LAND AT WANDSWORTH ROAD AND PASCAL STREET, NINE ELMS, LONDON BOROUGH OF LAMBETH (NGR: TQ 3003 7747): ENVIRONMENTAL ARCHAEOLOGICAL ASSESSMENT REPORT

D.S. Young, C.R. Batchelor and C.P. Green
Quaternary Scientific (QUEST), School of Human and Environmental Sciences, University of Reading, Whiteknights, PO Box 227, Reading, RG6 6AB, UK

INTRODUCTION

This report summarises the findings arising out of the environmental archaeological assessment undertaken by Quaternary Scientific (University of Reading) in connection with the proposed development of Land at Wandsworth Road and Pascal Street, Nine Elms, London Borough of Lambeth (National Grid Reference: *centred on* TQ 3003 7747; Figure 1). Quaternary Scientific were commissioned by CgMs Consulting to undertake the geoarchaeological and environmental archaeological investigations. The site is located on the floodplain of the River Thames, approximately 400m from the modern waterfront (Figure 1). The site is mapped by the British Geological Society (BGS) as lying on the margin of a substantial former channel known as the Battersea Channel, where the superficial geology is recorded as alluvium overlying London Clay bedrock; in the eastern part of the site the superficial geology is mapped as Kempton Park Gravel (1:50,000 Sheet 270 South London 1998). Previous geoarchaeological investigations to the west and southwest of the site (Dawson *et al*., 2009; Morley, 2009/2010; Corcoran *et al*., 2007; Branch *et al*., 2010) have revealed that a number of channels, bisecting areas of higher gravel 'islands' (eyots), existed in the Battersea area during the Late Devensian/early Holocene.

At the location of the Wandsworth Road and Pascal Street site the Battersea Channel is aligned approximately SW-NE. Recent investigations (Morley, 2009/2010) indicate that the channel was active until at least the early Holocene, the main channel accommodating a network of smaller channels, within which a sequence of Shepperton Gravel, Alluvium and Peat (radiocarbon dated to the Mesolithic period) accumulated. By the Roman period the Battersea Channel had been reduced to a narrow creek, due to a combination of climate alterations, changes in sea level and the impacts of human intervention (Morley, 2009/2010). Boreholes were monitored during recent geotechnical investigations at the Nine Elms site. The resultant sedimentary logs were integrated with existing British Geological Society (BGS) borehole records from the nearby vicinity in order to produce a model of the sub-surface stratigraphy (Young & Green, 2013). The results of this investigation revealed that a channel aligned approximately southwest-northeast traversed the eastern part of the site; this may have formed part of the Battersea Channel, either as a tributary joining the main

channel from the southeast, or as part of a network of channels on the floor of the Battersea Channel itself. Within this channel the Shepperton Gravel surface was recorded at between *ca*. -2.5 and -3.0m OD, whilst outside the limits of the channel and where it rises to above *ca*. -2.0m OD the sand and gravel is likely to equate to the Kempton Park Gravel, rising to a level of *ca*. -1.0m OD in the western part of the site.

The Gravel surface is overlain by Alluvium across the site, in places containing a Peat horizon between *ca*. -1.0 and 0.5m OD and between 0.10 and 0.60m thick. Significantly, this Peat horizon represents the development of a more stable terrestrial surface across the floor of the valley at this location, which may contain palaeobotanical remains and artefacts indicative of past environmental change and human activity. At the 120-146 Stewarts Road site (Morley, 2009/2010) Peat was recorded between *ca*. -1.25 and -1.75m OD; the upper part of this Peat horizon was subsequently radiocarbon dated to 7670-7510 cal BP (the Mesolithic cultural period). At the Battersea Power Station (Branch *et al*., 2010) Peat horizons radiocarbon dated to the Middle Neolithic and Middle Bronze Age were identified at -2.09 to -2.16m OD (5320 to 4960 cal BP) and -1.52 to -1.56m OD (4000 to 3690 cal BP). It is possible that the Peat horizons at the present site are contemporaneous with those at 120-146 Stewarts Road, or on the basis of height OD they may represent a later phase of peat accumulation such as that identified at Battersea Power Station. Significantly, there appears to be no clear relationship at the previously investigated sites between height OD and the age of peat accumulation.

As a consequence of the findings of the stratigraphic modelling, it was recommended that two geoarchaeological boreholes were collected from the site. Borehole <QBH1> was targeted to ground-truth the area of supposed high Gravel surface towards the west of the site, and to investigate the presence of an organic horizon (possible soil). Borehole <QBH2> was targeted to ground-truth the supposed channel and to investigate the Peat in this area of the site. An assessment of one of these sequences was recommended in order to elucidate the age of the Peat, and to evaluate the potential for reconstructing the past environmental conditions of the site and its environs. The assessment incorporated: (1) laboratory-based description of both sequences; (2) organic matter determinations to aid identification of the sedimentary units; (3) radiocarbon dating of the base and top of the Peat to ascertain the age of peat accumulation and cessation; (4) assessment of the pollen and waterlogged plant macrofossils to provide a provisional reconstruction of the vegetation history; (4) assessment of the diatoms to provide an indication of the potential to derive palaeohydrological information (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 aims to highlight any indications of nearby human activity, and provide recommendations for further analysis (if necessary).

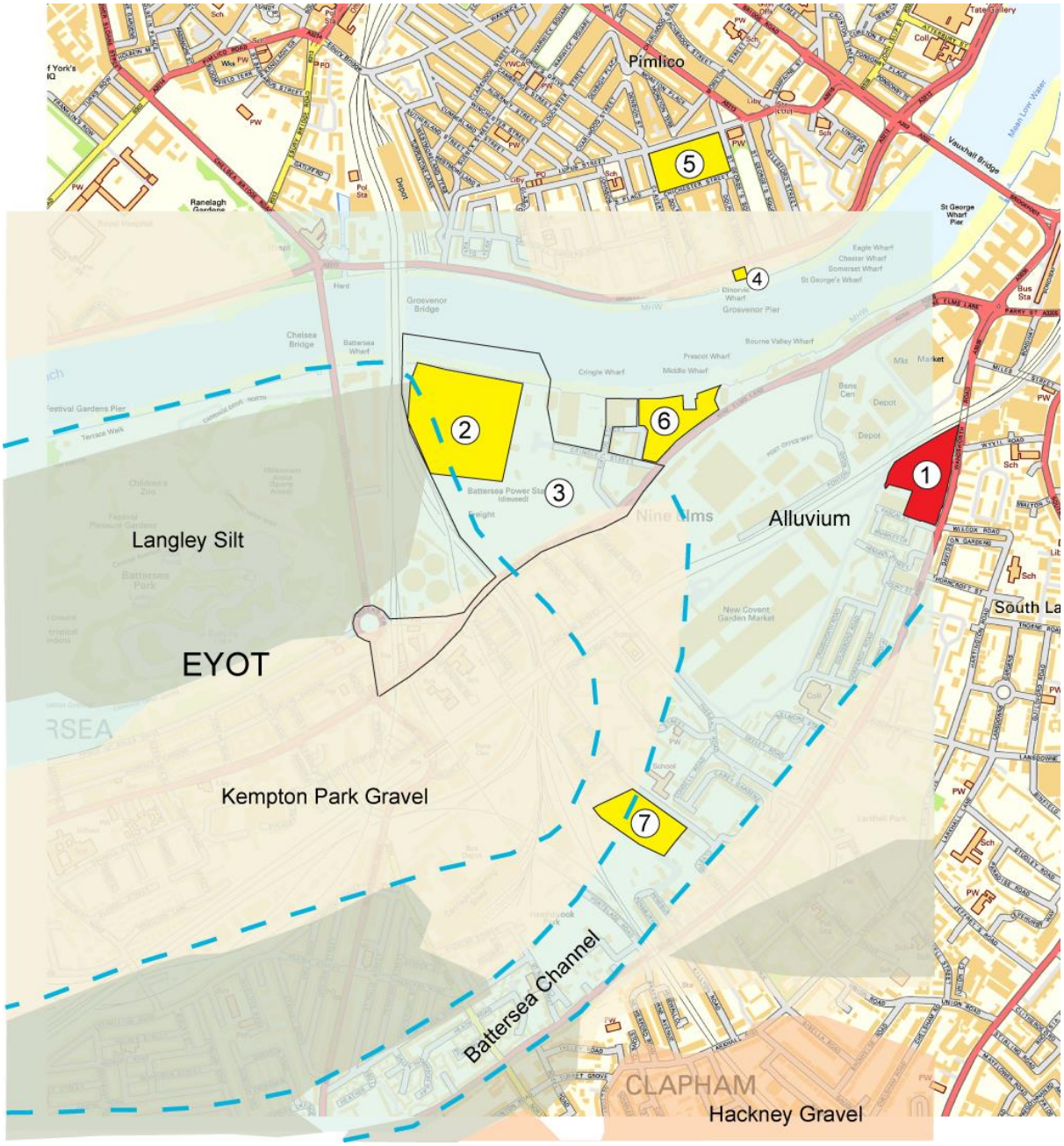

Figure 1: Location of (1) site at Wandsworth Road and Pascal Street, Nine Elms, London Borough of Lambeth; (2) Battersea Power Station (Branch *et al.*, 2010); (3) Battersea Power Station (Dawson *et al.*, 2009); (4) 135 Grosvenor Road, Pimlico (Green & Young, 2012); (5) Lupus Court (Green, 2008); (6) Tideway Wharf (Green & Young, 2011); (7) 102-104/120-146 Stewarts Road (Morley, 2009/2010) and (8) Chelsea Bridge Wharf (Corcoran *et al.*, 2007). Superficial geology is shown as mapped by Morley (2009/2010), showing the projected course of the Battersea Channel. *Contains Ordnance Survey data © Crown copyright and database right [2012]*

