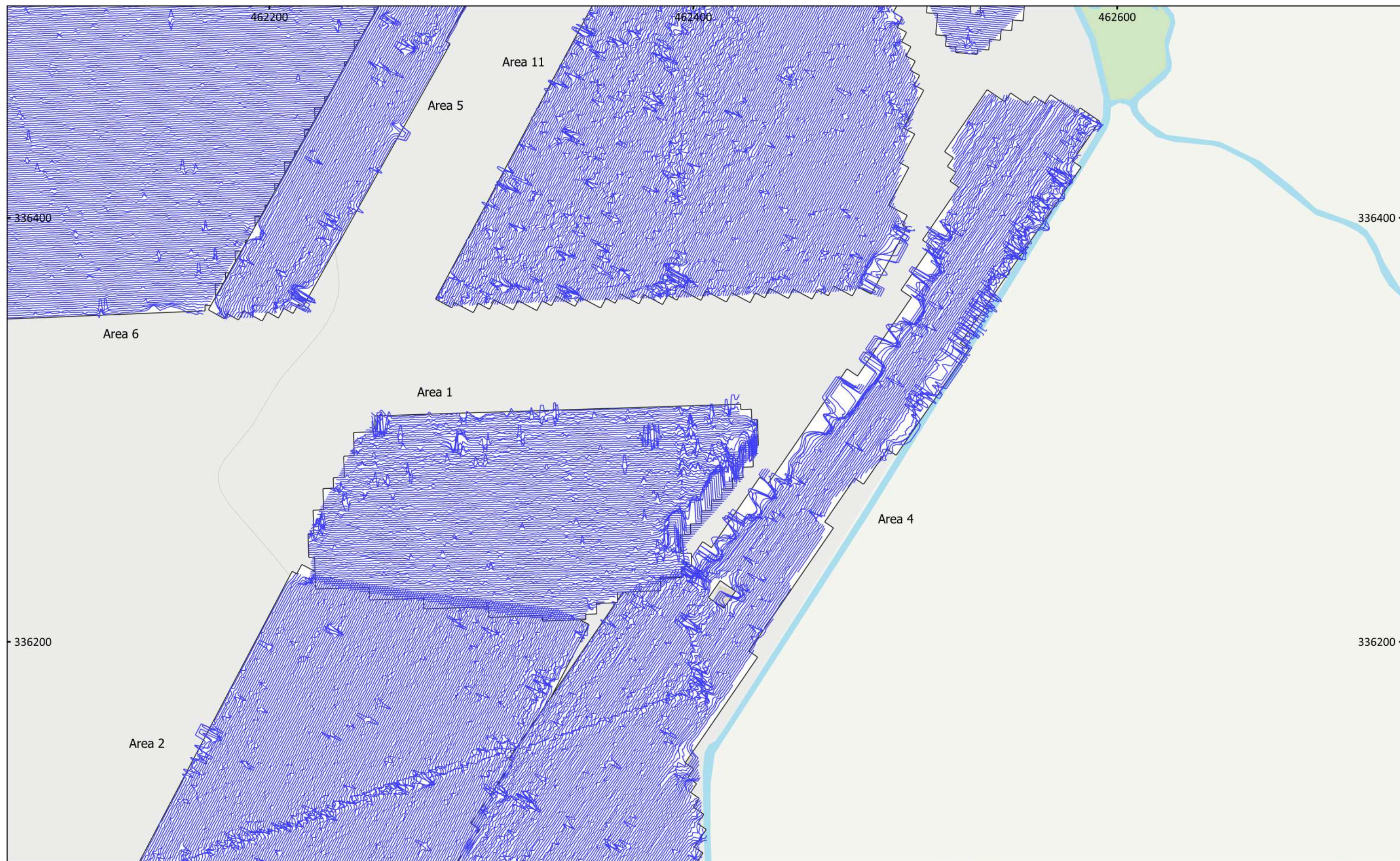




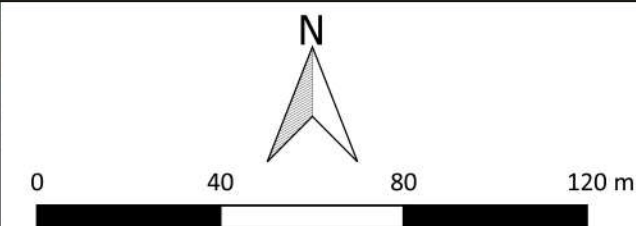
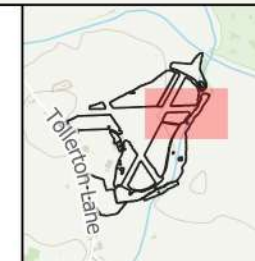
MSSK1538: Land North of Tollerton, Nottinghamshire
 Figure 17 - Magnetic Interpretation (Areas 1, 2, 4, 5, 6, and 11)
 1:1,500 @ A3
 Copyright Magnitude Surveys Ltd 2023
 Contains Ordnance Survey data © Crown Copyright and database right 2023

- | | | |
|-----------------------|----------------------------|--------------------------|
| Agricultural (Spread) | Ferrous/Debris (Spread) | Service |
| Agricultural (Strong) | Undetermined (Weak) | Ridge and Furrow (Trend) |
| Agricultural (Weak) | Industrial/Modern (Spread) | Drainage Feature |
| Magnetic Disturbance | Industrial/Modern | Ferrous (Spike) |



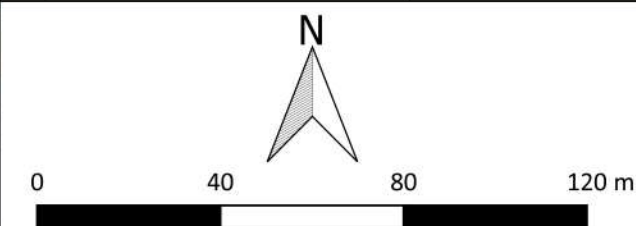
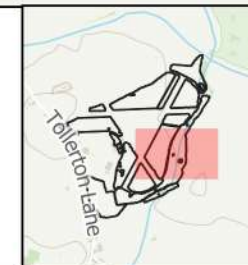
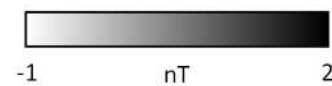


