

# THE EBURY CENTRE, SUTHERLAND STREET, LONDON BOROUGH OF WESTMINSTER (SITE CODE: SST15): GEOARCHAEOLOGICAL FIELDWORK AND DEPOSIT MODEL REPORT

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## INTRODUCTION

This report summarises the findings arising out of the geoarchaeological fieldwork and deposit modelling undertaken by Quaternary Scientific (University of Reading) in connection with the proposed development of land at the Ebury Centre, Sutherland Street, London Borough of Westminster (Site Code: SST15; National Grid Reference: *centred on* TQ 2869 7834; Figure 1). Quaternary Scientific were commissioned by CgMs Consulting to undertake the geoarchaeological investigations. The site is located on the floodplain of the River Thames, approximately 500m north of the modern waterfront. The site is mapped by the British Geological Survey (BGS) as lying on Alluvium, overlying London Clay bedrock (1:50,000 Sheet 270 South London 1998). The site lies close to the confluence of the River Westbourne with the Thames, and is approximately 300m to the northwest of a small remnant of the Mid to Late Devensian Kempton Park Terrace, which forms a gravel 'island' underlying Pimlico.

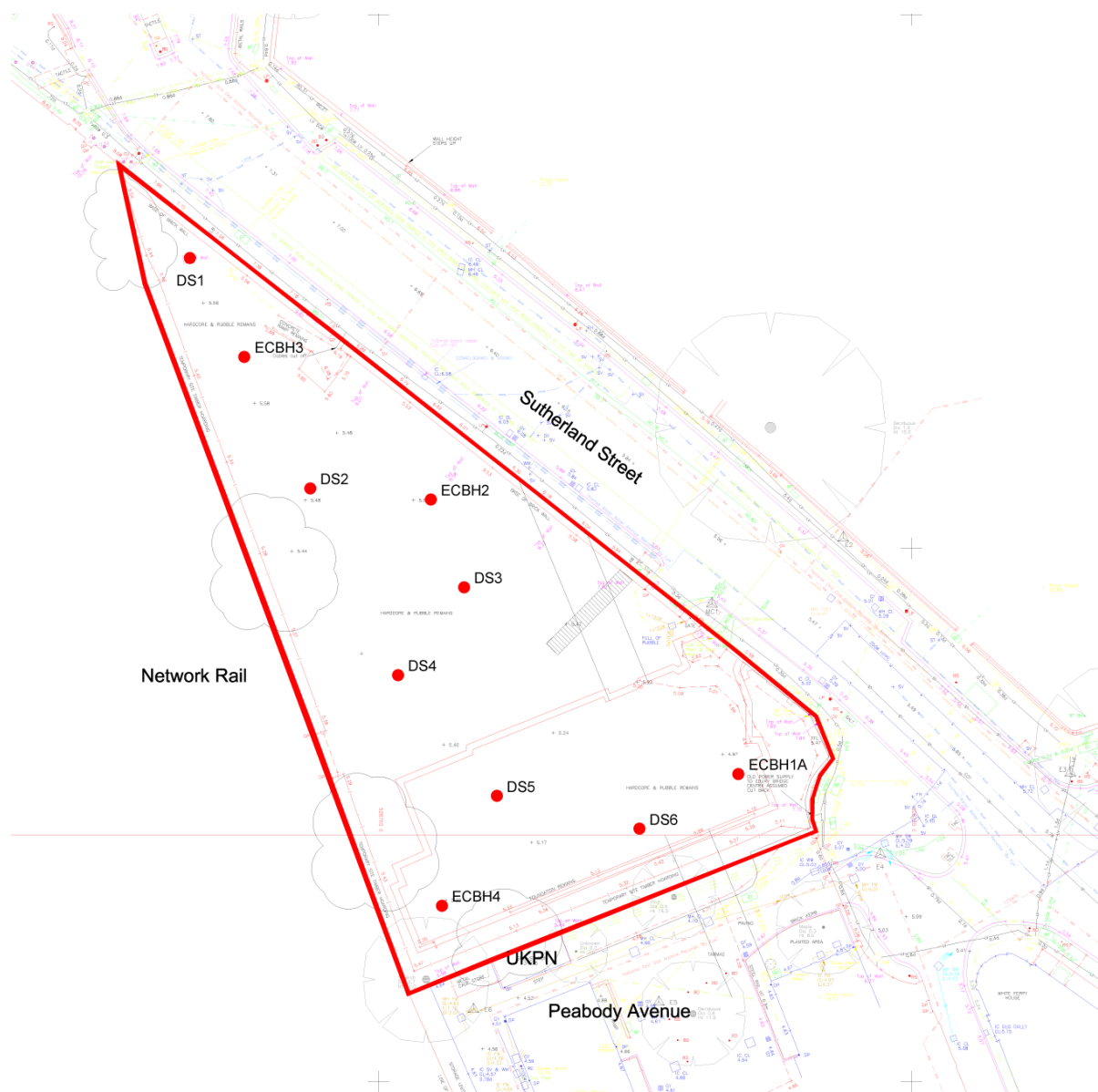
At the Lupus Street (Green, 2008) and 135 Grosvenor Road (Green & Young, 2012) sites, ca. 500m to the southeast and lying on the Kempton Park Gravel 'island' (Figure 1), clayey silt Alluvium was recorded overlying the lower margins of the island, and was considered to form part of the Staines Alluvial Deposits of Holocene age described in the Pimlico area by Gibbard (1985). Gibbard records 4.5m of 'organic clay and peat' to the north of Lupus Street site near Victoria Station (TQ 289 790) and 3.0m of 'similar sediments' between Victoria Station and Lupus Road at TQ 295 786. The upper surface of these alluvial deposits in the area immediately to the east of the Pimlico gravel 'island' is between 1.09m and 1.75m OD (BGS Boreholes TQ27NE725, 726 and 727) and the upper surface of the natural Alluvium further north in Westminster is recorded by Sidell *et al.* (2000) at levels generally below 1.50m OD. The substantial thicknesses of Holocene Alluvium recorded by Gibbard (1985) reflect the infilling of a complex of deep channels created late in the Devensian, and responsible for the dissection of the Kempton Park Terrace. The whole of the area immediately to the south of Westminster and to the north and east of the Pimlico gravel 'island' remained wet marshland at least until the early years of the 18th century (Barton, 1992) and it is probable that until the 13th or 14th century the lower course of the Tyburn,

