GEOPHYSICAL SURVEY REPORT

STRATASCAN™

SUMO Survey Services
SUMO Group Member

Project name:

Dings Crusaders, Landseer Avenue, Lockleaze, Bristol

Client:

CgMs Consulting

Job ref:

J10085

July 2016

GEOPHYSICAL SURVEY REPORT

Project name: **Dings Crusaders, Landseer Avenue, Lockleaze, Bristol** Client: **CgMs Consulting**	Job ref: **J10085**
Survey date: **8th July 2016**	Report date: **July 2016**
Field team: **Robert Knight** BA (Hons) **Thomas Hynd** BSc (Hons) **Stephen Weston** BA (Hons)	Project Manager: **Simon Haddrell** BEng(Hons) AMBCS PCIfA
Report written by: **Rebecca Davies** BSc (Hons)	Report approved by: **David Elks** MSc ACIfA
CAD illustrations by: **Rebecca Davies** BSc (Hons)	Site Director: **Peter Barker** CEng MICE MCIWEM MCIfA FCInstCES
Version number and issue date:	Amendments:
V1 29/07/2016	

STRATASCAN LTD
Vineyard House Upper Hook Road Upton upon Severn
Worcestershire WR8 0SA United Kingdom

T: 01684 592266 F: 01684 594142
info@stratascansumo.com www.stratascan.co.uk

SUMO Survey Services
SUMO Group Member

TABLE OF CONTENTS

LIST OF FIGURES

1 SUMMARY OF RESULTS

A detailed gradiometry survey was conducted over approximately 0.8 hectares of land used as a rugby pitch. No features of probable archaeology have been identified, however two linear anomalies may relate to former cut features, though their exact origin is uncertain. The remaining features are modern in origin and relate to features of the rugby pitch, including land drains, disturbance from goalposts and barriers, underground services, and magnetic spikes which are likely to be modern rubbish.

2 INTRODUCTION

2.1 Background synopsis

Stratascan were commissioned to undertake a geophysical survey of an area outlined for development. This survey forms part of an archaeological investigation being undertaken by CgMs Consulting.

2.2 Site Details

NGR / Postcode	ST 609 775 / BS7 9YT
Location	The site is located to the east of Landseer Avenue, Lockleaze, Bristol. Residential housing bounds the site to the south, with rugby pitches to the north and east.
HER/SMR	South Gloucestershire
Unitary Authority	South Gloucestershire
Parish	Stoke Gifford Civil Parish
Topography	Flat
Current Land Use	Rugby pitch
Weather Conditions	Overcast, dry
Soils	The overlying soils are known as Denchworth, which are typical pelo-stagnogley soils. These consist of clayey soils with similar fine loamy over clayey soils (Soil Survey of England and Wales, Sheet 5 South West England).
Geology	The underlying geology comprises interbedded limestone and mudstone of Rugby Limestone Member. No drift geology is recorded (British Geological Survey website).

Archaeology	The area immediately north and east of the site has been subject to Archaeological Desk-Based Assessment (CgMs 2015), geophysical survey (ArchaeoPhysica (AP) 2014) and Archaeological Evaluation (Cotswold Archaeology, 2016). The following is a summary of these assessments. No prehistoric archaeological assets have been identified within the site. A possible barrow is noted within Stoke Park, approximately 125m to the south-east of the site; however, this is alternatively recorded as a post-medieval landscape feature. The latter interpretation is more in line with other landscape features (see below). No other prehistoric material is noted within a 1km radius of the site (CgMs 2015). Roman material is sparse, being represented only by isolated pottery recorded during archaeological evaluation of the Filton Business Park (north of the site). No other Roman material is noted within a 1km radius of the site (CgMs 2015). Anglo-Saxon archaeological assets are noted in the area surrounding the site. The main asset is an inhumation cemetery c280m to the east of the site; it is possible that this is duplicated by a separate record of burials located at Wallscourt Farm (located to the north-east of the site). Other undated inhumations are noted c800m to the north-east of the site. While these assets suggest underlying activity in the Saxon period, no indication of settlement or activity is currently noted within 1km of the site. The underlying impression of medieval activity on site, and in the near vicinity, is of open land. Only boundary ditches have been identified (e.g. c500m to the north-west of the site) and a single sherd of pottery (800m north-east) (CgMs 2015). The geophysical survey identified a number of features of potential archaeological interest. In the north-west of the site, a series of linear anomalies were identified, though the assessment concluded that the underlying low magnetic susceptibility meant that small archaeological features may not have been detected (AP 2014). The archaeological evaluation has identified a number of archaeological features within the site, including boundary and enclosure ditches, pits and a number of stone built structures predominantly Roman in date. Evidence for Iron Age activity comprised a single curvilinear ditch forming the western part of an enclosure which potentially encompasses additional internal features including pits and a gully of similar date. Roman activity comprised pits, stone built walls and a series of ditched enclosures and boundary ditches. The artefacts suggest the site was occupied throughout the 1st to 4th centuries with domestic material, animal processing waste and industrial debris being recovered. Ceramic field drains relate to the draining of the sports pitches installed in the late 1940s. Historic mapping suggest the site has been in agricultural use in recent centuries (Cotswold Archaeology, 2016).

