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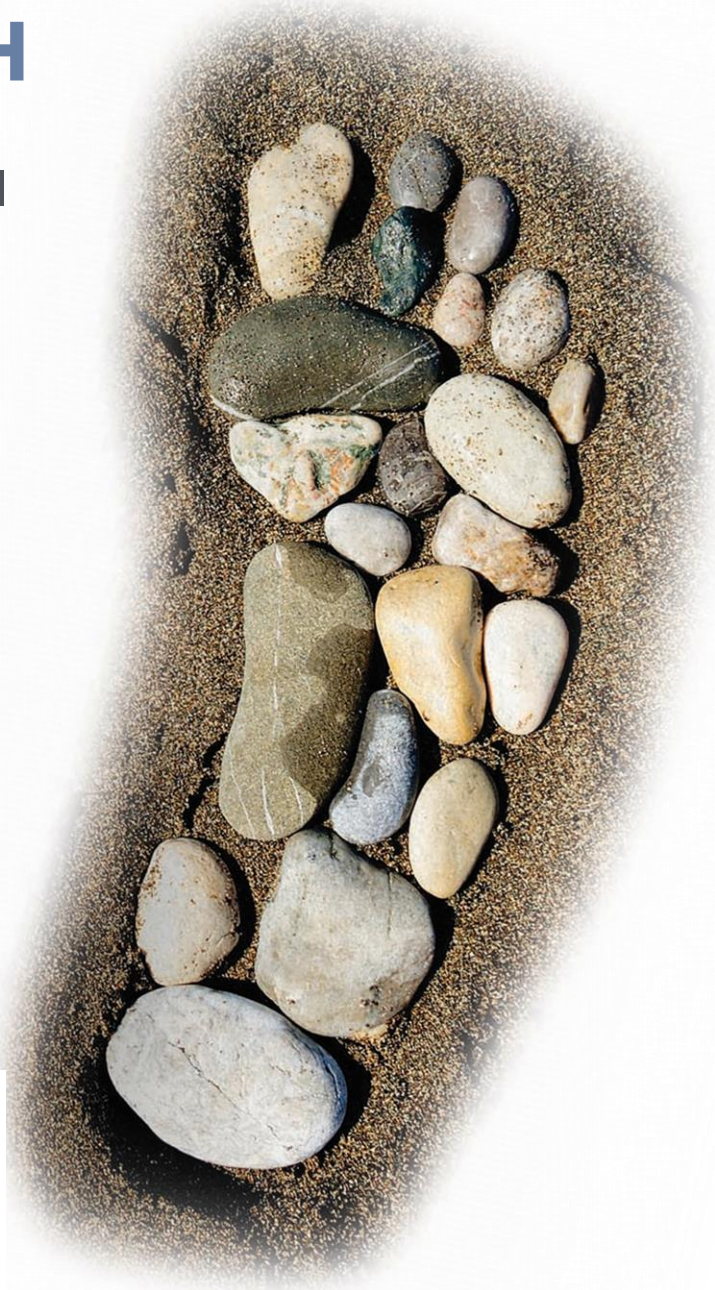
LAND AT LINTON FUELS, OSIERS ROAD, LONDON BOROUGH OF WANDSWORTH

Geoarchaeological And Palaeoenvironmental Assessment Report



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Site code: OSI17

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Written by: Dr C.R. Batchelor

QUEST, School of Archaeology, Geography and Environmental Science, Whiteknights, University of Reading, RG6 6AB

Tel: 0118 378 8941 / 7978
Email: c.r.batchelor@reading.ac.uk
http://www.reading.ac.uk/quest

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1. NON-TECHNICAL SUMMARY

A geoarchaeological and palaeoenvironmental assessment of one sequence was carried out at the Linton Fuels site in order (1) to establish the age of the organic-rich alluvium recorded at the site; (2) to assess the palaeoenvironmental potential of the sequence; (3) to highlight any indications of nearby human activity, and (4) to provide recommendations for further analysis.

The new record from Linton Fuels is of interest because unlike other sequences from the River Wandle, it is the only one that dates to the medieval and post-medieval period and thus can provide a fairly unique record of environmental change during this period, potentially picking up evidence of the Medieval Warm Period (ca. 950-1050 cal AD) and Little Ice Age (1300-1850 cal AD).

