Darren Camp Hillfort, Ceredigion

Detailed Gradiometer Survey Report

Report Ref.: 238990.04
December 2020

wessexarchaeology

Portway House
Old Sarum Park
Salisbury
Wiltshire
SP4 6EB

www.wessexarch.co.uk

Wessex Archaeology Ltd is a company limited by guarantee registered in England, company number 1712772. It is also a Charity registered in England and Wales number 287786, and in Scotland, Scottish Charity number SC042630. Our registered office is at Portway House, Old Sarum Park, Salisbury, Wiltshire, SP4 6EB

Document Information

Document title	Darren Camp Hillfort, Ceredigion
Document subtitle	Detailed Gradiometer Survey Report
Document reference	238990.03
Client name	Royal Commission on the Ancient and Historical Monuments of Wales (RCAHMW)
Address	Ffordd Penglais Penglais Road Aberystwyth Ceredigion SY23 3BU
Site location	Darren Camp Hillfort
County	Ceredigion
National grid reference	267895 283020 (SN 67895 83020)
Statutory designations	Scheduled monument CD028 / NPRN 303592
WA project name	Darren Camp Hillfort, Ceredigion
WA project code	238990
Dates of fieldwork	20/10/2020 – 21/10/2020
Fieldwork directed by	Chris Hirst
Project management by	Tom Richardson
Document compiled by	Nicholas Crabb
Contributions from	Alexander Schmidt
Graphics by	Nicholas Crabb

Quality Assurance

Issue	and date	Status	Author	Approved by	
1	04/11/2020	Draft for client comment	NLC		TR
2	02/12/2020	Version 2	NLC		TR

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 **1**

3 METHODOLOGY **2**
3.1 Introduction 2
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

List of Figures

Figure 1 Site location and survey extent
Figure 2 Detailed gradiometer survey results: greyscale plot (-2 - +3 nT)
Figure 3 Detailed gradiometer survey results: greyscale plot (-6 - +9 nT)
Figure 4 Detailed gradiometer survey results: XY Trace plot (-30 - +30 nT)
Figure 5 Detailed gradiometer survey results: Interpretation

Summary

A detailed gradiometer survey was conducted over land at Darren Camp Hillfort, Ceredigion (centred on NGR 267895 283020). The project was commissioned by RCAHMW with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features for a wider study being undertaken on the monument by RCAHMW.

The site is located over land within the interior of Darren Camp Hillfort and fields located to the south and west. Area A is the largest, measuring 225 x 140 m and is located to the west of the Darren hillfort. Area B comprises an oval area within the hillfort interior measuring 100 x 40 m, and Area C is located to the south-west of the hillfort approach covering a 70 x 40 m area.

A large number of anomalies of archaeological origin were identified and the survey has enhanced the understanding of the architecture of the hillfort and its immediate surroundings. Within the Hillfort interior, much of this is associated with topographic features that have been previously recorded by detailed surveys of the hillfort in the 1980s (Thorburn 1987) and 2005 (RCAHMW 2005). This includes a burial Cairn, possible building platforms and elements of the hillfort defences themselves. However, it has also identified numerous other anomalies that are associated with further remains that are not visible as upstanding remains.

At least four possible roundhouses have been identified as penannular anomalies, which are mostly centred around a probable cairn in the south of the survey area. In the northern part of the hillfort interior, numerous pit-like anomalies have been identified that are thought to be associated with localised extraction activity. Within this, there is also evidence for hearths or metalworking activity.

Beyond the hillfort interior, a large number of earthworks are preserved as upstanding remains of defences and later mining outworks. Many of these have also been identified by this geophysical survey and some are more extensive than has been previously recorded. To the west of the hillfort, numerous poorly defined pit and ditch-like anomalies have also been identified that may relate to extra-mural activity. Two areas of possible grave features have been identified, one which lies around the main western entrance.

Evidence for ridge and furrow ploughing has been identified across the entirety of the western portion of Area B. This has resulted in an area of increased magnetic response that may have prevented the detection of any subtle or weakly magnetised remains. However, within this, it is possible to identify a series of other linear trends that likely relate to former boundaries, trackways or vehicle ruts that traverse the site.

Acknowledgements

Wessex Archaeology would like to thank RCAHMW for commissioning the geophysical survey. The assistance of Steve Bailey John and Dr Toby Driver is gratefully acknowledged in this regard. We would also like to thank Mr J T Lewis, Rhosgoch, for kindly allowing access to the land and the hillfort and Louise Mees and Cadw for granting Section 42 consent for the survey.

The fieldwork was undertaken by Chris Hirst and Amy Dunn. Alexander Schmidt processed and interpreted the geophysical data and Nicholas Crabb wrote the report and prepared the illustrations. The geophysical work was quality controlled by Tom Richardson. The project was managed on behalf of Wessex Archaeology by Tom Richardson.

Darren Camp Hillfort, Ceredigion

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by RCAHMW to carry out a geophysical survey at Darren Camp Hillfort, Ceredigion (centred on NGR 267895 283020) (**Figure 1**). The survey forms part of an ongoing programme of archaeological works being undertaken on the monument by the Royal Commission.

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 site is located over land within the interior of Darren Camp Hillfort and fields located to the south and west. It is 500 m south of the village of Pen-bont Rhydybeddau, 9.5 km east-north-east of Aberystwyth, in the county of Ceredigion, Wales.

1.3.2 The survey comprises 2.8 ha of open grassland, split across three areas. Area A is the largest, measuring 225 x 140 m and is located to the west of the hillfort. Area B comprises an oval area within the hillfort interior, measuring 100 x 40 m, and Area C is located to the south-west of the hillfort approach covering a 70 x 40 m area. These areas are bounded by open pasture to the north, east, and west with the settlement of Banc-y-Darren to the south.

