# Full Sutton to Stamford Bridge Pipeline

# Geophysical Survey Report

# For Morrison Water Services

October 2022

# Ecus Ltd

**Report to**: Morrison Water Services

**Report Title:** Full Sutton to Stamford Bridge Pipeline
Geophysical Survey Report

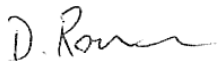
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# FULL SUTTON TO STAMFORD BRIDGE

# EAST RIDING OF YORKSHIRE

# GEOPHYSICAL SURVEY REPORT

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# FULL SUTTON TO STAMFORD BRIDGE

# EAST RIDING OF YORKSHIRE

# GEOPHYSICAL SURVEY REPORT

## 1.0 SUMMARY

On behalf of Morrison Water Services and Yorkshire Water, Ecus Ltd carried out geophysical survey during September and October 2022 within a c.14ha proposed pipeline corridor extending between Full Sutton and Stamford Bridge, East Riding of Yorkshire. The entire pipeline will pass through an archaeologically rich landscape containing significant remains representing several periods.

Specifically, geophysical survey indicates that the route will interact with cropmarks representing Iron Age trackways and associated enclosures. Groundworks may also expose up to three Roman roads linked with *Derventio* Roman town (Scheduled Monument NHLE 1416328), along with additional traces of contemporary activity at the edge of the settlement. There is also the potential to encounter further remains where the pipeline follows a modern road that bisects the monument.

The proposed route also traces the southern edge of the Registered Battlefield site attributed to the Battle of Stamford Bridge in 1066 (NHLE 1000035). While the survey did not obviously identify any features or materials attributable to the event, it is recognised that insubstantial remains of historical importance can be masked by widespread ridge and furrow earthworks, and by magnetic anomalies of later origin, so their potential discovery cannot be ruled out. Numerous additional features indicated by geophysical anomalies are distributed across the survey area and are currently of unknown date and significance.

On the basis of desk-based study and geophysical survey, it is anticipated that the local planning authority will recommend archaeological monitoring of the complete pipeline corridor and any launch/reception pits, and that archaeological remains discovered during the works are investigated appropriately.

## 2.0 INTRODUCTION

2.1 Ecus Ltd was commissioned by Morrison Water Services, on behalf of Yorkshire Water, to undertake an archaeological geophysical survey of c.14ha of proposed pipeline corridor between Full Sutton and Stamford Bridge, East Riding of Yorkshire (between NGR: SE 70674 55333 and SE 74089 55289; Fig. 1). The work was undertaken to support the installation of a new wastewater main. The new pipe will require planning permission from East Riding of Yorkshire Council and Ryedale District Council (North Yorkshire), while other elements of the scheme will be constructed under permitted development rights. The survey was carried out in accordance with an approved Written Scheme of Investigation (NAA 2022) submitted to, and approved by, Kingston upon Hull City Council and the City of York Council. The survey was carried out between the 27th September and the 4th October 2022

## 3.0 LOCATION, TOPOGRAPHY AND GEOLOGY

3.1 The proposed development area (PDA) is located to the west and south of Stamford Bridge, c.11km east of the centre of York. The scheme follows the west and south edges of Stamford Bridge village before turning east towards Full Sutton. The survey corridor extends through agricultural fields.

3.2 The PDA follows a relatively level route westwards from Full Sutton, along the valley of Millsike Beck, at an average height of c.16m above Ordnance Datum (aOD) before descending to c.10m aOD adjacent to the River Derwent, west of Stamford Bridge.

3.3 Bedrock to the east of Stamford Bridge consists of Triassic mudstone of the Mercia Mudstone Group, while that beneath Stamford Bridge and to the west and south comprises Permian and Triassic sandstone of the Sherwood Sandstone Group (BGS 2022). Superficial deposits across most of the study area comprise Quaternary silty clay of the Thorganby Clay Member, although Stamford Bridge is built on silty, gravelly sand of the Naburn Sand Member. The floodplain of the River Derwent at the west side of the study area is covered in clay, silt, sand and gravel alluvium. The soils throughout most of the study area are mapped as being of the Worcester Association, being slowly permeable reddish clayey soils over mudstone and typically used for dairying and stock rearing, although in drier areas suited to winter cereals, as in the Stamford Bridge area (Soil Survey of England and Wales 1983; Jarvis *et al*. 1984, 314–5). At the west end of the route, adjacent to the River Derwent, there are soils of the Everingham Association: deep stoneless sandy soils suited to cereals and root crops (*ibid*., 190–3).

3.4 The geological conditions are deemed to be suitable for magnetometer survey.

## 4.0 ARCHAEOLOGICAL AND HISTORICAL BACKGROUND

4.1 The archaeological and historical background for the site has been set out in detail in the historic environment desk-based assessment (NAA 2022), extracts of which are included below.

### Designated heritage assets

4.2 There are no World Heritage Sites or Historic Parks and Gardens within the vicinity of the pipeline scheme.

4.3 There is one Scheduled Monument close by: *Derventio* Roman town (National Heritage List for England 1416328). This is located to the south of Stamford Bridge on both banks of the River Derwent.

4.4 To the south-east of Stamford Bridge there is a Registered Battlefield: Battle of Stamford Bridge (NHLE 1000035).

4.5 There are 14 Listed Buildings within the near-vicinity of the scheme. Two of these, Stamford Bridge Railway Viaduct (NHLE 1083841) and the road bridge over the River Derwent (NHLE 1346426), are listed Grade II*, while the others are all Grade II. With the exception of the railway viaduct, all of the Listed Buildings are located away from, and will not be impacted by the proposed pipeline route.

### Conservation Area

4.6 The core of Stamford Bridge is designated as a Conservation Area (East Riding of Yorkshire Council 2009) but is not affected by the pipeline scheme.

### Previous Archaeological Investigations

4.7 The Humber Historic Environment Record (HER) records 33 previous archaeological interventions within, or encompassing parts of, the study area. One other intervention has been noted by the current study.

4.8 Two previous interventions close to the west end of the pipeline route have produced significant results. In 1995, fieldwalking (surface collection of artefacts) was carried out by the Humber Archaeology Partnership in a field on the west side of Low Catton Road (EHU 2150). This work recovered a significant quantity of Roman pottery of 1st–4th-century date, mainly concentrated on the higher ground in the east part of the field closest to Low Catton Road and the pipeline route.

4.9 The second intervention was carried out in 2003 by Northern Archaeological Associates along the route of a new pipeline forming part of the Etton Wold Water Treatment Works Nitrate Reduction Scheme. The work included a desk-based assessment, geophysical survey and excavation along a route running to the south and south-east of Stamford Bridge (NAA 2007). The pipeline south-west from Moor Lane ran westwards parallel to the north bank of Millsike Beck, crossing High Catton and Low Catton Roads. It then continued west to the edge of the River Derwent floodplain where it turned northwards before crossing the river adjacent to the south-western corner of Forresters Walk. The work revealed significant archaeological remains including a Bronze Age burnt mound to the east of High Catton Road and extensive remains of *Derventio* Roman town (NHLE 1416328) to the west of Low Catton Road.

4.10 Two small-scale watching briefs were undertaken in Stamford Bridge, close to the west end of the pipe route at 87 Low Catton Road (EHU 2791) and 65 Low Catton Road (EHU 1576). Neither identified any archaeological features or artefacts.

4.11 A historic environment desk-based assessment for a selection of potential pipeline routes was produced by NAA (2022).

**Prehistoric period (500,000BC – AD43)**

4.12 The HER only records a single early prehistoric find within the study area: a Neolithic flint arrowhead in the field west of Low Catton Road, which will be traversed by the pipe route. The 2003 pipeline excavations to the south of Stamford Bridge recorded a further 66 pieces, mainly found residually in later features (NAA 2007, 13–14). The material ranged in date from Mesolithic to Early Bronze Age and indicated the presence of a 'background' of such material in the vicinity of Millsike Beck. Single struck flint flakes have also been found by a watching brief on the north bank of the Derwent at Weir Caravan Park (EHU 1156) and, presumably residually, in an otherwise undated ditch by trial trenching near Burtonfields Hall (EHU 3256).

4.13 As noted above, the 2003 pipeline excavation located a Bronze Age burnt mound and associated troughs and pits near the north bank of Millsike Beck to the east of High Catton Road (NAA 2007). Burnt mounds are dumps of discarded stones, which were heated in a fire and then used to heat water in troughs, although there is some disagreement as to whether the resulting heated water was used for cooking or some other activity. Together with local finds of Bronze Age axes recorded on the Portable Antiquities Service database, this suggests that Millsike Beck was a focus for significant Bronze Age activity. From a similar context, a Bronze Age dagger has been recovered from the River Derwent at the north edge of Stamford Bridge.

4.14 The only other heritage asset that could be of Bronze Age date recorded in the study area is a cropmark of what has been interpreted as a Late Bronze Age or Early Iron Age ritual enclosure in a field to the south of the pipeline route between Moor Road and High Catton Road. Within the same field are cropmarks of an undated curvilinear enclosure and field system and two groups of Iron Age square barrows, while more square barrows may be present in the adjacent field to the north-east.

4.15 Most of the evidence for late prehistoric sites within the study area consists of cropmarks recorded from aerial photographs and interpreted as prehistoric on the basis of form or their relationship to other features of known date. Many of the sites were recorded from photographs taken in the 1970s and the sites were no longer visible during the more recent Vale of York Mapping Project carried out by English Heritage, suggesting that some have been disturbed or destroyed by recent agricultural activity.

4.16 South of Moor Lane, adjacent to the east end of the pipeline route, are fragmentary cropmarks of a field system thought to be of Iron Age or Roman date (HA 37, NAA 2022). In the area between Moor Lane and Moor Road crossed by the route are more cropmarks of enclosures and a field system also thought to be of Iron Age or Roman date, while on the north bank of Millsike Beck, east of Moor Road, is an area of cropmarks of enclosures aligned on trackways.

4.17 In the fields adjacent to HMP Full Sutton, there are extensive cropmarks of a sinuous trackway (HA 40, NAA 2022) running northwards, with other marks that could represent parts of an associated field system and an enclosure.

4.18 North of the pipeline route, more cropmarks to the south-east of Stamford Bridge or now covered by it further indicate widespread Iron Age and/or Roman settlement and exploitation of the landscape.

