A REPORT ON THE GEOARCHAEOLOGICAL BOREHOLE INVESTIGATIONS AND DEPOSIT MODELLING ON LAND AT ENDERBY WHARF, CHRISTCHURCH WAY, LONDON BOROUGH OF GREENWICH SE10 0AG (NGR: TQ 3925 7873)

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INTRODUCTION

This report summarises the findings arising out of the deposit modelling undertaken by Quaternary Scientific (University of Reading) in connection with the proposed development at Enderby Wharf, Christchurch Way, London Borough of Greenwich (National Grid Reference centred on: TQ 3925 7873; Figures 1 and 2). The site is approximately 4.0 hectares in size, and is located towards the south-western corner of Greenwich Peninsula, bounded to the west by the River Thames and to the east by Blackwall Lane. Greenwich Peninsula is formed and bounded by a meander of the Thames to the west, east and north of the site, and lies opposite the confluence of the River Lea. The ground across the area originally formed part of the natural floodplain of the Thames and is underlain by river alluvium (British Geological Survey 1:50,000 sheets 256 North London 1993, 257 Romford 1996, 270 South London 1998, 271 Dartford 1998). This alluvium consists of fine-grained mineral-rich deposits and Peat, and is mapped to the south to approximately the position of the A206 where it meets higher drier ground. Beneath the alluvium, sand and gravel is present and is assigned by Gibbard (1994) to the Late Devensian Shepperton Gravel. The bedrock beneath this is mapped as the Palaeogene Lambeth Group – Clay, Silt and Sand. Ground level at the site is recorded at between 2.6 and 4.6m OD (Hawkins, 2013).

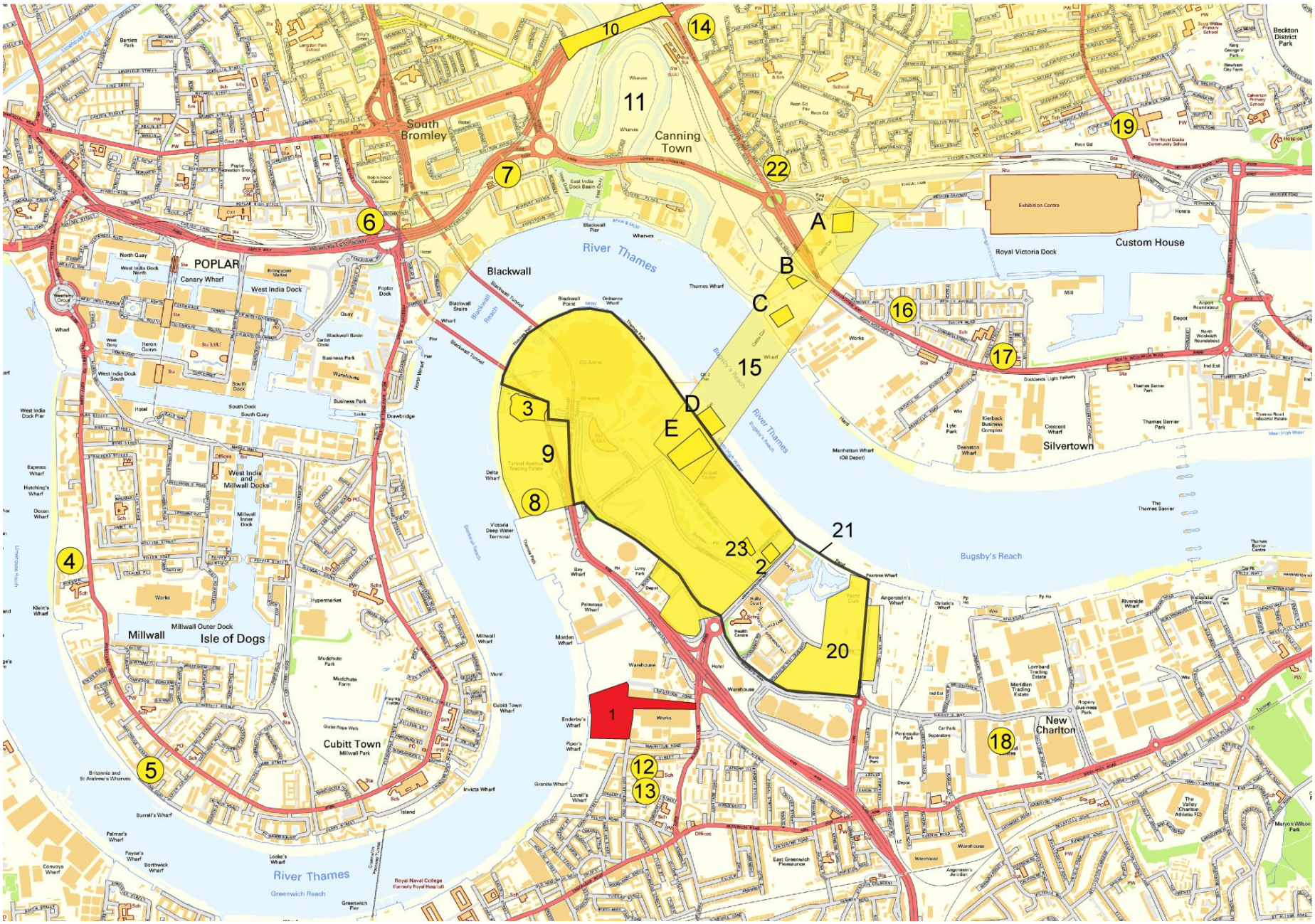
During previous geotechnical investigations at the site, boreholes and test pits were put down by URS (2013), Water and Earth Science Associated UK Ltd (1993) and Babtie (2003). The results of the borehole investigations recorded a terrace gravel surface (the Late Devensian 'Shepperton Gravel') that fell westwards from between 4.0 and 5.6m bgs in the eastern part of the site, to between 6.0 and 7.5m bgs in the west. Alluvium between 3 and 5m thick was recorded overlying the Shepperton Gravel, containing Peat in variable thicknesses between *ca*. 2.5 and 6.0m bgs. In the western half of the site Peat was recorded in URS boreholes BH202 (2.9 to 4m bgs) and BH203 (4.2 to 5.3m bgs), and in test pits TP205 (2.8 to 4.0m bgs) and TP208 (2.5 to 3.3m bgs); in WESA boreholes BH6 (3.5 to 5.0m bgs), BH4 and BH11 (both 3.5 to 6.0m bgs) and in Babtie borehole BH10 (2.5 to 3.4m bgs). Towards the east, Peat was recorded in URS borehole BH205 between 2.6 and 4.5m bgs.

Made Ground generally between 1.0 and 2.0m thick was recorded overlying the Alluvium across the site.

Previous geoarchaeological investigations (see Figure 1) at the Millennium Festival Site, Greenwich (BWP97; Bowsher & Corcoran, unknown date), the Cable Car South Station (CAB11; Batchelor *et al*., 2012), Greenwich Millennium Village (Miller & Halsey, 2011) and at the Victoria Deep Water Terminal and across Greenwich Peninsula as a whole (TUA02; Corcoran, 2002) have revealed a sequence of Shepperton Gravel, overlain by Alluvium and Made Ground. At these sites, and at others nearby to the Greenwich Peninsula area (e.g. Silvertown; Wilkinson *et al*., 2000), a horizon of Peat within the alluvium has been radiocarbon dated as accumulating between approximately 6000 and 3000 cal BP, equating to the Neolithic and Bronze Age cultural periods.

The different stratigraphic units recorded are significant as they represent different environmental conditions that would have existed in a given location. For example, soil and Peat represent former terrestrial or semi-terrestrial land-surfaces, whilst fine to medium-grained sediments such as sands, silts and clays represent periods of inundation/flooding by estuarine or fluvial waters. Thus by studying the sub-surface stratigraphy across a given area (i.e. the Enderby Wharf site), it is possible to gain an understanding of the former landscapes and environmental changes that took place over space and time. Furthermore, any soils or Peat horizons represent potential areas that might have been utilised or even occupied by prehistoric people. Similarly, high areas of Shepperton Gravel may also represent utilised surfaces as they remained elevated above the floodplain during periods of inundation. Evidence for such utilisation of the floodplain landscape has, for example, been recorded at two sites on Bellot Street, only *ca*. 150m south of Enderby Wharf (GLB05 / BSG93; Branch *et al*., 2005; McLean, 1993; Philp, 1993), and at Atlas Wharf (AWF98; Lakin, 1998) where Bronze Age trackways were found in the Peat.

