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**Geophysical Survey Report
Prospect Avenue, Rushden**

**For
RPS**

**On Behalf Of
Ilke Homes**

Magnitude Surveys Ref: MSSP741

HER Event Number: ENN109954

September 2020



magnitude surveys

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Abstract

Magnitude Surveys was commissioned to assess the subsurface archaeological potential of c.3.3ha of land off Prospect Avenue, Rushden, Northamptonshire. A fluxgate gradiometer survey was successfully completed across c.2.4ha of the survey area, the rest was unsurveyable due to overgrown vegetation. Several undetermined anomalies have been identified in the centre of the survey area in close proximity to a former building shown on historic mapping. Further anomalies have been identified which are considered likely to be related to a nearby gas works or other recent activity however, an archaeological origin cannot be ruled out and so these have an undetermined classification. The survey has also identified anomalies relating to natural drainage near the northern boundary of the survey area. A section of the survey area was hardstanding ground from a former coal yard, which has resulted in a strong anomaly, under which, if present, no anomalies of any kind could be discerned. Further impact of modern activity on the results is limited to magnetic disturbance from fences at field edges and other metal detritus expected in an urban setting.

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1. Introduction

- 1.1. Magnitude Surveys Ltd (MS) was commissioned by RPS on behalf of Ilke Homes to undertake a geophysical survey on a c.3.3ha area of land off Prospect Avenue, Rushden, Northamptonshire (SP 9600 6760).
- 1.2. The geophysical survey comprised hand-carried, 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 WSI produced by MS (Magnitude Surveys, 2020).
- 1.5. The survey took place over two days between 20 August and 15 September.

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.

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.1km north-west from the centre of Rushden (Figure 1). Gradiometer survey was undertaken across 3 fields under scrubland and hardstanding. The survey area was bounded by housing on Prospect Avenue to the north, housing on Peck Way and Regency Close to the west and by a former rail track, now footpath, to the south and east. (Figure 2). C.0.9ha of the site was unsurveyable due to overgrown vegetation.

4.2. Survey considerations:

Survey Area	Ground Conditions	Further Notes
1 Surveyed on 20.08.20	The area was a freshly cleared area of scrubland that sloped gently down to the south.	Bounded to the north by hedges and metal fencing which separated the area from housing on Prospect Avenue. Bounded to the east by hedges and a metal fence which separated the area from a former rail track and current footpath. Bounded to the south by hedges. Bounded to the west by hedges that separated the area from housing along Peck Way.
2 Surveyed on 15.09.20	The area was a flat area of concrete hardstanding.	Bounded to the north and west by hedges. Bounded to the south by woodland. Bounded to the east by metal fencing which separated the area from a former rail track and current footpath.
3 Surveyed on 15.09.20	The area was a freshly cleared field that sloped down towards the centre from the north and south.	Bounded to the north and west by housing and metal and wooden fencing on Peck Way and Regency Close. Bounded to the east by hedges and to the south by woodland.

4.3. The underlying geology comprises Jurassic limestones of the Blisworth Formation. Quaternary superficial deposits are present across the entirety of the area, comprising glaciofluvial deposits of till, diamicton and sand and gravels. (British Geological Survey, 2020).

4.4. The soils consist of freely draining lime-rich loamy soils across the entire site. (Soilscapes, 2020).

5. Archaeological Background

5.1. The following is a summary of a desk-based assessment produced and provided by RPS (Flitcroft, M. 2020).

5.2. Late Iron Age and early Romano-British rural settlement activity has been previously identified in the proximity of the survey area. A Late Iron Age and early Romano-British rural settlement site is known c.400m-600m north-east of the survey area. The settlement site contains a complex series of inter-cutting enclosures, gullies and ditches, forming an extended cluster of remains on a north-east-south-west axis. A second probable Iron Age/ Roman settlement site has been identified from features visible on aerial photographs c.750m east of the survey area. Finally, a further probable settlement site is known c.1km north-west of the survey area from archaeological trial trenching.

