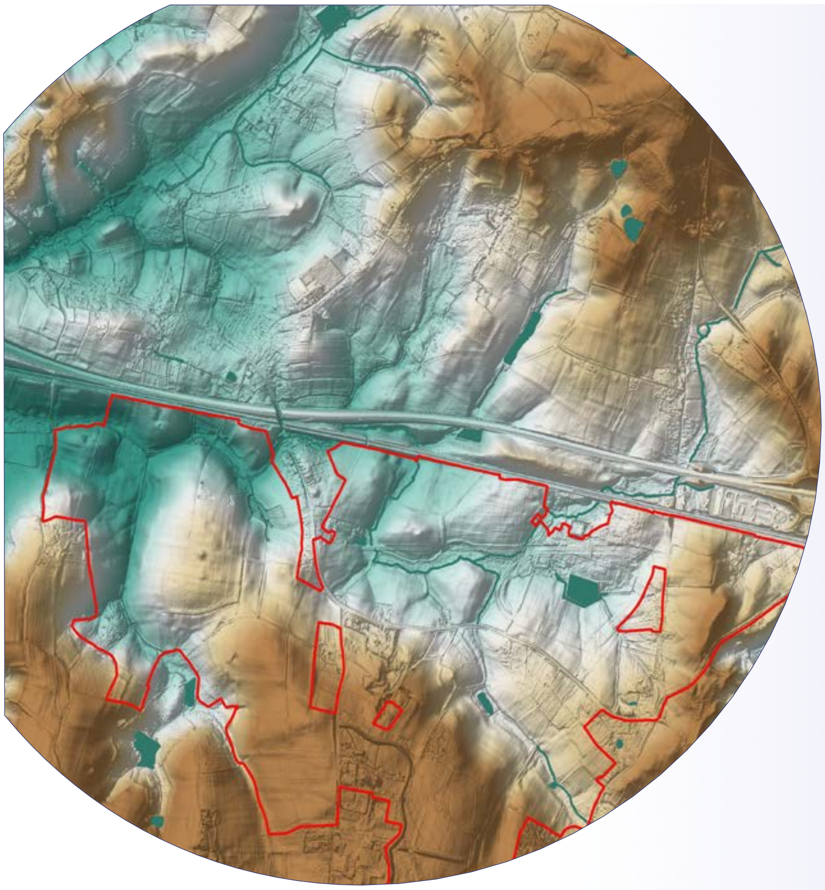
Note: Outline Planning Application (OPA) Site Boundary

The following report was produced prior to the finalisation of the application site boundary. The final application site boundary is shown on Figure 1.1 in ES Appendix 1.1. Therefore, references within the report to the site boundary do not reflect the site area and site boundary submitted with the OPA.

The reports were correct at the time of preparation, and all information within the Environmental Statement assessment reflects the latest relevant information.



Otterpool Park
Sellindge, Kent
Desk-based Geoarchaeological Assessment of Pleistocene and Early Holocene Stratigraphy

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Otterpool Park, Sellindge, Kent

Desk-based Geoarchaeological Assessment of Pleistocene and Early Holocene Stratigraphy

By Elizabeth Stafford (OA) and Dr. Matthew Pope (UCL)

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1 INTRODUCTION

1.1 Project details

1.1.1 Oxford Archaeology (OA) was commissioned by Arcadis, acting on behalf of Folkstone & Hythe District Council and Cozumel Estates, to undertake a desk-based geoarchaeological assessment of Pleistocene and Holocene stratigraphy associated with the proposed development of Otterpool Park. The work was undertaken prior to an outline planning application for a new garden settlement, accommodating up to 8,500 homes (use class C2 and C3) and use class D1, D2, A1, A2, A3, A4, B1a, B1b, B2, C1 development with related highways, green and blue infrastructure (access, appearance, landscaping, layout and scale matters to be reserved).

1.1.2 The assessment was intended to aid in the development of evaluation fieldwork strategies, addressing primarily the Palaeolithic/Pleistocene potential of the Site, but also considering the Holocene alluvial tract associated with the East River Stour. Although the Local Planning Authority has not set a brief for the work, discussions between Arcadis and Kent County Council (KCC) Archaeological Section have resulted in the preparation of an Otterpool Park Archaeological Appraisal and Fieldwork Strategy (Arcadis 2017), which established the overall scope of archaeological work required. A Written Scheme of Investigation (WSI) prepared by OA (OA 2017) included a requirement to produce this geoarchaeological report, in line with KCC guidelines for investigating sites with Palaeolithic potential.

1.2 Location, topography and geology

1.2.1 The Site is located south of the M20 and north of the B2067/Aldington Road, between Harringe Lane in the west and Junction 11 of the M20 in the east. Its southern limit is Aldington Road (**Fig. 1**). The Site incorporates areas either side of the A20 and the north–south section of the B2067. The Site is centred on TR 118 363 and covers a total area of *c* 590 hectares.

1.2.2 The Site lies at the north-eastern edge of the Weald. The Stour river valley forms the main drainage axis of this area of southeast Kent. The River East Stour, which passes through the Site in its northern extent, is a tributary of this river and the topography of the Site reflects this, the river valley formed by the River East Stour lying at around 68m OD. Land rises to the west, reaching 80m west of Barrowhill and east of Harringe Court. The highest point within the Site is at its southern edges between Lympne/Link Industrial Park and the village of Lympne where the land rises to 100-105m OD (**Fig. 2**).

1.2.3 The site mostly consists of enclosed farmland which is currently used for arable and pasture. Several large ponds are also present. The area includes a few built-up areas, most notably part of Sellindge, south of the M20 on Barrow Hill, parts of Westenhanger, Newingreen and Lympne on the western side of Stone Street, and Lympne Industrial Estate which lies close to the junction of the B2067 and Aldington Road.

1.2.4 The bedrock geology of the area is highly variable (**Fig. 3**). The western and southern parts of the site are largely mapped by the British Geological Survey (BGS) as interbedded sandstone and limestone of the Hythe Formation, although Weald Clay and Atherfield Clay are present at the western boundary. Much of the eastern and northern parts of the site are mapped as sandstone, siltstone and mudstone of the Sandgate Formation, with the Folkstone Formation in the northeast sector.

1.2.5 The bedrock geology is variously mantled by Quaternary Head deposits of clay and silt, which also includes Pleistocene brickearth deposits and Holocene colluvium. The brickearth is likely to have been deposited originally by aeolian processes (wind), but on sloping ground deposits have frequently been reworked by sub-aerial erosion.

1.2.6 Alluvial clays, silts, sands and fluvial gravels have accumulated in the valley of the East River Stour and associated streams (Fig. 4). The fine-grained deposits are likely to be mostly of Holocene age (< 12, 000 yrs. BP), although these deposits may blanket coarse-grained sands and gravels of Late Pleistocene age. The River East Stour is now only a small stream, but may have been significantly deeper and wider in the area of the Site in the past with a floodplain in places c 100-200m wide. The river rises at the foot of the Chalk Downs where springs issue from interface of the Lower Chalk and Gault Clay, and in the Roman period the watercourse reached the sea at Lympne, a short distance to the south of the Site. However, longshore drift caused the silting up of Romney Marsh, radically altering the previous coastline, and has affected the drainage of the local rivers and streams.

1.3 The Palaeolithic record of the Kent Weald

1.3.1 A general summary of the archaeological and historical background of the site can be found in the Archaeological DBA (Arcadis 2016), the Archaeological Appraisal and Fieldwork Strategy (AAFS, Arcadis 2017) and the WSI (OA 2017).

