# A REPORT ON THE GEOARCHAEOLOGICAL BOREHOLE INVESTIGATIONS AND DEPOSIT MODELLING ON LAND AT ROYAL WHARF, SILVERTOWN, LONDON BOROUGH OF NEWHAM

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## INTRODUCTION

This report summarises the findings arising out of the geoarchaeological borehole investigations and deposit modelling undertaken by Quaternary Scientific (University of Reading) in connection with the proposed development at Royal Wharf, Silvertown, London Borough of Newham (National Grid Reference centred on: TQ 4085 7990; site code RWH14; Figures 1 and 2). The Royal Wharf site is approximately 4 hectares in size, and lies on the floodplain of the Lower Thames where the Woolwich Reach of the river forms a broad southward bend. The ground across the area originally formed part of the natural floodplain of the Thames and is underlain by Holocene alluvial deposits (British Geological Survey (BGS) 1:50,000 Sheets 257 Romford 1996), which consisted of fine-grained mineral-rich sediments and peat. 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 the Lower Tertiary Lambeth Group.

In June 2014, a desk-based geoarchaeological deposit modelling exercise was carried out using a combination of geotechnical, geoarchaeological and archaeological records resulting from previous investigations both on and immediately adjacent to the site (Batchelor *et al*., 2014). The aim of this exercise was to produce a model of the sub-surface stratigraphy of the site and its surroundings so as to provide a reconstruction of the site's former landscape and its evolution through time. The findings were also to be used to guide recommendations for further archaeological, geoarchaeological and palaeoenvironmental investigations (if necessary).

A total of 337 archive sequences were used in the deposit modelling exercise, demonstrating the following sedimentary sequence was present beneath the site:

Made Ground
Upper Alluvium – widely present
Peat – only locally present
Lower Alluvium – only locally present, occasionally peaty
Gravel (Shepperton Gravel)

The spatial distribution of the sediments across the modelled area indicates the presence of two contrasting landscapes within the site, and in the wider modelled area, throughout much of the Holocene. In the southern part of the Royal Wharf site the results suggests the deposition of mineral-rich alluvium reflecting the presence of active river channels, probably the main channel of the River Thames and short N-S aligned streams draining off the slightly more elevated area to the north (see Figure 3). Peat formation here was restricted to the more elevated remnants of the gravel surface between the depressions in which fluvial deposition persisted for much of the Holocene. In the northern part of the Royal Wharf site and further north there are no obvious deep depressions that might have been the site of Peat formation early in the Holocene. Moreover the pattern of Peat accumulation indicated by the modelling of Peat thickness (Figure 4) shows very little relationship to the relief of the surface of the Shepperton Gravel/Lower Alluvium on which the Peat rests as is suggested by modelling exercises elsewhere along the River Thames (e.g. Green *et al*., 2014).

It was noted however that a lack of sufficiently deep boreholes in four areas of the Royal Wharf site have resulted in voids in the model of the Shepperton Gravel surface (Figures 3 & 4). It was therefore recommended (Batchelor *et al*., 2014) that geoarchaeological boreholes (QBH1 to QBH4) were put down in these areas of the site with the aim of completing the deposit model (Figure 2), and for the peat sequences present to be radiocarbon dated to improve the chronological framework of deposition. The placement of borehole QBH3 was also selected to enable investigation of a suspect Peat horizon in the Upper Alluvium identified in a nearby geotechnical test-pit. No palaeoenvironmental investigations were recommended however, since detailed reconstructions have already been carried out in the nearby area (e.g. the London Cable Car [Batchelor *et al*., in press], Fort Street [Wessex Archaeology, 2000; Crockett *et al*., 2003] and West Silvertown [Wilkinson *et al*., 2000]). In order to achieve the aims, the following objectives were proposed within the Written Scheme of Investigation for the site (Young, 2014):

1. To obtain a maximum of four geoarchaeological boreholes from the selected locations;
2. To use the stratigraphic data from the new locations to update and enhance the existing deposit model of the major depositional units across the site;
3. To carry out range finder radiocarbon dating to determine the approximate chronology of the periods of peat formation recorded within selected borehole samples;
4. To publish the results of the site investigations in an academic journal, either as a standalone site, or integrating the results of other nearby investigations, depending on the significance of the findings.

In providing the results of the geoarchaeological borehole investigations and updating the deposit model, this report therefore fulfils the first three of these objectives.

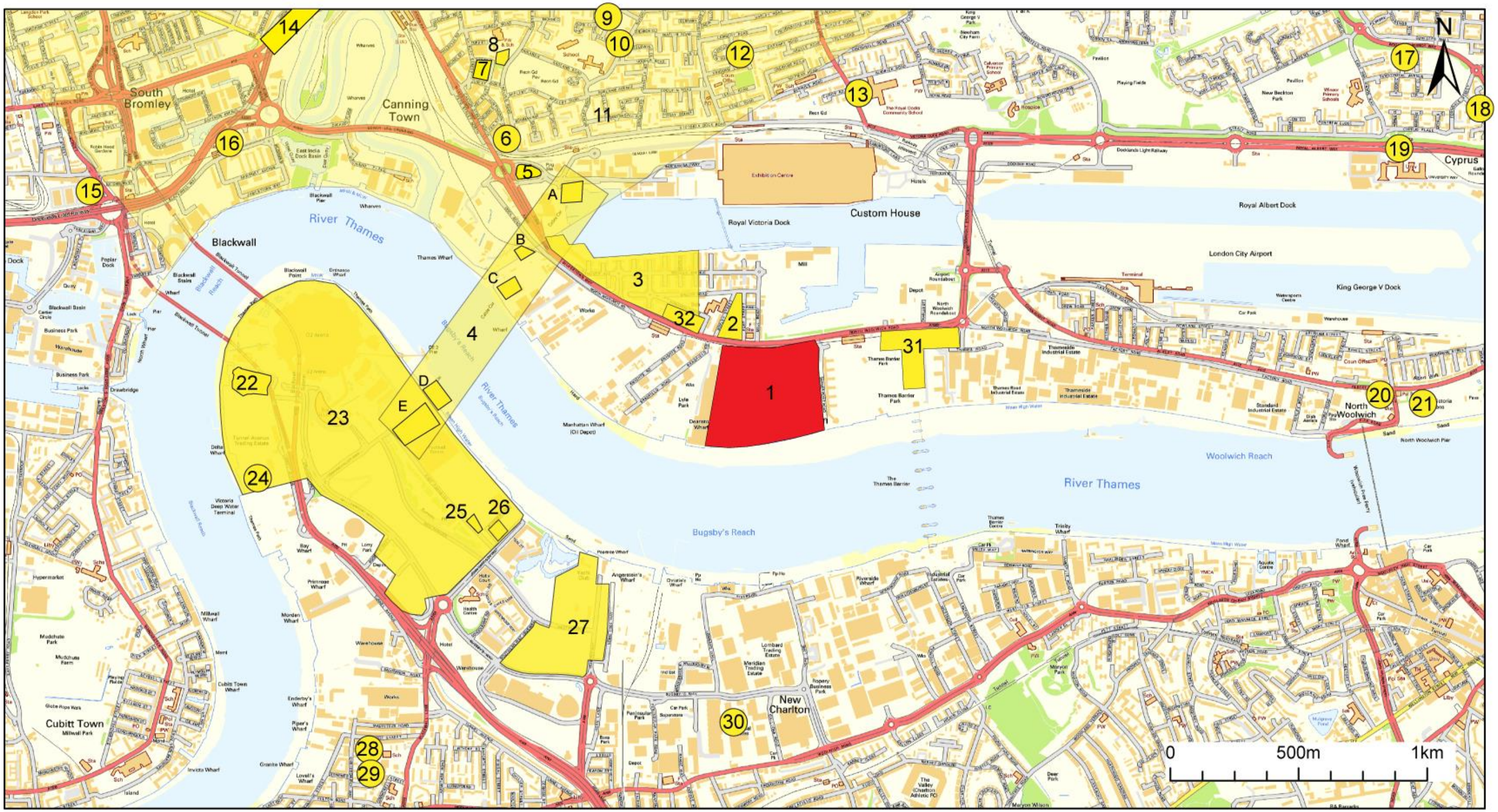


**Figure 1: Location of (1) Royal Wharf, Silvertown, London Borough of Newham and other selected archaeological sites nearby: (2) Fort Street (HW-FO94; Wessex Archaeology, 2000; Crockett et al., 2002); (3) Silvertown (BWC96; Wilkinson *et al*., 2000); (4) the Cable Car route (CAB11; Batchelor *et al*., in press) (A) North Station; (B) North Intermediate Tower; (C) North Tower; (D) South Tower; (E) South Station); (5) Tidal Basin Road (Young & Batchelor, 2013-a); (6) 118 Victoria Dock Road (Barnett *et al*., 2012); (7) St Luke's**

**Square (LUC07; Weale, 2008; Wicks, 2010); (8) 105-107 Tarling Road (TAR13; Batchelor & Young, 2013); (9) Crediton Road (CDZ07; Eastbury *et al*., 2009); (10) Butchers Road (BUZ07; Eastbury *et al*., 2009); (11) Lower Lea Valley Mapping Project (Corcoran *et al*., 2011); (12) Vandome Close (VAD07; Eastbury *et al*., 2009); (13) Royal Docks Community School (PRG97; Holder, 1998); (14) Canning Town (Stafford, 2012); (15) Preston Road (PPP06; Branch *et al*., 2007); (16) East India Docks (Pepys, 1665); (17) East Ham FC (PRY00; Scaife, 2001); (18) Ferndale Street (HE-FE95; Divers, 1995); (19) Royal Albert Dock (RAD97; Batchelor, 2009); (20) Albert Road (AET01; Spurr *et al*., 2001); (21) North Woolwich Pumping Station (WW-PS93; Sidell, 2003); (22) Tunnel Avenue (GPF12; Batchelor, 2013); (23) Millennium Festival Site, Greenwich (BWP97; Bowsher & Corcoran, unknown; Corcoran, 2002); (24) Victoria Deep Water Terminal (TUA02; Corcoran, 2002); (25) Plot MO115, Greenwich Peninsula (CHB13; Young & Batchelor, 2013-b); (26) Plot MO117, Greenwich Peninsula (JHW13; Young & Batchelor, 2013-c); (27) Greenwich Millennium Village (Miller & Halsey, 2011); (28) Bellot Street (GLB05; Branch *et al*., 2005); (29) 72-88 Bellot Street (BSG93; McLean, 1993; Philp, 1993); (30) Greenwich Industrial Estate (GIE02; Morley, 2003); (31) Thames Barrier Park East (TBP06; Green *et al*., 2006); (32) Barnwood Court (HW-BC97; Farid, 1997).** 