Survey Methods	Detailed magnetic survey (gradiometry)
Study Area	c. 0.8 hectares

2.3 Aims and objectives

To locate and characterise any anomalies of possible archaeological interest within the study area.

3 METHODS, PROCESSING & PRESENTATION

3.1 Standards & Guidance

This report and all fieldwork have been conducted in accordance with the latest guidance documents issued by Historic England (2008) and the Chartered Institute for Archaeologists (2002 & 2014).

Stratascan Ltd are a Registered Organisation with the CIfA and are committed to upholding its policies and standards.

3.2 Survey methods

Due to the potential for Iron Age and Roman remains, detailed magnetic survey was used as an efficient and effective method of locating archaeological anomalies.

More information regarding this technique is included in Appendix A.

3.3 Processing

The following schedule shows the basic processing carried out on the data used in this report:

1. *Destripe*
2. *Destagger*

3.4 Presentation of results and interpretation

The presentation of the data for each site involves a plot of the minimally processed data as a greyscale plot and a colour plot showing extreme magnetic values. Magnetic anomalies have been identified and plotted onto the 'Interpretation of Anomalies' drawing.

When interpreting the results several factors are taken into consideration, including the nature of archaeological features being investigated and the local conditions at the site (geology, pedology, topography etc.). Anomalies are categorised by their potential origin. Where responses can be related to very specific known features documented in other sources, this is done (for example: Abbey Wall, Roman Road). For the generic categories levels of confidence are indicated, for example: probable, or possible archaeology. The former is used for a confident interpretation, based on anomaly definition and/or other corroborative data such as cropmarks. Poor anomaly definition, a lack of clear patterns to the responses and an absence of other supporting data reduces confidence, hence the classification "possible".

4 RESULTS

The detailed magnetic gradiometer survey conducted at Landseer Avenue has identified a small number of anomalies that have been characterised as being *possible* archaeological origin. The following refers to numerical labels on the interpretation plots.

4.1 Probable Archaeology

No probable archaeology has been identified within the survey area.

4.2 Possible Archaeology

A small, positive curvilinear anomaly and additional positive linear anomaly **[1]** in the centre of the site are indicative of former cut features, such as ditches. It is possible that these are of archaeological origin, given the proximity of recorded Iron Age and Roman remains to the north, but this is tentative at best.

4.3 Medieval/Post-Medieval Agriculture

No features of medieval or post-medieval agriculture have been identified within the survey area.

4.4 Other Anomalies

A number of parallel linear anomalies **[2]** in the west of the site are of uncertain origin, but are possibly related to land drains. They appear to align with a utility detected in a geophysical survey to the north (ArchaeoPhysica 2014), however the nearby magnetic disturbance makes further interpretation difficult. Magnetic disturbance **[3]** in the north and south of the site are related to goalposts, whereas magnetic disturbance around the perimeter of the site **[5]** is a result of metal railings surrounding the rugby pitch. Strong bipolar linear anomalies **[4]** running east-west across the site are related to underground services, and run towards 'electricity services' marked on the base mapping potentially supplying flood lights. Magnetic spikes **[6]** are indicative of ferrous metal objects, and are likely to be modern rubbish.

5 DATA APPRAISAL & CONFIDENCE ASSESSMENT

Limestone and mudstone geologies, such as those recorded across the site, generally provide a good response for magnetic survey. In this instance, the site is likely to have been heavily landscaped and altered in development of the rugby pitch. Areas of magnetic disturbance across the site have the potential to mask weaker archaeological anomalies. In areas not affected by the disturbance, two possible archaeological anomalies have been detected, suggesting that the survey has been effective.

6 CONCLUSION

The survey at Dings Crusaders, Lockleaze, has identified a small number of possible archaeological anomalies. These features may relate to the Iron Age and Roman activity recorded immediately north of the site, however the weak response of the features makes further interpretation difficult and this is speculative. The remaining features are modern in origin and largely relate to features of the rugby pitch. The modern anomalies include probable land drains, disturbance from goalposts and barriers, underground services, and magnetic spikes which are likely to be modern rubbish.

