# Cambridge International School

# Little Abington, Cambridge

# Geophysical Survey Report MSTL20

**For**

**CgMs**

**on behalf of**

**Magnitude Surveys Ref: MSTL20**

**April 2016**

**Unit 17, Commerce Court**

**Challenge Way**

**Bradford**

**BD4 8NW**

**+44 (0)1274 926020**

**info@magnitudesurveys.co.uk**

**Report Written by:**

Chrys Harris BA MSc

**Figures Produced by:**

Graeme Attwood MSc MCIfA

**Report Checked by:**

Finnegan Pope-Carter BSc MSc FGS

**Draft Issued:**

27 April 2016

## Abstract

Magnitude Surveys was commissioned to assess the archaeological potential of *c.* 4 ha of land at the Cambridge International School, Little Abington through geophysical survey. A full coverage cart-based fluxgate gradiometer survey and a targeted earth resistance survey were successfully completed and identified several anomalies of probable and possible archaeological origin. Anomalies reflecting natural soil variation and modern structures were also detected.

# Contents

# List of Figures

# 1. Introduction

1.1. Magnitude Surveys Ltd (MS) was commissioned by CgMs on behalf of CLIENT'S CLIENT to undertake a geophysical survey on land at the Cambridge International School, Little Abington (TL 730 560). The geophysical survey comprised:

1.1.1. Hand-pulled, cart-mounted fluxgate gradiometer survey of entire survey area.

1.1.2. Manual earth resistance survey of a targeted area.

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

1.3. The survey commenced on 18 April 2016 and took two days to complete.

# 2. Quality Assurance

2.1. Project management, survey work, data processing and report production have been carried out by qualified and professional geophysicists to standards exceeding the current best practice (CIfA, 2014; David et al., 2008, Schmidt et al., 2015).

2.2. Magnitude Surveys is a corporate member of ISAP (International Society of Archaeological Prospection).

2.3. Graeme Attwood is a Member of the Chartered Institute for Archaeologists (CIfA), the chartered UK body for archaeologists, as well as a member of GeoSIG, the CIfA Geophysics Special Interest Group.

2.4. Finnegan Pope-Carter is a Fellow of the London Geological Society, the chartered UK body for geophysicists and geologists, as well as a member of GeoSIG, the CIfA Geophysics Special Interest Group.

2.5. All MS staff members have postgraduate qualifications in archaeological geophysics.

# 3. Objectives

3.1. The geophysical survey aimed to assess the potential archaeological landscape of the survey area.

# 4. Geographic Background

4.1. The underlying geology comprises Holywell Nodular Chalk Formation (BGS, 2016). Historic England guidelines state the average magnetic response over chalk is good (David et al., 2008: 15).

4.2. The soils consist of freely draining slightly acid but base-rich soils (Soilscapes, 2016).

4.3. Survey was undertaken over a single field, which was generally flat but sloped gently down from northwest to southeast.

# 5. Archaeological Background

5.1. The following archaeological background is summarised from the site's desk-based assessment written by CgMs (Clark, 2015).

5.2. An aerial photographic assessment has provided evidence for substantial prehistoric monuments in and around the survey area (Palmer, 1994). Within the survey area, crop marks in the form of two curved infilled ditches have been interpreted as a possible Neolithic long barrow (CHER No: 09356a). Directly north of the survey area lies two Bronze Age round barrows and a third probably barrow (CHER No: 09356). Geophysical survey 60 m southeast of the survey area confirmed a ring ditch (Cranfield Forensic Institute, 2013), which has been interpreted as an additional round barrow site. Farther away from the survey area, a group of four 30 m – 40 m sized ring ditch barrows lie 910 m northeast of the survey area (CHER No: 06281). An additional round barrow has been recorded 325 m east of the survey area (CHER No: 06172).

5.3. Bronze Age settlement and occupational activity has been identified in the area surrounding the survey area through fieldwalking and excavation. Two burials and a 10 m ring-ditch with a partial circle of pits outside its perimeter have been identified 365 m west of the survey area.

5.4. Iron Age/Roman activity has been identified in the areas surrounding the survey area including artefactual remains, pits, field systems, roads, enclosures, ditches and settlement activity.

5.5. Early Saxon activity has been identified to the west of the survey area, in the form of Grubenhauser, artefactual remains and potential burials.

5.6. Late Saxon/Medieval activity has been identified mostly to the south and southeast of the survey area.

# 6. Methodology

## 6.1. Data Collection

6.1.1. Geophysical prospection comprised magnetic and earth resistance methods as described in the following table.

6.1.2. Table of survey strategies:

| Method | Instrument | Traverse Interval | Sample Interval |
|---|---|---|---|
| Magnetic | Bartington Instruments Grad-13 Digital Three-Axis Gradiometer | 1 m | 200 Hz reprojected to 0.125 m |
| Earth Resistance | Geoscan Research RM15 with a PA20 probe array interfaced with an MPX15 multiplexer. | 1.0 m | 1.0 m |

6.1.3. Magnetic data were collected using MS' bespoke hand-pulled cart system.

6.1.3.1. The cart system supports the magnetic and GPS instruments with a bespoke datalogger. The magnetic instrument comprises four Bartington Instruments Grad-13 Digital Three-Axis Gradiometer operating in NMEA mode. Positional referencing is through a Hemisphere S321 RTK GPS outputting in NMEA mode. Corrections were made through Topcon TopNet. Data from both instruments were logged in a bespoke datalogger. Data were transferred to a laptop computer for processing.