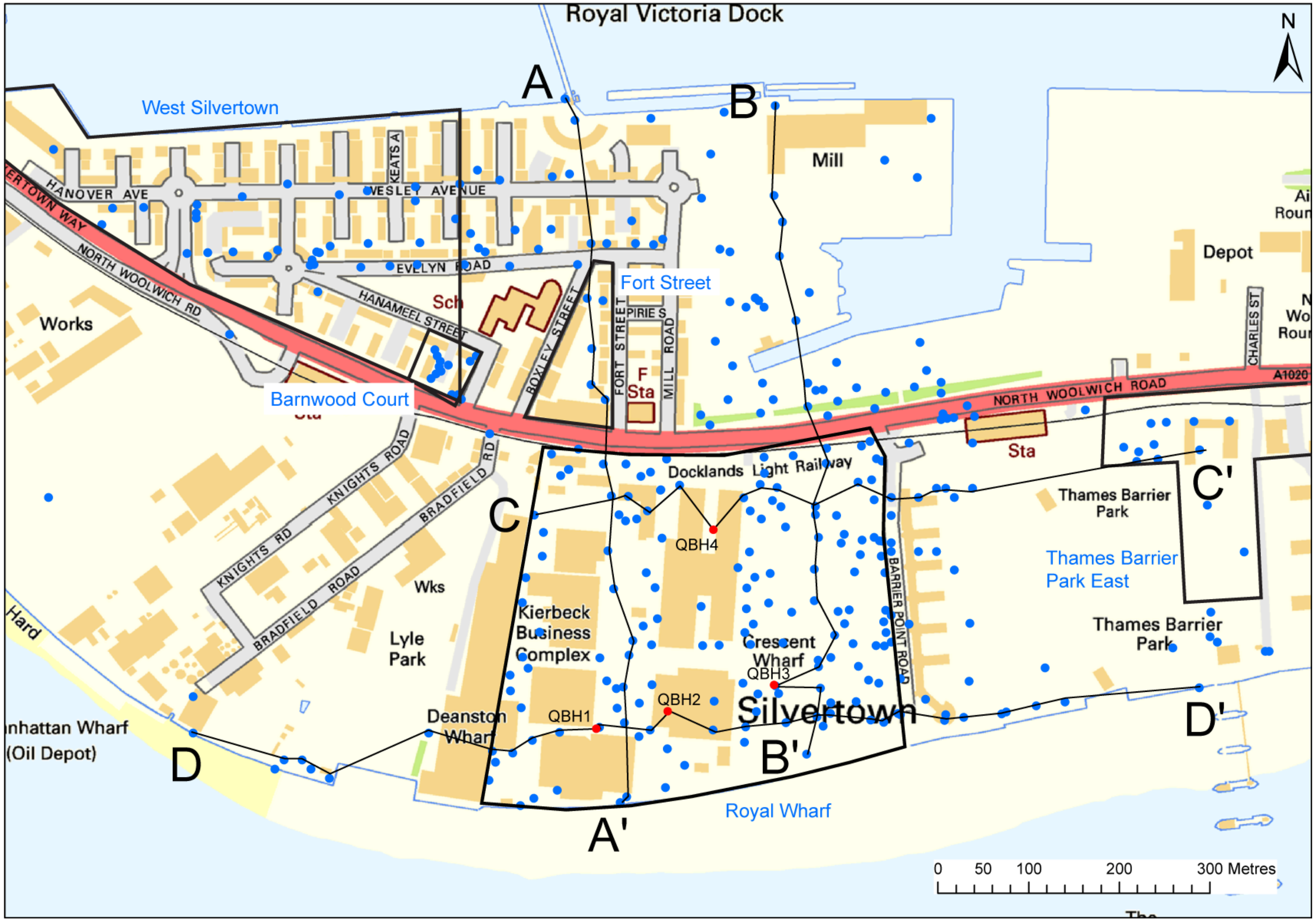


**Figure 2: Detailed plan of Royal Wharf, London Borough of Newham, illustrating the location of the new geoarchaeological boreholes (red), and historical geotechnical and archaeological sequences both on and adjacent to the site (blue). Borehole transect locations are also indicated. *Contains Ordnance Survey data © Crown copyright and database right [2014]***