1.3.2 In general, the rich Palaeolithic record of Pleistocene fluvial systems in Kent has contributed an exceptional dataset through which significant parts of the British occupation record, from the Early Middle Pleistocene onwards, has been reconstructed and elucidated (Wenban-Smith *et al.* 2010). However, beyond the fluvial and Head deposits forming staircase sequences in the Thames, Darent, Stour and Medway Valleys lies a record of human activity in interfluve areas, in capture points beyond river terrace sequences. This activity can be loosely divided into records from the Chalk plateau, where Palaeolithic material is recovered from areas mapped as Clay-with Flints (and specifically from doline structures formed on the surface of the chalk), and records from the Lower Greensand ridges. While the majority of the latter were found by Benjamin Harrison around Ightham, the Lower Greensand throughout the Weald has a widespread record of Palaeolithic human activity (Pope *et al.* 2015).

1.3.3 One key Lower Greensand locality in Kent is Oldbury, near Ightham, from where Harrison recovered a large assemblage of tools and debitage from Head deposits on the slopes of a Folkstone Beds escarpment (Cook and Jacobi 2001). On the basis of technology and the abundance of small debitage, it is reasonable to assume that the Oldbury material represents the slope-entrained remains of a Late Middle Palaeolithic occupation site. The only comparable site in the region is Beedings in West Sussex, where Middle Palaeolithic tools and debitage were recovered from gull fissures in the Lower Greensand Hythe Beds (Pope *et al.* 2013).

1.3.4 As the current Site lies within an area in which all three principal components of the Lower Greensand (Folkstone Beds, Sandgate Beds and Hythe Beds) outcrop, albeit covered in part by quaternary Head deposits, the possibility that evidence for early human occupation is preserved needs to be considered. One locality within the site, Otterpool Manor Farm (Fig.2, Zone G, OMF13), was investigated as part of the Stour Valley Palaeolithic Project (Wenban-Smith 2015). OSL dating of Head-Brickearth deposits at Otterpool Manor Farm, indicated a Last Glacial Maximum date, although the presence of older Head Deposits on higher ground was not ruled out.

1.3.5 Palaeolithic finds in the immediate environs of the current site are rare but indicate an occupation record for the area. A single hand-axe was recovered from brickearth at Folkestone *c* 3km to the southeast (TR 225 361), with another from Port Lympne c 2.5km to the southwest (TR 097 348). An evaluation undertaken on the racecourse in 1969 retrieved some waste and worked flints of possible Upper Palaeolithic or Mesolithic date (Swanton 1973, 203-7). The proven presence of Palaeolithic material from contexts unrelated to river terraces and from within fissure capture points in the Lower Greensand of the Weald requires special consideration of the Palaeolithic potential for the current site.

2 PROJECT AIMS

2.1.1 The overall aim of the work is to provide additional base-line data from existing sources on the sub-surface quaternary sediments and their archaeological, geoarchaeological and palaeoenvironmental potential, to inform future evaluation fieldwork. The focus is on the Pleistocene/Palaeolithic sequences, although sequences post-dating the Last Glacial Maximum - Late Glacial/Late Upper Palaeolithic and Early Holocene/Mesolithic - will also be considered.

2.1.2 It is intended that this enhanced base-line may identify areas of the Site for targeted evaluation work, as well as allow the development of strategies and methods for investigation. The proposed Scheme is largely residential and impact is expected to be confined to foundations, service installations and infrastructure, but precise design details are not currently available.

2.1.3 Specific aims as set out in the Archaeological Appraisal and Fieldwork Strategy (AAFS, Arcadis 2017, Sec. 6.3) for 'palaeoenvironmental investigations' (which includes Palaeolithic archaeology) during the evaluation stage are as follows:

- To establish with a high degree of confidence the nature, character, distribution, extent and depth of Quaternary deposits across the Site
- To assess the palaeoenvironmental potential associated with documented Hythe beds and Head Deposits using past investigations within the wider area.
- To establish a robust model for the Site's Palaeolithic archaeological remains, by identifying Historic Environment Areas (HEAs) of different character and potential
- To establish the extent to which previous development and/or other processes have affected Quaternary deposits at the Site
- To establish the likely impact on any surviving Quaternary deposits of the proposed development
- To determine the presence and potential of lithic artefact evidence and faunal remains in the sediments encountered
- To determine the presence and potential of palaeoenvironmental evidence in the sediments encountered
- To determine the presence of, or potential for, undisturbed primary Palaeolithic occupation surfaces in the sediments encountered
- To interpret the depositional and post-depositional history of any artefactual or biological evidence found
- To establish correlations of any Pleistocene deposits found with reference to adjacent and regional sequences and to national frameworks
- To assess in local, regional and national terms, the archaeological and geological significance of any Pleistocene deposits encountered, and their potential to fulfil current research objectives
- To establish the likely impact of the proposed development upon any Palaeolithic remains, to identify priorities for further investigation, and to make recommendations on suitable methods and approaches for possible mitigation work.

3 METHODOLOGY

3.1.1 All geotechnical data was provided as graphical logs by the client and derives from a phase of ground investigations carried out in in August 2017. The lithological data was input into geological modelling software (Rockworks 17) to allow correlation of broad stratigraphic units.

3.1.2 It should be noted that all of the geotechnical data derives from paper records. The problems associated with using geotechnical records in geoarchaeological deposit models have been outlined by Bates (1998), and recently reviewed by Bates and others in Carey *et al.* (2018). Despite these problems, however, the information in the geotechnical logs for this Scheme is useful in providing a broad preliminary indication of the nature of the sub-surface stratigraphy and deposit survival, from which inferences about the likely environments of deposition can be made.

3.1.3 The geotechnical locations were then inputted into GIS software to allow comparison with a range of datasets. These included 1m LiDAR open data sourced from the Environment Agency and geological mapping from the British Geological Survey (BGS). The LiDAR data is represented as a colored DTM with a hill shade overlay. Geophysical data derives from a series of magnetometer surveys, mainly carried out by SUMO during 2017-2018.

4 RESULTS

4.1 Review of subsurface geotechnical data

4.1.1 Recent geotechnical ground investigations undertaken by Arcadis in August 2017 comprised the drilling of 5 rotary boreholes (BH), 15 windowless samples (WS) and the excavation of 14 trial pits (TP). The distribution of the interventions is illustrated in **Figure 2** and summarised in **Table 1**. The distribution is spread across the Site, but tends to be clustered, with large areas having no data. It is noted that no interventions are located in areas mapped as alluvium in the lower-lying areas of the river valley (**Fig 4**).

4.1.2 A review of data held by the BGS at Keyworth revealed a large number of borehole records located along the alignment of the High Speed 1 rail line (HS1, formerly known as the Channel Tunnel Rail Link, CTRL). However, these lie outside the northern boundary of the current site and, given the general limitations of historical borehole logs (see Sec. 3 above), it was thought more useful to provide a qualitative assessment of the results of purposive archaeological investigations associated with HS1 (see below).

Table 1: Summary of geotechnical interventions from Otterpool Park

Intervention	Easting	Northing	Total depth (m)	GL Elevation (m OD)
BH101	610950.1	136019.1	10	101.23
BH102	610306.5	137311.6	10	73.39
BH103	611768.1	136716.1	10	70.3
BH104	611750.5	135820.1	9.95	94.56
BH105	613555.5	136952.2	10	79.97
WS101	610985	135716.4	3	102.28
WS102A	611356.3	136095.9	0.3	94.65
WS102B	611356.3	136095.9	0.2	94.65
WS103	611049.7	136228.5	5	94.59
WS104A	611197.5	136561.7	0.3	82.61
WS104B	611197.2	136561.7	0.15	82.49
WS104C	611197	136561.7	4	82.44
WS105	611285.9	136770	2.85	70
WS106	611608.4	136750.4	3	69.87
WS107	611867.5	136919.2	3	68.45
WS108	612461.3	137157.2	2.8	73.99
WS109	612704.1	136191.4	3	83.26
WS110	612443.9	137140.4	3	73.64