The aim of this report is to produce a model of the sub-surface stratigraphy of the site using a combination of the recent geotechnical boreholes monitored by Quaternary Scientific, and existing BGS borehole records on or nearby to the site. This model will be used to provide a reconstruction of the site's former landscape and its evolution through time, as well as its potential utilisation by prehistoric people. Finally, this report will provide recommendations on the suitability for further geoarchaeological investigations.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Custom House
Royal Victoria Dock
Silvertown
New Charlton
Millwall
Isle of Dogs
Cubitt Town
Bugsby's Reach
Greenwich Reach

Figure 1: Location of (1) Enderby Wharf, Christchurch Way, London Borough of Greenwich and other geoarchaeological and archaeological sites nearby: (2) Plot MO117 (JHW13; Young & Batchelor, 2013b); (3) Tunnel Avenue (GPF12; Batchelor, 2013); (4) Atlas Wharf (AWF98; Lakin, 1998); (5) Mast House Terrace (MHT95; Bowsher & Wilkinson, 1995); (6) Preston Road (PPP06; Branch *et al*., 2007); (7) East India Docks (Pepys, 1665); (8) Victoria Deep Water Terminal (TUA02; Corcoran, 2002); (9) Greenwich Peninsula (Corcoran, 2002); (10) Canning Town (Stafford, 2012); (11) Lower Lea Valley Mapping Project (Corcoran *et al*., 2011); (12) Bellot Street (GLB05; Branch *et al*., 2005); (13) 72-88 Bellot Street (BSG93; McLean, 1993; Philp, 1993); (14) Canning Town Regeneration Area 7 & 1C (CTR12; Green & Young, 2012); (15) the Cable Car route (CAB11; Green *et al*., 2011) (A) North Station; (B) North Intermediate Tower; (C) North Tower; (D) South Tower; (E) South Station) (Batchelor *et al*., 2012); (16) Silvertown (BWC96; Wilkinson *et al*., 2000); (17) Fort Street (HW-FO94; Wessex Archaeology, 2000); (18) Greenwich Industrial Estate (GIE02; Morley, 2003); (19) Royal Docks Community School (PRG97; Holder, 1998); (20) Greenwich Millennium Village (Miller & Halsey, 2011); (21) Millennium Festival Site, Greenwich (BWP97; Bowsher & Corcoran, unknown); (22) 118 Victoria Dock Road (Barnett *et al*., 2012); (23) Plot MO115 (CHB13; Young & Batchelor, 2013a). *Contains Ordnance Survey data © Crown copyright and database right [2012]*

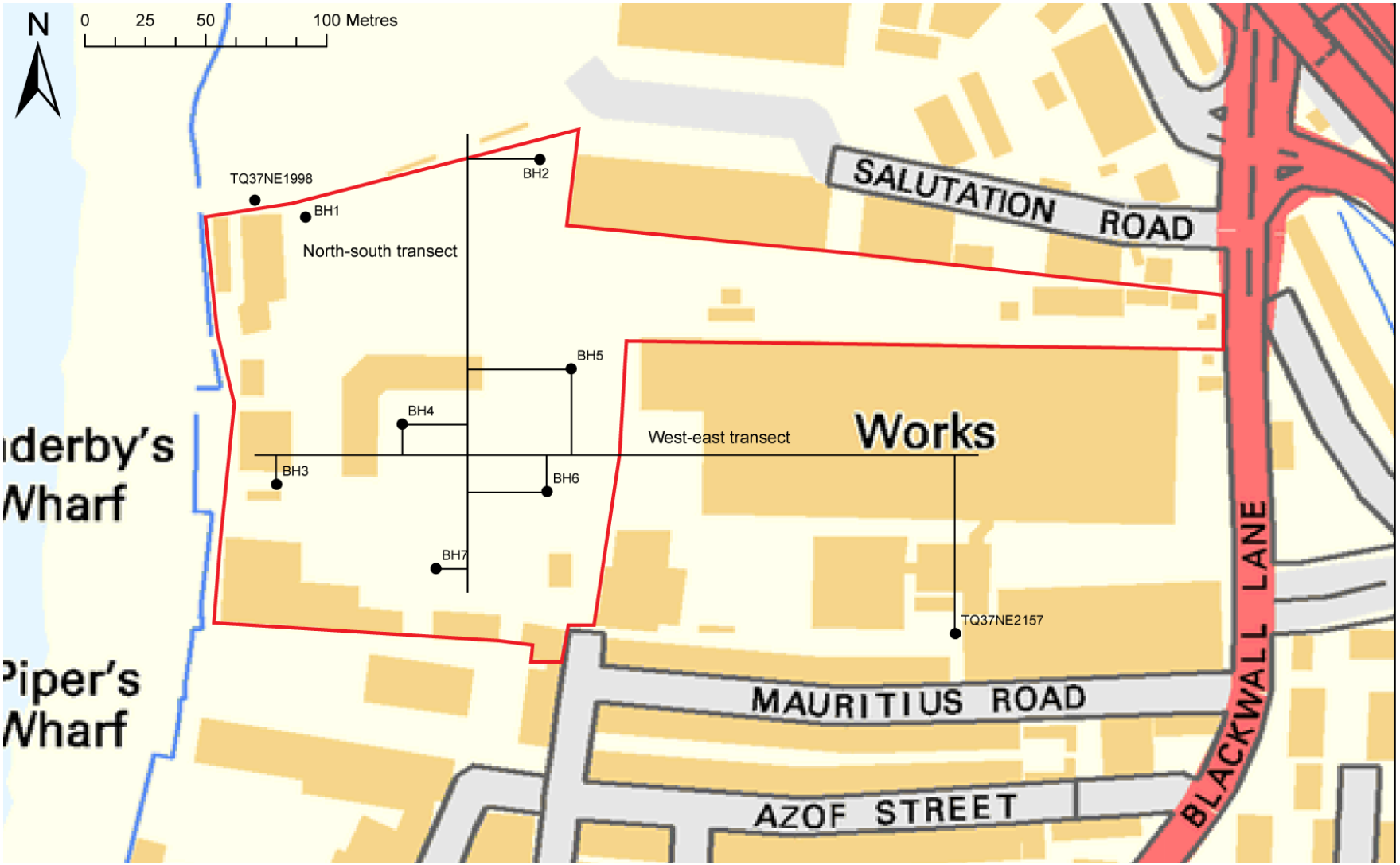

Figure 2: Detailed plan of Enderby Wharf, Christchurch Way, London Borough of Greenwich (red outline) and the geotechnical boreholes put down in or immediately adjacent to the site. BGS boreholes used in the deposit model also shown. *Contains Ordnance Survey data © Crown copyright and database right [2012]*

METHODS

Field investigations

Seven geotechnical boreholes were put down at the site by URS in November 2013 by cable percussion (BH1 to BH7). The spatial co-ordinates for the boreholes were recorded by URS (Table 1). Selected boreholes (BH2, BH3, BH5 and BH7) were monitored and described in the field by Quaternary Scientific, and compared with the geotechnical descriptions provided by the drilling team. All descriptions were made 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 of the descriptions are displayed in Tables 2 to 8 and in Figures 9 and 10.

Deposit modelling

The following resources were used for the collection of stratigraphic information for the creation of the deposit model: (1) geotechnical boreholes put down at the site, and (2) boreholes put down nearby to the site, provided by the British Geological Society (NERC). Co-ordinates and OD height data were not available for the previous geotechnical boreholes put down at the site by Water and Earth Science Associated UK Ltd (1993) and Babtie (2003), and previous investigations by URS (2013); these boreholes were thus not included in the deposit model. This resulted in 9 sediment logs for the deposit modelling process (Table 1).

Sedimentary units from the boreholes were classified into the following groupings: (1) Shepperton Gravel; (2) Lower Alluvium, (3) Peat, (4) Upper Alluvium and (5) Made Ground. The Lower Alluvium and Peat were not recorded in all boreholes; and where only alluvium was recorded, this was designated as the Upper Alluvium. The classified data for groups 1-5 were input into a database with the RockWorks 2006 geological utilities software. Models of surface height (using a nearest neighbour routine) were generated for the Shepperton Gravel, Lower Alluvium, Peat and Upper Alluvium (Figures 3, 4, 5 and 7). The thickness of the Peat, combined Alluvium and Made Ground was also modelled (also using a nearest neighbour routine) (Figures 6, 8 and 9). In addition, north-south and west-east 3-Dimensional interpolated transects are provided for the site; these include selected

borehole records for comparative purposes (Figures 9 and 10).

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. This is particularly true of the eastern spur of the site, where no borehole records with OD height data were available.

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. As a consequence of this, the modelling procedure has been manually adjusted so that only those areas for which sufficient stratigraphic data is present will be modelled; in order to achieve this, a maximum distance cut-off filter of 15% is applied to all deposit models except those for the Peat, which used a 10% filter due to the less ubiquitous nature of this unit. In addition, and as highlighted above, 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. In particular, it is important to recognise that at least three 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.

