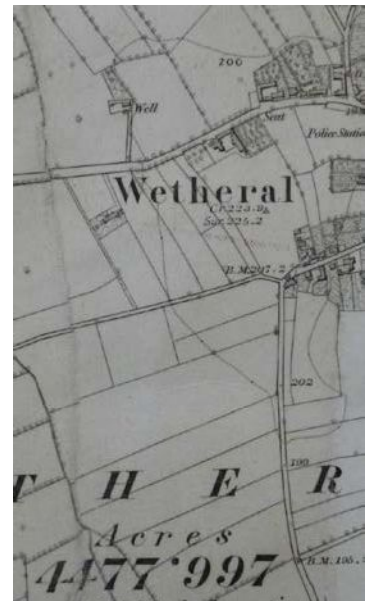


LAND WEST OF STEELE'S BANK, WETHERAL, CARLISLE, CUMBRIA

Archaeological Desk-Based Assessment and Geophysical Survey



Client: The Church Commissioners for England

NGR: 346350 554154 (centre)

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Contents

Illustrations and Tables.....	2
List of Figures.....	2
List of Plates.....	2
List of Tables.....	2
Non-Technical Summary.....	3
Acknowledgements.....	3
1. Introduction.....	4
1.1 Circumstances of the Project.....	4
1.2 Location, Geology, and Topography.....	4
2. Methodology.....	6
2.1 Desk-Based Assessment.....	6
2.2 Site Visit.....	6
2.3 Geophysical Survey.....	6
2.4 Archive.....	6
3. Results.....	7
3.1 Introduction.....	7
3.2 Desk-Based Assessment.....	7
3.3 Map Regression.....	9
3.4 Site Visit.....	10
3.5 Geophysical Survey.....	11
3.6 Conclusion.....	13
4. Site History.....	14
4.1 Introduction.....	14
4.2 Prehistoric Period (c11,000BC – 1 st century AD).....	14
4.3 Romano-British to Early Medieval Period (1 st century AD – 11 th century AD).....	14
4.4 Medieval Period (11 th century AD – 16 th century AD).....	15
4.5 Post-Medieval (16 th century AD – present).....	16
4.6 Previous Archaeological Work.....	16
5. Discussion.....	18
5.1 Introduction.....	18
5.2 Significance.....	18
5.3 Potential for Unknown Archaeological Remains.....	18
5.4 Disturbance.....	19
5.5 Impact.....	19
5.6 Recommendations.....	19
6. Bibliography.....	21
6.1 Primary and Cartographic Sources.....	21

6.2	Secondary Sources	21
6.3	Aerial Photographs	23
	Appendix 1: Site Gazetteer	24
	Appendix 2: Significance Criteria	30
	Appendix 3: Geophysical Survey	31

Illustrations and Tables

List of Figures

Figure 1: Site location	5
Figure 2: Site gazetteer	8
Figure 3: Results of the geophysical survey	12

List of Plates

Plate 1: Extract from the tithe map for Wetheral township (CAC(C) DRC/8/196 1842)	9
Plate 2: Extract from the Ordnance Survey map of 1863	9
Plate 3: Extract from the Ordnance Survey map of 1868	10
Plate 4: Extract from the Ordnance Survey map of 1901	10
Plate 5 (left): View of the properties along Steele's Bank, from the west side of the site	10
Plate 6 (right): General view of the north-west corner of the site from Steele's Bank	10
Plate 7 (left): General view of the west end of the site	11
Plate 8 (right): The sheep pen in the north-west corner	11

List of Tables

Table 1: Summary of sites of archaeological interest within the study area	7
Table 2: Details of the plots within the site as given in the tithe apportionment (CAC(C) DRC/8/196 1842)	9
Table 3: Significance by site	18
Table 4: Degree of potential for unknown archaeological remains by period	19

Non-Technical Summary

As part of pre-planning consultation made by Smiths Gore on behalf of the Church Commissioners for England for a proposed residential development on land west of Steele's Bank, Wetheral, Carlisle, Cumbria, Greenlane Archaeology was commissioned to carry out a desk-based assessment and geophysical survey of the site. This is intended to identify whether there are any known archaeological remains within the site, and what the potential is for as yet unknown archaeological remains to be present. The project was carried out in February 2014; the desk-based assessment, including site visit, was undertaken by Greenlane Archaeology and the geophysical survey by Phase Site Investigations, working as sub-contractors on behalf of Greenlane Archaeology.

The site is situated on the south side of the village of Wetheral, which is historically dominated by the medieval Priory, but is in an area of known prehistoric and Roman remains and potentially also early medieval remains. The Historic Environment Record for the area has records of sites of most periods within the study area. The priory of Wetheral is known to have been established c1100, but Wetheral is seemingly recorded at an earlier date as being on the boundary of the diocese of Hexham, which did not exist after the 9th century, and there are apparently early references to a group of artificial caves known as Constantine's Cells and a holy well dedicated to St Cuthbert, which might also indicate an important early medieval presence in the area. A group of Roman inscriptions near these caves indicate a Roman, probably military, presence in the area, which is in the hinterland of Hadrian's Wall and the important Roman city of Carlisle. The village of Wetheral is at least medieval in origin, although a fragment of Anglian cross was found in the churchyard. It is likely that the village saw relatively little development until the post-medieval period, following the Dissolution and after the coming of the Newcastle-Carlisle railway.

The site visit identified few constraints to further archaeological work, although there is a high level electrical cable running across the west edge of the site area, but no other obvious areas of disturbance within it. The geophysical survey revealed numerous dipolar anomalies and a large area of magnetic disturbance along the east side of the southern edge of the site, probably resulting from modern activity, and areas of ridge and furrow across much of the site. In addition, it revealed a linear feature apparently comprising a parallel pair of anomalies along the east side, broadly parallel to the present road, and a large area of more amorphous linear anomalies across the whole of the northern half of the site. The nature and date of all of these features is uncertain.

In view of the archaeological evidence from the wider area, there is some potential for remains from various periods to be present within the site area. In addition, the linear features identified by the geophysical survey are potentially also of archaeological interest, although a modern origin cannot be ruled out. It is therefore recommended that these be examined through the excavation of archaeological evaluation trenches in order to be certain of their origin and function. This work could be undertaken either in advance of the submission of a planning application or dealt with as a condition on it.

Acknowledgements

Greenlane Archaeology would like to thank The Church Commissioners for England for commissioning the project. Additional thanks are due to Jeremy Parsons, Historic Environment Officer at Cumbria County Council, for approving the project design and for help with accessing the HER, the staff of Cumbria Archive Centre in Carlisle (CAC(C)) for help with accessing their archives.

The project was managed by Dan Elsworth, who also carried out the desk-based assessment and site visit, and wrote the report with Tom Mace, who also produced the illustrations. The geophysical survey was carried out and the associated report produced by Phase Site Investigations, to whom special thanks are due, especially to Mark Whittingham, and the final report was edited by Jo Dawson.

1. Introduction

1.1 Circumstances of the Project

1.1.1 As part of pre-planning consultation made by Smiths Gore on behalf of the Church Commissioners for England (hereafter 'the client') for a proposed residential development on land west of Steele's Bank, Wetheral, Carlisle, Cumbria (NGR 346350 554154 (centre)), Jeremy Parsons, Historic Environment Officer at Cumbria County Council, recommended that a programme of desk-based assessment and geophysical survey be carried out. This was intended to establish at an early stage whether the area was likely to have any known sites of archaeological interest within it or whether there was any potential for as yet unknown sites to be present. In response Greenlane Archaeology produced a project design and following its acceptance by the client and approval by Jeremy Parsons, the work was carried out in February 2014.

1.1.2 The proposed development site comprises an area of 1.66 hectares and is on the south-west edge of the village of Wetheral. It is in an area of known archaeological potential, with crop mark sites of probable prehistoric and Romano-British date in the general area. Wetheral itself is primarily a medieval settlement, although it is potentially recorded in the early medieval period and a previous archaeological investigation of a similar nature to the east revealed features of interest (Greenlane Archaeology 2012b).

1.2 Location, Geology, and Topography

1.2.1 The site occupies an area of relatively level ground, sloping down slightly from north to south, at c60m above sea level (Ordnance Survey 2007) (Figure 1). The main road through Wetheral passes the site to the east and the steep valley of the River Eden is approximately 550m to the east. The solid geology comprises red Permian sandstone of the Penrith group (Moseley 1978, plate 1), with overlying glacial deposits concealing much of the bedrock (Countryside Commission 1998, 40), although it is revealed along the length of the deep gorge containing the River Eden.

1.2.2 The landscape is situated within the Eden Valley, which is primarily dominated by '*improved pasture bounded by mature hedgerows and dry stone walls*' but with areas of arable cultivation also (Countryside Commission 1998, 41). The site is on the south side of the core of the village of Wetheral, with Steele's Bank (the B6263) to the east.

