

A30 Chiverton to Carland Cross Environmental Statement

**Volume 6 Document Ref 6.4 ES Appendix 6.5
Geophysical Survey Report**

HA551502-ARP-EHR-SW-RP-LE-000008

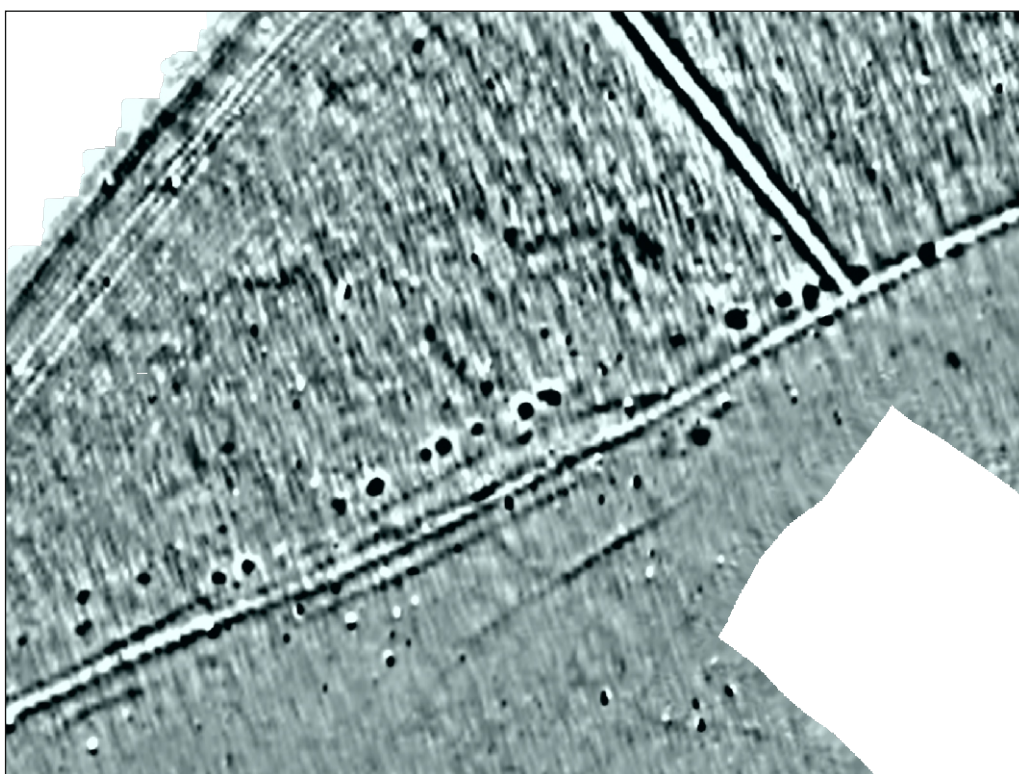
August 2018

Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure)
Regulations 2009 (as amended)
APFP Regulation 5(2)(a)



A30 Chiverton to Carland Cross, Cornwall

Detailed Gradiometer Survey Report



Ref: 203520.04
June 2018



© Wessex Archaeology Ltd 2018, all rights reserved.

Portway House
Old Sarum Park
Salisbury
Wiltshire
SP4 6EB

www.wessexarch.co.uk

Wessex Archaeology Ltd is a Registered Charity no. 287786 (England & Wales) and SC042630 (Scotland)

Disclaimer

The material contained in this report was designed as an integral part of a report to an individual client and was prepared solely for the benefit of that client. The material contained in this report does not necessarily stand on its own and is not intended to nor should it be relied upon by any third party. To the fullest extent permitted by law Wessex Archaeology will not be liable by reason of breach of contract negligence or otherwise for any loss or damage (whether direct indirect or consequential) occasioned to any person acting or omitting to act or refraining from acting in reliance upon the material contained in this report arising from or connected with any error or omission in the material contained in the report. Loss or damage as referred to above shall be deemed to include, but is not limited to, any loss of profits or anticipated profits damage to reputation or goodwill loss of business or anticipated business damages costs expenses incurred or payable to any third party (in all cases whether direct indirect or consequential) or any other direct indirect or consequential loss or damage.



Contents

Summary	ii
Acknowledgements.....	ii
1 INTRODUCTION	1
1.1 Project background.....	1
1.2 Scope of document.....	1
1.3 The site.....	1
2 ARCHAEOLOGICAL BACKGROUND.....	2
3 METHODOLOGY	3
3.1 Introduction.....	3
3.2 Aims and objectives.....	3
3.3 Fieldwork methodology	3
3.4 Data processing.....	3
4 GEOPHYSICAL SURVEY RESULTS AND INTERPRETATION	3
4.1 Introduction.....	3
4.2 Gradiometer survey results and interpretation	4
5 DISCUSSION	7
REFERENCES	8
Bibliography.....	8
Cartographic and documentary sources.....	8
Online resources.....	8
APPENDICES	9
Appendix 1: Survey Equipment and Data Processing.....	9
Appendix 2: Geophysical Interpretation	11
Appendix 3: OASIS form	12

List of Figures

- Figure 1** Chiverton survey area location
Figure 2 Chiverton survey area – greyscale plot
Figure 3 Chiverton survey area – interpretation
Figure 4 Carland Cross survey area location
Figure 5 Carland Cross survey area – greyscale plot
Figure 6 Carland Cross survey area – interpretation



Summary

A detailed gradiometer survey was conducted over two areas along the A30 at Chiverton and Carland Cross, Cornwall (centred on NGR 174900 46900 and 185050 54150). The project was commissioned by SOCOTEC with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features at the sites of two proposed compound areas along the A30.

The Chiverton area is 2.1 ha in size, while the Carland Cross area is 5.5 ha. Both comprise agricultural land, currently utilised for pasture. The geophysical survey was undertaken on 1 – 2 and 23 – 24 May 2018.