Table 1: Borehole records used in the creation of the Enderby Wharf deposit model

Provider	Borehole number	Easting	Northing	Surface elevation (m OD)
URS	BH1	539161	178803	2.25
	BH2	539258	178827	1.90
	BH3	539149	178692	2.77
	BH4	539201	178717	2.16
	BH5	539271	178740	2.05
	BH6	539261	178689	2.05
	BH7	539215	178657	2.44
BGS	TQ37NE2157	539430	178630	1.57
	TQ37NE1998	539140	178810	5.20

RESULTS AND INTERPRETATION OF THE GEOARCHAEOLOGICAL MONITORING AND DEPOSIT MODELLING

The results of the deposit modelling are displayed in Figures 3 to 10. Figures 3 to 8 provide surface elevation and thickness models for each of the main stratigraphic units, whilst Figures 9 and 10 provide 2-Dimensional west-east and north-south transects across the site respectively. The results of the deposit modelling indicate that a sufficient number and spread

of boreholes with sufficient spatial data have been put down to permit modelling across the majority of the site, with the exception of the eastern spur that projects towards Blackwall Lane. It is noted that only two BGS borehole records with sufficient data for deposit modelling were available within the area of or close to the site.

The basal unit recorded in the deposit model for the site is a horizon of sand and gravel (the Shepperton Gravel). These sediments were deposited during the Late Devensian (Marine Isotope Stage 2, *ca*. 16,000-11,500 cal BP), within a high energy braided river system. The surface of this unit is relatively even across the site, recorded at between *ca*. -3.5 and -4.0m OD in the majority of boreholes (Figure 3). The Gravel surface rises in the northern part of the site however towards borehole BH2, where it was recorded at -2.8m OD. Southeast of the site the Gravel surface falls in the area of BGS borehole TQ37NE2157 to -4.9m OD. As stated above, the absence of suitable borehole data for deposit modelling in the eastern spur of the site means that the Gravel surface was not modelled in this area; in general, the previous geotechnical data (which assumes a level surface across the site) indicates that the Gravel surface rises in this part of the site by up to 0.5m, before falling again (by up to 1.5m) towards the eastern boundary of the site.

Where the Shepperton Gravel is recorded at its lowest in boreholes BH7 and TQ37NE2157, it is overlain by a horizon of sand between -3.86 and -4.06 (BH7) and -4.4 and -4.9m OD (TQ37NE2157). Where this unit is recorded, it is indicative of a gradual reduction in flow rate from that which deposited the coarser Shepperton Gravel, and was most likely deposited within palaeochannels during the Early Holocene. Elsewhere, the Shepperton Gravel is overlain by sandy or clayey silt with frequent detrital organic inclusions of wood or herbaceous material, considered here to represent the Lower Alluvium and indicative of the former presence of low energy fluvial or estuarine conditions during the Early to Middle Holocene. The surface of this unit across the site lies at between -0.5 and -2.5m OD (Figure 4), generally sloping down towards the east of the site, falling from -0.5m OD in borehole BH3 in the west to -2.8 (BH2) and -2.45m OD (BH5) in the east. Beyond the southeastern margin of the site the surface of the Lower Alluvium lies at -3.7m OD in borehole TQ37NE2157.

In all boreholes except BH6 (where Peat is absent), the Lower Alluvium is overlain by a variably woody or herbaceous Peat horizon. The Peat lies at between 0.0 and -2.5m OD, and is generally between 0.5 and 2m thick (Figures 5 and 6). Whilst the upper surface of the Peat is generally even across the site (Figure 5), the thickness increases eastwards, reflecting the sloping surface of the Lower Alluvium (Figure 6). Beyond the southeastern margin of the site,

the Peat was recorded as 3.3m thick in borehole TQ37N2157, between -0.4 and -3.7m OD. The deposit model for the Peat across the site is thus consistent with the previous geotechnical boreholes for the site; these demonstrate that Peat up to 2m in thickness extends across the eastern spur of the site. The Peat formation is indicative of a transition to semi-terrestrial conditions across the site, supporting the growth of wetland vegetation including herbaceous and woody taxa. Notably, in boreholes BH4 and BH5 the Peat is separated by a horizon of clayey silt, between -1.04 and -1.54 and -1.65 and -1.95m OD respectively. Although not recorded at exactly the same elevation, these horizons may represent a contemporaneous flooding event which brought an influx of mineral-rich material across the Peat surface. It is possible that the absence of a distinct Peat horizon in borehole BH6 (which lies close to boreholes BH4 and BH5) may be a consequence of erosion of the Peat surface related to this flood event.

The Peat is overlain across the site by a horizon of silty clay with occasional detrital organic matter and Mollusca fragments, referred to here as the Upper Alluvium. This unit is representative of flooding of the Peat surface by low energy fluvial conditions. The surface of the Upper Alluvium is relatively even across the site, generally lying at between 1.0 and 0.5m OD (Figure 7). The Upper Alluvium is overlain by variable thicknesses of Made Ground (1-3m; Figure 9); the Made Ground is thickest towards the west, where it is recorded in borehole BH3 at 2.45m thick, and in BGS borehole TQ37NE1998 (just beyond the northwest margin of the site) at 4.0m thick. The modern surface of the site generally lies at between 2.5 and 2.0m OD.

Table 2: Geotechnical description of borehole BH1 (not monitored)

Depth (m OD)	Depth (m bgs)	Geotechnical description	Geoarchaeological interpretation
2.25 to 1.05	0.00 to 1.20	Made Ground	Made Ground
1.05 to -0.25	1.20 to 2.50	Clay	Upper Alluvium
-0.25 to -1.15	2.50 to 3.40	Peaty clay	
-1.15 to -3.85	3.40 to 6.10	Sandy clay	
-3.85 to -5.45	6.10 to 7.70	Gravel	Shepperton Gravel
< -5.45	7.70+	Sandy gravel	

Table 3: Lithostratigraphic description of borehole BH2

Depth (m OD)	Depth (m bgs)	Geotechnical description	Geoarchaeological description	Geoarchaeological interpretation
1.90 to 0.50	0.00 to 1.40	Made Ground	-	Made Ground
0.50 to -0.60	1.40 to 2.50	Clay	As3 Ag1; grey silty clay	Upper Alluvium
-0.60 to -1.60	2.50 to 3.50	Peaty clay		
-1.60 to -2.10	3.50 to 4.00		Sh3 Tl^{2}1 Th+ Ag+; humo. 2/3; brown moderately to well humified woody peat with a trace of herbaceous material and silt.	Peat
-2.10 to -2.40	4.00 to 4.30		Ag2 As2; grey silt and clay	Lower Alluvium
-2.40 to -2.80	4.30 to 4.70	Sandy clay	Ag2 As2 Dh+; grey silt and clay with a trace of detrital herbaceous material.	
-2.80 to -3.00	4.70 to 4.90	Sandy gravel	Gg3 Ga1; sandy gravel. Flint clasts 20-60mm in diameter; well-rounded to sub-angular.	Shepperton Gravel
-3.00 to -4.90	4.90 to 6.80	Gravel		
< -4.90	6.80+	Sandy gravel		

Table 4: Lithostratigraphic description of borehole BH3

Depth (m OD)	Depth (m bgs)	Geotechnical description	Geoarchaeological description	Geoarchaeological interpretation
2.77 to 0.32	0.00 to 2.45	Made Ground	Made Ground	Made Ground
0.32 to -0.03	2.45 to 2.80	Peaty clay	Sh2 Ag1 Dl1; brown very organic silt with detrital herbaceous material.	Upper Alluvium
-0.03 to -0.53	2.80 to 3.30	Clay	Sh3 Tl^{1}1 Ag+; humo. 2/3; brown moderately to well humified woody peat with a trace of silt.	Peat

-0.53 to -2.43	3.30 to 5.20		As2 Ag2 Ga+ Dh+; grey silt and clay with a trace of sand and detrital herbaceous material	Lower Alluvium
-2.43 to -3.53	5.20 to 6.30	Slightly clayey, slightly silty sand	Ga3 Ag1; greenish blue silty sand with occasional Mollusca fragments.	
-3.53 to -4.03	6.30 to 6.80	Gravel with sand	Gg3 Ga1 Ag+; sandy gravel with a trace of silt	Shepperton Gravel
< -4.03	6.80+	Sandy gravel		

Table 5: Geotechnical description of borehole BH4 (not monitored)

Depth (m OD)	Depth (m bgs)	Geotechnical description	Geoarchaeological interpretation
2.16 to 0.86	0.00 to 1.30	Made Ground	Made Ground
0.86 to -0.24	1.30 to 2.40	Clay	Upper Alluvium
-0.24 to -1.04	2.40 to 3.20	Clayey peat with some woody remains and bands of clay	Peat
-1.04 to -1.54	3.20 to 3.70	Clayey silt	
-1.54 to -1.94	3.70 to 4.10	Slightly clayey peat with some plant remains	
-1.94 to -2.74	4.10 to 4.90	Silty clay	Lower Alluvium
-2.74 to -3.44	4.90 to 5.60	Sandy gravelly clay	
-3.44 to -4.64	5.60 to 6.80	Gravel	Shepperton Gravel
< -4.64	6.80+	Slightly sandy gravel	