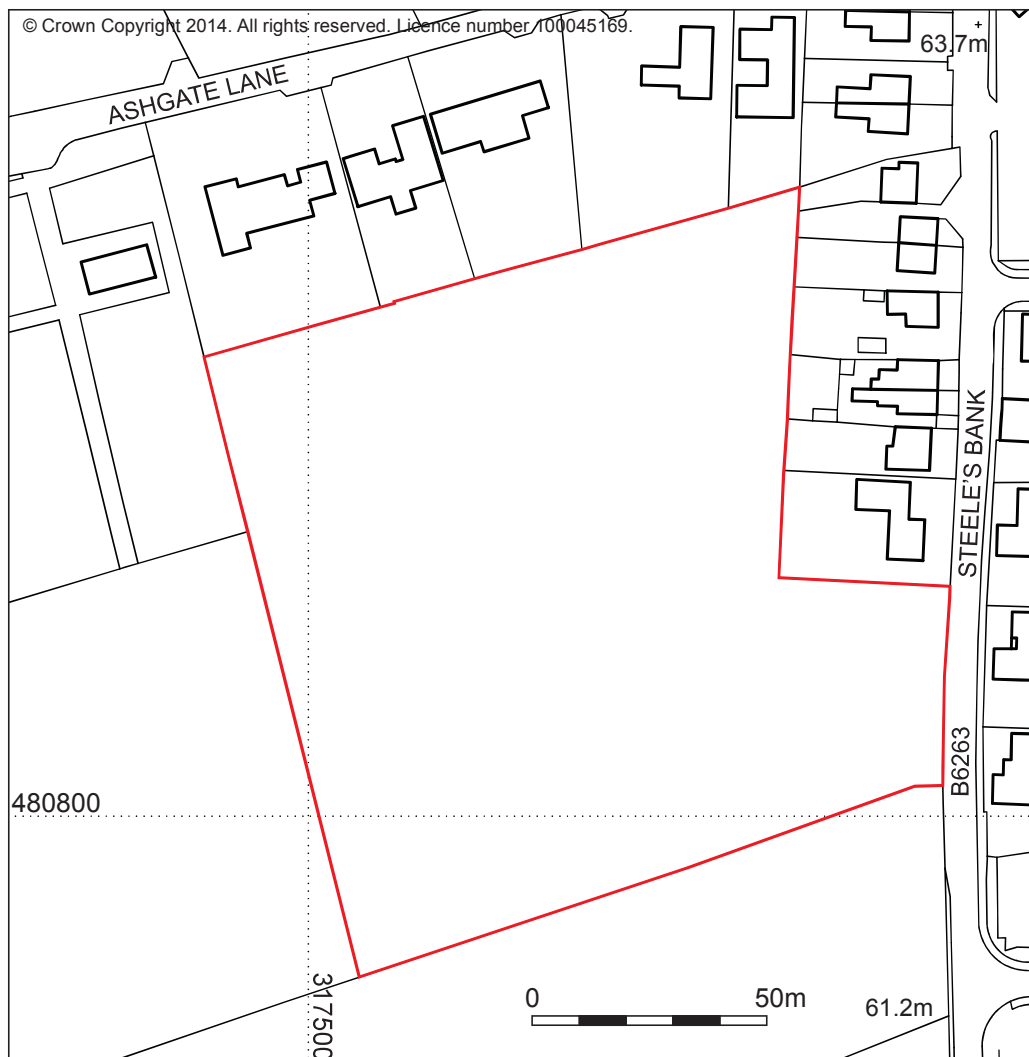
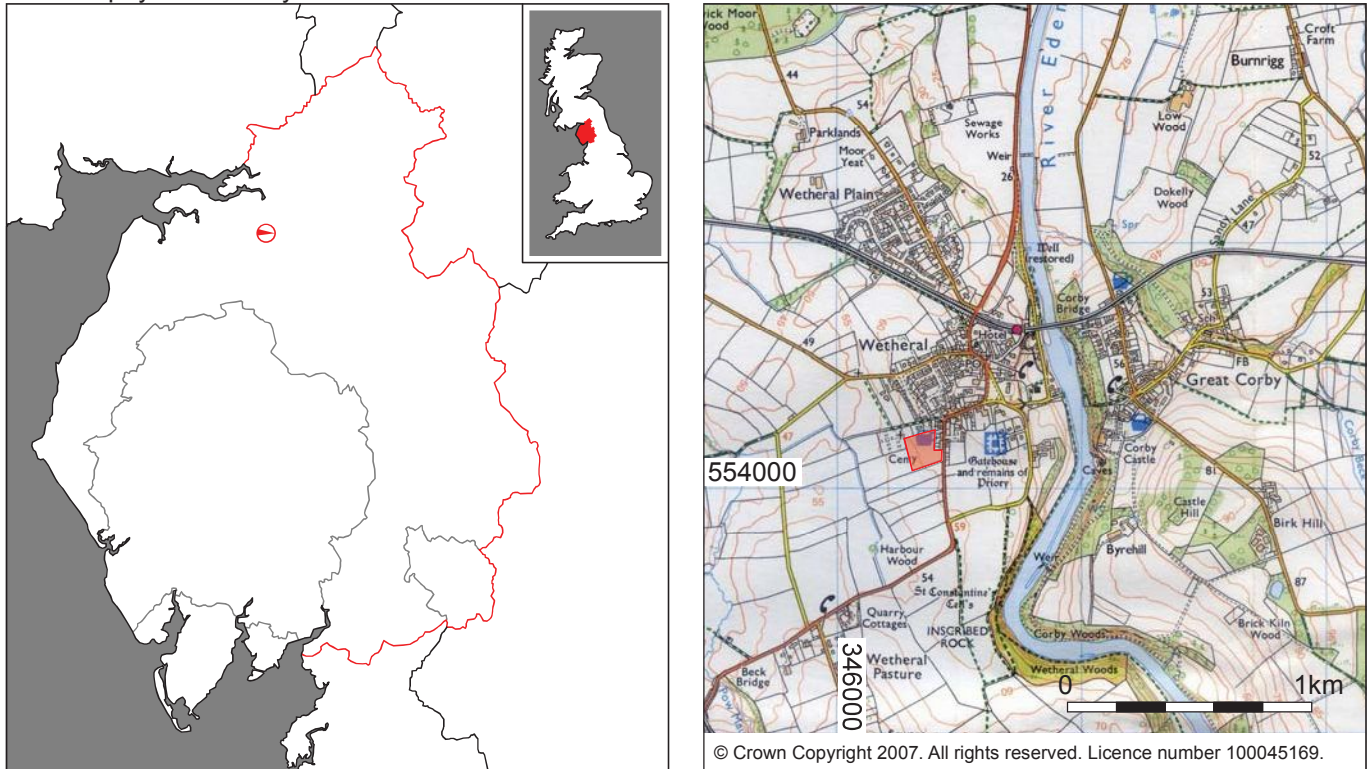


Figure 1: Site location

2. Methodology

2.1 Desk-Based Assessment

2.1.1 A desk-based assessment was carried out in accordance with the guidelines of the Institute for Archaeologists (IfA 2008). This principally comprised an examination of early maps of the site and published secondary sources. A number of sources of information were used during the desk-based assessment:

- **Cumbria Historic Environment Record (HER):** this is a list of all the known sites of archaeological interest within the county, which is maintained by Cumbria County Council and is the primary source of information for an investigation of this kind. All of the known sites of archaeological interest within 1km of the centre of the proposed development area were examined; each identified site comes with a grid reference, description and source and any additional information which was referenced was also examined as necessary. In addition, unpublished reports of archaeological investigations in the vicinity of the site were examined;
- **Cumbria Archive Centre, Carlisle (CAC(C)):** this was visited principally in order to examine early maps and plans of the site, but other documentary sources and published records were also consulted in order to gather information about the historical development of the site and its environs, and also information about the archaeology of its immediate environs;
- **Greenlane Archaeology library:** additional secondary sources were examined to provide information for the site background.

2.2 Site Visit

2.2.1 A site visit was carried out in February 2014, primarily with the intention of identifying any areas that might prove constraining to any subsequent archaeological work and whether the site had been affected by any modern activity that might have impacted upon archaeological remains. In addition, the presence of any features, finds, or deposits of possible archaeological interest was noted. Brief written notes were made during the site visit and areas of interest noted on a plan of the site. Colour digital photographs showing the general arrangement of the site and any features of interest were also taken.

2.3 Geophysical Survey

2.3.1 Full details of the methodology used during the geophysical survey are presented in *Appendix 3*. A detailed magnetic survey was carried out using a Bartington Grad601-2 magnetic gradiometer with data logger. The data was recorded over 30m by 30m grids with readings taken on the 100nT range (0.1nT sensitivity) at 0.25m intervals on profiles spaced 1m apart.

2.4 Archive

2.4.1 A comprehensive archive of the project has been produced in accordance with the project design, and current IfA and English Heritage guidelines (Brown 2007; English Heritage 1991). The paper and digital archive and a copy of this report will be deposited in the Cumbria Archive Centre in Carlisle following the completion of the project. A copy of this report will be provided for the client, a digital copy for the client's agent, and a copy will be retained by Greenlane Archaeology. In addition, at a suitable time a digital copy will be provided to the Historic Environment Record Officer at Cumbria County Council, and a record of the project will be made on the OASIS scheme.

3. Results

3.1 Introduction

3.1.1 A total of 23 sites of archaeological interest were identified within the study area during the desk-based assessment (Figure 2; *Appendix 1*; summarised in Table 1 below) ranging from prehistoric to post-medieval in date. All of these sites, apart from one (**Site 3**), were previously recorded in the HER and none are situated within the proposed development area. However, at least four sites (**Site 6, 14, 16, and 21**) are not accurately located, and so their significance to the study area is uncertain. Sites included in the gazetteer that relate to periods of the study area's history are individually mentioned in the site history (see *Section 4* below). The cropmarks (**Site 5**) and other possible earthworks (**Site 17, 21, and 22**) are of unknown date and some or all of these are unlikely to be of any specific archaeological interest. Some of the other sites are also of uncertain date, although these are perhaps medieval in origin, including **Site 6, 9, 10, 12, and 16**.

Site No.	Type	Period	Site No.	Type	Period
1	Railway	Post-medieval	13	Tower house	Medieval – post-medieval
2	Well	Medieval?	14	Findspot	Roman
3	'Gallow Acre' field name	Medieval – post-medieval?	15	Findspot	Early medieval
4	Mill	Medieval – post-medieval?	16	Possible chapel site	Medieval?
5	Cropmarks	Uncertain	17	Earthwork	Roman or medieval?
6	Possible chapel site	Medieval?	18	Salmon coops	Medieval – post-medieval
7	Cross	Post-medieval	19	Cave	Early medieval – medieval
8	Church	Early medieval – post-medieval	20	Inscriptions	Roman
9	Church cross	Medieval – post-medieval	21	Possible quarry site	Uncertain
10	Ridge and furrow	Medieval?	22	Cropmark	Uncertain
11	Priory	Medieval	23	Findspot	Prehistoric
12	Drinking trough	Medieval?			

Table 1: Summary of sites of archaeological interest within the study area

3.2 Desk-Based Assessment

3.2.1 The results of the desk-based assessment have been used to produce two separate elements. Firstly all sites of archaeological interest recorded within the study area were compiled into a gazetteer (*Appendix 1*). The gazetteer is used to assess the general type of historic landscape that makes up the study area, contribute to the compilation of the general history of the site (see *Section 4*) and, more importantly, identify sites that are likely to be affected by the proposed development. The significance of each of these sites and the degree to which they are likely to be affected is considered in *Section 5* and from this recommendations for further work are produced.

3.2.2 The second purpose of the desk-based assessment is to produce a background history of the site. This is intended to cover all periods, in part to provide information that can be used to assess the potential of the site (particularly for the presence of remains that are otherwise not recorded in the study area), but more importantly to present the documented details of any sites that are known (see *Section 4*).