known as the Tachbrook, crossed this marshland immediately to the east of the Pimlico gravel island, where the modern Tachbrook Estate is now situated. The Holocene alluvial deposits overlying the lower margins of the 'island' at the Lupus Road site probably represented a relatively late stage in the infilling of this marshy area, a process that was brought to an unnatural conclusion by land-raising operations in the 18th century. At the Ebury Centre site, previous geotechnical investigations revealed a sequence of sand and gravel, the surface of which lay at between 4.95 and 5.85m below ground level (bgl); approximately 1.05 to 0.15m OD), overlain by predominantly clayey and in places silty or sandy Alluvium to a level of between 2.6 and 3.8m bgl (approximately 3.4 and 2.2m OD). The sequence was capped across the site by between two and four metres of Made Ground.

The aim of the geoarchaeological investigations at the site was to (1) clarify the nature of the sub-surface stratigraphy, in particular the presence and thickness of Alluvium (including Peat) across the site, and (2) to evaluate the potential of the sedimentary sequences for reconstructing the environmental history of the site and its environs. In order to achieve this aim, two selected geotechnical boreholes at the site were monitored by Quaternary Scientific and a programme of deposit modelling undertaken.



**Figure 1: Location of (1) the Ebury Centre, Sutherland Street, London Borough of Westminster (SST15); and other nearby ge archaeological investigations: (2) Lupus Street (Green, 2008) and (3) 135 Grosvenor Road (Green & Young, 2012). Contains Ordnance Survey data © Crown copyright and database right [2014]**



**Figure 2: Detailed site map showing the location of the new geotechnical boreholes. Original figure provided by CgMs Consulting.**

## METHODS

### *Field investigations*

A total of ten geotechnical boreholes were put down at the site by Ground Engineering Limited using either a Terrier rig (boreholes DS1 to DS6) or cable percussion (BH1A to BH4). Of these, two cable percussion boreholes were monitored by Quaternary Scientific (BH3 and BH4). The lithostratigraphy of these boreholes 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) examining grab samples from the geotechnical boreholes where possible; (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 spatial attributes of all boreholes used in the deposit model are shown in Table 1 and in Figure 2.

**Table 1: Borehole attributes for the records used in the deposit model, the Ebury Centre, Sutherland Street, London Borough of Westminster**

<b>Borehole</b>	<b>Easting</b>	<b>Northing</b>	<b>Elevation (m OD)</b>
BH1A	528733	178329	5.00
BH2	528705	178354	5.50
BH3	528688	178367	5.50
BH4	528706	178317	5.20
DS1	528683	178376	5.50
DS2	528694	178355	5.40
DS3	528708	178346	5.40
DS4	528702	178338	5.40
DS5	528711	178327	5.30
DS6	528724	178324	5.30

### *Deposit modelling*

The deposit model was based on a review of the ten new geotechnical borehole records. Sedimentary units from the boreholes were classified into five main groups: (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 16 geological utilities software. Models of surface height (using a nearest neighbour routine) were generated for the Gravel and Upper Alluvium (Figures 3 and 5), with thickness models for the Peat, total Alluvium (incorporating the Lower Alluvium, Peat and Upper Alluvium), and Made Ground (Figures 4, 6 and 7) (also using a nearest neighbour routine). The boreholes are generally well-distributed over the area of investigation; however, 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. In addition, the reliability of individual models is affected by the quality of the stratigraphic records which in turn are affected by the nature of the sediments and/or their post-depositional disturbance during previous stages of development on the site. As a consequence of this the modelling procedure has been manually adjusted so that only those areas for which sufficient stratigraphic data is present will be modelled. In order to achieve this, a maximum distance cut-off filter equivalent to a 50m radius around each borehole is applied to all deposit models except the Peat, where a maximum distance cut-off filter equivalent to a 10m radius is applied, since this horizon is present in only two boreholes. In addition, it is important to recognise that two lithostratigraphic records are represented, recorded using different descriptive terms and subject to differing technical constraints in terms of recorded detail including the exact levels of the stratigraphic boundaries. Of the records used in the deposit model, the cores from the boreholes observed by Quaternary Scientific represent the most detailed record of the sediment sequences.

