FIVE ESTUARIES
OFFSHORE WIND FARM

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PRELIMINARY ENVIRONMENTAL INFORMATION REPORT

VOLUME 5, ANNEX 7.3: GEOARCHAEOLOGICAL DESK BASED ASSESSMENT

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North Falls Offshore Windfarm - Onshore Project Area

Geoarchaeological Desk Based Assessment

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Summary

A Geoarchaeological Desk Based Assessment (GDBA) has been undertaken for the 'Onshore Project Area' of the North Falls Offshore Wind Farm ('the Scheme'). The GDBA outlines the sub-surface superficial deposits underlying the Scheme, and provides an assessment of their archaeological and geoarchaeological potential. It provides a suitable baseline within which to inform a program of further geoarchaeological or archaeological works.

Through deposit modelling, the GDBA has assessed the likely presence and lateral and horizontal extent of Quaternary deposits across the Scheme. The archaeological and paleoenvironmental potential of these deposits has been assessed, and the significance of any archaeological material they may contain considered in relation to national and regional research themes and priorities (EH 2008; EERRF 2021). The GDBA has identified areas where Quaternary deposits may be present which could contain significant archaeological evidence and/or deposits with palaeoenvironmental potential, as well as some areas where there is insufficient data to consider potential.

Consequently, a Geoarchaeological Landscape Characterisation based on BGS archive boreholes, mapping of superficial deposits, analysis of Lidar data and baseline character mapping has been used to define nine Geoarchaeological Character Zones based on variations in the geological characteristics of the deposits present, linked to the assessment of their archaeological and geoarchaeological potential.

Quaternary superficial deposits present within the Scheme include deposits of both Pleistocene and Holocene date. Pleistocene deposits are likely to be widely present across the Scheme, including Kesgrave Sands and Gravels and Brickearth, with Alluvium of Holocene date, and potentially Pleistocene fluvial deposits associated with the Holland Brook, located at the southern end of the Scheme. Pleistocene and/or Holocene deposits of Head/Colluvium, though unmapped, may be present on valley slopes or at the base of valleys in various parts of the Scheme.

The Kesgrave Sands and Gravels underlying much of the Scheme are likely to comprise deposits of the pre-Anglian (MIS 12) Colchester Formation, equivalent to the Cooks Green/Wivenhoe (MIS 14-13) and Ardleigh (MIS 16-14) Gravels. Towards the south of the Scheme deposits of the Anglian (MIS 12) Holland Gravel, and unmapped post-Anglian fluvial deposits, may also be present, along with post-Anglian fluvial deposits of the Holland Brook. On the basis of Palaeolithic finds within the study area, these deposits are of high archaeological and geoarchaeological potential.

The sands and gravels in the area of the Scheme are overlain by a widespread unit of Pleistocene Brickearth; these deposits are undated, but may include deposits of Late Devensian (MIS 2; 23-11.7 Ka) or older Pleistocene date. They are likely to be originally aeolian in origin, but may be substantially reworked by various processes. The geoarchaeological and archaeological potential of these deposits is unknown, and they warrant further investigation.

Towards the south of the Scheme in the area of Holland Haven Marshes, and in the valley of the Holland Brook and its tributaries, Holocene Alluvium is likely to be encountered. In the absence of GI data for these areas the depth, thickness and character of these deposits is unknown, but they may contain peat or organic-rich units of high geoarchaeological and archaeological potential.

Targeted archaeological and geoarchaeological field evaluation, based on the potential and significance of the deposits likely to be encountered, has been proposed for each Zone, comprising geoarchaeological boreholes in areas of deeper deposits and machine excavated Palaeolithic test pits targeting areas of Pleistocene deposits.

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North Falls Offshore Wind Farm
Onshore Project Area

Geoarchaeological Desk Based Assessment

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology (WA) were commissioned by Royal HaskoningDHV to undertake a Geoarchaeological Desk Based Assessment (GDBA) for the 'Onshore Project Area' of the North Falls Offshore Wind Farm (hereafter referred to as 'the Scheme'). The GDBA is required to inform the Preliminary Environmental Information Report (PEIR) submission as part of the Development Consent Order (DCO) application. This GDBA was prepared following the specification in Royal HaskoningDHV (2022).

1.1.2 The North Falls offshore wind farm project is a proposed extension to the Greater Gabbard offshore wind farm, located off the east coast of England in the Southern North Sea. The project is being developed by North Falls Offshore Wind Farm Ltd (NFOW), a joint venture between SSE Renewables and RWE.

1.1.3 The project will comprise an array of offshore wind turbines and offshore electrical platforms which will be connected to the shore by offshore export cables installed within an offshore cable corridor (Royal HaskoningDHV 2022). The project requires onshore infrastructure in order to connect the offshore wind farm to the National Grid, the footprint for which is collectively referred to as the 'onshore project area'. The onshore project area comprises:

- Landfall;
- Buried electrical cables located within an onshore cable corridor, from landfall (between Clacton-on-Sea and Frinton-on-Sea) to the onshore substation zone; and
- Onshore substation zone.

1.1.4 The GDBA has been undertaken on a revised footprint for the project's landfall, onshore cable corridor and onshore substation zone (the 'Onshore Project Area') as it stands at the time of writing, as described by Royal HaskoningDHV (2022) and as shown in **Figure 1**.

1.1.5 The results of the GDBA provide further information on geoarchaeological and archaeological potential of the Scheme, qualifying and quantifying the archaeological risks to the project represented by the superficial deposits, and facilitating an informed decision with regard to the requirement for, and methods of, any further archaeological and geoarchaeological works.

1.2 Site location and geology

1.2.1 The area of the Scheme is located within the Tendring District of Essex, making landfall between Frinton-on-Sea and Clacton-on-Sea where the Scheme passes through Holland Haven Marshes SSSI and Holland Haven Local Nature Reserve.

1.2.2 The Scheme extends north-westwards from here over a distance of approximately 20 km, passing close to the villages of Thorpe-le-Soken, Tendring and Little Bromley before terminating to the east of Burnt Heath.

1.2.3 The bedrock geology in the area of the Scheme is mapped by the British Geological Survey (BGS) as clays, silts and sands of the Thames Group, formed in estuarine or marine environments during the Palaeogene period (47.8-56 Ma). In BGS archive boreholes in the area of the Scheme record that these deposits are mainly London Clay, described as a firm or stiff silty, in places sandy, clay.

1.2.4 Outcrops of the Red Crag Formation, of Pliocene or Early Pleistocene age (c. 3.3 to 2.5 Ma) are mapped by the BGS towards the north of the Scheme close to Lawford, and towards the centre of the Scheme at Beaumont. These are marine sands that are in places fossiliferous.

1.2.5 Quaternary superficial deposits are mapped in parts of the Scheme by the BGS, including both Pleistocene and Holocene deposits. Deposits likely to be of Pleistocene date include Coversand and sands and gravels of the Kesgrave Catchment Subgroup, with Alluvium of Holocene date, and potentially Pleistocene fluvial deposits, associated with the Holland Brook and its tributaries. These sediments and their geoarchaeological potential are considered in **Section 4**.

1.3 Scope of document

1.3.1 This GDBA outlines the sub-surface superficial deposits underlying the Scheme, and provides an assessment of their archaeological and geoarchaeological potential. It provides a suitable baseline within which to inform a program of further geoarchaeological or archaeological works (where appropriate).

1.3.2 In format and content, this document conforms to current best practice, including the guidance in *Geoarchaeology: Using Earth Sciences to Understand the Archaeological Record* (Historic England 2015a), *Management of Research Projects in the Historic Environment* (Historic England 2015b) and *Deposit modelling and archaeology: guidance for mapping buried deposits* (HE 2020).

1.3.3 The GDBA has been prepared with reference to wider regional and national guidance and research frameworks relevant to the Site, including the East of England Regional Research Framework (EERRF; 2021), the Research and Conservation Framework for the British Palaeolithic (English Heritage 2008) and the Greater Thames Estuary Historic Environment Research Framework (English Heritage 2010).

2 GEOARCHAEOLOGICAL BACKGROUND

2.1 Introduction

2.1.1 This section provides a summary of the known geoarchaeological record for the Scheme and the surrounding landscape.

2.1.2 Where age estimates are available for deposits these are expressed in millions of years (Ma), thousands of years (Ka) and within the Holocene epoch as either years Before Present (BP), Before Christ (BC) and Anno Domini (AD). Where radiocarbon dates are included, they are quoted as calibrated (cal.) BC or AD. These dates are supplemented

where relevant with the comparable Marine Isotope Stage (MIS) where odd numbers indicate an interglacial period and even numbers a glacial period (**Table 1**).

Table 1 British Quaternary chronostratigraphy

Geological Period	Archaeological Period	Traditional British Chronostratigraphy		Age (ka)	Marine Isotope Stage (MIS)
Holocene		Holocene		11.7 – present	1
Late Pleistocene	Upper Palaeolithic	Late Devensian	Loch Lomond Stadial	11.7 – 12.9	2
			Windermere Interstadial	12.9 – 14.7	
			Dimlington Stadial	14.7 – 29	
	Late Middle Palaeolithic	Middle Devensian		29 – 59	3
				59 – 70	4
		Early Devensian		70 – 116	5a – 5d
		Ipswichian		128 – 116	5e
Middle Pleistocene	Early Middle Palaeolithic			191 – 128	6
			Avery interglacial	243 – 191	7
				300 – 243	8
			Purfleet interglacial	337 – 300	9
	Lower Palaeolithic			374 – 128	10
		Hoxnian		424 – 374	11
		Anglian		478 – 424	12
		Cromerian		524 - 478	13
				790 – 524	14 – 19
Lower Pleistocene				866 – 790	20 – 21

2.2 Previous investigations

2.2.1 Essex County Council (ECC) have commissioned a number of recent investigations relevant to the geoarchaeological assessment of the Scheme. These include the National Mapping Programme for Essex (Essex County Council 2003), Tendring District Historic Environment Characterisation (Essex County Council 2008), the Tendring Geodiversity Characterisation Report (Essex County Council 2009) and Managing The Essex

Pleistocene (O'Connor 2015). A summary of the information relevant to the geoarchaeological assessment of the Scheme is given below.

National Mapping Programme for Essex (Essex County Council 2003)

2.2.2 The National Mapping Programme (NMP) for Essex was undertaken as part of the National Mapping Programme of Archaeological Recording in England, with the aim of plotting all archaeological features visible on both oblique and vertical aerial photographs from early prehistory to 1945.

2.2.3 The NMP identified a number of geomorphological features, including those of glacial origin, ice polygons and former river channels, and whilst not mapped, the authors point out that such features can assist in assessing the archaeological potential of an area (Essex County Council (2003).

2.2.4 A number of features of prehistoric date were recorded, with the Tendring peninsula showing the highest concentration of sites of 'unknown prehistoric' date, including those associated with enclosures and linear features, some of which are located within or very close to the present Scheme. Essex County Council (2003) note that the distribution of prehistoric sites follows very distinct patterns, with a large proportion of sites located on alluvium and sands and gravels.

Tendring District Historic Environment Characterisation (Essex County Council 2008)

2.2.5 As part of the Tendring District Environment Characterisation, the area of Tendring District was broken down in to Historic Environment Character Areas (HECAs) and more detailed Historic Environment Character Zones (HCZs), building on knowledge of the historic environment resource and to inform the Local Development Framework within the District.

2.2.6 The majority of the present Scheme is located within HECAs 3 (Great Oakley area) and 6 (South East Tendring Plateau and the Sokens), with the northern end of the Scheme located within parts of HCAs 11 (St. Osyth and Great Bentley), 12 (Ardleigh) and 13 (Little Bentley area).

2.2.7 At the southern end of the Scheme the corridor passes through HECA 6, comprising a 'gently undulating agricultural plateau in the south east of Tendring, drained by the shallow valley of the Holland Brook with tidal marshes at its mouth' (ECC 2008). ECC (2008) note that although there are no specific records of Palaeolithic finds from the short section of coast between Holland and Frinton, this area along with much of the remaining Tendring coastline has potential for survival of Pleistocene deposits which may contain Palaeolithic material.

2.2.8 From south to north, the Scheme passes through HECZs 6.4 (Great Holland area), 6.3 (The Sokens) and 6.2 (Weeley area), all three of which are described as having good potential for below ground archaeological deposits. HECZ 6.4 is characterised by numerous stray finds ranging in date from the Palaeolithic to the post-medieval period recorded, along with evidence for medieval and earlier phases of settlement, possibly later prehistoric or Roman, and ring-ditch cemeteries of possible Bronze Age date (ECC 2008).

2.2.9 Although little fieldwork has been undertaken in both HECZs 6.2 and 6.3, a number of groups of cropmarks have been identified, many representing medieval or post-medieval field boundaries, but with some indicative of surviving earlier archaeological features, including a possible settlement site in HECZ 6.3 (ECC 2008). In HECZ 6.2 excavations in

advance of the construction of the A133 revealed a series of sites dating from the Bronze Age onwards.

2.2.10 North of HECA 6, the Great Oakley area (HECA 3) comprises the gently undulating rural plateau in the north east of Tendring. ECC (2008) suggest that the area is likely to contain deposits related to widespread prehistoric activity and occupation. The corridor passes through HECZ 3.2 (Wix area), described as having good potential for below ground archaeological deposits and likely to contain deposits related to widespread prehistoric activity and occupation, including Prehistoric ring ditches and ring ditch cemeteries that are particularly characteristic of this zone (ECC 2008).

2.2.11 At its northern end the Scheme passes through HEZCs 13.2 (Bradfield Heath), 11.1 (Area to the north of Little Bentley) and 12.3 (Great Bromley). HECZ 13.2 is described as having extensive below ground deposits, with a high density of cropmarks throughout the zone indicating a long history of human occupation and activity, including prehistoric cemeteries and settlements, Roman settlements and roads and multi-period cropmarks.

2.2.12 HEZC 11.1 is described as having good potential for below ground archaeological deposits, with evidence for a number of cropmark complexes including ring-ditches of probable Bronze Age date, settlement enclosures and trackways of later prehistoric or Roman date (ECC 2008).

2.2.13 HEZC 12.3 is described as having high potential for below ground deposits, with multi-period archaeological deposits present throughout the zone including ring ditch cemeteries, probably of Bronze Age date, and other prehistoric monuments including a possible henge and settlement enclosures of both prehistoric and Roman date.

Tendring Geodiversity Characterisation Report (Essex County Council 2009)

2.2.14 The Geodiversity Characterisation project was undertaken in order to define the broad geological and geomorphological character of the Tendring area, to identify key natural systems (including fluvial and coastal) and to define the extent of internationally, national and locally designated sites, in order to inform he Local Development Framework. As part of this work, Tendring was divided in to Geodiversity Character Areas (GCAs), each of which has been subdivided in to Geodiversity Character Zones (GCZs).

2.2.15 The present Scheme lies within GCAs 1 (Tendring Plateau), 7 (Wivenhoe Gravels & Cooks Green Gravels), 13 (London Clay plateau) and 16 (Holland Brook valley). The southern part of the Scheme is located within GCA 16, comprising the valley of the Holland Brook, at a point where the valley widens to form a broad area of estuarine deposits at Holland Haven marshes.

2.2.16 ECC (2009) describe the alluvial deposits within the Holland Brook as increasing in thickness from 1.2 m in its upper reaches to more than 1.8 m at its downstream extent, with both freshwater and estuarine alluvium present at the coast. They describe the valley as asymmetric, with steeper south-western slopes falling from c. 25 to -5 m OD, with dry valleys on some of the steeper slopes. The narrow floodplains along the valley floor are flat and flanked by shallow slopes, and would have been unsuitable for settlement (ECC 2009).

2.2.17 The southern part of the Scheme crosses GCZ 16.2, representing estuarine alluvial deposits within the lower reaches of the Holland Brook and Holland Haven marsh. ECC (2009) point out that the alluvium within GCZ 16.2 has the potential for providing palaeoenvironmental evidence for Holocene sea-level and environmental change,

particularly where organic-rich deposits have accumulated within the alluvium within the broad former estuary, now enclosed by a sea wall. North of here the Scheme crosses GCZ 16.3, described by ECC (2009) as comprising the steep valley sides of the Holland Brook, where bedrock London Clay is exposed at surface.

2.2.18 North of Holland Haven marshes the Scheme passes through parts of GCA 7, characterised by the Wivenhoe and Cooks Green Gravels, which belong to the third highest of the four Kesgrave Sand and Gravel terraces on the Tendring Plateau (ECC 2009). In GCZ 7.1 the Cooks Green Gravels, representing deposits at the confluence of the Thames and Medway Rivers, are recorded along the valley sides of the Holland Brook at heights of between 10-20 m OD. These deposits are contemporaneous with the Wivenhoe Gravels from which Palaeolithic flints have been recovered (ECC 2009).

2.2.19 North of here the Scheme passes through GCZ 7.4, characterised by deposits of the Cooks Green Gravel that are orientated west-east from Little Clacton to the coast at Frinton and where they rise to levels of c. 20-25 m OD. Further north the Scheme passes through GCZ 7.2, also characterised by the Cooks Green Gravel where they lie along the mid-valley slopes of the Holland Brook at heights of 15-25 m OD.

2.2.20 Palaeolithic findspots have been recorded within GCZ 7.2. Some uncertainty remains as to the age of the gravels in which they were found; if these were indeed Cooks Green Gravels then they would be of pre-Anglian (MIS 12) age, although recent investigation of some of the gravels suggests that they may be a post-Anglian deposit of the Holland Brook (ECC 2009).