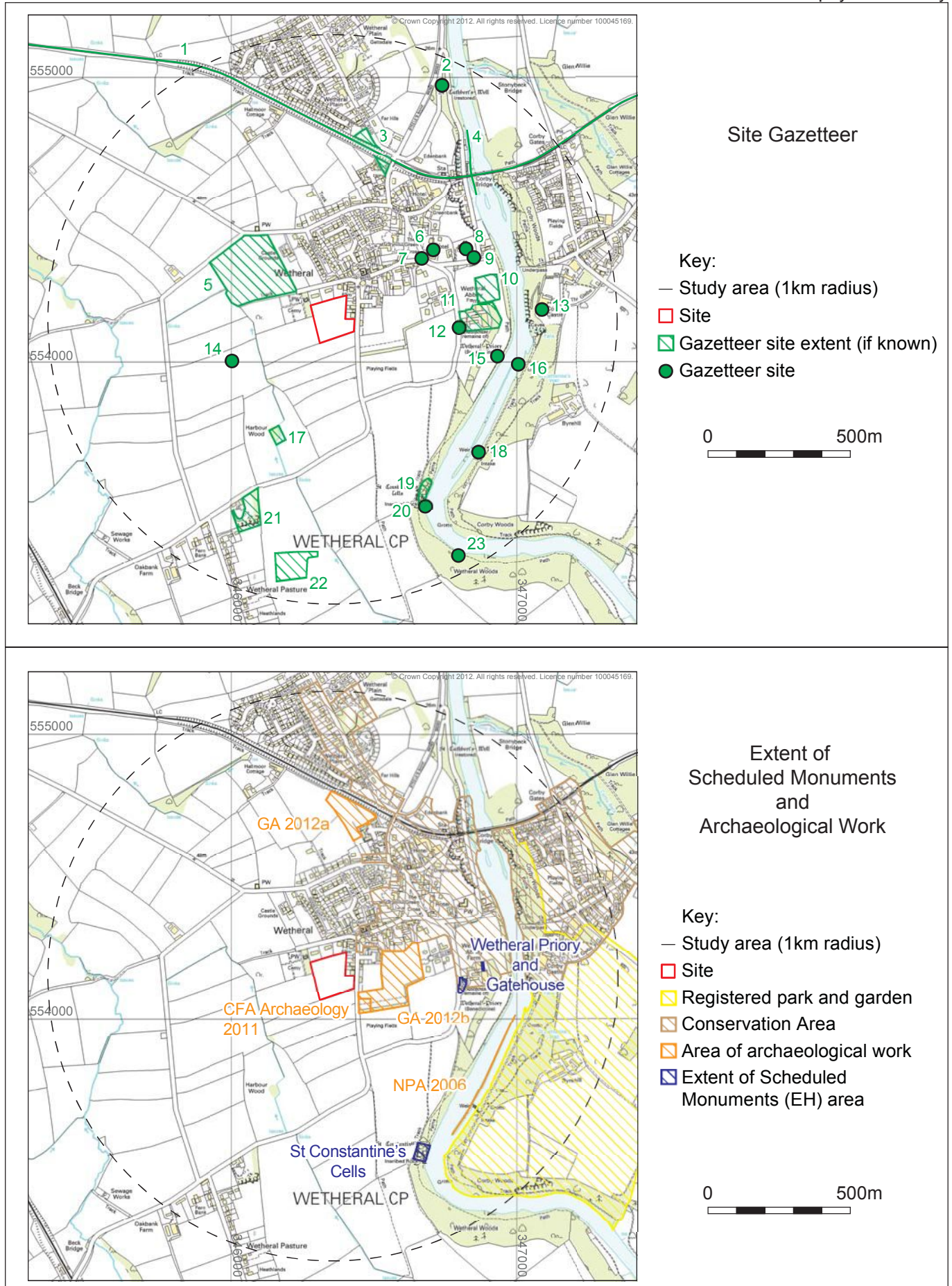


Figure 2: Site gazetteer

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3.3 Map Regression

3.3.1 **Tithe map for Wetheral township (CAC(C) DRC/8/196 1842)**: this is the earliest detailed map of the area and shows the site as comprising parts of two fields labelled 311 and 332 (Plate 1). The accompanying apportionment provides details of the owners and occupiers as well as the names of the fields and descriptions of their state of agriculture, as outlined in Table 2 below.

Plot No.	Owner	Occupier	Name	Description
311	John Robinson of Scalesceugh	William Robinson	Above town close	Arable
332	William Robinson	William Robinson	Long lands	Arable

Table 2: Details of the plots within the site as given in the tithe apportionment (CAC(C) DRC/8/196 1842)

3.3.2 **Ordnance Survey 1863**: the site and surrounding area is largely unchanged (Plate 2).



Plate 1: Extract from the tithe map for Wetheral township (CAC(C) DRC/8/196 1842)

Plate 2: Extract from the Ordnance Survey map of 1863

3.3.3 **Ordnance Survey 1868**: the site appears unchanged (the north-west/south-east line shown cutting across the site is a contour) (Plate 3).

3.3.4 **Ordnance Survey 1901**: a cemetery and mortuary chapel has been built to the north-west of the area and the sides of Steele's Bank have seen some development, including a school to the east side of the road and a very small building in the south-east corner of the site (Plate 4). The field boundary cutting across the north side of the site has also been removed.

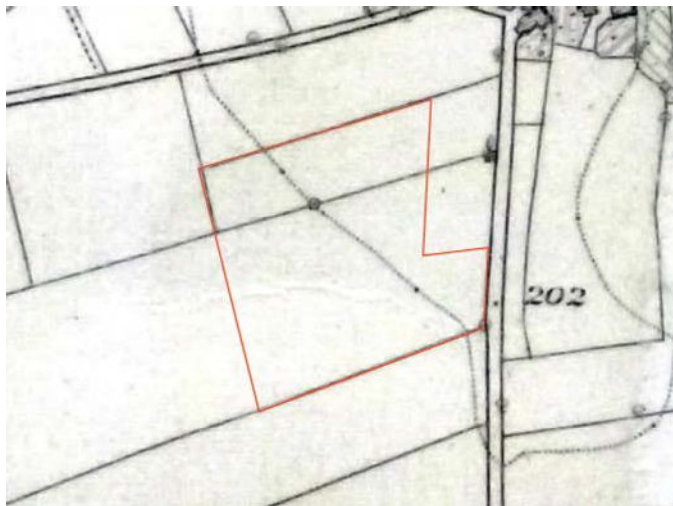


Plate 3: Extract from the Ordnance Survey map of 1868

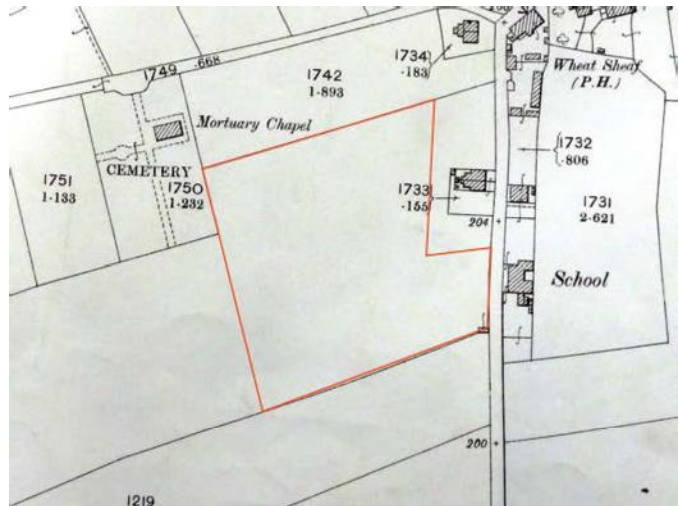


Plate 4: Extract from the Ordnance Survey map of 1901

3.4 Site Visit

3.4.1 **Site Arrangement and Character:** the site now comprises the wider east end of a long narrow field orientated approximately east/west, running up to Steele’s Bank (the B6263). Only a small part of it actually meets the road, the rest runs behind a row of detached houses (Plate 5), which are also present along the north side along Ashgate Lane. The north side of the west edge of the site is also the boundary of the adjoining cemetery, while the remainder of the west end is actually open into the field beyond. All of the boundaries to the area comprise post and wire fences with hedges, although there are some mature trees in the west boundary (Plate 6) and the east, behind the houses off Steele’s Bank, is a stone wall. The land is entirely improved pasture, used at the time of the site visit as grazing for sheep (Plate 7), and is accessed via a field gate from Steele’s Bank. There is a small sheep pen in the north-west corner constructed from metal fence panels (Plate 8).



Plate 5 (left): View of the properties along Steele’s Bank, from the west side of the site



Plate 6 (right): General view of the north-west corner of the site from Steele’s Bank



Plate 7 (left): General view of the west end of the site



Plate 8 (right): The sheep pen in the north-west corner

3.4.2 **Constraints:** there are no particular constraints to further archaeological work evident across the site, although an overhead electricity line was present running approximately north/south across the western end of the site.

3.5 Geophysical Survey

3.5.1 The full geophysical report is presented in *Appendix 3*. In summary, while there are several dipolar anomalies across the site, which are probably isolated iron finds or burnt material, and areas of magnetic disturbance along the east end of the southern boundary, these are all likely to be of modern origin. Of more interest are the positive or enhanced linear responses running approximately parallel to the east side of the site and the road, although diverging from this line at the north end, and an area of amorphous linear or curvilinear trends filling much of the north half of the site. While the origin of these is uncertain they may be of archaeological interest. In addition, there is evidence for former agricultural practice, in particular ridge and furrow, running largely east-west across the site.









ANOMALY TYPE	INTERPRETATION
 area of strong dipolar responses (magnetic disturbances)	surface / near-surface ferrous or fired material
 limit of very strong response	interference caused by modern magnetic feature, other features within this area may not be detected
 approximate orientation of weak, broadly parallel positive linears	agricultural features; modern ploughing regime or possible ridge and furrow
 linear / curvilinear trend	possible sub-surface feature
 isolated positive or enhanced response	uncertain origin; possible modern feature / material but may be geological / pedological variation deeper buried ferrous / fired material or infilled feature
 positive or enhanced linear / curvi-linear	uncertain origin; possible modern feature / material but may be caused by infilled ditch

Figure 3: Results of the geophysical survey

3.6 Conclusion

3.6.1 The map regression shows that the area has been mostly open fields since at least 1842. The field boundary to the north side of the site was removed in the late 19th century, creating a single area, and a very small building was constructed at the south-east corner of the site around that time but this has since been removed.

3.6.2 The site appears to have otherwise seen relatively little modern disturbance, so any archaeological features present within it are likely to have survived. The only potential obstruction to any further archaeological work is the presence of a high voltage cable running across the west side of the site north/south.

3.6.3 The geophysical survey did not reveal any features of obviously great archaeological potential, although a possible feature on the east side comprising paired linear anomalies and an area of more amorphous linear anomalies in the north half of the site may be of archaeological origin.

4. Site History

4.1 Introduction

4.1.1 The history of the local landscape is arguably dominated by two significant elements: the medieval priory of Wetheral and the village of Wetheral, although Corby Castle, which has at least medieval origins, is a short distance to the east on the other side of the River Eden, and there are numerous other sites of archaeological interest recorded in the general area dating from the prehistoric period onwards. Information relating to specific sites recorded during the desk-based assessment (see *Section 3* above) is included where relevant.

4.2 Prehistoric Period (c11,000BC – 1st century AD)

4.2.1 While there is limited evidence for human activity in the county in the period immediately following the last Ice Age, this is typically found in the southernmost part on the north side of Morecambe Bay. Excavations of a small number of cave sites have found the remains of animal species common at the time but now extinct in this country and artefacts of Late Upper Palaeolithic type (Young 2002). Human remains from one of these have also recently been dated to approximately 7,100 BC (Smith *et al* 2013). No remains of this date are known from the immediate area of the site, although a pair of barbed spear heads made from antler were found at Crosby-on-Eden (Hodgson 1895), which, although undated, may belong to the end of the Palaeolithic or early Mesolithic. The county was clearly more densely inhabited during the following period, the Mesolithic (c8,000 – 4,000 BC), as large numbers of artefacts of this date have been discovered during field walking and eroding from sand dunes along the coast, but these are typically concentrated in the west coast area and on the uplands around the Eden Valley (Cherry and Cherry 2002). More recently a particularly large assemblage has been recovered during excavations, directly on the edge of the River Eden, outside Carlisle (Clark 2010) and field walking has found additional scatters of some significance also in the Eden valley near Penrith (Clarke *et al* 2008). Coastal areas and river valleys are notably places where such material is frequently found in the wider region (Middleton *et al* 1995, 202; Hodgkinson *et al* 2000, 151-152; Hodgson and Brennand 2006, 26).

4.2.2 In the following period, the Neolithic (c4,000 – 2,500 BC), large scale monuments such as burial mounds and stone circles begin to appear in the region and one of the most recognisable tool types of this period, the polished stone axe, is found in large numbers across the county, having been manufactured at Langdale in the central Lake District (Hodgson and Brennand 2006, 45). During the Bronze Age (c2,500 – 600 BC) monuments, particularly those thought to be ceremonial in nature, become more common still, and it is likely that settlement sites thought to belong to the Iron Age have their origins in this period. Sites of this type, while not present in the study area, are recorded, typically as crop marks revealed in aerial photographs, in the wider area although they are typically undated and little understood. In addition, there is likely to have been a considerable overlap between the end of the Iron Age and the beginning of the Romano-British period; it is evident that in this part of the country, initially at least, the Roman invasion had a minimal impact on the native population in rural areas (Philpott 2006, 73-74).

