Geophysical Survey Report

Land off Offenham Road

Evesham

For

Cotswold Archaeology

On Behalf Of

Lone Star Land

Magnitude Surveys Ref: MSSP1076

HER Event Number: WSM77747

OASIS Number: magnitud-502325

September 2021

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Abstract

Magnitude Surveys was commissioned to assess the sub-surface archaeological potential of c. 1ha area of land off Offenham Road, Evensham, Worcestershire. A fluxgate gradiometer survey was carried out across c. 0.6ha of land, with the remaining c. 0.4ha not able to be surveyed due to dense vegetation. The survey data is dominated by magnetic disturbance emanating from the extant field boundaries, and a ferrous spread, likely caused by construction debris or residential waste, producing large areas of noise across the survey area. However, trends within this debris have been identified. These likely relate to former hedges and/or fencing planted in a linear orientation, visible in satellite imagery. No anomalies suggestive of an archaeological origin were detected; however, due to the presence of such strong magnetic disturbance across the survey area, anomalies of archaeological origin (typically weaker), if present, will have been masked.

Contents

List of Figures

1. Introduction

1.1. Magnitude Surveys Ltd (MS) was commissioned by Cotswold Archaeology on behalf of Lone Star Land to undertake a geophysical survey over a c. 1ha area of land off Offenham Road, Evesham, Worcestershire (SP 0508 4400).

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 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 (Adams, 2021).

1.5. The survey commenced on 24/09/21 and took one day 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 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, is a Fellow of the Society of Antiquaries of London, 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. 1km northeast of the centre of Evesham (Figure 1). The gradiometer survey was undertaken across a single field under recently cut scrub vegetation. The survey area was bordered by residential buildings and gardens on all sides (Figure 2). Due to dense vegetation, c. 0.4ha was not able to be surveyed.

4.2. Survey considerations:

Survey Area	Ground Conditions	Further Notes
1	The area consisted of a generally level field covered by recently cut scrub vegetation.	The survey area was bordered by residential buildings and wooden panel fencing on all sides. Mounds of recently cut vegetation were present throughout the area, in addition to scattered building rubble.

4.3. The underlying geology comprises undifferentiated mudstone of the Blue Lias and Charmouth Mudstone Formations. Superficial deposits of sands and gravels of the Alstone Member are recorded in the south of the survey area. No superficial deposits are recorded in the north (British Geological Survey, 2021).

4.4. Lime-rich loamy and clayey soils with impeded drainage are present throughout the survey area. (Soilscapes, 2021).

5. Archaeological Background

5.1. The following is a summary of a draft Historic Environment Desk-Based Assessment produced and provided by Cotswold Archaeology (Heimpel, 2021).

5.2. No known pre-historic or Roman activity is recorded within the survey area. However, pre-historic settlement, spanning from the early Bronze Age to late Iron Age have been identified within the surrounding area. This includes a Bronze Age settlement and Iron Age enclosure excavated c. 200m north west and a beaker burial c. 480m north of the survey area. Further pre-historic to Roman activity is known from the National Mapping Programme, including several enclosures, barrows and hut circles. Further evidence comes from scattered findspots of flints, coins and pottery.

5.3. No known Early Medieval or Medieval remains are recorded within the survey area. However, the survey area lies immediately north of the settlement of Bengeworth, recorded in the Domesday Survey. The Manor of Bengeworth was used as the home of the priors of Evesham Abbey, c. 850m south of the survey area. The survey area would have formed part of the agricultural hinterland associated with the monastery at Evesham and monastic activity at Bengeworth.

5.4. During the post-medieval period the survey area has continued to be used for agriculture, with orchards being shown on the 1st edition OS Map. Post-medieval features identified within the vicinity of the survey area include a sand pit c. 400m west, a Victorian rubbish pit c. 660m west and a Penny of Charles I c. 20m west of the survey area.

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 hand-carried GNSS-positioned system.

6.1.4.1. 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.

6.1.4.2. 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 7). 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 (2021) 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 (Figure 6).