1.3.3 The topography of the area is dominated by the promontory on which the hillfort is located. The top of the hillfort is situated at 290 m above Ordnance Datum (aOD) (Area B) and the relief falls away from this in every direction. It is notably steeper towards the north and south of the hillfort and descends more gradually to the east and west. The hillfort itself survives as a series of upstanding earthworks, which were surveyed in 2005 by RCAHMW (**Figure 1**).

1.3.4 The solid geology comprises interbedded mudstone and sandstone of the Devil's Bridge Formation with no overlying superficial geological deposits recorded (BGS 2020).

1.3.5 The soils underlying the site are likely to consist of typical brown podzolic soils of the 611c (Manod) association (SSEW SE Sheet 2 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 following has been compiled using the scheme of investigation provided by the client (RCAHMW 2020) as well as publicly available online resources. The following background is not exhaustive but is summarised from aspects that are considered relevant to the interpretation of the geophysical survey data.

2.2 Summary of the archaeological resource

2.2.1 Darren Camp commands a prominent position, at the eastern end of an ascending ridge between the valleys of Nant Silo and Peithyll. It is a strongly sited fort, comprising a single strong rampart, enclosing an oval area of 0.44 ha (49 m east – west by 108 m north – south). To the west of the main rampart four lines of outworks cut off the main ridge giving added protection to the fort and its main gateway. The exact plan of these outworks is, however, obscured by an opencast mine and accompanying spoil tips. In addition to the main western gateway, two gateways were located on the east and north side of the fort. Within the fort, there is evidence of a broad quarry ditch and elsewhere across the interior there are slight traces of terracing together with possible platforms. On the summit, there stands a low cairn, presumably of Early Bronze Age date, and 10 m to the north of this there are slight traces of what may be a second cairn.

2.2.2 A detailed survey of the hillfort was carried out by Ceredigion Archaeological Survey in the 1980s (Thorburn 1987), although this has been superseded by the 2005 survey of the fort and adjacent mine workings (RCAHMW 2005). In 1996 a small excavation at the west gate was carried out to record a section of revetment wall exposed by severe erosion within the south gate terminal (Driver 1996). A further small scale excavation was undertaken by the Early Mines Research Group, whose primary objective was to look at the relationship between the fort and the mine, in hope of ascertaining a date for the initial exploitation of Darren Lode (a silver-lead vein). Recent research has also helped to place the architecture of the fort in its regional context (Driver 2013), while research by Aberystwyth University examined metalworking evidence from within the hillfort (Haylock 2015).

2.2.3 Excavations undertaken in 2005 (Timberlake and Driver 2006; Timberlake 2007) confirmed that the forward-facing ramparts were originally constructed between 400 – 380 BC and had been faced with bold dry-stone walling. It was suggested that the prominent quartz boulder excavated at the south gateway terminal in 2006 was matched by a flanking partner for the purposes of display. The excavations also confirmed that buried metal ores had been discovered and extracted during the construction of the Iron Age outworks. Opencast mines on site respect the main axis of approach to the hillfort gateway, suggesting that much of the mining in front of the fort has prehistoric origins.

2.2.4 The interior of the hillfort is extremely well preserved, with several rock-cut house platforms and an earlier burial cairn at the highest point. However, there has been limited excavation within the hillfort interior and it is unclear to what extent further remains (e.g. evidence for hearths, metalworking, and other activity) exist within the hillfort interior.

3 METHODOLOGY

3.1 Introduction

3.1.1 The geophysical survey was undertaken by Wessex Archaeology's in-house geophysics team between 20 and 21 October 2020. Field conditions were generally good throughout the period of survey. An overall coverage of 2.75 ha was achieved, with only minor reductions occurring in areas of steep terrain or densely vegetated areas at the edge of the fields.

3.1.2 The methods and standards employed throughout the geophysical survey conform to the written scheme of investigation (RCAHMW 2020) as well as to current best practice, and guidance outlined by the Chartered Institute for Archaeologists' (CIfA 2014) and European Archaeologiae Consilium (Schmidt *et al.* 2015).

3.2 Aims and objectives

3.2.1 The aims of the survey comprise the following:

- To determine, as far as is reasonably possible, the nature of the detectable archaeological resource within a specified area using appropriate methods and practices; and
- To inform either the scope and nature of any further archaeological work that may be required; or the formation of a mitigation strategy (to offset the impact of the development on the archaeological resource); or a management strategy.

3.2.2 In order to achieve the above aims, the objectives of the geophysical survey are:

- To conduct a geophysical survey covering as much of the specified area as possible, allowing for on-site obstructions;
- To clarify the presence/absence of anomalies of archaeological potential; and
- Where possible, to determine the general nature of any anomalies of archaeological potential.

3.3 Fieldwork methodology

3.3.1 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. Such instruments allow positions to be determined with a precision of 0.02 m in real-time and therefore exceeds European Archaeologiae Consilium recommendations (Schmidt *et al.* 2015).

3.3.2 The detailed gradiometer survey was undertaken using six Bartington Grad-01-1000L gradiometers spaced at 0.5 m intervals and mounted on a non-magnetic cart. Data were collected with an effective sensitivity of 0.03 nT at a rate of 10 Hz, producing intervals of 0.15 m along transects spaced 3 m apart.

