THAMES VIEW ESTATE, RENWICK ROAD, BARKING, ESSEX (SITE CODE: TVE12): GEOARCHAEOLOGICAL ASSESSMENT REPORT

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INTRODUCTION

This report summarises the findings arising out of geoarchaeological assessment undertaken by Quaternary Scientific (University of Reading) in connection with the proposed development at Thames View Estate, Renwick Road, Barking, Essex (National Grid Reference: centred on TQ 468 831; site code: TVE12; Figures 1 & 2). Quaternary Scientific were commissioned by CgMs Consulting to undertake the geoarchaeological investigations (see Batchelor, 2012). The site at Thames View Estate is located on the floodplain of the Estuarine Thames approximately 1.5km from the modern waterfront to the south, and 250m south of the floodplain edge. The site represents an area of land measuring *ca*. 400m north to south and a maximum of *ca*. 170m east to west (generally <100m wide).

A geoarchaeological borehole investigation was recently carried out at the site, and the resultant sedimentary logs were integrated with previous geotechnical investigations (carried out by Ian Farmer Associates Limited, 2011), to produce a model of the sub-surface stratigraphy of the site (Batchelor & Green, 2012). The results of this investigation revealed a generally uniform sequence of London Clay overlain by Shepperton Gravel, Holocene Alluvium (including Peat) and Made Ground (Figures 3 to 13; Appendix 1 & 2).

The surface of the Late Glacial Shepperton Gravel (which was deposited within a high energy braided river system) is relatively uniform across the site lying between *ca*. -4.50m and -3.30m OD (Figure 5). This surface is relatively low when compared with the neighbouring Barking Riverside site where potential topographic high points have been identified above -2.50m OD (Batchelor *et al*., 2011). Succeeding the Shepperton Gravel was a 0.4m to 1.50m thick unit of Lower Alluvium that comprised silty sands with varying quantities of wood that occasionally penetrated into the upper surface of the underlying deposits (Figure 6 & 9). This unit was deposited during the Early to Mid-Holocene as the energy of flow decreased and the Thames probably became confined to a single meandering channel. Well-humified wood Peat overlay the Lower Alluvium across the site, indicating a transition towards a semi-terrestrial environment supporting the growth of wetland woodland. The thickness of the Peat varied between 2.20m and 0.86m (Figure 7 &

10), and the upper surface lies between -2.00m OD and -0.50m OD. The Upper Alluvium overlies the surface of the Peat, and is representative of inundation of the wetland environment. The surface of the Upper Alluvium generally lies between +1.00m and 0m OD (Figures 8 and 11). In most cases, in those boreholes which continued to accumulate alluvium above 0m OD there are indications of soil forming processes.

It was concluded that the sequence of deposits recorded at Thames View Estate was analogous to those recorded across much of the Lower Thames Valley. On the basis of other sites within the region, the Peat at the site is likely to have accumulated somewhere between 6000 and 3000 cal BP (Neolithic to Bronze Age cultural periods), and *ca*. 2000 years may be represented in the thickest sequences. These units are highly significant as they have the potential to provide a detailed reconstruction of the environmental history of the site and its environs on both the semi-terrestrial Peat surface and neighbouring dryland. Work on other sites within the Lower Thames Valley has demonstrated that there are significant interactions between human activity, sea level change and vegetation history that warrant investigation, not only during the interfaces between the Lower Alluvium, Peat and Upper Alluvium, but during the accumulation of the Peat itself.

As a consequence of these findings, an assessment of three boreholes was recommended to elucidate the age of the Peat, and to evaluate the potential for reconstructing the past environmental conditions of the site and its environs. This assessment was recommended on the sequences from <QBH5> and <QBH1> as they are located at opposite ends of the site. In addition, a smaller assessment of the sequence from borehole <QBH4> was recommended due to the thinner Peat sequence recorded in this particular part of the site. The assessment will incorporate: (1) rangefinder radiocarbon dating, to provide an age for the onset and cessation of peat formation; (2) organic matter determinations to aid identification of the sedimentary units; (3) assessment of the archaeobotanical remains (pollen, waterlogged wood and seeds) to provide a provisional reconstruction of the vegetation history; (4) assessment of the diatoms to provide an indication of the palaeohydrology (e.g. marine, brackish or freshwater), and (5) assessment of the zooarchaeological remains (insects and Mollusca) to provide information on the general environmental conditions, climatic change and hydrology of the site. The environmental assessment will also highlight any indications of nearby human activity, and provide recommendations for further analysis (if necessary).

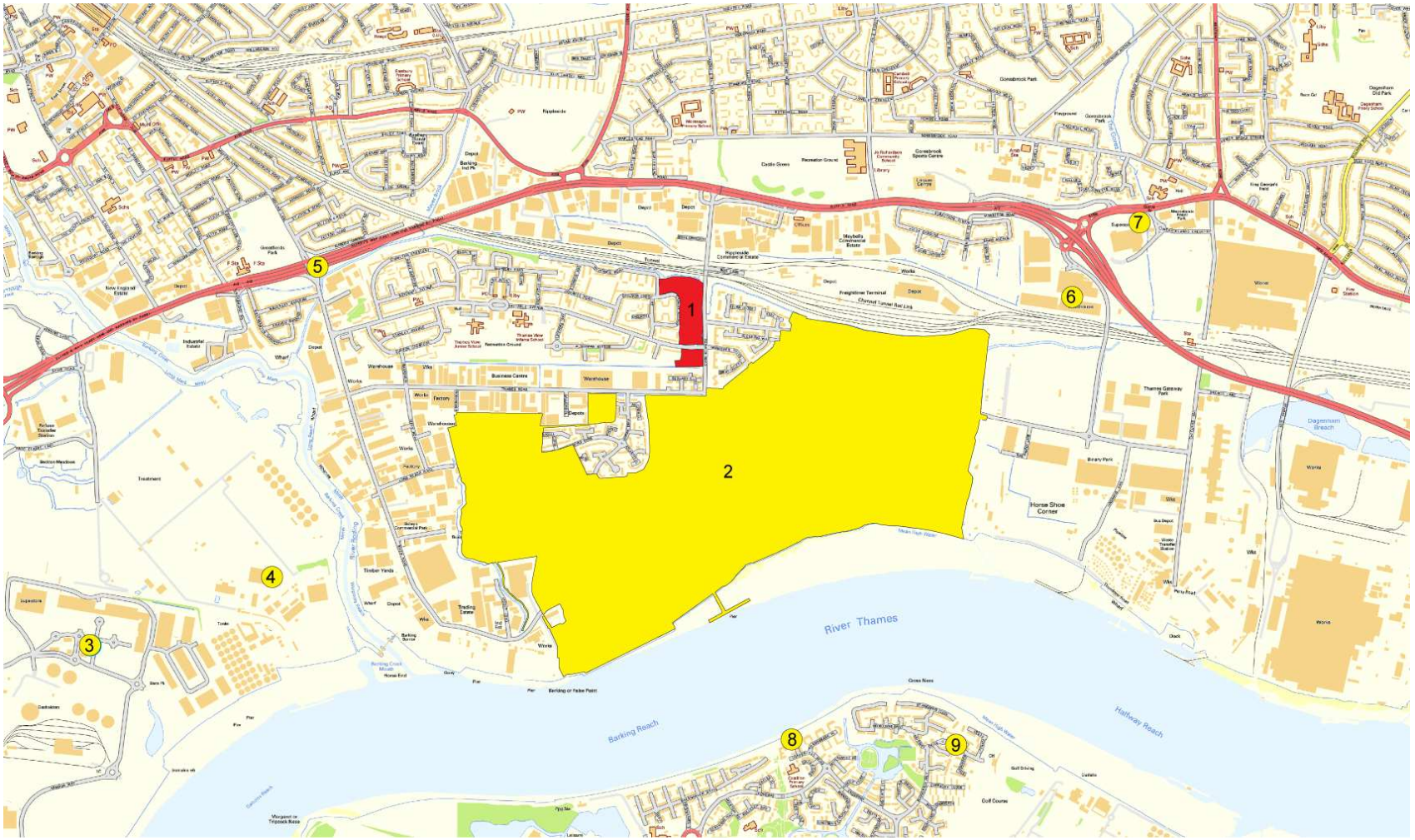

Figure 1: Location of Thames View Estate (1) and other selected local sites: (2) Barking Riverside (RWC10; Batchelor *et al*., 2011); (3) Gallions Reach Shopping Park (GAJ09; Batchelor, 2009a); (4) Beckton Sewage Works (HE-SW94; Divers, 1995); (5) A13 Movers Lane (no site code; Gifford and Partners, 2001); (6) Hays storage (DA-HS93; Divers, 1996); (7) Dagenham Idol (Coles, 1990); (8) Voyager's Quay (CPP96; Sidell, 2003), and (9) Summerton Way (SWY97; Lakin, 1999). *Contains Ordnance Survey data © Crown copyright and database right [2012]*

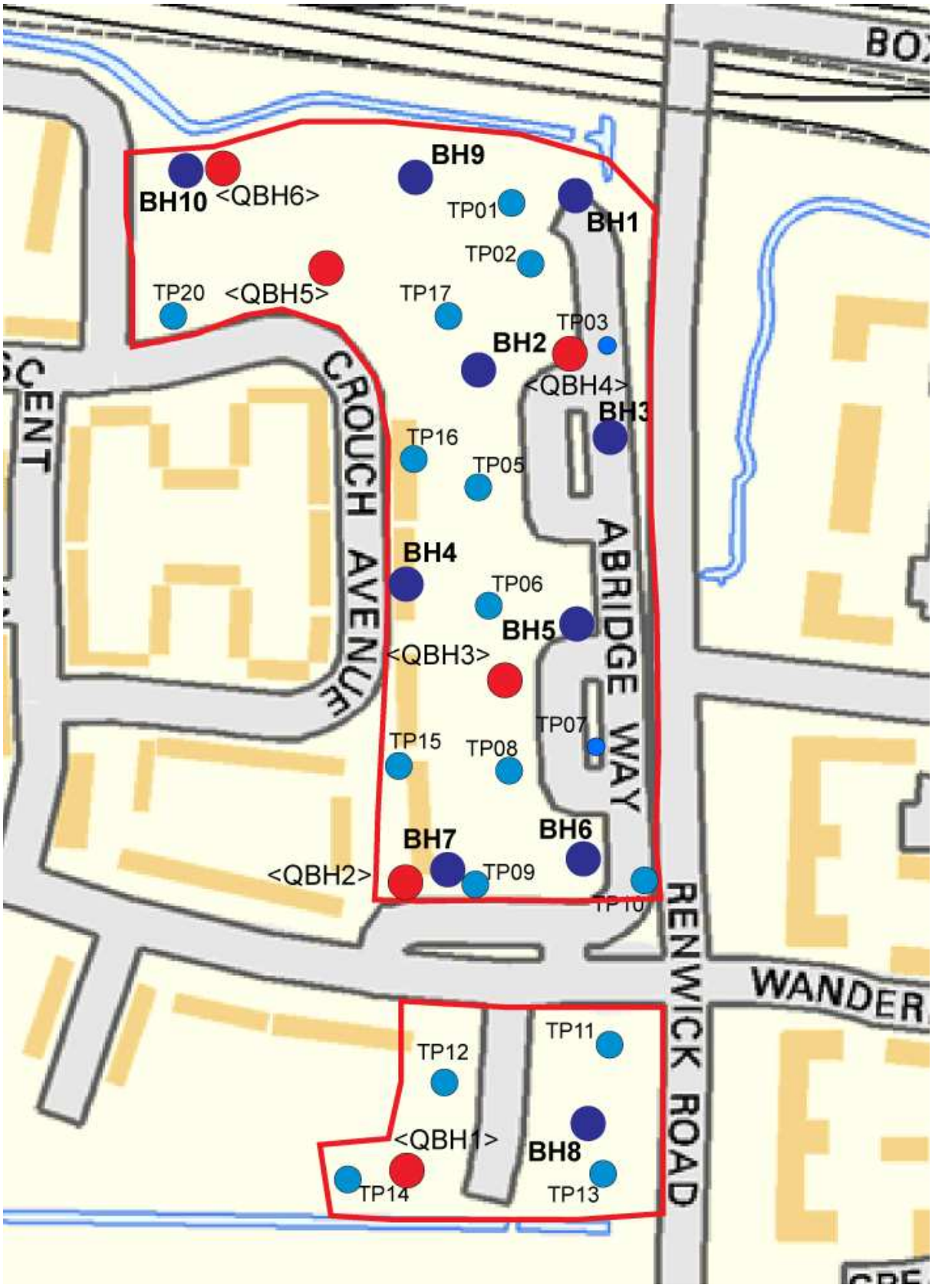

Figure 2: Proposed geoarchaeological borehole locations and existing geotechnical borehole and test-pit locations at Thames View Estate, Renwick Road, Barking, Essex. ***Contains Ordnance Survey data © Crown copyright and database right [2012]***

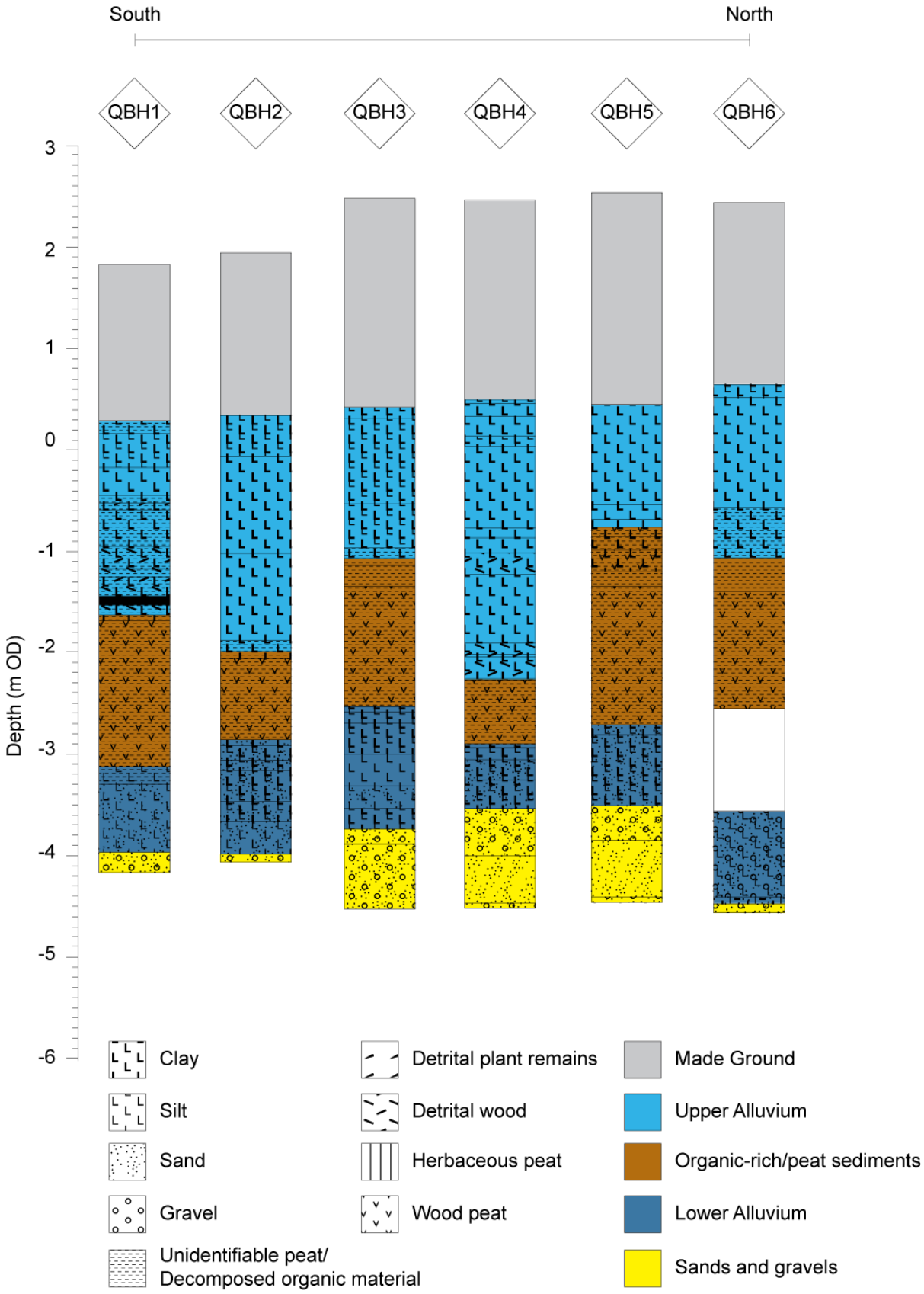

Figure 3: North-south transect of the geoarchaeological boreholes across Thames View Estate, Renwick Road, Barking, Essex (distance between boreholes is not to scale)