The results of the assessment have also indicated that the concentration and preservation of pollen, waterlogged wood and insects is sufficiently high for further analysis, and contains definitive evidence of historic human activity. Analysis of these remains and an additional radiocarbon date is therefore recommended to fulfil the aims set out in the original geoarchaeological and palaeoenvironmental aims of the project.

2. INTRODUCTION

2.1 Site context

This report summarises the findings arising out of the geoarchaeological and palaeoenvironmental assessment undertaken by Quaternary Scientific (University of Reading) in connection with the proposed development of land at Linton Fuels, Osiers Road, London Borough of Wandsworth (NGR centred on: TQ 25441 75088; site code: OSI17; Figures 1 & 2). Quaternary Scientific were commissioned by CgMs Heritage (part of RPS) to undertake the geoarchaeological investigations. The area of investigation is in the valley of the River Wandle, a right bank tributary of the tidal Thames. It is about 250m upstream from the confluence with the Thames and immediately adjacent to the most westerly surviving distributary of the lower Wandle, sometimes called Bell Lane Creek. Historically the ground formed the SE corner of Wandsworth Island and it appears to have remained in agricultural use until the end of the 19th century. Early maps (e.g. OS 1868) show tidal creeks extending westwards into the area from Bell Lane Creek. Throughout the 20th century the site, and the whole of the former Wandsworth Island, was occupied by industrial premises.

The results of a recent geoarchaeological fieldwork and deposit modelling exercise (Batchelor, 2017a) recorded the surface of the Wandle / Shepperton Gravel (deposited during the Late Devensian, 10-15,000 years before present) between -0.8 and -0.12m OD across the Linton Fuels and neighbouring Osiers Road sites (Green & Young, 2010), and nearby Morganite site (Branch et al., 2007). Elsewhere, the same surface is higher at sites such as Ram Brewery (0.5 to 3.0m OD; Young & Batchelor, 2015) and Garratt Lane (3.6m OD; Howe et al., 2002) consistent with their location higher up the Wandle Valley and/or beyond the margins of the floodplain.

The Wandle / Shepperton Gravel at Linton Fuels and Osiers Road is overlain by Alluvium. Initially organic-rich alluvium / peaty clay was deposited. Across the Linton Fuels site this measured between 1 and 3.5m in thickness; across the Osiers Road site, up to 5m of organic-rich deposits were recorded. This was capped on both sites by inorganic alluvium with occasional gravels. The alluvial sequence at the Morganite site consisted of a sequence of silty sands overlying an upper Peat and slightly gravelly organic silts, which passed down into calcareous sands including remains of molluscs and ostracods, with a second, lower Peat horizon at the base of the sequence resting directly on the underlying Gravel. This sequence was dated from at least 4780-4420 to 1570-1410 cal BP, with age-depth modelling of the sequence suggesting that the Peat overlying the Gravel may be of Mesolithic date, whilst the upper Peat accumulated during the Bronze Age (Branch *et al.* 2007; Jarrett *et al.*, 2010). On the basis of elevation, it is possible that accumulation of the organic alluvium at Linton Fuels commenced around the same time as on the Morganite site. However, since no calcareous sand/tufa deposits on the Linton Fuels site were recorded, a later date might be anticipated. On the nearby Ram Brewery site, the Gravels were overlain by more definitive peat units that might have included soil horizons. These deposits were recorded at a higher elevation than the organic-rich sediments at Linton Fuels, and radiocarbon dating of the base of the Peat in one of the boreholes indicated accumulation began during the Roman period (1860 to 1700 cal BP),

Other investigations nearby confirm the presence of organic sediments associated with the prehistoric River Wandle close to its confluence with the Thames. At the Former Shell Oil Terminal, Point Pleasant (Perry & Skelton, 1995a), these have been radiocarbon dated to between 3640-3380 and 2920-2500 cal BP (Bronze Age; -1.2 to -0.7m OD). At the Prospect Reach Foreshore site, Point Pleasant (Perry & Skelton, 1995b), a radiocarbon-dated Peat and alluvial sequence is of Roman and post-Roman age. To the south of the Morganite site at the Frogmore Depot, Dormay Street site, an alluvial sequence including organic-rich sediments and Peat dated from at least 2460-2160 to 910-700 (Iron Age to post-Roman; Spurr, 2004).

