



Castle Studies Trust
Advancing the Understanding of Castles



Aerial and geophysical surveys at Fotheringhay Castle Northamptonshire October 2017 - May 2018

Report No: 19/41

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Illustrators: James Ladocha and Olly Dindol



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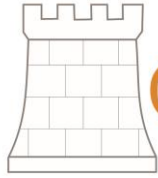
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OASIS REPORT FORM

PROJECT DETAILS OASIS No: molanort1 – 349811					
Project title	Aerial and geophysical surveys at Fotheringhay Castle, Northamptonshire, October 2017-May 2018				
<i>Aerial and geophysical surveys comprising Ground Penetrating Radar and magnetometer techniques, combined with a new analysis of resistivity data surveyed in 1991, has provided evidence of a tower on the motte and buildings and yards or rubble in the inner bailey of Fotheringhay Castle. The ground plan of buildings within the inner bailey is at variance with the only known depiction of the castle before its demolition in the late seventeenth and eighteenth centuries. The reason for this discrepancy is uncertain but could suggest either that the drawing is inaccurate, or that an otherwise undocumented phase of post-medieval buildings was constructed after the demolition of the castle. Only selected excavation would provide dating evidence for the buildings. Survey to the north and east of the castle has also identified historic remains including hollow-ways, tenements, foundations of small buildings one of which may be a dovecote and the moat surrounding the outer courts of the castle.</i>					
Project start date	14 October 2017	Project end date	9 May 2018		
Previous work	Geophysical survey (Masters 1991)	Future work	None planned		
Type of project	Aerial and geophysical surveys				
Instrumentation (1)	Bartington Grad-601 fluxgate gradiometers, on magnetometer cart				
Resolution	0.01 nT	Traverse separation	0.5m	Reading interval	0.25m
Instrumentation (2)	Sensors & Software Smartcart Noggin 250 ground penetrating radar				
Centre frequency	250Hz	Traverse separation	0.5m	Reading interval	0.05m
Subsurface velocity	0.95m/ns	Time window information and velocity estimation method not available			
Survey extent	5.7ha Magnetometer; 0.5ha GPR				
Geology (solid)	Rutland Formation limestone		Geology (drift)	River terrace gravel	
Site status	Scheduled Monument (1012072)				
Current land use	Pasture				
Monuments	Monument type			Monument date	
	Castle earthwork and environs			Medieval	
Significant finds	None				
PROJECT LOCATION					
County	Northamptonshire				
District	East Northamptonshire				
Parish	Fotheringhay				
Site name	Fotheringhay Castle				
Site co-ordinates	TL062929	Height aOD (min to max)			
PROJECT CREATORS					
Organisation	MOLA Northampton				
Project design originator	MOLA Northampton				
Brief originator	None				
Project manager/director	Stephen Parry (MOLA Northampton)	Project supervisor	John Walford		
Project sponsor	Castle Studies Trust				
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Archive recipient	MOLA Northampton	Archive ID			
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Aerial and geophysical surveys at Fotheringhay Castle Northamptonshire October 2017 - May 2018

Abstract

Aerial and geophysical surveys comprising Ground Penetrating Radar and magnetometer techniques, combined with a new analysis of resistivity data surveyed in 1991, has provided evidence of a tower on the motte and buildings and yards or rubble in the inner bailey of Fotheringhay Castle. The ground plan of buildings within the inner bailey is at variance with the only known depiction of the castle before its demolition in the late seventeenth and eighteenth centuries. The reason for this discrepancy is uncertain but could suggest either that the drawing is inaccurate, or that an otherwise undocumented phase of post-medieval buildings was constructed after the demolition of the castle. Only selected excavation would provide dating evidence for the buildings.

Survey to the north and east of the castle has also identified historic remains including hollow-ways, tenements, foundations of small buildings one of which may be a dovecote and the moat surrounding the outer courts of the castle.

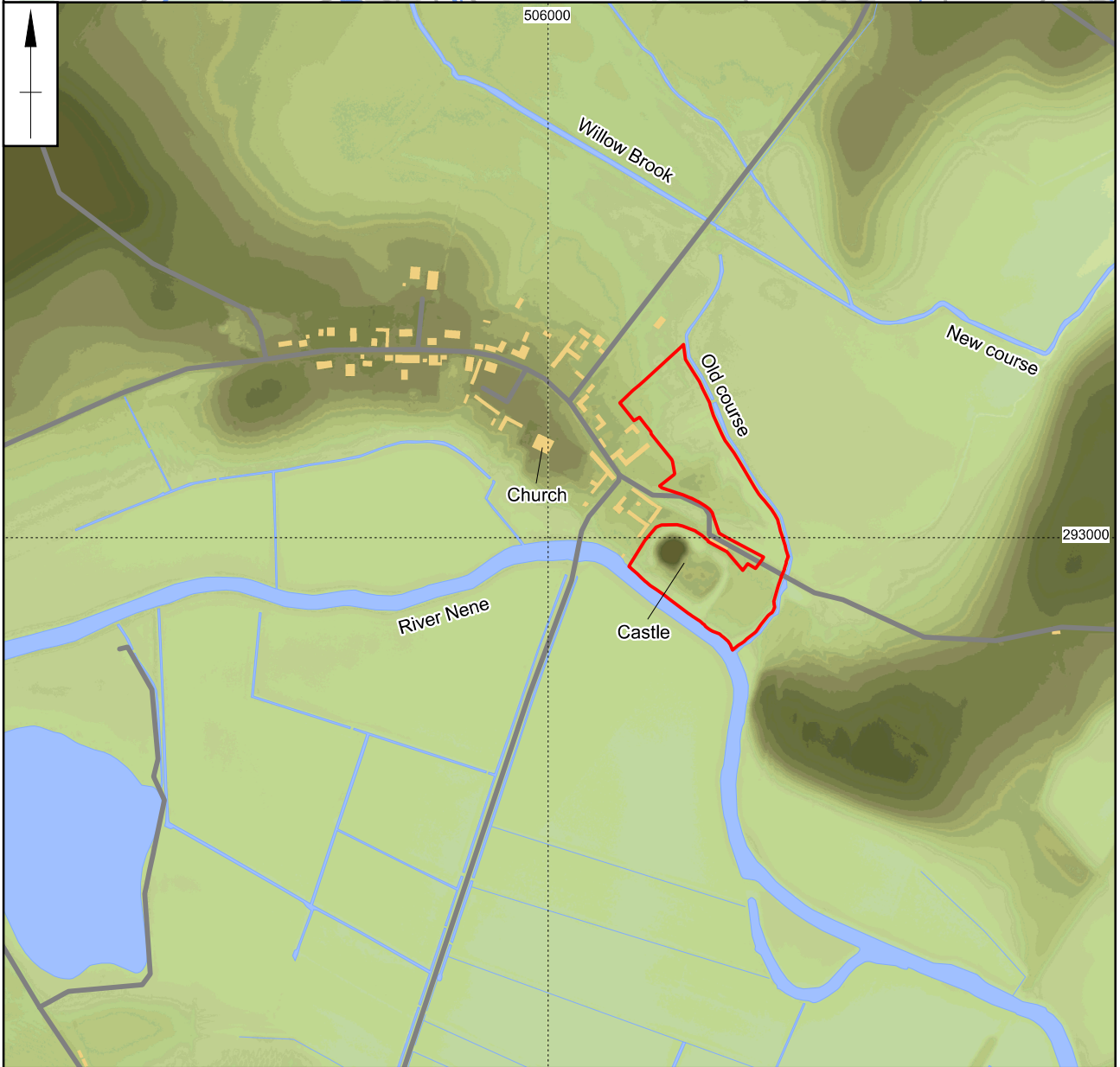
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Helen Woodhouse, Historic England, kindly supported the request for a Section 42 licence to carry out geophysical survey on the castle which is a Scheduled Monument. Staff at Northamptonshire Records Office, particularly Carenza Black, Archives and Heritage Services Commercial Project Manager and Charlotte Walker, Historic Environment Record Advisor were very helpful in providing a range of information used in this report.

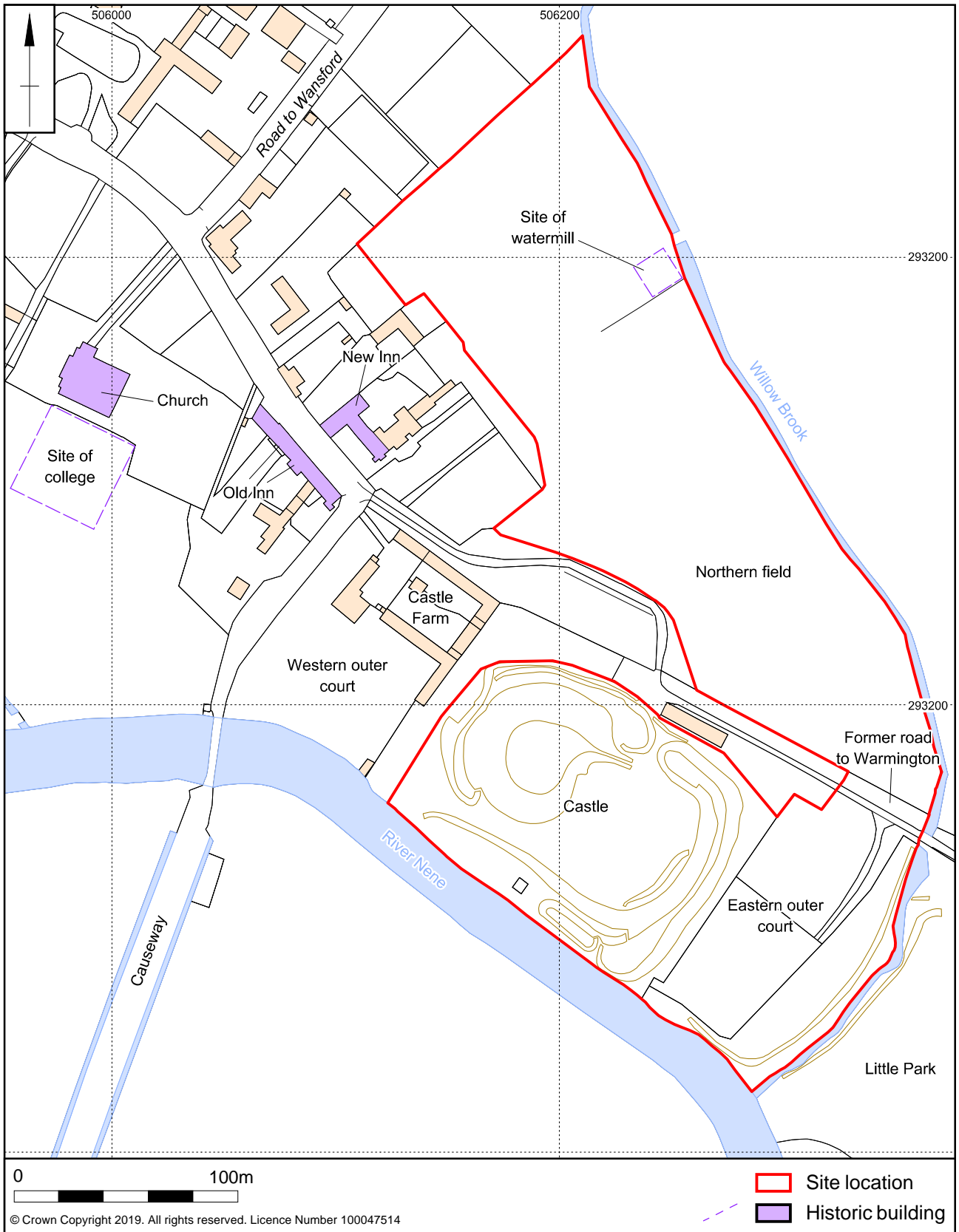
The local landowners very kindly gave their consent and encouragement to undertake the surveys.

The work would not have been possible without a grant from the Castle Studies Trust www.castlestudiestrust.org and the help and advice of its members is gratefully acknowledged. Jeremy Cunnington, Chair of Trustees has provided considerable support throughout the project.



Scale 1:10000

Site location Fig 1



Scale 1: 2500

Location of castle showing survey areas Fig 2

2 INTRODUCTION

The project seeks to enhance the current understanding of the evolution of Fotheringhay Castle, Northamptonshire (NRG TL062929; Figs 1 and 2) using geophysical survey comprising new GPR and magnetometer surveys, together with a reinterpretation of the 1991 resistivity survey. The site is a Scheduled Monument (NHLE ID: 1012072) and a Section 42 licence was granted to enable the work to take place (Ref AA/030735/5). An aerial survey using a Small Unmanned Aircraft (SUA) provided a detailed plan of the castle and its immediate environs, together with general oblique views (Figs 3 and 4).



Aerial photograph of castle and church with scaffold cover from south-east Fig 3



Aerial photograph of castle from south Fig 4

The castle survives as earthworks of a motte and bailey with remnants of an outer moat which enclosed two further courts arranged to either side of the original castle (Fig 2). The principal focus of the work was to investigate the inner bailey, which based on various medieval and later descriptions and a depiction of the castle from around 1640, is known to contain the hall, chapel and lodgings. This documentary evidence suggests that these buildings were arranged around the inside of the inner bailey curtain wall (Fig 5). However, magnetometer and resistivity surveys carried out by Northamptonshire Archaeology in 1991 suggested a different plan with free-standing structures within the bailey (Masters 1991). Therefore, the present work using modern equipment and software, was planned to investigate this apparent contradiction.

The GPR survey was extended to the top of the motte allowing the examination of the tower which was also identified in the medieval and later descriptions and shown in the 1640 illustration. The 1991 surveys had previously concluded that the top of the motte was too disturbed due to stone-robbing and perhaps antiquarian excavation to identify the tower. GPR survey was also carried out within part of the outer court to the south-east of the inner bailey which may have served as an orchard or garden with the intention to identify the location of a 'ruinous house' and gatehouse described in a survey of 1625. This area has been used as a caravan park and contains hardstanding which meant that the 1991 surveys were ineffective.

The aerial survey provides a detailed plan of the motte, inner bailey and outer court to the south-east, but did not extend to the other court to the north-west as the Castle Farmhouse and its barns are still in use as modern dwellings. However, the aerial survey and magnetometer survey were extended into the field to the north of the castle which also contains extensive earthworks though their purpose is uncertain (Figs 2 and 16).

3 BACKGROUND

3.1 Historical importance

The importance of Fotheringhay Castle is well known and it has played a part in wider castle studies since the nineteenth century (Bonney 1821). The castle may have been built by Simon de St Liz, Earl of Huntingdon and Northampton (died between 1111 and 1113) or his son Simon II de St Liz (died 1153). However, the focus of interest principally lies in the rebuilding and enlargement of the earlier motte and bailey castle by Edmund Langley, son of Edward III, followed by further substantial modifications by Edward IV. These works turned the *caput* of the honour of Huntingdon into a 'palace-fortress' and it became a favourite residence of the House of York and focus of their extensive east midlands estates (Pounds 1990, 66 and Emery 2000, 240). Richard III was born at the castle in October 1452. The importance of Fotheringhay is also shown by the rebuilding of the nearby parish church and foundation of an associated college by Edward second Duke of York who died in 1415 (RCHME 1975, 46; Fig 2). The House of York continued to invest in the church as well as the castle throughout most of the fifteenth century and it served as the burial place for both Edward and his nephew Richard third Duke (d. 1460; Matich and Alexander 2011). Edward IV also undertook extensive building works between 1463 and 1469 and again in 1478 (Emery 2000, 240).

The castle was given by Henry VII to his queen, Elizabeth of York and this relationship seems to have continued under his son so that each of Henry VIII's queens was granted the castle (Colvin and Summerson 1975, 248). Leland states that Catherine of Aragon had significant alteration made to the castle (Oetgen 2002, 119). Regular repairs were made throughout the reigns of Edward VI, Mary I and Elizabeth I. The

most important historic event associated with the castle is the trial and execution of Mary Queen of Scots on 8 February 1587. Descriptions and a plan of the trial identify a substantial hall 69ft by 21ft and a further chamber of 42ft by 21ft (Mackenzie 1897, 323). The castle continued in royal possession until 1603 when James granted it to Charles Blount, Lord Mountjoy. The manor of Fotheringhay was sold several times in the succeeding centuries and the castle lost its significance, leading to its demolition in the late seventeenth and early eighteenth centuries (VCH 1906, 571-2).