## **RESULTS AND INTERPRETATION OF THE LITHOSTRATIGRAPHIC DESCRIPTIONS AND DEPOSIT MODELLING**

The combined results of the geoarchaeological and geotechnical investigations have permitted a programme of deposit modelling of the surface elevation and thickness of each major stratigraphic unit recorded at the site (Figures 3 to 7).

The basal unit observed at the site is a horizon of sand and gravel, the surface of which is recorded in the four cable percussion boreholes at between -1.0 and -1.8m OD. The Gravel surface is recorded at its lowest in the southwestern corner of the site in BH4 (-1.8m OD), and in the central area of the site in BH2 (-1.5m OD) (Figure 3). The Gravel rises towards the northern (BH3) and eastern areas of the site (BH1A) to -1.0m OD. This horizon is considered to represent the Shepperton Gravel of Gibbard (1985), deposited within a high energy braided river system at the end of the Late Glacial period (Late Devensian; ca. 15,000-11,500 cal BP). The overall impression in the deposit model for this surface is of a linear depression aligned approximately north-south through the central area of the site, which may be related to a relatively narrow former channel in this location. It should be noted however that the model is based on only four records, and any interpretation of the features recorded should be made with caution.

In selected boreholes a horizon of silty sand is recorded (see Figure 3), overlying the Gravel

in boreholes (BH2, BH3 and BH4) and forming the basal unit in boreholes DS4 and DS6. These coarse-grained deposits are similar in nature to the Lower Alluvium recorded elsewhere in the Lower Thames Valley and its tributaries, the sediments of which were deposited during the Early to Mid-Holocene, as the energy of flow decreased and the Thames probably became confined to a single meandering channel. The surface of this unit is recorded at between 0.5 (BH3) and -0.8m OD (BH2); notably, its presence does not appear to be confined to the areas of lower Gravel topography recorded in the middle of the site (see Figure 3).

Overlying the sandy Lower Alluvium in these boreholes, and the Gravel elsewhere, is a horizon of silty clay, in places slightly sandy and with occasional detrital plant remains. This unit is similar in character to the Upper Alluvium frequently recorded in the Lower Thames Valley and its tributaries, and indicative of sediment accumulation on the floodplain at a distance from any active channels. In two boreholes a horizon of silty and clayey Peat with herbaceous remains up to 0.2m in thickness (Figure 4) is recorded within the Upper Alluvium, between 0.7 and 0.9m OD in borehole BH3 and between 0.6 and 0.7m OD in DS1. Significantly, the Peat horizon is indicative of a transition towards a semi-terrestrial environment, supporting the growth of wetland vegetation and which may have been utilised by prehistoric people. However, its presence is confined to a small area towards the northern corner of the site (see Figure 4).

The surface of the Upper Alluvium itself lies at between 0.2 and 2.5m OD (Figure 5), where it is overlain by Made Ground. The surface of the Upper Alluvium lies at between 1.7 and 2.5m OD in the central and northern areas of the site (boreholes DS1 to DS4, BH2 and BH3), falling to between 0.2 and 0.85m OD in the southern area of the site (in the footprint of a former basement in the area of boreholes DS5, DS6, BH1 and BH4). This has resulted in greater thicknesses of total Alluvium (incorporating the Lower Alluvium, Peat and Upper Alluvium) in the northern area of the site, where up to 3.7m is recorded (BH2; see Figure 6), and greater thicknesses of Made Ground in the south of the site (see Figure 7). The modern surface of the site is relatively even at between 5.0 and 5.5m OD.