The detailed gradiometer survey has been successful in detecting anomalies of archaeological origin at the Carland Cross area. This relates to a pit alignment crossing the area east-north-east to west-south-west. The exact function of this alignment is not clear, although it may represent a former boundary or land division. However, further investigation would be required to clarify the exact use of the pit alignment.

There is no clear evidence of archaeological activity within the Chiverton area. Whilst there are anomalies of possible archaeological origin in both areas, many of these could equally relate to agricultural activity or be modern in origin.

There is no evidence for any features that have a clear relationship with the surrounding barrows in either area. Whilst the possibility that some of the anomalies are associated cannot be completely discounted, there are not any that have a shared alignment or the expected form to suggest a clear association with Bronze Age funerary activity.

Post-medieval agricultural activity is evident in both areas in the form of several former field boundaries and ridge and furrow cultivation. The remaining anomalies are thought to be modern or relate to natural variation in the local geology and soils.

Acknowledgements

Wessex Archaeology would like to thank SOCOTEC for commissioning the geophysical survey. The assistance of Daniel Mallett is gratefully acknowledged in this regard.

The fieldwork was undertaken by Rok Plesnicar and Jenna Jackson. Rok Plesnicar processed the geophysical data. Tom Richardson interpreted the data, wrote the report, and prepared the illustrations. The geophysical work was quality controlled by Nicholas Crabb and Ben Urmston. The project was managed on behalf of Wessex Archaeology by Lucy Parker.



A30 Chiverton to Carland Cross, Cornwall

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

- 1.1.1 Wessex Archaeology was commissioned by SOCOTEC to carry out a geophysical survey at over two areas along the A30 at Chiverton and Carland Cross, Cornwall (centred on NGR 174900 46900 and 185050 54150) (**Figures 1 and 4**). The survey forms part of an ongoing programme of archaeological works being undertaken over two proposed compound areas along the A30.

1.2 Scope of document

- 1.2.1 This report presents a brief description of the methodology followed by the detailed survey results and the archaeological interpretation of the geophysical data.

1.3 The site

- 1.3.1 The western of the survey areas is located to the east of Chiverton, 8 km west of Truro. The eastern area is north-east of Carland Cross, 8 km south of Newquay, in the county of Cornwall.
- 1.3.2 The Chiverton area comprises 2.1 ha of agricultural land, currently utilised for pasture. The area is bounded by the A30 to the west, A390 to the south, and agricultural land to the north and east. The Carland Cross area covers 5.5 ha, also utilised as pasture. It is bounded by the A30 to the west and north, and by a unnamed road to the south, and agricultural land to the east.
- 1.3.3 Both areas lie on south facing slopes. The Chiverton area declines from 149 m above Ordnance Datum (aOD) at the northern boundary to 144 m aOD in the south. The Carland Cross area declines from a peak of 145 m aOD in the north to 135 m aOD at the southern boundary. The Carland Cross area also declines to 139 m at the northern boundary.
- 1.3.4 The underlying geology for the Chiverton area is mapped as Mudstone and Sandstone of the Porthtowan Formation with no recorded superficial deposits. The west of the Carland Cross area is recorded as interbedded Siltstone and Mudstone of the Grampound Formation, with Mudstone and Siltstone of the Trendrean Mudstone Formation across the east. There are no recorded superficial deposits for the Carland Cross survey area (BGS online).
- 1.3.5 The soils anticipated to be present within the Chiverton survey area are cambic stagnogley soils of the 713b (Sportsmans) association. The Carland Cross survey area is likely to comprise typical brown earths of the 541k (Denbigh 2) association (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 ARCHAEOLOGICAL BACKGROUND

2.1 Introduction

- 2.1.1 The archaeological and historical background has been assessed by a search of Historic England's Heritage Gateway (2018). A summary of the results is presented below, with relevant entry numbers from the National Heritage List for England (NHLE) included. Additional sources of information are referenced, as appropriate.

2.2 Summary of the archaeological resource

Chiverton survey area

- 2.2.1 There are two scheduled monuments recorded within the surrounding area. The nearest is a group of three Bronze Age bowl barrows 50 m north-east of the survey area (NHLE no. 1016056). These are extant mounds, although ploughing has reduced them to heights of between 1 and 1.5 m. A further bowl barrow lies 250 m to the west at Burrow Farm (NHLE no. 1016057). This is 3 m high and 18 m in diameter.
- 2.2.2 There are seven Grade II listed buildings within 1 km of the survey area. The nearest area a group of three buildings associated with the church of St. Peter, 200 m west of the area (NHLE no. 1328719, 1141481, 1141482).
- 2.2.3 There is extensive evidence of Bronze Age funerary activity in the surrounding area. There are numerous records relating to Bronze Age barrows and barrow cemeteries. The closest of these to the survey area are the aforementioned scheduled barrows (see 2.2.1).
- 2.2.4 Iron Age and Romano-British settlements are recorded in the form of three rounds identified as cropmarks from aerial photography. These are all recorded between 125 m and 450 m north-west of the survey area.
- 2.2.5 The majority of the remaining records relate to post-medieval mining and agricultural activity. This includes mine shafts, field systems, and trackways. There is also a modern military camp 600 m south-east at Penstraze.

Carland Cross survey area

- 2.2.6 There are seven scheduled barrows and barrow cemeteries within the surrounding area. This includes two barrows within the survey area (NHLE no. 101735); however, an exclusion buffer was placed around these to exclude them from the survey. The others are in groups 700 m to the south-west and 700 m to the east of the survey area.
- 2.2.7 There are four Grade II listed buildings within the surrounding area. The nearest of these to the survey is a milestone (NHLE no. 1394843) 450 m to the south-west. The other three relate to milestones and a 19th century farmhouse.
- 2.2.8 As with the Chiverton area, there is extensive evidence of Bronze Age funerary activity. Numerous records relate to barrows and barrow cemeteries are recorded in the surrounding area. There is also evidence of settlement activity 900 m to the south-west in the form of a Bronze Age hut circle.
- 2.2.9 Records relating to Iron Age and Romano-British activity in the area are limited to a single round 1 km south-west of the site.
- 2.2.10 There are several early medieval and medieval settlements recorded in the surrounding area. There is also evidence of agricultural activity and an early medieval beacon. Post-medieval activity is mostly associated with mining and agricultural activity.