3.2 Location

The castle is located on low ground, adjacent to the confluence of the original course of the Willow Brook with the River Nene (Fig 1). At this point the river forms a wide meander flowing eastward before returning to its northern course to Wansford. The Willow Brook, which rises near Corby and forms one of the principal tributaries of the Nene, also flows south-east and then southward, thereby creating a narrow piece of land partially occupied by the castle which incorporates the brook into the moat of the eastern outer court and through sluices allowed the remainder of the moat to be filled with water. To the north of the castle, a watermill mentioned in a sixteenth-century survey and shown on the 1715 estate map was powered by the brook, giving rise to the name at this point as Mill Brook (Fig 2). The brook has been diverted in the late eighteenth or early nineteenth century to flow east to empty into the Nene at Elton.

The castle is overlooked to the east by a narrow ridge which bisects a second meander of the river, while to the west most of the village is located on a low rise (Fig 1). The view from the castle both to the north, across the Willow Brook and over the river to the south is formed by low almost flat areas.

The castle is located on river terrace sands and gravels, as mapped by the British Geological Survey (BGS 2019).

3.3 Village topography

The castle is located on the east side of the village, which was arranged, as now, with a single main street orientated roughly east-west and parallel to the River Nene (Fig 2). This may have been an important early route from London via Warmington to Stamford (Foard *et al* 2009, 218 and figs 37 and 40) and the original motte and bailey was sited immediately to the south of its course. The route would have been enclosed within the later outer courts of the castle, but it is probable that this access was controlled, so that most traffic would have crossed the river immediately outside the outer court to the west. While the map of Cliffe Bailwick dated about 1640 shows the road leading to Warmington, its significance must have declined as it is not shown to the east of the castle on the estate map of 1716 (Figs 5 and 6) or Thomas Eyres County Map in 1791 (see below).

To the west of the castle a series of tenements with a continuous street frontage at least in the mid-seventeenth century were arranged to either side of the main street (Fig 5). To the rear of the tenements were two back lanes which had been partly disused by the early eighteenth century. The northern lane followed the course of the Willow Brook and therefore was set at an angle to the main street so that they intersected at the corner of the outer court of the castle, where the brook bends southward to join the river. This lane could have allowed traffic to bypass the castle and join the road to Wansford. The southern lane bordered the West Meadow before it turned a right-angle to join the main street at the west end of the village.

The road immediately outside the western outer court of the castle crosses the river and passes thence to Tansor and Oundle. A wooden bridge is first mentioned between 1469 and 1471 as 'le Newebrigge' may have been created by Edward IV as part his

building works (Foard 2000, 26). The route would have required considerable investment to construct both the bridge and a substantial causeway across the floodplain. Both the bridge and causeway required repair throughout the sixteenth century and the bridge was replaced partially in stone in 1573. The present structure was constructed in 1722 (RCHME 1984, 74-5 and Bowsher 2017, 60-61). At the staggered crossroads with the main street the road continued roughly northward to allow direct access to the watermill and northern back lane. Indeed, Eyres County map of 1791 shows this route as the main thoroughfare from Oundle to Wansford but by Bryant's County map of 1827 the present road which turns further west with the junction adjacent to the church is the only route to the north. The importance of this route is shown by its description in the 1586 survey as 'a common highe waye for many passengers leadeth betweene London and the Northe partes' (Oetgen 2002, 121). At the crossroads and opposite the western court of the castle are located the Old and New Inns which were built in the fifteenth century to provide additional lodgings for people visiting the castle (Fig 2; RCHME 1984, 71-3).

3.4 Documented building phases of the castle

The broad outline of the development of the castle may be identified by several historical descriptions and these show that there was significant redesign, rebuilding and repair of the castle, particularly within the inner bailey during the fourteenth to sixteenth centuries. This series of works makes interpretation of anomalies identified in geophysical survey more complex as buried remains could relate to different phases.

An inquisition of 1341 pre-dating the work of Edmund Langley, stated that the castle was well built in stone, having a tower, large hall, two chambers, two chapels, kitchen, bakehouse and gatehouse (RCHME 1975, 43 and 45). Outside the castle, probably within the subsequent western court, was 'another plot within the walls built over with houses and called the manor' and comprised 'a grange (i.e. a barn), a granary, a great stable, a long house used for oxhouse, cowhouse, dairy and larder, a forge, and a house for the outer gate with a chamber above' (Oetgen 2002, 119). The document also describes a list of lands and services related to the demesne and includes a dovecot and watermill. However, in 1377, the year of its acquisition by Edmund Langley, the castle buildings are described as weak and ruinous (VCH 1906, 573).

Based on an account by Camden, Edmund Langley is thought to have largely rebuilt the castle in the years following 1377 (VCH 1906, 573). This work included the 'highest fortification or keep' in the form described as 'fetterlocks' or horse-fetter. The survey of 1625 describes this as 'built round of eight or sixteen square, with chambers lower and upper ones round about' and 'in the midst of the round yard in the same there has been a well now landed up' (Bonney 1821, 30). It is however, uncertain whether this building was an entirely new construction or a re-ordering of an existing tower. It is possible that the outer courts defined within a broad moat were added at this time and perhaps more accommodation, service buildings, together with a garden and orchards were built within them (Emery 2000, 239), though an account of 1586 is the first mention of the outer moat and two separate gates (RCHME 1975, 45).

Edward IV's work at the castle in the years 1463 to 1466 included walls of the 'chambers, gallery, latrines, turrets and kitchen newly begun in the castle but not yet complete' whilst the roofing of the new chambers and of the turrets 'at the end of them' was carried out between 1466 and 1469 with further work in 1478 (Brown and Colvin 1963, 650). In addition, Colvin and Summerson suggest that the 'Buckingham Lodgings' were built by Edward IV (Colvin and Summerson 1975, 250). Edward IV's requirements for suitable additional lodgings was also met by the construction of the New Inn just outside the castle sometime between 1461 and 1476 (RCHME 1984, 71-73). It is uncertain if its predecessor the Old Inn continued to be used for lodgings at that time or if it had been replaced and converted into cottages.

Leland describes the castle as 'fair and meately with doble ditches and... a kepe very auncient and strong'. It had 'very fair lodggyns' that 'Catarine of Spaine did great costes in late tyme of refresching of it' suggesting that the castle was still a favoured residence which was worth improving (Colvin and Summerson 1975, 248-9). After that date and throughout the reigns of Edward VI, Mary and Elizabeth the castle was regularly repaired but apart from work undertaken ahead of Elizabeth staying there as part of her progress in 1566, there appears to have been no further significant building programmes (Colvin and Summerson 1975, 249-51).

3.5 Decline and demolition of the castle

The castle was abandoned in the seventeenth century and piecemeal demolition was largely complete by the early eighteenth century. An anonymous lieutenant in 'A Relation of a Short Survey of the Western Counties' dated 1635 describes 'a sickly, and dyeinge castle' with walls and battlements 'now much ruined' but how far this account is affected by the author's sympathy for Mary Queen of Scots is uncertain (Oetgen 2002, 122). Rev Bonney states that soon after the 1625 survey, Sir Robert Cotton purchased the 'hall in which the Queen of Scots was beheaded' and removed it to Conington (Bonney 1821, 30-31). He also states his belief that this work did not just include the interior fittings but also the arches and columns which had divided the hall into three aisles. Bonney continues by saying that other parts of the castle were purchased by Robert Kirkham in order to build a chapel in his house at Fineshade and the last remains were destroyed in the middle of the eighteenth century to repair the navigation of the Nene.

Bonney also describes more contemporary events when in 1820 there was substantial earthmoving with labourers cutting into the east side of the motte in order to find stone and at about the same time the infilling of part of the moat (Bonney 1821, 33).

In 1886 Cuthbert Bede commented 'but scanty remains of the old castle had been left for the utilitarian purposes of its last proprietor' and sketched the 'old castle wall' with 'three massive buttresses', against the southern side of which, barns and farm-buildings had been erected in 1852 (Bede 1886; Oetgen 2002, fig 13). This wall was located on the north side of the western outer court but according to Bede was destroyed prior to the construction of new farm buildings by Lord Overstone in 1863 or 1864. Around the same time Lord Overstone had part of the moat filled in to create a new garden.

3.6 Historic maps

Map of Cliffe Bailiwick, Rockingham Forest circa 1640 (PRO MR 1/314; Fig 5)

The earliest detailed depiction of Fotheringhay village including the castle is included in a larger map of Cliffe Bailiwick, one of three bailiwicks of Rockingham Forest (PRO MR 1/314). The significance of the map which provides the only known illustration of both the castle and former college associated with the church before they were demolished was first noted by Glenn Foard and Tracey Britnell (Foard and Britnell 2002, 140-143, Foard *et al* 2009, fig 45).

The map shows the principal buildings within the village, including the castle, church, former college, New Inn, watermill and an open space representing the market, together with a continuous street frontage of houses. The map is distorted with the space between church and castle foreshortened and the watermill wrongly located assuming that it is in the same place as mentioned in a rental of manor of Fotheringhay 1548-9 and the later map of 1716 (Figs 2 and 6). However, comparison of the depiction of the church with the existing building shows that it is broadly accurate albeit wrongly aligned.

The inner bailey of the castle with a large tower corresponding to the one described on top of the motte is shown in some detail. The scale of the depiction is too large so that the inner bailey also fills the area of the western outer court up to the road crossing the river and most of its eastern counterpart and therefore any buildings within these courts are not shown.

The large tower is depicted in three stages but as the motte is not shown it is uncertain what the lower part of the tower might represent as it could form a revetment wall or simply artistic licence. The shape of the tower is multi-angular with perhaps outside seven facets and a small hexagonal inner court. This is very similar to the description in the 1625-survey of a tower 'built round of 8 or 16 square with chambers lower and upper ones round about'. Rising above a flat roof are five chimneys or pinnacles. There are at least three small windows shown on the second stage facing the inner bailey. The map does not show arrangements for access into the tower but as buildings in the bailey are shown flush against its walls these could have either provided the point of entry or their depiction obscures external steps.



Detail of map of Cliffe Bailiwick, Rockingham Forest
circa 1640 (PRO MR 1/314) Fig 5

The inner bailey is shown as almost square with high curtain walls but no corner towers, other than the large tower which partially extends into the line of the bailey. Buildings are shown as continuous ranges along the inside of all four sides of the walls, thereby creating a large open courtyard without any visible structures. A gateway without flanking towers is shown in the northern range of buildings, roughly where the current causeway is located. There are no other entrances shown on the map. Opposite the gateway, the southern range probably contained the principal buildings including the great hall since three large windows overlook the river suggest the presence of a tall single storey suite of rooms. The windows depicted in the buildings on the other three sides indicate that rooms were arranged on two floors. The buildings of all four ranges are well furnished with chimneys.

While significantly distorted at this point the map shows the course of the main street passing to the north of the castle starting at the point where the northern back lane joins the street. Between the main street and the castle, a further parallel line could be intended to depict the outer moat or an alternative routeway. The map suggests that at least one and perhaps two routeways were present following the course of the Willow Brook leading from the river to the main street and these tracks may be identified as a shallow hollow-way (see below and Fig 16).

Estate map of Fotheringhay 1716 (NRO map 467; Fig 6)

The estate map provides a detailed depiction of the Fotheringhay village including parts of the moats of the castle and shows each house along the main street, together with their associated tenements. Three sides of the moat surrounding the motte and inner bailey are shown but not the mound itself. The moat is shown as containing water. At the southern side the moat is shown emptying directly in to the river while its western side simply stops without returning south or joining the river. The moat enclosing the north side of the outer courts is depicted as a broad feature divided into two at roughly the centre of the castle. It extends from the crossroads to almost the Willow Brook. A trackway immediately within the moat suggests the continued use of the original line of the road to Warmington. Close to the cross roads a short unenclosed area immediately outside the moat could form part of the alternative route shown on the 1640-map. A rectangular water-filled feature is shown just outside the outer eastern court of the castle at the point where the former road to Warmington crosses the Willow Brook. This feature is still visible as a hollow, (see below and Fig 16) and could represent the location of the 'Great Pool' mentioned in the 1625 survey.



Detail of estate map 1716 (Courtesy of Northamptonshire Record Office, NRO Map 467) Fig 6

The only structures shown within the castle are within the western outer court and comprise an L-shaped range of three buildings directly fronting the road junction and a smaller structure near the motte. These could represent surviving elements of the manor mentioned in various surveys from the inquisition of 1341 onwards. The plot containing these buildings appears to have a boundary wall which extends from the

Fotheringhay Causeway along the river bank almost to the inner ditch surrounding the motte and bailey. This could be part of the wall with arches shown in a drawing of August 1718, though in that view the wall is continued along the south side of the inner bailey (Bridges 1791, 453; Fig 7). It is uncertain if the wall formed the last vestiges of the castle defences or a subsequent boundary. The wall appears to have been demolished by the time of a similar view published as the frontispiece by Rev Bonney (Bonney 1821). It is possible that the magnetometer survey within this area may have identified part of the wall foundations (see below). The absence of buildings within the inner bailey suggests that by the early eighteenth century there were no habitable structures. Thus, the castle was demolished within a period of 70 years and there is no pictorial evidence for a further phase of building in the intervening years on the site.



Detail of a drawing taken in August 1718 showing Fotheringhay Church and its surroundings including a wall between the castle and river (Bridges 1791) Fig 7

The street pattern adjacent to the castle remains broadly the same as that shown on the 1640s-map but parts of the back lanes appear to have gone out of use. The triangular field to the north of the castle is defined by the outer moat, the Willow Brook and a broad enclosure with rounded corners which fronts onto the lane connecting the Fotheringhay causeway to the northern back lane (Fig 6, No 3). The watermill is shown as two ranges of buildings on the north side of the lane to the rear of the tenement for the New Inn (now known as Garden Farm) adjacent to the Willow Brook (Fig 6, Nos 4 and 5 respectively).

Estate map of Fotheringhay 1807 (NRO map 357; Fig 8)

This shows similar arrangements as the 1716 map, but additional buildings have been constructed within the western outer court. Only one of the mill buildings is shown and that is simply depicted as a single unshaded structure in contrast to other buildings within the village implying that the watermill fallen out of use by 1807. The map also shows a track extending the adjacent road over the Willow Brook and to the fields to the east.



Detail of estate map 1807 (Courtesy of Northamptonshire Record Office, NRO Map 357) Fig 8

Ordnance Survey Surveyor's Provisional 2-inch map 1814 (Fig 9)

Though the Surveyor's map is small scale it shows similar arrangements to the earlier estate maps and is principally useful for showing that of the outer moat on the north side of the castle was water filled and confirming the location of an entrance roughly inline with where the modern track crosses the moat and the causeway into the inner bailey.



Ordnance Survey Surveyor's provisional 2-inch map 1814 Fig 9

The Surveyor's Map also shows the moat surrounding the motte and inner bailey as a continuous water-filled C-shaped feature, ending close to the river. The possible location of the 'Great Pool' noted in the 1716 map is also shown. Three buildings are shown within the northern corner of the western outer court.

Estate Map of Fotheringhay 1841 (NRO 343; Fig 10)

The 1841 map depicts the motte and inner bailey moat in detail including showing that the moat turns at the southern corner to run parallel to the river for about half the length of the southern side. The map does not show any part of the outer moat or 'Great Pool'.

The map shows considerable change to the village since the early nineteenth century including the remodelling of Castle Farm within the western outer court. The property was extended by encroaching upon the street leading across the river to the Causeway and the buildings that formed the former frontage were demolished. It is possible that the building shown as No 1 on the 1807-map could have been the farmhouse but the 1841-map clearly shows the existing arrangement with the farmhouse at one corner of three ranges of barns. Two of the barn ranges may have reused parts of the earlier barns depicted in the 1716-map which could have themselves incorporated earlier buildings related to the castle as described by Bede (see above). If so, the changes brought about by Lord Overstone in the 1860s may have removed the last vestiges of castle buildings though the ground plan shown on the first edition Ordnance Survey 25-inch map dated 1886 is little changed.