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. Results are presented as a series of greyscale plots and archaeological interpretations at a scale of 1:1000 (**Figures 2** to **4**). Greyscale plots are displayed at -2 nT (white) to +3 nT (black) (**Figure 2**) and at -6 nT (white) to +9 nT (black) (**Figure 3**) in order to account for variability in the strength of the background response. In addition, an XY trace plot is displayed at +/- 30 nT, showing 1 profile in 5 (every 2.5 m). These images are also presented with the results of the 2005 earthwork survey to facilitate interpretation (RCAHMW 2005).

4.1.2 The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous responses, burnt or fired objects, and magnetic trends (**Figure 4**). 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 the 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

4.2.1 The gradiometer survey has been successful in identifying a wide range of anomalies of archaeological interest. This includes evidence for probable cairns, elements of the hillfort earthworks, and numerous pit-like features. In addition, numerous linear features have been located adjacent to the hillfort, that are likely associated with ditch features and agricultural activity.

Area A

4.2.2 Area A is located to the north-west of the hillfort and the majority of the earthworks recorded in 2005. There are a small number of anomalies in the north-eastern corner of the survey area that may be associated with the open-cast mining activity, which is known to have taken place to the west of the monument. The clearest example of this is located at **4000**, where a positive linear anomaly can be seen to traverse the area on a west-north-west to east-south-east alignment. Directly to the north of this, there is a negative linear anomaly and weak linear trends. It is possible that this is associated with a former trackway, probably to provide access to the site for the mining activity. However, it is also possible that this relates to a former field boundary, although there are no corresponding features visible on historical mapping of the area.

4.2.3 Directly south of **4000** is a small recti-linear arrangement of weakly positive and negative anomalies (**4001**). These are poorly defined, but cover an area of 23 x 6 m. This could relate to mining, possibly associated with the construction of the feature at **4000**. However, it is equally possible it is associated with early activity within the immediate hinterland of the hillfort. Their weak nature and proximity to the west entrance of the hillfort implies that they could relate to burials, but further investigation would be required to confirm this.

4.2.4 To the north of **4000**, there is a cluster of positive anomalies that are sub-circular in form (**4002**). These are 1 – 2 m in diameter and are likely pit features, possibly also relating to extramural activity surrounding the hillfort. Alternatively, they may relate to further mining activity or spoil from the outworks.

4.2.5 At **4003**, in the south-eastern part of the survey, to the west of the main entrance, there are numerous weakly positive oval and circular anomalies. These are up to 1.5 m in diameter and are thought to be associated with pit-like features. They are poorly defined, but the concentration of anomalies suggests that there may be more extensive archaeological activity in this area. Given the size, oval form and location close to the western main entrance of the hillfort it is possible that these are associated with graves, though this is difficult to ascertain on the basis of these results alone.

4.2.6 To the south of **4003**, there is an irregularly shaped positive linear anomaly, which extends on a north-eastern trajectory from the outermost earthworks at 4004. This is measures 14 m in length before turning 180 degrees, heading back towards the south-east. It is 1.6 m wide and most likely relates to a ditch-like feature. It is possible that it relates to an extension of the ramparts or the mining activity which is located to the east of this area.

4.2.7 A large number of further pit-like anomalies have been identified across Area A. These are generally characterised by a weak positive magnetic response and are 1 m – 3 m in diameter. These are generally very poorly defined in the western portion of the survey area as there is widespread increased magnetic response recorded resulting from agricultural activity. Despite this, there are some notable clusters of anomalies at **4005** and **4006** that are likely associated with archaeological activity. The anomaly at **4005** forms an L-shaped feature measuring 10 x 10 m and **4006** forms a roughly semi-circular area 9 m in diameter.

4.2.8 Elsewhere within the area of increased magnetic response, in the southernmost part of Area A, there are two weakly positive semi-circular anomalies (**4007**; **4008**). These both have an internal diameter of 6 m and measure 1.2 m wide. These are ditch-like features and could relate to the remains of a ring-ditch. However, given the incomplete nature of these and high likelihood that they have been heavily ploughed down, it is difficult to confirm this based on these geophysical survey results alone.

4.2.9 In the centre of Area A, there is a strong positive and negative linear anomaly situated on a north-west to south-east alignment (**4009**). This measures 27 m x 5 m and could relate to archaeological remains. The short length and strength of the anomaly is suggestive of a mining cut or trial trench, but further investigation would be required to ascertain the precise nature of this anomaly.

4.2.10 To the north of **4009**, there are two concentric linear trends at **4010**, which measure 5 and 15 m in diameter. It is possible that these relate to archaeological remains, but they may also simply relate to vehicle wheel ruts.

4.2.11 A series of closely spaced negative linear anomalies are apparent across the western portion of the survey area. In the north-western corner, they are positioned on a north-south orientation (**4011**), and in the south, they are roughly perpendicular to this (**4012**). They are separated by a distance of 2.5 – 3.5 m and are characteristic of a ridge and furrow cultivation. This agricultural activity has resulted in a significantly enhanced background response, possibly suggesting that the area has been deeply ploughed into the underlying bedrock. This response dominates the western portion of the survey area and it is possible that it has obscured the detection of any subtle or weakly magnetised remains. It is also likely that any shallow features that may be present could be heavily ploughed down.

4.2.12 There are a small number of poorly defined weakly negative linear trends within the western part of Area A (**4013** – **4016**). These likely relates to a ditch or field boundary. Whilst their poor definition prevents a more specific interpretation, their alignment does not appear to respect the axis of the hillfort. As such it is probable that some of these (particularly **4015**; **4016**) relate to vehicle wheel ruts or a former trackway, following the topography of the area.

