RIVERSIDE STUDIOS AND QUEENS WHARF, HAMMERSMITH, LONDON BOROUGH OF HAMMERSMITH AND FULHAM: (NGR: TQ 2312 7811): A REPORT ON THE GEOARCHAEOLOGICAL FIELDWORK AND DEPOSIT MODELLING

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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 Riverside Studios and Queens Wharf, Hammersmith, London Borough of Hammersmith and Fulham (National Grid Reference: *centred on* TQ 2312 7811; Figure 1). Quaternary Scientific were commissioned by CgMs Consulting to undertake the geoarchaeological investigations. The site lies on the north side of the River Thames, where the river forms a large northward meander loop. The site is near the apex of the loop, where the river has cut into the Kempton Park Terrace (Gibbard, 1994). There is no alluvial floodplain on the north side of the river at this point and the ground surface is at about 5.5m to 5.9m OD, representing approximately the surface of the terrace. The site is underlain by the Kempton Park Gravel (BGS 1:50,000 Sheet 270 North London 1998) of Middle to Late Devensian (30 to 80ka BP) age. The gravel rests directly on bedrock comprising the London Clay Formation of Lower Tertiary, Eocene age. In a few places upstream from the Hammersmith site, organic sediments have been recorded within the Kempton Park Gravel, e.g. at Kempton Park itself (Gibbard *et al.*, 1982) and at Isleworth (Coope & Angus, 1975), but no such deposits have been recognised downstream from Isleworth.

The site is bounded to the northeast by Crisp St, (formerly Queen St); to the northwest by Queen Caroline St (formerly Queen St); to the southwest by the Thames waterfront; and to the southeast by neighbouring commercial premises. Barton (1992) shows Parr's Ditch immediately to the southeast of the site, which he considers to have been most probably an artificial cut dug to mark the boundary between the parishes of Fulham and Hammersmith. There is no sign of this cut on any of the late 18th and 19th century maps and plans of the site. Early maps indicate that there was a substantial building within the site from at least the mid 18th century (John Rocque's map 1745). A.J. Roberts's map of 1853 indicates a building near the centre of the site, which appears to be residential in character and is named *The Chancellors*. Between 1830 (John Salter's map) and 1853 (A.J. Robert's map), a small dock

(named Queen Street Dock on the latter map) was created immediately to the west of the site (in effect the riverward end of Queen Street). By 1867 (OS 6 inch map), *The Chancellors* had disappeared and the site was largely occupied by terraced housing and wharfs. Some of the terraced housing survived until at least 1958, but more recently the site has been almost entirely occupied by commercial and industrial premises.

Geotechnical boreholes put down at the site in 2009 (ST Consult, 2009) show that between 1.0 and 3.0m of made ground overlies sand or sandy gravel, most likely representing the truncated surface of the Kempton Park Gravel. The aim of the geoarchaeological investigations at the site was (1) to clarify the nature of the sub-surface stratigraphy, (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, selected geotechnical boreholes across the site were monitored by Quaternary Scientific, and a programme of deposit modelling of the surface elevation and thickness of the major stratigraphic units at the site was carried out.