6.1.3.2. A series of temporary sight markers were established in each survey area to guide the surveyor and ensure full coverage with the cart. Data were collected by traversing the survey area along the longest possible lines, to ensure that the data was efficiently collected and processed.

6.1.4. Earth resistance data were collected using a Geoscan Research RM15 meter with a PA20 multi-probe array interfacing with an MPX15 multiplexer.

6.1.4.1. The PA20 probe array was configured in two parallel twin-probe configurations with 0.5 m electrode spacing.

6.1.4.2. Earth resistance data were collected in 30 m x 30m grids in a targeted area over the possible Neolithic long barrow and to the west of the barrow in an area of interest from the magnetic results. Grid corners were positioned using a Hemisphere S321 RTK GPS. Corrections were made through Topcon TopNet.

## 6.2. Data Processing

6.2.1. Magnetic data were processed in bespoke in-house software produced by MS. Processing steps were limited to:

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.

6.2.2. Earth resistance data were processed using the commercial software package Geoplot v. 4.0 by Geoscan Research. Processing steps were limited to:

Merge Data – The two parallel twin-probe datasets were merged to form one complete dataset.

Despike – Random and spurious readings are corrected using the despike tool. The despike algorithm compares the individual measurement values within a user-defined

window and replaces measurements outside a user-defined threshold with the window mean.

Edge Match – Imbalances between grid means due to the movement of the remote electrodes are corrected by adjusting the mean edge of a reference grid to match that of an adjacent grid.

High Pass Filter – A high pass filter is used to remove large scale background trends related to changes in geology or soil moisture content. These trends can mask small scale features which may be of archaeological significance. The resultant data is compared to pre-filtered data to ensure no features have been lost.

## 6.3. Data Visualisation

6.3.1. Geophysical results are presented as greyscale images in a layered environment.

6.3.2. Greyscales should be viewed alongside the XY trace plots, found on the archive disk. XY trace plots visualise the magnitude and form of the geophysical response, aiding in anomaly interpretation.

# 7. Survey Considerations

| Survey Area | No. Survey Blocks | Surveyed Y/N | Ground Conditions | Further Notes |
|---|---|---|---|---|
| 1 | 1 | Y | The NW corner of the survey area was a playing field, with the rest of the area under meadow grass. Topsoil was dry. | There were was no visible ground evidence for the possible Neolithic long barrow feature during survey. |

# 8. Results

## 8.1. Qualification

8.1.1. *Geophysical techniques 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.*

## 8.2. Discussion

8.2.1. The geophysical results were interpreted in consideration with satellite imagery overlain with aerial photography assessment (Bing, 2016; Palmer, 1994; Figures 5 and 10) and historic mapping (Ordnance Survey, 6" 2nd edition *c.*1882-1913; Figure 6 and 11).

8.2.2. The magnetic survey has responded well to the survey area's environment. Two anomalies of probable archaeological origin have been identified. The possible Neolithic long barrow identified in aerial photography has been clearly detected in the magnetic results. A possible henge feature has been detected directly northwest of the possible long barrow. The magnetic results also show strong, ferrous responses caused by neighbouring modern structures, as well as natural soil variation.

8.2.3. The earth resistance survey shows greater soil variability than the magnetic results, which is likely exacerbated by the dry ground conditions. The site conditions have also introduced erroneous data measurements ("spikes") due to high contact resistance with the dry topsoil. The despiking processing algorithm was able to correct most of these spikes; however, some remain and make data interpretation more difficult. Despite these factors, the earth resistance survey has also detected the possible Neolithic long barrow and suggests a greater extent for this feature than magnetic survey. The possible henge feature is not detected in the earth resistance.

## 8.3. Interpretation

### 8.3.1. General Statements

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

8.3.1.2. **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.

8.3.1.3. **Ferrous** – A number of discrete ferrous-like anomalies have been mapped throughout the survey area. These responses are likely to be the result of modern metallic disturbance on or near the ground surface. Broad ferrous responses from modern metallic features, such as fences, gates and neighbouring buildings may mask any weaker underlying archaeological anomalies should they be present.

### 8.3.2. Magnetic Results - Specific Anomalies

8.3.2.1. **Possible Neolithic Long Barrow** – The magnetic survey has detected the possible Neolithic long barrow identified in the aerial photography. The aerial photography (AP) assessment interprets this feature as a pair of curved, infilled ditches. However, the magnetic response resolves this feature as a positive ovate shaped anomaly encircled by negative curvilinear anomalies. The earth resistance

results show a strong, low resistance anomaly that correlates with magnetic anomaly. This low resistance anomaly appears to extend in a linear direction northwards, although with a less explicit response. High resistance anomalies flank this low resistance response, which could indicate a structural aspect to this feature. This anomaly form is similar to other Neolithic long barrows mapped using earth resistance, but more ambiguous in shape and less explicit in magnitude (Marshall, 1998). Overall, the combined magnetic and earth resistance results provide further evidence supporting the original AP interpretation of a Neolithic long barrow. The lack of surface evidence for this feature suggests much of the barrow has been removed or obscured, which would account for the ambiguous nature of the earth resistance response.

