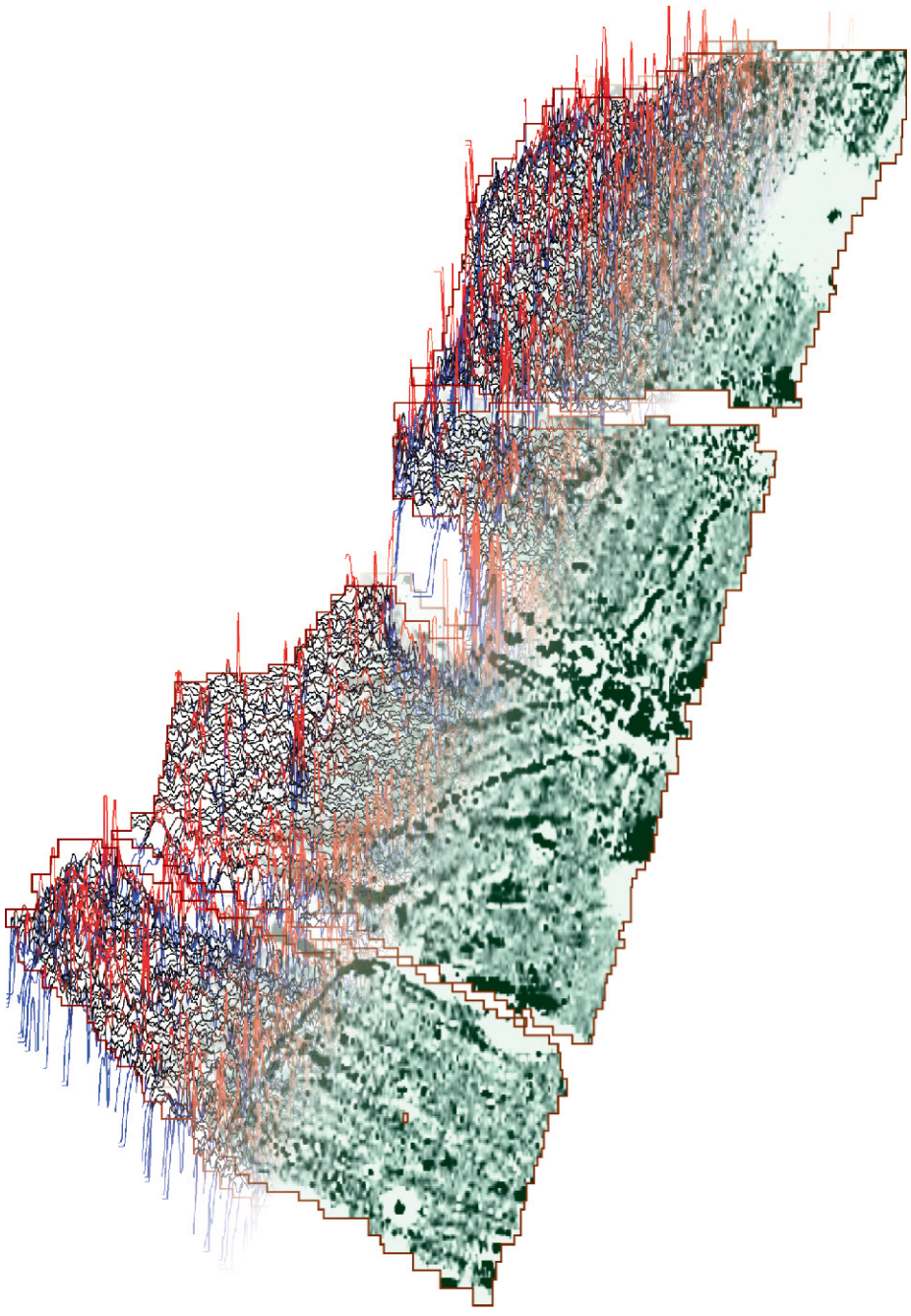
Wessex Archaeology

Sheephouse Wood, Langsett
South Yorkshire

Detailed Gradiometer Survey
and Archaeological Evaluation Report



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December 2011

SHEEPHOUSE WOOD, LANGSETT, SOUTH YORKSHIRE

Detailed Gradiometer Survey and Archaeological Evaluation

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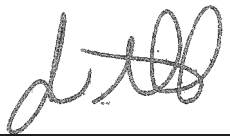
78490.02.01	E	MH	APN		07/12/11	S:\PROJECTS\78490 (SHEEPHOUSE WOOD)\REPORTS\
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Summary

In November 2011 Wessex Archaeology was commissioned by Mott Macdonald on behalf of The Coal Authority, to undertake a detailed gradiometer survey and trenched evaluation on land between Langsett and Midhopestones in the district of Barnsley (NGR SE 2310 0021). The works were in advance of a proposed minewater treatment scheme, and followed on from an archaeological desk based assessment (Woolhouse 2011) and air photo mapping exercise and lidar survey (Deegan 2011), which identified likely post-medieval mine-related activity. The Site comprised three fields of sloping pasture equating to approximately 2.7ha. The geophysical survey covered 2.46ha of the proposed site and demonstrated the presence of several archaeological features, along with a number of anomalies of possible archaeological interest.

The site was surveyed as three areas; north, central and south that were separated by field boundaries. The northernmost area is dominated by strong ferrous responses with a few trends visible along with some anomalies of possible archaeological interest. A number of linear and curvilinear features at different alignments are present in the central area, along with isolated anomalies of possible archaeological interest and ploughing trends. The area to the south contains a curvilinear trend that represents a ditch excavated within Trench 2, along with a number of isolated anomalies of possible archaeological interest. There were also a number of features that are fairly strongly magnetised. These anomalies may be geological in origin but cannot be completely ruled out as archaeological anomalies. A number of the isolated anomalies interpreted as possible archaeology could be natural features such as hollows or tree throws, and anomalies within Trench 2 were seen to be the continuation of ditches identified to the west.

Six trenches were excavated in the southern two fields, which were targeted on the results of a lidar survey, the geophysical survey and features visible on the ground. The archaeological remains revealed during the works were predominantly related to the late 19th century coal mine. A strong geophysical reading across the centre of the site was located within Trench 2, and was seen to be pitting and dumped deposits over the line of a coal seam.

Two linear features identified by the lidar survey and the geophysical survey were most likely hollow ways. The alignment of both features and their late dates makes a boundary ditch interpretation unlikely. No clear evidence of earlier mining was revealed, but one of the hollow ways may have been associated with an earlier phase of works. It is also feasible that one or both of the linear features was excavated to provide spoil for a tram way embankment. A north-south aligned ditch revealed during the geophysical survey, and excavated within Trench 7, may also pre-date the coal mine. The ditch is similarly aligned with the existing field boundaries but does not appear on any of the 19th century coal authority plans, although a similarly aligned ditch or track is shown to the south of the site. A revealed stone quarry pit may have been dug for stone for local buildings or walls.

A collecting museum will soon be opening in Barnsley and it is intended to deposit the archive shortly. At present there is no accession number.

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Acknowledgements

This project was commissioned by Mott Macdonald on behalf of The Coal Authority and Wessex Archaeology is grateful to Phillippa Adams in this regard. Wessex Archaeology would also like to thank Andy Lines of South Yorkshire Archaeology Service (SYAS).

The report was researched and compiled by Michael Hartwell and Ross Lefort. Finds were assessed by Lorraine Mepham. The project was managed for Wessex Archaeology by Andrew Norton. Field work was undertaken by Michael Hartwell, Martin Huggon and Grace Corbett.

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Detailed Gradiometer Survey and Archaeological Evaluation

1 INTRODUCTION

1.1 Project Background

1.1.1 Wessex Archaeology was commissioned by Mott Macdonald (hereafter 'The Client') on behalf of The Coal Authority to undertake a programme of Geophysical Survey and Archaeological Evaluation at Hand Bank Farm between Langsett and Midhopestones in the district of Barnsley (hereafter 'The Site'), centred on NGR SE 2310 0021.

1.1.2 The work was in advance of a proposed mine water treatment works, and was requested by Andy Lines, the Archaeological Officer for South Yorkshire Archaeology Services (SYAS), in order to assess the likely presence or absence of archaeological remains within the Site.

1.2 The Site, Location and Geology

1.2.1 The Site (**Figure 1**) is located at Hand Bank Farm just north of the A616 between Langsett and Midhopestones. The Site comprises three sloping pasture fields totalling an area of approximately 2.7ha (with approximately 2.5ha suitable for survey).

1.2.2 The site is located on the Lower Coal Measures of Carboniferous Age and lies on three coal seams (The Hard Bed,The Middle Band and The Soft Bed) which outcrop locally across the south. The northern two fields slope down from north (232mAOD) to south (216mAOD), and the southernmost field slopes up to the south-east from *c.* 216mAOD to 219mAOD.

2 ARCHAEOLOGICAL AND HISTORICAL BACKGROUND

2.1 General

2.1.1 The Site has been subject to an archaeological desk based assessment (Woolhouse 2011) and an air photo mapping exercise and lidar survey (Deegan 2011), which concluded that post-medieval remains associated with mining and quarrying activities may survive within the Site. There was also limited potential for earlier remains dating to the medieval periods. The following is summarised from the WSI (Mott MacDonald 2011).

