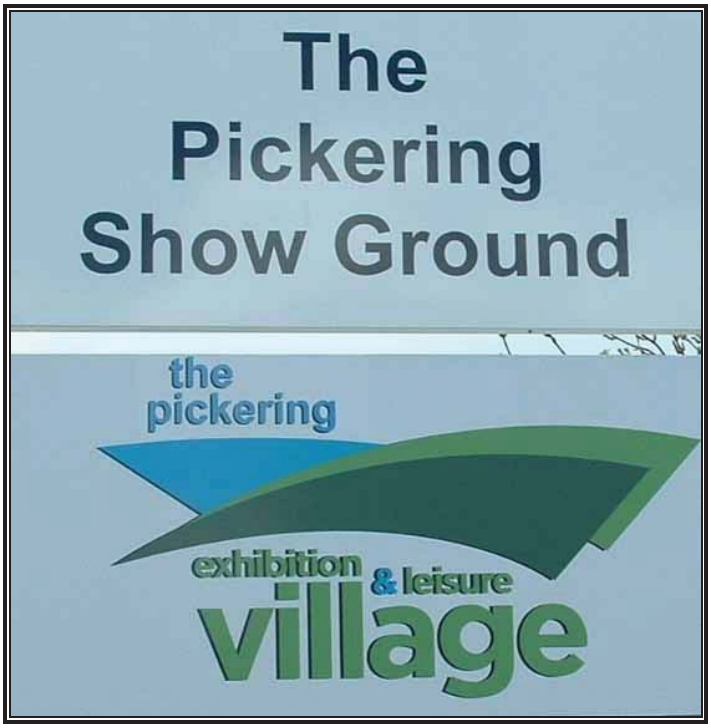
PICKERING SHOWGROUND, MALTON ROAD, PICKERING, NORTH YORKSHIRE.

REPORT ON A N ARCHAEOLOGICAL GEOPHYSICAL SURVEY
OSA REPORT No: OSA13EV09

June 2013



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Report Summary.

PROJECT NO:	OSA13EV09 (Geophysics)
SITE NAME:	Pickering Showground, Malton Road, Pickering
COUNTY:	North Yorkshire
NATIONAL GRID REFERENCE:	SE 79605 82365
COMMISSIONED BY:	Doug Jennings Chartered Town Planner 7 Kingtree Avenue, Cottingham Hull HU16 4DS
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TIMING:	Fieldwork June 2013 Report preparation June 2013
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1.0 Abstract.

A geophysical survey was carried out by On-Site Archaeology on the western section of the Pickering Showground on Malton Road, to the south of the town of Pickering. The survey was undertaken in advance of an application to develop the land, which is currently grass pasture and used mainly for showground events. This phase of evaluation was focused on a 12 hectare field directly to the west of the main permanent showground area.

A desk-based assessment revealed that the land is in an area of east Yorkshire where there is evidence of surviving archaeological remains, some of which have recently been investigated as part of previous evaluation work on nearby fields. Since the extent of archaeological remains in the proposed development area cannot be fully assessed on the basis of currently available information a geophysical survey was proposed as the best means of investigation for this stage of the development