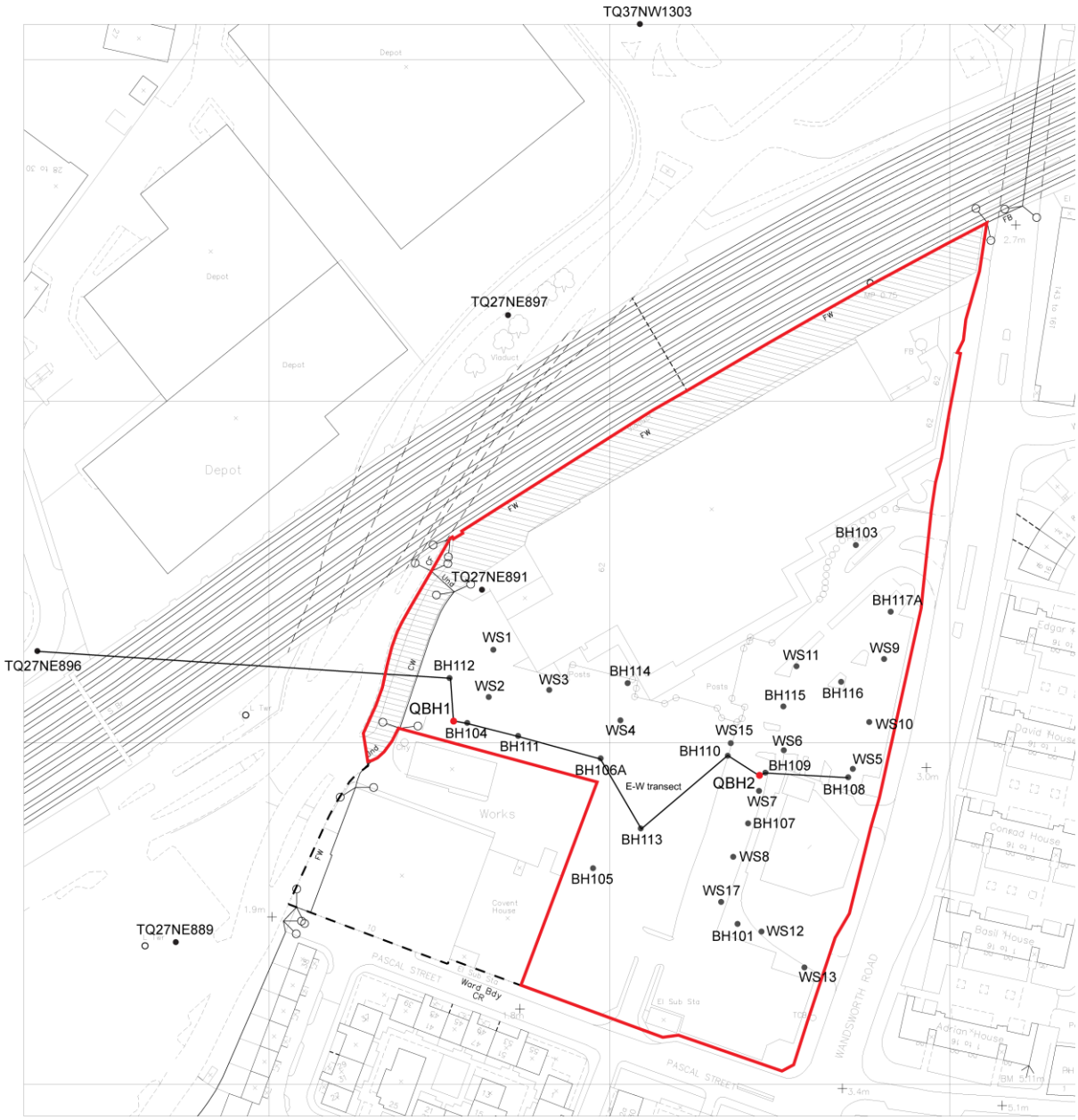

Figure 2: Location of the new geoarchaeological (red) and existing geotechnical and BGS boreholes (black). *Contains Ordnance Survey data © Crown copyright and database right [2012]*

METHODS

Previous investigations (field investigations and deposit modelling)

A total of 31 geotechnical boreholes were put down at the site using either cable percussion (boreholes BH101 to BH117A) or a terrier rig (window samples WS1 to WS17). Selected boreholes were monitored by Quaternary Scientific in order to observe those boreholes that recorded the full Holocene sequence, and to provide a good spatial distribution across the site. The resulting sedimentary logs were combined with those of the geotechnical boreholes and used to produce a deposit model, in combination with boreholes put down nearby to the site, provided by the British Geological Society (NERC).

Sedimentary units from the boreholes were classified into five groupings: (1) Gravel; (2) Lower Alluvium; (3) Peat; (4) Upper Alluvium, and (5) 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 7). Thickness of the Peat (Figure 8) and combined alluvial units (Figure 8) were also modelled (also using a nearest neighbour routine). 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.

An additional two boreholes (boreholes <QBH1> and <QBH2>) were put down at the site in January 2014 following the results of the deposit modelling exercise (Young & Green, 2013; 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: Spatial data for the new geoarchaeological boreholes attributes, Land at Wandsworth Road and Pascal Street, Nine Elms, London Borough of Lambeth.

Borehole number	Easting	Northing	Elevation (m OD)
<QBH1>	529953.59	177404.20	2.84
<QBH2>	530042.21	177390.25	2.83

Lithostratigraphic descriptions

The lithostratigraphy of boreholes <QBH1> and <QBH2> 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 10 and Tables 2 and 3.

Organic matter determinations

32 sub-samples from borehole <QBH2> were taken for determination of the organic matter content (Table 4 and Figure 10). 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°C 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 twig wood (<2-3 years old) were extracted from the top and base of the peat in borehole <QBH2> for radiocarbon dating. Both samples were submitted for AMS radiocarbon dating to the Scottish Universities Environmental Research Centre (SUERC), East Kilbride, Glasgow. The results have been calibrated using OxCal v4.0.1 Bronk Ramsey (1995, 2001 and 2007) and IntCal13 atmospheric curve (Reimer *et al*., 2013). The results are displayed in Figure 10 and Table 5.

Pollen assessment

Twelve sub-samples were extracted from borehole <QBH2> 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) (Table 6).

Diatom assessment

Five sub-samples from borehole <QBH2> 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 7.

Macrofossil assessment

A total of eight small bulk samples from borehole <QBH2> 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 (Table 8).

Preliminary identifications of the waterlogged seeds have been made using modern comparative material and reference atlases (e.g. Cappers *et al.* 2006). Nomenclature used follows Stace (2005) (Table 9).

RESULTS AND INTERPRETATIONS OF THE FIELD INVESTIGATIONS AND DEPOSIT MODELLING (PREVIOUS INVESTIGATIONS)

The results of the deposit modelling for the site (Figures 3 to 9; Appendix 1) have been reported previously (Young & Green, 2013). The results of this investigation revealed that the basal unit at the site is the London Clay bedrock. The surface of this unit is relatively uniform in the western part of the site, where it lies at *ca*. -3.0 to -3.5m OD in boreholes BH112, BH104, BH111, BH106A and BH114. Through the centre of the site the surface of the London Clay lies at between *ca.* -4.0 and -5.5m OD in boreholes BH101, BH103, BH105, BH107, BH109, BH110 and BH115. Along the eastern margin of the site the London Clay surface rises again to between -3.0 and -3.5m OD in boreholes BH108, BH116 and BH117A.

Overlying the London Clay is a horizon of sand and gravel (Figure 4), which below *ca*. -2.5m OD and east of borehole BH111 (Figure 3) is likely to equate to the Shepperton Gravel (Gibbard, 1985). These sediments were deposited during the Late Devensian within a high energy braided river system, in a channel that at this time was either subsidiary or tributary to the Thames (Morley, 2009/2010). This channel most likely traversed the eastern part of the site (east of borehole BH111), and may have formed part of the Battersea Channel, either as a tributary joining the main channel from the southeast, or as part of a network of channels aligned approximately southwest-northeast on the floor of the Battersea Channel itself. Outside the limits of this channel and where it rises to above *ca*. -2.5m OD the sand and gravel is likely to equate to the Kempton Park Gravel (Gibbard, 1985).

The new geotechnical boreholes indicate that the surface of the Gravel falls eastwards across the site, from -0.5 (BH112) and -1.28m OD (BH111) in the western part of the site, to -2.0 and -3.0m OD in the eastern half of the site (Figures 3 and 4). In borehole BH108 it was not possible to confirm the presence of the Gravel, most likely to due to its shallow depth in this part of the site and the method of drilling carried out. However, the London Clay surface

was recorded at -2.31m OD at this location, indicating that the surface of the Gravel (if present) lay at between -1.81 and -2.31m OD, and indicating a slight rise in this part of the site and delimiting the eastern margin of the channel within which Shepperton Gravel accumulated. If this is the case, the channel is likely to have been between 50 and 100m wide at this location. Approximately 200m north east of the site the gravel surface rises again to between 2.74 (TQ37NW1476) and 2.80m OD (TQ37NW1472), and is equivalent to the Kempton Park Gravel. To the west of the site the gravel surface is recorded at 1.22m OD in borehole TQ27NE896 (Figure 3); however, such a high Gravel surface seems unlikely at this location and the reliability of this record is unclear.

Succeeding the lower surface of the Shepperton Gravel in the eastern part of the site is a horizon of generally sandy or clayey silt, often containing occasional gravel clasts and detrital herbaceous material. This unit is generally 1.0 to 2.0m thick, the surface lying at between *ca*. -0.5 and -1.5m OD (Figure 5). This unit represents the Lower Alluvium, the sediments of which were deposited during the Early to Mid-Holocene, as the energy of flow decreased and the Thames and its tributaries became confined to single meandering channels. In the western part of the site (outside of the former channel) the Gravel is overlain by silty clay, except in borehole BH104 where it is overlain by silty Peat between -1.06 and -0.96m OD. This Peat horizon represents a short period of accumulation that may be contemporaneous with an occasionally woody or herbaceous Peat horizon which overlies the Lower Alluvium in the eastern part of the site (Figure 6), generally present between -1.0 and 0.5m OD and between 0.10 and 0.60m thick (Figure 8). Alternatively, this horizon may represent localised Peat accumulation in floodplain hollows, associated with channel migration across the floodplain at this time; it should be considered however that this horizon is relatively shallow, and may not have been identified in some of the geotechnical logs. Significantly, the Peat horizon present in the eastern part of the site, and in boreholes BH104 and BH106A in the western part of the site, represent a transition to a semi-terrestrial land surface. In the majority of cases, the Peat is silty, indicating frequent inundation of the Peat surface by mineral-rich sediment deposited during over-bank flood events. A thicker Peat horizon (up to 1.7m thick) was recorded in the geotechnical logs from borehole BH109; however, this borehole was not monitored by Quaternary Scientific and may in fact represent a combination of Peat and organic alluvium, summarised as Peat due to the different descriptive terms and differing technical constraints (in terms of recorded detail) of the geotechnical investigations. Geoarchaeological borehole <QBH2> was collected in the area of borehole BH109 (see below).

The upper surface of the Peat lies at between -1.0 and 0.5m OD across much of the site (Figure 6). The Peat is overlain across the site by the silty, occasionally sandy clay Upper Alluvium, representative of inundation of the former semi-terrestrial surface. The surface of the Upper Alluvium generally lies at between 2.0 and 0.5m OD (Figure 7). Towards the south of the site this surface lies at -0.67m OD in borehole BH101, and is indicative of a greater depth of truncation by Made Ground in this area of the site. Here the Made Ground is 3.6m thick; elsewhere it is between 2.0 and 3.0m thick so that the modern surface of the site is approximately level at *ca*. 3.0m OD.