2.2 Prehistoric to Anglo-Saxon

2.2.1 There is no evidence for Prehistoric or Roman settlement within the Site and the higher ground is likely to have been moorland in the Roman period (Bevan 2003). It is likely that Langsett originated in the Anglo-Saxon period, originally being called Langeside (long hillside; Smith 1952), and being recorded as heavily wooded in Domesday (Rackham 1976).

2.3 Medieval to Post-medieval

2.3.1 Neighbouring farmsteads are likely to have originated in the medieval period, and the market of Penisale is recorded as having been granted in 1290 and situated near Hollin Wood, to the west of the Site (Crossland 1995).

2.3.2 The land remained largely undeveloped during the medieval period, although both Langsett and Midhopestones expanded in the 20th century. Mining of the coal seams is likely to have commenced in the post-medieval period, and there are two coal pits which appear to have gone out of use by the time of the 1893 Ordnance Survey Map.

2.3.3 Aerial photographs and lidar survey indicate the presence of a bank of coal working across the middle of the site, and a hollow way in the south of the Site. An old mine shaft was revealed in the north of the Site, and a pit to the south of the Site.

2.3.4 A 19th century pottery and brickworks was located to the south of the site, between the Little Don River and the A616. The landscape of the valley changed drastically in the 19th and 20th century, with the introduction of the water industry and the construction of Langsett, Midhope and Underbank reservoirs.

3 AIMS AND LIMITATIONS

3.1 Aims and Scope of Works

Geophysical Survey

3.1.1 The aims of the geophysical survey were to:

- Conduct a detailed survey which covers as much of the specified area as possible, allowing for artificial obstructions.
- Clarify the presence/absence and extent of any buried archaeological remains within the site.
- To determine the general nature of the remains present.

Archaeological Evaluation

3.1.2 The aims of the Archaeological Evaluation were to:

- To determine the location, extent, date, character, condition, significance and quality of the anomalies suggested by the aerial photography, lidar assessment and the geophysical survey.
- To assess the vulnerability/sensitivity of any exposed remains.
- To provide sufficient information on the archaeological potential of the site, to enable the assessment of the archaeological implications of the proposed development.
- To assess the impact of previous land use on the site.
- To inform formulation of a strategy to avoid or mitigate impacts of the proposed developments on surviving archaeological remains.

3.2 Ground Conditions

3.2.1 The site was free draining and the work was carried out during mostly dry conditions. A badger sett was located in the centre west of the Site and no machine excavation was permitted within this zone.

4 METHODOLOGY

4.1 Introduction

4.1.1 The approach and strategy methodology described in the WSI produced by Mott Macdonald (2011) is not repeated in detail here.

4.2 Geophysical Survey

4.2.1 The methodology consisted of detailed gradiometer survey conducted using Bartington Grad 601-2 dual gradiometer systems. The survey was conducted in accordance with English Heritage guidelines *Geophysical Survey in Archaeological Field Evaluation* (2008).

4.2.2 The geophysical survey was conducted by Wessex Archaeology's in-house geophysics team from 15th to 21st November 2011. Ground conditions for survey were favourable with all three fields clear enough to be walked.

4.2.3 Individual survey grid nodes were established at 30m x 30m intervals using a Leica Viva RTK GNSS system, which is precise to within 0.05m and therefore exceeds English Heritage recommendations.

4.2.4 The detailed gradiometer survey was conducted using a Bartington Grad 601-2 gradiometer system over 30m x 30m grids with a sample interval of 0.25m along transects spaced 1m apart. This results in 3600 logged values per grid. Data were collected in the zigzag manner.

4.2.5 Data from the survey was subject to minimal data correction processes. These comprise a zero mean traverse function (±5nT thresholds) applied to correct for any variation between the two Bartington sensors used, and a de-step function to account for variations in traverse position due to varying ground cover and topography. These two steps were applied to all survey areas.

4.2.6 Data from the central survey area required further attention. This was not due to poor quality data but was more a failing of the zero mean traverse function (ZMT). Several linear archaeological features in the data were aligned with the orientation of the collected traverses. When ZMT was applied they were removed; they could not be retained even with a reduction in the thresholds used. To overcome this, ZMT was applied then the values from the removed features were pasted from the raw data onto the processed data. The add function was then used to remove some negative stripes created when raw data was pasted onto processed data. No further filtering or interpolation was applied to the data. The data were clipped at -2 to 3nT for the greyscale image and -25 to 25nT for the XY trace plots.

4.2.7 Further details of the geophysical and survey equipment, methods and processing are described in **Appendix 2**.

4.3 Archaeological Evaluation

4.3.1 In total six trenches were excavated with **Trench 1** not completed, as it overlay a disused mine shaft and was deemed unsafe. **Trenches 5-7** were excavated following the interpretation of the provisional geophysics results. Individual trench aims are outlined below

4.3.2 **Trench 1** was proposed in the north of the Site, and located to identify a probable mineshaft. Upon inspection of the Site, and discussions with Phillippa Adams (Mott MacDonald) and Andy Lines (SYAS), it was agreed that the feature was a mineshaft and trenching was not safe.

4.3.3 **Trench 2** was located against the eastern edge of the central field, and targeted an area of coal working and a probable hollow way running east-west across the site.

4.3.4 **Trench 3** was located in the west of the central field and targeted a probable hollow way (also targeted by **Trench 2**).

4.3.5 **Trench 4** was located in the south of the Site and targeted a probable quarry pit. This trench was relocated approximately 2m west of the originally proposed location, due to the targeted feature being evident on the ground, and slightly off alignment with the aerial photography and lidar data.

4.3.6 Following consultation with SYAS **Trench 5** was located in the west of the southern field, over a probable geological geophysical anomaly.

4.3.7 Following consultation with SYAS **Trench 6** was located at the northern edge of the southern field, over a probable geological geophysical anomaly.

4.3.8 Following consultation with SYAS **Trench 7** was located in the centre of the southern field, over a probable archaeological linear feature and two possible archaeological pits.

4.3.9 All trenches were excavated with a 180° excavator fitted with a toothless ditching bucket under constant archaeological supervision.

4.3.10 Machining ceased at the level of the first archaeological horizon or the natural geology, whichever was reached first. All revealed deposits were hand cleaned and planned at an appropriate scale. All recording took place in accordance with standard Wessex Archaeology methodologies and IfA and EH best practice.

4.3.11 The finds were collected by context and were treated in accordance with standard Wessex Archaeology and IfA guidelines and according to UKIC guidelines (UKIC 2001).

5 GEOPHYSICAL RESULTS

5.1 General

5.1.1 The geophysical survey identified a number of anomalies of definite and possible archaeological origins. Results are presented as a series of greyscale, XY trace plots and interpretation diagrams over the site at a scale of 1:1250 (**Figures 3 to 5**).

5.1.2 The interpretation of the datasets highlights the presence of potential archaeological anomalies, ploughing trends, ferrous/burnt or fired objects, and areas of general increased magnetic response. Full definitions of the interpretation terms used in this report are provided in **Appendix 3**.

5.1.3 Numerous ferrous anomalies are visible throughout the detailed survey dataset. These are presumed to be modern in provenance and are not referred to, unless considered relevant to the archaeological interpretation.

5.2 Detailed Survey Results and Interpretation

5.2.1 The northern field is dominated by ferrous responses from large and small iron objects (**4001** and **4003**), some of these anomalies appear as if they may relate to fired material such as ceramics. These strong ferrous responses may be obscuring archaeological features, which have a weaker magnetic response. This area has a higher concentration of ferrous anomalies than the other fields, and this is presumed to be due to the addition of ferrous and ceramic material to the field during industrial and/or agricultural activity. Anomaly **4001** represents the only large iron object with the rest of the ferrous responses being relatively small in scale and magnitude.

5.2.2 This area also contains a number of anomalies (**4000**) that are reasonably strong, with values around 10-20nT. These anomalies do not look to be ferrous responses based on their shape (**Figure 3**) but appear to be areas of burning. When soils and rocks are exposed to temperatures greater than 575-675°C, the magnetic minerals within these materials lose their randomised magnetic orientations and align themselves with the direction of the Earth's field at the time of firing. This common orientation for all magnetic minerals within a rock or sediment, increases the strength of the overall magnetic response when measured with a magnetometer (Aspinall et al. 2008, 21-22). The source of this heat cannot be established from the data alone. This area could have been heated from some geological process or through some form of industrial activity. For this reason these anomalies have been classified as areas of increased magnetic response and should be regarded as possibly archaeological.

5.2.3 There are a number of isolated anomalies that have been classified as possible archaeology. They have values in the region of 1-5nT which would be consistent with an archaeological feature but they have no obvious pattern in their distribution. They could be natural features such as hollows or tree throws; some larger examples of these anomalies can be seen around **4003**.

5.2.4 The last remaining group of anomalies are a number of weakly positive (≤1.5nT) and weakly negative (≥-1.5nT) linear trends. They are aligned

parallel to the eastern field boundary and have been interpreted as ploughing trends created as the plough cuts into and disturbs the subsoil.

5.2.5 The central field contains the greatest number of archaeological features with linear anomalies at four different alignments. Anomaly **4006** is aligned south-west to north-east and has values around 2-6nT. This anomaly is consistent with the sort of response a ditch would produce. There are some stronger responses within this ditch, which are thought to represent ferrous and ceramic material present in the backfill of the ditch. Anomaly **4006** terminates at a wide linear spread of ferrous responses that is marked as archaeology at **4007**.