2.2.21 Close to Thorpe Cross the Scheme passes through GCZ 1.5, where the Cooks Green Gravels are masked by a covering of brickearth (ECC 2009). These brickearth deposits are recorded widely across GCZ 1.5 on the lower levels of the Tendring Plateau, along the crest of the Holland Brook interfluve and the Oakley Ridge, generally at or above levels of c. 25 m OD (ECC 2009).

2.2.22 Although ECC (2209) suggest much of this Brickearth is Late Devensian (MIS 2; 23-11.7 Ka) age, deposited by aeolian (wind-blown) processes during the Devensian glacial stage, no investigation or dating of these deposits has been carried out and ECC (2009) point out that they may have been deposited during a number of periods of the Pleistocene.

2.2.23 Much of the centre of the Scheme crosses GCZs 13.1 and 13.2, where the London Clay is exposed on a plateau occupying a large area of the District at levels above 30 m OD near the Oakley Ridge and headwaters of the Holland Brook, and along the higher valley slopes down to levels of c. 10 m OD. ECC (2009) point out that a number of Palaeolithic artefacts have been recovered from cliffs in the area of Frinton (HER 3556, 3557 and 2813) within GCZ 13.1, but these are unrelated to the London Clay and are likely derive from Pleistocene fluvial deposits, which may belong to the sands and gravels of the Kesgrave Sands and Gravels.

2.2.24 In the northern part of the Scheme, the corridor crosses GCZs 1.2, 1.4, 1.7 and 1.8. GCZ 1.2 is characterised by brickearth deposits of the Tendring plateau at levels of c. 30-35 m OD, likely to broadly correlate to the Brickearth deposits described in GCZ 1.5. These deposits are recorded at levels of c. 25-35 m OD in GCZ 1.8 and rise to levels of c. 35-40 m OD in GCZs 1.4 and 1.7. Towards the north of the Scheme, in the area of GZCs 1.4 and 1.7, the brickearth may overlie deposits of the oldest Kesgrave Sands and Gravels within

the Tendring Plateau, the Waldringfield Gravel, and the second oldest, the Ardleigh Gravels (ECC 2009).

Managing the Essex Pleistocene (O'Connor 2015)

2.2.25 The Managing the Essex Pleistocene project was undertaken with the aim of creating a predictive model of the archaeological and palaeoenvironmental potential of Pleistocene deposits in Essex. As part of this work O'Connor (2015) reviewed the Palaeolithic and palaeoenvironmental potential of the Colchester Formation of the Kesgrave sands and gravels, and the brickearth, forming the superficial deposits on which much of the Scheme is located.

2.2.26 O'Connor (2015) highlights that the deposits of the Colchester Formation represent a time period of 200-300 Ka prior to the onset of the Anglian glaciation, during which there was known to be periodic occupation of Britain. Rich archaeological sites such as the Caversham Ancient Channel (Berkshire), Pakefield (the Norfolk Coast), High Lodge, Culford, Warren Hill (Suffolk), Boxgrove (West Sussex) and potentially Happisburgh are contemporaneous with these sediments, and there is thus potential within the deposits for minimally disturbed evidence Lower Palaeolithic archaeology in fine-grained horizons or buried land surfaces, as well as fluvially-reworked archaeology from high energy fluvial sands and gravel.

2.2.27 O'Connor (2015) describes relatively abundant Palaeolithic findspots associated with the Colchester Formation, with 13 findspots that can be reasonably or definitively associated with the Kesgrave Sands and Gravels (see **Section 3**). O'Connor (2015) suggests that these deposits should be considered for Palaeolithic investigations when affected by development impacts.

2.2.28 The brickearth deposits of the Tendring plateau are described by O'Connor (2015) as thin (generally less than 2 m) and having a poor archaeological record, 'probably reflecting the relatively few brick-pits using the resource'.

Archaeological assessment of marine geophysical data (Wessex Archaeology in prep)

2.2.29 An archaeological assessment of the geophysical data for the North Falls Offshore Wind Farm and Offshore Cable Corridor is currently underway (Wessex Archaeology in prep). The provisional results of this work relevant to this GDBA are presented below.

2.2.30 The dominant shallow geological unit identified along the North Falls Offshore cable corridor was the London Clay Formation bedrock. The unit is very characteristic in sub-bottom profiler data, and is characterised by distinct parallel internal reflectors disrupted by frequent relatively small scale extensional faults produced during dewatering of the sediment.

2.2.31 However, within the nearshore area (and in other places along the Offshore Cable Corridor), a number of submerged terrestrial features were visible; the main feature is a distinct palaeochannel, located trending approximately northwest-southeast in the nearshore area of the Offshore Cable Corridor and a likely offshore extension of the Holland Brook. This is a distinct channel with two phases of fill; an earlier chaotic/unstructured fill, and a later layered fill. The second phase of fill also contains areas of acoustic blanking, interpreted as shallow gas, suggesting the preservation of organic material within the sediments of the second phase of fill.

2.2.32 This channel is also visible within the multibeam echosounder (MBES) data, suggesting it is underfilled, along with a much wider area of irregular surrounding seabed that could

represent a preserved land surface at seabed. This wider area of seabed was not clearly identifiable in the sub-bottom profiler (SBP) data, suggesting deposits are restricted to outcrop at seabed and are not very thick, but they could be of archaeological potential.

2.2.33 The age of this channel feature is currently uncertain, but it likely dates from the post-Anglian to the early Holocene. This series of features is potentially important due to their location close to shore just along the coast from the known Lower Palaeolithic site at Clacton (see **Section 3**), which was also identified associated with a palaeochannel, and a preserved Mesolithic land surface/peat deposits at the foreshore in Jaywick. As such, these deposits are of high archaeological potential, and could contain both in situ and derived archaeology and preserved palaeoenvironmental material.

2.3 Superficial geology

2.3.1 Quaternary superficial deposits are mapped in parts of the Scheme by the BGS, including both Pleistocene and Holocene deposits. Deposits likely to be of Pleistocene date include Coversand and sands and gravels of the Kesgrave Catchment Subgroup, with Alluvium of Holocene date, and potentially Pleistocene fluvial deposits, associated with the Holland Brook and its tributaries. These sediments and their geoarchaeological potential are considered below.

Kesgrave Sands and Gravels

2.3.2 The Kesgrave Sands and Gravels are the sediments of the pre-Anglian (MIS 12; 478-424 Ka) River Thames. At the time of their deposition this river system flowed south-eastwards from Wales and the West Midlands, eastwards through the middle Thames valley, north-eastwards into East Anglia, then progressively eastwards to a contemporaneous shoreline in Suffolk and Essex (Rose et al. 1999).

2.3.3 Terraces associated with this river system were formed between c. 1.81 Ma and 460 Ka (late Early to early Middle Pleistocene), forming the older Sudbury and younger Colchester Formations, until they were overridden by the Anglian ice sheet (Rose et al 1999). On the basis of their altitude and position, Whiteman (1992) identified 10 terrace landforms associated with the Sudbury and Colchester Formations. In the area of the Scheme Rose et al (1999) show the Gravel terraces underlying the Scheme as those of the Colchester Formation (c. 860-460 Ka; **Table 2**).

2.3.4 Buried soils (Kemp et al 1993; Read 1994 and Read et al 1996) and organic deposits have been recorded associated with various terraces of the Colchester Formation. In eastern Essex in particular, the terrace stratigraphy has been refined at a relatively high resolution based on the presence of organic temperate- and cold-climate sediments (Bridgland & Allen, 1996; Rose et al 1999). Here, organic deposits of the Colchester Formation containing evidence of diverse animal and plant assemblages have been identified at Little Oakley (e.g. Bridgland et al 1990), Ardleigh and Wivenhoe (e.g. Bridgland 1994; Bridgland and Allen 1996), largely forming in channels eroded into the cold climate sands and gravels (Rose et al 1999).

2.3.5 The gravel Members of the Colchester Formation underlying the Scheme are likely to comprise the Wivenhoe, Ardleigh and Waldringfield Gravels of the River Thames (Bridgland 1994; Bridgland and Allen 1996). Towards the southern end of the Scheme the deposits of the Cooks Green Gravel are encountered, equivalent in age to the Wivenhoe Gravel but deposited downstream of the Thames/Medway confluence.

2.3.6 The geoarchaeological potential of the terraces of the Colchester Formation is highlighted by the presence of temperate stage and arctic organic beds at Ardleigh (Bridgland and Allen 1996), temperate organic and fossiliferous silts and sands associated with the Little Oakley Channel (Bridgland et al. 1990), and organic beds in at Wivenhoe (Bridgland and Allen 1996).

2.3.7 Two different soil types have been recorded on the terrace surfaces of the Kesgrave Sands and Gravels, with those on the Colchester Formation tending to be less well developed (Rose et al 1999). These soils show signification variation in form and structure, and are likely to have developed over various lengths of time during the Early and Middle Pleistocene. They include a complex argillic soil known as the Valley Farm Soil (Kemp 1985), formed mainly in temperate climates, and an arctic soil known as the Barham Soil (Rose et al 1985), formed in a periglacial climate during the latter part of the Cromerian (MIS 19-13) and the early part of the Anglian (MIS 12) glacial Stage.

2.3.8 Palaeochannel deposits that date to the interglacial immediately following the Anglian glaciation (MIS 11) have been identified to the southwest of the Scheme at Clacton-on-Sea, first described by Brown (1838; 1840; 1841). These deposits, being richly fossiliferous as well as containing an internationally important Palaeolithic assemblage, represent one of the most important Middle Pleistocene interglacial sites in Britain (Bridgland et al 1999).

2.3.9 Here, the Anglian (MIS 12) Holland Gravel are cut by the post-Thames diversion Clacton Channel Gravel and Clacton Channel deposits (MIS 11), which are post-dated and overlain by fluvial gravels of the Wigborough Gravel (post-diversion Thames Medway deposits correlated with the Boyn Hill Gravel in the Lower Thames).

Table 2 Eastern Essex Quaternary Stratigraphy (after Bridgland 1988; 1994; Bridgland and Allen 1996; Bridgland et al. 1990; 1999; and Westaway 2014)

High-Level East Essex Gravel (HEEG)				**Thames**	**Thames/Medway Confluence**
Postulated Marine Isotope Stage (MIS)	**Southend area**	**Dengie Peninsula**	**Mersea Island**	**Tendring Peninsula**	**Tendring Peninsula**
MIS 12-11-10 MIS 11	Southchurch Gravel Southend Channel	Asheldham Lower and Upper Gravel Ashheldham Channel	Mersea Island Gravel		Wigborough Channel Clacton Channel
MIS 12 (Anglian Ice)	Chalkwell Gravel	Caidge Gravel		Upr St Osyth Gravel	Upr Holland Gravel
MIS 12 (early)				Lwr St Osyth Gravel	Lwr Holland Gravel

MIS 13 MIS 13 MIS 14	Canewdon Gravel	St Lawrence Gravel		Wivenhoe Upper Gravel Wivenhoe Interglacial deposits Wivenhoe Lower Gravel	Cooks Green Gravel
MIS 14 MIS 15 MIS 16	Belfairs Gravel Ashingdon Gravel	Mayland Gravel		Ardleigh Upper Gravel Ardleigh Interglacial deposits Ardleigh Lower Gravel	Colluvium Little Oakley Silts & Sands
MIS 16	Oakwood Gravel			Waldringfield Gravel	(Offshore)
MIS 18	Daws Heath Gravel				(Offshore)
MIS 20/22	Claydon Gravel				(Offshore)

Brickearth

2.3.10 The BGS show deposits of clay, silt and sand overlying the overlying the Kesgrave Sands and Gravels in the area of the Scheme, described as Coversands. These form part of the sequence of 'Brickearth' deposits that are widespread in this part of Essex, the mode of deposition and age of which is uncertain. 'Brickearth' is a generic term used to describe a range of deposits. These are post-Anglian (<MIS 12) Pleistocene deposits, but their specific age range is uncertain. They are likely to include a significant aeolian (loess) component, but may also include deposits formed through both colluvial and alluvial processes.

2.3.11 Loess is a silt-sized wind-blown sediment transported in periglacial conditions close to the margins of ice sheets (Antoine et al 2003). Loess is present widely across southern England where it reaches a maximum thickness of 4m at Pegwell Bay, East Kent (Pilcher et al 1954; Antoine et al 2003). The majority of Loess is found in Kent and Sussex where it dates to the Late Devensian (MIS 2) between 18.8 to 14.6 Ka (Parks and Rendell 1992; Bateman 1998). Older loess deposits principally dated to MIS 6 and MIS 12 are known in southern England, however. Antoine et al (2003) interpret the deposits of Brickearth in this region as the result of local aeolian reworking of sandy glacial outwash sediments during the Late Devensian glaciation.

2.3.12 Primary loess is directly lain down as windblown sediments and this can be subsequently reworked downslope by colluvial processes. In both instances these deposits can contain or bury stabilisation horizons (which can be associated with soil formation) that may be associated with minimally disturbed Palaeolithic archaeology and palaeoenvironmental evidence.

2.3.13 O'Connor (2015) describes the basal element of the Brickearth throughout much of the Tendring District as a thin, fine sand, likely to have an aeolian origin and equivalent to the Coversand described by the BGS. Resting on top of the Coversand is a predominantly silty deposit (loess), usually less than 0.75 m thick but reaching over 1.0 m in thickness at Walton (O'Connor 2015). In places the Brickearth contains small stones worked upwards from the underlying gravels due to frost action (O'Connor 2015).

2.3.14 Fossiliferous brickearth deposits occur at Wrabness. Pleistocene faunal has been known from this site since the 18th century (Lufkin 1701), with reports of '"diverse bones of extraordinary bigness'. Descriptions also suggest that a whole mammoth may have been identified within cliffs on the eastern side of Wrabness Bay (Christy 1907, Wymer 1985), where sands and fine gravel was recorded.

2.3.15 The fauna from Wrabness has been reported to contain *Equus ferus* (horse), *Cervus elaphus* (red deer), Bos or Bison (aurochs or bison), *Palaeoloxodon antiquus* (straight-tusked elephant), *Mammuthus primigenius*/*Mammuthus trogontherii* (woolly/steppe mammoth) (O'Conner 2015). This range of species, including both straight tusked elephant and potentially steppe mammoth, may be indicative of an MIS 7 date (243-191 Ka).

2.3.16 The Wrabness brickearth is located south of the River Stour. On the opposite (northern) side of the Stour similar fossiliferous deposits have been identified in the cliffs between Stutton and Harksted in Holbrook Bay, Suffolk (Whittaker 1885, Evans 1897, Spencer 1958; 1962, 1979, Wymer 1985). The deposits here consist of Pleistocene sand and bedded silt (brickearth), with a basal gravel. The mammalian fauna from these deposits has been correlated that from the upper part pf the sequence at Aveley, which may indicate a later MIS 7 date (Schreve 1997).

2.3.17 Middle Palaeolithic Levallois material have been recovered from Holbrook Bay, mostly out of context, however one Levallois flake and a handaxe are recorded as from the Brickearth. Levallois flakes have also been reported from the Wrabness brickearth (George 2010), although Wymer (1985) states that collections from Wrabness in the British Museum do not contain type such diagnostic material (Wymer 1985).

2.3.18 The evidence indicates that the Wrabness brickearth may be broadly contemporary with the Holbrook Bay deposits.

Head and Colluvium

2.3.19 Head deposits are not mapped by the BGS within the area of the Scheme, but BGS boreholes in this area demonstrate that deposits of Head or Colluvium are likely to be present in places, in particular in areas of steeper topography at the sides of and within dry or stream valleys.

2.3.20 Head and Colluvium are deposits which include material reworked downslope through climatically and environmentally controlled slope processes associated with landscape instability.

2.3.21 Head is defined as Pleistocene slope deposits containing sediments reworked downslope from earlier formations through colluvial and/or solifluction processes (alternate freeze-thawing). Head deposits are therefore most widely recorded at the base of slopes and along river valleys.

2.3.22 Colluvium represents unconsolidated material which has been deposited downslope by either rainwash, sheetwash and/ or slow continuous downslope creep during the Holocene. Colluviation is likely in areas of topographic relief where soil instability has been brought on by activities such as clearance of woodland, agricultural activity and soil degradation, leading to downslope movement of sediment.

2.3.23 Whilst Head and Colluvium are not of direct geoarchaeological significance, they are they may include eroded and redeposited (including Palaeolithic) archaeology or seal underlying

stratigraphy of archaeological and geoarchaeological significance, including buried soil horizons.

Alluvium

2.3.24 Alluvium is a generalised term covering unconsolidated sediment transported by water in a non-marine environment. Pleistocene river terrace deposits are technically alluvium, but the term here is applied to fine-grained deposits of Holocene date (11.7 Ka to present).

2.3.25 Deposits of alluvium associated with the floodplain of the Holland Brook and its tributaries are likely to be encountered in parts of the Scheme, and these may include both freshwater and estuarine deposits. Where the Alluvium has been investigated within the Holland Brook it has been recorded as a stoneless grey silty alluvium over thin sandy gravel, up to c. 1.2 m thick in the upper reaches of the valley and at least 1.8 m downstream (Essex County Council 2009).

2.3.26 The geoarchaeological potential of alluvium is generally low, although it has the potential to contain layers of peat or organic-rich alluvium of high potential (see below) and may also contain or seal archaeological remains.

2.3.27 Floodplain alluvium may also contain palaeochannels which are key contexts for understanding the physical evolution of the landscape and act as effective traps preserving both artefacts and ecofacts indicative of the surrounding environment, human activity and land-use.