4.2.3 Only a single site of prehistoric date is recorded within the study area: an axe polishing stone, which was found on the bank of the River Eden (**Site 23**). A large enclosure in the southern part of the study area (**Site 22**) may be later prehistoric but this is uncertain.

4.3 Romano-British to Early Medieval Period (1st century AD – 11th century AD)

4.3.1 While the local area around Wetheral has relatively little evidence for activity of this date, the environs of the site are within a few kilometres of Hadrian's Wall, to the north, and the Roman city of Carlisle, to the west. The fort at Carlisle was first established in the autumn or winter of AD 72-73 (Zant 2011, 35) but was soon altered, in AD 83-84 (*op cit*, 36-37). It was abandoned for a time, before being rebuilt in the early 2nd century, cAD 105, but its character changed by the AD 120s, probably on account of the construction of Hadrian's Wall, which began in AD 122-123 (*op cit*, 42-43). This in turn led to the

construction of a new fort at Stanwix, but the fort at Carlisle continued to be occupied and in the early 3rd century AD it was rebuilt in stone (*op cit*, 48). Both Carlisle and Stanwix continued to be occupied into the 4th century and beyond, along with an extensive civilian settlement at the former. Evidence for post-Roman habitation is limited and inconclusive (*op cit*, 50-51) but it is apparent that Carlisle remained an important place into the early medieval period, with an historical account of the 7th century famously describing the extant walls of the Roman town and a working fountain (Zant 2009, 15). In more rural areas such as that around Wetheral the impact of the Romans, in what would have been a heavily militarised zone, is less clear. The size of the 'military market' to the local area must have been of great importance, but it is clear that many 'natives' initially continued to live in much the same way they had before the arrival of the Romans, perhaps supplying them with goods and, as a result, at first benefiting from their arrival (Higham 1986, 216-225). The extensively military nature of the area is represented by a crop mark to the west of the study area, which has been interpreted as a Roman temporary camp (Small 2008, 29 and 33). In addition, a pair of Roman inscriptions (**Site 20**) formerly situated in the cliff face south of Wetheral but now loose and stored in Tullie House Museum (Perriam and Ramshaw 2008, 4), have been taken as evidence for the military quarrying the local stone (Collingwood and Wright 1965, 335-336).

4.3.2 Physical and archaeological evidence from the post-Roman early medieval period is considerably less common in rural areas. Place-name evidence shows that Wetheral derives from the Anglian Old English *h(e)alh* meaning either low pasture, typically flat alluvial land on the side of a river (Armstrong *et al* 1950, 160), or a corner of land (Phythian-Adams 1996, 67) of the wethers (a castrated male sheep). Its existence at an early date is also seemingly confirmed by later sources describing it as on the boundary of Hexham diocese, which ceased to exist by the early 9th century (Rollason 2003, 45). Evidence for the presence of an early settlement at Wetheral is also found in a fragment of cross with a fragmentary runic inscription found at the church (**Site 9**) in c1965, thought to be of 8th to 9th century date (Bailey and Cramp 1988, 153-154; Perriam and Ramshaw 2008, 5). The presence of this cross and the significance of Wetheral's mention in relation to the boundary of Hexham Diocese has led to the suggestion that it was home to a '*literate religious community*' (Phythian-Adams 1996, 67), perhaps monastic. In addition, the rock-cut chambers known as Constantine's Cells (**Site 19**), in the southern part of the study area on the edge of the River Eden, may have early medieval, or even Roman, origins, being apparently mentioned in early documents relating to Wetheral priory as already in existence and relating to St Constantine (Armstrong *et al* 1950, 163). They have been little studied, however (Milborne 1749; Anon 1899), and may be entirely medieval in origin. Similarly, a holy well dedicated to St Cuthbert (**Site 2**) is described in a charter of AD 1200 (McIntire 1944, 15), but could have much earlier origins.

4.3.3 Apart from the sites already mentioned a stray coin find of 2nd century date has been found within the study area (**Site 14**). In addition, a square earthwork (**Site 17**) may also be a Roman fortlet but this is uncertain. Other early-medieval sites also include a zoomorphic metal strap-end probably dating to the 9th century, which was recovered from the River Eden by a metal detectorist in 1985 (**Site 15**). The field name 'Gallow Acre' (**Site 3**), although most probably relating to the site of a gallows of medieval or later date, could also derive from the Norse *Gallgoidil* meaning foreigners, a term used to distinguish between different groups of Vikings, which also gave its name to Galloway in Scotland (Griffith 2010, 40), but this is perhaps unlikely.

4.4 Medieval Period (11th century AD – 16th century AD)

4.4.1 Wetheral is first recorded in c1100 but in connection with Wetheral Priory (now only represented by the surviving gatehouse (**Site 11**); Armstrong *et al* 1950, 160), which is the approximate date of its foundation (Martindale 1922b). It was founded as a Benedictine house and cell of the Abbey of St Mary in York by Ranulph Meschin (*op cit*, 239) and subsequently received gifts from Henry I, Henry II, Henry III and Richard I, and also the future David I of Scotland (*op cit*, 240). The monastic church had at least two altars, one dedicated to the Blessed Virgin Mary the other to the Holy Trinity, but early references are also made to dedications to St Mary and St Constantine, and two chapels are also mentioned, one dedicated to St Anthony (**Site 6**) the other to St Servanus or St Severinus (**Site 16**), although the exact whereabouts of these is not known (*op cit*, 251). The priory also had fishing rights in the River Eden, and

the salmon coops (**Site 18**) still remaining there are thought to originate in the medieval period (Railton and Davies 2007, 97). Few remains of the priory now survive, with the exception of the gatehouse, which is early 16th century (Hyde and Pevsner 2010, 669). The priory was surrendered on 20th October 1538 during the Dissolution (Martindale 1922b, 241). The origins of the village of Wetheral are less clear, although it is likely to be at least medieval given that the church there (**Site 8**) contains mostly medieval and later fabric (Martindale 1922a) and the cross situated in the churchyard is also medieval in origin (**Site 9**). The other significant site within the study area of medieval origin is Corby Castle (**Site 13**), which started life as a 14th tower, around which later additions were added.

4.4.2 Aside from those sites already mentioned other sites of potential medieval date include the field named 'Gallows Acre' (**Site 3**), the square earthwork to the south-west (**Site 22**), and two areas of crop marks or other earthworks (**Site 5** and **Site 17**). In addition the stone horse drinking trough near Wetheral Priory (**Site 12**) might also be medieval in date, as might the area of ridge and furrow (**Site 10**) to the north of the priory.

4.5 Post-Medieval (16th century AD – present)

4.5.1 The map evidence (see *Section 3.3*) demonstrates that the site had reached approximately its present state by the beginning of the 19th century, with all the fields enclosed, and it is likely that relatively little changed in the area following the end of the medieval period. Following the Dissolution the lands and properties formerly held by Wetheral Priory passed into the hands of local families, the Tullie family acquiring the lease of Wetheral Manor from the Dean and Chapter of Carlisle (Perriam and Ramshaw 2008, 16) and the Howard family of Corby Castle ultimately acquiring the salmon coops thought to have originally belonged to the priory (Railton and Davies 2007, 97). The former site of the priory became home to a farm, known as Wetheral Abbey Farm (Perriam and Ramshaw 2008, 21). The area in general remained very rural in character and probably saw little substantial change until the coming of the Newcastle-Carlisle railway (**Site 1**), which opened in 1838 (Robinson 2011, 175-176). This heralded a new period of industrialisation seen at a national and local level, with nearby Carlisle developing a substantial range of industries, particularly those relating to textiles (Newman 2011). There is considerably less evidence for industrialisation in rural areas such as Wetheral, although the mill (**Site 4**), at least, dates to the post-medieval period, and the possible quarry site (**Site 21**) may also belong to this period.

4.5.2 In addition to those sites already described, several sites of potentially medieval origin evidently continued in use into the post-medieval period, although not necessarily in the same form, such as the church (**Site 8**), the priory (**Site 11**), and Corby Castle (**Site 13**). The church cross (**Site 7**), which is socketed in a squared base that was previously used for the maypole before being moved to its current location, also dates to the 19th century.

4.6 Previous Archaeological Work

4.6.1 Four pieces of archaeological work have previously been carried out within the study area:

- evaluation and recording of salmon coops situated in the River Eden recorded several phases of development of the structures, probably dating from the 17th, 18th and 19th centuries (NPA 2006; Railton and Davies 2007, 103);
- evaluation of land adjacent to the B6263 revealed only a single undated linear feature, thought to represent the line of a former field boundary (CFA Archaeology 2011);
- a desk-based assessment and geophysical survey on land off Hallmoor Court on the north side of Wetheral revealed an area of former strip fields on the edge of the medieval settlement close to a field called 'Gallows Acre' in an area of generally high archaeological potential, but the geophysical survey only showed a small number of anomalies, some of which probably related to the earlier field boundaries while others were less readily identifiable (Greenlane Archaeology 2012a);

- a desk-based assessment and geophysical survey on land adjacent to the playing fields immediately opposite the current site on the other side of the B6263 revealed a former field boundary, shown to cross the site on the early maps, was preserved as an earthwork across part of the site and the geophysical survey revealed the same earthwork feature as a linear anomaly as well as large a further linear feature to the south of the extant earthwork and another orientated east/west to the east, areas of magnetic disturbance around the edges of the site (probably resulting from modern activity), and a number of smaller anomalies and areas of ridge and furrow across much of the site (Greenlane Archaeology 2012b).

5. Discussion

5.1 Introduction

5.1.1 The discussion of the results of the desk-based assessment, site visit and geophysical survey is intended to determine the archaeological significance and potential of any known remains (above or below ground) and the potential for any as yet unidentified remains being present. The system used to judge the significance of the remains identified within the development area, or those thought to have the potential to be present within the development area, is based on the criteria used to define Scheduled Monuments (DoE 1990, Annex 4; *Appendix 2*). Of the 23 sites identified within the study area, none are situated within the proposed development area and they are therefore unlikely to be affected by any subsequent groundworks.

5.2 Significance

5.2.1 No previously recorded sites of archaeological interest are recorded within the proposed development area. However, two features of potential archaeological interest were revealed during the geophysical survey; a linear feature apparently comprising two parallel elements along the east side of the site, and an a large area of linear trends filling much of the northern half of the site, neither of which can be dated or given a function with any certainty.

5.2.2 The level of significance of the features within the proposed development area is categorised, according to each criterion, as high, medium, or low, and an average of this has been used to produce an overall level of significance for each site (see Table 3 below: H=high, M=medium, L=low). As can be seen in Table 3 all of these features are considered to be of medium or low to medium significance.