5.2.6 Anomaly **4007** is aligned north-west to south-east and was thought to be an archaeological anomaly rather than a modern service, as there is no regular pattern of positive and negative responses that would be visible with an iron or ceramic pipe. The spread appeared to be from mostly small iron objects and could relate to the previous mining activity on site. Excavation within **Trench 2** supported this theory. The spread of ferrous responses in the north-east corner of the field at **4004** could be due to similar industrial activity. Anomaly **4009** is a short curvilinear feature aligned west south-west to east north-east with a variable strength of response across its length. This variation corresponds with a Tram Way shown on the 19th century coal board plan, but may also represent a group of pits.

5.2.7 Anomaly **4010** lies on a similar alignment to **4009** and forms a curvilinear ditch response similar to **4006**. This ditch appears to be filled with more ferrous/ceramic debris than **4006**; this may simply be a product of **4010** being located down slope from the mass of ferrous responses at **4007**. Anomaly **4011** intersects with **4010** and is aligned east-west. The strength of magnetic response varies across its length (1-6nT), but it is likely to represent another ditch. Its fill does not appear to be composed of large amounts of ferrous/ceramic responses which may suggest it was cut at a different time to **4010**. Excavation of both features was carried out during the evaluation (see below).

5.2.8 There is an alignment of three closely spaced responses north of **4013** that have been tagged as probable archaeology. Their values and shape of response suggest that these anomalies may represent pits, but their close proximity to ferrous material makes this interpretation a little uncertain. There are more isolated features that are possibly archaeological throughout this field. There is no obvious pattern to their distribution and could represent natural features.

5.2.9 There are three clusters of anomalies classed as increased magnetic response at **4005, 4008** and **4012** that are similar to the responses observed at **4000**. These may be archaeological features related to high-temperature industrial processes but could potentially be geological in origin.

5.2.10 There are a number of slight linear anomalies running through the data; some are aligned with field boundaries and have been termed ploughing trends and others are aligned with **4010** and have been classed as trends. Many of the anomalies termed trends may relate to ploughing.

5.2.11 The southern field contains only one anomaly of archaeological interest which is a curvilinear anomaly (**4015**) aligned south-west to north-east. The strength of its response (around 3nT) is consistent with a cut feature such as a ditch. The ditch is interrupted along its length towards the south and may represent an entrance across the ditch.

5.2.12 There are a number of isolated anomalies of probable and possible archaeological interest in this area. There is no obvious pattern in the distribution of most of them, but some are located close together such as at **4016** where a group of closely spaced larger anomalies can be seen. The majority have positive values (1-4nT) but **4017** has negative values (around -3nT); this may be related to ploughing with a trend observed running through this anomaly.

5.2.13 There are trends aligned with the field boundaries that are thought to be ploughing trends. There is also a fairly dense concentration of ferrous responses in this field; many are close to field boundaries and are likely to be modern but some could relate to earlier industrial activity on site. As was the case with the previous two fields there are some anomalies tagged as increased magnetic response. Like those discussed above they appear to have been heat affected and may possibly be archaeological.

6 EVALUATION RESULTS

6.1 Trench Descriptions

Trench 2

6.1.1 Trench 2 (**Figure 5**) measured 50m x 1.8 m and was aligned north-north-east to south-south-west. The natural geology within the trench comprised an orange clay (**202**) and a natural seam of coal (**203**) in the centre of the trench. The clay was overlain by 0.3m of topsoil (**Figure 6**).

6.1.2 In the south of the trench a wide east-west aligned linear feature (**204**) was revealed. This feature had shallow regular sides and a flat base and probably formed a hollow way. The feature was also identified by the Lidar survey (**Figure 2**), and was aligned with geophysical anomaly **4011**. The fill (**205**) was a very mixed deposit comprising redeposited natural clay as well as waste stone and coal fragments. This deposit was presumably derived from mining upcast. Ceramics dating from the 19th/20th century were recovered from the fill of the hollow way.

6.1.3 Within the central portion of the trench a curvi-linear feature (**206**) was revealed on an east-west alignment. The sides of this feature were concave and moderately sloping and the base was flat, and the feature may have also formed a hollow way. Geophysical anomaly **4010** appears to represent a continuation of the feature, which was not revealed on the lidar survey. The probable hollow way was filled with a brown silty clay loam (**207**) with bluish mottling and occasional waste coal and stone fragments, and a second fill (**208**) that was very similar in makeup to fill **203** (feature **204**) and may represent the same backfilling (mining upcast) event. Pottery dating from the 19th or 20th century was recovered from these fills.

6.1.4 Truncating the north side of the coal seam (**203**) was a pit extending to 1.65m below ground level (**210**). The sides of this pit were steep and the base was slightly concave. The full extent of the pit could not be defined but it coincides with an area of pitting clearly visible from the lidar data, and it did not extend beyond the northern extent of made-ground deposit (**209**). The bottom 0.68m of the pit was filled with a redeposited natural deposit (**212**) consisting of mid greyish yellow clay. Overlying this deposit and filling the pit was a dark grey silty clay (**211**) with frequent coal fragments, possibly upcast from the coal seam. Whilst no finds were recovered from the pit fills the presence of small amounts of CBM and the nature of the fills indicated a post-medieval date. The pit was possibly a test pit evaluating the coal seam, or may have been some shallow open cut mining event.

6.1.5 The coal seam and pit **210** were overlain by a made ground deposit (**209**) of variable mid greyish brown silty clay. This deposit was obviously modern with degraded sawn wood and a black plastic bin bag evident.

Trench 3

6.1.6 Trench 3 (**Figure 7**) was located in order to investigate a probable hollow way. Aligned north-south it measured 20m x 1.8m and the natural geology (**306**) comprised an orange clay with grey mottling. The natural clay was overlain by a thin silty clay relic plough soil (**302**) below a similar but more humic topsoil (**301**).

6.1.7 The hollow way (**303**) was aligned east-west across the centre of the trench, and tied in with the lidar survey and geophysical anomaly **4011**. With a shallow irregular cut, the profile of the hollow way differed from that in Trench 2 (**204**), being shallower with an irregular base. The hollow way was filled by dumps of silt and clay (**304** and **305**) derived from the topsoil, plough soil and natural. The upper fill (**304**) contained finds dating from the 19th and 20th centuries.

6.1.8 South of the hollow way a patch of dark grey clay was investigated but found to be geological in origin (not illustrated).

Trench 4

6.1.9 Trench 4 (**Figure 8**) was excavated over the site of a depression at the southern edge of the Site, it measured 10m x 1.8m and was over 1m deep. The natural geology in this trench consisted of a yellow sandy clay (**407**) at the northern end, and an outcrop of dark sandstone at the southern end (**406**). The natural geology to the north of the pit was covered by a relic plough soil (**402**) and a thin topsoil deposit (**401**).

6.1.10 The pit (**403**) lay within the southern end of the trench, and following machine excavation was found to have been partly backfilled with 19th century rubbish, including frequent glass and pottery (**405**), which was overlain by a layer of decayed leaf mould and humic matter (**404**). The pit was steep sided and located entirely within the area of the sandstone natural (**406**). The pit is interpreted as a 19th century quarry.

Trench 5

6.1.11 Trench 5 (**Figure 9**) was excavated at the western end of the southern field, measuring 10m x 1.8m. It was located over a geophysical anomaly of higher

magnetic response, close to the upper edge of a slope. No archaeological features were revealed but a layer of localised colluvium may account for the magnetic response. The natural geology (**504**) comprised a sandy clay with silty clay patches, and occasional small stone inclusions. The deposit was overlain by a dark orange clay silt colluvium (**503**), measuring 0.11m thick and featuring small stone inclusions. The colluvium was overlain by a relic-plough soil and the modern topsoil (**501** and **502**).

Trench 6

6.1.12 Trench 6 (**Figure 10**) was excavated in the centre of the southern part of the Site, which sloped up significantly to the south. It was targeted on a geophysical anomaly and measured 10m x 1.8m. The natural geology was an orange yellow clay (**604**), which was overlain by a colluvial layer of dark orangey silty clay (**603**), at the northern end of the trench on the lower part of the slope. The colluvium was overlain by a thin relic-plough soil (**602**) and topsoil (**601**).

Trench 7

6.1.13 Trench 7 (**Figure 11**) measured 20m x 1.8m and targeted a probable ditch and two possible pits. The natural geology in this trench was variable but in the most part was a light orangey brown clay with patches of dark grey weathered mudstone (**703**). This was covered by a patchy relic plough soil (**702**) and a silty loam topsoil (**701**).

6.1.14 The natural geology was cut by ditch (**704**), which was aligned north-south with irregular concave sides, and filled with a light yellowish brown silt (**705**). No dating evidence was recovered from the fill. Several possible features in the western end of the trench were investigated but were found to be a combination of bioturbation/root disturbance and geological changes (not illustrated).

6.2 Finds and Environmental Remains

6.2.1 A small quantity of finds was recovered. These comprise fragments of pottery (coarse earthenwares, stonewares, and factory-produced refined wares), glass (bottles and jars), clay pipe (stem fragments only), ceramic building material (brick fragments) and animal bone (see **Table 1**).