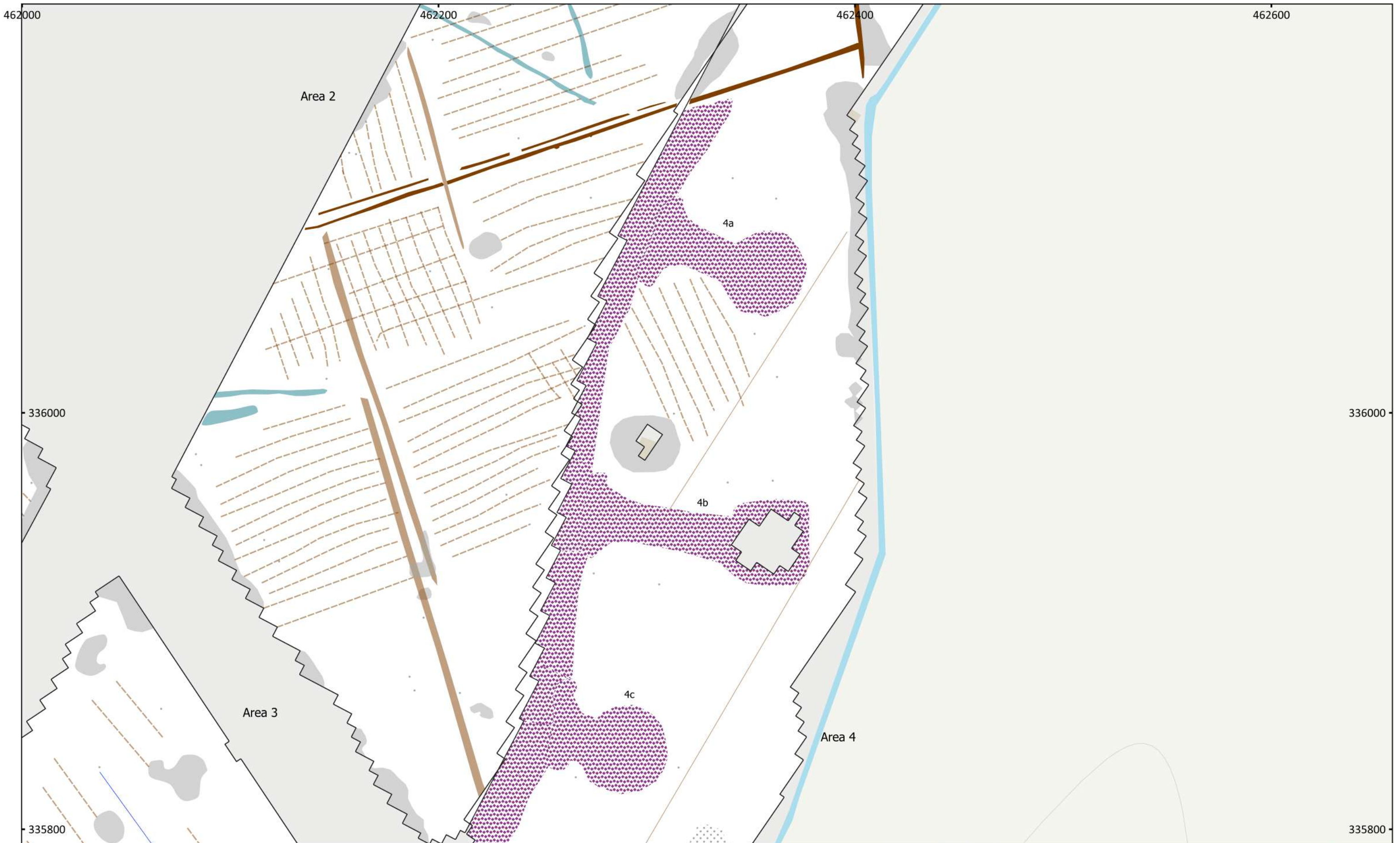
MSSK1538: Land North of Tollerton, Nottinghamshire
 Figure 18 - XY Trace Plot (Areas 1, 2, 4, 5, 6, and 11)
 30nT/cm at 1:1,500 @ A3
 Copyright Magnitude Surveys Ltd 2023
 Contains Ordnance Survey data © Crown Copyright and database right 2023





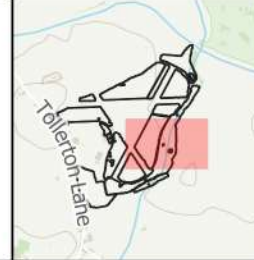
MSSK1538: Land North of Tollerton, Nottinghamshire
Figure 19 - Magnetic Gradient (Areas 2, 3, and 4)
1:1,500 @ A3
Copyright Magnitude Surveys Ltd 2023
Contains Ordnance Survey data © Crown Copyright and database right 2023





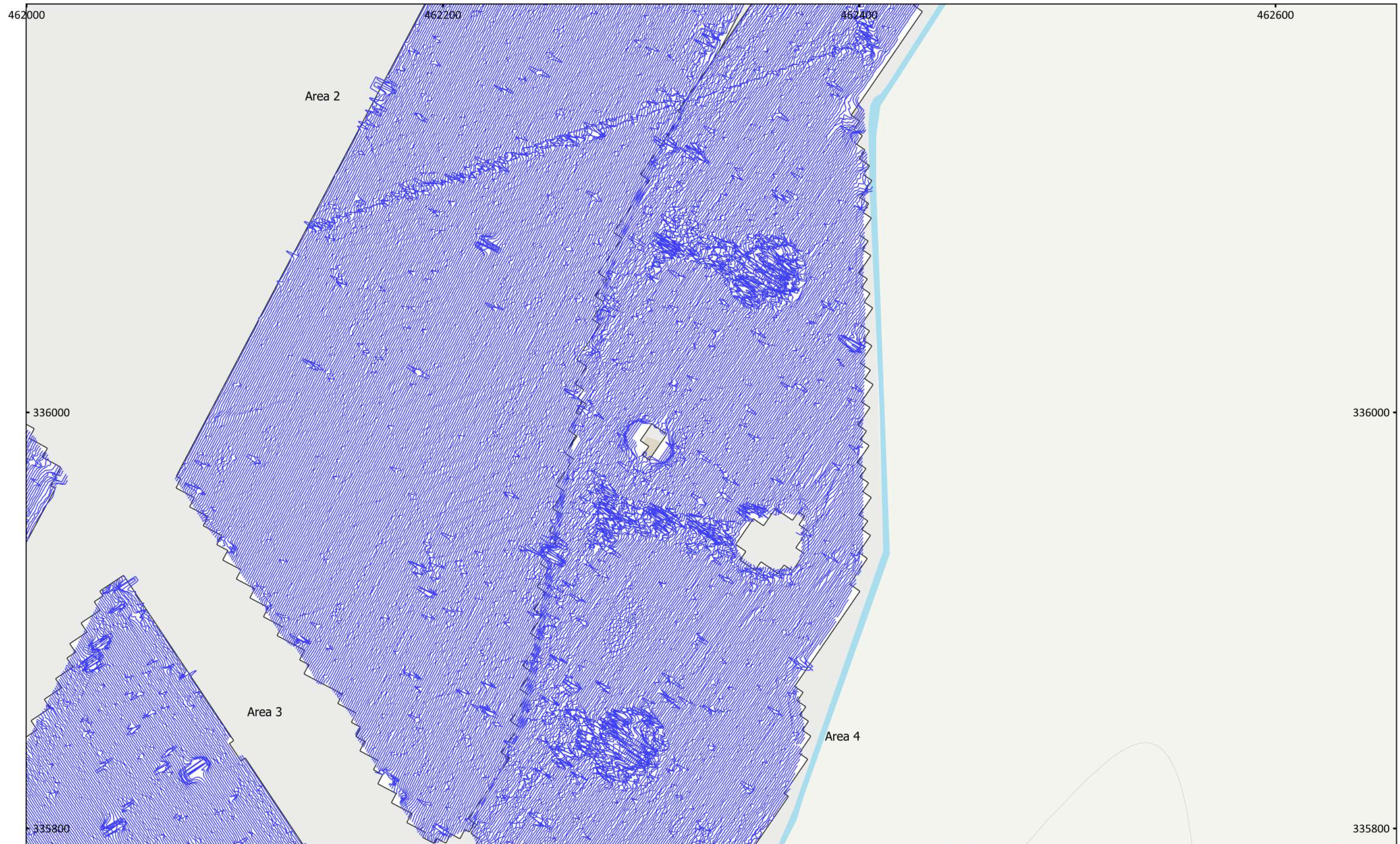
MSSK1538: Land North of Tollerton, Nottinghamshire
Figure 20 - Magnetic Interpretation (Areas 2, 3, and 4)
1:1,500 @ A3
Copyright Magnitude Surveys Ltd 2023
Contains Ordnance Survey data © Crown Copyright and database right 2023