7 REFERENCES

ArchaeoPhysica (AP) Ltd, 2014. *Landsser Avenue, Lockleaze, Bristol. Geophysical Survey Report*

British Geological Survey, n.d., *website*: (http://www.bgs.ac.uk/opengeoscience/home.html?Accordion1=1#maps) Geology of Britain viewer. [Accessed 25/07/2016]

CgMs Consulting, 2015. *Archaeological Desk-Based Assessment – Lockleaze Recreation Ground, Landseer Avenue, Lockleaze*

Chartered Institute For Archaeologists. *Standard and Guidance for Archaeological Geophysical Survey. (*http://www.archaeologists.net/sites/default/files/CIfAS&GGeophysics_1.pdf)

Cotswold Archaeology, 2016. *Ding's Crusaders, Landseer Avenue, Lockleaze, South Gloucestershire – Archaeological Evaluation*

English Heritage, 2008. *Geophysical Survey in Archaeological Field Evaluation.*

IfA 2002. The Use of Geophysical Techniques in Archaeological Evaluations, IFA Paper No 6, C. Gaffney, J. Gater and S. Ovenden. Institute for Archaeology, Reading

Soil Survey of England and Wales, 1983. *Soils of England and Wales, Sheet 5 South West England*

Appendix A - Technical Information: Magnetometer Survey Method

Grid Positioning

For hand held gradiometers the location of the survey grids has been plotted together with the referencing information. Grids were set out using a Trimble R8 Real Time Kinematic (RTK) VRS Now GNSS GPS system.

An RTK GPS (Real-time Kinematic Global Positioning System) can locate a point on the ground to a far greater accuracy than a standard GPS unit. A standard GPS suffers from errors created by satellite orbit errors, clock errors and atmospheric interference, resulting in an accuracy of 5m-10m. An RTK system uses a single base station receiver and a number of mobile units. The base station re-broadcasts the phase of the carrier it measured, and the mobile units compare their own phase measurements with those they received from the base station. This results in an accuracy of around 0.01m.

Technique	Instrument	Traverse Interval	Sample Interval
Magnetometer	Bartington Grad 601-2	1m	0.25m

Instrumentation: Bartington *Grad*601-2

Bartington instruments operate in a gradiometer configuration which comprises fluxgate sensors mounted vertically, set 1.0m apart. The fluxgate gradiometer suppresses any diurnal or regional effects. The instruments are carried, or cart mounted, with the bottom sensor approximately 0.1-0.3m from the ground surface. At each survey station, the difference in the magnetic field between the two fluxgates is measured in nanoTesla (nT). The sensitivity of the instrument can be adjusted; for most archaeological surveys the most sensitive range (0.1nT) is used. Generally, features up to 1m deep may be detected by this method, though strongly magnetic objects may be visible at greater depths. The Bartington instrument can collect two lines of data per traverse with gradiometer units mounted laterally with a separation of 1.0m.

The readings are logged consecutively into the data logger which in turn is daily down- loaded into a portable computer whilst on site. At the end of each site survey, data is transferred to the office for processing and presentation.

Data Processing

Zero Mean Traverse	This process sets the background mean of each traverse within each grid to zero. The operation removes striping effects and edge discontinuities over the whole of the data set.
Step Correction (Destagger)	When gradiometer data are collected in 'zig-zag' fashion, stepping errors can sometimes arise. These occur because of a slight difference in the speed of walking on the forward and reverse traverses. The result is a staggered effect in the data, which is particularly noticeable on linear anomalies. This process corrects these errors.

Display

Greyscale/ Colourscale Plot	This format divides a given range of readings into a set number of classes. Each class is represented by a specific shade of grey, the intensity increasing with value. All values above the given range are allocated the same shade (maximum intensity); similarly all values below the given range are represented by the minimum intensity shade. Similar plots can be produced in colour, either using a wide range of colours or by selecting two or three colours to represent positive and negative values. The assigned range (plotting levels) can be adjusted to emphasise different anomalies in the data-set.

Interpretation Categories

In certain circumstances (usually when there is corroborative evidence from desk based or excavation data) very specific interpretations can be assigned to magnetic anomalies (for example, *Roman Road, Wall,* etc.) and where appropriate, such interpretations will be applied. The list below outlines the generic categories commonly used in the interpretation of the results.

