WYAS Archaeological Services

Northern Walled Garden
Newcastle Racecourse
Tyne and Wear

Geophysical Survey

Report no. 2902
June 2016

Client: All Saints Living

Northern Walled Garden, Newcastle Racecourse, Tyne and Wear

Geophysical Survey

Summary

A geophysical (magnetometer and earth resistance) survey was carried out on the northern walled garden at Newcastle Racecourse, High Gosforth, Newcastle-upon-Tyne, prior to the proposed development of the site. The survey area comprised of an enclosed area of around 0.5 hectares which had been recently cleared. Portions of the survey area around the periphery were unsuitable for survey. The magnetometer survey supplied no discernible data due to mass disturbance over the area surveyed. Anomalies consistent with ground disturbance and landscape gardening features have been identified using earth resistance. The overall archaeological potential of this site is low to moderate.

WYAS
Archaeological Services

Report Information

Client:	All Saints Living
Address:	2nd Floor Cuthbert House, All Saints Business Centre, Newcastle, NE1 2ET
Report Type:	Geophysical Survey
Location:	Newcastle Racecourse
County:	Tyne and Wear
Grid Reference:	NZ 2429 7160
Period(s) of activity:	Modern
Report Number:	2902
Project Number:	6329
Site Code:	NCR16
OASIS ID:	archaeol11-266145
Date of fieldwork:	June 2016
Date of report:	June 2016
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Fieldwork:	Rebbeca Goulding BSc MSc
	Mark Evans BA
Report:	Mark Evans
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Photography:	Mark Evans
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Authorisation for distribution: ----------

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1 Introduction

Archaeological Services WYAS (ASWYAS) were commissioned by AAG Archaeology (the Client) on behalf of All Saints Living (their client) to undertake a geophysical (magnetometer and resistance) survey of land in northern the walled garden at Newcastle Racecourse to inform a proposed planning application (2014/1457/01/DET). Guidance contained within the National Planning Policy Framework (DCLG 2012) was followed, in line with current best practice (CIfA 2014; David *et al*. 2008) as detailed in the project design (Sykes 2016). The survey was carried out on the 6th June 2016 to provide additional information on the archaeological resource of the Proposed Development Area (PDA).

Site location, topography and land-use

The PDA lies within a walled garden of approximately 0.5ha, to the immediate east of the A1056 and west of Newcastle Racecourse. The site is located approximately 7km to the north of the city centre of Newcastle (see Fig. 1). The survey area is centred at NZ 2429 7160 at a height above Ordnance Datum (aOD) of approximately 67m.

Soils and geology

The proposed development overlies superficial bedrock deposits of mudstone, siltstone and sandstone of the Pennine Middle Coal Measures, overlain by Devensian Till (BGS 2016). There are Quaternay lake deposits in the south-east of the site and limited areas of alluvium along the burns (Soil Survey of England and Wales 1983).

2 Archaeological Background

The historical and archaeological background provided here has been largely extracted from an analysis of the Newcastle County Archaeologist's specification.

The southern walled garden, associated with the northern garden is considered to of regional significance as bricks are pre 1784. The northern garden was added in 1838, and is considered to be of local significance. Both relate to the Grade II* listed building of Brandling House.

The northern walled garden has external stone face and internal brick face with an arched entrance gate in the south wall. A second entrance further east has been blocked up. The south wall, built of sandstone rubble is lower to allow cold air to flow out, rather than be trapped and form a frost pocket. The east end of the south wall curves up to a pier. The matching pier at the west side has disappeared. Vestiges of beds or walks can be seen from the aerial photographs (Morrison 2016).

3 Aims and Methodology

The main aim of the geophysical survey was to provide sufficient information to enable an assessment to be made of the impact of the development on potential sub-surface archaeological remains and for further evaluation or mitigation proposals, if appropriate, to be recommended. To achieve this aim, a magnetometer and resistance survey covering all amenable parts of the PDA was undertaken (see Fig. 2).