3 METHODOLOGY

3.1 Introduction

- 3.1.1 The geophysical survey was undertaken by Wessex Archaeology's in-house geophysics team on 1 – 2 and 23 – 24 May 2018. Field conditions were generally good, being dry throughout the survey period. An overall coverage of 2.1 ha was achieved in the Chiverton area and 5.4 ha in the Carland Cross area. Slight reductions to both survey areas are due to overgrown vegetation at field boundaries.

3.2 Aims and objectives

- 3.2.1 The aims of the survey comprise the following:
- to conduct a detailed survey covering as much of the specified area as possible, allowing for artificial obstructions;
 - to clarify the presence/absence and extent of any buried archaeological remains within the site; and
 - to determine the general nature of the remains present.

3.3 Fieldwork methodology

- 3.3.1 Individual survey nodes were established using a Leica Viva RTK GNSS instrument at regular intervals tailored for each survey area. The cart-based gradiometer system used a Leica Captivate RTK GNSS instrument, which receives corrections from a network of reference stations operated by the Ordnance Survey (OS) and Leica Geosystems. Both instruments allow positions to be determined with a precision of approximately 0.02 m in real-time and therefore exceed Historic England recommendations (2008).
- 3.3.2 The detailed gradiometer survey was undertaken using four Bartington Grad-01-1000L gradiometers, with an effective sensitivity of 0.03 nT, spaced at 1 m intervals and mounted on a non-magnetic cart. Data were collected at a rate of 10 Hz, producing intervals of c. 0.15 m along transects spaced 3.5 m apart, therefore exceeding Historic England guidelines (2008).

3.4 Data processing

- 3.4.1 Data from the survey were subjected to minimal correction processes. These comprise a 'Destripe' function (± 5 nT thresholds), applied to correct for any variation between the sensors, and an interpolation used to grid the data and discard overlaps where transects have been collected too close together.
- 3.4.2 Further details of the geophysical and survey equipment, methods and processing are described in **Appendix 1**.

4 GEOPHYSICAL SURVEY RESULTS AND INTERPRETATION

4.1 Introduction

- 4.1.1 The detailed gradiometer survey has identified magnetic anomalies across the site, along with a large number of ferrous responses. Results are presented as a series of greyscale plots and archaeological interpretations at a scale of 1:1500 (**Figures 2, 3, 5, 6**). The data are displayed at -4 nT (white) to +6 nT (black) for the greyscale image.
- 4.1.2 The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous responses, burnt or fired objects, and magnetic trends (**Figures 3** and

6). Full definitions of the interpretation terms used in this report are provided in **Appendix 2**.

- 4.1.3 Numerous ferrous anomalies are visible throughout the dataset. These are presumed to be modern in provenance and are not referred to, unless considered relevant to the archaeological interpretation.
- 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 present than have been identified through geophysical survey.
- 4.1.5 Gradiometer survey may not detect 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.

4.2 Gradiometer survey results and interpretation

Chiverton survey area

- 4.2.1 The survey has not identified any anomalies in the Chiverton area that can be confidently attributed an archaeological origin. However, several possible archaeological anomalies have been seen. In the north of the area, a positive linear is visible on a west-north-west to east-south-east alignment at **4000**. This extends 55 m, including three gaps totalling 15 m. This anomaly is indicative of a ditch feature, with the fragmentation likely related to modern plough damage. Whilst it is possible this is evidence of archaeological activity, it is most likely that this is associated with post-medieval agricultural activity. The anomaly appears to extend from a former field boundary to the west (**4004**) and runs parallel to two to the north (**4003**). Alternatively, it is possible this is associated with a former trackway or other boundary feature.
- 4.2.2 In the south-east of the area, a negative penannular anomaly has been identified at **4001**. This has an internal diameter of 3 m with a 1 m opening to the north. This is indicative of a bank feature with a width of 0.8 m. It is possible that this is associated with a round barrow, however the lack of any obvious corresponding positive response, that may be associated with a ditch, suggests that, if this is the case, it is heavily ploughed down. However, it is equally likely that this relates to a natural variation in the underlying geology or soils, and further investigation would therefore be required to clarify this.
- 4.2.3 Concentrations of discrete positive anomalies have been identified across the area. An example of these can be seen in the north at **4002**. These vary in diameter from 0.5 m to 2.5 m and are consistent with pit-like features of uncertain origin. It is possible that they relate to archaeological activity, although it is equally plausible that these features are associated with natural pitting in the sandstone bedrock or the result of modern agricultural activity.
- 4.2.4 Several broad (4 m – 6 m) linear anomalies have been identified across the area (**4003 – 4005**). These are all characterised by parallel, moderately strong positive linear anomalies either side of a negative response. This type of response is typical of Cornish field boundaries, formed of two ditches either side of a bank. All of the anomalies also correspond with former field boundaries visible on the 1880 OS map of the area and are therefore interpreted as such.
- 4.2.5 At **4003**, two closely spaced boundaries can be identified traversing the northern field on an east – west alignment. These are both approximately 3 m wide and 60 m long, being separated by a 4 m gap. Adjoining these in the west is similar response at **4004**. This is on a slightly curved north – south alignment for 70 m, with a possible westerly extension that

is not visible on any available historic mapping. In the southern part of the site, two parallel boundaries have been identified which extend for 63 m and 108 m across the area on a north-east to south-west alignment (**4005**). These are separated by a distance of 59 m, and there is further boundary running perpendicular between them. This forms an 'H' shape and does not appear to continue into the field to the north.