The area to the north of the castle has also been rearranged with straight-sided tenements replacing the close with rounded corners and the realignment of and closure to public access the lane leading to the now demolished watermill.



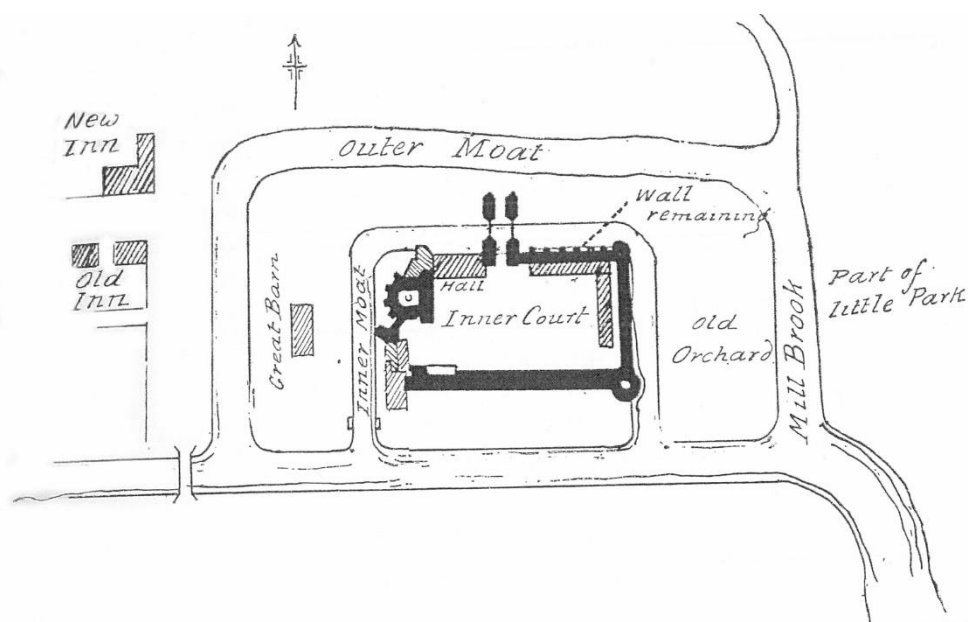
Detail of estate map 1841 (Courtesy of Northamptonshire Record Office, NRO Map 343) Fig 10

3.7 Previous investigations

The castle survives simply as earthworks, principally of the motte, inner bailey and part of the moat which defines the outer courts while other remains are indistinct. There have been various attempts to reconstruct the ground plan of the castle based upon the surviving earthworks and historic descriptions, but each is frustrated by limited evidence.

An early attempt to reconstruct the plan of the castle was undertaken by Sir James Mackenzie who showed the broad outline of the castle, albeit in a slightly stylised fashion (Mackenzie 1897, 320-327, showing 'Fotheringhay as it was'; reproduced as Fig 11). The plan shows the inner bailey and its moat, as well as the moat surrounding the outer courts. He notes part of the northern curtain wall of the inner bailey as 'wall remaining' perhaps indicating that there was otherwise unrecorded Victorian excavation. His source for the remainder of the plan including the D-shaped tower on the motte (the earthworks are not shown) is uncertain beyond using the 1625-survey as a guide. Further excavation was recorded by the Peterborough Natural History, Scientific and Archaeological Society report of 31 December 1911 which shows a photograph of 'the angle in the wall where the keep of the castle is believed to have joined a southern tower'.

The Royal Commission's conjectural reconstruction of the castle is also based upon the 1625 survey (RCHME 1975, fig 55) and follows Mackenzie in arranging the principal buildings on the inside of the curtain wall, though the hall was suggested as part of the east range rather than that to the north. This reconstruction also suggests that two gates in the outer courts were located in line with the former road to Warmington providing access directly into Little Park to the east and to the crossroads to the west. In contrast to the eighteenth and early nineteenth-century map evidence, the outer moats were interpreted as continuous with no other entrances to the castle. The Great Pond is shown as conjoined to the eastern end of the northern arm of the outer moat to either side of the Willow Brook, but it is uncertain why this location was suggested. S J Hunt suggested an alternative location for the entrance to the castle to the south-west of the motte, presumably accessed via a track from the Causeway close to the bridge (Hunt 1987, 2-3). There is a raised area at this point, but this may be due disturbance caused by stone robbing in the eighteenth and nineteenth centuries (see below).



Plan of castle (Mackenzie 1897) Fig 11

During the conversion of the Castle Farm barns into dwellings within the western court of the outer bailey an archaeological watching brief located part of the moat (Ivens 2007). The work included observation of service trenches which appear to confirm that the moat was divided into two suggesting an entrance from the north as shown in the Estate Maps of 1716 and 1807 and the Ordnance Survey Surveyor's map. The results of watching brief also suggested that rather than continuing in a straight line to the crossroad close to the New Inn, the moat may curve inwards. This is at variance to the maps which show the northern moat as straight and therefore this area requires further investigation. In addition, the watching brief also identified substantial stone foundations, but the limited nature of the groundwork precluded a firm interpretation of the remains. Other small-scale archaeological watching briefs have been carried out but with no significant results (NA 2002 and McAree 2005).

The Round Mounds Project investigated the motte at Fotheringhay and radiocarbon dating of core samples produced a date of mid/late eleventh to late twelfth century for its construction (RMP 2016). The project also undertook a detailed survey of the earthworks of the motte and inner bailey (Elaine Jamieson *pers comm*).

4 SURVEY RESULTS

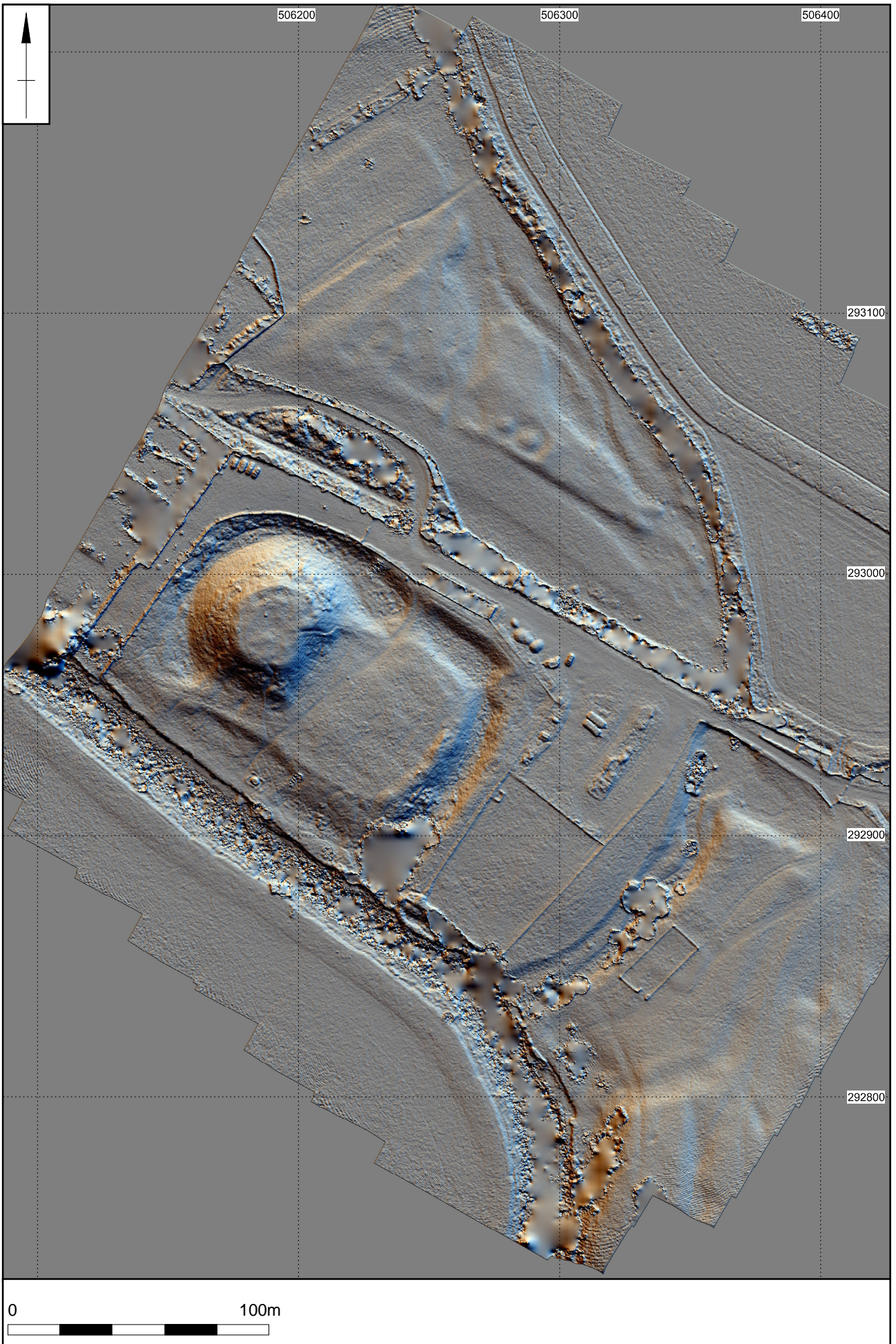
The following overview of archaeological remains discovered brings together the results of the aerial survey and the three geophysical techniques comprising GPR, magnetometer and resistivity surveys. By combining the techniques, it allows a single coherent description while methodological details of the individual surveys are contained in Appendices 1 to 4. The work is presented in four broad areas comprising the motte and inner bailey, the eastern outer court and areas to the north and east of the castle. It should be noted that the extent of each survey varied depending upon ground conditions (Figs 18-20, end of this report). It was particularly unfortunate that the high growth of vegetation between the inner bailey and the river prevented GPR survey though the magnetometer survey was able to fully investigate the area.

4.1 Motte and inner bailey

Overall plan

The earthworks of the original motte and bailey are well-defined as the current land-use is occasionally grazed pasture. The aerial survey has confirmed that the earthwork plans prepared by the RCHME and as part of the Conservation Statement and Archaeological Management Survey are largely accurate in most details (RCHME 1975, fig 54 and Oetgen 2002, fig 4; Fig 12). The motte is located to one side so that its now filled in ditch would have projected into the bailey.

The original form of the motte was probably a circular mound 7m high with a diameter of 70m at its base and 30m at its top, encircled by its own moat which is now only visible to the north and west. Substantial modification to the mound occurred at some point when the east and south sides were cut back to an almost vertical slope and the adjacent moat was filled in (Fig 12). It is probable that these works were carried out at different times with the infilling of the moat occurring in the late Middle Ages to create greater space within the bailey. The cutting back of the motte, which would have undercut the tower at its summit was likely to have been undertaken after the castle fell into disuse, perhaps as a result of stone robbing described by Bonney (Bonney 1821, 33). The top of the motte is fairly flat but irregular suggesting that stone robbing and antiquarian excavation may have taken place after the tower had been demolished.



Scale 1: 2000

Digital elevation model Fig 12

The inner bailey is roughly square with rounded corners and is bounded by a deep moat on its north and east sides (Fig 12). The current entrance to the bailey is located on the north side of the castle and comprises an earthwork causeway across the moat. It is probable that the original entrance was in the same location as shown by the 1640 map depiction (Fig 5). The moat is also partly visible on the southern side, adjacent to the river, but closer to the motte it cannot be traced in the surviving earthworks or magnetometer data. At this point there is no survival of the rampart but rather simply a steep scarp 1m to 3m high perhaps again created as the result of stone-robbing activities in the eighteenth or nineteenth centuries (Fig 13 [1]). The area affected measures 44m by 12m. Close by, a large block of limestone rubble forms the only remains of the castle superstructure, but it is thought to have been moved to its current position from either the motte or elsewhere in the bailey (Fig 13 [2]). The block was in this position by 1861 when it was drawn by Cuthbert Bede (Oetgen 2002, fig 12), and it was fenced with metal railings in the twentieth century.

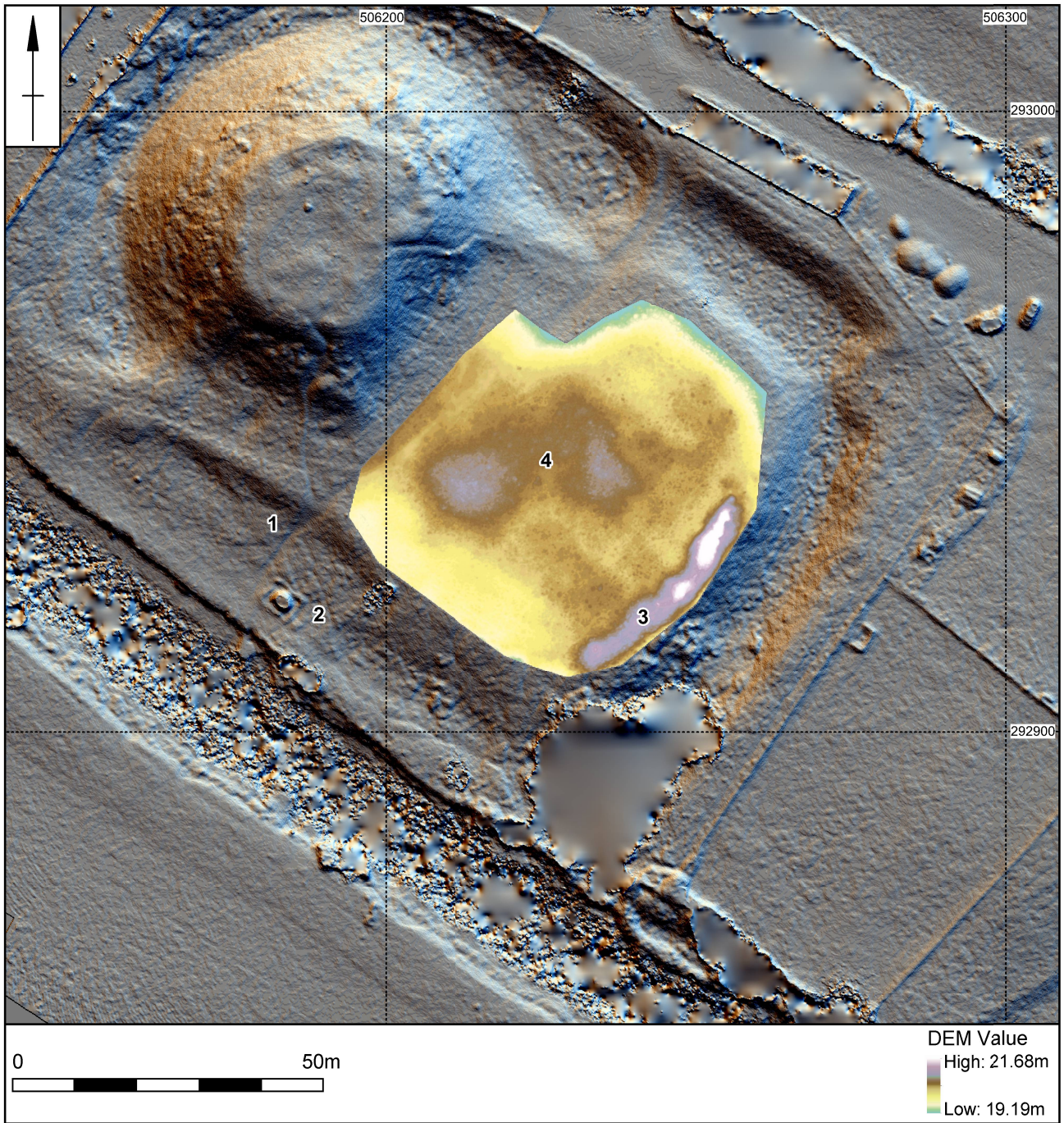
The earthworks along the southeast edge of the bailey are in part narrow and irregular and the current landowner remembers his grandfather saying that in the 1940s the interior of the bailey was 'bulldozed flat' and the soil heaped up along the edge of the ditch in preparation for vegetable cultivation (J Gould *pers comm*; Fig 13 [3]). Low, almost imperceptible earthworks are present forming slight platforms in the centre and southern corner of the bailey (Fig 13 [4]). These could derive from the agricultural works in the 1940s, or be a survival of earlier features including perhaps rubble from the demolition of buildings.