Table 6: Lithostratigraphic description of borehole BH5

Depth (m OD)	Depth (m bgs)	Geotechnical description	Geoarchaeological description	Geoarchaeological interpretation
2.05 to 0.45	0.00 to 1.60	Made Ground	Made Ground	Made Ground
0.45 to 0.25	1.60 to 1.80		As3 Ag1; blue grey silty clay with Mollusca fragments.	Upper Alluvium
0.25 to -0.15	1.80 to 2.20	Clay		
-0.15 to -0.25	2.20 to 2.30	Slightly clayey peat		
-0.25 to -0.85	2.30 to 2.90		Sh3 $Tl^2$1; humo. 2; reddish brown moderately humified woody peat	Peat
-0.85 to -1.65	2.90 to 3.70		Sh2 $Th^2$1 $Tl^2$1; humo. 2; moderately humified	

			reddish brown herbaceous and wood peat	
-1.65 to -1.75	3.70 to 3.80		Ag2 Dl1 As1; blue grey clayey silt with detrital wood	
-1.75 to -1.95	3.80 to 4.00	Clay	Ag2 Dl1 As1; blue grey clayey silt with detrital wood	
-1.95 to -2.45	4.00 to 4.50		Sh2 $Th^2$1 $Tl^2$1; humo. 2; moderately humified reddish brown herbaceous and wood peat	
-2.45 to -3.05	4.50 to 5.10	Clay going in to slightly clayey sand	Ag2 Dl1 As1; blue grey clayey silt with detrital wood	Lower Alluvium
-3.05 to -3.75	5.10 to 5.80		Ag2 As1 Ga1 Dl+; grey clayey sandy silt with a trace of detrital wood material	
< -3.75	5.80+	Sandy gravel	Gg3 Ga1; sandy gravel. Flint clasts 40-60mm in diameter, rounded to sub-angular	Shepperton Gravel

Table 7: Geotechnical description of borehole BH6

Depth (m OD)	Depth (m bgs)	Geotechnical description	Geoarchaeological interpretation
2.05 to 0.75	0.00 to 1.30	Made Ground	Made Ground
0.75 to -0.45	1.30 to 2.50	Clay with occasional gravel clasts	Upper Alluvium
-0.45 to -0.50	2.50 to 2.55	Clay with bands of organic clay	
-0.50 to -0.95	2.55 to 3.00	Peaty clay with rare fragments of plant remains	
-0.95 to -3.55	3.00 to 5.60	Clay with bands of peaty clay	
< -3.55	5.60+	Gravel	Gravel

Table 8: Lithostratigraphic description of borehole BH7

Depth (m OD)	Depth (m bgs)	Geotechnical description	Geoarchaeological description	Geoarchaeological interpretation
2.44 to 1.14	0.00 to 1.30	Made Ground	Made Ground	Made Ground
1.14 to -0.26	1.30 to 2.70	Clay	As3 Ag1 Sh+ Dl+; grey silty clay with occasional	Upper Alluvium

			pockets of organic matter and detrital wood.	
-0.26 to -1.26	2.70 to 3.70	Peat with plant remains including wood	-	Peat
-1.26 to -2.16	3.70 to 4.60	Clayey silt	As3 Ag1 Sh+ Dl+; grey silty clay with occasional pockets of organic matter and detrital wood.	Lower Alluvium
-2.16 to -3.56	4.60 to 6.00	Clay		
-3.56 to -3.86	6.00 to 6.30	Clay		
-3.86 to -4.06	6.30 to 6.50	Sand	-	
< -4.06	6.50+	Sandy gravel	Gg3 Ga1; sandy gravel. Flint clasts 20-60mm; rounded.	Shepperton Gravel

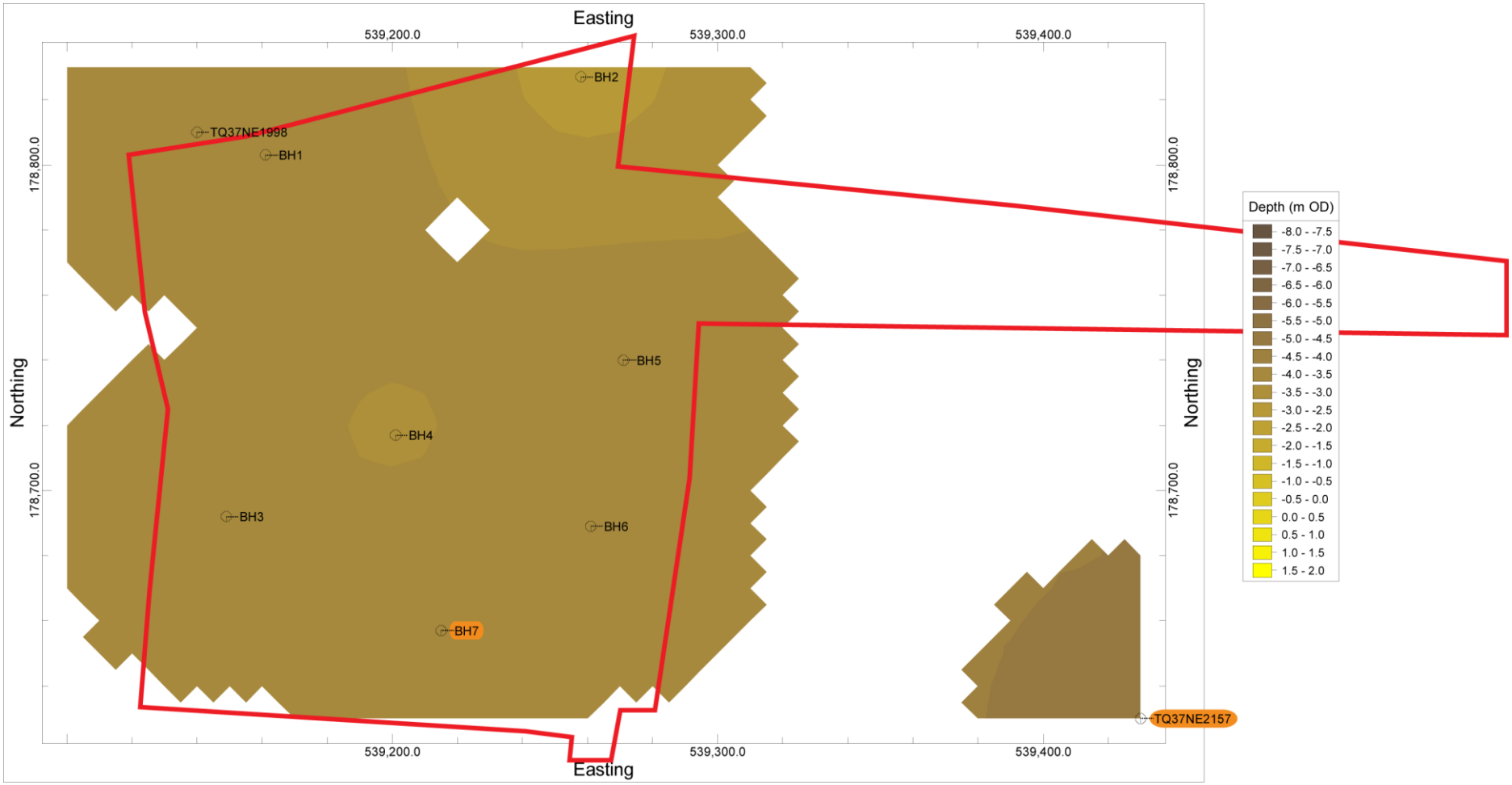

Figure 3: Modelled surface of the Shepperton Gravel (contour heights in metres OD). Boreholes with sand overlying the Shepperton Gravel are highlighted in orange.