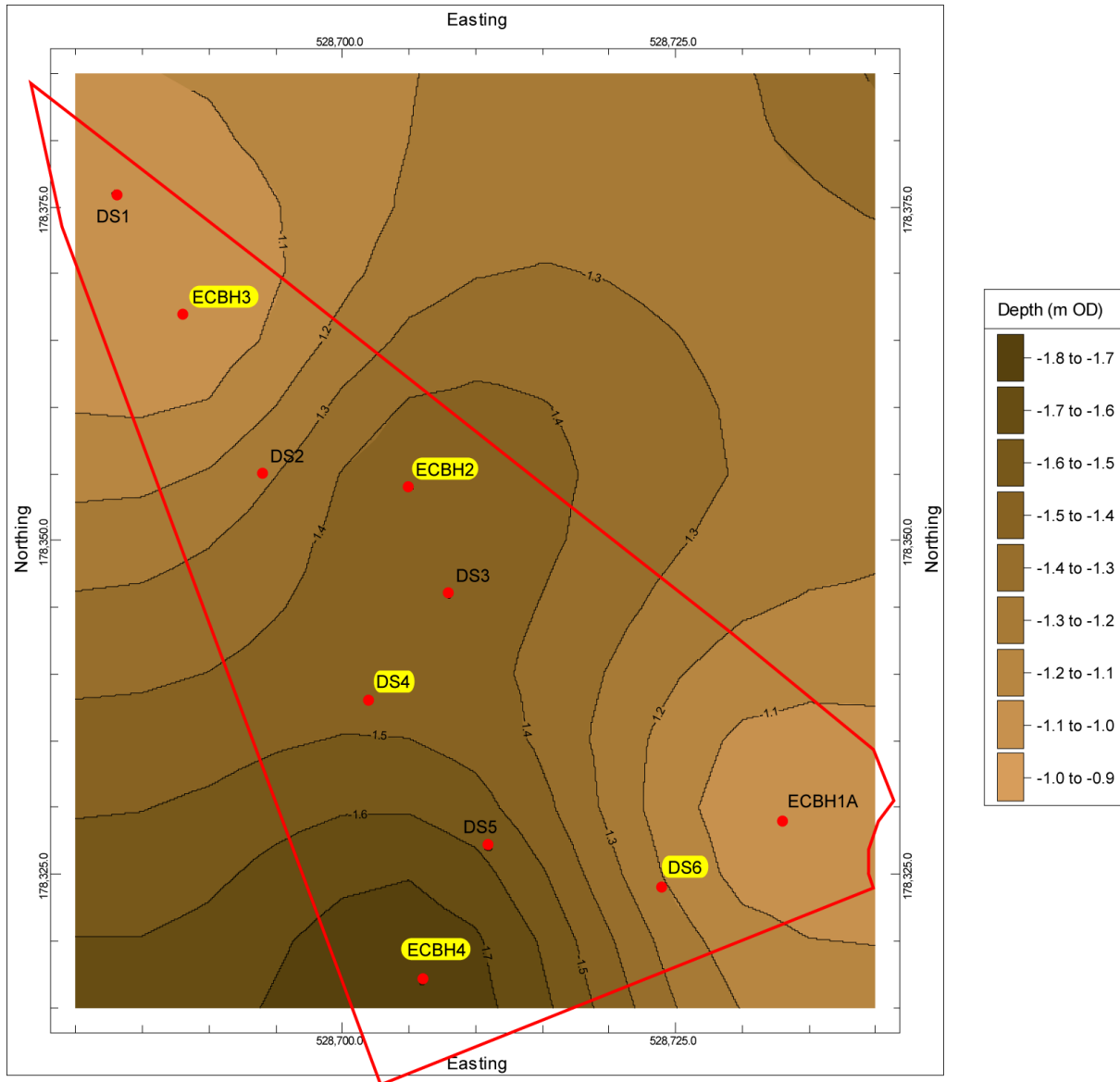
**Table 2: Lithostratigraphic description of borehole BH3, the Ebury Centre, Sutherland Street, London Borough of Westminster (Site Code: SST15)**

Depth (m OD)	Depth (m bgs)	Composition
5.50 to 4.50	0.00 to 1.00	Made Ground of demolition rubble/crush
4.50 to 3.00	1.00 to 2.50	Made Ground of ?post-Medieval fill with brick, gravel, sand and mortar in a matrix of grey silty clay.
3.00 to 2.30	2.50 to 3.20	Made Ground of clay-rich ?post-Medieval fill with frequent brick fragments, gravel, sand and mortar.
2.30 to 2.00	3.20 to 3.50	As3 Ag1 Dh+ Ga+ Gg+; blueish grey silty clay with a trace of detrital herbaceous material, sand and occasional gravel clasts. Occasional Mollusca fragments. Diffuse contact in to:
2.00 to 1.50	3.50 to 4.00	As2 Ag2 Dh+; dark blueish grey silt and clay with a trace of detrital herbaceous material.
1.50 to 0.90	4.00 to 4.60	Ag2 As2 Dl+; blue grey silt and clay with a trace of detrital wood. Diffuse contact in to:
0.90 to 0.70	4.60 to 4.80	Ag1 As1 Sh1 Th <sup>2</sup> 1; humo. 2; greyish brown very organic silt and clay with frequent herbaceous material. Diffuse contact in to:
0.70 to 0.50	4.80 to 5.00	Ag3 Ga1 Dh+; blueish grey sandy silt with a trace of detrital herbaceous material. Diffuse contact in to:
0.50 to -0.30	5.00 to 5.80	Ga3 Ag1; dark grey silty sand.
-0.30 to -0.50	5.80 to 6.00	Ga4 Ag+; grey sand with a trace of silt.
-0.50 to -1.00	6.00 to 6.50	Ga4 Ag+ Gg+; grey sand with a trace of silt and occasional gravel clasts.
-1.00 to -1.50	6.50 to 7.00	Gg3 Ga1; sandy gravel. Gravel is flint, sub-angular to well-rounded, up to 50mm in diameter.