2.2 Geoarchaeological, palaeoenvironmental and archaeological potential

The recently completed geoarchaeological deposit model indicates important variation in the height of the Gravel surface, and the type, thickness and age of the subsequent Holocene deposits within the vicinity of the site. Such variations are significant as they represent different environmental conditions that would have existed in a given location. For example: (1) the varying surface of the Gravel may represent the location of pre-Holocene river terraces, former channels and bars; (2) the presence of peat represents former terrestrial or semi-terrestrial land-surfaces, and (3) the various alluvial units represent periods of changing hydrological conditions. Thus by studying the sub-surface stratigraphy across the site in greater detail, it will be possible to build an understanding of the former landscapes and environmental changes that took place across space and time.

Organic-rich sediments (in particular peat) also have high potential to provide a detailed reconstruction of past environments on both the wetland and dryland. In particular, they provide the potential to increase knowledge and understanding of the interactions between hydrology, human activity, vegetation succession and climate. Significant vegetation changes include the Mesolithic/Neolithic decline of elm woodland, the Neolithic colonisation and decline of yew woodland; the Late Neolithic/Early Bronze Age growth of elm on Peat, and the general decline of wetland and dryland woodland during the Bronze Age. Such investigations are carried out through the assessment/analysis of palaeoecological remains (e.g. pollen, plant macrofossils & insects) and radiocarbon dating. For example, palaeoenvironmental investigations at the Morganite site (Branch *et al.,* 2007) are indicative of a period of Peat formation that was subject to intermittent flooding, with flora consisting of tall grasses, sedges, rushes and herbs, persisting from the Middle Bronze Age through to the late Roman period. At the Prospect Reach Foreshore site, Point Pleasant (Perry and Skelton, 1995b), the Peat (of Roman and post-Roman age) is characterised by open mixed deciduous woodland and herbaceous taxa on the nearby dryland, with wetland taxa including aquatic and marginal aquatic plants. At Garratt Lane (MoLAS, 2004) organic sediments of post-Bronze Age date were dominated by wet sedge fen, with shallow standing water, and evidence for the cultivation of cereals on the nearby dryland.

Finally, areas of high gravel topography, soils and peat represent potential areas that might have been utilised or even occupied by prehistoric people, evidence of which may be preserved in the archaeological (e.g. features and structures) and palaeoenvironmental record (e.g. changes in

vegetation composition). Nearby finds and the archaeological potential of the site are outlined within the archaeological desk-based assessment (CgMs Heritage (part of RPS), 2016).

2.3 Aims & objectives

The initial aims of the geoarchaeological investigations at the Linton Fuels site were: (1) to clarify the nature of the sub-surface stratigraphy across the site, and (2) to clarify the nature, depth, extent and date of any Alluvium and Peat deposits. The results of the previous geoarchaeological fieldwork and deposit modelling achieved the majority of these aims. The findings also indicated the presence of deposits that have the potential to fulfil the remaining aims of the overall geoarchaeological investigation (as outlined within the WSI for the site; Batchelor, 2017b):

1. To clarify the date of any Alluvium and Peat deposits
2. To investigate whether the sequences contain any artefact or ecofact evidence for prehistoric or historic human activity;
3. To investigate whether the sequences contain any evidence for natural and/or anthropogenic changes to the landscape (wetland and dryland);
4. To integrate the new geoarchaeological record with other recent work in the local area for publication in an academic journal.

As such, it was recommended that an assessment of the deposits from QBH102 be carried out. This sequence has the greatest thickness of, and most organic-rich deposits. The following report outlines the results of this assessment.