6.2.2 All these finds are of post-medieval date, and the most closely datable types (pottery and glass) indicate a date range for the majority of 19th to 20th century, although there is a possibility that some of the coarse earthenwares could be slightly earlier.

6.2.3 Given the small quantity of finds recovered, and their date range, retention for long-term storage is not recommended, and the finds will be discarded prior to archive deposition.

6.2.4 No deposits suitable for environmental sampling were encountered.

Table 1: Incidence of finds by context

Context No	Material Type	Fragment No	Weight (g)	Notes
205	Pottery	1	2	Orange fabric, brown glaze.
207	Clay Pipe	2	4	Stem fragments.
207	CBM	1	2	Small fragment of CBM.
208	CBM	1	1	Small fragment of CBM.
208	Pottery	1	1	Small Whiteware sherd.
209	Animal Bone	1	48	Single long bone.
209	Pottery	2	366	Includes large thick Whiteware sherd.
305	Glass	1	18	Aqua blue bottle sherd.
305	Clay Pipe	1	2	Stem fragment.
305	Pottery	1	12	Whiteware fragment.
405	Pottery	30	610	Assorted 19th/20th century fragments.
405	Glass	9	278	Clear and green bottle glass fragments.

7 DISCUSSION

7.1 Gradiometer Survey

7.1.1 The detailed gradiometer survey has been successful in detecting anomalies of probable and possible archaeological potential within the study area, and can therefore be considered to have successfully fulfilled the aims as set out in the geophysical specification. The northern field within the survey area contained a large number of ferrous responses that may have obscured archaeological features; this area cannot be considered to be absent of archaeological features because none were observed in the data.

7.1.2 This geophysical survey has clearly demonstrated the presence of archaeological features throughout the survey area. Many of these extend beyond the limits of the survey area, which was delimited by field boundaries.

7.1.3 Of interest are a number of curvilinear ditches (**4006, 4007, 4009, 4010, 4011** and **4015**) that are aligned on different orientations. It is thought that these represent at least two phases of activity on site. A couple of other anomaly groups (possible pit group north of **4013** and **4016**) also may prove to be of interest.

7.1.4 Numerous discrete anomalies appear throughout the dataset and it is likely that some of these will be archaeological in origin. In similar geological settings, evaluation of geophysical survey data has demonstrated that tree

throws may exhibit similar responses; whilst a more definite interpretation of such anomalies cannot be given, it seems probable that stronger, better defined responses are more likely to be archaeological.

7.1.5 The anomalies termed increased magnetic response (**4000, 4005, 4008, 4012** and **4014**) are not very well understood from the data alone. These areas appear to have been created by high-temperature activity but their irregular shapes make it difficult to suggest that they are likely to be archaeological. It is entirely possible that these anomalies were formed through geological processes.

7.1.6 Weak linear trends across the survey area may be archaeological in origin, although little more can be said about many of them. Some appear to be related to ploughing.

7.1.7 It should be noted that not all archaeological features will have been detected through geophysical survey, particularly in the case of small discrete features such as pits and post holes. Where dense concentrations of pit-like responses have been identified, it is possible that clusters of features may result in a single extended anomaly. It is also possible that the fill of archaeological features may not exhibit sufficient magnetic contrast from the surrounding natural layers to be resolved as an anomaly.

7.2 Evaluation

7.2.1 The archaeological remains revealed during the works were predominantly related to the late 19th century coal mine. A strong geophysical reading across the centre of the site was located within **Trench 2**, and was seen to be pitting and dumped deposits over the line of a coal seam.

7.2.2 Two linear features running across the site were most likely hollow ways or possibly drainage ditches. The features were identified by the geophysical survey in the centre of the site as archaeological anomalies, and possible archaeological features within **Trench 2**. Both contained 19th/20th finds and were located to the south of a tram way shown on the 19th century plan of the coal mine (**Figure 12**). The alignment of both features and their late dates makes a boundary ditch interpretation unlikely.

7.2.3 Although the coal authority map is not precise it also seems unlikely that the hollow way/ditches represent the tram way; the revealed features lie significantly to the south of the drawn tram way, and there was a lack of any archaeological evidence or material remains associated with the tram way (although any rails and sleepers may have been reused). The tram way may have been constructed on an embankment, which was subsequently levelled and ploughed away. Either of the linear ditches in **Trenches 2** and **3** may have represented a hollow way/tow path alongside the tram way, but they appear too far to the south. It is also feasible that one or both of the linear features was excavated to provide spoil for the embankment. It seems most likely that the features represented two phases of pedestrian routes associated with the mine.

7.2.4 The north-south aligned ditch revealed during the geophysical survey, and excavated within **Trench 7**, may pre-date the coal mine. The ditch is similarly aligned with the existing field boundaries but does not appear on

any of the 19th century coal authority plans, although a similarly aligned ditch or track is shown to the south of the site (**Figure 12**). The stone quarry may also pre-date the mine, and have been dug for stone for local buildings or walls.

7.3 Conclusions

7.3.1 The geophysical and trenching evidence are indicative of a landscape associated with the late 19th century mining, with the revealed linear features most likely representing two phases of a hollow way. No clear evidence of earlier mining was revealed, although it is feasible that hollow way **204**/**303** may relate to earlier activity. The undated boundary ditch in the south of the site is most likely a post-medieval field boundary.

8 ARCHIVE AND COPYRIGHT

8.1 Archive

8.1.1 A collecting museum will soon be opening in Barnsley and it is intended to deposit the archive shortly. At present there is no accession number.

8.1.2 The site archive will be prepared in line with United Kingdom Institute for Conservation (2001), Museums and Galleries Commission (1992), English Heritage (2006) guidelines and the requirements of the Sheffield Galleries and Museums Trust.

8.2 Copyright

8.2.1 This report, and the archive generally, may contain material that is non-Wessex Archaeology copyright (e.g. Ordnance Survey, British Geological Survey, Crown Copyright), or the intellectual property of third parties, which we are able to provide for limited reproduction under the terms of our own copyright licences, but for which copyright itself is non-transferrable by Wessex Archaeology. Users remain bound by the conditions of the Copyright, Designs and Patents Act 1988 with regard to multiple copying and electronic dissemination of the report.

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10 APPENDIX 1: TRENCH DESCRIPTIONS

Trench No. 2	**Co-ordinates: E423141.61/N400182.18; E423158.14/N400229.37. N Ground Level (m AOD): 222.61**	**Dimensions: 50m x 1.8m Max depth 1.65m**
Context	**Description**	**Depth (m)**
201	Topsoil - Mid-dark brown sandy silt, Frequent coal fragments and moderate small stones	0-0.3m
202	Natural - variable light yellow orange clay with lenses of more brown and blue clays visible at depth.	0.3m+
203	Natural deposit: Coal seam with occasional grey clay.	0.3m+
204	Wide linear feature running across trench at south end, probable hollow way.	0.3-0.74m
205	Fill of **204,** yellow and orange redeposited natural clay and coal.	0.3-0.74m
206	Wide linear feature running across trench, probable hollow way.	0.3-0.76m
207	1st fill of **206**, mid greyish brown silty clay dumping deposit.	0.3-0.76m
208	2nd fill of **206**, yellow and orange redeposited natural clay and coal.	0.3-0.76m
209	Made ground layer covering large portion of northern half of trench.	0.3-0.74m
210	Cut of pit at north of coal seam **203**.	0.74-1.65
211	2nd fill of **210**, dark grey redeposited natural clays	0.74-1m
212	1st fill of **210**, mid yellow orange redeposited natural clay	1-1.65m

Trench No. 3	**Co-ordinates: E423073.88/N400175.34; E423073.88/N400195.34. N Ground Level (m AOD): 215.89**	**Dimensions: 20m x 1.8m Max depth 0.50m**
Context	**Description**	**Depth (m)**
301	Topsoil - Mid brown grey very friable silty clay. Occasional sub angular small stones.	0-0.14m
302	Subsoil - Mid brown grey slightly friable silty clay. Occasional sub angular small stones, occasional sub angular medium stones, Moderate small streaks of orange brown clay	0.14-0.26m
303	Shallow irregular linear feature running east-west across trench, probable hollow way	0.26-0.42m
304	2nd fill of **303**, mid brown grey silty clay with yellow hue. Occasional small sub angular stones occasional-moderate lenses of redeposited natural **306**.	0.26-0.34m
305	1st fill of **303**, mid orange yellow clay, disturbed mixed natural deposit with moderate yellow grey clay lenses.	0.34-0.42m
306	Natural - variable light yellow orange clay	0.26m+

Trench No. 4	**Co-ordinates: E423048.11/N400115.93; E423054.60/N400123.53. NE Ground Level (m AOD): 218.11**	**Dimensions: 10m x1 .8m Max depth 1.00m**
Context	**Description**	**Depth (m)**
401	Topsoil – dark brown grey friable clay silt, heavily rooted	0-0.12m
402	Subsoil – mid yellow grey slay silt, heavily rooted with 5% Large sub-angular sandstone blocks.	0.12-0.5m
403	Rectangular quarry pit measuring 3.8m x 7.2m, excavated to a depth of 0.7m. against edge of field with dry stone wall built along southern edge.	0.5-1.34m+
404	Final fill of (**403**), 50/50 decayed leaf matter and very dark brown sandy silt.	0.56-0.68m
405	Main fill of (**403**), dark yellow grey sandy silt, very heavily root disturbed containing 10% large sandstone bocks and $18^{th}/19^{th}$C. pottery. Probable deliberate dumping in disused quarry pit	0.68m-1.34m+
406	Natural – degraded sandtone, dark orange yellow sandstone with dark greyish orange sand. Limited to southern portion of the trench	0.5m+
407	Natural – Light greyish yellow sandy clay, very compact. Limited to northern end of the trench	0.5m+