- | | | |
|-----------------------|----------------------------|--------------------------|
| Agricultural (Spread) | Ferrous/Debris (Spread) | Service |
| Agricultural (Strong) | Undetermined (Weak) | Ridge and Furrow (Trend) |
| Agricultural (Weak) | Industrial/Modern (Spread) | Drainage Feature |
| Magnetic Disturbance | Industrial/Modern | Ferrous (Spike) |

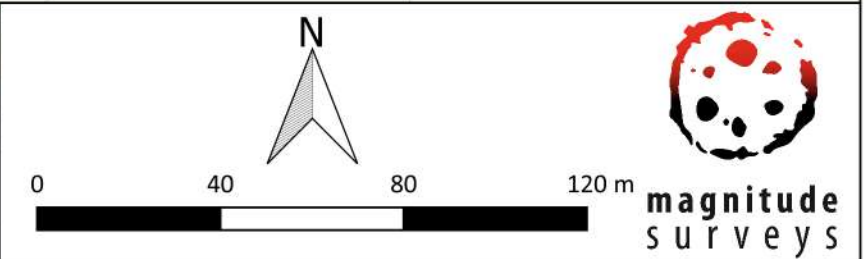
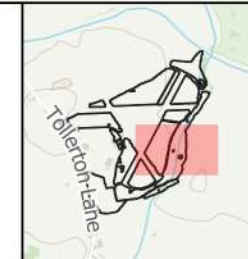


0 40 80 120 m

magnitude
surveys



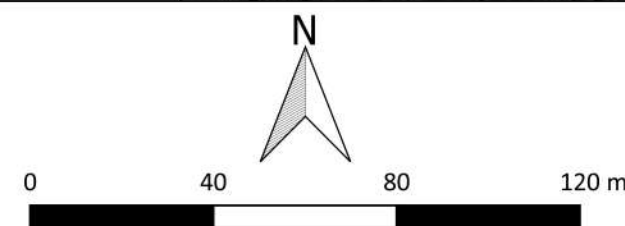
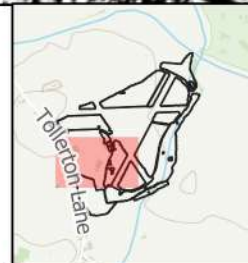
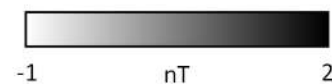
MSSK1538: Land North of Tollerton, Nottinghamshire
Figure 21 - XY Trace Plot (Areas 2, 3, and 4)
30nT/cm at 1:1,500 @ A3
Copyright Magnitude Surveys Ltd 2023
Contains Ordnance Survey data © Crown Copyright and database right 2023



magnitude
surveys



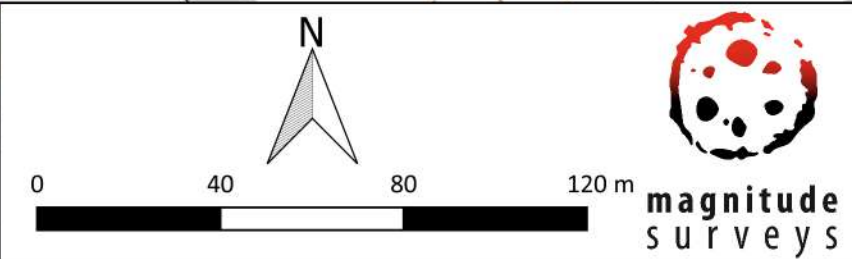
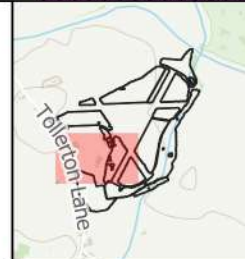
MSSK1538: Land North of Tollerton, Nottinghamshire
 Figure 22 - Magnetic Gradient (Areas 3, 10, 14, and 15)
 1:1,500 @ A3
 Copyright Magnitude Surveys Ltd 2023
 Contains Ordnance Survey data © Crown Copyright and database right 2023