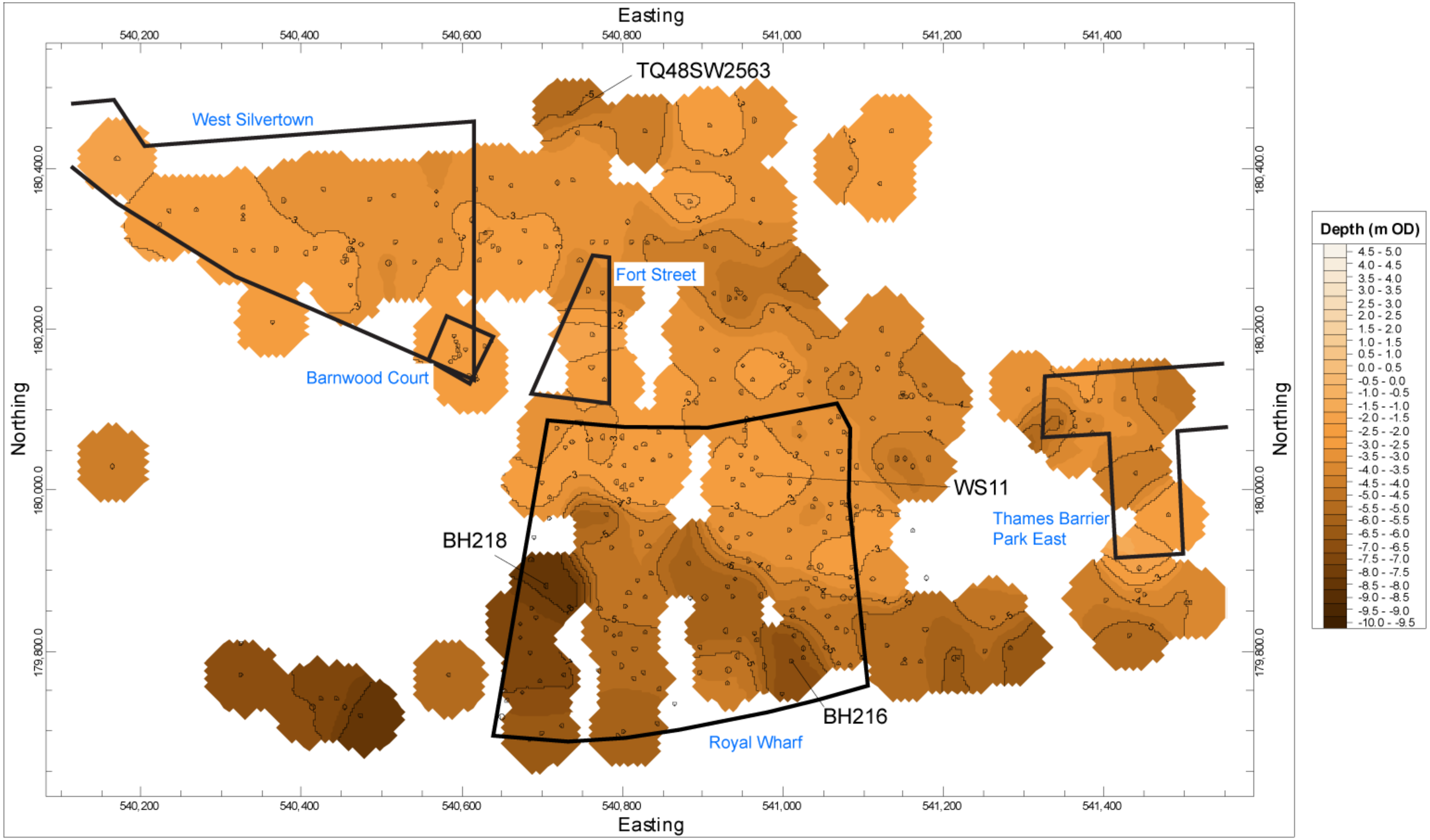


**Figure 3: Modelled surface of the Shepperton Gravel (metres OD) (Batchelor *et al*., 2014)**

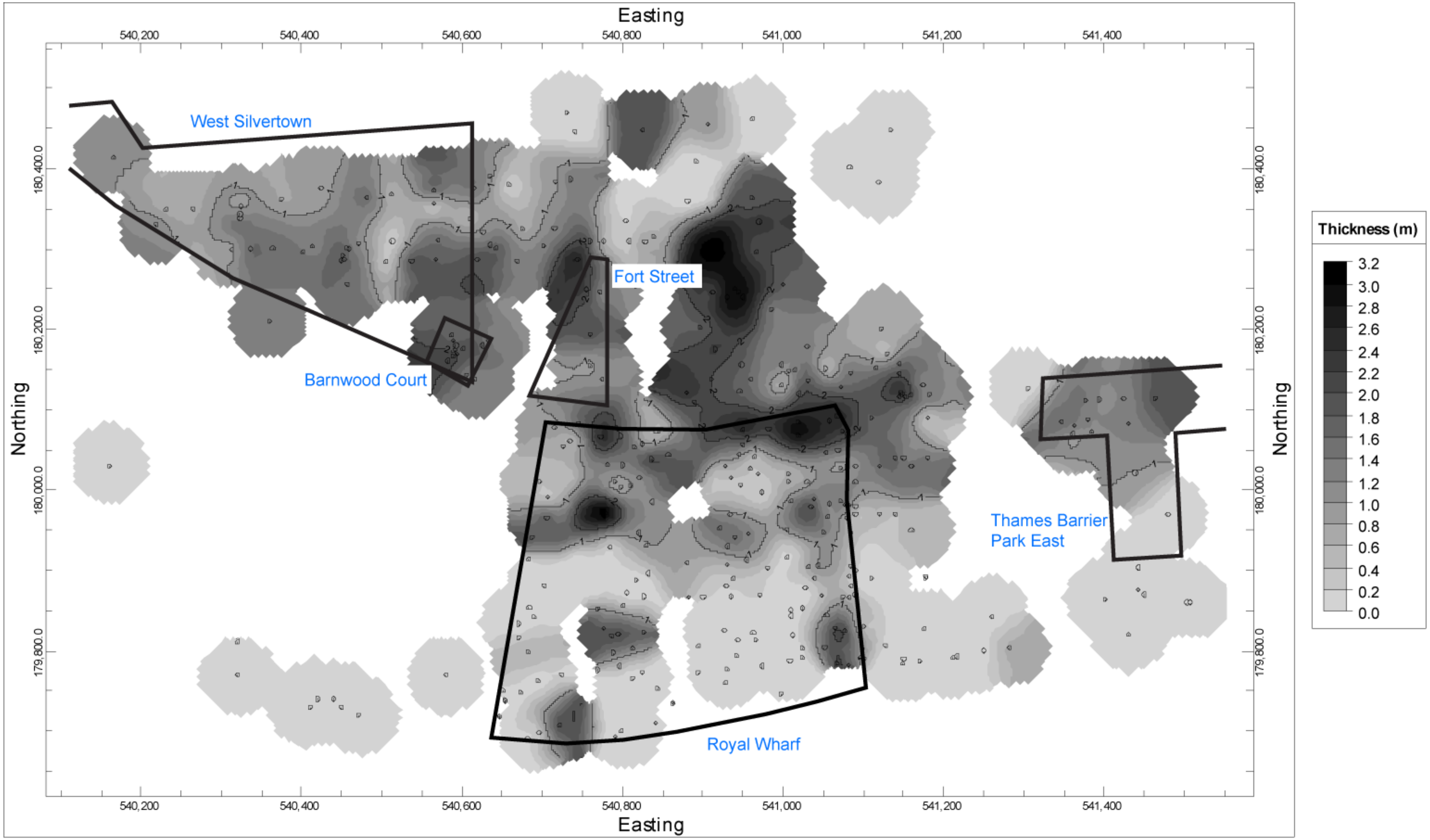


**Figure 4: Modelled thickness of the Peat (metres) (Batchelor *et al*., 2014)**

**METHODS**

*Fieldwork*

Four geoarchaeological boreholes (boreholes QBH1 to QBH4) were put down at the site in July 2014 (Figure 2) by Quaternary Scientific. Borehole core samples were recovered using an Eijkelkamp windowless 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 borehole locations were recorded using a Leica GS09 Differential GPS (Table 1).

**Table 1: Borehole attributes for the four geoarchaeological boreholes, Royal Wharf, Silvertown, , London Borough of Newham**

| Borehole | Easting | Northing | Elevation (m OD) |
|---|---|---|---|
| QBH1 | 540765.6 | 179774.2 | 4.597 |
| QBH2 | 540844.8 | 179793.1 | 5.015 |
| QBH3 | 540964.8 | 179825.7 | 4.566 |
| QBH4 | 540896.1 | 179994.7 | 2.14 |

*Lithostratigraphic descriptions*

The lithostratigraphy of boreholes QBH1 and QBH3 were described in the field; their content was not retained. The lithostratigraphy of QBH2 and QBH4 were described in the laboratory. Each sequence was described 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 sample using a scalpel; (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 geoarchaeological descriptions of the boreholes are displayed in Tables 2 to 5.

*Deposit modelling*

The reconstruction of the sedimentary architecture beneath the site and its surroundings was undertaken using records from 337 archived sequences and the four new geoarchaeological boreholes. In the present investigation, modelling was undertaken using RockWorks v16 software. The term 'deposit modelling' describes any method used to depict the sub-surface arrangement of geological deposits, but particularly the use of computer programmes to create contoured maps or three dimensional representations of contacts between stratigraphic units. The first requirement is to classify the recorded borehole sequences into uniformly identifiable stratigraphic units. At the sub-station site five stratigraphic units were recognised: (1) Shepperton Gravel; (2) Lower Alluvium; (3) Peat; (4) Upper Alluvium and (5) Made Ground.

How effectively Rockworks portrays the relief features of stratigraphic contacts or the thickness of sediment bodies depends on the number of data points (e.g. boreholes) per unit area and the extent to which these points are evenly distributed across the modelled area. The portrayal is also affected by the significance assigned to these data points, in terms of the extent of the area around the point to which the data are deemed to apply. This can be predetermined for each data set. Obviously the larger the chosen distance the less reliable the overall portrayal. In the present case the distance chosen for each data point has been set to a radius of 50m; thus for complete coverage across any given site, the boreholes must be spaced on a grid of approximately 100m intervals.

Because the boreholes are not uniformly distributed over the area of investigation, the reliability of the models is variable. In general, reliability improves from the boundaries of the modelled area, where edge effects adversely influence the reconstructions, towards the core area of the site where mutually supportive data are likely to be available from several adjacent boreholes

Reliability is also affected by the quality of the stratigraphic records which in turn are affected by the nature of the sediments and/or their post-depositional disturbance during previous stages of land-use on the site. Quality is also affected where boreholes have been 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.

Finally, 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.

**RESULTS, INTERPRETATION AND DISCUSSION OF THE DEPOSIT MODELLING**

The results of the deposit modelling are displayed in Figures 5 to 15; Figures 5 to 11 represent surface elevation and thickness models for each of the main stratigraphic units. Figures 12 to 15 are 2-dimensional transects across the site from N to S and W to E. The results of the deposit modelling indicate that the number and spread of the boreholes logs accessed within the site is sufficient to permit modelling with a high level of confidence across the majority of the site. In the area immediately surrounding the site, borehole coverage is good to the north, north-west and east of the site is sufficient to enable modelling, but to the west and north-east there is an insufficient number of data-points available.

The full sequence of sediments recorded in the boreholes comprises:

Made Ground
Upper Alluvium – widely present
Peat – only locally present
Lower Alluvium – only locally present, occasionally peaty
Gravel (Shepperton Gravel)

***The Shepperton Gravel***

The Shepperton Gravel was present beneath the Holocene alluvial sediments in all the boreholes that penetrated to the bottom of the Holocene sequence. It comprises the deposits of a high-energy braided river system which, while it was active would have been characterised by longitudinal gravel bars (eyots) and intervening low-water channels in which finer-grained sediments might have been deposited. Such a relief pattern would have been present on the valley floor at the beginning of the Holocene when a lower-energy fluvial regime was being established.

The results of the deposit modelling of the Shepperton Gravel indicate the presence of a broad upstanding gravel surface mainly between -3m and -4m OD with a well-defined southern margin that extends WNW-ESE across the Royal Wharf site (Figure 3; Figure 10-13). Towards the north of the modelled area the gravel surface falls gently away in a northward direction. To the south of this more elevated gravel area, in the southern part of the Royal Wharf site, the gravel surface falls away steeply towards the modern channel of the River Thames. This downward slope is apparently dissected by a number of depressions with roughly N-S alignments. Some of these depressions are substantially deep; in boreholes

BH218 and BH216 for example, the gravel surface is recorded at -8.25m OD and -7.20m OD respectively (Figure 3). This broad relief pattern is most clearly apparent in the model displaying total alluvium thickness (Figure 8), but can also be made out in the modelled surfaces of the Shepperton Gravel (Figure 3), Lower Alluvium (Figure 4) and Peat (Figure 5).

The more elevated gravel surface on the northern half of the Royal Wharf site and beyond has a gently undulating relief which probably indicates the presence of low gravel bars and intervening channels, but in general the relief amplitude is only 1.0-2.0m. On northern half of the Royal Wharf site, the gravel surface is rarely recorded above -2.50m OD. Towards the north-east of the site, a single window sample records gravel at -1.63m OD (WS11; Transect B-B' - Figure 10), but since neighbouring sequences indicate a gravel surface in excess of -2.50m OD, this is considered to be an anomaly. On the Fort Street site just to the north of Royal Wharf however, the high gravel surface reaches approximately -1.5m OD and the sediments above it contain a Neolithic trackway (Wessex Archaeology, 2000; Crockett *et al*., 2003).

Other features of note in the Shepperton Gravel model include a west-east aligned trough recorded between approximately -4.50 and -5.00m immediately to the north and north-east of Fort Street. This trough may be representative of a former channel orientated parallel to the Thames. Finally, the trough in the gravel surface towards the very north of the modelled area, is considered to represent an artificially low level consequent of the construction of the Royal Victoria Dock (Figure 3; Transect A-A' – Figure 10); this is also suggested by the model of the Made Ground surface (Figure 9).

***The Holocene alluvial sequence***

The sediments overlying the Shepperton Gravel surface in chronological order consist of the Lower Alluvium (Figure 4), Peat (Figures 5 & 6) and Upper Alluvium (Figure 7). The Lower Alluvium is defined here as a generally silty or sandy (sometimes organic) deposit that accumulated during the Early to Middle Holocene (Mesolithic cultural period) within a fluvial or estuarine environment. In many cases across the Lower Thames Valley it is separated from the more clayey and inorganic Middle to Late Holocene Upper Alluvium by a thick horizon of Peat representative of a shift towards semi-terrestrial environment supporting the growth of fen woodland. Across the modelled area, the Peat is not always present, generally preventing definitive distinction between the Lower Alluvium and Upper Alluvium.

The Holocene sequences display a fairly well-marked spatial pattern across the modelled area. This is most clearly seen in a comparison between the modelled thickness of the Peat

(Figure 6) and the modelled total thickness of the alluvial sequence (Figure 8). In the southern part of the Royal Wharf site, the Peat is almost completely absent and the limited sequences in which it does occur tend to overlie the more elevated parts of the gravel surface (i.e. the areas intervening between the N-S depressions that dissect the gravel surface in this area of the site). Thicker occurrences of Peat are recorded on the upstanding gravel area on the northern part of the Royal Wharf site and to the north of it, though even in these areas Peat development is irregular (see Figure 6). Where present, the Peat generally varies between 1 and 3m thick, although thicker horizons up to 4m are occasionally recorded (e.g. BH229; Transect A-A' – Figure 10). At nearby sites, radiocarbon dating has demonstrated the Peat and organic-rich deposits accumulated over several millennia, spanning multiple cultural periods – *ca*. 12,000 to 2500 cal BP at West Silvertown, (Wilkinson *et al*., 2000), *ca*. 5500 to 3500 cal BP at Fort Street (Wessex Archaeology, 2002; Crockett *et al*., 2003) and *ca*. 4000 to 500 cal BP at Thames Barrier Park East (Green *et al*., 2006).