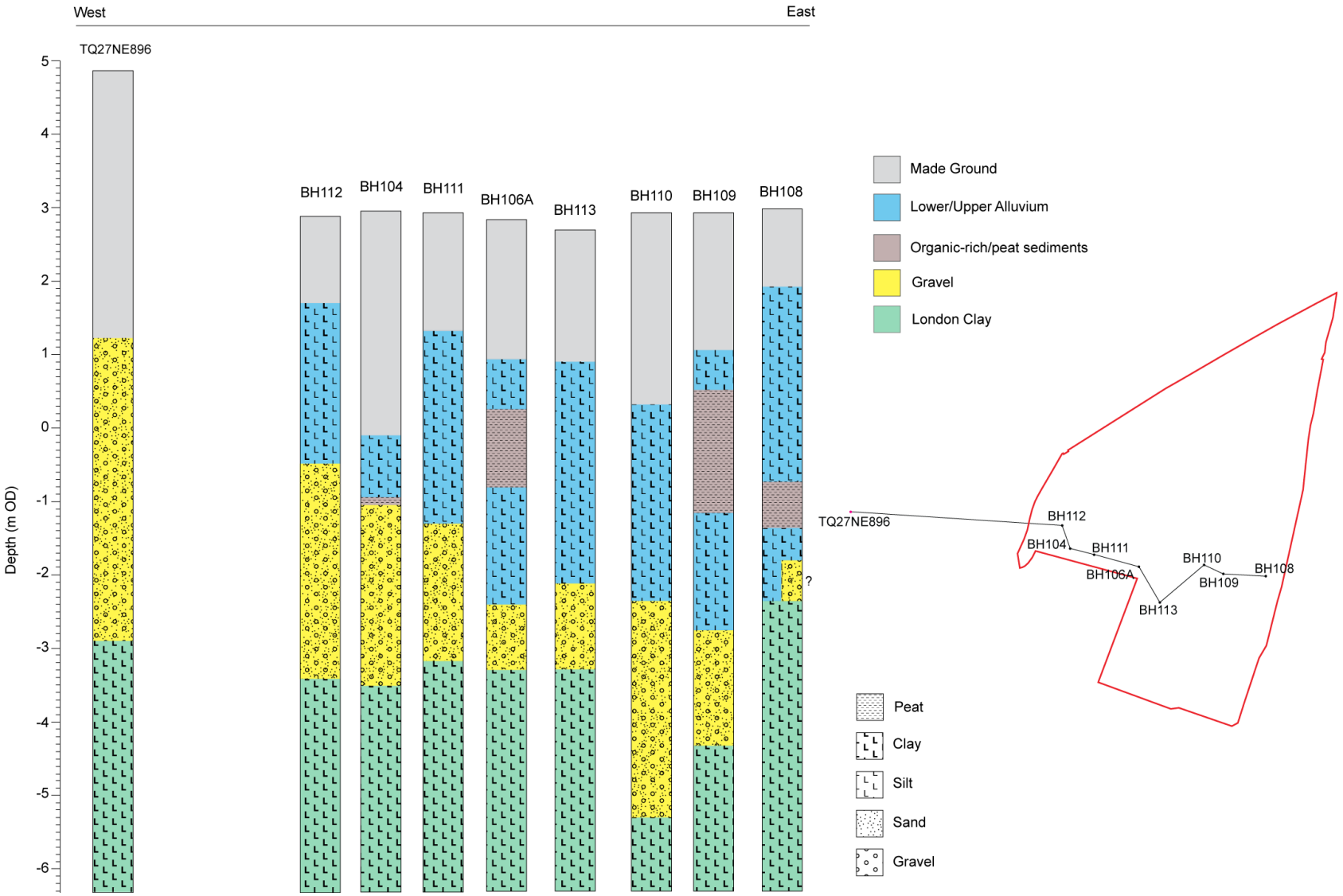

Figure 3: West-East transect of selected boreholes across the site. Wandsworth Road and Pascal Street, Nine Elms, London Borough of Lambeth.

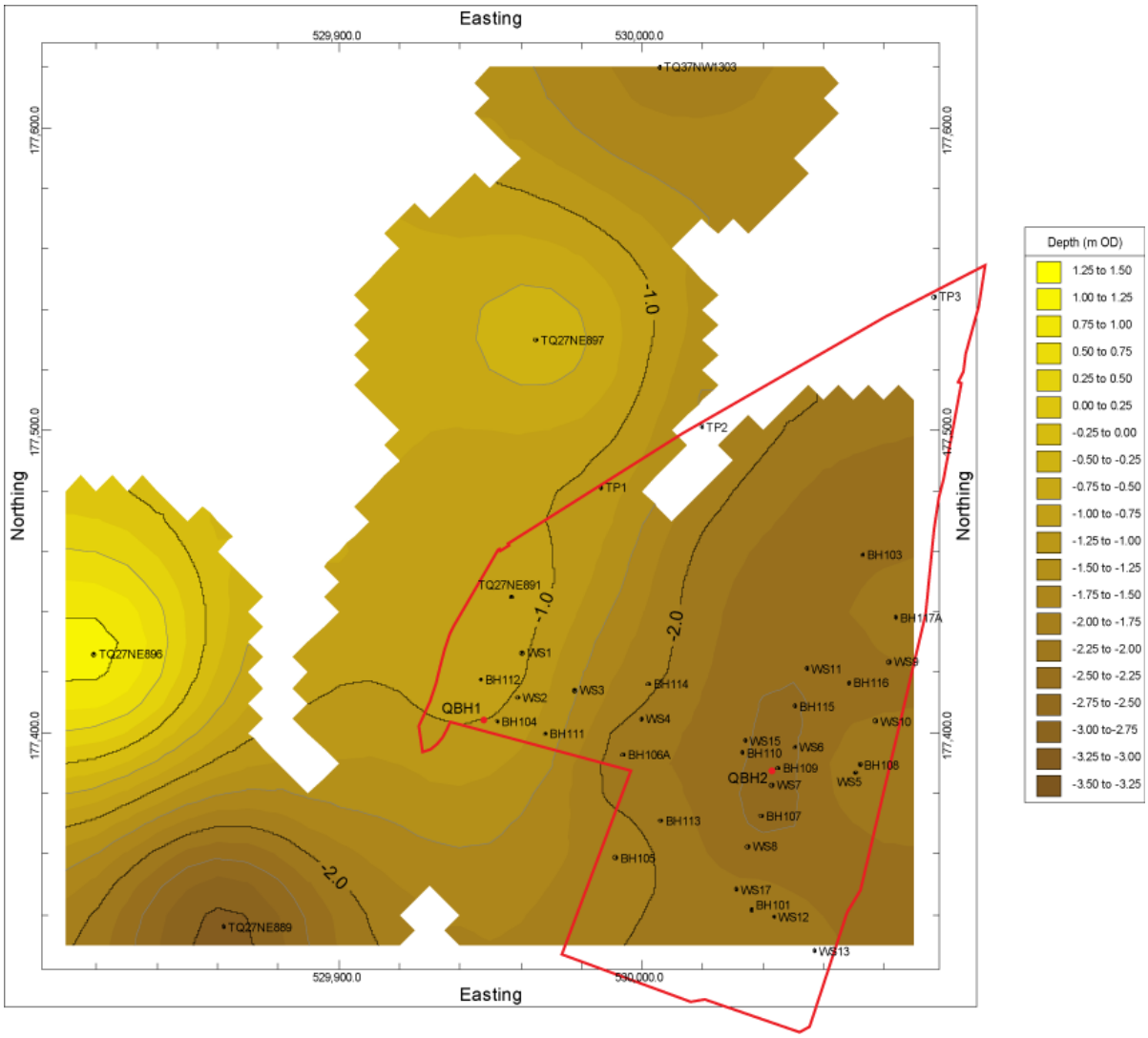

Figure 4: Top of the Gravel / Base of the Lower Alluvium (m OD). The reliability of the Gravel surface recorded in BGS borehole TQ27NE896 is unclear.

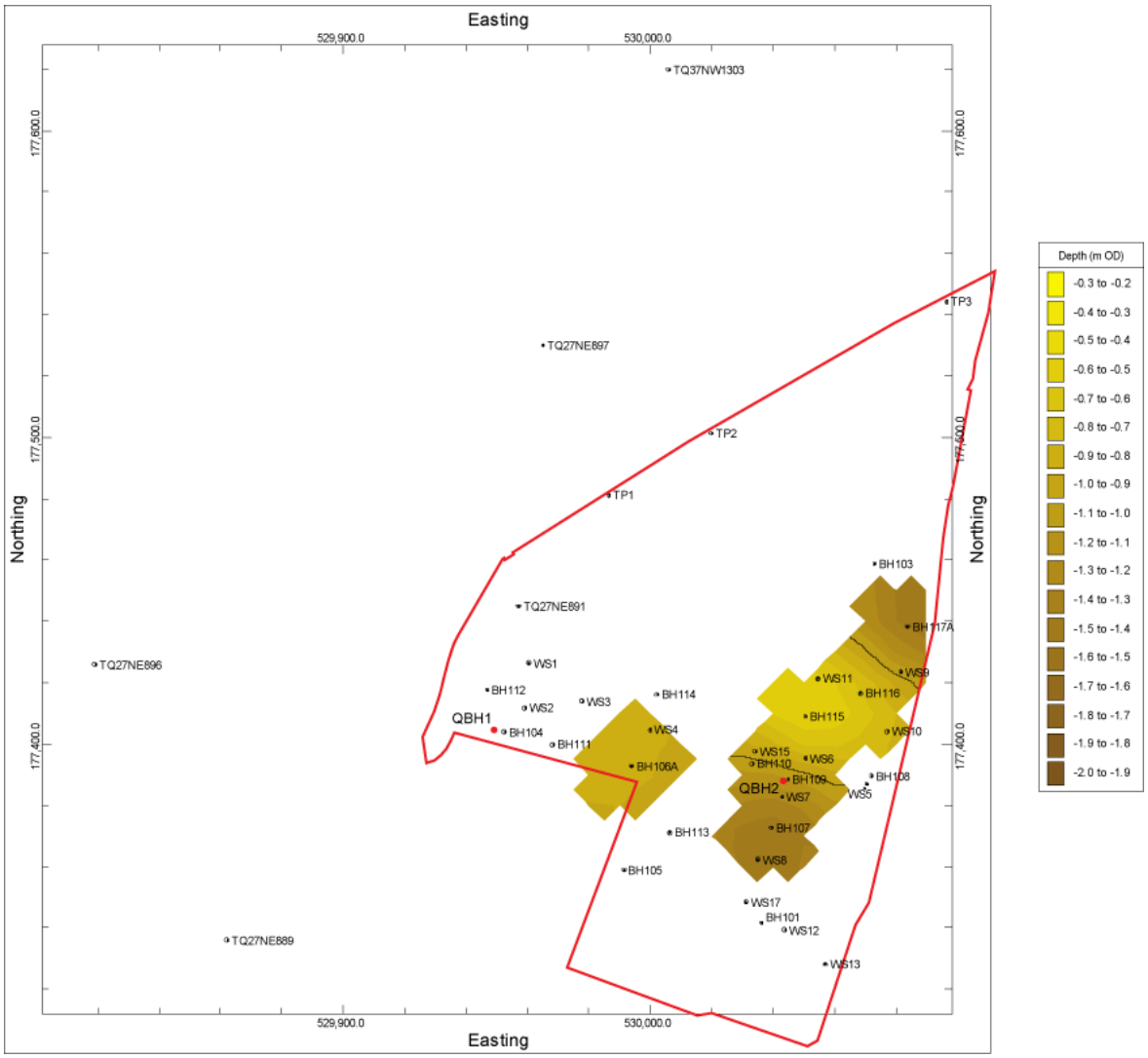

Figure 5: Top of Lower Alluvium / Base of the Peat (m OD)