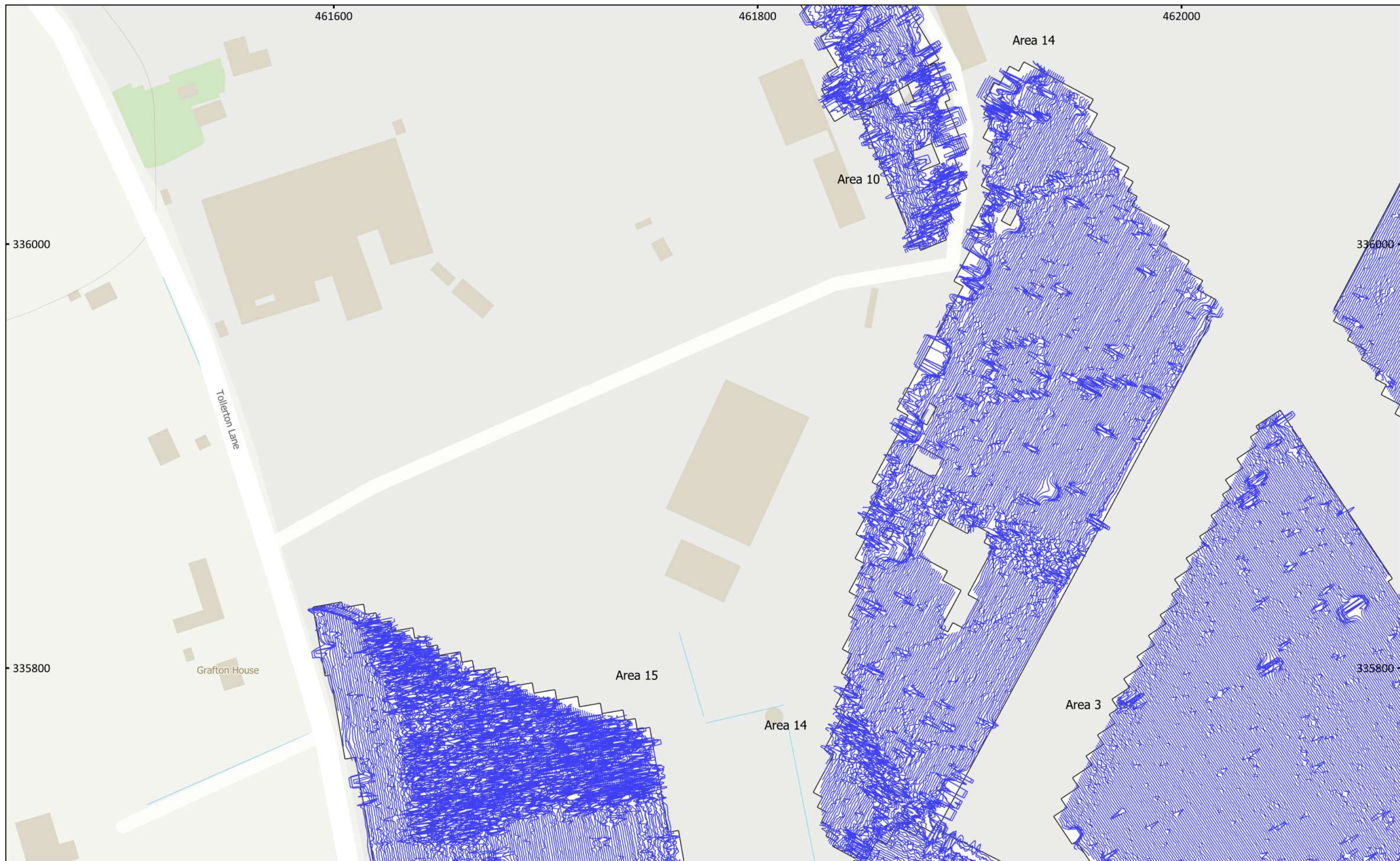




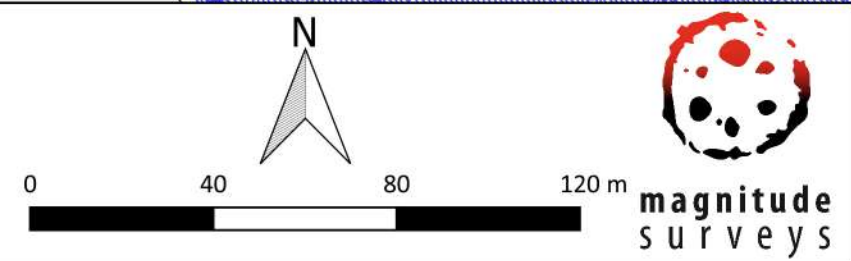
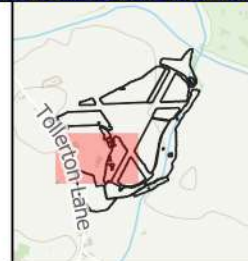
MSSK1538: Land North of Tollerton, Nottinghamshire
 Figure 23 - Magnetic Interpretation (Areas 3, 10, 14, and 15)
 1:1,500 @ A3
 Copyright Magnitude Surveys Ltd 2023
 Contains Ordnance Survey data © Crown Copyright and database right 2023