Site	<i>East linear</i>	<i>Northern linear trends</i>
<i>Period</i>	-	-
<i>Rarity</i>	-	-
<i>Documentation</i>	L	L
<i>Group value</i>	M	M
<i>Survival/condition</i>	M	M
<i>Fragility/Vulnerability</i>	M	M
<i>Diversity</i>	L	M
<i>Potential</i>	M	M
Significance	L-M	M

Table 3: Significance by site

5.3 Potential for Unknown Archaeological Remains

5.3.1 The details of those archaeological remains present within the proposed development area is presented in the results of the desk-based assessment (*Section 3*; *Figure 2*; *Appendix 1*) and the importance of these sites is discussed above (*Section 5.2*). The potential for as yet unidentified archaeological remains to be present, however, is based on the known occurrence of such remains elsewhere in the study area and local environs (see *Section 4*). Where there are no remains known within the study area the potential is based on the known occurrence within the wider local area. The degree of potential is examined by period and the results are presented in Table 4 below; in each case the level of potential is expressed as low, medium, or high.

Period	Present in study area?	Potential
Late Upper Palaeolithic	N	L
Mesolithic	N	M
Neolithic	Y	L
Bronze Age	N?	L
Iron Age	N?	L
Roman	Y	M
Early Medieval	Y	L
Medieval	Y	H
Post-medieval	Y	H

Table 4: Degree of potential for unknown archaeological remains by period

5.3.2 In consideration of Table 4 it is worth noting that the possibility of finding Mesolithic remains could perhaps be assessed as medium because they are often associated with sites adjacent to watercourses (Middleton *et al* 1995, 202; Hodgkinson *et al* 2000, 151-152). Areas along the River Eden in particular have also recently been the site of significant and large-scale discoveries of finds and sites of Mesolithic date (Clark 2010; Clarke *et al* 2008). Sites of Neolithic, Bronze Age, and Iron Age date are general rare in the local area, Iron Age especially, and the only certain find from within this period is a single stray find of Neolithic date. Similarly, sites of early medieval date, although present in the study area, are generally very rare.

5.3.3 Sites of Roman, early-medieval, medieval, and post-medieval date all have examples from within the study area. In the case of the medieval and post-medieval finds this is largely due to the presence of the nearby Wetheral Priory and village of Wetheral, while the Roman and early medieval finds seem indicative of some activity in the local area, although the extent and form of this is not necessarily certain.

5.4 Disturbance

5.4.1 The area appears to have seen relatively little disturbance apart from that associated with agriculture, such as ploughing, which has certainly taken place across the site. However, the presence of areas of high magnetic disturbance revealed by the geophysical survey is suggestive of some modern activities across parts of the site, particularly the centre and edges.

5.5 Impact

5.5.1 Although no detailed plans were available regarding proposed developments the nature of the ground cover, which probably comprises a relatively shallow topsoil and would require considerable ground movement, would suggest that any building on site would substantially impact on any archaeological remains that might be present.

5.6 Recommendations

5.6.1 While there are no certain archaeological remains present within the site, the geophysical survey has revealed a number of linear responses that are potentially of archaeological origin. Dating them or identifying a function is very difficult without further archaeological investigation, although it is conceivable that the linear feature on the east side represents a former road line, in which case it is arguable that it perhaps represents a Roman road connecting the supposed Roman quarries on the edge of the river (**Site 20**) to a road into the Roman city of Carlisle from the east. In addition, the area of curvilinear anomalies superficially has the appearance of a Romano-British settlement with possible hut circles, in which case its proximity to the possible road is of interest.

5.6.2 Without further archaeological work it is impossible to reveal the nature and date of any of these features. Therefore, as a minimum, it is recommended that the areas of greatest archaeological potential be examined through archaeological evaluation trenching. This should specifically include the north/south linear along the east side of the site, and the area of more amorphous linear anomalies filling

much of the northern half of the site. Such additional investigation could be carried out in advance of the submission of a planning application, or be dealt with by means of a planning condition placed on the application, although in either case evaluation could reveal the presence of more significant archaeological deposits requiring further archaeological work.

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6.3 Aerial Photographs

CCC (Cumbria County Council), n.d. **NY4654/B-E** (formerly 2400/1-2 and 4-5)

CCC, 1984 **NY4653/A-D** (formerly 2520/21-24)

Appendix 1: Site Gazetteer

Site Number: 1**NGR:** -**HER No:** 41002**Sources:** HER; Robinson 2011, 175-176**Designation:** none**Description:** the Newcastle-Carlisle railway opened at the Carlisle end in 1836. The whole line opened in 1838. It became part of the North Eastern Railway (NER) in 1865.**Period:** post-medieval

Site Number: 2**NGR:** 346733 554958**HER No:** 3815**Sources:** McIntire 1944, 15**Designation:** none**Description:** St Cuthbert's holy well described in charter 1200 as rising above Muchwat (Monks Ford) and below that part of Eden called the Camera Constantini. The spring lies in the wood below the mill and weir. It is covered by a small, stone well-house inscribed 'The Holy Well, Called in the 12th Century, Fons Sancti Cuthberti'. Repaired in 1897.**Period:** medieval?

Site Number: 3**NGR:** 346490 554740 (centre)**HER No:** -**Sources:** CAC(C) DRC/8/196 1842**Designation:** none**Description:** field named 'Gallow Acre' shown on the tithe map.**Period:** medieval – post-medieval?

Site Number: 4**NGR:** 346850 554580**HER No:** 10194**Sources:** Ordnance Survey 1863**Designation:** none**Description:** mill complex consisting of mill and mill race. The mill appears to have been converted to housing now. The mill race is still evident.**Period:** medieval to post-medieval?

Site Number: 5**NGR:** 346100 554300**HER No:** 6925**Sources:** CCC n.d. NY4654/B-E

Designation: none

Description: crop marks, some of which appear to relate to earlier field boundaries, others appear to be natural.

Period: unknown

Site Number: 6

NGR: 346700 554400

HER No: 512, 3816 [repeated entry]

Sources: Martindale 1922b, 251; Clack and Gosling 1975

Designation: none

Description: possible site of a chapel dedicated to St Anthony. The chapel is supposedly situated on the road between Wetheral and Cumwhinton but there is no evidence to support this.

Period: medieval?

Site Number: 7

NGR: 346660 554368

HER No: 4535

Sources: HER

Designation: Listed Grade II

Description: squared red sandstone column c3.5 to 4m high, with chamfered corners and head carved to give a quatrefoil cross c1844 on a chamfered plinth hollowed to form a shaft socket and set on two squared step slab supports. The octagonal socket is over 1m wide and c0.8m high on a squared base and was formerly used for the wooden maypole in the centre of the green; the cross was added when it was moved to its present location.

Period: post-medieval

Site Number: 8

NGR: 346810 554400

HER No: 4536

Sources: Martindale 1922a; Hyde and Pevsner 2010, 668

Designation: Listed Grade II*

Description: church of the Holy Trinity and St Constantine with 13th century fabric and alterations made in the 16th century, between 1790-91, in 1872, and between 1881-2. The church is dressed red sandstone with graduated slate roofs and a coped east gable. It has a west tower nave with vestry and south porch, chancel, chapel, and bellcote at the east end. The hexagonal tower is on the site of the medieval porch. Medieval features include a 13th century hexagonal font, tomb chest with effigies c1500, and fragments of stained glass. The arcades although much renewed are essentially 13th century.

Period: early medieval – post-medieval

Site Number: 9

NGR: 346840 554370

HER No: 4534

Sources: HER

Designation: none

Description: Wetheral churchyard cross and sundial; a rough red sandstone polygonal pillar, bearing a brass sundial with Roman numerals dated 1751, fitted into a carved socket stone which may be the remains of a churchyard cross surrounded by two low steps.

Period: medieval to post-medieval

Site Number: 10

NGR: 346880 554250

HER No: 18919

Sources: HER

Designation: none

Description: an area of faint broad ridge and furrow in poor condition immediately north of the remains of Wetheral Priory.

Period: medieval?

Site Number: 11

NGR: 346800 554100

HER No: 2910

Sources: Martindale 1922b; Hyde and Pevsner 2010, 668-669

Designation: Scheduled Monument; Listed Grade I

Description: Benedictine Priory founded in 1106, surrendered in 1538 and largely demolished, with the exception of the well-preserved 14th or 15th century gatehouse. The three-storey gatehouse has dressed red sandstone walls with moulded dressing and a stone-slab replacement roof. It has two bays, a chamfered plinth course, moulded string course to each storey, one and two-light mullioned windows, and battlement parapet. The entrance arch has a barrel-vaulted passage. Label moulds to the sides show the single storey roofline of the original adjoining buildings. Internally it has a spiral staircase. Part of a one storey, but probably originally two storey wall remains, c25m long; possibly the east wall of Chapter House. Windows in the stonework match those in the gatehouse. The Scheduled area includes the upstanding and buried remains of the Priory. Below ground features include the remains of two buildings known, from visible fragments of rooflines, to have been attached to the north and south external faces of the gatehouse.

Period: medieval

Site Number: 12

NGR: 346790 554123

HER No: 18918

Sources: HER

Designation: none

Description: a stone horse drinking trough is built into a stone wall just opposite the entrance to Wetheral Priory Gatehouse. It appears of considerable age.

Period: medieval?

Site Number: 13

NGR: 347080 554190

HER No: 3817

Sources: Perriam and Robinson 1998, 142-143; Hyde and Pevsner 2010, 300-301

Designation: Listed Building, Grade I; National Parks and Gardens Register, Grade I

Description: 13th century tower house encased in later buildings. Additions were made in 1630 and 1690 and the present façade was built between April 1812 and September 1817 by Peter Nicholson for Henry Howard in Grecian Doric style. It is red sandstone ashlar, with slate roofs. It is three-storeys with five bays to the south and three-storeys with seven bays to the west. The main staircase dates to the 1720s and there is a medieval spiral staircase in the original tower. The early 18th century landscape garden with principal landscaping by Thomas Howard is included in the National Parks and Gardens Register, Grade I.

Period: medieval – post-medieval

Site Number: 14

NGR: 346000 554000

HER No: 19107

Sources: Shotter 1989, 42

Designation: none

Description: a second century Roman coin was found in Wetheral in 1980, but the exact findspot is unknown. It is a Sesterius of Antoninus Pius

Period: Roman

Site Number: 15

NGR: 346930 554030

HER No: 17972

Sources: Richardson 1990, 40-41

Designation: None

Description: zoomorphic metal strap-end recovered from the River Eden by a metal detectorist in 1985. This example is covered by two intertwining creatures and has a stylised 'animal-head' terminal with a broad snout, eyes and swept back ears. The inlay is niello rather than silver and it has three iron rivets in situ where the object was attached to a leather belt or strap; probably dating to the 9th century.

Period: early medieval

Site Number: 16

NGR: 347000 554000

HER No: 513

Sources: Martindale 1922b, 251

Designation: none

Description: Wetheral chapel, a chapel dedicated to St Servanus or St Severinus and belonging to Wetheral Priory, has not been located, but there is a tradition it was on the River Eden bank east of the Priory.

Period: medieval?

Site Number: 17

NGR: 346150 553760

HER No: 12793

Sources: Ordnance Survey 1868

Designation: none

Description: ditched enclosure; rectangular enclosure c26m by 26m, ditched on the east and south sides, with evidence of former ditches on the other two. The ditches have been incorporated into the field drainage system. More than half of the enclosure forms a raised platform about six feet above the field, but on the east side there is a bank some 3.4m wide, with very straight faces and a curved southern corner. Local tradition suggests the enclosure was a monastic burial ground, but it has also been suggested that it was a Roman fortlet or moated medieval site. It is labelled 'Harbour Wood' on the Ordnance Survey map of 1868.