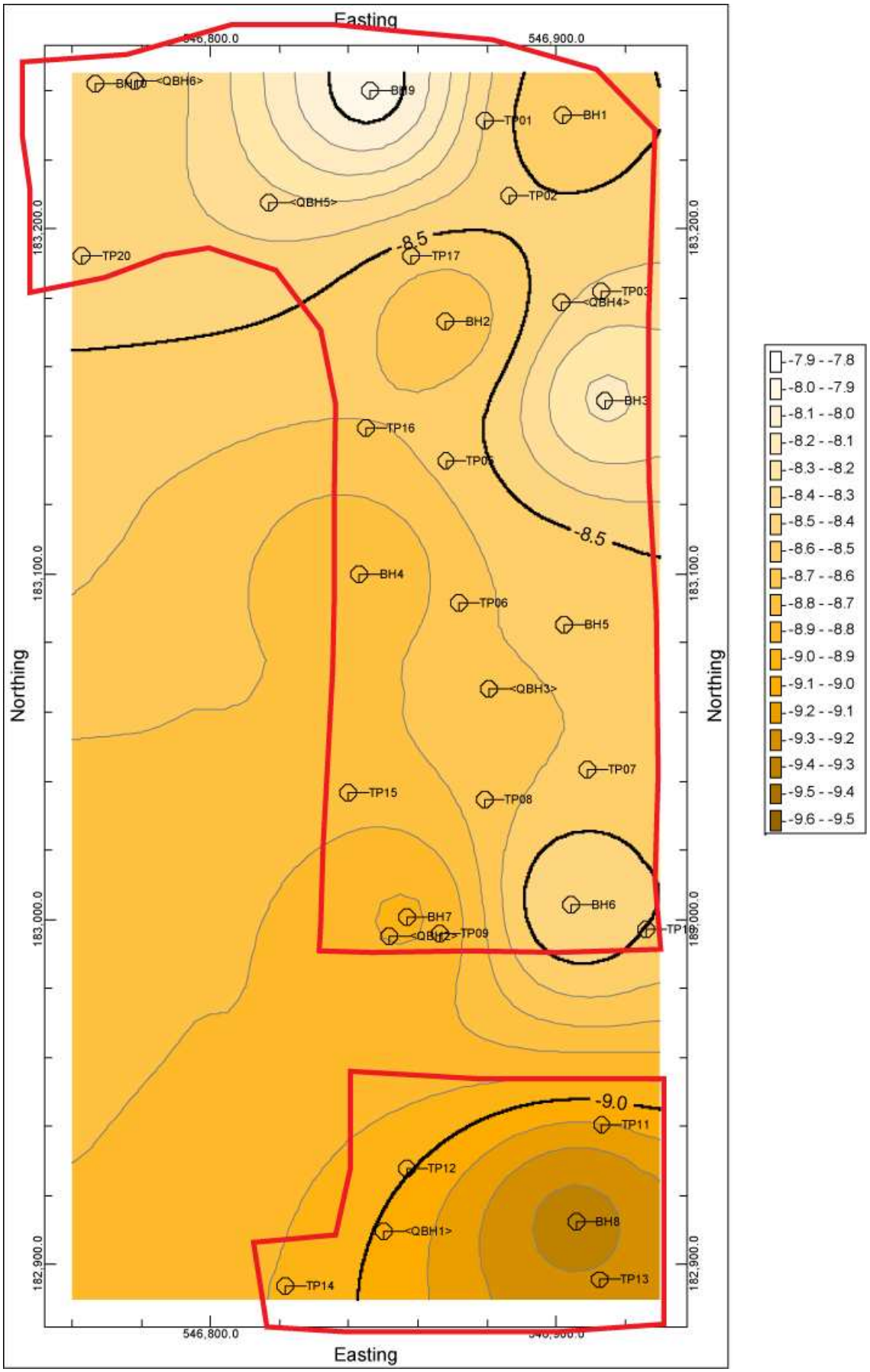

Figure 4: Top of London Clay / Base of Shepperton Gravel (m OD)

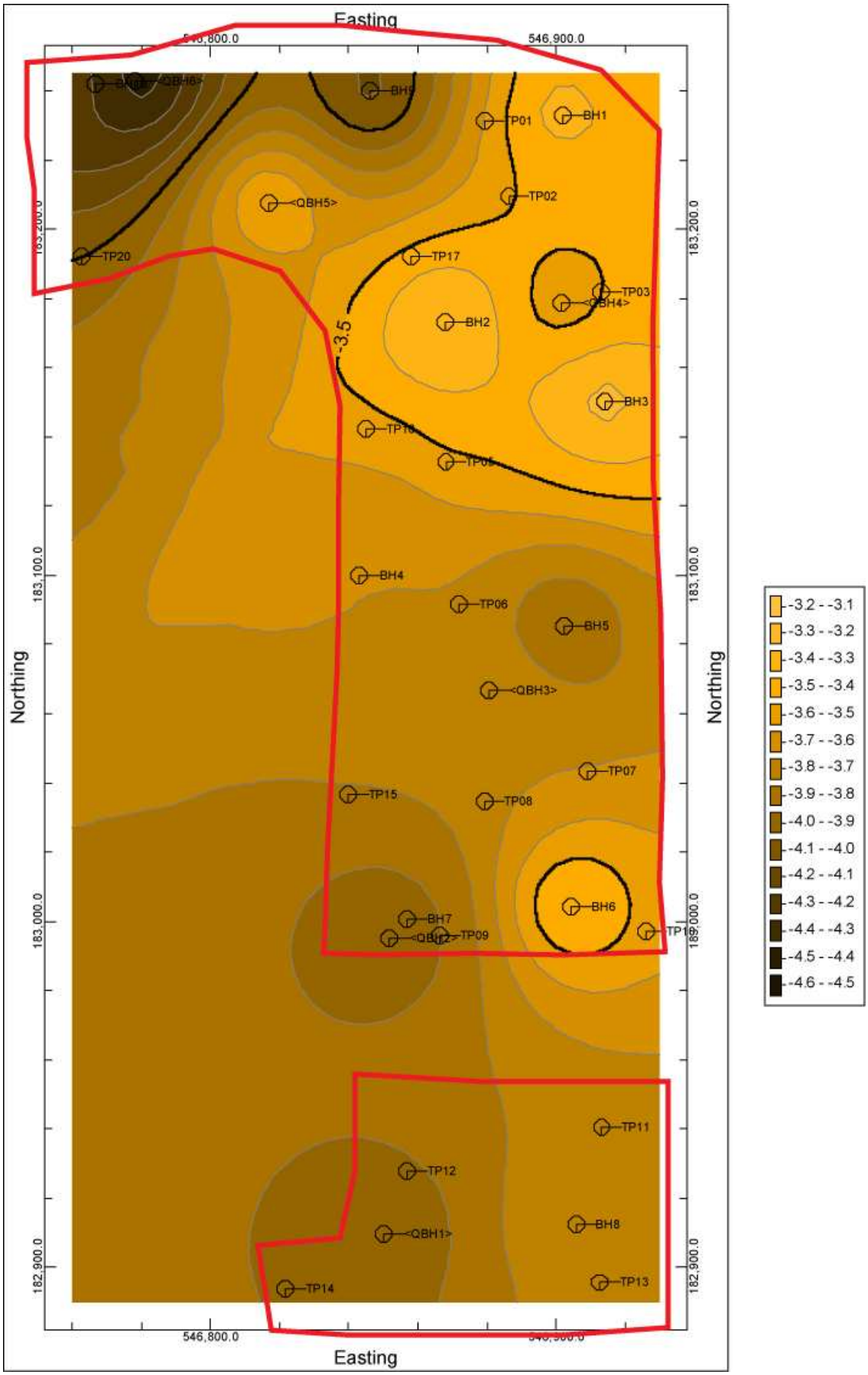

Figure 5: Top of the Shepperton Gravel / Base of the Lower (Sandy) Alluvium (m OD)

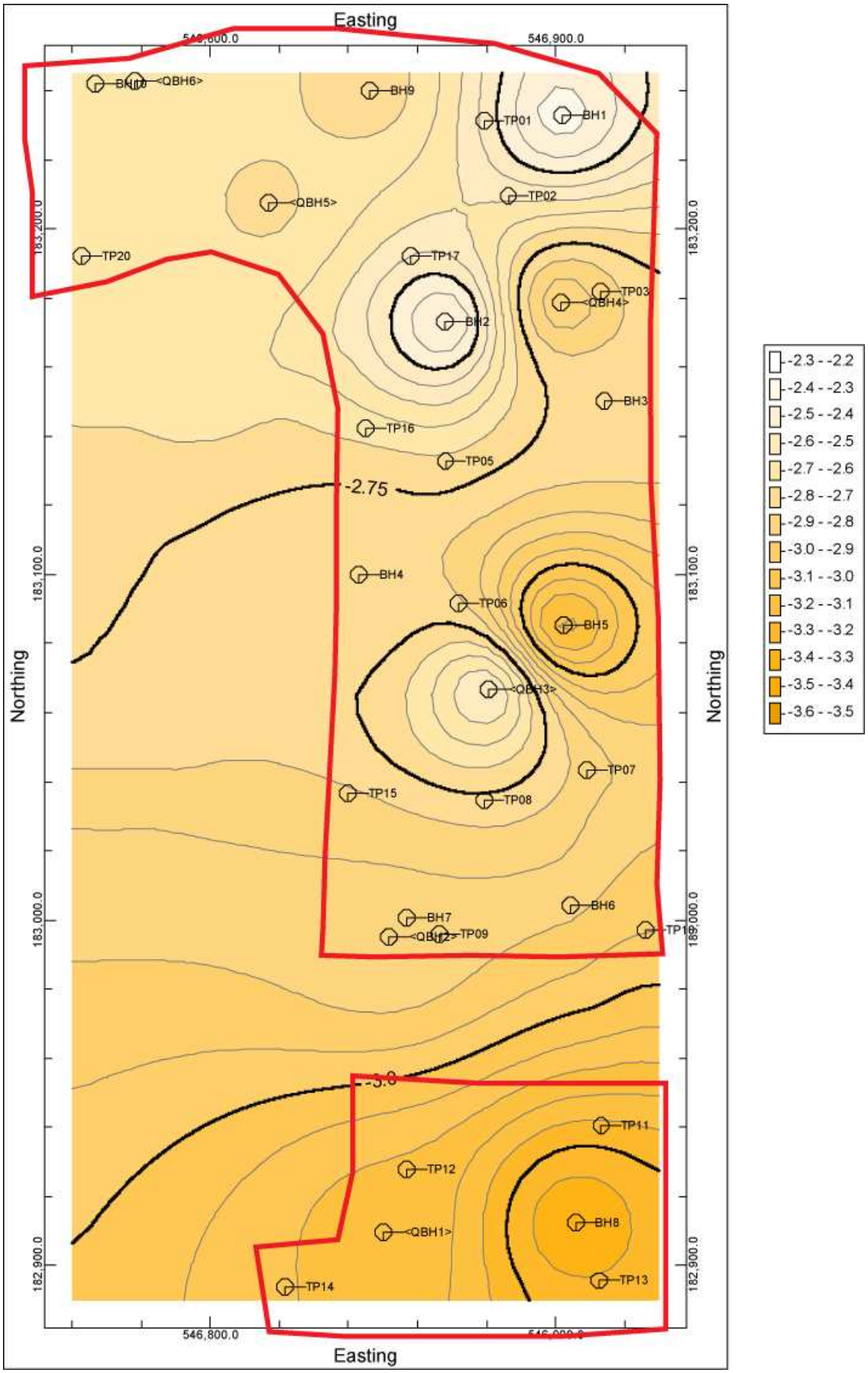

Figure 6: Top of Lower Alluvium / Base of the Peat (m OD)

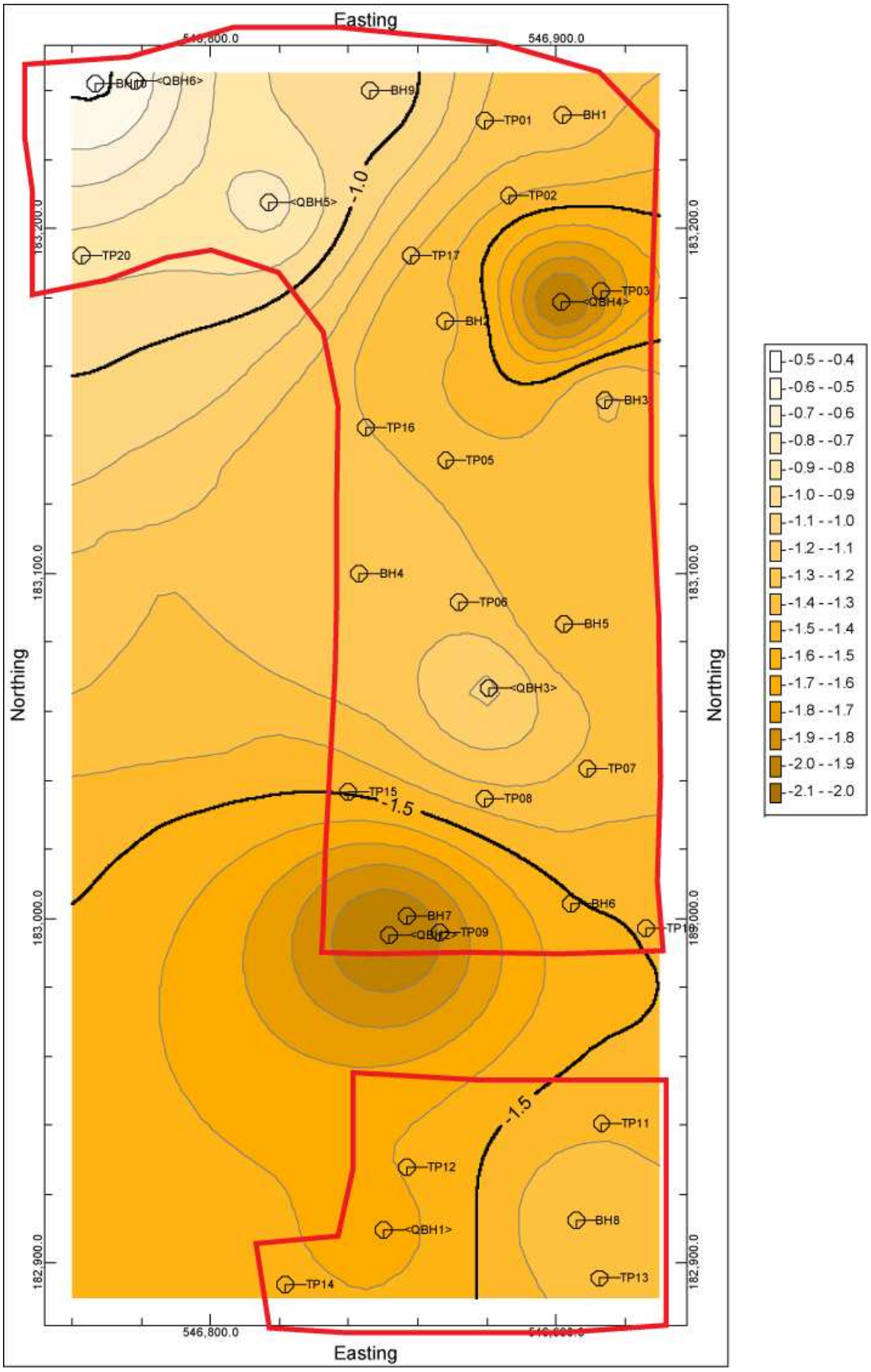

Figure 7: Top of Peat / Base of the Upper Alluvium (m OD)

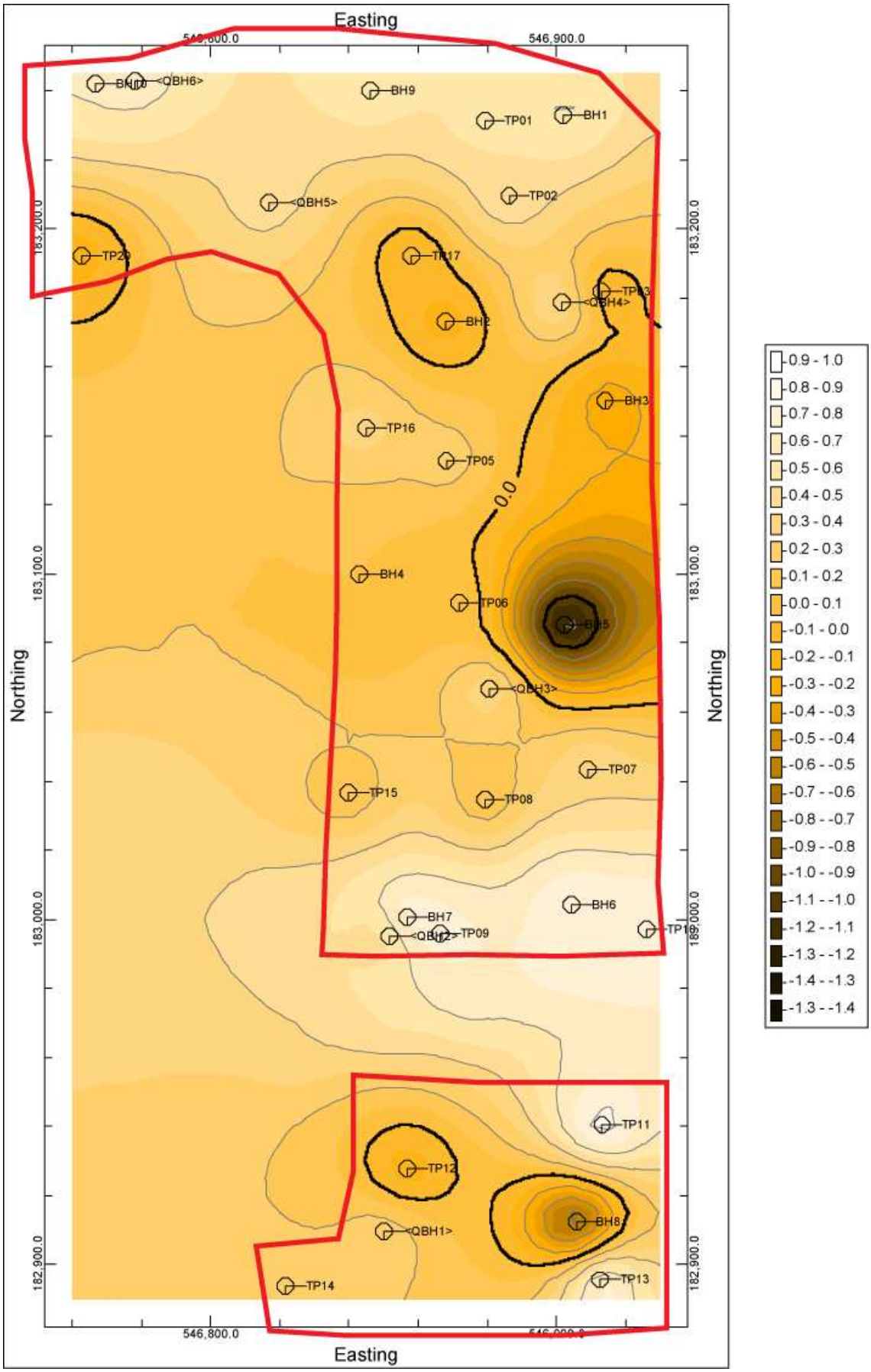

Figure 8: Top of Upper Alluvium / Base of Made Ground (m OD)