Area B

4.2.13 Area B is located within the interior of the hillfort. There are a large number of well-preserved earthworks recorded within the monument, many of which have been identified by this survey. The clearest of these is located in the southern portion of the area and is associated with the remains of a burial cairn, which occupies the highest point of the area (**4017**). It is characterised by a strongly magnetic response, which is at least in part associated with the stone structure. Surrounding this are three strong dipolar linear anomalies that radiate irregularly from the cairn. The strength and form of these anomalies are characteristic of a

lightning strike and given that this feature occupies the highest aspect of the promontory, such an interpretation is feasible.

4.2.14 Directly north of the cairn is a small cluster of irregular positive and negative anomalies that may relate to evidence of an additional cairn (**4018**). This covers a 6 x 8 m area and is amorphous in form, suggesting that it is more limited in character than that at **4017**. However, there is also a 4.5 m diameter semi-circular positive anomaly surrounding this, which is 1 m wide. This may represent a ditch or gully, possibly relating to a ring ditch.

4.2.15 There are two further curvilinear anomalies to the east and south of **4017**, that may relate to possible roundhouses within Area B (**4019** – **4020**). These are both characterised by a penannular positive magnetic response, with **4019** being the larger of the two at 7 m in diameter and **4020** at 3.5 m. Additionally, there is a further example in the north-west of the survey area that is 6 m in diameter (**4021**). These are all characterised by a relatively weak positive response with the ditch or gully measuring 0.5 – 1 m wide.

4.2.16 Throughout Area B there are several poorly defined curvi-linear trends. These measure between 3.5 and 7 m in diameter and are characterised by a very weak magnetic response. They could relate to further evidence of roundhouses, possibly denoting structural elements or scoops. However, given their weak and fragmentary nature, it is difficult to confirm this based on these results alone.

4.2.17 Along the south-western edge of Area B, there are several strongly positive responses (**4022**). These are thought to relate to the presence of former quarry ditches, but these are very poorly defined. To the north of this, there is also a series of small (0.8 – 1.3 m diameter) discrete anomalies that likely relate to pit features.

4.2.18 In the centre of the hillfort interior, there are a larger number of moderately strong discrete positive anomalies. They are 1.5 m – 3 m in diameter and are most prevalent at **4023** and **4024**. At these locations, there is a notable negative response directly to the north of these features, which is indicative of thermoremanent magnetisation. This can be caused by in-situ burning and it is possible, that some of these pit-like features contain evidence for hearths or metal-working activity. More widely, it is probable that many of these features represent localised extraction contemporary with the hillfort. However, further investigation would be required to confirm the precise nature and date of these anomalies.

4.2.19 In the northern portion of Area B, there are a series of strongly positive anomalies and weak linear trends that correlate earthworks recorded by the 2005 survey (RCAHMW). This is located to the south of the northern entrance and may relate to building platforms (**4025**).

4.2.20 Surrounding Area B, there is a notable negative response on the inside edge of the hillfort defences. This is not recorded at the entirety of the outer limits of the survey, but it is consistently present close to the innermost earthwork ditch. This may represent bank material surrounding the hillfort interior. In addition, at the eastern and westernmost part of the survey, a positive response has been identified that may relate to part of this innermost rampart ditch (**4026**; **4027**). The strength of the magnetic response of these suggests that the ditches contain burnt material. As previous excavations have identified that buried metal ores had been discovered and extracted during the construction of the Iron Age outworks, it is feasible that this may be associated with further such activity.

Area C

4.2.21 Area C is located to the south-west of the hillfort. Although the north-western portion of the area was dominated by upstanding earthworks that prevented data collection, several anomalies of archaeological interest were located.

4.2.22 In the north-west corner, there is a positive anomaly that traverses south on a curving orientation that broadly respects the form of the hillfort (**4028**). This is most likely an extension of extant earthworks recorded during the 2005 survey.

4.2.23 Extending east from the southern part of **4028**, is a further positive anomaly (**4029**). This is orientated east – west and measures 3.5 m x 27 m. It may relate to a further ditch or rampart, extending from those that are visible as an upstanding feature, but is perhaps more likely associated with mining outworks

4.2.24 To the north of **4029**, there is a weak negative linear trend that extends southward from earthworks recorded as being associated with mining outworks (**4030**). This likely represents further evidence of this activity that may not be as easily identifiable as upstanding remains.

4.2.25 In the south-west of the area, there is a weakly positive anomaly situated on a curving linear alignment (**4031**). This is 3 – 4 m wide by 35 m long and corresponds with a ditch recorded by the earthwork survey. To the south-west of this, there are a small number of weakly positive discrete anomalies, that are 1 – 3 m in diameter. These could relate to pit-like features or may simply be associated with natural undulations in the underlying bedrock.

5 DISCUSSION

5.1.1 The detailed gradiometer survey has been successful in detecting a large number of anomalies of archaeological origin and has enhanced the understanding of the architecture of the hillfort and its immediate surroundings. Within the hillfort interior, much of this is associated with topographic features that have been previously recorded by detailed surveys in the 1980s (Thorburn 1987) and 2005 (RCAHMW 2005). This includes a burial cairn, possible building platforms, and elements of the hillfort defences themselves. However, it has also identified numerous other anomalies that are associated with further remains that are not visible as upstanding remains.

5.1.2 At least four possible roundhouses have been identified as penannular anomalies, which are mostly centred around a probable cairn in the south of the survey area. Within the northern part of the hillfort interior, numerous pit-like anomalies have been identified that are thought to be associated with localised extraction activity. Within this, there are also a smaller number of thermoremanent anomalies that could be associated with hearths or metal working activity. As excavations in 2005 (Timberlake and Driver 2006; Timberlake 2007) identified that buried metal ores had been discovered and extracted during the construction of the Iron Age outworks, these may relate to further evidence of such activity.