Period: Roman or medieval?

Site Number: 18

NGR: 346855 553685

HER No: 42132

Sources: NPA 2006; Railton and Davies 2007

Designation: Listed Building, Grade I

Description: 12th century salmon coops for Wetheral Priory, with later repairs. After the Dissolution the coops passed to the Howard family of Corby Castle, who still own them and use them occasionally. An evaluation was undertaken in 2005 prior to floor damage repairs to the intricate system of sluice gates, weirs and artificial eyots. Structural deposits were identified in all five of the test pits excavated, and evidence of successive phases of rebuilding and repairs were found which most likely date to the 17th, 18th and 19th centuries.

Period: medieval – post-medieval

Site Number: 19

NGR: 346680 553530

HER No: 411

Sources: Milbourne 1749; Anon 1899

Designation: Scheduled Monument

Description: 'St Constantine's Cells' or 'Wetheral Safeguard'; three rectangular rock cut chambers, each measuring 6m by 3m, cut high in the cliff face, connected by a 14th century gallery, formerly roofed. The caves may date back to Romans who quarried here and possibly later improved by monks. The site has a masonry front wall with three small windows and a fireplace. Access would originally have been by ladder, but now by a stone cut path. Popularly thought to have been used by St Constantine when a hermit and generally considered to have been a place of concealment or safety, particularly during Scottish incursions; used by the Priory of Wetheral as a place of refuge during border raids and hence the name Safe Guard. The entrance has been blocked by a locked wrought iron gate probably to protect it from further defacement.

Period: early medieval – medieval

Site Number: 20

NGR: 346670 553500

HER No: 514

Sources: Collingwood and Wright 1965, 335-336

Designation: Scheduled Monument

Description: three Roman quarry inscriptions cut on the rock face c10 feet above the River Eden on its west bank, 25 yards south of St Constantine's Cells. The first, 'MAXIMUS SCRIPSIT', is 30 inches long with 3 ½ inch high letters. 30 inches away and 20 inches lower, 'LEG XXVV CONDRAUSISIUS', with figure of a stag; followed by 'II', in letters usually 2 ½ inches high, but 5 ½ inches maximum.

Period: Roman

Site Number: 21

NGR: 346063 553477

HER No: 12461

Sources: HER

Designation: none

Description: the name 'Quarry Cottages' suggests a quarry nearby. Behind the cottages the map features some earthworks which appear to be the remains of a quarry but they are not marked as such on the Ordnance Survey map.

Period: unknown

Site Number: 22

NGR: 346200 553300

HER No: 5883

Sources: CCC 1984, NY4653/A-D

Designation: none

Description: an aerial photograph shows a crop mark sub-rectangular enclosure with a small sub-rectangular annex or projection on its north-eastern corner. On some of the aerial photographs it appears to extend further outwards on its northern end. There also appears to be another sub-oval feature within the enclosure.

Period: unknown

Site Number: 23

NGR: 346790 553330

HER No: 43848

Sources: Jamie Lund pers comm

Designation: none

Description: axe polishing stone found on the bank of the River Eden.

Period: prehistoric

Appendix 2: Significance Criteria

After DoE 1990, Annex 4: 'Secretary of State's Criteria for Scheduling Ancient Monuments'

- i) *Period*: all types of monuments that characterise a category or period should be considered for preservation;
- ii) *Rarity*: there are some monument categories which in certain periods are so scarce that all surviving examples which retain some archaeological potential should be preserved. In general, however, a selection must be made which portrays the typical and commonplace as well as the rare. This process should take account of all aspects of the distribution of a particular class of monument, both in a national and regional context;
- iii) *Documentation*: the significance of a monument may be enhanced by the existence of record of previous investigation or, in the case of more recent monuments, by the supporting evidence of contemporary written records;
- iv) *Group Value*: the value of a single monument (such as a field system) may be greatly enhanced by its association with related contemporary monuments (such as a settlement and cemetery) or with monuments of different periods. In some cases, it is preferable to protect the complete group of monuments, including associated and adjacent land, rather than to protect isolated monuments within the group;
- v) *Survival/Condition*: the survival of a monument's archaeological potential both above and below ground is a particularly important consideration and should be assessed in relation to its present condition and surviving features;
- vi) *Fragility/Vulnerability*: highly important archaeological evidence from some field monuments can be destroyed by a single ploughing or unsympathetic treatment; vulnerable monuments of this nature would particularly benefit from the statutory protection which scheduling confers. There are also existing standing structures of particular form or complexity whose value can again be severely reduced by neglect or careless treatment and which are similarly well suited by scheduled monument protection, even if these structures are already listed historic buildings;
- vii) *Diversity*: some monuments may be selected for scheduling because they possess a combination of high quality features, others because of a single important attribute;
- viii) *Potential*: on occasion, the nature of the evidence cannot be specified precisely but it may still be possible to document reasons anticipating its existence and importance and so to demonstrate the justification for scheduling. This is usually confined to sites rather than upstanding monuments.

Appendix 3: Geophysical Survey



PHASE
SITE INVESTIGATIONS

**Site off Steeles Bank
Wetheral**

Archaeological geophysical survey

Project No. ARC/1194/433

March 2014

Site off Steeles Bank Wetheral

Archaeological geophysical survey

Project No. ARC/1194/433

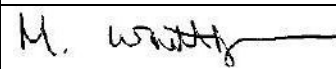
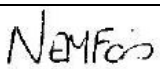
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Date	03/03/14	Date	04/03/14

Table of Contents

1. SUMMARY	1
2. INTRODUCTION	2
2.1 OVERVIEW	2
2.2 SITE DESCRIPTION	2
2.3 ARCHAEOLOGICAL BACKGROUND	2
2.4 SCOPE OF WORK	2
3. SURVEY METHODOLOGY	3
3.1 MAGNETIC SURVEY	3
3.2 DATA PROCESSING AND PRESENTATION	3
4. RESULTS	5
4.1 GENERAL	5
4.2 DIPOLAR RESPONSES	5
4.3 LINEAR / CURVI-LINEAR ANOMALIES (PROBABLE AGRICULTURAL)	6
4.4 LINEAR / CURVI-LINEAR TRENDS	6
4.5 ISOLATED POSITIVE OR ENHANCED RESPONSES	6
4.6 POSITIVE OR ENHANCED LINEAR / CURVI-LINEAR ANOMALIES	7
5. DISCUSSION AND CONCLUSIONS	8
DRAWINGS	
ARC_1194_433_01	Site location map
ARC_1194_433_02	Greyscale plot of magnetic gradient data
ARC_1194_433_03	Interpretation of magnetic gradient data
REFERENCES	9
APPENDIX 1	Magnetic survey; technical information
	10

DIGITAL COPY OF REPORT CAN BE FOUND ON CD ATTACHED TO BACK COVER

1. SUMMARY

Phase Site Investigations Ltd was commissioned to carry out a magnetic gradient survey at a site off Steeles bank, Wetheral. The aim of the survey was to help establish the presence / absence, extent, character, relationships and date (as far as circumstances and the inherent limitations of the techniques permits) of archaeological features within the survey area.

A Bartington Grad 601-2 gradiometer was utilised with data collected at 1 m by 0.25 m intervals over a series of 30 m grids.

The majority of the anomalies identified by this survey are thought to relate to agricultural practice / features, modern material / objects or geological / pedological variations.

There are several areas where very strong responses or magnetic disturbance from modern features dominate the surrounding data. It should be recognised that the strength of the strong responses could mask anomalies from other sub-surface features in the area.

The agricultural responses that are present are quite weak and diffuse but it is not certain if this is because the soils have a weak magnetic susceptibility, in which case potential archaeological features may be difficult to identify, or because the agricultural features have been truncated / eroded. If the soils have a low magnetic susceptibility then it is possible that the weaker, diffuse anomalies could be associated with infilled features.

A number of other anomalies have been identified whose cause cannot be determined. An archaeological origin cannot be completely ruled out for many of these but without supporting evidence it is considered more likely that the majority of these are caused by natural magnetic variations or modern features. In some cases it is not certain if an anomaly is caused by sub-surface features / variations or if it is a product of strongly magnetic modern features adjacent to the survey area. If the responses are caused by sub-surface features then it is possible that they have an archaeological origin, although the strength and regularity of the anomalies is more suggestive of modern features.

2. INTRODUCTION

2.1 Overview

Phase Site Investigations Ltd was commissioned by Mr Dan Elsworth of Greenlane Archaeology Ltd to carry out an archaeological geophysical survey at a site off Steeles Bank, Wetheral.

The aim of the survey was to help establish the presence / absence, extent, character, relationships and date (as far as circumstances and the inherent limitations of the technique permit) of archaeological features within the survey area.

The location of the site is shown in drawing ARC_1194_433_01.

2.2 Site description

The site is situated west of Steeles Bank, on the south-western edge of Wetheral, Cumbria (centred at NGR NY 463 541).

The site was approximately 1.66 ha in area and covers part of a single pasture field. The survey area was relatively level with a suggestion of ridge and furrow aligned broadly north to south. The northern and southern boundaries were a mix of hedges and wire fences and the eastern boundary was a mix of fencing and stone walls. The western edge of the survey area was not defined by a fixed boundary.

The geology of the site consists of St Bees Sandstone Formation overlain by glacial till (British Geological Survey, 2014).

2.3 Archaeological background

The site is located in an area where there are cropmarks of sites thought to be of prehistoric date in the vicinity and the medieval Wetheral Priory is located to the east of the site (pers. comm. D Elsworth, Greenlane Archaeology 2014).

2.4 Scope of work

The survey area was specified by the client based on a proposed development boundary. The extent of the magnetic survey shown in drawing ARC_1194_433_02.

No problems were encountered during the survey which was carried out on the 12 February 2014.

3. SURVEY METHODOLOGY

3.1 Magnetic survey

A Bartington Grad601-02 magnetic gradiometer was used for the magnetic survey. The instrument was balanced and 'zeroed' on site in a magnetically uniform area at the start of the survey. The instrument was regularly checked for instrument drift during the course of the day and rebalanced as required.

The data was collected over a series of 30 m by 30 m survey grids. All data was collected at 0.25 m intervals over profiles spaced 1 m apart and stored in the instrument for download at the end of the day.

Major grid points on the survey areas were established using a Sokkia GRX-1 VRS RTK GNSS system direct to the Ordnance Survey national grid system, using the UKO OSTN2 projection, to an accuracy better than 0.03 m. Bamboo canes or tent pegs were used to mark the grid points. Intermediate grid points were established using tape measures and the position of each profile was established by stringing either a pre-marked rope or a 100 m tape measure between grid points. Bamboo canes were then used to mark profiles and the operator walked between these at a constant pace.

The location of the survey grid was recorded directly to Ordnance Survey national grid co-ordinates using the UKO OSTN2 projection to an accuracy better than 0.03 m.

3.2 Data processing and presentation

The Bartington gradiometer data was downloaded and gridded using Archaeosurveyor v 1.5.13. Where required, the data were minimally processed or improved to remove errors caused by instrument drift and / or collection errors (See Appendix 1.4).

The data was exported as raster images (PNG files) and are presented in greyscale format with accompanying interpretations at a scale of 1:1000. All greyscale plots were clipped at -3 nT to 3 nT. Greyscale plots have been 'smoothed' using a visual interpolation but the data itself has not been interpolated.