The areas of greater total alluvium thickness (including Lower Alluvium, Peat and Upper Alluvium; Figure 8) lie to the south of the upstanding gravel area, in the southern part of the Royal Wharf site and in the north of the modelled area where the gravel surface falls away gently to the north. These are areas in which Peat is thin, patchily present or absent, thus the bulk of the alluvial sequence is mineral sediment. This is clearly apparent in the N-S cross sections A-A, B-B and in the E-W cross section D-D (Figures 10, 11 and 13) where the thickness of the alluvium (represented as Upper Alluvium) is greatest in the south of the modelled area, where the gravel surface falls away steeply southward.

Finally, an upper Peat horizon was recorded within the Upper Alluvium of a small collection of test-pits towards the south-east of the site (e.g. TP911.4 – Transect B-B'; Figures 5 & 11). The elevation of this Peat is unusually high however (over 2m OD), when compared to the likely natural level of the Thames floodplain prior to artificial raising (0 to 1m OD). Thus it is uncertain whether or not this represents a natural or redeposited Peat horizon.

***Holocene landscape evolution***

The pattern of alluvial deposits indicates the presence of two contrasting landscapes within the Royal Wharf site, and in the wider modelled area, throughout much of the Holocene. In the southern part of the Royal Wharf site it seems likely that deposition of mineral-rich alluvium reflects the presence of active river channels, probably the main channel of the River Thames and short N-S aligned steams draining off the slightly more elevated area to the north. Peat formation here was restricted to the more elevated remnants of the gravel surface between the depressions in which fluvial deposition persisted for much of the Holocene.

In the northern part of the Royal Wharf site and further north there are no obvious deep depressions that might have been the site of Peat formation early in the Holocene. Moreover the pattern of Peat accumulation indicated by the modelling of Peat thickness (Figure 6) shows very little relationship to the relief of the surface of the Shepperton Gravel/Lower Alluvium on which the Peat rests as is suggested by modelling exercises elsewhere along the River Thames (see below). This might reflect post-formational erosion of the Peat, or it may reflect a pattern of formation controlled by subtle variations of relief and hydrological conditions which are not recognisable at the level of resolution possible in the modelling exercise.

**CONCLUSIONS & RECOMMENDATIONS**

The distribution of sediments on the Royal Wharf site is quite different to those recorded during recent large-scale modelling exercises carried out on the Greenwich Peninsula (e.g. Batchelor *et al*., 2012) and further along the Lower Thames Valley floodplain (e.g. the Barking Reach [Green *et al*., in press] and on the Plumstead and Erith Marshes [Quest, in prep]), where thicker Peat horizons tend to be associated with areas of lower rather than higher Shepperton Gravel topography. There are however, some similarities with the conditions described by Corcoran et al (2011) in the Lower Lee valley where they were able to recognise contrasts between areas affected by persistent Holocene river activity and characterised by mineral-rich sediment sequences, and more stable areas where Peat accumulation had occurred.

The results of the deposit modelling exercise are considered to make a valuable contribution to our knowledge and understanding of the evolution of the floodplain landscape along this stretch of the Lower Thames Valley, against which the archaeological record can considered. It is therefore recommended that the results are used to produce a publication that builds upon similar recent regional site investigations carried out along the Barking Reach, Plumstead and Erith Marshes, Greenwich Peninsula and Lower Lea Valley. A lack of sufficiently deep boreholes in four areas of the Royal Wharf site have resulted in voids in the model of the Shepperton Gravel surface (Figure 3); it is recommended that geoarchaeological boreholes are put down in these areas of the site to complete the study, and that the peat sequences present are radiocarbon dated to improve the chronological framework of deposition. The placement of these boreholes will also enable investigation of the suspect Peat horizon in the Upper Alluvium identified towards the south-east of the site (TP911.4 – Figure 5). No palaeoenvironmental investigations are recommended however, since detailed reconstructions have already been carried out in the nearby area (e.g. the London Cable Car [Batchelor *et al*., in press], Fort Street [Wessex Archaeology, 2000; Crockett *et al*., 2003] and West Silvertown [Wilkinson et al., 2000]).

Finally, the results of the deposit modelling provide an indication of the archaeological potential of the site. Towards the south of the site, this is considered to be relatively low due to the greater depth of the Shepperton Gravel and largely inorganic sediments overlying it. The peat sediments from the northern part of the site have higher potential, particularly when considering the presence of the known archaeological remains on the Fort Street site. However, even this is considered to be moderate at best, since the surface of the Shepperton Gravel is rarely above -2.50m OD.