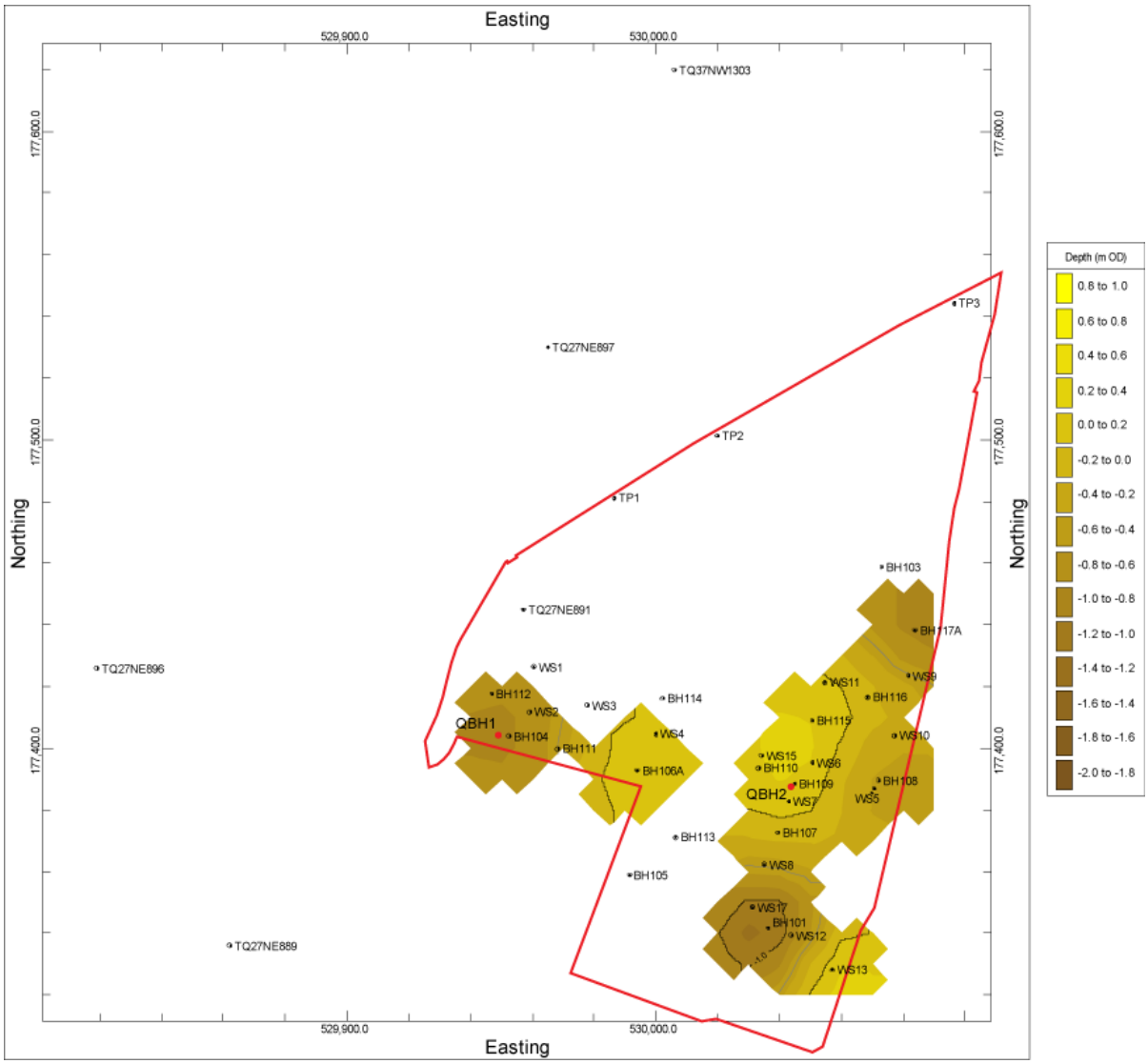

Figure 6: Top of Peat / Base of the Upper Alluvium (m OD)

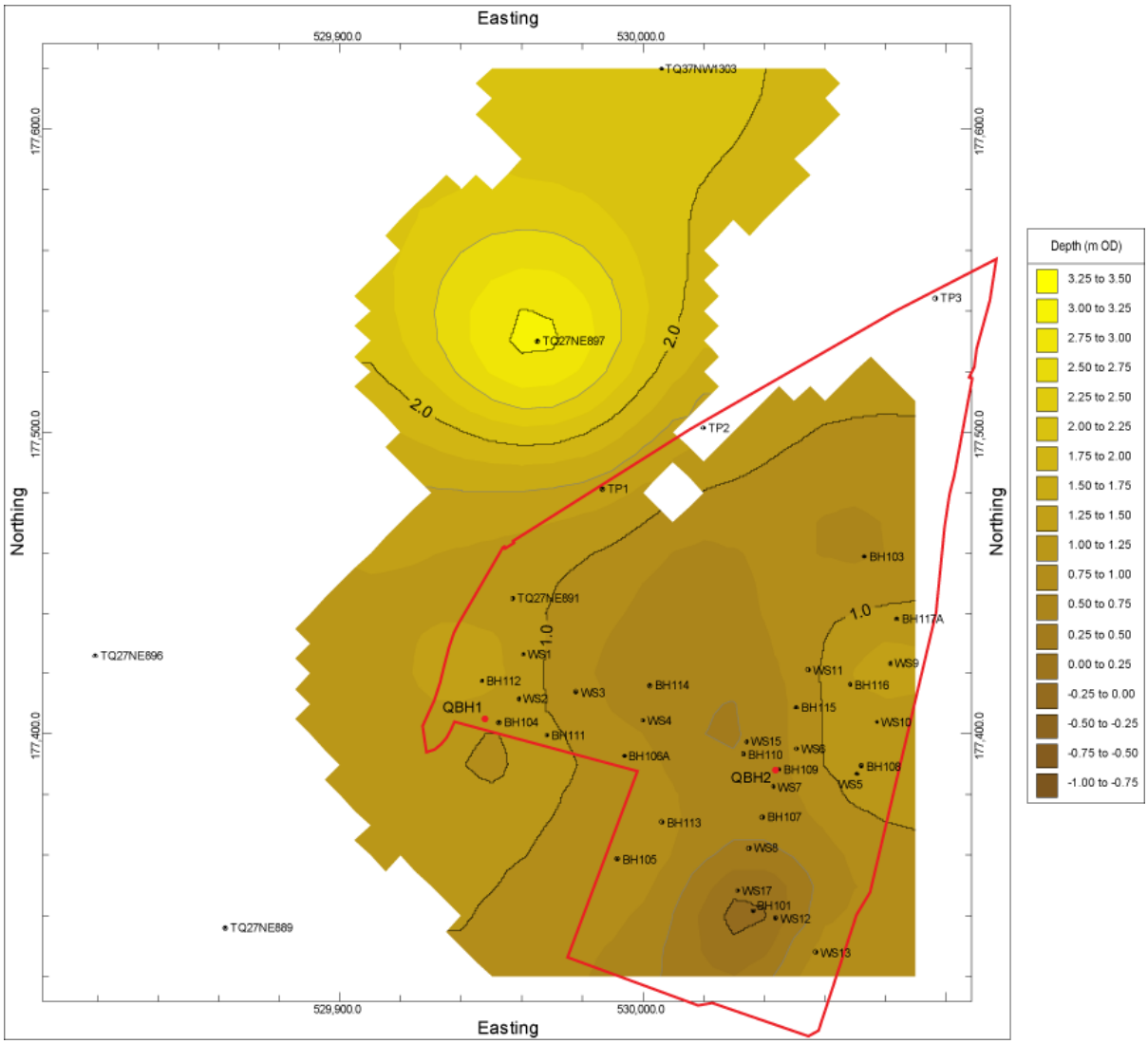

Figure 7: Top of Upper Alluvium / Base of Made Ground (m OD)

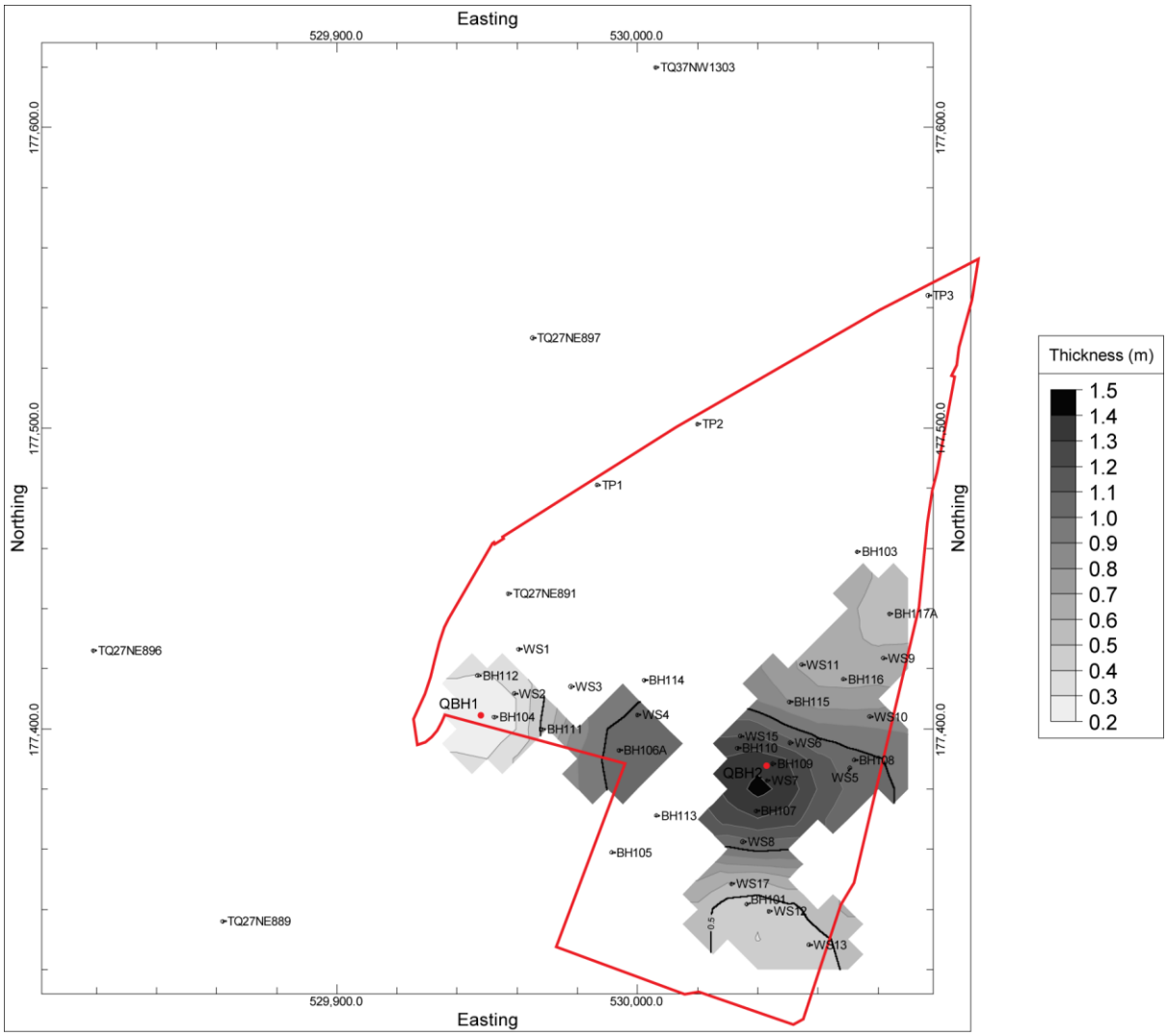

Figure 8: Thickness of the Peat (m)