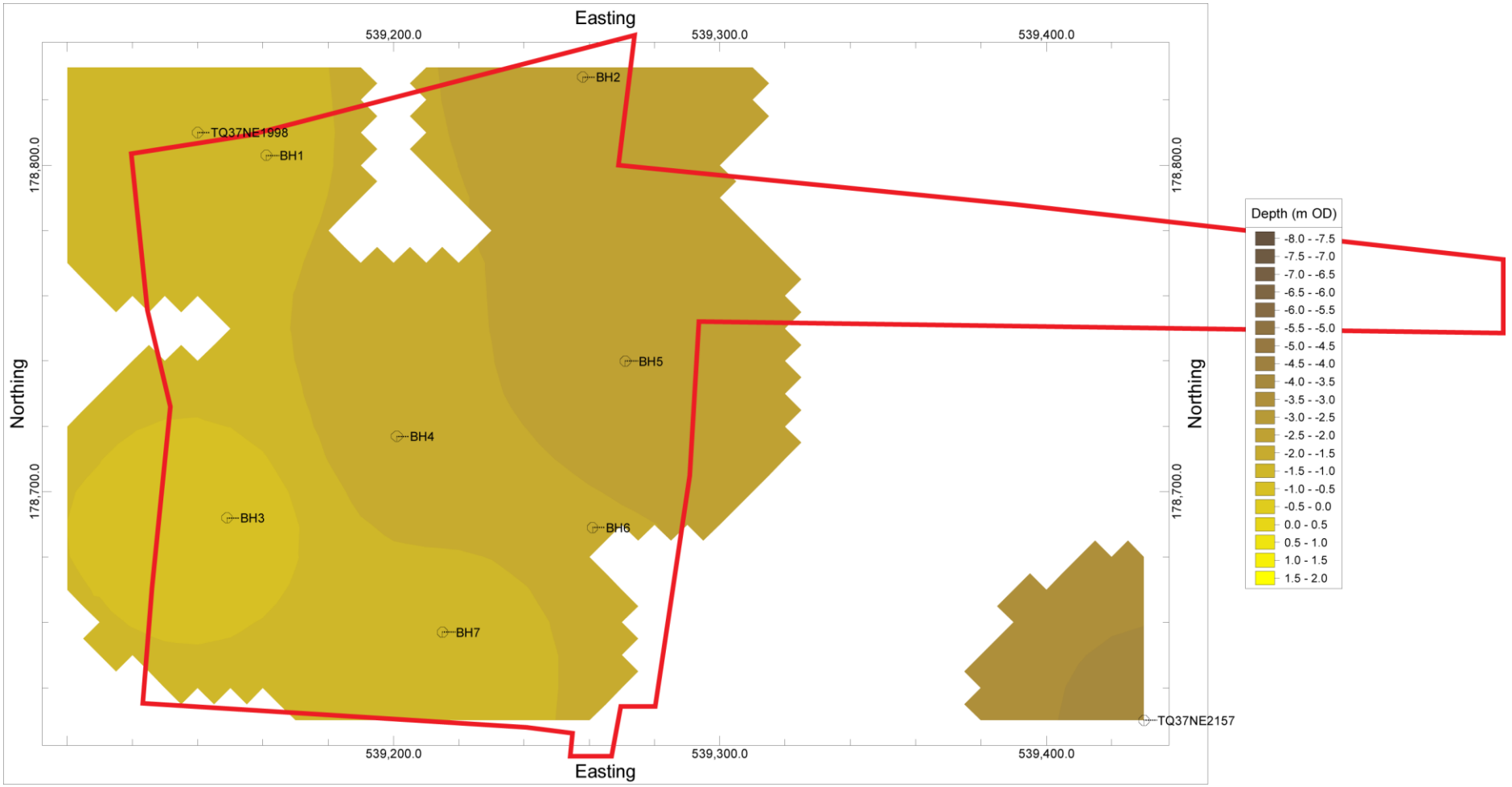

Figure 4: Modelled surface of the Lower Alluvium (contour heights in metres OD).

Figure 5: Modelled surface of the Peat (contour heights in metres OD).

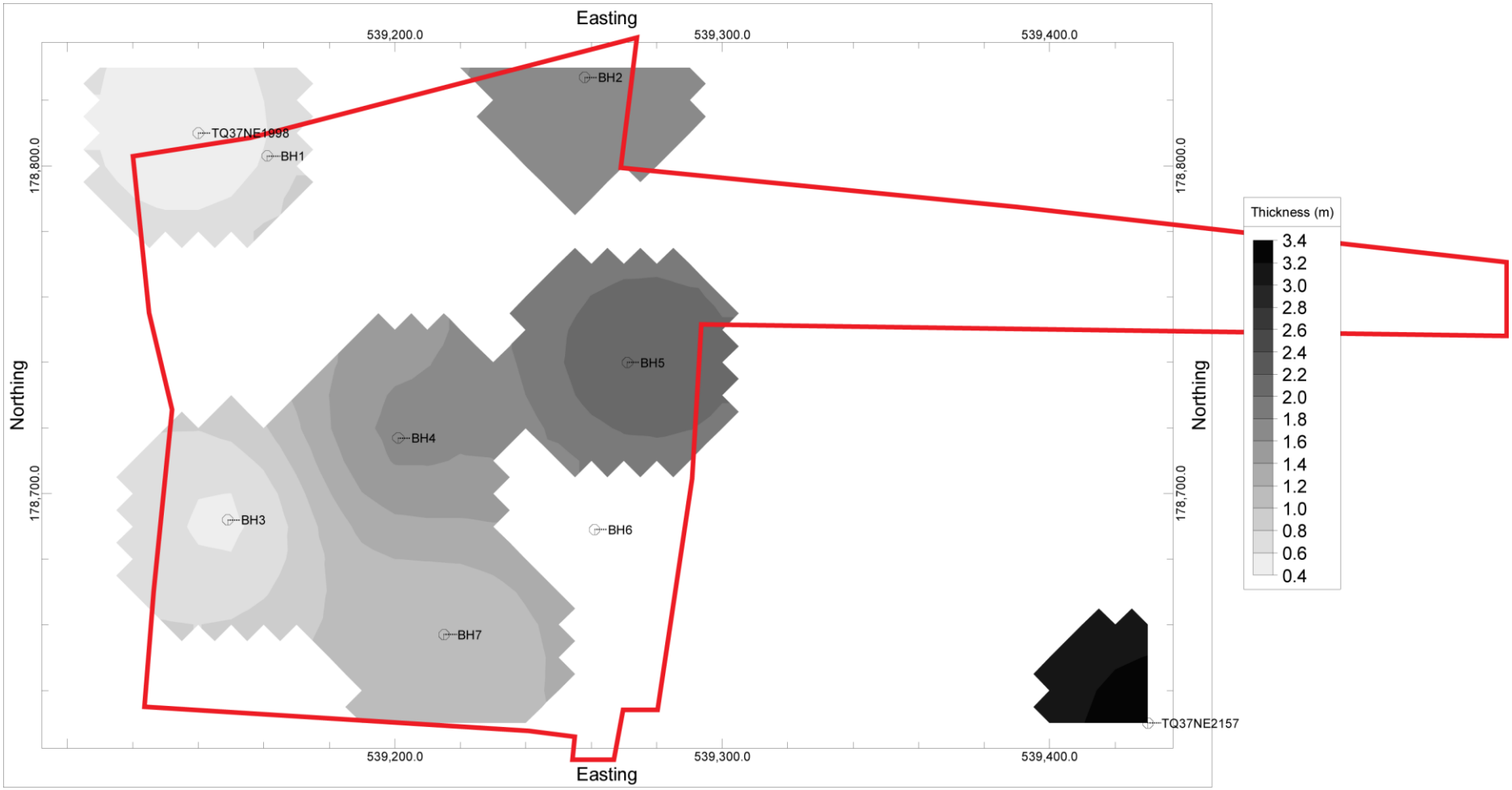

Figure 6: Modelled thickness of the Peat (metres).