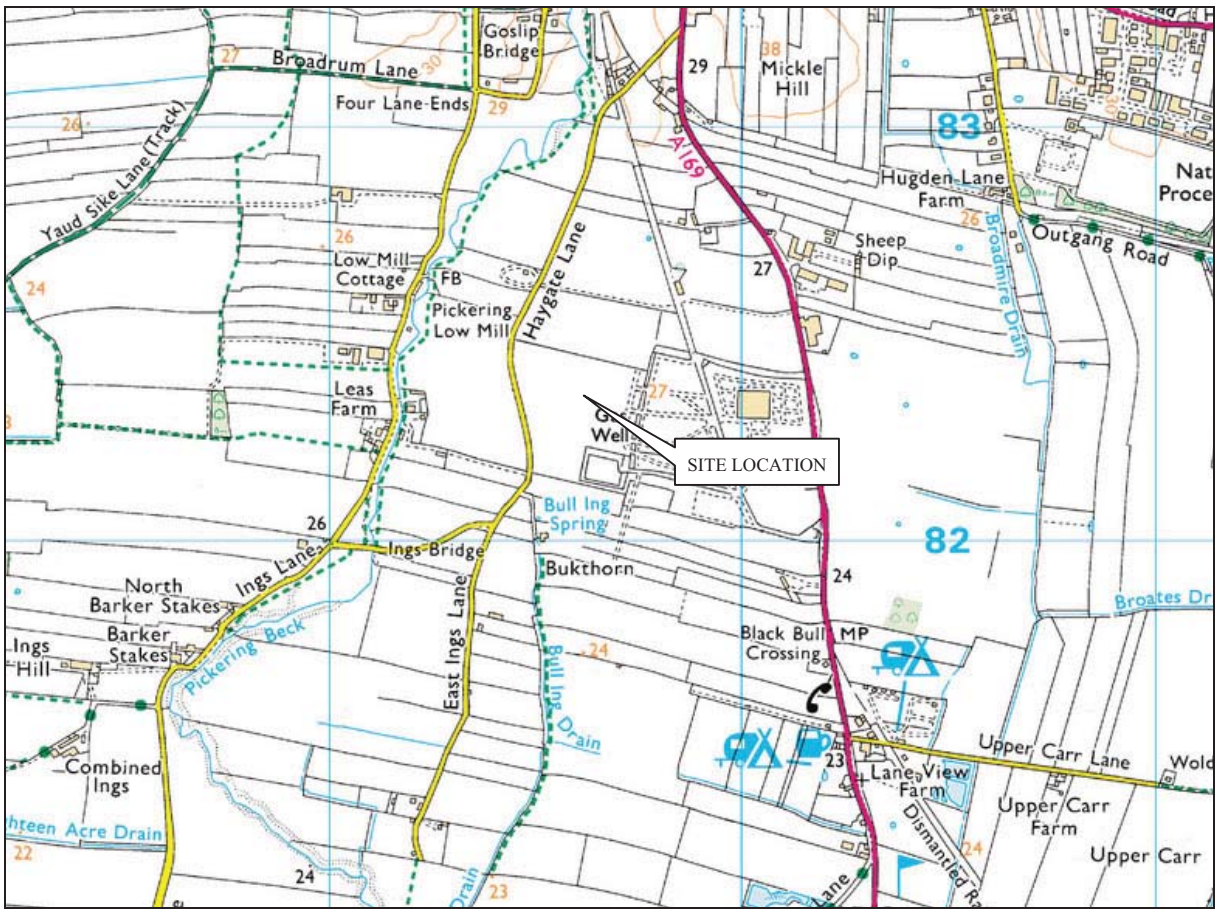

Figure 1. Site location (SE 79605 82365)

2.0 Site Location, Geology, Topography and Land Use.

The land around the Pickering showground is of mixed use with some pasture land mixed in amongst predominantly agricultural cropland. The site of the proposed development is separated into several fields to the west and to the south of the current Showground proper. This phase of survey was focused on the largest of these, which lies directly to the west of the showground. It is currently used as an open field for events such as car boot sales, rallies etc and as such is left as a simple open grassland. It is centred at approximately National Grid Reference SE 79605 82365.

The field boundaries in the area clearly preserve a trace of medieval and post medieval land division as can be seen in the historic map record for the area. Despite this the site is clearly a conglomeration of a number of smaller strip fields that have been aggregated into one large area. The total area of the present survey equals approximately 12 hectares.

The terrain in the vale of Pickering is very consistent and characterized by low lying post glacial sediments of the prehistoric lake which used to cover much of the land here. The survey area is almost completely flat lying at the height of *circa* 27m above Ordnance Datum (AOD). Evidence of historic agriculture is relatively sparse in the surface topography although there are impressive example of intact ridge and furrow on adjacent fields.

The bedrock geology of the area belongs to the West Walton Formation, Amthill Clay Formation and Kimmeridge Clay formation, all sedimentary bedrocks formed in shallow prehistoric seas. The superficial geology comprises lacustrine clays laid down when the area was occupied by lakes and lagoons.

Figure 2 shows the exact location of the geophysical work. In total, approximately 12 hectares of ground was covered over the three fields providing a representative picture of geophysics responses across the site.

Figure 2. Location of survey

3.0 Archaeological Background.

A desk-based assessment was carried out in advance of the geophysical survey (OSA 2013). The research indicated that the site lies in an area with high potential to contain Iron Age to Roman remains. These may include elements of the ladder settlement identified at Mickle Hill, approximately 700m to the north, or associated field systems.

There is moderate potential for the site to contain archaeological remains of medieval date. These are likely to relate to agricultural landuse and would probably be limited to the remains of ridge and furrow cultivation, and possibly ditches forming field boundaries.

There are four listed buildings within the search area. None of these lie immediately adjacent to the site. Those to the west are separated from the site by existing farmland, whilst that to the south is beyond several buildings and an existing caravan and camping site.

4.0 Methodology.

4.1 General

The survey and reporting were conducted in accordance with the current professional guidelines "Geophysical Survey in Archaeological Field Evaluation" (English Heritage 2008) and "Draft Standard and Guidance for Archaeological Geophysical Survey" (Institute for Archaeologists 2010).

Geophysical surveying enables the relatively rapid and non-invasive identification of potential archaeological features within landscapes and can involve a variety of complementary techniques such as magnetometry, electrical resistivity, ground-penetrating radar and electromagnetic survey. Some techniques are more suitable than others in particular situations, depending on a variety of site-specific factors including the nature and depth of likely targets; ground conditions; proximity of buildings, fences or services and the local geology and drift.

In this instance, based on existing knowledge of sites in the vicinity together with knowledge of surviving archaeological deposits in adjacent fields, it was considered likely deposits would also be present on the site of the present survey. Of particular note are features that are cut into the existing soils/ geology such as historic ditches, pits and other similar features, which typically are found in sites of Roman (and later) date. Other landscape features such as track ways, and historic field boundaries are also a feature of this landscape and reflect significantly historical patterns of land use. Finally, with evidence of extensive human activity in such a landscape there is also a likelihood that fired areas including kilns or small hearths associated with both settlement and industry will be present.

Magnetic survey is generally well suited to the detection of features such as those mentioned above, and it is most commonly employed as the most rapid means of assessing the extent of archaeological deposits across a large area- particularly where silted up 'cut' features are thought to be present. Geological conditions do play a significant role in the successful identification of deposits with this technique. Clay geology as found at Pickering ranges from poor to good susceptibility to magnetometer survey (English Heritage 2008, 15). Localised geological variation on a small scale, and geological anomalies such as manmade quarries, or historic drainages channels, also are easily detected with this method.

It should be noted that whilst useful for the remote identification of archaeological anomalies, magentometry is also significantly affected by changes in the localised magnetic field caused by ferrous material in the soil and on the surface in the immediate area. Modern conduits, electricity pylons, metal fences/ buildings, and any other ferrous objects in the topsoil all produce elevated magnetic responses that can confuse interpretation of results. At the Pickering showground the site is used for many different kinds of activities, and the extent of metallic pollution is quite high in comparison with purely agricultural land. Hence quite a few metallic features are present on this site and are identified in the following summary.