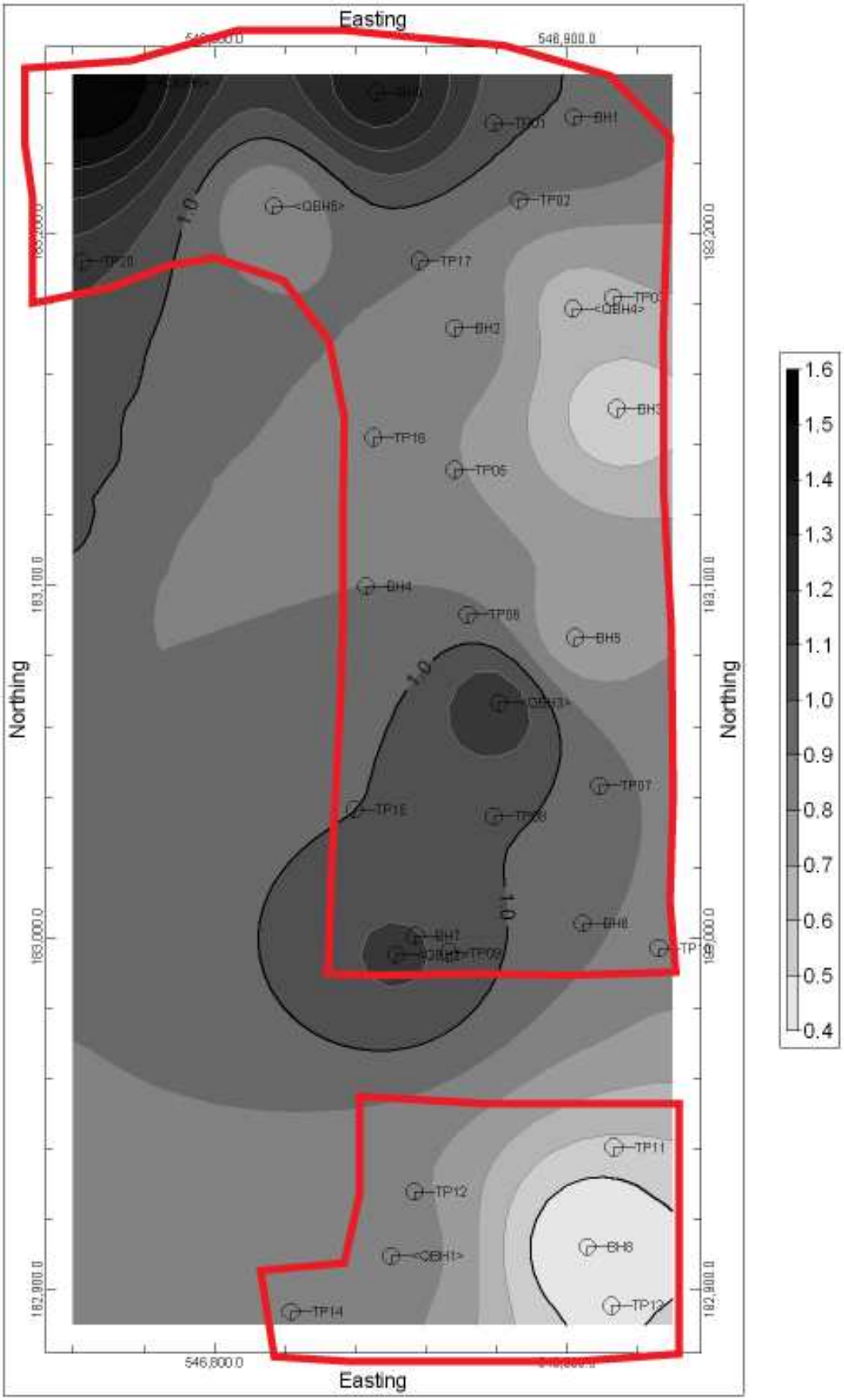

Figure 9: Thickness of the Lower Alluvium (m)

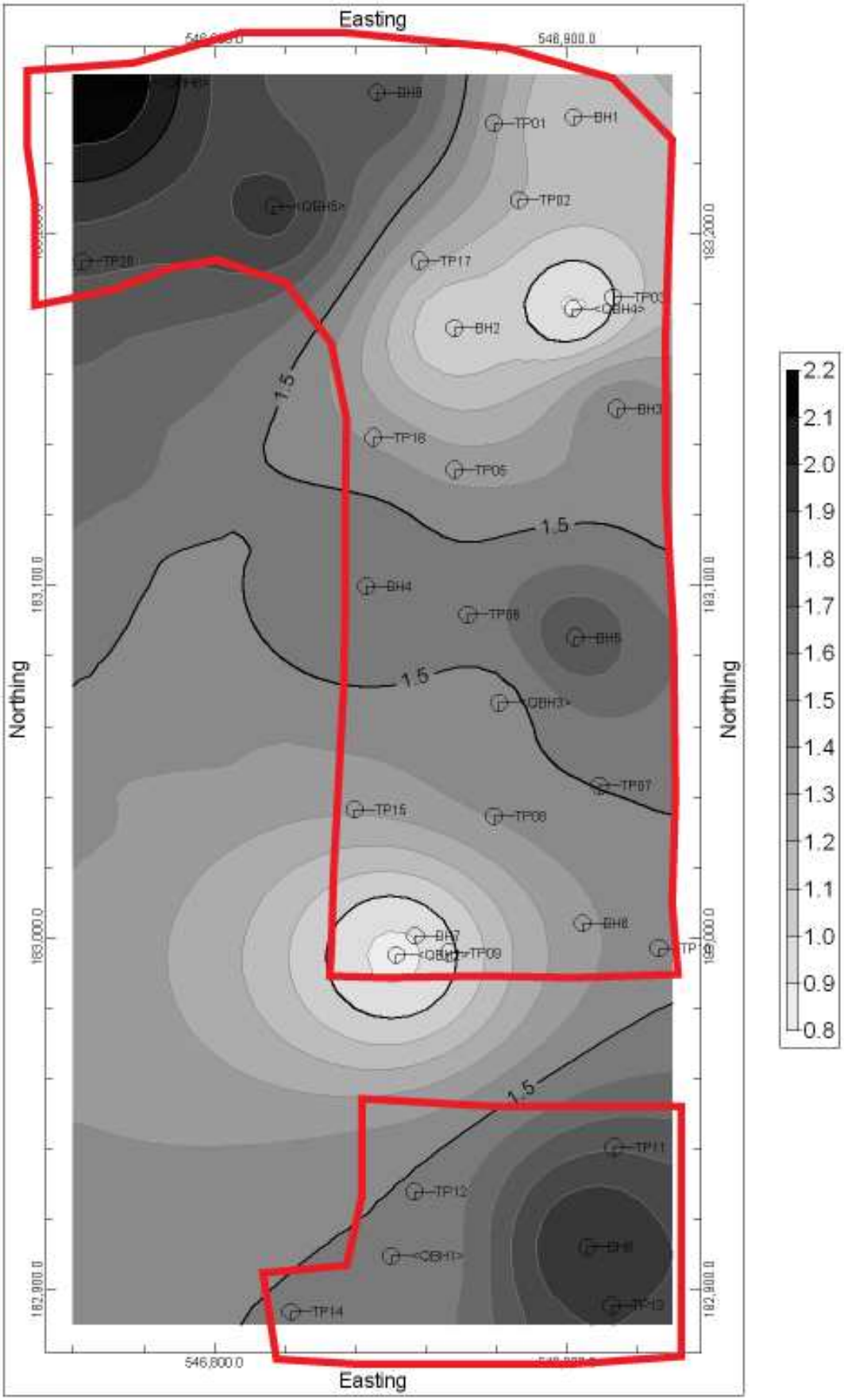

Figure 10: Thickness of the Peat (m)

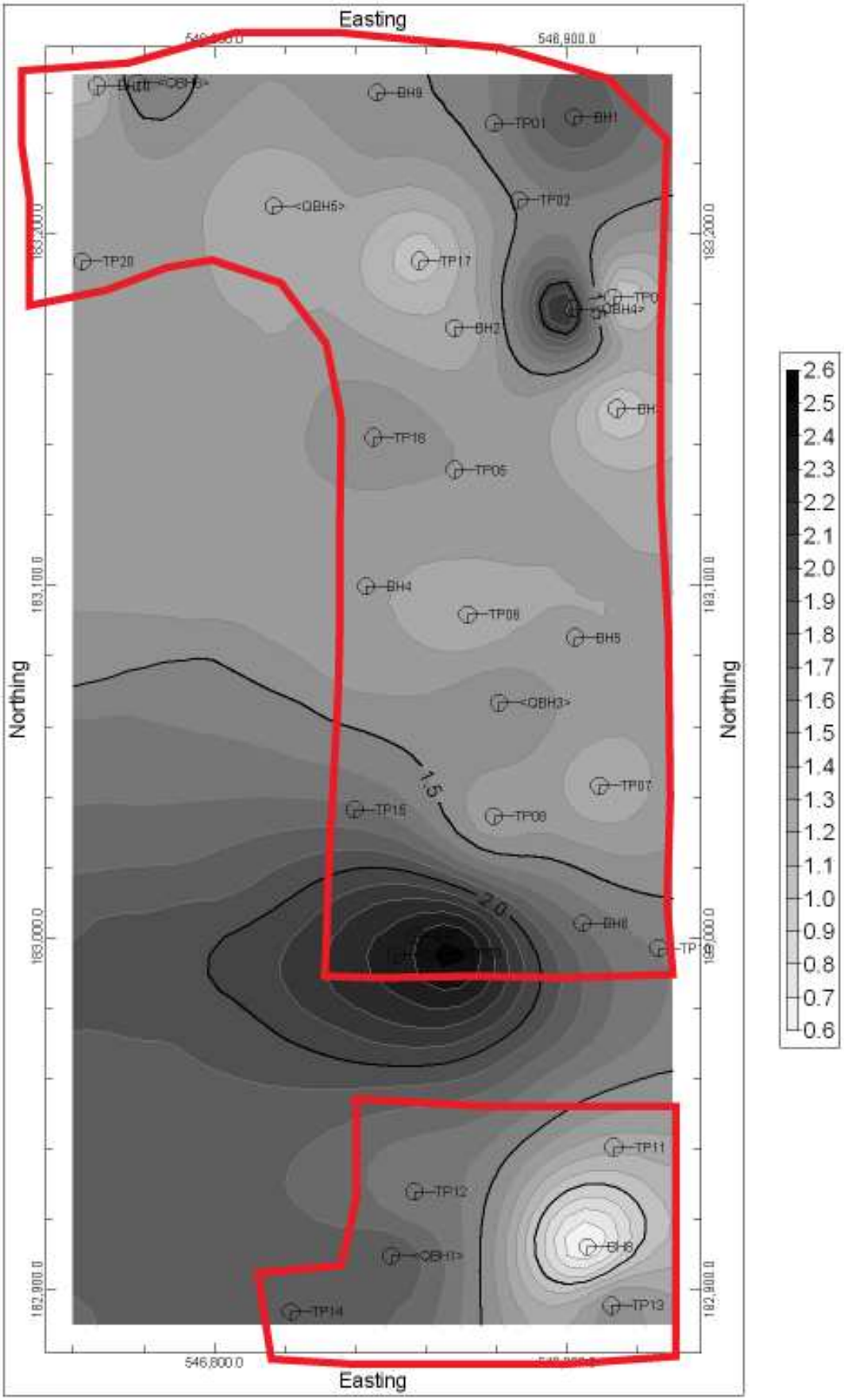

Figure 11: Thickness of the Upper Alluvium (m)

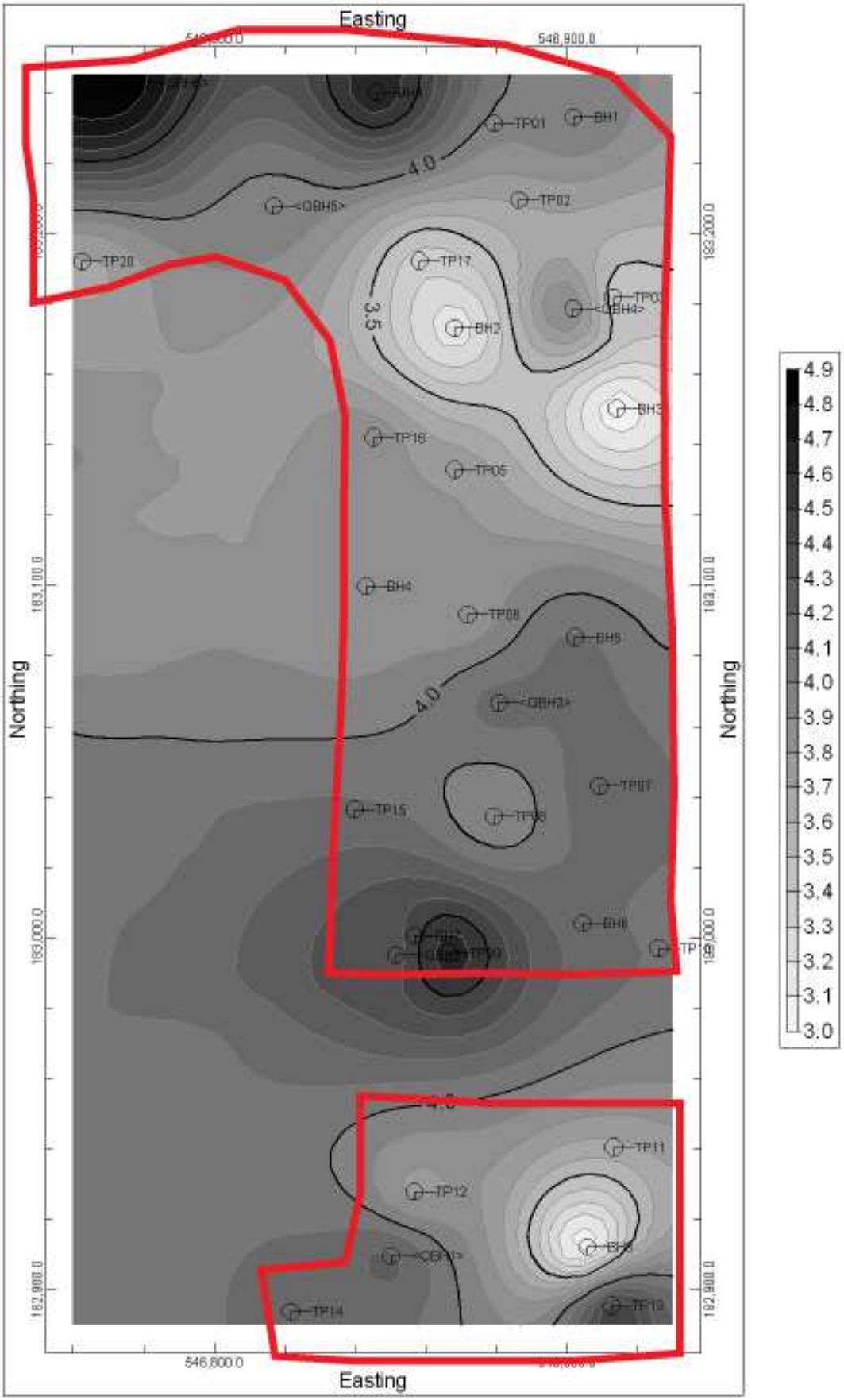

Figure 12: Thickness of Total Alluvium (m)

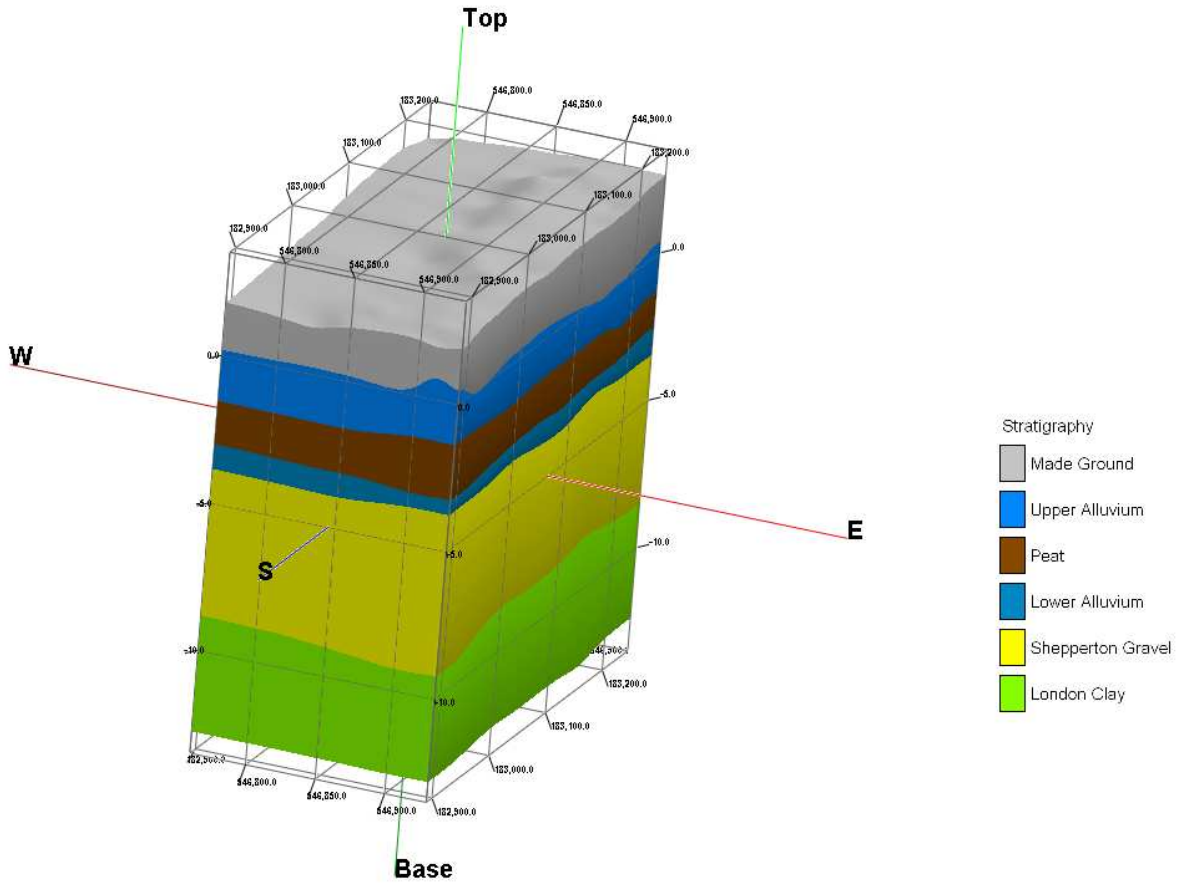

Figure 13: Three-Dimensional topographic model of the sub-surface stratigraphy at Thames View Estate, Renwick Road, Barking, Essex

METHODS

Previous investigations (field investigations; lithostratigraphic descriptions and deposit modelling)

Six boreholes (Boreholes <QBH1> to <QBH6>) were put down at the site in April 2011 (Figure 2). Borehole core samples were recovered using an Eijkelkamp window sampler and gouge set using an Atlas Copco TT 2-stroke percussion engine. This coring technique is a suitable method for the recovery of continuous, undisturbed core samples and provides sub-samples suitable for not only sedimentary and microfossil assessment and analysis, but also macrofossil analysis. The recovered core samples were wrapped in clear plastic to prevent moisture loss, labelled with the depth (metres from ground surface) and orientation (top and base) and returned to Quaternary Scientific for storage in a purpose built facility at 2^{o}C. This temperature prevents fungal growth on the core surface, which may lead to anomalous radiocarbon dates, and moisture loss. The spatial attributes of each borehole were recorded (Table 1 and Figure 2).