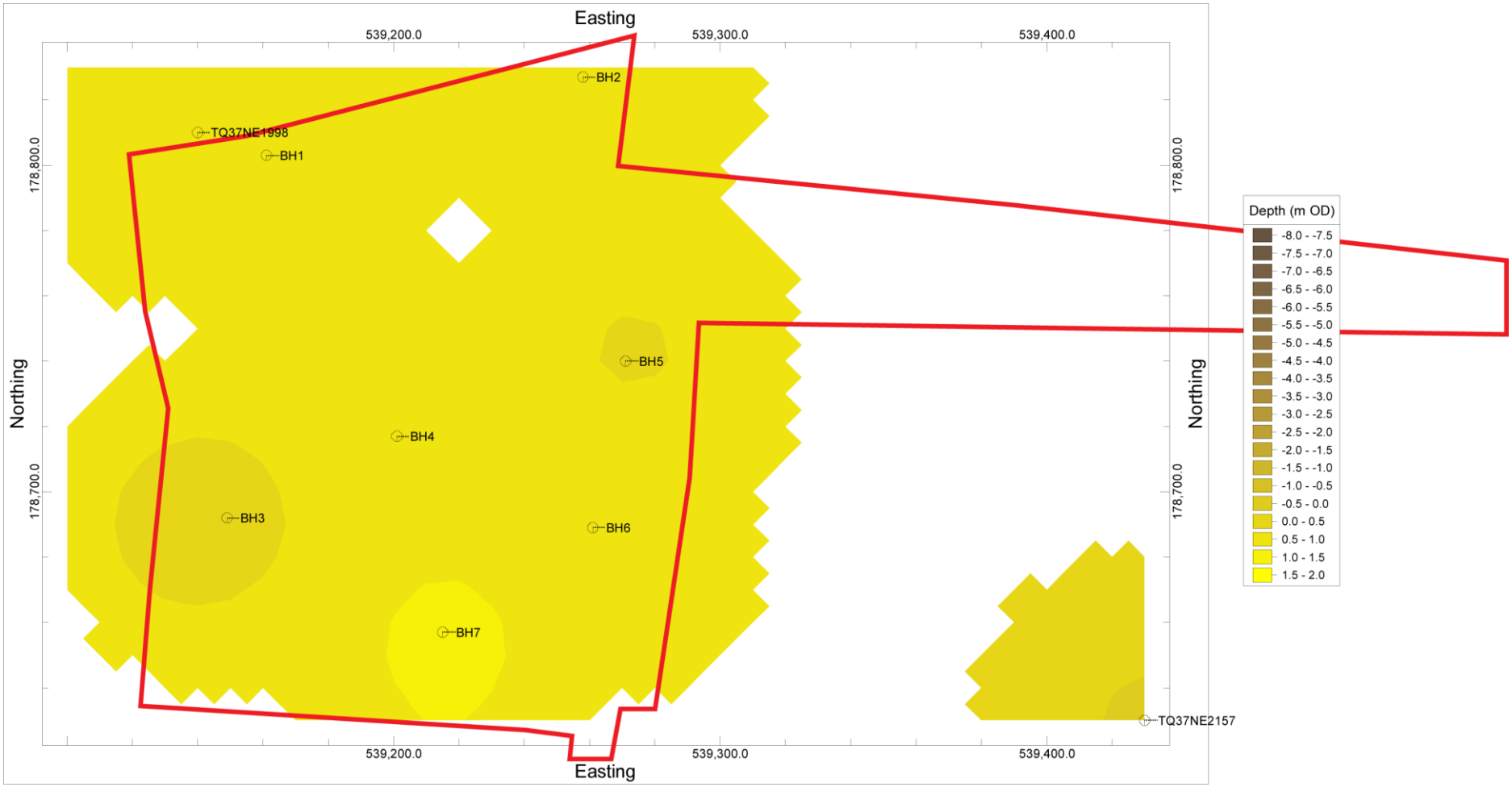

Figure 7: Modelled surface of the Upper Alluvium (contour heights in metres OD)

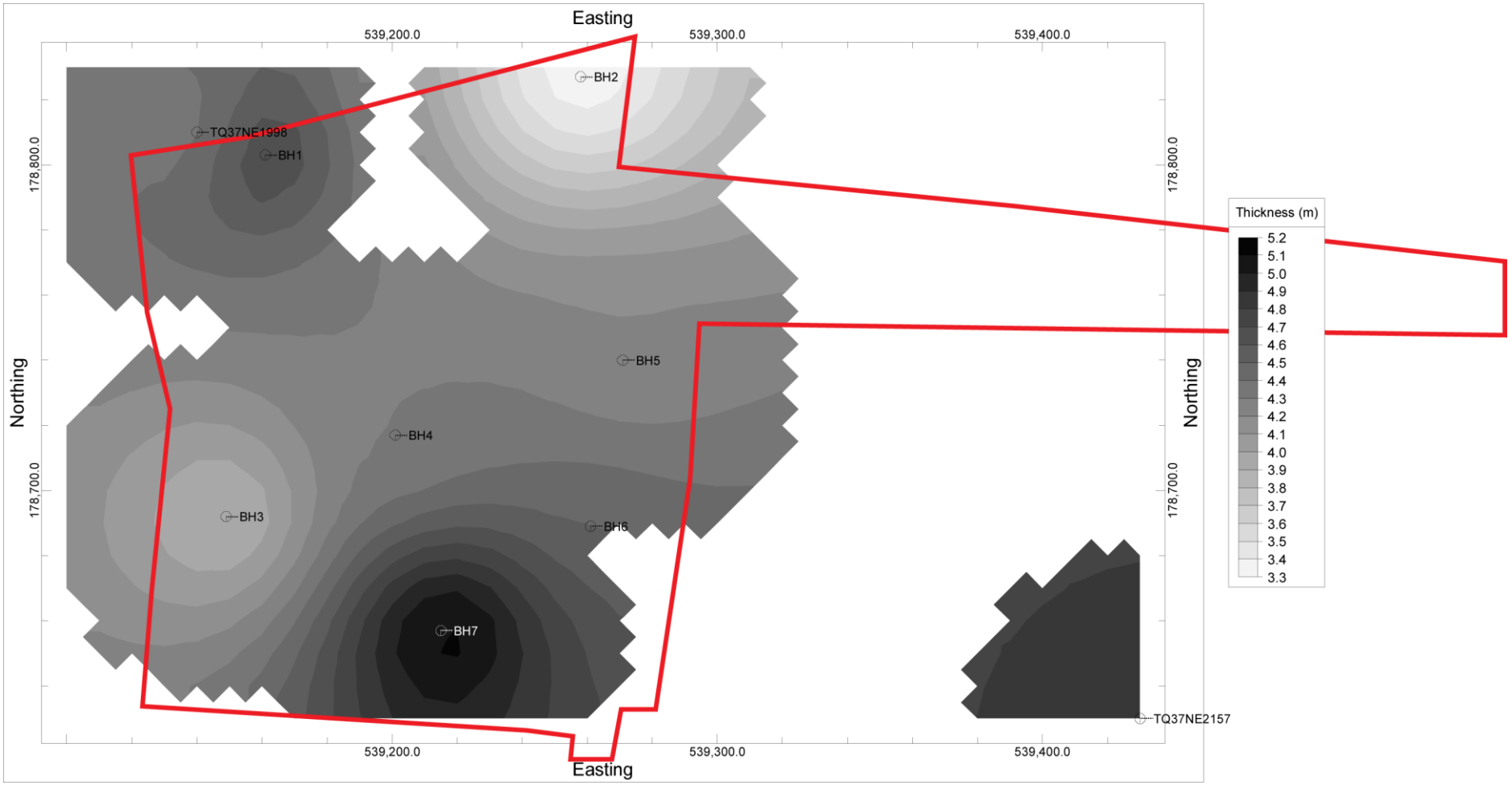

Figure 8: Modelled thickness of the combined Alluvium (incorporating the Lower Alluvium, Peat and Upper Alluvium) (metres)