4.2 Fieldwork methodology.

In archaeological geophysics in Britain the most frequently used magnetic technique is Fluxgate Gradiometry, a method which detects minor variations in the vertical component of the local magnetic field of near surface soils and subsoils. These variations are caused by changes in a soil's magnetic susceptibility or permanent thermo-remnant magnetism both of which can reflect the form and extent archaeological activity. Data is collected at regular intervals over a gridded area producing a continuous coverage over the site.

The magnetic survey at the Pickering Showground comprises an area of approximately twelve hectares. The site was divided into one hundred and twenty three 30x30m grids and tied-in to known Ordnance Survey points using a Leica GPS900. The GPS900 is a real time kinemeatic GPS unit providing survey quality location information accurate to around 10mm.

Data collection was carried out using two Bartington Grad 601 fluxgate gradiometers with automatic data logging facilities. Samples were recorded on an interval of 0.25 x 1 m in accordance with current archaeological guidelines (English Heritage 2008), yielding 3600 measurements per 30m square. The instrument sensitivity was set to 0.03nT within a +/-100nT range ensuring the accurate recording of small variation in the local magnetic gradient.

4.3 Processing and data treatment.

Following initial field survey, data was prepared and processed using a series of software tools to eliminate data defects resulting from local conditions or field collection problems. Typically, once defects have been identified, images are prepared using a greyscale representation of the relative strength of magnetic response in the survey areas. The greyscale plots provide a graphic' 2D image' of subsurface magnetic conditions and form the basis of the interpretation diagram in Figures 7 and 8. (Additional 'X/Y trace' plots are also included as an alternative graphic representation of results for comparison with greyscale plots).

For processing, Geoscan *Geoplot 3.0* software was used for initial data processing and Golden Software's *Surfer* used for the production of both raw and processed data plots. Maps of the site were prepared using *Esri ArcGIS* geographical informatics software.

The following processing and image enhancement functions have been applied to the data (see Appendix 1 for details):

Clip – Clips or limits data to specified maximum or minimum values; to eliminate the effects of very strong magnetic responses often caused by modern features; Clipping such responses makes statistical calculations more realistic for the determination of potential archaeological anomalies (which generally display weaker magnetic variation than those for large ferrous features). In this instance data was clipped from a maximum range of +/-100nT to +/-20nT to eliminate the responses from the large electricity pylons present on the site.

Despike – Used to locate and reduce the effects of random ferrous responses in the survey area that most commonly result from iron objects near to the surface. NB. Some anomalies of this type cannot be successfully eliminated using 'despike' (especially if they are caused by

larger iron objects in top-soils) without compromising the reading for the nearby data, and in these cases they are left in the dataset and marked in the interpretation plot accordingly.

Considerable despiking was needed in this instance to eliminate mostly near surface pollution in the topsoil. The parameters used for the despike process were: radius of X4 x Y1 readings for local averaging with a threshold of 3.0. A 'mean spike replacement method' was applied using the despike filter in Geoplot 3.0 software.

Zero Mean Traverse – For removing striping effects in the data caused by the orientation of the instrument sensors; also removes traverse striping caused by abnormally strong responses caused by ferrous pollution. For settings see Appendix 2 below.

Interpolation – This is mostly an image optimisation process designed to create a more coherent and 'readable' graphic. Interpolating increases the number of data points in a survey on one or both axes. In this instance survey data was collected using a 0.25 x 1m sampling interval, and for final graphic preparation clipped and processed data was interpolated on the Y-axis resulting in a smoothed greyscale plot where one pixel is the equivalent to a 0.25 x 0.5m survey sample. Geoplot's *sin x/x* interpolation method was used for this process.

5.0 Results.

The data is presented here using greyscale and X/Y plots with minimal processing to give an impression of the full range data statistics (Figure 3). Darker greys and blacks represent elevated magnetic readings, and lighter values lower readings, while middle grey indicates the 'survey average' response of the underlying geological conditions.

Magnetic values are measured here in Nanotesla (*nT)* and the Bartington is configured at a sensitivity of 0.3 *nT*, recording data within a range of -100nT/ +100nT. Within this range most archaeological and geological features occupy relatively low *nT* value with respect to the survey zero (typically between -20 and +20 nT and lower).

Responses of very high magnitude in the top and bottom end of this scale usually result from isolated metallic objects in the topsoil, or from major features with a high iron content nearby, or in the survey area. There are many such examples in the Pickering data due to the relatively high human traffic on the site which brings with it lots of metallic pollution (coins, bottle caps etc).

Figure 3 displays the unprocessed raw data using a greyscale gradient. As this data is unprocessed the majority of the features visible are those occupying the higher end of the magnetic gradient recorded by the instrumentation, and therefore mostly showing the location and distribution of ferrous disturbance in the survey. Responses of a lower magnitude can be also be made out in the data form of linear responses and other localised features occupying the range between -20 and +20 nT .