- 5.3. Roman period finds - generally single coins - have also been found in close proximity to the survey area, particularly in the Rushden area south of the survey area.

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 hand-carried GNSS-positioned system.

- 6.2.3.1. MS' 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.

- 6.2.3.2. 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 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 7). 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.

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 6).

7.2.2. The fluxgate gradiometer was completed across c.2.4ha of the survey area, c.0.9ha of which was unsurveyable due to overgrown vegetation. The survey area's urban setting and past usage as a coal yard has meant that some sections of the survey area have not responded well to the fluxgate gradiometer. These comprise a section of hardstanding related to the former coal yard located in the centre of the Area 2 and magnetic disturbance produced by a burnt-out car in the centre of Area 1. The strength of the magnetic signal at these locations does not allow for any weaker underlying features, if present, to be discerned. Further magnetic disturbance has been produced from fences at field edges and other metal detritus across the survey area, expected in an urban setting.

7.2.3. In Area 1 linear anomalies lead from a former building recorded on historic mapping (OS Mapping 1926). These anomalies are partially obscured by ferrous noise from a nearby burnt-out car, which makes it difficult to make a certain interpretation of these anomalies and would also obscure any further potential underlying anomalies. Area 3 contains linear anomalies; some of which are relatively well defined and strong. While an archaeological origin cannot be discounted, they are considered more likely to relate to industrial activity, such as the coal yard or the former gasworks immediately to the south and west of the survey area. This includes a spread of strongly magnetic material present on the western edge of the survey area (OS Mapping 1902).

7.2.4. Several weak linear anomalies have been identified across the site. Most are grouped along the northern boundary in a north-south orientation across the slope. This is indicative of downslope natural drainage.

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. **Undetermined (Strong and Weak)** – Several strong and weak linear anomalies [1a] have been identified in Area 1. They exhibit a strong signal most explicit in the gradient data (Figure 4). These anomalies all appear to lead from the location of an old building on historic mapping (OS Map 1926). However, this location is currently covered by a burnt-out car whose ferrous signal obscures any further potential underlying anomalies and which also does not allow for a certain interpretation of the surrounding anomalies.
- 7.3.2.2. **Undetermined (Strong and Weak)** – Within Area 3 are a series of fragmented linear anomalies. One of these anomalies stands out [3a] because it is stronger and more sharply defined than the others in the survey area. While an archaeological origin cannot be fully discounted, the presence of a gas works and gravel pits, c.150m to the west and c.90m to the north respectively, suggests a more recent, possibly industrial origin.
- 7.3.2.3. **Industrial/Modern (Spread)** – Dominating much of the western side of Area 3 is a series of small but strong dipolar anomalies, characteristic of a spread of magnetic material. The strength of this response suggests it could be caused by made ground or other activity relating to the gas works or gravel pits both of which are visible in historic mapping (OS Map 1902).

8. Conclusions

- 8.1. A fluxgate gradiometer survey has been successfully completed at land off Prospect Avenue, Rushden, Northamptonshire. C.0.9ha of the original area was unsurveyable due to overgrown vegetation. In the centre of the survey area was an area of hardstanding related to a former coal yard. Any anomalies or features that could possibly be underneath this area cannot be discerned due to the strong anomaly caused by the material used to create the level ground. Further modern activity and disturbance across the site relate to metal fencing around the edges of the survey area, a burnt-out car and other metal detritus that can be expected within an urban setting.
- 8.2. The geophysical survey has identified anomalies without clear interpretation. In the north east the anomalies all lead to/from a former building seen on historic mapping (OS Map 1926). However, this location is currently covered by a burnt-out car, which makes it difficult to make a confident interpretation of these anomalies as being related to the building. Further anomalies of undetermined origin are located in the south west and while an archaeological origin cannot be fully discounted any of these anomalies, their position next to a former gas works and gravel pits means that an industrial origin is considered more likely.
- 8.3. The survey has also identified a group of linear anomalies along the northern boundary that likely relate to natural downslope drainage.