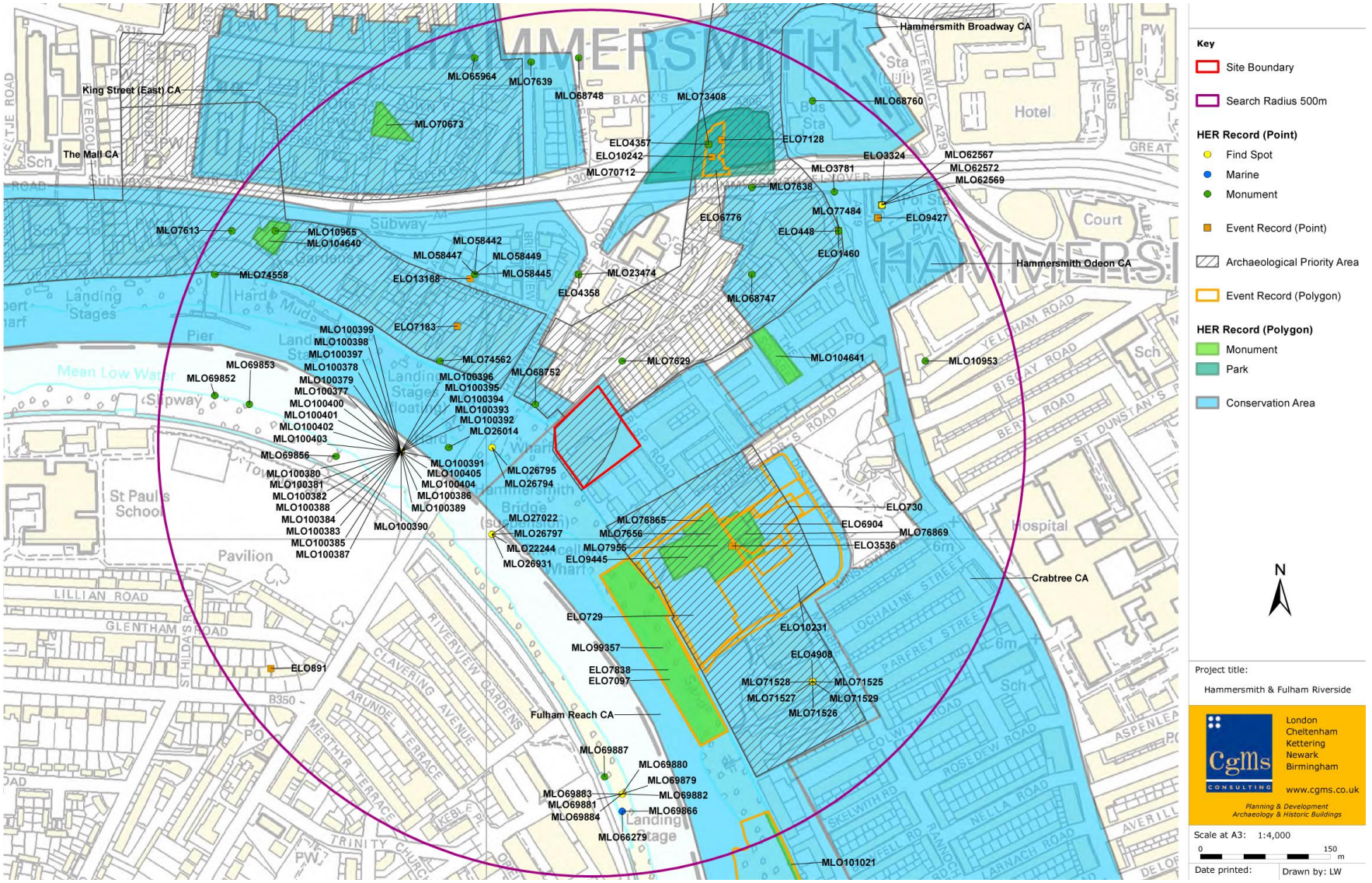

Figure 1: Location of Riverside Studios and Queens Wharf, Hammersmith, London Borough of Hammersmith and Fulham with associated HER data (figure provided by CgMs Consulting).