Trench No. 5	**Co-ordinates: E423028.52/N400176.52; E423022.02/N400168.92. SW Ground Level (m AOD): 212.59**	**Dimensions: 10m x 1.8m Max depth 0.40m**
Context	**Description**	**Depth (m)**
501	Topsoil – Friable dark brown grey clay silt	0-0.12m
502	Subsoil – mid brownish blue grey friable clay silt, occasional orange brown flecks and small sub angular stones	0.12-0.24m
503	Colluvium – dark brownish orange clay silt with occasional small sub-angular stones	0.24-0.35m
504	Natural – Mid orange yellow sandy clay, frequent mid brown silty clay patches and mottling throughout.	0.35m+

Trench No. 6	**Co-ordinates: E423067.78/N400169.11; E423061.29/N400161.51. NE Ground Level (m AOD): 214.24**	**Dimensions: 10m x 1.8m Max depth 0.50m**
Context	**Description**	**Depth (m)**
601	Topsoil – Friable dark brown grey clay silt	0-0.1m
602	Subsoil – mid brownish blue grey friable clay silt, occasional brownish orange flecks	0.1-0.18m
603	Colluvium – dark orange brown silty clay with occasional small sub-angular stone inclusions	0.18-0.5m
604	Dark orange yellow silty clay, moderatepatches of both yellow sandy clay and orange grey clay	0.5m+

Trench No. 7	**Co-ordinates: E423055.66/N400140.79; E423067.06/N400131.05. NW Ground Level (m AOD): 216.84**	**Dimensions: 20m x 1.8m Max depth 1m**
Context	**Description**	**Depth (m)**
701	Topsoil – Mid to dark brown silty loam with occasional small stones and coal fragments	0-0.25
702	Subsoil – Dark grey brown clayey silt with occasional small stones. Thin and sparse not visible over whole of trench.	0.25-0.3m
703	Natural – variable clays and weathered mudstone from light orange brown to dark purpleish grey.	0.25m+
704	Ditch running north-south across trench	0.25-0.75m
705	Fill of ditch (**704**), light yellowish brown silty clay	0.25-0.75m

11 APPENDIX 2: SURVEY EQUIPMENT AND DATA PROCESSING

Survey Methods and Equipment

The magnetic data for this project was acquired using a Bartington 601-2 dual magnetic gradiometer system. This instrument has two sensor assemblies fixed horizontally 1m apart allowing two traverses to be recorded simultaneously. Each sensor contains two fluxgate magnetometers arranged vertically with a 1m separation, and measures the difference between the vertical components of the total magnetic field within each sensor array. This arrangement of magnetometers suppresses any diurnal or low frequency effects.

The gradiometers have a resolution of 0.1nT over a ±3000nT range, and measurements from each sensor are logged at intervals of 0.25m. All of the data are stored on an integrated data logger for subsequent post-processing and analysis.

Wessex Archaeology undertakes two types of magnetic surveys: scanning and detail. Both types depend upon the establishment of an accurate 20m or 30m site grid, which is achieved using a Leica 1200 RTK GPS system and then extended using tapes. The Leica 1200 RTK GPS system receives corrections from a network of reference stations operated by the Ordnance Survey and Leica Geosystems, allowing positions to be determined to an accuracy of 1-2cm in real-time and therefore exceed the level of accuracy recommended by English Heritage (2008) for geophysical surveys.

Scanning surveys consist of recording data at 0.25m intervals along transects spaced 10m apart, acquiring a minimum of 80 data points per transect. Due to the relatively coarse transect interval, scanning surveys should only be expected to detect extended regions of archaeological anomalies, when there is a greater likelihood of distinguishing such responses from the background magnetic field.

The detail surveys consist of 20m x 20m or 30m x 30m grids, and data are collected at 0.25m intervals along traverses spaced 1m apart. These strategies give 1600 or

3600 measurements per 20m or 30m grid respectively, and are the recommended methodologies for archaeological surveys of this type (English Heritage, 2008).

Post-Processing

The magnetic data collected during the detail survey are downloaded from the Bartington system for processing and analysis using both commercial (Geoplot) and in-house software. This software allows for both the data and the images to be processed in order to enhance the results for analysis; however, it should be noted that minimal data processing is conducted so as not to distort the anomalies.

As the scanning data are not as closely distributed as with detailed survey, they are georeferenced using the GPS information and interpolated to highlight similar anomalies in adjacent transects. Directional trends may be removed before interpolation to produce more easily understood images.

Typical data and image processing steps may include:

- Destripe – Applying a zero mean traverse in order to remove differences caused by directional effects inherent in the magnetometer;
- Destagger – Shifting each traverse forward or backward by a number of readings. This corrects for operator errors and is used to enhance linear features;
- Despike – Filtering isolated data points that exceed the mean by a specified amount to reduce the appearance of dominant anomalous readings (generally only used for earth resistance data)

Typical displays of the data used during processing and analysis:

- XY Plot – Presents the data as a trace or graph line for each traverse. Each traverse is displaced down the image to produce a stacked profile effect. This image can include a hidden line algorithm to remove certain lines and enhance the image. This type of image is useful as it shows the full range and shape of individual anomalies.
- Greyscale – Presents the data in plan view using a greyscale to indicate the relative strength of the signal at each measurement point. These plots can be produced in colour to highlight certain features but generally greyscale plots are used during analysis of the data.

12 APPENDIX 3: GEOPHYSICAL INTERPRETATION

The interpretation methodology used by Wessex Archaeology separates the anomalies into two main categories: archaeological and unidentified responses.

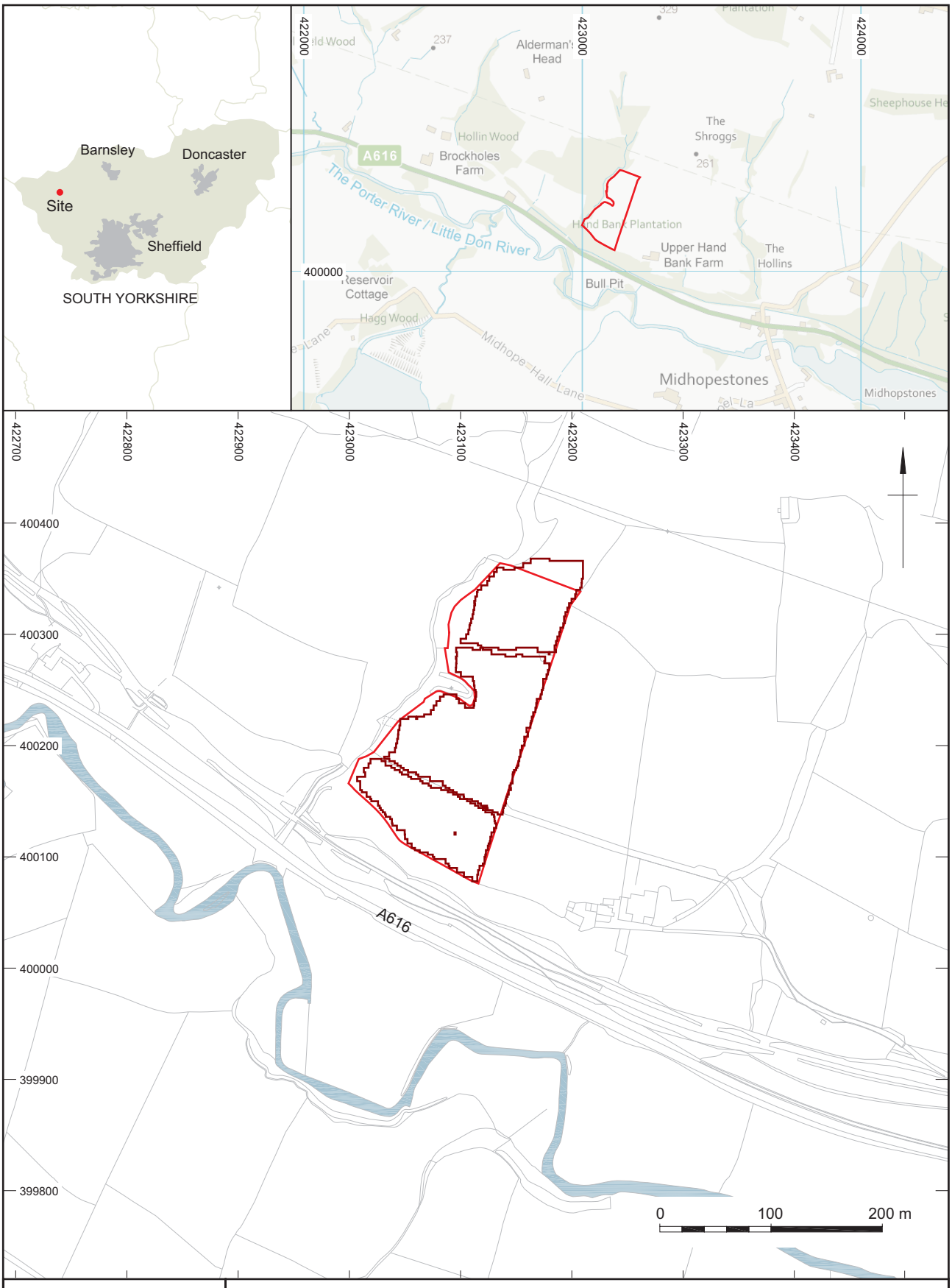
The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided into three groups, implying a decreasing level of confidence:

- Archaeology – used when there is a clear geophysical response and anthropogenic pattern.
- Probable archaeology – used for features which give a clear response but which form incomplete patterns.
- Possible archaeology – used for features which give a response but which form no discernable pattern or trend.

