# Land At Shrivenham
# Oxfordshire

## Detailed Gradiometer Survey Report

**Prepared for:**
Taylor Wimpey Oxfordshire
Windrush Court Suite J
Abingdon Business Park
Abingdon
Oxfordshire
OX14 1SY

**Prepared by:**
Wessex Archaeology
Portway House
Old Sarum Park
Salisbury
SP4 6EB

www.wessexarch.co.uk

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## Detailed Gradiometer Survey Report

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## Detailed Gradiometer Survey Report

**Summary**

A detailed gradiometer survey was conducted over land off Longcot Road, Shrivenham, Oxfordshire. The project was commissioned by Taylor Wimpey (UK) Limited with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features on the site ahead of a proposed development.

The site comprises a pasture field to the west of Longcot Road, approximately 8.9km northeast of Swindon. The site occupies an area of relatively flat land, sloping down towards the southeast. The gradiometer survey covered 3.4ha and has demonstrated the presence of anomalies of definite, probable and possible archaeological interest within the survey area, along with a region of increased magnetic response and at least two modern services.

Two pit-like anomalies were identified along with a number of linear anomalies that may possibly represent former field boundaries. The majority of observed anomalies appear to relate to relatively recent use of this land for agriculture. Weak linear and curvilinear trends were observed throughout the dataset, although their origins are unclear.

The geophysical survey was undertaken on the 11th and 12th September 2013.

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## Detailed Gradiometer Survey Report

**Acknowledgements**

The detailed gradiometer survey was commissioned by Taylor Wimpey (UK) Limited. The assistance of Andy Cattermole is gratefully acknowledged in this regard.

The fieldwork was directed by Clara Dickinson and assisted by Jennifer Smith and Rachel Williams. Jennifer Smith processed the geophysical data which was interpreted by Ross Lefort who also wrote this report. The geophysical work was quality controlled by Ben Urmston. Illustrations were prepared by Linda Coleman. The project was managed on behalf of Wessex Archaeology by Sue Farr.

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## Detailed Gradiometer Survey Report

## 1 INTRODUCTION

### 1.1 Project background

1.1.1 Wessex Archaeology was commissioned by Taylor Wimpey (UK) Limited to carry out a geophysical survey of land off Longcot Road, Shrivenham, Oxfordshire (**Figure 1**), hereafter "the Site" (centred on NGR 424350, 188725). The survey forms part of an ongoing programme of archaeological works being undertaken ahead of proposed development at the Site.

1.1.2 The aim of the geophysical survey was to establish the presence/absence, extent and character of detectable archaeological remains within the survey area.

1.1.3 A Desk-Based Assessment (DBA) was carried out by Wessex Archaeology that revealed there are no recorded heritage assets within the survey area although this lack of evidence may be related to a lack of archaeological investigation in this area (WA 2012).

1.1.4 This report presents a brief description of the methodology followed, the detailed survey results and the archaeological interpretation of the geophysical data.

### 1.2 The Site

1.2.1 The survey area comprises one pasture field off Longcot Road, Shrivenham, some 8.9km northeast of the centre of Swindon (**Figure 1**). Detailed gradiometer survey was undertaken over all accessible parts of the Site, a total of 3.4ha.

1.2.2 The Site occupies an area of gently sloping land at a height between 90m and 95m above Ordnance Datum (aOD) and slopes downhill toward the southeast. The survey extents are defined by the surrounding field boundaries.

1.2.3 The solid geology on Site is recorded as Corallion with Kimmeridge Clay (Upper Jurassic) close by to the southeast (Ordnance Survey 1957). The Quaternary deposits nearby are recorded as alluvium (Ordnance Survey 1977). The soils underlying the Site are likely to be typical stagnogley soils of the 711j (Kingston) association. There are pelo-stagnogley soils of the 712b (Denchworth) association further to the southeast (SSEW 1983). Soils derived from such geological parent material have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetometer survey.

# 2 METHODOLOGY

## 2.1 Introduction

2.1.1 The detailed magnetometer survey was conducted using a Bartington Grad601-2 dual fluxgate gradiometer system. The survey was conducted in accordance with English Heritage guidelines (2008).

2.1.2 The geophysical survey was undertaken by Wessex Archaeology's in-house geophysics team on 11th and 12th September 2013. Field conditions at the time of the survey were good, with firm ground under foot and little vegetation present on site.

## 2.2 Method

2.2.1 Individual survey grid nodes were established at 30m x 30m intervals using a Leica Viva RTK GNSS instrument, which is precise to approximately 0.02m and therefore exceeds English Heritage recommendations (2008).

2.2.2 The magnetometer survey was conducted using a Bartington Grad601-2 fluxgate gradiometer instrument, which has a vertical separation of 1m between sensors. Data were collected at 0.25m intervals along transects spaced 1m apart with an effective sensitivity of 0.03nT, in accordance with EH guidelines (2008). Data were collected in the zigzag method.

2.2.3 Data from the survey was subject to minimal data correction processes. These comprise a zero mean traverse function (±8nT thresholds) applied to correct for any variation between the two Bartington sensors used, and a de-step function to account for variations in traverse position due to varying ground cover and topography. These two steps were applied to all survey areas, with no interpolation applied.