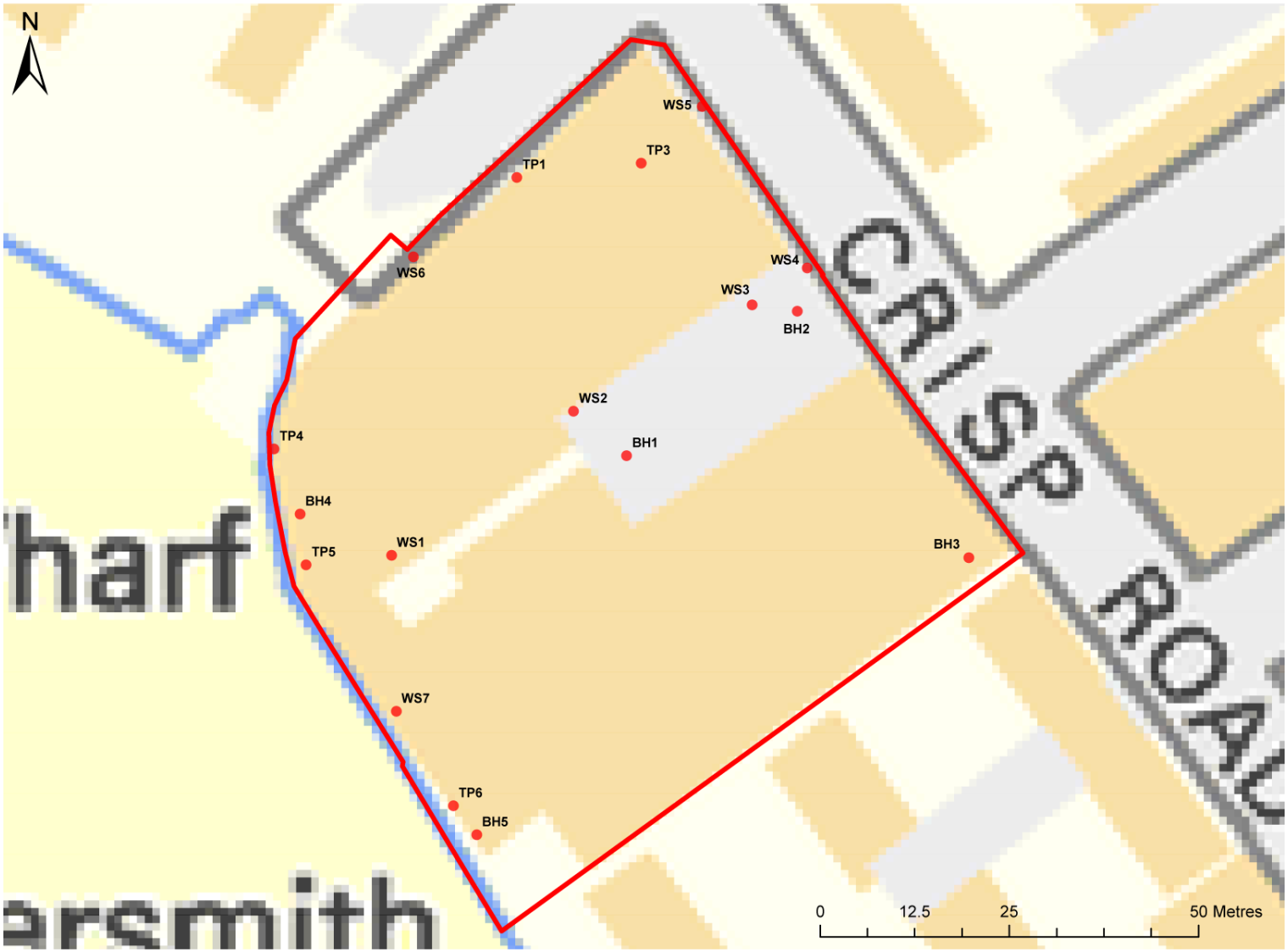

Figure 2: Location of the new geotechnical records at Riverside Studios and Queens Wharf, Hammersmith, London Borough of Hammersmith and Fulham. ***Contains Ordnance Survey data © Crown copyright and database right [2012]***

METHODS

Field investigations

A total of five cable percussion boreholes (BH1 to BH5), seven window sample boreholes (WS1 to WS7) and five geotechnical test pits (TP1 and TP3 to TP6) were put down at the site (Figure 2; Table 1). Of these, four cable percussion boreholes were monitored by Quaternary Scientific. These boreholes provided a good spatial distribution of sequences across the site, and represented the most reliable records for geoarchaeological description. 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, including colour; (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 and geotechnical descriptions of the cable percussion boreholes are displayed in Tables 2 to 6. The spatial attributes of the new geotechnical records are displayed in Table 1 and in Figure 2.

Table 1: Spatial attributes for the new records, including cable percussion boreholes (BH), test pits (TP) and window samples (WS) at Riverside Studios and Queens Wharf, Hammersmith, London Borough of Hammersmith and Fulham. Of these, selected sequences were used in the deposit model (see below).

Borehole	Easting	Northing	Elevation (m OD)
BH1	523124.70	178118.65	5.68
BH2	523147.26	178137.74	5.85
BH3	523169.93	178105.22	5.49
BH4	523081.53	178110.95	4.70
BH5	523104.89	178068.65	5.72
TP1	523110.20	178155.39	3.08
TP3	523126.62	178157.25	3.09
TP4	523078.10	178119.57	4.60
TP5	523082.34	178104.25	4.70
TP6	523101.81	178072.51	5.70
WS1	523093.63	178105.53	4.70
WS2	523117.70	178124.52	5.24
WS3	523141.28	178138.58	3.10
WS4	523148.57	178143.46	3.07
WS5	523134.70	178164.77	3.10
WS6	523096.53	178144.89	4.95
WS7	523094.26	178084.94	5.72

Deposit modelling

The deposit model was based on a review of the 17 records listed above. No British Geological Survey (BGS) borehole records with sufficient data for inclusion in the deposit model were located nearby to the site. In addition, geotechnical boreholes put down at the site in 2009 (ST Consult, 2009) do not include sufficient spatial data for inclusion in the model; the deposit model was thus based on the records from cable percussion boreholes BH1 to BH5, window samples WS1, WS3, WS4, WS6 and WS7, and test pit TP3. The remaining window sample and test pit records were not included in the deposit model since they did not penetrate beyond the Made Ground.

Sedimentary units from the records were classified into three groupings: (1) London Clay; (2) Kempton Park Gravel and (3) Made Groun. The classified data for groups 1-3 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 the London Clay and Kempton Park Gravel stratigraphic groups (Figures 3 and 4). Thickness of the Kempton Park Gravel (Figure 5) and Made Ground (Figure 6) were also modelled (also using a nearest neighbour routine). Because the records 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 interventions. Because of the 'smoothing' effect of the modelling procedure, the modelled levels of stratigraphic contacts may differ slightly from the levels recorded in the stratigraphic logs and section drawings. 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, INTERPRETATION AND DISCUSSION OF THE LITHOSTRATIGRAPHIC DESCRIPTIONS AND DEPOSIT MODELLING

The combined results of the geoarchaeological investigations (Tables 2 to 6) have enhanced the previous geotechnical investigations, and permitted a programme of deposit modelling of the surface elevation and thickness of each major stratigraphic unit (Figures 3 to 6).

