A585 Windy Harbour to Skippool Improvement Scheme

TR010035

6.7.3 ES Appendix 7.3: Geoarchaeological Assessment

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A585 Windy Harbour to Skippool Improvement Scheme

Development Consent Order 201[ ]

ES APPENDIX 7.3: GEOARCHAEOLOGICAL ASSESSMENT

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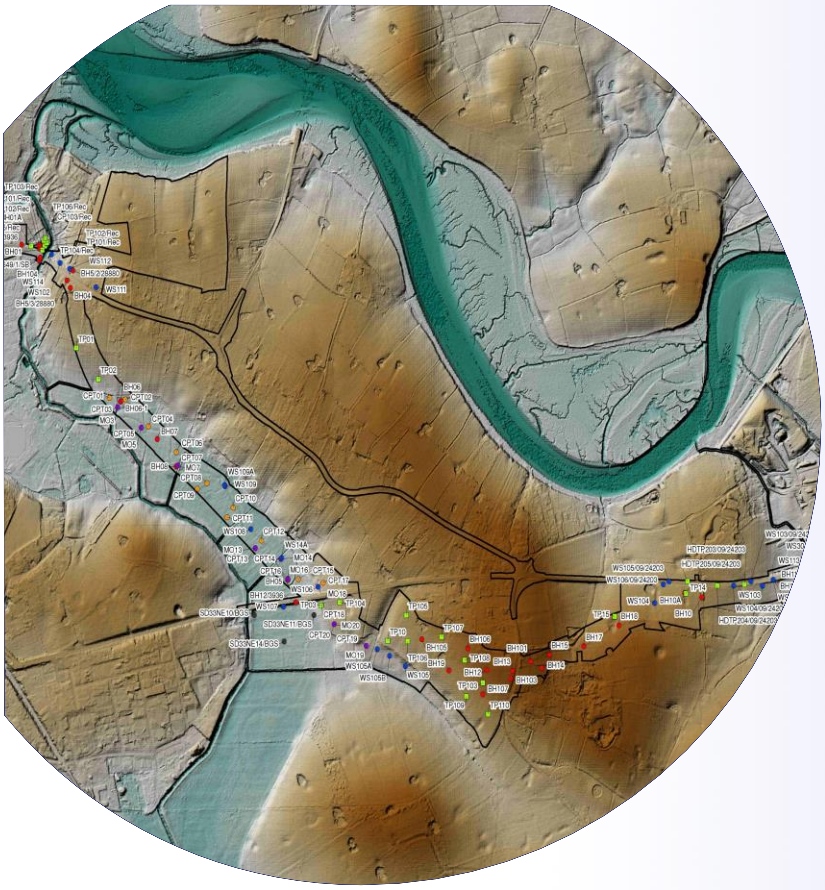

Windy Harbour to Skippool, Lancashire

Deposit Model Report

July 2018

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A585 Windy Harbour to Skippool Improvements, Lancashire Deposit Model Report

Written by [redacted]
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Summary

Oxford Archaeology were commissioned by Arcadis Consulting to undertake geoarchaeological deposit modelling along the route of the proposed A585 Windy Harbour to Skippool Improvement Scheme, Lancashire. The Scheme covers an area of *c* 106,200 hectares, stretching *c* 5km along the south of the A585 and to the east of Skippool, between Skippool and Windy Harbour junction.

The primary aim of the deposit modelling was to provide preliminary base-line data on the nature of the sub-surface sediment sequences and their geoarchaeological and palaeoenvironmental potential, and to identify any horizons within these deposits with the potential to preserve evidence of human occupation.

Records from a total of 85 recent geotechnical interventions, supplemented by historical borehole data, have been used to compile the deposit model. The modelling revealed a basal sequence of mudstone bedrock overlain by Glacial Till and Glaciofluvial Deposits, probably dating to the last glacial period, the Devensian (> 12, 000 years BP). The surface of these deposits essentially defines the topography of the early Holocene landscape (<12, 000 years BP), which undulates locally within four valley areas (Valleys 1-4), separated by high ground. Two of these (Valleys 1 and 2) are associated with the Main Dyke and are filled by substantial depths of interbedded tidal flat deposits. Two smaller tributary valleys have been identified, one of which (Valley 3) is infilled with substantial thicknesses of peat. Thinner localised peat deposits are located in the easternmost tributary (Valley 4). The peat deposits have high potential for radiocarbon dating and palaeoenvironmental work and may be found associated with *in situ* archaeological remains in marginal ecotonal locations. Thick deposits of recent made ground are present overlying the natural sequences at the eastern and western extents of the Scheme, although the majority of the remainder has only a thin covering of topsoil.

Acknowledgements

Oxford Archaeology would like to thank Arcadis Consulting for commissioning this project. The project was managed for Oxford Archaeology by [redacted] [redacted] and [redacted]. The deposit model was compiled by [redacted] [redacted] and [redacted]

1 INTRODUCTION

1.1 Scope of work

1.1.1 Oxford Archaeology were commissioned by Arcadis Consulting to undertake geoarchaeological deposit modelling along the route of the proposed A585 Windy Harbour to Skippool Improvement Scheme, Lancashire (Fig. 1).

1.1.2 The A585 Windy Harbour to Skippool Improvement Scheme is a Nationally Significant Infrastructure Project (NSIP) under the Planning Act 2008. The proposed Improvement Scheme ("the Scheme") is a 4.86km double-carriageway road scheme located between the Windy Harbour junction and the Skippool junction near Poulton-le-Fylde. The aim of the proposed road is to alleviate a major bottle neck along the A585, between the two junctions.

1.1.3 Currently the A585 is a single-carriageway trunk road, providing the only viable access from junction 3 of the M55 into Fleetwood and the associated urban areas. As a result, the A585 suffers from extreme congestion. The Government's 2014 Autumn Statement consequently identified the need for an improvement scheme along the A585, to ameliorate the impact of traffic on the route between the two villages and remove the bottleneck.

1.1.4 It is proposed that the Scheme will provide a bypass for the village of Little Singleton, by following a route to the south of the existing A585 between Skippool and Little Singleton. Consequently, the Scheme will bypass two of the significant 'pinch points' to improve traffic flow and reduce the congestion affecting commuters and local residents.

1.1.5 The purpose of this report is to supplement the Cultural Heritage Desk-based Assessment (DBA) currently being prepared by Arcadis. The DBA is intended to inform the Scheme design and the Environmental Impact Assessment (EIA) with regard to Cultural Heritage constraints present within the draft order limits.

1.2 Location, topography and geology

1.2.1 The site lies to the south of the A585 and to the east of Skippool, between the Skippool and Windy Harbour junctions (Fig. 1). It is 7.5 km northeast of Blackpool town centre between NGR SD 354405 and SD 376395. To the north is the River Wyre, which at this location is tidal. The tidal limit of the river lies approximately 5km upstream to the west. Downstream the estuary veers north, entering Morecambe Bay at Fleetwood *c* 10km to the northwest.

1.2.2 The area of proposed development consists of a *c* 5km parcel of land, roughly linear in shape, crossing agricultural fields and a number of roads including Mains Lane, Garstang Road, Lodge Lane and Garstang New Road. In the vicinity of Skippool, the route crosses an area of infilled ground through which the Main Dyke discharges into the River Wyre. Between Skippool and Little Singleton the corridor runs adjacent to the Main Dyke. From Little Singleton to Bankfield Manor the corridor crosses undulating ground that rises above the Main Dyke (Figs 2 and 3).

1.2.3 The bedrock geology of the area comprises the Singleton Mudstone Member with the Tarporley Siltstone Formation and the Sherwood Sandstone Group to the north. Superficial deposits along the estuary are mapped as tidal flat deposits (clay and silt) with peat and Devensian Glaciofluvial Deposits and Glacial Till along the Main Dyke which joins the River Wyre from the south at Skippool (Fig. 4).

1.3 Archaeological background

1.3.1 Details of the archaeological background to the Scheme are provided in the DBA currently being prepared by Arcadis. The numbers associated with heritage assets quoted below derive from the gazetteer included in the DBA.

1.3.2 There are 12 designated and 118 known non-designated heritage assets within a 1km study area of the Scheme. A further 33 assets have been identified through a walkover survey, LiDAR, aerial photographic and cartographic analysis within the draft order limits. There are no designated heritage assets located within the draft order limits, but there are 51 non-designated heritage assets. The baseline conditions and the predominantly agricultural nature of the land use across the draft order limits indicate that there is the potential for previously unrecorded archaeological remains to be present.

1.3.3 In summary, the DBA concludes there is a medium to low potential for prehistoric remains to be located within the Scheme. This potential is focused primarily to the south of Garstang Road, where several prehistoric find spots (**126 and 158**), a flint scatter (**157**), and an undated circular enclosure (**60**) have suggested the presence of early human activity close to the Scheme. Furthermore, potential areas of peat within the Scheme to the south of Garstang Road highlight the potential for the survival of early organic archaeological deposits. This potential is also likely in areas of peat to the north of Garstang Road, particularly following the identification of a possible Romano-British enclosed settlement (**112**) immediately to the west. There is, however, the potential for post-medieval activity such as quarrying and modern drainage to have impacted below ground archaeological remains. Their full impact on earlier archaeological deposits are, however, not known.