8.3.2.2. **Possible Henge** – A substantial, positive magnetic circular anomaly has been detected immediately northwest of the possible Neolithic long barrow in the magnetic results. While this anomaly is situated between modern structures within the playing field of the school, its magnetically weak and ditch-like nature of response does not suggest a modern feature. At its widest extent, the diameter of this feature is ~ 66 m, which is significantly larger than known ring ditch barrows in the survey area's greater landscape. Furthermore, there are not any further distinct responses within the greater circular anomaly. Given the ditch-like nature of the anomalous response, the anomaly's substantial size and the lack of any distinct anomalies within the feature, this anomaly has been interpreted as a possible henge feature. While the anomaly has been classified as having probable archaeological origin, further investigative work would be required to confirm the henge origin.

8.3.2.3. **Possible Henge** – The earth resistance does not detect a correlating anomaly to the magnetic results. The lack of detection in the earth resistance indicates a very subtle and low contrast feature. Detection of the possible henge in the earth resistance is also likely hindered by the dry ground conditions; the earth resistance shows a noisy and highly variable environment in this area, which was likely exacerbated or caused by the dry ground conditions.

8.3.2.4. **Natural** – In the magnetic results, natural soil variations have produced a dappling effect running northeast-southwest in the eastern half of the site. This alignment coincides with topography noted on the historic mapping (Figures 6 and 11) and a "patterned soil area" (Palmer, 1994) marked on the aerial photography assessment (Figures 5 and 10).

8.3.2.5. **Natural** – In the earth resistance results, anomalies of a natural origin along the tree lines have been attributed to the absorption of moisture from tree roots.

8.3.2.6. **Ferrous** – A substantial ferrous anomaly in the centre of this natural variation is caused by a modern fire pit.

# 9. Conclusions

9.1. The geophysical survey has responded well to the survey area's archaeological, modern and natural environment.

9.2. The possible Neolithic long barrow identified in aerial photography has been detected in the magnetic and earth resistance results. The shape and nature of the geophysical responses provides further supporting evidence for a long barrow feature.

9.3. A previously unknown possible henge feature has been detected directly northwest of the possible long barrow. This feature is explicit in the magnetic results as a weak, positive magnetic contrast anomaly. The feature is not detected in the earth resistance results.

9.4. Natural soil variation detected in the magnetic survey correlates with historic mapping and aerial photography assessment.

9.5. The magnetic survey shows many strong, high contrast ferrous responses caused by modern structures and activity.

# 10. Archiving

10.1. MS maintains an in-house digital archive, which is based on Schmidt and Ernenwein (2013).

10.2. MS contributes all reports to the ADS Grey Literature Library subject to any time embargo dictated by the client.

10.3. Whenever possible, MS has a policy of making data available to view in easy to use forms on its website. This can benefit the client by making all of their reports available in a single repository, while also being a useful resource for research. Should a client wish to impose a time embargo on the availability of data this can be achieved in discussion with MS.

# 11. Copyright

11.1. 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.

# 12. References

Bing, 2016. Little Abington, Cambridgeshire. 52®7'29.18N, 0®13'22.32"W. ©Bing. [Accessed 25/04/2016]

British Geological Survey, 2016. Geology of Britain. Cambridge International School, Little Abington, CB21 6AN. [http://mapapps.bgs.ac.uk/geologyofbritain/home.html/]. [Accessed 25/04/2016].

Charted Institute for Archaeologists, 2014. Standards and guidance for archaeological geophysical survey. CIfA.

Clark, P., 2015. Archaeological Desk-Based Assessment: Cambridge International School, Little Abington, Cambridgeshire. Unpublished report by CgMs.

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.

Marshall, A., 1998. Neolithic long barrows: use of integrated remote sensing at high resolution to establish general layout and detect foreground structure. *Archaeological Prospection* 5: 101-116.