The basal unit at the site is the London Clay bedrock. The surface of this unit appears to fall eastwards (Figure 3), lying at between -0.45 and -0.41m OD in boreholes BH2 and BH3 towards the eastern margin of the site; in boreholes BH4 and BH5, on the western margin of the site, it is recorded at 0.10 and 0.42m OD respectively. Towards the centre of the site in borehole BH1 it is recorded at -0.22m OD.

The London Clay is overlain across the site by a horizon of sand and gravel (Figure 4), considered to represent the Kempton Park Gravel (Gibbard, 1985). These sediments were deposited during the Middle to Late Devensian (30 to 80ka BP) within a high energy braided river system. No organic sediments were recorded within the Gravel; however, the upper part of this unit is generally silty and clayey, and most likely represents either the upper, reworked surface of the Kempton Park Gravel, or disturbance by the overlying Made Ground. The surface of the Gravel generally rises eastwards (Figure 4), recorded at 0.50 and 1.32m OD in boreholes BH4 and BH5 in the eastern part of the site, and at 3.95 and 3.89m OD in boreholes BH2 and BH3. In the central part of the site the surface of the Gravel is recorded at 3.78m OD in borehole BH1. The lower surface of the London Clay and higher surface of the Gravel in the eastern part of the site are reflected in both the thickness model for the Gravel (Figure 5) and for the overlying Made Ground (Figure 6). In the eastern part of the site the Gravel is between 4.3 (BH3) and 4.4m thick (BH2), whilst in the western part of the site the Gravel is recorded at between 0.4 (BH4) and 0.9m thick (BH5). Towards the centre of the site in borehole BH1, the Gravel is 4.0m thick.

The thickness of the Made Ground across the site (Figure 6) is recorded at between 2.6 and 4.4m in boreholes BH4 and BH5 respectively. Elsewhere the Made Ground is generally between 1.6 and 1.9m thick (boreholes BH1 to BH3). It is unclear whether the thicker Made Ground in the western part of the site reflects a greater extent of ground raising in this area, or deeper truncation of the Gravel in this part of the site; the presence of the silty and clayey upper unit within the Gravel in these boreholes suggests that the former is perhaps more likely. The modern surface of the site is recorded at between approximately 4.7 and 5.7m OD, again reflecting the variable extent of ground raising across the site.

Table 2: Geotechnical and geoarchaeological description of Borehole BH1, Riverside Studios and Queens Wharf, Hammersmith, London Borough of Hammersmith and Fulham

Depth (m bgs)		Depth (m OD)		Geotechnical description	Additional Geoarchaeological description (m bgs)	Stratigraphic interpretation
Top	Base	Top	Base			
0.00	1.90	5.68	3.78	Made Ground	*Not monitored*	MADE GROUND
1.90	2.60	3.78	3.08	Slightly sandy very gravelly clay		KEMPTON PARK GRAVEL
2.60	5.90	3.08	-0.22	Sand and gravel		
5.90	+	-0.22	?	Silty clay		LONDON CLAY

Table 3: Geotechnical and geoarchaeological description of Borehole BH2, Riverside Studios and Queens Wharf, Hammersmith, London Borough of Hammersmith and Fulham

Depth (m bgs)		Depth (m OD)		Geotechnical description	Additional Geoarchaeological description (m bgs)	Stratigraphic interpretation
Top	Base	Top	Base			
0.00	1.90	5.85	3.95	Made Ground	*Made Ground*	MADE GROUND
1.90	2.50	3.95	3.35	Sandy very gravelly clay	*Gg2 As1 Ag1; orangey brown silty, clayey gravel. Gravel clasts are flint, sub-angular to sub-rounded, 5-50mm in diameter.*	KEMPTON PARK GRAVEL
2.50	5.20	3.35	0.65	Sand and gravel	*Gg3 Ga1; sandy gravel. Flint clasts 15-40mm diameter; sub-rounded to sub-angular. Gravel clasts becoming larger with depth (60mm at 3.2-3.6m bgs).*	
5.20	6.20	0.65	-0.35		*Ga3 Gg1; gravelly sand with lenses of Ga2 As1 Gg1; gravelly clayey sand.*	
6.20	6.30	-0.35	-0.45		*Gg3 Ga1; sandy gravel. Flint clasts 15-40mm diameter; sub-rounded to sub-angular.*	
6.30	+	-0.45	?	Silty clay	*As4 Ag+; stiff grey clay with a trace of silt.*	LONDON CLAY

Table 4: Geotechnical and geoarchaeological description of Borehole BH3, Riverside Studios and Queens Wharf, Hammersmith, London Borough of Hammersmith and Fulham

Depth (m bgs)	Depth (m OD)	Geotechnical description	Additional Geoarchaeological description (m bgs)	Stratigraphic interpretation