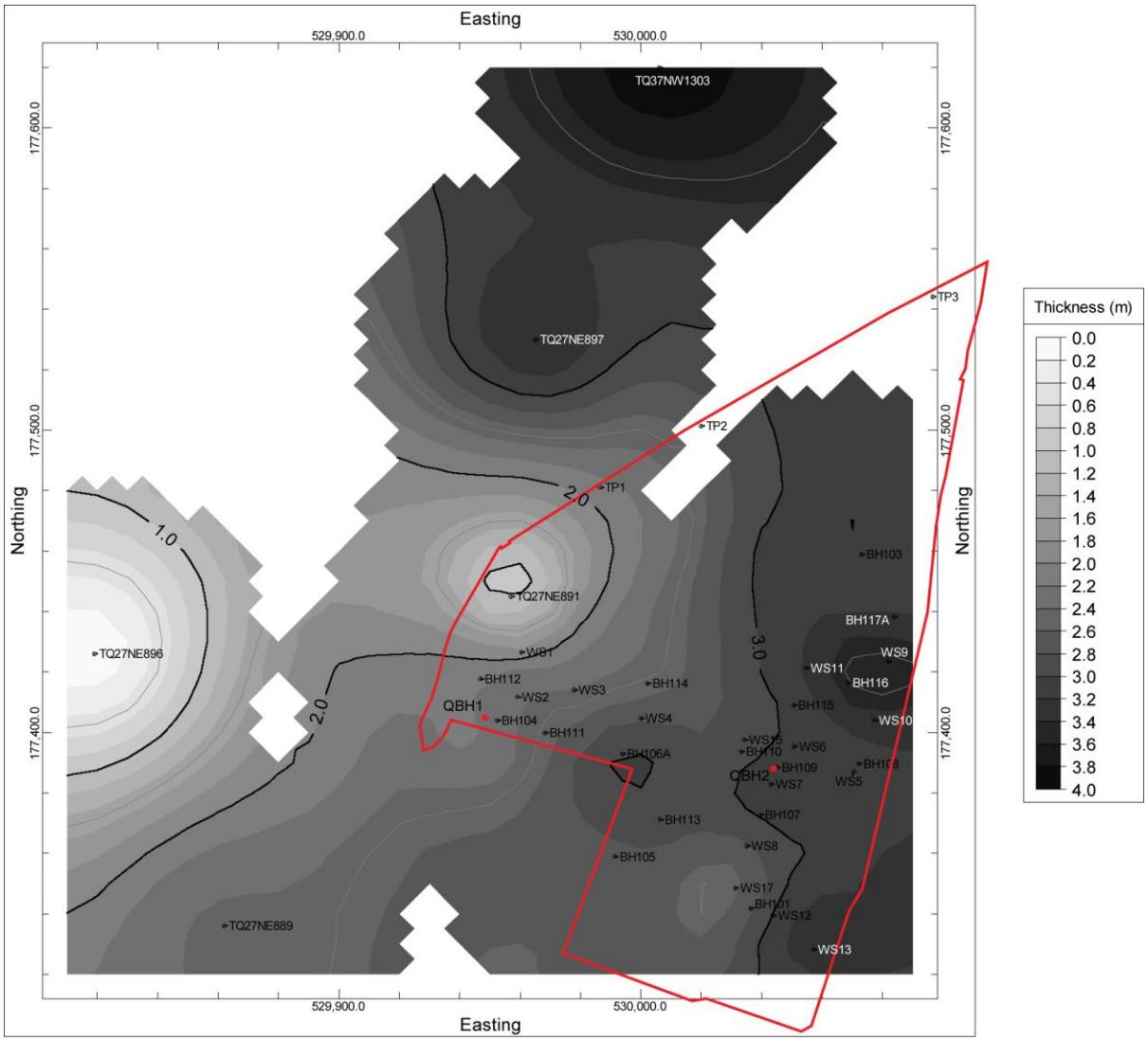

Figure 9: Thickness of Total Alluvium (m)

RESULTS AND INTERPRETATION OF THE LITHOSTRATIGRAPHIC DESCRIPTIONS, ORGANIC MATTER CONTENT & RADIOCARBON DATING

Lithostratigraphic description of two new geoarchaeological boreholes, <QBH1> (collected in the area of geotechnical borehole BH104) and <QBH2> (collected in the area of BH109), and quantification of the organic matter content by Loss-on-Ignition in borehole <QBH2> has allowed further detail to be added to the lithostratigraphic descriptions of the Holocene Alluvium and Peat (Figure 10; Tables 2 and 3). The sequence recorded in borehole <QBH1> was very similar to that recorded in borehole BH104, with a Gravel surface recorded at -1.06m OD (Figures 4 and 10). The Gravel surface here was overlain by a very thin horizon of Peat (less than 5mm thick), to a level of 1.055m OD. The thin nature of the Peat in this borehole may be a result of subsequent erosion of the Peat surface during deposition of the overlying Alluvium; it was therefore not possible to determine if this horizon was a remnant of a former soil. The Peat was overlain by silty clay Upper Alluvium to a level of 0.84m OD, and Made Ground, to a level of 2.84m OD.

The sequence recorded in borehole <QBH2> was markedly different to that in borehole BH109, with a lower Gravel surface (-3.60m OD) overlain by variably sandy or silty Lower Alluvium to a level of -0.96m OD (Figure 10). A void is recorded between -2.69 and -3.17m OD in borehole <QBH2>, most likely a consequence of the unconsolidated nature of the very sandy horizon recorded at the base of this particular core. Organic matter content was minimal within the mineral-rich Lower Alluvium as might be expected (generally <10%; Figure 10). A transition to organic silty clay occurs between -0.96 and -0.79m OD, reflected in increased organic content values (up to 50%), before a transition to silty wood Peat between -0.79 and -0.22m OD (generally 50-60% organic content). Values of 60 to 80% organic content are common within the Peat of the Middle and Lower Thames Valley, with a constant input of fine-grained mineral rich material (silt and clay) resulting from over-bank flood events and inundation of the Peat surface by mineral-rich material. The Peat is noticeably thinner here than was suggested in the geotechnical description of borehole BH109, where it was recorded at a similar elevation but nearly 2.0m thick. The Peat is overlain by generally clay-rich Upper Alluvium between -0.22 and 0.18m OD (<10% organic content), and Made Ground, which caps the sequence between 0.18 and 2.83m OD.

Sub-samples of twig wood (<2-3 years old) were extracted from the top and base of the Peat in borehole <QBH2> for radiocarbon dating. The sample from the base of the Peat (-0.79 to -0.84m OD) provided an age of 3460 to 3360 cal BP (1510 to 1410 cal BC), whilst the sample from the top of the Peat (-0.22 to -0.27m OD) was dated to 3150-2930 cal BP (1200-980 cal

BC). The δ13C (‰) values are consistent with that expected for organic remains from peat sediment, and there is no evidence for mineral or biogenic carbonate contamination. These results indicate that Peat accumulation commenced in the area of borehole <QBH2> during the Middle Bronze Age, and that cessation occurred during the Late Bronze Age/Early Iron Age.

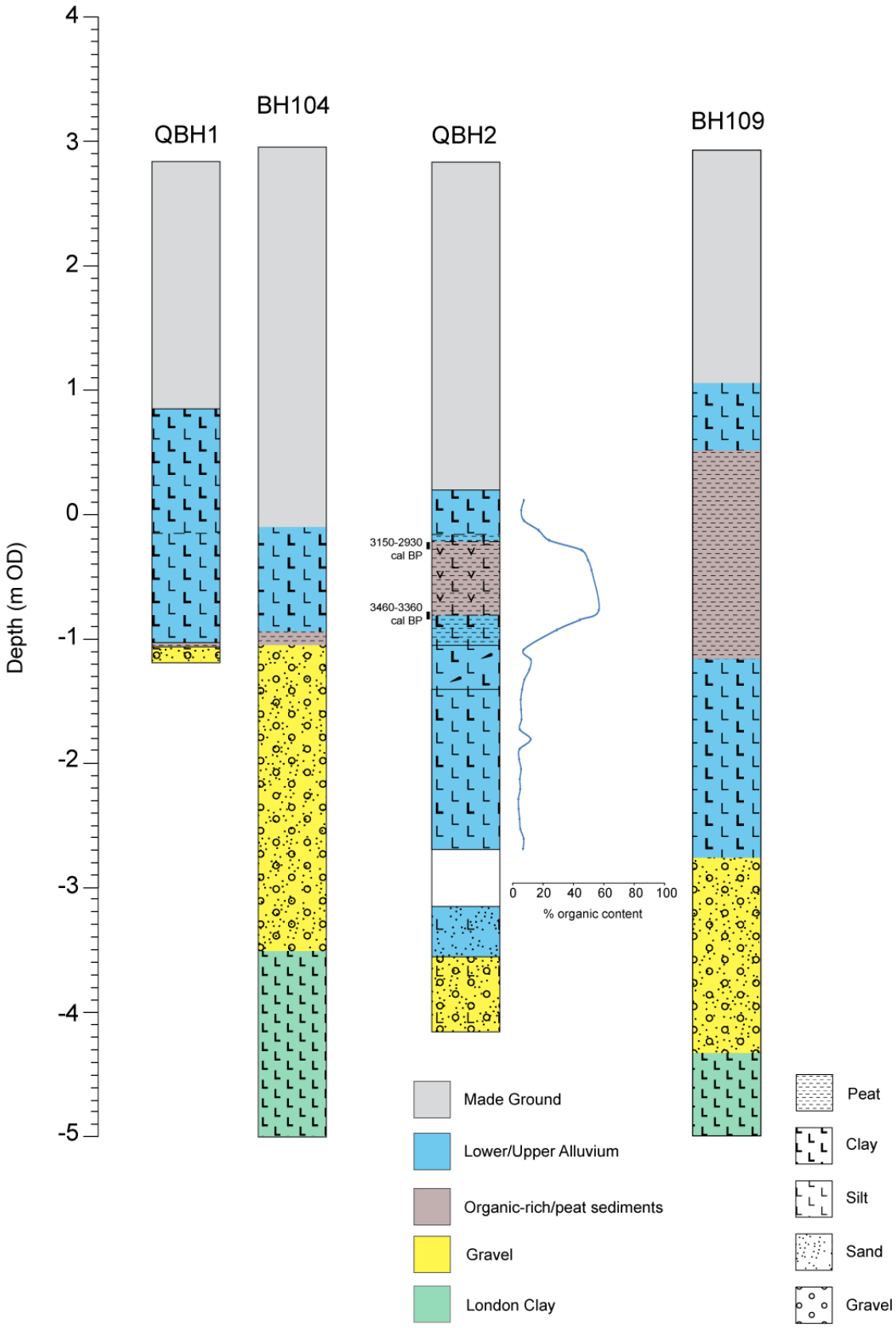

Figure 10: Results of the borehole <QBH1> and <QBH2> lithostratigraphic analysis, incorporating lithostratigraphic descriptions and organic matter content, plotted with associated radiocarbon dates. The sedimentary logs from geotechnical boreholes BH104 and BH109 are shown for comparison. Land at Wandsworth Road and Pascal Street, Nine Elms, London Borough of Lambeth.

Table 2: Lithostratigraphic description of borehole <QBH1>, Land at Wandsworth Road and Pascal Street, Nine Elms, London Borough of Lambeth.

Depth (m OD)	Depth (m bgs)	Composition
2.84 to 0.84	0.00 to 2.00	Made Ground
0.84 to -0.16	2.00 to 3.00	Gley 1 4/10Y; As3 Ag1 Gg+; dark greenish grey silty clay with occasional gravel clasts. Some iron staining.
-0.16 to -1.055	3.00 to 3.895	Gley 1 6/10Y; As2 Ag2 Gg+; greenish grey silt and clay with occasional gravel clasts and calcareous nodules. Some iron staining. Sharp contact in to:
-1.055 to -1.06	3.895 to 3.90	2.5YR 2.5/1; Sh2 Ag2; humo. 4; reddish black very well humified peat and silt lying on the surface of the unit below (gravel). Sharp contact in to:
-1.06 to -1.16	3.90 to 4.00	Gley 1 6/10Y; Gg2 Ga1 Ag1; greenish grey sandy silty gravel.