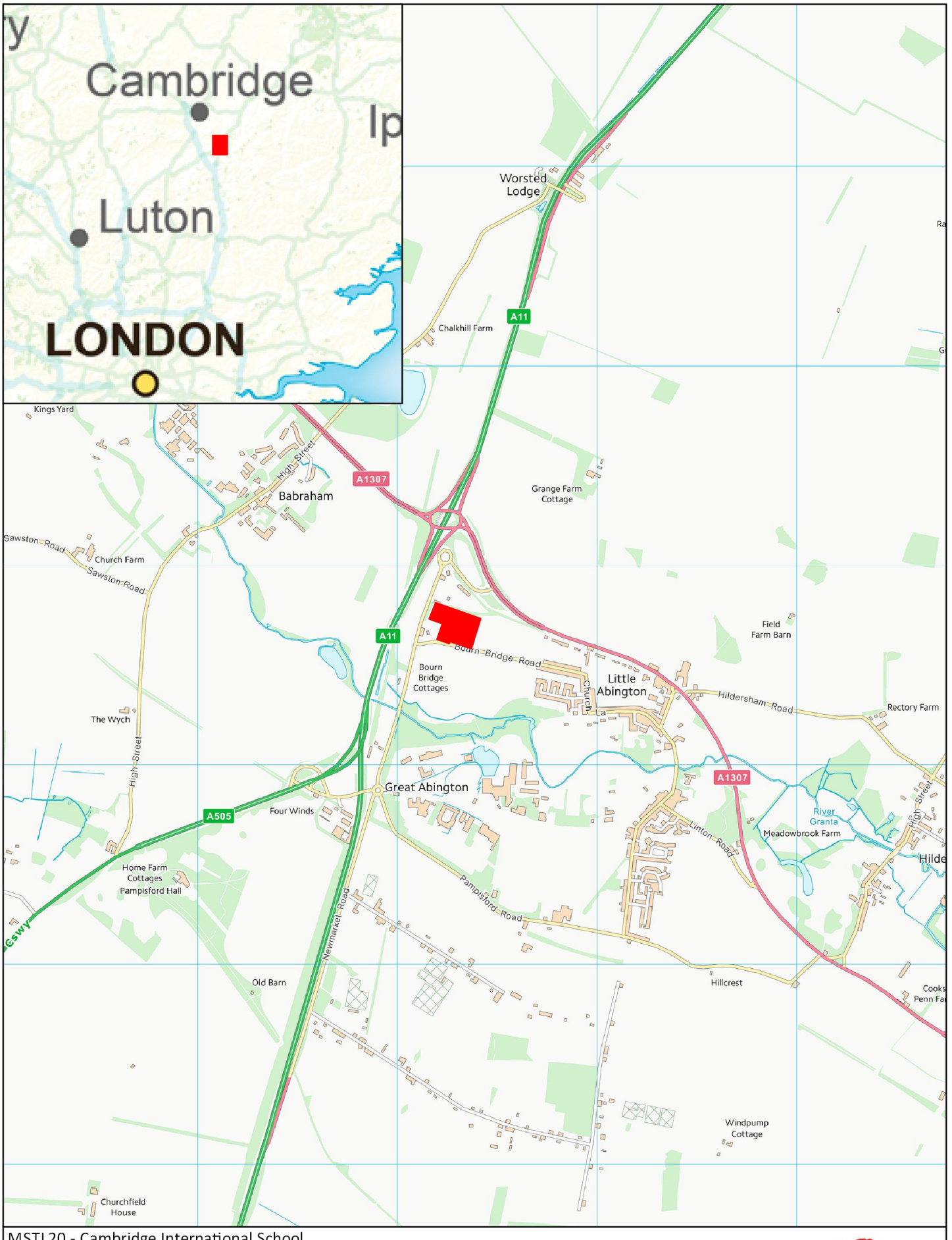
Ordnance Survey, 6" 2nd edition *c.*1882-1913. National Library of Scotland, 2016 [http://maps.nls.uk]. [Accessed 25/04/2016].

Palmer, R., 1994. A11/A604, Four Wentways (Centred TL523498), Abington, Cambridgeshire: Aerial Photographic Assessment. Unpublished report by Air Photo Services.

Schmidt, A. and Ernenwein, E., 2013. Guide to Good Practice: Geophysical Data in Archaeology. 2nd ed., 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, 2016. Cambridge International School, Little Abington, CB21 6AN.Cranfield University, National Soil Resources Institute [http://landis.org.uk]. [Accessed 25/04/2016].