- 4.2.6 Across the west of the area, series of weakly positive and negative parallel linear anomalies have been identified. These share the same orientation as the former field boundaries at **4003** – **4005** and are spaced approximately 4 m apart. Their linear nature and regular is indicative of post-medieval ridge and furrow and it is likely that this is contemporary with the former field boundaries.
- 4.2.7 In the centre of the southern field, an area of strongly magnetic dipolar responses has been identified at **4006**. This type of response is commonly associated with disturbed or made ground and is located in an area where a building is visible on the 1967 OS map of the area. It is likely therefore that this response is related to the demolished remains of the building.
- 4.2.8 Numerous linear trends have been identified, particularly across the east of the area. Whilst the weak and short nature of these anomalies makes confident interpretation difficult, it is likely that the majority relate to modern agricultural activity, such as ploughing.

Carland Cross survey area

- 4.2.9 The gradiometer survey of the area at Carland Cross has identified a linear alignment of discrete positive anomalies running west-south-west to east-north-east across the north of the area at **4007** and **4008**. These are strongly magnetic, with some having a negative 'halo' effect that is predominantly located on the northern edge of the feature. This is indicative of pit features with a strongly magnetic backfill. The pits are 2 m – 3.5 m in diameter and irregularly spaced. The pit alignment extends 200 m across the area, but may continue further east beyond the bounds of the survey area. Whilst this feature is considered likely to be archaeological in origin, particularly given the proximity to the scheduled barrows, its function is not clear. Given that it follows a similar alignment as a post-medieval field boundary (**4020**), it is possible it relates to an earlier delineation of the same boundary. However, further investigation would be required to confirm this and provide dating information.
- 4.2.10 A similar strongly magnetic discrete positive anomaly is seen 10 m south of the pit alignment at **4009**. It is slightly larger than those in the alignment at 4.5 m in diameter, but could be associated and potentially of the same origin. However, further investigation would be required to confirm any relationship between these anomalies.
- 4.2.11 In the centre of the area, three parallel positive linear anomalies have been identified at **4010**. These extend 45 m – 55 m on a west-south-west to east-north-east alignment and are 1 m – 2 m wide. A weak positive linear anomaly can also be seen running between the southern two anomalies, covering a distance of 11 m. These anomalies are all indicative of ditch features and may relate to a small enclosure or part of a wider field system. However, as they are in the same position as a post-medieval field boundary (**4020**), it is also possible that they may relate to this boundary, perhaps being associated footpaths or trackways. A further positive linear anomaly has been identified on the same alignment to the west at **4011**. This is 16 m long and likely forms part of the same feature.
- 4.2.12 In the east of the area another weak positive linear anomaly has been identified on a west-south-west to east-north-east alignment at **4012**. This is indicative of a ditch feature, 49 m in length and 1.5 m wide. The shared alignment with the former field boundary at **4020** suggests the anomaly is likely related to agricultural activity; however, an archaeological origin cannot be discounted.

- 4.2.13 In the south-west of the site, a weak positive rectilinear anomaly has been identified at **4013**. This forms a 3.5 m square with an open southern side. This is indicative of a ditch feature, which may form a small square enclosure of uncertain function and date. However, the weak nature of the anomaly makes a more confident interpretation difficult. A weak positive discrete anomaly at the centre of the rectilinear may be evidence of an associated pit feature with a diameter of 0.5 m.
- 4.2.14 A similarly weak positive rectilinear anomaly has been identified in the south-east of the site at **4014**. This forms a 6 m square, with gaps in the south-western corner and to the east. As with the anomaly at **4013** this may relate to a small ditched enclosure feature, but the weak nature of the anomaly makes interpretation difficult. Furthermore, this is also hindered by the position of this feature on the same alignment as the numerous ploughing trends that have been identified in this area of the site.
- 4.2.15 In the north of the site, a weak negative rectilinear anomaly has been identified at **4015**. This is a 6.5 m square anomaly with gaps at the south-eastern corner and in the northern side. This is indicative of a bank feature with a width of 1 m – 2 m. It is possible that this represents a small banked enclosure, but the weak nature of the anomaly combined with the extensive agricultural activity in the area makes a more confident interpretation difficult.
- 4.2.16 The three square anomalies at **4013** – **4015** could all represent small enclosure features. However, they are all weakly magnetic anomalies, which inhibits a confident interpretation. Each of them could equally relate to the various phases of agricultural activity evident across the site. As such, further investigation would be required to confirm their origins.
- 4.2.17 In the north-east of the area, a positive linear anomaly has been identified at **4016**. This is 50 m long, 2 m – 3.5 m wide. It is situated on a north-north-west to south-south-east alignment and is indicative of a ditch feature. A shared alignment with a current field boundary to the south suggests that it may be an earlier extension of this, possibly pre-dating the earliest available mapping (1880).
- 4.2.18 Three areas of discrete positive anomalies have been identified across the west of the area at **4017** – **4019**. These anomalies are between 0.5 m and 3.5 m in diameter and may relate to pit features of possible archaeological origin. However, the anomalies could equally be caused by natural pitting in the underlying bedrock.
- 4.2.19 A broad (4 m) linear anomaly has been identified traversing the area on an east-north-east to west-south-west orientation at **4020**. This comprises a negative response with positive responses either side. This type of anomaly is typical of Cornish field boundaries, which comprise a bank flanked by two ditches. A similar anomaly projects 100 m north-west of **4020** at **4021**. This is 7 m wide and is also associated with a boundary. Both of these can be attributed to former field boundaries present on the 1880 OS map of the area.
- 4.2.20 Further evidence of post-medieval agricultural activity has been identified across the north of the area, where a series of broadly spaced (5 m – 6 m), parallel linear anomalies can be identified. These are situated on a north-west to south-east orientation and are thought to be associated with ridge and furrow cultivation, with the straight nature of the anomalies suggesting a probable post-medieval date.
- 4.2.21 Across the area, although mostly seen in the east and south of the site, several sinuous, weak positive anomalies have been identified at **4022** – **4024**. These anomalies have no clear shape or pattern to them, suggesting that they are most likely related to natural variation in the local geology and soils.
- 4.2.22 Numerous weak linear trends have been identified across the south of the area. Whilst their weak nature makes accurate interpretation difficult, the majority of these are most likely natural or agricultural in origin.