Top	Base	Top	Base			
0.00	1.60	5.49	3.89	Made Ground	*Made ground*	MADE GROUND
1.60	1.90	3.89	3.59	Very sandy slightly gravelly clay	*Ag1 As1 Ga1 Gg1; orangey brown silt, clay, sand and gravel*	KEMPTON PARK GRAVEL
1.90	5.90	3.59	-0.41	Sand and gravel	*Gg2 Ga2; sand and gravel. Flint clasts 20-60mm in diameter, sub-angular to rounded.*	
5.90	+	-0.41	?	Silty clay	*As4 Ag+; stiff grey clay with a trace of silt.*	LONDON CLAY

Table 5: Geotechnical and geoarchaeological description of Borehole BH4, Riverside Studios and Queens Wharf, Hammersmith, London Borough of Hammersmith and Fulham

Depth (m bgs)		Depth (m OD)		Geotechnical description	Additional Geoarchaeological description (m bgs)	Stratigraphic interpretation
Top	Base	Top	Base			
0.00	2.60	4.70	2.10	Made Ground	*Made ground*	MADE GROUND
2.60	3.20	2.10	1.50	Slightly silty sandy clay with occasional fine gravels	*Ag1 As1 Ga1 Gg1; orangey brown silt, clay, sand and gravel with brick and ash inclusions*	
3.20	4.20	1.50	0.50	Slightly clayey slightly silty slightly gravelly sand		
4.20	4.60	0.50	0.10	Slightly silty clay with occasional gravels	*Gg2 Ga1 As1; grey brown clayey sandy gravel. Flint clasts 10-40mm in diameter, sub-angular to sub-rounded.*	KEMPTON PARK GRAVEL
4.60	+	0.10	?	Clay		LONDON CLAY

Table 6: Geotechnical and geoarchaeological description of Borehole BH5, Riverside Studios and Queens Wharf, Hammersmith, London Borough of Hammersmith and Fulham

Depth (m bgs)		Depth (m OD)		Geotechnical description	Additional Geoarchaeological description (m bgs)	Stratigraphic interpretation
Top	Base	Top	Base			
0.00	4.40	5.72	1.32	Made Ground	*Not monitored*	MADE GROUND
4.40	5.10	1.32	0.62	Clayey sandy gravel		KEMPTON PARK GRAVEL
5.10	5.30	0.62	0.42	Slightly sandy clay, occasional gravels		
5.30	+	0.42	?	Clay		LONDON CLAY