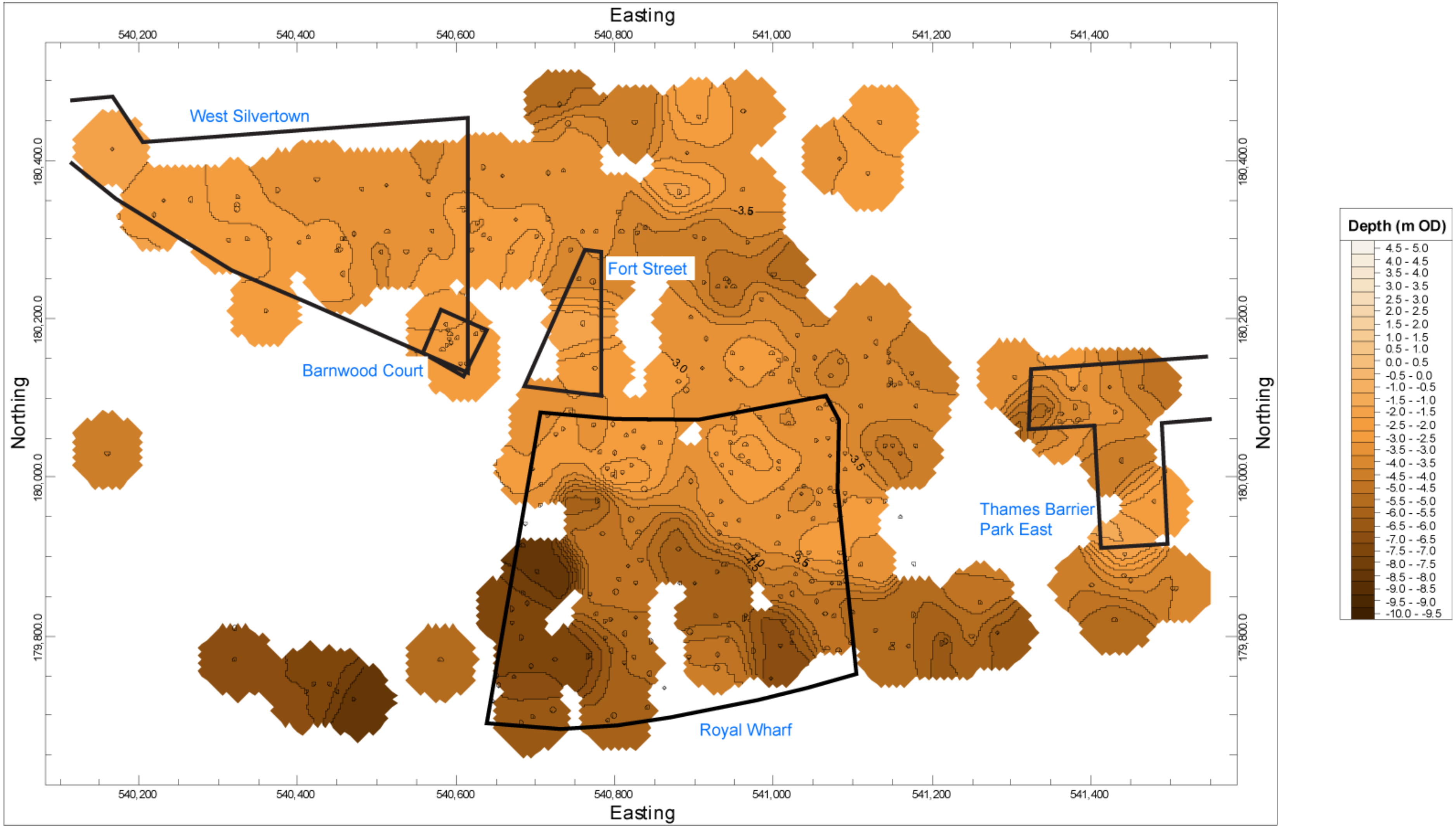


**Figure 5: Modelled surface of the Shepperton Gravel (metres OD)**

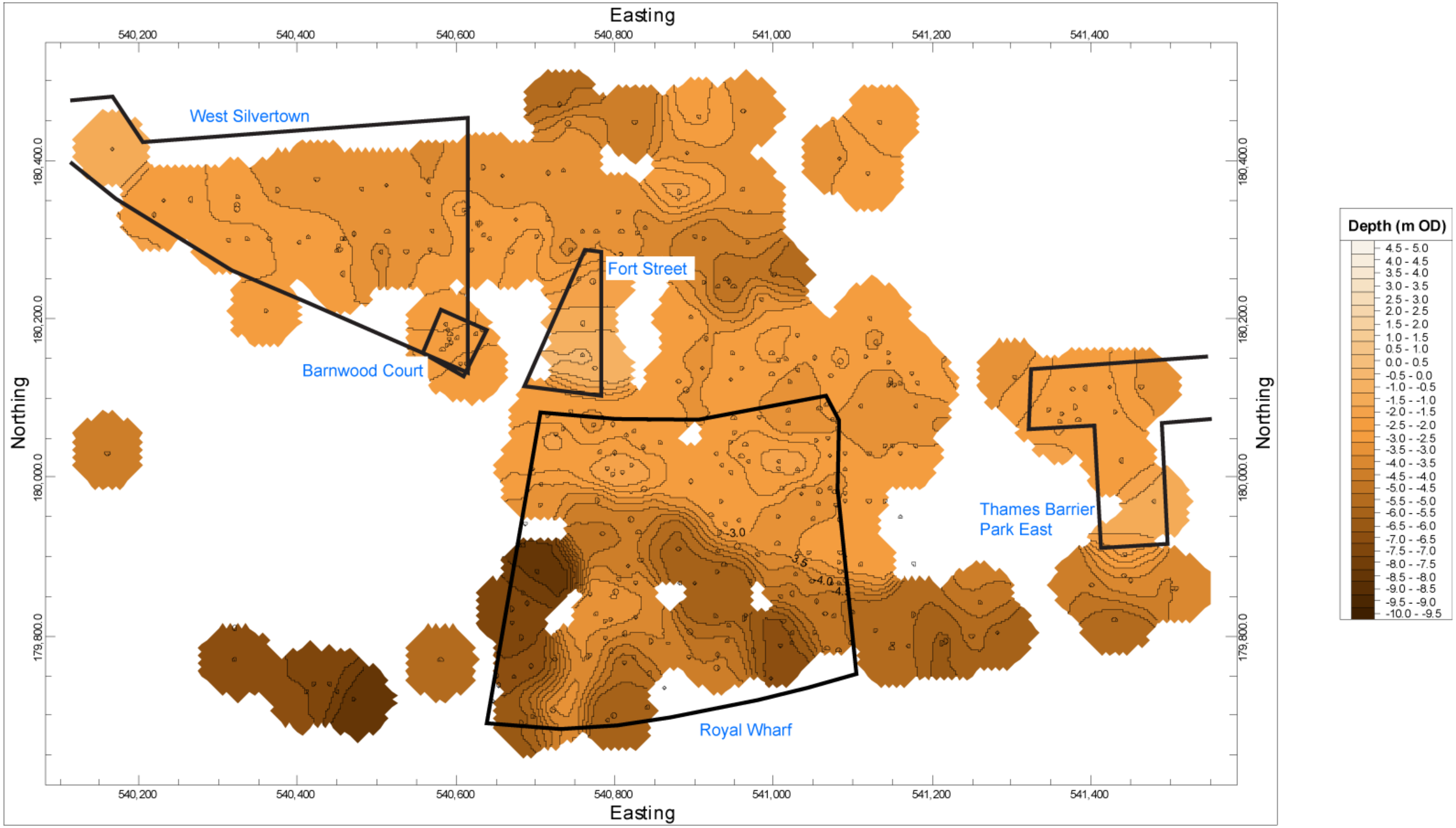


**Figure 6: Modelled surface of the Lower Alluvium (metres OD)**

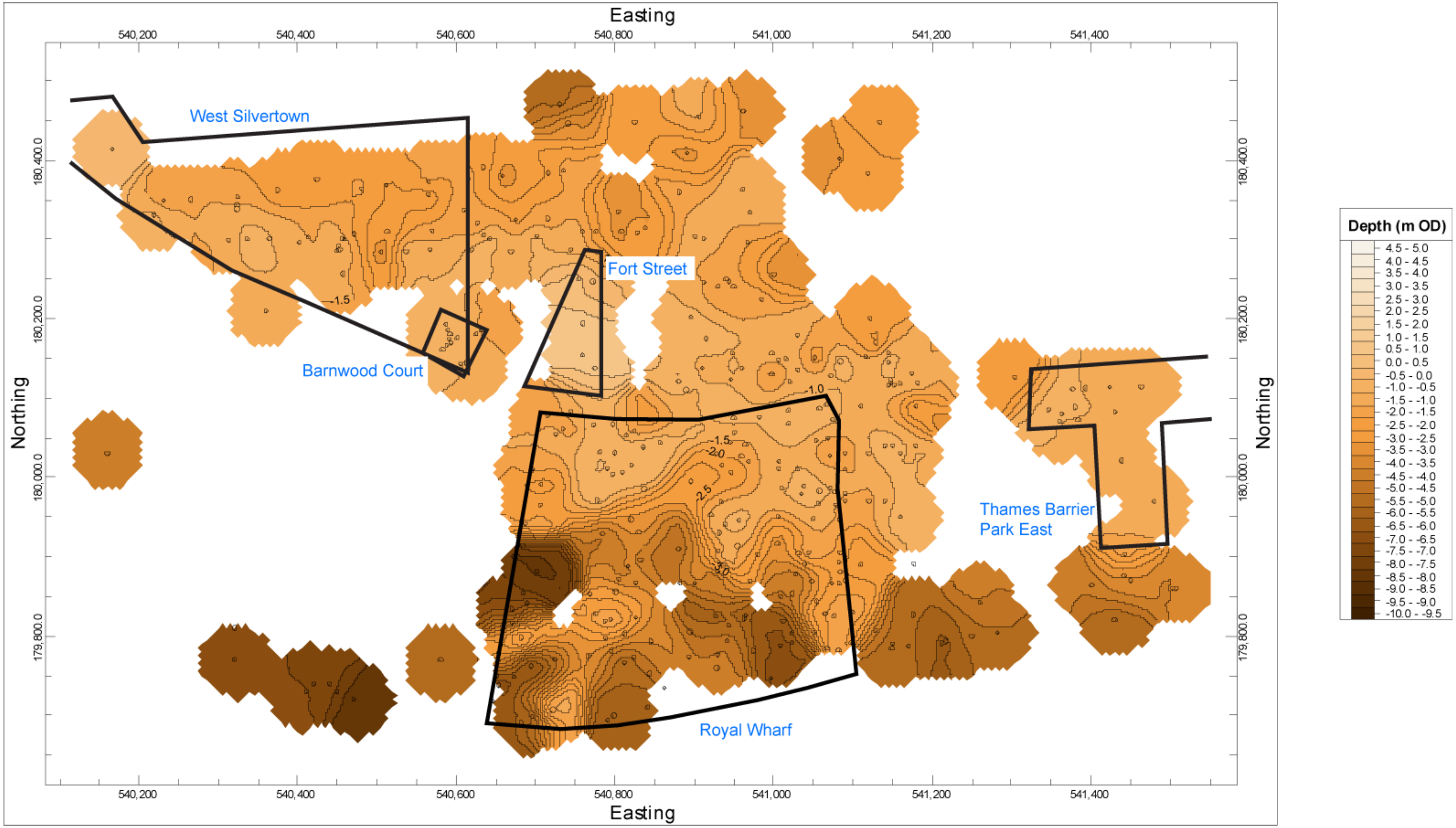


**Figure 7: Modelled surface of the Peat (metres OD)**

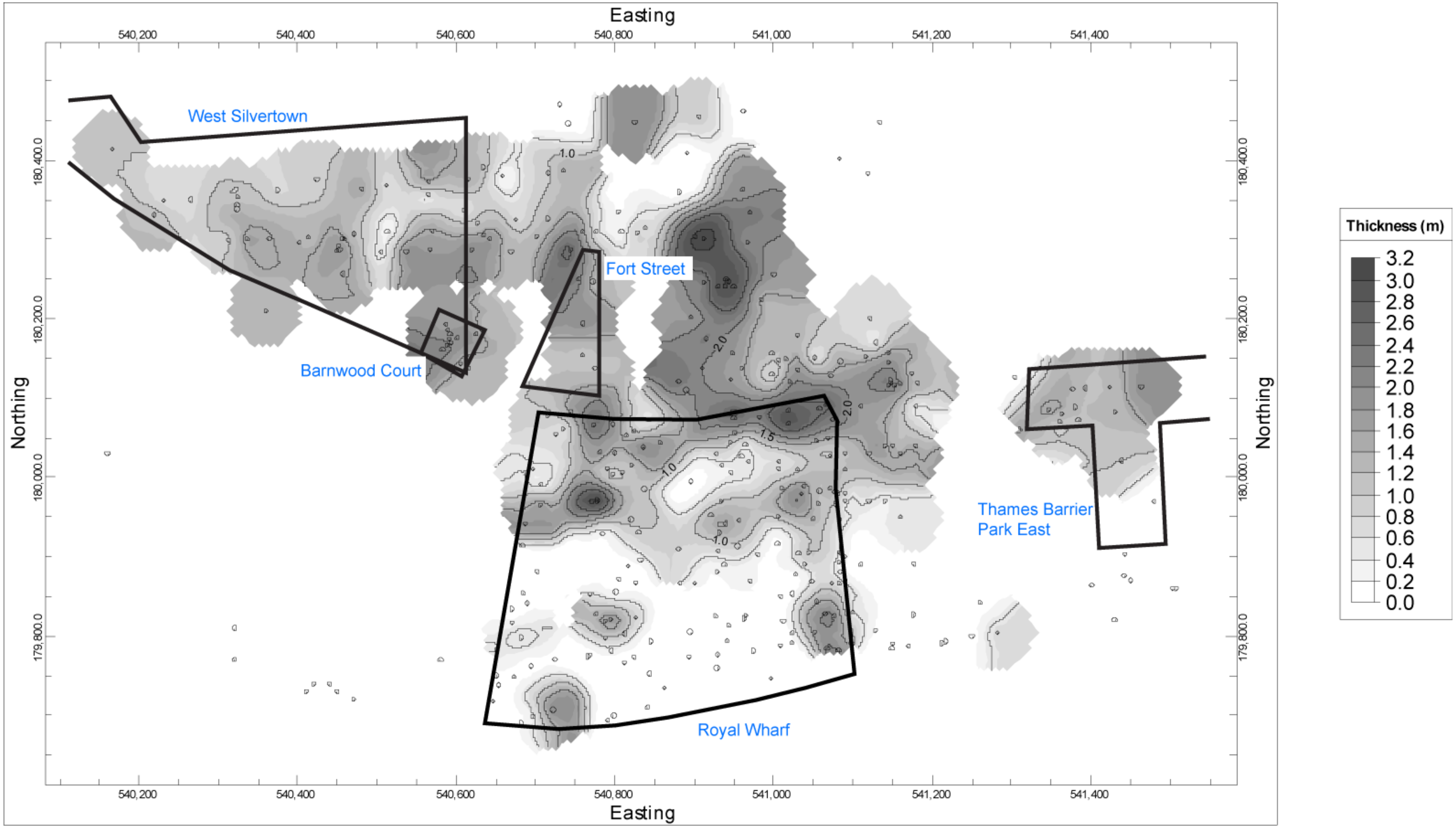


**Figure 8: Modelled thickness of the Peat (metres)**

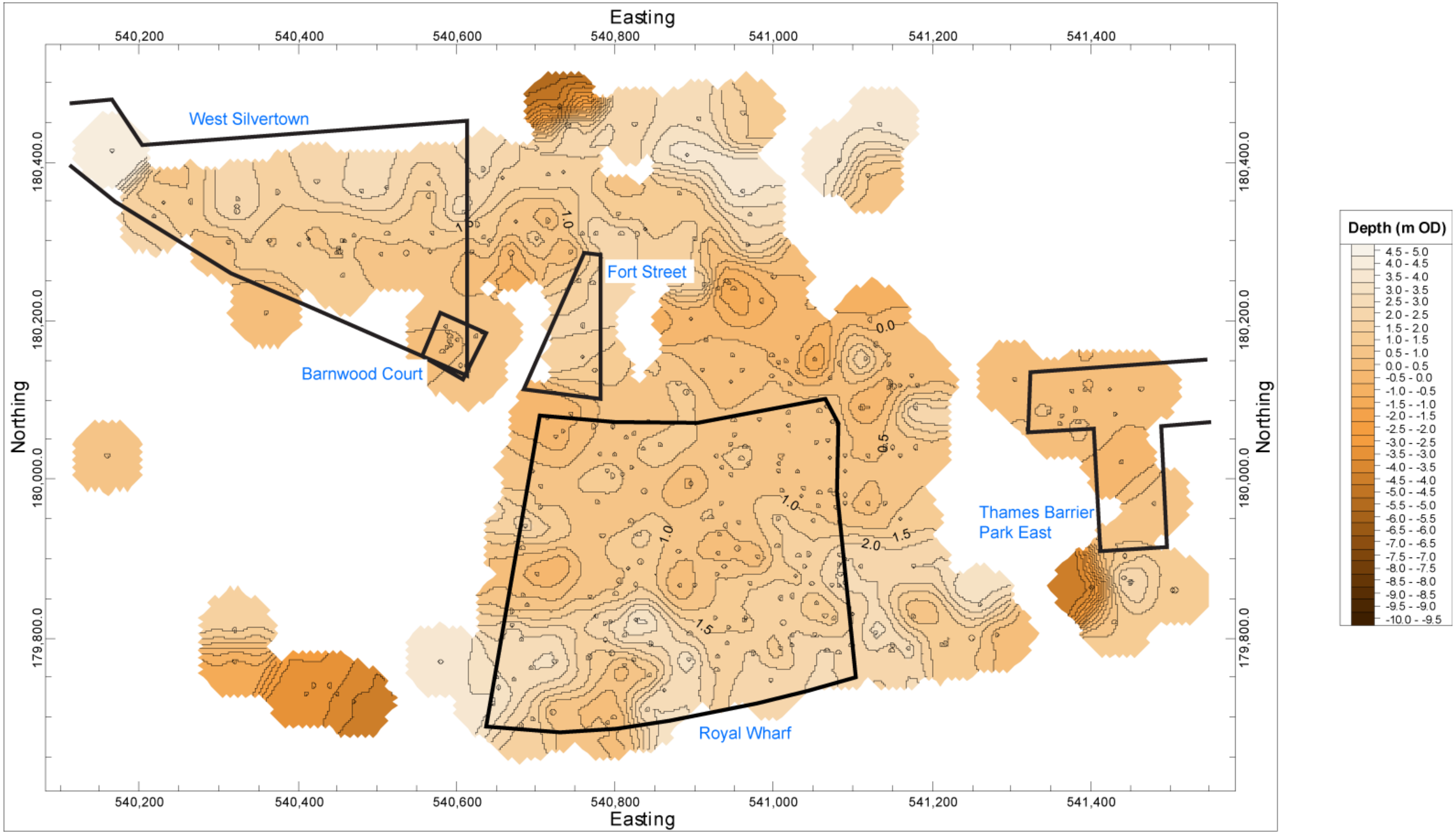


**Figure 9: Modelled surface of the Upper Alluvium (metres OD)**

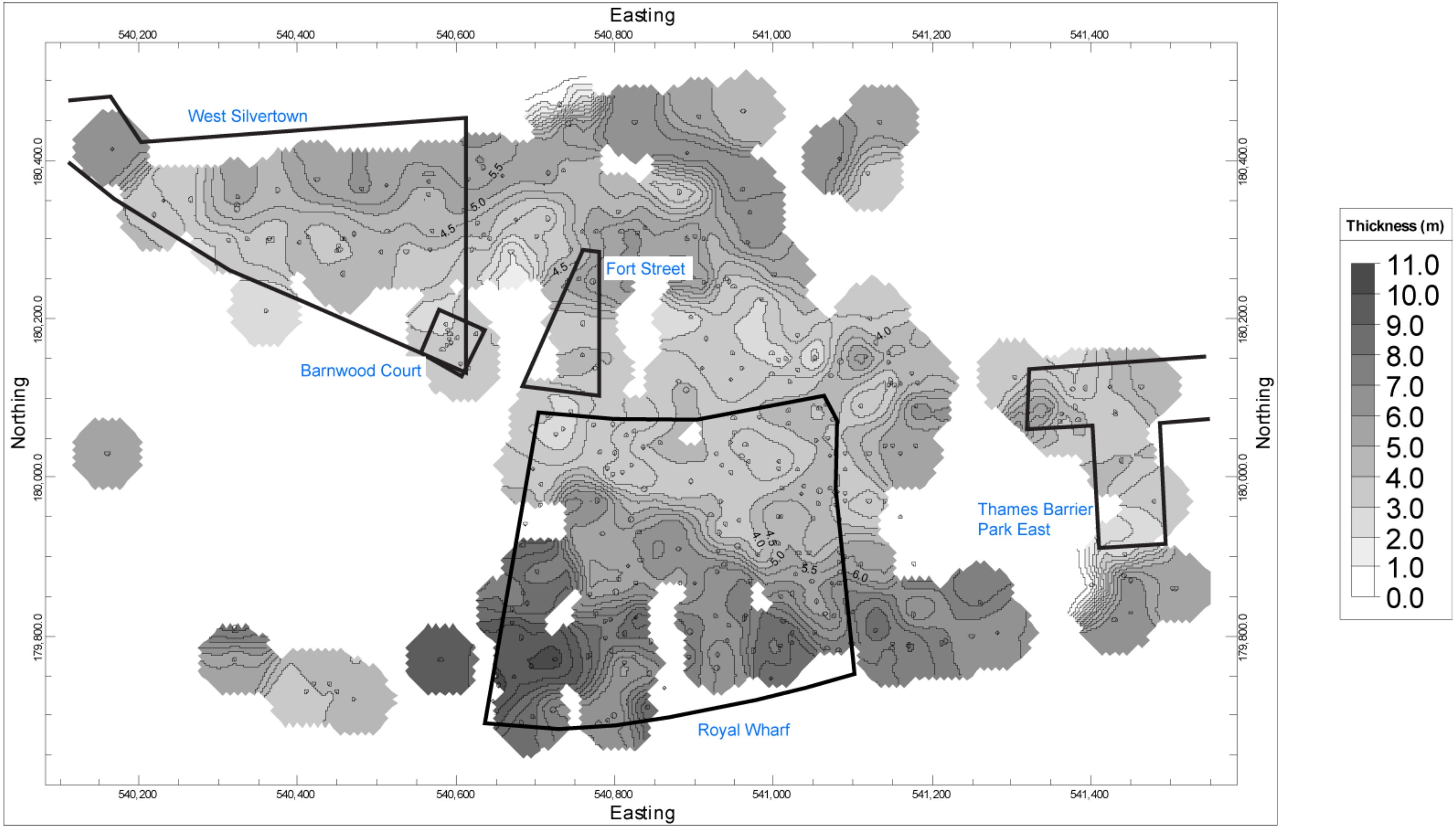


**Figure 10: Modelled thickness of the Total Alluvium (metres)**

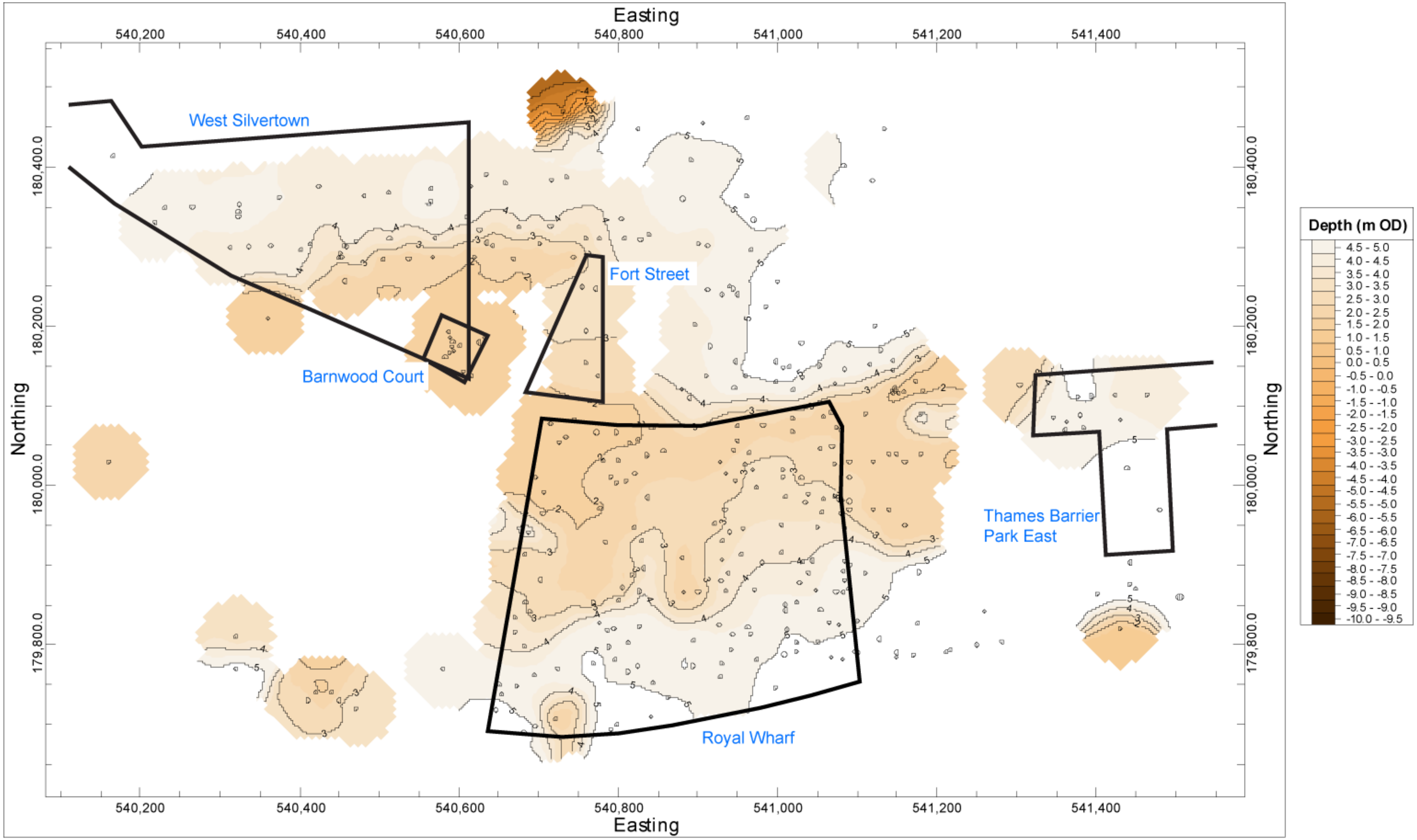


**Figure 11: Modelled surface of the Made Ground (m OD)**

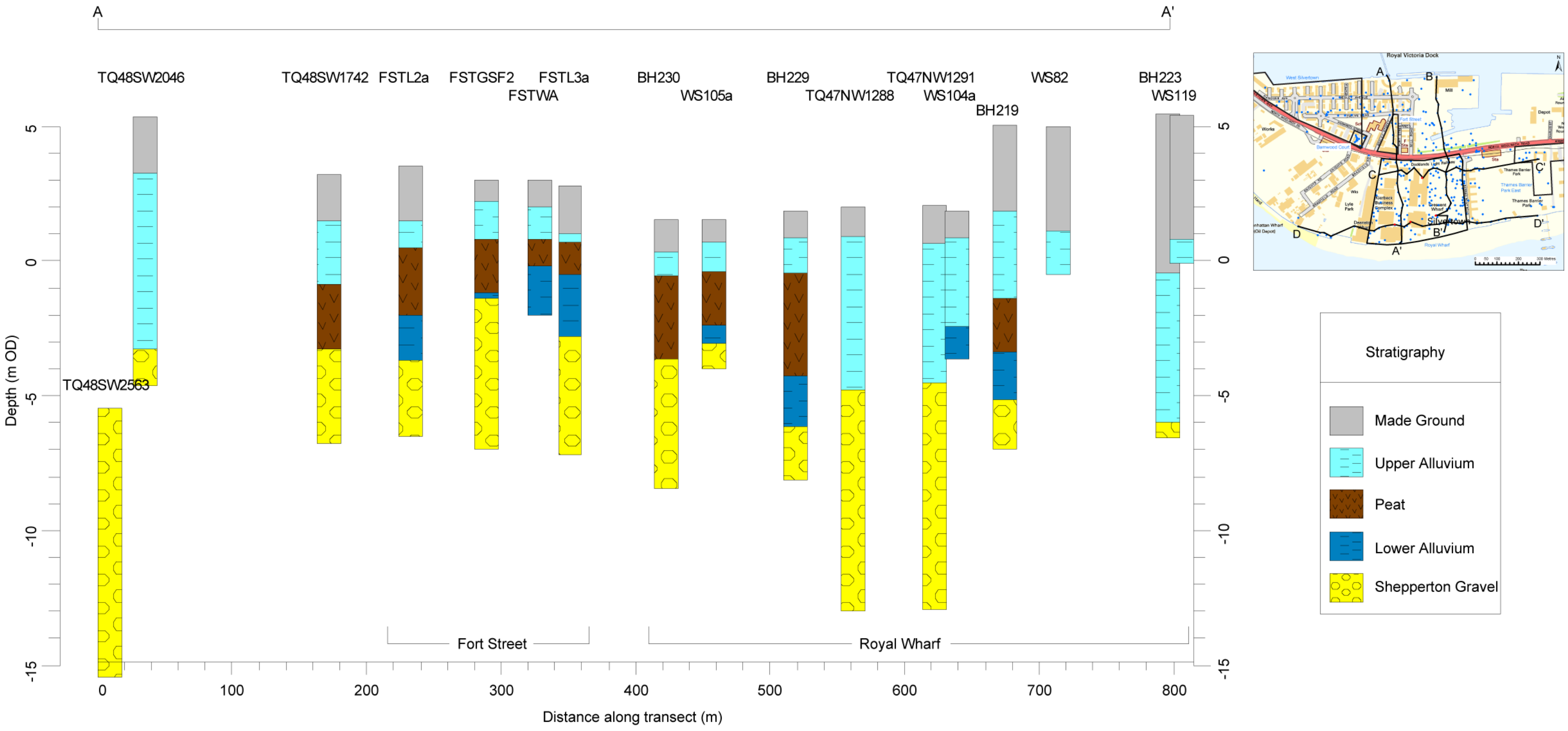


**Figure 12: North to south transect A-A'**

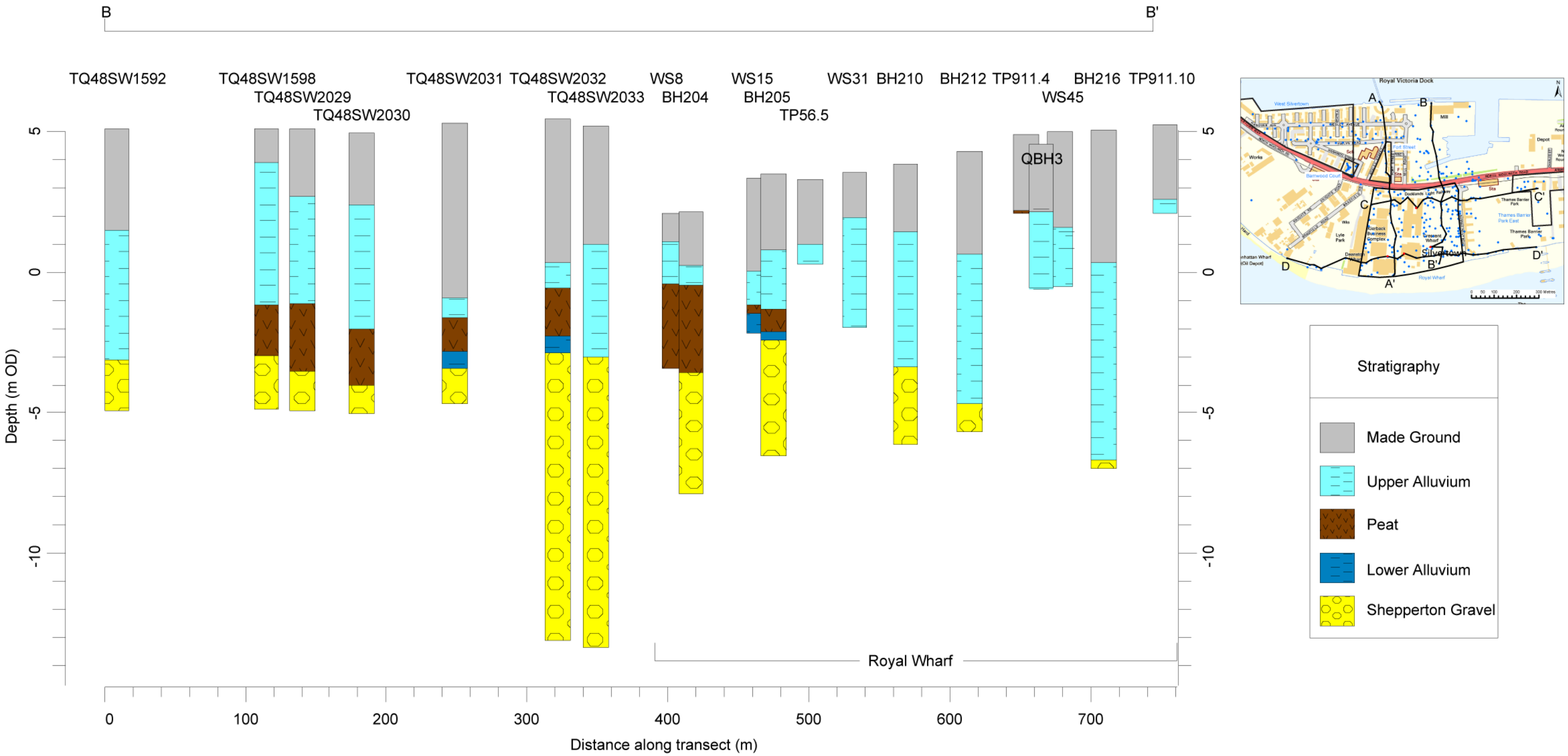


**Figure 13: North to south transect B-B'**

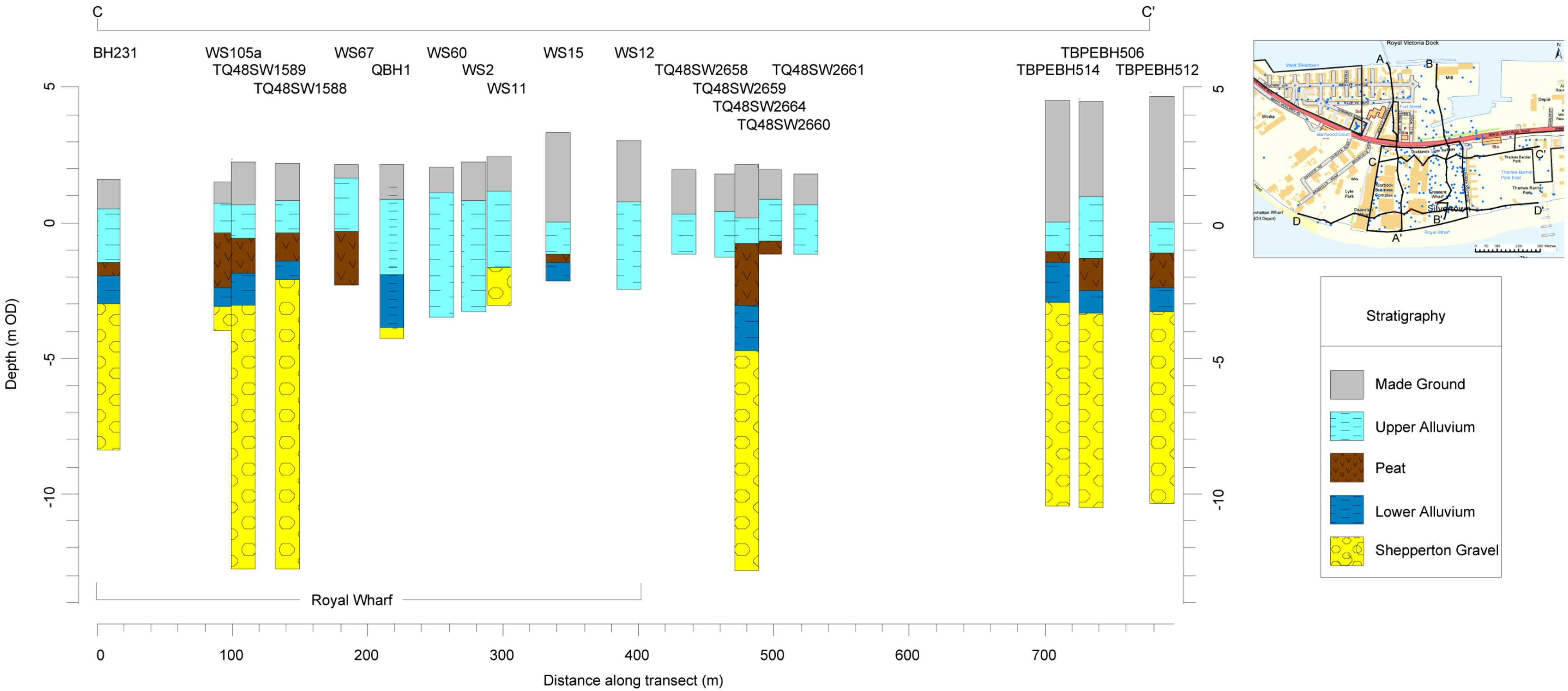


**Figure 14: East to west transect C-C'**

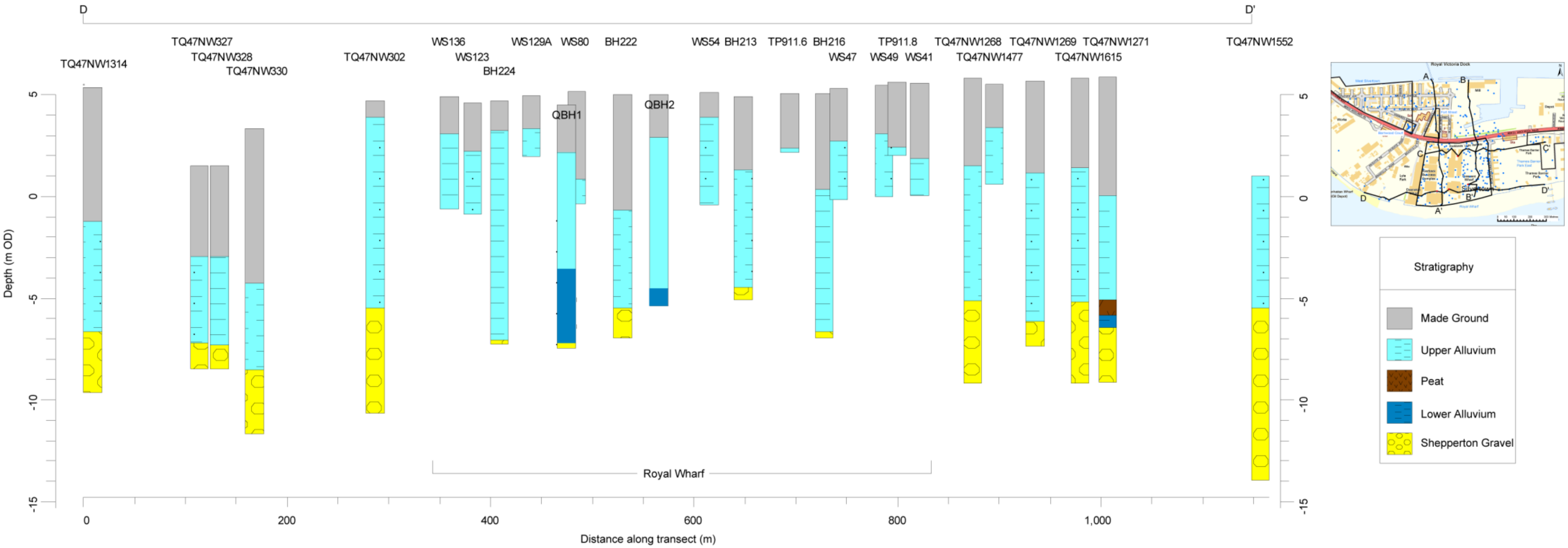


**Figure 15: East to west transect D-D'**

**Table 2: Field-based lithostratigraphic description of borehole <QBH1>**

| Depth (m OD) | Depth (m bgs) | Composition |
|---|---|---|
| 4.60 to 2.10 | 0.00 to 2.50 | Made Ground |