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	MSSP741
Project Name	Prospect Avenue, Rushden
Client	RPS
Grid Reference	SP 9600 6760
Survey Techniques	Magnetometry
Survey Size (ha)	3.3ha (Magnetometry)
Survey Dates	2020-08-26
Project Lead	Julia Cantarano Ingénieur PCIfA
Project Officer	Julia Cantarano Ingénieur PCIfA
HER Event No	ENN109954
OASIS No	N/A
S42 Licence No	N/A
Report Version	0.5

13. Document History

Version	Comments	Author	Checked By	Date
0.1	Initial draft for Project Lead to Review	JD	JC	26 August 2020
0.2	Corrections for Director to Review	JD	FPC	27 August 2020
0.3	Corrections from Client	JC	JC	02 September 2020
0.4	Additional area surveyed	CA	KA	21 September 2020
0.5	Corrections from Client	JC	JC	24 September 2020



MSSP741 - Prospect Avenue, Rushden

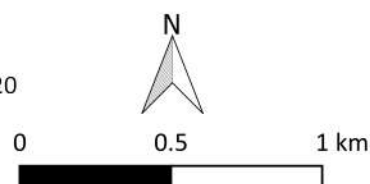
Figure 1 - Site Location

1:25,000 @ A4

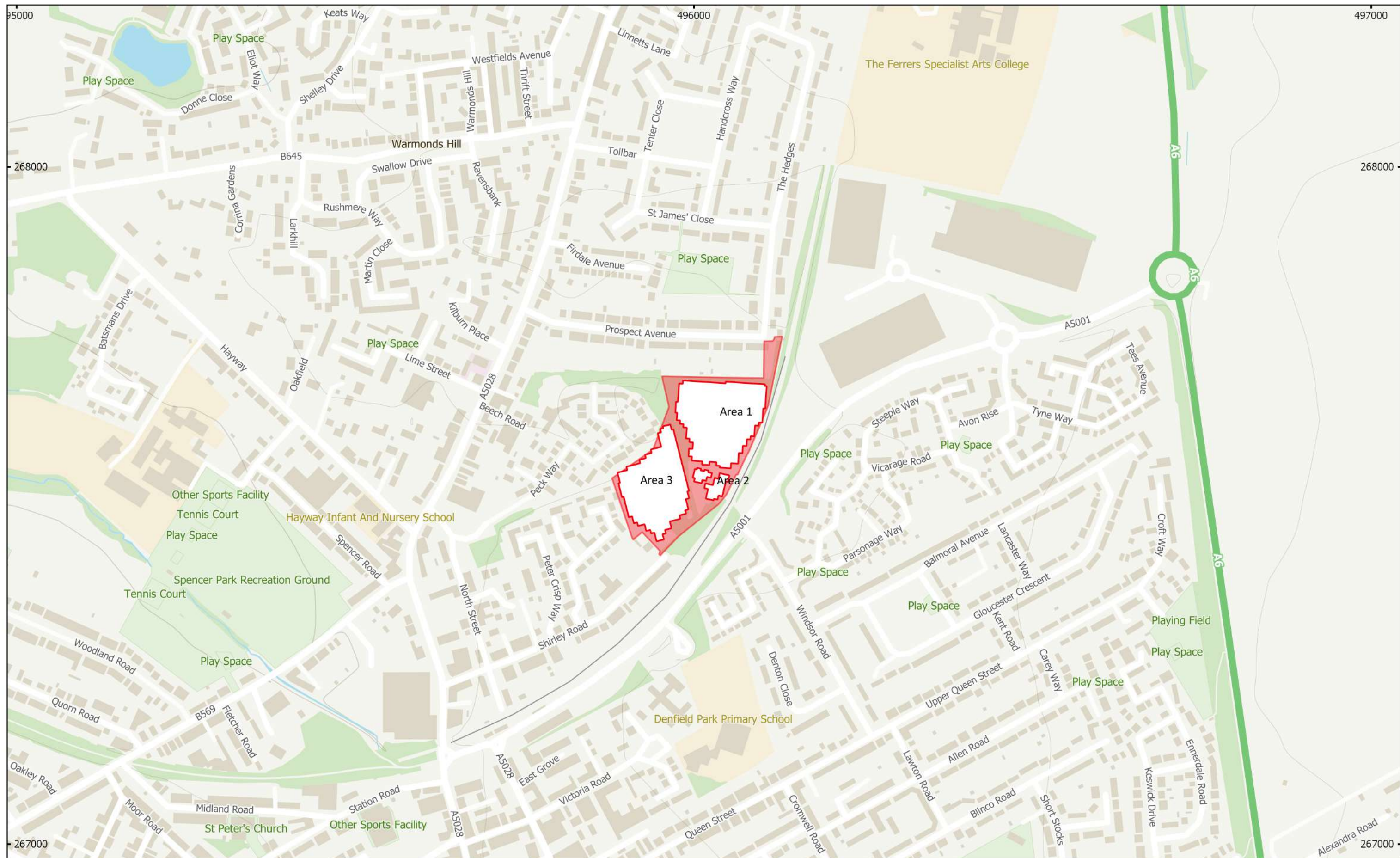
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 Site Boundary

