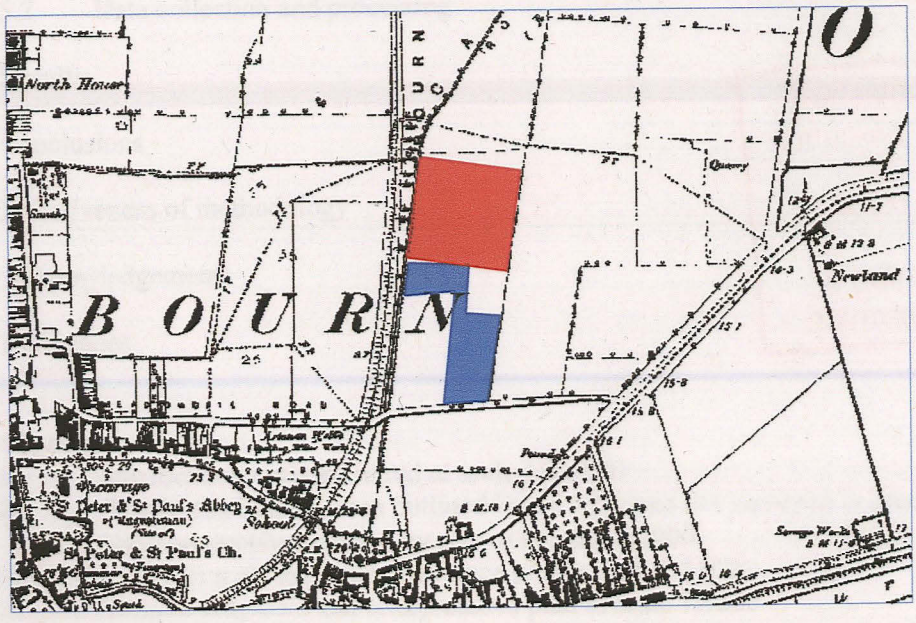
ARCHAEOLOGICAL EVALUATION REPORT:

FLUXGATE GRADIOMETER SURVEY OF LAND TO THE REAR OF PLAYING FIELD, OFF MANNING ROAD IN BOURNE, LINCOLNSHIRE

Planning Reference: S08/1406/12 and S08/1410/12
Ordnance Survey NGR: TF 10326 20481
Site Code: BOPF 09
OASIS Reference: allenarc1-55435



Report prepared for

Larkfleet Homes

by

Allen Archaeological Associates and Grid Nine Geophysics

AAA Report Number: 2009.007

February 2009

GRID NINE

FREELANCE ARCHAEOLOGICAL GEOPHYSICS
(FLUXGATE GRADIOMETER & RESISTANCE)

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Cover image: 1891 first edition Ordnance Survey map of Bourne with site outlined in red and previous survey shown in blue

Summary

- A fluxgate gradiometer geophysical survey was undertaken on land to the rear of the playing field, off Manning Road in Bourne, Lincolnshire, by Grid Nine Geophysics, in partnership with Allen Archaeological Associates on the behalf of Larkfleet Homes. The survey was undertaken prior to the determination of two planning applications for redevelopment of the site.

- The survey appears to have revealed a single anomaly that may be of archaeological importance; an area of subdued response that may represent elements of the Car Dyke bank to the east of the watercourse. Furrows associated with former ploughing, probably of medieval date, were also noted throughout the dataset.

- There are many dipolar responses which are likely to have been caused by modern ferrous detritus or other highly fired material, especially adjacent to field boundaries and fencing.

- A modern service was clearly shown running north-west to south-east across the site, and a known water pipe running along the eastern boundary was also evident.