Peat and organic-rich alluvium

2.3.28 Peat comprises partially decayed organic matter preserved within waterlogged anaerobic (oxygen-free) conditions. Peats and organic-rich alluvium are ideal contexts for the preservation of palaeoenvironmental remains (e.g. pollen, plant macrofossils, insects) that provide important data on past climate, vegetation, environment and land-use.

2.3.29 Peat deposits may form a component of Holocene alluvial sequences preserved within river valleys or preserved as discrete landform deposits (e.g. palaeochannels). However, mapping by the BGS is unlikely to fully resolve peat deposits within river valleys where they may simply be classified as alluvium.

2.3.30 Any peat deposits identified at the Scheme, interbedded in alluvium or preserved in palaeochannels, will be of high geoarchaeological potential.

2.4 Summary of geoarchaeological potential

2.4.1 A review of the available baseline data will provide important information on the likely age, depth and extent of superficial deposits at the Scheme, helping to inform on the archaeological risk and the future development proposals.

2.4.2 The key deposits and their associated geoarchaeological potential is summarised as follows:

- Pleistocene Kesgrave Sands and Gravels – potential for Lower Palaeolithic archaeology and faunal remains and fossiliferous horizons containing a range of palaeoenvironmental evidence;

- Pleistocene Brickearth – may contain or seal deposits containing Palaeolithic, including Middle Palaeolithic, archaeological and paleoenvironmental material, including mammalian fauna;

- Pleistocene Head and Holocene Colluvium - may include eroded and redeposited archaeology of Palaeolithic and/or later date. May seal underlying stratigraphy, including buried soil horizons, associated with minimally disturbed Palaeolithic archaeology, or bury Holocene archaeological features and/or layers of archaeological and geoarchaeological significance;

- Holocene Alluvium – potential to contain or partially mask Holocene archaeological features and/or layers, preserve palaeochannels and contain peat or richly-organic units of a high geoarchaeological potential;

- Holocene Peat – potential for peat units to be preserved in Holocene floodplain alluvium, including within palaeochannels. High geoarchaeological potential, preserving a range of palaeoenvironmental remains informing on past landscape, environment and land-use.

3 ARCHAEOLOGICAL BACKGROUND

3.1.1 The principal potential of Quaternary deposits in the Scheme boundary is to contain archaeology and geoarchaeological evidence of Palaeolithic and/or Mesolithic date. This section considers the Palaeolithic and Mesolithic archaeological resources from the area of Scheme. The post-Mesolithic archaeological resource and potential for such archaeology within the Scheme is considered in a separate archaeological desk-based assessment prepared by Royal HaskoningDHV (2021).

3.1.2 Sources consulted include the Essex Historic Environment Record (HER) using a study area of 1km from the Scheme boundary, The English Rivers Project (TERPS; WA and Wymer 2009) and Palaeolithic and Mesolithic Lithic Artefact Database (PaMELA; WA and Jacobi 2014) using a 2km study area, and relevant published and unpublished literature and reports.

3.2 Lower Palaeolithic (Pre MIS 12 – Kesgrave Sands and Gravels)

3.2.1 The Kesgrave Sands and Gravels in Scheme boundary have undergone little research and their distribution and stratigraphy is uncertain. Nevertheless, they have been shown to contain Lower Palaeolithic archaeology in the study area that predates the diversion of the Thames further to the south during the Anglian glaciation (MIS 12; 478–424 Ka).

3.2.2 This is earliest archaeology from the region and some of the earliest archaeology from Britain. Units within the Kesgrave Sands and Gravels contain organic and other fossiliferous sediments, and therefore also have significant geoarchaeological potential. Consequently, these deposits have potential to contain Palaeolithic archaeological and geoarchaeological evidence that will contribute to national and regional research themes and priorities (EH 2008; EERRF 2021).

3.2.3 Lower Palaeolithic findspots with the study area are shown on **Figures 4-6** and relevant discoveries are summarised below.

Badley Hall, Great Bromley (TERPS 31986)

3.2.4 Potentially the earliest Lower Palaeolithic artefact from the study areas is a small broken handaxe from Badley Hall, Great Bromley. Although this artefact does not have a recorded context, its condition has been assessed as rolled and stained (Wymer 1985), indicating that it originates from Pleistocene fluvial deposits.

3.2.5 The Badley Hall findspot is within the valley of the Ten Penny Brook, which has incised through the Ardleigh Gravel in the area. The handaxe likely, therefore, originates from the Ardleigh Gravel, which would indicate a minimum age of MIS 16–14 (676–524 Ka). A second handaxe, a surface find, is recorded from 2.7 km to the south-west at Elmsted Market, where the Bromley Book, a tributary of the Ten Penny Brook, has similarly cut through the Ardleigh Gravel.

Daking's Pit, Weeley (TERPS 31918–31920)

3.2.6 The most significant collection of Lower Palaeolithic archaeology from the study areas is from Daking's Pit, Weeley. Palaeolithic artefacts were first collected from this site, a disused gravel pit, by Warren in the 1930s (Warren 1933). Five handaxes, eight cores and 17 flakes from the site are in Warren's collection in the British Museum (Wymer 1985). Most are slightly fluvially abraded, though one handaxe is noted as in nearly mind condition.

3.2.7 A section through deposits in Daking's Pit was excavated and recorded by Wymer in 1970. This recorded sands overlying fluvially bedded sandy gravel (Wymer 1985). Wymer recovered 39 Palaeolithic artefacts when cutting this section, all from the lower bedded sandy gravel. These consisted of 37 flakes and spalls and one core. 27 of these artefacts are either unabraded or only slightly so.

3.2.8 Although the Daking's Pit material is in a range of condition states, it includes fresh and only slightly abraded pieces which are contemporary with the fluvial sandy gravels. This indicates that these artefacts are minimally disturbed and reflect activity in the immediate area that is contemporary with the deposition of the gravel.

3.2.9 The Pleistocene deposits in Daking's Pit are part of a spread of Pleistocene fluvial deposits which likely correlate with the Winvenhoe/Cooks Green Gravel. This indicates a MIS 14–13 age (563–478 Ka).

3.2.10 West of Daking's Pit, the Holland Brook has cut through these deposits. The Winvenhoe/Cooks Green Gravel west of the Holland Brook has also produced Palaeolithic artefacts. Warren recorded a flake from a temporary pit (British Museum register referenced in Wymer 1985), whilst Wymer reported on the discovery of two flakes from a small pit open in 1970 in this same area (Wymer 1985).

3.2.11 The Lower Palaeolithic archaeology from Daking's Pit is highly significant as it demonstrates that the Wivenhoe/Cooks Green Gravel contains minimally disturbed archaeology reflecting human activity during one of the earliest periods of the settlement history of Britain and of north-west Europe.

Bradley Hall Farm, Thorpe-Le-Soken (TERPS 31921/HER MEX6960 and TERPS 319222)

3.2.12 A Palaeolithic handaxe was found during ploughing at Bradley Hall Farm. The handaxe is described as in good condition but slightly abraded (HER MEX6960). Differential patination and staining were noted on the artefact (Wymer 1985), which may reflect having been from a context at the contact between two deposits and/or having been exposed on a Pleistocene land surface.

3.2.13 A second handaxe is recorded from an unidentified location at Thorpe-Le-Soken (Wymer 1985).

3.2.14 The original contexts of these artefacts are uncertain, but outcrops of the Cooks Green Gravel are mapped in the Thorpe-Le-Soken area. The Cooks Green Gravel is dated to MIS 14–13 (563–478 Ka). These add to the evidence from Daking's Pit, Weeley, that deposits of this age in the study area have potential to contain Lower Palaeolithic archaeology.

Holland Brook, Pig Street, Little Clacton (TERPS 31923)

3.2.15 A Palaeolithic handaxe and four flakes from unknown contexts are recorded from the valley side of the Holland Brook at Pig Street. The Holland Brook has incised a valley through Cooks Green Gravel in this area. This suggests that these artefacts may be from deposits broadly contemporary with those from Daking's Pit, Weeley. It is also possible that the valley contains unrecorded Pleistocene sediments deposited by the Holland Brook itself.

Frinton-on-Sea (TERPS 31953–31963)

3.2.16 Significant numbers of Palaeolithic artefacts are recorded from Frinton-on-Sea. Their context is uncertain; most were recovered out of context on the modern beach, whilst Pleistocene deposits are poorly characterised and mapped in this area.

3.2.17 Warren (1909) records Palaeolithic artefacts from an outcrop of gravel that has been mapped as belonging to the Cooks Green Gravel (Brigland and Allen 1996), but this material could not be identified in Warren's extant collection in the British Museum (Wymer 1985).

3.2.18 Palaeolithic artefacts recorded by Wymer (1985) from the modern beach at Frinton include a handaxe from Sandy Hook, four handaxes, four retouched flakes, 14 flakes and three miscellaneous pieces recorded from Stone Groin and a fresh handaxe from the 'base of crumbing cliffs'.

3.2.19 These beach finds may originate from pre-MIS 12 deposits (most likely the Crooks Green Gravel) exposed in cliff sections, or from unmapped post-Anglian sediments present either within the cliffs or in the intertidal/marine zone.

3.3 Lower/Middle Palaeolithic (Post MIS 12 – Thames-Medway deposits)

3.3.1 Pleistocene deposits of the Thames-Medway, which post-date the rerouting of the River Thames in the Anglian (MIS 12; 478-424 Ka), are recorded north-east and south-west of the study areas, along the modern coast. These include sediments of the Clacton Channel at Clacton-on-Sea, which contained nationally significant Lower Palaeolithic archaeology and palaeoenvironmental evidence. Such deposits may occur in area of the landfall of the cable corridor, and may be present in the offshore zone. Key locations in the area where such deposits have been identified are summarised below.

Clacton-on-Sea (TERPS 31940–31949)

3.3.2 Pleistocene deposits associated with the Clacton Channel have been recorded exposed on the modern shoreline in an area extending from Lion Point, Jaywick in the west to the West Cliff section, located south of Clacton prier, in the east.

3.3.3 Highly fossiliferous Pleistocene channel deposits were first discovered in the West Cliff in the late 1830s by Brown, who recovered mammal bones, marine and freshwater molluscs and plant remains (Brown 1828; 1840; 1841). The Clacton Channel deposits were subsequently investigated in detail in the first half of the 20th century by Warren (1911; 1912;

1922; 1923; 1924; 1933; 1940; 1951; 1955; 1958), who identified further outcrops of the deposits at Lion Point, Jaywick.

3.3.4 Warren recovered large numbers of Lower Palaoelithic artefacts and mammalian faunal remains during his studies. The artefacts consisted of cores and flakes, but no handaxes, which led to Warren identifying them as belonging to a distinct Lower Palaeolithic non-handaxe industry (Warren 1912), which he termed the Clactonian. Warren also recovered a wooden spear point from channel deposits (Warren 1911); this is earliest wooden artefact known from Britain.

3.3.5 Excavations of Clacton Channel deposits were carried out on a golf course near Jaywick Sands in 1934 by Oakley and Leakey and by Wymer between 1969 and 1970 (Singer et al. 1973). Further detailed work was undertaken during the redevelopment of Butlins Holiday Camp (Bridgland et al. 1999).

3.3.6 The Clacton Channel is dated to the MIS 11 interglacial and is associated with post-Anglian stratigraphy of the Thames/Medway. The deposits were originally dated based on the pollen record they preserved (West 1956, 1963), and subsequently through biostratigraphic correlations of molluscan faunas (Kerney 1971) and mammalian faunas (Schreve 1997), as well as amino acid geochronology (Miller et al. 1979; Bowen et al. 1989; Penkmen et al. 2010).

3.3.7 The composite Clacton Channel stratigraphy is summarised in **Table 3**. It consisted of clayey sands and gravel overlain by fresh water and estuarine clays and sands. The freshwater and estuarine deposit have produced Palaeolithic archaeology, mammal bones, mollusc, ostracods and plant macro fossils.

3.3.8 The channel deposits were cut into London Clay Bedrock and sands and gravels attributed to the Lower Holland Gravel (MIS 12) and overlain in places by later fluvial sands and gravels of Wigborough Gravel.

Table 3 Clacton Channel composite stratigraphy; channel deposits highlighted (after Bridgland et al. 1999)

Deposits	Stratigraphy	Age
Bedded gravel	Wigborough Gravel	
Estuarine sand with shells, passing laterally into estuarine calcareous clay	Estuarine Beds	MIS 11
Estuarine laminated clay containing localized lens with freshwater fauna		MIS 11
Loamy sands and clays, with much channelling	Upper Freshwater Beds	MIS 11
Clayey gravel and sand	Lower Freshwater Beds/ Clacton Channel Gravel	MIS 11
Sand and gravel	Lower Holland Gravel	MIS 12
Clay	London Clay	

Holland-on-Sea (TERPS 31950)

3.3.9 A core and possible flake recorded as from the Holland Gravel, exposed in a cliff section at Holland-on-Sea, were collected by Warren (Wymer 1985). This would suggest at least an MIS 12 date for the artefacts.

Walton-on-the-Naze

3.3.10 Palaeolithic artefacts have been recovered from the foreshore at Stone Point, Walton-on-the Naze. The original contexts of these are unknown, but they are likely eroded from deposits either exposed in cliff faces or in the intertidal zone. Notably, material recovered from Stone Point include pieces potentially techno-typologically diagnostic of different periods of the Palaeolithic (Wymer 1985). These include Lower Palaeolithic handaxes, a Middle Palaeolithic Levallois core and a bout coupé handaxe (recorded by Roe 1968), which is regarded as late Middle Palaeolithic. This suggests potential for different deposits of multiple Pleistocene dates in the area.

3.3.11 Fossiliferous Pleistocene deposits also occur in the area. Wymer (1985) identifies that William Camden in 1610 quotes a passage from a 13th century monk, 'Ralph, the Monk of Coggeshall', who said '*two teeth of a certain Giant, of such bigness, that two such teeth as men have now a daies might be cut out of them*' were found on the seashore at 'Erdulplinesse', which is now Walton-on-the-Naze. These were most likely mammoth teeth.

3.3.12 Significant amounts of Pleistocene fauna were subsequently collected in the Walton-on-Naze area in the 19th century. A complete mammoth skeleton exposed on the foreshore is referred to by Warren (1918), whilst Whitaker (1877) provided a list of fauna from the area, which comprised lion, hyena, red deer and bear.

3.3.13 Pleistocene fauna from Walton-on-the-Naze occurs in several museum collections. Unfortunately these lack detailed contextual information. Wymer (1985) records the following species in collections in Colchester, Manchester and Saffron Waldon museums:

- Straight tusked elephant
- Mammoth
- Bos/bison
- Giant deer
- Hippopotamus
- Rhinoceros

3.3.14 Only limited more recent investigations have been carried out at Walton-on-the-Naze (Boatman 1973; Bowden et al. 1995; Bridgland 1995). These identified several Pleistocene channel fills which included one containing clayey silts that preserved a pollen record that may be indicative of a Hoxnian (MIS 11) date (Boatman 1973, Bowden et al. 1995), as well as a gravel whose lithology is indicative of a pre-Anglian (MIS 12) Thames-Medway origin, potentially belonging to the Cooks Green Gravel (Bridgland 1995).

3.3.15 The evidence suggests that significant Pleistocene deposits of both pre- and post-Anglian date occur in the Walton-on-the-Naze area, which are associated with Lower and Middle Palaeolithic archaeology, and which have potential to contain significant paleoenvironmental remains.

3.4 Upper Palaeolithic

3.4.1 Only one Upper Palaeolithic artefact is recorded from the study areas. This consists of a late Upper Palaeolithic backed blade from an unknown context in Frinton-on-Sea (PaMELA 685).

3.5 Mesolithic

3.5.1 The PaMELA database records Mesolithic artefacts from across the study areas. These mostly consist of chance finds of tranchet axes and adze/axes. As such pieces are the largest and most easily identifiable Mesolithic artefacts, the presence of these across the study areas likely hints at a wider potential for Mesolithic lithic scatters.

3.5.2 The following Mesolithic tranchet axe and adze/axe findspots are recorded:

- Frinton-on-Sea (PaMELA 12303–12304) – Early Mesolithic tranchet axe and Mesolithic adze/axe;
- Tendring (PaMELA 12343) – Early Mesolithic tranchet axe/adze;
- Badley Hall, Great Bromley (PaMELA 123413/HER MEX6962) – Early Mesolithic tranchet axe/adze;
- Great Bromley (PaMELA 12311–12312) – two early Mesolithic tranchet axes/adzes, one provenanced to Cock Lane;
- Lawford Grange, Lawford (PaMELA 12352/HER MEX1040120) – two early Mesolithic tranchet axes/adzes, one provenanced to Cock Lane.

3.5.3 In addition to the Mesolithic axe and adze/axe findspots, two Mesolithic lithic scatters are recorded from the study areas. These are a Mesolithic lithic assemblage from Holland Brook, Pig Street, Little Clacton (PaMELA 12344) that included obliquely backed points and partially backed pieces, and a lithic assemblage from Lawford containing patinated blades and flakes identified as Mesolithic (PaMELA 12340) and a separate find of a Mesolithic microlith from the same location (PaMELA 6654).

4 AIMS AND OBJECTIVES

4.1.1 The aims of the Geoarchaeological Desk Based Assessment were to:

- use available geoarchaeological and geotechnical data to characterise the principal superficial geological deposits present within the Scheme;
- assess the archaeological and geoarchaeological potential of the superficial deposits underlying the area of the Scheme;
- identify the extent of superficial deposits with archaeological and/or geoarchaeological potential; and
- make suitable suggestions to guide a program of further geoarchaeological or archaeological works, where appropriate.