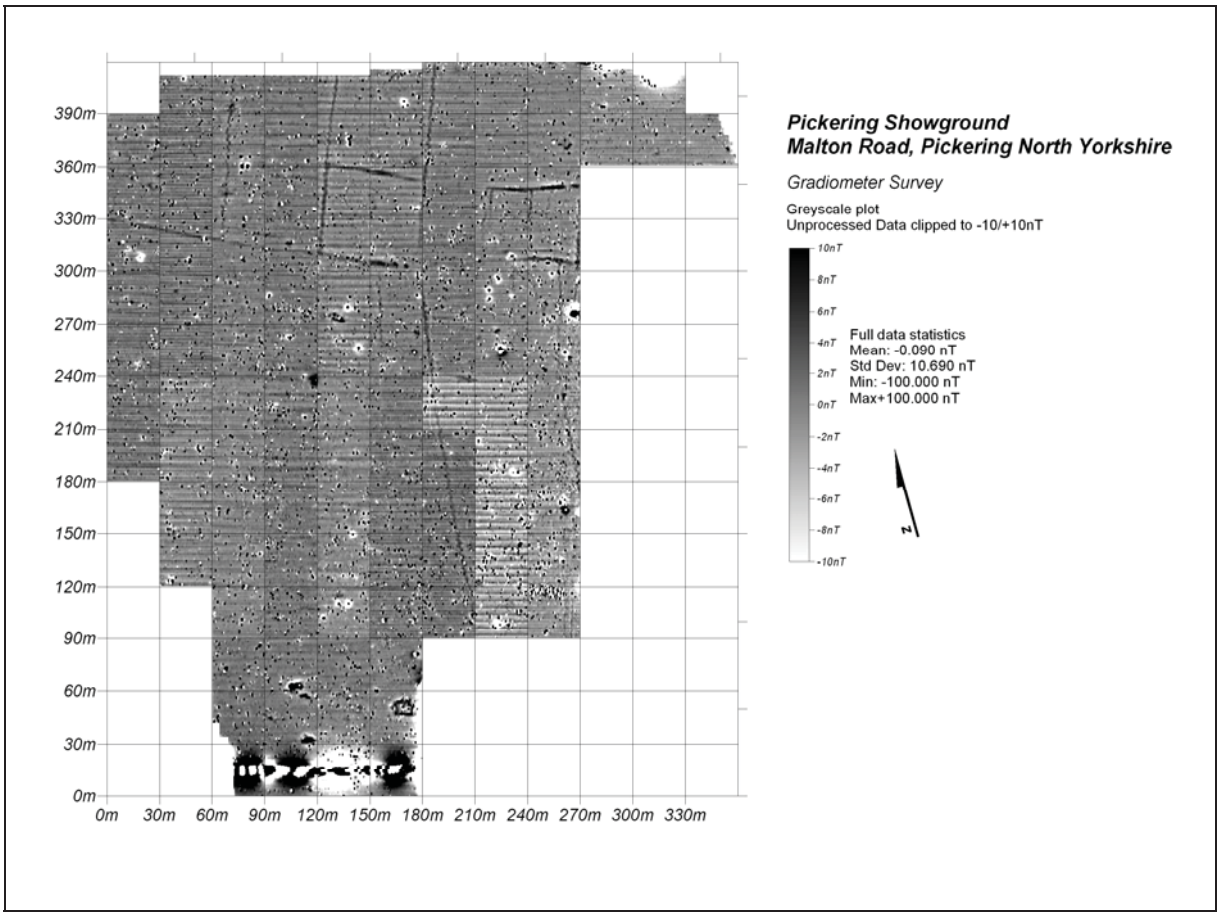

Figure 3: Greyscale plot of raw results (displayed greyscale range -10/ +10 nT)

Processed Data

Processing was undertaken to eliminate data anomalies. As above these include*, Clip, Despike, ZMT, and Interpolate*. Figures 4, 5, and 6 show the processed data in greyscale, 3d surface plot, and location plans respectively. The data here has been optimised to show magnetic variations in the lower *nT* range (typical of non metallic geological and archaeological features.