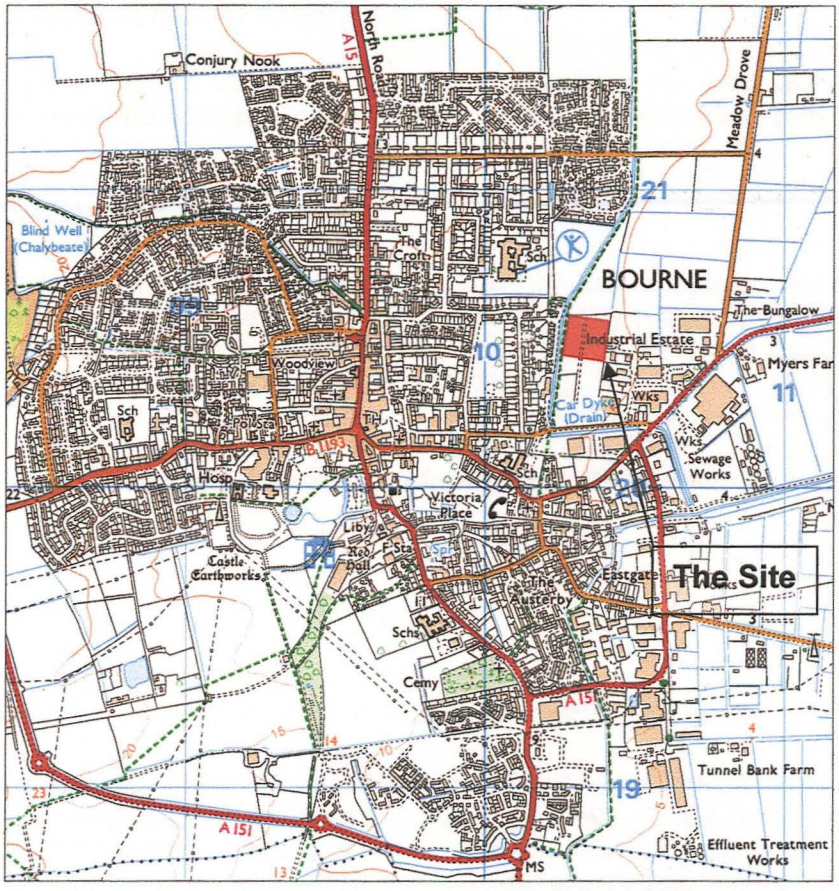

Figure 1: Site location outlined in red at scale 1:25,000

1.0 Introduction

1.1 Allen Archaeological Associates and Grid Nine Geophysics were commissioned by Larkfleet Homes to undertake a geophysical survey in advance of the determination of two planning applications for a commercial development, and change of use of agricultural land off Manning Road in Bourne, Lincolnshire.

1.2 The site works and reporting conform to current national guidelines, as set out in the Institute for Archaeologists '*Standards and guidance for archaeological evaluations*' (IfA 2001) and the English Heritage document '*Geophysical Survey in Archaeological Field Evaluation*' (English Heritage 2008). A brief for geophysical survey and comments by the South Kesteven Planning Archaeologist (Young 2008) was also adhered to, and a specification was prepared for the works (Allen 2009).

2.0 Site location and description

2.1 The site is situated in the administrative district of South Kesteven and within the town of Bourne, approximately 15km west-south-west of Spalding. The site comprises a roughly rectangular area of approximately 150m x 120m, east of the Car Dyke, north of Manning Road and also to the north of a previous geophysical survey (AAA and Grid 9 2009). The site is centred on NGR TF 10326 20481.

2.2 The local geology is fen gravel drift deposits overlying the solid geology Oxford Clay (NERC 1972). The local soils comprise fresh draining lime-rich loamy soils (NSRI 2009).

3.0 Planning background

3.1 Two planning applications have been submitted by Larkfleet Homes for development off Manning Road in Bourne. Planning permission is being sought for eight office buildings and associated infrastructure (Planning Reference S08/1406/12), and also to change the use of agricultural land to secure storage (Planning Reference S08/1410/12). Prior to determination of the applications, the South Kesteven Planning Archaeologist requested the undertaking of an archaeological evaluation (Young 2008), initially to comprise a geophysical survey of the proposed development area. The results of this survey will then be used to inform a trial trenching strategy.

4.0 Archaeological and historical background

4.1 The site itself lies adjacent to the Car Dyke, a linear channel or drain that is believed to have originated in the Romano-British period (Simmons and Cope-Faulkner 2004).

4.2 Bourne is first mentioned in the Domesday Survey as *Brune*, probably from the Old Norse '*brunnr*' meaning 'a spring, a stream' (Cameron 1998). At the time of Domesday Book (1086-87) the settlement was a thriving agricultural manor belonging to Earl Morcar, who held two and a half carucates of land, half a church and a priest, 3 mills, 6 fisheries, 19 acres of meadow and woodland (Morgan and Thorn 1986).

4.3 The town prospered in the medieval period, possibly due its inclusion in the wool trade through Vaudney Abbey during the 13th century, and at its height contained a large castle with two baileys (Owen 1990). The site lies close to the known medieval pottery industry of Bourne, which is likely to have emerged in the 13th century, and subsequently disappeared in

the 17th century. Evidence of this industry has been found to the south and south-east of the proposed development area.

4.4 A preceding geophysical survey was undertaken immediately to the south of the proposed development area to inform a planning application for a residential development (AAA and Grid 9 2009). The survey identified a number of anomalies of potential archaeological significance, including an ephemeral circular anomaly to the south-west of the site. A programme of trial trenching on the site revealed a palimpsest of mainly undated archaeological features cut by agricultural furrows of probable medieval date (AAA forthcoming). A trench across the circular anomaly exposed a series of deposits that have been interpreted as forming the eastern bank of the Car Dyke. These bank deposits sealed a former soil that in turn sealed several archaeological features of probable prehistoric date.

5.0 Methodology

5.0.1 A Level II Evaluation geophysical survey (Gaffney and Gater 2003) using fluxgate gradiometer was chosen as the most appropriate type of survey for the site. Although there can be no preferred recommendation of which technique to use until the merits of the individual site have been assessed, magnetometer survey should usually be the prime consideration (English Heritage 2008).

5.0.2 The response from superficial gravel deposits to magnetic surveying is very variable, but usually good on materials derived from Jurassic limestones. The response over a solid geology of Oxford Clay is usually average and thus magnetometer surveying can be recommended, which is true over most sedimentary parents (English Heritage 2008; Gaffney and Gater 2003; Clark 1996).

5.0.3 The geology of the site is relatively uncommon and results from geophysical surveys over these geologies are not well represented in the English Heritage Geophysical Survey Database (EHGSD). However, several survey reports encountering these types of geologies are held by the EHGSD. A search of the EHGSD for surveys over these geologies in the general area provided surveys reporting generally successful results.