Table 3: Lithostratigraphic description of borehole <QBH2>, Land at Wandsworth Road and Pascal Street, Nine Elms, London Borough of Lambeth.

Depth (m OD)	Depth (m bgs)	Composition
2.83 to 0.18	0.00 to 2.65	Made Ground
0.18 to -0.17	2.65 to 3.00	Gley 1 3/10Y; As3 Ag1; very dark greenish grey silty clay.
-0.17 to -0.22	3.00 to 3.05	10YR 3/2; Ag2 As1 Sh1 Dl+ Dh+; very dark greyish brown organic clayey silt with traces of detrital herbaceous material and detrital wood. Diffuse contact in to:
-0.22 to -0.79	3.05 to 3.62	2.5YR 2.5/1; Sh2 Ag1 Tl[1]1; humo. 2/3; reddish black moderately to well humified silty woody peat. Diffuse contact in to:
-0.79 to -0.96	3.62 to 3.79	10YR 3/2; Ag2 As1 Sh1 Dl+ Dh+; very dark greyish brown organic clayey silt with traces of detrital herbaceous material and detrital wood. Sharp contact in to:
-0.96 to -1.17	3.79 to 4.00	Gley 1 5/10Y; Ag2 As1 Dl1; greenish grey clayey silt with detrital wood.
-1.17 to -1.42	4.00 to 4.25	Gley 1 4/10Y; Ag2 As1 Dl1 Dh+; dark greenish grey clayey silt with detrital wood and a trace of detrital herbaceous material. Some horizontal beds of detrital herbaceous material. Diffuse contact in to:
-1.42 to -2.69	4.25 to 5.52	Gley 1 4/10Y; Ag3 As1 Dh+ Ga+; dark greenish grey clayey silt with traces of detrital herbaceous and sand.
-2.69 to -3.17	5.52 to 6.00	VOID
-3.17 to -3.60	6.00 to 6.43	Gley 1 6/10Y; Ga3 Ag1; greenish grey silty sand. Sharp contact in to:
-3.60 to -4.17	6.43 to 7.00	Gley 1 6/10Y; Gg2 Ga1 Ag1; greenish grey sandy silty gravel.

Table 4: Results of the borehole <QBH2> organic matter determinations, Land at Wandsworth Road and Pascal Street, Nine Elms, London Borough of Lambeth.

Depth (m OD)		Organic matter content (%)
From	To	
0.11	0.10	7.38
0.03	0.02	5.67
-0.05	-0.06	7.25
-0.13	-0.14	17.04
-0.21	-0.22	23.97
-0.29	-0.30	45.43
-0.37	-0.38	49.61
-0.45	-0.46	51.91
-0.77	-0.78	56.72
-0.85	-0.86	44.21
-0.93	-0.94	29.12
-1.09	-1.10	7.22
-1.17	-1.18	11.90
-1.25	-1.26	10.99
-1.33	-1.34	7.73
-1.41	-1.42	6.21
-1.49	-1.50	5.29
-1.57	-1.58	5.54
-1.65	-1.66	5.83
-1.73	-1.74	4.68
-1.81	-1.82	11.87
-1.89	-1.90	4.48
-1.97	-1.98	4.24
-2.05	-2.06	5.51
-2.13	-2.14	4.67
-2.21	-2.22	4.96
-2.29	-2.30	3.74
-2.37	-2.38	3.91
-2.45	-2.46	4.53
-2.53	-2.54	5.04
-2.61	-2.62	7.26
-2.69	-2.70	6.84

Table 5: Results of the borehole <QBH2> radiocarbon dating, Land at Wandsworth Road and Pascal Street, Nine Elms, London Borough of Lambeth.

Laboratory code / Method	Material and location	Depth (m OD)	Uncalibrated radiocarbon years before present (yr BP)	Calibrated age BC/AD (BP) (2-sigma, 95.4% probability)	δ13C (‰)
SUERC-50520 (GU33049)	Twig wood; top of Peat	-0.22 to -0.27	2892 ± 29	1200-980 cal BC (3150-2930 cal BP)	-29.1
SUERC-50521 (GU33050)	Twig wood; base of Peat	-0.79 to -0.84	3186 ± 29	1510 to 1410 cal BC (3460 to 3360 cal BP)	-29.4

RESULTS AND INTERPRETATION OF THE POLLEN ASSESSMENT

Twelve sub-samples from borehole <QBH2> were extracted for an assessment of pollen content (Table 6). These samples were targeted on the Alluvial and Peat deposits between -2.20 and 0.04m OD.

Three distinct pollen assemblages are indicated by the results of the assessment. Between -2.20 and -1.00m OD, a high concentration of pollen is recorded in a moderate state of preservation. The four samples assessed between these depths are characterised by high values of *Pinus* (pine) with *Betula* (birch), *Corylus* type (e.g. hazel), Poaceae (grasses), Cyperaceae (sedges), *Ranunculus* type (buttercup / water crowfoot), Caryophyllaceae (pinks) and *Artemisia* (mugwort); *Alnus* (alder) values increase upwards. In addition, these samples all contain aquatic taxa (e.g. *Myriophyllum* type – water milfoil; *Typha latifolia* – bulrush, and *Sparganium* type – bur-reed), high values of microcharcoal and unidentifiable pollen.

A still or moving aquatic/semi-aquatic environment is clearly indicated by the presence of sedges, buttercup/water crowfoot, water milfoil, bulrush and bur-reed. This environment was gradually invaded by alder, most likely growing on drier areas of the floodplain and/or banks of the river. The high values of pine together with birch, willow (*Salix*), mugwort and grasses might also indicate the growth of pine and birch woodland, suggestive of cold climatic conditions such as those recorded towards the beginning of the Holocene. The increase of temperate taxa such as alder enhances this interpretation. However, it is also highlighted that *Pinus* pollen tends to be over-represented within alluvial deposits as a consequence of its morphology, which allows it to travel long distances (by both fluvial and aeolian means). The high number of unidentifiable pollen grains is also considered likely to represent the reworking and physical deterioration of pollen as a consequence of moving water. Similarly, the high microscopic charcoal content may not represent in situ or nearby burning; due to the nature of the environment of deposition, it is more likely that this concentration represents the accumulation and deposition of fragments from a wider area.

Between -0.92 and -0.28m OD and corresponding with the Peat, the pollen assemblage is generally lower, and dominated by alder and oak (*Quercus*) with hazel, lime (*Tilia*), and a limited number of herbaceous taxa. The abrupt change in assemblage may suggest a hiatus in deposition between the Alluvium and Peat. The pollen taxa recorded indicate that alder carr colonised the Peat surface, whilst the dryland was occupied by mixed oak and lime woodland. The reduction of lime above -0.76m OD may be representative of a decline in dryland woodland midway through the Peat. However, the lower pollen concentration within

the succeeding samples means that it is not possible to elucidate the nature or causes of this decline at this stage.

In samples -0.20 and 0.04m OD, the concentration of pollen is very high and in a good state of preservation. Within these samples, a reduction of tree and shrub pollen is indicative of the decline of woodland on both the wetland and dryland surfaces. The high number and diversity of herbaceous taxa, including grasses, sedges, daisies (Asteraceae), dandelions (Lactuceae), plantain (*Plantago* type), cereals and knotgrass (*Polygonum aviculare*) is suggestive of nearby open and disturbed ground and an anthropogenic influence.

Table 6: Results of the pollen assessment from borehole <QBH2>, Land at Wandsworth Road and Pascal Street, Nine Elms, London Borough of Lambeth.

	Depth (m OD)	**0.03 to 0.04**	**-0.20 to -0.21**	**-0.28 to -0.29**	**-0.36 to -0.37**	**-0.44 to -0.45**	**-0.76 to -0.77**	**-0.84 to -0.85**	**-0.92 to -0.93**	**-1.00 to -1.01**	**-1.40 to -1.41**	**-1.80 to -1.81**	**-2.20 to -2.21**
Latin name	**Common name**												
Trees													
Alnus	alder	2	17	13	5	7	7	11	19	14	2		1
Quercus	oak	1	4		3	1	6	3	5	5			1
Pinus	pine	1	1	1						7	7	11	8
Tilia	lime						2	1	7	1			
Betula	birch	1								2	2	3	2
Shrubs													
Corylus type	e.g. hazel	6	1		4		1	4	7	4	2	4	7
Salix	willow			1		1						1	
Rosaceae	rose family											1	
Herbs													
Cyperaceae	sedge family	12	1				1			1	4	4	2
Poaceae	grass family	12	4	1				1		3	8	3	4
Cereale type	oats/barley/wheat	2	1										
Asteraceae	daisy family	2	1										1
Artemisia	mugwort		1		1						2	2	
Lactuceae	dandelion family	3	2	1	1								
Plantago type	plantain		1				1						
Chenopodium type	goosefoot family		4					1					
Caryophyllaceae	pink family	5								2	1		1
Galium tyoe	bedstraw				1								
Ranunculus type	buttercup	1		1						1	3	5	
Thalictrum	meadow-rue											1	

Filipendula type	e.g. dropwort			1									
Primula veris	cowslip		1										
Polygonum aviculare	knotgrass		1										
Apiaceae	carrot family	1											
Aquatics													
Sparganium type	bur-reed								1				1
Myriophyllum type	water milfoil									3	11	3	
Typha latifolia	bulrush										2	1	
Spores													
Filicales	ferns	7	2	1			6	6	1				2
Pteridium aquilinum	bracken	5	3	1			1	1	1			2	1
Polypodium vulgare	polypody		1				1	1	2				1
Unidentifiable		25	2			1	2	3		8	5	Mod-High	High
Total Land Pollen (grains counted)		49	40	19	15	9	18	21	38	43	31	35	27
Concentration*		5	5	3	2-3	2	3	3	5	5	5	5	4
Preservation**		3	4-5	4	3	3	3	4	4	3	3-4	3-4	2-3
Microcharcoal Concentration***		4	0	0	0	0	0	0	0	4	4	4	5
Suitable for analysis		**YES**	**YES**	**YES**	**YES**	**NO**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**

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 = absent; 1 = very poor; 2 = poor; 3 = moderate; 4 = good; 5 = excellent*
****Microcharcoal Concentration: 0 = none, 1= negligible, 2 = occasional, 3 = moderate, 4 = frequent, 5 = abundant*

RESULTS AND INTERPRETATION OF THE DIATOM ASSESSMENT

Five sub-samples from borehole <QBH1> were extracted for the assessment of diatoms, the results of which are displayed in Table 7. The results of the diatom assessment indicate that diatoms are generally poorly preserved, except in one sample where preservation is moderate (-0.84 to -0.85m OD). In general the concentration of diatoms is moderate to high, except in the sample from -0.76 to -0.77m OD where diatoms are present in low concentrations. The diversity of the diatom assemblages is generally moderate.

The quantification of diatom assemblages has contributed to our understanding of the environmental and hydrological history of the Middle and Lower Thames, including changes in sea-level, salinity and water quality. Existing models of relative sea-level change (e.g. Devoy, 1979) have been shown to be oversimplistic however, and a greater understanding of rates of relative sea-level rise and tidal influence in individual study areas is required, particularly in the inner estuary of the Thames (Sidell *et al.,* 2000). The assessment indicates that quantification of the samples from the Wandsworth Road and Pascal Street site would thus represent an opportunity to refine our knowledge of relative sea-level, salinity and water quality in an area of the Middle Thames, and during a period (i.e. the Late Holocene), for which relatively few studies have been undertaken.