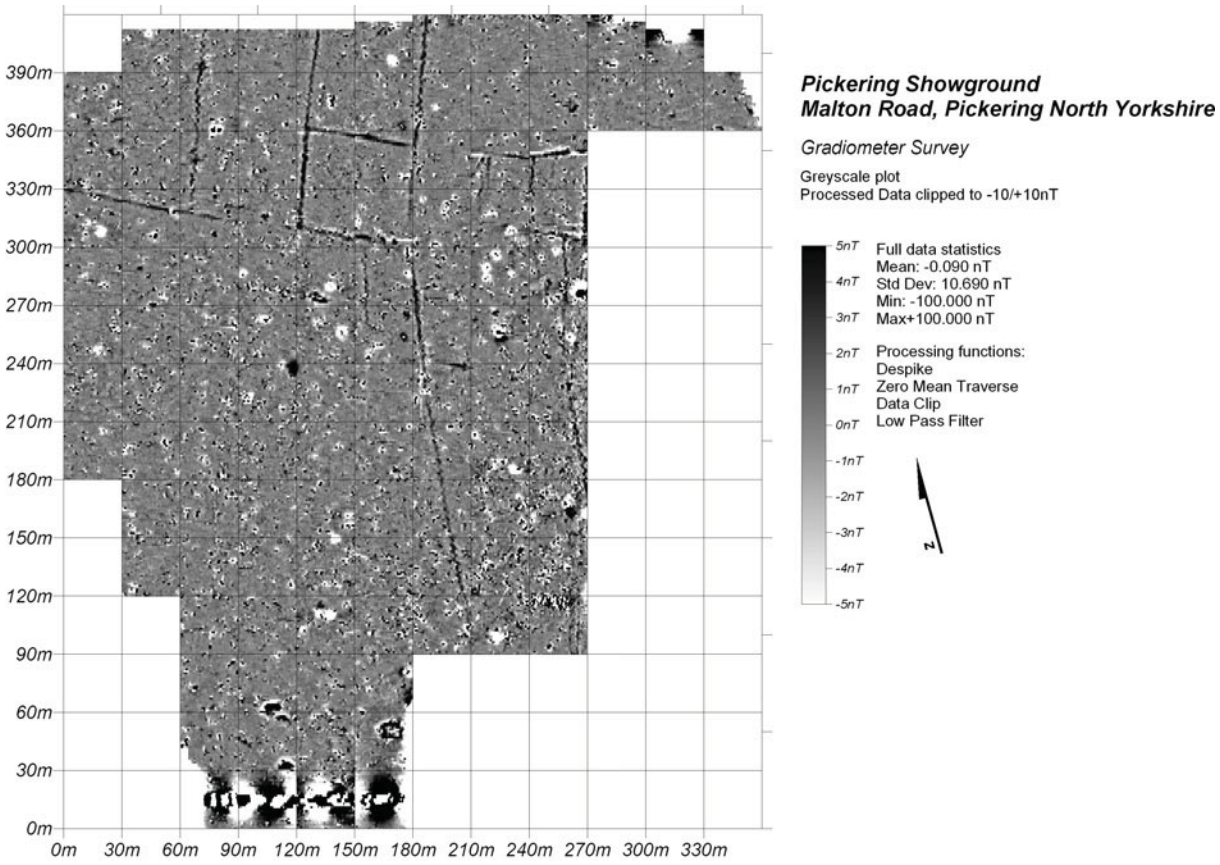

Figure 4:Greyscale plot of processed results (visible greyscale range -5/ +5 nT)

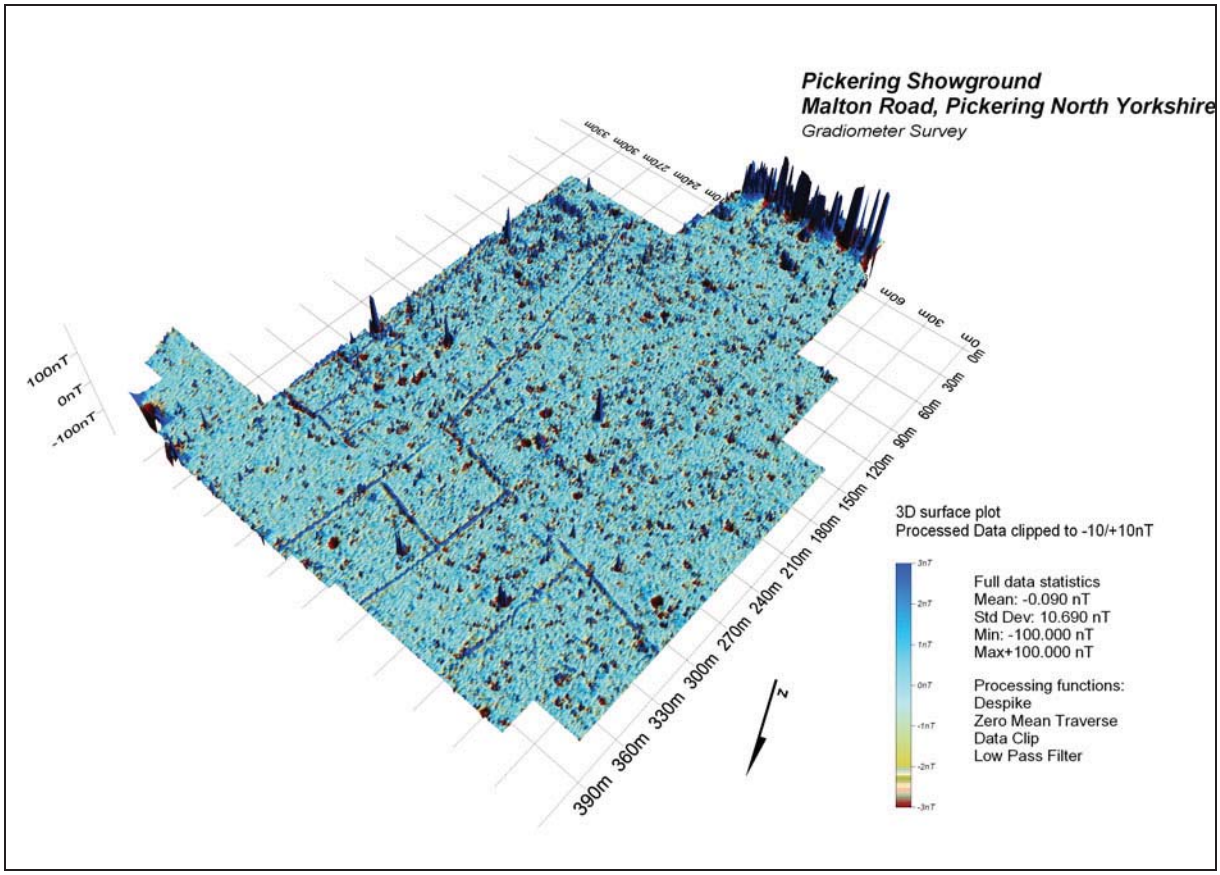

Figure 5:3d surface plot of processed results (visible greyscale range -5/ +5 nT)