1.3.4 There is also thought to be a medium potential for Roman remains to be located within the Scheme. This potential is primarily thought to lie to the north of Garstang Road and may represent an extension to, or have been associated with, the phased Roman settlement activity (**112**) identified in excavations (ELA2408/ELA2409) to the west of the Main Dyke. A known area of peat in this area of the Scheme reflects the conditions found when the Roman settlement was excavated.

1.3.5 The potential for previously unrecorded Roman archaeology to be identified within the Scheme is also supported by the projected line of Ribchester Roman road (**139**) to the west. The area with the highest potential for archaeological remains associated with this road to occur in the Scheme is to the south west of Skippool roundabout.

1.3.6 There is negligible potential for previously unrecorded early medieval archaeological remains to be located within the Scheme. There is no known early medieval activity within the draft order limits or the 1km study area. Archaeological remains of early medieval date are, however, relatively scarce nationwide, and should further investigations of the Scheme locate such remains, these will be at least of medium value due to their potential to contribute to regional and national research objectives.

1.3.7 There is a medium potential for both medieval and post-medieval remains to be located within the Scheme. Baseline conditions have illustrated an extensive agricultural resource from both periods and some post-medieval industrial evidence within the draft order limits.

1.3.8 There is a negligible potential for modern remains to be located within the Scheme. Baseline conditions have presented no evidence for modern activity within the draft order limits other than that of land use.

1.3.9 The overall archaeological potential for currently unknown archaeological remains to be present within the Scheme is considered to be medium.

1.4 Regional vegetation history

1.4.1 The Over Wyre area (the northern part of the Fylde) is distinguished from the southern part which is the area between the Wyre and the Ribble (and includes Poulton-le-Fylde). Peat deposits formerly dominated this landscape with mires occupying the waterlogged marine clay flats and Glacial Till hollows, from the salt marshes of the northern shore of Over Wyre to the River Wyre in the south (Middleton *et al.* 1995). In the south Fylde, valley and raised mires occupied low-lying topography between till uplands, forming a mosaic of open wetland and initially afforested, then cultivated ground (ibid.). The Lower Wyre Valley district is low lying and has been wet throughout the Holocene, submerged at times by marine flooding or with extensive areas of raised mires (ibid.).

1.4.2 The work of Barnes (1975) established beyond doubt that human activity had played a major role in shaping the Over Wyre landscape from the Mesolithic onwards. Environmental data spanning the second half of the Holocene have been obtained from an Over Wyre site at Fenton Cottage (Wells *et al.* 1997). These data, including palynology and plant macrofossil analysis, demonstrate that there has been a continuous human influence on the development of the landscape since the mire began growing, with a particularly significant deforestation episode commencing in the late Iron Age (ibid.). A major expansion of the mire system began in the late Bronze Age/early Iron Age and may have led to the abandonment of settlement in and around the peatlands during much of the Iron Age (ibid.). Wells *et al*. (2001) described a human skull discovered within the basal sediments of a relict mire at Poulton-le-Fylde, dating to the later Bronze Age. The find was located within a layer of silty wood peat, approximately 1m deep, representing the ancient root system of a hazel copse and containing many hazelnuts and some charcoal.

1.4.3 Previous palaeoenvironmental work by Oxford Archaeology (OA North 2010) on a Russian core adjacent to Holt's Lane, Poulton-le-Fylde suggested that the deposits accumulated when the site lay within an area of floodplain largely occupied by alder carr, adjacent to the River Wyre. The earliest sediments date to the Mesolithic period (SUERC 33859: 5640-5510 cal BC; 6650±35 BP). These deposits were succeeded by a marine blue/grey clay, containing foraminiferal test linings and dinoflagellate cysts.

This deposit was overlain by peat, which has been dated to the earliest Bronze Age to latest Iron Age (SUERC 37121: 734-690 cal BC; 2405±30 BP). Pollen from the peat has been interpreted as suggesting a disturbed landscape, with evidence that the landscape was utilised and managed by people both as a source of wood and for farming (both pastoral and arable).

1.4.4 Pollen from two ditches from an enclosed settlement at Poulton-le-Fylde (OA North 2010) span Romano-British, medieval and post-medieval periods, and provide evidence for human impact on the landscape. Open areas of grassland together with records of cereal-type pollen have been interpreted as suggesting mixed farming economies.

1.5 Sea-level changes in northern England

1.5.1 During the last three decades detailed investigations dealing with Holocene vegetational history, the stratigraphy of coastal sediments and sea-level changes have been carried out on sites around Morecambe Bay. Marine inundation of Morecambe Bay began during the early Holocene, the rapidly rising sea-level allowing a great amount of marine sediment to infill the lower valleys - the present estuaries in Morecambe Bay. The work of Tooley (1982) has shown that areas open to the coasts of the Fylde and southern Lancashire were filled with marine sediments during several phases of sea-level rise which have occurred since the early Holocene.

1.5.2 Tooley (1982) used data from this work to reconstruct Holocene sea-level history, which shows a rapid rise in sea-level at around 7800 BP followed by a fluctuating and slowly rising sea-level for the rest of the Holocene (Zong and Tooley 1996). Since the mid-Holocene, as the rate at which sea-level rose decreased, marine sediments have accumulated to seaward, and the coastal lowlands have gradually formed.

1.5.3 Tooley's work (1982) identified a series of 12 transgressive and regressive tendencies for the whole of Northwest England. A transgressive tendency or positive sea-level tendency is when the sea advances landward over a former land surface and the water deepens, so terrestrial sediments are replaced by littoral facies which are succeeded by deepening water facies. The converse is referred to as a regressive or negative sea-level tendency. For purposes of correlation, Tooley proposed that previously referred to transgressive sequences, Lythum I-IX, should not now be used, and they have been superseded by the 12 transgressive and regressive overlap sequences.

1.5.4 Barnes (1975) described a Bronze Age transgressive overlap and a regressive overlap sequence from Lousanna, and a Neolithic regressive overlap from Moss Farm, both sites adjacent to the River Wyre and Poulton-le-Fylde.

1.5.5 Wells *et al.* (1997) recorded a silty clay beneath wood peat at the base of the stratigraphic profile for Fenton Cottage. This silty clay unit contains high levels of Chenopodiaceae pollen, and records the natural development of salt marsh to reedswamp following marine transgression. The top of the silty clay (regressive overlap) has been dated from 3950-3370 to 3350-2900 cal BC (GU 5146: 4860±110 and GU 5148: 4410±80BP). Beneath this silty clay, marine silts and clays occur, which are thought to correspond to a marine transgression, dated to the Late Mesolithic (*c* 5570-4897 BP).

1.5.6 The rate of sea-level rise for the last 3500 years is probably around 2mm/year, although a rise of over 4mm/year may have resulted in extensive inundation of coastal lowlands and shoreline retreat in Morecambe Bay (Zong and Tooley 1996). Archaeological evidence suggests that during the final marine inundation within this area, after the late Roman period but before the early medieval period, the sea encroached at least as far as the village of Pilling. This is based on finds of late Roman pottery from a deposit underneath a clay thought to be of possible marine origin (Middleton *et al*. 1995).

2 AIMS AND METHODOLOGY

2.1 Aims

2.1.1 The project aims and objectives were to supplement the geotechnical sediment logs with archaeologically relevant detail to provide additional base-line data for assessing the archaeological and palaeoenvironmental potential of sub-surface deposits that may be impacted on by the Scheme. Specifically:

i. To characterise the sequence of sediments and patterns of accumulation along the route, including the depth and lateral extent of major stratigraphic units through a review of geotechnical logs and examination of samples.
ii. To identify significant variations in the deposit sequence indicative of localised features such as palaeochannels, topographic highs or buried 'islands'.
iii. To identify the location and extent of any waterlogged organic deposits and/or buried soils or land-surfaces and address the potential for the preservation and the likely location of archaeological and palaeoenvironmental remains.
iv. To clarify the relationships between sediment sequences and other deposit types, including periods of 'soil' or peat growth, and the effects of relatively recent human disturbance, including the location, extent and date of 'made ground'.
v. To discuss the sequence of sediments within the wider landscape context of known quaternary geology and geomorphology, referencing previous geoarchaeological and palaeoenvironmental work carried out in the vicinity.

2.2 Methodology

2.2.1 The geotechnical ground investigation comprised excavation of cable percussion and rotary boreholes, trial pits, dynamic (windowless) sampling and cone penetration testing, some of which included Mostap sampling. This report covers the stratigraphic sequences revealed by the boreholes from which a deposit model has been compiled. A summary of the geotechnical interventions is provided in Table 1 and the array is illustrated in Figures 2-4.