The general objectives of the geophysical survey were:

- to provide information about the nature and possible interpretation of any magnetic anomalies identified;
- to therefore determine the presence/absence and extent of any buried archaeological features; and
- to prepare a report summarising the results of the survey.

Magnetometer survey

The site grid was laid out using a Trimble VRS differential Global Positioning System (Trimble 5800 model). The survey was undertaken using Bartington Grad601 magnetic gradiometers. These were employed taking readings at 0.25m intervals on zig-zag traverses 1.0m apart within 30m by 30m grids, so that 3600 readings were recorded in each grid. These readings were stored in the memory of the instrument and later downloaded to computer for processing and interpretation. Geoplot 3 (Geoscan Research) software was used to process and present the data. Further details are given in Appendix 1.

Resistance survey

The survey was undertaken using a Geoscan RM15 resistance meter with MPX15 multiplexer. These were employed taking readings at 1m intervals on zig-zag traverses 1.0m apart within 30m by 30m grids. These readings were stored in the memory of the instrument and later downloaded to computer for processing and interpretation. Geoplot 3 (Geoscan Research) software was used to process and present the data. Further details are given in Appendix 1.

Reporting

A general site location plan, incorporating the 1:50000 Ordnance Survey (OS) mapping, is shown in Figure 1. Figure 2 displays the survey location showing greyscale magnetometer data at scale 1:2000 @A4. Figure 3 displays the processed magnetometer data at a scale of 1:1000 and Figure 4 the interpretation of this data at the same scale. Figure 5 depicts the

processed resistivity data at 1:1000 and Figure 6 the interpretation of this data also at the same scale of 1:1000.

Technical information on the equipment used, data processing and survey methodologies are given in Appendix 1 and 2. Technical information on locating the survey area is provided in Appendix 3. Appendix 4 describes the composition and location of the archive. A copy of the completed OASIS form is included in Appendix 5.

The survey methodology, report and any recommendations comply with guidelines outlined by English Heritage (David *et al.* 2008) and by the Chartered Institute for Archaeologists (CIfA 2014). All figures reproduced from Ordnance Survey mapping are with the permission of the controller of Her Majesty's Stationery Office (© Crown copyright).

The figures in this report have been produced following analysis of the data in processed formats and over a range of different display levels. All figures are presented to most suitably display and interpret the data from this site based on the experience and knowledge of Archaeological Services staff.

4 Results and Discussion (see Figures 3 to 6)

Magnetometer survey

The magnetometer survey supplied no discernible data due to the mass of disturbance across the survey area as illustrated in Figures 3 and 4. However a trend which may relate to a former pathway has been identified (Fig 3-4). A number of anomalies have been classified as ferrous in origin, and a fully description is given below.

Ferrous anomalies

Ferrous anomalies, as individual 'spikes', or as large discrete areas are typically caused by ferrous (magnetic) material, either on the ground surface or in the plough-soil. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as modern ferrous debris or material is common on rural sites, often being present as a consequence of manuring or tipping/infilling. There is no obvious pattern or clustering to their distribution in this survey to suggest anything other than a random background scatter of ferrous debris probably caused by structural demolition and former garden remains.

Resistance survey

Within the PDA zones of very high and very low resistance have been recorded. There are no obvious topographic or visual explanations for these variations. Two possible circular anomalies of high resistance can be inferred, labelled A and B, both of which may be interpreted as possible landscape gardening features. Within the walled garden, the remnants

of a now demolished building described as 'The Bungalow' (Wardell Armstrong, 2014) appears on historical maps between 1939 and 1990. This feature appears on an east-west alignment in the top northwest corner of the walled garden. Traces of this have been detected, although most of the area was unsuitable for survey at the time.

There is another area of high resistance in the northeast of the survey area. Analysis of historic aerial photos from 1945 (Google Earth 2016) indicates that there was a former wall which further sub-divided the walled garden. This area of high resistance is likely to relate to the demolition/scattering of rubble in this part of the site.