Intervention	Easting	Northing	Total depth (m)	GL Elevation (m OD)
WS111	612710.1	136343	0.6	82.23
WS112	610977.8	136085.2	3.5	99.93
TP101	610259.3	137376.2	2	71.59
TP102	611605.5	137227.6	2.5	68.56
TP103	613536.7	136951.6	2.5	79.73
TP104	609988.2	136627.8	2.8	65.76
TP105	611195.1	137037.4	2.5	66.65
TP106	612677.4	136514	2.5	77.41
TP107	610704.3	136503.2	2.7	92.67
TP108	611770.6	136484.5	2	73.04
TP109	612231.6	136228.2	2.5	80.25
TP110	610956.2	136019.6	2.5	101.14
TP111	611372	136251	2.1	91.43
TP111A	611403.9	136322.5	0.4	89.21
TP112	611665	135941.1	1.6	96.44
TP113	611251.4	136540.1	3.1	82.66
HD101	609688.1	136765.1	1.2	68.09
HD102	609855.6	136667	1.2	65.22
HD103	609754.6	136560.7	1.2	79.01

4.2 Sediment stratigraphy

4.2.1 The stratigraphic sequence of sediments recorded during the geotechnical investigation is summarized in Table 2. As previously noted, no interventions were located on areas mapped by the BGS as alluvium, but this has been included in the section below for completeness, along with fluvial river gravels associated with the River East Stour. These two stratigraphic units have been recognized and investigated on the HS1 sites to the north.

4.2.2 The stratigraphic sequence may be summarized as follows

- Bedrock (Cretaceous)
- Head/Brickearth (Pleistocene – Late Glacial)
- Fluvial terrace gravel (Pleistocene – Late Glacial)
- Floodplain alluvium and palaeochannel fills (Late Glacial – Holocene)
- Colluvium and ploughwash (Holocene)
- Made ground (Recent)

- Topsoil/ploughsoil (Recent)

Table 2: Summary of geotechnical interventions from Otterpool Park

Intervention	Total depth	GL Elevation (m OD)	Thickness (m)			Bedrock (m BGL)
			Topsoil	Made Ground	Head	
BH101	10	101.23	0.1		3.9	4
BH102	10	73.39	0.2		2.8	3
BH103	10	70.3	0.2		2.3	2.5
BH104	9.95	94.56	0.2			0.2
BH105	10	79.97	0.2	0.1	3.2	3.5
WS101	3	102.28	0.2	1	1.8	refusal
WS102A	0.3	94.65	0.3			refusal
WS102B	0.2	94.65	0.2			refusal
WS103	5	94.59	0.35		4.65	not reached
WS104A	0.3	82.61		0.3		refusal
WS104B	0.15	82.49		0.15		refusal
WS104C	4	82.44	0.2	0.1	3.7	refusal
WS105	2.85	70	0.23		2.47	2.7
WS106	3	69.87	0.3		2	2.3
WS107	3	68.45	0.3		2.7	refusal
WS108	2.8	73.99	0.2		2.6	refusal
WS109	3	83.26	0.2	0.5	2.3	refusal
WS110	3	73.64	0.15		2.85	refusal
WS111	0.6	82.23		0.6		refusal
WS112	3.5	99.93	0.3		3.2	refusal
TP101	2	71.59	0.3		1.7	2.0
TP102	2.5	68.56	0.4		2.1+	Not reached
TP103	2.5	79.73		0.35	2.15+	Not reached
TP104	2.8	65.76	0.3		2.5+	Not reached

Intervention	Total depth	GL Elevation (m OD)	Thickness (m)			Bedrock (m BGL)
			Topsoil	Made Ground	Head	
TP105	2.5	66.65	0.3		2.2+	Not reached
TP106	2.5	77.41	0.3		2.2+	Not reached
TP107	2.7	92.67	0.5		2.2+	Not reached
TP108	2	73.04	0.4		1.6	2.0
TP109	2.5	80.25		0.6	1.9+	Not reached
TP110	2.5	101.14	0.4		2.1+	Not reached
TP111	2.1	91.43	0.6		1.5	2.0
TP111A	0.4	89.21	0.4			0.4
TP112	1.6	96.44	0.3		1.3	1.6
TP113	3.1	82.66		3.1		Not reached
HD101	1.2	68.09	0.25		0.95+	Not reached
HD102	1.2	65.22	0.2		1+	Not reached
HD103	1.2	79.01	0.2		1+	Not reached

Bedrock

4.2.3 Bedrock was reached in very few geotechnical interventions (Table 2). Although refusal may indicate the rockhead had been reached, this is not a reliable indicator as a window sampler may refuse on dense gravel lag.

Head/brickearth and colluvial ploughwash

4.2.4 Head deposits were recorded in 29 geotechnical interventions, and the intervention logs show that the distribution of Head deposits is extensive across the Scheme, in places exceeding 3m in thickness **(Fig. 4)**.

4.2.5 It is notable the distribution is more extensive than deposits mapped by the BGS. This may in part be due to the presence of sub-surface hollows and bedrock fissures acting as sediment traps (see below), along with other localised deposits of plateau drift. Descriptions of the sediments were variable, as would be expected on variable bedrock. The majority of the Head is recorded as sandy clay (or silt), but also sand in deeper deposits in BH105 and WS112. Limestone gravel was noted in TP112. In WS103 several layers of Head were recorded, some of which could be colluvial in nature. In WS105 laminated sand was recorded at the base of the Head. Sand and gravel recorded as Head in TP105 may be related to fluvial deposition rather than slope deposits given its location in the valley bottom.

4.2.6 The Head, although for the most part likely to be of Pleistocene age, may also include Holocene colluvium/ploughwash, which has the potential to contain stabilisation horizons and buried soils that may be associated with archaeological features and artefact scatters stratified within or beneath them. It was, however, impossible to differentiate these from the geotechnical logs, and the lack of detail precludes identification of bedding structures of the presence of stabilisation horizons.

4.2.7 Head/brickearth investigated at Otterpool Manor Farm (Fig. 2, OMF13) at the southern edge of the Scheme, was investigated as part of the Stour Valley Palaeolithic Project (Wenban-Smith 2015). The deposits comprised Head/brickearth 2-3m thick, gravelly at the base, deposited by slope processes. OSL dating indicated a Last Glacial Maximum date for deposition (19.36 +/- 2.23 ka BP). The project report concluded that this date is consistent with similar sites investigated as part of the Stour Project and others in southeast England. During this period, Britain was unpopulated, so the main thickness of these deposits is clearly of low archaeological potential, although they may contain reworked evidence from earlier occupation. However, relatively undisturbed remains of rare early Devensian occupation may be buried at the base of LGM or pre-LGM brickearth accumulation, as in the Dartford case (Wenban-Smith *et al.* 2010). Likewise, some slopewash brickearths may have formed in pre-Devensian episodes of cold climate, as at Baker's Hole, Kent (Wenban-Smith 1995) and at Red Barns, West Sussex (Wenban-Smith *et al.* 2000), and these could bury minimally disturbed remains of earlier date.

4.2.8 It should be noted that the presence of older Head Deposits on higher ground was not discounted at Otterpool Manor Farm. At Dreal's Farm (NGR 619500, 144700), another site investigated for the Stour Project, a substantial spread of brickearth capping Clay-with-Flints produced an OSL date of 119.91 +/- 18.61 ka BP, demonstrating the possibility of a considerably older age for deposition in higher plateau locations. The report concluded that some areas of brickearth capping high ground may be aeolian in nature, as opposed to slopewash, and of late Middle or Late Pleistocene date with some Palaeolithic potential. Where brickearth deposits cap high ground or plateau areas, without any obvious higher ground to provide source material for slopewash accumulation, then deposition is most likely to be aeolian (Wenban-Smith 2015).