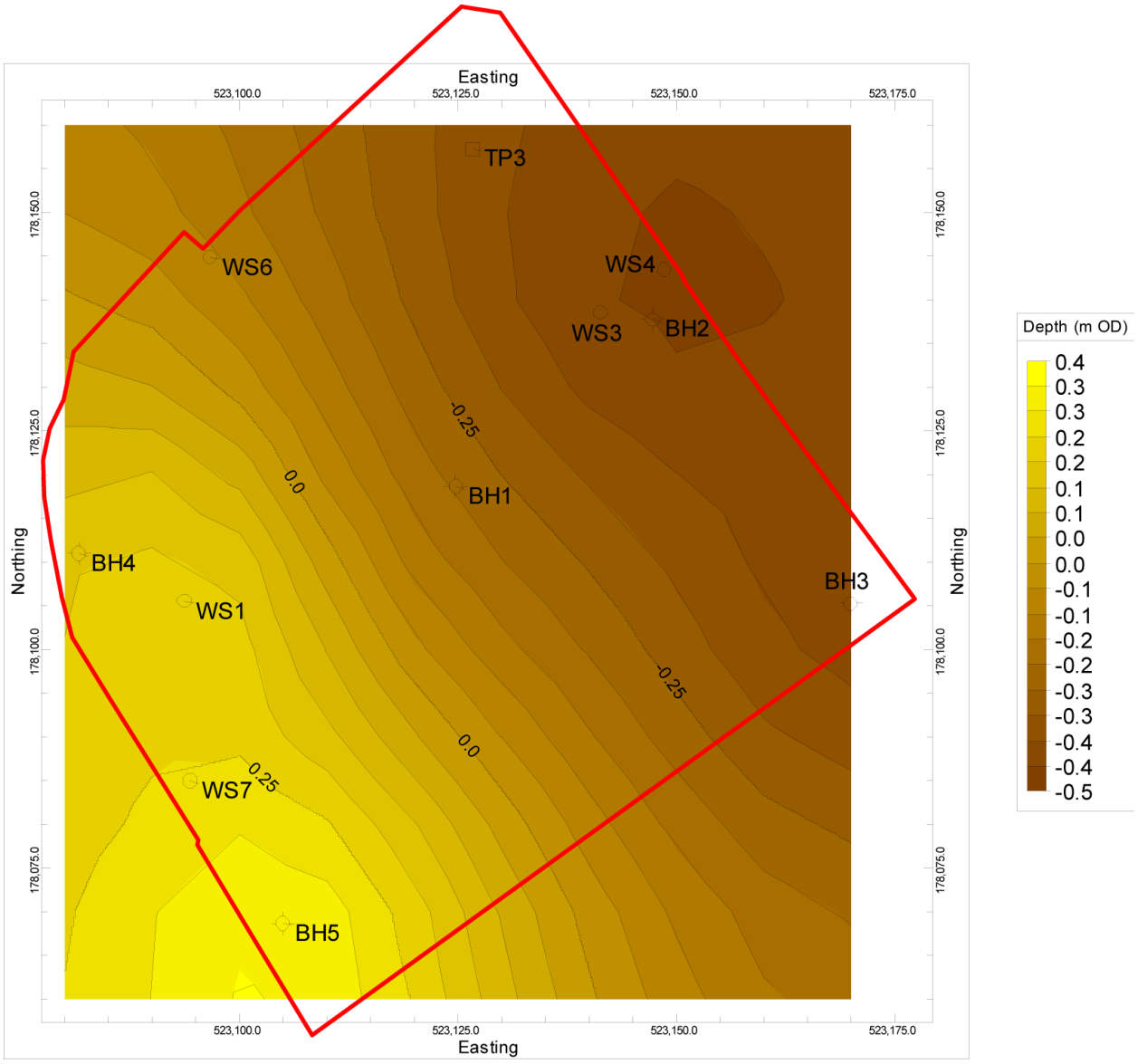

Figure 3: Top of the London Clay / Base of the Kempton Park Gravel (m OD)

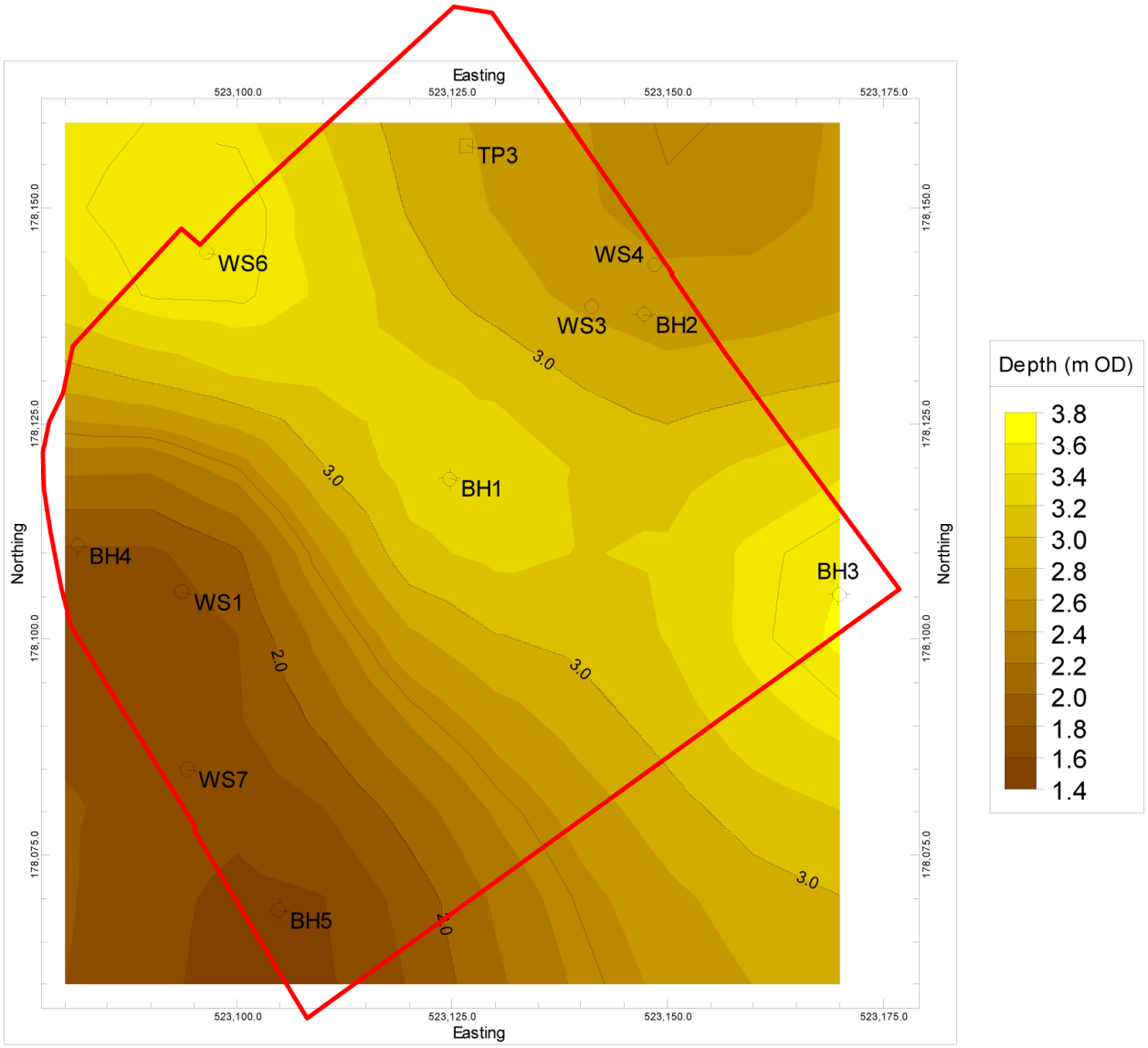

Figure 4: Top of Kempton Park Gravel / Base of the Made Ground (m OD)