| 2.10 to 1.60 | 2.50 to 3.00 | Contaminated Alluvium (blue grey silty clay) |
| 1.60 to 0.60 | 3.00 to 4.00 | Contaminated Alluvium (blue grey clay with frequent herbaceous material) |
| 0.60 to -1.40 | 4.00 to 6.00 | As3 Ag1; grey silty clay. |
| -1.40 to -3.40 | 6.00 to 8.00 | As3 Ag1 Ga+; grey silty clay with horizontal beds of fine sand. |
| -3.40 to -4.40 | 8.00 to 9.00 | Ag2 As1 Ga1; greenish grey clayey sandy silt with horizontal bedding. |
| -4.40 to -5.40 | 9.00 to 10.00 | Ag2 As1 Ga1 Gg+; greenish grey clayey sandy silt with occasional lenses of brown silt and occasional gravel clasts. |
| -5.40 to -7.33 | 10.00 to 11.93 | Ag2 Ga2; greenish grey sandy silt/brown silt and sand in alternating horizontal beds every *ca*. 5cm. |
| -7.33 to -7.40 | 11.93 to 12.00 | Gg3 Ga1; sandy gravel. Predominantly flint clasts up to 40mm in diameter, sub-angular to well-rounded. |

**Table 3: Laboratory-based lithostratigraphic description of borehole <QBH2>**

| Depth (m OD) | Depth (m bgs) | Composition |
|---|---|---|
| 5.02 to 3.02 | 0.00 to 2.00 | Made Ground |
| 3.02 to 2.52 | 2.00 to 2.50 | VOID |
| 2.52 to 2.18 | 2.50 to 2.84 | Made Ground |
| 2.18 to 2.02 | 2.84 to 3.00 | 10YR 3/1; Ag3 As1 Ga+; very dark grey clayey silt with a trace of sand. |