5 DISCUSSION

- 5.1.1 The detailed gradiometer survey has been successful in detecting anomalies of archaeological origin at the Carland Cross area. This relates to a pit alignment crossing the area east-north-east to west-south-west. The precise character and date of this alignment is not clear, but it may represent a former boundary or land division. This is supported by a post-medieval boundary (present on 1880 OS map) in roughly the same position. However, further investigation would be required to clarify the exact nature of these pits, as it is possible that these features are earlier in origin.
- 5.1.2 There is no definitive evidence of archaeological activity within the Chiverton area, but there are anomalies of possible archaeological origin. Many of these could equally relate to agricultural activity or be modern in origin. Both areas also include possible enclosure features, ditches, and pits of uncertain date and function.
- 5.1.3 There is no evidence for any features that have a clear relationship with the surrounding barrows in either area. Whilst the possibility that some of the anomalies are associated cannot be completely discounted, there are discernible shared alignments or obvious relationships that might suggest a clear association with Bronze Age funerary activity.
- 5.1.4 Post-medieval agricultural activity is evident in both areas, with several former field boundaries having been identified from the 1880 OS mapping. The areas surrounding this contain evidence for associated ridge and furrow cultivation and more recent ploughing has also been identified.
- 5.1.5 The remaining anomalies are thought to be modern or relate to natural variation in the local geology and soils. The modern anomalies include a former building seen on 1967 OS mapping and numerous ferrous responses mostly associated with the surrounding fence lines.



REFERENCES

Bibliography

English Heritage 2008 *Geophysical Survey in Archaeological Field Evaluation*. Research and Professional Service Guideline No 1. Swindon (2nd Edition)

Schmidt, A, Linford, P, Linford, N, David, A, Gaffney, C, Sarris, A and Fassbinder, J. 2015 *Guidelines for the use of geophysics in archaeology: questions to ask and points to consider*. EAC Guidelines 2, Belgium: European Archaeological Council.

Wessex Archaeology 2018 *A30 Chiverton to Carland Cross: WSI for Archaeological Geophysical Survey*. Ref 203520.02

Cartographic and documentary sources

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

Online resources

British Geological Survey Geology of Britain Viewer (accessed May 2018) <http://mapapps.bgs.ac.uk/geologyofbritain/home.html>

Historic England 2018 Heritage Gateway (accessed May 2018) www.heritagegateway.org.uk

Old Maps (accessed May 2018) <https://www.old-maps.co.uk>

APPENDICES

Appendix 1: Survey Equipment and Data Processing

Survey methods and equipment

The magnetic data for this project will be acquired using a non-magnetic cart fitted with 4x Bartington Grad-01-1000L magnetic gradiometers. The instrument has four sensor assemblies fixed horizontally 1 m apart allowing four 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 0.03 nT over a ± 100 nT range, and measurements from each sensor are logged at intervals of 0.25 m. All of the data are then relayed to a Leica Viva CS35 tablet, running the MLgrad601 program, which is used to record the survey data from the array of Grad601 probes at a rate of 10 Hz. The program also receives measurements from a GPS system, which is fixed to the cart at a measured distance from the sensors, providing real time locational data for each data point.

The cart-based system relies upon accurate GPS location data which is collected using a Leica Viva system with rover and base station. This 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 0.02 m in real-time and therefore exceed the level of accuracy recommended by Historic England (English Heritage 2008) for geophysical surveys.

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 0.125 m intervals along traverses spaced up to 0.25 m apart.

Post-processing

The magnetic data collected during the detail survey are downloaded from the Bartington cart 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.

The cart-based system generally requires a lesser amount of post-processing than the handheld Bartington Grad 601-2 fluxgate gradiometer instrument. This is largely because mounting the gradiometers on the cart reduces the occurrence of operator error; caused by inconsistent walking speeds and deviation in traverse position due to varying ground cover and topography.

Typical data and image processing steps may include:

- GPS Destripe – Determines the median of each transect and then subtracts that value from each data point in the transect. May be used to remove the striping effect seen within a survey caused by directional effects, drift, etc.
- GPS Base Interpolation – Sets the X & Y interval of the interpolated data and the track radius (area around each data point that is included in the interpolated result).
- Discard Overlaps - Intended to eliminate a track(s) that have been collected too close to one another. Without this, the results of the interpolation process can be distorted as it tries to accommodate very close points with potentially differing values.



Typical displays of the data used during processing and analysis:

- 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.
- 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.

Appendix 2: Geophysical Interpretation

The interpretation methodology used by Wessex Archaeology separates the anomalies into four main categories: archaeological, modern, agricultural, and uncertain origin/geological.

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.
- Possible archaeology – used for features which give a response but which form no discernible pattern or trend.

The modern category is used for anomalies that are presumed to be relatively modern in date:

- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.
- Modern service – used for responses considered relating to cables and pipes; most are composed of ferrous/ceramic material although services made from non-magnetic material can sometimes be observed.

The agricultural category is used for the following:

- Former field boundaries – used for ditch sections that correspond to the position of boundaries marked on earlier mapping.
- Ridge and furrow – used for broad and diffuse linear anomalies that are considered to indicate areas of former ridge and furrow.
- Ploughing – used for well-defined narrow linear responses, usually aligned parallel to existing field boundaries.
- Drainage – used to define the course of ceramic field drains that are visible in the data as a series of repeating bipolar (black and white) responses.

The uncertain origin/geological 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.
- Superficial geology – used for diffuse edged spreads considered to relate to shallow geological deposits. They can be distinguished as areas of positive, negative, or broad bipolar (positive and negative) anomalies.