Table 1: Borehole attributes, Thames View Estate, Renwick Road, Barking, Essex

Borehole number	Easting	Northing	Elevation (m OD)
<QBH1>	546850.044	182909.746	1.83
<QBH2>	546851.519	182995.257	1.94
<QBH3>	546880.654	183066.729	2.47
<QBH4>	546901.571	183178.654	2.46
<QBH5>	546816.763	183207.698	2.54
<QBH6>	546777.978	183242.743	2.44

The lithostratigraphy of boreholes <QBH1> to <QBH6> was described in the laboratory using standard procedures for recording unconsolidated sediment and organic sediments, noting the physical properties (colour), composition (gravel, sand, clay, silt and organic matter) and inclusions (e.g. artefacts) (Tröels-Smith, 1955). The procedure involved: (1) cleaning the samples with a spatula or scalpel blade and distilled water to remove surface contaminants; (2) recording the physical properties, most notably colour using a Munsell Soil Colour Chart; (3) recording the composition; gravel (Grana glareosa; Gg), fine sand (Grana arenosa; Ga), silt (Argilla granosa; Ag) and clay (Argilla steatoides); (4) recording the degree of peat humification and (5) recording the unit boundaries e.g. sharp or diffuse. The results are displayed in Figure 3 and Tables 2 to 4.

The deposit model was based on a review of sixteen borehole records incorporating the six new Quaternary Scientific geoarchaeological boreholes and ten existing geotechnical boreholes (Ian Farmer Associates, 2011; see Appendix 2). In addition, the records from the fourteen geotechnical test-pits were used where applicable (Ian Farmer Associates, 2011;

see Appendix 2).

Sedimentary units from the boreholes were classified into six groupings: (1) London Clay (2) Shepperton Gravel; (3) Lower (Sandy) Alluvium; (4) Peat; (5) Upper Alluvium, and (6) Made Ground. The classified data for groups 1-5 were then input into a database with the RockWorks 2006 geological utilities software. Models of surface height (using a nearest neighbour routine) were generated for each of these stratigraphic groups (Figures 4 to 8). Thickness of the combined alluvial units was also modelled (also using a nearest neighbour routine) (Figures 9 to 12). A 3-Dimensional topographic model is displayed in Figure 13. Because the boreholes are not uniformly distributed over the area of investigation, the reliability of the models generated using RockWorks is variable. In general, reliability improves from outlying areas where the models are largely supported by scattered archival records towards the core area of commissioned boreholes. Because of the 'smoothing' effect of the modelling procedure, the modelled levels of stratigraphic contacts may differ slightly from the levels recorded in borehole logs and section drawings.

In addition, the reliability of individual models is affected by the quality of the stratigraphic records which in turn are affected by the nature of the sediments and/or their post-depositional disturbance during previous stages of development on the site. In particular, it is important to recognise that two sets of boreholes are represented, put down at different times and recorded using different descriptive terms and subject to differing technical constraints in terms of recorded detail including the exact levels of the stratigraphic boundaries. The cores from the six new boreholes (<QBH1> to <QBH6>) represent the most detailed record of the sediment sequences.

Organic matter determinations

Fifty-four sub-samples from borehole <QBH1>, thirty-two from <QBH4> and twenty-seven from <QBH5> were taken for determination of the organic matter content (Tables 5 to 7; Figure 14). These records were important as they can identify increases in organic matter possibly associated with more terrestrial conditions. The organic matter content was determined by standard procedures involving: (1) drying the sub-sample at 110^0C for 12 hours to remove excess moisture; (2) placing the sub-sample in a muffle furnace at 550℃ for 2 hours to remove organic matter (thermal oxidation), and (3) re-weighing the sub-sample obtain the ‘loss-on-ignition’ value (see Bengtsson and Enell, 1986).

Radiocarbon dating

Sub-samples of waterlogged seeds (*Alnus* catkins) or twigs were extracted from the top and base of the peat in boreholes <QBH1>, <QBH4> & <QBH5> for radiocarbon dating. All six samples were submitted for AMS radiocarbon dating to Beta Analytic INC, Radiocarbon Dating Laboratory, Florida, USA. The results have been calibrated using OxCal v4.0.1 Bronk Ramsey (1995, 2001 and 2007) and IntCal04 atmospheric curve (Reimer *et al*., 2009). The results are displayed in Figure 14 and Table 8.

Pollen assessment

Twenty-two sub-samples (ten from borehole <QBH1>, five from borehole <QBH4> and seven from borehole <QBH5>) were extracted for an assessment of pollen content. The pollen was extracted as follows: (1) sampling a standard volume of sediment (1ml); (2) adding two tablets of the exotic clubmoss *Lycopodium clavatum* to provide a measure of pollen concentration in each sample; (3) deflocculation of the sample in 1% Sodium pyrophosphate; (4) sieving of the sample to remove coarse mineral and organic fractions (>125µ); (5) acetolysis; (6) removal of finer minerogenic fraction using Sodium polytungstate (specific gravity of 2.0g/cm^3); (7) mounting of the sample in glycerol jelly. Each stage of the procedure was preceded and followed by thorough sample cleaning in filtered distilled water. Quality control is maintained by periodic checking of residues, and assembling sample batches from various depths to test for systematic laboratory effects. Pollen grains and spores were identified using the University of Reading pollen type collection and the following sources of keys and photographs: Moore *et al* (1991); Reille (1992). The assessment procedure consisted of scanning the prepared slides, and recording the concentration and preservation of pollen grains and spores, and the principal taxa on four transects (10% of the slide) (Tables 9 to 11).

Diatom assessment

Two sub-samples from each borehole were extracted for the assessment of diatoms. The diatom extraction involved the following procedures (Battarbee *et al.,* 2001):

1. Treatment of the sub-sample (0.2g) with Hydrogen peroxide (30%) to remove organic material and Hydrochloric acid (50%) to remove remaining carbonates
2. Centrifuging the sub-sample at 1200 for 5 minutes and washing with distilled water (4 washes)
3. Removal of clay from the sub-samples in the last wash by adding a few drops of Ammonia (1%)

4. Two slides prepared, each of a different concentration of the cleaned solution, were fixed in mounting medium of suitable refractive index for diatoms (Naphrax)

Duplicate slides each having two coverslips were made from each sample and fixed in Naphrax for diatom microscopy. The coverslip with the most suitable concentration of the sample preparation was selected for diatom evaluation. A large area of this coverslip was scanned for diatoms at magnifications of x400 and x1000 under phase contrast illumination using a Leica microscope. The results are displayed in Table 12.

Macrofossil assessment

A total of fifteen small bulk samples (4 from borehole <QBH1>, 5 from borehole <QBH4> and 6 from borehole <QBH5>) were extracted for the recovery of macrofossil remains including waterlogged plant macrofossils, waterlogged wood, insects and Mollusca. The extraction process involved the following procedures: (1) removing a sample up to 10cm in thickness; (2) measuring the sample volume by water displacement, and (3) processing the sample by wet sieving using 300µm and 1mm mesh sizes. Each sample was scanned under a stereozoom microscope at x7-45 magnifications, and sorted into the different macrofossil classes. The concentration and preservation of remains was estimated for each class of macrofossil (Tables 13 to 15).

Preliminary identifications of the waterlogged seeds have been made using modern comparative material and reference atlases (Cappers *et al.* 2006, Schoch *et al*. 2004). Nomenclature used follows Stace (2005) (Table 16).

RESULTS AND INTERPRETATION OF THE LITHOSTRATIGRAPHIC DESCRIPTIONS AND ORGANIC MATTER CONTENT DETERMINATIONS

The results of the lithostratigraphic descriptions for boreholes <QBH1>, <QBH4> and <QBH5> (Tables 2 to 4, and Figure 6) have been reported previously (Batchelor and Green, 2012). The results of this investigation revealed a generally uniform sequence of London Clay overlain by Shepperton Gravel, Holocene Alluvium (including Peat) and Made Ground (Figures 3 to 13; Appendix 1 & 2). Quantification of the organic matter content by Loss-on-Ignition has allowed further detail to be added to the lithostratigraphic descriptions of the Holocene Alluvium (Figure 14; Tables 5 to 7).

Organic matter content was minimal within the mineral-rich Lower Alluvium as might be expected (<10%). Within the overlying Peat these values increased sharply to 80%. Values of 60 to 80% are common within the Peat of the Lower Thames Valley, with a constant input of fine-grained mineral rich material (silt and clay) resulting from flooding. However, consistently high values, such as those recorded in all three boreholes, are unusual and suggest that Thames View Estate occupied a more stable area of the floodplain that was less prone to flooding. In boreholes <QBH1> and <QBH5>, organic matter content decreases steadily from the top of the Peat into the Upper Alluvium, enhancing the interpretation for gradual inundation of the Peat surface. However, the Peat in borehole <QBH4> is much thinner than that recorded in the other boreholes, with a much more abrupt reduction in organic matter content at the contact with the Upper Alluvium. This is suggestive of erosion during inundation of the Peat surface. Organic matter content remains low (<10%) during the deposition of the Upper Alluvium.

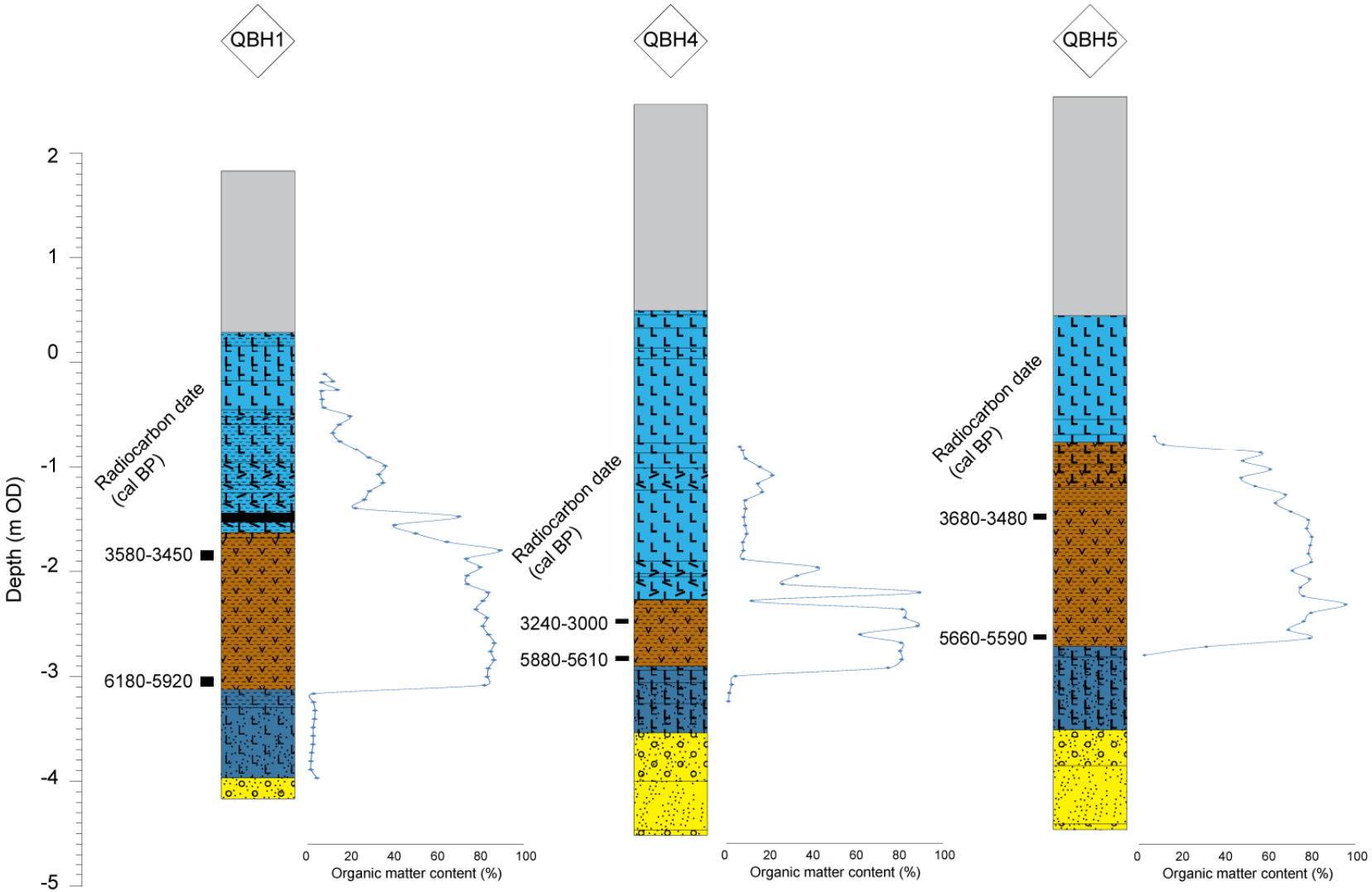

Figure 14: Results of the borehole <QBH1>, <QBH4> and <QBH5> lithostratigraphic analysis, incorporating lithostratigraphic descriptions and organic matter content, plotted with associated radiocarbon dates, Thames View Estate, Renwick Road, Barking, Essex (site code: TVE12)

Table 2: Lithostratigraphic description of Borehole <QBH1>, Thames View Estate, Renwick Road, Barking, Essex (site code: TVE12)

Depth (m OD)	Depth (BGS)	Unit number	Description
1.83 to 0.29	0 to 1.54	5	Made Ground; sharp contact into:
0.29 to 0.16	1.54 to 1.67	4	7.5YR 4/1; As3, Sh1; Dark grey organic-rich clay; diffuse contact into:
0.16 to -0.17	1.67 to 2.00	4	10YR 6/2; As3, Ag1; Light brownish grey silty clay; diffuse contact into:
-0.17 to -0.45	2.00 to 2.28	4	10YR 5/1 mottled 10YR 7/6; As4; Grey mottled yellow clay; sharp contact into:
-0.45 to -0.52	2.28 to 2.35	4	10YR 5/1; As3, Sh1; Grey organic-rich clay; diffuse contact into:
-0.52 to -0.59	2.35 to 2.42	4	10YR 4/1; As2, Sh1, Dl/Tl1; Dark grey organic-rich clay with detrital or *in situ* wood; diffuse contact into:
-0.59 to -0.95	2.42 to 2.78	4	10YR 5/1; As3, Sh1; Dl+; Grey organic-rich clay with traces of detrital wood which increases downwards; diffuse contact into:
-0.95 to -1.17	2.78 to 3.00	4	10YR 4/1; As2, Sh1, Dl/Tl1; Dark grey organic-rich clay and detrital or *in situ* wood remains; diffuse contact into:
-1.17 to -1.25	3.00 to 3.08	4	10YR 5/1; As1, Ag1, Dl/Tl1, Sh1; Grey organic-rich silty clay with detrital or *in situ* wood remains; Diffuse contact into:
-1.25 to -1.44	3.08 to 3.27	4	10YR 5/1 to 10YR 7/1; As3, Dl1, Sh1; Grey to light grey organic-rich silty clay with detrital or *in situ* wood remains
-1.44 to -1.53	3.27 to 3.36	4	Wood macrofossil
-1.53 to -1.62	3.36 to 3.45	4	10YR 5/1; As3, Sh1; Dl+; Grey organic-rich clay with traces of detrital wood which increases downwards; diffuse contact into:
-1.62 to -1.68	3.45 to 3.51	3	10YR 3/1; Sh2, As2; Humo 4; Very dark grey well humified clay-rich peat; diffuse contact into:
-1.68 to -3.12	3.51 to 4.95	3	10YR 2/1; Sh3, $Tl^3$1, As+; Humo 4; Black very well humified wood peat with clay traces; sharp contact into:
-3.12 to -3.30	4.95 to 5.13	2	10YR 4/1; Ag2, Sh1, As1, Ga+; Dark grey organic-rich clayey silt with traces of sand; diffuse contact into:
-3.30 to -3.97	5.13 to 5.80	2	10YR 4/1 to 5Y 6/2; Ag2, Ga1, As1; Dark grey to light olive grey clayey sandy silt; sharp contact into:
-3.97 to -4.17	5.80 to 6.00	1	10YR 6/2; Ga2, Gg2; Light brownish grey sandy gravel.