An east-west linear response, has been detected by both the resistance and the magnetometer. It occurs predominantly across the middle of the site, and it corresponds with identified trackways from aerial photographs (Morrison 2016).

The results and subsequent interpretation of data from geophysical surveys should not be treated as an absolute representation of the underlying archaeological and non-archaeological remains. Confirmation of the presence or absence of archaeological remains can only be achieved by direct investigation of sub-surface deposits.

Conclusions

Due to the mass disturbance over the area surveyed, the magnetometer was unable to supply any discernible data. The use of earth resistance has identified anomalies consistent with ground disturbance and possible landscape gardening features. Therefore based upon the geophysical survey the archaeological potential of the site is low to moderate.

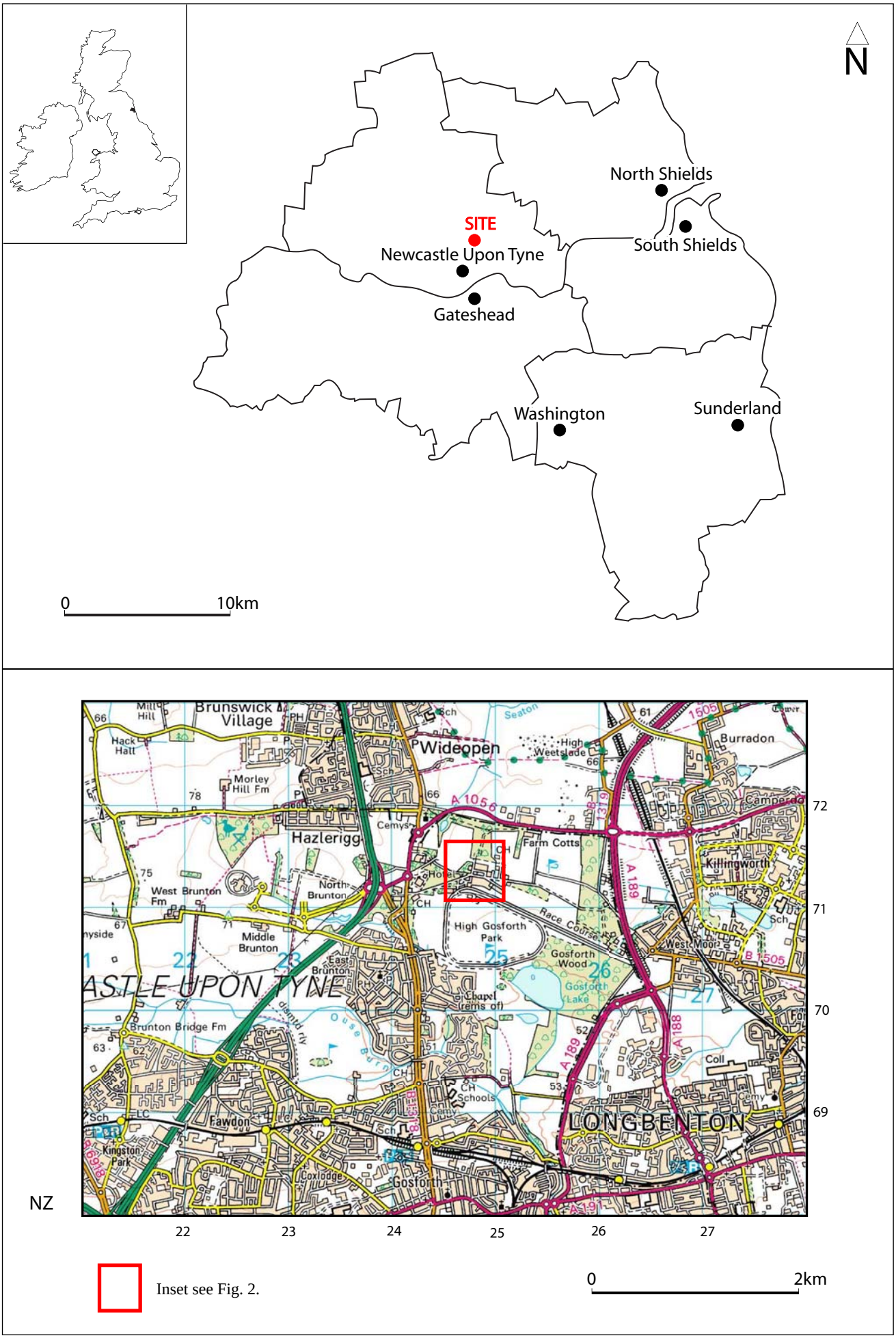

Fig. 1. Site location

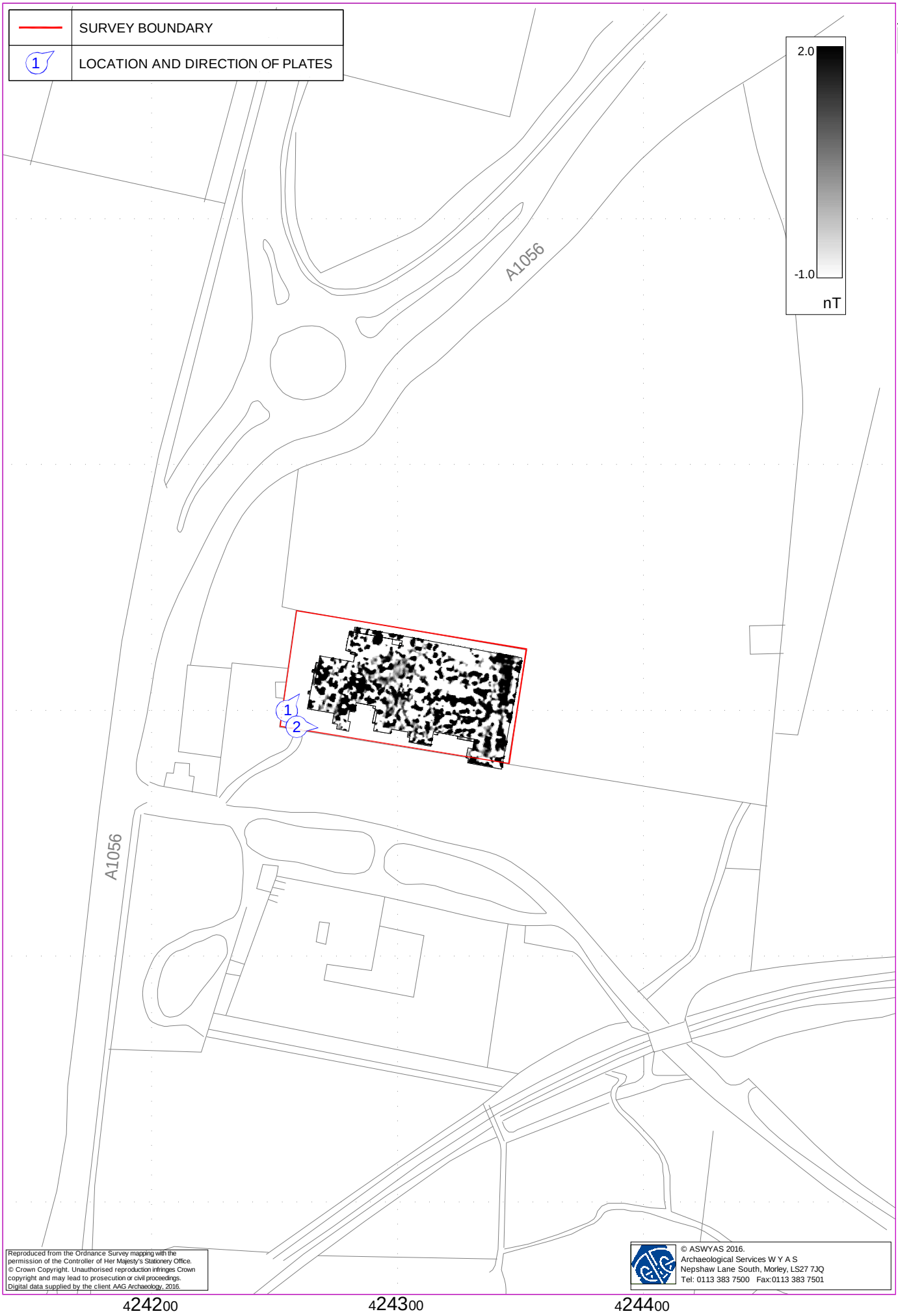

Fig. 2. Survey location showing greyscale magnetometer data (1:2000 @ A4)