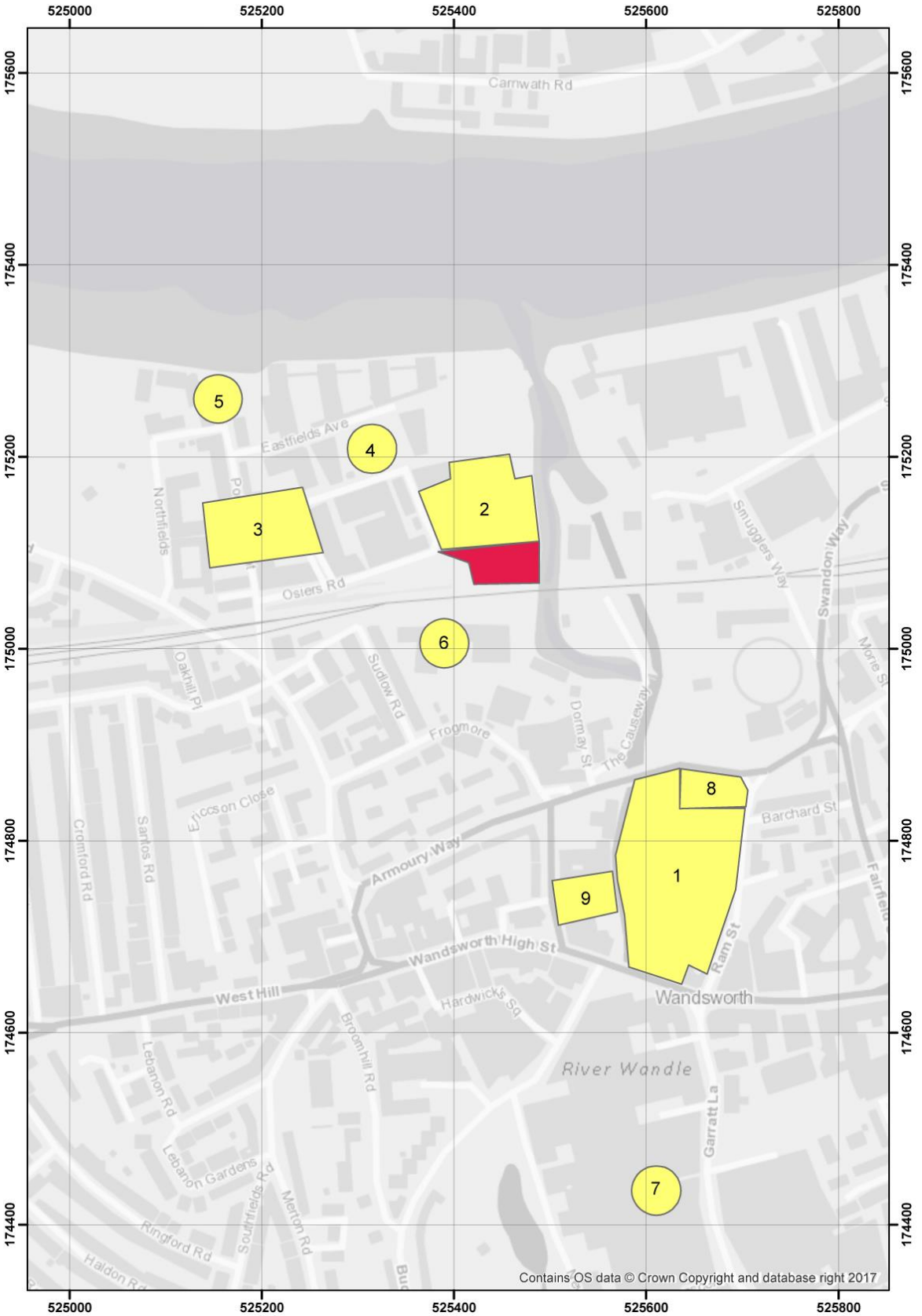

Figure 1: Location of the Linton Fuels site, London Borough of Wandsworth (in red) and other sites of geoarchaeological interest: (1) Ram Brewery Phase 1 (Young & Batchelor, 2015); (2) Osiers Estate (Green & Young, 2010); (3) Morganite Site (Branch *et al*., 2007); (4) Former Shell Oil Terminal (Perry & Skelton, 1995a); (5) Prospect Reach Foreshore (Perry & Skelton, 1995b); (6) Frogmore Depot (Spurr, 2004) (7) Garratt Lane (Howe *et al*., 2002); (8) Ram Brewery – Phase 1 (MoLA, 2012), and (9) Ram Brewery Phase 2 (Batchelor, 2016)