Table 3: Lithostratigraphic description of Borehole <QBH4>, Thames View Estate, Renwick Road, Barking, Essex (site code: TVE12)

Depth (m OD)	Depth (BGS)	Unit number	Description
2.46 to 0.50	0 to 1.96	5	Made Ground; sharp contact into:
0.50 to 0.46	1.96 to 2.00	4	10YR 6/1 and 10YR 7/2; As3, Ag1; Grey to very pale brown silty clay; diffuse contact into:
0.46 to 0.33	2.00 to 2.13	4	10YR 6/1; As4, Ag+; Grey clay with traces of silt; diffuse contact into:
0.33 to 0.14	2.13 to 2.32	4	10YR 5/1; As3, Ag1, Sh+; Grey silty clay with traces of organic-rich remains; diffuse contact into:
0.14 to 0.04	2.32 to 2.42	4	10YR 5/1; As4, Sh+, Ag+; Grey clay with traces of organic-rich remains and silt; diffuse contact into:
0.04 to -0.77	2.42 to 3.23	4	10YR 6/1; As4; Grey clay; diffuse contact into:
-0.77 to -0.86	3.23 to 3.32	4	10YR 5/1; As4, Sh+; Grey clay with traces of organic-rich remains; diffuse contact into:
-0.86 to -1.01	3.32 to 3.47	4	10YR 5/1 to 10YR 4/1; As3, Sh1, Dl+; Grey to dark grey organic-rich clay and traces of detrital wood; diffuse contact into:
-1.01 to -1.22	3.47 to 3.68	4	10YR 5/1; As3, Dl/Tl1, Sh+, Mollusca+; Grey clay with detrital or *in situ* wood remains and occasional Mollusca; diffuse contact into:
-1.22 to -1.90	3.68 to 4.36	4	10YR 6/1 mottled Gley 1 8/10Y and 10YR 5/1; As4, Ag+, Dl+; Grey mottled light greenish grey clay with traces of silt and detrital wood; diffuse contact into:
-1.90 to -1.96	4.36 to 4.42	4	10YR 5/1; As3, Dl1; Grey clay with detrital wood; sharp contact into:
-1.96 to -2.02	4.42 to 4.48	4	10YR 2/1 and 10YR 5/1; Dl/Tl3, As1, Mollusca+; Black and grey clay detrital or *in situ* wood with clay; sharp contact into:
-2.02 to -2.05	4.48 to 4.51	4	10YR 5/1; As4, Mollusca+, Dl+; Grey clay with Mollusca and detrital wood inclusions; sharp contact into:
-2.05 to -2.26	4.51 to 4.72	3	10YR 2/1 and 10YR 5/1; Dl/Tl3, As1, Mollusca+; Black and grey clay detrital or *in situ* wood with clay; sharp contact into:
-2.26 to -2.27	4.72 to 4.73	3	10YR 7/1; Ga4; Light grey sand; sharp contact into:
-2.27 to -2.90	4.73 to 5.36	3	10YR 2/1; Sh3, $Tl^{3}1$; Humo 4; Black very well humified wood peat; sharp contact into:
-2.90 to -2.94	5.36 to 5.40	2	10YR 3/1; Ag2, As1, Sh1; Very dark grey organic-rich clayey silt; diffuse contact into:
-2.94 to -3.06	5.40 to 5.52	2	10YR 4/1 to 10YR 5/1; Ag2, As2, Sh+, Dl+; diffuse
-3.06 to -3.26	5.52 to 5.72	2	10YR 5/1; Ag2, Ga1, As1, Dl+, Sh+; Grey clayey silty sand with traces of detrital wood and organic material; diffuse contact into:
-3.26 to -3.54	5.72 to 6.00	2	Gley 1 8/10Y; Ag2, Ga1, As1, Dl+; Light greenish grey clayey silty sand with traces of detrital wood; sharp contact into:
-3.54 to -4.00	6.00 to 6.46	1	10YR 6/2; Ga3, Gg1; Light brownish grey gravelly sand; diffuse contact into:
-4.00 to -4.46	6.46 to 6.92	1	10YR 6/2; Ga4, Gg+; Light brownish grey sand with traces of gravel.

-4.46 to -4.54	6.92 to 7.00	1	10YR 6/2; Ga2, Gg2; Light brownish grey sandy gravel.

Table 4: Lithostratigraphic description of Borehole <QBH5>, Thames View Estate, Renwick Road, Barking, Essex (site code: TVE12)

Depth (m OD)	Depth (BGS)	Unit number	Description
2.54 to 0.45	0 to 2.09	5	Made Ground; sharp contact into:
0.45 to -0.46	2.09 to 3.00	4	10YR 6/2; As4, Ag+, chalk+; Light brownish grey clay with silt and chalk inclusions and brownish yellow concretions; diffuse contact into:
-0.46 to -0.69	3.00 to 3.23	4	10YR 7/1 to 10YR 6/1; As4, Ag+; Grey to light grey clay with silt inclusions; diffuse contact into:
-0.69 to -0.76	3.23 to 3.30	4	10YR 5/1; As4, Sh+; Grey clay with traces of organic-rich material; diffuse contact into:
-0.76 to -0.85	3.30 to 3.39	3	10YR 3/1; $Tl^3$2, Sh1, As1; Humo 4; Very dark grey very well humified wood peat with clay; diffuse contact into:
-0.85 to -0.98	3.39 to 3.52	3	10YR 5/2; Sh2, As2, Dl/Tl+; Greyish brown clay-rich peat with inclusions of detrital or in situ wood; diffuse contact into:
-0.98 to -1.20	3.52 to 3.74	3	10YR 4/1; Sh2, As1, $Tl^3$1; Humo 4; Dark grey very well humified wood peat with clay; diffuse contact into:
-1.20 to -1.34	3.74 to 3.88	3	5YR 4/3; Sh4, Tl+; Humo 4; Reddish brown very well humified unidentifiable peat with inclusions of wood; diffuse contact into:
-1.34 to -2.71	3.88 to 5.25	3	5YR 4/3; Sh3, $Tl^3$1; Humo 4; Reddish brown very well humified wood peat; sharp contact into:
-2.71 to -2.81	5.25 to 5.35	2	10YR 5/1; Ag2, As1, Ga1, Sh+, Dl+; Grey sandy clayey silt with traces of organic-rich remains and detrital wood; diffuse contact into:
-2.81 to -3.51	5.35 to 6.05	2	10YR 5/1 to Gley 1 8/10Y; Ag2, As1, Ga1, Dl+; Grey to light greenish grey sandy clayey silty with detrital wood inclusions; sharp contact into:
-3.51 to -3.85	6.05 to 6.39	1	10YR 6/2; Ga2, Gg2; Light brownish grey sandy gravel; diffuse contact into:
-3.85 to -4.41	6.39 to 6.95	1	10YR 6/2; Ga4, Gg+, Dl+; Light brownish grey sand with gravel and detrital wood inclusions; diffuse contact into:
-4.41 to -4.46	6.95 to 7.00	1	10YR 6/2; Ga2, Gg2; Light brownish grey sandy gravel.

Table 5: Results of the borehole <QBH1> organic matter determinations, Thames View Estate, Renwick Road, Barking, Essex (site code: TVE12)

Depth (m OD)		Organic matter content (%)
From	To	
-0.12	-0.13	7.51
-0.19	-0.20	11.35
-0.20	-0.21	6.10
-0.27	-0.28	13.48
-0.28	-0.29	6.09
-0.36	-0.37	6.30
-0.44	-0.45	7.27
-0.52	-0.53	19.50
-0.60	-0.61	14.46
-0.68	-0.69	11.37
-0.76	-0.77	14.76
-0.84	-0.85	22.52
-0.92	-0.93	28.53
-1.00	-1.01	36.28
-1.07	-1.08	33.29
-1.16	-1.17	35.15
-1.24	-1.25	28.81
-1.32	-1.33	26.40
-1.40	-1.41	22.10
-1.48	-1.49	71.26
-1.56	-1.57	40.86
-1.64	-1.65	50.80
-1.72	-1.73	65.59
-1.80	-1.81	90.88
-1.88	-1.89	74.84
-1.96	-1.97	81.40
-2.04	-2.05	75.22
-2.12	-2.13	75.33
-2.20	-2.21	85.08
-2.28	-2.29	82.68
-2.36	-2.37	79.46
-2.44	-2.45	84.61
-2.52	-2.53	82.68
-2.60	-2.61	85.45
-2.68	-2.69	88.14
-2.76	-2.77	86.45
-2.84	-2.85	87.94
-2.92	-2.93	85.30
-3.00	-3.01	84.72
-3.08	-3.09	83.39
-3.16	-3.17	2.31
-3.24	-3.25	2.24
-3.32	-3.33	2.89
-3.40	-3.41	2.62
-3.48	-3.49	2.03
-3.56	-3.57	2.02
-3.64	-3.65	1.96
-3.72	-3.73	1.30
-3.80	-3.81	1.00

-3.88	-3.89	1.01
-3.96	-3.97	3.76

Table 6: Results of the borehole <QBH4> organic matter determinations, Thames View Estate, Renwick Road, Barking, Essex (site code: TVE12)

Depth (m OD)		Organic matter content (%)
From	To	
-0.81	-0.82	6.82
-0.85	-0.86	8.12
-0.93	-0.94	9.60
-1.01	-1.02	16.16
-1.09	-1.10	21.99
-1.17	-1.18	15.31
-1.25	-1.26	17.24
-1.33	-1.34	9.44
-1.41	-1.42	9.49
-1.49	-1.50	8.74
-1.57	-1.58	9.33
-1.65	-1.66	10.02
-1.73	-1.74	8.27
-1.81	-1.82	8.50
-1.89	-1.90	8.44
-1.97	-1.98	43.05
-2.05	-2.06	33.47
-2.13	-2.14	26.80
-2.21	-2.22	90.40
-2.29	-2.30	12.42
-2.37	-2.38	82.43
-2.45	-2.46	83.64
-2.53	-2.54	89.57
-2.61	-2.62	62.84
-2.69	-2.70	81.93
-2.77	-2.78	81.51
-2.85	-2.86	82.22
-2.93	-2.94	75.82
-3.01	-3.02	4.88
-3.09	-3.10	3.08
-3.17	-3.18	1.92
-3.25	-3.26	1.52

Table 7: Results of the borehole <QBH5> organic matter determinations, Thames View Estate, Renwick Road, Barking, Essex (site code: TVE12)

Depth (m OD)		Organic matter content (%)
From	To	
-0.72	-0.73	7.30
-0.80	-0.81	11.38
-0.88	-0.89	56.19
-0.96	-0.97	47.99
-1.04	-1.05	60.70
-1.12	-1.13	47.26
-1.20	-1.21	53.79
-1.28	-1.29	67.66

-1.36	-1.37	63.11
-1.44	-1.45	70.12
-1.53	-1.53	78.29
-1.60	-1.61	77.54
-1.68	-1.69	79.85
-1.76	-1.77	79.15
-1.84	-1.85	78.35
-1.92	-1.93	79.54
-2.00	-2.01	70.89
-2.08	-2.09	78.84
-2.16	-2.17	74.62
-2.24	-2.25	75.94
-2.32	-2.33	95.50
-2.40	-2.41	79.52
-2.48	-2.49	76.06
-2.56	-2.57	69.01
-2.64	-2.65	78.88
-2.72	-2.73	31.19
-2.80	-2.81	2.67

RESULTS AND INTERPRETATION OF THE RADIOCARBON DATING

Sub-samples of waterlogged seeds (*Alnus* catkins) or twigs were extracted from the top and base of the Peat in boreholes <QBH1>, <QBH4> & <QBH5> for radiocarbon dating. Samples from the base (-3.00 to -3.10m OD) and top (-1.80 to -1.90m OD) of the Peat from borehole <QBH1>, provided ages of 6180-5920 cal BP and 3580-3450 cal BP respectively. In borehole <QBH4> samples from the base (-2.80 to -2.85m OD) and top (-2.40 to -2.45m OD) of the shorter Peat sequence provided ages of 5880-5610 cal BP and 3240-3000 cal BP respectively. Finally, in borehole <QBH5> the base of the Peat (-2.65 to -2.70m OD) was radiocarbon dated to 5660-5590 cal BP and top of the Peat (-1.45 to -1.50m OD) to 3680-3480 cal BP. The δ13C (‰) values are consistent with that expected for peat sediment, and there is no evidence for mineral or biogenic carbonate contamination.

These results indicate that Peat accumulation commenced during the Early Neolithic across the site, and continued into the Late Bronze Age. They also suggest that Peat accumulation commenced earlier towards the south of the site and migrated northwards. However, it is likely that variations in the underlying topography were also important in determining the onset of Peat formation, since accumulation appears to have commenced earlier in those boreholes with a lower gravel surface. It is also of note that Peat inundation occurred latest in <QBH4>, despite it also having the thinnest Peat horizon. It is considered likely that this, in combination with the sharp contact between the Peat and Upper Alluvium is persuasive evidence for the erosion and reworking of sediment.

Table 8: Results of the boreholes <QBH1>, <QBH4> and <QBH5> radiocarbon dating, Thames View Estate, Renwick Road, Barking, Essex (site code: TVE12)

Laboratory code / Method	Borehole number	Material and location	Depth (m OD)	Uncalibrated radiocarbon years before present (yr BP)	Calibrated age BC/AD (BP) (2-sigma, 95.4% probability)	δ13C (‰)
Beta-324680	<QBH1>	Twig wood; top of Peat	-1.80 to -1.90	3290 ± 30	1630-1500 cal BC (3580-3450 cal BP	-27.1
Beta-324681	<QBH1>	*Alnus* catkins; base of Peat	-3.00 to -3.10	5250 ± 40	4230-3970 cal BC (6180-5920 cal BP)	-26.4
Beta-324682	<QBH4>	*Alnus* catkins; top of Peat	-2.45 to -2.50	2960 ± 30	1290-1060 cal BC (3240-3000 cal BP)	-27.1
Beta-324683	<QBH4>	Twig wood; base of Peat	-2.80 to -2.85	4980 ± 40	3930-3660 cal BC (5880-5610 cal BP)	-27.6
Beta-324684	<QBH5>	Twig wood; base of Peat	-1.45 to -1.50	3350 ± 30	1730-1530 cal BC (3680-3480 cal BP)	-27.7
Beta-324685	<QBH5>	Twig wood; base of Peat	-2.65 to -2.70	4880 ± 30	3710-3640 cal BC (5660-5590 cal BP)	-27.0

RESULTS AND INTERPRETATION OF THE POLLEN ASSESSMENT

Twenty-two sub-samples (ten from borehole <QBH1>, five from borehole <QBH4> and seven from borehole <QBH5>) were extracted for an assessment of pollen content. The results are displayed in Tables 9 to 11.

Borehole <QBH1>

The results of the assessment indicate a mainly moderate to excellent concentration and preservation of pollen through the <QBH1> Peat and Upper Alluvium sequence; the two exceptions to this are at -0.68 to -0.69 and -0.19 to -0.20m OD which contain a poor concentration and preservation of remains. Between -2.53 and -1.00m OD, the assemblage was dominated by tree and shrub taxa including *Alnus* (alder), *Quercus* (oak), *Corylus* type (e.g. hazel), *Pinus* (pine), *Betula* (birch), *Tilia* (lime), *Salix* (willow), *Hedera* (ivy), *Ilex* (holly) and possibly *Ulmus* (elm). Herb, aquatic and spore taxa were more limited including Poaceae (grass family), Cyperaceae (sedge family), Apiaceae (carrot family), *Galium* type (bedstraw), Lactuceae (dandelion family), *Sparganium* type (bur-reed), *Dryopteris* type (buckler fern) and *Polypodium vulgare* (polypody). This assemblage is indicative of a wetland environment occupied by fen carr woodland dominated by alder with willow, ivy and holly and an understorey of grasses, sedges, occasional aquatics and ferns. Hazel, birch and elm may also have occupied the wetland woodland, but may also have formed part of the nearby dryland woodland with oak and lime. Elm is only possibly present within one of the basal samples assessed; its limited occurrence suggests that the sequence post-dates the Neolithic elm decline. Interestingly, a potential grain of cereal pollen was also recorded at -1.00m OD. There are known problems associated with the identification of cereal pollen grains from lowland wetland environments such as the Lower Thames Valley (see Andersen, 1979; Waller & Grant, 2012), however, if correct this identification provides persuasive evidence for nearby human activity at this time since such grains do not travel far from source.

Above -1.00m OD, the assemblage changes to one dominated by herbaceous and aquatic taxa including Poaceae, Cyperaceae, *Chenopodium* type, *Plantago lanceolata* (ribwort plantain), *Sinapis* type (e.g. charlock), *Cereale* type, Lactuceae, Asteraceae (daisy family), *Artemisia* (mugwort), *Cereale* type, *Ranunculus* type (buttercup), *Centaurea cyanus* (cornflower), *Typha latifolia* (bulrush) and *Sparganium* type. Trees and shrubs are present but much reduced including only *Quercus*, *Alnus* and *Corylus* type. This assemblage is indicative of the decline of woodland on both the wetland and dryland. On the wetland, the decline of alder dominated fen carr woodland is reflected by an increase in herbs and aquatics suggestive of open and wetter conditions. Furthermore, pollen values of

Chenopodium type may indicate the growth of saltmarsh plants (and therefore a brackish water influence) on the wetland rather than open conditions. Plants of the Chenopodiaceae family may be split into two broad groups, those associated with brackish and marine environments such as *Salsola kali*, and those commonly found in waste places and the edges of arable fields on dryland, such as *Chenopodium album*. Unfortunately, it is not possible to separate these two groups using pollen analysis.