Table 1: Summary of geotechnical interventions

Type	Quantity	Depth range (m)	Exploratory hole IDs
Cable Percussion Boring	21	0.70 - 30.15	BH01-BH06, BH06-1, BH07, BH08, BH10, BH10A, BH11, BH11A, BH12, BH14, BH15 BH17, BH18, BH19, BH103, BH105, BH106, BH107
Cable Percussion Boring extended by Rotary Core Drilling/Open Hole Drilling	4	24.70 - 36.50	BH01A, BH13, BH101 and BH104

Machine dug Trial Pits	14	2.50 - 3.50	TP01- TP003, TP10, TP14, TP15, TP103-TP110
Cone Penetration Tests (CPTs)	20	8.14 - 15.02	CPT01-CPT20
Mostap Sampling	9	1.54 - 6.00	MO3, MO5, MO7, MO13, MO14, MO16, MO18, MO19 and MO20
Dynamic (windowless) Sampling	17	5.00 - 8.00	WS14A, WS102-WS105, WS105A, WS105B, WS106-WS109, WS109A, WS111-WS115
Total	85		

2.2.2 The lithological data from the geotechnical logs was entered into geological modelling software (Rockworks™ v17.0) to allow correlation of broad stratigraphic units. A single representative linear transect has been created to illustrate the distribution and extent of these stratigraphic units across the Scheme (Fig. 5), along with a 3d thickness plot of the Holocene sequence (Fig. 6). The interpolation algorithm for the modelling was inverse distance on 4 points with a weighting of 2. The results of the modelling were imported in GIS software for comparison with current BGS mapping and LiDAR data.

2.2.3 It should be noted that all data derives from paper records and no sediment samples were available to corroborate the interpretation of the sediments. The problems associated with using geotechnical records in geoarchaeological deposit models has been outlined by Bates (1998), and recently reviewed for linear corridors in Carey *et al.* (2018). However, the detail in the geotechnical logs for this Scheme is considered sufficient to provide a preliminary indication of the nature of the sub-surface stratigraphy and deposit survival from which inferences about the likely environments of deposition can be made.

3 RESULTS

3.1 Introduction and presentation of results

3.1.1 A deposit model has been created from the geotechnical logs outlined above and is presented as a stratigraphic transect (Fig. 5) and 3d thickness plot of the Holocene sequence (Fig. 6). Appendix A provides details of the geotechnical locations and the correlated stratigraphy for each intervention. Appendix B includes a small number of images extracted from the geotechnical report illustrating the character of the peat deposits encountered (SOCOTEC 2018).

3.1.2 The following stratigraphic sequence has been identified:

- Bedrock (Singleton Mudstone Member)
- Glacial Till (Devensian)
- Glaciofluvial Deposits (Devensian)
- Tidal flat deposits
- Peat
- Alluvium
- Made ground
- Topsoil

3.2 Stratigraphic sequence

Pre-Holocene deposits

3.2.1 Bedrock in the area comprises the Singleton Mudstone Member and was encountered in the deeper interventions (BH01A, BH13 and BH101) at *c* -5m OD (15.45m, 27.2m and 26.9m below ground level (BGL) respectively).

3.2.2 The bedrock is in turn overlain by Pleistocene Glacial Till and Glaciofluvial Deposits, both units dating to the last glacial period (Devensian). The Glacial Till (Boulder Clay) is extensive in the area and was deposited through the action of ice and meltwater. It is generally described as very stiff red brown, locally grey, slightly sandy, slightly gravelly, clay with occasional sub-rounded cobbles of sandstone and mudstone. The Glaciofluvial Deposits are more localised, comprising beds, channels, plains and fans of coarse-grained sediment, deposited by meltwater, generally described as loose brown sand and gravel with lenses of clay and clayey zones. These deposits are recorded both beneath the Holocene valley sequences and capping some of the higher ground areas.

3.2.3 The surface of the Pleistocene deposits essentially defines the topography of the early Holocene landscape. The shape of this surface would have affected sedimentation patterns throughout the Holocene and influenced the site's unique sedimentary sequence. By understanding the nature of this surface, it is possible to develop a better understanding of landscape evolution and archaeological potential. The modelled surface of the Pleistocene deposits is shown in Figure 5. Areas of higher ground are apparent, separating four valleys (Valleys 1-4). Two (Valleys 1 and 2) relate to the main drainage system associated with the Main Dyke, one a minor tributary (Valley 3) and the fourth a separate system draining into the River Wyre (Valley 4). All four are visible on surface LiDAR (Fig. 3).

3.2.4 In the northwest, BGS boreholes SD34SE64/BGS and SD34SE65/BGS show the surface of the Pleistocene deposits at *c* 7m OD (1.8m BGL). This drops to *c* -1m OD (7.5m BGL) at BH14/3936, into the valley of the Main Dyke (Valley 1). The low elevation here along with the presence of Glaciofluvial Deposits indicates that this was a substantial channel during the late Devensian and at the beginning of the Holocene.

3.2.5 The land to the west reaches an elevation of approximately 12m OD (0.8m BGL) at WS111, before the route then rejoins the Main Dyke valley (Valley 2) and runs along the northeastern edge of the valley as it veers southeast between TP02 and WS105. The surface of the Pleistocene deposits is relatively constant at an elevation of *c* -1 to -2m OD (5.53m and 3.57m BGL) between CPT05 and CPT15 respectively. The surface of the Glaciofluvial Deposits in WS106 lies at higher elevations at *c* 4m OD (3.5m BGL) which marks the location edge of a minor tributary (Valley 3) running into the Main Dyke from the east (which is visible on the LiDAR plot: Fig. 3). However, MO19, WS105A, WS105B and WS105, penetrating to a maximum depth of 7m, did not reach Pleistocene deposits.

3.2.6 The land to the east of the Main Dyke has the highest surface elevation across the site (Fig. 3). This is reflected in the deposit model, with the highest elevations of the surface of the Pleistocene deposits reaching *c* 22m OD (0.4m BGL) in BH101.

3.2.7 Valley 4 represents a small north-south tributary draining into the River Wyre, to the east of the high ground between BH10 and WS301/13/27803. The surface of the Pleistocene deposits is lower in this valley, the lowest being *c* 1m OD. Again, Glaciofluvial Deposits are present at the base of the channel suggesting it was active during the Late Devensian and early Holocene.

Holocene sedimentary sequence

3.2.8 Following the end of the Devensian glacial period, as the climate ameliorated, sea-levels began to rise, depositing fine grained sediment in lower lying areas. Extensive tidal flat deposits infilling the Main Dyke valley (Valleys 1 and 2) have an average thickness of *c* 6m (with a maximum thickness of 7.7m at BH649/1/SB), generally between elevations of *c* -2m and 5m OD but rising to *c* 7m OD at the valley edge. It is likely that they were deposited under a mixed energy regime, and are described as grey soft to firm silty or sandy clay varying to silty sand, often with fibrous plant inclusions and organic detritus.

3.2.9 The tidal deposits are overlain by a substantial peat unit in the vicinity of Valley 3, between CPT15 (also MO15) and WS105. This unit is thickest, between -1m and +2m OD (0.7m to 3.55m BGL) in MO19 (Plate 2). It is described as firm and spongy dark brown, slightly clayey, pseudo fibrous, locally amorphous peat with frequent fibrous plant material and moderate organic (humic) odour. The sequence in WS105 appeared a little more complex with a 0.20m bed of silty sand within the peat unit at 4.76m OD.

The lower part of the peat here is described as plastic dark brown slightly clayey and amorphous (Plate 1).

3.2.10 Elsewhere, the peat deposits tend to be quite localised, and in addition to those shown in Figure 5, peat was also present in SD33NE10/BGS, SD33NE11/BGS and WS106 (Fig. 6). The majority of the peat deposits recorded are close to the valley edges in the vicinity of Valley 3. A thin unit of peat is also present in WS115 in Valley 4. Here it sits directly on the Glacial Till at *c* 3m OD (1.2-1.8m BGL).

3.2.11 Between WS106 and MO19 in Valley 3, further tidal flat deposits overlie the peat. They occur at *c* 7m OD, slightly higher than the other tidal flat deposits and may have been deposited during spring or other extreme high tides.

3.2.12 The fine-grained sediment infilling Valley 4 has been classified as Alluvium in the geotechnical log. This sediment unit occurs at relatively high elevations of up to +11m OD, so it is likely that part of this sediment body was deposited above the tidal limit for the area.

3.2.13 In the vicinity of Valley 1 the tidal flat deposits are sealed by relatively thick (*c* 2m) deposits of recent made ground, varying in composition from concrete to brown gravelly clayey fine and medium sand with a low cobble content including brick, limestone and mudstone.

3.2.14 Made ground deposits are also present in the vicinity of and east of Valley 4, although they are more localised in this area, clustering along the A585 (Fig. 6). Elsewhere the natural sequence is sealed by much thinner deposits of topsoil, described as soft, dark brown, slightly sandy, slightly gravelly clay with frequent rootlets, with a maximum thickness of 0.5m at WS14A and 0.7m at WS105B.