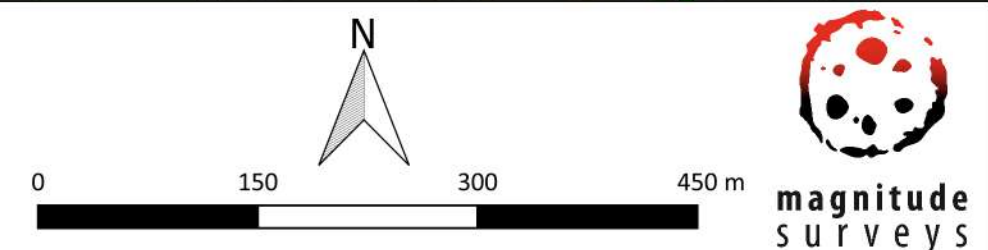


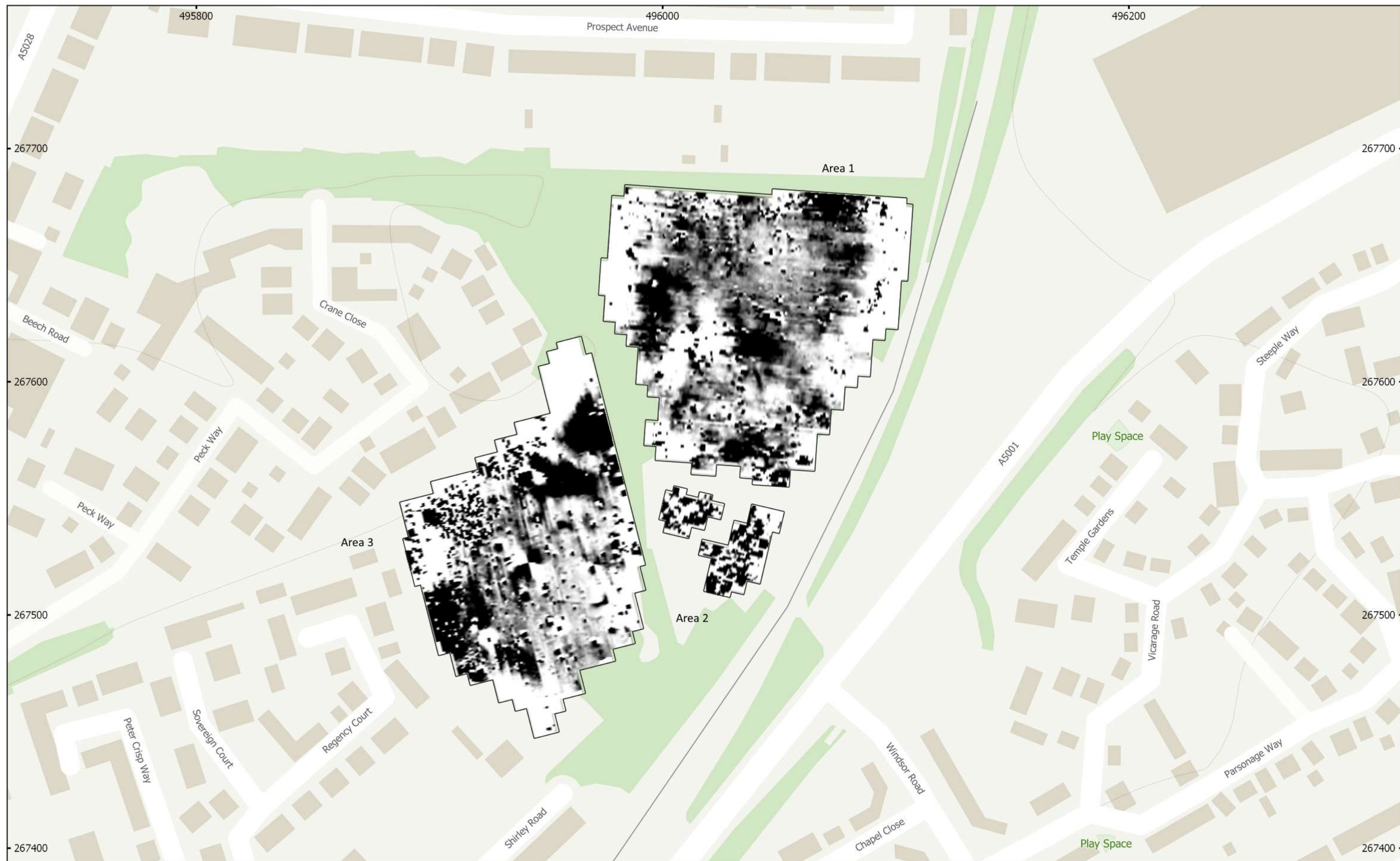
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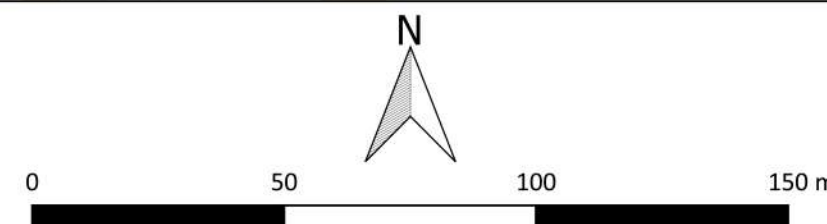
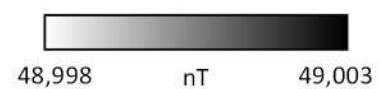
MSSP741 - Prospect Avenue, Rushden
 Figure 2 - Location of Survey Area
 1:5,000 @ A3
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- Survey Extent
- Unsurveyable Area



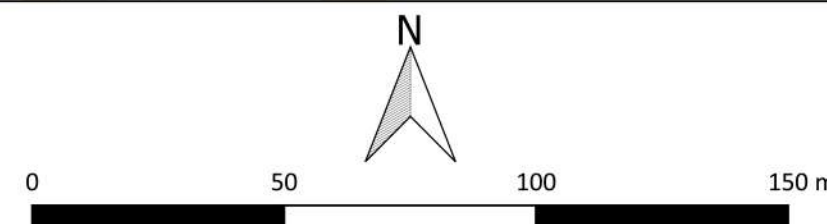
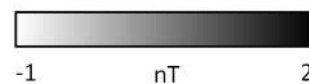