Tower on the motte

The GPR survey has identified foundations of parts of the tower on the summit of the motte, starting at a depth of 0.846m below present ground surface, but the clearest plan is at 1.154m (Figs 14 and 15 [1]). The remains consist of two rings, which represent the outer wall of the tower and the inner wall of rooms facing into a small courtyard. The exterior diameter of the tower is approximately 27m but appears to have been built slightly off-centre to the top of the motte creating a short berm to the edge of the mound to the north and east. The rooms within the tower are about 5-6m wide. The outer wall foundation is about 2.2m thick while the inner circuit has a slighter construction measuring 1.1m. The shape of the tower appears to be multi-angular, but the incomplete survival makes the number of sides uncertain. The clearest evidence is on the east side where two walls at right angles to the circuit suggest that the principal entrance to the tower was about 4m wide and located facing the inner bailey close to the northern rampart. If broadly symmetrical, the eastern part of the outer wall has been removed by stone-robbing which had cut into this side of the motte. The more complete inner circuit suggests that the tower was provided with a straight side close to the entrance with a sharp angle to join the curvature of the rest of the tower. This may account for the description of the tower being the shape of fetterlocks. There may have been subdivisions of the rooms with the presence of two, perhaps three partition wall foundations. The 'now landed up' well within the courtyard described in the 1625 survey has not been identified.

Moat surrounding the motte

The magnetometer survey identified the infilled moat on the east and southern sides of the motte (Fig 14 and 15 [2]). It is up to 8m wide. The southern section of the moat underlies the scarp noted above suggesting that this arrangement is a later alteration. It appears that the moat was discontinuous with breaks in its circuit close to where the bailey ramparts would have joined the motte. The gap to the north appears to be wider than that to the south thereby perhaps allowing more space for access to the top of the motte.



Scale 1: 1000

Digital elevation model showing earthworks in inner bailey Fig 13

Both the GPR and resistivity surveys identified strong anomalies along the north-west side of the bailey partially overlying the filled in moat (Fig 15. [3]). Together these may represent a metallised yard or rubble used to create a firm surface. This feature is up to 10m wide but tapers to the south and extends to a depth of at least 1.154m below ground surface. The moat itself may be expected to be deeper but is not visible in the lower images of the GPR time slices.

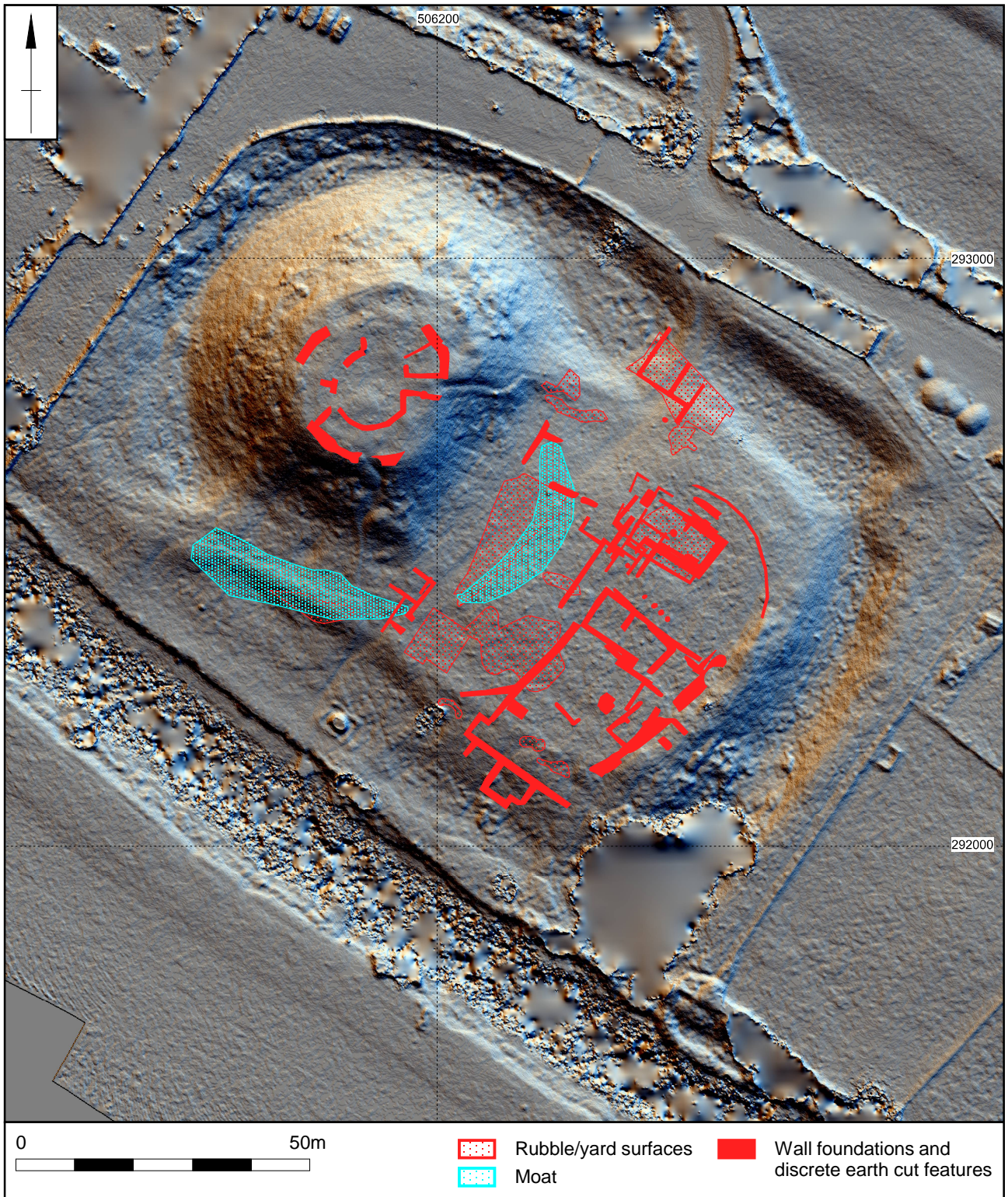
The magnetometer survey was extended to cover the area between the base of the motte and Castle Farm. Here the partially filled-in moat contained ferrous debris the magnetic signature of which obscures other details (Fig 25). This material may have been derived from work carried out by Lord Overstone in the mid-nineteenth century when the barns of Castle Farm were constructed (RCHM, 1975, 43).

Inner bailey curtain wall and possible gate and towers

Linear anomalies identified by the GPR and resistivity surveys on the eastern side of the bailey to the south represents part of a substantial foundation some 3m thick, probably denoting the line of the curtain wall (Figs 14 and 15 [4]). If so, outside the wall there would have been a berm of 4m. Alternatively, if the stone rampart was located on the edge of the moat, and hence beyond the survey area, then the foundations could represent an inner wall of buildings arranged around the curtain wall. However, the massive size of the foundation suggests a defensive function. At the south, further anomalies suggest that there was either a small structure projecting outside the line of the wall or an internal division within the putative buildings.

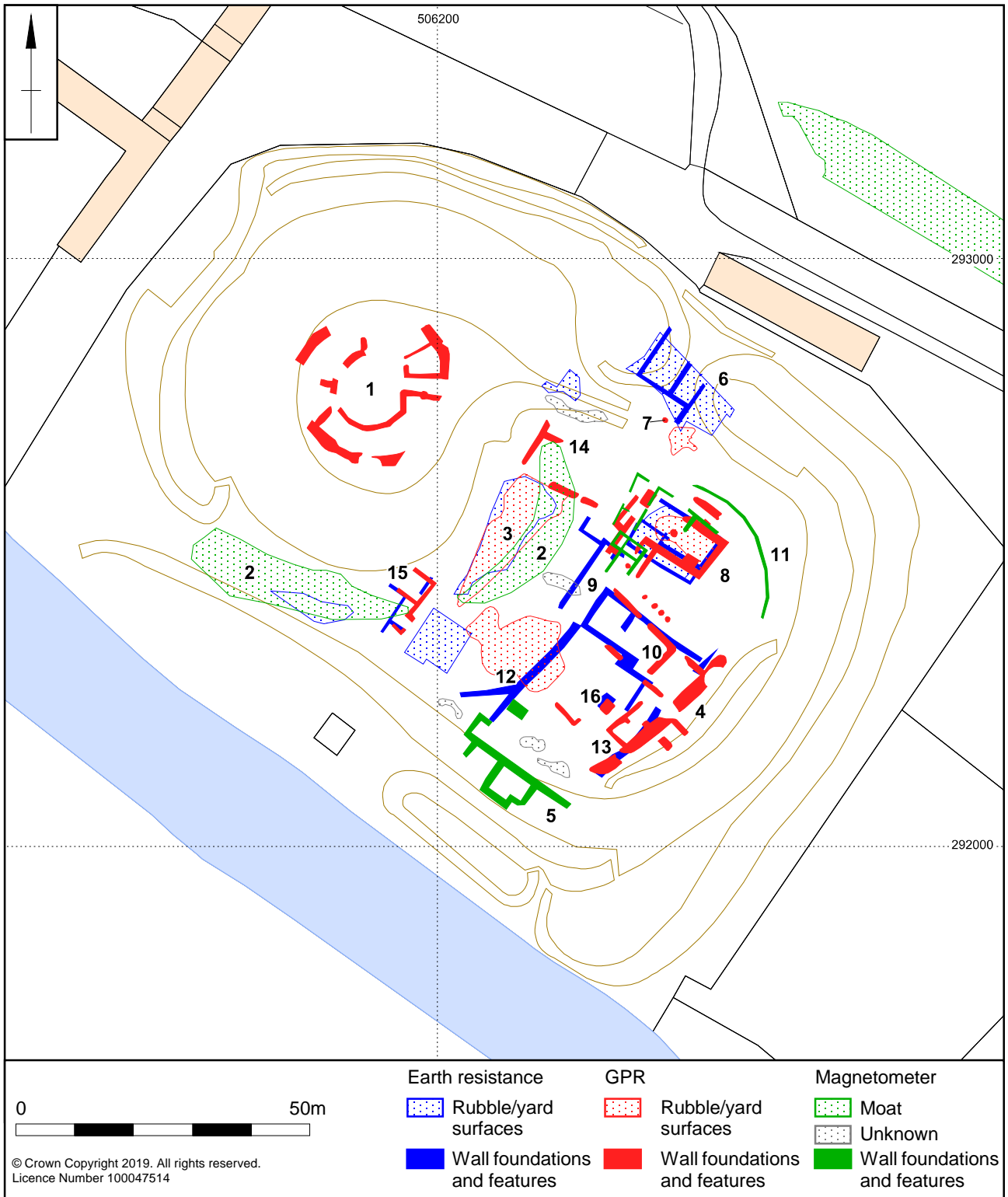
A further linear anomaly located part way down the slope to the river on the south side of the castle may be identified from lower susceptibility readings within the magnetometer data (Figs 14, 15 [5] and 24). This type of anomaly may denote stone or brick foundations (Clark 1996, 125). Due to the slope and height of undergrowth GPR and resistivity surveys could not be undertaken to further investigate this feature. Any continuation of this feature to the northwest may have been removed when the steep scarp was created, perhaps in the nineteenth century. The anomaly could denote the foundations of the southern curtain wall and a possible rectangular tower or other structure projecting towards the river. If the anomaly indicates a separate construction, this is probably part of the boundary wall shown on the 1718 illustration published by Bridges (Bridges 1791; Fig 7) although he did not indicate a tower in this location. The tower-like structure measures 8m by 7m but the anomaly is indistinct at the southern corner.

There was no evidence for the curtain wall elsewhere along the circuit of the rampart. Close to the present causeway entrance GPR and resistivity survey anomalies perhaps represent rubble from previous structures associated with the gateway (Figs 14, 15 [6] and 27). The resistivity survey was extended partly over the modern causeway and perhaps provides further details of arrangements at the entrance. This suggests that at least at foundation level there was a continuous wall in line with the inner bailey rampart. At right angles to this construction and extending part way across the causeway are three further wall foundations. The purpose of these foundations is uncertain but they could have acted as revetment or other strengthening elements to prevent the causeway slipping into the moat. At a depth of about 1.231m a prominent anomaly central identified in the GPR survey could represent the base of an architectural element associated with the entrance (Fig 15 [7]).



Scale 1: 1000

Interpretation of all geophysical anomalies on the motte and in the inner bailey Fig 14



Scale 1: 1000

Interpretation of geophysical anomalies by survey method on the motte and in the inner bailey Fig 15

Buildings within the inner bailey

All three geophysical survey techniques provided complementary evidence for the presence of buildings and other structures within the inner bailey. As might be expected from the well documented building campaigns in the fourteenth to sixteenth century there is evidence for a number of phases of work in some areas. Elsewhere the bailey appears to have had a more open aspect, but it is uncertain if this reflects the medieval arrangements or simply the result of the demolition of the castle and the subsequent robbing of foundations between the seventeenth and nineteenth centuries. Extensive anomalies identified in the GPR and resistivity surveys could denote yard surfaces or areas of rubble that could indicate that further structures were present but have been largely destroyed.

Principal buildings

The principal buildings identified in the geophysical surveys are largely freestanding within the north and central parts of the bailey and form three sides around a small courtyard. The buildings appear to comprise two main ranges (Fig 15 [8] and 10) with a smaller building linking them (Fig 15 [9]). The main ranges are orientated north-west by south-east so that one of their gable ends faces the motte and the other gable of the southern building joins the eastern curtain wall. However, the buildings are arranged on slightly different alignments and therefore form an asymmetrical plan.

The foundations of the northern rectangular building measure 14.1m by 5.6m. Its eastern half is well-defined from the GPR survey with foundations about 0.90m wide beneath areas of stone rubble. A prominent GPR anomaly within the northern corner of the building and another at the centre point are of uncertain origin. A number of parallel wall foundations along the line of the north-west gable-end may denote the presence of small chambers or a series of significant modifications to the structure at this point. Some of these foundations have been principally identified by magnetometer survey (Figs 24 and 25). Similarly, wall foundations to either side of the long-sides of the building could represent pentice-like corridors, or aisles, or further modifications to the main structure.

To the south the building linking the main ranges comprises a rectangular structure 16.1m by 4.2m (Fig 15 [9]). Its northern end also shows a complex building history with three wall foundations suggesting a narrow room with corridor or covered walkway facing the courtyard. At the point where it joins the northern building are a further series of small chambers, while two further wall foundations suggest the presence of an ancillary structure to the north-west.

The wall foundations of the southern building are clearly visible based on a combination of GPR and resistivity anomalies (Fig 15 [10]). The alignment of the anomalies is slightly different between the two surveys which is probably due to minor inaccuracies in the resistivity survey location, since the 1991 work predates the use of GPS. The range is 20.2m long and its width changes from 5.9m to the west to 7.2m from the centre point eastwards. The widening is due to part of the southern wall being off-set and at this point the width of the foundations has been doubled. The range appears to have been divided into three rooms which from west to east measured 5.1m, 7.6m and 5.8m. The room divisions do not correlate to the change of width of the building suggesting that some of the structural arrangements may not have been identified. Along its northern side facing the courtyard are four small GPR anomalies which may represent column bases used to support a continuation of the corridor noted on the outside of the northern and link ranges, or which formed an open loggia.

Structures adjacent to the principal buildings

The areas to either side of the principal buildings appear to have been defined perhaps to create enclosed open areas. An earth-cut feature curves around the north and east

side of the northern building, separating it from the bailey ramparts (Fig 15 [11]). It is uncertain if this feature represents a robber trench for a boundary wall, or simply a drain.

To the south of the southern range a roughly rectangular area measuring 23.8m by 19.3m is formed by the east curtain wall and southern boundary wall, with its northern side closed off by a substantial wall foundation which at its southern end divides into two, close to the boundary wall (Fig 15 [12]). A small possibly two room building is located flanking the southern range against the eastern curtain wall (Fig 15 [13]). Outside the building a square anomaly measuring about 2m was identified in the GPR and resistivity surveys is probably a well since it could be detected to a depth of at least 2.153m (Fig 15 [16]). Three magnetometer anomalies within the rectangular area could betoken some form of contemporary activity, their intensity does not suggest severe burning that might be associated with hearths of kilns.