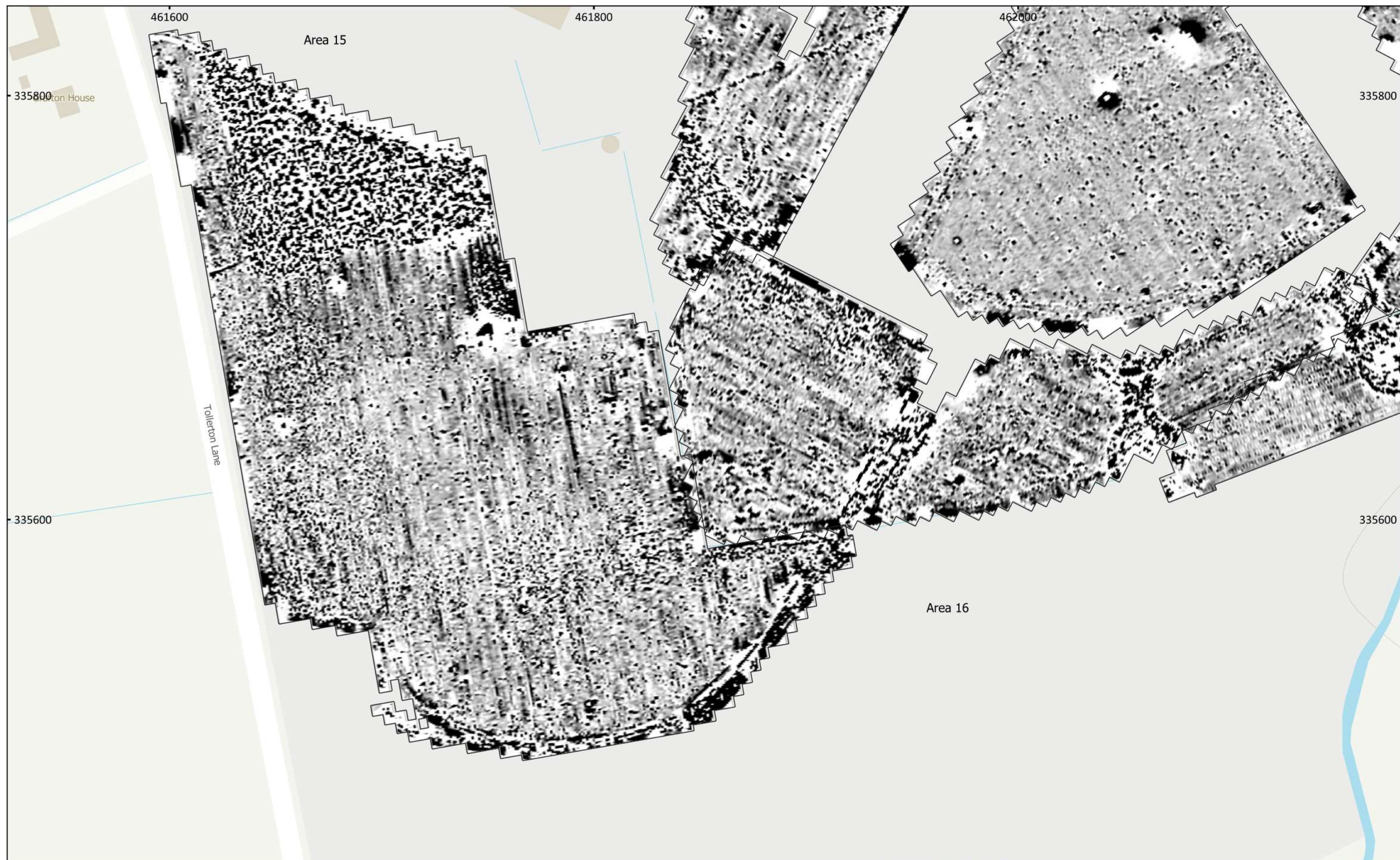
- | | | |
|-----------------------|----------------------------|--------------------------|
| Agricultural (Spread) | Ferrous/Debris (Spread) | Service |
| Agricultural (Strong) | Undetermined (Weak) | Ridge and Furrow (Trend) |
| Agricultural (Weak) | Industrial/Modern (Spread) | Drainage Feature |
| Magnetic Disturbance | Industrial/Modern | Ferrous (Spike) |



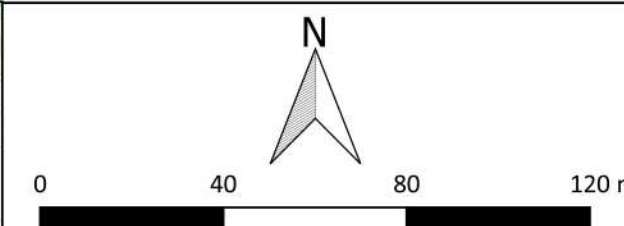
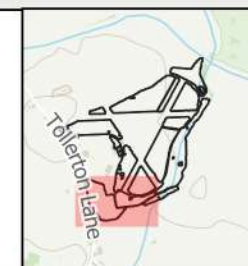
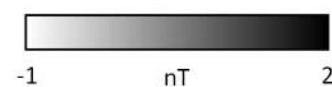


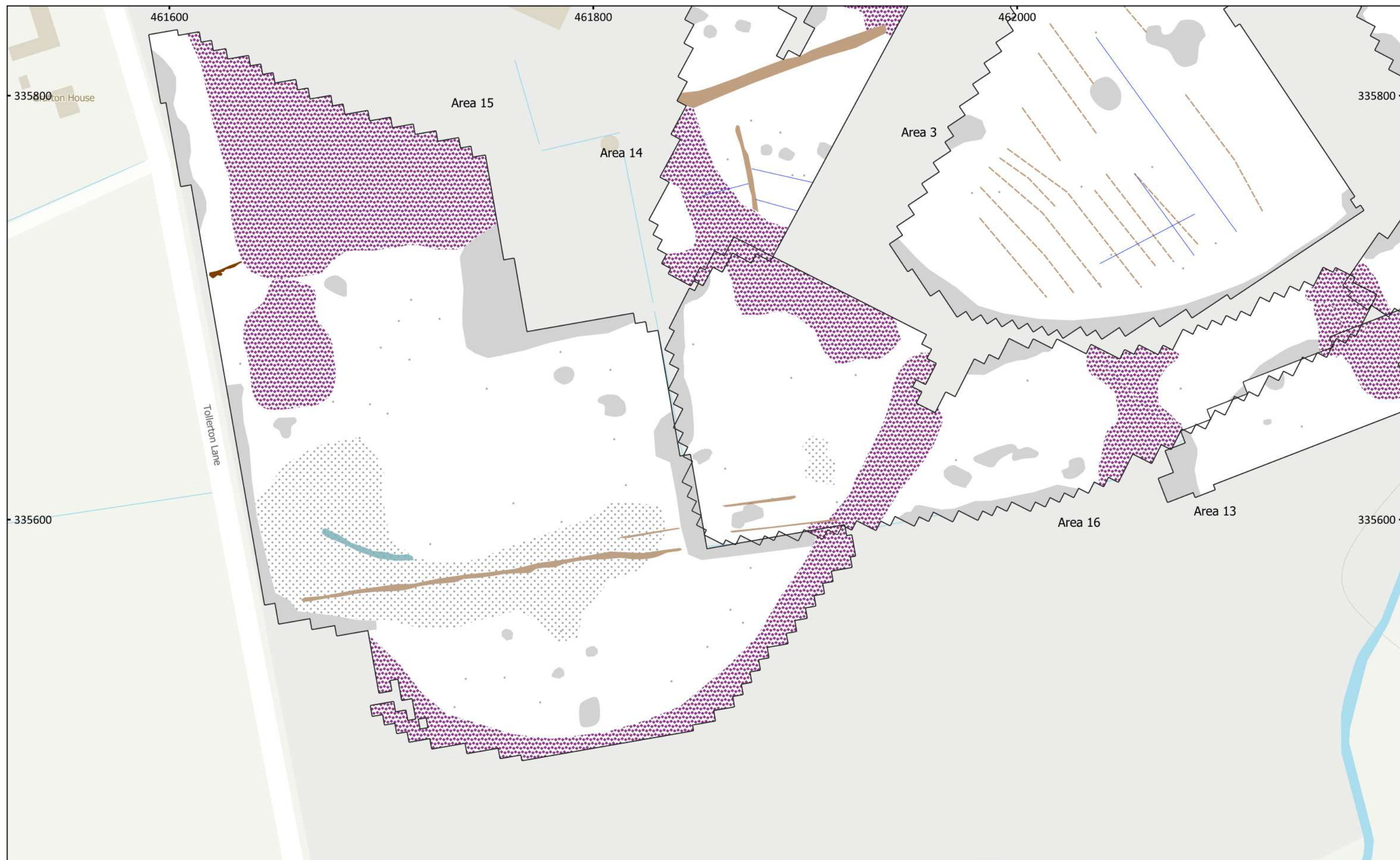
MSSK1538: Land North of Tollerton, Nottinghamshire
Figure 24 - XY Trace Plot (Areas 3, 10, 14, and 15)
30nT/cm at 1:1,500 @ A3
Copyright Magnitude Surveys Ltd 2023
Contains Ordnance Survey data © Crown Copyright and database right 2023