Table 7: Summary diatom assessment results for borehole <QBH2>, Land at Wandsworth Road and Pascal Street, Nine Elms, London Borough of Lambeth.

Depth (m OD)		Diatom concentration	Quality of preservation	Diversity
From	To			
-0.20	-0.21	High	Poor to moderate	Moderate
-0.24	-0.25	Moderate	Poor	Moderate
-0.76	-0.77	Low	Poor	Low
-0.80	-0.81	Moderate	Poor	Moderate
-0.84	-0.85	Moderate to high	Moderate	Moderate

RESULTS AND INTERPRETATION OF THE MACROFOSSIL ASSESSMENT

A total of eight small bulk samples were extracted from borehole <QBH2> for the recovery of macrofossil remains, including waterlogged plant macrofossils, waterlogged wood, insects and Mollusca (Table 8). 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), Mollusca, bone or insects were recorded in any of the samples. Waterlogged wood was recorded in moderate to high quantities in all eight samples, whilst waterlogged seeds were recorded in low quantities in the three samples between -0.27 and -0.50m OD.

Waterlogged plant macrofossils (seeds)

The results of the macrofossil rapid assessment indicated that waterlogged seeds were present in low quantities in the three samples between -0.27 and -0.50m OD; these samples thus underwent a more detailed assessment, the results of which are displayed in Table 9. The combined seed assemblage comprised *Alnus glutinosa* (alder), *Rubus* sp. (e.g. bramble), *Sambucus nigra/racemosa* (elder), *Ranunculus* cf. *repens* (cf. creeping buttercup) and *Ranunculus sceleratus* (celery-leaved buttercup). Although the assemblage is limited, these taxa are typical of wetland fen environments, with relatively dry conditions indicated by the absence of aquatic taxa and sedges. The limited concentration of remains prevents any further interpretation of this assemblage.

Table 8: Results of the macrofossil assessment of borehole <QBH2>, Land at Wandsworth Road and Pascal Street, Nine Elms, London Borough of Lambeth.

				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
-0.22 to -0.27	0.025	0.025	>300µm	-	-	-	-	-	2	-	-	-	-	-	-	-
-0.27 to -0.32	0.025	0.025	>300µm	-	-	-	-	-	2	1	-	-	-	-	-	-
-0.34 to -0.44	0.05	0.05	>300µm	-	-	-	-	-	2	1	-	-	-	-	-	-
-0.44 to -0.50	0.05	0.05	>300µm	-	-	-	-	-	4	1	-	-	-	-	-	-
-0.54 to -0.64	0.05	0.05	>300µm	-	-	-	-	-	5	-	-	-	-	-	-	-
-0.64 to -0.74	0.06	0.06	>300µm	-	-	-	-	-	4	-	-	-	-	-	-	-
-0.74 to -0.79	0.05	0.05	>300µm	-	-	-	-	-	3	-	-	-	-	-	-	-
-0.79 to -0.84	0.025	0.025	>300µm	-	-	-	-	-	2	-	-	-	-	-	-	-

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 9: Results of the waterlogged plant macrofossil (seeds) assessment of borehole <QBH2>, Land at Wandsworth Road and Pascal Street, Nine Elms, London Borough of Lambeth.

Depth (m OD)	Waterlogged seeds		
	Latin name	**Common name**	**Number**
-0.22 to -0.27	-	-	-
-0.27 to -0.32	*Alnus glutinosa* catkin *Rubus* sp. *Sambucus nigra/racemosa* *Ranunculus sceleratus*	alder e.g. bramble elder celery-leaved buttercup	1 2 1 1
-0.34 to -0.44	*Alnus glutinosa* catkin	alder	5
-0.44 to -0.50	*Ranunculus* cf. *repens* *Alnus glutinosa* catkin	cf. creeping buttercup alder	1 1
-0.54 to -0.64	-	-	-
-0.64 to -0.74	-	-	-
-0.74 to -0.79	-	-	-
-0.79 to -0.84	-	-	-

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. Two borehole sequences were collected to achieve this aim. Borehole <QBH1> was targeted to ground-truth the area of supposed high Gravel surface towards the west of the site, and to investigate the presence of an organic horizon (possible soil). Borehole <QBH2> was targeted to ground-truth the supposed channel and to investigate the Peat in this area of the site.

Within the initial deposit modelling report, it was concluded that the deposits recorded at the Wandsworth Road and Pascal Street site were analogous to those recorded across much of the Middle and Lower Thames Valley, with a sequence of Shepperton Gravel overlain by Holocene Alluvium (including Peat), capped by Made Ground. The results of the deposit modelling (Young & Green, 2013) indicated that a channel aligned approximately southwest-northeast traversed the eastern part of the site, which may have formed part of the Battersea Channel, either as a tributary joining the main channel from the southeast, or as part of a network of channels on the floor of the Battersea Channel itself. Within this channel the Shepperton Gravel surface was recorded at between *ca*. -2.5 and -3.0m OD, consistent with investigations at the 120-146 Stewarts Road site (Figure 1; Morley, 2009/2010), where a channel was identified within which the Gravel surface was recorded at between *ca*. -2.8 and -3.0m OD. At the Battersea Power Station site (Figure 1; Dawson *et al*., 2009; Branch *et al*., 2010), west of the present site and within what is thought to be a separate subsidiary channel, the Shepperton Gravel surface was recorded at between *ca*. -2.0 and -3.0m OD. Outside the limits of the channel identified at the Wandsworth Road and Pascal Street site

and where it rises to above *ca*. -2.0m OD the sand and gravel is likely to equate to the Kempton Park Gravel, rising to a level of *ca*. -1.0m OD within the western part of the site. At the 102-104 Stewarts Road site (Figure 1; Morley, 2009/2010) the Kempton Park Gravel surface rises north of the Battersea Channel to between *ca*. -1.0 and -0.5m OD; south of Battersea Power Station, beyond the margins of the smaller subsidiary channel identified here the Gravel surface rises to between *ca*. -1.0 and 2.0m OD (Dawson *et al*., 2009).

At the Wandsworth Road and Pascal Street site the Gravel surface is overlain by Alluvium, which below *ca*. -1.0m OD is generally sandy or silty, often containing occasional gravel clasts and detrital herbaceous material (the Lower Alluvium). The combined results of the palaeobotanical assessment (pollen, waterlogged wood and seeds) indicate the dominant growth of aquatic and semi-aquatic taxa during the accumulation of the Lower Alluvium as might be expected. However, high values of pine with birch, willow, grasses and mugwort may be suggestive of cold climatic conditions such as those recorded during the Late Glacial/Early Holocene. The Lower Alluvium is overlain in places by a Peat horizon between *ca*. -1.0 and 0.5m OD and between 0.10 and 0.60m thick. Within borehole <QBH2> a silty, woody Peat was recorded between -0.79 and -0.22m OD, whilst a very thin (<5mm) horizon of Peat was recorded in borehole <QBH1> between 1.06 and 1.055m OD. It was not possible to determine if the organic horizon within <QBH1> is the remnant of a former soil horizon. Significantly however, the Peat horizon recorded across the site represents the development of a more stable terrestrial surface across the floor of the valley. The results of the radiocarbon dating of borehole <QBH2> demonstrates that Peat accumulation commenced during the Middle Bronze Age (3460 to 3360 cal BP), and that cessation occurred during the Late Bronze Age/Early Iron Age (3150-2930 cal BP). During the accumulation of the Peat, the pollen and seed remains are indicative of an alder carr dominated environment on the Peat surface, with mixed deciduous woodland on the dryland. No definitive evidence for human activity is recorded within the Peat; however, a possible decline in lime woodland may be associated with human activity. Within the overlying Upper Alluvium a decline of woodland is recorded on both the wetland and dryland surfaces, whilst open, disturbed ground is recorded on the dryland, with evidence for human activity (including disturbed ground taxa and cereal pollen).

At the 120-146 Stewarts Road site (Morley, 2009/2010) Peat was recorded between *ca*. -1.25 and -1.75m OD. The upper part of this Peat horizon was subsequently radiocarbon dated to 7670-7510 cal BP (the Mesolithic cultural period). At the Battersea Power Station (Branch *et al*., 2010) peat horizons radiocarbon dated to the Middle Neolithic (5320 to 4960 cal BP) and Middle Bronze Age (4000 to 3690 cal BP) were identified at -2.09 to -2.16 and -

1.52 to -1.56m OD respectively. Relatively few palaeobotanical records are available for this part of the Middle Thames Valley; however, at the Battersea Power Station site the presence of mixed coniferous/deciduous woodland is indicated during the Late Mesolithic and Early Neolithic, with evidence for woodland clearance and cultivation at some point during the Late Mesolithic/Early Neolithic transition (Branch *et al*., 2010). During the Middle Neolithic and through to the Early Bronze Age open, mixed oak and lime woodland is indicated on the dryland, with alder and willow on the wetland surface with evidence for periods of cultivation on the dryland (Branch *et al*., 2010).

Significantly, the Peat horizon at Wandsworth Road and Pascal Street is later, and is recorded at a higher elevation than those at the Stewarts Road and Battersea Power Station sites. The Peat horizon recorded here thus has the potential to provide a new record of environmental change and vegetation history for an area in which relatively few palaeobotanical records are available, and for a new period which post-dates the Peat horizons recorded elsewhere.

RECOMMENDATIONS

On the basis of the evidence presented above, and due to the distinct age and elevation of the Peat horizon at the site (compared to those recorded elsewhere in this area of Battersea/Nine Elms, including within the Battersea Channel) analysis of the sequence from borehole <QBH2> is recommended. The analysis of these sequences will quantify the changes in vegetation history identified during the assessment, in particular (1) the presence/absence of a decline in lime woodland, (2) the presence/absence of human activity during the formation of the Peat, and (3) the timing and nature of the environmental changes recorded towards the top of the Peat sequence.

It is recommended that this analysis should consist of full percentage counts of the pollen, and detailed assessment of the waterlogged wood, in selected samples within the Peat horizon. No additional radiocarbon dates are recommended, since the period of Peat formation is relatively short (200-500 years). Publication of the results should be integrated with the results of other palaeoenvironmental investigations in this area of Battersea/Nine Elms.

REFERENCES

Batchelor, C.R., Branch, N.P., Christie, R., Elias, S. Young, D.S., Austin, P., Williams, K., and Wilkinson, K. (2008) *Imperial Gateway, Belvedere: environmental archaeological assessment report.* Quaternary Scientific (QUEST) Unpublished Report December 2008;

Project Number 056/08.

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., Green, C., Batchelor, C.R., Young, D.S., Elias, S., Cameron, N. and Athersuch, J. (2010) A tale of two power stations: environmental archaeological investigations at Battersea and Lots Road. *London Archaeologist* **12** (Autumn 2010): 267-273.