7.2.2. A fluxgate gradiometer survey was successfully completed across c. 0.6ha of a field consisting of recently cut scrub vegetation. An area of c. 0.4ha was unable to be surveyed due to dense vegetation (see Section 4). Overall, the fluxgate gradiometer data is dominated by magnetic disturbance attributed to extant field boundaries, in addition to spreads of ferrous debris, likely originating from construction and/or residential waste. The survey has not detected any anomalies of probable or possible archaeological origin. However, weaker anomalies, including those of an archaeological origin if present, will have been masked by the aforementioned magnetic disturbance and ferrous debris.

7.2.3. Some of the ferrous spreads appear to form a linear pattern. These trends align with hedges and/or fencing visible in satellite imagery (Google Earth Pro, 2021) (Figure 6) and will likely have been caused by the removal or remains of these features.

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.

7.3.2. Magnetic Results - Specific Anomalies

7.3.2.1. **Ferrous (Trends)** – Three broad, linear trends have been identified within the survey area running roughly northeast-southwest. These anomalies align with

linear features, likely hedges and/or fencing, crossing the survey area and visible in satellite imagery (Google Earth Pro, 2021) (Figure 6). Due to this shared alignment these trends are considered likely to be caused by material remaining from the removal of these features.

8. Conclusions

8.1. A fluxgate gradiometer survey has been successfully undertaken over part of the commissioned survey area. The remaining area was not surveyed due to the presence of dense vegetation. A spread of ferrous anomalies likely originating from construction debris or residential waste was identified. Within this spread, linear trends are present which likely relate to fencing or other features which are visible on satellite imagery.

8.2. No anomalies suggestive of significant archaeological activity were identified within the survey area. However, it should be noted that magnetic disturbance caused by extant boundaries may have masked any such features, if present.

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

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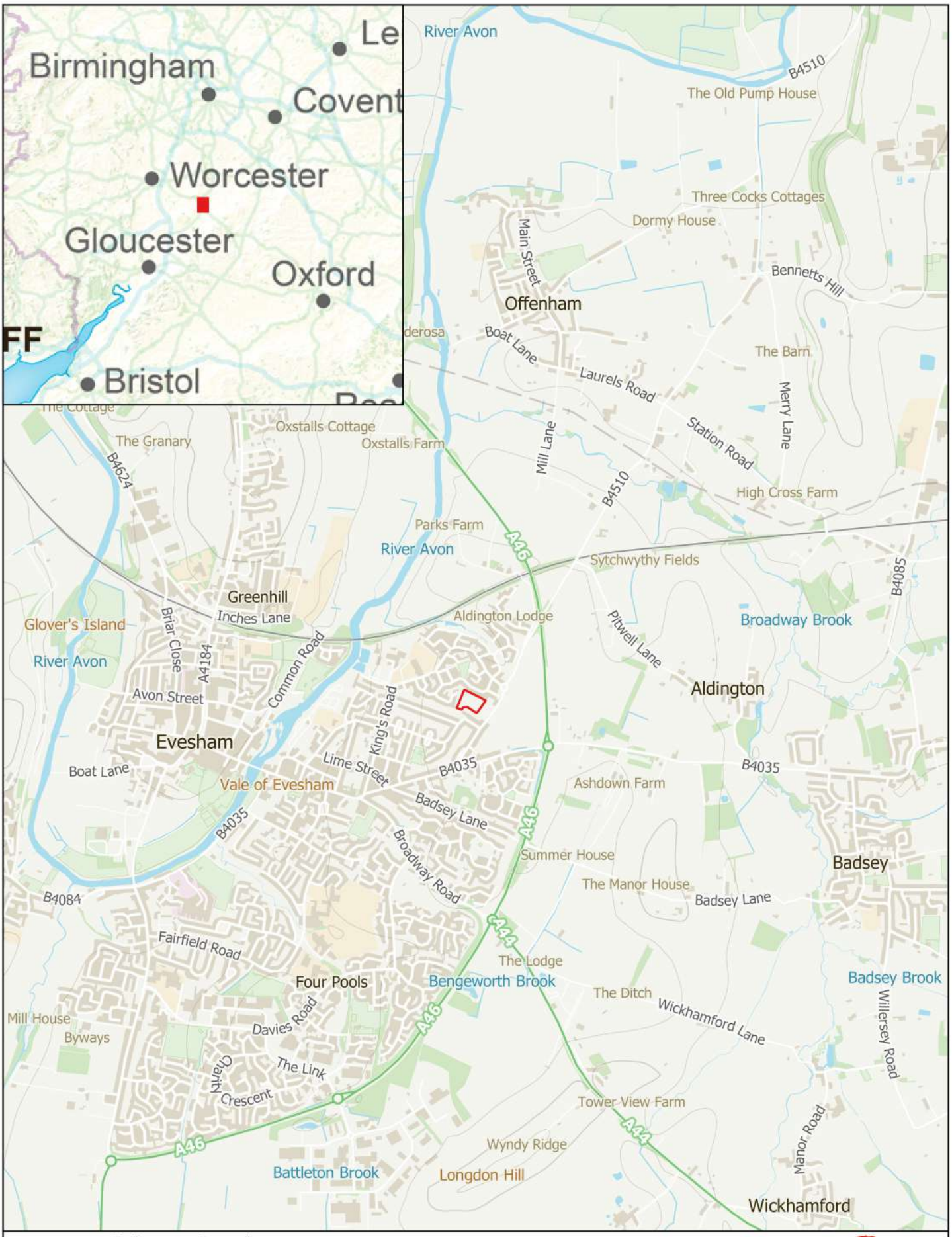
12. Project Metadata