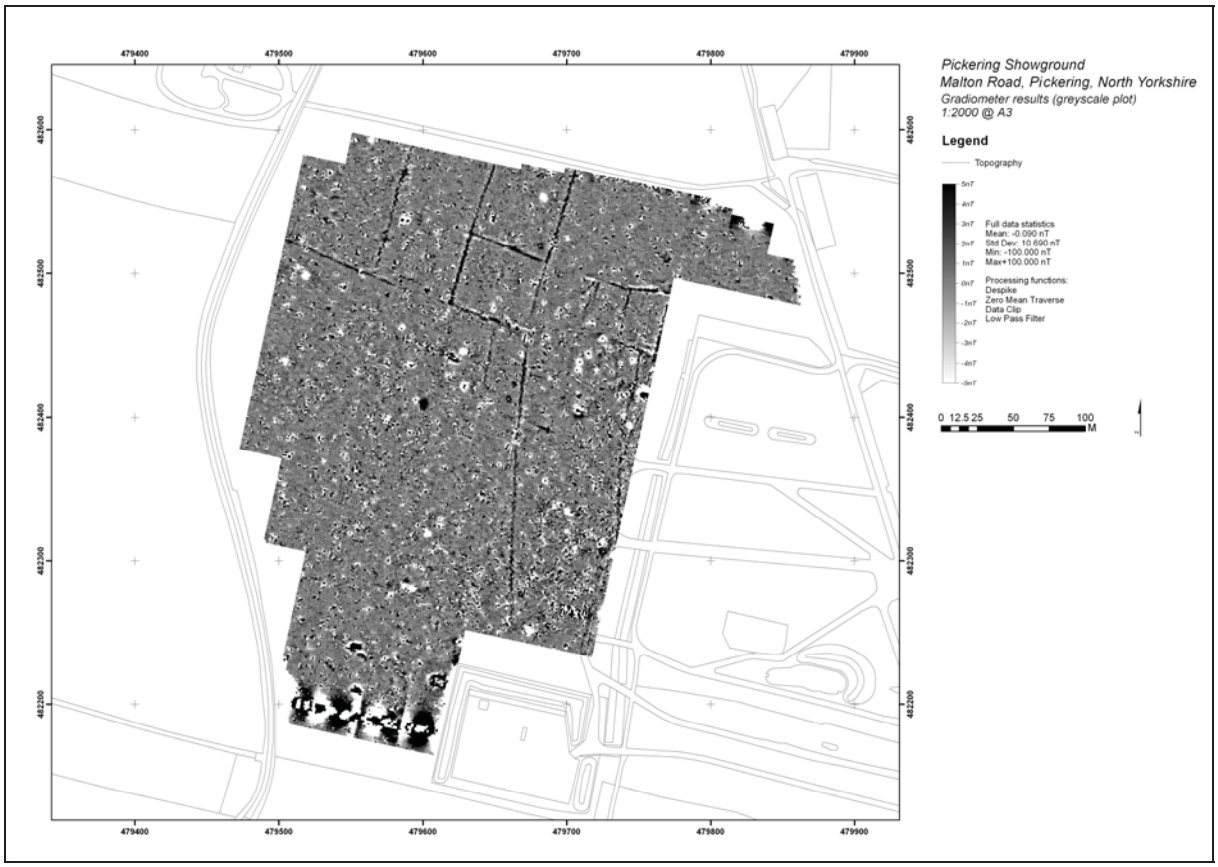

Figure 6: Greyscale plot of processed results displayed on a location map of the site.

Figures 7 shows a greyscale representation of significant anomalies with a colour coded interpretation overlaid in the results. Figure 8 is a colour coded anomaly maps showing interpretation of results with significant anomalies identified with an alphabetical code.

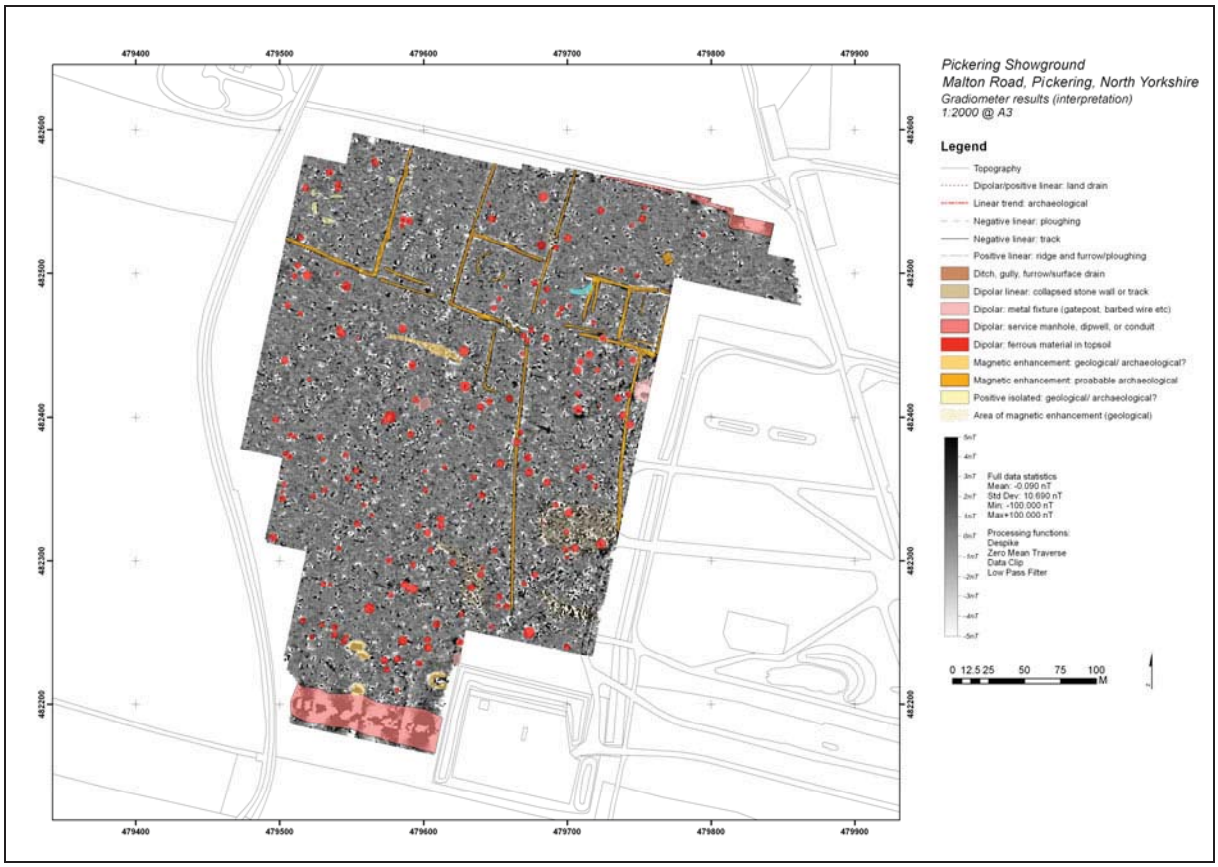

Figure 7: Greyscale plot with interpretation: greyscale range clipped to –5/+5 nT