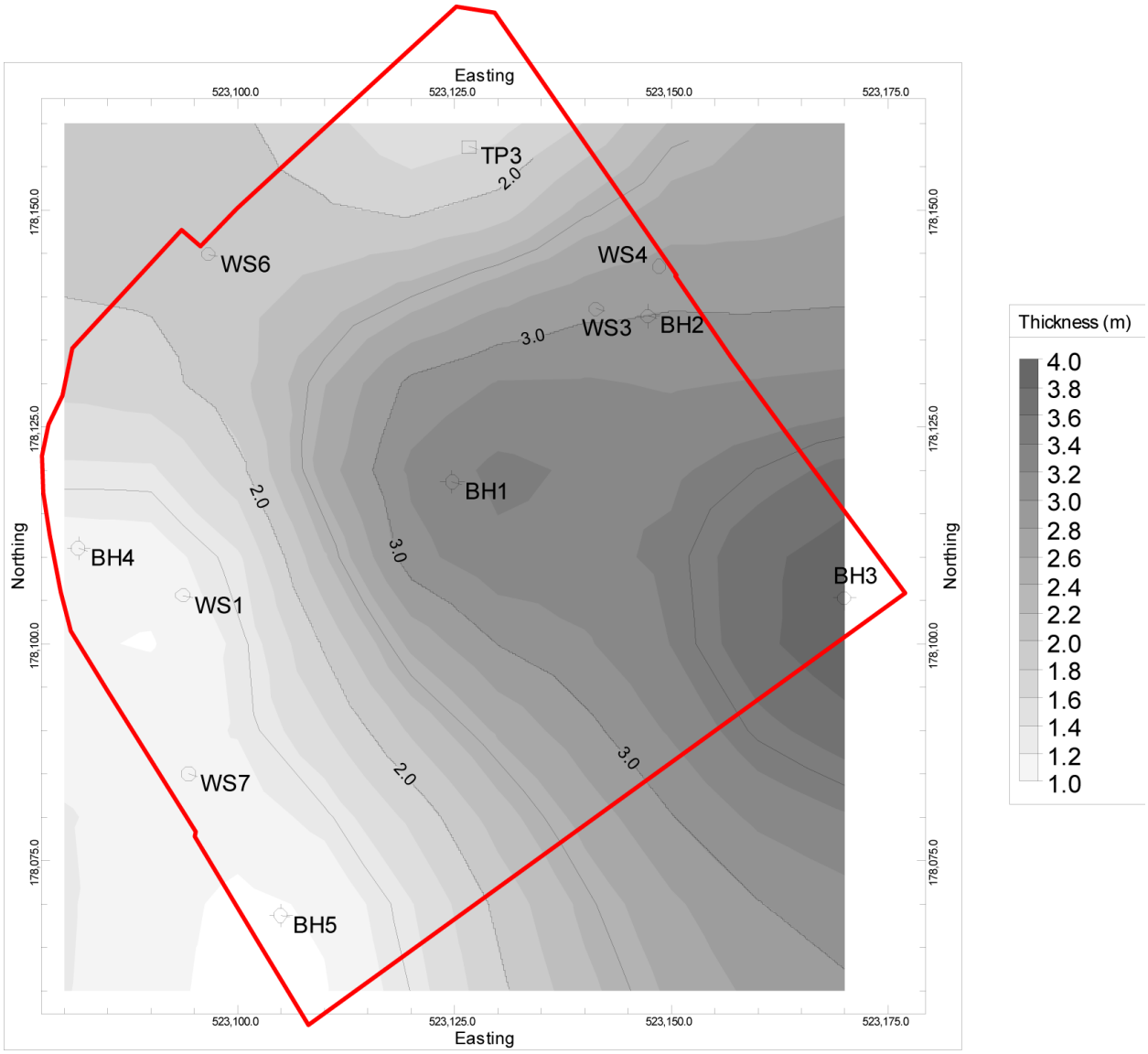

Figure 5: Thickness of the Kempton Park Gravel (m)