Fig. 3. Processed greyscale magnetometer data (1:1000 @ A4)

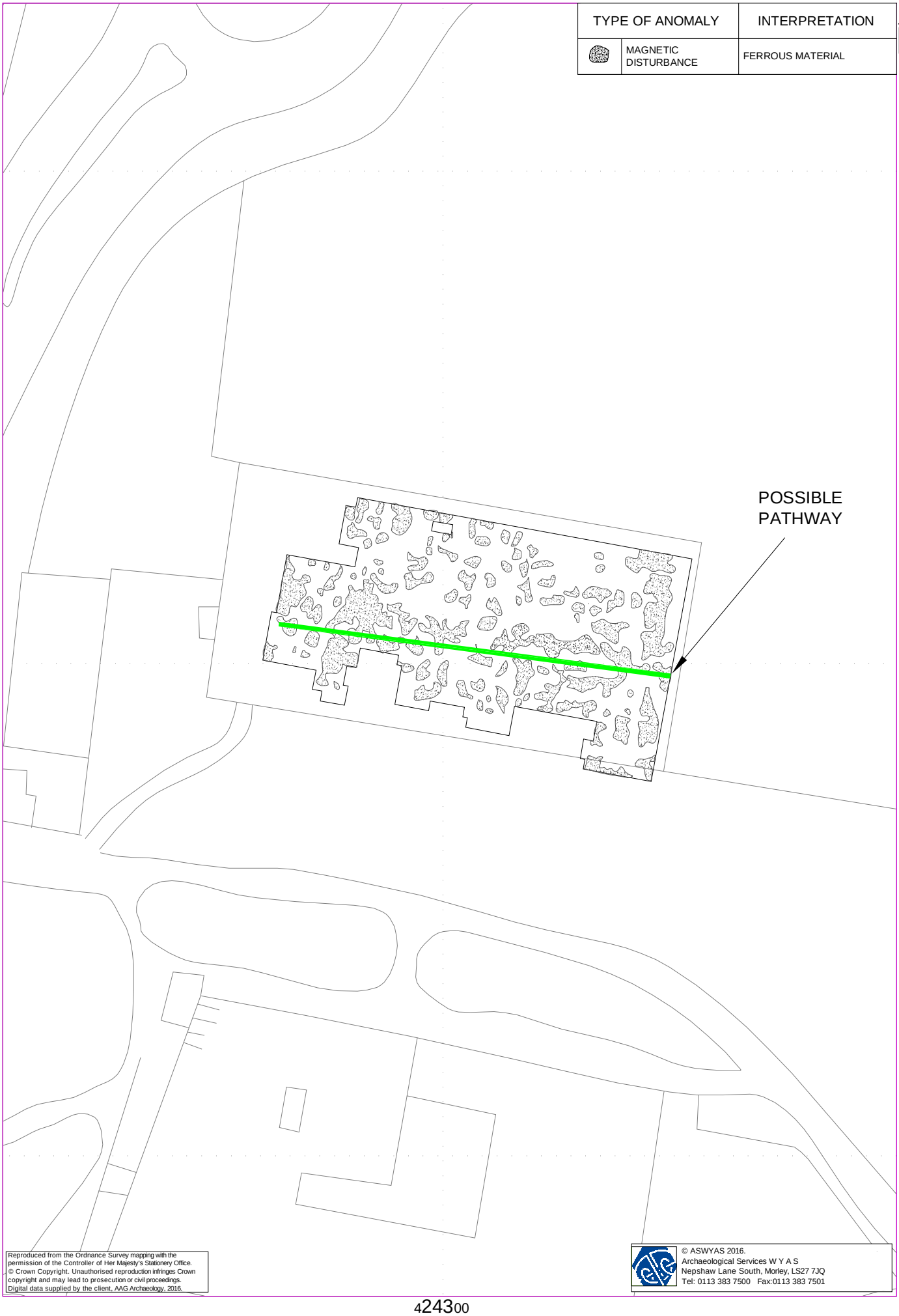

Fig. 4. Interpretation of magnetometer data (1:1000 @ A4)

Fig. 5. Processed greyscale resistance data (1:1000 @ A4)

Fig. 6. Interpretation of resistance data (1:1000 @ A4)

0 30m

Plate 1. General view of site, looking north

Plate 2. General view of site, looking northeast

Appendix 1: Magnetic survey - technical information

Magnetic Susceptibility and Soil Magnetism

Iron makes up about 6% of the Earth's crust and is mostly present in soils and rocks as minerals such as maghaemite and haemetite. These minerals have a weak, measurable magnetic property termed magnetic susceptibility. Human activities can redistribute these minerals and change (enhance) others into more magnetic forms. Areas of human occupation or settlement can then be identified by measuring the magnetic susceptibility of the topsoil because of the attendant increase (enhancement) in magnetic susceptibility. If the enhanced material subsequently comes to fill features, such as ditches or pits, localised isolated and linear magnetic anomalies can result whose presence can be detected by a magnetometer (fluxgate gradiometer).

In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of topsoils, subsoils and rocks into which these features have been cut, which causes the most recognisable responses. This is primarily because there is a tendency for magnetic ferrous compounds to become concentrated in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected. The magnetic susceptibility of a soil can also be enhanced by the application of heat and the fermentation and bacterial effects associated with rubbish decomposition. The area of enhancement is usually quite large, mainly due to the tendency of discard areas to extend beyond the limit of the occupation site itself, and spreading by the plough.

Types of Magnetic Anomaly

In the majority of instances anomalies are termed 'positive'. This means that they have a positive magnetic value relative to the magnetic background on any given site. However some features can manifest themselves as 'negative' anomalies that, conversely, means that the response is negative relative to the mean magnetic background.

Where it is not possible to give a probable cause of an observed anomaly a '?' is appended.