4.1.2 These aims were addressed by achieving the following objectives:

- collation of relevant geoarchaeological and geotechnical data;
- production of a series of outputs to model the vertical and lateral extent of deposits across the Scheme;
- interpretation of the sediments in their local and regional geoarchaeological context;
- assessment of the likely archaeological and geoarchaeological potential of the deposits present;
- production of a preliminary characterisation for the Scheme, dividing it into different Geoarchaeological Characterisation Zones (GCZs) of varying sub-surface archaeological and geoarchaeological potential; and
- provision of recommendations to guide a program of geoarchaeological or archaeological works (where appropriate).

5 METHODOLOGY

5.1 Introduction

5.1.1 The aims of the GDBA have been achieved through preliminary deposit modelling and a Geoarchaeological Landscape Characterisation (GLC) of the Scheme. These techniques are important in providing a framework for more precisely determining the archaeological and geoarchaeological potential of the Scheme at a scale which can most effectively inform future decision making, management and mitigation of impact to the buried archaeological and geoarchaeological resource.

5.2 Review of BGS archive boreholes

5.2.1 A total of 59 British Geological Survey (BGS) archive boreholes in the area of the Scheme were reviewed, resulting in a total of 51 useable stratigraphic logs, in three clusters towards the north, centre and south of the Scheme (**Appendix 1** and **Figure 3**). Of these, 17 were located either within or very close to the Scheme boundary; the additional logs reviewed provide a wider landscape context to those deposits recorded within the Scheme itself.

5.2.2 The log review was undertaken by a suitably qualified geoarchaeologist, with an assessment of the quality of the sediment descriptions and a geoarchaeological interpretation of the deposits cross-referencing the data with existing BGS mapping and their topographic context. The results of this review were compiled in an Excel spreadsheet for deposit modelling purposes.

5.3 Deposit modelling

5.3.1 Preliminary deposit modelling was required to map the lateral extent and depth of Quaternary deposits across the area of the Scheme. The preliminary models have been prepared on the basis of the currently available geotechnical data set. At present, this is limited to relatively few BGS archive boreholes located within or close to the Scheme (see **Figure 3**); however, these preliminary models contribute data for the subsequent GLC.

5.3.2 To create a deposit model of the potential lateral and horizontal extent of geoarchaeological deposits, lithological and stratigraphic data was entered into a digital (Rockworks 17) database.

5.3.3 The Rockworks data was utilised to map the lateral extent of key stratigraphic units and to produce three representative stratigraphic profiles (transects) mapping the Quaternary stratigraphy beneath the area of the Scheme. These include west-east transects across the Scheme towards the north (Transect A; **Figure 7**) and south (Transect B; **Figure 8**), and a north-south transect along the length of the Scheme (Transect C; **Figure 9**).

5.4 Geoarchaeological Landscape Characterisation

5.4.1 The GLC works on the same principles as a Historic Landscape Characterisation (English Heritage 2004) and Landscape Character Assessment (Natural England 2014), but in this case largely considers the shallow buried and outcropping superficial geological elements of the landscape.

5.4.2 The GLC involves breaking down the Scheme into defined zones called Geoarchaeological Character Zones (GCZs). The GCZs are specific to the North Falls Scheme, and are based primarily on the expected variation in superficial geological characteristics and surface topography, linked to an assessment of the archaeological and geoarchaeological potential of the deposits.

5.4.3 The process of generating the GCZs has been informed by the Character Zones defined in the National Mapping Programme for Essex (Essex County Council 2003), Tendring District Historic Environment Characterisation (Essex County Council 2008), the Tendring Geodiversity Characterisation Report (Essex County Council 2009) and Managing the Essex Pleistocene (O'Connor 2015).

6 RESULTS

6.1 Stratigraphy

6.1.1 The stratigraphy recorded in the BGS archive boreholes from across the Scheme is divided into six main units:

- Topsoil (modern)
- Made Ground (modern)
- Head/Colluvium (Holocene and/or Pleistocene)
- Brickearth (Pleistocene)
- Kesgrave Sands and Gravels (Pleistocene)
- Bedrock (Palaeogene)

6.1.2 Deposits of Alluvium (Holocene) were not recorded within the BGS archive boreholes, but are likely to be present in parts of the Scheme (see below).

Topsoil

6.1.3 A unit of modern topsoil was recorded in 30 of the 59 BGS archive boreholes. The topsoil was generally between 0.1 and 0.5 m thick, increasing to 0.76 m thick towards the north of the Scheme in borehole TM12NW35. The topsoil was generally not described in detail in the geotechnical logs, but in most cases it formed on parent material described as 'loam' (generally a sandy, silty clay).

Made Ground

6.1.4 A unit of modern Made Ground was recorded in 14 of the 59 BGS archive boreholes. This was generally between 0.3 and 0.9 m thick, increasing to 1.6 m in borehole TM11NE46. The composition of the Made Ground was variable, but in most cases it included fragments of modern brick and/or concrete.

Head/Colluvium

6.1.5 Deposits interpreted as Head or Colluvium were recorded in three BGS archive boreholes (TM11NE45, TM11NE51 and TM12NW34), generally described as a gravelly sandy or silty clay. Here the Head/Colluvium is distinguished from deposits of Brickearth on the basis of their high gravel content and poor sorting. They are considered to represent either Pleistocene cold-climate slope deposits (Head) or sediments re-worked down slope during the Holocene (Colluvium).

6.1.6 In these boreholes the Head/Colluvium was between 0.20 and 0.45 m thick. Although none of these boreholes was located within the Scheme itself, they demonstrate the potential for Head or Colluvium to be present on slopes or at the base of slopes within the wider area of the Scheme.

Alluvium

6.1.7 Deposits of Alluvium were not recorded within the BGS archive boreholes, but none of these were located within mapped areas of Alluvium shown by the BGS. On the basis of this mapping, Alluvium is likely to be present in the area of Holland Haven Marshes towards the south of the Scheme, on the floodplain of the Tendring Brook towards the centre of the Scheme (northeast of Tendring), and towards the north in the area of Holland Brook (close to Horsley Cross).

6.1.8 Depending on the preferred route, Alluvium may also be encountered in a stream valley located north of Thorpe-le-Soken, draining east towards Landermere Creek and Hamford Water.

6.1.9 As outlined in **Section 2.3**, Alluvium may contain evidence for palaeochannels, peat and organic-rich deposits of high geoarchaeological potential.

Brickearth

6.1.10 Deposits collectively interpreted as Brickearth were recorded in 33 of the 59 BGS archive boreholes. These were generally described as a variably sandy silty clay, often with fine or medium sized gravel inclusions, at various elevations. The proportion of gravels was generally smaller, and the gravels finer, in these deposits compared to those interpreted as Head or Colluvium.

6.1.11 The Brickearth deposits were between 0.2 (TM11NE17, TM02NE14/A) and at least 2.75 m thick (TM12NW41), although they were not bottomed in nine boreholes (including TM12NW41).

6.1.12 These deposits are undated, but may include deposits of Late Devensian (MIS 2; 23-11.7 Ka) or older Pleistocene date (as highlighted in **Section 2.3**). They are likely to be originally aeolian in origin, but may be substantially reworked by various processes. Although sandier units were recorded in places in the logs, no distinct sand-rich unit was identified at the base of the Brickearth that may be equivalent to the Coversands described at the base of the sequence in this area by O'Connor (2015).

6.1.13 Towards the north of the Scheme the brickearth was recorded at elevations between c. 33 and 36 m OD, whilst towards the south they are recorded at lower elevations of between c. 20 and 25 m OD (**Figures 7-9**).

Kesgrave Sands and Gravels

6.1.14 Deposits of sand and gravel, interpreted as the Kesgrave Sands and Gravels of the Colchester Formation and of pre-Anglian (MIS 12) date, were recorded in 29 of the 59 BGS archive boreholes, generally between 0.2 and 6.4 m thick but increasing to 9.2 m thick in TM02NE14/A and over 17 m towards the centre of the Scheme in the area of boreholes TM12NW13/B-E. The Sands and Gravels are recorded at elevations between c. 25 and 35 m OD towards the north of the Scheme, and at between c. 15 and 25 m OD towards the south (**Figure 9**).

6.1.15 Towards the south of the Scheme where they are recorded at levels of c. 15–25 m OD the sands and gravels are likely to be equivalent to the Cooks Green Gravels (MIS 13–14), representing gravels deposited at the confluence of the Thames and Medway Rivers, generally orientated west-east in this area from Little Clacton to the coast at Frinton and (ECC 2009).

6.1.16 Towards the centre of the Scheme the Sands and Gravels are recorded at a similar basal elevation to those of the south, but their surface elevation rises to c. 33 m OD, potentially equivalent to either the Cooks Green (Thames/Medway) or Wivenhoe (Thames) Gravels.

6.1.17 Where they rise to surface elevations of between 25 and 35 m OD towards the north of the Scheme, the Sands and Gravels are likely to be equivalent to the earlier Ardleigh or Waldringfield Gravels of the Thames (MIS 14–16; see **Table 2**).

6.1.18 In the absence of data towards the far south of the Scheme, in the area of Holland Haven Marshes, it is not possible to confirm if pre-Anglian, Anglian or post Anglian Thames/Medway deposits, or Pleistocene deposits laid by the Holland Brook, are present. The Holland Gravel Gravels (MIS 12) are evident towards the west towards Clacton-on-Sea (**Figure 8**) at elevations between c. 4 and 7 m OD, indicating that the deposits may be present underlying the lower levels of the Scheme in the area of Holland Haven Marshes.

6.1.19 No distinct fine-grained or organic units were recorded within the Sands and Gravels in the geotechnical logs.

Bedrock

6.1.20 Bedrock London Clay, generally described as a firm or stiff in places sandy or silty clay, was reached in 32 of the 59 BGS archive boreholes.

6.2 Deposit modelling

6.2.1 The deposit modelling comprised three stratigraphic profiles (transects) aligned broadly southwest-northeast across the north (Transect A; **Figure 7**) and south of the Scheme (Transect B; **Figure 8**) and north-south along the length of the Scheme (Transect C; **Figure 9**).

6.2.2 The cross-sections are composed of two-dimensional vertical visualisations of the stratigraphic records, along lines drawn through BGS archive boreholes within and close to the Scheme boundary. These transects model the possible make-up of the deposits

between these individual deposit records, drawn as horizontal lines between the upper and lower surfaces of the stratigraphic units.

6.2.3 Data coverage within the Scheme is generally poor, with only 17 archive boreholes located within or very close to the Scheme boundary. It is anticipated that a more robust series of deposit models will be generated following a review of logs arising from proposed ground investigations. These models do however provide a preliminary interpretation of the possible presence and distribution of Quaternary deposits across the area of the Scheme.

Transect A

6.2.4 Transect A (**Figure 7**) is a west-east transect across the northern part of the Scheme. The transect demonstrates the height of the Kesgrave Sands and Gravels in this area of the Scheme (c. 30–35 m OD), where they are overlain by deposits of Brickearth at elevations up to c. 37 m OD. At these elevations the Gravels are likely to be equivalent to either the Ardleigh or Waldringfield Gravels of the pre-Anglian Thames (MIS 14–16).

6.2.5 The Brickearth deposits here are up to 2.75 m in thickness.

Transect B

6.2.6 Transect B (**Figure 8**) is a transect running northwest across the Scheme, from Clacton-on-Sea across the southern part of the Scheme to Mayfields Farm. Within the Scheme, the Kesgrave Sands and Gravels are recorded at elevations between c. 15 and 24 m OD, and are likely to be equivalent to the Cooks Green Gravels of MIS 13–14 date, deposited by the Rivers Thames and Medway downstream of their confluence.

6.2.7 The Gravels here are overlain by Brickearth recorded at elevations of up to c. 24 m OD and up to c. 2 thick, but generally thinning towards the southwest to between c. 0.1 and 0.6 m in thickness.).

6.2.8 To the southwest of the Scheme the Brickearth and Kesgrave Sands and Gravels thin to absence in TM11NE1 and TM11NE2. Towards Clacton-on-Sea a separate gravel terrace is recorded at elevations between c. 4 and 7 m OD, possibly equivalent to the Holland Gravel (MIS 12).

Transect C

6.2.9 Transect C (**Figure 9**) is a north-south transect along the length of the Scheme. The transect illustrates the basal elevations of the different gravel terraces underlying the Scheme, with the deposits of the Cooks Green Gravels at elevations between c. 15 and 24 m OD towards the south, the Cooks Green/Wivenhoe Gravels towards the centre (c. 15–34 m OD) and the Ardleigh or Waldringfield Gravels towards the north (c. 25-35 m OD).

6.2.10 Deposits of Brickearth are recorded overlying the Gravels across the Scheme; these are relatively thin towards the south and centre of the Site (where they are generally less than 1 m in thickness), increasing to a minimum of 2.75 m towards the north.

6.2.11 As highlighted above, in the absence of data in the far south of the Scheme, it is not possible to confirm if Pleistocene deposits, and/or Holocene Alluvium, are present in the area of Holland Haven Marshes.

6.3 Geoarchaeological Landscape Characterisation

6.3.1 On the basis of the available data, including BGS archive boreholes, mapping of superficial deposits, analysis of Lidar data and baseline character mapping, the Scheme has been divided into nine Geoarchaeological Character Zones specific to the North Falls Scheme (**Figure 10**). These zones are summarised in **Table 4** and discussed below.

Table 4 North Falls Geoarchaeological Character Zones

GCZ	Principal Quaternary deposits	Depth of deposits (m bgl)	Depth of Made Ground overlying Quaternary deposits (m)
1	Alluvium ?Post MIS 12 Thames Medway Deposits ?Kesgrave Sands and Gravels (Cooks Green Gravel, Holland Gravel)	Unknown Unknown Unknown	Unknown
2	Unknown (none on BGS mapping)	Unknown	Unknown
3	?Head/Colluvium Brickearth Kesgrave Sands and Gravels (Cooks Green Gravel)	Unknown 0.20-1.00 0.50-6.00+	None recorded
4	Unknown	Unknown	Unknown
5	Alluvium ?Head/Colluvium ?Kesgrave Sands and Gravels (Wivenhoe Gravel, Cooks Green Gravel)	Unknown	Unknown
6	Alluvium ?Head/Colluvium ?Kesgrave Sands and Gravels (Wivenhoe Gravel)	Unknown	Unknown
7	?Head/Colluvium Brickearth Kesgrave Sands and Gravels (Ardleigh Gravel, Wivenhoe Gravel)	Unknown 0.20-3.00+ 0.50-3.50+	None recorded
8	Alluvium ?Head/Colluvium ?Kesgrave Sands and Gravels (Ardleigh Gravel)	Unknown	Unknown
9	?Head/Colluvium Brickearth Kesgrave Sands and Gravels (Ardleigh Gravel)	Unknown 0.00-2.75 0.00-10.00	0.00-0.80

GCZ 1

6.3.2 GCZ 1 is defined by potential survival of Holocene Alluvium at the mouth of the Holland Brook in the area of Holland Haven Marshes. In the absence of data for this Zone, the depth, thickness and character of these deposits is unknown. They may contain peat or organic-

rich units formed on the estuarine floodplain of the Holland Brook, and may be underlain (at depth).

6.3.3 Although no such deposits are mapped, unmapped Pleistocene units of the Cooks Green Gravel (MIS 14–13) and/or Holland Gravel (MIS 12) of the Kesgrave Sands and Gravels may occur in this zone. Additional unmapped post-MIS Thames/Medway deposits may be present, which may extend into the intertidal and offshore zones.

GCZ 2

6.3.4 No previous interventions have been carried out in GCZ 2 and the extent of survival of any Quaternary deposits is unknown. BGS mapping indicates that no superficial deposits are present, although there is potential for unmapped Pleistocene deposits of the Holland Brook or Cooks Green Gravel, and Pleistocene Head and/or Holocene Colluvium.

GCZ 3

6.3.5 Pleistocene deposits of Kesgrave Sands and Gravels, likely equivalent to the Cooks Green Gravel (MIS 14–13) and Brickearth, are present in this Zone. Limited BGS archive borehole data indicates that Pleistocene Brickearth of unknown date is present at depths between c. 0.20-1.00 m bgl, overlying fluvial sands and gravels of the Cooks Green Gravel at depths between 0.50 and at least 6.00 m bgl. There is potential for Head and/or Holocene Colluvium on valley slopes in this zone.

GCZ 4

6.3.6 No previous interventions have been carried out in GCZ 4 and the extent of survival of any Quaternary deposits is unknown. BGS mapping indicates that outcrops of the Pleistocene Kesgrave Sands and Gravels, likely equivalent to the Cooks Green/Wivenhoe Gravels (MIS 14–13), are present within this zone, and there is potential for unmapped deposits of either Pleistocene Head and/or Holocene colluvium in valleys trending broadly southwest-northeast across the zone.

GCZ 5

6.3.7 GCZ 5 is defined by the potential presence of Holocene Alluvium associated with a stream valley draining east towards Landermere Creek. No previous interventions have been carried out in this zone and the extent, character and depth of any Holocene Alluvium is unknown. The valley may have dissected Pleistocene deposits of Cooks Green/Wivenhoe Gravels, and Pleistocene Head and/or Holocene Colluvium may be present on the valley sides or at the base of the valley.

GCZ 6

6.3.8 GCZ 6 is defined by the potential presence of Holocene Alluvium associated with the Tendring Brook, a tributary of the Holland Brook. Like GCZ 5, no previous interventions have been carried out in this zone and the extent, character and depth of any Alluvium is unknown. The Tendring Brook may have cut through Pleistocene deposits of the Cooks Green/Wivenhoe Gravel Gravels (MIS 14–13), and Pleistocene Head and/or Holocene Colluvium may be present on the valley sides or at the base of the valley.