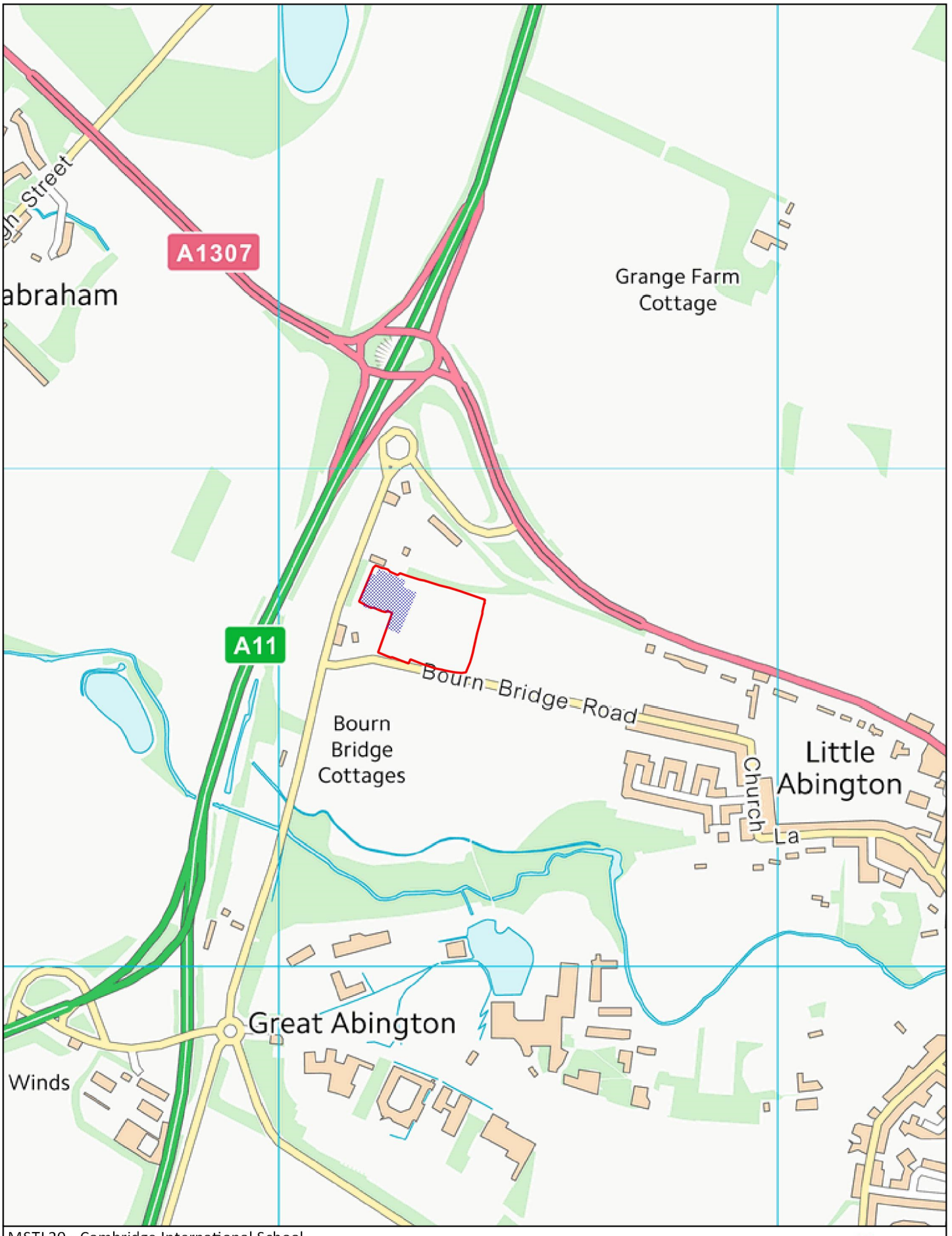

MSTL20 - Cambridge International School
Figure 1 - Site Location
1 : 25,000 @ A4


Survey Area

N

0 0.5 1 km

magnitude surveys




MSTL20 - Cambridge International School
Figure 2 - Survey Area
1 : 10,000 @ A4


N

0 200 400 m

Earth Resistance Survey  Magnetic Survey

magnitude surveys

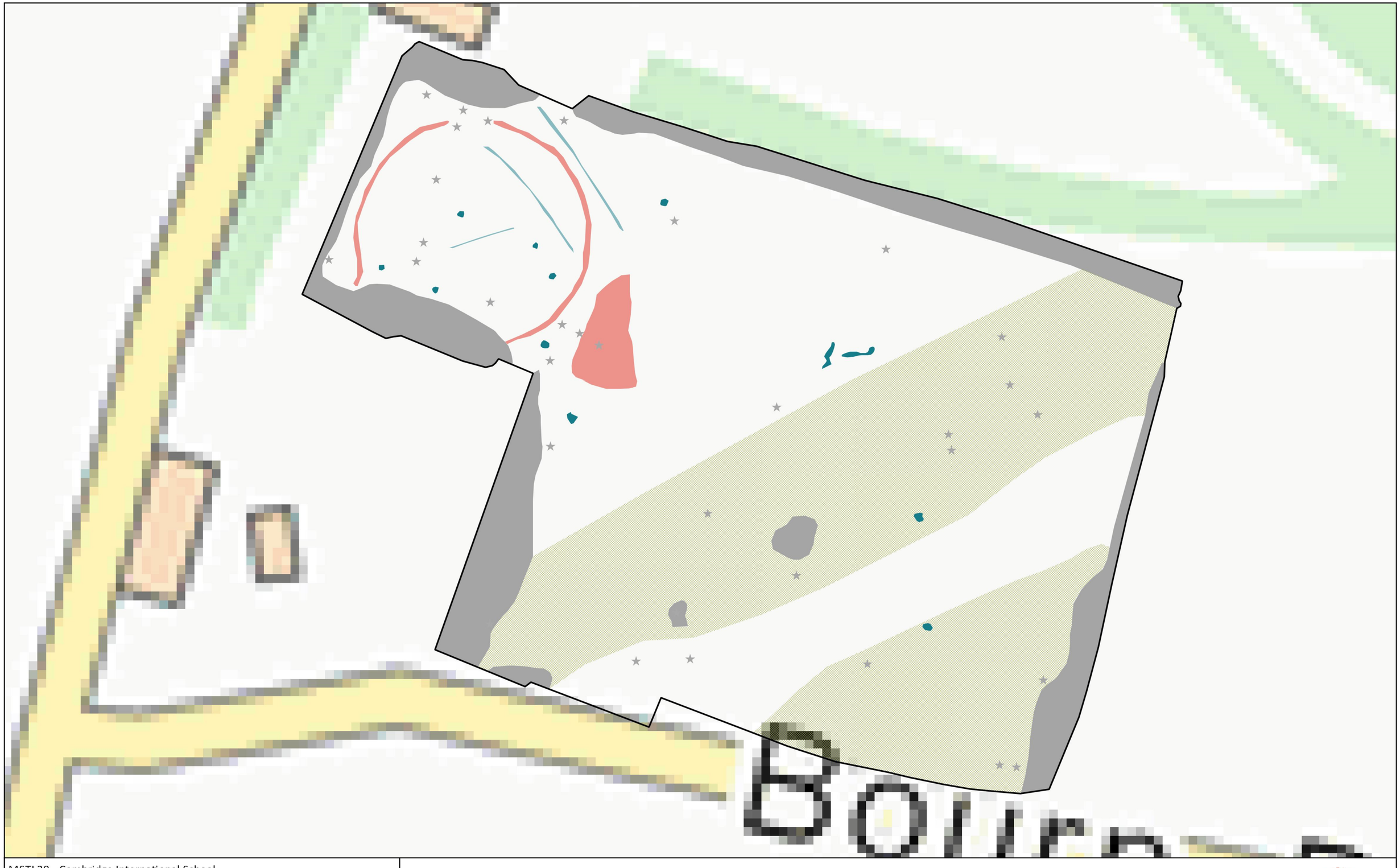
MSTL20 - Cambridge International School
Figure 3 - Magnetic Greyscale
1 : 1000 @ A3