5.0.4 Magnetic surveying measures very small changes in the Earth's magnetic field which can be created by man-made or geological changes in the magnetic properties of the soil and/or underlying geology. Magnetic surveying can usually detect magnetically enhanced features such as areas of anthropogenic activity (for example pits, ditches, hearths and kilns), but also will react to buried 'modern' items such as nails, agricultural equipment fragments, wire fences and generally any ferrous material in the immediate area.

5.0.5 The geology of the site can play an important role in how successful a magnetic survey will be. If the local geology is inherently magnetic then it may not be practicable or possible to undertake a magnetic survey. Similarly, buried services can have an adverse effect on the data. The magnetic 'signature' from certain anomalies, for example from a ditch or kiln, is often very characteristic to that type of known feature. This can assist with providing an informed, but quantitative rather than qualitative interpretation to certain anomalies. It should be noted that geomorphological features can give both positive and negative responses.

5.0.6 The magnetic survey was carried out using a Bartington Grad601-2 Dual Fluxgate Gradiometer with an onboard automatic DL601 data logger. This instrument is a highly stable magnetometer which utilises two vertically aligned fluxgates, one positioned 1m above the other. This arrangement is then duplicated and separated by a 1m cross bar. The 1m vertical spacing of the fluxgates provides for deeper anomaly detection capabilities than

0.5m spaced fluxgates. The dual arrangement allows for rapid assessment of the archaeological potential of the site. Data storage from the two fluxgate pairs is automatically combined into one file and stored using the onboard data logger.

5.1 Summary of survey parameters

5.1.1 Fluxgate magnetometer

Instrument:	Bartington Grad601-2 Dual Fluxgate Gradiometer
Sample interval:	0.25m
Traverse interval:	1.00m
Traverse separation:	1.00m
Traverse method:	Zigzag
Resolution:	0.1 nT
Processing software:	ArchaeoSurveyor 2.4.0.X
Surface conditions:	Settled snow over ploughed field
Area surveyed:	1.722 ha.
Surveyors	David Charles Hibbitt AIfA and Angela Hazel Hibbitt
Data interpretation:	David Charles Hibbitt AIfA and Mark Allen BSc MIfA
Date of survey:	8th February 2009

5.2 Data collection and processing

5.2.1 The site was marked out with a series of 30m x 30m grids aligned broadly north – south. A north – south traverse direction is preferable for a magnetic survey as enhancements to the magnetic field caused by buried features is mapped increasingly stronger the closer the traverse direction can get to a magnetic north – south direction (Scollar et al. 1990). Data was collected by making successive parallel traverses across each grid in a zigzag pattern, as close to a magnetic north – south alignment as practicable. The survey grid was accurately tied in to a previously installed ground marker in the north-west corner of the field, and existing boundaries.

5.2.2 The data collected from the survey has been analysed using the current version of ArchaeoSurveyor 2 (2.4.0.X). The resulting data set plots are presented with positive nT as black and negative nT as white.

The data sets have been subjected to processing using the following filters:

- De-spike
- De-stripe (also known as Zero Mean Traverse or ZMT)
- Clipping
- High Pass Filter (HPF)

5.2.3 The de-spike process is used to remove spurious or extremely high intensity anomalies or datapoint values in magnetic data. These are often caused by small ferrous objects (for example modern surface or sub-surface 'rubbish', ferrous fence posts or buried services) which may affect subsequent filter use, data enhancement and interpretation.

5.2.4 The de-stripe process is used to equalise underlying differences between grids or traverses. Differences are most often caused by directional effects inherent to magnetic surveying instruments, instrument drift, instrument orientation (for example off-axis surveying or heading errors) and delays between surveying adjacent grids. The destripe process is used with care however as it can sometimes have an adverse effect on linear features that run parallel to the orientation of the process.

5.2.5 The clipping process is used to remove extreme datapoint values which can mask fine detail in the data set. Excluding these values allows the details to show through.

5.2.6 The High Pass Filter (HPF) is used to remove low frequency, large scale spatial data. It is appropriate to use a HPF if there is a localised anomaly present which has superimposed a gradient on the dataset. Such a situation might arise if the edge of the site is bounded by a wire fence, or as in this case, a fence and buildings, both of which exhibit a high ferrous content.

5.2.7 Plots of the data are presented in raw linear greyscale, processed linear greyscale and trace plot form with any corrections to the measured values or filtering processes noted, and as a separate simplified graphical interpretation of the main magnetic anomalies detected.

6.0 Results (See Figures 2 – 6; anomalies in square brackets are shown on Figure 6)

6.1 Although the survey is separate from the previous geophysical survey undertaken to the south (Allen and Grid 9 2009), for continuity purposes the anomalies maintain the numbering system used in the previous survey.

6.2 Originally the site was to be surveyed in two separate areas; Area A measuring 150m x 120m, and Area B measuring 90m x 60m. Unfortunately due to the hazardous ground conditions the magnetometer was damaged following the completion of Area A, and following consultation with the South Kesteven Planning Archaeologist with regard to the results obtained to date, it was agreed that Area B would not require surveying.