4 DISCUSSION

4.1.1 Overall the deposit modelling has served well in broadly characterising the nature and extent of the sub-surface stratigraphy along the route of the proposed Scheme. In summary:

- The sediment sequences on a superficial level are relatively consistent with the BGS mapping of the area and are comparable with other sites investigated in the vicinity.
- Four valley areas (Valleys 1-4) have been identified, infilled with mainly fine grained minerogenic sediments, probably deposited in a brackish water environment of tidal mud flats, creeks and saltmarsh. Two of these valleys (Valleys 1 and 2) are directly associated with the Main Dyke, whereas the other two are smaller tributary systems.
- Substantial waterlogged peat deposits up to *c* 2.75m thick were found to be associated with one of the tributaries (Valley 3) and at its confluence with the Main Dyke (Valley 2). A thin localised peat was also identified in Valley 4.
- No Holocene sediments were found to be present on the areas of high ground where topsoil directly overlies Pleistocene glacial deposits.
- Substantial made ground deposits overlying Holocene sediments were identified in the vicinity of the Main Dyke at the north-western of the route (Valley 1) and along the line of the A585 at the eastern extent.

4.1.2 By nature, peat accumulates in stable low-energy conditions, and consequently any archaeological remains found in association are likely to be stratified and preserved *in situ.* The marginal location of the peat deposits, associated with a tributary valley is archaeologically significant, occupying an ecotonal zone at the interface between dry ground and wetland. Such areas may have provided a focus for activity in the past due to the abundance of natural resources available for exploitation, and preserved remains could include waterlogged timber structures.

4.1.3 The peat deposits are generally sealed beneath 0.3m to 0.7m of topsoil and/or tidal flat deposits, and those in the Valley 4 to the east are sealed by 1.0m of alluvium and 0.2m of topsoil. Where alluvium or tidal flat deposits are present overlying the peat, it is unlikely that the organic deposits have been subject to recent human disturbance, although some erosion of the upper surface may have occurred. In addition, agricultural activity in the vicinity of WS105, WS105A and WS105B may have truncated some of the peat where it is directly overlain by topsoil.

4.1.4 Any archaeological remains associated with the tidal flat deposits have the potential to have undergone a degree of reworking, particularly within the lower reaches of the Main Dyke valley (eg Valley 1) which is likely to have been influenced by marine conditions to a greater extent than other areas. The environment of deposition would suggest that activity was low-level, perhaps seasonal (eg salt-making or fish traps). There is the potential for stabilisation horizons to occur within these deposits, particularly towards the feather-edge at valley margins and in the tributary valleys away from major scour processes.

4.1.5 Due to the thin cover of topsoil over higher ground areas, it is likely that archaeological features and artefacts has suffered a degree of disturbance and/or truncation in these areas, depending on the distribution of past land-use (eg arable and/or pastoral agriculture) and the effects of deep ploughing. However, deeper features should survive beyond the plough zone.

4.1.6 The peat deposits are considered to have high potential for the preservation of palaeoenvironmental remains (eg pollen, plant remains and insects) analysis of which could complement other studies carried out in the region (see sections 1.4 and 1.5). This is especially the case around WS105 where interdigitating layers of peat and tidal flat deposits have the potential to provide a high resolution record of past vegetation and hydrological change, the latter through the study of microfossils such as diatoms, ostracods and foraminifera. The peat deposits have excellent potential for radiocarbon dating which can provide a chronological framework for palaeoenvironmental work and any associated archaeological remains. The tidal flat deposits also offer potential for luminescence dating.

5 RECOMMENDATIONS

5.1.1 It is recommended the next stage of work includes a programme of purposive boreholes, specifically to recover high quality cores suitable for palaeoenvironmental assessment and dating work. The boreholes should aim to fill data gaps, but also target representative sequences from each of the valley locations, both at the deepest points and where the peat deposits are known to be thickest. Boreholes along the valley margins may look for indicators of human activity such as charcoal inclusions, micro-artefacts or evidence of disturbance/trampling, although shallower depths at the feather-edge should be accessible by test-pitting and/or evaluation trenching which are more reliable methods of detecting stratified archaeological remains due to the greater visibility and access to section faces they provide.

5.1.2 Boreholes targeting peat deposits should employ a coring technique that minimises compaction during drilling. This may include the use of a Russian corer or a hydraulic system such as a Mostap or Delft sampler. Should sediments be excavated during test-pitting and/or evaluation trenching, a geoarchaeologist should attend site to record the sequences and advise on sampling in line with Historic England guidelines (2015). Both borehole and trench stratigraphy should be integrated to allow the current deposit model to be updated as part of any forthcoming evaluation works.

APPENDIX A DEPOSIT MODEL DATASET

Location Details

Bore	Easting	Northing	Elevation	Total depth
BH01	335746.72	440586.05	6.11	5.3
BH01A	335736	440588.05	5.87	27.5
BH04	335859.94	440453.94	11.19	12.85
BH05	336735.3	439459.45	4.78	7
BH06	336062.06	440067.23	4.77	4.95
BH06-1	336063.66	440067.83	4.77	8.95
BH07	336209	439939.04	4.51	8.55
BH08	336285.47	439846.76	4.62	7.95
BH10	338402.73	439400.1	13.62	10.5
BH101	337713.85	439181.99	22.67	33
BH103	337633.6	439123.73	20.8	30.15
BH104	335735.06	440547.86	5.35	24.7
BH105	337275.39	439256.97	13.26	10.15
BH106	337460.36	439226.88	18.25	15.15
BH107	337520.18	439069.87	15.64	10.15
BH10A	338334.11	439416.14	13.77	18.15
BH11	338811.31	439472.18	4.97	0.7
BH11A	338809.59	439470.58	4.93	8.05
BH12	337536.11	439152.41	19.25	15.15
BH12/3936	336768	439384	8.06	13.2
BH13	337640.3	439150.57	21.86	36.5
BH13/3936	338839	439488	6.4	13.2
BH14	337758.72	439159.72	21.08	19.6
BH14/3936	335664	440602	6.32	15.8
BH15	337789.09	439205.78	19.84	20
BH15/3936	335503	440595	6.49	15.45
BH17	337927.63	439234.41	17.1	11.15
BH18	338068.69	439305.32	17.04	7.05
BH19	337383.92	439151.58	13.83	10.15
BH5/2/28880	335870	440514	8.3	15
BH5/3/28880	335847	440480	10.43	14
BH649/1/SB	335739	440558	5.75	16.3
CP101/Rec	335746	440595	4.2	8.55
CP102/Rec	335733	440600	4.3	9.88
CP103/Rec	335761	440615	4.5	5.45

Bore	Easting	Northing	Elevation	Total depth
CPT01	336017.06	440080.06	4.83	8.14
CPT02	336082	440074	4.75	15
CPT03	336050.01	440048	4.7	10
CPT04	336173.92	439982.03	4.71	13.11
CPT05	336144.92	439977.93	4.71	13.45
CPT06	336287	439895	4.7	12.5
CPT07	336291.68	439850.11	4.69	10.42
CPT08	336407.88	439790.16	4.45	13.33
CPT09	336370.45	439770.22	4.17	13.03
CPT10	336515.71	439706.23	4.54	12
CPT11	336490.99	439673.63	4.33	15
CPT12	336628.83	439593.98	4.54	10.96
CPT13	336603.85	439568.92	4.49	13.04
CPT14	336707	439531	4.48	11.95
CPT15	336777.51	439462.28	4.48	10
CPT16	336735.63	439463.53	4.51	8.22
CPT17	336876.84	439450.29	8.53	9.06
CPT18	336872	439373	8	8.42
CPT19	337050.39	439234.82	7.22	15.02
CPT20	336921.34	439309.47	8.12	8.15
HDTP201/09/24203	339205	439625	9.2	0.8
HDTP202/09/24203	338835	439505	6.1	1.2
HDTP203/09/24203	338575	439445	10.5	1.2
HDTP204/09/24203	338465	439440	12.6	1.2
HDTP205/09/24203	338345	439455	12.9	1.2
MO13	336603.85	439568.92	4.49	5
MO16	336735.63	439463.53	4.51	5
MO19	337050.39	439234.82	7.22	3.55
MO20	336921.34	439309.47	8.12	1.54
MO3	336050.01	440048	4.7	3.6
MO5	336144.92	439977.93	4.71	6
MO7	336291.68	439850.11	4.69	5
SD33NE10/BGS	336600	439340	4.4	9
SD33NE11/BGS	336840	439340	5.1	9.55
SD33NE14/BGS	336720	439250	4.7	14.7
SD34SE64/BGS	335202	440605	8.69	4
SD34SE65/BGS	335322	440579.9	7.92	4
TP01	335883.58	440250.04	9.46	3.5
TP02	335972.77	440143.61	6.25	3.3