5.1.3 Beyond the hillfort interior, a large number of earthworks are preserved as upstanding remains of defences and later mining outworks. Many of these have also been identified by this geophysical survey and some are more extensive than has been previously recorded, particularly in Area C. To the west of the hillfort, numerous poorly defined pit and ditch-like anomalies have also been identified that may relate to extra-mural activity. However, these are somewhat obscured by the dominance of a series of strong linear trends caused by later agricultural activity. Two areas of possible grave features have been identified, one which lies around the main western entrance.

5.1.4 Evidence for ridge and furrow ploughing has been identified across the entirety of the western portion of Area B. This has resulted in an area of increased magnetic response that may have prevented the detection of any subtle or weakly magnetised remains. However, within this, it is possible to identify a series of other linear trends that likely relate to former boundaries, trackways, or vehicle ruts that traverse the site.

REFERENCES

Bibliography

Chartered Institute for Archaeologists [CIfA] 2014 *Standards and guidance for archaeological geophysical survey*. Reading, CIfA

Davies, J.L. & Lynch, F. 2000. *The Late Bronze and Iron Age, in Lynch, F. Aldhouse-Green, S. & Davies, J.L. Prehistoric Wales*, Sutton Publishing, 139-219.

Driver, T G. 1996. *Darren Hillfort, Trefeurig (SN 678 830), Ceredigion, Archaeology in Wales 36, 61. Driver, T. 2013. Architecture, Regional Identity and Power in the Iron Age landscapes of Mid Wales: The hillforts of north Ceredigion*. BAR 583, Archaeopress.

Driver, T. 2016. *The Hillforts of Cardigan Bay*. Logaston Press.

Driver, T. 2018 New Perspectives on the Architecture and Function of Welsh Hillforts and Defended Settlements, Internet Archaeology 48.

Haylock, K. 2015. *The Relationship between Iron Age Hill Forts, Roman Settlements and Metallurgy on the Atlantic Fringe*. Unpublished PhD thesis. Aberystwyth University.

Thornburn, J. 1987 *Pen y daren, Trefeirig (SN 679 830)*. Archaeology in Wales 27, 34.

Timberlake, S. 2007. *Darren Camp and Darren Mine, Banc y Darren, Trefeurig (SN 679 830). The Radiocarbon Dates*. Archaeology in Wales 46 (2006), 182-3.

Timberlake, S. and Driver, T., 2006. *Excavations at Darren Camp and Darren Mines (opencuts), Banc-y-darren, Trefeurig, Ceredigion*. Archaeology in Wales 45 (2005), 98-102.

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.

RCAHMW 2020. *Darren Camp Hillfort, Ceredigion: Specification for geophysical survey of 3 areas, 2020.*

Cartographic and documentary sources

Ordnance Survey 1983 *Soil Survey of England and Wales Sheet 2, Soils of Wales.* Southampton.

Online resources

British Geological Survey Geology of Britain Viewer (accessed October 2020) http://mapapps.bgs.ac.uk/geologyofbritain/home.html

Google Earth (accessed October 2020)

Heritage Gateway (accessed October 2020) https://www.heritagegateway.org.uk/gateway/

Magic Maps (accessed October 2020) https://magic.defra.gov.uk/MagicMap.aspx

National Library of Scotland (accessed October 2020) https://maps.nls.uk/geo/explore

Old Maps (accessed October 2020) https://www.old-maps.co.uk

APPENDICES

Appendix 1: Survey Equipment and Data Processing

Survey methods and equipment

The magnetic data for this project were acquired using a non-magnetic cart fitted with 6x Bartington Grad-01-1000L magnetic gradiometers. The instrument has six sensor assemblies fixed horizontally 0.5 m apart allowing four traverses to be recorded simultaneously. Each sensor contains two fluxgate magnetometers arranged vertically with a 0.5m 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 0.15 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 0.02m in real-time and therefore exceed the level of accuracy recommended by European Archaeologiae Consilium recommendations (Schmidt *et al.* 2015) 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 0.25m 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 datapoint 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 datapoint 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:

- 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. XY trace plots are available upon request.

- Greyscale – Presents the data in plan 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 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:

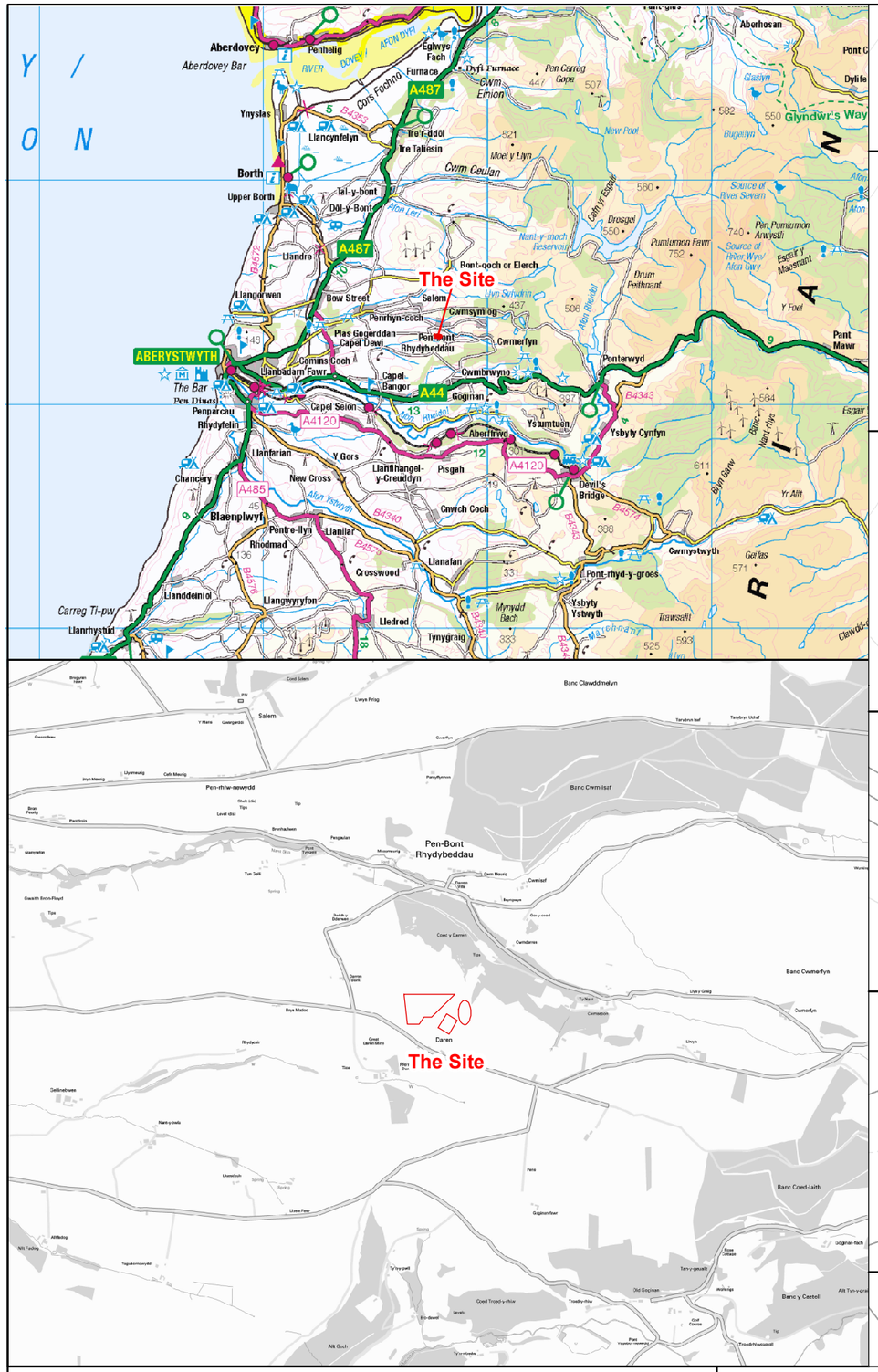
- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.
- Modern service – used for responses considered relating to cables and pipes; most are composed of ferrous/ceramic material although services made from non-magnetic material can sometimes be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

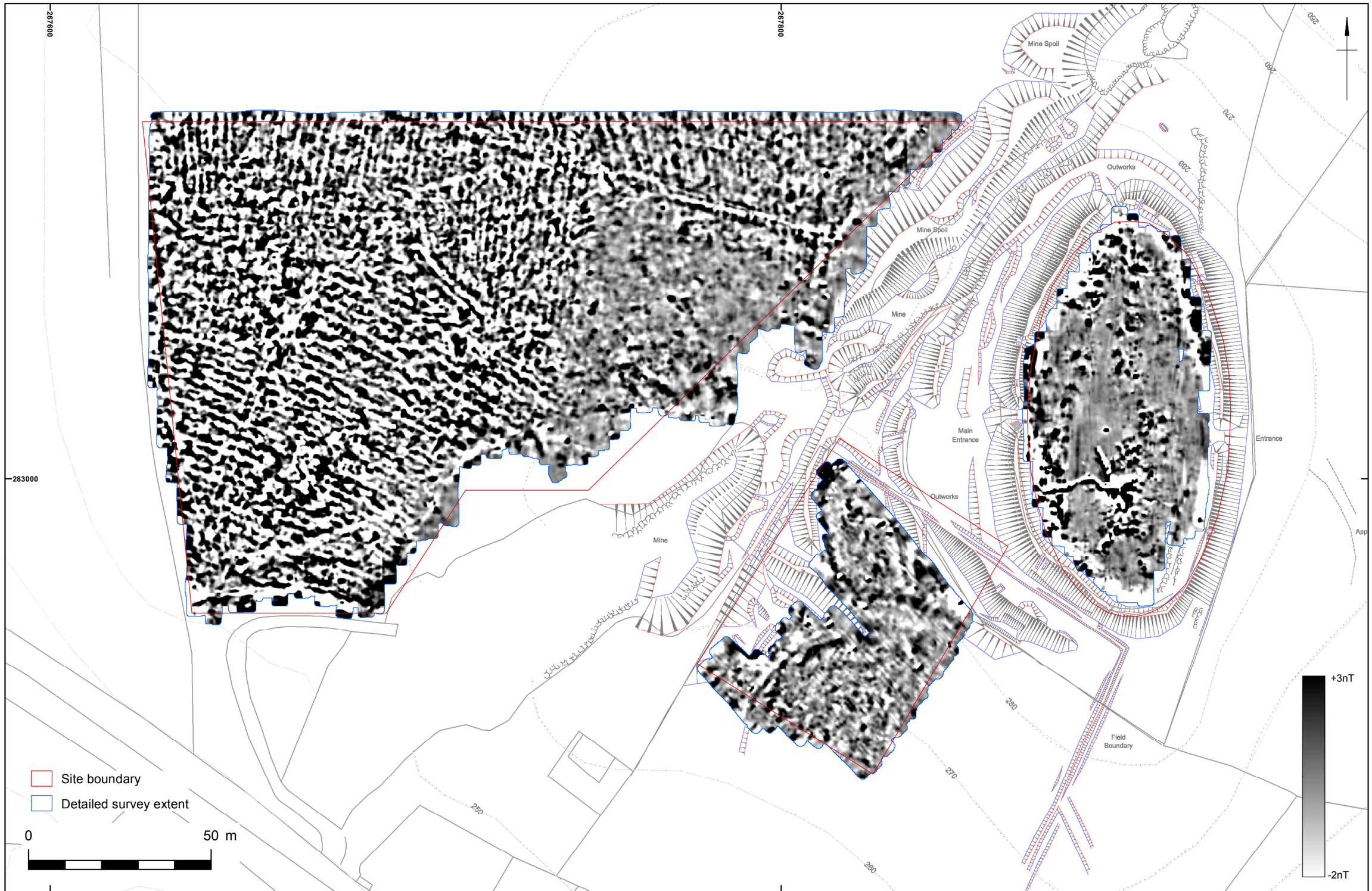
- Increased magnetic response – used for areas dominated by indistinct anomalies which may have some archaeological potential.
- Trend – used for low amplitude or indistinct linear anomalies.
- Superficial geology – used for diffuse edged spreads considered to relate to shallow geological deposits. They can be distinguished as areas of positive, negative, or broad bipolar (positive and negative) anomalies.