GCZ 7

6.3.9 Pleistocene deposits of the Kesgrave Sands and Gravels, overlain by Brickearth, are present in GCZ 7; the former may include deposits of the Ardleigh (MIS 16–14) and/or Wivenhoe (MIS 14–13) Gravels. BGS archive boreholes indicate that the Pleistocene

Brickearth, of unknown date, is present at depths between c. 0.20 and at least 3.00 m bgl, with the underlying Gravels present at between c. 0.50 and at least 3.50 m bgl.

6.3.10 There is potential for Pleistocene Head and/or Holocene Colluvium on valley slopes within this zone.

GCZ 8

6.3.11 Zone GCZ 8 is characterised by the potential presence of Holocene Alluvium associated with the floodplain of the Holland Brook. No previous interventions have been carried out in this zone and the extent, character and depth of any Alluvium is unknown.

6.3.12 Pleistocene deposits of the Ardleigh Gravels (MIS 16–14) of the Kesgrave Sands and Gravels may be present, whilst it is possible that Pleistocene sediments deposited by the Holland Brook may occur. Pleistocene Head and/or Holocene Colluvium may be present on the valley sides or at the base of the valley.

GCZ 9

6.3.13 BGS archive boreholes in this zone indicate that Pleistocene Brickearth is present at depths between c. 0.00 and 2.75 m bgl, with fluvial sands and gravels (likely equivalent to the Ardleigh Gravel (MIS 16–14) of the Kesgrave Sands and Gravels) present at between c. 0.0 and at least 10.0 m bgl.

6.3.14 There is potential for Pleistocene Head and/or Holocene Colluvium on valley slopes within this zone.

7 ASSESSMENT OF ARCHAEOLOGICAL AND GEOARCHAEOLOGICAL POTENTIAL

7.1 Introduction

7.1.1 Examination of BGS archive boreholes, mapping of Pleistocene and Holocene deposits, analysis of Lidar data and character mapping has provided baseline data on the presence of Quaternary deposits across the Scheme. Assessment of the local resource indicates that these units have archaeological and/or geoarchaeological potential. This potential has been assessed for each deposit in each Geoarchaeological Character Zone (GCZ).

7.1.2 An archaeological and palaeoenvironmental '*potential*' rating has been assigned to deposits in each GCZ, representing a measure of probability. This has been determined via the application of professional judgement, informed by the evidence from the study area and surrounding area. '*Potential'* is expressed on a four-point scale, assigned in accordance with the following criteria:

- **High** Situations where evidence is known or strongly suspected to be present within deposits and which are likely to be well preserved.

- **Moderate** Includes cases where there are grounds for believing that evidence may be present, but for which conclusive evidence is not currently available. This category is also applied in situations in which material are likely to be present, but also where their state of preservation may have been compromised.

- **Low** Circumstances where the available information indicates that evidence is unlikely to be present, or that their state of preservation is liable to be severely compromised.

- **Unknown** Cases where currently available information does not provide sufficient evidence on which to provide an informed assessment with regard to the potential for material to be present.

7.1.3 The relative '*Significance'* of known and potential archaeological assets has been determined in accordance with the criteria set out in **Table 5.** These criteria are related to national (EH 2008) and regional (EERRF 2021) research themes and priorities.

Table 5 Generic schema for classifying the significance of archaeological assets (based on HE 2015)

Significance	Categories
Very High	World Heritage Sites (including nominated sites) Assets of recognised international importance Assets that contribute to international research objectives
High	Scheduled Monuments Non-designated assets of national importance Assets that contribute to national research agendas
Moderate	Assets that contribute to regional research objectives
Low	Assets compromised by poor preservation and/or poor contextual associations Assets with importance to local interest groups
Negligible	Little or no archaeological or geoarchaeological interest
Unknown	The importance of the asset has not been ascertained from available evidence

7.2 Areas of archaeological and geoarchaeological potential

7.2.1 The archaeological and palaeoenvironmental potential of deposits in each GCZ is summarized in **Table 6**; consideration of the possible significance of any archaeological evidence present in relation to national (EH 2008) and regional (EERRF; 2021) research themes and priorities is also provided.

Table 6 Geoarchaeological Landscape Characterisation framework for the Scheme

GCZ	Principal Quaternary deposits	Archaeological potential of deposits	Archaeological Significance	Paleoenvironmental potential of deposits
1	Alluvium (inc. estuarine deposits) ?Post MIS 12 Thames Medway Deposits ?Kesgrave Sands and Gravels (Cooks Green Gravel, Holland Gravel)	Low* Moderate-High Moderate-High	Moderate Moderate-High Moderate-High	Moderate* Moderate Moderate
2	Unknown (none on BGS mapping)	Unknown	Unknown	Unknown

3	?Head/Colluvium Brickearth Kesgrave Sands and Gravels (Cooks Green Gravel)	Unknown Unknown Moderate-High	Low-Moderate Unknown Moderate-High	Low-Moderate** Unknown Moderate
4	Unknown	Unknown	Unknown	Unknown
5	?Alluvium ?Head/Colluvium ?Kesgrave Sands and Gravels (Wivenhoe Gravel, Cooks Green Gravel)	Low* Unknown Moderate-High	Moderate Low-Moderate Moderate-High	Low-Moderate* Low-Moderate** Moderate
6	?Alluvium ?Head/Colluvium ?Kesgrave Sands and Gravels (Wivenhoe Gravel)	Low* Unknown Moderate-High	Moderate Low-Moderate Moderate-High	Moderate Low-Moderate** Moderate
7	?Head/Colluvium Brickearth Kesgrave Sands and Gravels (Ardleigh Gravel, Wivenhoe Gravel)	Unknown Low-Moderate Moderate-High	Low-Moderate Unknown Moderate-High	Low-Moderate** Unknown Moderate
8	?Alluvium ?Head/Colluvium ?Kesgrave Sands and Gravels (Ardeigh Gravel)	Low* Unknown Moderate	Moderate Low-Moderate Moderate-High	Low-Moderate* Low-Moderate** Moderate
9	?Head/Colluvium Brickearth Kesgrave Sands and Gravels (Ardeigh Gravel)	Low-Moderate Unknown Moderate	Low-Moderate Unknown Moderate-High	Low-Moderate** Unknown Moderate

**may contain organic-rich or peat units of high archaeological and palaeoenvironmental potential*
***may contain calcareous units of moderate palaeoenvironmental potential*

GCZ 1

7.2.2 Holocene Alluvium is likely to be present in this zone, although little is known about the character and thickness of these deposits and they may contain peat or organic-rich units.

7.2.3 Where the alluvium is composed of minerogenic sediments (e.g. sands, silts and clays) it likely formed away from dryland areas in an active floodplain environment, and is therefore considered to have limited archaeological potential. The palaeoenvironmental potential of such minerogenic sediments is similarly limited, although they may contain remains of diatoms, ostracods and forams that are important proxies for reconstructing changing conditions from freshwater to brackish water environments associated with changing estuarine influences.

7.2.4 The alluvium may be underlain by unmapped Pleistocene deposits of the Holland Brook (of post-MIS 12 date), deposits of the Holland Gravel (MIS 12) and/or deposits of the Cooks Green Gravel (MIS 14–13), the sediments of which may extend in to the intertidal and offshore zones.

7.2.5 These deposits have the potential to contain Lower (and in the case of any terraces of the Holland Brook, Middle and Upper) Palaeolithic archaeology, and organic and other fossiliferous sediments of significant geoarchaeological potential. Where archaeological finds are reworked, such material would be of moderate potential in relation to national and regional research questions and priorities. If minimally disturbed/in situ, such archaeology would be of high significance.

GCZ 2

7.2.6 There is no available stratigraphic data for this zone and assessing the survival and potential of Quaternary deposits is not currently possible. BGS mapping indicates that no superficial deposits are present, although there is potential for unmapped Pleistocene deposits of the Holland Brook (post-MIS 12) or the Cooks Green Gravel (MIS 14–13), and Pleistocene Head and/or Holocene Colluvium.

7.2.7 As described in **Section 3**, the Lower Palaeolithic archaeology from Daking's Pit (TERPS 31918–31920) and Bradley Hall Farm (TERPS 31921/HER MEX6960 and TERPS 319222) demonstrate the potential of the Wivenhoe/Cooks Green Gravels to contain deposits of minimally disturbed archaeology reflecting human activity during one of the earliest periods of the settlement history of Britain and north-west Europe. Such deposits also have the potential to contain organic and other fossiliferous sediments of significant geoarchaeological potential.

7.2.8 Where archaeological finds are reworked, such material would be of moderate potential in relation to national and regional research questions and priorities. If minimally disturbed/in situ, such archaeology would be of high significance.

7.2.9 Unmapped Pleistocene deposits of the Holland Brook have a similar archaeological and geoarchaeological potential for the Middle and Upper Palaeolithic periods.

7.2.10 Where deposits of Pleistocene Head and/or Holocene Colluvium are present, these have moderate potential to contain reworked archaeological finds, potentially of multiple periods; the significance of such material is likely to be low. However, if they include stable land surfaces, these could be associated with archaeological layers, features and/or lithic scatters. The palaeoenvironmental potential of these deposits is likely to be low; however, if calcareous, the colluvial sediments could contain molluscs that can reflect landscape and environmental change.

GCZ 3

7.2.11 Pleistocene deposits likely equivalent to the Cooks Green Gravel (MIS 14–13) and Brickearth are likely to be present in this zone, as well as Head and/or Holocene Colluvium on valley slopes.

7.2.12 The deposits of the Cooks Green Gravel and Brickearth have the potential to contain Lower and Lower/Middle Palaeolithic archaeology respectively, and organic and other fossiliferous sediments of significant geoarchaeological potential. Where archaeological finds are reworked within fluvial gravels and colluvial sediments, such material would be of moderate potential. If minimally disturbed/in situ, such as within finer grained fluvial sediments or associated with stable land surfaces within the Brickearth, such archaeology would be of high significance.

7.2.13 Deposits of Pleistocene Head and/or Holocene Colluvium have moderate potential to contain reworked archaeological finds, potentially of multiple periods; the significance of

such material is likely to be low. However, if they include stable land surfaces, these could be associated with archaeological layers, features and/or lithic scatters. The palaeoenvironmental potential of these deposits is likely to be low, except where calcareous units are identified.

GCZ 4

7.2.14 There is no available stratigraphic data for this zone and, similar to GCZ 2, gauging the survival and potential of Quaternary deposits is not currently possible. BGS mapping records outcrops of the Kesgrave Sands and Gravels within this zone, likely of the Cooks Green/Wivenhoe Gravels (MIS 14 –13), however, their extent may be greater than mapped. Unmapped deposits of either Pleistocene Head and/or Holocene colluvium may occur within valleys that are located in the zone.

7.2.15 The Cooks Green/Wivenhoe Gravels have the potential to contain Lower Palaeolithic archaeology, and organic and other fossiliferous sediments of significant geoarchaeological potential. Where archaeological finds are reworked within fluvial gravels, such material would be of moderate significance; if minimally disturbed/in situ, such archaeology would be of high significance.

7.2.16 Deposits of Pleistocene Head and/or Holocene Colluvium have moderate potential to contain reworked archaeological finds, potentially of multiple periods; the significance of such material is likely to be low. However, if they include stable land surfaces, these could be associated with archaeological layers, features and/or lithic scatters. The palaeoenvironmental potential of these deposits is likely to be low except where calcareous units are identified.

GCZ 5

7.2.17 Holocene Alluvium may be present within this zone, although no stratigraphic data is available that would enable an assessment of the presence, character and thickness of these deposits. Where the alluvium is composed of minerogenic sediments (e.g. sands, silts and clays) it is considered to have limited archaeological and paleoenvironmental potential. Peat or organic-rich units within the Alluvium would have high palaeoenvironmental potential and high potential for Holocene archaeology.

7.2.18 Where Pleistocene deposits of Cooks Green/Wivenhoe Gravels are present in this zone, they have the potential to contain Lower Palaeolithic archaeology, and organic and other fossiliferous sediments of significant geoarchaeological potential. Where archaeological finds are reworked within fluvial gravels and colluvial sediments, such material would be of moderate potential. If minimally disturbed/in situ, such archaeology would be of high significance.

7.2.19 Deposits of Pleistocene Head and/or Holocene Colluvium have moderate potential to contain reworked archaeological finds, potentially of multiple periods; the significance of such material is likely to be low. However, if they include stable land surfaces, these could be associated with archaeological layers, features and/or lithic scatters. The palaeoenvironmental potential of these deposits is likely to be low, except where calcareous units are identified.

GCZ 6

7.2.20 The deposits that may be encountered in GCZ 6 are of a similar archaeological and geoarchaeological potential to those of GCZ 5, including Holocene Alluvium with the

potential to contain organic-rich units or peat, Pleistocene deposits of the Cooks Green/Wivenhoe Gravels with the potential to contain Lower Palaeolithic archaeology and organic/fossiliferous sediments, and Pleistocene Head and/or Holocene Colluvium with moderate potential to contain reworked archaeological finds of multiple periods.

GCZ 7

7.2.21 Deposits of the Ardleigh (MIS 16–14) and/or Wivenhoe (MIS 14-13) Gravels, overlain by Pleistocene Brickearth, may be encountered in GCZ 7.

7.2.22 The deposits of the Ardleigh/Wivenhoe Gravels and Brickearth have the potential to contain Lower and Lower/Middle Palaeolithic archaeology respectively, and organic and other fossiliferous sediments of significant geoarchaeological potential. One of the earliest Lower Palaeolithic artefacts from the study area, thought to derive from deposits of the Ardleigh Gravel (TERPS 31986; **Section 3**), highlights the potential of these deposits to contain significant Lower Palaeolithic archaeology.

7.2.23 Where archaeological finds are reworked within fluvial gravels and colluvial sediments, such material would be of moderate potential in relation to national and regional research questions and priorities. If minimally disturbed/in situ, such as within stable land surfaces in the Brickearth, such archaeology would be of high significance.

7.2.24 Deposits of Pleistocene Head and/or Holocene Colluvium have moderate potential to contain reworked archaeological finds, potentially of multiple periods; the significance of such material is likely to be low. However, if they include stable land surfaces, these could be associated with archaeological layers, features and/or lithic scatters. The palaeoenvironmental potential of these deposits is likely to be low except where calcareous units are identified.

GCZ 8

7.2.25 Holocene Alluvium associated with the Holland Brook may be present within GCZ 8, potentially underlain by Ardleigh Gravels (MIS 16–14). Pleistocene Head and/or Holocene Colluvium may also be present on the valley sides or at the base of the valley. Holocene Alluvium has the potential to contain organic-rich units or peat of high palaeoenvironmental potential and may contain Holocene archaeology, whilst the deposits of the Ardleigh Gravels may contain significant Lower Palaeolithic archaeology and organic/fossiliferous sediments.

7.2.26 Pleistocene Head and/or Holocene Colluvium have moderate potential to contain reworked archaeological finds of multiple periods, but are likely to be of low palaeoenvironmental potential except where calcareous units are identified.

GCZ 9

7.2.27 Zone GCZ 9 is likely to be underlain by the Ardleigh Gravel (MIS 16–14) of the Kesgrave Sands and Gravels, overlain by Pleistocene Brickearth. The Ardleigh Gravels have the potential to contain significant Lower Palaeolithic archaeology (see **Section 3**); where archaeological finds are reworked, such material would be of moderate potential, but if minimally disturbed or in situ, such archaeology would be of high significance.

7.2.28 Deposits of Pleistocene Head and/or Holocene Colluvium have moderate potential to contain reworked archaeological finds, potentially of multiple periods; the significance of such material is likely to be low. However, if they include stable land surfaces, these could

be associated with archaeological layers, features and/or lithic scatters. The palaeoenvironmental potential of these deposits is likely to be low.

8 RECOMMENDATIONS

8.1 Introduction

8.1.1 Through deposit modelling, the GDBA has assessed the likely presence and lateral and horizontal extent of Quaternary deposits across the Scheme. The archaeological and paleoenvironmental potential of these deposits has also been assessed, and the significance of any archaeological material they may contain considered in relation to national and regional research themes and priorities (EH 2008; EERRF 2021).

8.1.2 The GDBA has identified areas where Quaternary deposits may be present which could contain significant archaeological evidence and/or deposits with palaeoenvironmental potential, as well as some areas where there is insufficient data to consider potential. Consequently, to assess potential and to characterise archaeological and geoarchaeological risk of proposed development impacts, targeted archaeological and geoarchaeological field evaluation is likely to be required.

8.1.3 Should GI works be undertaken within the Scheme, monitoring of these GI works may address some aims of the evaluation proposed in **Table 7** and may negate the need for further purposive geoarchaeological evaluation. In addition, some of the evaluation proposed in **Table 7** could be undertake in tandem with any proposed archaeological trial trench evaluation.

8.1.4 Based on variations in geological characteristics of the deposits present, linked to the assessment of the archaeological and geoarchaeological potential of any Quaternary deposits, the Scheme has been divided into nine GCZs specific to the North Falls Scheme.

8.1.5 Likely requirements for, and appropriate methods of evaluation, have been considered for each zone and are summarised in **Table 7**.