**Romano-British period (AD43 – 410)**

4.19 Since the mid-19th century, finds of Roman objects have hinted at the presence of significant Roman settlement at Stamford Bridge (HA 1, NAA 2022). However, it was not until the 1970s that aerial photography revealed a c.50ha area of linear features to the south of the village. These were indicative of settlement activity focused along a road running from east-northeast to west-southwest and crossing the River Derwent. A second road branched off at SE 7045 5455, running to the north-east below the modern settlement, and is crossed by the pipeline route. The HER records this as being medieval or post-medieval, but modern aerial photographic plotting shows it to be part of the Roman town.

4.20 Other roads are known in the vicinity. The modern A166 approaches the village from the west and has been suggested to follow a Roman road from York, continuing eastwards towards Bridlington, but this is now considered more likely to be a later route (Roman Roads Research Association (RRRA) gazetteer, Margary Road 810). A Roman road has also been suggested running from south-east to north-west, broadly following the line of Moor Lane and leading towards a suggested Roman crossing of the River Derwent at the northern edge of Stamford Bridge village. Cropmarks of a Roman fort have been recorded on the south bank of the Derwent in this area, and an oven was excavated in 1954 in a location corresponding to the north-west fort rampart. A more certain Roman road (HA 53, NAA 2022) has been recorded running to the south-east from immediately east of Stamford Bridge (SE 7740 4870) heading towards Market Weighton (RRRA gazetteer Margary Road 2e). This was identified during the 2003 pipeline works (EHU 4072).

4.21 A number of archaeological fieldwork projects have provided more detail about the settlement, now classified by Historic England as a minor Roman town and thought likely to equate to *Derventio*, mentioned in the Antonine Itinerary. On the west side of the River Derwent, c.13ha of the settlement has been recorded by fieldwalking and monitoring of groundworks, which have recorded a well, enclosure ditches and building foundations dating from the 1st–4th centuries AD (Lawton 1994).

4.22 In addition to aerial photographic evidence, archaeological investigation within the Roman town included fieldwalking in 1995 (EHU 2150) and the 2003 pipeline excavation (EHU 4072). The pipeline, which passed to the south of Stamford Bridge, ran from east to west, lengthways through ‘back-plot’ areas of the Roman town to the south of, and mostly parallel to, the Roman road (NAA 2007). It recorded extensive, but plough-truncated, Roman remains in the area to the west of Low Catton Road, including enclosure ditches, pits, kilns and several burials, the features ranging in date from the 1st–4th centuries. Where the pipeline route turned northwards at the edge of the Derwent floodplain it crossed the line of the Roman road; part of the road agger and surface together with a roadside ditch were investigated. Evidence for a possible bridge over the Derwent in this area is represented by a large stone block, which could have formed part of a bridge abutment.

4.23 There is some evidence that the Roman town extended northwards beyond the scheduled area and beneath part of the modern settlement. This includes cropmarks of a Roman enclosure (now built over) and finds such as a Roman bead.

4.24 Although not included in the HER data, excavation in advance of a housing development on Moor Road in 1998 found a group of cremation burials succeeded by at least two stages of ditched

agricultural enclosures aligned along trackways and dated between the 2nd and 4th centuries (Roe 2001). Small rectangular structures were thought to be of agricultural function and other finds included a wicker-lined pit and a kiln or oven.

4.25 Beyond the Roman town, there is widespread evidence for Roman activity. As noted above, many of the cropmarks of enclosures, trackways and field systems recorded across the local area could be of either Iron Age or Roman date.

**Medieval (AD410 – 1540)**

4.26 No early medieval archaeological remains are recorded in the vicinity of the pipeline route.

4.27 Stamford is Old English for 'stone or stony ford'. The first surviving documentary evidence for Stamford Bridge dates from c.1075 when it was called Stanford brycg (Mills 1998, 323), confirming the early presence of a bridge, although a bridge is also mentioned in some accounts of the Battle of Stamford Bridge, 1066.

4.28 On 25th September 1066, the battle of Stamford Bridge was fought between the invading forces of King Harald Hardrada of Norway and those of King Harold II of England. The main battle is thought to have been fought in the area of Battle Flat to the south-west of the modern settlement (centred on SE 720 553), and the area is now designated a Registered Battlefield (NHLE 1000035). It has been suggested, however, that the Roman bridge 1.3km to the south-west may still have survived in some form at this time, and that the battle could therefore have taken place further to the west (to the south of Stamford Bridge).

4.29 The medieval village of Stamford Bridge probably formed part of the Manor of Catton, which was acquired by the Percy family (East Riding of Yorkshire Council 2009, 8). There is documentary evidence for mills on the Derwent from c.1130–5. Some physical evidence for the medieval village, in the form of occasional archaeological features and potsherds, has been identified during investigations at The Firs on Main Street, Daneswell Garage, the Manor House and at Weir Caravan Park.

4.30 A medieval silver ring has been found just to the south-east of Stamford Bridge.

4.31 Beyond Stamford Bridge, at Burtonfields, the pipeline route passes to the south of an extensive area of cropmarks representing the site of Hundeburton deserted medieval village (HA 68). Aerial photographs show a north–south oriented track at the east side of Hundeburton.

4.32 The villages of Stamford Bridge and Hundeburton remained small, the Poll Tax of 1377 giving them a combined population of only 62. Nevertheless, there is extensive evidence for medieval or early post-medieval agriculture around both settlements in the form of ridge and furrow cultivation surviving as either cropmarks or upstanding earthworks (Fig. 4). Excavation has shown that some ridge and furrow was still in use (or may have been created) in the early post-medieval period. Evidence for ridge and furrow is present in most of the modern fields crossed by the route.

**Post-medieval and modern (AD1540 – present day)**

4.33 The post-medieval period saw increasing development within Stamford Bridge, but Hundeburton was abandoned. Stamford Bridge initially remained small, with only 18 houses recorded in the 1673 Hearth Tax Returns (East Riding of Yorkshire Council 2009), but by 1801 the population had risen to 170 and doubled in the following 50 years. However, even by 1851 it consisted essentially only of properties fronting Main Street (Ordnance Survey 1854a). The First Edition Ordnance Survey map sheets (1854a and b) show that the surrounding landscape had already been Enclosed, with the surviving rural road layout and the same basic field framework as the modern landscape layout but with more divisions creating smaller strip fields. Many of these appear to have been divisions of the earlier ridge and furrow landscape, with some boundaries following the reverse-S shape of the furrows.

4.34 The study area was crossed from north-west to south-east by the line of the (now dismantled) railway running between York and Market Weighton. It was constructed in 1847 for the York and North Midland Railway Company and depicted on the First Edition Ordnance Survey maps of the area (1854a and b). The viaduct across the River Derwent is Listed Grade II*. Material thought to have been dumped during construction of the railway has been found during near the railway line at Brown's Field.

4.35 Of relevance to the current project, during the 19th century, a brickyard and kiln, accompanied by extensive clay pits, were present on the south bank of Millsike Beck at Beachwood House, adjacent to the pipeline route. The site was described as 'Old clay pit' by 1909 (Ordnance Survey 1911b).

4.36 By the early 20th century, there had been only small expansion to Stamford Bridge and the surrounding countryside had changed little (Ordnance Survey 1911a and b). There was some expansion of the village during the first half of the 20th century, particularly the development of Stamford Bridge West in 1931, and some removal of field boundaries to create larger fields in the surrounding area (Ordnance Survey 1953a and b). The settlement has continued to expand to the south-west and east during the latter half of the 20th century and the beginning of the 21st.

**LiDAR**

4.37 2m LiDAR data exists for part of the proposed survey line. A few linear field boundaries are visible within the dataset which may be of archaeological interest.

## 5.0 GEOPHYSICAL SURVEY METHODOLOGY

5.1 All survey work was completed following published standards and guidelines of practice:

- *Yorkshire, the Humber and the North East: A Regional Statement of Good Practice for Archaeology in the Development* Process (SYAS 2018)
- *Code of Conduct: professional ethics in archaeology* (CIfA 2021)
- *Standard and Guidance for Archaeological Geophysical Survey* (CIfA 2020a);
- *Management of Research Projects in the Historic Environment: The MoRPHE Project Managers' Guide* (Historic England 2015);
- *EAC Guidelines for the Use of Geophysics in Archaeology* (Schmidt et al. 2015).

5.2 The objectives of the survey were to:

- undertake a geophysical survey within the agreed areas deemed suitable for data collection within the PDA;
- attempt to identify, record and characterise any subsurface remains within the survey boundary;
- assess the archaeological significance of identified anomalies;
- identify possible concentrations of past activity in order to inform the requirement for any further archaeological investigation at the site.

5.3 The gradiometer survey used Bartington Grad601-2 dual magnetic gradiometer systems with data loggers. Readings were recorded at a resolution of 0.01nT and data was collected with a traverse interval of 1m and a sample interval of 0.25m. The survey data was collected with reference to a site survey grid comprised of individual 30m x 30m squares. The survey was located using Real Time Kinematic (RTK) differential GPS equipment with a positional accuracy of at least 0.1m.

5.4 The processing was undertaken using TerraSurveyor software and consisted of minimal industry standard processing procedures.

5.5 On the greyscale plots (Figures 3–11), positive readings are shown as increasingly darker areas and negative readings are shown as increasingly lighter areas. The interpreted data uses colour coding to highlight specific readings in the survey area (Figures 3-11). In this report, the word

anomaly is used to refer to any outstanding high or low readings forming a particular shape or covering a specific area. Appendix B details the terminology and characterisation of anomalies used for interpreting data.

## 6.0 MITIGATING FACTORS

6.1 Field boundaries comprised fences and hedges. At the time of survey, dry conditions prevailed which should not have had any negative impact on the collected data. Where necessary, a two-metre buffer was observed along metal fences to minimise the effects of magnetic interference on the survey and to help to reduce any masking of potential buried features. Field 10 was omitted to avoid crop damage, and Field 9 and a section of Field 13 were omitted because of the presence of livestock.

6.2 The results of geophysical survey may not reveal all potential archaeology within a survey area, and geological, agricultural and modern features may mask weaker archaeological responses.