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

Dawson, H., Molina-Burguera, G. and Morley, M. (2009) Battersea Power Station, Battersea, London Borough of Wandsworth. Archaeological desk-based assessment. *Museum of London Archaeology Service Unpublished Report June 2009.*

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

Green, C. (2008) Pimlico School, Lupus Street, Pimlico, London Borough of Westminster: Geoarchaeological Assessment Report. *ArchaeoScape Unpublished Report.*

Green, C. and Young, D.S. (2012) Land at 135 Grosvenor Road, Pimlico, London Borough

of Westminster (NGR: TQ 2958 7791): Geoarchaeological Assessment Report. *Quaternary Scientific Unpublished Report July 2012.*

Gibbard, P.L. (1985) *Pleistocene History of the Lower Thames Valley*. Cambridge University Press, Cambridge.

Hawkins, D. (2013) Land at Wandsworth Road and Pascal Street, Nine Elms, London SW8 2LF. Archaeological desk Based Assessment. *CgMs Consulting Unpublished Report February 2013.*

Morley, M. (2009/2010) The Battersea Channel: Investigations of a possible former course of the River Thames? *London Archaeologist* **12** No. 7/ Winter 2009/2010.

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

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

Reimer, P.J., Bard, E., Bayliss, A., Beck, J.W., Blackwell, P.G., Bronk Ramsey, C., Buck, C.E., Edwards, R.L., Friedrich, M., Grootes, P.M., Guilderson, T.P., Haflidason, H., Hajdas, I., Hatté, C., Heaton, T.J., Hoffmann, D.L., Hogg, A.G., Hughen, K.A., Kaiser, K.F., Kromer, B., Manning, S.W., Niu, M., Reimer, R.W., Richards, D.A., Scott, E.M., Southon, J.R., Turney, C.S.M., and van der Plicht, J., (2013) IntCal13 and Marine13 radiocarbon age calibration curves, 0-50,000 years cal BP. *Radiocarbon* **55**: 1869-1887.

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.

Sidell, J., Wilkinson, K., Scaife, R. and Cameron, N. (2000) *The Holocene Evolution of the London Thames.* MoLAS Monograph 5, Museum of London Archaeology Service.

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.

Young, D.S. and Green, C.P. (2013) Land at Wandsworth Road and Pascal Street, Nine Elms, London Borough of Lambeth (NGR: TQ 3003 7747): Geoarchaeological Fieldwork Report. *Quaternary Scientific Unpublished Report, May 2013.*

APPENDIX 1: ADDITIONAL QUEST BOREHOLE LOGS

Geotechnical and geoarchaeological description of Borehole BH104, Land at Wandsworth Road and Pascal Street, Nine Elms, London Borough of Lambeth.

Depth (m bgs)		Depth (m OD)		Geotechnical description	Additional Geoarchaeological description (m bgs)	Stratigraphic interpretation
Top	Base	Top	Base			
0.00	2.30	2.94	0.64	Made ground	-	MADE GROUND
2.30	3.00	0.64	-0.06	Brown and blue grey silty clay with occasional gravel clasts and brick fragments	As3 Ag1; blue grey silty clay. Appears redeposited	REDEPOSITED ALLUVIUM
3.00	3.90	-0.06	-0.96	Orange brown and blue grey silty clay with occasional organic material	As3 Ag1; blue grey silty clay	UPPER ALLUVIUM
3.90	4.00	-0.96	-1.06	Brown and black peaty clay	Sh2 Ag2; humo. 3; grey brown silty humified peat	PEAT
4.00	6.50	-1.06	-3.56	Brown and green brown slightly clayey sandy gravel	Gg3 Ag1; grey brown silty gravel	KEMPTON PARK GRAVEL
6.50	35.20	-3.56	-32.26	Stiff dark grey silty clay	-	LONDON CLAY

Geotechnical and geoarchaeological description of Borehole BH105, Land at Wandsworth Road and Pascal Street, Nine Elms, London Borough of Lambeth.

Depth (m bgs)		Depth (m OD)		Geotechnical description	Additional Geoarchaeological description (m bgs)	Stratigraphic interpretation
Top	Base	Top	Base			
0.00	1.70	2.73	1.03	Made ground	-	MADE GROUND
1.70	2.20	1.03	0.53	Dark grey slightly sandy slightly silty slightly organic clay with occasional calcareous nodules	Ag2 As1 Ga1 Dh+; dark grey sandy clayey silt with traces of detrital herbaceous material.	UPPER ALLUVIUM
2.20	3.00	0.53	-0.27	Dark grey slightly sandy slightly silty peaty clay	Ag1 Sh1 Dh1 Dl1; grey brown organic silt with detrital herbaceous material and detrital wood	
3.00	3.20	-0.27	-0.47		Sh2 Ag1 Th^{2}1 Tl+ Gg+; Humo. 3; brown silty humified herbaceous and woody peat	PEAT
3.20	3.45	-0.47	-0.72	Dark grey and black slightly sandy	Ag2 As1 Dh1 Dl+; grey blue clayey silt with	LOWER ALLUVIUM

				slightly silty peaty clay with occasional gravel clasts	detrital herbaceous material and detrital wood	
3.45	4.30	-0.72	-1.57		Sh2 Ag1 Th^{2}1 Tl+ Gg+; humo. 3; brown silty humified herbaceous and woody peat	PEAT
4.30	4.40	-1.57	-1.67		Ag3 As1 Ga+ Dh+; grey clayey silt with a trace of sand and detrital herbaceous material	LOWER ALLUVIUM
4.40	4.45	-1.67	-1.72		Ag2 Ga1 Gg1; grey sandy gravelly silt	
4.45	7.60	-1.72	-4.87	Brown/dark brown slightly clayey slightly silty gravel	Gg3 Ag1; grey brown silty gravel	SHEPPERTON GRAVEL
7.60	10.00	-4.87	-7.27	Dark grey stiff slightly silty clay	-	LONDON CLAY

Geotechnical and geoarchaeological description of Borehole BH108, Land at Wandsworth Road and Pascal Street, Nine Elms, London Borough of Lambeth.

Depth (m bgs)		**Depth (m OD)**		**Geotechnical description**	**Additional Geoarchaeological description (m bgs)**	**Stratigraphic interpretation**
Top	**Base**	**Top**	**Base**			
0.00	1.10	2.99	1.89	Made ground	-	MADE GROUND
1.10	2.30	1.89	0.69	Grey slightly organic silty very sandy clay with occasional gravel clasts	Ag2 Ga2 Gg+; dark greenish grey sand and silt with occasional gravel clasts	UPPER ALLUVIUM
2.30	3.70	0.69	-0.71			
3.70	4.30	-0.71	-1.31	Dark grey brown clayey peat	Sh2 Th^{2}1 Ag1 Tl+; humo. 3; brown silty humified herbaceous peat with occasional wood macrofossils	PEAT
4.30	4.80	-1.31	-1.81	Dark grey brown peaty clay	Ag3 As1 Gg+; light greyish brown clayey silt with occasional gravel clasts	LOWER ALLUVIUM
4.80	5.30	-1.81	-2.31	Organic silty clay with occasional gravel clasts; occasional organic lenses	Ag 2 As1 Gg1; light greyish brown clayey gravelly silt	LOWER ALLUVIUM/ KEMPTON PARK GRAVEL
5.30	10.00	-2.31	-7.01	Grey brown stiff silty clay	As4 Ag+; greenish grey clay with a trace of silt	LONDON CLAY

Geotechnical and geoarchaeological description of Borehole BH116, Land at Wandsworth Road and Pascal Street, Nine Elms, London Borough of Lambeth.

Depth	**Depth**	**Geotechnical description**	**Additional Geoarchaeological**	**Stratigraphic**

(m bgs)		(m OD)			description (m bgs)	interpretation
Top	**Base**	**Top**	**Base**			
0.00	1.35	2.87	1.52	Made ground	-	MADE GROUND
1.35	2.00	1.52	0.87	Black slightly sandy clayey peat with occasional gravel clasts	-	UPPER ALLUVIUM
2.00	2.20	0.87	0.67		As3 Ag1; blue grey silty clay	
2.20	2.90	0.67	-0.03	Dark grey and brown slightly sandy silty clay with occasional gravel clasts	As3 Ag1; blue grey silty clay	
2.90	3.30	-0.03	-0.43	Black slightly silty clayey peat	Sh2 Ag1 Th^{3}1 Tl+; humo. 3; brown well humified silty herbaceous peat with occasional wood macrofossils	PEAT
3.30	3.50	-0.43	-0.63		Sh3 Tl^{2}1 Ag+; humo. 3; brown well humified herbaceous peat with traces of silt	PEAT
3.50	3.90	-0.63	-1.03		Ag3 Dh1 Ga+; blue grey silt with detrital herbaceous material and traces of sand	LOWER ALLUVIUM
3.90	4.00	-1.03	-1.13	Dark grey slightly silty clay with occasional pockets of peat		
4.00	4.50	-1.13	-1.63			
4.50	5.30	-1.63	-2.43		Ag3 Ga1 As+; blue grey sandy wilt with a trace of clay	
5.30	6.00	-2.43	-3.13	Brown sand and gravel	Gg3 Ga1; sandy gravel.	SHEPPERTON GRAVEL
6.00	10.00	-3.13	-7.13	Dark grey stiff slightly sandy silty clay	-	LONDON CLAY

Geotechnical and geoarchaeological description of Borehole BH117A, Land at Wandsworth Road and Pascal Street, Nine Elms, London Borough of Lambeth.

Depth (m bgs)		Depth (m OD)		Geotechnical description	Additional Geoarchaeological description (m bgs)	Stratigraphic interpretation
Top	**Base**	**Top**	**Base**			
0.00	2.00	2.96	0.96	Made ground	Made ground	MADE GROUND
2.00	2.40	0.96	0.56		Ag2 As2; grey blue silt and clay	UPPER ALLUVIUM
2.40	3.00	0.56	-0.04	Dark brown and black slightly sandy slightly peaty clay with occasional gravel clasts	Ag2 As1 Ga1 Sh+ Dh+; blue grey clayey sandy silt with traces of organic matter and detrital herbaceous material	
3.00	3.40	-0.04	-0.44		Ag2 Ga1 Dh1 Sh+; grey brown sandy silt with detrital herbaceous material and	
3.40	3.50	-0.44	-0.54	Dark grey slightly organic silty clay with		

				occasional gravel clasts and calcareous pockets	traces of organic matter	
3.50	4.10	-0.54	-1.14	Dark grey and black slightly sandy silty peaty clay with occasional gravel clasts and calcareous pockets	Ag2 Dh1 Dl1 Sh+; greyey brown silt with detrital herbaceous material and detrital wood. Occasional large Mollusca remains.	
4.10	4.50	-1.14	-1.54		Sh2 $Tl^2$1 Ag1 Ga+; humo. 3; brown well humified silty woody peat with a trace of sand	PEAT
4.50	4.70	-1.54	-1.74	Grey slightly organic silty clay	Ag2 Ga2 Gg+ Dh+; grey sand and silt with occasional gravel clasts and traces of detrital herbaceous material	LOWER ALLUVIUM
4.70	5.00	-1.74	-2.04	Dark grey sandy silty peaty clay with occasional gravel clasts		
5.00	5.20	-2.04	-2.24		Ga2 Ag1 Gg1; grey green silty gravelly sand	SHEPPERTON GRAVEL
5.20	5.30	-2.24	-2.34		Gg3 Ag1 Ga+; silty gravel with a trace of sand	
5.30	5.40	-2.34	-2.44	Brown sand and gravel		
5.40	10.00	-2.44	-7.04	Dark grey stiff slightly sandy silty clay	As4 Ag+ Dh+; greenish grey clay with traces of silt and detrital herbaceous material	LONDON CLAY