Fluvial terrace gravel and alluvium

4.2.9 The alluvial tracts associated with the East River Stour as mapped by the BGS (Fig, 4) were generally not sampled in geotechnical investigations. It is anticipated that in these areas the alluvial deposits, and perhaps colluvium on the valley slopes, may mask earlier fluvial terrace gravels dating to at least the Late Devensian (eg. TP105). As part of the HS1 investigations to the north of the Site (Fig. 2), further information is provided:

4.2.10 At West of Stone Street (ARC SST98, Wessex Archaeology 1999a) and the East Stour Diversion (ARC ESD98, Wessex Archaeology 1999b) a general sequence of bedded fine-grained minerogenic alluvium sealed fluvial gravel at *c* 2m BGL. The alluvium was interpreted as representing channel fill and/or overbank floodplain alluvium, with mottling and oxidation becoming more common towards the top, where a fluctuating water table occurs. A dark grey, possibly humic layer with well-defined upper and lower horizons was evident in trenches at SST98, and this may represent a stabilisation horizon, perhaps indicating a more rapidly buried, rather than gradually inundated, surface.

4.2.11 The morphology and coarse matrix of the basal mixed fluvial gravel and sand may be considered indicative of high-energy water action, scouring and mixing deposits from various parent materials prior to deposition (i.e. stream bed deposits). Higher energy levels are generally associated with glacial retreat and lowered sea levels, and as such it is possible that this deposit either originates following the Devensian glaciation (i.e. *c* 18,000 BP), when sea levels were *c.* 100-120 m lower than present day, or a result of seasonal (spring) discharge during the Late Devensian. However, there is also evidence to suggest that the Late Boreal/Early Atlantic period (*c.* 11. 9,000 BP) witnessed a significant rise in water tables, associated with a series of cut and fill phases within alluvial zones. It has been suggested that this may have been due to increased rainfall associated with the sea level rises occurring at this time (Brown 1997, 210).

4.2.12 The preservation of waterlogged plant macrofossils within a later fluvial gravel is notable, and presumably represents the organic surface of the river bed with plant growth which was sealed (and possibly truncated) by fluvially-rolled flint pebbles and nodules deposited in periods of high-energy flow. Although undated, the organic deposit was thought unlikely to predate the early Holocene period (i.e. Mesolithic), and is perhaps more likely to be Neolithic or later, representing either a former course of the River East Stour, or (in the case of SST98) a former tributary.

4.2.13 Although no peaty organic deposits were noted during the HS1 investigations, there is certainly potential for stratified peats and palaeochannel sequences with high palaeoenvironmental potential to have been preserved in other locations within the River East Stour floodplain. If such deposits are preserved at wetland edge locations and on buried floodplain islands, they may also be associated with archaeological remains preserved in waterlogged conditions.

4.3 Interpretation of geological anomalies from the magnetometer survey

4.3.1 In excess of 140 linear and sub-linear anomalies have thus far been identified in the transcription of the magnetometer survey, ranging in size from less than 10m to more than 250m in length (Figs 5 and 6). They are largely present on slopes across the western half of the site.

4.3.2 While some of these features might be cultural in origin, it is strongly suspected that these could represent the expression of fissures in the solid geology. The distribution of the linear anomalies is broadly coincident with the outcrop of the Cretaceous Hythe Beds, being largely absent in the areas of the site where the Sandgate and Folkstone Beds outcrop. The Hythe Beds in Kent and Sussex are known to give rise to fissures (or 'gulls') that formed during the Quaternary in response to the denudation of the Wealden landscape under periglacial and interglacial conditions (Topley 1975; Worrsam 1965; Colcutt 2001). These structures are normally associated with geomorphologies related to cambering, a process by which hard sedimentary rock overlying thick clays arches downwards close to escarpment and river valley edges. This is due to erosion of the softer clays at the base of the valley sides, which subsequently leads to the detachment of blocks of sedimentary rock along widened joints or 'Gulls'.

4.3.3 Gulls form parallel to the slope edge and are evident as a series of fissures becoming generally narrower the closer they are to the centre of the plateau. Three factors primarily control fissure formation: the steepness of the slope, the degree of erosion acting at its base over long time periods and the degree to which the rock is jointed.

4.3.4 Pleistocene fauna appears to have been found in a fissure at Loose near Maidstone in the first half of the 19th century (Dawkins 1869). It was not, however, until the late 19th century that the wider prevalence of fissure sites and their potential was firmly demonstrated. At a quarry located in the parish of Ightham, near Sevenoaks, Kent, the presence of fissures was first recognised by Benjamin Harrison, who began to make regular visits to the quarry to collect faunal material and artefacts from them (Harrison 1928). Work at the site was continued in turn by Lewis Abbot and Edwin Newton, who monitored the Ightham Fissures during their removal by quarrying, and made extensive collections of faunal material. The eventual list of recovered fauna from the site was extensive, and included Pleistocene mammals (mammoth, rhinoceros, horse, reindeer, hyena and bear) and Holocene mammals (roe deer, red deer, sheep and pig), as well as a large range of avian, amphibian and small mammal fauna. The assemblage recovered was in excellent condition, and suggested that the fissures had acted as traps whose fills had been protected from later erosion, preserving material of parts of the late Quaternary (late Pleistocene and early Holocene) period (Lewis Abbott 1854; Newton 1894; Newton 1899). An undetermined quantity of stone tools was found associated with these assemblages; these unfortunately are now lost (Jacobi pers. com.).

4.3.5 At the Palaeolithic site of Beedings, West Sussex, situated on the edge of the Hythe Beds scarp slope, fieldwork was undertaken in response to planned agricultural works which threatened the archaeology (Jacobi 2007). The network of fissures was effectively mapped using an RM15 Geoscan meter, and likely dominant features thought to be gulls were isolated and targeted through excavation. A total of seven trenches were eventually excavated, sampling a range of fissure features including one suspected to be a significant gull. The excavations revealed well-preserved Early Upper Palaeolithic material surviving at depths of less than 0.5m within the fissures. Below these were further scatters of material of Middle Palaeolithic affinity (Pope *et al.* 2013).

4.3.6 Gulls have not yet been recorded on the Sandgate or Folkstone Beds, and Figure 6 shows a prevalence of linear anomalies on slopes closer to the boundary between the Hythe Beds and area of outcropping Atherfield Clay on the Site. It is therefore likely that these features, if indeed gulls, have a limited distribution across the site. They can, however, lie beneath Head deposits, and so where such sediments are present overlying the Hythe Beds, the possibility of gulls that are not detectable by magnetometry should also be borne in mind.

5 Discussion

5.1 Significance and potential

5.1.1 In conclusion the following points are worthy of note regarding the significance and potential of the sediment sequences across the Site:

- The Site straddles several bedrock geologies, which have given rise to highly variable sequences of superficial drift deposits comprising Pleistocene Head/brickearth and Holocene colluvium/ploughwash on the higher ground and slopes, and Late Devensian fluvial river gravels overlain by alluvium associated with the River East Stour in lower-lying locations.
- The Head/brickearth spreads mapped by the BGS are, for the most part, likely to represent Late Devensian slope deposits, the main body of which are likely to be of low archaeological potential. The distribution of these deposits may be more extensive than the BGS mapping indicates. However, older aeolian deposits dating to the Middle to Late Palaeolithic may also be present on higher plateau areas (eg Area I). These deposits, if present, are considered to have higher potential to preserve *in situ* Palaeolithic archaeology.
- Buried soils and stabilisation horizons may occur within or at the base of the colluvium/ploughwash, or at the base of Late Devensian Head deposits, and these may also be associated with *in situ* archaeological remains. Any such Palaeolithic remains associated with the base of the Head deposits are very rare and would be of regional and potentially national importance.
- The geophysical survey has revealed a network of linear geological anomalies interpreted as potential bedrock fissures associated with the Hythe Beds in the western part of the Site. Previous investigations on similar geologies have shown that such features can act as sediment traps, preserving important assemblages of Palaeolithic artefacts and faunal remains, as well as later archaeological remains at shallower depths.
- Holocene alluvium and Late Devensian fluvial gravels are present in low-lying areas associated with the River East Stour. Although investigations for HS1 to the north of the Site concluded that the sequences there were of limited palaeoenvironmental potential, only limited investigation of the river valley within the Site has thus far been carried out. Localised peat deposits and palaeochannel sequences may prove more productive here. Waterlogged Holocene floodplain sequences have the potential to preserve important palaeoenvironmental remains (pollen, plant remains and insects), providing a landscape context for any contemporary occupation on higher, drier areas. At wetland edge locations, complex deposits may exist whereby colluvial and alluvial sequence interdigitate, preserving stratified *in situ* evidence of human activity (eg flint scatters, burnt mounds).