## 7.0 RESULTS AND INTERPRETATION

7.1 For convenience and ease of managing survey data, each field was given a field (F) number (Fig. 2).

7.2 Anomalies found within the survey data are listed in Table 2.

***Table 2: Survey anomalies***

| Anomaly | Area | Anomaly type | Description | Interpretation |
|---|---|---|---|---|
| 1 | F2 | Probable archaeology | Roughly circular strong positive anomaly | The anomaly possibly represents a pit feature. |
| 2 | F2 | Possible archaeology | Linear weak positive anomaly with NW to SE orientation | The anomaly is a possible ditch feature of unknown period. |
| 3 | F2 | Possible archaeology | Irregular linear weak positive anomaly | The anomaly is possibly the remains of a ditch or ditches and may indicate an enclosure. |
| 4 | F3 | Possible archaeology | Linear weak positive discontinuous anomaly with roughly NE to SW orientation | This anomaly is a possible ditch feature of unknown period. |
| 5 | F3 | Dipoles | Small concentration of dipolar anomalies | Because of proximity to a Roman road (6) just beyond a Roman |

| | | | | |
|---|---|---|---|---|
| | | | | settlement these anomalies have the potential to relate to graves. |
| 6 | F3 | Probable archaeology | Two parallel linear weak positive anomalies with roughly NE to SW orientation | The anomaly appears to be the NE to SW oriented Roman road leading northwards out of the Roman town (HA 1, NAA 2022) |
| 7 | F4 | Possible archaeology | Small strong positive circular anomaly | The anomaly may indicate a pit type feature. |
| 8 | F4 | Possible archaeology | Oval strong positive anomaly | The anomaly may indicate a pit type feature. |
| 9 | F4 | Probable archaeology | Large strong positive oval anomaly with weak negative halo | Feature could be the remains of a pit or hearth of unknown date. |
| 10 | F5 | Possible archaeology | Small strong positive circular anomaly | The anomaly may indicate a pit feature. |
| 11 | F5 | Possible archaeology | Two small strong positive circular anomalies | The anomalies may indicate pit type features. |
| 12 | F5 | Possible archaeology | Weak negative curvilinear anomaly. | Feature may indicate an infilled ditch of unknown date. |
| 13 | F5 | Possible archaeology | Small strong positive oval anomaly | The anomaly may indicate a pit type feature. |
| 14 | F6 | Possible archaeology | Linear weak negative anomaly with roughly NE to SW orientation | Anomaly may just be a surface effect but could indicate an infilled ditch of unknown date. |
| 15 | F6 | Possible archaeology | Linear weak positive anomaly with roughly NW to SE orientation | Anomaly may indicate an infilled ditch of unknown date. |
| 16 | F6 | Possible archaeology | Oval weak positive anomaly | The anomaly may indicate a pit type feature. |
| 17 | F7 | Possible archaeology | Oval weak positive anomaly | The anomaly may indicate a pit type feature. |
| 18 | F7 | Possible archaeology | Weak linear positive anomaly | The anomaly may represent the edge of a Roman road where it passed Millsike Beck. |
| 19 | F12 | Possible archaeology | Oval weak positive anomaly | The anomaly may indicate a pit feature relating to cropmarks of possible Iron Age or Roman enclosures (HA 37, NAA 2022) |
| 20 | F12 | Possible archaeology | Three oval weak positive anomaly | These anomalies may indicate pit features. |
| 21 | F12 | Possible archaeology | Weak positive linear anomaly | Feature may indicate an infilled ditch or gully possibly associated with Iron Age/roman cropmarks (HA37, NAA 2022). |
| 22 | F13 | Possible archaeology | Small strong positive circular anomaly | The anomaly may indicate a pit feature. |
| 23 | F13 | Possible archaeology | Small strong positive circular anomalies and a week positive linear anomaly | Feature may indicate an infilled ditch or gully along the line of a possible Iron Age trackway visible on cropmarks (Google Earth 2018). |

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|---|---|---|---|---|
| 24 | F13 | Probable archaeology | A strong positive roughly circular larger pit surrounded by four smaller possible pits | The anomaly possibly represents a pit cluster feature. Though its location potentially relates to a track or hollow-way leading south from a DMV (HA68, NAA 2022). |
| 25 | F14 | Possible archaeology | Small strong positive circular anomaly | The anomaly may indicate a pit feature. |
| 26 | F14 | Possible archaeology | Three small strong positive circular anomalies | These anomalies are likely indicating pits or a pit alignment, possibly associated with a former fence line. |
| 27 | F14 | Possible archaeology | Small strong positive circular anomaly | The anomaly may indicate a pit feature. |
| 28 | F14 | Possible archaeology | Small strong positive circular anomaly | The anomaly may indicate a pit feature. |
| 29 | F15 | Possible archaeology | Small weak positive circular anomaly | The anomaly may indicate a pit feature. |
| 30 | F15 | Possible archaeology | Small strong positive circular anomaly | The anomaly likely indicates a pit feature or fence post location. |
| 31 | F15 | Possible archaeology | Small strong positive circular anomaly | The anomaly likely indicates a pit feature or fence post location. |
| 32 | F15 | Possible archaeology | Weak curvilinear anomaly | The anomaly may represent portion of a curvilinear ditch feature. |
| 33 | F15 | Possible archaeology | Small strong positive circular anomaly | The anomaly likely indicates a pit feature or fence post location. |

## 8.0 DISCUSSION

8.1 The geophysical survey produced usable data of the fields under study, though some areas are obscured by the masking effect of highly magnetic readings.

8.2 F1 was located on the west bank of the River Derwent. No features of archaeological origin were detected within the field (Fig. 3), though there are large areas of magnetic masking visible.

8.3 F2 was located along west side of Stamford Bridge and contained three features that may be of archaeological interest. A probable pit (1), a linear feature (2) on the same line as some ridge and furrow and possibly associated with it were recorded. A possible T-shaped boundary junction (3) on a different alignment to current boundaries and possibly indicating an enclosure or field system (Figure 3). Areas of strong magnetic masking towards the southern end of the area may relate to previous services or to the Etton Wold to Stamford Bridge 2003 Pipeline.

8.4 F3 was located along the west side of Stamford Bridge and contained relatively few features within the survey area. A possible ditch (4) is located in the northeast corner and is of unknown date but is on a similar alignment to features associated with the Roman town of *Derventio* (HA1, NAA2022) immediately to the south. Two parallel linear weak positive anomalies (6) with roughly north-east to south-west orientations are probably the continuation of the Roman road leading

north-east out of the Roman town. There are some dipolar anomalies (5) immediately west of the line of the Roman road, which indicate ferrous responses, these may just be rubbish within the plough soil, but because of their location and grouping it is possible they may relate to ferrous objects within Roman graves outside of the settlement along the line of the Roman road (Fig. 4). Other features within the surveyed area are of agricultural origin, mostly ridge and furrow to the west and some more modern ploughing to the east.

8.5 F4 was located to the south of some allotments, to the southwest of Stamford Bridge. The field contains one probable pit (9) and two possible smaller pits (7, 8) of unknown date (Fig. 5), along with some hints of ridge and furrow.

8.6 F5 was located to the south of Smackdam Beck, between area F4 and High Catton Road to the east. Three pit-like features (10, 11, 13) were identified within the field. There is one faint curvilinear feature (12), which may be the remnant of field systems or a ditch. Faint, straight parallel linear features visible within the field can be attributed to agricultural practices including ridge and furrow and modern ploughing (Fig. 5).

8.7 F6 was located east of High Catton Road, south of Millsike Beck and extended east to the field boundary. Two faint linear trends (14, 15) were identified, which could be agricultural but may relate to underlying ditch-type features. A possible pit (16) was recorded towards the eastern field boundary (Fig. 6).

8.8 F7 was located east of F6 and went around a constructed pond south of Millsike Beck. A single possible pit (17) along with faint agricultural features were detected within the survey area. A weak linear feature (18) is in the vicinity of the line of a Roman road and could be associated (Fig. 6).

8.9 F8 was located between F7 and the abandoned railway line. Only agricultural features were detected within the field (Fig. 7).

8.10 F9 was not surveyable due to livestock in the field (Fig. 7).

8.11 F10 was not surveyable due to a crop in the field (Fig. 7).

8.12 F11 was located along the north side of Winchmore, no features of archaeological origin were recorded within the field. A possible service may exist towards the west end of the field. The field shows evidence of possible soil improvements, visible as black/white noise (Fig. 8).

8.13 F12 was located east of F11. Four pit-like features (19, 20) were identified within the field to the southeast of some cropmarks of a possible Iron Age or Roman period enclosure (HA 37, NAA 2022). One curvilinear ditch or gully feature (21) was also detected within the field; again potentially relating to HA 37 (NAA 2022) (Fig. 8).

8.14 F13 was located east of F12 and extended east towards a pig farm. One small possible pit-type anomaly (22) was recorded towards the west end of the field. Two other possible pits with two small faint straight linear features (23) may relate to a trackway visible on cropmarks visible on Google Earth imagery of 2017. A larger probable pit surrounded by four smaller possible pits (24) is located at the eastern end of the field, which potentially relates to a track or hollow-way leading south from the Deserted Medieval Village of Hundeburton (HA 68, NAA 2022). Other features consisted of straight linear features of more recent agricultural origin (Fig. 9).

8.15 F14 was located along the southern edge of the pig farm alongside Moor Lane. The western edge of the pig farm was not surveyable because of livestock. In total, six pit features (25, 26, 27, and 28) were detected. These pits form a straight line and may indicate a former fence line (Fig. 10). Some evidence of modern agricultural ploughing was also seen along with some magnetic masking along the northern end, which may relate to a trackway or a service alongside it.

8.16 F15 was the eastern-most stretch of the surveyable area. Four possible pits (29, 30, 31 and 33) roughly follow the southern edge of the survey area and could represent old fence posts. One fragmented faint, curvilinear feature (32) may be remains of a ditch extending outside the area (Fig. 11). A number of cropmarks, possibly relating to Iron Age trackways (HA 40, NAA 2022) have been recorded immediately north of the survey area, but could not be seen within the survey data.