Coordinate system: OSGB36 (OSTN15/OSGM15)	Digital data reproduced from Ordnance Survey data © Crown Copyright 2020 All rights reserved. Reference Number: 100022432. Contains Ordnance Survey data © Crown copyright and database right 2020. Hachure plan Crown Copyright: Royal Commission on the Ancient & Historical Monuments of Wales, 2006. Hawlfraint y Goron: Comisiwn Brenhinol Henebion Cymru, 2006. This material is for client report only © Wessex Archaeology. No unauthorised reproduction.	Date: 29/10/2020	Revision Number: 0
		Scale: 1:250,000, 1:20,000 and 1:2000	Illustrator: NLC
		Path: X:\PROJECTS\238990\GIS\FigsMXD\Geophysics	

Site location and detailed survey extent

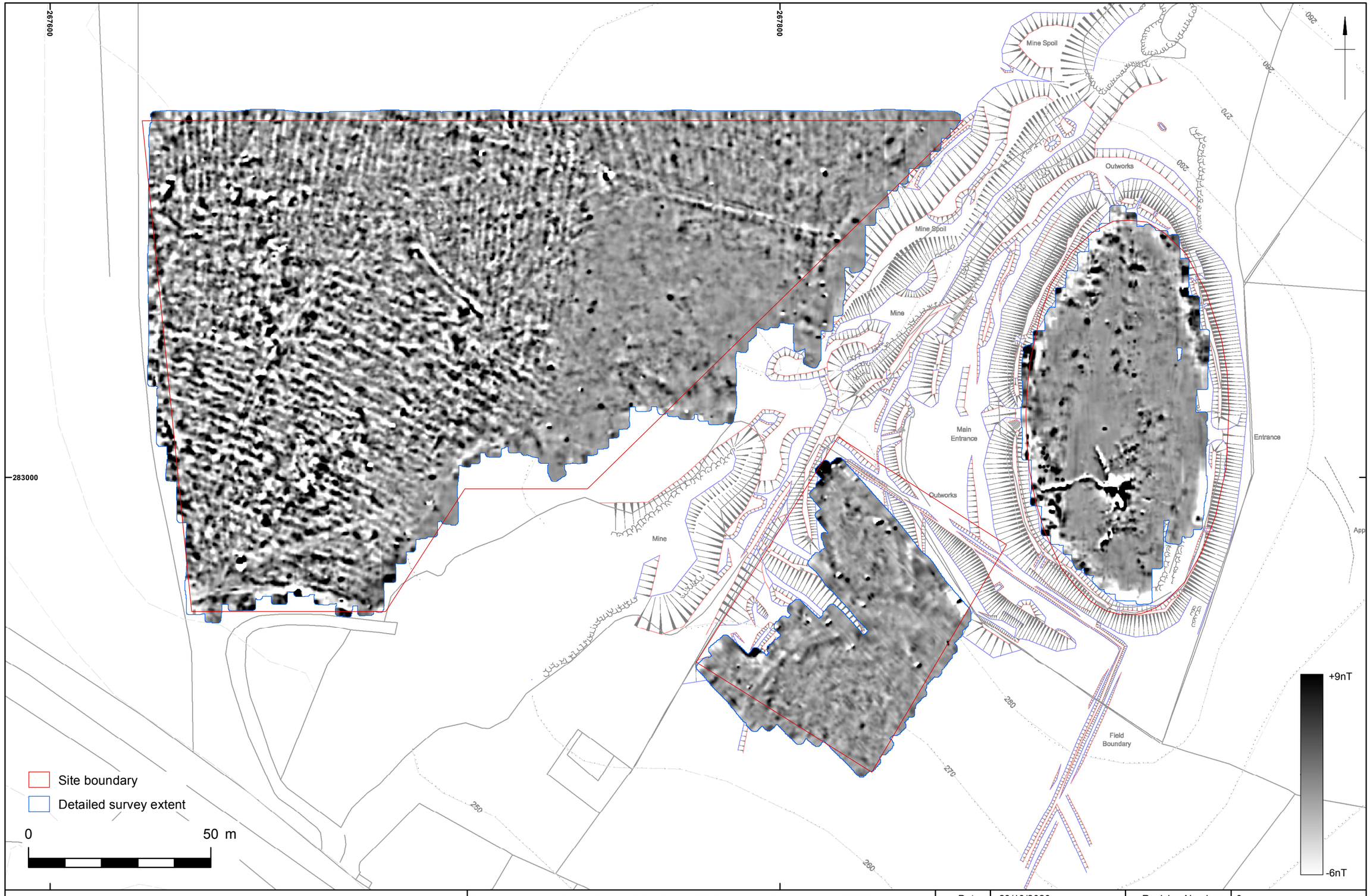
Figure 1



Date:	29/10/2020	Revision Number:	0
Scale:	1:1,000 at A3	Illustrator:	NLC
Path:	X:\PROJECTS\238990\GIS\FigsMXD\Geophysics		