6.3 Immediately apparent in the dataset is a service pipe [14] running north-west to south-east through the site. The enhanced response from this has produced unusable data approximately 10 metres either side of the pipe. Also clearly visible along the full length of the eastern boundary is intense magnetic interference [15] likely associated with a water pipe that is known to run along the eastern boundary (M. Croker *pers. comm.*), coupled with interference from adjacent buildings and fencing with a ferrous content. The strong magnitudes from these features has, not unexpectedly, adversely affected the data from this area by saturating the magnetometer's fluxgate sensors, recording values of -/+3000nT.

6.4 Visible in the data are broad positive striations running roughly east-north-east to west-south-west through the data (shown as blue dashed lines on Figure 6). The regular spacing and low positive magnitudes of around 2nT from these anomalies suggest they are likely to be the remains of ridge and furrow of probable medieval date running parallel with Manning Road to the south. This interpretation has been confirmed in the evaluation of the field to the immediate south of this site (AAA forthcoming).

6.5 Several areas of intense disturbance can be seen in the data, notably the amorphous areas [16] and [17]. These areas of disturbance corresponded with a former field boundary running north – south through the site. The cause of the disturbance is likely to be a general scattering of ceramic building material and magnetically enhanced detritus which has collected along the course of this former boundary (this was noted during the previous survey). Closer study of the data would also suggest that there may also be a linear anomaly [18] giving a response consistent with a service or similar feature running parallel and very close to, or possibly under, this former boundary.

6.6 A series of ephemeral curvilinear anomalies [19] have been detected close to the northern boundary of the site. Although these anomalies appear to potentially be of archaeological

interest, they are more likely to represent a plough turning at the field boundary. The modern north - south cultivation trend noted would support this hypothesis.

6.7 An area of subdued response [20] has been detected along part of the western boundary of the site. A similar response was detected adjacent to the Car Dyke by the previous survey and interpreted as potentially geomorphological response, due to its weak magnitude and ephemeral nature (AAA and Grid 9 2009). However, subsequent trial trenching of this anomalous area revealed well-preserved elements of the Car Dyke bank surviving over a former soil (AAA forthcoming). If the subdued response does reflect elements of the Car Dyke bank, as the data appears to show, then it may be of significance that the anomaly appears to terminate half way up the western boundary of the proposed development area. This may indicate a break in the bank, or perhaps disturbance of the deposits by modern ploughing.

6.8 Visible throughout the data are numerous small pit-like anomalies. Many of these have relatively high magnitudes of around 10nT. Although a precise cause for these cannot be given with confidence, it is likely that they are the result of geomorphological processes or near surface ferrous responses rather than anthropogenic (i.e. human) activity.

6.9 A number of strong dipolar responses (>100nT) have been recorded scattered randomly throughout the data. The characteristic dipole response of pairs of positive and negative 'spikes' suggests near-surface ferrous metal or other highly fired material (Clarke 1996).

6.10 There are also a plethora of weak dipolar responses within the dataset. The peak magnitude of these anomalies is generally less than 10nT, with most being around 3nT. These responses are likely to be caused by modern ferrous detritus scattered across the field or possibly subtle responses to geomorphological variations.

7.0 Conclusions

7.1 The geophysical surveying has supported the previous survey conclusions that the site of the proposed development lies within an area containing some anomalies of possible archaeological origin. Deposits adjacent to the western boundary of the site may be associated with the eastern bank of the Car Dyke, and therefore be of archaeological importance. A series of parallel east-north-east to west-south-west anomalies have been identified as representing furrows associated with former, probably medieval, ploughing. This was confirmed in the evaluation of the site immediately to the south (AAA forthcoming).

7.2 A number of pit-like anomalies were noted throughout the data set that may be of archaeological interest; however the ephemeral nature of the results combined with the local geology means that any interpretation at this stage would be tenuous.

7.3 Magnetic interference from the surrounding boundaries has caused some distortion to the edge of the dataset, although this has not compromised the overall result significantly. It should be noted that former maps of the site indicate that the field was utilised as allotment gardens from at least the beginning of the 20th century to the 1930s, so a number of the anomalies may therefore be related to this activity.

7.4 The ephemeral nature of the potential archaeological remains may in part be due to modern plough damage, and the trial trenching of the site to the south has shown that especially in the eastern half of the field, this has certainly been the case (AAA forthcoming). This trenching has also shown that a shallow subsoil exists sporadically in the eastern half of the

site. This former soil has survived to a greater extent in the western half of the site, especially below the Car Dyke deposits identified adjacent to the western site boundary.

8.0 Effectiveness of methodology

8.1 The non-intrusive evaluation methodology employed was appropriate to the scale, nature and time constraints of the proposed development. Magnetometry surveying was the prospection technique best suited to the investigation. Other techniques would have required justification (English Heritage 2008) and may have proved too time consuming or cost-prohibitive given the size and nature of the development area.