Appendix 3: OASIS form

Project Details:

Project name	A30 Chiverton to Carland Cross, Cornwall				
Type of project	Detailed gradiometer survey (Field evaluation)				
Project description	<p>The project was commissioned with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features at the sites of two proposed compound areas along the A30.</p> <p>The detailed gradiometer survey has been successful in detecting anomalies of archaeological origin at the eastern (Carland Cross) area. This relates to a pit alignment crossing the area east-north-east to west-south-west. The exact function of this alignment is not clear, although it may represent a former boundary or land division. However, further investigation would be required to clarify the exact use of the pit alignment.</p> <p>There is no clear evidence of archaeological activity within the western (Chiverton) area. Whilst there are anomalies of possible archaeological origin in both areas, many of these could equally relate to agricultural activity or be modern in origin.</p>				
Project dates	Start: 01-05-2018		End: 24-05-2018		
Previous work	Not known				
Future work	Not known				
Project Code:	203520	HER event no.	N/A	OASIS form ID:	wessexar1-318786
		NMR no.	N/A		
		SM no.	1017350		
Planning Application Ref.	N/A				
Site Status	Scheduled Monument (SM)				
Land use	Cultivated Land 1 – Minimal cultivation				
Monument type	Round barrows	Period	Early Bronze Age (-2500 to -1500)		

Project Location:

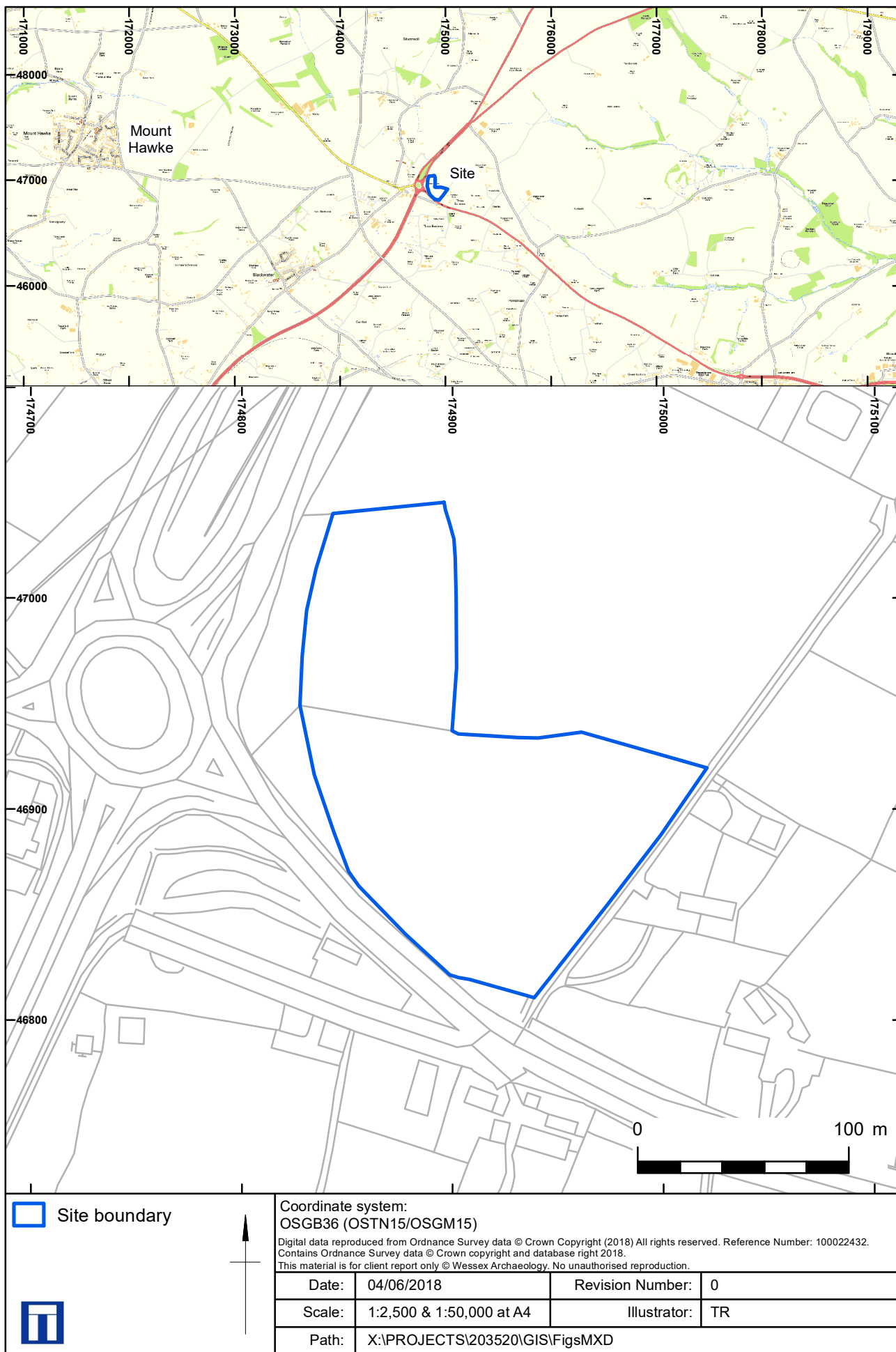
Site Address	Carland Cross, Mitchell, Newquay			Postcode	TR8 5AY
County	Cornwall	District	Carrick	Parish	St Newlyn East
Study Area	7.7 ha	Height OD	135 – 149 m aOD	NGR	SW 74900 46900 - SW 85050 54150

Project Creators:

Name of Organisation	Wessex Archaeology		
Project brief originator	SOCOTEC	Project design originator	Wessex Archaeology
Project Manager	Lucy Parker	Project Supervisor	Tom Richardson
Sponsor or funding body	SOCOTEC	Type of Sponsor	Construction company

Project Archive and Bibliography:

Physical archive	N/A	Digital Archive	Geophysics, survey and report	Paper Archive	N/A
Report title	A30 Chiverton to Carland Cross, Cornwall			Date	June 2018
Author	Wessex Archaeology	Description	Unpublished report	Report ref.	203520.04