The unidentified category is used for features when the form, nature and pattern of the anomaly are not sufficient to warrant a classification as an archaeological feature. This category is further sub-divided into:

- Increased magnetic response – used for areas dominated by indistinct anomalies which may have some archaeological potential.
- Trend – used for low amplitude or indistinct linear anomalies.
- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.

Finally, services such as water pipes are marked where they have been identified.



Site boundary
Detailed survey area

Wessex Archaeology

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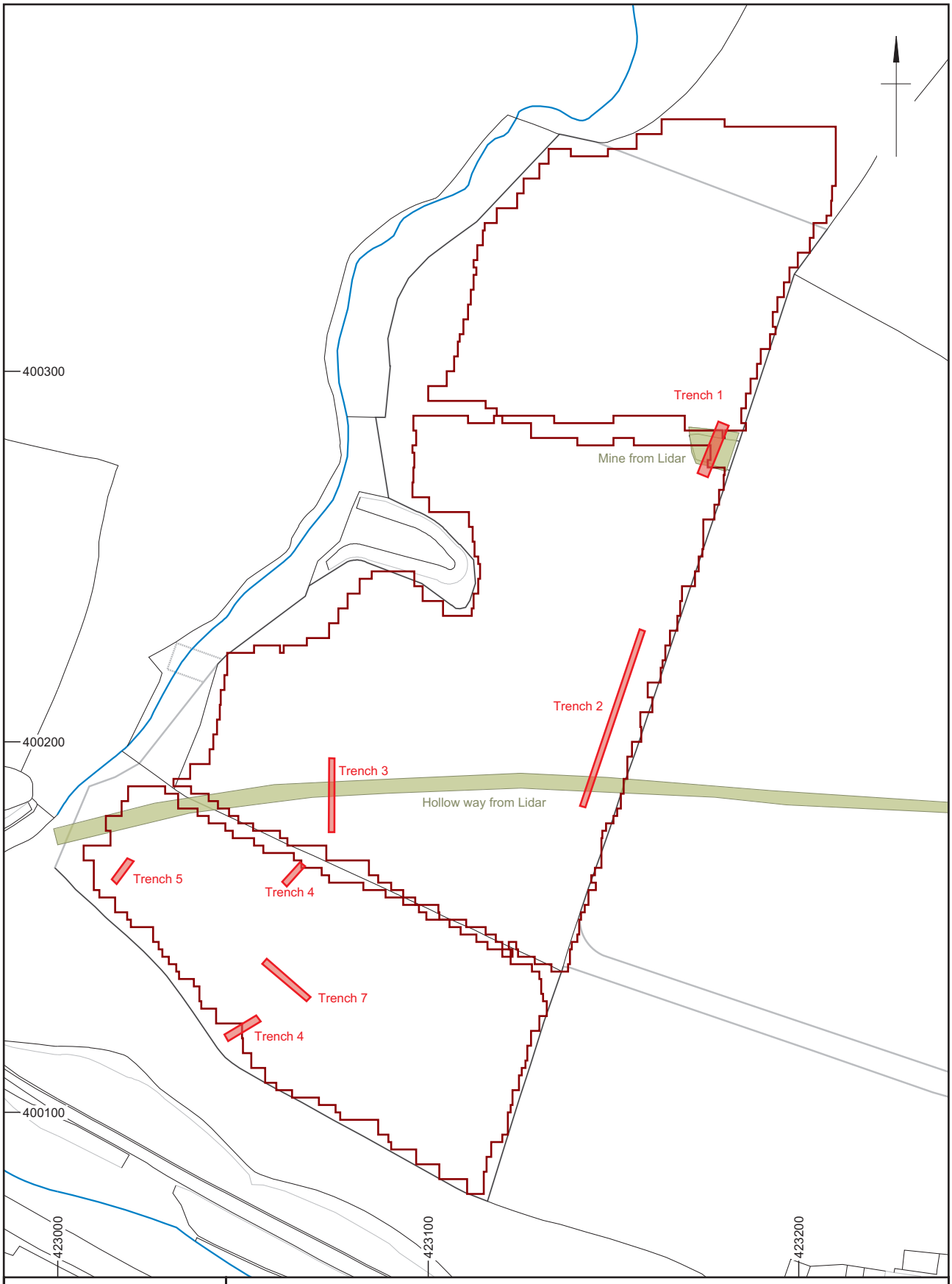
Site Location and Survey Extents

Figure 1



Trench

Extent of geophysical survey

Wessex Archaeology

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Trench Location

Figure 2

Wessex Archaeology

Key

+3nT

-2nT

Site boundary

Detailed survey area

0 50 m

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Illustrator:	KJF
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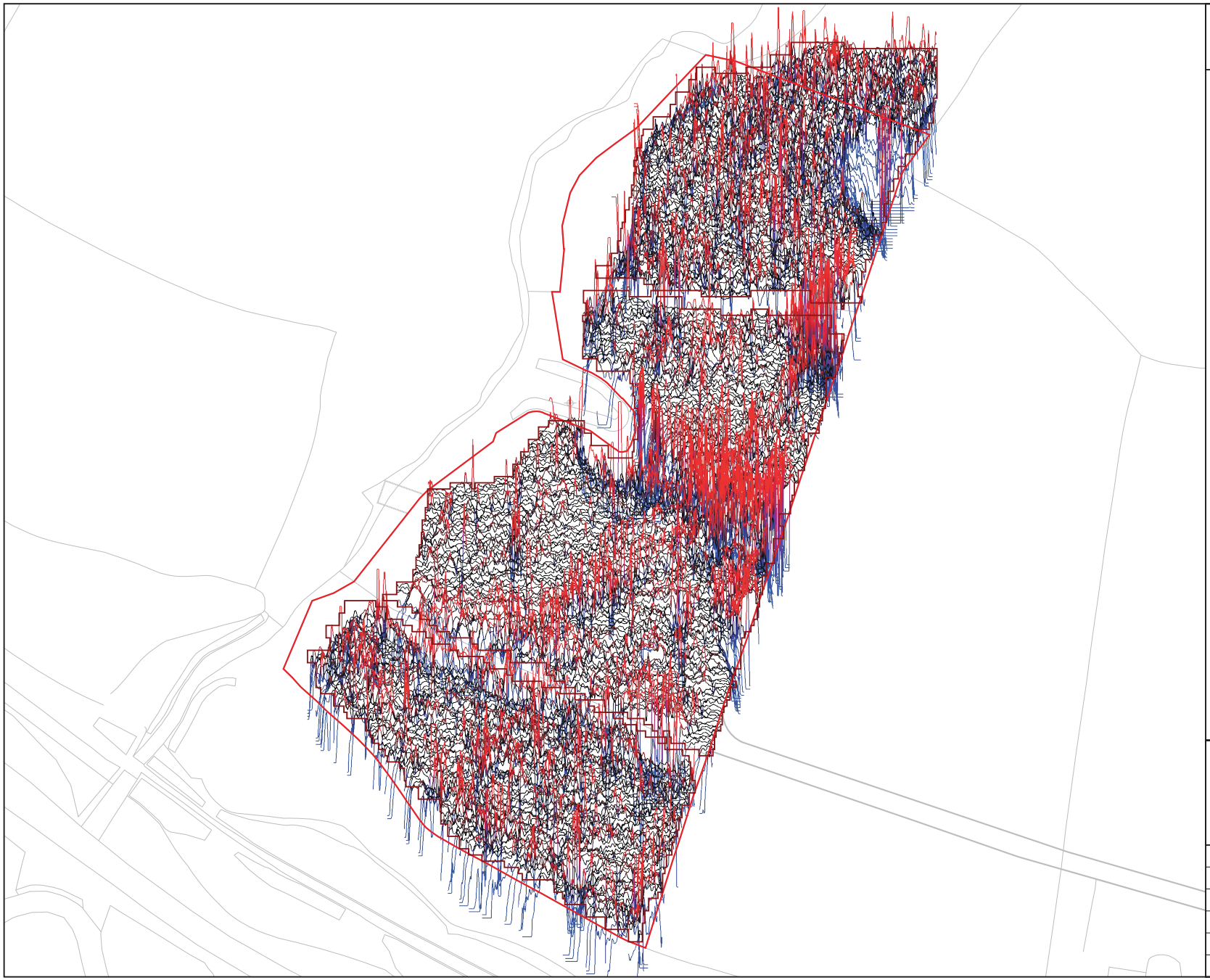
Greyscale