5.2 Strategies and approaches for further evaluation

5.2.1 If practicable, the potential fissures identified in the western area of site may be initially investigated during future standard evaluation trenching. Figure 7 illustrates the array of trenches excavated to date, and the proposed trenches in Arcadis Zone B, some of which cross potential fissures.

5.2.2 An initial strategy for investigation may be to probe the depth of fissure fill sequences with a hang auger at up to six trench locations. Should they prove to be shallow a small number of slots could be hand-excavated to record the stratigraphy and check for artefacts and ecofacts. Deeper sequences could be excavated by machine dug slots in 0.1m spits, as far as practicable. The investigation of the fissure deposits should be carried out in the field under the supervision of a Palaeolithic/Pleistocene specialist, features such as these are not always wholly apparent on initial removal of topsoil. It is anticipated where fissures are aligned perpendicular to the trench a profile should be achievable across the full width of the feature. The approach to assessing the fissure features will reviewed in conjunction with KCC either during, or at the close, of this phase of fieldwork to ensure that the methodology is aligned with the conditions on the ground.

5.2.3 The Pleistocene Head/brickearth deposits appear much more extensive across the Scheme and in places are very deep. As stated previously, although the majority of the deposits are likely to be Late Devensian in age and have limited palaeoenvironmental and archaeological potential, significant deposits may occur towards the base of the sequences. Consequently, it is recommended purposive investigation through test pitting is carried out on targeted areas when more details of the Scheme and construction impacts are known. This is possibly with the exception of Zone I. This is a plateau location that has been highlighted in the Stour Palaeolithic Project as having higher potential for preservation of Middle to Late Pleistocene deposits and associated Palaeolithic archaeology. It is recommended a programme of test pits be carried out, supervised by a Palaeolithic/Pleistocene specialist at this location early in the programme to further ascertain potential.

5.2.4 With reference to Holocene colluvium/ploughwash deposits, these have potential to contain stratified archaeological remains and, if practicable, a sample can be initially investigated during standard evaluation trenching through a combination of hand augering and sondages, similar to the investigation of the fissures/gulls where the deposits are identified. Should complex sequences and buried soils be identified a geoarchaeologist should attend site to advise on the recording and sampling of the deposits. This may be extended to a sample of discrete larger bedrock hollows that may contain fine-grained sediments and potential *in situ* artefact scatters. The AAFS proposed the floodplain sequences associated with the River East Stour be the subject to an initial programme of borehole investigation. It may be worthwhile combining the auger/borehole and test pitting work with an initial electromagnetic conductivity survey (EM) to further map the buried sub-surface topography, palaeochannels, floodplain islands and organic sediments, in order that fewer interventions can be more accurately placed over a large area. EM Survey was used extensively on sequences in the Combe Haven for the Bexhill to Hastings Link Road (Champness 2018), albeit on more extensive wetland/estuarine valley sequences.

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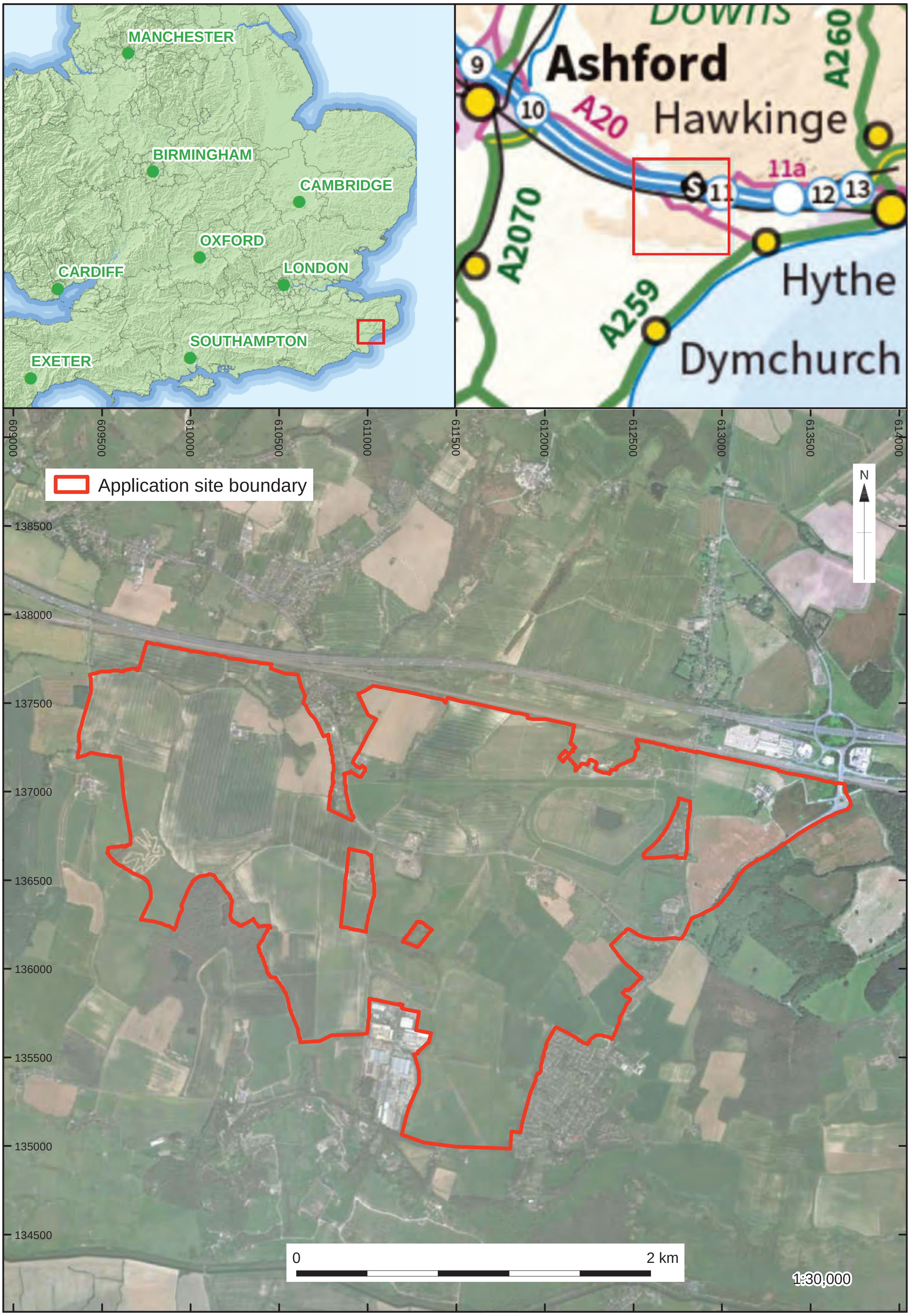