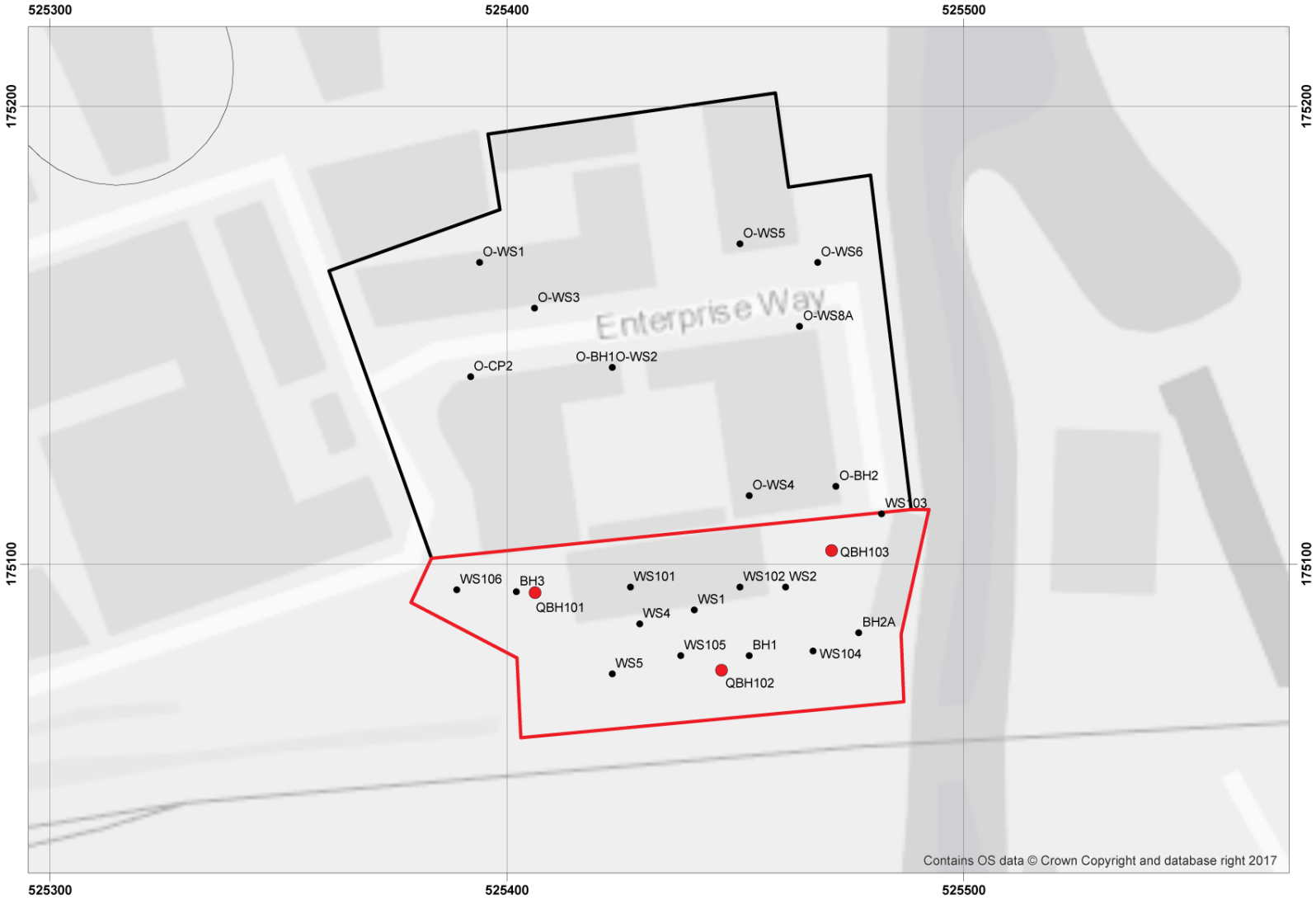

Figure 2: Geoarchaeological and geotechnical investigations across the Linton Fuels and Osiers Road sites

3. METHODS

3.1 Field investigations

Three geotechnical boreholes (BH101 to BH103) put down by CGL were initially monitored and recorded on the site by a geoarchaeologist in September 2017. These initial results indicated the presence of sediments with geoarchaeological and palaeoenvironmental potential; as such, repeat boreholes (QBH1 to QBH3) were put down in October 2017 to enable the retrieval of undisturbed core samples. The borehole core samples were recovered using a window sampling terrier rig carried out by CGL. This coring technique can provide 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 positions of the new locations were surveyed by CGL (Table 1).