**Table 3: Lithostratigraphic description of borehole BH4, the Ebury Centre, Sutherland Street, London Borough of Westminster (Site Code: SST15)**

Depth (m OD)	Depth (m bgs)	Composition
5.20 to 3.50	0.00 to 1.70	Made Ground of concrete and brick fragments in a brown matrix of silty clay.
3.50 to 1.50	1.70 to 3.70	Made Ground of concrete, brick fragments and oyster shell in a brown matrix of silty clay (?post-Medieval fill)
1.50 to 0.70	3.70 to 4.50	Gg2 Ga1 Ag1; orange silty sandy gravel with frequent Mollusca fragments. Clasts are flint, sub-angular to well-rounded, up to 40mm in diameter. Diffuse contact in to:
0.70 to 0.30	4.50 to 4.90	Gg2 Ga1 Ag1; orange silty sandy gravel. Clasts are flint, sub-angular to well-rounded, up to 40mm in diameter. Diffuse contact in to:
0.30 to 0.10	4.90 to 5.10	Ga2 As1 Gg1; orange gravelly clayey sand. Diffuse contact in to:
0.10 to 0.00	5.10 to 5.20	As2 Ag2 Gg+; grey silt and clay with occasional gravel clasts. Diffuse contact in to:
0.00 to -1.80	5.20 to 7.00	Ga3 Ag1; orange silty sand.
-1.80 to -2.30	7.00 to 7.50	Gg3 Ga1; sandy gravel. Gravel is flint, sub-angular to well-rounded, up to 50mm in diameter.





**Figure 3: Top of the Gravel (m OD). Those boreholes where the sandy Lower Alluvium is recorded are highlighted in yellow. For deposit modelling purposes the cable percussion boreholes are given the prefix 'EC'.**