The data has been displayed relative to a digital Ordnance Survey base plan provided by the client as drawing '*OS base map.dwg*'. The base plan was in the National Grid co-ordinate system and as the survey grids were set-out directly to national grid co-ordinates the data could be simply superimposed onto the base plan in the correct position.

X-Y trace plots were examined for all of the data and overlain onto the greyscale plot to assist in the interpretation, primarily to help identify dipolar responses that will probably be associated with surface / near-surface iron objects. However, X-Y trace plots have not been presented here as they do not show any additional anomalies that are not visible in the greyscale data. A digital drawing showing the X-Y trace plot overlain on the greyscale plot is provided in the digital archive.

All isolated responses have been assessed using a combination of greyscale and X-Y trace plots. Only the stronger responses, or those that could have archaeological potential, have been shown on the interpretation.

Anomalies associated with agricultural practices are present in the data but each individual anomaly has not been shown on the interpretation. Instead the general orientation of the agricultural regime is indicated.

The data was examined over several different ranges during the interpretation to ensure that the maximum information possible was obtained from the data.

The anomalies have been categorised based on the type of response that they exhibit and an interpretation as to the cause(s) or possible cause(s) of each anomaly type is also provided.

A general discussion of the anomalies is provided for the entire site.

The geophysical interpretation drawing must be used in conjunction with the relevant results section and appendices of this report.

4. RESULTS

4.1 General

The data quality across the majority of the survey area is good allowing the data to be viewed at a narrow range of readings to better identify weak anomalies. There are several areas that have a more disturbed magnetic background but this is due to the presence of magnetic material in the topsoil or sub-surface, rather than low data quality.

There are responses associated with probable agricultural features in the data, a large number of weak diffuse trends of uncertain origin and linear anomalies of uncertain origin but none of the responses are indicative of definite archaeological features.

The agricultural responses are quite weak and diffuse but it is not certain if this because the soils have a weak magnetic susceptibility, in which case potential archaeological features may be difficult to identify, or because the agricultural features have been truncated / eroded.

The categories of anomaly, and their possible causes, which have been identified by the survey are discussed in detail below.

4.2 Dipolar responses

Dipolar responses are those that have a sharp variation between strongly positive and negative components. In the majority of cases dipolar responses are usually caused by modern ferrous features / objects, although fired material (such as brick), some ferrous or industrial archaeological features and strongly magnetic gravel could also produce dipolar responses. All of the dipolar responses at this site are believed to be non-archaeological in origin.

There are numerous **isolated dipolar responses** (iron spikes) across the survey area that are indicative of ferrous or fired material on or near to the surface. The isolated responses are often caused by small objects, such as spent shotgun cartridges, iron nails and horseshoes or pieces of modern brick or pot. Archaeological artefacts can also produce this type of response but unless there is strong supporting evidence to the contrary they are assumed not to be of archaeological significance. As such this type of anomaly has not been shown on the interpretation.

There are several areas containing strong or numerous dipolar responses (**magnetic disturbance**). This type of anomaly is usually caused by concentrations of ferrous or fired material and are often found adjacent to field boundaries where such material tends to accumulate. If an area of magnetic disturbance is located away from existing field boundaries then it could indicate a former field boundary, several large isolated objects in close proximity, an area where modern material has been tipped or an infilled cut feature, such as a quarry pit. Areas of dipolar response can occasionally be caused by features / material associated with archaeological industrial activity but they are usually caused by modern activity. Responses in areas of magnetic disturbance can sometimes be so strong that archaeological features located beneath them may not be detected.

Above ground metallic or strongly magnetic features, such as fences, gates, pylons and buildings can produce very strong dipolar responses. The strength of magnetic response from these features is such that any sub-surface features located in their vicinity may not be detected.

There are several areas where very strong responses, from modern features, dominate the data for a significant distance beyond the feature. The extent of these areas have been shown as a **limit of very strong response**. It is possible much of the area encompassed by these anomalies may not actually contain a modern feature or disturbed ground but it should be recognised that archaeological features located within these areas will not have been detected.

4.3 Linear / curvi-linear anomalies (probable agricultural)

The survey area contains two series of **weak, broadly parallel positive linear** anomalies. These responses are probably associated with agricultural regimes. The faint vestiges of possible ridge and furrow were visible aligned north to south and it is possible that the series of faint responses on this alignment is associated with this, although they could also be caused by a more modern ploughing regime. The east to west series are probably associated with a relatively modern ploughing regime.

The general alignment of the agricultural anomalies has been shown on the interpretation drawing but individual anomalies have not been shown.

4.4 Linear / curvi-linear trends

There are a large number of linear and curvi-linear responses that are weak, irregular or discontinuous. These anomalies have been categorised as **trends** as it is not certain what their cause is or even if they are associated with definite features.

Some of the trends appear to form regular patterns or shapes but the responses are too weak and diffuse to determine their origin with any certainty. It is possible that they are caused by sub-surface features, but even in this case they could be associated with natural fissures or variations in the geology rather than being anthropogenic. It is also possible that many of the trends are caused by pedological variations associated with the two crossing agricultural regimes.

4.5 Isolated positive or enhanced responses

Isolated positive or enhanced responses can occur if the magnetism of a feature, area or material has been enhanced or if a feature is naturally more magnetic than the surrounding material. It is often difficult to determine which of these factors causes any given responses and so the origin of this type of anomaly can be difficult to determine. They can have a variety of causes including geological variations, infilled archaeological features, areas of burning (including hearths), industrial archaeological features such as kilns or deeper buried ferrous material and modern fired material.

The large number of isolated responses and lack of an obvious pattern to their distribution suggests that these anomalies are probably associated with geological / pedological variations. As such only the stronger responses have been shown on the interpretation.

There are several larger or stronger areas of positive / enhanced response around the edges of the survey area. It is not certain if these are caused by sub-surface features / variations or if they are a product of strongly magnetic modern features adjacent to the survey area.

4.6 Positive or enhanced linear / curvi-linear anomalies

Positive magnetic anomalies indicate an increase in magnetism and if the resulting anomaly is linear or curvi-linear then this can indicate the presence of a man-made feature. **Positive or enhanced linear / curvi-linear** anomalies can be associated with agricultural activity but they can also be caused by ditches that are infilled with magnetically enhanced material and as such can indicate the presence of archaeological features.

The positive linear anomalies at this site are located around the edges of the survey area. There are other strong responses in these areas and it is not certain if the linear anomalies are caused by sub-surface features / variations or if they are a product of strongly magnetic modern features adjacent to the survey area. If the responses are caused by sub-surface features then it is possible that they are archaeological in origin. However, the strength and regularity of the anomalies is more suggestive of modern features.

5. DISCUSSION AND CONCLUSIONS

The majority of the anomalies identified by this survey are thought to relate to agricultural practice / features, modern material / objects or geological / pedological variations.

There are several areas where very strong responses or magnetic disturbance from modern features dominate the surrounding data. It should be recognised that the strength of the strong responses could mask anomalies from other sub-surface features in the area.

The agricultural responses that are present are quite weak and diffuse but it is not certain if this is because the soils have a weak magnetic susceptibility, in which case potential archaeological features may be difficult to identify, or because the agricultural features have been truncated / eroded. If the soils have a low magnetic susceptibility then it is possible that the weaker, diffuse anomalies could be associated with infilled features.

A number of other anomalies have been identified whose cause cannot be determined. An archaeological origin cannot be completely ruled out for many of these but without supporting evidence it is considered more likely that the majority of these are caused by natural magnetic variations or modern features. In some cases it is not certain if an anomaly is caused by sub-surface features / variations or if it is a product of strongly magnetic modern features adjacent to the survey area. If the responses are caused by sub-surface features then it is possible that they have an archaeological origin, although the strength and regularity of the anomalies is more suggestive of modern features.

It should be noted that a geophysical survey does not directly locate sub-surface features - it identifies variations or anomalies in the background response caused by features. The interpretation of geophysical anomalies is often subjective and it is rarely possible to identify the cause of all such anomalies. Not all features will produce a measurable anomaly and the effectiveness of a geophysical survey is also dependant on the site-specific conditions. The main factors that may limit whether a feature can be detected are the composition of a feature, its depth and size and the surrounding material. It is not possible to guarantee that a geophysical survey will identify all sub-surface features. Confirmation on the identification of anomalies and the presence or absence of sub-surface features can only be achieved by intrusive investigation.

REFERENCES

D. Elsworth, Greenlane Archaeology Ltd, 2014, *pers. comm.* General archaeological background to the site

British Geological Survey, 2014, online resource - www.bgs.ac.uk

APPENDIX 1

Magnetic survey: technical information

1.1 Theoretical background

- 1.1.1 Magnetic instruments measure the value of the Earth's magnetic field; the units of which are nanoTeslas (nT). The presence of surface and sub-surface features can cause variations or anomalies in this magnetic field. The strength of the anomaly is dependent on the magnetic properties of a feature and the material that surrounds it. The two magnetic properties that are of most interest are magnetic susceptibility and thermoremnant magnetism.
- 1.1.2 Magnetic susceptibility indicates the amount of ferrous (iron) minerals that are present. These can be redistributed or changed (enhanced) by human activity. If enhanced material subsequently fills in features such as pits or ditches then these can produce localised increases in magnetic responses (anomalies) which can be detected by a magnetic gradiometer even when the features are buried under additional soil cover.
- 1.1.3 In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of topsoils, subsoils and rocks into which these features have been cut which causes the most recognisable responses. This is primarily because there is a tendency for magnetic ferrous compounds to become concentrated in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected. Less magnetic material such as masonry or plastic service pipes which intrude into the topsoil may give a negative magnetic response relative to the background level. The strength of magnetic responses that a feature will produce will depend on the background magnetic susceptibility, how rapidly the feature has been infilled, the level and type of human activity in the area and the size and depth of a feature. Not all infilled features can be detected and natural variations can also produce localised positive and negative anomalies.
- 1.1.4 Thermoremnant magnetism indicates the amount of magnetism inherent in an object as a result of heating. Material that has been heated to a high temperature (fired), such as brick, can acquire strong magnetic properties and so although they may not appear to have a high iron content they can produce strong magnetic anomalies
- 1.1.5 The magnetic survey method is highly sensitive to interference from surface and near-surface magnetic 'contaminants'. Surface features such as metallic fencing, reinforced concrete, buildings or walls all have very strong magnetic signatures that can dominate readings collected adjacent to them. Identification of anomalies caused by sub-surface features is therefore more difficult, or even impossible, in the vicinity of surface magnetic features. The presence of made ground also has a detrimental effect on the magnetic data quality as this usually contains magnetic material in the form of metallic scrap and brick. Identification of features beneath made ground is still possible if the target feature is reasonably large and has a strong magnetic response but smaller features or magnetically weak features are unlikely to be identified.
- 1.1.6 The interpretation of magnetic anomalies is often subjective and it is rarely possible to identify the cause of all magnetic anomalies. Not all features will produce a measurable magnetic response and the effectiveness of a magnetic survey is also dependant on the site-specific conditions. The main factors that may limit whether a feature can be detected are the

composition of a feature, its depth and size and the surrounding material. It is not possible to guarantee that a magnetic survey will identify all sub-surface features.