| 2.02 to 1.66 | 3.00 to 3.36 | 10YR 4/1; Ag3 As1; dark grey clayey silt. Sharp contact in to: |
| 1.66 to 1.02 | 3.36 to 4.00 | 10YR 4/1; Ag2 As1 Dh1; dark grey clayey silt with frequent detrital herbaceous material. |
| 1.02 to 0.02 | 4.00 to 5.00 | 10YR 4/1; Ag2 As2 Dh+; dark grey clay and silt with a trace of detrital herbaceous material. Frequent vertical root material (cf. *Phragmites*). |
| 0.02 to -1.47 | 5.00 to 6.49 | 10YR 4/1; Ag2 As2 Dh+; dark grey clay and silt with a trace of detrital herbaceous material. Diffuse contact in to: |
| -1.47 to -1.98 | 6.49 to 7.00 | Gley1 4/10Y; Ag3 As1 Ga+; dark greenish grey clayey silt with a trace of sand. |
| -1.98 to -2.27 | 7.00 to 7.29 | 10YR 4/1; Ag3 As1 Ga+ Dl+; dark grey clayey silt with traces of sand and detrital wood. Sharp contact in to: |
| -2.27 to -2.98 | 7.29 to 8.00 | 10YR 4/1; Ag2 As1 Dh1; dark grey clayey silt with detrital herbaceous material. |
| -2.98 to -3.98 | 8.00 to 9.00 | 2.5Y 4/1; As3 Ag1 Ga+; dark grey silty clay with a trace of sand. |
| -3.98 to -4.61 | 9.00 to 9.63 | 2.5Y 4/1; As2 Ag2 Ga+; dark grey silt and clay with a trace of sand. Sharp contact in to: |