MSSP741 - Prospect Avenue, Rushden
Figure 3 - Magnetic Total Field (Lower Sensor)
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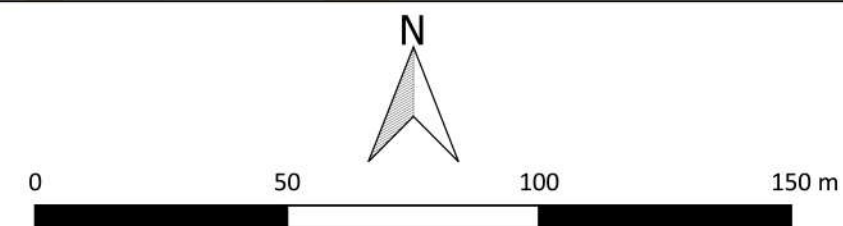
MSSP741 - Prospect Avenue, Rushden
Figure 4 - Magnetic Gradient
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MSSP741 - Prospect Avenue, Rushden
Figure 5 - Magnetic Interpretation
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- | | |
|------------------------------|---------------------------|
| ■ Undetermined (Strong) | ■ Natural (Weak) |
| ■ Undetermined (Weak) | ■ Magnetic Disturbance |
| ■ Hardstanding | ■ Ferrous/Debris (Spread) |
| ■ Industrial/Modern (Spread) | ■ Ferrous (Spike) |