The presence of woodland on the wetland naturally reduces the quantity of pollen originating from the dryland by filtering it out. Therefore, more open conditions on the wetland should cause an increase in dryland pollen taxa. The fact that this does not take place suggests the near-contemporaneous large-scale decrease of woodland on the dryland. It is possible that inundation of the wetland also caused flooding of the dryland, however, the timing of the transition (late prehistoric) in combination with the occurrence of cereal pollen, ribwort plantain, e.g. charlock and cornflower, is suggestive of anthropogenic activity including clearance and arable and pastoral activity. In this case, the occurrence of cereals seems more plausible due to the number recorded and occurrence of arable weed taxa such as cornflower and charlock.

Borehole <QBH4>

Of the four samples assessed from <QBH4>, two contained an excellent concentration and preservation of remains, whilst the other two contained a poor concentration and preservation of remains. The assemblage recorded in all four samples was similar including a mixture of tree, shrub, herb and spore taxa such as *Alnus*, *Quercus*, *Corylus* type, Poaceae, Cyperaceae, *Chenopodium* type, *Dryopteris* type and *Polypodium vulgare*. *Salix* and *Ulmus* were also present within the basal sample. The assemblage recorded is similar to that recorded in <QBH1> and is indicative of the fen carr woodland on the wetland and mixed deciduous woodland on the dryland through much of the sequence. In uppermost sample -1.57 to -1.58m OD, the reduction of tree/shrub pollen taxa and increase of herbaceous types is suggestive of the same wetland and dryland environmental changes as recorded in <QBH1>. No unequivocal evidence for human activity was recorded in this borehole sequence.

Borehole <QBH5>

The results of the assessment indicate a mainly moderate to excellent concentration and preservation of pollen through the <QBH5> Peat and Upper Alluvium sequence; the two exceptions to this are at -1.68 to -1.69 and -1.10 to -1.11m OD which contain a poor/very poor concentration and preservation of remains. The taxa recorded through the sequence is

similar to that recorded in boreholes <QBH1> and <QBH4> comprising mainly tree and shrub taxa such *Alnus*, *Quercus* and *Corylus* type with *Fraxinus*, *Betula*, *Tilia*, *Ulmus*, *Salix* and *Sambucus nigra* (elder). Herb and spore taxa include Poaceae, Cyperaceae and *Dryopteris* type. Whilst this assemblage suggests the same combination of wetland and dryland woodland to that recorded within the two other boreholes, there are two important differences. Firstly, there is no strong indication for a decline in wetland and dryland woodland towards the top of the sequence, despite the fact that the uppermost samples post-date those of the <QBH1> sequence. It is possible that this is because Peat accumulation appears to have continued longer in the <QBH5> sequence thus allowing the continuance of wetland woodland growth. Secondly, there are no strong indications for the nearby presence of human activity within the <QBH5> sequence despite being located closer to the dryland edge than <QBH1>.

Table 9: Results of the pollen assessment of borehole <QBH1>, Thames View Estate, Renwick Road, Barking, Essex (site code: TVE12)

Depth (m OD)		Main pollen taxa			Concentration 0-5	Concentration grains/cm^3	Preservation 0- 5	Microcharcoal 0 - 5
From	To	Latin name	Common name	Number				
0.20	0.19	*Quercus*	oak	1	5	180530	3-4	3
		Corylus type	e.g. hazel	2				
		Poaceae	grass family	3				
		Cereale type	e.g. barley	3				
		Plantago lanceolata	ribwort plantain	2				
		Sinapis type	e.g. charlock	2				
		Asteraceae	daisy family	8				
		Artemisia	mugwort	1				
		Valeriana type	e.g. marsh valerian	1				
		Lactuceae	dandelion family	1				
		Chenopodium type	e.g. fat hen	2				
		Centaurea cyanus	cornflower	5				
		Ranunculus type	buttercup	3				
		Typha latifolia	bulrush	1				
-0.19	-0.20	*Alnus*	alder	1	2	66076	3	2
		Corylus type	e.g. hazel	1				
		Poaceae	grass family	7				
		Cyperaceae	sedge family	2				
		Lactuceae	dandelion family	3				
		cf *Cereale* type	e.g. barley	1				
		Asteraceae	daisy family	1				
		Sparganium type	bur-reed	5				
		Dryopteris type	buckler fern	1				
		Pteridium aquilinum	bracken	1				
-0.68	-0.69	*Alnus*	alder	1	2	80531	3	1
		Corylus type	e.g. hazel	2				
		Poaceae	grass family	2				
		Cyperaceae	sedge family	2				
		Chenopodium type	e.g. fat hen	1				
		Plantago lanceolata	ribwort plantain	1				
		Pteridium aquilinum	bracken	1				
-1.00	-1.01	*Alnus*	alder	17	5	148672	3	0
		Quercus	oak	4				

		Pinus *Hedera* *Ilex* Poaceae cf *Cereale* type *Plantago* type *Chenopodium* type *Filipendula* cf *Typha latifolia*	pine ivy holly grass family e.g. barley plantain e.g. fat hen meadowsweet bulrush	2 1 1 3 1 1 1 1 1				
-1.40	-1.41	*Alnus* *Quercus* *Tilia* *Fraxinus* *Pinus* *Corylus* type Poaceae *Chenopodium* type Apiaceae Lactuceae *Dryopteris* type	alder oak lime ash pine e.g. hazel grass family e.g. fat hen carrot family dandelion family buckler fern	14 10 1 1 1 2 5 4 1 1 4	5	30842	4	0
-1.80	-1.81	*Alnus* *Tilia* *Dryopteris* type Unknown	alder lime buckler fern	2 1 1 2	3	2323	4	0
-2.04	-2.05	*Alnus* *Quercus* *Betula* *Tilia* *cf Ulmus* *Pinus* *Corylus* type *Salix* Poaceae Cyperaceae *Galium* type Apiaceae *Dryopteris* type *Polypodium vulgare*	alder oak birch lime elm pine e.g. hazel willow grass family sedge family bedstraw carrot family bucker fern polypody	14 7 1 3 1 1 6 2 2 2 1 1 17 1	5	84660	3-4	0

-2.28	-2.29	*Alnus* *Quercus* *Pinus* *Tilia* *Salix* *Hedera* Poaceae Cyperaceae *Dryopteris* type	alder oak pine lime willow ivy grass family sedge family buckler fern	2 5 1 1 2 1 1 7 25	3	30973	4	0
-2.45	-2.46	*Alnus* *Quercus* *Corylus* type Cyperaceae *Dryopteris* type	alder oak e.g. hazel sedge family buckler fern	13 10 3 2 18	4	28127	3	0
-2.52	-2.53	*Alnus* *Quercus* Cyperaceae *Sparganium* type *Dryopteris* type	alder oak sedge family bur-reed buckler fern	35 2 4 1 3	5	159822	4-5	0

Key:
Concentration: 0 = 0 grains; 1 =1-75 grains, 2 = 76-150 grains, 3 =151-225 grains, 4 = 226-300, 5 =300+ grains per slide
Preservation: 0 = none, 1 = very poor, 2 = poor, 3 = moderate, 4 = good, 5 = excellent
Charcoal: 0 = none, 1= negligible, 2 = occasional, 3 = moderate, 4 = frequent, 5 = abundant

Table 10: Results of the pollen assessment of borehole <QBH4>, Thames View Estate, Renwick Road, Barking, Essex (site code: TVE12)

Depth (m OD)		**Main pollen taxa**			**Concentration 0-5**	**Concentration grains/cm^3**	**Preservation 0- 5**	**Microcharcoal 0 - 5**
From	**To**	**Latin name**	**Common name**	**Number**				
-1.57	-1.58	*Alnus* *Pinus* *Quercus* *Corylus* type Poaceae Cyperaceae *Chenopodium* type *Cirsium* type *Rumex* undifferentiated	alder pine oak e.g. hazel grass family sedge family e.g. fat hen e.g. thistle dock/sorrel	3 4 6 1 7 5 2 1 1	5	569909	4	2

		Dryopteris type *Pteridium aquilinum*	buckler fern bracken	3 2				
-2.40	-2.41	*Alnus* *Quercus* *Corylus* type Poaceae Cyperaceae *Dryopteris* type *Polypodium vulgare*	alder oak e.g. hazel grass family sedge family buckler fern polypody fern	3 1 1 2 1 1 1	2	25605	4	0
-2.69	-2.70	*Alnus* *Quercus* *Tilia* *Corylus* type Poaceae Cyperaceae *Chenopodium* type *Dryopteris* type	alder oak lime e.g. hazel grass family sedge family e.g. fat hen buckler fern	3 5 1 1 1 20 1 65	5	7624	4	0
-2.93	-2.94	*Alnus* *Quercus* *Ulmus* *Salix* *Dryopteris* type	alder oak elm willow buckler fern	1 6 1 1 1	2	92920	3	0

Key:
Concentration: 0 = 0 grains; 1 =1-75 grains, 2 = 76-150 grains, 3 =151-225 grains, 4 = 226-300, 5 =300+ grains per slide
Preservation: 0 = none, 1 = very poor, 2 = poor, 3 = moderate, 4 = good, 5 = excellent
Charcoal: 0 = none, 1= negligible, 2 = occasional, 3 = moderate, 4 = frequent, 5 = abundant

Table 11: Results of the pollen assessment of borehole <QBH5>, Thames View Estate, Renwick Road, Barking, Essex (site code: TVE12)

Depth (m OD)		**Main pollen taxa**			**Concentration 0-5**	**Concentration grains/cm^3**	**Preservation 0- 5**	**Microcharcoal 0 - 5**
From	**To**	**Latin name**	**Common name**	**Number**				
-0.88	-0.89	*Alnus* *Quercus* *Tilia* *Corylus* type *Salix* Cyperaceae	alder oak lime e.g. hazel willow sedge family	19 7 1 3 1 2	5	108407	3-4	2

		Sparganium type *Dryopteris* type	bur-reed buckler fern	1 4				
-1.10	-1.11	*Alnus* Poaceae Cyperaceae *Sinapis* type *Plantago lanceolata* *Dryopteris* type	alder grass family sedge family e.g. charlock ribwort plantain buckler fern	3 3 5 1 1 4	2	19392	3-4	0
-1.44	-1.45	*Alnus* *Quercus* *Tilia* *Corylus* type *Sambucas nigra* Poaceae *Dryopteris* type	alder oak lime e.g. hazel elder grass family buckler fern	9 5 1 1 1 1 3	4	35619	3	0
-1.68	-1.69	*Alnus* *Quercus* *Tilia* Cyperaceae *Dryopteris* type	alder oak lime sedge family buckler fern	2 2 1 1 2	1	74336	3	0
-1.82	-1.83	*Alnus* *Quercus* *Ulmus* *Betula* *Tilia* *Pinus* *Fraxinus* *Corylus* type *Salix* Cyperaceae *Filipendula*	alder oak elm birch lime pine ash e.g. hazel willow sedge family meadowsweet	5 5 2 1 2 1 1 3 2 7 1	4/5	23724	4	0
-2.64	-2.65	*Alnus* *Quercus* *Dryopteris* type	alder oak buckler fern	30 2 12	5	132153	4/5	0
-3.16	-3.17	*Alnus* *Quercus* *Tilia* *Betula*	alder oak lime birch	26 5 1 1	5	108407	3/4	0

		Cyperaceae *Dryopteris* type	sedge family buckler fern	2 11				

Key:
Concentration: 0 = 0 grains; 1 =1-75 grains, 2 = 76-150 grains, 3 =151-225 grains, 4 = 226-300, 5 =300+ grains per slide
Preservation: 0 = none, 1 = very poor, 2 = poor, 3 = moderate, 4 = good, 5 = excellent
Charcoal: 0 = none, 1= negligible, 2 = occasional, 3 = moderate, 4 = frequent, 5 = abundant

RESULTS AND INTERPRETATION OF THE DIATOM ASSESSMENT

Two sub-samples from each borehole were extracted for the assessment of diatoms. The results are displayed in Table 12. The results of the diatom assessment indicate a limited concentration or absence of diatoms in the majority of the samples from all three boreholes. A number of factors influence diatom preservation, and it is probable that in the sediments examined here diatom concentrations were always low and that post-depositional destruction of the frustules has occurred due to drying-out, abrasion and possibly unfavourable chemical conditions. Dissolution of the diatom silica, for example, can occur as a response to the ambient dissolved silica concentration, the pH in open water, and the interstitial water in sediments. Using both fossil and modern diatoms, these and other environmental factors have been shown to affect the quality of preservation of assemblages (Flower, 1993; Ryves *et al*., 2001).

Table 12: Summary diatom assessment results of boreholes <QBH1>, <QBH4> & <QBH5>, Thames View Estate, Renwick Road, Barking, Essex (site code: TVE12)

Borehole number	Depth (m OD)		Diatom concentration	Quality of preservation	Diversity
	From	To			
<QBH1>	-1.56	-1.57	None	-	-
<QBH1>	-1.72	-1.73	Very low	Poor (fragmented & dissolved)	Low
<QBH4>	-2.29	-2.30	Low-moderate	Poor	Moderate
<QBH4>	-2.93	-2.94	None	-	-
<QBH5>	-0.96	-0.97	Very low	Poor (fragmented & dissolved)	Low
<QBH5>	-2.72	-2.73	None	-	-

RESULTS AND INTERPRETATION OF THE MACROFOSSIL ASSESSMENT

A total of fifteen small bulk samples (4 from borehole <QBH1>, 5 from borehole <QBH4> and 6 from borehole <QBH5>) were extracted for the recovery of macrofossil remains including waterlogged plant macrofossils, waterlogged wood, insects and Mollusca (Tables 13 to 15). The samples were focussed on the organic-rich sections of each borehole only. The results of the macrofossil rapid assessment indicate that no charred plant remains (charcoal, seeds or chaff) or bone were recorded in any of the samples. In borehole <QBH1> waterlogged wood was abundant in all samples, minimal waterlogged seeds were present in one sample and fragmented insect remains were present in two samples; no Mollusca remains were noted. In <QBH4>, waterlogged wood was present in moderate concentrations in all samples, minimal waterlogged seeds were present in two samples, and largely fragmented insect and Mollusca remains were present in the uppermost sample. In borehole <QBH5>, waterlogged wood was present in low to moderate quantities in all samples, minimal waterlogged seeds were present in two samples and fragmented insect remains were present in three samples; no Mollusca remains were noted.

Table 13: Results of the macrofossil assessment of borehole <QBH1>, Thames View Estate, Renwick Road, Barking, Essex (site code: TVE12)

				Charred					Waterlogged		Mollusca		Bone			
Depth (m OD)	Volume sampled (l)	Volume processed (l)	Fraction	Charcoal (>4mm)	Charcoal (2-4mm)	Charcoal (<2mm)	Seeds	Chaff	Wood	Seeds	Whole	Fragments	Large	Small	Fragments	Insects
-1.80 to -1.90	0.1	0.1	>300µm	-	-	-	-	-		-	-	-	-	-	-	-
			>1mm	-	-	-	-	-	1	-	-	-	-	-	-	-
-2.20 to -2.30	0.1	0.1	>300µm	-	-	-	-	-	-	-	-	-	-	-	-	-
			>1mm	-	-	-	-	-	4	-	-	-	-	-	-	-
-2.60 to -2.70	0.1	0.1	>300µm	-	-	-	-	-	-	-	-	-	-	-	-	1
			>1mm	-	-	-	-	-	3	-	-	-	-	-	-	-
-3.00 to -3.10	0.1	0.1	>300µm	-	-	-	-	-	-	-	-	-	-	-	-	1
			>1mm	-	-	-	-	-	3	1	-	-	-	-	-	-

Key: 0 = Estimated Minimum Number of Specimens (MNS) = 0; 1 = 1 to 25; 2 = 26 to 50; 3 = 51 to 75; 4 = 76 to 100; 5 = 101+

Table 14: Results of the macrofossil assessment of borehole <QBH4>, Thames View Estate, Renwick Road, Barking, Essex (site code: TVE12)

				Charred					Waterlogged		Mollusca		Bone			
Depth (m OD)	Volume sampled (l)	Volume processed (l)	Fraction	Charcoal (>4mm)	Charcoal (2-4mm)	Charcoal (<2mm)	Seeds	Chaff	Wood	Seeds	Whole	Fragments	Large	Small	Fragments	Insects
-2.40 to -2.45	0.1	0.1	>300µm	-	-	-	-	-	-	-	1	3	-	-	-	1
			>1mm	-	-	-	-	-	2	1	-	-	-	-	-	-
-2.45 to -2.50	0.1	0.1	>300µm	-	-	-	-	-	-	-	-	-	-	-	-	-
			>1mm	-	-	-	-	-	3	1	-	-	-	-	-	-
-2.62 to -2.72	0.1	0.1	>300µm	-	-	-	-	-	1	-	-	-	-	-	-	-
			>1mm	-	-	-	-	-	2	-	-	-	-	-	-	-
-2.80 to -2.85	0.1	0.1	>300µm	-	-	-	-	-	-	-	-	-	-	-	-	-
			>1mm	-	-	-	-	-	1	-	-	-	-	-	-	-
-2.85 to -2.90	0.1	0.1	>300µm	-	-	-	-	-	-	-	-	-	-	-	-	-
			>1mm	-	-	-	-	-	1	-	-	-	-	-	-	-

Key: 0 = Estimated Minimum Number of Specimens (MNS) = 0; 1 = 1 to 25; 2 = 26 to 50; 3 = 51 to 75; 4 = 76 to 100; 5 = 101+

Table 15: Results of the macrofossil assessment of borehole <QBH5>, Thames View Estate, Renwick Road, Barking, Essex (site code: TVE12)

				Charred					Waterlogged		Mollusca		Bone			
Depth (m OD)	Volume sampled (l)	Volume processed (l)	Fraction	Charcoal (>4mm)	Charcoal (2-4mm)	Charcoal (<2mm)	Seeds	Chaff	Wood	Seeds	Whole	Fragments	Large	Small	Fragments	Insects
-1.40 to -1.45	0.1	0.1	>300µm	-	-	-	-	-	-	-	-	-	-	-	-	1
			>1mm	-	-	-	-	-	1	-	-	-	-	-	-	-
-1.45 to -1.50	0.1	0.1	>300µm	-	-	-	-	-	-	-	-	-	-	-	-	-
			>1mm	-	-	-	-	-	1	1	-	-	-	-	-	-
-1.80 to -1.85	0.1	0.1	>300µm	-	-	-	-	-	-	-	-	-	-	-	-	1
			>1mm	-	-	-	-	-	3	-	-	-	-	-	-	-
-2.20 to -2.30	0.1	0.1	>300µm	-	-	-	-	-	-	-	-	-	-	-	-	1
			>1mm	-	-	-	-	-	3	-	-	-	-	-	-	-
-2.60 to -2.65	0.1	0.1	>300µm	-	-	-	-	-	-	-	-	-	-	-	-	-
			>1mm	-	-	-	-	-	1	-	-	-	-	-	-	-
-2.65 to -2.70	0.1	0.1	>300µm	-	-	-	-	-	-	-	-	-	-	-	-	-
			>1mm	-	-	-	-	-	1	1	-	-	-	-	-	-

Key: 0 = Estimated Minimum Number of Specimens (MNS) = 0; 1 = 1 to 25; 2 = 26 to 50; 3 = 51 to 75; 4 = 76 to 100; 5 = 101+

RESULTS OF THE WATERLOGGED PLANT MACROFOSSIL ASSESSMENT (SEEDS)

The results of the macrofossil rapid assessment indicated that waterlogged seeds were present in a very small number of the samples assessed; these samples underwent a more detailed assessment. The results are displayed in Table 16. The combined seed assemblage comprised *Alnus glutinosa* (alder), *Betula* (birch), *Rubus* (bramble), Cyperaceae (sedge family) and *Sparganium erectum* (bur-reed). These taxa are all typical of peatland fen environments. The limited concentration of remains prevents any further interpretation of this assemblage.