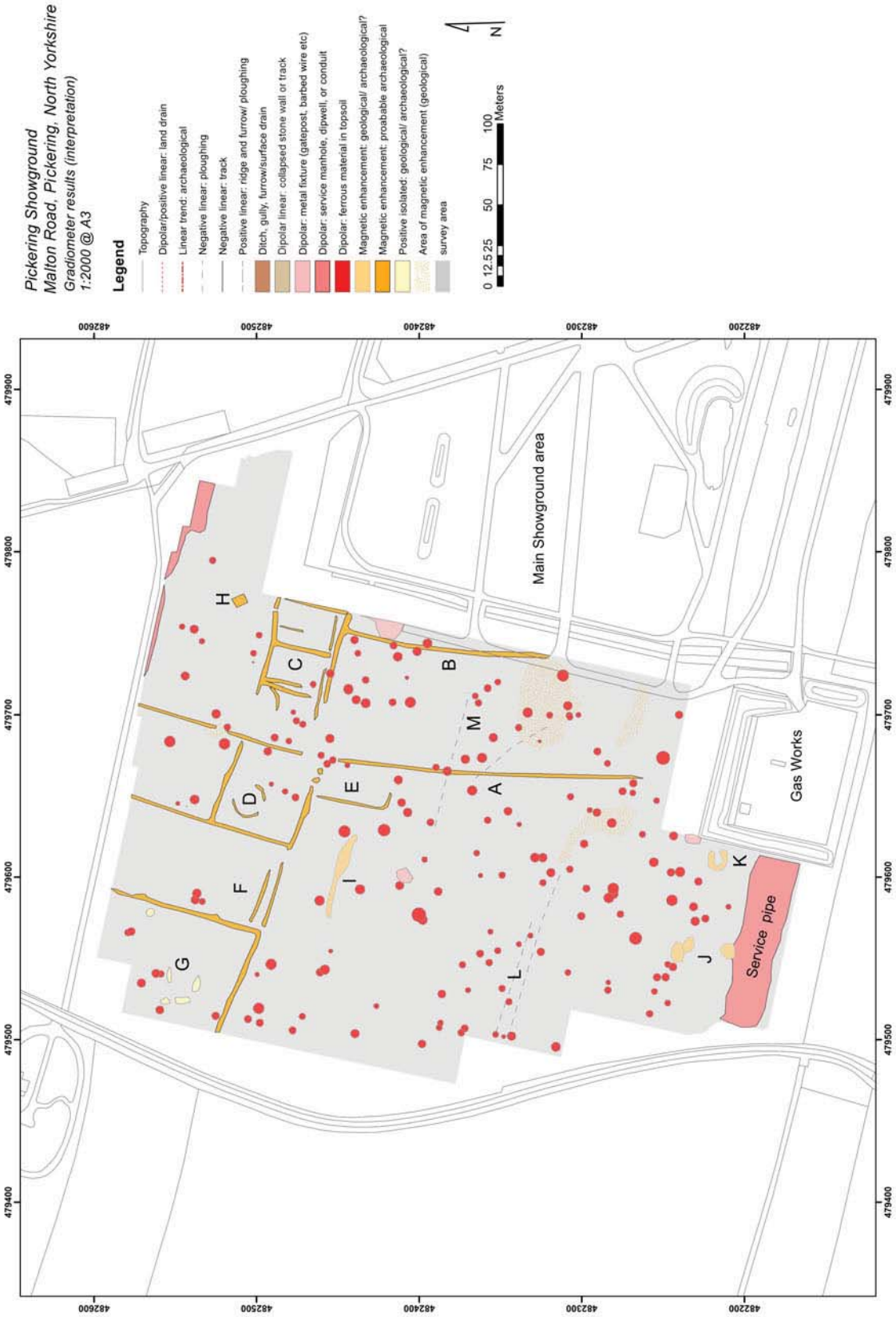

Figure 8: Interpretation with significant anomalies labelled.

Terminology: In magnetic survey, responses are described by *Nano Tesla* values in relation to the survey '*zero'* or *mean.* Therefore, '*positive'* refers to elevated or enhanced magnetic values, '*negative'* refers to lower values, and '*dipolar'* refers to responses that consist of an

elevated peak and a negative trough. Depending on their origin and structure, each of these can constitute linear features, localised features, or features covering and area.

A combination of factors including: subsurface/ surface conditions, the depth of anomaly, and material composition all affect the form of magnetic responses.

The categories of anomalies present in the Pickering Showground survey are relatively limited and can be divided quite clearly into responses associated with modern ferrous pollution, and responses associated with past agriculture activity or archaeology. The background geological response shows remarkably little variation and is a reflection of the consistency of the underlying drift sediments.

Responses in the second category (those associated with historic land use) are distributed across the site, but appear for form a network of field boundaries or enclosures dividing the land into smaller units. They are mostly linear features indicative of ditches cut into native soil deposits and geology which have since silted up with magnetically enhanced soils.