9.0 Acknowledgements

9.1 Allen Archaeological Associates and Grid Nine Geophysics would like to thank Larkfleet Homes for this commission.

10.0 References

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The following Ordnance Survey maps of the area were viewed on-line at www.old-maps.co.uk:

1888 Ordnance Survey map, Lincolnshire 1:2,500
1891 Ordnance Survey map, Lincolnshire 1:10,560
1904 Ordnance Survey map, Lincolnshire 1:2,500
1906 Ordnance Survey map, Lincolnshire 1:10,560
1931 Ordnance Survey map, Lincolnshire 1:10,560
1938 Ordnance Survey map, Lincolnshire 1:10,560

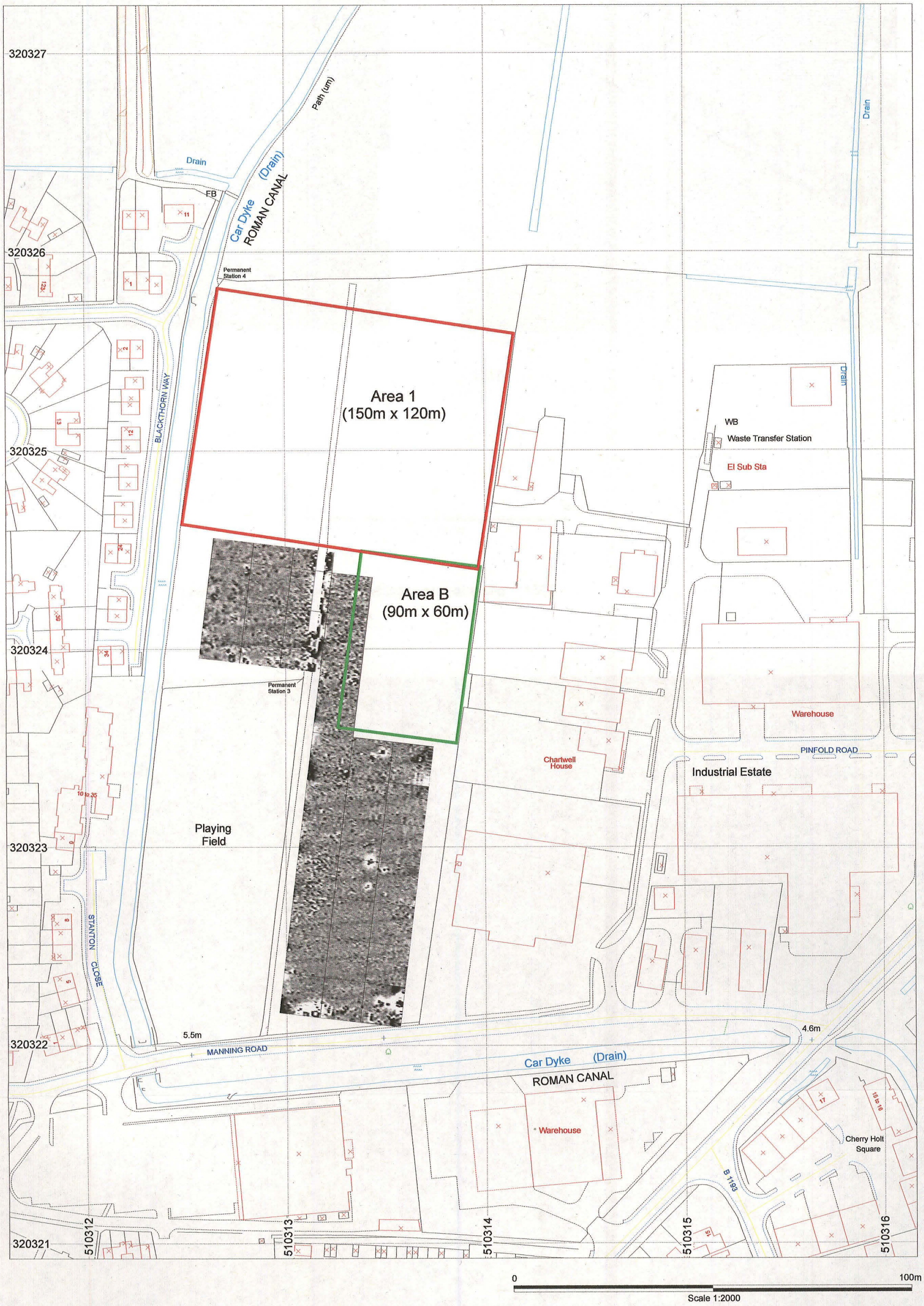


Figure 2: Geophysical survey area outlined in red with area not surveyed in green and previous geophysical survey shown at scale 1:2000