MS Job Code	MSSP1076
Project Name	Land off Offenham Road, Evesham
Client	Cotswold Archaeology
Grid Reference	SP 0508 4400
Survey Techniques	Magnetometry
Survey Size (ha)	1ha
Survey Dates	2021-09-24
Project Lead	Christian Adams BA MSc ACIfA
Project Officer	Christian Adams BA MSc ACIfA
HER Event No	WSM77747
OASIS No	magnitud-502325
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	DW	CA	01 October 2021
0.2	Corrections from Project Lead	DW	HB	01 October 2021
1.0	Report issued as Final	CA	CA	18 October 2021



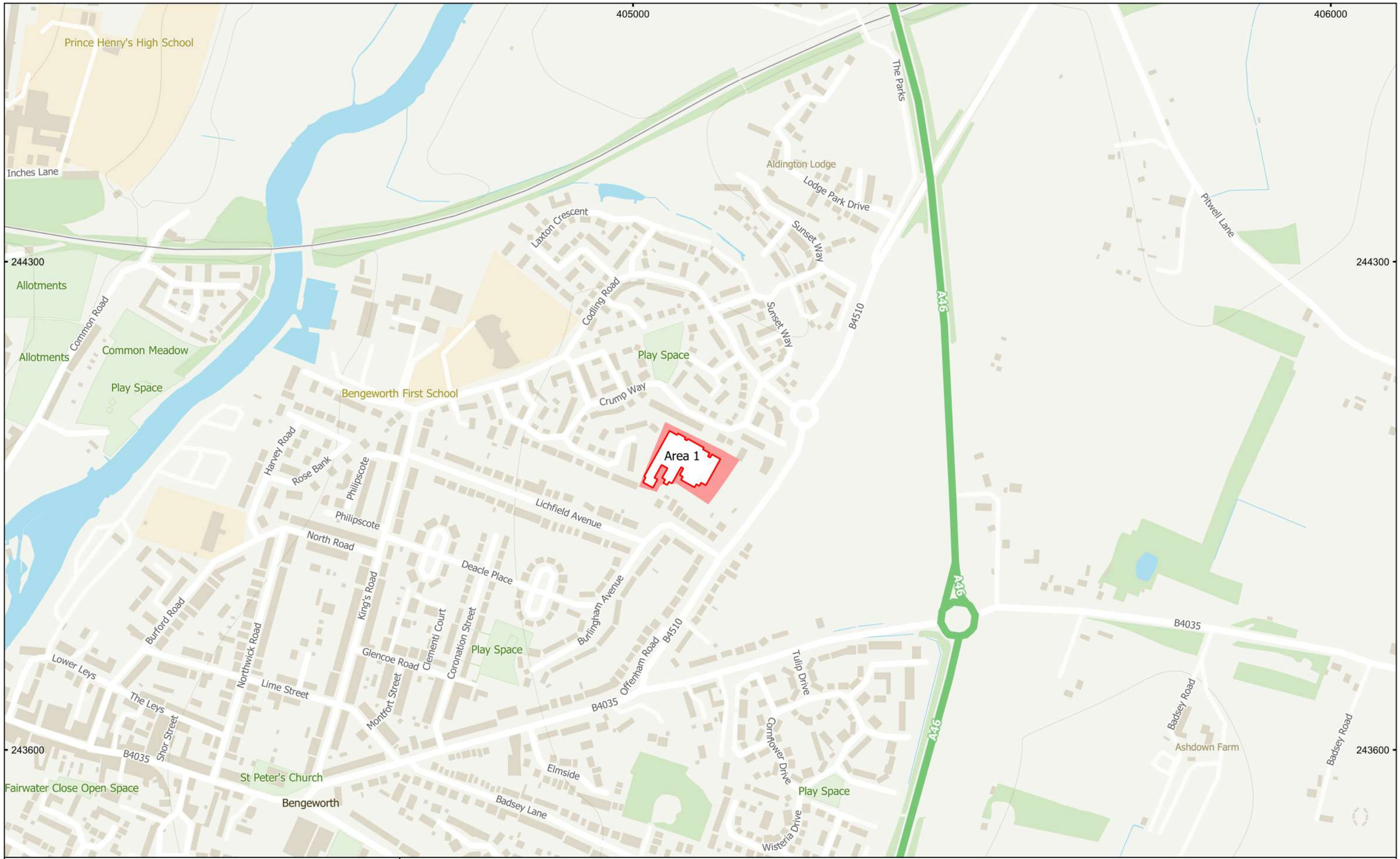
MSSP1076 - Offenham Road, Evesham
Figure 1 - Site Location
1:25,000 @ A4