8.17 Overall, the survey has shown that potential archaeological features are visible within the survey data. The line of three Roman roads cross the survey areas; of these only the one within F3 presents as clear anomalies. The one in F7 is unclear but potentially crosses a watercourse and may have changed alignment frequently to accommodate an active beck. The one in F9 was unconfirmed as the field was not surveyed. Cropmark evidence of possible Iron Age trackways has been recorded in F13 and F15, but only F13 shows potentially associated anomalies. Intersecting linears (3) are visible in F2 forming a ditch T junction or possible enclosure on a different alignment to modern boundaries. No other clear evidence suggestive of settlement was found, though anomalies 19 to 21 in F12 may relate to an adjacent Iron Age cropmark enclosure. The majority of the remaining identified anomalies relate to possible pits and ditches of unknown date, along with evidence of ridge and furrow and later agricultural ploughing regimes. Masking anomalies of differing sizes are visible in most of the fields, these appear to be caused by a

combination of metallic fencing, buried services and isolated dipoles. It is not clear whether any of the magnetic masking anomalies have anything to do with the Registered Battlefield.

8.18 On the basis of desk-based study and this geophysical survey, it is anticipated that the local planning authority will recommend archaeological monitoring of the complete pipeline corridor and any launch/reception pits, and that archaeological remains discovered during the works are investigated appropriately.

## 9.0 STORAGE AND CURATION

9.1 The records of the geophysical survey are currently held by Ecus.

9.2 In determining which material will form part of the archive, the Chartered Institute for Archaeologist Archive Selection Toolkit will be used (available online at http://cifa.heritech.net/selection-toolkit).

9.3 The archive will be prepared in accordance with national guidelines (Brown 2011; CIfA 2020b). The integrity of the primary field record will be preserved. Security copies will be maintained where appropriate. Digital records of the geophysical survey will be held by Ecus.

9.4 The archiving of the digital data arising from the project will be undertaken in a manner consistent with professional standards and guidance (Archaeology Data Service/Digital Antiquity 2011). Preparation of the digital archive will follow policy, guidance and procedures issued by the Archaeology Data Service (2020), Historic England (https://historicengland.org.uk/research/methods/archaeology/archaeological-archives/adapt-tookit/) and DigVentures (https://digventures.com/projects/digital-archives/).

9.5 An OASIS form has been completed on the results of the works (Appendix D) under the reference number ecusltd1-510541. Following approval, a pdf version of this final report will be submitted within three months to the Archaeology Data Service via the OASIS form.

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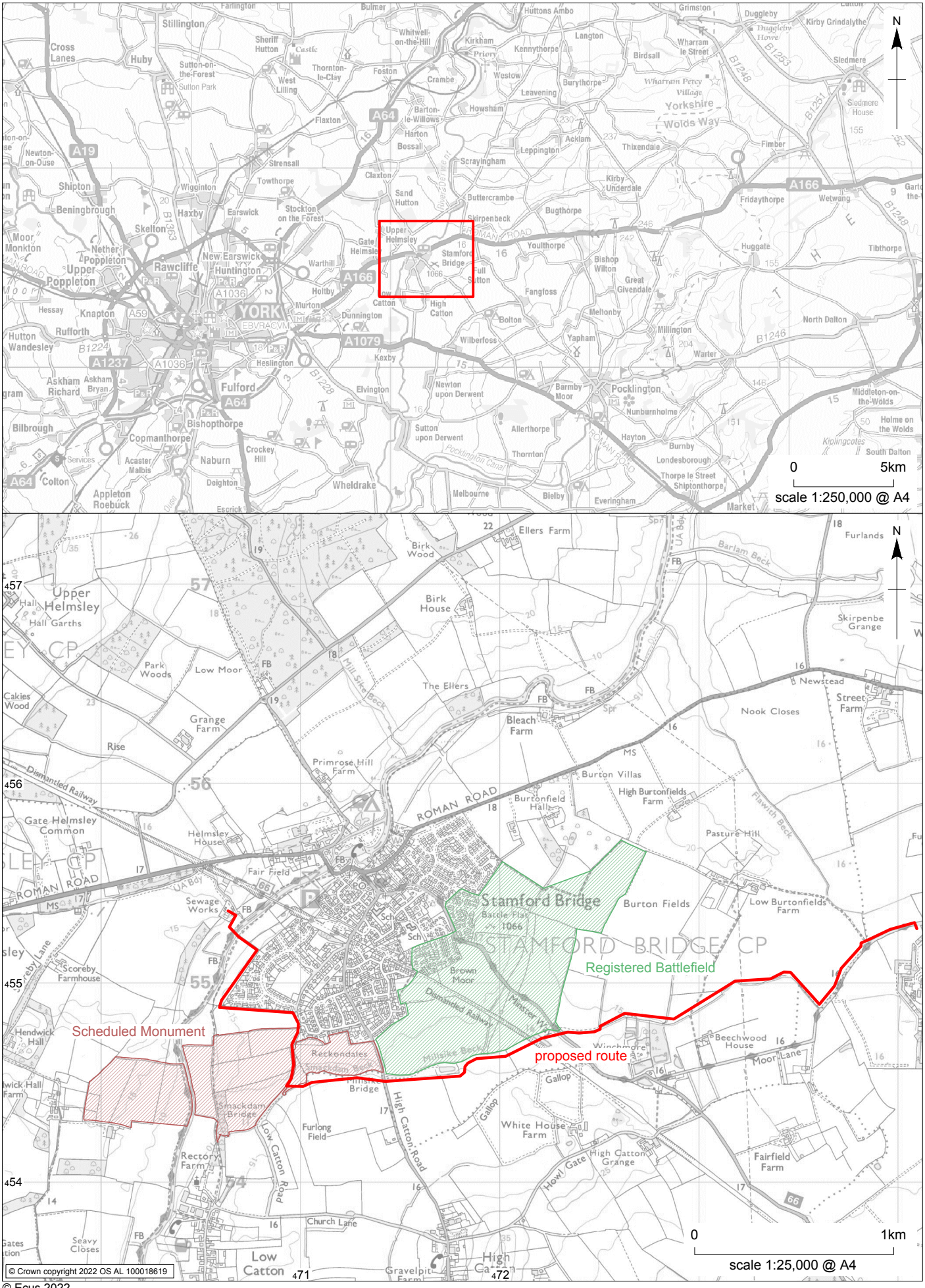
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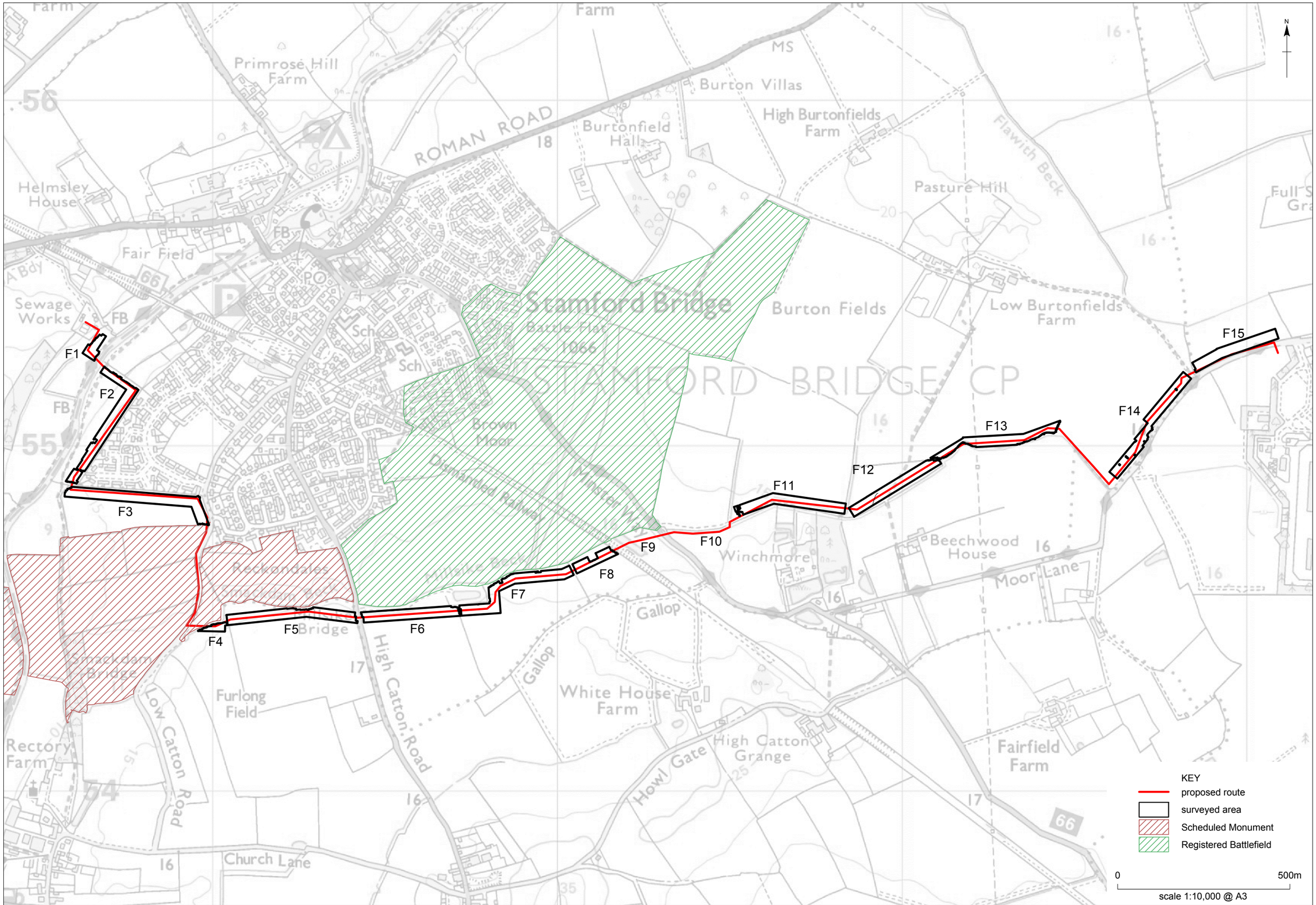
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Full Sutton to Stamford Bridge, East Riding of Yorkshire: site location