Bore	Easting	Northing	Elevation	Total depth
TP03	336870.27	439373.15	6.31	3.5
TP10	337137.93	439252.22	9.61	2.5
TP103	337520.53	439109.39	17.35	3.5
TP104	336944.68	439383.32	9.84	3.5
TP105	337212.63	439340.05	13.34	3.5
TP106	337218.07	439250.43	12.13	3.5
TP107	337354.74	439266.18	15.24	3.5
TP108	337448.19	439186.31	17.13	3
TP109	337453.52	439062.31	13.47	3
TP110	337542.2	439002.57	14.29	3.5
TP14	338339.17	439413.93	13.71	3.5
TP15	338051.6	439335.32	15.44	3
TP302/13/27803	339455	439556	12.8	3.5
WS1/20648	339045.81	439588	7.91	2.9
WS101/09/24203	339155	439625	8.9	4.8
WS102	335817.92	440538.63	7.64	6.28
WS102/09/24203	338690	439460	8.1	5
WS103	338647.41	439439.25	8.56	5.45
WS103/09/24203	338600	439455	9.9	5
WS104	338212.97	439381.12	13.74	5.45
WS104/09/24203	338530	439440	11.6	6.4
WS105	337208.05	439166.28	6.77	5
WS105/09/24203	338270	439455	12.6	5
WS105A	337095.58	439223.75	7	7
WS105B	337145	439201	7	6.45
WS106	336857.48	439436.65	7.82	7
WS106/09/24203	338248	439445	12.4	5
WS107	336717.06	439368.32	4.32	7.5
WS108	336586.41	439633.1	4.45	6.6
WS109	336482.67	439779.56	4.75	8
WS109A	336480.17	439783.75	4.68	5.5
WS111	335962.94	440456.09	12.34	6.45
WS112	335857.19	440519.4	8.99	6
WS113	338819.7	439525.8	6.5	5.45
WS115	338853.36	439474.46	5.08	5.45
WS14A	336709.74	439534.67	4.82	5.5
WS2/20648	339076.83	439582.83	8.2	3
WS301/13/27803	338989	439567	8.2	6

Bore	Easting	Northing	Elevation	Total depth
WS302/13/27803	339099	439616	9.5	6.3
WS303/13/27803	339323	439719	10.2	6
WS304/13/27803	339428	439745	11.5	6

Correlated Stratigraphy

Bore	Top (m)	Base (m)	Stratigraphy
BH01	0	3.2	TOPSOIL
BH01	3.2		TIDAL FLAT DEPOSITS
BH01A	0	0.8	MADE GROUND
BH01A	0.8	6.5	TIDAL FLAT DEPOSITS
BH01A	6.5	9.8	GLACIOFLUVIAL DEPOSITS
BH01A	9.8		BEDROCK
BH04	0	0.8	MADE GROUND
BH04	0.8		GLACIAL TILL
BH05	0	0.2	TOPSOIL
BH05	0.2	6.2	TIDAL FLAT DEPOSITS
BH05	6.2		GLACIAL TILL
BH06	0	0.15	TOPSOIL
BH06	0.15	2.1	TIDAL FLAT DEPOSITS
BH06	2.1		GLACIOFLUVIAL DEPOSITS
BH06-1	0	0.1	TOPSOIL
BH06-1	0.1	2.1	TIDAL FLAT DEPOSITS
BH06-1	2.1		GLACIAL TILL
BH07	0	6.2	TIDAL FLAT DEPOSITS
BH07	6.2	7.1	GLACIOFLUVIAL DEPOSITS
BH07	7.1		GLACIAL TILL
BH08	0	0.15	TOPSOIL
BH08	0.15	5.62	TIDAL FLAT DEPOSITS
BH08	5.62		GLACIOFLUVIAL DEPOSITS
BH10	0	1.1	TOPSOIL
BH10	1.1		GLACIAL TILL
BH101	0	0.4	TOPSOIL
BH101	0.4	3.5	GLACIOFLUVIAL DEPOSITS
BH101	3.5	26.9	GLACIAL TILL
BH101	26.9		BEDROCK
BH103	0	0.4	TOPSOIL
BH103	0.4	28	GLACIAL TILL
BH103	28		BEDROCK
BH104	0	0.4	TOPSOIL

Bore	Top (m)	Base (m)	Stratigraphy
BH104	0.4	6.5	TIDAL FLAT DEPOSITS
BH104	6.5	7.5	GLACIOFLUVIAL DEPOSITS
BH104	7.5	10.5	GLACIAL TILL
BH104	10.5		BEDROCK
BH105	0	0.35	TOPSOIL
BH105	0.35		GLACIAL TILL
BH106	0	0.4	TOPSOIL
BH106	0.4		GLACIAL TILL
BH107	0	0.4	TOPSOIL
BH107	0.4		GLACIAL TILL
BH10A	0	0.4	TOPSOIL
BH10A	0.4	6	GLACIOFLUVIAL DEPOSITS
BH10A	6		GLACIAL TILL
BH11	0	0.15	TOPSOIL
BH11	0.15		TIDAL FLAT DEPOSITS
BH11A	0	0.15	TOPSOIL
BH11A	0.15	3.9	ALLUVIUM
BH11A	3.9		GLACIOFLUVIAL DEPOSITS
BH12	0	0.3	TOPSOIL
BH12	0.3	6.5	GLACIOFLUVIAL DEPOSITS
BH12	6.5		GLACIAL TILL
BH12/3936	0	0.5	TOPSOIL
BH12/3936	0.5	2.6	MADE GROUND
BH12/3936	2.6	7.8	TIDAL FLAT DEPOSITS
BH12/3936	7.8	10.2	GLACIOFLUVIAL DEPOSITS
BH12/3936	10.2		GLACIAL TILL
BH13	0	0.5	TOPSOIL
BH13	0.5	27.2	GLACIAL TILL
BH13	27.2		BEDROCK
BH13/3936	0	0.8	MADE GROUND
BH13/3936	0.8	6.5	ALLUVIUM
BH13/3936	3.2		GLACIAL TILL
BH14	0	0.4	TOPSOIL
BH14	0.4	4.7	GLACIOFLUVIAL DEPOSITS
BH14	4.7		GLACIAL TILL
BH14/3936	0	0.1	TOPSOIL
BH14/3936	0.1	2	MADE GROUND
BH14/3936	2	7.5	TIDAL FLAT DEPOSITS

Bore	Top (m)	Base (m)	Stratigraphy
BH14/3936	7.5	11.6	GLACIOFLUVIAL DEPOSITS
BH14/3936	11.6	12	GLACIAL TILL
BH14/3936	12	15.8	BEDROCK
BH15	0	0.6	TOPSOIL
BH15	0.6	5	GLACIOFLUVIAL DEPOSITS
BH15	5		GLACIAL TILL
BH15/3936	0	2.3	MADE GROUND
BH15/3936	2.3	5.6	TIDAL FLAT DEPOSITS
BH15/3936	5.6		GLACIAL TILL
BH17	0	0.7	TOPSOIL
BH17	0.7	3.7	GLACIOFLUVIAL DEPOSITS
BH17	3.7		GLACIAL TILL
BH18	0	0.3	TOPSOIL
BH18	0.3		GLACIAL TILL
BH19	0	0.4	TOPSOIL
BH19	0.4		GLACIAL TILL
BH5/2/28880	0	0.4	TOPSOIL
BH5/2/28880	0.4		GLACIAL TILL
BH5/3/28880	0	0.5	TOPSOIL
BH5/3/28880	0.5		GLACIAL TILL
BH649/1/SB	0	0.3	TOPSOIL
BH649/1/SB	0.3	8	TIDAL FLAT DEPOSITS
BH649/1/SB	8	8.6	GLACIOFLUVIAL DEPOSITS
BH649/1/SB	8.6	11.8	GLACIAL TILL
BH649/1/SB	11.8		BEDROCK
CP101/Rec	0	0.2	TOPSOIL
CP101/Rec	0.2	5.3	TIDAL FLAT DEPOSITS
CP101/Rec	5.3	7.7	GLACIOFLUVIAL DEPOSITS
CP101/Rec	7.7		GLACIAL TILL
CP102/Rec	0	0.6	TOPSOIL
CP102/Rec	0.6	5.2	TIDAL FLAT DEPOSITS
CP102/Rec	5.2	7.8	GLACIOFLUVIAL DEPOSITS
CP102/Rec	7.8	9.2	GLACIAL TILL
CP102/Rec	9.2		BEDROCK
CP103/Rec	0	0.3	TOPSOIL
CP103/Rec	0.3	4.5	TIDAL FLAT DEPOSITS
CP103/Rec	4.5		GLACIOFLUVIAL DEPOSITS
CPT01	0	0.3	TOPSOIL
CPT01	0.3	2.43	TIDAL FLAT DEPOSITS