Table 7 Recommendations for archaeological and geoarchaeological evaluation

GCZ	Principal Quaternary deposits	Depth of deposits (m bgl)	Recommended method of evaluation
1	Alluvium (inc. estuarine deposits)	Unknown	Deep boreholes to assess nature of Quaternary deposits (max depth – drilled to bedrock)
	?Post MIS 12 Thames Medway Deposits		
	?Kesgrave Sands and Gravels (Cooks Green Gravel, Holland Gravel)		
2	Unknown (none on BGS mapping)	Unknown	Test pits to assess whether Quaternary deposits are present and to assess archaeological/geoarchaeological potential (max depth c. 4m bgl)

3	?Head/Colluvium	Unknown	Targeted test pits to assess whether deposits are present and to assess archaeological/geoarchaeological potential (max depth c. 4m bgl)
	Brickearth	c. 0.20-1.00	Targeted test pits and to assess Palaeolithic archaeological/geoarchaeological potential (max depth c. 4m bgl)
	Kesgrave Sands and Gravels (Cooks Green Gravel)	c. 0.50-6.00+	
4	Unknown	Unknown	Test pits to assess whether Quaternary deposits are present and to assess archaeological/geoarchaeological potential (max depth c. 4m bgl)
5	?Alluvium	Unknown	Test pits to assess whether Quaternary deposits are present and to assess archaeological/geoarchaeological potential (max depth c. 4m bgl)
	?Head/Colluvium		
	?Kesgrave Sands and Gravels (Wivenhoe Gravel, Cooks Green Gravel)		
6	?Alluvium	Unknown	Test pits to assess whether Quaternary deposits are present and to assess archaeological/geoarchaeological potential (max depth c. 4m bgl)
	?Head/Colluvium		
	?Kesgrave Sands and Gravels (Wivenhoe Gravel)		
7	?Head/Colluvium	Unknown	Test pits to assess whether Quaternary deposits are present and to assess archaeological/geoarchaeological potential (max depth c. 4m bgl)
	Brickearth	c. 0.20-3.00	Targeted test pits and to assess Palaeolithic archaeological/geoarchaeological potential (max depth c. 4m bgl)
	Kesgrave Sands and Gravels (Ardleigh Gravel, Wivenhoe Gravel)	c. 0.50-3.50	
8	?Alluvium	Unknown	Test pits to assess whether Quaternary deposits are present and to assess archaeological/geoarchaeological potential (max depth c. 4m bgl)
	?Head/Colluvium		
	?Kesgrave Sands and Gravels (Ardeigh Gravel)		
9	?Head/Colluvium	Unknown	Test pits to assess whether Quaternary deposits are present and to assess archaeological/geoarchaeological potential (max depth c. 4m bgl)
	Brickearth	c. 0.00-2.75	Targeted test pits/boreholes and to assess Palaeolithic archaeological/geoarchaeological potential (max depth c. 4m bgl)
	Kesgrave Sands and Gravels (Ardeigh Gravel)	c. 0.00-10.00+	

8.2 GCZ 1

8.2.1 Holocene Alluvium of unknown depth is likely to be present in GCZ 1, potentially containing peat or organic-rich units formed on the estuarine floodplain of the Holland Brook. They may

be underlain (at depth) by unmapped Pleistocene units of the Cooks Green Gravel (MIS 14–13) and/or Holland Gravel (MIS 12).

8.2.2 The most appropriate method of evaluating these deposits is through borehole survey. It is recommended that boreholes are distributed across the corridor of the Scheme in this zone to establish the lateral and vertical extent of Quaternary deposits, confirm the depositional processed associated with these deposits, recover suitable samples for palaeoenvironmental assessment and, if possible, recover material for dating.

8.2.3 The results of the borehole survey will enable assessment of whether targeted archaeological work (possibly test pits/trial trenches) will be required in any areas in order to offset any proposed development impacts.

8.2.4 With regards to geophysical survey of GCZ 1, it is recommended that Electrical Resistivity Tomography (ERT) transects are collected as these may be able to identify sub-surface structures and lithological changes, which in combination with any new or existing borehole data, could fill in the gaps between the borehole locations and provide a more robust and complete cross section of the deposits.

8.2.5 ERT is collected in profiles with probes at regular intervals dependant on the resolution and depth of data required. The survey can be tailored to the requirements of the site and investigation, and is capable of reaching depths in excess of 20 m. The survey works by looking at changes in electrical resistance in the ground caused by different materials and moisture content. For archaeological investigation, this makes it suitable for the recording of paleoenvironments, deposit depths, and former water courses.

8.2.6 At the resolution required to adequately record the deposit depths expected at the survey area, in excess of 10 metres below ground level, the ERT profiles would be unlikely to record archaeological features, though there may be some potential to identify substantial sub-surface structures such as culverts or tunnels. It is therefore recommended that ERT is undertaken in combination with more traditional methods (e.g. Magnetic gradiometer) in GCZ 1.

8.3 GCZ 2

8.3.1 The extent of survival of Quaternary deposits in this zone is currently unknown. Machine dug test pits (with a maximum depth of c. 4.0 m bgl), distributed across the corridor of the Scheme in this zone, would be a suitable method of evaluation to assess the extent of survival of Quaternary sediments and to assess their archaeological and geoarchaeological potential.

8.4 GCZ 3

8.4.1 Pleistocene deposits with Lower and Middle Palaeolithic archaeological potential are present in this zone. BGS archive borehole data indicates that Pleistocene Brickearth of unknown date is present at depths between c. 0.20-1.00 m bgl, overlying fluvial sands and gravels, likely equivalent to the Cooks Green Gravel, at depths between 0.50 and at least 6.00 m bgl. There is also potential for Head and/or Holocene Colluvium on valley slopes in this zone.

8.4.2 Machine dug test pits with associated artefact sieving and sampling for paleoenvironmental and dating evidence the most appropriate method of evaluation. These should target known areas of Pleistocene deposits of Brickearth and fluvial sands and gravels, as well as

providing a more widespread distribution across the corridor of the Scheme that assesses the presence of unrecorded sediments.

8.5 GCZ 4

8.5.1 The extent of survival of Quaternary deposits in this zone is currently unknown. Machine dug test pits (with a maximum depth of c. 4.0 m bgl), distributed across the zone, would be a suitable method of evaluation to assess the extent of survival of Quaternary sediments and to assess their archaeological and geoarchaeological potential.

8.6 GCZ 5 and 6

8.6.1 No previous interventions have been undertaken in zones GCZ 5 and 6 and the extent of survival of Quaternary deposits in this zone is currently unknown. Holocene Alluvium may be present in these zones, overlying Pleistocene deposits of the Cooks Green/Wivenhoe Gravels. Pleistocene Head and/or Holocene Colluvium may also be present on the valley sides or at the base of valleys.

8.6.2 Machine dug test pits (with a maximum depth of c. 4.0 m bgl), distributed across the corridor of the Scheme in these zones, would be a suitable method of evaluation to assess the extent of survival of Quaternary sediments and to assess their archaeological and geoarchaeological potential.

8.7 GCZ 7

8.7.1 Pleistocene deposits of the Kesgrave Sands and Gravels, overlain by Brickearth, are present in GCZ 7; the former likely to include deposits of the Ardleigh (MIS 16–14) and/or Wivenhoe (MIS 14–13) Gravels. BGS archive boreholes indicate that the Pleistocene Brickearth is present at depths between c. 0.20 and at least 3.00 m bgl, with the underlying Gravels present at between c. 0.50 and at least 3.50 m bgl. There is also potential for Pleistocene Head and/or Holocene Colluvium on valley slopes within GCZ 7.

8.7.2 Machine dug Palaeolithic test pits with associated artefact sieving and sampling for paleoenvironmental and dating evidence are the most appropriate method of evaluation. These should target known areas of Pleistocene deposits of Brickearth and fluvial sands and gravels, as well as providing a more widespread distribution across the corridor of the Scheme that assesses the presence of unidentified deposits.

8.8 GCZ 8

8.8.1 Holocene Alluvium may be present this zone, overlying Pleistocene deposits of the Ardleigh Gravels. Pleistocene Head and/or Holocene Colluvium may also be present on the valley sides or at the base of valleys.

8.8.2 Machine dug test pits (with a maximum depth of c. 4.0 m bgl), distributed across the corridor of the Scheme in this zone, would be a suitable method of evaluation to assess the extent of survival of Quaternary sediments and to assess their archaeological and geoarchaeological potential.

8.9 GCZ 9

8.9.1 BGS archive boreholes indicate that Pleistocene Brickearth is present in GCZ 9 at depths between c. 0.00 and 2.75 m bgl, with fluvial sands and gravels (likely equivalent to the Ardleigh Gravel) present at between c. 0.0 and at least 10.0 m bgl. Pleistocene Head and/or Holocene Colluvium may also be present on valley slopes within this zone.

8.9.2 Machine dug Palaeolithic test pits with associated artefact sieving and sampling for paleoenvironmental and dating are recommended, alongside limited targeted boreholes to characterise the full Pleistocene sequences (up to 10m). These should target known areas of Pleistocene deposits of Brickearth and fluvial sands and gravels, as well as providing a more widespread distribution across the corridor of the Scheme that assesses the full lateral extent of these deposits.

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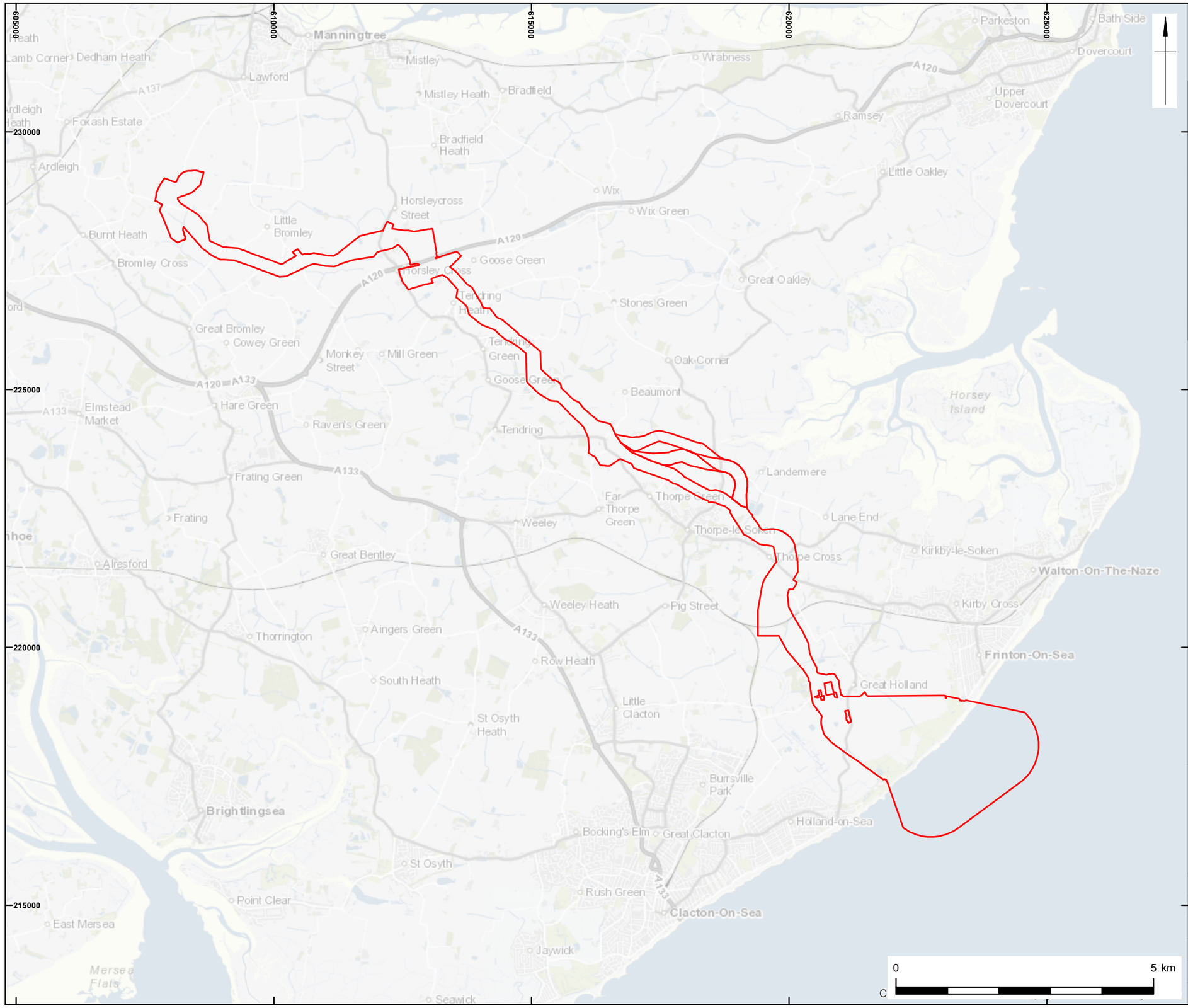
APPENDIX

Appendix 1 Review of BGS archive boreholes

Name	Total Depth (m)	Easting	Northing	Elevation (m OD)	Notes
TM11NE2	10.70	619230	218870	13.10	Elevation acquired from lidar
TM11NE1	9.80	619160	218950	15.00	Elevation acquired from lidar
TM22SW17	6.10	620220	220140	22.50	Elevation acquired from lidar
TM22SW12	12.19	620200	220160	22.40	Elevation acquired from lidar
TM22SW21	3.05	620340	220200	23.60	Elevation acquired from lidar
TM22SW13	6.10	620240	220210	22.90	Elevation acquired from lidar
TM22SW20	12.19	620310	220230	23.20	Elevation acquired from lidar
TM22SW19	6.10	620320	220240	23.20	Elevation acquired from lidar
TM22SW18	6.10	620300	220250	23.20	Elevation acquired from lidar
TM22SW14	6.10	620320	220280	24.00	Elevation acquired from lidar
TM22SW16	12.50	620390	220300	24.00	Elevation acquired from lidar
TM22SW15	6.10	620360	220320	24.00	Elevation acquired from lidar
TM22SW5	121.92	620750	220620	23.47	
TM22SW31	5.50	621180	220780	N/A	No stratigraphy data
TM11NE20	10.00	618460	216230	9.20	Elevation acquired from lidar
TM11NE18	10.00	618410	216250	7.70	Elevation acquired from lidar
TM11NE16	10.00	618370	216300	6.70	Elevation acquired from lidar
TM11NE17	10.00	618460	216300	6.20	Elevation acquired from lidar
TM11NE42	3.00	618380	216470	7.45	
TM11NE43	1.10	618410	216490	5.81	
TM11NE41	10.00	618390	216500	6.77	
TM11NE50	3.00	618370	216500	7.10	
TM11NE44	1.10	618410	216510	5.55	
TM11NE45	3.00	618390	216520	6.15	
TM11NE40	10.00	618370	216530	6.75	
TM11NE49	3.00	618350	216530	7.60	
TM11NE46	2.00	618410	216550	4.64	
TM11NE48	1.10	618370	216550	6.55	
TM11NE51	1.10	618400	216550	5.45	
TM11NE47	3.00	618410	216550	4.64	
TM11NE19	10.00	618360	216230	7.70	Elevation acquired from lidar
TM12NW34	1.83	611949	227199	27.76	
TM12NW35	3.35	612089	227264	34.81	
TM12NW36	1.83	612233	227315	35.97	
TM12NW37	1.83	612382	227351	36.64	
TM12NW53	10.00	612350	227480	36.58	
TM12NW54	20.11	613050	227500	N/A	Insufficient detail
TM12NW52	8.53	612320	227510	N/A	Insufficient detail

Name	Total Depth (m)	Easting	Northing	Elevation (m OD)	Notes
TM12NW55	3.20	612360	227520	36.65	
TM12NW38	1.83	613249	227592	37.19	
TM12NW39	1.83	613394	227642	36.85	
TM12NW40	2.74	613542	227690	37.03	
TM12NW41	3.05	613687	227734	36.85	
TM12NW42	3.05	613835	227772	36.33	
TM12NW43	2.44	613983	227807	35.02	
TM02NE14/B	7.62	608350	229220	35.40	
TM02NE14/A	17.37	608360	229220	35.40	
TM02NE15	10.10	608430	228550	34.40	
TM02NE193	10.00	608600	228500	N/A	No stratigraphy data
TM02NE164	Unknown	609100	228000	N/A	No stratigraphy data
TM02NE165	Unknown	609100	227900	N/A	No stratigraphy data
TM02NE21	6.40	609410	227770	33.20	
TM02NE174	7.92	607960	228400	35.05	
TM02NE175	8.07	608000	228360	N/A	No stratigraphy data
TM12NW13/E	4.87	613520	226350	33.52	
TM12NW13/D	152.40	613510	226410	33.52	
TM12NW13/B	103.63	613750	226460	35.36	
TM12NW13/A	152.40	613420	226530	N/A	No superficial recorded (well on to bedrock)
TM12NW13/C	4.87	613420	226530	33.53	