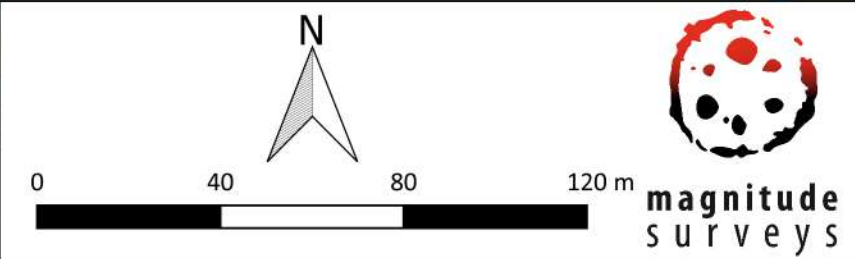
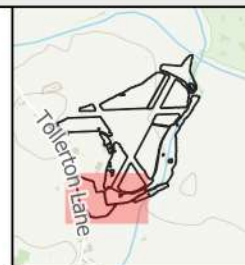
MSSK1538: Land North of Tollerton, Nottinghamshire
 Figure 25 - Magnetic Gradient (Areas 3, 13, 14, 15, and 16)
 1:1,500 @ A3
 Copyright Magnitude Surveys Ltd 2023
 Contains Ordnance Survey data © Crown Copyright and database right 2023

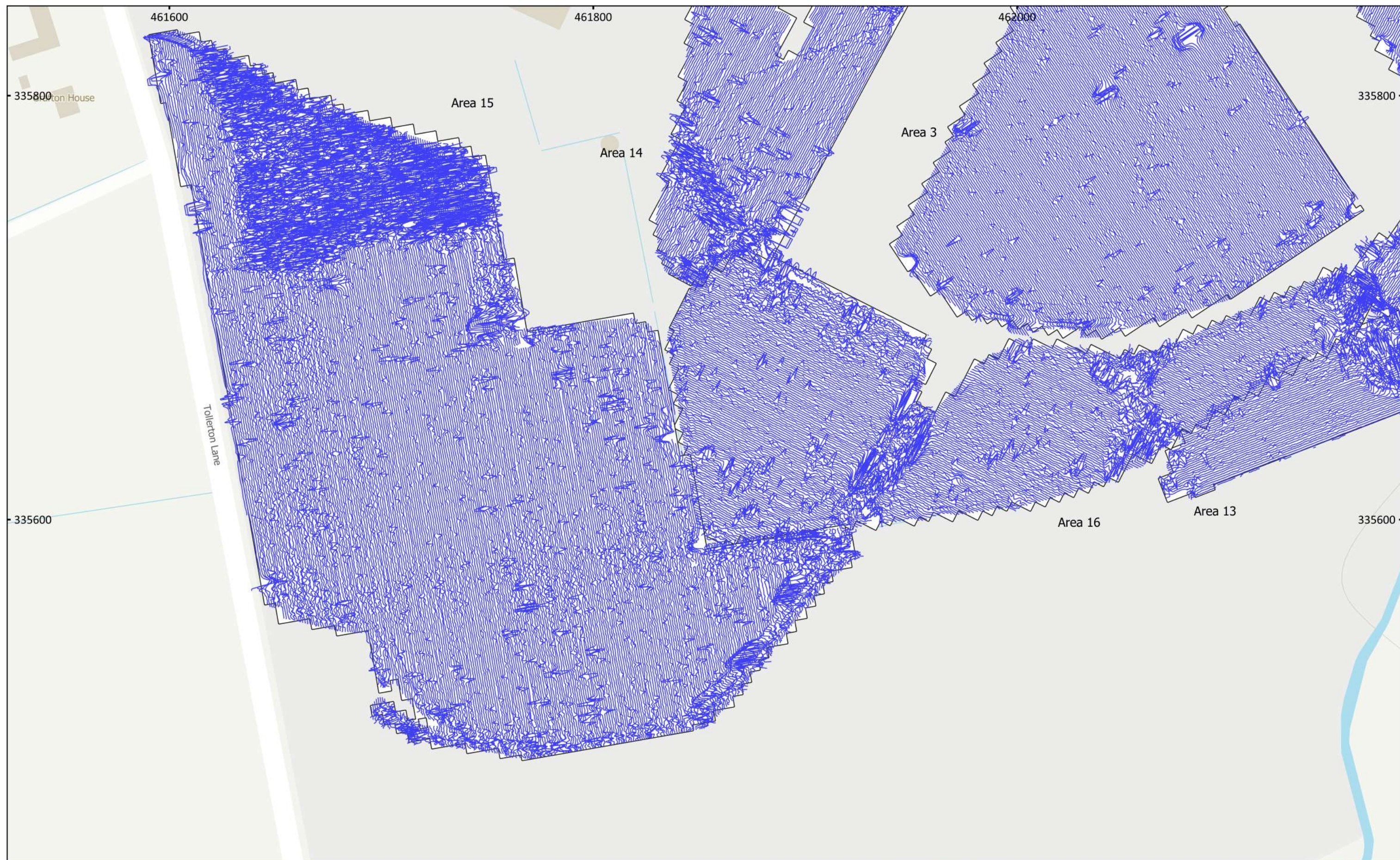




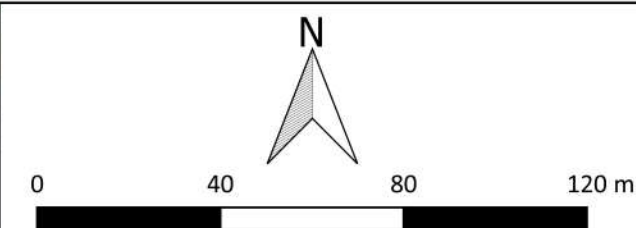
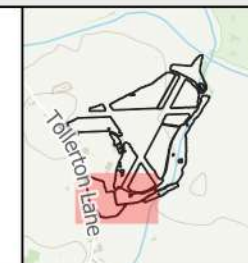
MSSK1538: Land North of Tollerton, Nottinghamshire
 Figure 26 - Magnetic Interpretation (Areas 3, 13, 14, 15, and 16)
 1:1,500 @ A3
 Copyright Magnitude Surveys Ltd 2023
 Contains Ordnance Survey data © Crown Copyright and database right 2023