Figure 3



Wessex Archaeology

Key

+25nT

-25nT

Site boundary

Detailed survey area

0 50 m

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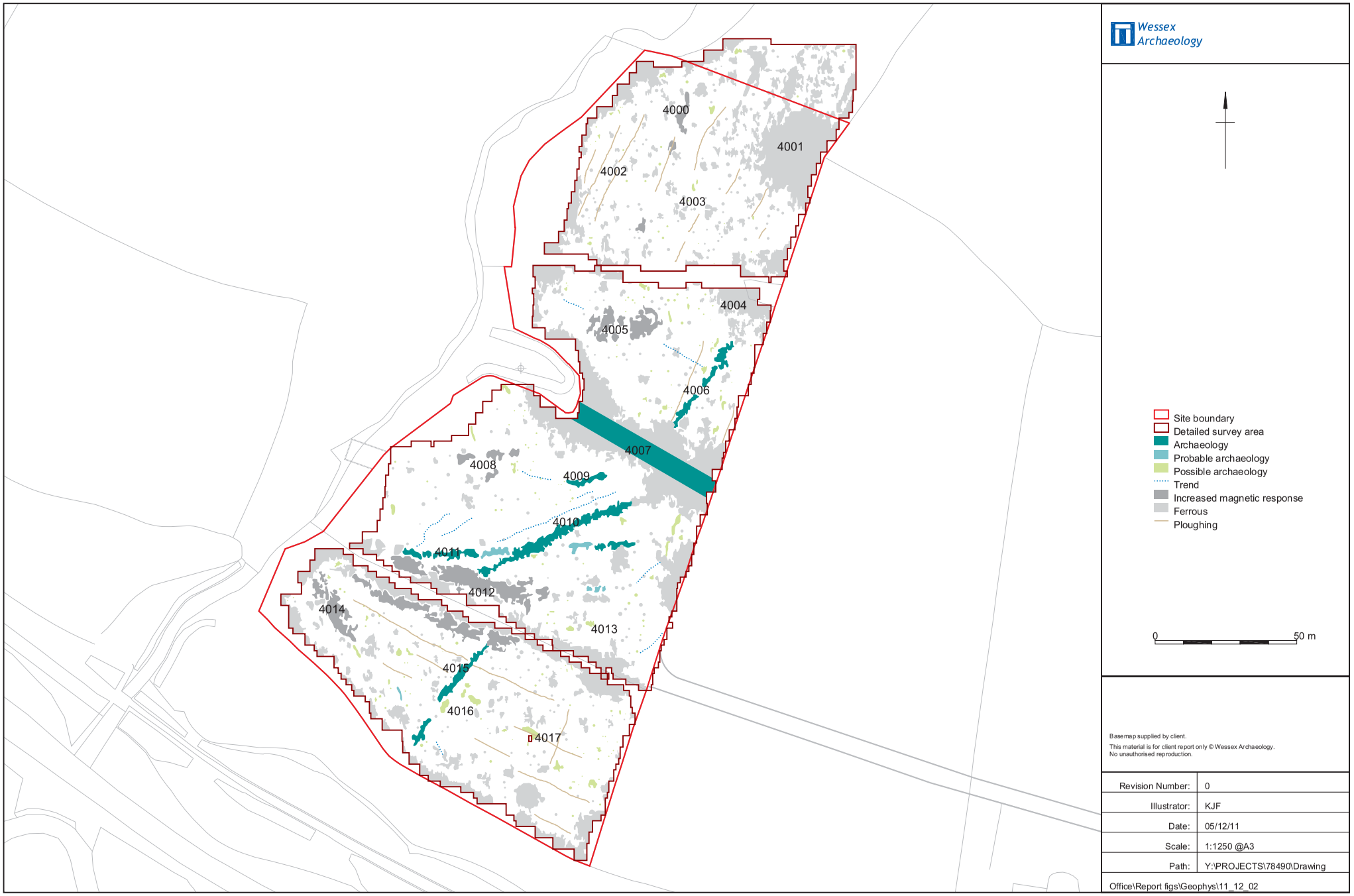
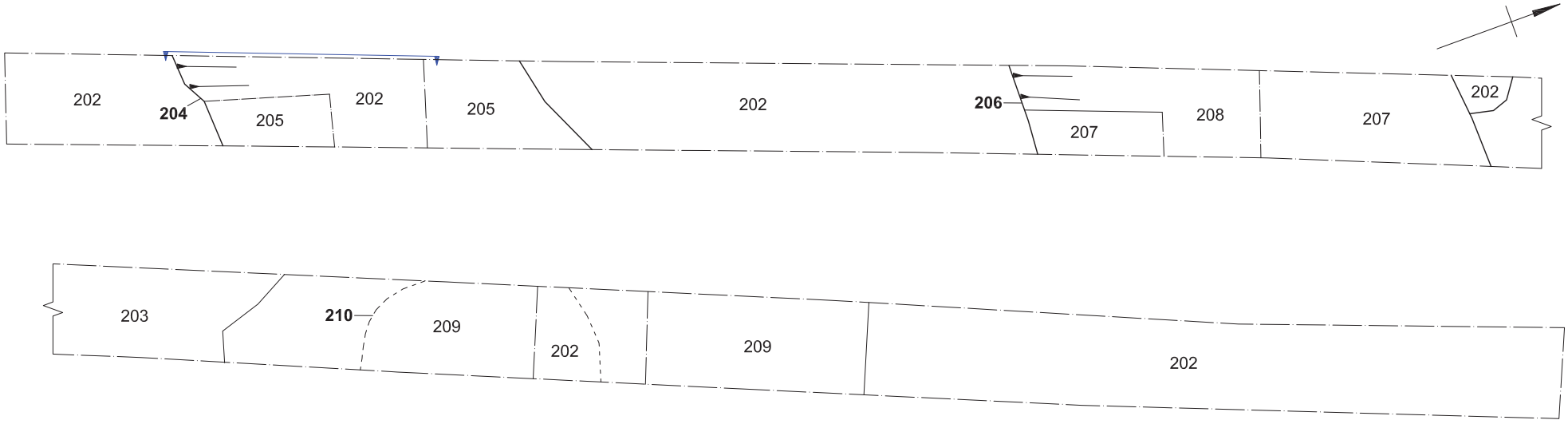
XY Trace

Figure 4



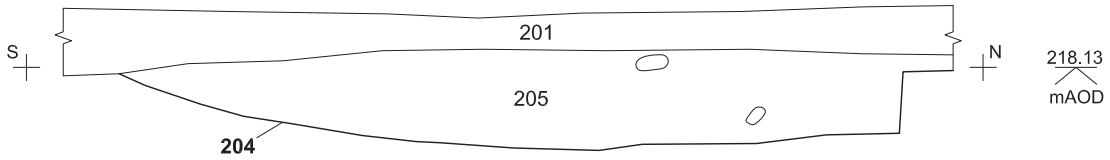
Interpretation

Figure 5



Plan of Trench 2 1:100

0 5m



East facing section through feature **204** 1:40

0 1 2m

Trench 2, looking south

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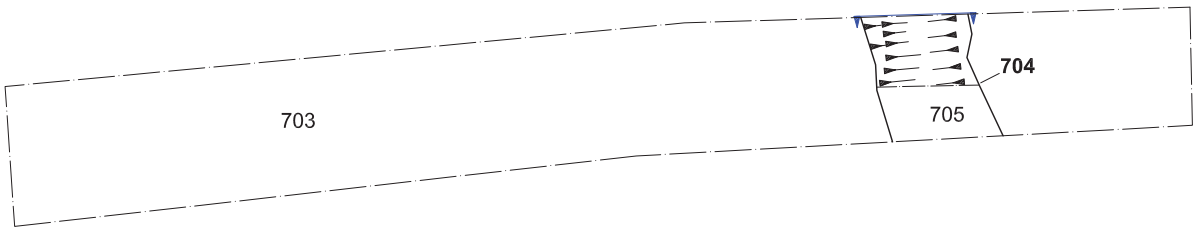
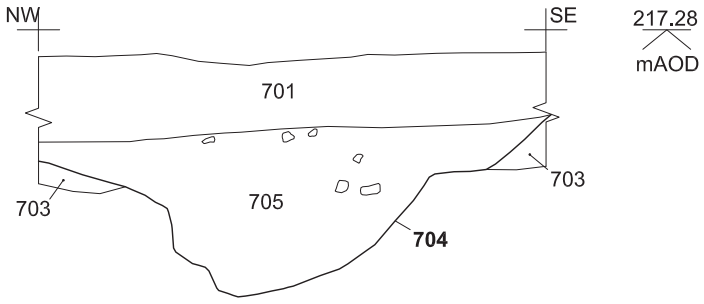


Plan of Trench 7 1:100

0 5m



South-west facing section through linear feature **704** 1:25

0 1m

Linear feature **704**, looking north-east

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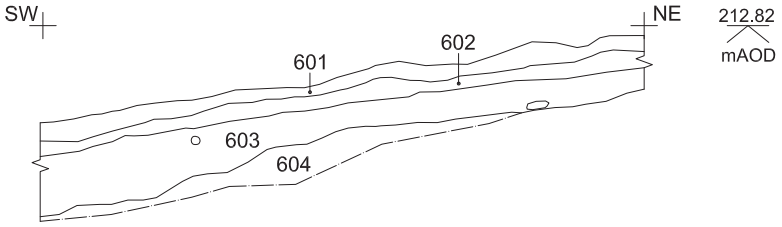
Plan of Trench 6 1:100