Bore	Top (m)	Base (m)	Stratigraphy
CPT01	2.43		GLACIAL TILL
CPT02	0	0.3	TOPSOIL
CPT02	0.3	2.33	TIDAL FLAT DEPOSITS
CPT02	2.33		GLACIAL TILL
CPT03	0	0.3	TOPSOIL
CPT03	0.3	3.35	TIDAL FLAT DEPOSITS
CPT03	3.35		GLACIAL TILL
CPT04	0	0.3	TOPSOIL
CPT04	0.3	5.5	TIDAL FLAT DEPOSITS
CPT04	5.5		GLACIAL TILL
CPT05	0	0.3	TOPSOIL
CPT05	0.3	5.53	TIDAL FLAT DEPOSITS
CPT05	5.53		GLACIAL TILL
CPT06	0	0.3	TOPSOIL
CPT06	0.3	4.85	ALLUVIUM
CPT06	4.85	8.57	GLACIOFLUVIAL DEPOSITS
CPT06	8.57		GLACIAL TILL
CPT07	0	0.3	TOPSOIL
CPT07	0.3	5.7	TIDAL FLAT DEPOSITS
CPT07	5.7		GLACIOFLUVIAL DEPOSITS
CPT08	0	0.3	TOPSOIL
CPT08	0.3	3.81	TIDAL FLAT DEPOSITS
CPT08	3.81		GLACIOFLUVIAL DEPOSITS
CPT09	0	0.3	TOPSOIL
CPT09	0.3	4.02	TIDAL FLAT DEPOSITS
CPT09	4.02		GLACIOFLUVIAL DEPOSITS
CPT10	0	0.3	TOPSOIL
CPT10	0.3	5.81	TIDAL FLAT DEPOSITS
CPT10	5.81	11.07	GLACIOFLUVIAL DEPOSITS
CPT10	11.07		GLACIAL TILL
CPT11	0	0.2	TOPSOIL
CPT11	0.2	4.84	TIDAL FLAT DEPOSITS
CPT11	4.84	14.15	GLACIOFLUVIAL DEPOSITS
CPT11	14.15		GLACIAL TILL
CPT12	0	0.3	TOPSOIL
CPT12	0.3	5.69	TIDAL FLAT DEPOSITS
CPT12	5.69		GLACIOFLUVIAL DEPOSITS
CPT13	0	0.3	TOPSOIL

Bore	Top (m)	Base (m)	Stratigraphy
CPT13	0.3	3.77	TIDAL FLAT DEPOSITS
CPT13	3.77	12.88	GLACIOFLUVIAL DEPOSITS
CPT13	12.88		GLACIAL TILL
CPT14	0	0.4	TOPSOIL
CPT14	0.4	5.38	TIDAL FLAT DEPOSITS
CPT14	5.38		GLACIOFLUVIAL DEPOSITS
CPT15	0	1.2	PEAT
CPT15	1.2	3.57	TIDAL FLAT DEPOSITS
CPT15	3.57		GLACIAL TILL
CPT16	0	0.4	TOPSOIL
CPT16	0.4	5.32	TIDAL FLAT DEPOSITS
CPT16	5.32	6.24	GLACIOFLUVIAL DEPOSITS
CPT16	6.24		GLACIAL TILL
CPT17	0	0.3	TOPSOIL
CPT17	0.3	2	TIDAL FLAT DEPOSITS
CPT17	2		GLACIOFLUVIAL DEPOSITS
CPT18	0	0.5	TOPSOIL
CPT18	0.5	1.2	TIDAL FLAT DEPOSITS
CPT18	1.2		GLACIAL TILL
CPT19	0	0.3	TOPSOIL
CPT19	0.3	3.76	TIDAL FLAT DEPOSITS
CPT19	3.76		GLACIOFLUVIAL DEPOSITS
CPT20	0	0.4	TOPSOIL
CPT20	0.4		GLACIAL TILL
HDTP201/09/24203	0		MADE GROUND
HDTP202/09/24203	0		MADE GROUND
HDTP203/09/24203	0	0.8	MADE GROUND
HDTP203/09/24203	0.8		GLACIAL TILL
HDTP204/09/24203	0	0.7	MADE GROUND
HDTP204/09/24203	0.7	1.2	GLACIAL TILL
HDTP205/09/24203	0		MADE GROUND
MO13	0	0.35	TOPSOIL
MO13	0.35		TIDAL FLAT DEPOSITS
MO16	0	0.4	TOPSOIL
MO16	0.4		TIDAL FLAT DEPOSITS
MO19	0	0.18	TOPSOIL
MO19	0.18	0.7	UPPER TIDAL FLAT
MO19	0.7	3.45	PEAT
MO19	3.45		TIDAL FLAT DEPOSITS

Bore	Top (m)	Base (m)	Stratigraphy
MO20	0	0.14	TOPSOIL
MO20	0.14		GLACIAL TILL
MO3	0	0.2	TOPSOIL
MO3	0.2	3.2	TIDAL FLAT DEPOSITS
MO3	3.2		GLACIAL TILL
MO5	0	0.15	TOPSOIL
MO5	0.15		TIDAL FLAT DEPOSITS
MO7	0	0.2	TOPSOIL
MO7	0.2		TIDAL FLAT DEPOSITS
SD33NE10/BGS	0	0.2	TOPSOIL
SD33NE10/BGS	0.2	0.4	PEAT
SD33NE10/BGS	0.4	6.9	TIDAL FLAT DEPOSITS
SD33NE10/BGS	6.9	8.4	GLACIOFLUVIAL DEPOSITS
SD33NE10/BGS	8.4		GLACIAL TILL
SD33NE11/BGS	0	0.25	TOPSOIL
SD33NE11/BGS	0.25	0.55	PEAT
SD33NE11/BGS	0.55	1.05	TIDAL FLAT DEPOSITS
SD33NE11/BGS	1.05		GLACIAL TILL
SD33NE14/BGS	0	0.4	TOPSOIL
SD33NE14/BGS	0.4	9.05	TIDAL FLAT DEPOSITS
SD33NE14/BGS	9.05		GLACIOFLUVIAL DEPOSITS
SD34SE64/BGS	0	1.8	MADE GROUND
SD34SE64/BGS	1.8		GLACIAL TILL
SD34SE65/BGS	0	1.8	MADE GROUND
SD34SE65/BGS	1.8		GLACIAL TILL
TP01	0	0.4	TOPSOIL
TP01	0.4		GLACIAL TILL
TP02	0	0.5	TOPSOIL
TP02	0.5		GLACIAL TILL
TP03	0	0.4	MADE GROUND
TP03	0.4		GLACIAL TILL
TP10	0	0.4	TIDAL FLAT DEPOSITS
TP10	0.4		GLACIAL TILL
TP103	0	0.2	TOPSOIL
TP103	0.2		GLACIAL TILL
TP104	0	0.4	TOPSOIL
TP104	0.4		GLACIAL TILL
TP105	0	0.3	TOPSOIL

Bore	Top (m)	Base (m)	Stratigraphy
TP105	0.3		GLACIAL TILL
TP106	0	0.3	TOPSOIL
TP106	0.3		GLACIAL TILL
TP107	0	0.3	TOPSOIL
TP107	0.3		GLACIAL TILL
TP108	0	0.3	TOPSOIL
TP108	0.3		GLACIAL TILL
TP109	0	0.5	TOPSOIL
TP109	0.5		GLACIAL TILL
TP110	0	0.2	TOPSOIL
TP110	0.8		GLACIAL TILL
TP14	0	0.35	TOPSOIL
TP14	0.35		GLACIAL TILL
TP15	0	0.3	TOPSOIL
TP15	0.3		GLACIAL TILL
TP302/13/27803	0	0.35	TOPSOIL
TP302/13/27803	0.35		GLACIAL TILL
WS1/20648	0	1.2	MADE GROUND
WS1/20648	1.2		GLACIAL TILL
WS101/09/24203	0	1.4	MADE GROUND
WS101/09/24203	1.4		GLACIAL TILL
WS102	0	1	MADE GROUND
WS102	1		GLACIAL TILL
WS102/09/24203	0	3	MADE GROUND
WS102/09/24203	3		ALLUVIUM
WS103	0	0.2	TOPSOIL
WS103	0.2	3.6	GLACIOFLUVIAL DEPOSITS
WS103	3.6		GLACIAL TILL
WS103/09/24203	0	1.5	MADE GROUND
WS103/09/24203	1.5		GLACIOFLUVIAL DEPOSITS
WS104	0	0.55	MADE GROUND
WS104	0.55		GLACIAL TILL
WS104/09/24203	0	0.85	MADE GROUND
WS104/09/24203	0.85	2.5	ALLUVIUM
WS104/09/24203	2.5	4.7	GLACIOFLUVIAL DEPOSITS
WS104/09/24203	4.7		GLACIAL TILL
WS105	0	0.3	TOPSOIL
WS105	0.3	1.8	PEAT
WS105	1.8	2	TIDAL FLAT DEPOSITS