2.2.4 Further details of the geophysical and survey equipment, methods and processing are described in **Appendix 1**.

# 3 GEOPHYSICAL SURVEY RESULTS AND INTERPRETATION

## 3.1 Introduction

3.1.1 The gradiometer survey has been successful in identifying anomalies of likely, probable and possible archaeological interest across the Site, along with at least two modern services. Results are presented as a series of greyscale and XY plots, and archaeological interpretations, at a scale of 1:1,250 (**Figures 2** and **3**). The data are displayed at -4nT (white) to +6nT (black) for the greyscale image and ±50nT at 50nT per cm for the XY trace plots.

3.1.2 The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous/burnt or fired objects, and magnetic trends (**Figure 4**). Full definitions of the interpretation terms used in this report are provided in **Appendix 2**.

3.1.3 Numerous ferrous anomalies are visible throughout the detailed survey dataset. These are presumed to be modern in provenance and are not referred to, unless considered relevant to the archaeological interpretation.

### 3.2 Gradiometer Survey Results and Interpretation

3.2.1 The two anomalies identified of definite archaeological interest comprise a pair of sub-oval positive anomalies at **4000** and **4001**, to the west of the centre of the Site; they have magnetic values over +6nT and measure 4.5m and 3m along their greatest axes respectively. Both anomalies have a smooth profile in the XY plots and are considered to represent pits. There are a number of other similar responses concentrated in the vicinity that have been variously classed as probable archaeology and possible archaeology based on their size, shape in plan and strength and shape of their measured response. It is not clear whether the wider area represents a cluster of pits or a concentration of natural features such as tree throws.

3.2.2 A positive linear is present at **4002** and has magnetic values between +1nT and +3nT; it is aligned roughly NNW to SSE and does not run parallel to any other modern features or field boundaries. This anomaly is considered to represent a ditch and is classed as probable archaeology; it may represent a former field boundary.

3.2.3 A group of positive linear anomalies can be seen near the northeastern extent of the survey area (**4003** and **4004**); they are aligned approximately NW to SE and NE to SW on similar orientations to the present field boundaries. These anomalies are intermittent but have stronger magnetic values over +6nT in their strongest regions; both of these responses have been classed as probable archaeology and may represent former field divisions.

3.2.4 There are two weakly positive linear anomalies running through the data at **4005** and **4006**; the former is aligned roughly parallel to the northwest field boundary and the latter is roughly parallel to the southeast boundary. They both have magnetic values typically ranging between +1nT and +3nT and have been classed as possible archaeology due to their weak magnetic values and their common alignment with modern field boundaries.

3.2.5 There are numerous trends extending throughout the data; most of these clearly relate to ploughing scars but some others such as those at **4007**, **4008** and **4009** may prove to be archaeological.

3.2.6 The remaining anomalies of possible archaeological interest are small sub-circular and sub-oval anomalies that could represent anything from small archaeological features such as postholes to geological features. These anomalies have been classed as possible archaeology as there is no significant patterning in their spatial distribution to enable a firmer interpretation of them.

3.2.7 There are also a number of fairly strong positive anomalies running parallel to one another on a roughly northwest to southeast alignment such as the example at **4010**. They have magnetic values around +3nT and have been interpreted as agricultural, possibly representing drainage features.

3.2.8 There are several concentrated regions of bipolar and dipolar responses such as those at **4011** and **4012**; these are considered to either represent geological variations or concentrations of modern ceramic and metallic debris.

3.2.9 There are two modern services visible in the data at **4013** and **4014** to **4017**; these will be discussed in more detail in the next section of the report. The remaining anomalies are broad and weak positive anomalies that are believed to relate to geological variation such as those around **4018** and **4019**.

### 3.3 Gradiometer Survey Results and Interpretation: Modern Services

3.3.1 There are at least two modern services located in the data at **4013** and **4014** to **4017**; the former appears to be a ferrous pipe and the latter appears to be largely made of a material other than ferrous metal or ceramic. This second service (**4014** to **4017**) is aligned northwest to southeast and has negative magnetic values along its length with regularly spaced ferrous anomalies at separations around 40m along its length. This may represent a plastic pipe with some grit backfill and inspection covers or manholes made of metal spaced along the pipe. The ferrous pipe at **4013** is aligned roughly northeast to southwest and continues beyond the limits of the geophysical survey.

3.3.2 It is not clear from the geophysical data whether any of the services identified are in active use or not. Also gradiometer data will not be able to locate and identify all services present on site. This report and accompanying illustrations should not be used as the sole source for service locations and appropriate equipment (e.g. CAT and Genny) should be used to confirm the location of buried services before any trenches are opened on site.

## 4 CONCLUSION

4.1.1 The detailed gradiometer survey has been successful in detecting anomalies of definite, probable and possible archaeological interest within the Site, in addition to regions of increased magnetic response and at least two modern services.

4.1.2 The probable pits at **4000** and **4001** represent the most interesting anomalies but there is some uncertainty as some of the surrounding positive anomalies may prove to be geological. The remaining ditch-like anomalies all appear to be former field divisions of varying date.