Figure 1: Site location

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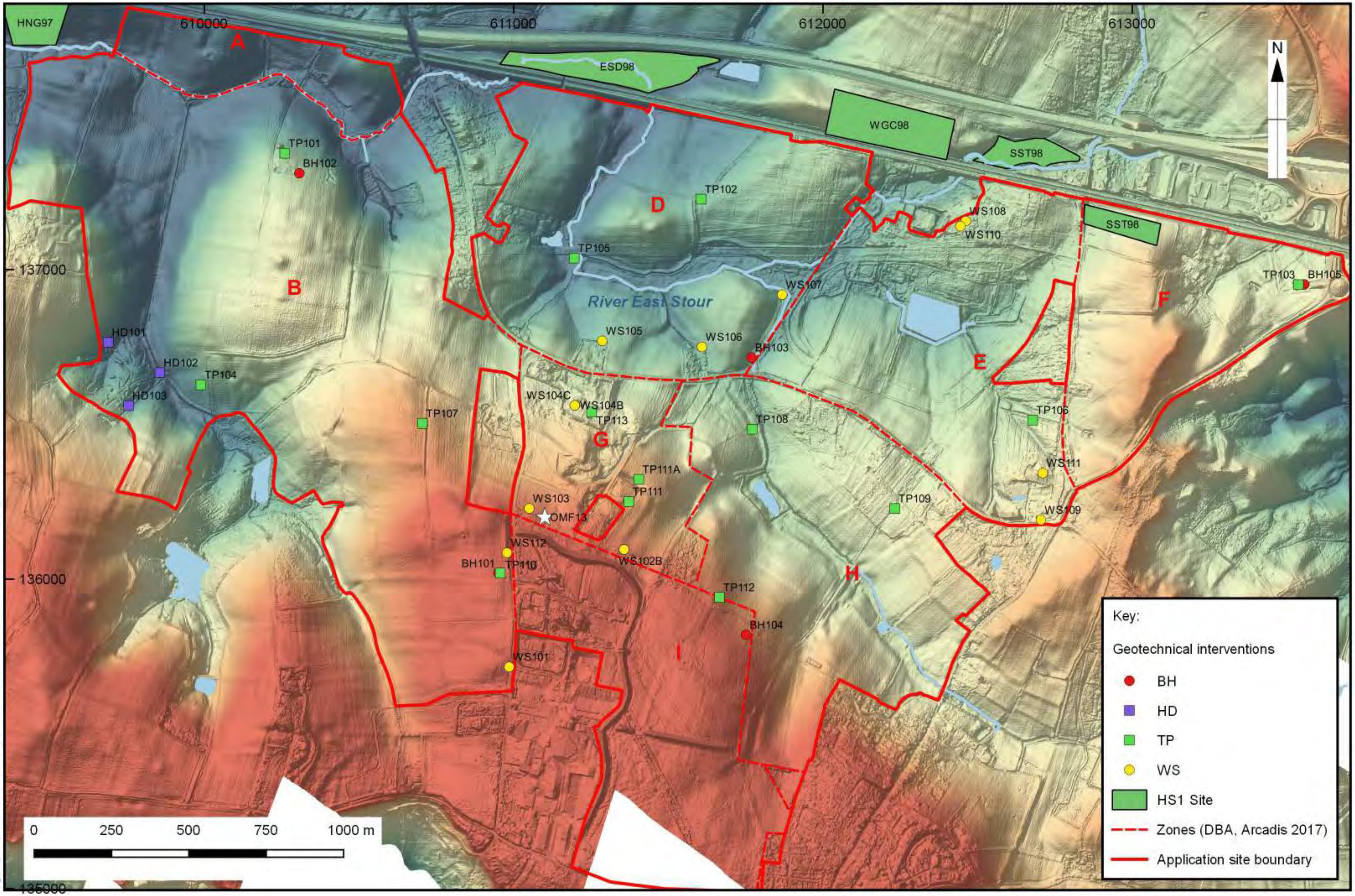

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Figure 2: Location of geotechnical interventions and LiDAR data