Archaeology/Probable Archaeology	This term is used when the form, nature and pattern of the response are clearly or very probably archaeological and /or if corroborative evidence is available. These anomalies, whilst considered anthropogenic, could be of any age.
Possible Archaeology	These anomalies exhibit either weak signal strength and / or poor definition, or form incomplete archaeological patterns, thereby reducing the level of confidence in the interpretation. Although the archaeological interpretation is favoured, they may be the result of variable soil depth, plough damage or even aliasing as a result of data collection orientation.
Industrial / Burnt-Fired	Strong magnetic anomalies that, due to their shape and form or the context in which they are found, suggest the presence of kilns, ovens, corn dryers, metal- working areas or hearths. It should be noted that in many instances modern ferrous material can produce similar magnetic anomalies.
Former Field Boundary (probable & possible)	Anomalies that correspond to former boundaries indicated on historic mapping, or which are clearly a continuation of existing land divisions. Possible denotes less confidence where the anomaly may not be shown on historic mapping but nevertheless the anomaly displays all the characteristics of a field boundary.
Ridge & Furrow	Parallel linear anomalies whose broad spacing suggests ridge and furrow cultivation. In some cases the response may be the result of more recent agricultural activity.
Agriculture (ploughing)	Parallel linear anomalies or trends with a narrower spacing, sometimes aligned with existing boundaries, indicating more recent cultivation regimes.
Land Drain	Weakly magnetic linear anomalies, quite often appearing in series forming parallel and herringbone patterns. Smaller drains will often lead and empty into larger diameter pipes and which in turn usually lead to local streams and ponds. These are indicative of clay fired land drains.
Natural	These responses form clear patterns in geographical zones where natural variations are known to produce significant magnetic distortions.
Magnetic Disturbance	Broad zones of strong dipolar anomalies, commonly found in places where modern ferrous or fired materials (e.g. brick rubble) are present. They are presumed to be modern.
Service	Magnetically strong anomalies usually forming linear features indicative of ferrous pipes/cables. Sometimes other materials (e.g. pvc) cause weaker magnetic responses and can be identified from their uniform linearity crossing large expanses.
Ferrous	This type of response is associated with ferrous material and may result from small items in the topsoil, larger buried objects such as pipes, or above ground features such as fence lines or pylons. Ferrous responses are usually regarded as modern. Individual burnt stones, fired bricks or igneous rocks can produce responses similar to ferrous material.
Uncertain Origin	Anomalies which stand out from the background magnetic variation, yet whose form and lack of patterning gives little clue as to their origin. Often the characteristics and distribution of the responses straddle the categories of *Possible Archaeology* and *Possible Natural* or (in the case of linear responses) *Possible Archaeology* and *Possible Agriculture*; occasionally they are simply of an unusual form.

Where appropriate some anomalies will be further classified according to their form (positive or negative) and relative strength and coherence (trend: weak and poorly defined).

Appendix B - Technical Information: Magnetic Theory

Detailed magnetic survey can be used to effectively define areas of past human activity by mapping spatial variation and contrast in the magnetic properties of soil, subsoil and bedrock. Although the changes in the magnetic field resulting from differing features in the soil are usually weak, changes as small as 0.2 nanoTeslas (nT) in an overall field strength of 48,000nT, can be accurately detected.

Weakly magnetic iron minerals are always present within the soil and areas of enhancement relate to increases in *magnetic susceptibility* and permanently magnetised *thermoremanent* material.

Magnetic susceptibility relates to the induced magnetism of a material when in the presence of a magnetic field. This magnetism can be considered as effectively permanent as it exists within the Earth's magnetic field. Magnetic susceptibility can become enhanced due to burning and complex biological or fermentation processes.

Thermoremanence is a permanent magnetism acquired by iron minerals that, after heating to a specific temperature known as the Curie Point, are effectively demagnetised followed by re-magnetisation by the Earth's magnetic field on cooling. Thermoremanent archaeological features can include hearths and kilns and material such as brick and tile may be magnetised through the same process.

Silting and deliberate infilling of ditches and pits with magnetically enhanced soil creates a relative contrast against the much lower levels of magnetism within the subsoil into which the feature is cut. Systematic mapping of magnetic anomalies will produce linear and discrete areas of enhancement allowing assessment and characterisation of subsurface features. Material such as subsoil and non-magnetic bedrock used to create former earthworks and walls may be mapped as areas of lower enhancement compared to surrounding soils.

Magnetic survey is carried out using a fluxgate gradiometer which is a passive instrument consisting of two sensors mounted vertically 1m apart. The instrument is carried about 30cm above the ground surface and the top sensor measures the Earth's magnetic field whilst the lower sensor measures the same field but is also more affected by any localised buried field. The difference between the two sensors will relate to the strength of a magnetic field created by a buried feature, if no field is present the difference will be close to zero as the magnetic field measured by both sensors will be the same.

Factors affecting the magnetic survey may include soil type, local geology, previous human activity, disturbance from modern services etc.

Your Survey Partner

For a complete and complementary range of survey services

Survey services you can rely on

Archaeological
As Built Records
BIM Ready 3D Models
Boundary Disputes
CCTV
Geophysical
Laser Scanning
Measured Building
Pipeline Routes
Railway
Retrofit
Setting Out
Statutory Plan Collation
Topographic
Utility Mapping
UXO Detection
Void Detection

STRATASCAN LTD
Vineyard House Upper Hook Road Upton upon Severn
Worcestershire WR8 0SA United Kingdom

T:01684 592266 F: 01684 594142
info@stratascan.co.uk www.stratascan.co.uk

STRATASCAN™

SUMO Group Member