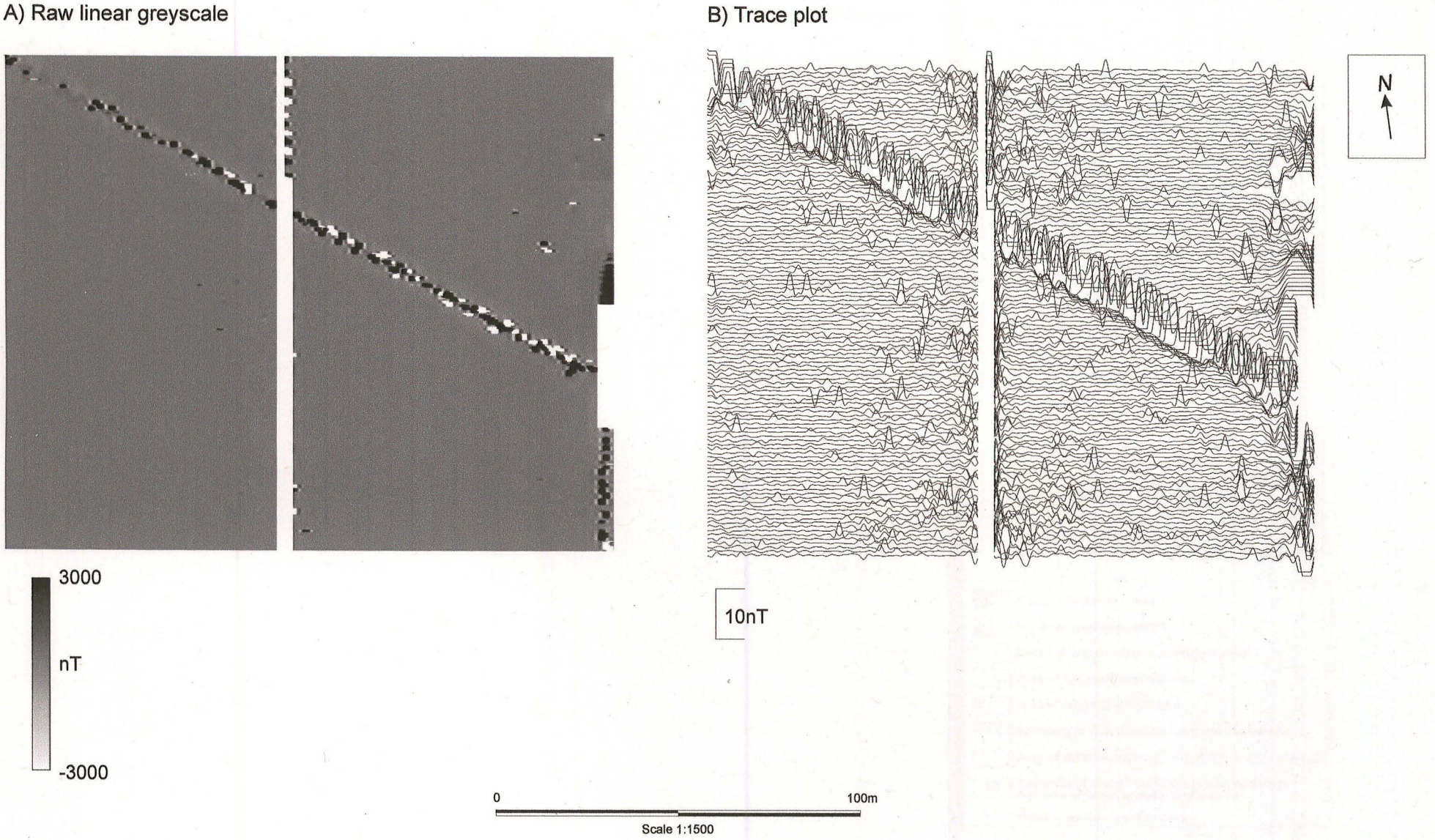
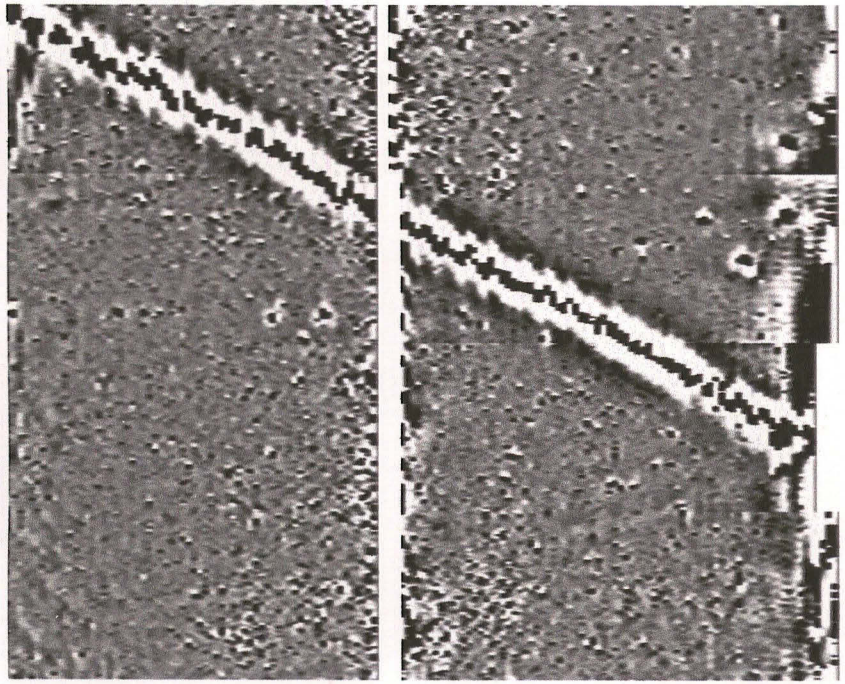
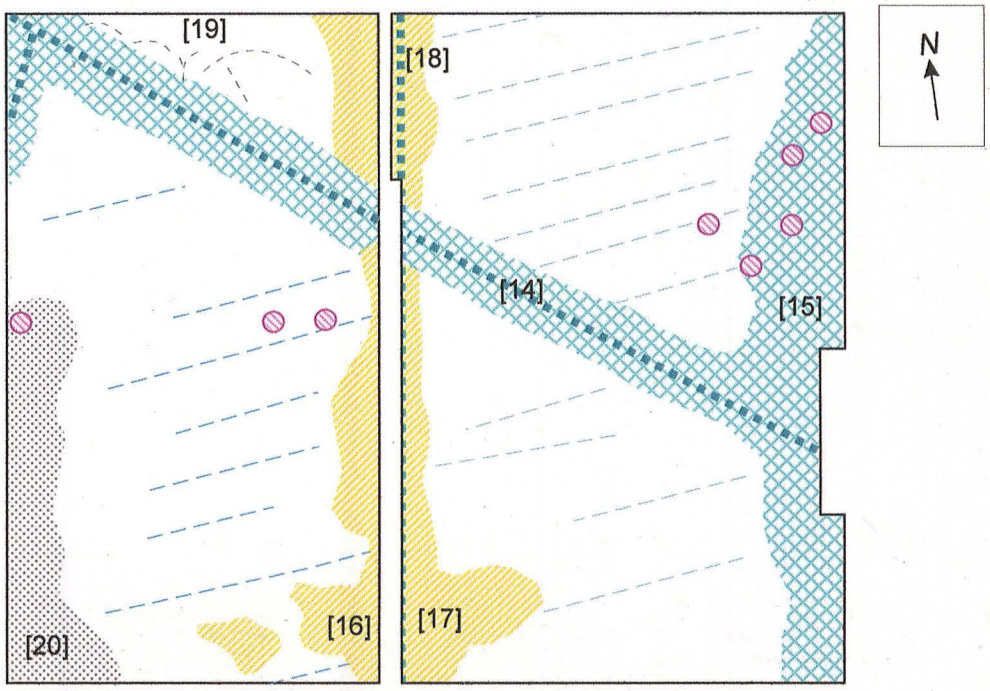