It is difficult to assign a date to most of the likely archaeological responses, but it is clear that in their configuration they represent a consistent and likely broadly contemporary system of land division. Evidence from historic maps would suggest that these were intact in the landscape as field boundaries until relatively recently, but it also seems possible that they conform to and maintain much earlier systems of enclose, possible Iron Age or Romano-British.

The survey has also identified a number of anomalies associated with larger ferrous objects and services. Of particular note here are the responses associated with the gas works in the south-eastern corner of the showground.

Figure 8 shows a detailed breakdown and an interpretation of the specific anomalies detected in the survey. The various categories identified in the associated legend and significant features are labelled alphabetically:

Magnetic Enhancement: probable archaeological

a) A major linear response suggesting a significant land boundary running on a curving north-south alignment. This alignment corresponds with a pattern of alignments evident in the early edition OS maps, but is not itself recorded on those maps. It seems likely that this boundary is medieval if not earlier.

b) A similar anomaly to A running on the same alignment and clearly part of the same system, but only traceable in the south section of the field. At its northern extent this anomaly intersect with a rectilinear enclosed group of responses (C).

c) Series of rectilinear responses probably associated with the silted fill of former ditches defining two adjacent roughly square areas. These also may have roots in a medieval filed system, but internal features including a parallel ditch system are suggestive of an earlier date. Parallel ditches in particular can reflect track-ways and in this instance it seems very likely that the southern boundary of these enclosures is borders on n east-west trackway.

d) A third rectilinear enclosed are to the west of the major north-south linear

boundary A. This area reflects a continuation of the enclosed system described in C. The curvilinear response at its centre is of interest from a dating perspective for this group of responses.

e) A rectangular enclosed area to the south of D and west of A, clearly post dating both.

f) A continuation of the parallel ditch responses noted in C. Running perpendicular to this feature are a series of major north-south linear responses. Although these are most likely medieval in date, it seems possible that they broadly conform to an early pattern of land division.

g) A series of indistinct responses occupying a range of -10/+10nT. These are of note because of the lack of variation on geological responses in this survey. Normally such responses would reflect geology, but in the context it seems equally likely that they are archaeological.

h) A localised rectangular response to the north of C.

i) An area of magnetic enhancement associated with a slight depression of the surface topography.

j) A group of major responses of indistinct form, probably associated with the service pipe to the gas works.

k) A strong rectangular response suggesting a structure- possibly associated with gas works.

6.0 Discussion and Conclusions.

Geophysical survey at Pickering showground has identified a series of anomalies associated with past human activity on the site. On the face of it most of these can be attributed to medieval and post-medieval agriculture in the area. Several of the anomalies correspond with field boundaries shown on the historic maps. It seems possible however that these later field divisions in turn correspond with earlier patterns of land use. The presence of internal features within some of the enclosed areas, and especially those of curvilinear form, may indicate Iron Age or Romano- British activity on the site.

Given the range of feature types there is uncertainty about the date and phasing in the geophysical detail. It would be desirable to test the results through the excavation of trial trenches, focused on identification the nature, extent and stratigraphy of near-surface remains. Area C and D in particular should be investigated and it would be desirable to test the relationship between features at most of the major intersection points of the features outlined above.

7.0 Appendix 1: Methodology.

Survey area	Pickering Showground, Malton Road, Pickering	
Crop types	Grassland	
Geology	Clay	
Instrumentation	Bartington Grad 601-2 Leica GPS900	
Software	Geoplot 3.00, ArcGIS 9.3, AutoCAD 2004, ArcGIS 9.3 Surfer	
Survey	Resolution: Sample Interval: Traverse interval: Grid Size: Cell size: Traverse method Survey Date	0.03nT/m used in 100nT range 0.25m 1m 30x30m 1x0.25m Zig-Zag Jan 2013
Processing	Using Geoplot 3.0 software: Clip, Despike, Zero Mean Grid, Zero Mean Traverse, Interpolation	
Coordinate system	GB Ordnance Survey	
Staff	Ben Gourley	

8.0 Appendix 2: Processing Methodology.

All processing and image preparation was done using Geoplot 3.00 software

Data Statistics: min/ max/mean and std. dev:

Mean: 1.799 nT

Std. Dev.: 13.340 nT

Min: -100.00 nT

Max: 43.670 nT

Processing procedures:

Despike: Search radius X=4 Y=1, Threshold: 3, Replacement method: Mean

Zero mean traverse: using Threshold Standard Deviation= 0.25

Zero mean traverse: using Geoplot Presets Grid=All, LMS=On. Pos.Threshold = +5, Neg.Threshold = -5.

Interpolate Using Geoplot Sin X/X on y-axis.

9.0 Appendix 3: Equipment used.

Bartington Grad 601- 2 dual fluxgate gradiometer. Data is stored in a non-volatile memory.

Full technical specification is available via http://www.bartington.com/templates/asset-relay.cfm?frmAssetFileID=102

Geoscan Geoplot 3.0 software http://www.geoscan-research.co.uk/page9.html

Leica GPS900 RTK dual frequency GPS. The GPS900 is a dual-frequency, geodetic, real-time RTK receiver with a potential accuracy of Kinematic (phase) Horizontal: 10mm + 1ppm and moving mode after initialisation Vertical: 20mm + 1ppm.

Full technical data and specification for the GPS900 may be obtained from http://www.leica-geosystems.com/en/downloads-downloads-search_74590.htm?search=true&product=GPS900

10.0 Appendix 4: Bibliography.

British Geological Survey *OpenGeoscience*
http://maps.bgs.ac.uk/geologyviewer_google/googleviewer.html

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