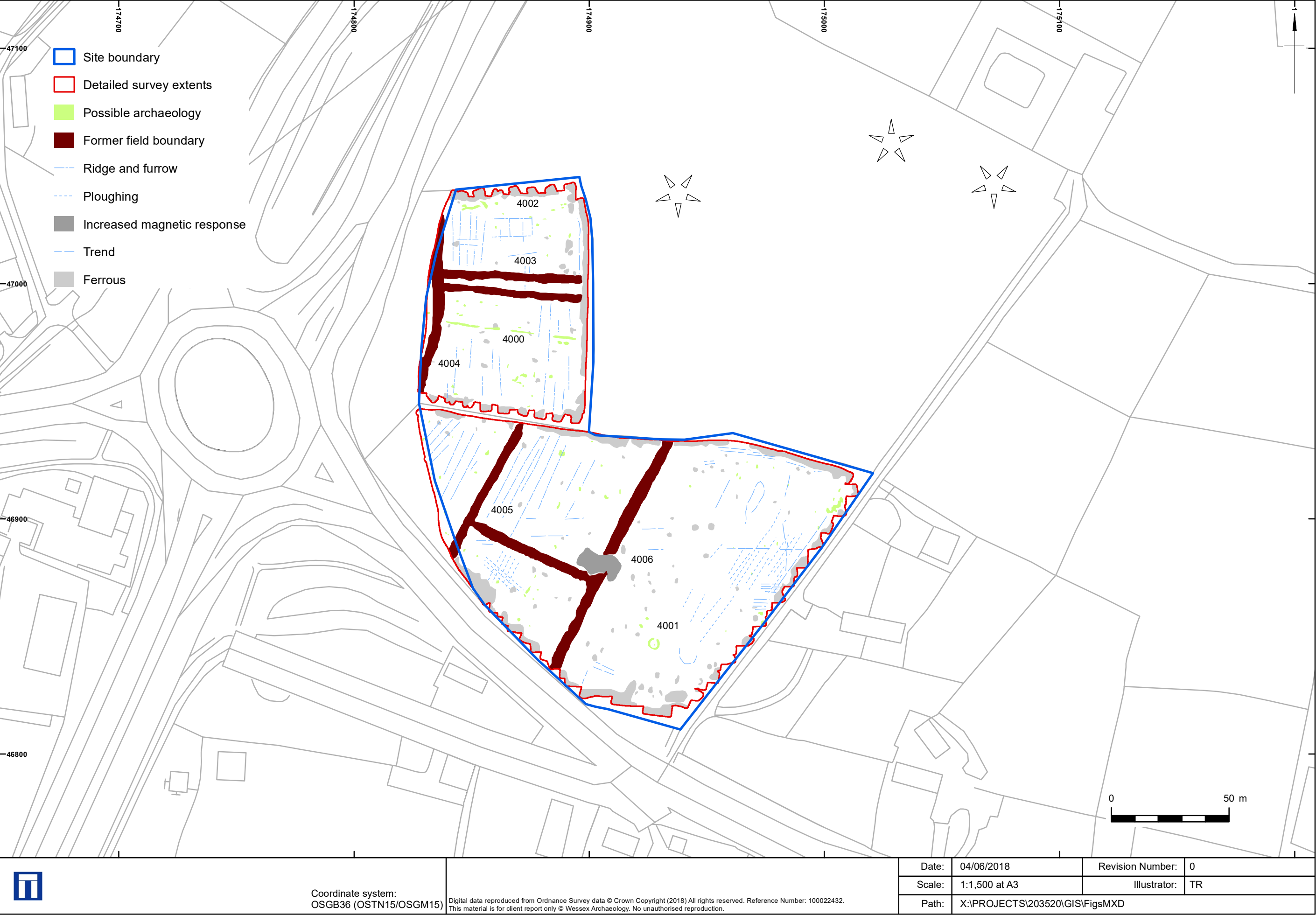
Chiverton survey area location

Figure 1



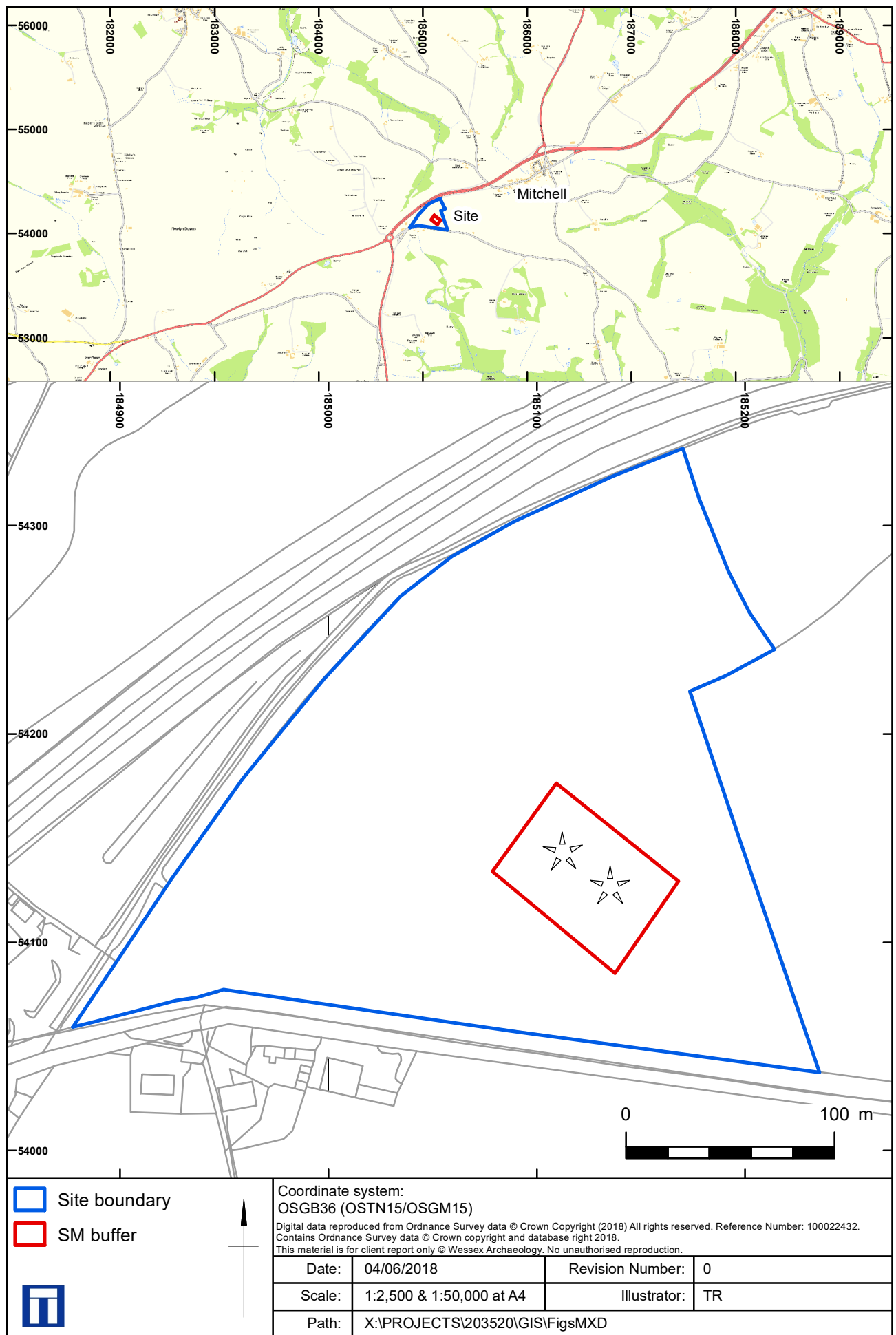
Digital data reproduced from Ordnance Survey data © Crown Copyright (2018) All rights reserved. Reference Number: 100022432.
This material is for client report only © Wessex Archaeology. No unauthorised reproduction.