- 1.1.7 Most high resolution, near surface magnetic surveys utilise a magnetic gradiometer. A gradiometer is a hand-held instrument that consists of two magnetic sensors, one positioned directly above the other, which allows measurement of the magnetic gradient component of the magnetic field. A gradiometer configuration eliminates the need for applying corrections due to natural variations in the overall field strength that occur during the course of a day but it only measures relative variations in the local magnetic field and so comparison of absolute values between sites is not possible.
- 1.1.8 Features that are commonly located using magnetic surveys include archaeological ditches and pits, buried structures or foundations, mineshafts, unexploded ordnance, metallic pipes and cables, buried piles and pile caps. The technique can also be used for geological mapping; particularly the location of igneous intrusions.

1.2 Instrumentation

A Bartington Grad601-2 magnetic gradiometer was used for the magnetic survey. The Bartington Grad601-2 is a dual sensor instrument, incorporating two Grad-01-1000 gradiometers set at a distance of 1 m apart.

1.3 Survey methodology

- 1.3.1 The magnetic survey was carried out on a series of regular 30 m grids. Data was collected on zig-zag profiles (walking along a profile and then returning up the adjacent profile in the opposite direction) that were 2 m apart (the dual sensor array means that this equates to 1 m profile intervals). All data was collected at 0.25 m and stored in the instrument for download at the end of the survey.
- 1.3.2 Readings were taken on 100 nT range (0.1 nT sensitivity). The instrument was balanced and 'zeroed' at a base station that was established on site in a magnetically quiet and uniform location. The instrument was checked for electronic and mechanical drift at this base station at regular intervals during the course of the survey.
- 1.3.3 Major grid points on the survey areas were established using a Sokkia GRX-1 VRS RTK GNSS system direct to the Ordnance Survey national grid system, using the UKO OSTN2 projection, to an accuracy better than 0.03 m. Bamboo canes or tent pegs were used to mark the grid points. Intermediate grid points were established using tape measures and the position of each profile was established by stringing either a pre-marked rope or a 100 m tape measure between grid points. Bamboo canes were then used to mark profiles and the operator walked between these at a constant pace.
- 1.3.4 Bamboo canes or tent pegs were used to mark the grid points. Intermediate grid points were established using tape measures and the position of each profile was established by stringing either a pre-marked rope or a 100 m tape measure between grid points. Bamboo canes were then used to mark profiles and the operator walked between these at a constant pace.

1.4 Data processing, presentation and interpretation

- 1.4.1 The Bartington gradiometer data was downloaded and gridded using Archaeosurveyor v 1.5.13.

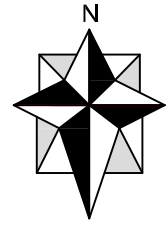
- 1.4.2 Where required the data was destriped and destaggered to remove errors caused by instrument drift and heading errors. This data has been classed as minimally processed data as no other processing steps were used.
- 1.4.3 The following processing schedule was applied to all data presented within the report.
- Zero median sensor
 - Destagger (selected grids) - outbound and inbound -2
 - The data presented in the greyscale plots has been 'smoothed' using the Grad. Shade option clipped at -3 nT to 3 nT.
- 1.1.1. The data was exported as raster images (PNG files), and are presented in greyscale format at 1:1000.
- 1.4.4 The data has been displayed relative to a digital Ordnance Survey base plan provided by the client as drawing '*OS base map.dwg*'. The base plan was in the National Grid co-ordinate system and as the survey grids were set-out directly to national grid co-ordinates the data could be simply superimposed onto the base plan in the correct position.
- 1.4.5 The anomalies have been categorised based on the type of response that they have and an interpretation as to the cause(s) or possible cause(s) of each anomaly type is also provided.
- 1.4.6 Several different ranges of data were used in the interpretation to ensure that the maximum information possible is obtained from the data.
- 1.4.7 X-Y trace plots were examined for all of the data and overlain onto the greyscale plot to assist in the interpretation, primarily to help identify dipolar responses that will probably be associated with surface / near-surface iron objects. X-Y trace plots have not been used in the report as they do not show any additional anomalies that are not visible in the greyscale data. A digital drawing showing the X-Y trace plot overlain on the greyscale plot has been provided in the digital archive.
- 1.4.8 All isolated responses have been assessed using a combination of greyscale and X-Y trace plots. Only the stronger responses, or those that could have archaeological potential, have been shown on the interpretation.
- 1.4.9 Anomalies associated with agricultural activity are present in the data. The general orientation of these has been shown on the interpretation but each individual anomaly has not been shown.
- 1.4.10 The greyscale plots and the accompanying interpretations of the anomalies identified in the magnetic data are presented as 2D AutoCAD drawings. The interpretation is made based on the type, size, strength and morphology of the anomalies, coupled with the available information on the site conditions. Each type of anomaly is displayed in separate, easily identifiable layers annotated as appropriate.

1.5 Limitations of magnetic surveys

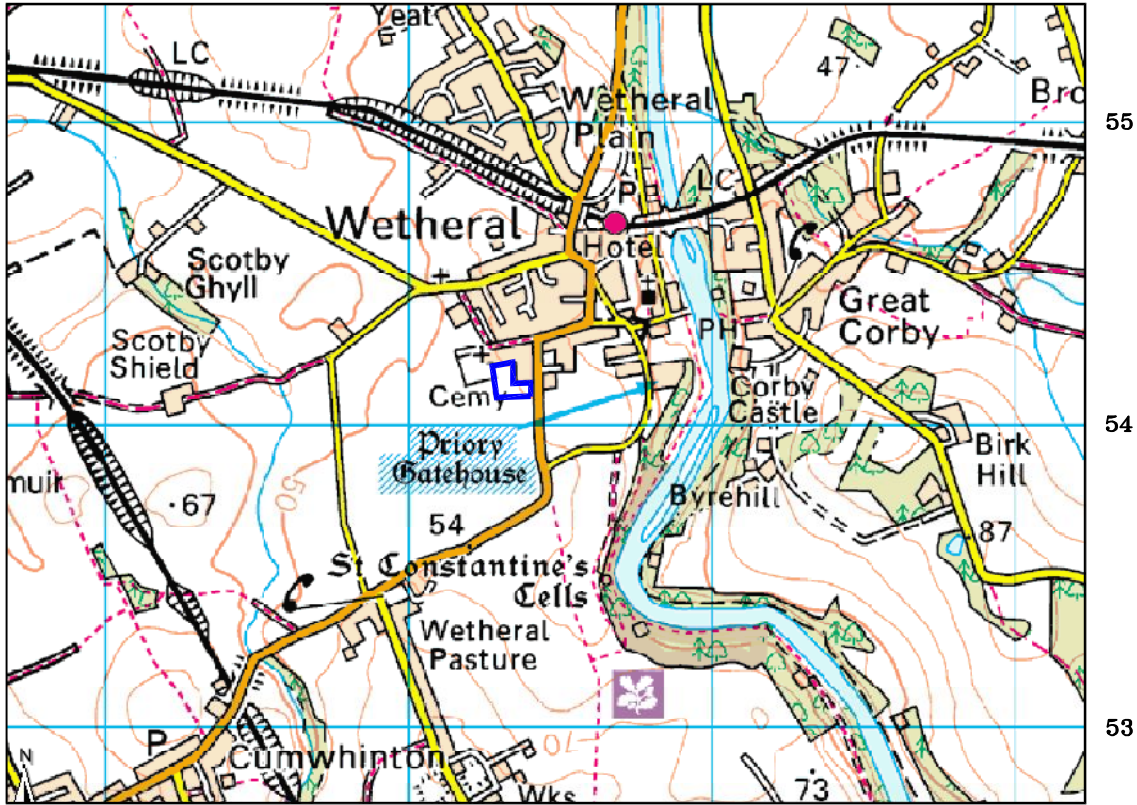
- 1.5.1 The magnetic survey method requires the operator to walk over the site at a constant walking pace whilst holding the instrument. The presence of an uneven ground surface, dense, high or mature vegetation or surface obstructions may mean that some areas cannot be surveyed.
- 1.5.2 The depth at which features can be detected will vary depending on their composition, size, the surrounding material and the type of magnetometer used for the survey. In good conditions large, magnetic targets, such as buried drums or tanks can be located at depths of

more than 4 m. Smaller targets, such as buried foundations or archaeological features can be located at depths of between 1 m and 2 m.

- 1.5.3 A magnetic survey is highly sensitive to interference from surface and near-surface magnetic 'contaminants'. Surface features such as metallic fencing, reinforced concrete, buildings or walls all have very strong magnetic signatures that can dominate readings collected adjacent to them. Identification of anomalies caused by sub-surface features is therefore more difficult or even not possible in the vicinity of surface and near-surface magnetic features.
- 1.5.4 The presence of made ground also has a detrimental effect on the magnetic data quality as this usually contains magnetic material in the form of metallic scrap and brick. Identification of features beneath made ground is still possible if the target feature is reasonably large and has a strong magnetic response but smaller features or magnetically weak features are unlikely to be identified.
- 1.5.5 It should be noted that anomalies that are interpreted as modern in origin may be caused by features that are present in the topsoil or upper layers of the subsoil. Removal of soil to an archaeological or natural layer can therefore remove the feature causing the anomaly.
- 1.5.6 A magnetic survey does not directly locate sub-surface features - it identifies variations or anomalies in the local magnetic field caused by features. It can be possible to interpret the cause of anomalies based on the size, shape and strength of response but it should be recognised that a magnetic survey produces a plan of magnetic variations and not a plan of all sub-surface features. Interpretation of the anomalies is often subjective and it is rarely possible to identify the cause of all magnetic anomalies. Geological or pedological (soil) variations or features can produce responses similar to those caused by man-made (anthropogenic) features.
- 1.5.7 Anomalies identified by a magnetic survey are located in plan. It is not usually possible to obtain reliable depth information on the features that cause the anomalies.
- 1.5.8 Not all features will produce a measurable magnetic response and the effectiveness of a magnetic survey is also dependant on the site-specific conditions. It is not possible to guarantee that a magnetic survey will identify all sub-surface features. A magnetic survey is often most-effective at identifying sub-surface features when used in conjunction with other complementary geophysical techniques.



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SITE LOCATION

SCALE



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Scale [A4 Sheet]	Drawing	Status
AS SHOWN	ARC_1194_433_01	FINAL

Client	GREENLANE ARCHAEOLOGY LTD ULVERSTON
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Site	SITE OFF STEELES BANK WETHERAL
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Title	SITE LOCATION MAP
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Job No	ARC_1194_433
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Chk.	NF	Drawn	CW
		Date	12/02/2014

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Scale	(A3 sheet)	Drawing	Status
1:1000		ARC_1194_433_02	FINAL

Client
GREENLANE ARCHAEOLOGY LTD
ULVERSTON

Site
SITE OFF STEELES BANK
WETHERAL

Title
GREYSCALE PLOT OF
MAGNETIC GRADIENT DATA

Job No
ARC_1194_433

Surveyed	MC, KK, SV	Drawn	MW
Chk.	NF	Date	12/02/2014





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KEY

— SITE BOUNDARY



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Scale (A3 sheet) Drawing Status
1:1000 ARC_1194_433_03 FINAL

Client
GREENLANE ARCHAEOLOGY LTD
ULVERSTON

Site
SITE OFF STEELES BANK
WETHERAL

Title
INTERPRETATION OF MAGNETIC
GRADIENT DATA

Job No
ARC_1194_433

Surveyed Drawn MW
Chk. NF Date 12/02/2014