4.1.3 The relative dimensions of the modern services identified by the gradiometer survey are indicative of the strength of their magnetic response, which is dependent upon the materials used in their construction and the backfill of the service trenches. The physical dimensions of the services indicated may therefore differ from their magnetic extents in plan; it is assumed that the centreline of services is coincident with the centreline of their anomalies, however. Similarly, it is difficult to estimate the depth of burial of the services through gradiometer survey.

4.1.4 It should be noted that small, weakly magnetised features may produce responses that are below the detection threshold of magnetometers. It may therefore be the case that more archaeological features may be encountered than have been identified through geophysical survey.

## 5 REFERENCES

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## APPENDIX 1: SURVEY EQUIPMENT AND DATA PROCESSING

### *Survey Methods and Equipment*

The magnetic data for this project was acquired using a Bartington 601-2 dual magnetic gradiometer system. This instrument has two sensor assemblies fixed horizontally 1m apart allowing two traverses to be recorded simultaneously. Each sensor contains two fluxgate magnetometers arranged vertically with a 1m separation, and measures the difference between the vertical components of the total magnetic field within each sensor array. This arrangement of magnetometers suppresses any diurnal or low frequency effects.

The gradiometers have an effective resolution of 0.03nT over a ±100nT range, and measurements from each sensor are logged at intervals of 0.25m. All of the data are stored on an integrated data logger for subsequent post-processing and analysis.

Wessex Archaeology undertakes two types of magnetic surveys: scanning and detail. Both types depend upon the establishment of an accurate 20m or 30m site grid, which is achieved using a Leica Viva RTK GNSS instrument and then extended using tapes. The Leica Viva system receives corrections from a network of reference stations operated by the Ordnance Survey and Leica Geosystems, allowing positions to be determined with a precision of 0.02m in real-time and therefore exceed the level of accuracy recommended by English Heritage (2008) for geophysical surveys.

Scanning surveys consist of recording data at 0.25m intervals along transects spaced 10m apart, acquiring a minimum of 80 data points per transect. Due to the relatively coarse transect interval, scanning surveys should only be expected to detect extended regions of archaeological anomalies, when there is a greater likelihood of distinguishing such responses from the background magnetic field.

The detailed surveys consist of 20m x 20m or 30m x 30m grids, and data are collected at 0.25m intervals along traverses spaced 1m apart. These strategies give 1600 or 3600 measurements per 20m or 30m grid respectively, and are the recommended methodologies for archaeological surveys of this type (EH, 2008).

Data may be collected with a higher sample density where complex archaeological anomalies are encountered, to aid the detection and characterisation of small and ephemeral features. Data may be collected at up to 0.125m intervals along traverses spaced up to 0.25m apart, resulting in a maximum of 28800 readings per 30m grid, exceeding that recommended by English Heritage (2008) for characterisation surveys.

### Post-Processing

The magnetic data collected during the detail survey are downloaded from the Bartington system for processing and analysis using both commercial and in-house software. This software allows for both the data and the images to be processed in order to enhance the results for analysis; however, it should be noted that minimal data processing is conducted so as not to distort the anomalies.

As the scanning data are not as closely distributed as with detailed survey, they are georeferenced using the GPS information and interpolated to highlight similar anomalies in adjacent transects. Directional trends may be removed before interpolation to produce more easily understood images.

Typical data and image processing steps may include:

- Destripe – Applying a zero mean traverse in order to remove differences caused by directional effects inherent in the magnetometer;
- Destagger – Shifting each traverse longitudinally by a number of readings. This corrects for operator errors and is used to enhance linear features;
- Despike – Filtering isolated data points that exceed the mean by a specified amount to reduce the appearance of dominant anomalous readings (generally only used for earth resistance data)

Typical displays of the data used during processing and analysis:

- XY Plot – Presents the data as a trace or graph line for each traverse. Each traverse is displaced down the image to produce a stacked profile effect. This type of image is useful as it shows the full range of individual anomalies.
- Greyscale – Presents the data in plan view using a greyscale to indicate the relative strength of the signal at each measurement point. These plots can be produced in colour to highlight certain features but generally greyscale plots are used during analysis of the data.

## APPENDIX 2: GEOPHYSICAL INTERPRETATION

The interpretation methodology used by Wessex Archaeology separates the anomalies into two main categories: archaeological and unidentified responses.

The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided into three groups, implying a decreasing level of confidence:

- Archaeology – used when there is a clear geophysical response and anthropogenic pattern.
- Probable archaeology – used for features which give a clear response but which form incomplete patterns.
- Possible archaeology – used for features which give a response but which form no discernible pattern or trend.

The unidentified category is used for features when the form, nature and pattern of the anomaly are not sufficient to warrant a classification as an archaeological feature. This category is further sub-divided into:

- Increased magnetic response – used for areas dominated by indistinct anomalies which may have some archaeological potential.
- Trend – used for low amplitude or indistinct linear anomalies.
- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.

Finally, services such as water pipes are marked where they have been identified.