Other buildings and structures

Other buildings within the bailey may be suggested though the anomalies are incomplete. Linear anomalies between the northern part of the principal range and the motte may represent the presence of a further substantial building measuring 13.3m by 6.5m (Fig 15 [14]). If contemporary with the principal range its gable end would have been close to the other buildings making any access to the centre of the bailey quite narrow. The putative building overlies part of the motte ditch and its southern side is formed by the edge of the stone spread (Fig 15 [3]).

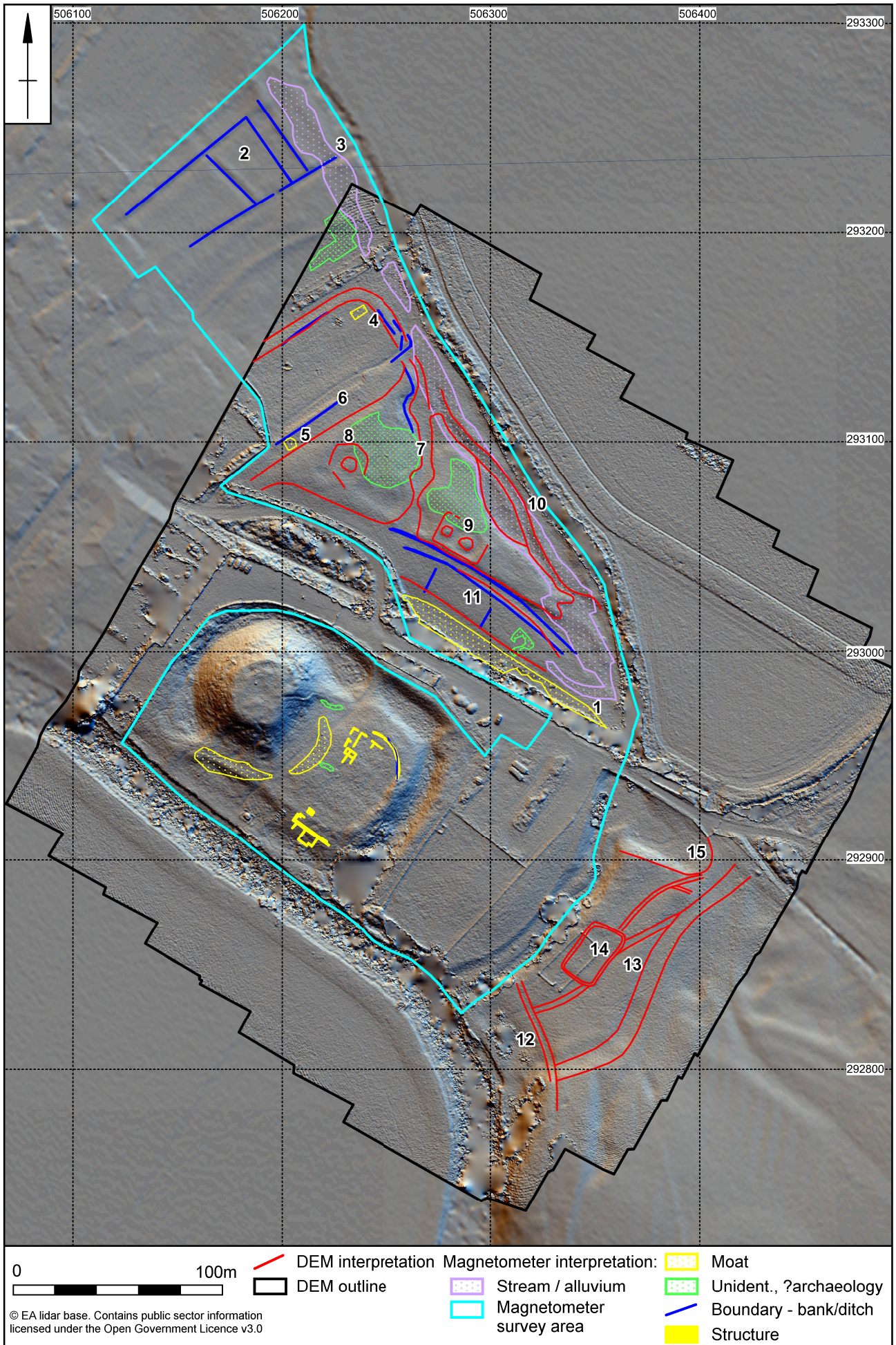
A further range of buildings has been located by both GPR and resistivity surveys immediately to the south of the motte (Fig 15 [15]). This structure also appears to post-date the infilling of the motte moat. While not all the plan has been identified the building has two rooms, the southern of which appears to have been provided with an external porch with an entrance 1.7m wide.

4.2 Moated outer courts

Part of the outer ditch immediately north of the motte and inner bailey was visible from both aerial and magnetometer surveys, though tree cover prevented full investigation (Fig 16 [1]). The outer edge of the moat is located adjacent in the northern field close to the current farm track. The survey has extended the length of the moat from that shown by the Royal Commission which is otherwise accurately located (RCHM 1975, fig 54).

The aerial survey showed the eastern outer court as virtually flat and without earthworks or other historic features. All three geophysical survey techniques were applied within the area which was described in the 1625 survey as old orchard or garden. The GPR survey focussed on the northern half of the court including the line of the former road to Warmington which is now formed by a modern track. The magnetometer survey was more extensive, and the resistivity survey extended the survey to the edge of the Willow Brook. The storage of modern farm machinery prevented full investigation in some locations.

No clearly defined anomalies have been found from any of the surveys even in those areas that were not obscured by modern disturbance. Other than recent services along the southern edge of the track, the GPR results recorded two areas of reflections which lacked coherent structure making interpretation uncertain (Figs 22 and 23). All the magnetometer anomalies probably relate to metal items including machinery and fences. A single area of high reading identified in the resistivity survey is also of uncertain cause (Figs 27 and 28).



Scale 1: 2500

Interpretation of digital elevation model and magnetometer survey in adjacent areas north and east of the castle

Fig 16

4.3 Adjacent areas to the north of the castle

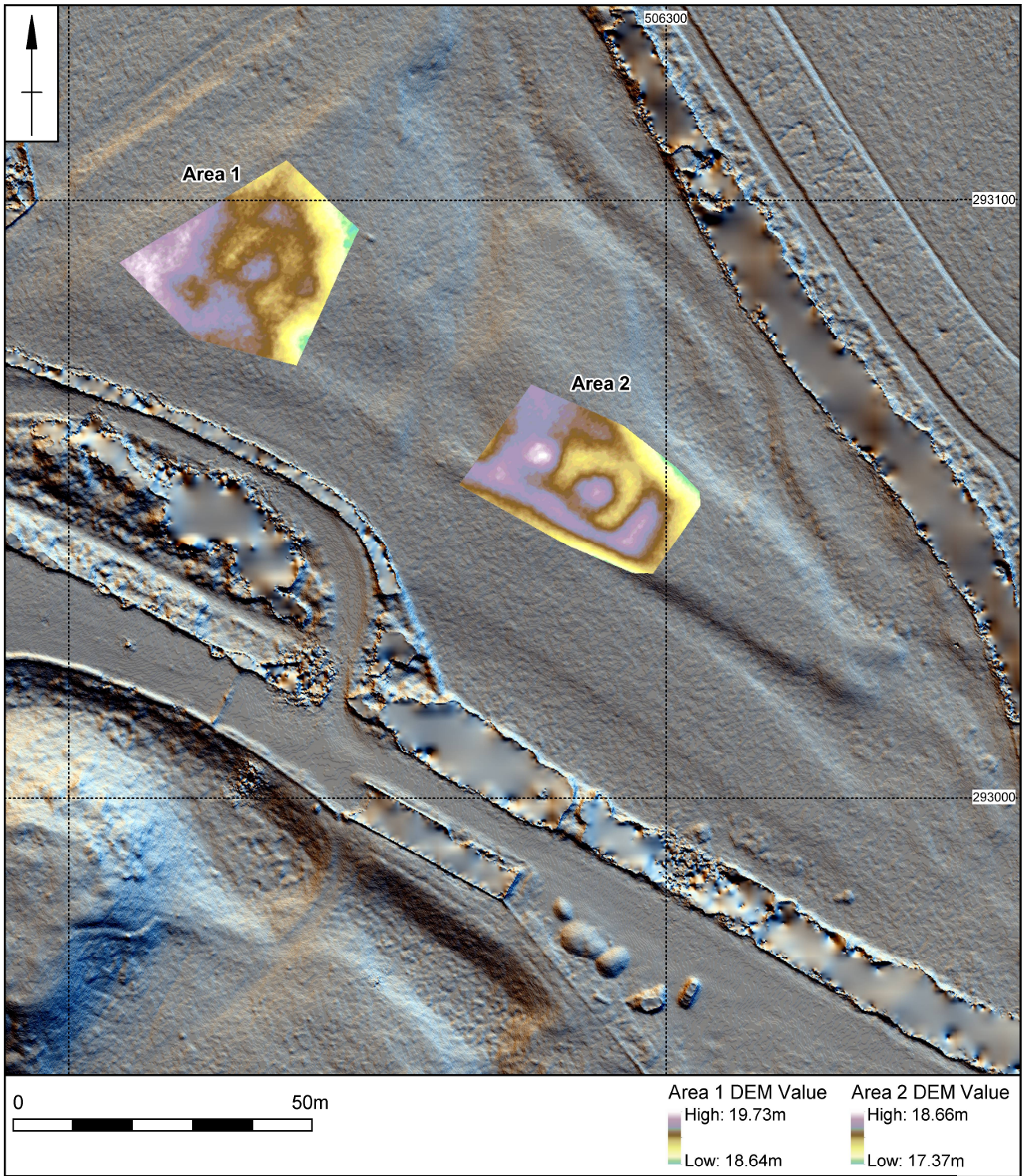
A magnetometer survey was undertaken covering the whole of the field to the north of the castle while aerial survey was limited to the southern part. The remainder of the field is shown using less detailed LiDAR image from the Environment Agency (<https://environment.data.gov.uk/> accessed on 13 December 2018; Fig 16). The field is well-grazed pasture which facilitated the survey and is bounded to the north-east by Willow Brook (Figs 12 and 16). The stream runs from the north and curves to form the outer ditch of the castle and thence into the River Nene. Thus, the southern part of the field is triangular. Across the stream is a large arable field with no trace of earthworks.

The results may be divided into two areas. To the north the magnetometer survey identified parts of the rear of three tenements relating to properties fronting onto the main street and clearly depicted on the various eighteenth and nineteenth-century estate maps. The present northern field boundary may have been repositioned and the area subdivided at some stage (Fig 16 [2]). High magnetic readings along the edge of Willow Brook may indicate the presence of an infilled leat or perhaps part of a millpond (Fig 16 [3]) which lead to indistinct anomalies immediately to the rear of the New Inn that could relate to the watermill shown in a similar location on the 1716 estate map though it was not visible either through aerial survey or during the associated walkover survey (Figs 2 and 6, No 4). To the south of the possible mill the water course appears to join Willow Brook. The lane leading from the main street to the mill is not visible due to disturbance caused by ferrous debris. Two other anomalies measuring 7m by 3.7m and 5m by 4.8m could denote the location of possible structures of uncertain purpose (Fig 16 [4] and [5]).

Immediately to the south lie the low earthwork banks of a rectangular close with rounded corners which stop short of the stream. Elements of this close were also identified in the magnetometer survey. To the south-east the boundary to the close is formed by a scarp with higher ground beyond. The relationship at this point is uncertain but the boundary could have been terraced into a natural rise in ground level or cut into an existing earthwork. This close is visible on the 1716 and 1807 estate maps as well as the 1814 Ordnance Survey Surveyors map (Figs 6, 8 and 9). Cutting through the close is a shallow ditch which forms the south-eastern side of a later enclosure that extended to the stream (Fig 16 [6]). The other side of this later enclosure is visible just to the north of the close. This enclosure is shown on the Estate Map of 1841 (Fig 10).

To the south-east of the close, in the southern part of the field, the land rises to form an irregular-shaped feature which follows the same triangular shape as the modern hedge boundaries. The sides are steep particularly along its southern edge and the feature is bisected by a narrow cutting thereby creating two irregular areas of raised ground (Fig 16 [7]). If the cutting represents a routeway, and if projected south-ward it is aligned with the modern crossing of the outer moat and thence to the modern causeway across in to the inner bailey of the castle.

It is uncertain how much of the feature is formed by cutting into a natural rise or whether it was created by dumping of soil. The magnetometer survey shows some limited disturbance on the top of the two rises, but the remainder of area has relatively even data, to the extent that the triangular shape appears to be defined by features to either side, thereby supporting the probability that area is natural ground (Fig 24). On top of the feature are two prominent earthworks indicating the probably location of the wall foundations for small buildings measuring 7m by 5.4m and 7.2m by 6m (Figs 16 [8-9] and 17). The southern building had a smaller rectangular annex (4.3m by 4.2m) to the northwest. The magnetometer survey only recorded subtle and uninformative anomalies over these structures. Their function is uncertain, but one at least could be a dovecot (Oetgen 2002, 26).



Scale 1: 1000 Detail of digital elevation model showing building earthworks in north field Fig 17

Between the feature and the stream is a sinuous hollow which is also reflected in the magnetometer data and is probably an abandoned channel of the Willow Brook (Fig 16 [10]). The feature continues to retain surface water during wet weather (Fig 3). Alternatively, this location coincides with the route of the back lane shown on the 1640 and 1716 maps. On the castle side of the rising ground is a steep slope which may have been in part created as a hollow way some 4.3m wide. This would have allowed traffic to bypass the outer courts of the castle before returning to the main street near the New Inn as suggested by the map of 1640 (Figs 5 and 16 [11]). The magnetometer survey has further defined the hollow way and short lengths of ditch between it and the outer moat which may represent former property boundaries. There is no surface evidence or magnetometer data to suggest the presence within the field of the 'Great Pond' described in the 1625 survey and shown in the Royal Commission interpretation plan (RCHM 1975, fig 55).

4.4 Adjacent areas to the east of the castle

To the south-east on the opposite bank of the Willow Brook from the castle aerial survey recorded a series of earthworks which extend from the river to the modern track (Figs 1 and 16). The features may form part of the boundary to Little Park which includes a substantial bank and ditch that have been recorded along the edge of the floodplain (Oetgen 2002, 27). Alternatively, they could have developed as hollow ways where a route running beside the river turned to join the main road from Warmington to Fotheringhay as depicted on the 1640-map (Figs 5 and 16 [12-13]). In this case the alternative routes may have been created when one or other became impassable in wet conditions. The hollow ways converge near the main route close to the bridge over the Willow Brook to avoid an area of low ground which is shown on the 1716 estate map and Ordnance Survey Surveyors map as a pond (Figs 5, 6 and 16 [15]). The feature still retains surface water following wet weather (Fig 4). While its dimensions are only 50m by 27m this pond might be the 'Great Pond' described in the 1625 survey. Overlying two of the hollow ways is a small rectangular enclosure with rounded corners defined by a low earthen bank and measuring 27.4m by 15.1m (Fig 16 [14]).

5 DISCUSSION

If the map of c1640 provides a clear illustration of the layout of the castle at that time, it depicts the main buildings as forming a quadrangle around the curtain walls of the inner bailey. It is possible that this design, though modified later, was created by Edmund Langley in the years following his acquisition of the castle in 1377. The plan resembles near contemporary northern castles such as those at Lumley and Bolton, though there is no evidence for substantial corner towers at Fotheringhay suggesting a greater emphasis on the residential character of the buildings (Anthony Emery *pers comm* and Emery 2000, 239-40).

The structure shown on the 1640 map is not confirmed by the geophysical survey evidence which has identified a range of free-standing buildings, together with ancillary structures, within the inner bailey. The northern building of the range appears to have been a single room which could have served as a hall with smaller chambers to the west, while the southern building which was divided into three rooms may have provided accommodation. The scale of the buildings and the presence of the linking structure with external corridors suggests some sophistication and status, albeit with an irregular layout.