-1 nT 2

N

0 25 50 m

magnitude surveys




MSTL20 - Cambridge International School
Figure 4 - Magnetic Interpretation
1 : 1000 @ A3


MSTL20 - Cambridge International School
Figure 5 - Magnetic Interpretation - Satellite and AP Overlay
1 : 2500 @ A3

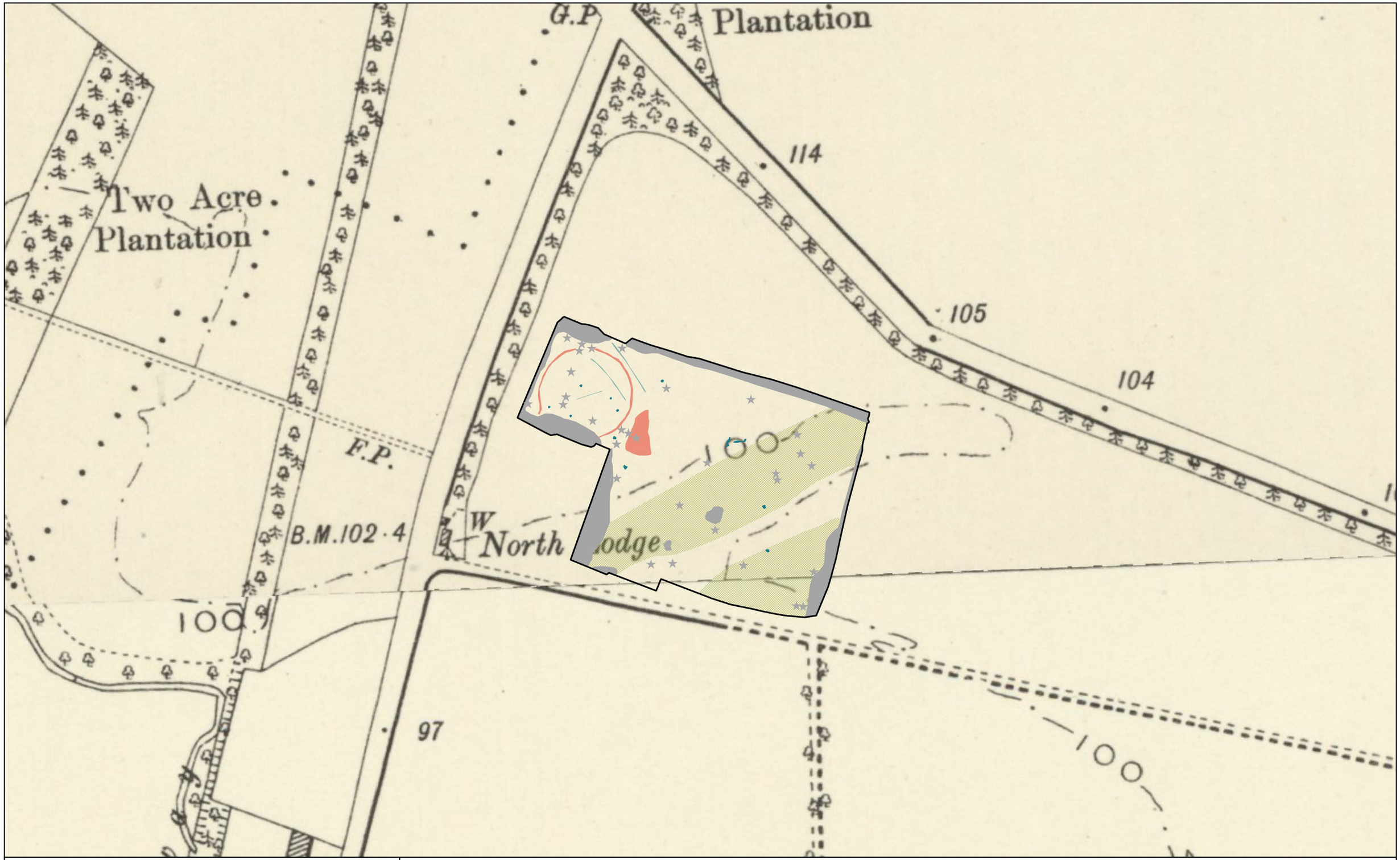
AP Figure after, Palmer, 1994

Survey Border
Archaeology Probable (Weak)