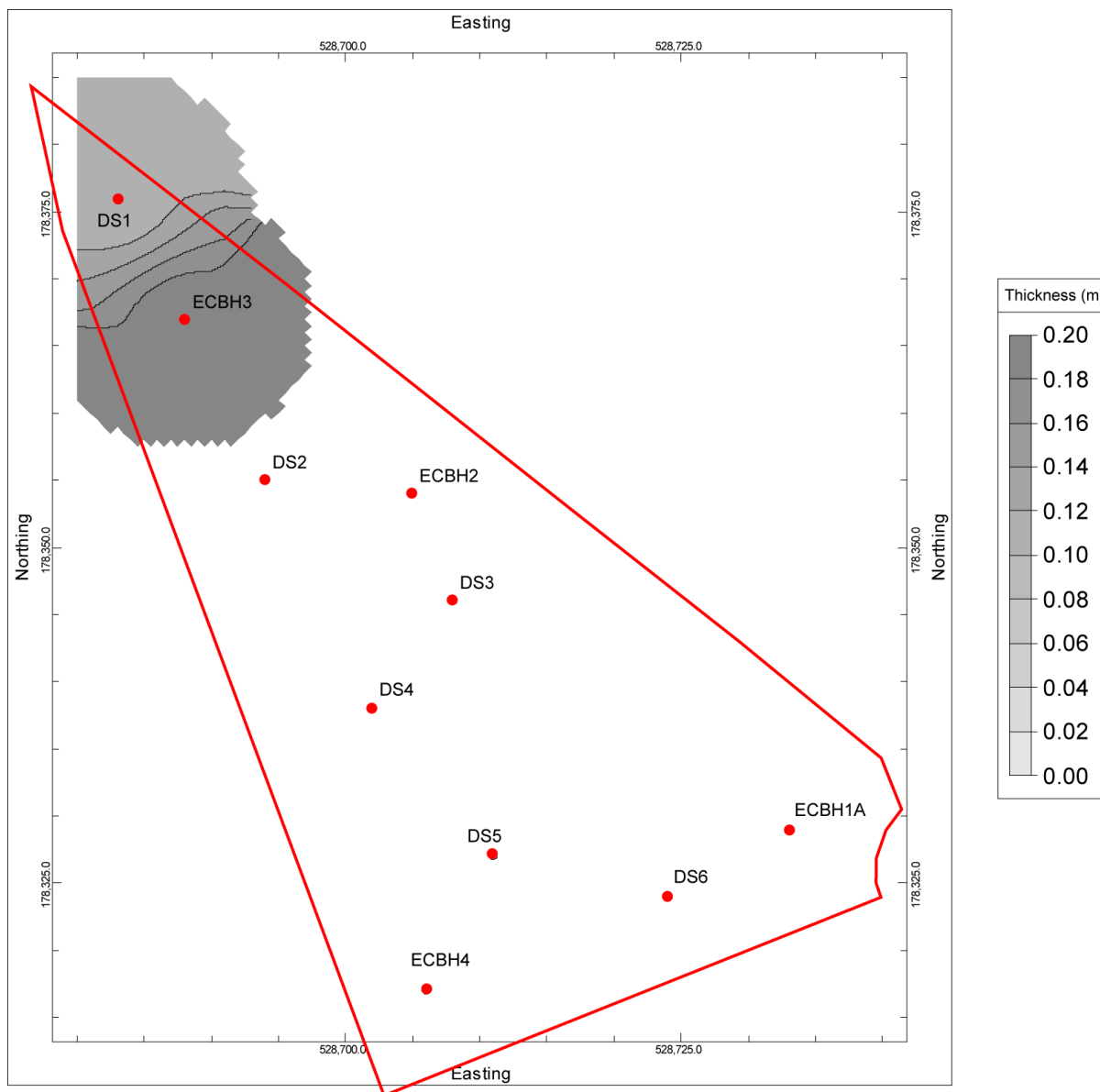
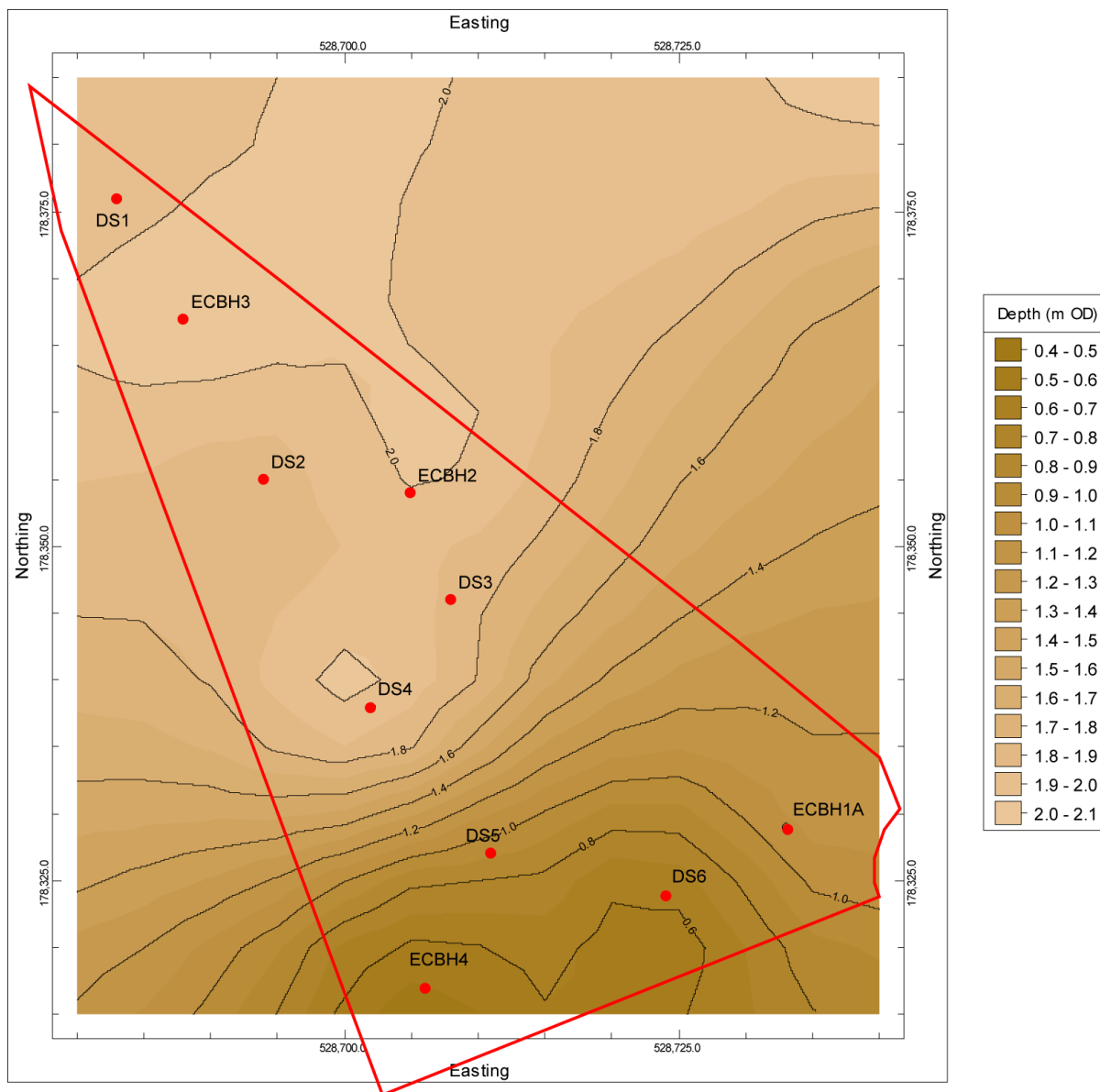
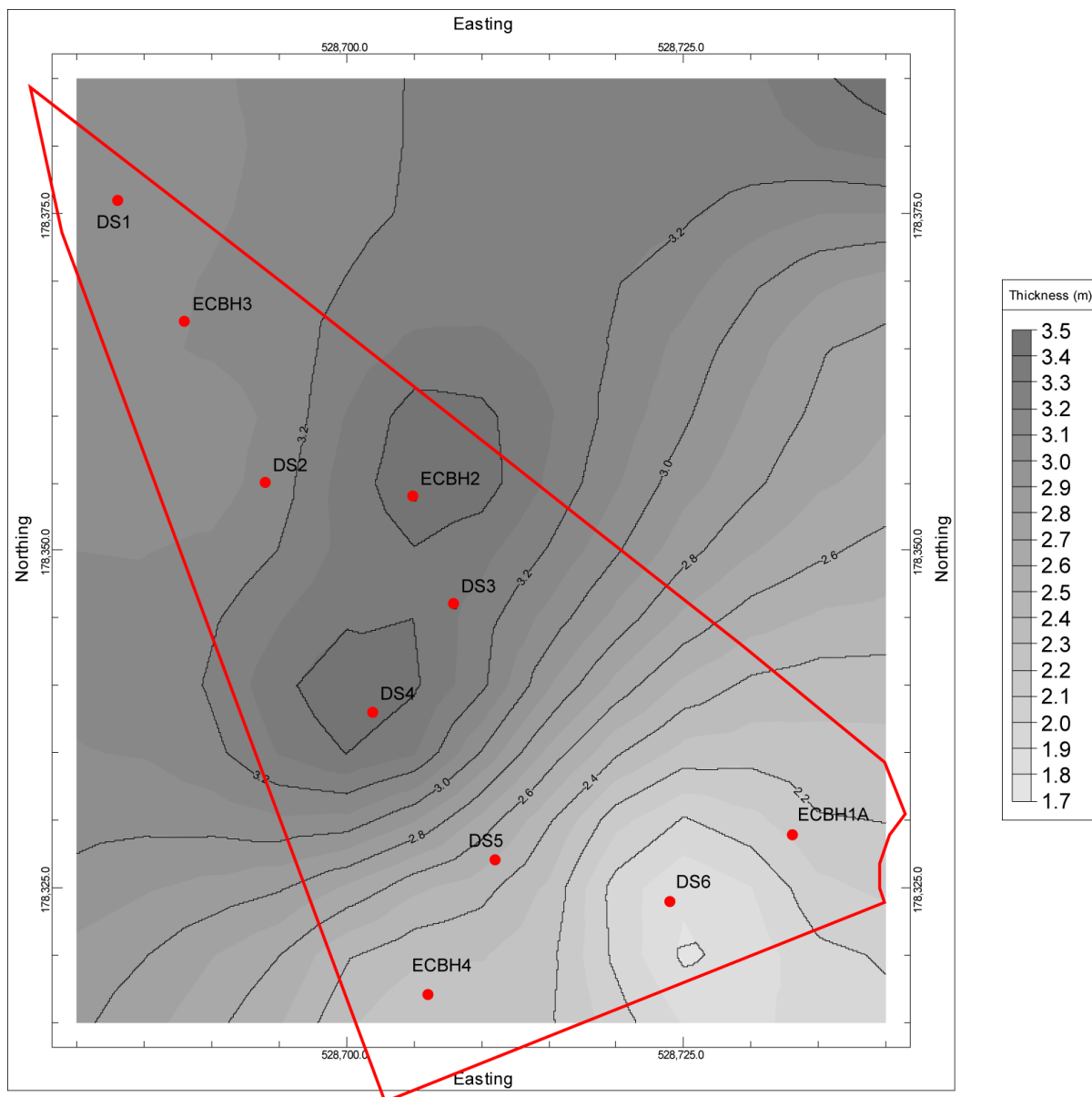