It is difficult to reconcile the map and survey evidence. It is possible that the cartographer who drew the map of Cliffe Bailwick was inaccurate in his depiction of the castle as elements of the image are clearly foreshortened and misplaced. However, the representation of the church and the position and shape of the Fetterlocks tower

on the motte does suggest some attention to detail. An alternative explanation could be that the free-standing buildings were constructed after the demolition of the castle in the late seventeenth century. If so, the wall and external structure demarcating the southern side of the bailey as published by Bridges could form part of this phase. In this case the earlier foundations of the principal buildings of the medieval castle must have been so thoroughly removed to leave little trace in the geophysical surveys. However, no documentary evidence has yet been found to support the construction of these substantial buildings. The buildings would have been short-lived as they are not shown on the estate map of 1716 nor mentioned by county historians such as John Bridges (1666–1724; Bridges 1791) and John Morton (1671-1726; Morton 1712). The geophysical surveys suggest that the northern building of the range may have undergone a succession of phases which would perhaps be more consistent with a longer timescale.

As the building foundations identified cannot be dated, it is possible that they represent an earlier phase of castle construction than those depicted in the 1640 illustration, though in that case their survival but not those of the later buildings is difficult to explain. Targeted excavation to provide dating evidence is probably the only means of resolving the issue.

The GPR survey has identified the foundations of the tower on top of the motte. This multi-angular structure with a flat side facing the inner bailey seems to match the various descriptions of the Fetterlocks tower. The remains as surveyed represent a single phase of construction, but it is uncertain if an earlier tower was simply refurbished by Edmund Langley such as Bishop Hatfield's fourteenth rebuilding of Durham Castle (Emery 1996, 76) or if any earlier remains were swept away during these works.

Investigations of the eastern outer court of the castle have not identified any clear evidence for buildings or other structures. Although all three surveys were partially affected by the remains of the recent caravan park and the presence of farm machinery which prevented full coverage, this open aspect is in keeping with the use of the area as gardens and orchard.

The northern part of the field to the north of the castle is typical of the rear of village tenements that are defined by ditches to create rectangular plots. The surviving earthworks probably date to the nineteenth century but could well have medieval antecedents. The raised ground to the south is more difficult to interpret but probably forms a natural rise with its long sides scarped by hollow ways or, to the north by stream channels. There is no evidence that the rise was used as an outwork or gun platform to the castle or indeed as gardens as suggested by the Conservation Plan (Oetgen 2002, 26). It is possible that the hollow way that bisects the rise may have allowed visitors to approach the castle from the north via the back lane.

To the east of Willow Brook earthworks suggest that there was a series of hollow ways linking a route along the river bank to the former road to Warmington. The Great Pond mentioned in the 1625 Survey may have also been identified close to where the road from Warmington would have crossed the brook.

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MOLA

9th May 2019

7 APPENDICES

Appendix 1: Aerial survey methodology

The aerial photographic survey was carried out using a DJI Phantom 3 Professional quadcopter in accordance with the MOLA Operations Manual for the aircraft (Rauxloh 2018). The survey was carried out by a Pilot in Command (PIC), who was a BNUC-S qualified SUA pilot responsible for the safe execution of the flying required. The PIC was aided by several observers to help monitor public ingress into the area of operation.

Shortly prior to the survey the PIC carried out a detailed risk assessment using both relatively static (e.g. airspace demarcation) and dynamic resources including an assessment of Notices to Airman (NoTAMs) which give notice of short duration unusual flying permissions.

Additionally, the potential of the survey to compromise the separation distances stated in the Permission for Commercial Operations (PfCO) was assessed. The SUA was not flown:

- At a height exceeding 400 feet above ground level
- Beyond the visual range of the PIC, or a maximum range of 500 metres
- Directly over or within 50m of any person, vessel, vehicle or structure that is not under the control of the PIC

The latter was mitigated by gaining permission from owners of adjacent dwellings but in the event the survey did not overfly their homes.

The survey was carried out using a DJI Phantom 3 Pro with a camera capable of taking 12 megapixel photographs and 4K video. The aircraft was flown in a grid pattern over the survey area taking overlapping images of the site. Most of these flights were carried out by the aircraft navigating between 3D GPS waypoints. These flight plans were created, uploaded and monitored throughout by the PIC.

Prior to the survey ground control points (GCPs) were evenly distributed over the area of interest. They comprised 0.8m vinyl squares, pegged to the ground. Their locations were measured using survey grade differential GPS providing an expected absolute accuracy of 20-30mm in XY and 50-60mm in Z.

The results of the survey were processed in digital photogrammetric software to create a geo referenced 3D model from which a Digital Elevation Model (DEM) and 2D photo orthomosaic were created (Fig 12). Further metric outputs were generated by geo-processing of these raw products, including contour plans, hill shading and clipping of the DEM to allow for better height differentiation of specific areas. The resultant plots show the castle and its environs in detail except where tree cover masked the terrain, creating light uniform areas particularly the hedged field boundary between the former road to Warmington and the northern field, as well as along the riverbank. A similar effect has occurred in the depiction of the former Castle Farm barns, now modern dwellings.

Appendix 2: Ground Penetrating Radar (GPR) survey methodology

The GPR survey investigated the motte, inner bailey and part of the outer court to the south-east (Fig 18). It collected data using a Sensors & Software Smartcart Noggin 250 plus with antenna range of 3dB bandwidth from 125MHz to 375MHz. The survey was conducted with a track spacing of 0.5m and a sample spacing of 50mm. The survey was undertaken by 'push mode' using a guide rope with base line of marked grid. The baseline and end points of the grid were accurately located to Ordnance

Survey National Grid using a Leica VIVA Global Positioning System (GPS) using Smartnet real-time corrections. The work was conducted under OFCOM Licence Number 0839975/1.

The data was initially processed Michael de Bootman and further enhanced by Tim Dennis using his own software to produce a series of timeslice plans of below ground remains at different depths, thereby allowing the differentiation between structural remains and demolition rubble. A selection of the results are shown in Figures 21 and 22 and the combined interpretation as Figure 23. Within the inner bailey the GPR readings at a shallow depth of 0.375m has mostly identified the route of modern-day paths from the causeway entrance to moorings at the river bank and up the side of the motte where timber-revetted steps have been provided (Fig 21). A less prominent path links the two main paths at the base of the motte. These anomalies probably simply reflect soil compaction caused by visitors over the years.

Appendix 3: Magnetometer survey methodology

The survey was undertaken with a Bartington magnetometer cart and covered the inner bailey, eastern outer court and the entire field to the north (Fig 20). The cart is a two-wheeled, lightweight sensor platform designed to be pushed by hand. It was configured to carry six vertically-mounted Bartington Grad601 magnetic sensor tubes, spaced at half-metre intervals along a bar aligned crossways to the direction of travel, with a Leica Geosystems Viva GPS antenna mounted on the central axis, 1.02m astern of the sensors. The magnetic sensors each output data at a rate of eight readings per second and the GPS antenna output NMEA format data (GGA messages) at a rate of one position every second. These data streams were fed into a laptop computer where they were compiled into a single raw data file by MultiGrad601 logging software specifically developed for that purpose.

The cart was propelled along straight and parallel traverses across the survey area, with data logging being manually toggled on and off at the start and end of each traverse to avoid the collection of spurious data whilst turning. Traverse ends were marked with ranging poles to aid even coverage, and the evenness of coverage was further checked by monitoring the positional trace plotted in real time by the MultiGrad601 logging software. The average speed of coverage was c 2m/s and the effective data resolution thus approximated to 0.25m x 0.50m.

The raw survey data was initially processed with MLGrad601 software, which calculated an actual UTM co-ordinate for each data point by interpolating the GPS readings and applying offset corrections based on the array geometry and calculated heading direction. This produced an output file in XYZ format which could be imported into TerraSurveyor software for data visualisation and further processing.

The raw XYZ data exhibited striping caused by slight mis-matches in the calibration of the individual magnetic sensors. This was removed in TerraSurveyor by applying the median destripe function to runs of data from each sensor, using, where necessary, manually inserted line-breaks to control the function's effect. No other processing functions were applied.

The processed data is presented in this report as greyscale raster plots (range +20nT to -20nT / black to white), rotated and scaled for display against the Ordnance Survey base mapping (Fig 24). An interpretive overlay is presented in Figure 25 and a plot of the unprocessed survey data in Figure 26. Parts of the eastern outer court and the moat around the motte and inner bailey contained large amounts of iron objects which masked the results in these areas. A similar affect was caused by the iron railings around the surviving masonry fragment near the river.

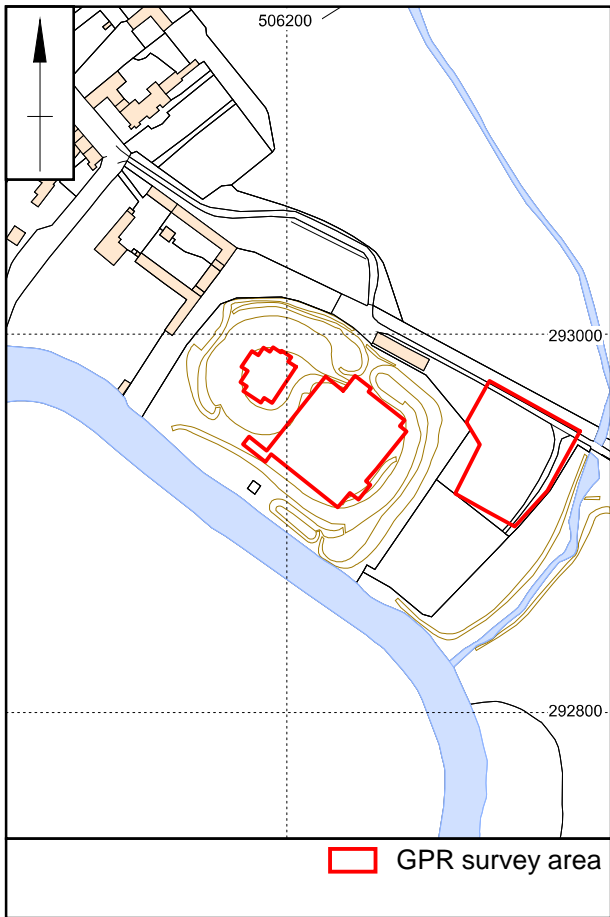
Appendix 4: 1991 Resistivity and Magnetometer surveys methodologies

The 1991 resistivity and magnetometer surveys investigated the top of the motte, the inner bailey and parts of the eastern outer court (Masters 1991, fig 1; Fig 19). The surveys shared a common 20m grid though both techniques were not used for every grid square. The corners of the survey grids were surveyed using tape measures leading to minor inaccuracies of location within the inner bailey, but greater anomalies have been identified in the outer court. The data was analysed, and results processed using a contemporary version of Geoplot to provide dot-density illustrations used in the original report.

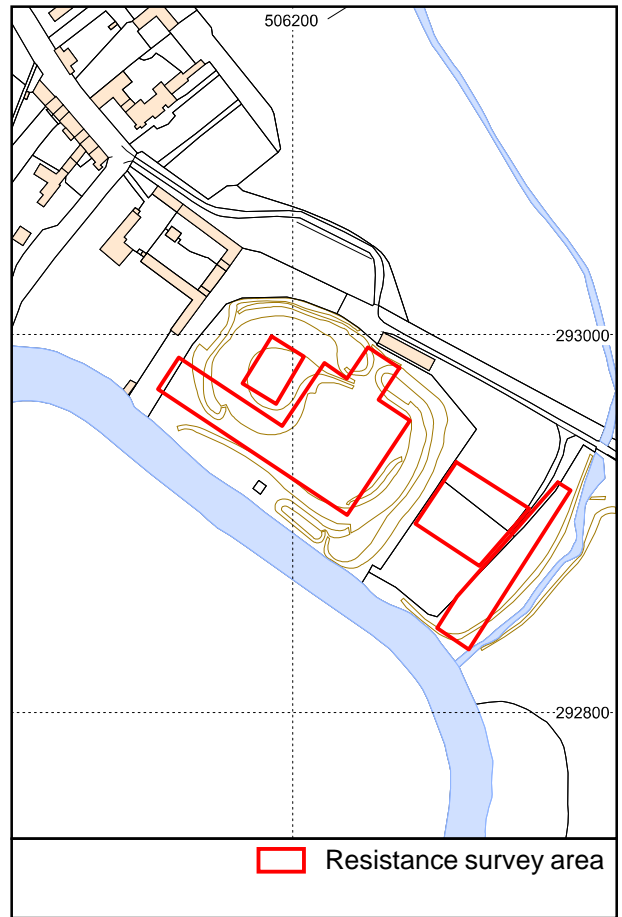
The magnetometer survey was undertaken using a Geoscan FM18 Fluxgate Gradiometer with readings taken at 1m intervals. The new magnetometer survey covers a greater area than the work in 1991 but did not examine the top of the motte. Comparison of the two surveys shows that there was close similarity of results but as may be expected greater detail is present in the recent investigation due to the greater number of data points. The description of the 1991 survey is therefore subsumed into a consideration of the current work.

The resistivity survey was carried out using a Geoscan Research RM15 meter with twin electrode configuration in a mobile probe spacing of 0.5m and individual readings were taken at 1m intervals. The survey of the inner bailey was undertaken in August 1991 but due to the dry soil conditions high contact resistance was noted so the area was resurveyed in October that year when circumstances were more favourable.

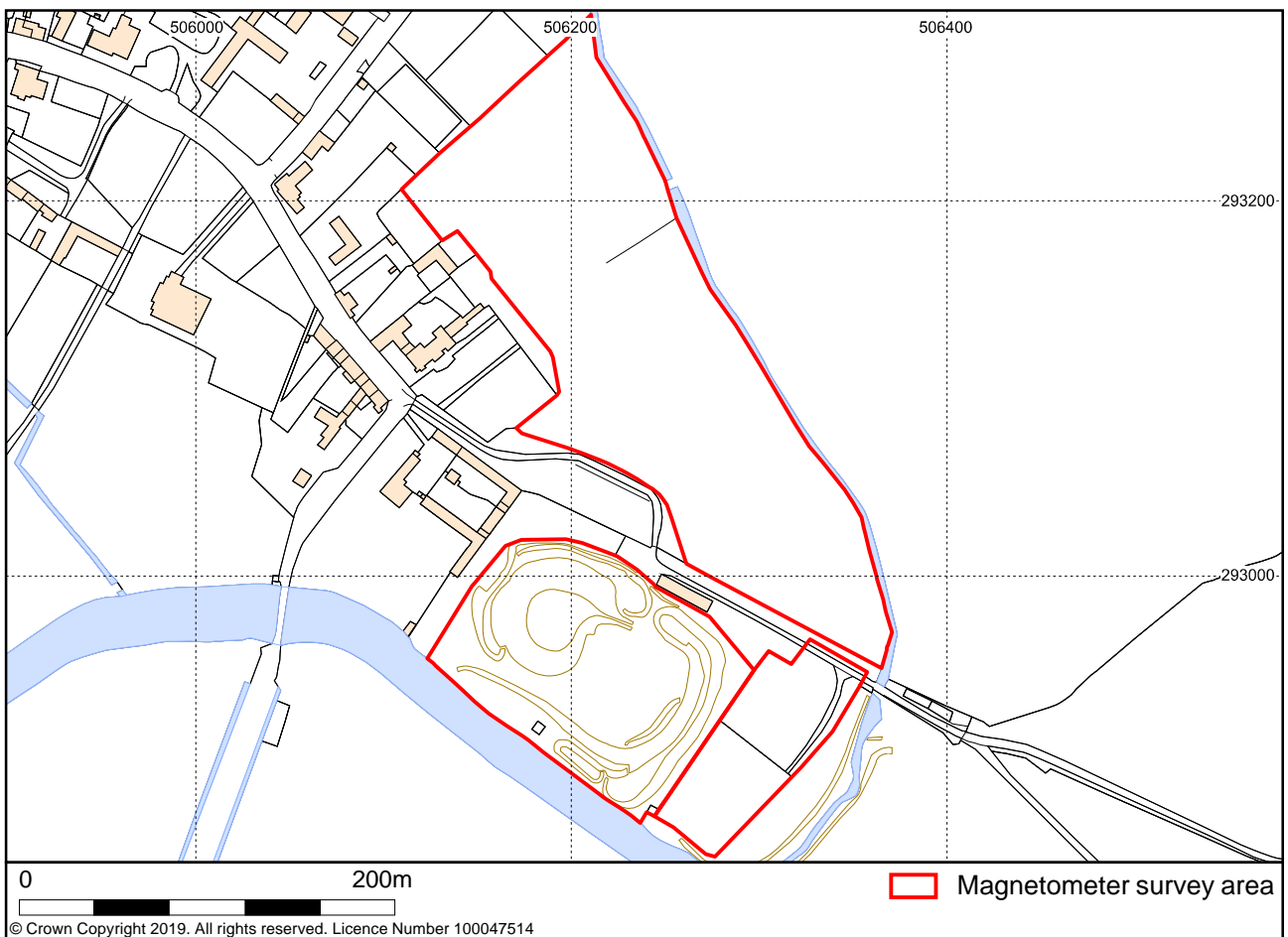
The original results of the survey identified areas of high resistance mostly denoting rubble spreads or hardstanding but also possible wall foundations (Masters 1991, fig 8). The opportunity has been taken within the current work to re-visualise the data, using a greyscale palette which allows for a clearer plot (Fig 27). This has enabled the identification of subtle details including wall foundations which were not apparent in the 1991 plots (Fig 28).