It should be noted that anomalies interpreted as modern in origin might be caused by features that are present in the topsoil or upper layers of the subsoil. Removal of soil to an archaeological or natural layer can therefore remove the feature causing the anomaly.

The types of response mentioned above can be divided into five main categories that are used in the graphical interpretation of the magnetic data:

Isolated dipolar anomalies (iron spikes)

These responses are typically caused by ferrous material either on the surface or in the topsoil. They cause a rapid variation in the magnetic response giving a characteristic 'spiky' trace. Although ferrous archaeological artefacts could produce this type of response, unless there is supporting evidence for an archaeological interpretation, little emphasis is normally given to such anomalies, as modern ferrous objects are common on rural sites, often being present as a consequence of manuring.

Areas of magnetic disturbance

These responses can have several causes often being associated with burnt material, such as slag waste or brick rubble or other strongly magnetised/fired material. Ferrous structures such as pylons, mesh or barbed wire fencing and buried pipes can also cause the same disturbed response. A modern origin is usually assumed unless there is other supporting information.

Linear trend

This is usually a weak or broad linear anomaly of unknown cause or date. These anomalies are often caused by agricultural activity, either ploughing or land drains being a common cause.

Areas of magnetic enhancement/positive isolated anomalies

Areas of enhanced response are characterised by a general increase in the magnetic background over a localised area whilst discrete anomalies are manifest by an increased response on two or three successive traverses. In neither instance is there the intense dipolar response characteristic exhibited by an area of magnetic disturbance or of an 'iron spike' anomaly (see above). These anomalies can be caused by infilled discrete archaeological features such as pits or post-holes or by kilns. They can also be caused by pedological variations or by natural infilled features on certain geologies. Ferrous material in the subsoil can also give a similar response. It can often therefore be very difficult to establish an anthropogenic origin without intrusive investigation or other supporting information.