Bore	Top (m)	Base (m)	Stratigraphy
WS105	2	3	PEAT
WS105	3		TIDAL FLAT DEPSOTS
WS105/09/24203	0	2	MADE GROUND
WS105/09/24203	2		GLACIAL TILL
WS105A	0	0.5	TOPSOIL
WS105A	0.5	2.2	PEAT
WS105A	2.2		TIDAL FLAT DEPOSITS
WS105B	0	0.7	TOPSOIL
WS105B	0.7	1.9	PEAT
WS105B	1.9		TIDAL FLAT DEPOSITS
WS106	0	0.25	TOPSOIL
WS106	0.25	1	UPPER TIDAL FLAT
WS106	1	1.2	PEAT
WS106	1.2	3.5	TIDAL FLAT DEPOSITS
WS106	3.5		GLACIOFLUVIAL DEPOSITS
WS106/09/24203	0	1.8	MADE GROUND
WS106/09/24203	1.8	3.2	GLACIOFLUVIAL DEPOSITS
WS106/09/24203	3.2		GLACIAL TILL
WS107	0	0.4	TOPSOIL
WS107	0.4		TIDAL FLAT DEPOSITS
WS108	0	0.2	TOPSOIL
WS108	0.2		TIDAL FLAT DEPOSITS
WS109	0	0.4	TOPSOIL
WS109	0.4	4.5	TIDAL FLAT DEPOSITS
WS109	4.5		GLACIAL TILL
WS109A	0	0.3	TOPSOIL
WS109A	0.3		TIDAL FLAT DEPOSITS
WS111	0	0.8	TOPSOIL
WS111	0.8		GLACIAL TILL
WS112	0	0.8	MADE GROUND
WS112	0.8		GLACIAL TILL
WS113	0	2.9	MADE GROUND
WS113	2.9		GLACIAL TILL
WS115	0	0.2	TOPSOIL
WS115	0.2	1.2	ALLUVIUM
WS115	1.2	1.8	PEAT
WS115	1.8		GLACIAL TILL
WS14A	0	0.5	TOPSOIL

Bore	Top (m)	Base (m)	Stratigraphy
WS14A	0.5		TIDAL FLAT DEPOSITS
WS2/20648	0	1.2	MADE GROUND
WS2/20648	1.2		GLACIAL TILL
WS301/13/27803	0		GLACIAL TILL
WS302/13/27803	0	0.1	TOPSOIL
WS302/13/27803	0.1		GLACIAL TILL
WS303/13/27803	0		GLACIAL TILL
WS304/13/27803	0	0.6	MADE GROUND
WS304/13/27803	0.6		GLACIAL TILL

APPENDIX B PLATES

Plate 1: WS105B 1.2-1.7m BGL, peat deposit (image from SOCOTEC 2018)

Plate 2: MO19 0-3.5m BGL, peat deposit at 0.7-3.45m BGL (image from SOCOTEC 2018)

APPENDIX B BIBLIOGRAPHY

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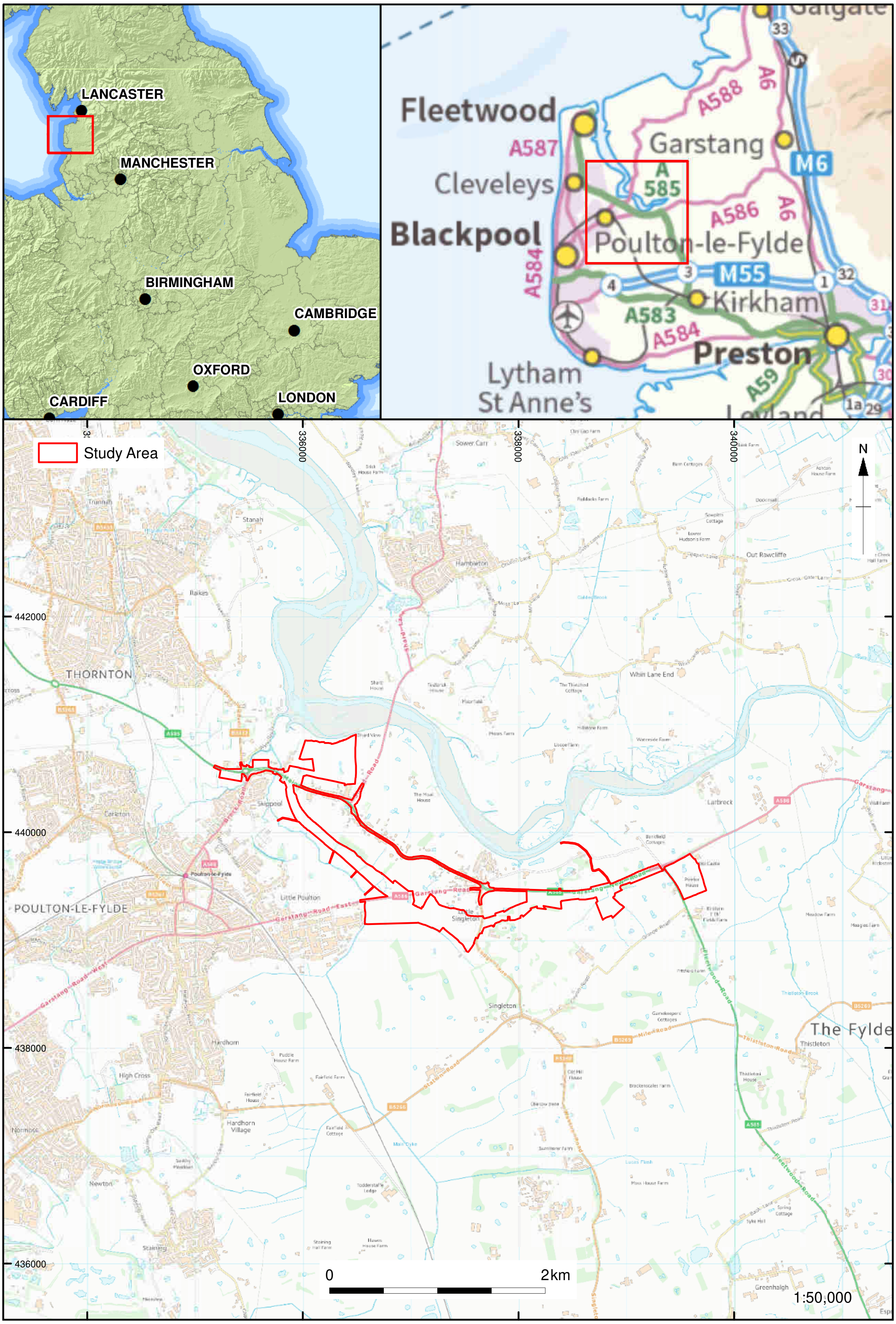

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Figure 1: Site location

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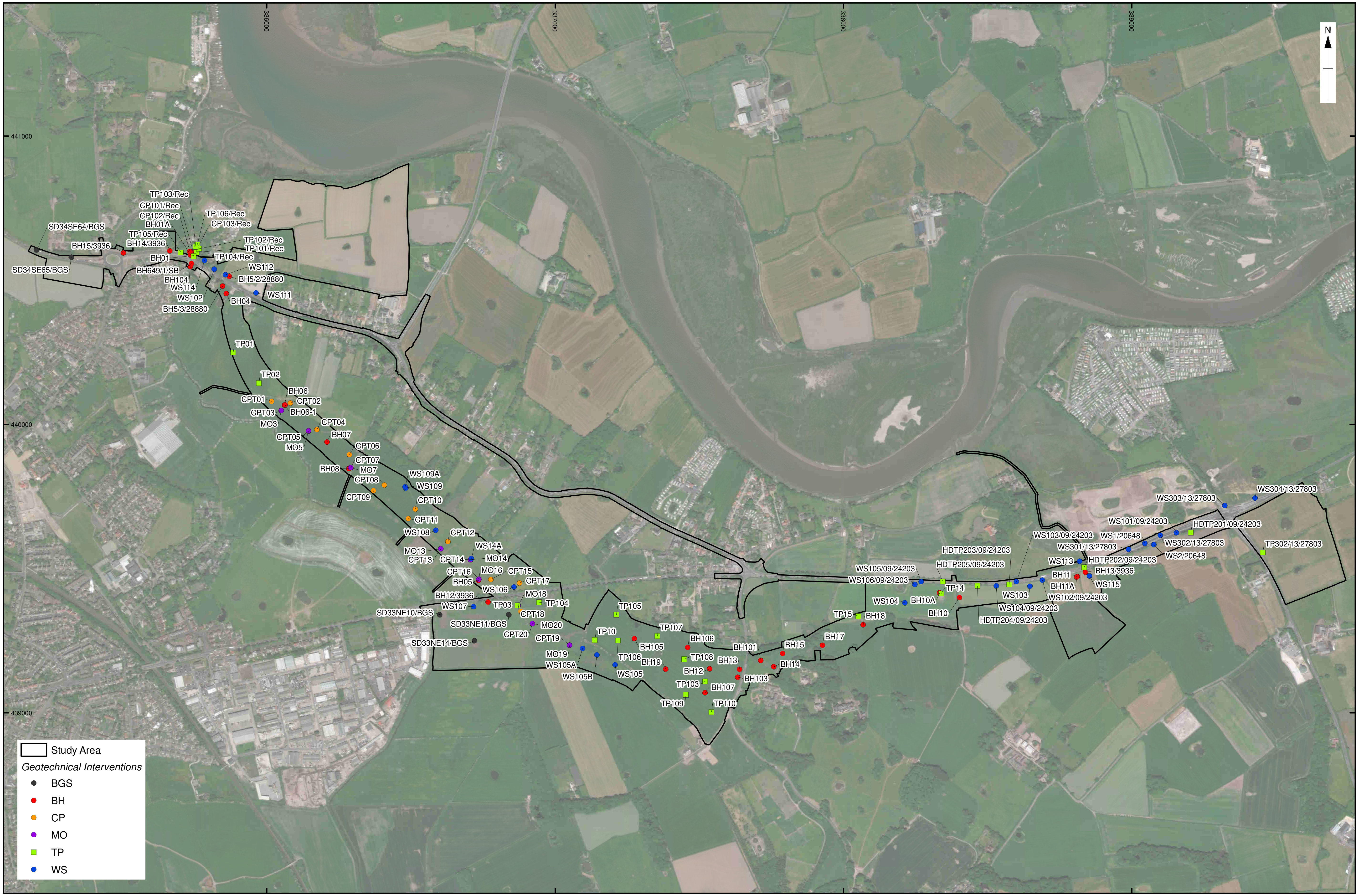