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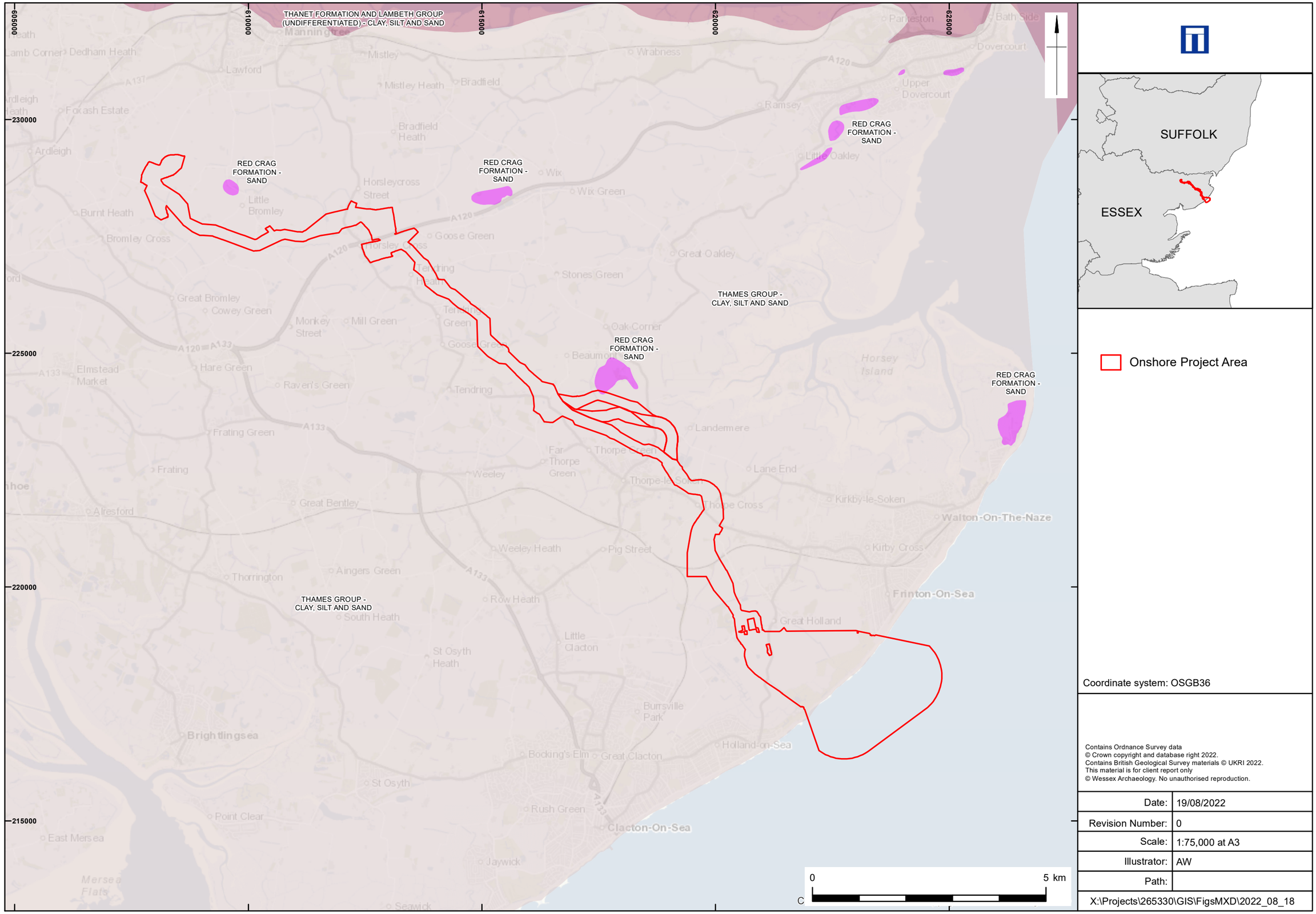
Site location

Figure 1



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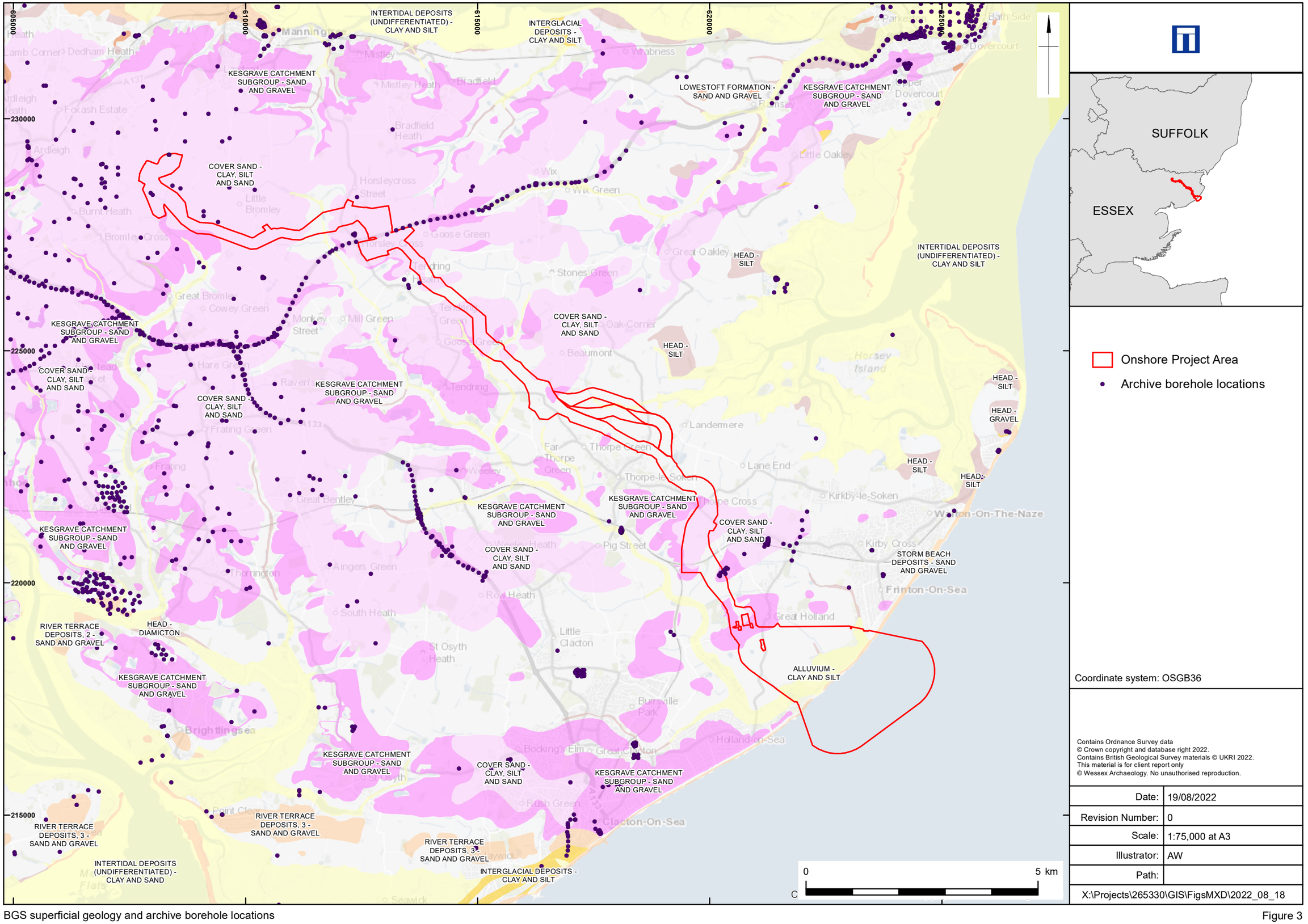
BGS solid geology and site boundary

Figure 2



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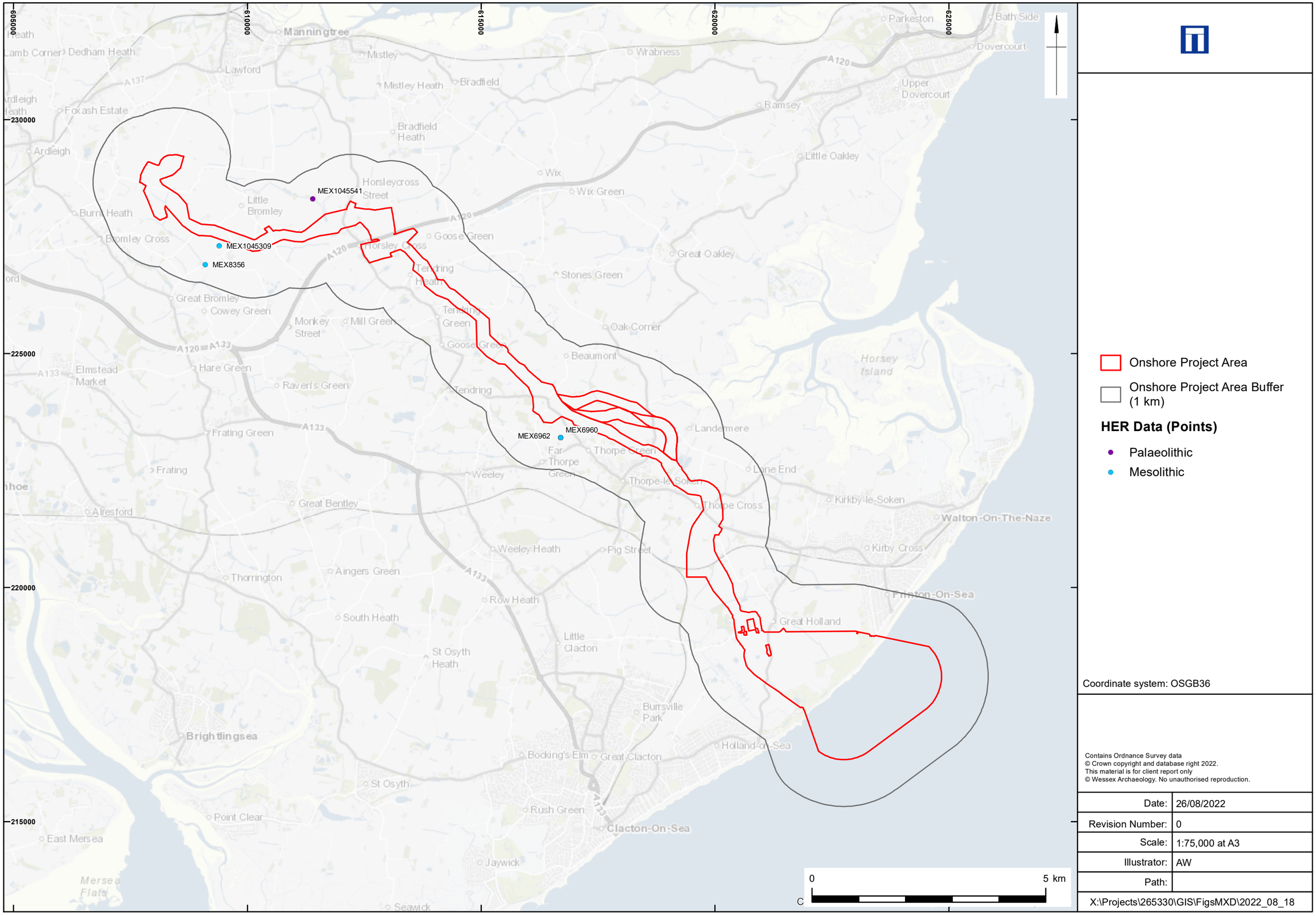
BGS superficial geology and archive borehole locations

Figure 3



Onshore Project Area

Onshore Project Area Buffer (1 km)

HER Data (Points)

- Palaeolithic
- Mesolithic

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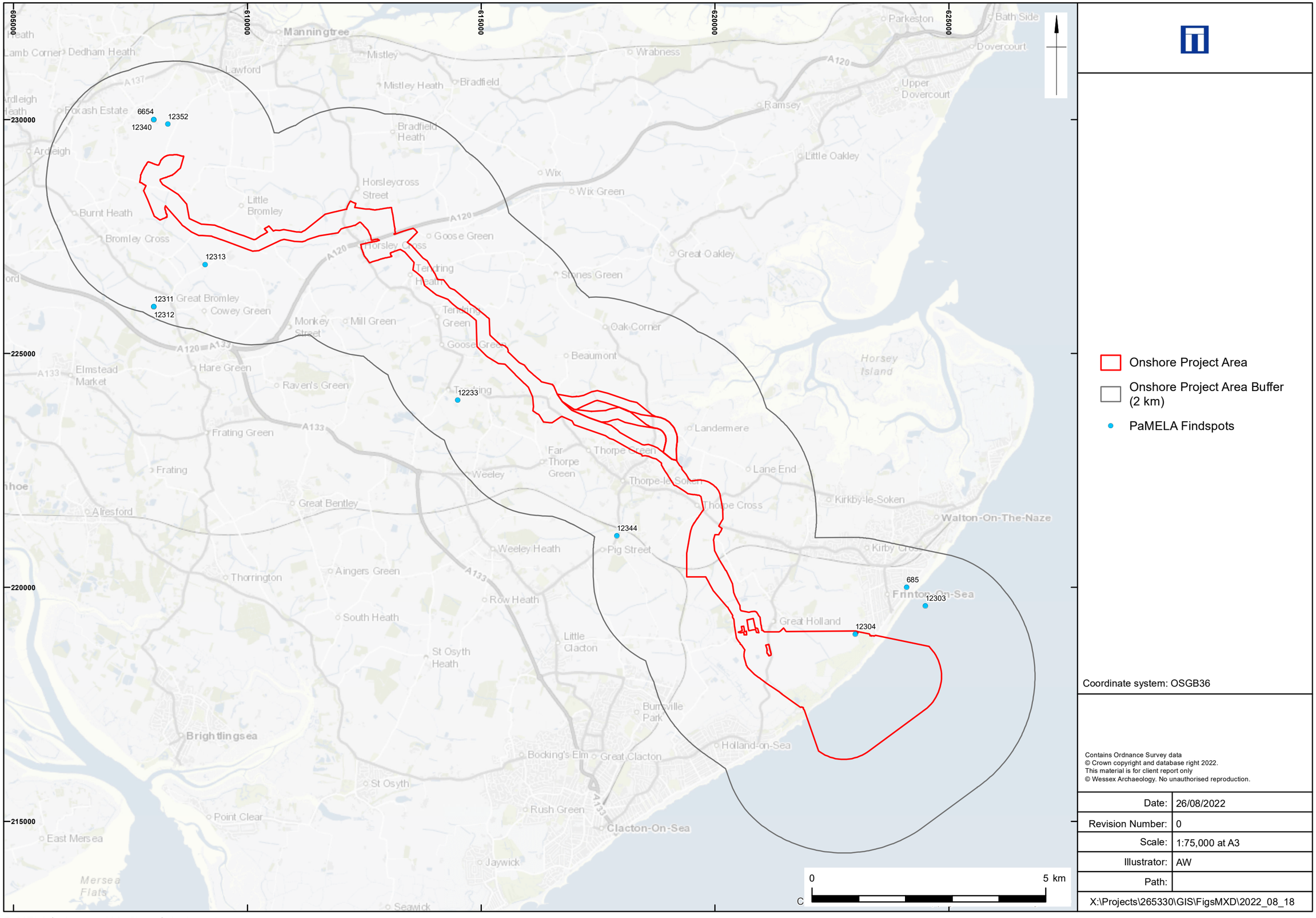
HER Data: Palaeolithic and Mesolithic data from within 1 km of site boundary

Figure 4



Onshore Project Area

Onshore Project Area Buffer (2 km)

PaMELA Findspots

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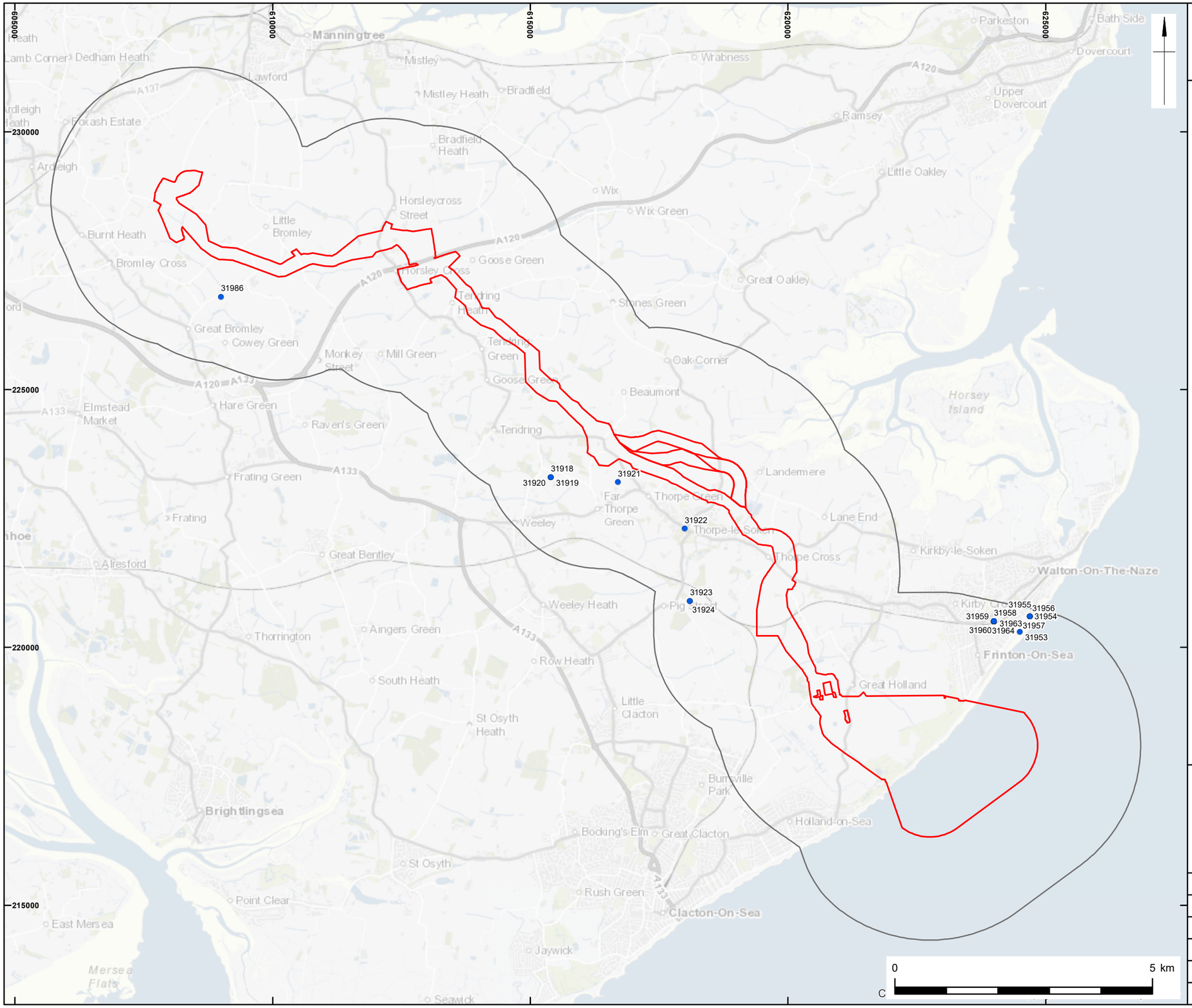
PaMELA findspots within 2km of site boundary