Undetermined (Strong)
Undetermined (Weak)
Ferrous (Dipolar)
Magnetic Spike

N

0 25 50 75 100 m

magnitude surveys




MSTL20 - Cambridge International School
Figure 6 - Magnetic Interpretation - Historic Mapping
1 : 2500 @ A3

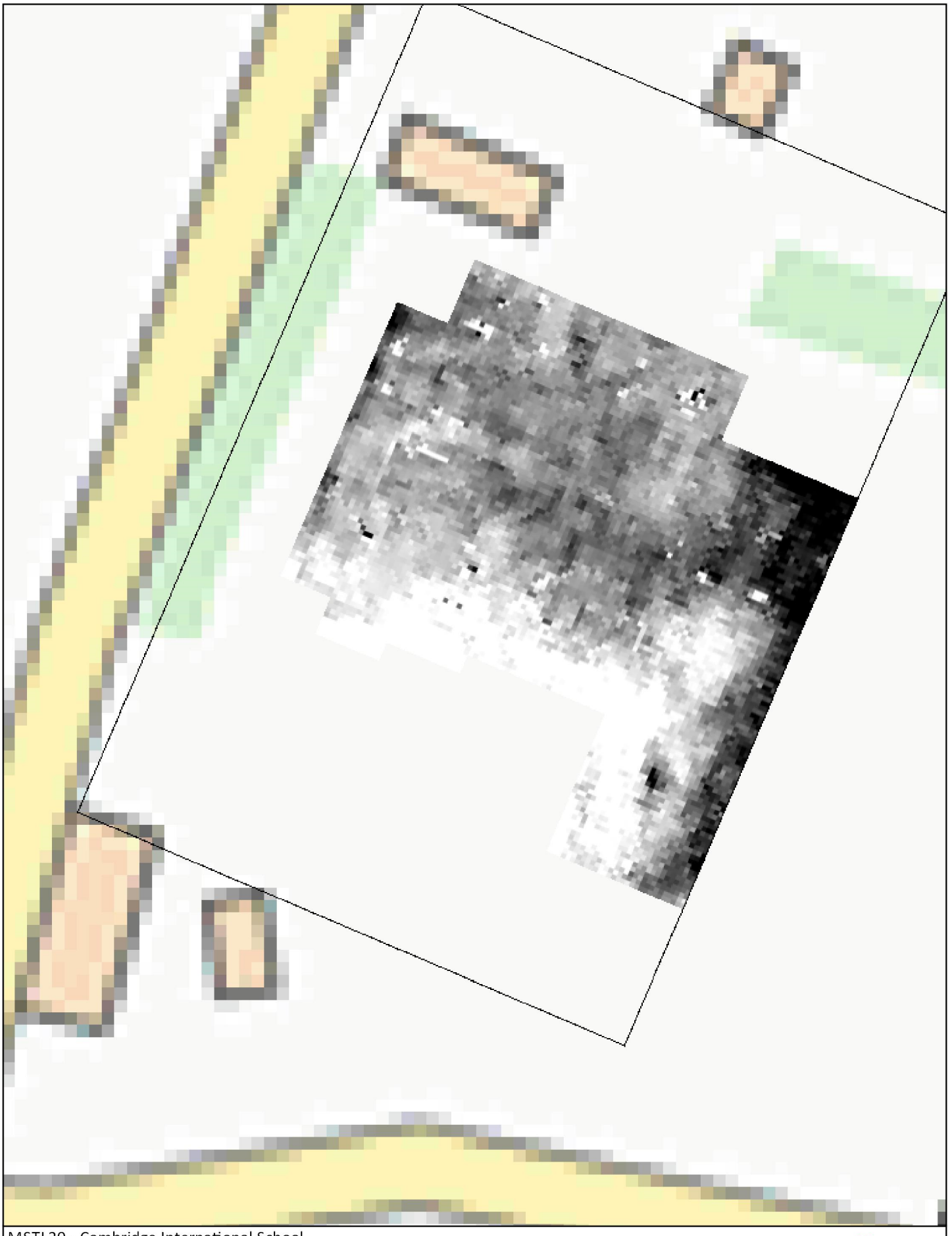
Historic Mapping Ordnance Survey, 6" second edition c. 1882-1913.
National Library of Scotland