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Figure 2: Borehole location plan

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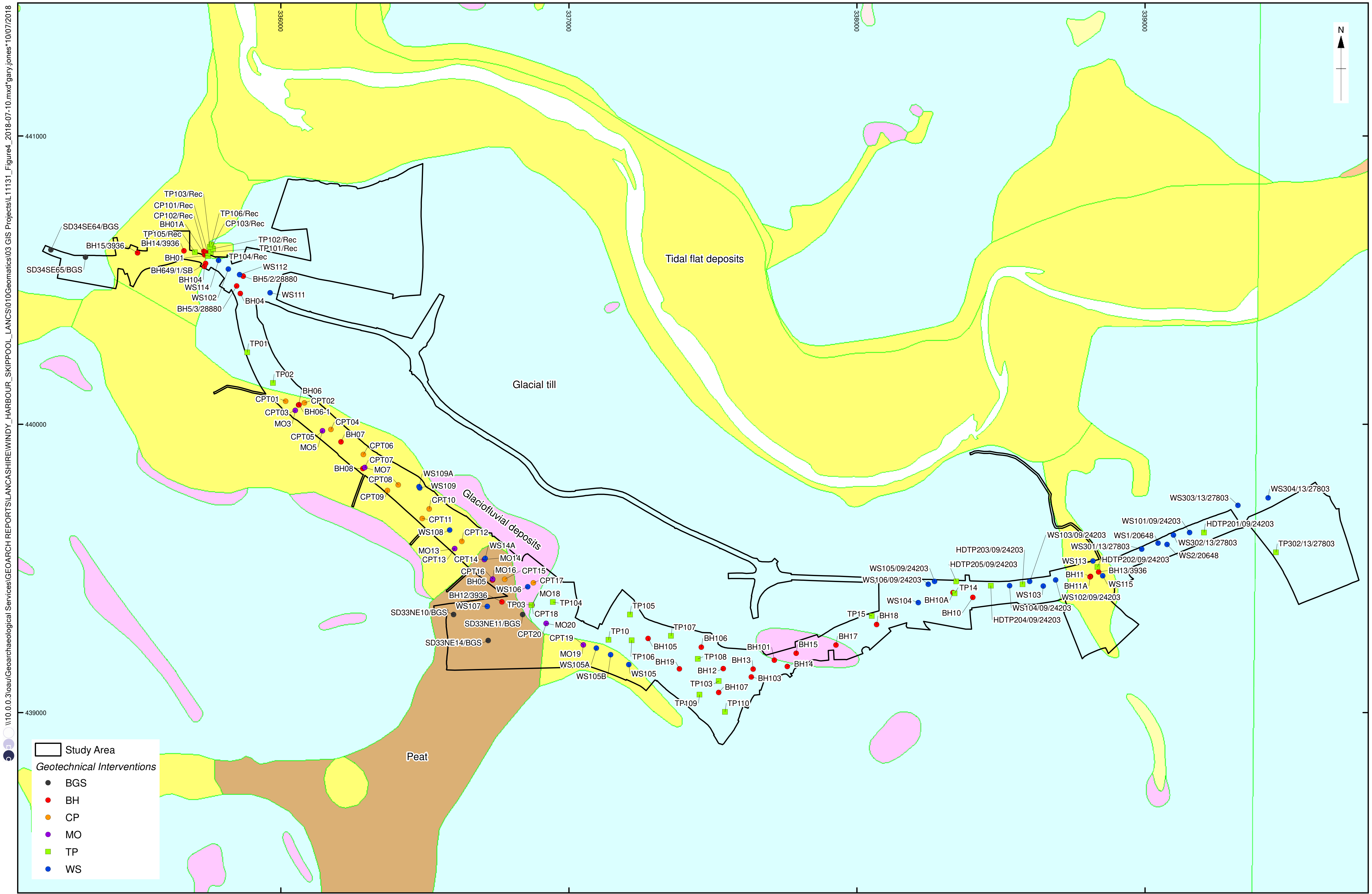
Figure 3: Borehole location and Lidar elevation data



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BGS geological data Copyright NERC 2018

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Figure 4: Superfical surface geology mapped by the BGS

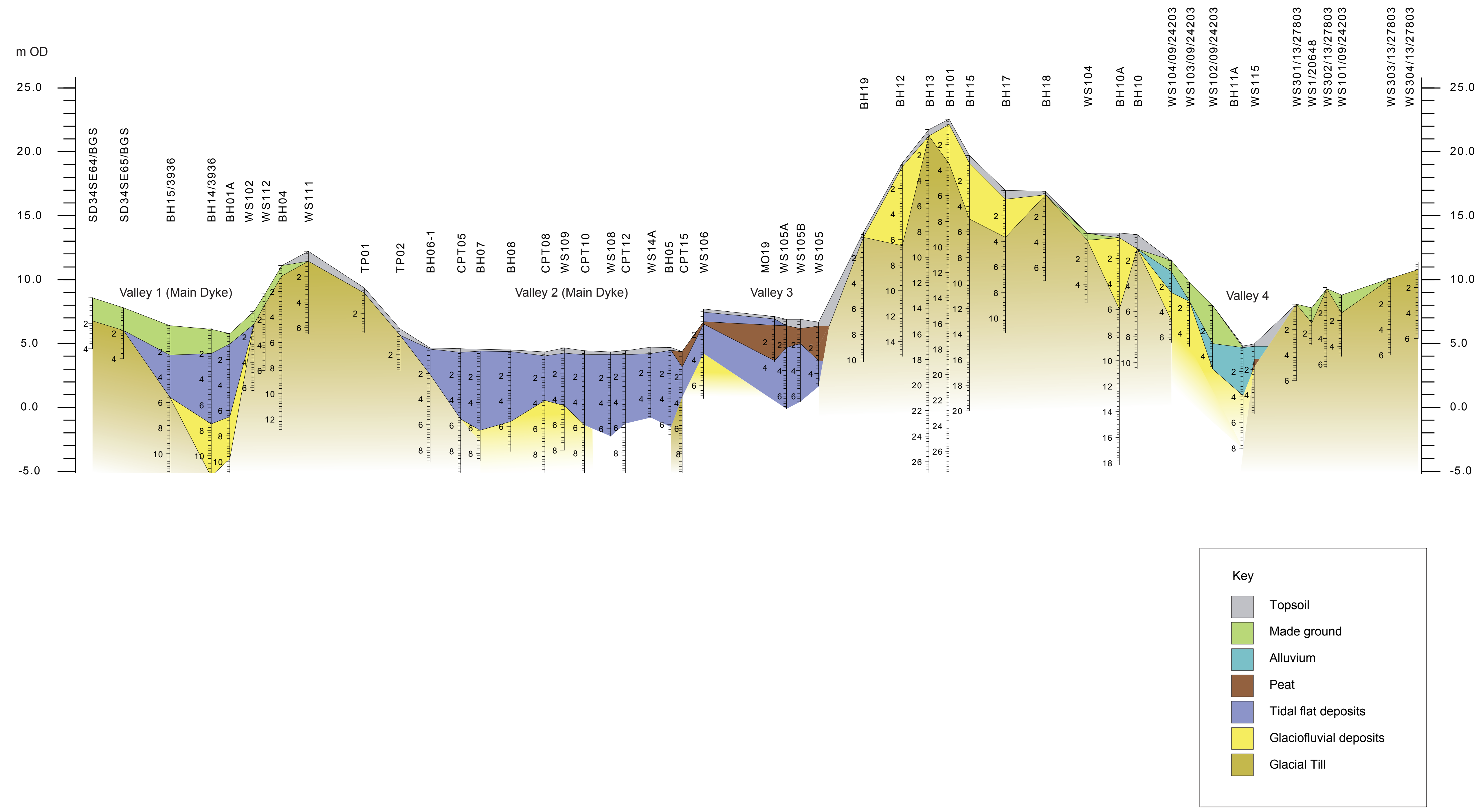

Figure 5: Stratigraphic transect

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Figure 6: Modelled thickness of Holocene deposits in metres (including made ground)