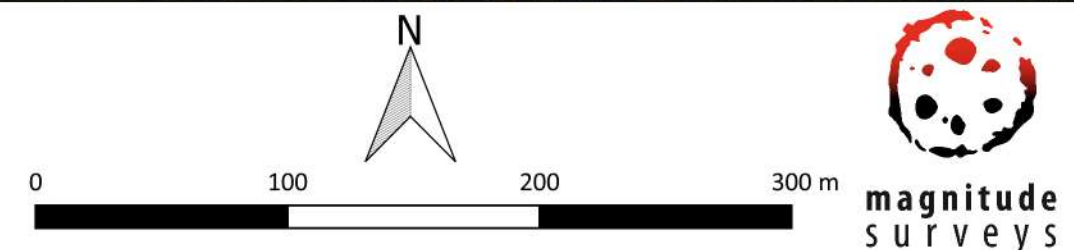


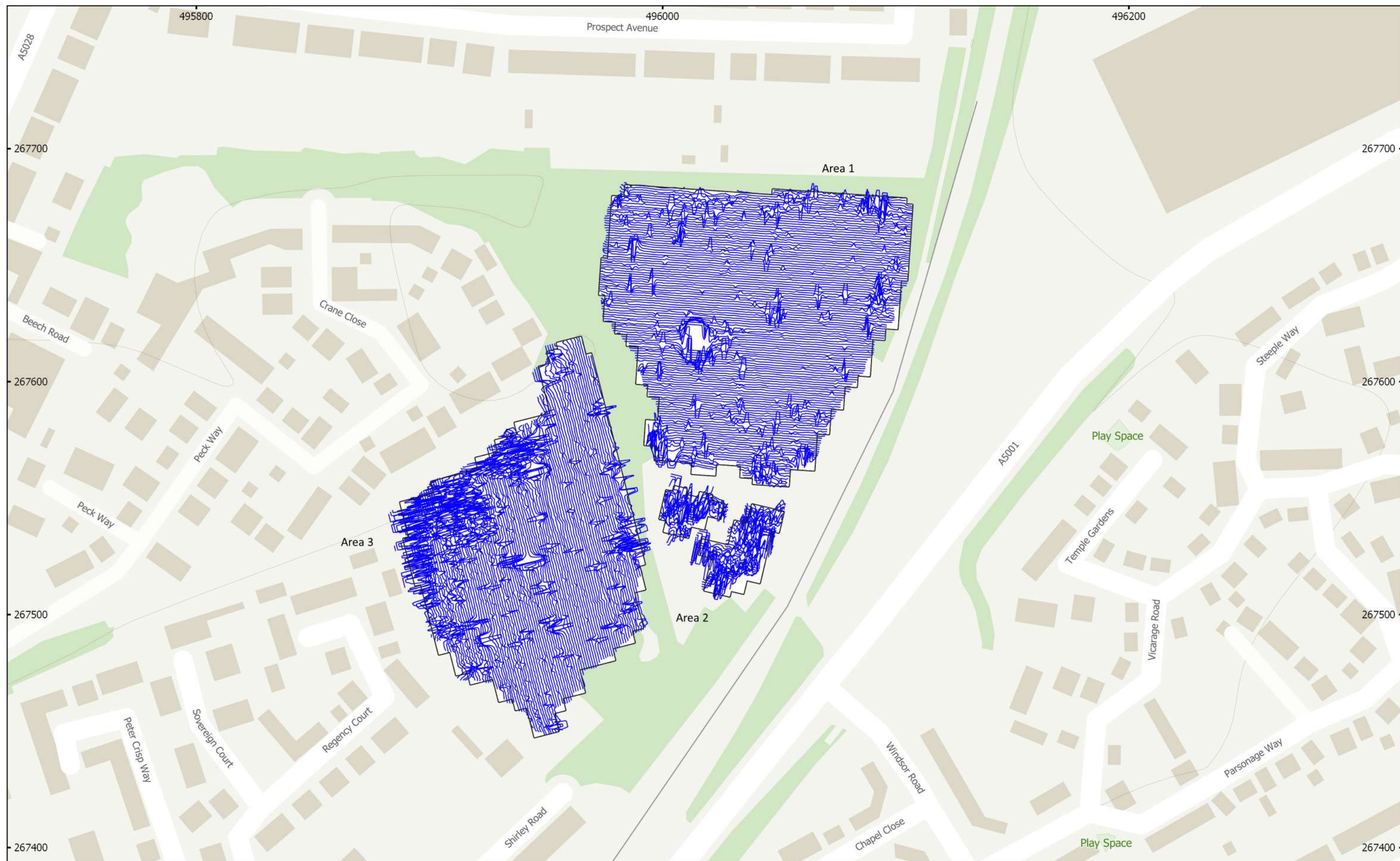
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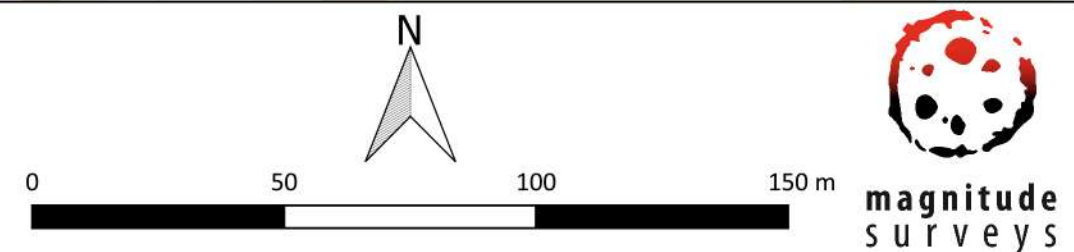
MSSP741 - Prospect Avenue, Rushden
 Figure 6 - Magnetic Interpretation Over Historic Maps
 1:3,000 @ A3
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 Contains historic maps: Ordnance Survey, 6" 2nd edition c. 1882-1913 ©
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- | | |
|----------------------------|-------------------------|
| Undetermined (Strong) | Natural (Weak) |
| Undetermined (Weak) | Magnetic Disturbance |
| Hardstanding | Ferrous/Debris (Spread) |
| Industrial/Modern (Spread) | Ferrous (Spike) |





MSSP741 - Prospect Avenue, Rushden
Figure 7 - XY Trace Plot
90nT/cm at 1:1,500 @ A3
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