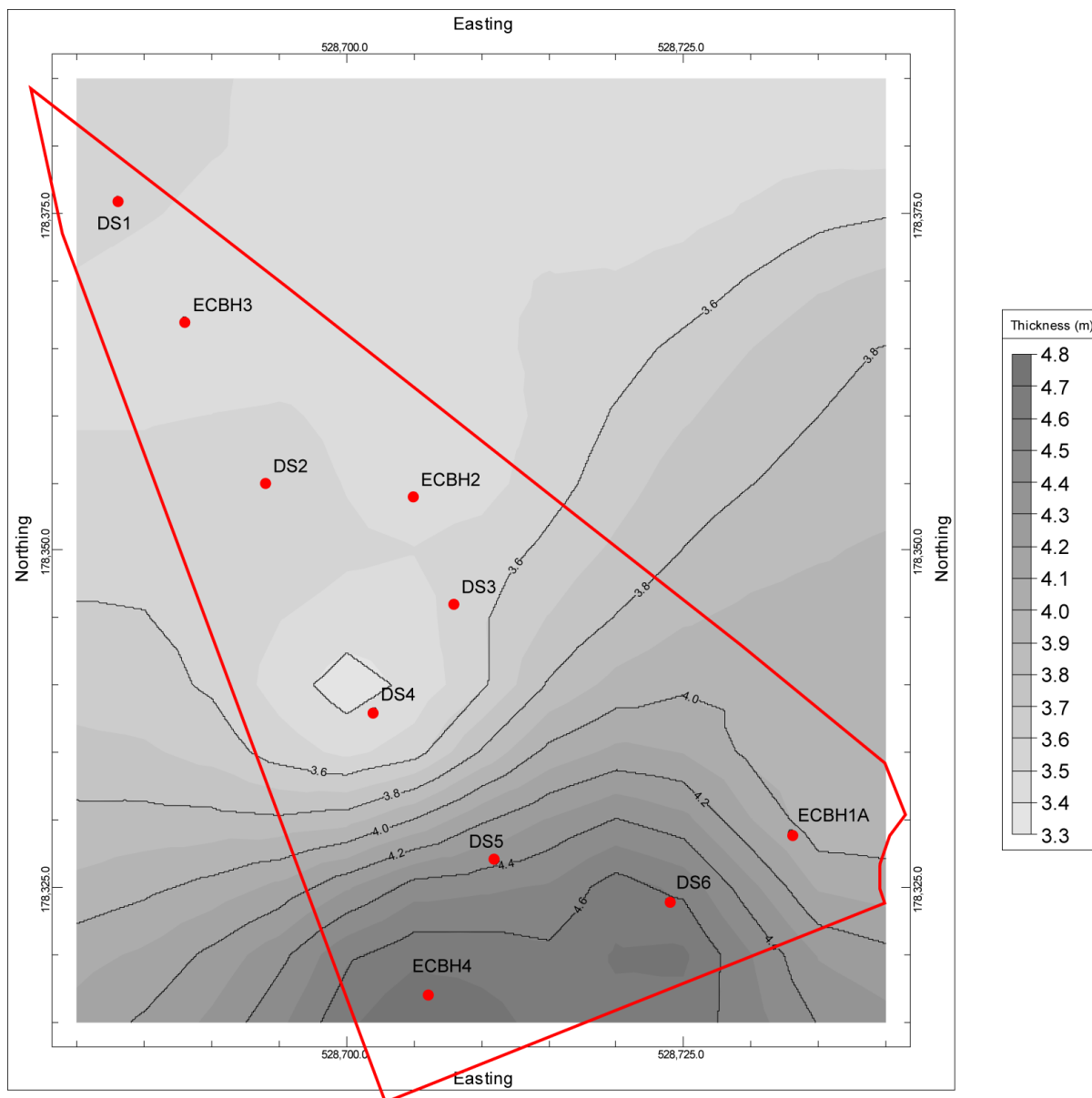
Figure 4: Thickness of the Peat (m). For deposit modelling purposes the cable percussion boreholes are given the prefix 'EC'.