Table 16: Results of the waterlogged plant macrofossil (seeds) assessment of borehole <QBH1>, <QBH4> & <QBH5> Thames View Estate, Renwick Road, Barking, Essex (site code: TVE12)

Borehole number	Depth (m OD)	Waterlogged seeds		
		Latin name	**Common name**	**Number**
<QBH1>	-3.00 to -3.10	*Alnus glutinosa* catkins	alder	2
<QBH4>	-2.40 to -2.45	*Alnus glutinosa* catkins	alder	1
<QBH4>	-2.45 to -2.50	*Alnus glutinosa* catkins *Betula* sp. *Rubus* sp. *Sparganium erectum*	alder birch bramble bur-reed	7 1 2 1
<QBH5>	-1.45 to -1.50	*cf* Cyperaceae	sedge	1
<QBH5>	-2.65 to -2.70	*Rubus* sp.	Bramble	1

DISCUSSION AND CONCLUSIONS

The aim of the geoarchaeological assessment was to evaluate the potential of the borehole sequences for reconstructing the past environmental conditions of the site and its environs. Three borehole core sequences were selected to achieve this aim: <QBH1> and <QBH5> which are located at opposite ends of the site, and <QBH4> which contains a different sedimentary sequence to that recorded across the rest of the site.

Within the initial deposit modelling report, it was concluded that the deposits recorded at Thames View Estate were analogous to those recorded across much of the Lower Thames Valley (Batchelor and Green, 2012), with a sequence of Shepperton Gravel overlain by Holocene Alluvium (including Peat), capped by Made Ground. In addition, on the basis of other sites in the area, the Peat at the site was thought likely to have accumulated somewhere between 6000 and 3000 cal BP, with up to *ca*. 2000 years represented in the thickest sequences. The results of the assessment confirm this hypothesis, indicating that accumulation commenced at <QBH1> around 6180-5920 cal BP, at <QBH4> around 5880-5610 cal BP and at <QBH5> around 5660-5590 cal BP, all of which equate to the Early Neolithic cultural period. In addition, there is some indication that Peat formation may have commenced earliest towards the south of the site and migrated northwards. However, there is some uncertainty with this interpretation as the commencement of Peat accumulation may also reflect small variations in the underlying Shepperton Gravel topography (i.e. accumulation commenced earlier in areas with a deeper Shepperton Gravel surface).

Peat cessation took place during the Late Bronze Age, occurring at <QBH1> around 3580-3450 cal BP, at <QBH4> around 3240-3000 cal BP, and at <QBH5> sometime after 3680-3480 cal BP. However, establishing any specific pattern for cessation is not possible for the following reasons: (1) the thinner Peat horizon and nature of transition into the Upper Alluvium in <QBH4> is suggestive of an erosive/reworked contact; (2) Peat formation clearly continued after 3680-3480 cal BP (-1.45 to -1.50m OD) in <QBH5>, but the horizon horizon dated was selected due to a peak in organic matter content values. It is also of note that Waller *et al*. (2006) argue that dating the cessation of peat formation in lowland wetland environments may be subject to difficulties due to the presence of erosional/reworked contacts.

At Barking Riverside, a west-east transect of four borehole sequences were radiocarbon dated (Figure 1; Batchelor *et al*., 2011). The thickest Peat sequence was recorded furthest to the west between *ca*. -3.70 and -0.70m OD; this was radiocarbon dated between 6270-5990 and 3580-3400 cal BP. The remaining four sequences contained a much thinner horizon of

Peat, generally located between -1.00 and -2.50m OD and radiocarbon dated between *ca*. 5500 and 3300 cal BP. The new radiocarbon dated sequences from Thames View Estate therefore correspond well with the westernmost of the four sequences from Barking Riverside.

Peat units are highly significant as they have the potential to provide a detailed reconstruction of the environmental history of the site and its environs on both the semi-terrestrial Peat surface and neighbouring dryland. In the main, the concentration and preservation of palaeobotanical and zooarchaeological remains is high within such organic-rich deposits, and work on these remains from other sites within the Lower Thames Valley has demonstrated that there are significant interactions between human activity, sea level change and vegetation history that warrant investigation, not only at the interfaces between the Lower Alluvium, Peat and Upper Alluvium, but during the accumulation of the Peat itself.

At Thames View Estate, the concentration and preservation of the palaeobotanical and zooarchaeological remains is variable. Very few waterlogged seed, insect and diatom remains are preserved; however, with only a few exceptions, pollen and waterlogged wood are generally present in moderate to very high concentrations, and in a good state of preservation. The pollen and limited waterlogged seed assemblage is indicative of the growth of typical fen carr woodland dominated by alder growing on the wetland, whilst oak-lime dominated mixed deciduous woodland grew on the dryland. It is possible that the variable state of preservation is related to a very dry (more terrestrial) Peat surface as indicated by high and non-varying organic matter content values.

Significantly, the date of Peat accumulation in combination with the limited number of *Ulmus* pollen grains recorded suggests that the sequence post-dates the Neolithic elm decline. This decline is a well-documented phenomenon in pollen diagrams across the British Isles occurring between 6343 and 5290 cal BP (Parker *et al*., 2002), and is important from an archaeological point of view as anthropogenic activity in the form of temporary land clearance for pastoral/arable purposes is strongly advocated as a cause of the decline (e.g. Scaife, 1988; Lamb and Thompson, 2005), along with disease (e.g. Perry and Moore, 1987; Girling, 1988), and possibly climate change (e.g. Smith, 1981), competition (e.g. Huntley and Birks, 1983; Peglar and Birks, 1993) and soil deterioration (Peglar and Birks, 1993). In the Lower Thames Valley, good evidence for a combination of human activity and disease has recently been recorded at Horton Kirby, Old Seager Distillery and Golfers Driving Range (Batchelor *et al*., in prep). However, the number of radiocarbon dated sequences containing a Neolithic elm decline remains limited in the Lower Thames Valley, and the chronology and

causes of the event remain an important geoarchaeological consideration.

Also of importance is the lack of *Taxus* (yew) pollen and seeds recorded during the course of the assessment. Yew is now well recognised as forming an important component of the fen carr woodland spanning from at least East India Docks (Pepys, 1665) in the west to Aveley Parish and Erith Forest in the east (Wilkinson and Murphy, 1995; Seel, 2001), between 5000 and 4000 cal BP. The importance of increasing knowledge and understanding of the timing and causes of this colonisation and decline have recently been highlighted by Batchelor (2009b) and Branch *et al*., (2012) who propose five possible mechanisms: (1) variations in peat surface hydrology; (2) variations in the rate of relative sea level rise; (3) human activity; (4) climatic change, and (5) genetic variability. Of these, variations in peat surface hydrology driven by relative sea level change appear to be the main cause. However, the initial colonisation of yew sometimes occurs shortly after the Neolithic elm decline, whilst its decline occurs at the same time as an increase in wetland and dryland utilisation during the Early Bronze Age. Unequivocal evidence for the use of yew contemporaneous with its decline is only recorded at Golfers Driving Range (Batchelor, 2009b). Despite this, the impact of humans upon the decline of yew should not be underestimated. Many palaeoenvironmental and archaeological records indicate that the wetland had a role in the rearing of domesticated animals. The impact of such animals on *Taxus* in modern day contexts is well documented, as whilst the tree is toxic, animals can become tolerant with continual browsing, which the tree is highly susceptible to, and disadvantaged by (e.g. Mysterud and Østbye, 2004). For this reason, the timing and causes of the colonisation and decline of yew is considered significant from an archaeological viewpoint.

Towards the top of the Peat, the assemblage from <QBH1> indicates the decline of alder dominated fen carr woodland and increase of herbs and aquatics suggestive of open and wetter conditions. There is also potential pollen evidence for the growth of saltmarsh plants (and therefore a brackish water influence) on the wetland at this time. On the dryland, a near-contemporaneous large-scale decline in the oak-lime dominated woodland also occurred, which appears to have been at least partially linked to Bronze Age human activity in the form of clearance for farming and/or settlement purposes. Combined, these environmental changes are highly significant as they indicate interactions not only between the wetland and dryland but also between vegetation change, relative sea level change and human activity. Also of interest is that the record from <QBH5> does not concur with that from <QBH1>, instead indicating the continuance of wetland and possibly dryland woodland growth well beyond 3680-3480 cal BP. This result suggests variability in the environmental history of the site during at least the latter part of the sequence.

The final significant finding from the assessment is the concentration of anthropogenic indicators towards the top of the <QBH1> sequence above 0m OD. These include multiple cereal, cornflower, Chenopodiaceae (potentially fat hen), e.g. charlock, daisy, dandelion and ribwort plantain pollen grains, all of which are strongly suggestive of cultivation on the floodplain. This occurrence is located within an organic-rich clay beneath the Made Ground, and thus is clearly either a very late prehistoric, or more likely historic event. Unfortunately, obtaining a chronology on this horizon is made difficult by the lack of identifiable macrofossil remains.

RECOMMENDATIONS

Analysis of borehole core samples from the Thames View Estate is recommended. However, due to the poor concentration and preservation of macrofossil remains, this analysis should be limited to pollen analysis of the <QBH1> and <QBH5> sequences, which will only be concentrated on the top and base of the Peat. The analysis of these sequences will elucidate: (1) the presence/absence of a Neolithic elm decline, (2) the presence/absence of yew, and (3) the timing and nature of the environmental changes towards the top of the Peat sequences. Furthermore, the analysis of these sequences will provide a transect of environmental changes between the River Thames and dryland edge (particularly when combined with the recent Barking Riverside records), and elucidate the different environmental signals provided towards the top of the Peat in each sequence. Finally, and most importantly, this analysis will permit the identification of anthropogenic indicators and the impact of human activity upon the local landscape. Due to the probable erosional/reworked Peat surface in <QBH4>, further work on this borehole is not recommended.

REFERENCES

Andersen, S.Th. (1979) Identification of wild grasses and cereal pollen. *Danmarks Geologiske Undersogelse,* **1978**, 69-92.

Batchelor, C.R. (2012) Written Scheme of Investigation for the Geoarchaeological Investigation of Land at Thames Valley Estate, Renwick Road, Barking Essex. Quaternary Scientific (QUEST) Unpublished Report March 2012.

Batchelor, C.R. (2009a) Gallions *Reach Shopping Park, London Borough of Newham: environmental archaeological report*. Quaternary Scientific (QUEST) Unpublished Report March 2009; Project Number 001/09.

Batchelor, C.R. (2009b) *Middle Holocene environmental changes and the history of yew (*Taxus baccata *L.) in the lower Thames Valley*. Royal Holloway, University of London Unpublished PhD Thesis.

Batchelor, C.R. & Green, C.P. (2012) Thames View Estate, Renwick Road, Barking, Essex (site code: TVE12): Geoarchaeological fieldwork report. *Quaternary Scientific (QUEST) Unpublished Report April 2012; Project Number 069/12.*

Batchelor, C.R., Green, C.P., Young, D.S., Brown, A., Austin, P., Cameron, N., & Elias, S. (2011) *A report on the geoarchaeological borehole investigations and deposit modelling on land at Barking Riverside (site code: RWC10).* Quaternary Scientific (QUEST) Unpublished Report December 2010; Project Number 002/10.

Batchelor, C.R., Branch, N.P., Allison, E., Austin, P.A., Bishop, B., Brown, A., Elias, S.E., Green, C.P. & Young D.S. (in prep) The causes of the Neolithic elm decline: New evidence from the Lower Thames Valley for human activity and disease.

Battarbee, R.W., Jones, V.J., Flower, R.J., Cameron, N.G., Bennion, H.B., Carvalho, L. & Juggins, S. (2001) *Diatoms.* In (J.P. Smol and H.J.B. Birks eds.), *Tracking Environmental Change Using Lake Sediments Volume 3: Terrestrial, Algal, and Siliceous Indicators*, 155-202. Dordrecht: Kluwer Academic Publishers.

Bengtsson, L. & Enell, M. (1986) Chemical Analysis. In (Berglund, B.E. ed.) *Handbook of Holocene palaeoecology and palaeohydrology,* 423-451. Chichester: John Wiley and Sons.

Branch, N.P., Batchelor, C.R., Cameron, N.G., Coope, G.R., Densem, R., Gale, R., Green, C.P. & Williams, A.N. (2012) Holocene environmental changes in the Lower Thames Valley, London, UK: Implications for our understanding of the history of *Taxus* woodland. *The Holocene*, in press.

Bronk Ramsey C. (1995) Radiocarbon Calibration and Analysis of Stratigraphy: The OxCal Program, *Radiocarbon* **37 (2)**, 425-430.

Bronk Ramsey C. (2001) Development of the Radiocarbon Program OxCal, *Radiocarbon* **43 (2a)**, 355-363.

Bronk Ramsey, C. (2007) Deposition models for chronological records. *Quaternary Science*

Reviews (INTIMATE special issue; 27(1-2), 42-60.
Cappers, R.T.J., Bekker R.M. & Jans J.E.A. (2006) Digital Seed Atlas of the Netherlands. Groningen Archaeological Series 4. Barkhuis, Netherlands

Coles, B. (1990) Anthropomorphic wooden figures from Britain and Ireland. *Proceedings of the Prehistoric Society,* **56**, 315-33.

Divers, D. (1996) *Archaeological Investigation of Hays Storage Services LTD, Pooles Lane, Ripple Road, Dagenham, Essex*. Newham Museum Service Unpublished Report.

Divers, D. (1995) *Archaeological evaluation at the site of the proposed East London Sludge Incineration Plant, Beckton Sewage Treatment Works, London E6*. Newham Museum Service Unpublished Report.

Flower, R.J. (1993) Diatom preservation: experiments and observations on dissolution and breakage in modern and fossil material. *Hydrobiologia 269/270*, 473-484.

Gifford & Partners Ltd. (2001) *A13 Thames Gateway Phase III Archaeological Works: Freemasons Road Underpass Assessment Report on Detailed Excavation*. Gifford Unpublished Report.

Girling, M.A. (1988) The bark beetle *Scolytus scolytus* (Fabricius) and the possible role of elm disease in the early Neolithic, In (M. Jones, ed.) *Archaeology and the Flora of the British Isles*. Oxford University Committee for Archaeology, **14**, 34-38.

Ian Farmer Associates (2011) Draft report on Phase 2 Ground Investigation carried out at East End Thames View, Barking, London. Ian Farmer Associates (1998) Limited unpublished report.

Huntley, B. & Birks, H.J.B. (1983) *An atlas of past and present pollen maps of Europe: 0-13,000 years ago*. Cambridge: Cambridge University Press.

Lakin, D. (1999) A Romano-British site at Summerton Way, Thamesmead, London Borough of Bexley. *Archaeologia Cantiana*, **119**, 311-41.

Lamb, H. & Thompson, A. (2005) Unusual mid-Holocene abundance of *Ulmus* in western

Ireland - human impact in the absence of a pathogen? *The Holocene,* **15(3)**, 447-452.

Moore, P.D., Webb, J.A. and Collinson, M.E. (1991) *Pollen Analysis* (2nd Ed.). Oxford: Blackwell.

Mysterud, A. & Ostbye, E. (2004) Roe deer (Capreolus capreolus) browsing pressure affects yew (*Taxus baccata*) recruitment within nature reserves in Norway. *Biological Conservation,* **120**, 545-548.

Parker, A.G., Goudie, A.S., Anderson, D.E., Robinson, M.A. & Bonsall, C. (2002) A review of the mid-Holocene elm decline in the British Isles. *Progress in Physical Geography,* **26(1)**, 1-45.