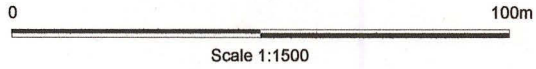
Figure 3: Raw greyscale and processed trace plot at scale 1:1500

A) Clipped greyscale



B) Interpretative plan





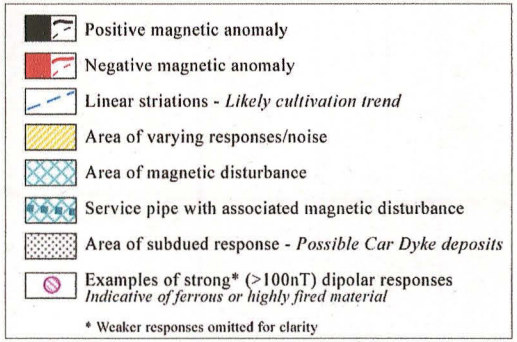


Figure 4: Clipped greyscale and interpretative plan at scale 1:1500

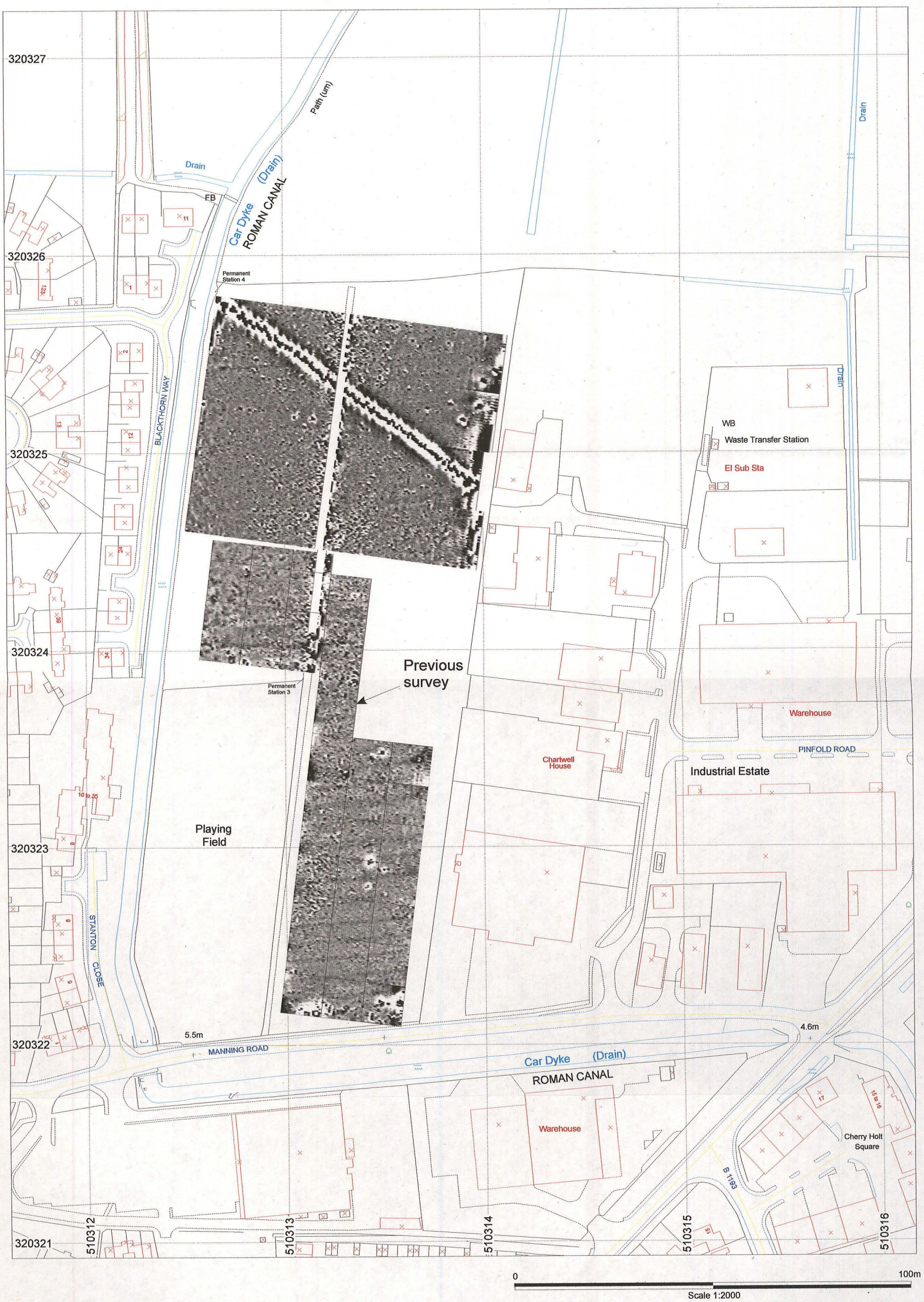


Figure 5: Clipped greyscale plot with previous survey results shown, at scale 1:2000

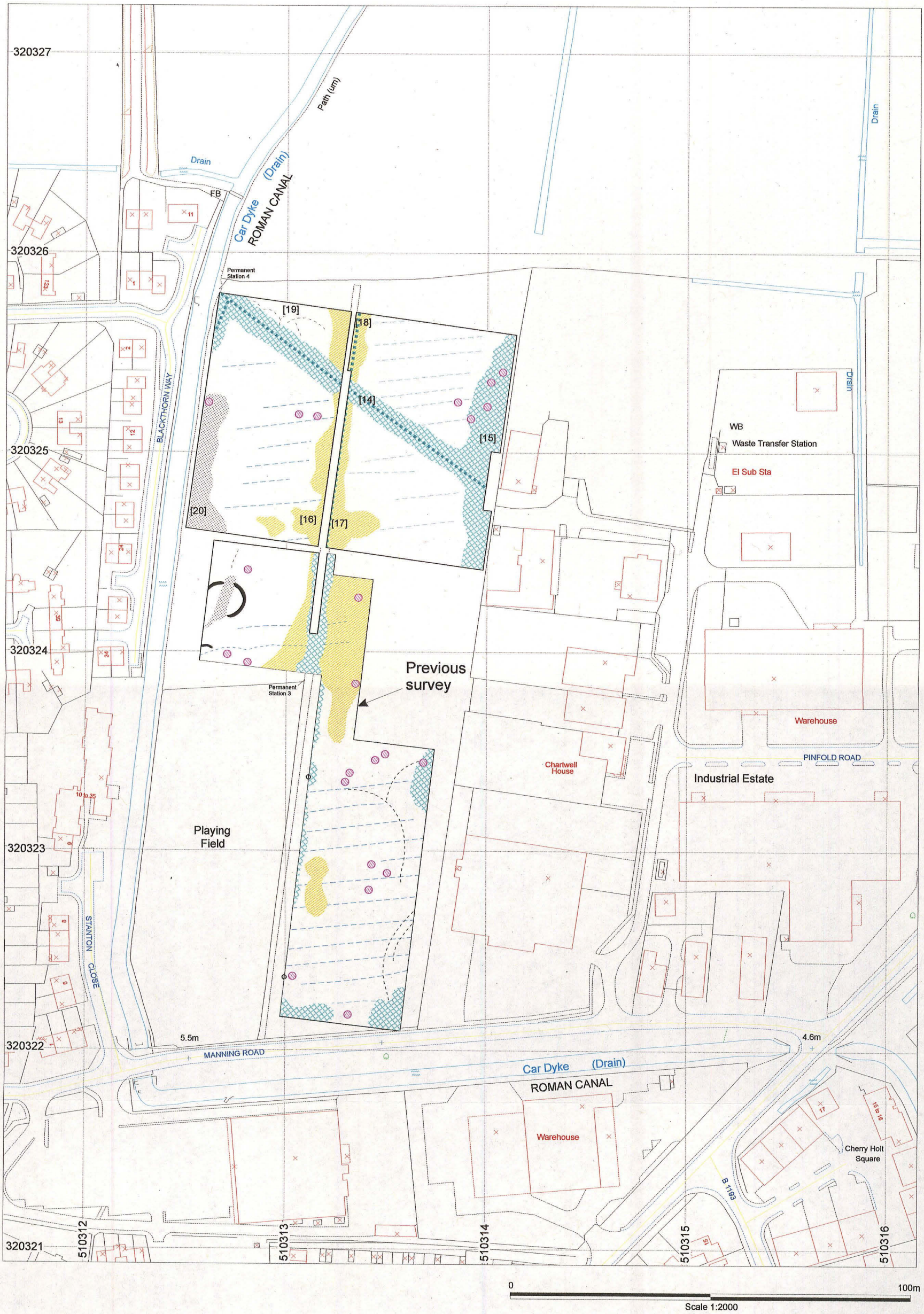


Figure 6: Interpretative plan with previous survey interpretation included, at scale 1:2000