Linear and curvilinear anomalies

Such anomalies have a variety of origins. They may be caused by agricultural practice (recent ploughing trends, earlier ridge and furrow regimes or land drains), natural geomorphological features such as palaeochannels or by infilled archaeological ditches.

Methodology: Gradiometer Survey

The main method of using the fluxgate gradiometer for commercial evaluations is referred to as ***detailed survey*** and requires the surveyor to walk at an even pace carrying the instrument within a grid system. A sample trigger automatically takes readings at predetermined points, typically at 0.25m intervals, on traverses 1m apart. These readings are stored in the memory of the instrument and are later dumped to computer for processing and interpretation.

During this survey a Bartington Grad601 magnetic gradiometer was used taking readings on the 0.1nT range, at 0.25m intervals on zig-zag traverses 0.5m apart within 30m by 30m square grids. The instrument was checked for electronic and mechanical drift at a common point and calibrated as necessary. The drift from zero was not logged.

The gradiometer data have been presented in this report in processed greyscale format. The data in the greyscale images have been interpolated and selectively filtered to remove the effects of drift in instrument calibration and other artificial data constructs and to maximise the clarity and interpretability of the archaeological anomalies.

The results and subsequent interpretation of data from geophysical surveys should not be treated as an absolute representation of the underlying archaeological and non-archaeological remains. Confirmation of the presence or absence of archaeological remains can only be achieved by direct investigation of sub-surface deposits.

Appendix 2: Earth resistance survey - technical information

Soil Resistance

The electrical resistance of the upper soil horizons is predominantly dependant on the amount and distribution of water within the soil matrix. Buried archaeological features, such as walls or infilled ditches, by their differing capacity to retain moisture, will impact on the distribution of sub-surface moisture and hence affect electrical resistance. In this way there may be a measurable contrast between the resistance of archaeological features and that of the surrounding deposits. This contrast is needed in order for sub-surface features to be detected by a resistance survey.

The most striking contrast will usually occur between a solid structure, such as a wall, and water-retentive subsoil. This shows as a resistive high. A weak contrast can often be measured between the infill of a ditch feature and the subsoil. If the infill material is soil it is likely to be less compact and hence more water retentive than the subsoil and so the feature will show as a resistive low. If the infill is stone the feature may retain less water than the subsoil and so will show as a resistive high.

The method of measuring variations in ground resistance involves passing a small electric current (1mA) into the ground via a pair of electrodes (current electrodes) and then measuring changes in current flow (the potential gradient) using a second pair of electrodes (potential electrodes). In this way, if a structural feature, such as a wall, lies buried in a soil of uniform resistance much of the current will flow around the feature following the path of least resistance. This reduces the current density in the vicinity of the feature, which in turn increases the potential gradient. It is this potential gradient that is measured to determine the resistance. In this case, the gradient would be increased around the wall giving a positive or high resistance anomaly.

In contrast a feature such as an infilled ditch may have a moisture retentive fill that is comparatively less resistive to current flow. This will increase the current density and decrease the potential gradient over the feature giving a negative or low resistance anomaly.

Survey Methodology

The most widely used archaeological technique for earth resistance surveys uses a twin probe configuration. One current and one potential electrode (the remote or static probes) are fixed firmly in the ground a set distance away from the area being surveyed. The other current and potential electrodes (the mobile probes) are mounted on a frame and are moved from one survey point to the next. Each time the mobile probes make contact with the ground an electrical circuit is formed between the current electrodes and the potential gradient between the mobile and remote probes is measured and stored in the memory of the instrument.