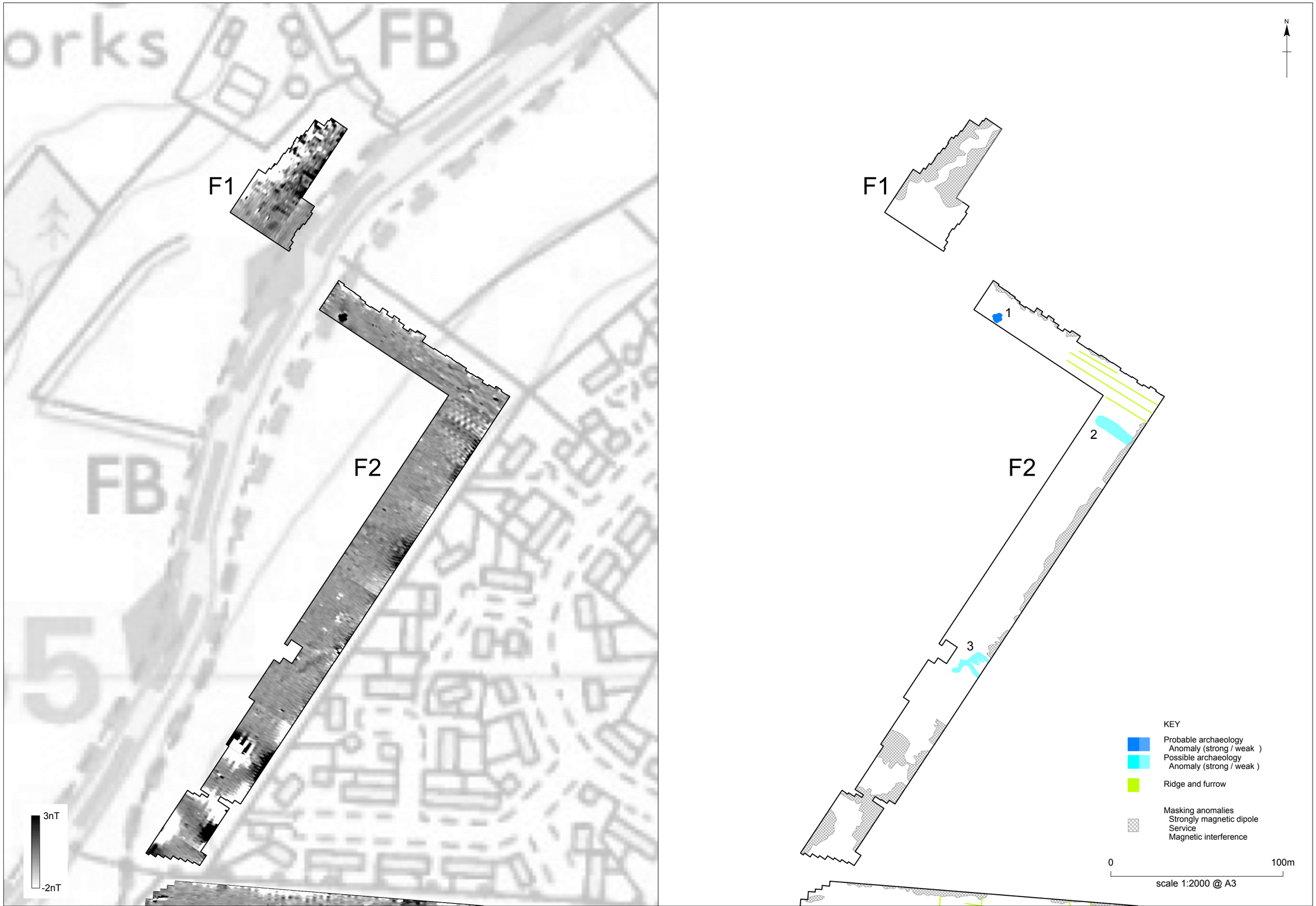
Figure 1




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Full Sutton to Stamford Bridge, East Riding of Yorkshire: surveyed area

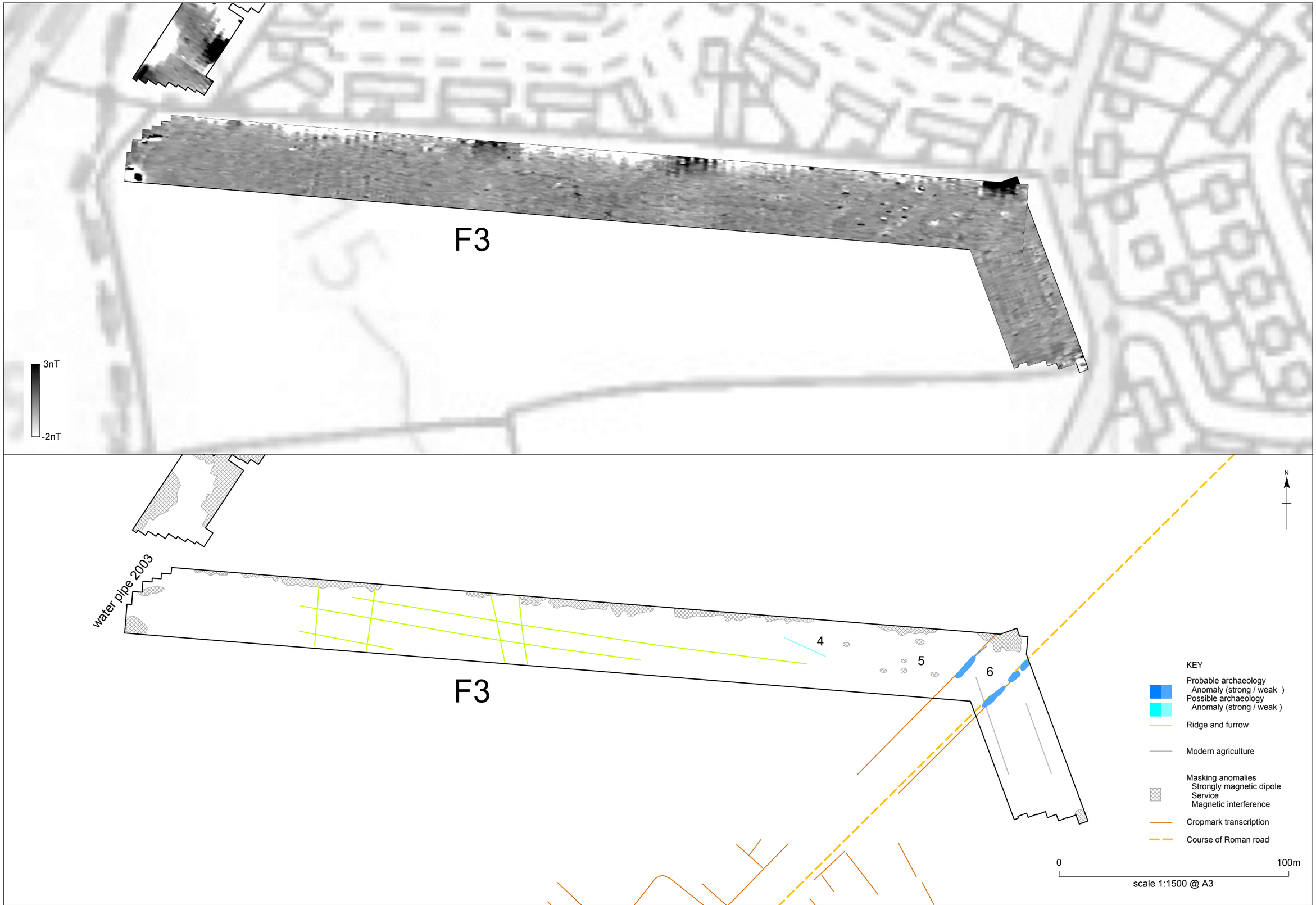
Figure 2




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Full Sutton to Stamford Bridge, East Riding of Yorkshire: greyscale gradiometer survey results and interpretation, fields F1 and F2

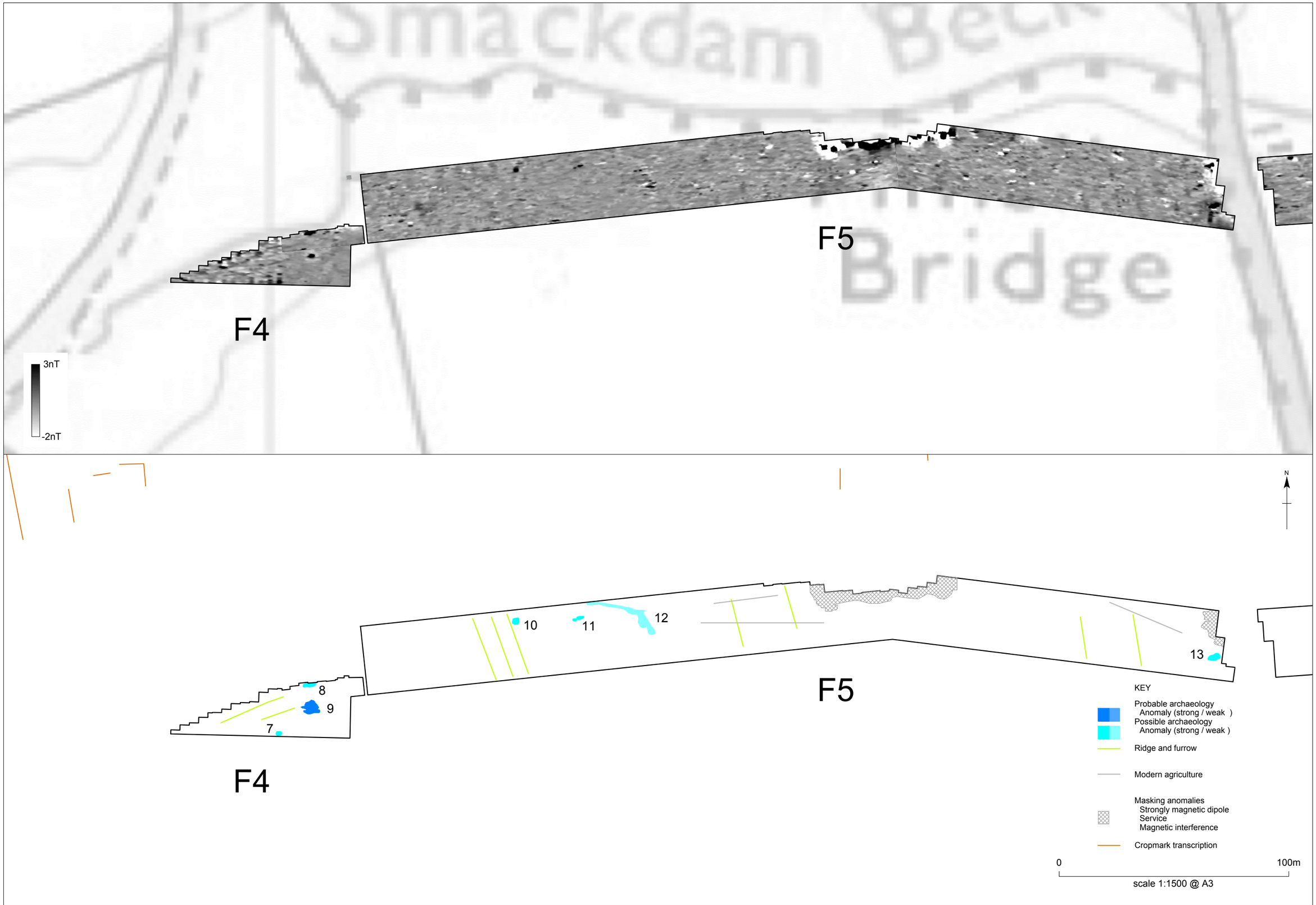
Figure 3




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Full Sutton to Stamford Bridge, East Riding of Yorkshire: greyscale gradiometer survey results and interpretation, field F3