Figure 5



Onshore Project Area

Onshore Project Area Buffer (2 km)

TERPS Findspots

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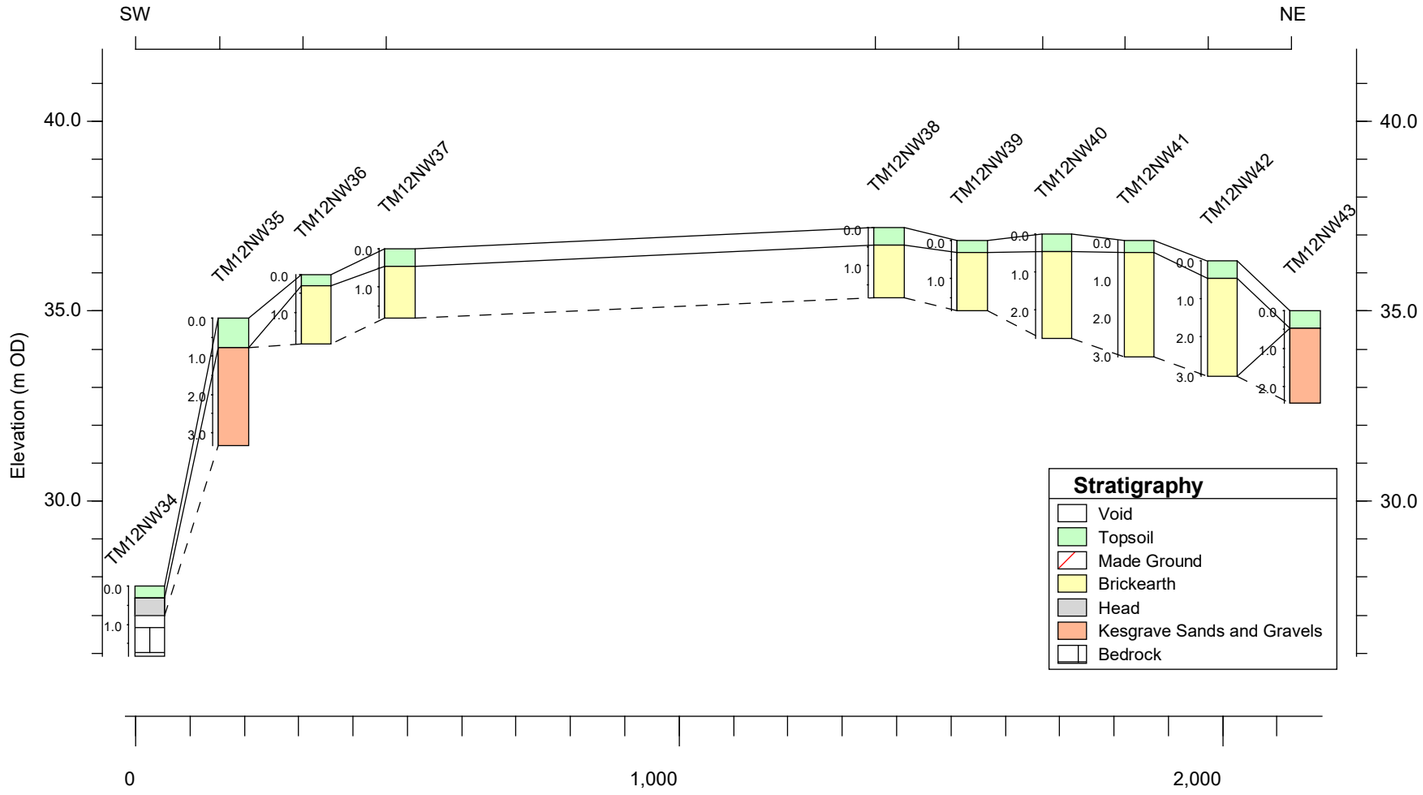
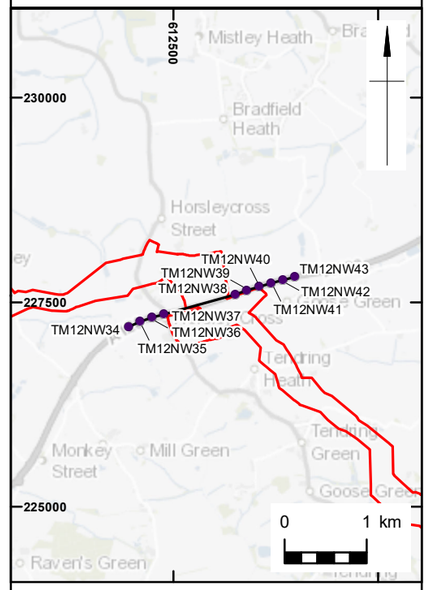
TERPS findspots within 2km of site boundary

Figure 6





Onshore Project Area

Transect

Archive borehole locations

Coordinate system: OSGB36

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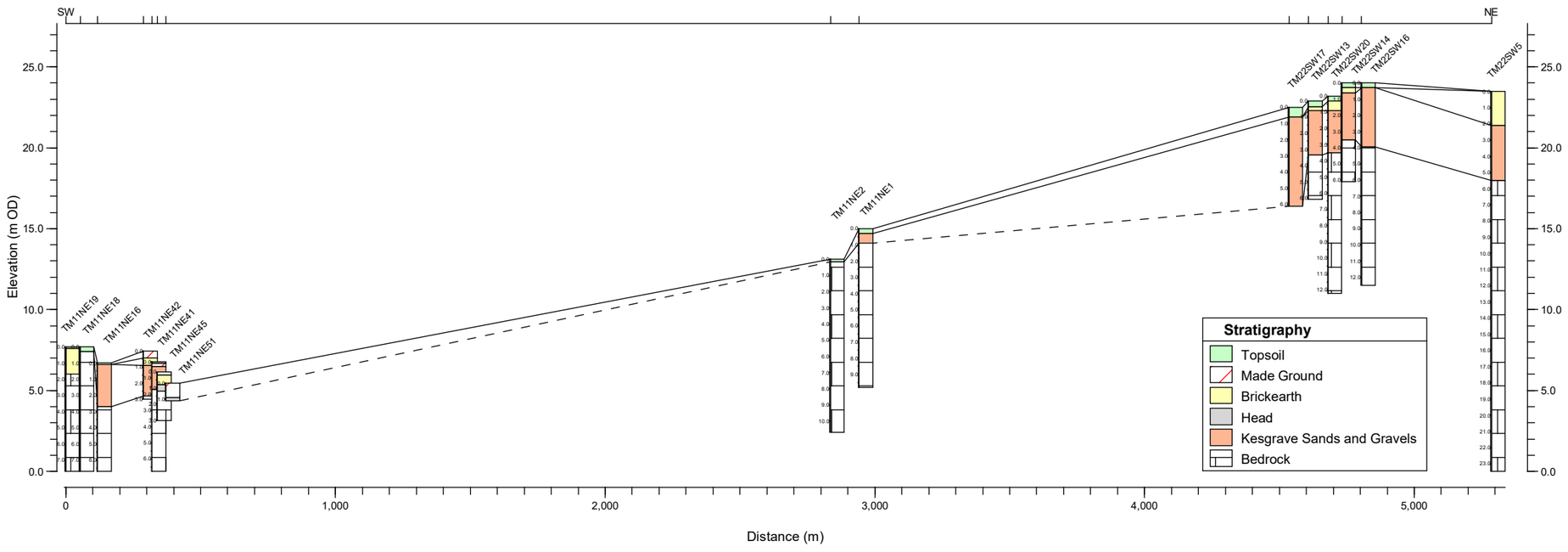
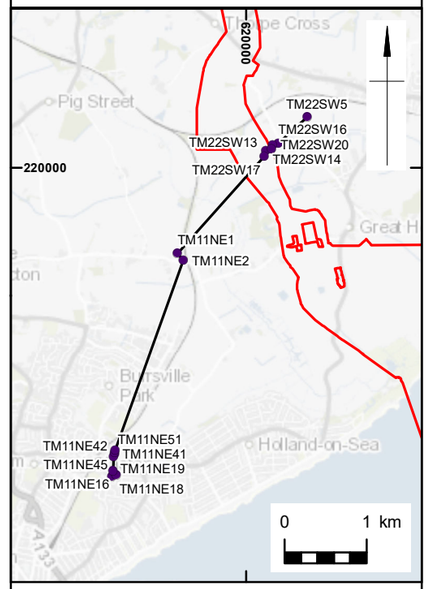
Transect A showing BGS archive boreholes and Lidar DTM data

Figure 7





Onshore Project Area

Transect

Archive borehole locations

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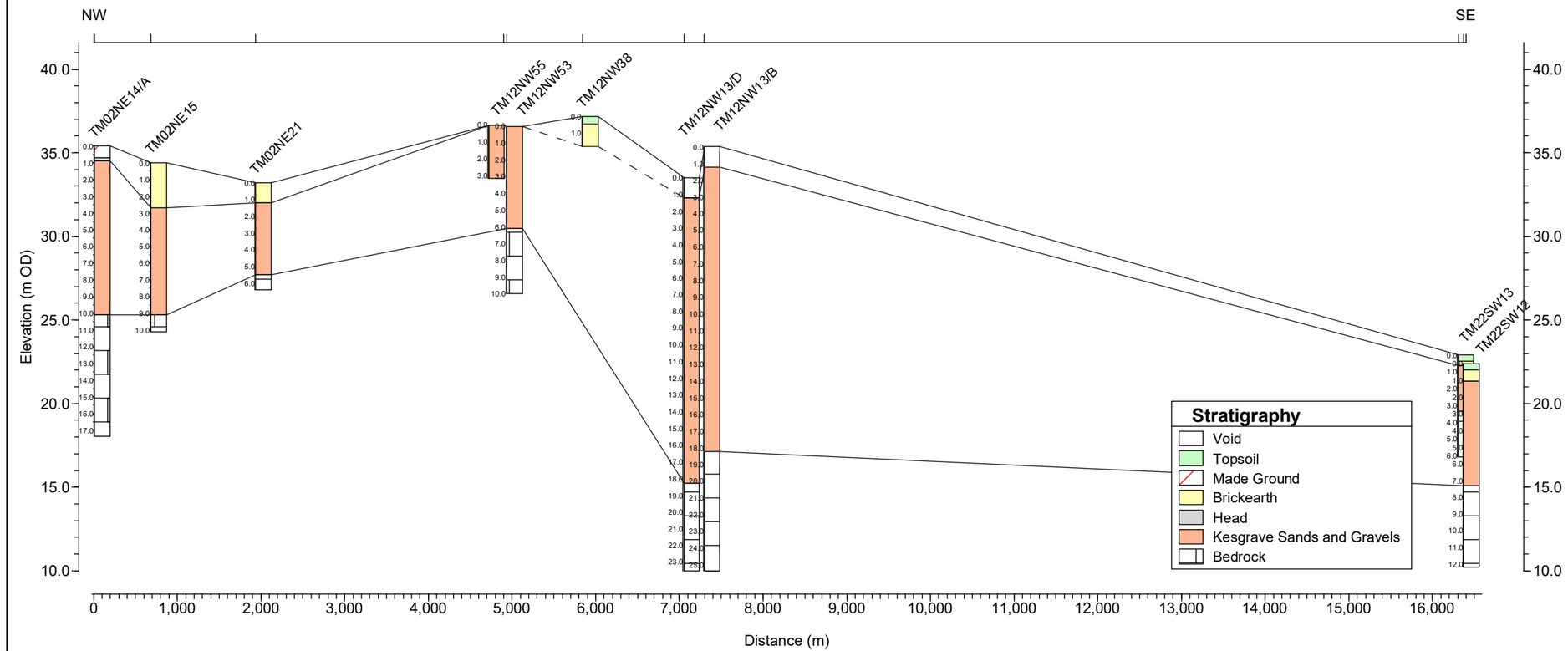
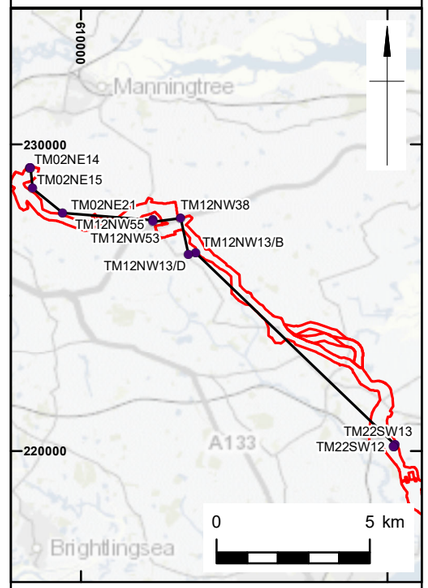
Transect B showing BGS archive boreholes and Lidar DTM data

Figure 8





Onshore Project Area

Transect

Archive borehole locations

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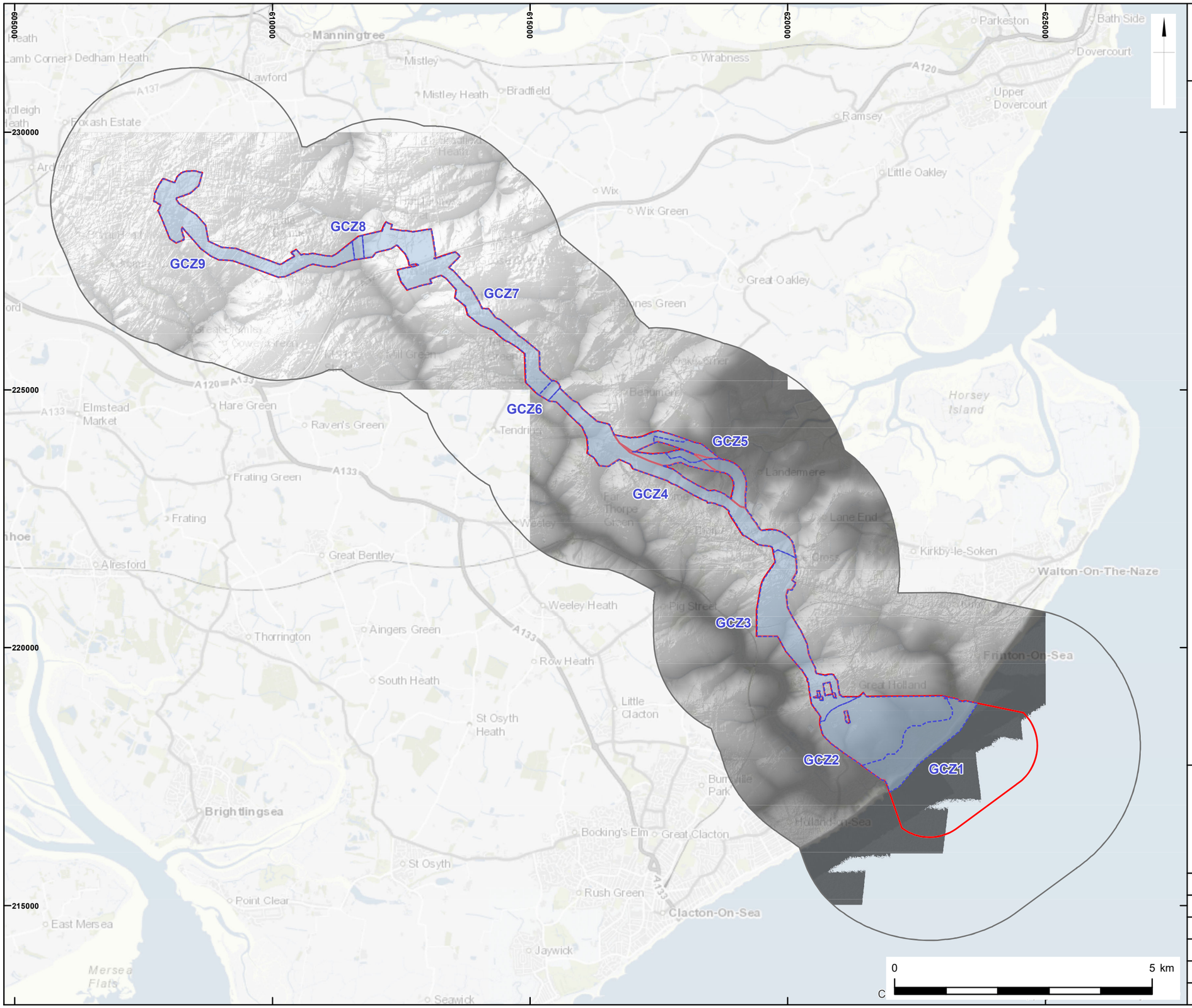
Transect C showing BGS archive boreholes and Lidar DTM data

Figure 9



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Geoarchaeological Landscape Characterisation showing North Falls GCZs

Figure 10

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