- Survey Border
- Archaeology Probable (Weak)
- Undetermined (Strong)
- Undetermined (Weak)
- Ferrous (Dipolar)
- Magnetic Spike

N

0 25 50 75 100 m

magnitude surveys



MSTL20 - Cambridge International School
Figure 7 - Earth Resistance Greyscale
1 : 1000 @ A4


N

0 25 50 m

magnitude surveys

MSTL20 - Cambridge International School
Figure 8 - Earth Resistance Greyscale - High Pass Filtered
1 : 1000 @ A4


N

0 25 50 m

magnitude surveys


MSTL20 - Cambridge International School
Figure 9 - Earth Resistance Interpretation
1 : 1000 @ A4


N

0 25 50 m

magnitude surveys

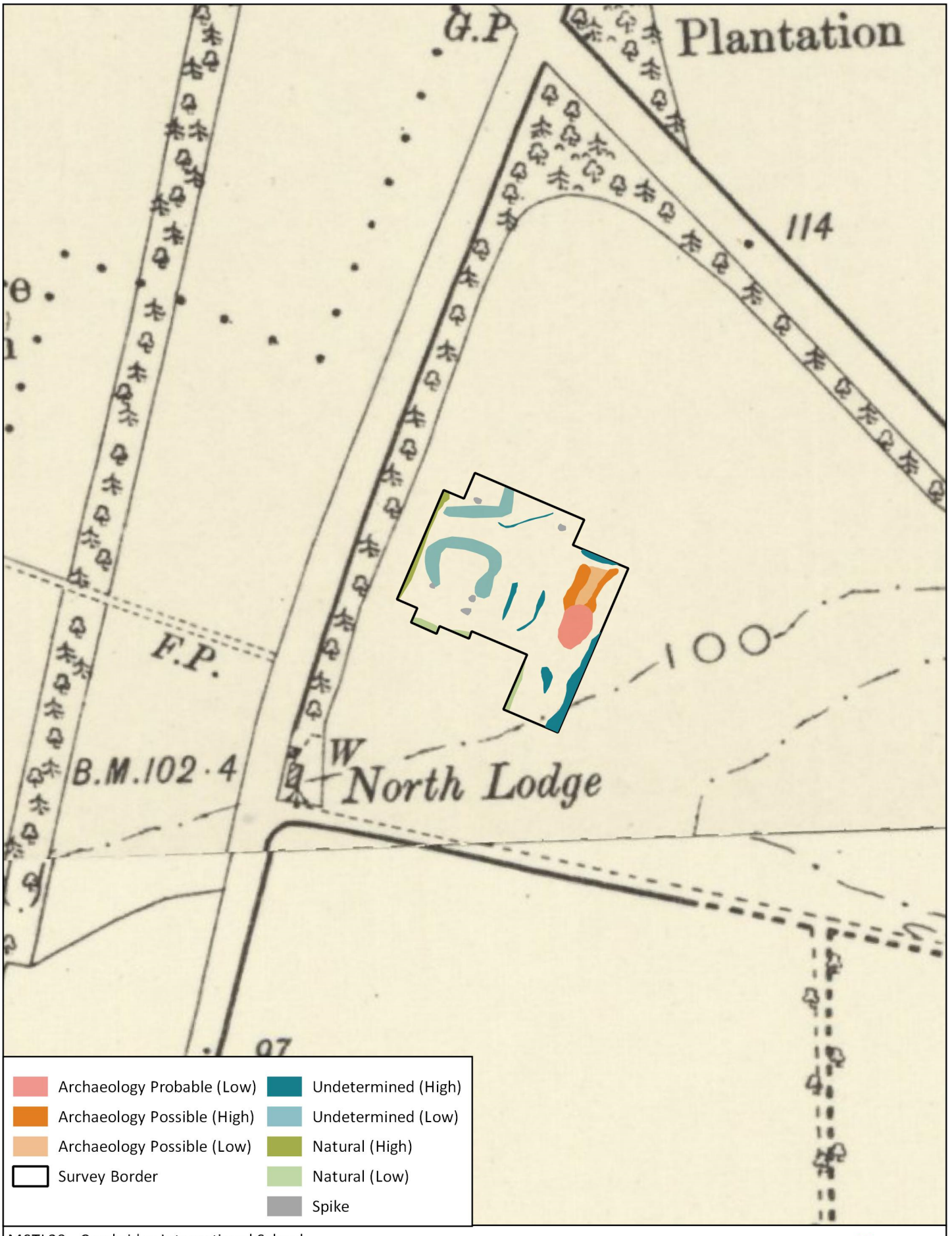

MSTL20 - Cambridge International School
Figure 10 - Earth Resistance Interpretation - Satellite and AP Overlay
1 : 2500 @ A4

AP Figure after, Palmer 1994

N

0 25 50 75 100 m

magnitude surveys




MSTL20 - Cambridge International School
Figure 11 - Earth Resistance Interpretation - Historic Mapping
1 : 2500 @ A4

Historic Mapping Ordnance Survey, 6" second edition c. 1882-1913.
National Library of Scotland

N

0 25 50 75 100 m

magnitude surveys