A Geoscan RM15 resistance meter was used during this survey, with the instrument logging each reading automatically at 1m intervals on traverses 1m apart. The mobile probe spacing

was 0.5m with the remote probes 15m apart and at least 15m away from the grid under survey. This mobile probe spacing of 0.5m gives an approximate depth of penetration of 1m for most archaeological features. Consequently a soil cover in excess of 1m may mask, or significantly attenuate, a geophysical response.

Appendix 3: Survey location information

An initial survey station was established using a Trimble VRS differential Global Positioning System (Trimble R6 model). The cart data was geo-referenced using the geo-referenced survey station with a Trimble RTK differential Global Positioning System (Trimble R6 model). The accuracy of this equipment is better than 0.01m. The survey grids were then super-imposed onto a base map provided by the client to produce the displayed block locations. However, it should be noted that Ordnance Survey positional accuracy for digital map data has an error of 0.5m for urban and floodplain areas, 1.0m for rural areas and 2.5m for mountain and moorland areas. This potential error must be considered if co-ordinates are measured off hard copies of the mapping rather than using the digital co-ordinates.

Archaeological Services WYAS cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party.

Appendix 4: Geophysical archive

The geophysical archive comprises:-

- an archive disk containing compressed (WinZip 8) files of the raw data, report text (Microsoft Word 2000), and graphics files (Adobe Illustrator CS2 and AutoCAD 2008) files; and
- a full copy of the report.

At present the archive is held by Archaeological Services WYAS although it is anticipated that it may eventually be lodged with the Archaeology Data Service (ADS). Brief details may also be forwarded for inclusion on the English Heritage Geophysical Survey Database after the contents of the report are deemed to be in the public domain (i.e. available for consultation in the Tyne and Wear Environment Record).

Appendix 5: Oasis form

OASIS DATA COLLECTION FORM: England

OASIS ID: archaeol11-266145

Project details

Project name	Northern Walled garden, Newcastle Racecourse
Short description of the project	A geophysical (magnetometer and earth resistance) survey was carried out on the northern walled garden at Newcastle Racecourse, High Gosforth, Newcastle-upon-Tyne, prior to the proposed development of the site. The survey area comprised of an enclosed area of around 0.5 hectares which had been recently cleared. Portions of the survey area around the periphery were unsuitable for survey. The magnetometer survey supplied no discernible data due to mass disturbance over the area surveyed. Anomalies consistent with ground disturbance and landscape gardening features have been identified using earth resistance. The overall archaeological potential of this site is low to moderate.
Project dates	Start: 06-06-2016 End: 06-06-2016
Previous/future work	No / Not known
Any associated project reference codes	6329 - Sitecode
Type of project	Field evaluation
Current Land use	Grassland Heathland 5 - Character undetermined
Monument type	NONE None
Significant Finds	NONE None
Methods & techniques	"Geophysical Survey"
Development type	Not recorded
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Not known / Not recorded
Solid geology (other)	Pennine Coal Measures
Drift geology	ALLUVIUM
Techniques	Magnetometry
Techniques	Resistivity - area

Project location

Country	England
Site location	TYNE AND WEAR NEWCASTLE UPON TYNE NORTH GOSFORTH Northern Walled Garden, Newcastle Racecourse
Study area	0.5 Hectares
Site coordinates	NZ 242 716 55.038257135207 -1.621291031538 55 02 17 N 001 37 16 W Point
Height OD / Depth	Min: 67m Max: 67m

Project creators

Name of Organisation	Archaeological Services WYAS
Project brief originator	AAG Archaeology
Project design originator	AAG Archaeology
Project director/manager	C. Sykes
Project supervisor	R. Goulding

Project archives

Physical Archive Exists?	No
Digital Archive recipient	AAG Archaeology
Digital Contents	"Survey"
Digital Media available	"Geophysics","Images raster / digital photography","Text"
Paper Archive Exists?	No

Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	Northern Walled Garden, Newcastle Racecourse
Author(s)/Editor(s)	Evans, M
Other bibliographic details	2902
Date	2016
Issuer or publisher	ASWYAS
Place of issue or publication	Morley, Leeds
Description	A4 report

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Entered on	20 October 2016

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