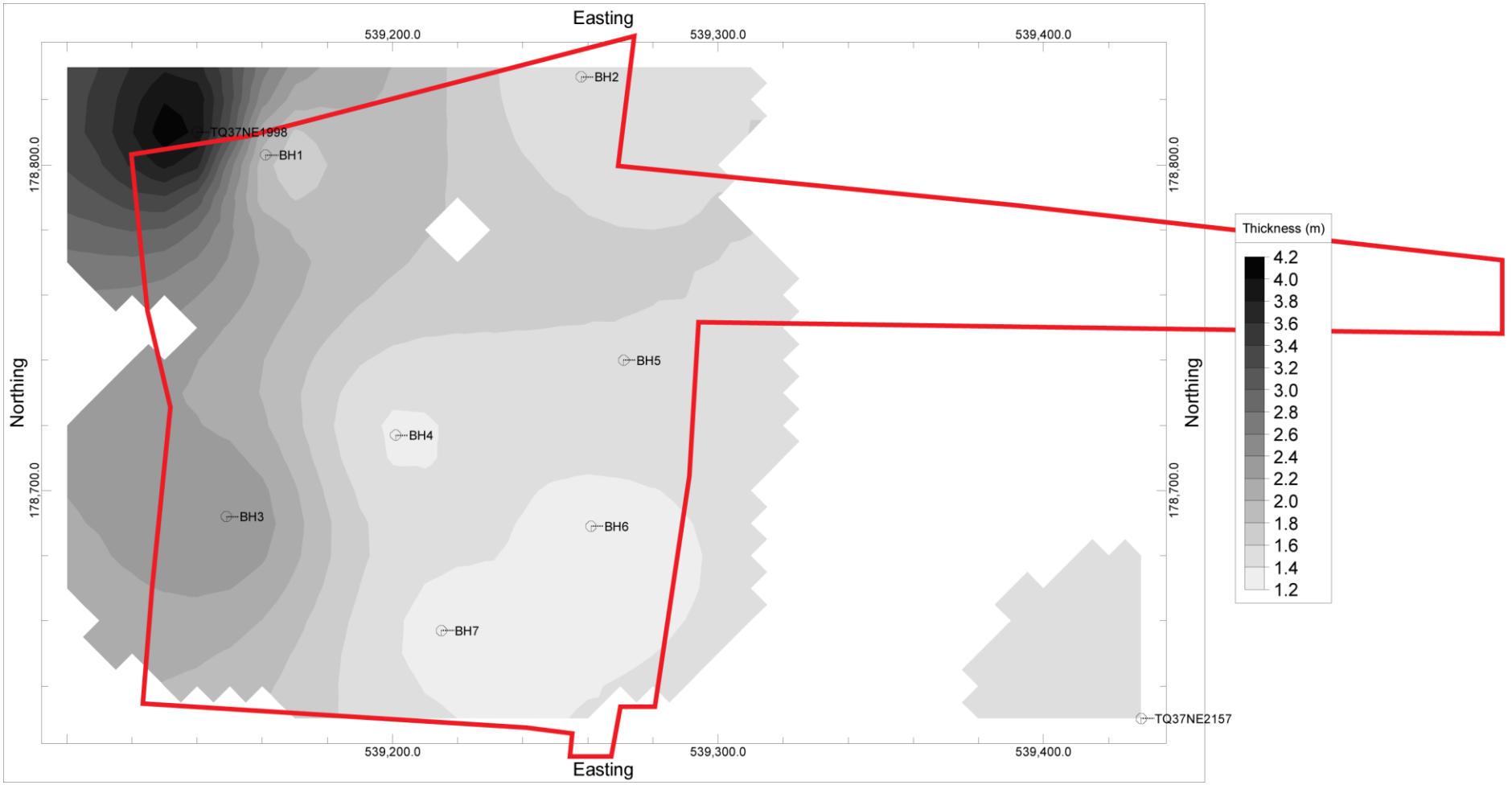

Figure 9: Modelled thickness of the Made Ground (metres)

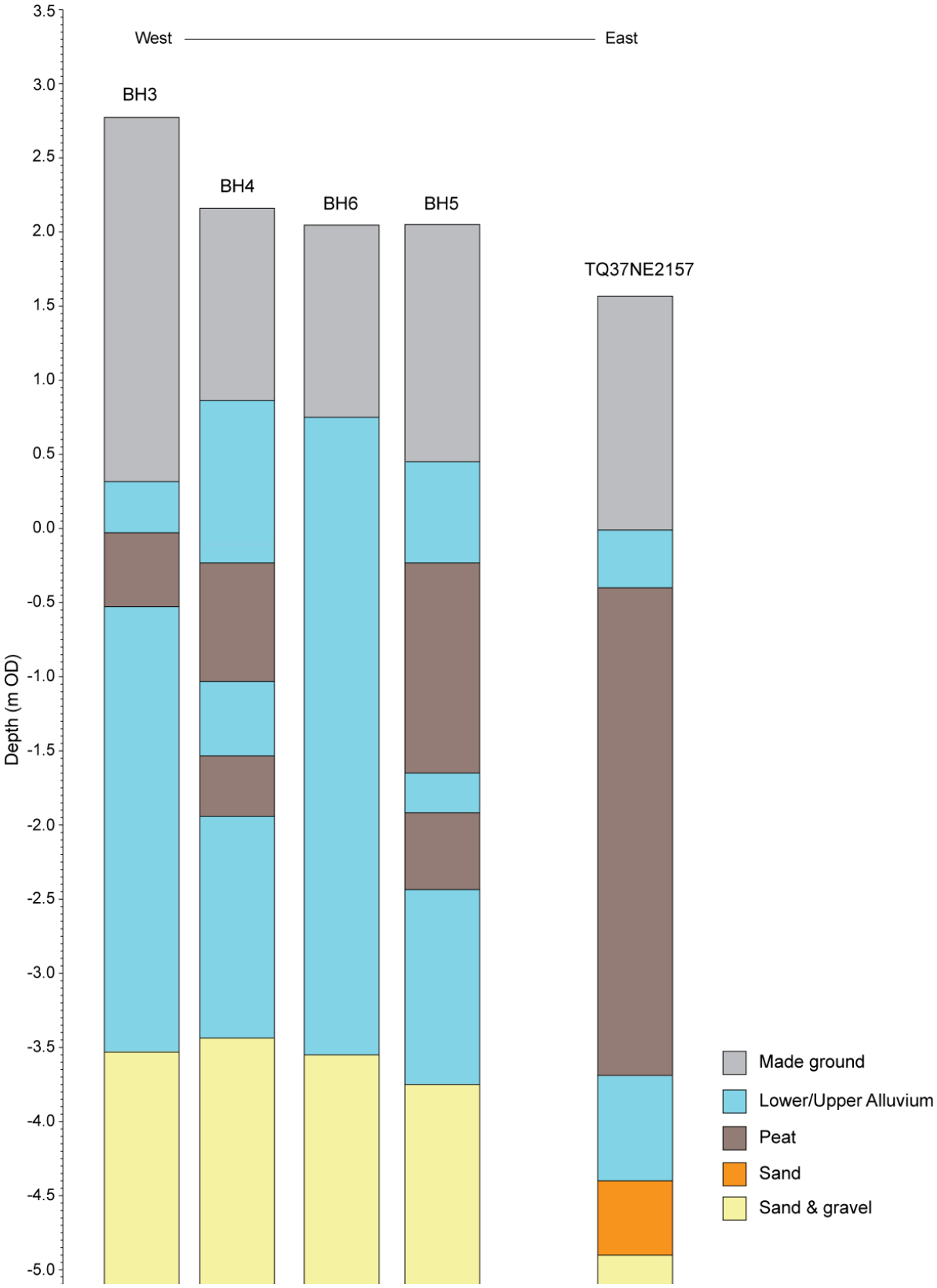

Figure 9: West-East transect of boreholes across the site (borehole spacing is not to scale)

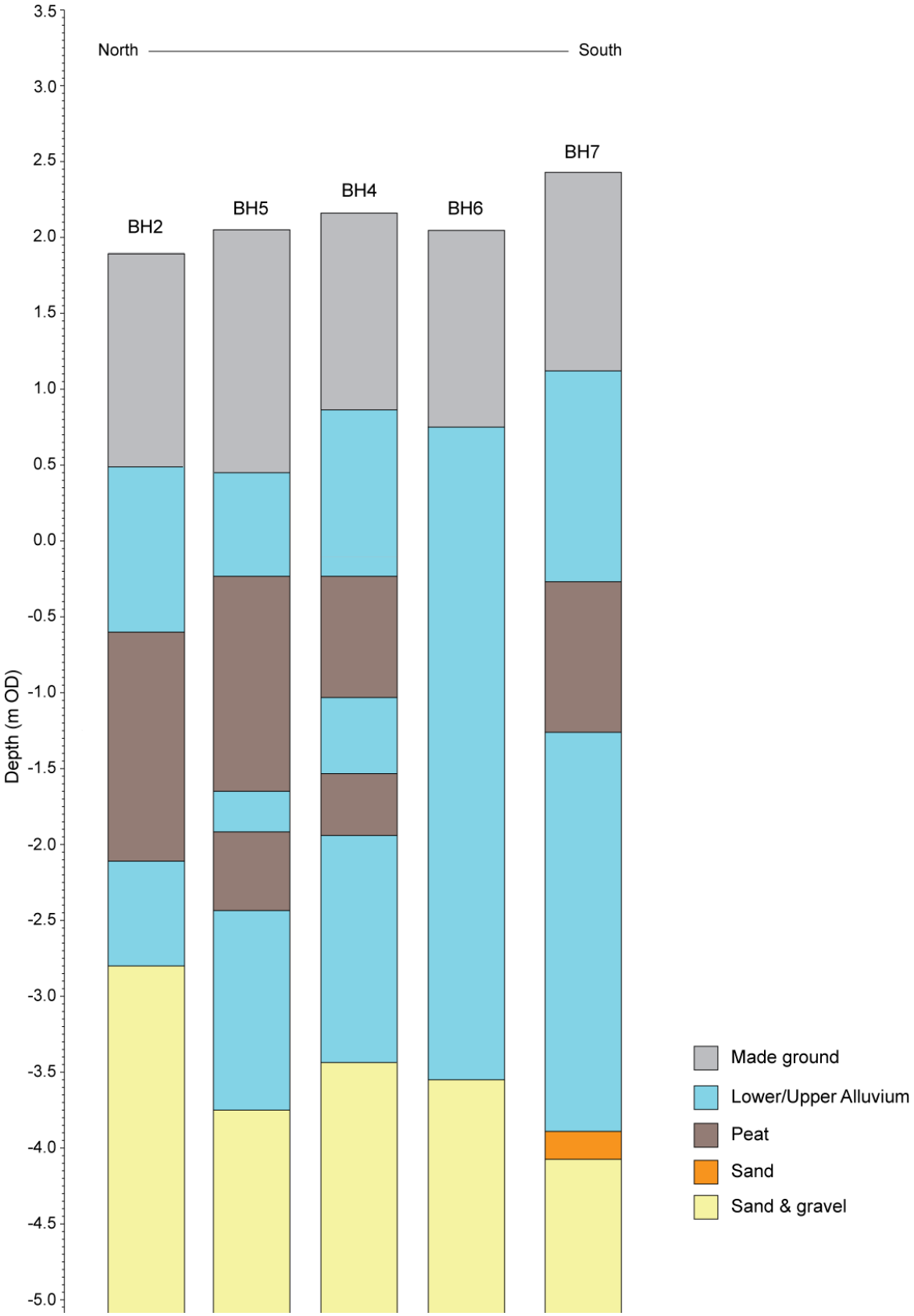

Figure 10: North-South transect of boreholes across the site (borehole spacing is not to scale)

DISCUSSION

The results of the deposit modelling indicate that the sediments recorded at the Enderby Wharf site are analogous to those recorded elsewhere in the Lower Thames Valley, with a sequence of Shepperton Gravel overlain by Holocene Alluvium containing Peat, capped by Made Ground.