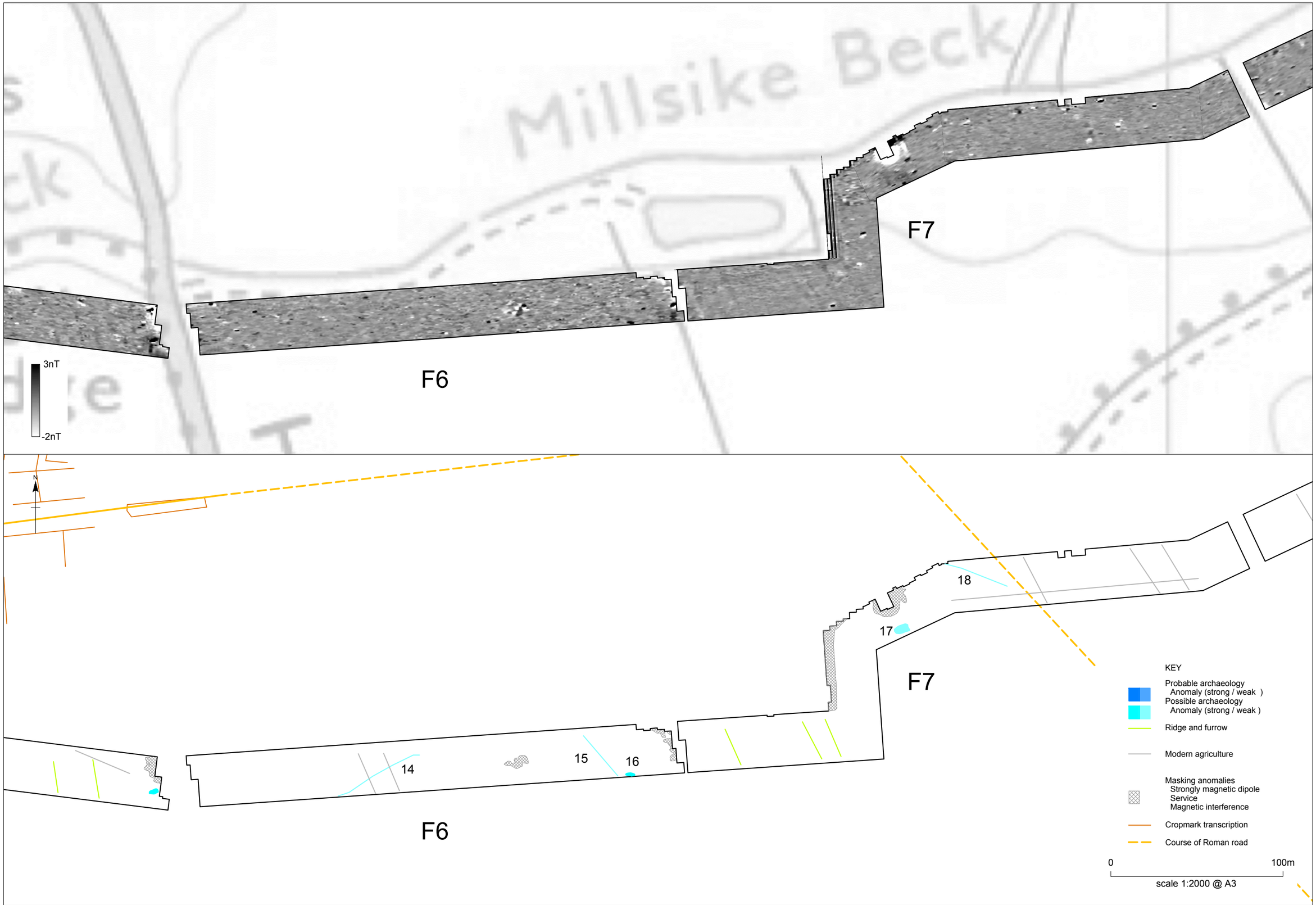
Figure 4




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Full Sutton to Stamford Bridge, East Riding of Yorkshire: greyscale gradiometer survey results and interpretation, field F4 and F5

Figure 5




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Full Sutton to Stamford Bridge, East Riding of Yorkshire: greyscale gradiometer survey results and interpretation, field F6 and F7

Figure 6

F8

F9

F10

3nT

-2nT

N

KEY

Probable archaeology
Anomaly (strong / weak )
Possible archaeology
Anomaly (strong / weak )

Ridge and furrow

Modern agriculture

Masking anomalies
Strongly magnetic dipole
Service
Magnetic interference

Course of Roman road

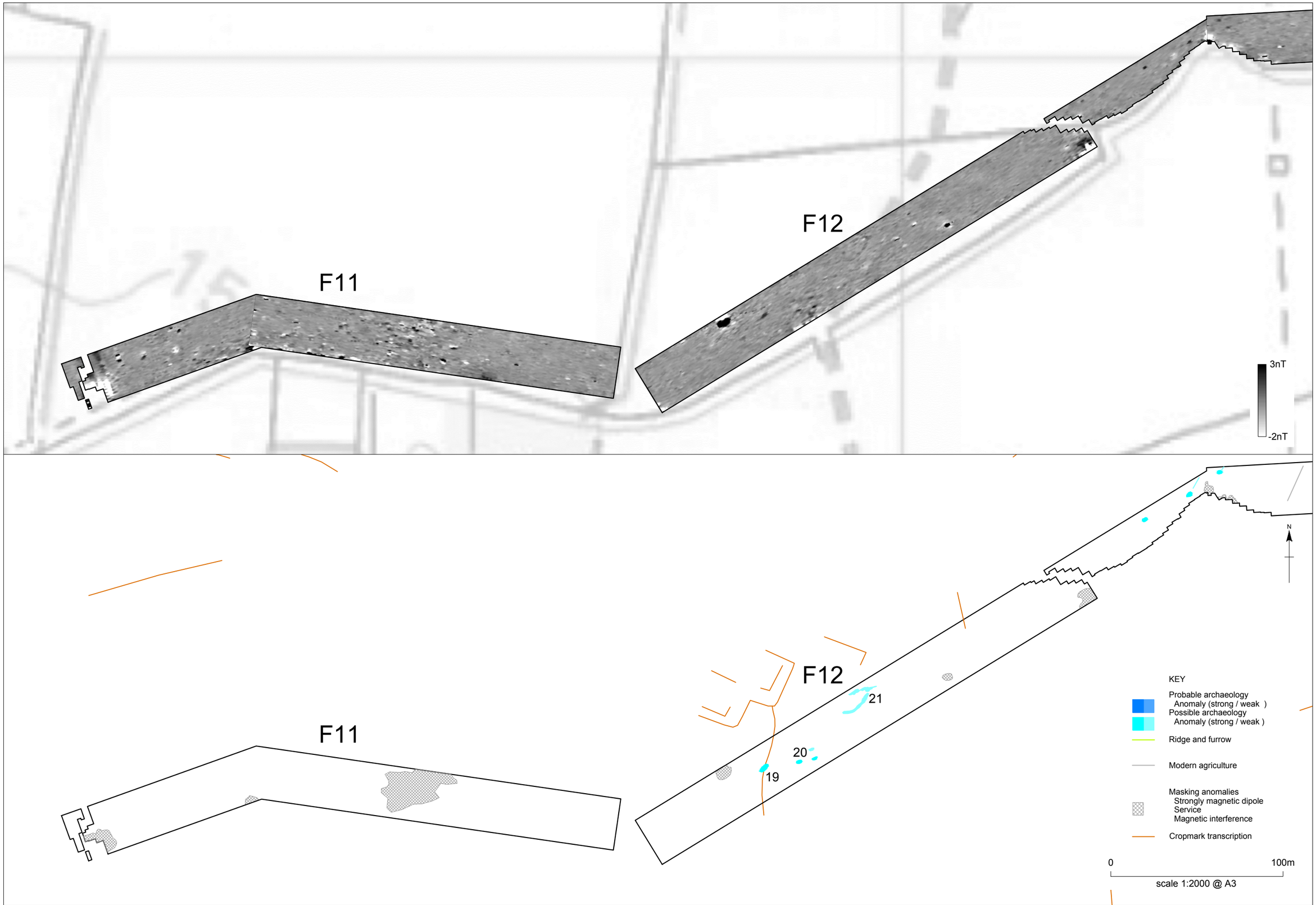
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Full Sutton to Stamford Bridge, East Riding of Yorkshire: greyscale gradiometer survey results and interpretation, field F8