Figure 2



Chiverton survey area - interpretation

Figure 3

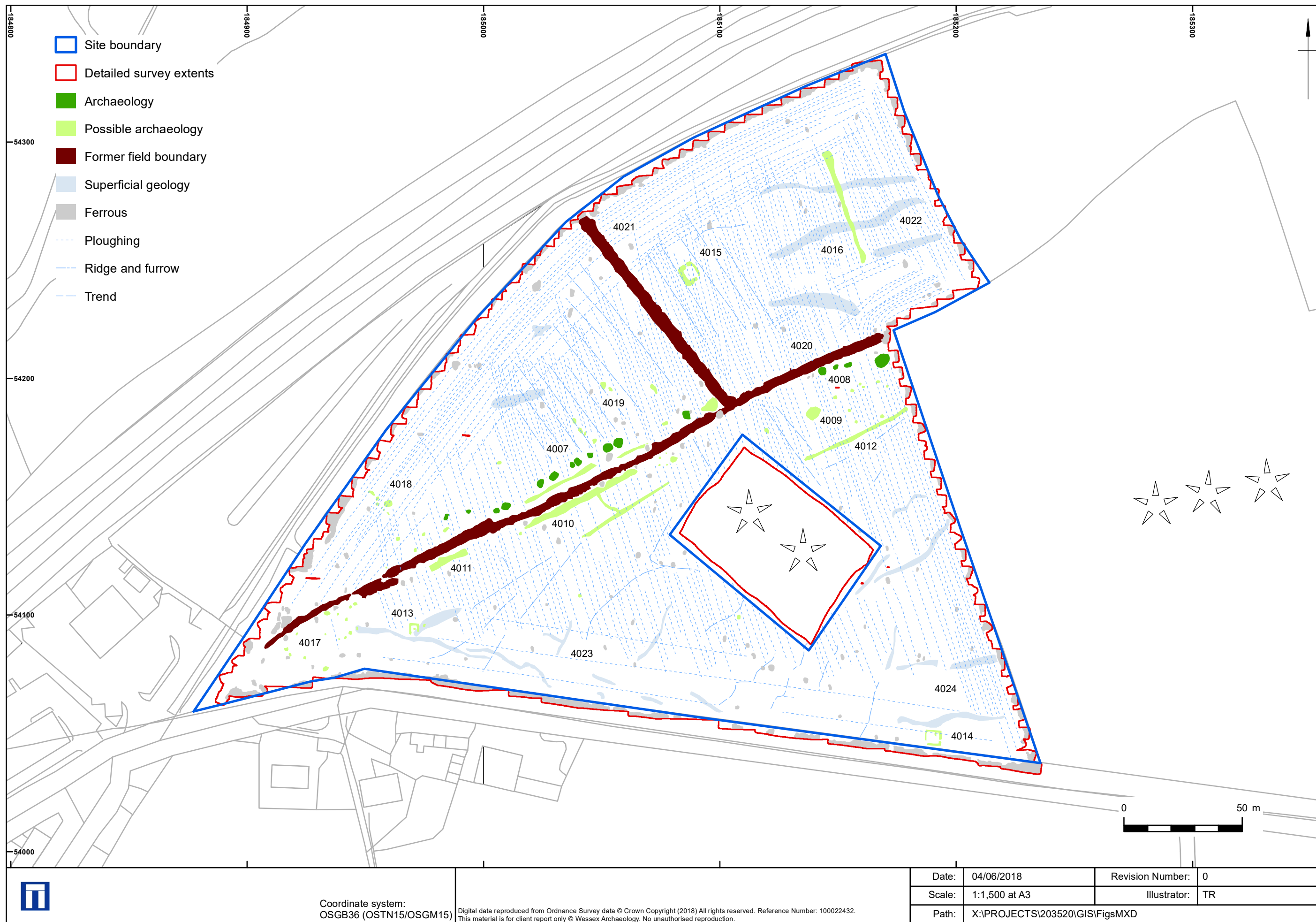


Carland Cross survey area location

Figure 4



Carland Cross survey area - greyscale plot



Carland Cross survey area - interpretation

Figure 6



Wessex Archaeology Ltd registered office Portway House, Old Sarum Park, Salisbury, Wiltshire SP4 6EB
Tel: 01722 326867 Fax: 01722 337562 info@wessexarch.co.uk www.wessexarch.co.uk



If you need help accessing this or any other Highways England information, please call **0300 123 5000** and we will help you.