Detailed gradiometer survey results: greyscale plot (-2 - +3 nT)

Figure 2



Date:	29/10/2020	Revision Number:	0
Scale:	1:1,000 at A3	Illustrator:	NLC
Path:	X:\PROJECTS\238990\GIS\FigsMXD\Geophysics		

Detailed gradiometer survey results: greyscale plot (-6 - +9 nT)

Figure 3

267600

267800

283000

Mine Spoil

Outworks

Mine Spoil

Mine

Main Entrance

Entrance

Outworks

Mine

Field Boundary

290

280

270

260

250

30

nT

-30

Site boundary

Detailed survey extent

Trace plot

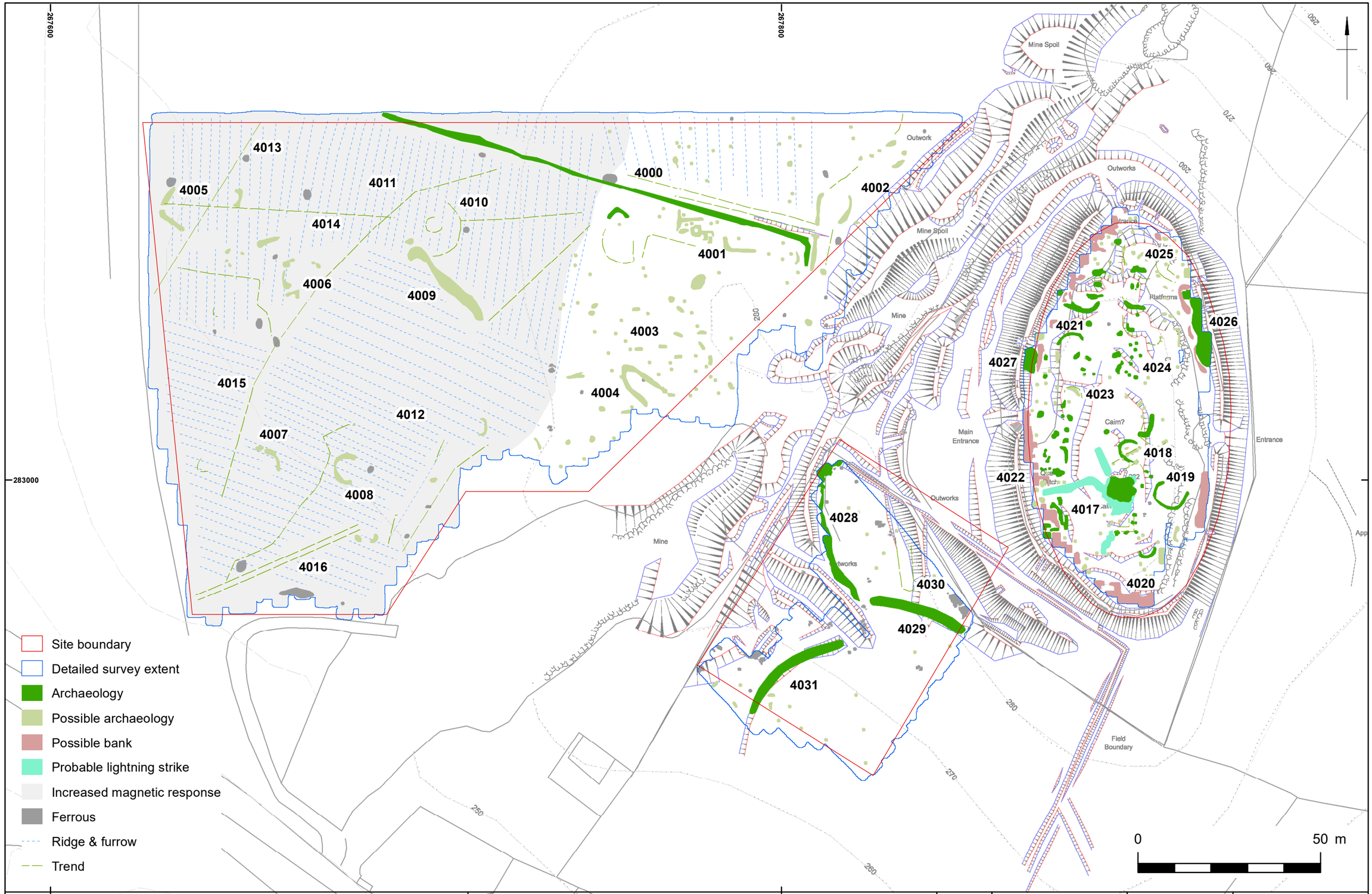
0

50 m

Date:	29/10/2020	Revision Number:	0
Scale:	1:1,000 at A3	Illustrator:	NLC
Path:	X:\PROJECTS\238990\GIS\FigsMXD\Geophysics		

Detailed gradiometer survey results: XY Trace plot

Figure 4



Date:	29/10/2020	Revision Number:	0
Scale:	1:1,000 at A3	Illustrator:	NLC
Path:	X:\PROJECTS\238990\GIS\FigsMXD\Geophysics		

Detailed gradiometer survey results: interpretation

Figure 5

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