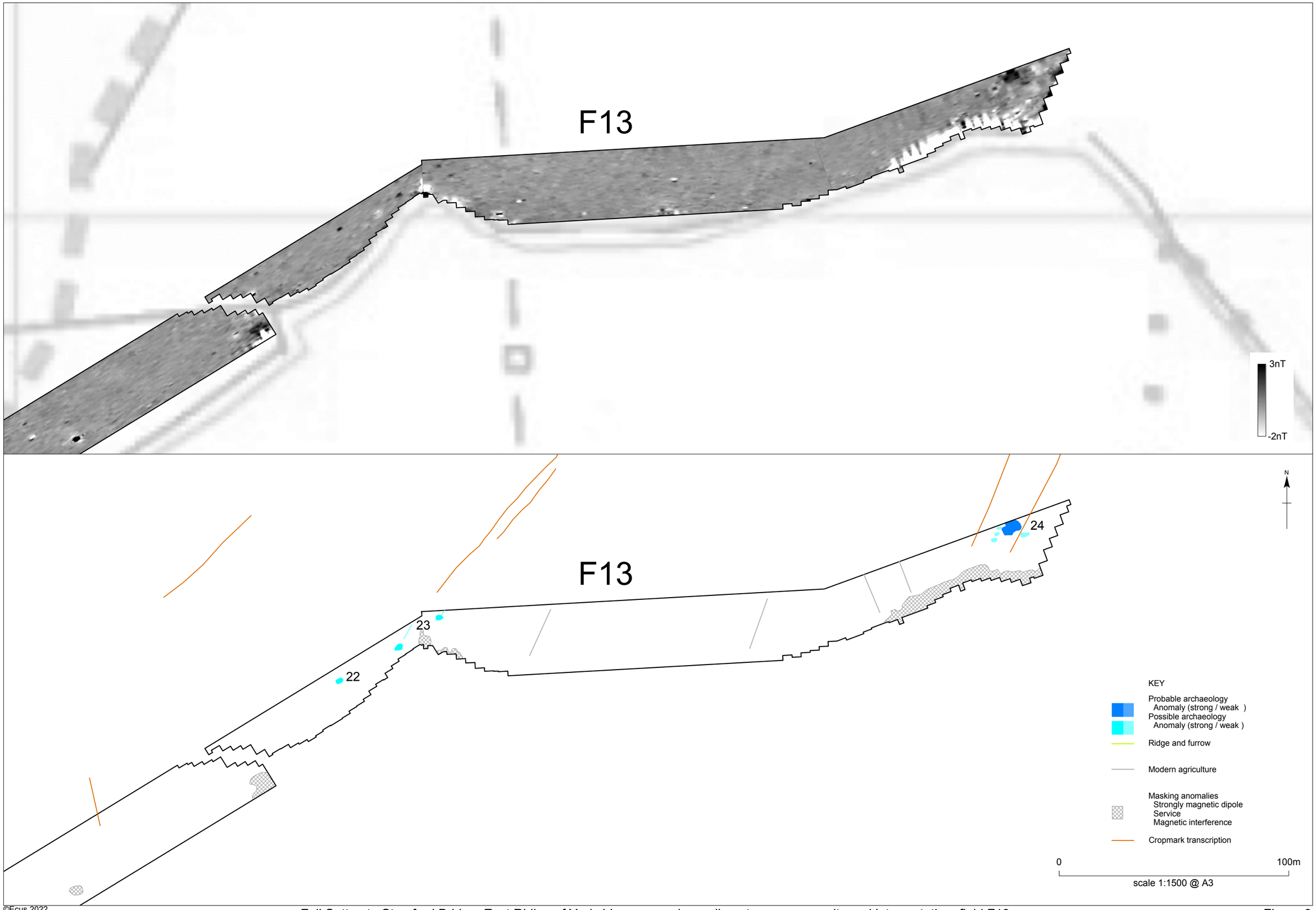
Figure 7




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Full Sutton to Stamford Bridge, East Riding of Yorkshire: greyscale gradiometer survey results and interpretation, field F11 and F12

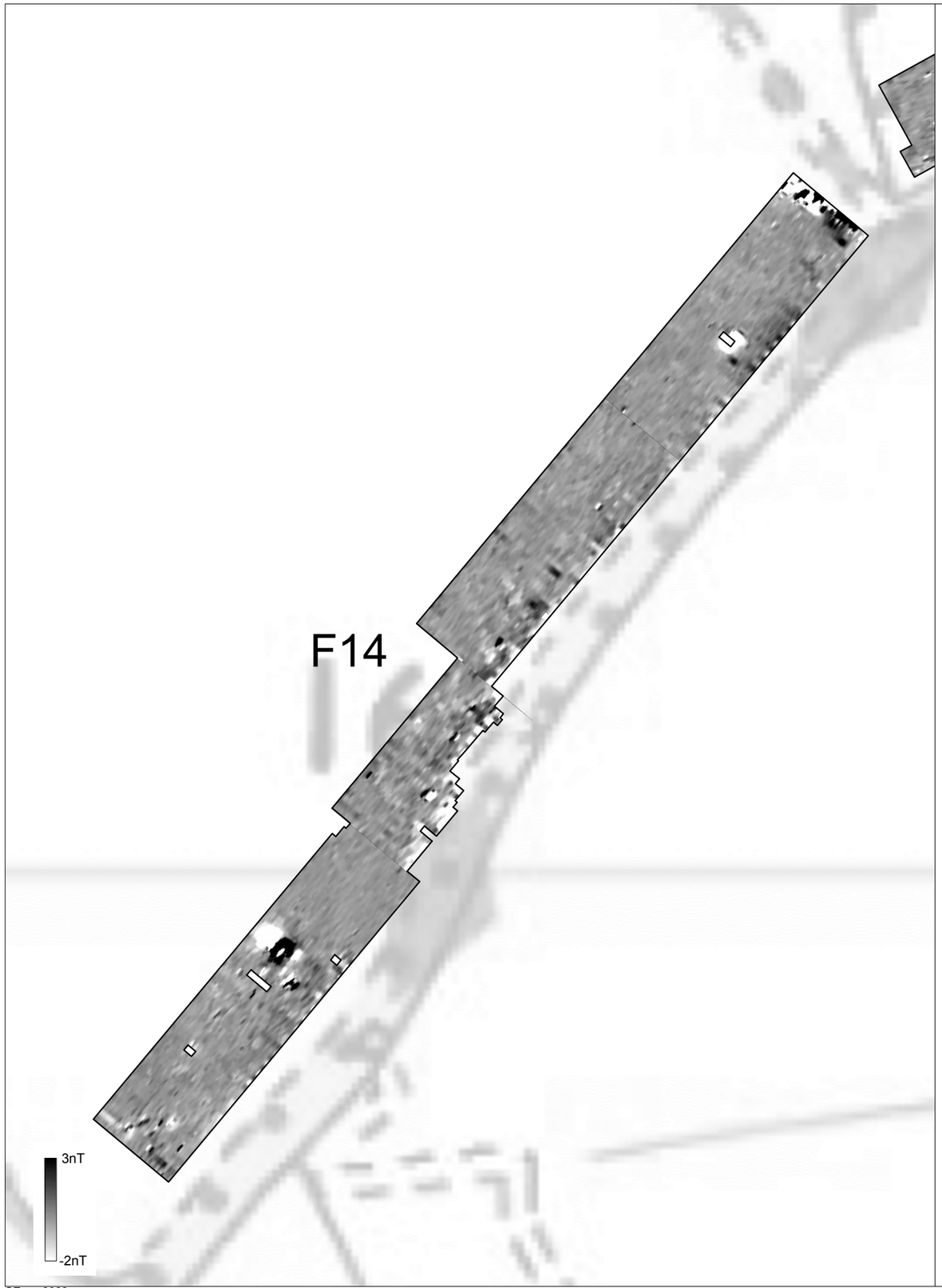
Figure 8

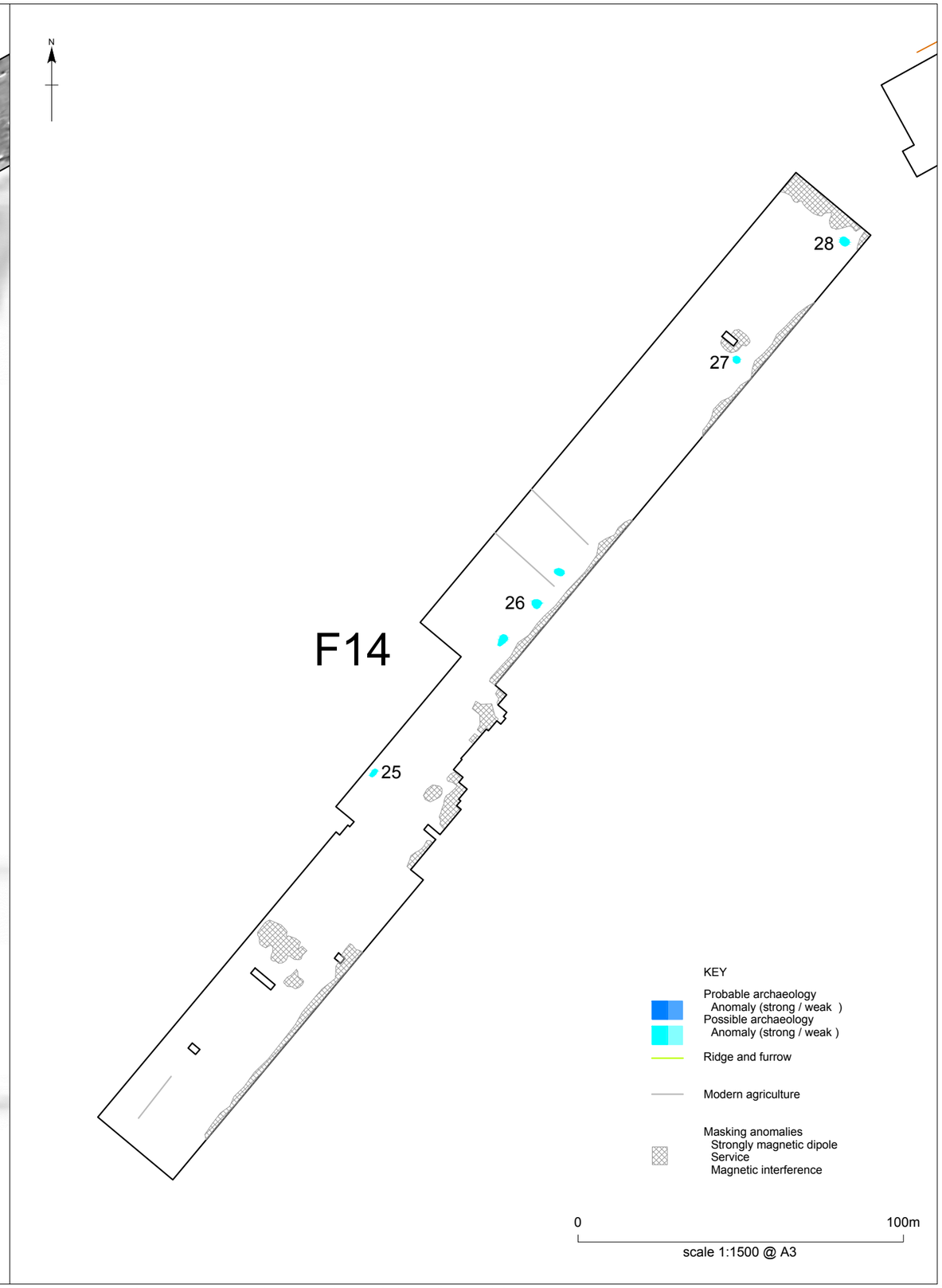



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Full Sutton to Stamford Bridge, East Riding of Yorkshire: greyscale gradiometer survey results and interpretation, field F13