| -4.61 to -5.25 | 9.63 to 10.27 | 2.5Y 4/1; Ag2 As1 Ga1 Dh+; dark grey clayey sandy silt with a trace of detrital herbaceous material. Horizontal bedding throughout. |

**Table 4: Field-based lithostratigraphic description of borehole <QBH3>**

| Depth (m OD) | Depth (m bgs) | Composition |
|---|---|---|

| | | |
|---|---|---|
| 4.57 to 1.77 | 0.00 to 2.80 | Made Ground |
| 1.77 to -0.43 | 2.80 to 5.00 | Contaminated Alluvium (not retained) |

**Table 5: Laboratory-based lithostratigraphic description of borehole <QBH4>**

| **Depth (m OD)** | **Depth (m bgs)** | **Composition** |
|---|---|---|
| 2.14 to -0.39 | 0.00 to 2.53 | Made Ground |
| -0.39 to -0.86 | 2.53 to 3.00 | 2.5Y 4/1; As3 Ag1 Dh+; dark grey silty clay with a trace of detrital herbaceous material. |
| -0.86 to -2.86 | 3.00 to 5.00 | 2.5Y 4/1; Ag2 As2 Dh+; dark grey silt and clay with a trace of detrital herbaceous material. |
| -2.86 to -3.56 | 5.00 to 5.70 | 2.5Y 4/1; Ag3 As1 Ga+ Dl+; dark grey clayey silt with traces of sand and detrital wood. Some horizontal bedding. Occasional Mollusca fragments. Sharp contact in to: |
| -3.56 to -3.86 | 5.70 to 6.00 | Gg3 Ga1; sandy gravel. Predominantly flint clasts up to 40mm in diameter, sub-angular to well-rounded. |

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**APPENDIX 1: OASIS**