Location plan of GPR survey Fig 18

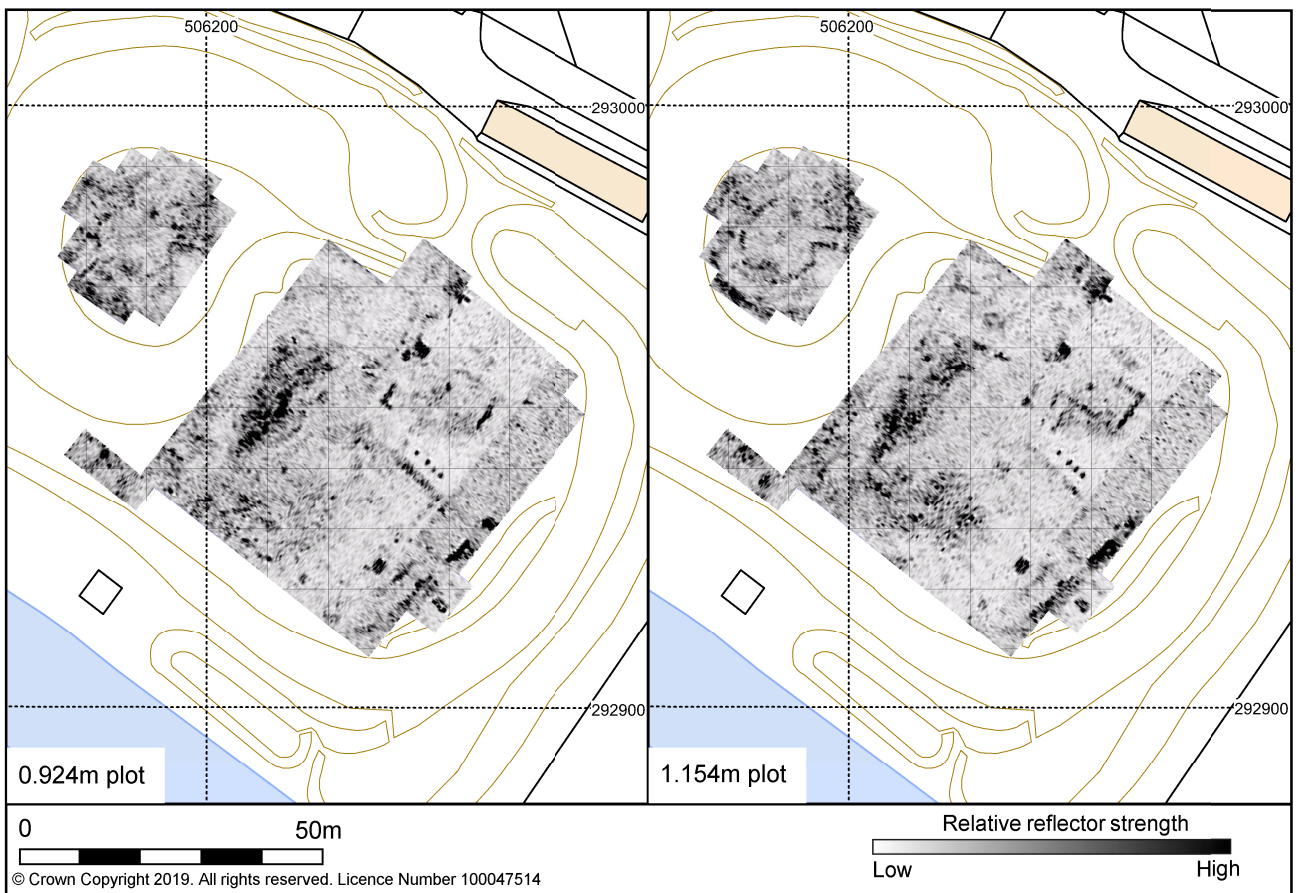
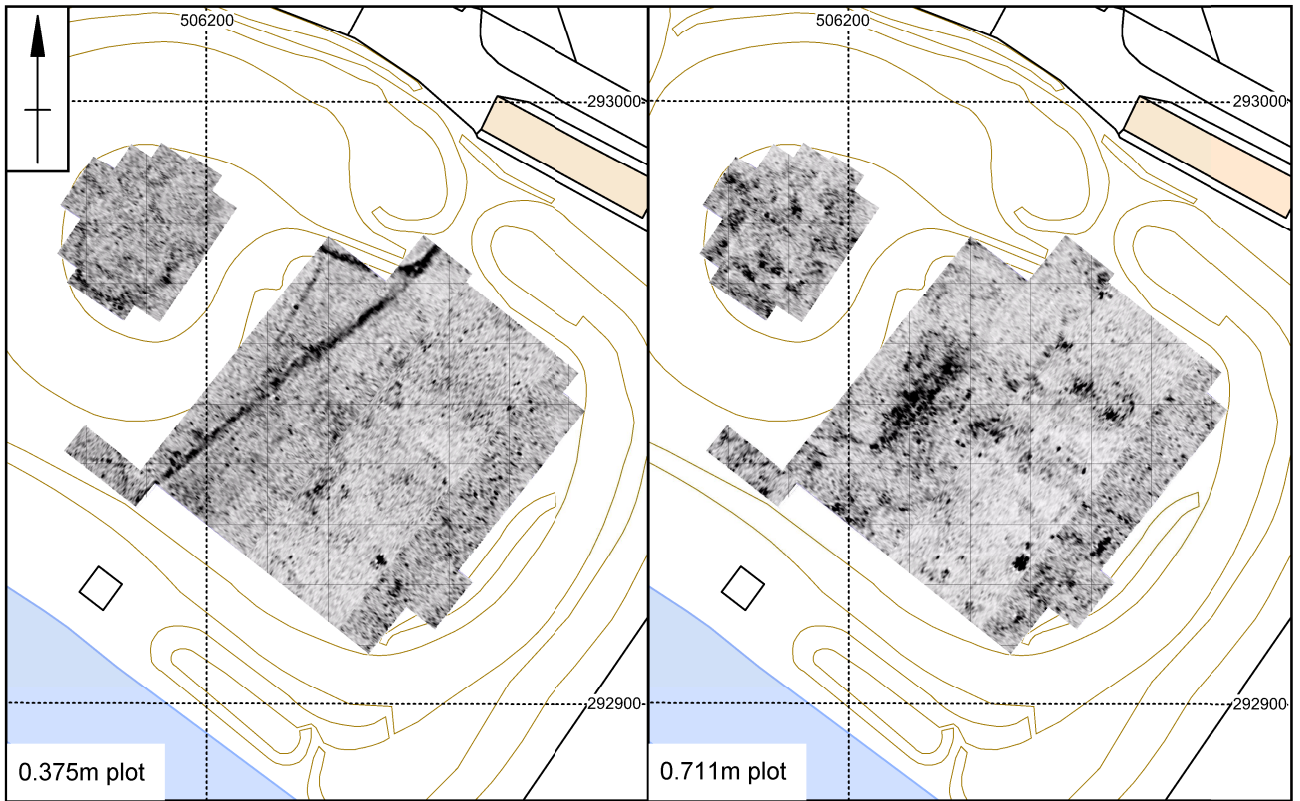


Location plan of resistivity survey Fig 19



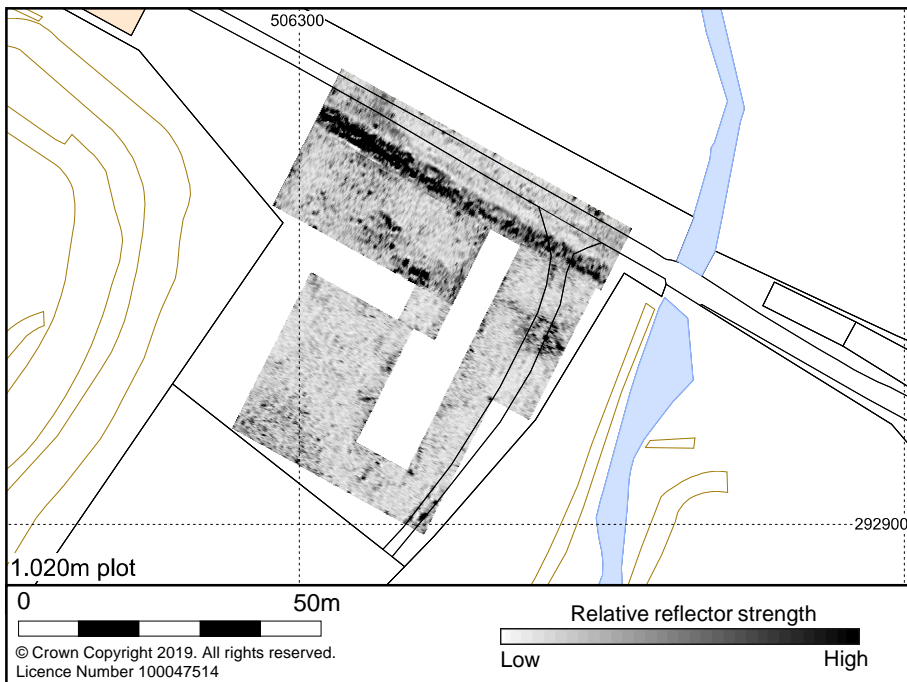
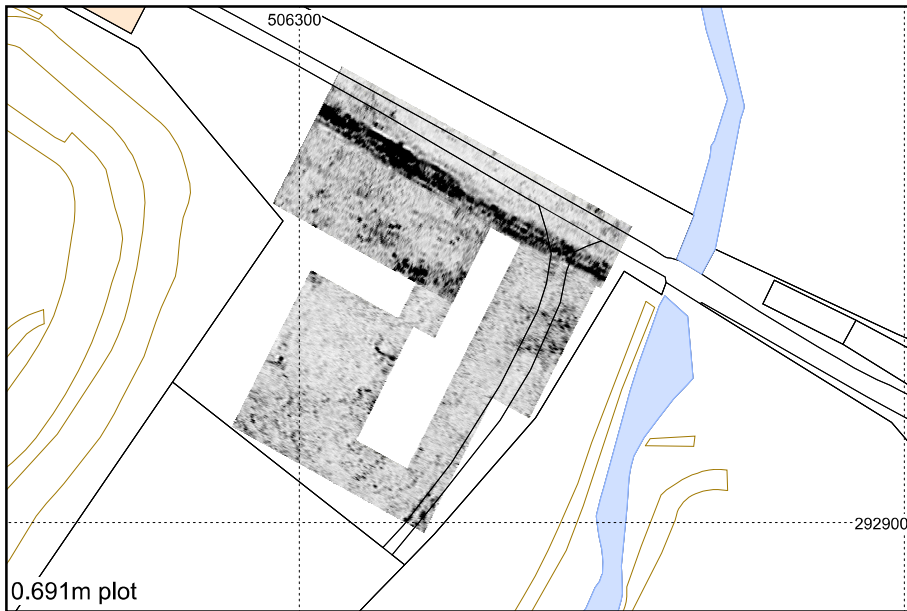
Scale 1: 4000