- | | | |
|-----------------------|----------------------------|--------------------------|
| Agricultural (Spread) | Ferrous/Debris (Spread) | Service |
| Agricultural (Strong) | Undetermined (Weak) | Ridge and Furrow (Trend) |
| Agricultural (Weak) | Industrial/Modern (Spread) | Drainage Feature |
| Magnetic Disturbance | Industrial/Modern | Ferrous (Spike) |



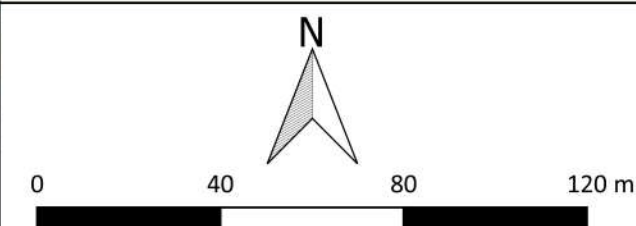
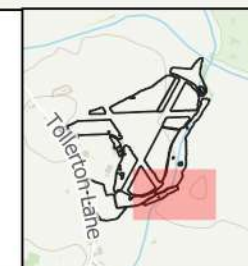
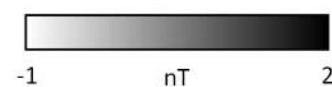


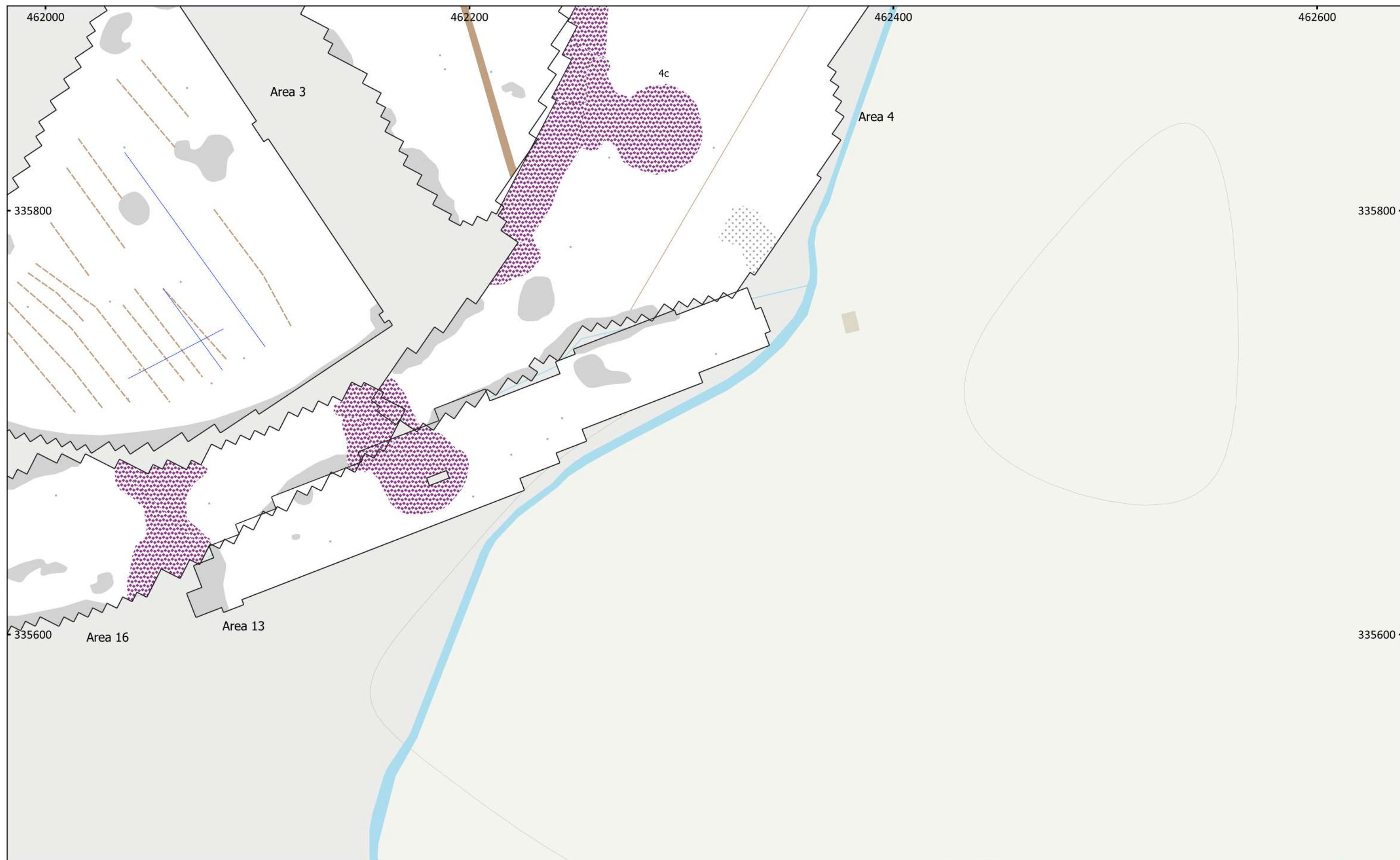
MSSK1538: Land North of Tollerton, Nottinghamshire
 Figure 27 - XY Trace Plot (Areas 3, 13, 14, 15, and 16)
 30nT/cm at 1:1,500 @ A3
 Copyright Magnitude Surveys Ltd 2023
 Contains Ordnance Survey data © Crown Copyright and database right 2023





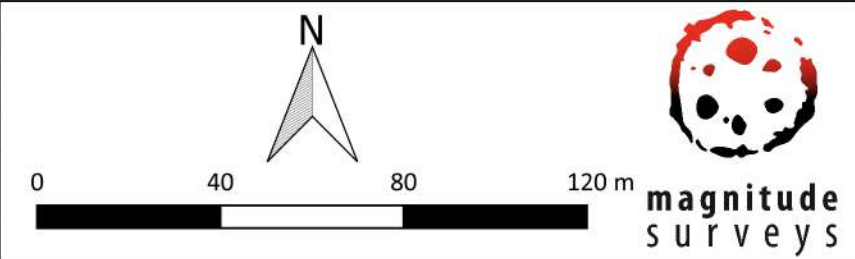
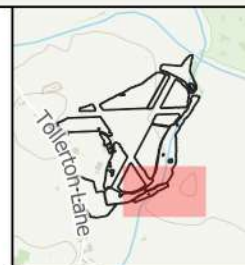
MSSK1538: Land North of Tollerton, Nottinghamshire
Figure 28 - Magnetic Gradient (Areas 3, 4, 13, and 16)
1:1,500 @ A3
Copyright Magnitude Surveys Ltd 2023
Contains Ordnance Survey data © Crown Copyright and database right 2023