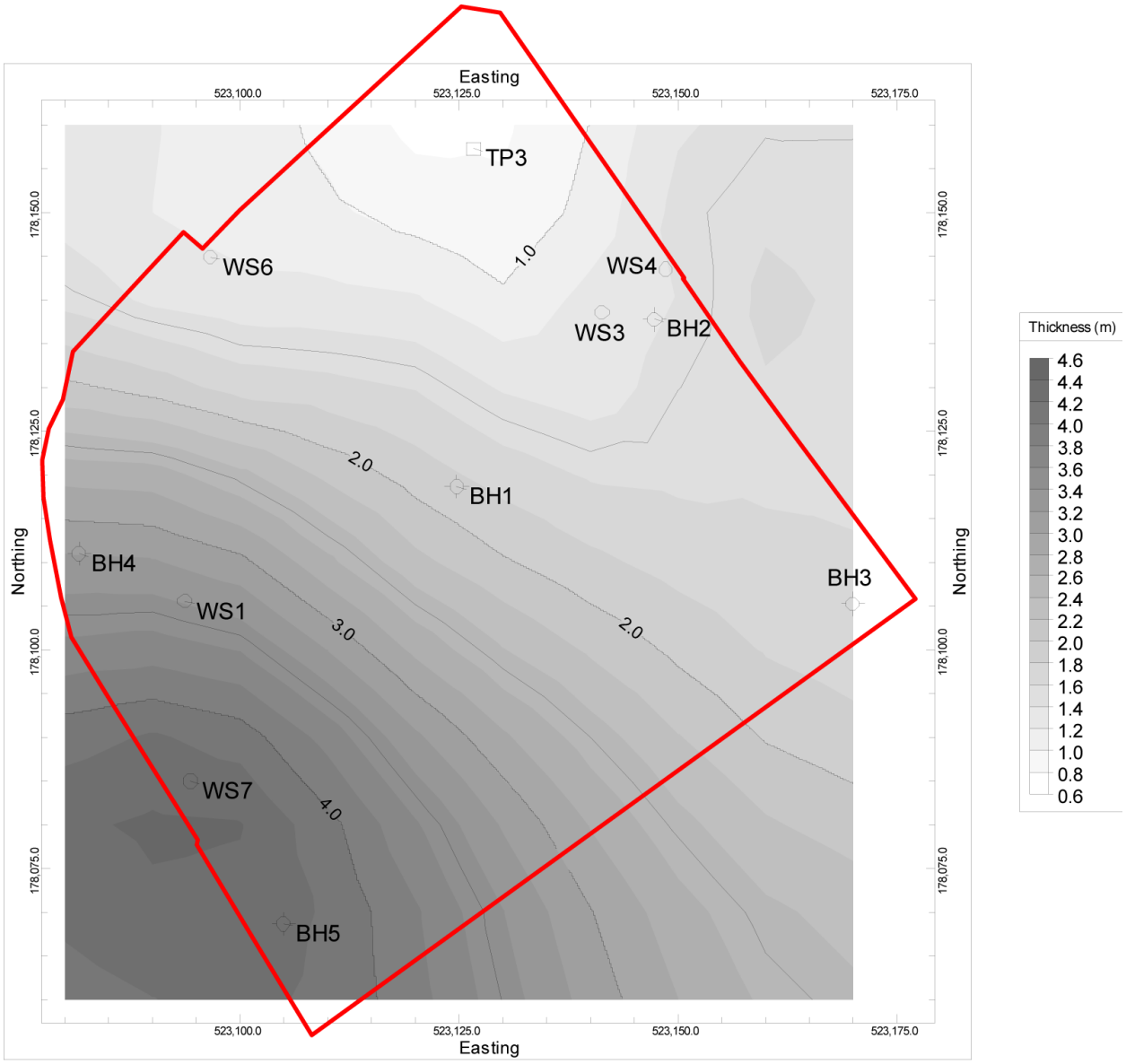

Figure 6: Thickness of the Made Ground (m)

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

The aim of the geoarchaeological investigations at the site was (1) to clarify the nature of the sub-surface stratigraphy, (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, selected geotechnical boreholes across the site were monitored by Quaternary Scientific, and 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 site lies on the Kempton Park Terrace (Gibbard, 1994), where no alluvial floodplain is recorded. The results of the geoarchaeological deposit modelling are consistent with the existing BGS mapping, and confirm that the site is underlain by London Clay, the surface of which appears to fall eastwards and lies at between -0.45 and -0.41m OD, in turn overlain by the Kempton Park Gravel, deposit during the Middle to Late Devensian (30 to 80ka BP). The surface of this unit rises eastwards, recorded at between 0.50 and 3.95m OD, so that the gravel is thickest in the eastern part of the site (between 4.3 and 4.4m). The Gravel is notably thinner in the eastern part of the site, recorded at between 0.4 and 0.9m thick. No evidence was found for a unit of Langley Silt at the site (mapped elsewhere overlying the Kempton Park Gravel). Variable thicknesses of Made Ground cap the sequence, so that the modern surface of the site lies at between *ca*. 4.7 and 5.7m OD.

As noted above, in a few places upstream from the site organic sediments have been recorded within the Kempton Park Gravel, e.g. at Kempton Park itself (Gibbard *et al.*, 1982) and at Isleworth (Coope & Angus, 1975); however, no organic horizons were recorded at the present site. With the results of this investigation in mind, no further geoarchaeological investigation of the site is recommended.

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