The surface of the Shepperton Gravel across the site is relatively even, recorded at between *ca*. -3.5 and -4.0m OD in the majority of boreholes. The Gravel surface rises in the northern part of the site, where it was recorded at -2.8m OD; southeast of the site in BGS borehole TQ37NE2157 the Gravel surface falls to -4.9m OD. The site lies to the southwest of the area of Greenwich Peninsula investigated by Corcoran (2002), who defined landscape zones based on the geoarchaeological characteristics of those areas. In this investigation, four landscape zones were identified as follows: Landscape Zone A, representing an area of higher Gravel surface (higher than -2m OD); Landscape Zone B, where the Gravel surface lies at between -2 and -4m OD; and Landscape Zones C and D, where it lies below -4m OD. The Enderby Wharf site lies *ca*. 300m southwest of Corcoran's (2002) Landscape Zone B, where the Sand and Gravel surface is described as lying at between -4 and -2m OD, and 'probably not overlain by sand'. The deposit model for the site shows that the surface of the Shepperton Gravel lies within this range. However, in borehole BH7, and in BGS borehole TQ37NE2157 where the Gravel surface is recorded at -4.9m OD, it is overlain by a horizon of sand; these boreholes thus show similarities to Corcoran's (2002) landscape zone D, where Gravel surfaces below -4m OD are often overlain by a horizon of sand that accumulated within palaeochannels most likely of early Holocene date. It is possible therefore that a palaeochannel is present in the area southeast of the Enderby Wharf site, and that the edge of this palaeochannel is recorded within the southeastern part of the site itself (in the area of borehole BH7). South of this possible palaeochannel, at the Bellot Street site (Branch *et al*., 2005) *ca*. 150m to the south of Enderby Wharf, the Shepperton Gravel surface rises to between -0.70 and -1.49m OD.

Elsewhere on Greenwich Peninsula, relatively high Shepperton Gravel surfaces (between *ca*. -1 and -1.7m OD) have been recorded at the Tunnel Avenue (Landscape Zone B; Batchelor, 2013) and Victoria Deep Water Terminal sites (Landscape Zone A; Corcoran, 2002). Towards the north-east of the Tunnel Avenue site however, the Shepperton Gravel surface drops to below -4m OD. It does the same towards the south-west and south-east of the MO115 (Landscape Zone B; Young & Batchelor, 2013a) and MO117 (Landscape Zones A and B; Young & Batchelor, 2013b) sites, and in the far south-eastern corner of Greenwich Millennium Village (Miller & Halsey, 2011). In addition, smaller 'patches' of lower gravel

surface >-4m OD were recorded towards the centre and south-western areas of the Millennium Festival Site (Landscape Zone D; Bowsher & Corcoran, unknown). These areas of lower Gravel surface have been interpreted as either localised hollows, or part of interconnected palaeochannels.

A unit of Lower Alluvium overlying the Shepperton Gravel was recorded across the Enderby Wharf site, indicative of deposition under low-energy fluvial conditions during the Early to Middle Holocene. In the area of BH7 and southeast of the site in borehole TQ37NE2157 the Shepperton Gravel was overlain by a horizon of sand, interpreted elsewhere as having accumulated within palaeochannels during the Early Holocene (Corcoran, 2002).

The Lower Alluvium was overlain by a horizon of Peat, recorded in the majority of boreholes across the Enderby Wharf site and representative of a transition to a semi-terrestrial environment, most likely supporting the growth of wetland woodland. A peat horizon was described within the Alluvium in Corcoran's (2002) landscape zone B as an 'interbedded peat and clay or sandy peat about 3m thick with a surface between -0.5 and -1.5m OD'. The Peat horizon recorded at the Enderby Wharf site lies at between 0.0 and -2.5m OD, and is generally between 1 and 2m thick. In general, the thickness increases towards the east, increasing from 0.5m in borehole BH3 in the western part of the site, to 3.3m thick in borehole TQ37NE2157, beyond the southeastern margins of the site and in the area of the possible palaeochannel recorded here.

At the Victoria Deep Water Terminal site, Peat accumulation was radiocarbon dated to 5280-4660 cal BP (Neolithic), whilst at the Cable Car South Station in SSBH1C, the base of the Peat was recorded around 5580-5310/5890-5610 cal BP and continued until 3380-3210 cal BP (Neolithic through to Bronze Age). At the Bellot Street (Branch *et al*., 2005) site *ca*. 150m to the south, variable thicknesses of Peat were recorded between -1.52 and -0.12m OD. Significantly, a Bronze Age trackway aligned north-south was found within Peat at -0.50m OD at the 72-88 Bellot Street site (Mclean, 1993; Philp, 1993), and a wooden structure was recorded within the Peat at the Bellot Street site (MLO98089, Branch *et al*., 2005) between -0.31m OD and -0.22m OD. Radiocarbon dating of the Peat above and below the structure at the Bellot Street site (Branch *et al.*, 2005) showed that both the Peat horizon and wooden structure were of Middle Bronze Age date (3890-3680 to 3720-3570 cal BP). Environmental archaeological assessment of this Peat horizon showed that the vegetation cover during its formation consisted of alder carr woodland on the wetland surface, with lime, oak, elm and birch woodland dominating the nearby dryland; during the period of Peat formation associated with the wooden structure, a general reduction in woodland cover on the dryland

was recorded, with evidence for increasingly wet conditions on the wetland which may have led to the abandonment of the structure (Branch *et al*., 2005).

The Upper Alluvium overlies the Peat across the site, representing a transition from semi-terrestrial to alluvial/estuarine conditions, and most likely brought about by a regional increase in the rate of relative sea level rise (see Sidell, 2003). Finally, a variable thickness of Made Ground caps the sequence.

CONCLUSIONS AND RECOMMENDATIONS

The aim of this report was to produce a model of the sub-surface stratigraphy of the site to (1) provide a reconstruction of the site's former landscape and its evolution through time, as well as its potential exploitation by prehistoric people; and (2) to provide recommendations on the suitability for further geoarchaeological investigations at the site.

The results of the deposit modelling have revealed a sequence of Shepperton Gravel overlain by Alluvium, containing Peat, overlain by Made Ground. The altitude and relief of the Gravel surface is relatively even and lies at between *ca*. -3.5 and -4.0m OD across the site, before falling south-eastwards towards a possible Early Holocene palaeochannel where the Gravel surface is recorded at -4.9m OD in BGS borehole TQ37NE2157. The margins of this palaeochannel are recorded towards the southeast of the site, in the area of borehole BH7. The Peat horizon is between 0.5 and 2.0m thick across the site, and represents a period of semi-terrestrial conditions that may date to the Neolithic through to Bronze Age periods, and may be contemporaneous with Bronze Age archaeology recorded within *ca*. 150m at the 72-88 Bellot Street (Mclean, 1993; Philp, 1993) and Bellot Street (Branch *et al*., 2005) sites.

The palaeoenvironmental potential of the sequences at the Enderby Wharf site is therefore considered to be high, and may contain evidence for prehistoric activity associated with the archaeological structures recorded nearby and within Peat at the same elevation (between -0.50 and -0.22m OD) as that recorded at Enderby Wharf. It is therefore recommended that a minimum of two geoarchaeological boreholes are collected from the site, in the area of boreholes BH7 on the margins of the possible palaeochannel (towards the southeast of the site) and BH5 (towards the centre of the site), where the thickest Peat horizon was recorded. In addition, a geoarchaeological borehole in the eastern spur of the site would provide additional information for the deposit modelling of this area. Environmental archaeological assessment of a minimum of one selected borehole is recommended, which should consist of: (1) radiocarbon dating of the base and top of the Peat in order to ascertain the age of peat accumulation and cessation; (2) organic matter determinations to aid identification of the

sedimentary units; (3) assessment of the palaeobotanical 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 assessment will also highlight any indications of nearby human activity, and provide recommendations for further analysis (if necessary).

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