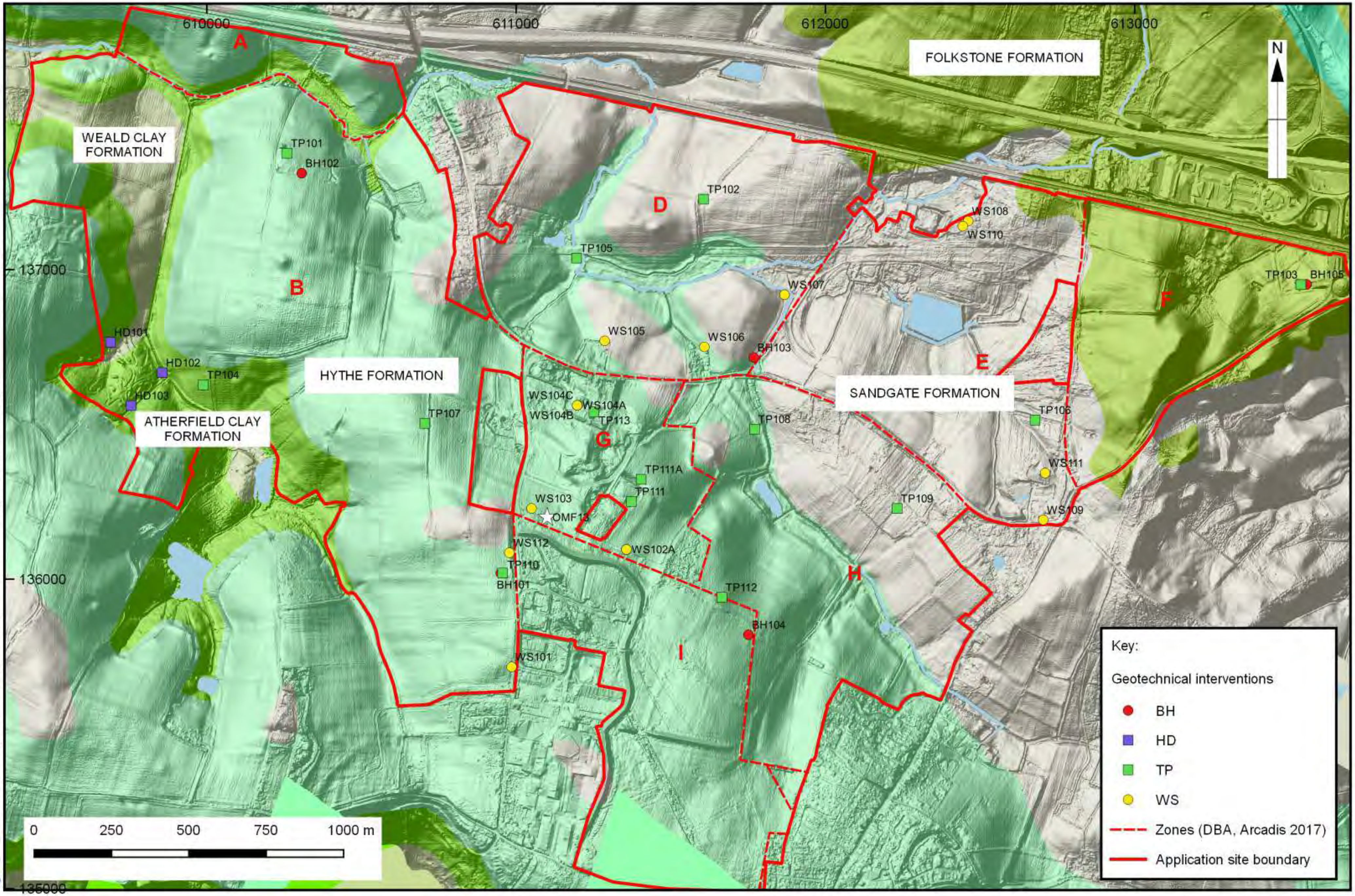

Figure 3: BGS mapped bedrock geology and location of geotechnical investigations

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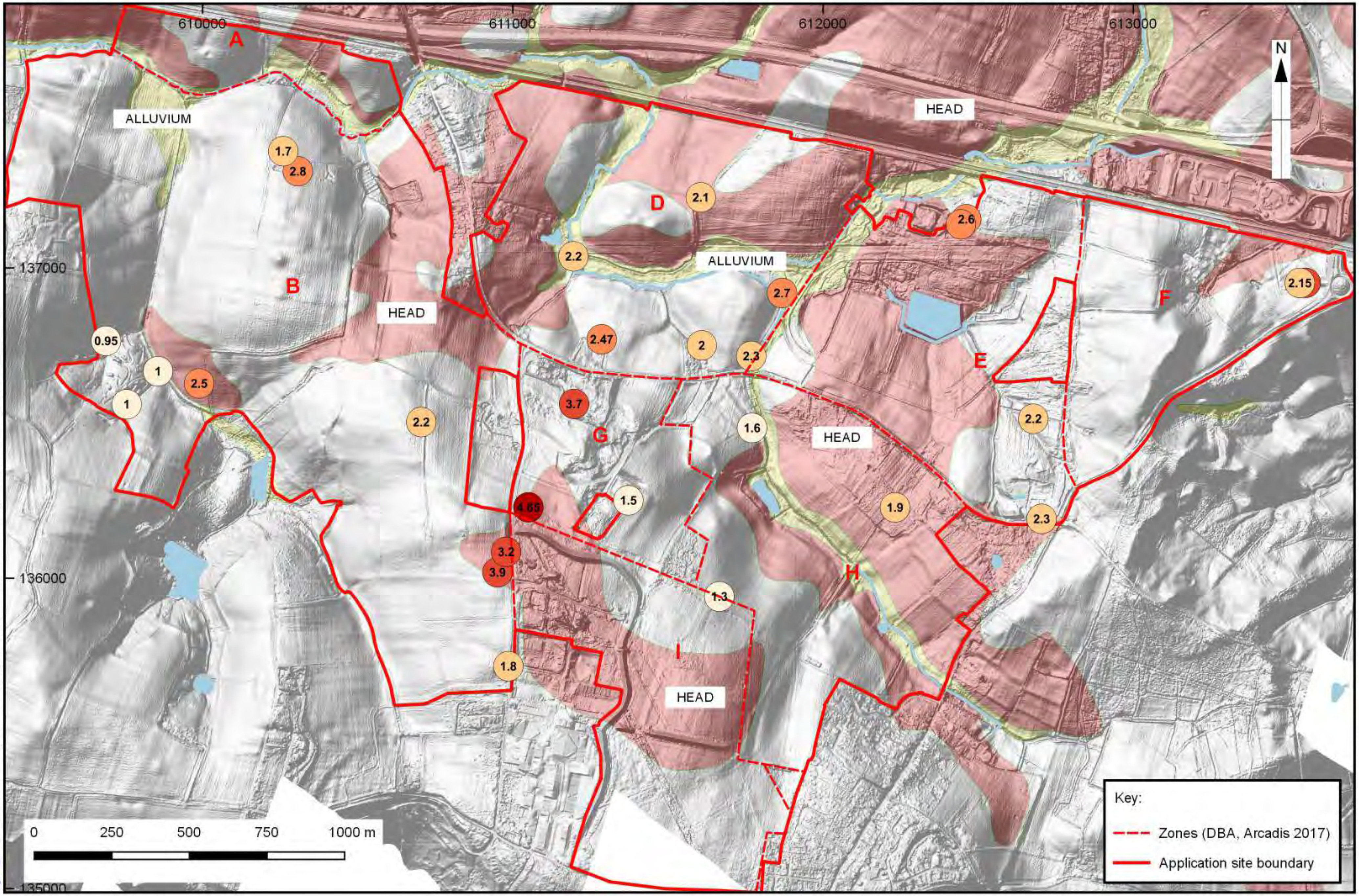

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Figure 4: BGS mapped superficial geology and thickness (m) of Head from geotechnical data

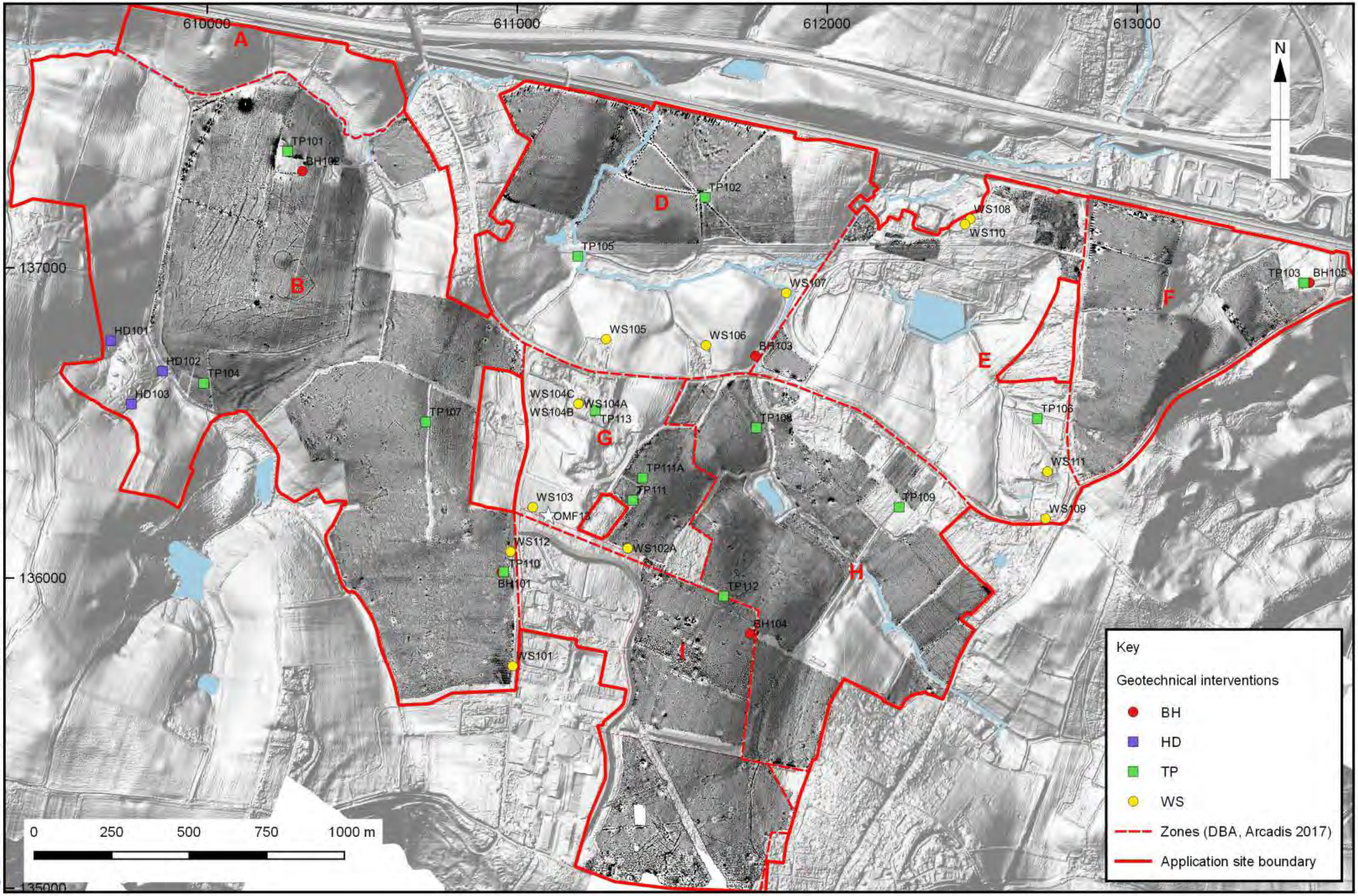

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Figure 5: Magnetometer survey greyscale plots draped over LiDAR data