Figure 9




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Full Sutton to Stamford Bridge, East Riding of Yorkshire: greyscale gradiometer survey results and interpretation, field F14

Figure 10




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Full Sutton to Stamford Bridge, East Riding of Yorkshire: greyscale gradiometer survey results and interpretation, field F15

Figure 11

# APPENDIX A
# TECHNICAL INFORMATION

## GRADIOMETER SURVEY

Magnetic surveys measure distortions in the earth's magnetic field caused by small magnetic fields associated with buried features (Gaffney and Gater 2003, 36) that have either remnant or induced magnetic properties (Aspinal *et al.* 2008, 21–26). Human activity and inhabitation often alter the magnetic properties of materials (Aspinal *et al.* 2008, 21) resulting in the ability for numerous archaeological features to be detected through magnetic surveys. Intensive burning or heating can result in materials attaining a thermoremanent magnetisation; examples of which include kilns, ovens, heaths and brick structures (Aspinal *et al.* 2008, 27; Gaffney and Gater, 2003, 37). When topsoil rich with iron oxides, fills a man-made depression in the subsoil, it creates an infilled feature, such as a pit or ditch, with a higher magnetic susceptibility compared to the surrounding soil (Aspinal *et al.* 2008, 37–41; Gaffney and Gater 2003, 22–26). Magnetic surveys can also detect features with a lower magnetically susceptibility than the surrounding soil, an example of which is a stone wall.

## LIMITATIONS

Poor results can be due to several factors including short lived archaeological occupation/use or sites with minimal cut or built features. Results can also be limited in areas with soils naturally deficient in iron compounds or in areas with soils overlying naturally magnetic geology, which will produce strong responses masking archaeological features.

Overlying layers, such as demolition rubble or layers of made ground, can hide any earlier archaeological features. The presence of above ground structures and underground services containing ferrous material can distort or mask nearby features.

Particularly uneven or steep ground can increase the processing required or distort results beyond the capabilities of processing. It is also possible in areas containing dramatic topographical changes that natural weathering, such as hillwash, often in combination with intensive modern ploughing, will reduced the topsoil on slopes and towards the peaks of hills and possibly destroy or truncate potential archaeological features. Conversely features at the bottom of slopes may be covered by a greater layer of topsoil and so if buried features are present they appear faint within the results, if at all.

Over processing of data can also obscure or remove features, especially if there are on the same orientation as the direction of data collection. Consequently, where possible, attempts are made to ensure data is not collected on the same orientation as known potential features and that data quality is sufficient to minimise the required data processing.

## INSTRUMENTATION

The data will be collected using Bartington Grad 601-2 fluxgate gradiometers, either in a cart configuration with four sensors arranged at one metre intervals or as handheld pairs of sensors. The Bartington 601-2 is a single axis, vertical component fluxgate gradiometer comprising a data logger battery cassette and two sensors. The sensors are Grad-01-1000L cylindrical gradiometer sensors mounted on a rigid carrying frame; each sensor contains two fluxgate magnetometers with 1m vertical separation.

The difference in the magnetic field between the two fluxgates in each sensor is measured in nanoTesla (nT). NAA gradiometer data is recorded with a range of ±100nT, which equates to a resolution of 0.01nT. It should be noted that the actual resolution is limited to 0.03nT as a consequence of internal instrumental noise (Bartington Instruments Ltd, n.d., 23).

The gradiometer records two lines of data on each traverse, the grids are walked in a zig-zag pattern amounting to 15 traverses per 30m grid. The gradiometers are calibrated at the start of every day and recalibrated whenever necessary.

## APPENDIX B DATA VISUALISATION INFORMATION

The data was used to produce a series of images to demonstrate the results of surveys, detailed below:

- Greyscale/colourscale plot – This visualised the results as a shaded drawing with highest readings showing as black, running through different shades to lowest showing as white.

- Interpreted plot – Through detailed analysis, anomalies have been interpreted and possible features identified. Interpretation drawings are used to show potential features and in particular to reinforce and clarify the written interpretation of the data. Anomalies have been characterised using the terminology detailed in the following section and have been assigned colour coding, which is outlined in keys on figures associated with this report.

### MAGNETIC ANOMALIES AND TERMINOLOGY

***Table B1: Lexicon of terminology***

| Terminology | Detail |
|---|---|
| Anomaly | Any outstanding high or low readings forming a particular shape or covering a specific area with the survey results. |
| Feature | A man-made or naturally created object or material that has been detected through investigation works and has sufficient characteristics or supporting evidence for positive identification. |
| Magnetic susceptibility | The ability of a buried feature to be magnetically induced when a magnetic field is applied. |
| Magnetic response | The strength of the changes in magnetic values caused by a buried feature with either a greater or lesser ability to be magnetised compared with the soil around it.<br><br>Anomalies are considered to either have strong/weak or positive/negative responses.<br><br>The strength of magnetic response (along with patterning) can be essential in determining the nature of an anomaly, but it should be noted that the size or strength of the magnetic response does not correlate with the size of the buried feature. |

| | |
|---|---|
| Patterning of an anomaly | The shape or form of an individual anomaly. |
| Thermoremanence | The affect caused when a material has been magnetically altered through a process of heating. Thermoremanent magnetisation occurs when an object or material is heated passed the Curie Point and acquires a permanent magnetisation that is associated with the magnetic field that they cooled within (Gaffney and Gater 2003, 37). |

Different anomalies can represent different features created by human occupation, agricultural or modern activity, or natural pedological or geological changes in the substrata.

Anomalies interpreted as 'greater' are considered more likely to be of the interpreted characterisation; whereas a 'lesser' categorisation represents a more tentative interpretation applied to those anomalies with weaker increases in magnetic response or if the anomaly has incomplete patterning or irregular form.

The strength and size of anomalies can vary depending on the magnetic properties of the feature, the magnetic susceptibility of the soil, the depth at which the feature is buried, and the state of preservation.

### *Table B2: Characterisation of anomalies*

| **Characterisation** | **Detail** |
|---|---|
| Archaeology | |
| Archaeology and Probable archaeology | Linear anomalies with a positive or negative magnetic responses, and composed of a patterning or shape that is suggestive of a buried archaeological feature. These are often indicative of structural remains or infilled features such as ditches.<br><br>The strength of anomaly signal can be suggestive of the properties of the feature. Negative linear anomalies represent upstanding or infilled features that are less magnetically susceptible than background readings, for example structures or ditches composed of a non-igneous stone material. Bipolar linear anomalies considered to be of an archaeological nature are indicative of material with a high magnetic susceptibility, such as a brick wall.<br><br>Isolated anomalies or anomalies with a more amorphous form possibly represent infilled features or thermomagnetic features such as areas of heating/burning of an archaeological origin.<br><br>Unless associated with conclusively identified archaeological remains, such as |

| Characterisation | Detail |
|---|---|
| | linear anomalies, absolute identification of positive responses can be problematic as it is often not possible to decipher if they are of an archaeological, modern or agricultural origin. Consequently, isolated positive responses are not shown within the interpretation unless composed of a broad form or belonging to a series of isolated positive responses.<br><br>Bipolar responses considered likely to be of an archaeological origin are also interpreted as isolated anomaly (archaeology). These are considered to relate to material with a very strong magnetic susceptibility or thermoremanent magnetisation. |
| Possible archaeology | Weak and diffuse anomalies with an uncertain origin are denoted by trends. It is possible that these belong to archaeological features but given their weak signatures or incomplete patterning it is equally plausible that they relate to agricultural features or natural soil formations. |
| Recorded field boundary | Linear anomalies, either with positive or negative magnetic responses, that correspond with the location of field boundaries recorded on historic maps, Aerial photos or LiDAR coverage of the site. |
| Ridge and furrow | Broadly spaced linear anomalies that are likely to be indicative of earlier forms of agriculture, such as ridge and furrow. These often correspond with the location of earthworks visible on the ground or identified on aerial photos or LiDAR survey coverage. |
| Masking anomalies | |
| Strongly magnetic bipolar or dipolar.<br><br>Service | Positive anomalies with associated negative ‘halo’ (bipolar) denote features with a strong magnetic response are likely to be of a modern origin.<br><br>Isolated bipolar responses of a modern nature are likely to relate to buried ferrous material or objects, such as metallic agricultural debris. If a trend is noted in the alignment or spacing of isolated bipolar responses, it is possible that they are indicative of ferrous fittings or connectors used on buried non-magnetic buried utilities. |

| Characterisation | Detail |
|---|---|
| | Linear bipolar anomalies are likely to be indicative of modern services.<br><br>Dipolar anomalies relate to individual spikes within the data and tend to be caused by ferrous objects. These responses have only been shown when located near to archaeological features.<br><br>When the site is located in a mining landscape it is possible that identified dipolar anomalies relate to mining activity and are indicative of further pits or mine shafts. |
| Magnetic interference | Areas of magnetic disturbance, often along the edges of survey areas are caused by standing metal structures such as fencing and buildings.<br><br>Also, areas of increased magnetic response denote areas of disturbance containing a high concentration of dipolar or bipolar responses. These are generally considered to be caused by modern debris in the topsoil, although it is possible that the disturbance is in part also caused by isolated archaeological material or geological or pedological changes in the substrata. |
| Modern agriculture | |
| Ploughing trend, land drain | Ploughing trend tends to be regularly spaced linear anomalies, often with a narrower spacing, that conform with ploughing regime at the time of survey, or a recent regime recorded on aerial photos of the site.<br><br>The response and distribution of land drains varies depending on the composition of the land drain and associated ditch or channel. Consequently, land drains can be composed of weak / strong positive / negative magnetic responses and are identified as a product of either their variance in magnetic values or positioning compared with regularly spaced linear anomalies considered to relate to modern ploughing.<br><br>Land drains can be located within former agricultural regimes, such as ridge and furrow. |

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