**Figure 5: Top of the Alluvium / Base of the Made Ground (m OD). For deposit modelling purposes the cable percussion boreholes are given the prefix 'EC'.**



**Figure 6: Thickness of the Alluvium (m). For deposit modelling purposes the cable percussion boreholes are given the prefix 'EC'.**



**Figure 7: Thickness of the Made Ground (m). For deposit modelling purposes the cable percussion boreholes are given the prefix 'EC'.**

## **DISCUSSION AND CONCLUSIONS**

The aim of the geoarchaeological investigations at the Ebury Centre site was to (1) clarify the nature of the sub-surface stratigraphy, in particular the presence and thickness of Alluvium and Peat across the site, and (2) to evaluate the potential of the sedimentary sequences for reconstructing the environmental history of the site and its environs. In order to achieve this aim, a programme of deposit modelling of the surface elevation and thickness of the major stratigraphic units at the site was carried out, incorporating geotechnical borehole descriptions and records from those boreholes monitored in the field.

The results of the deposit modelling have demonstrated a sequence of Late Devensian (ca. 15,000-11,500 cal BP) Shepperton Gravel, overlain by Holocene Alluvium, in places containing Peat (the Staines Alluvial Deposits), and Made Ground. The Gravel surface in the area of the site lies at between -1.0 and -1.8m OD, recorded at its lowest in the central and south-western areas of the site. The deposit model gives the impression of a linear depression, aligned approximately north-south, which may be related to a former channel in this area. However, the model for the Gravel surface is based on only four records and any interpretation of this feature should be treated with caution. At the 135 Grosvenor Road (Green & Young, 2012) and Lupus Street sites (Green, 2008), ca. 500m to the southeast and lying on the higher Kempton Park Gravel 'island' recorded here, the Gravel surface was recorded at 0.85 to 1.45m OD and 1.16 to 2.59m OD respectively.

At the Ebury Centre site the Gravel was overlain by variable thicknesses of sandy Lower Alluvium in the majority of boreholes, to a level of between -0.8 and 0.5m OD; this was in turn overlain by the generally clay-rich Upper Alluvium, to a level of between 1.7 and 2.5m OD in the central and northern areas of the site and between 0.2 and 0.85m OD in the southern area of the site. Peat was recorded within the Upper Alluvium in two boreholes towards the north of the site, at elevations between 0.7 and 0.9m OD (BH3) and 0.6 and 0.7m OD (DS1). Significantly, the Peat is indicative of a transition to semi-terrestrial conditions supporting the growth of wetland vegetation. However, the Peat is confined to the northern area of the site, suggesting that it formed only in localised floodplain hollows, or has subsequently been eroded elsewhere by fluvial activity.

The lower surface of the Alluvium in the southern area of the site is the result of truncation by the overlying Made Ground, which is present in greater thicknesses in this area of the site. In places the contact between the Alluvium and Made Ground lies as low as 0.2m OD, below the level of the Peat recorded in the northern area of the site and indicating that any Peat

that may have been present in this area has subsequently been removed. The natural surface of the Alluvium has been recorded previously in the area immediately to the east of the Pimlico gravel 'island' at between 1.09m and 1.75m OD (BGS boreholes TQ27NE725, 726 and 727) and the upper surface of the natural Alluvium further north in Westminster is recorded by Sidell *et al.* (2000) at levels generally below 1.50m OD.

## **RECOMMENDATIONS**

In the absence of widespread Peat horizons at the site and the relatively thin (<0.2m) nature of the Peat that is recorded, no further geoarchaeological or environmental archaeological investigations are recommended.

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