0 5m



Noth-west facing representative section of deposits within Trench 6 1:40

0 1 2m

Deposits within Trench 6, looking south-east

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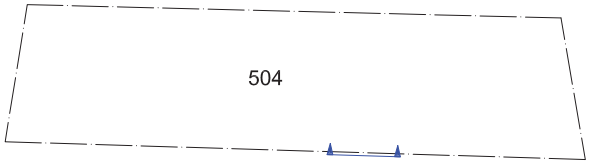
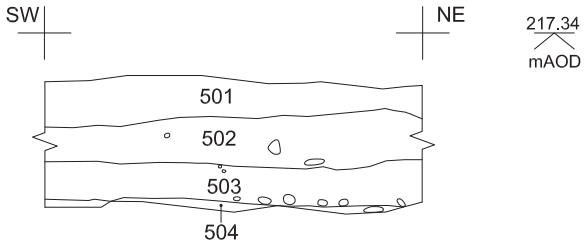


Plan of Trench 5 1:100

0 5m



Noth-west facing representative section of deposits within Trench 5 1:20

0 1m

Deposits within Trench 5, looking south-east

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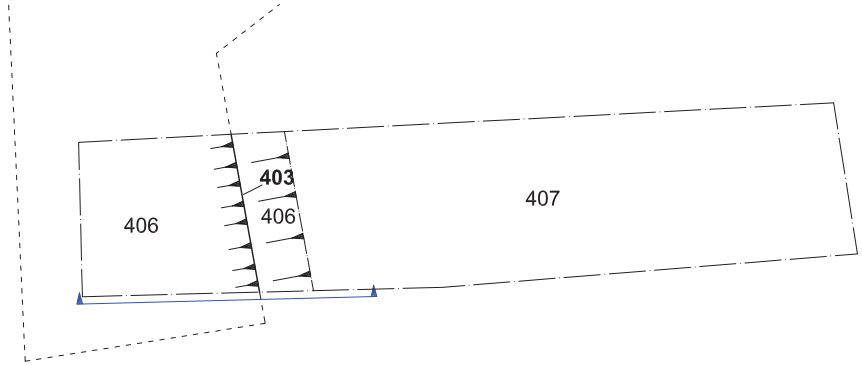
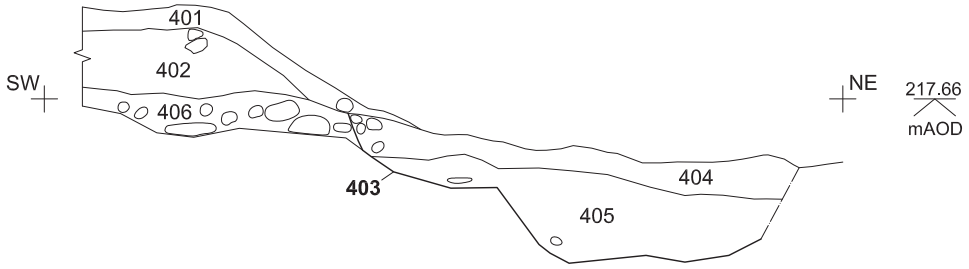


Plan of Trench 4 1:100

0 5m



North-west facing section through quarry pit **403** 1:50

0 1 2m

Quarry pit **403**, looking south-east

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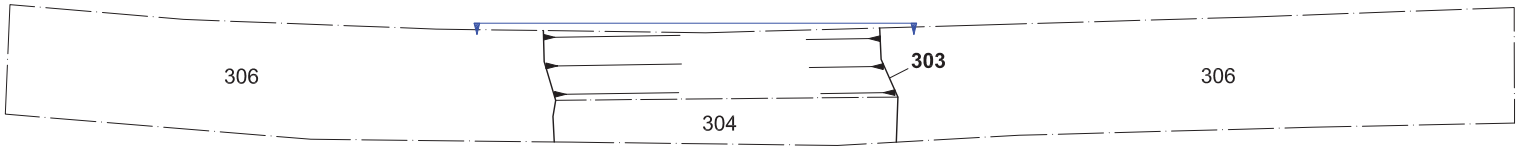
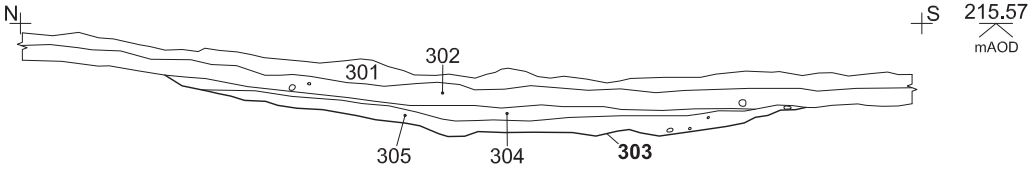


Plan of Trench 3 1:100

0 5m



West facing section through hollow way **303** 1:50

0 1 2m

Hollow way **303**, looking east

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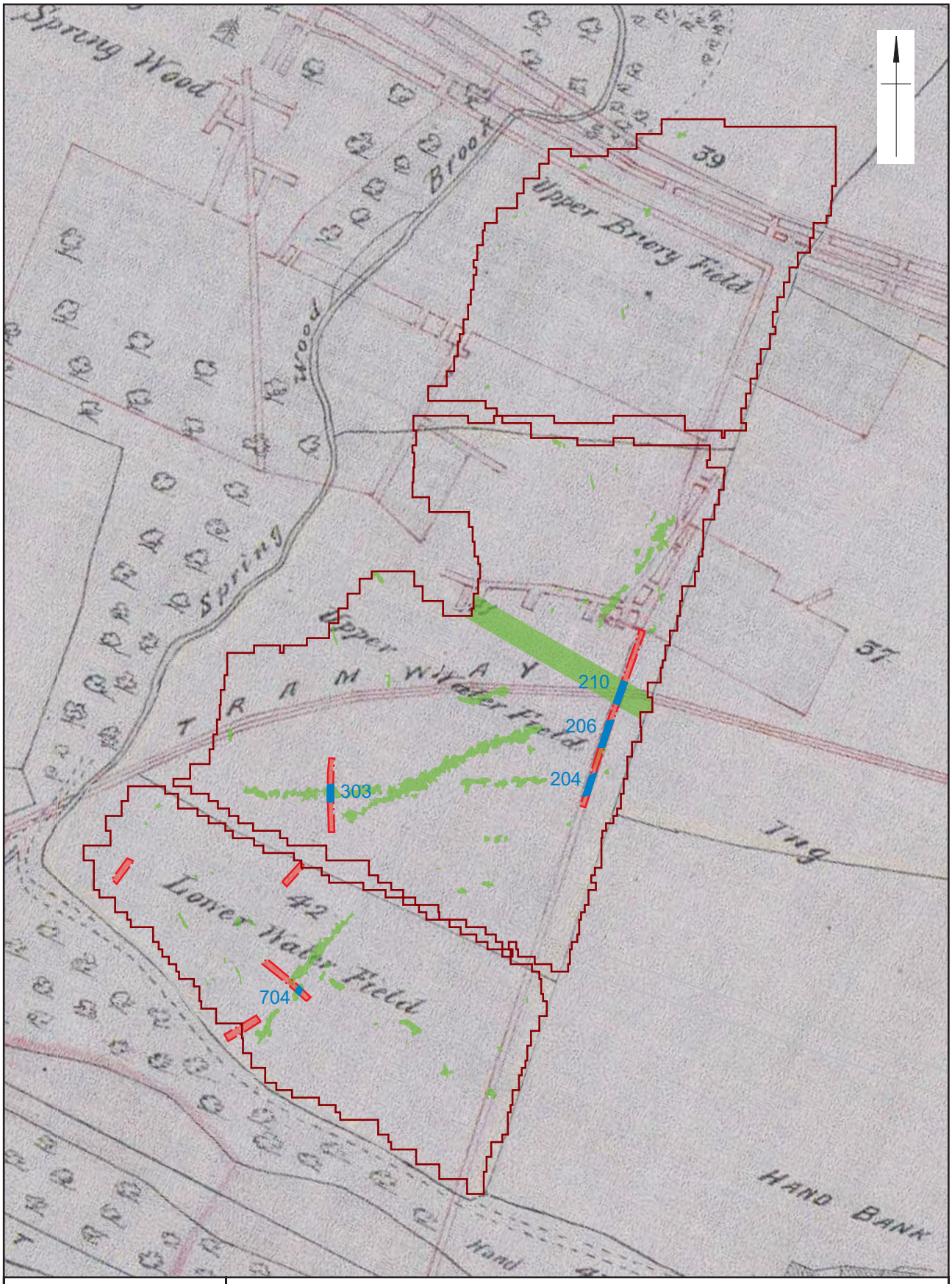

Trench
Archaeological feature
Geophysical anomaly
Extent of geophysical survey

Wessex Archaeology

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19th Century Coal Authority Plan

Figure 12

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