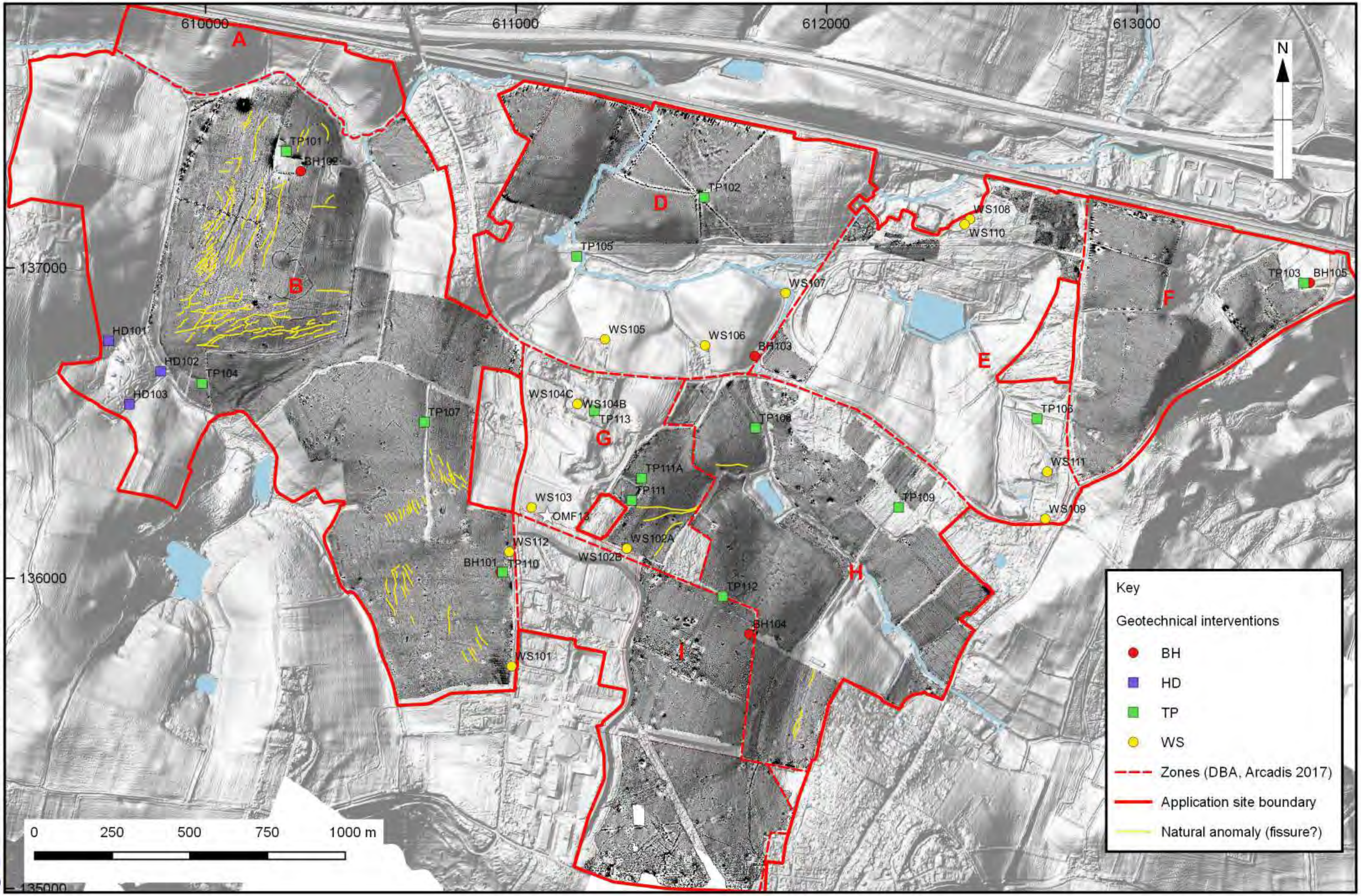

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Figure 6: Magnetometer greyscale plots highlighting linear probable geological anomalies or fissures.

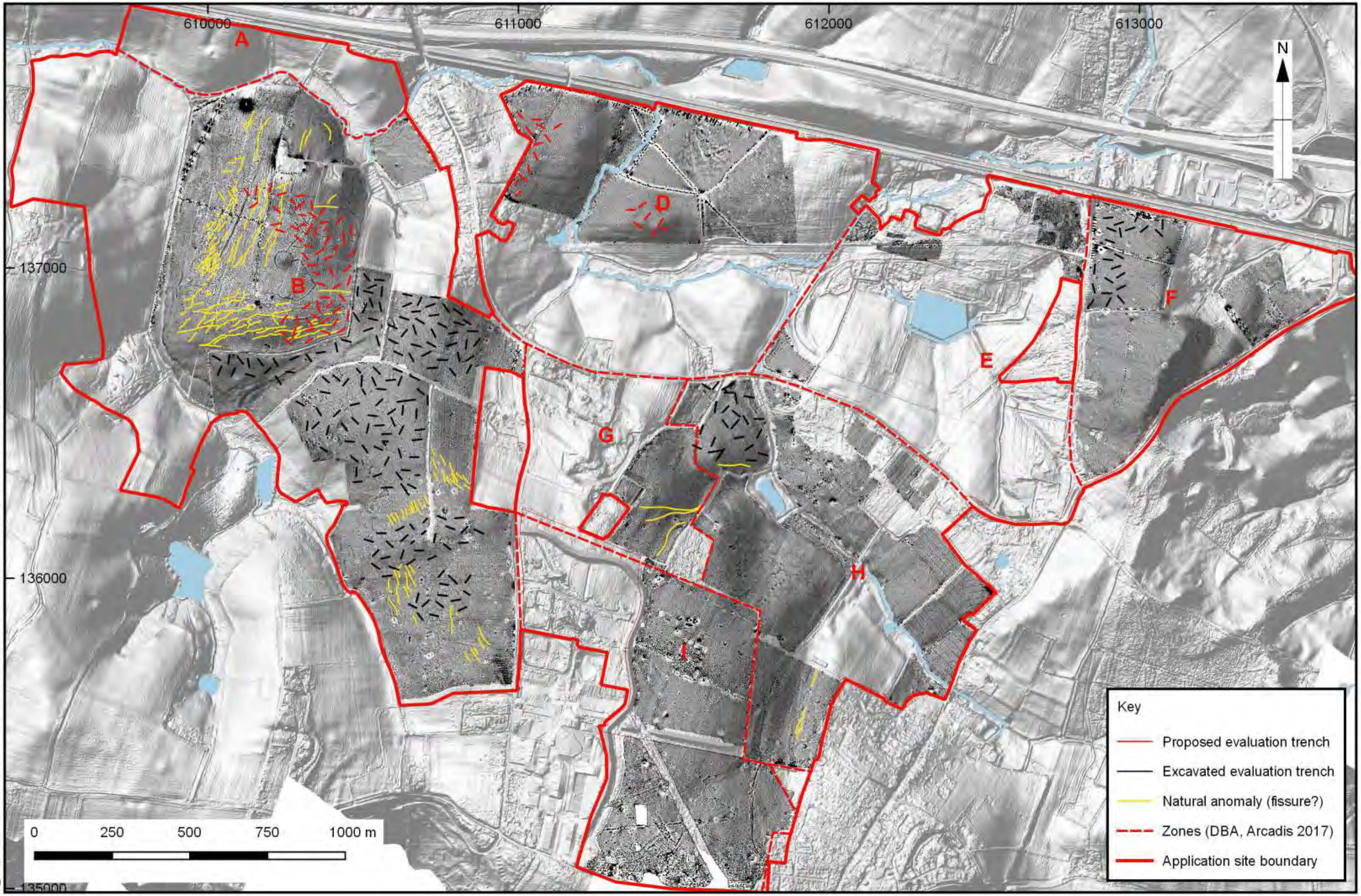

Figure 7: Highlighted probable fissures and evaluation trench locations

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