Location plan of magnetometer survey Fig 20

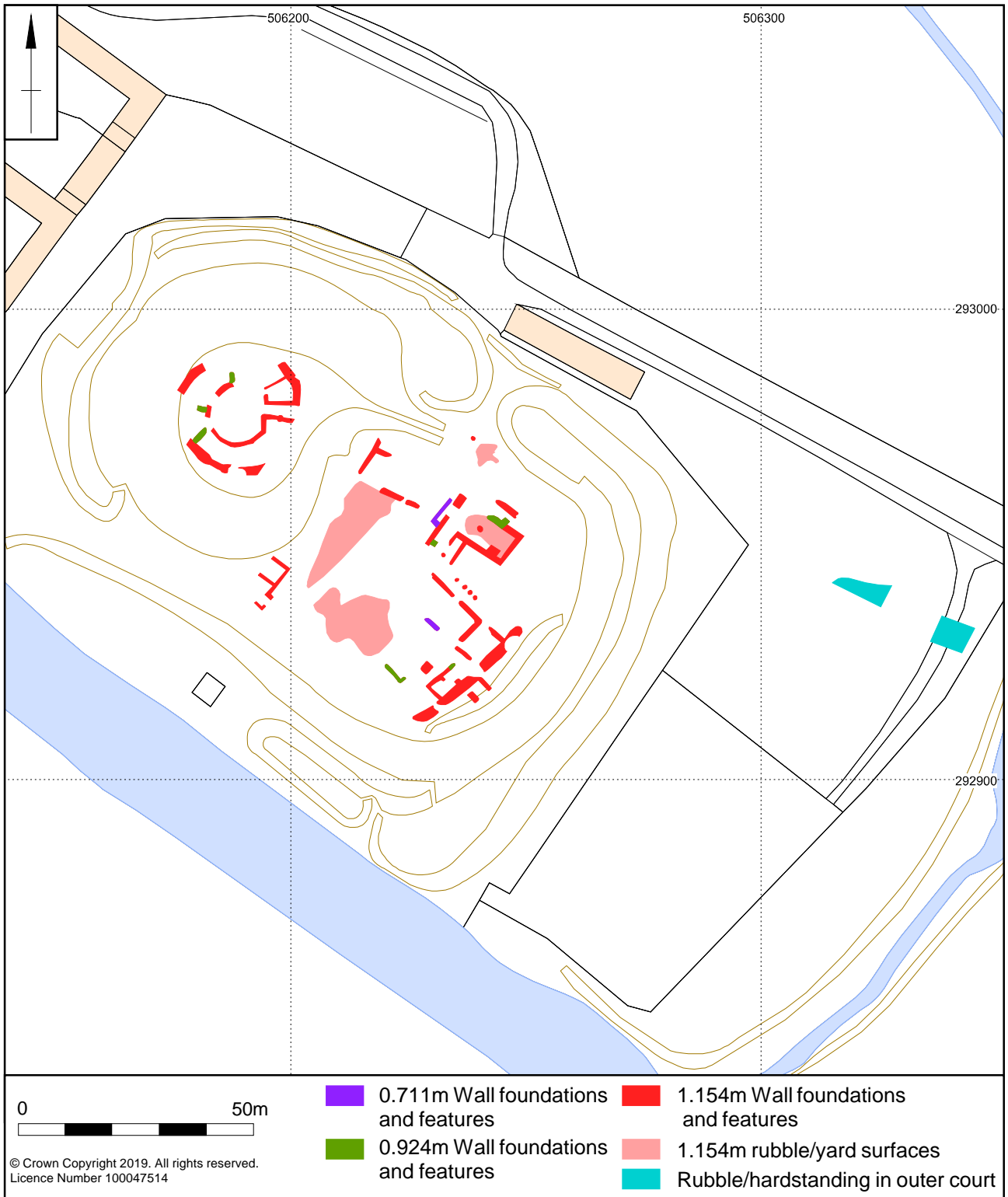


Scale 1:1250

GPR survey results of motte and inner bailey Fig 21

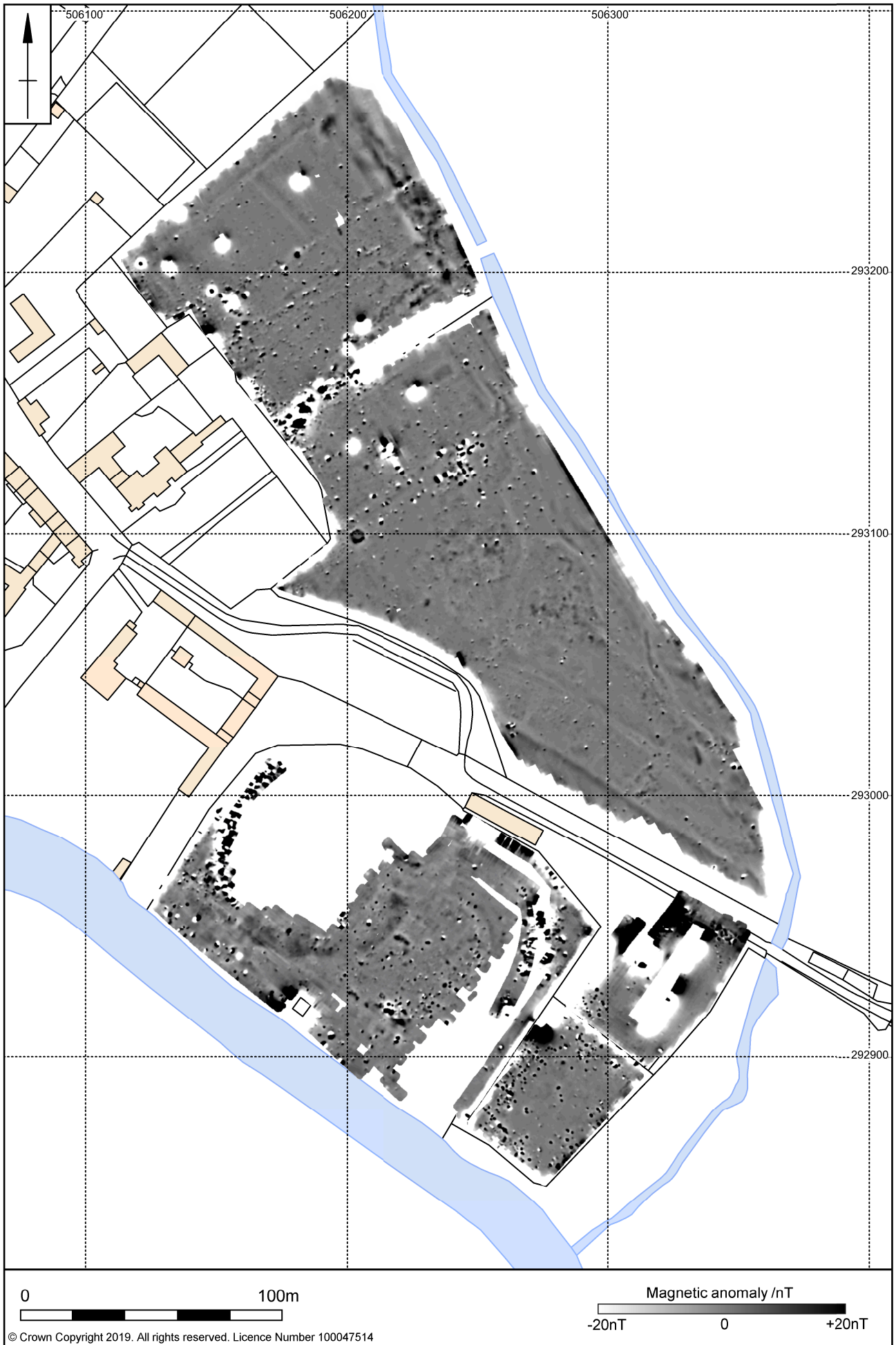


Scale 1:1250 GPR survey results of eastern outer court Fig 22



Scale 1: 1250

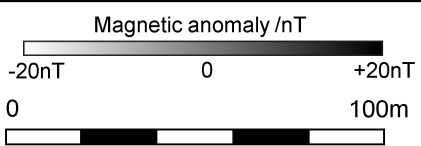
Interpretation of GPR survey Fig 23



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Scale 1: 2000

Magnetometer survey results Fig 24

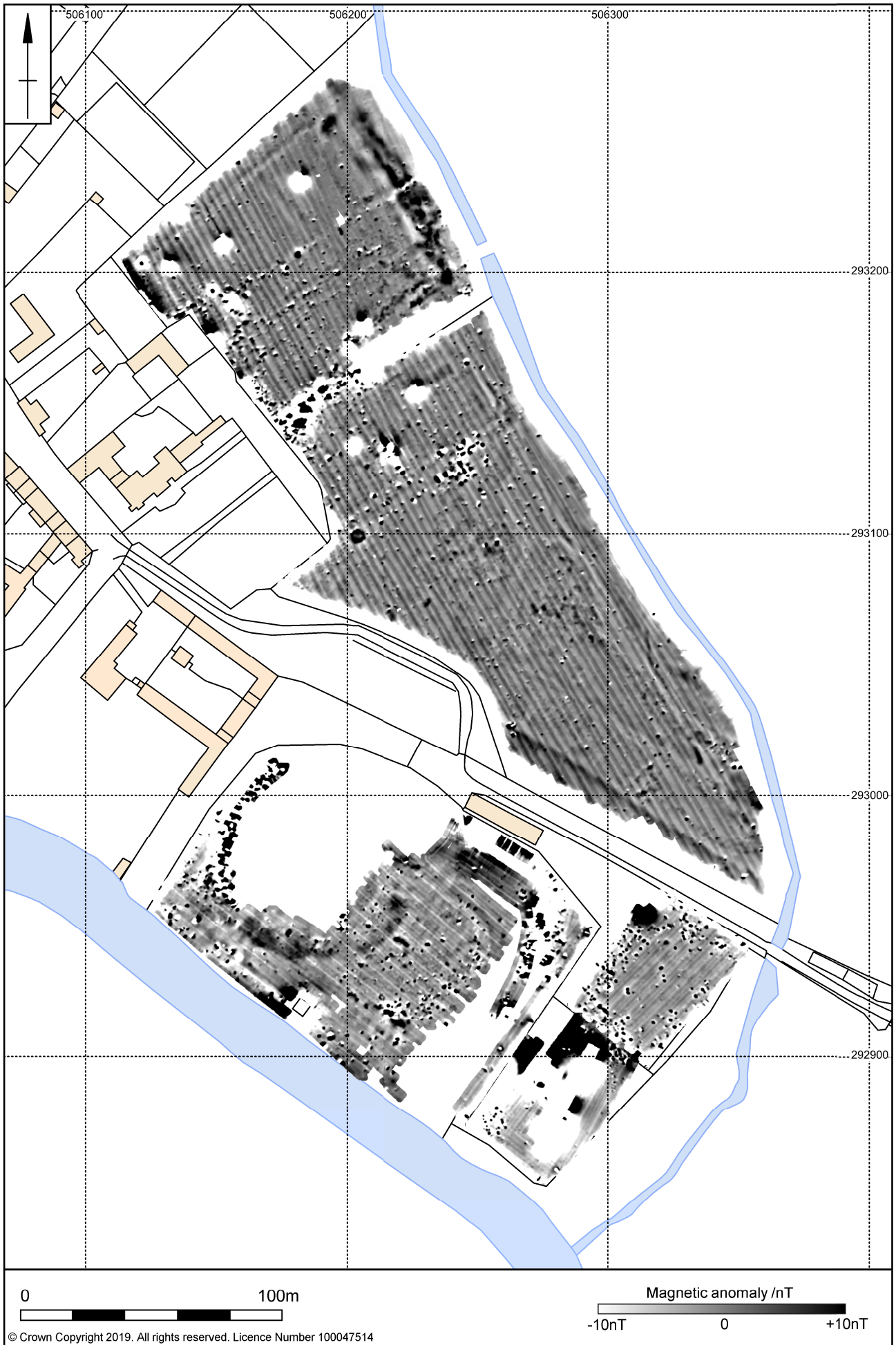


- | | |
|------------------------|---------------------------|
| Structure | Stream / alluvium |
| Moat | Ferrous halo |
| Unident., ?archaeology | Scatter of ferrous debris |
| Boundary - bank/ditch | Ferrous object |

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Scale 1: 2000

Magnetometer survey interpretation Fig 25

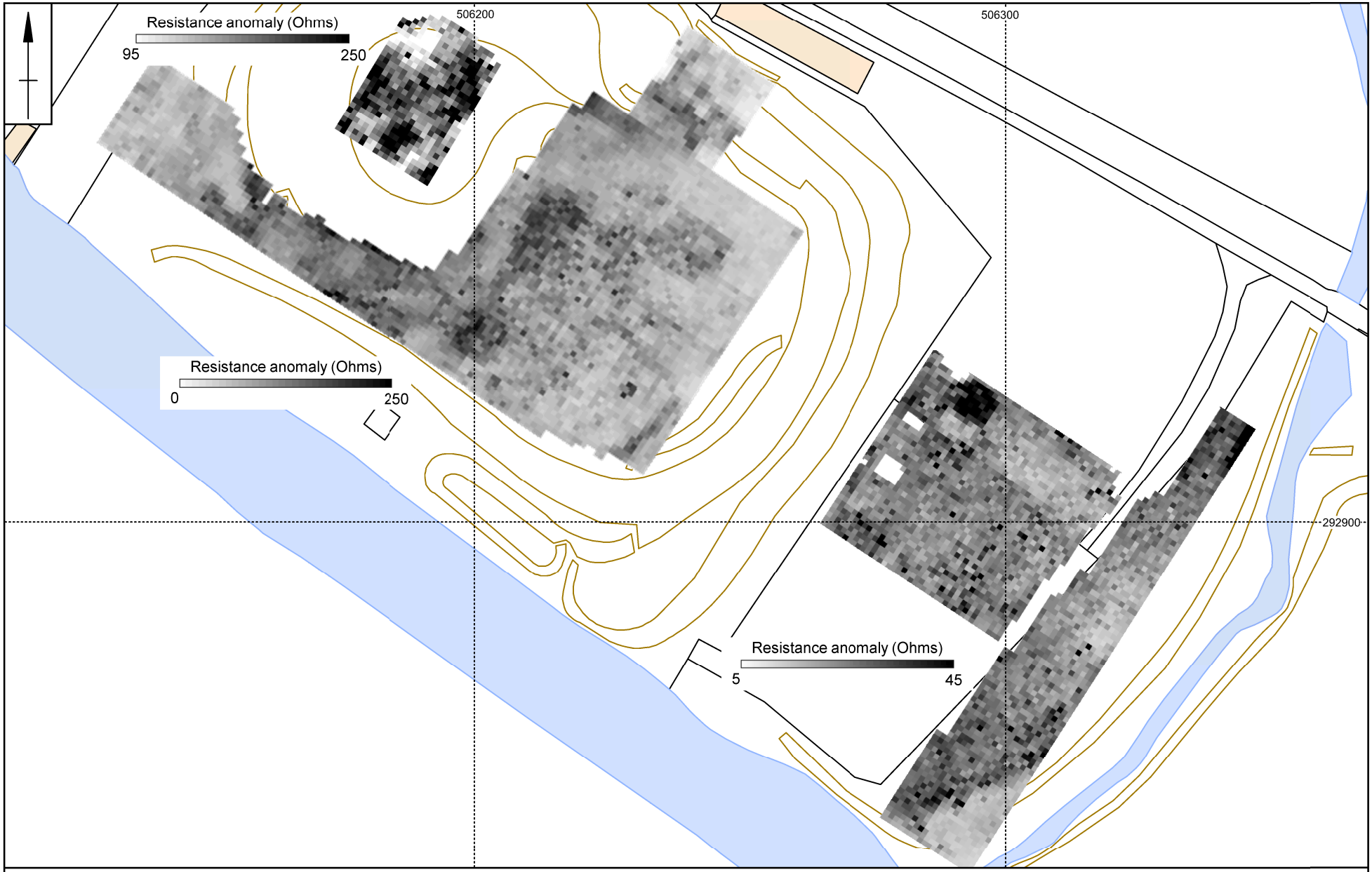


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Scale 1: 2000

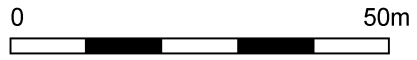
Magnetometer survey raw data Fig 26

Scale 1: 1000

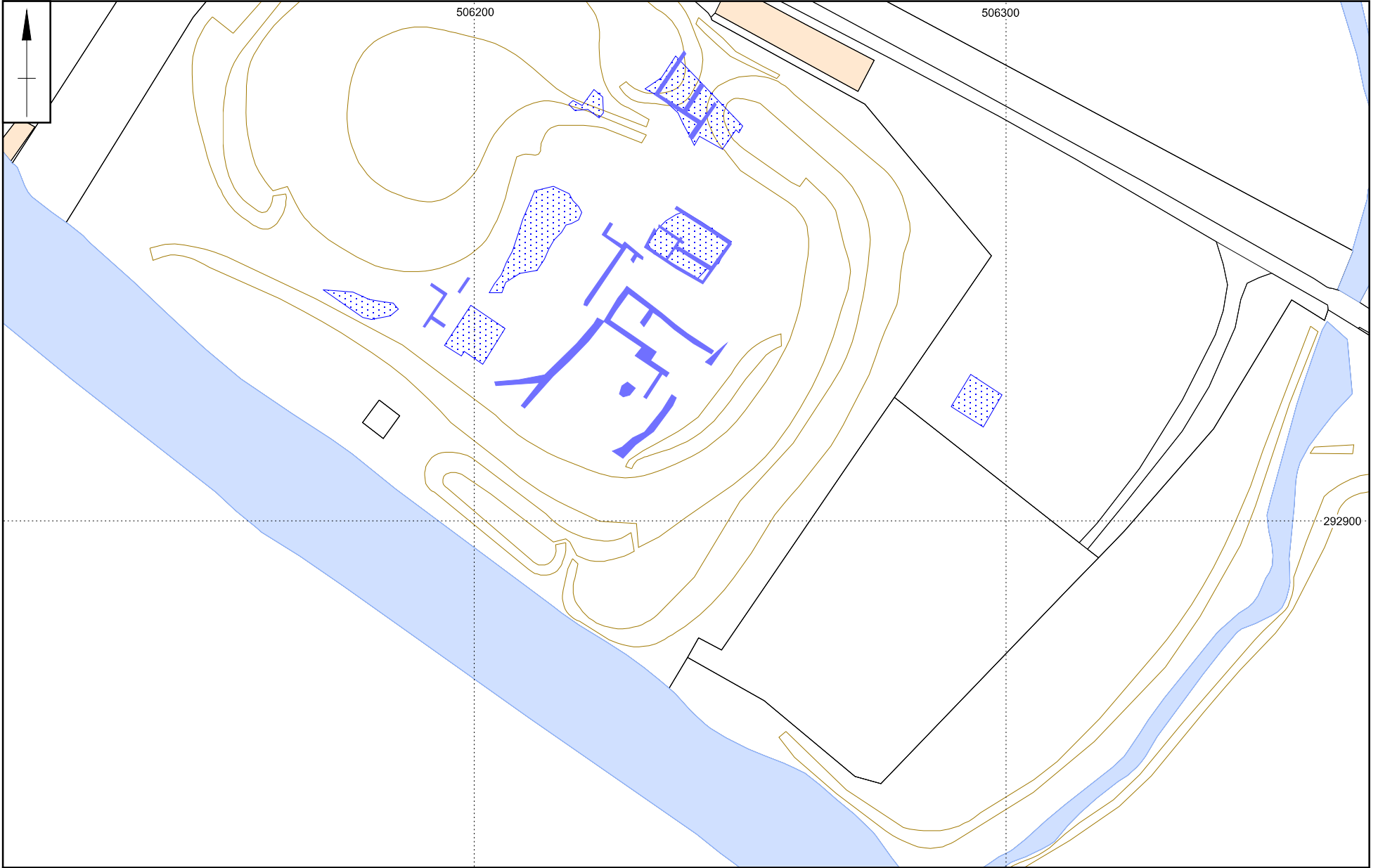


Resistivity survey results

Fig 27



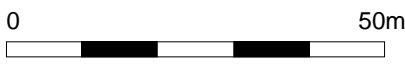
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Scale 1 : 1000

Resistivity survey interpretation

Fig 28



- Rubble/yard surfaces
- Wall foundations and features