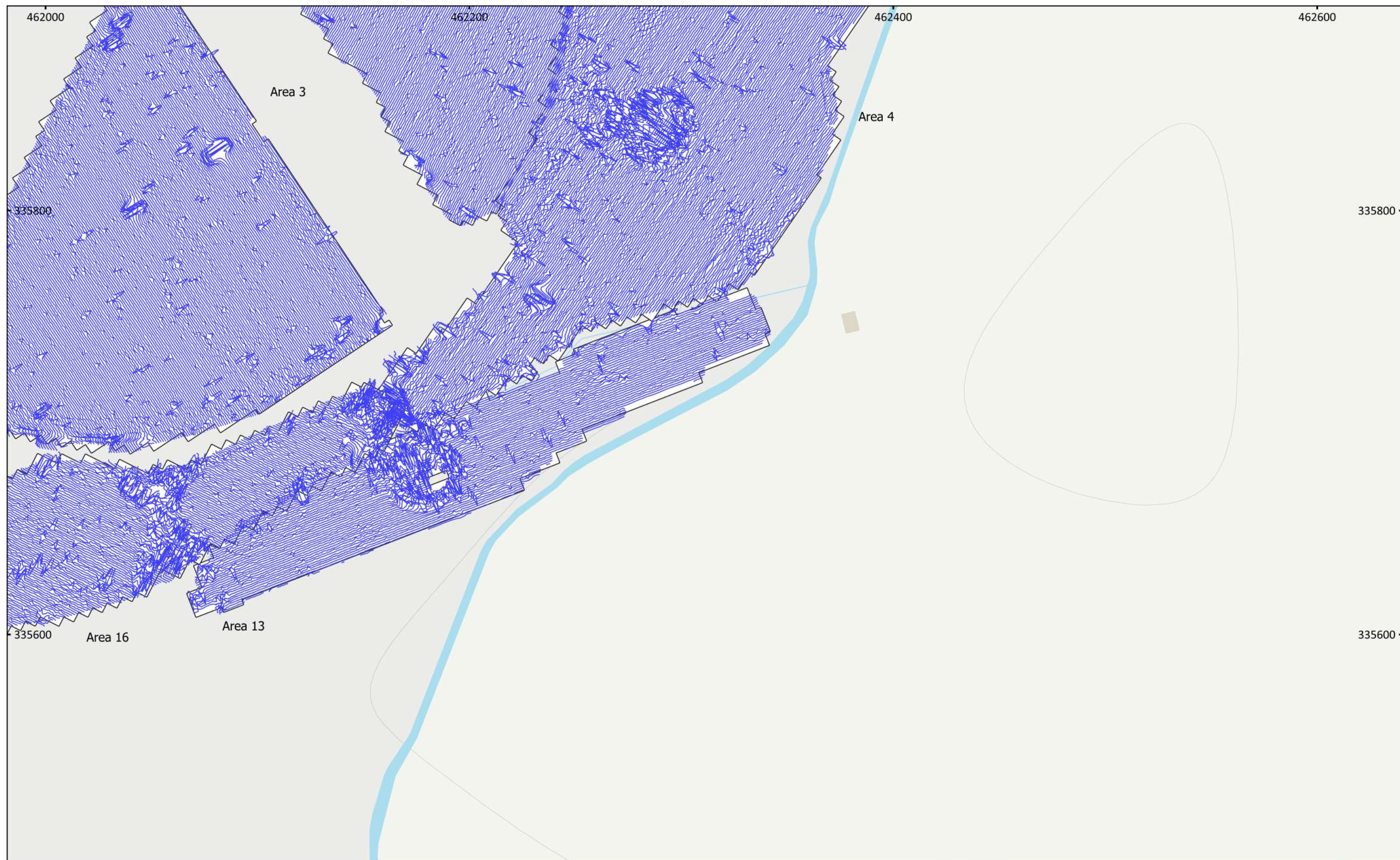




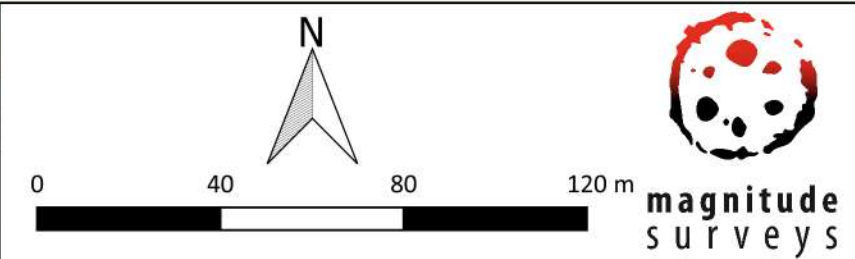
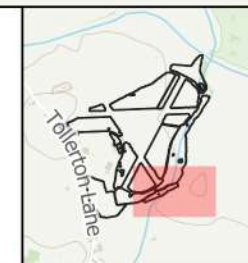
MSSK1538: Land North of Tollerton, Nottinghamshire
 Figure 29 - Magnetic Interpretation (Areas 3, 4, 13, and 16)
 1:1,500 @ A3
 Copyright Magnitude Surveys Ltd 2023
 Contains Ordnance Survey data © Crown Copyright and database right 2023

- | | | |
|-----------------------|----------------------------|--------------------------|
| Agricultural (Spread) | Ferrous/Debris (Spread) | Service |
| Agricultural (Strong) | Undetermined (Weak) | Ridge and Furrow (Trend) |
| Agricultural (Weak) | Industrial/Modern (Spread) | Drainage Feature |
| Magnetic Disturbance | Industrial/Modern | Ferrous (Spike) |





MSSK1538: Land North of Tollerton, Nottinghamshire
Figure 30 - XY Trace Plot (Areas 3, 4, 13, and 16)
30nT/cm at 1:1,500 @ A3
Copyright Magnitude Surveys Ltd 2023
Contains Ordnance Survey data © Crown Copyright and database right 2023



magnitude
surveys