Site Boundary

N

0 0.5 1 km

magnitude surveys



MSSP1076 - Offenham Road, Evesham
Figure 2 - Location of Survey Area
1:5,000 @ A3

Survey Extent
Not Surveyable

N

0 125 250 375 m

magnitude surveys

405000

405200

Discovery Lane

Pearmain Drive

Crump Way

Codling Road

B4510

Biffin Close

244050

244050

Area 1

Egremont Close

B4510

Lichfield Avenue

243900

243900

MSSP1076 - Offenham Road, Evesham
Figure 3 - Total Field (Lower Sensor)
1:1,000 @ A3

48,990 nT 49,020

N

0 20 40 60 m

magnitude surveys

405000

405200

Discovery Lane

Pearmain Drive

Crump Way

Codling Road

B4510

244050

244050

Biffin Close

Area 1

Egremont Close

B4510

Lichfield Avenue

243900

243900

MSSP1076 - Offenham Road, Evesham
Figure 4 - Magnetic Gradient
1:1,000 @ A3

-1 nT 2

N

0 20 40 60 m

magnitude surveys

405000

405200

Discovery Lane

Pearmain Drive

Crump Way

Codling Road

B4510

244050

244050

Biffin Close

Area 1

Egremont Close

B4510

Lichfield Avenue

243900

243900

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Figure 5 - Magnetic Interpretation
1:1,000 @ A3

Magnetic Disturbance
Ferrous/Debris (Spread)
Ferrous (Trend)
Ferrous (Spike)

N

0 20 40 60 m

magnitude surveys

405000

405600

244200

244200

243900

243900

Area 1

Evesham Joint Hospital

Mund. Boro. By.

BENGEWORTH

B.M. 155·0

B.M. 134·7

B.M. 146·2

B.M. 147·4

The Elm

Evesham

Chipping Campden

MSSP1076 - Offenham Road, Evesham
Figure 6 - Magnetic Interpretation Over Historical Maps and Satellite Imagery
1:3,000 @ A3

Contains historical mapping © CLS Data 2021: Ordnance Survey, 6" 2nd edition c. 1882-1913
Contains satellite imagery © Bing Satellite 2021

Magnetic Disturbance
Ferrous/Debris (Spread)
Ferrous (Trend)
Ferrous (Spike)

N

0 50 100 150 m

magnitude surveys

405000

405200

Discovery Lane

Pearmain Drive

Crump Way

Codling Road

B4510

244050

244050

Biffin Close

Area 1

Egremont Close

B4510

Lichfield Avenue

243900

243900

MSSP1076 - Offenham Road, Evesham
Figure 7 - XY Trace Plot
30nT/cm at 1:1,500 @ A3

N

0 20 40 60 m

magnitude surveys