Peglar, S.M. & Birks, H.J.B. (1993) The mid-Holocene Ulmus fall at Diss Mere, south-east England – disease and human impact? *Vegetation history and Archaeobotany,* **2**, 61-68.

Pepys, S. (1665). *Samuel Pepys Diary September 1665*. Available at http://www.pepysinfo/1665/ 1665sep.html accessed on 20th April 2007.

Perry, I. & Moore, P.D. (1987) Dutch elm disease as an analogue of Neolithic elm decline. *Nature,* **326**, 72-73.

Reille, M. (1992) *Pollen et Spores d'Europe et d'Afrique du Nord*. Marseille : Laboratoire de Botanique Historique et Palynologie.

Reimer, P.J., Baillie, M.G.L., Bard, E., Bayliss, A., Beck, J.W., Blackwell, P.G., Bronk Ramsey, C., Buck, C.E., Burr, G.S., Edwards, R.L., Friedrich, M., Grootes, P.M., Guilderson, T.P., Hajdas, I., Heaton, T.J., Hogg, A.G., Hughen, K.A., Kaiser, K.F., Kromer, B., McCormac, F.G., Manning, S.W., Reimer, R.W., Richards, D.A., Southon, J.R., Talamo, S., Turney, C.S.M., van der Plicht, J. &,(2009), IntCal09 and Marine09 Radiocarbon Age Calibration Curves, 0–50,000 Years cal BP. *Radiocarbon*, **51(4)**, 1111-1150.

Ryves, D.B., Juggins, S., Fritz, S.C. & Battarbee, R.W. (2001) Experimental diatom dissolution and the quantification of microfossil preservation in sediments. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 172, 99-113.

Scaife, R.G. (1988) The elm decline in the pollen record of South-east England and its

relationship to early agriculture. In (M. Jones, ed.) *Archaeology and the flora of the British Isles*, 21-33. Oxford University Committee for Archaeology.

Schoch, W., Heller, I., Schweingruber, F. H., and Kienast, F. (2004) *Wood anatomy of central European Species*. Online version: www.woodanatomy.ch.

Seel, S.P.S. (2001) *Late Prehistoric woodlands and wood use on the Lower Thames floodplain.* University College, London: Unpublished PhD thesis.

Sidell, E.J. (2003) *Relative sea-level change and archaeology in the inner Thames estuary during the Holocene.* University College, London, Unpublished PhD Thesis.

Smith, A.G. (1981) The Neolithic. In (I.G. Simmonds & M.J. Tooley, eds.) *The environment in British prehistory*, 125-209. London: Duckworth.

Stace, C. (2005) *New Flora of the British Isles*. Cambridge: Cambridge University Press.

Tröels-Smith, J. (1955) Karakterisering af løse jordater (Characterisation of unconsolidated sediments), *Danm. Geol. Unders., **Ser IV* **3**, 73.

Waller, M.P., Long, A.J. & Schofield, J.E. (2006) Interpretation of radiocarbon dates from the upper surface of late-Holocene peat layers in coastal lowlands. *The Holocene,* **16(1)**, 51-61.

Waller, M. & Grant, M.J. (2012) Holocene pollen assemblages from coastal wetlands: differentiating natural and anthropogenic causes of change in the Thames estuary, UK. *Journal of Quaternary Science*, in press.

Wilkinson, T.J. & Murphy, P.L. (1995) *The archaeology of the Essex coast, volume 1: The Hullbridge Survey*. East Anglian Archaeology.

APPENDIX 1: ADDITIONAL QUEST BOREHOLE LOGS

Lithostratigraphic description of Borehole <QBH2>, Thames View Estate, Renwick Road, Barking, Essex

Depth (m OD)	Depth (BGS)	Unit number	Description
1.94 to 0.34	0 to 1.60	5	Made Ground; sharp contact into:
0.34 to -0.06	1.60 to 2.00	4	10YR 5/3; As3, Ag1; Brown silty clay; diffuse contact into:
-0.06 to -1.01	2.00 to 2.95	4	10YR 7/4; As4, Ag+; Very pale brown clay with traces of silt and brownish yellow concretions; diffuse contact into:
-1.01 to -1.88	2.95 to 3.82	4	10YR 6/1; As4, Ag+, Dl+; Grey clay with traces of sily and detrital wood; sharp contact into:
-1.88 to -2.00	3.82 to 3.94	4	10YR 4/1; As3, Sh1, Dl+; Dark grey organic-rich clay with traces of detrital wood; diffuse contact into:
-2.00 to -2.06	3.94 to 4.00	3	10YR 4/1; As2, Sh2, Dl/Tl+; Dark grey clay-rich peat with traces of detrital or *in situ* wood remains; diffuse contact into:
-2.06 to -2.86	4.00 to 4.80	3	10YR 2/1; Sh2, $Tl^2$2, Humo 3; Black well humified wood peat with lenses at 4.47 to 4.49m BGS & 4.69 to 4.72m BGS of Gley 1 8/10Y; As3, Ga1; Light greenish grey sandy silt; sharp boundaries between each sub-unit and into:
-2.86 to -2.91	4.80 to 4.85	2	Gley 1 8/10Y and 10YR 5/1; As3, Ga1, Dl+; Light greenish grey and grey sandy silt with traces of detrital wood; sharp contact into:
-2.91 to -3.06	4.85 to 5.00	2	10YR 4/1; Ga2, Ag1, As1; Dark grey clayey silty sand; diffuse contact into:
-3.06 to -3.17	5.00 to 5.11	2	5Y 7/1; Ga3, Ag1; Light grey silty sand; sharp contact into:
-3.17 to -3.47	5.11 to 5.41	2	5Y 6/1; As2, Ag1, Ga1; Grey silty sandy clay; diffuse contact into
-3.47 to -3.67	5.41 to 5.61	2	5Y 6/1; As2, Ag1, Ga1, Dl/Tl+; Grey silty sandy clay with traces of detrital or *in situ* (root?) wood; diffuse contact into:
-3.67 to -3.98	5.61 to 5.92	2	5Y 7/2; Ga2, Ag1, As1; Light grey silty clayey sand; sharp contact into:
-3.98 to -4.06	5.92 to 6.00	1	5Y 7/2; Ga2, Gg2; Light grey sandy gravel.

Lithostratigraphic description of Borehole <QBH3>, Thames View Estate, Renwick Road, Barking, Essex

Depth (m OD)	Depth (BGS)	Unit number	Description
2.47 to 0.42	0 to 2.05	5	Made Ground; sharp contact into:
0.42 to 0.32	2.05 to 2.15	4	10YR 4/1; As2, Ag1, Ga1, brick+, Gg+; Dark grey silty sandy clay with inclusions of brick and gravel; sharp contact into:
0.32 to -0.53	2.15 to 3.00	4	10YR 5/1 becoming 10YR 6/1; As3, Ag1, chalk+; Grey becoming light grey silty clay with chalk inclusions and brownish yellow concretions; diffuse contact into:
-0.53 to -0.96	3.00 to 3.43	4	10YR 6/1 to 10YR 5/1; As3, Ag1; Light grey to grey silty clay; sharp contact into:
-0.96 to -1.07	3.43 to 3.54	4	10YR 5/2; As3, Sh1, Dl+; Greyish brown organic-rich clay with detrital wood inclusions; diffuse contact into:
-1.07 to -1.13	3.54 to 3.60	3	10YR 4/2; As2, Sh2, Dl/Tl+; Dark greyish brown clay-rich peat with traces of detrital or *in situ* wood; diffuse contact into:
-1.13 to -1.34	3.60 to 3.81	3	10YR 2/1; Sh4, Tl+; Humo 4; Black very well humified unidentifiable peat with traces of wood; diffuse contact into:
-1.34 to -2.53	3.81 to 5.00	3	10YR 3/1 to 10YR 3/2; Sh3, $Tl^3$1; Humo 4; Very dark grey to very dark greyish brown very well humified wood peat; sharp contact into:
-2.53 to -2.59	5.00 to 5.06	2	10YR 4/1; Ag2, Sh1, As1, Dl/Tl+; Dark grey organic-rich clayey silt with traces of detrital or in situ wood remains; diffuse contact into:
-2.59 to -2.70	5.06 to 5.17	2	10YR 5/1; Ag2, As2, Sh+; Grey silty clay with traces of organic material; diffuse contact into:
-2.70 to -3.00	5.17 to 5.47	2	10YR 6/1 to Gley 1 8/10Y; As2, Ag2, Dl+; Grey to light greenish grey clayey silt with traces of detrital wood; diffuse contact into:
-3.00 to -3.32	5.47 to 5.79	2	10YR 6/1; As2, Ag2, Dl/Tl+, Ga+; Grey clayey silt with traces of detrital or in situ (root?) remains; sharp contact into:
-3.32 to -3.53	5.79 to 6.00	2	Gley 1 8/10Y; Ag2, Ga2; Light greenish grey silty sand; diffuse contact into:
-3.53 to -3.74	6.00 to 6.21	2	10YR 6/1; As2, Ag2, Dl/Tl+, Ga+; Grey clayey silt with traces of detrital or in situ (root?) remains; sharp contact into:
-3.74 to -3.89	6.21 to 6.36	1	10YR 6/1 to 10YR 5/1; Ga2, Ag1, Gg1; Grey silty sand with gravel; sharp contact into:
-3.89 to -4.53	6.36 to 7.00	1	5YR 7/6; Ga2, Gg2; Yellow sandy gravel.

Lithostratigraphic description of Borehole <QBH6>, Thames View Estate, Renwick Road, Barking, Essex

Depth (m OD)	Depth (BGS)	Unit number	Description
2.44 to 0.65	0 to 1.79	5	Made Ground; sharp contact into:
0.65 to 0.51	1.79 to 1.93	4	10YR 5/2; As3, Ag1; Greyish brown silty clay; diffuse contact into:
0.51 to -0.56	1.93 to 3.00	4	10YR 7/2; As4, Ag+; Light grey clay with traces of silt and brownish yellow concretions; sharp contact into:
-0.56 to -1.06	3.00 to 3.50	4	10YR 5/1; As3, Sh1, Tl/Dl+; Grey organic-rich clay with inclusions of detrital or *in situ* wood remains (increasing downwards); diffuse contact into:
-1.06 to -1.40	3.50 to 3.84	3	10YR 4/1; As2, Sh2, Th+, Tl+; Dark grey clay-rich peat with inclusions of wood and herbaceous peat; diffuse contact into:
-1.40 to -2.56	3.84 to 5.00	3	10YR 2/1; Sh3, $Tl^3$1, As+, Th+; Humo 3; Black well humified wood peat with traces of clay and herbaceous peat
-2.56 to -3.56	5.00 to 6.00		VOID (non-retrieval)
-3.56 to -4.41	6.00 to 6.85	2	2.5Y 7/3; Ga2, Gg1, Ag1; Pale yellow silty sand with gravel; diffuse contact into:
-4.41 to -4.47	6.85 to 6.91	2	2.5Y 7/3; As2, Ga1, Ag1; Pale yellow silty sandy clay; sharp contact into:
-4.47 to -4.56	6.91 to 7.00	1	10YR 6/2; Ga2, Gg2; Light brownish grey sandy gravel.

APPENDIX 2: SUMMARY EXISTING GEOTECHNICAL DATA FROM THAMES VIEW ESTATE, RENWICK ROAD, BARKING, ESSEX

Borehole number	Easting	Northing	Surface elevation (m OD)	Top of Upper Alluvium (m OD)	Top of Peat (m OD)	Top of Lower Alluvium (m OD)	Gravel surface (m OD)	London Clay surface (m OD)	Peat thickness (m)
<QBH1>	546850.044	182909.746	1.83	0.29	-1.62	-3.12	-3.97		1.50
<QBH2>	546851.519	182995.257	1.94	0.34	-2.00	-2.86	-3.98		0.86
<QBH3>	546880.654	183066.729	2.47	0.42	-1.07	-2.53	-3.74		1.46
<QBH4>	546901.571	183178.654	2.46	0.50	-2.05	-2.90	-3.54		0.85
<QBH5>	546816.763	183207.698	2.54	0.45	-0.76	-2.71	-3.51		1.95
<QBH6>	546777.978	183242.743	2.44	0.65	-1.06	Not recorded	-4.47		
BH1	546901.8	183233	2.63	0.63	-1.27	-2.27	-3.37	-8.57	1.9
BH2	546868	183173.1	3.12	-0.18	-1.38	-2.38	-3.28	-8.68	1
BH3	546914	183150.3	2.23	-0.27	-1.27	-2.77	-3.27	-8.17	1.5
BH4	546843	183099.8	2.1	0.1	-1.1	-2.8	-3.7	-8.80	1.6
BH5	546902.2	183085.3	2.41	None	-1.39	-3.19	-3.89	-8.59	1.8
BH6	546904.4	183004.2	2.51	0.81	Units described together		-3.39	-8.39	
BH7	546856.9	183000.6	1.98	0.88	Units described together		-3.92	-8.92	
BH8	546905.7	182912.3	2.16	-0.84	-1.34	-3.34	-3.74	-9.34	2
BH9	546846.1	183240	2.57	0.57	-0.93	-2.73	-4.13	-7.93	1.8
BH10	546766.7	183241.9	2.22	0.62	-0.48	-2.68	-4.28	-8.48	2.2
TP01	546879.2	183231.2	2.66	0.56					
TP02	546886.3	183209.5	3.01	0.51					
TP03	546913	183181.8	2.24	-0.16	-0.96				
TP05	546868.1	183132.9	2.76	0.26	-1.14				
TP06	546871.8	183091.8	2.39	0.09	-1.11				
TP07	546909.1	183043.2	2.1	0.4	-0.8				
TP08	546879.2	183034.6	2.49	0.09	-1.21				
TP09	546866.4	182995.8	2.08	0.78	-1.82				
TP10	546926	182997.1	2.31	0.81					
TP11	546913.2	182940.6	2.19	0.89					
TP12	546856.7	182928	2.01	-0.19	-1.79				
TP13	546912.6	182895.6	1.73	0.83	-0.67				
TP14	546821.7	182893.9	1.53	0.23	-1.67				
TP15	546839.7	183036.5	1.82	0.12					
TP16	546845.1	183142.1	2.35	0.35	-1.15				
TP17	546858.1	183192.2	2.56	-0.14	-1.14				
TP20	546762.5	183192	2.54	-0.16	-1.56				

APPENDIX 3: OASIS

Project details

Project name	Thames View Estate, Renwick Road: Geoarchaeological fieldwork and assessment
Short description of the project	Geoarchaeological fieldwork was carried out at the site to investigate the nature of the sub-surface stratigraphy. The results of the fieldwork were intergrated with previous geotechnical records from the site to provide a series of topographic maps for the surface of each major stratigraphic unit as follows: London Clay, Shepperton Gravel, Lower Alluvium, Peat, Upper Alluvium and Made Ground. The results revealed a reasonably uniform sequence of Holocene Alluvium overlying a gravel surface that lay between -3.20 and -4.50m OD. A subsequent assessment of three boreholes core samples indicates that Peat deposition commenced during the Early Neolithic and continued until the Late Bronze Age. The sequences appear to post-date the Neolithic elm decline, and no evidence of yew was recorded (both of which require clarification). Peat cessation appears to coincide with the decline of wetland and dryland woodland and the occurrence of anthropogenic activity. A limited final stage of analysis was recommend to elucidate the findings of the assessment.
Project dates	Start: 12-04-2012 End: 09-07-2012
Previous/future work	No / Yes
Any associated project reference codes	TVE12 - Sitecode
Type of project	Environmental assessment
Site status	None
Current Land use	Vacant Land 1 - Vacant land previously developed
Significant Finds	PEAT Late Prehistoric
Survey techniques	Archaeology

Project location

Country	England
Site location	GREATER LONDON BARKING AND DAGENHAM BARKING Thames View Estate, Renwick Road
Postcode	IG11
Site coordinates	TQ 46800 83100 51 0 51 31 37 N 000 06 59 E Point
Height OD / Depth	Min: -1.00m Max: 1.00m

Project creators

Name of Organisation	Quaternary Scientific (QUEST)
Project brief originator	CgMs Consulting

Project design originator	Dr C.R. Batchelor
Project director/manager	C.R. Batchelor
Project supervisor	C.R. Batchelor
Type of sponsor/funding body	Developer

Project archives

Physical Archive recipient	LAARC
Physical Contents	"Environmental"
Digital Archive recipient	LAARC
Paper Archive recipient	LAARC
Paper Media available	"Report"

Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	WRITTEN SCHEME OF INVESTIGATION FOR THE GEOARCHAEOLOGICAL INVESTIGATION OF LAND AT THAMES VIEW ESTATE, RENWICK ROAD
Author(s)/Editor(s)	Batchelor, C.R.
Date	2012
Issuer or publisher	Quaternary Scientific
Place of issue or publication	University of Reading

Project bibliography 2

Publication type	Grey literature (unpublished document/manuscript)
Title	THAMES VIEW ESTATE, RENWICK ROAD, BARKING, ESSEX (SITE CODE: TVE12): GEOARCHAEOLOGICAL FIELDWORK REPORT
Author(s)/Editor(s)	Batchelor, C.R.
Author(s)/Editor(s)	Green, C.P.
Other bibliographic details	Quaternary Scientific (QUEST) Unpublished Report April 2012; Project Number 069/12

Date	2012
Issuer or publisher	Quaternary Scientific
Place of issue or publication	University of Reading

Project bibliography 3

Publication type	Grey literature (unpublished document/manuscript)
Title	THAMES VIEW ESTATE, RENWICK ROAD, BARKING, ESSEX (SITE CODE: TVE12): GEOARCHAEOLOGICAL FIELDWORK REPORT
Author(s)/Editor(s)	Batchelor, C.R.
Author(s)/Editor(s)	Young, D.S.
Author(s)/Editor(s)	Green, C.P.
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Date	2012
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