Table 1: Borehole attributes of the recovered geoarchaeological boreholes

Borehole / test-pit number	Easting	Northing	Elevation (m OD)
QBH101	525864	174140	7.30
QBH102	525448	175084	6.78
QBH103	525741	175097	6.46

3.2 Lithostratigraphic description

The lithostratigraphy of the recovered samples 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 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 monitored boreholes are displayed in Tables 2 to 4.

3.3 Deposit modelling

The deposit model was based on a review of 26 borehole records, incorporating records from the site and Osiers Road (Figure 2). Sedimentary units from the boreholes were classified into four groupings: (1) Wandle / Shepperton Gravel, (2) Organic Alluvium; (3) Upper Alluvium and (4) Made Ground. The classified data for groups 1-4 were then input into a database with the RockWorks geological utilities software. Models of surface height were generated for the Gravel, Organic Alluvium and Upper Alluvium (Figures 3, 4 and 6). Thickness of the Organic Alluvium. Upper Alluvium and Made Ground (Figures 5, 7 & 8) were also modelled. 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. 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 30m radius around each record is applied to all deposit models. In addition, it is important to recognise that multiple sets of boreholes are represented, put down at different times and recorded using different descriptive terms and subject to differing technical constraints in terms of recorded detail including the exact levels of the stratigraphic boundaries.

3.3 Radiocarbon dating

Two subsamples were extracted from the base and top of the organic-rich sediment from QBH2 for radiocarbon dating. The samples were submitted for AMS radiocarbon dating to the BETA Analytic Radiocarbon Dating Facility, Miami, Florida. The results have been calibrated using OxCal v4.2 (Bronk Ramsey, 1995; 2001 and 2007) and the IntCal13 atmospheric curve (Reimer *et al.*, 2013). The results are displayed in Figure 9 and in Table 5.

3.4 Pollen assessment

Twelve subsamples from borehole QBH2 were extracted 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).

3.5 Diatom assessment

A total of four samples from borehole QBH2 were submitted for an assessment of diatom presence. 0.5g of sediment was required for the diatom sample preparation. All samples were first treated with sodium hexametaphosphate and left overnight, to assist in minerogenic deflocculation. Samples were then treated with hydrogen peroxide (30% solution) to remove organic material. Samples were finally sieved using a 10µm mesh to remove fine minerogenic sediments. The residue was transferred to a plastic vial, from which a slide was prepared for subsequent assessment. A minimum of four slide traverses were undertaken across each slide sample. When encountered, diatom species ware identified with reference to van der Werff and Huls (1958-74), Hendy (1964) and Krammer & Lange-Bertalot (1986-1991). However, due to the nature of the rapid assessment, many taxa were only identified to genera level. The results of the assessment are shown in Table 7.

3.6 Macrofossil assessment

A total of three samples from QBH2 were extracted and processed for the recovery of macrofossil remains, including waterlogged plant macrofossils, wood, insects and Mollusca (Tables 8). The samples were focussed on the peat horizons in both boreholes, in QBH2 extending down to the surface of the timber recorded at the base of this borehole. The extraction process involved the following procedures: (1) measuring the sample volume by water displacement, and (2) 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 (Tables 9 and 10). Preliminary identifications of the waterlogged seeds have been made using modern comparative material and reference atlases (e.g. NIAB, 2004; Cappers *et al.* 2006). Nomenclature used follows Stace (2005).

4. RESULTS AND INTERPRETATION OF THE FIELDWORK, LITHOSTRATIGRAPHIC DESCRIPTIONS, DEPOSIT MODELLING AND RADIOCARBON DATING

Initial monitoring and recording of three geotechnical boreholes (BH101 to BH103) indicated the presence of sediments with geoarchaeological and palaeoenvironmental potential. As such, repeat boreholes (QBH101 to QBH103) were put down to enable the retrieval of undisturbed core samples. Only the results of QBH101 to QBH103 are detailed here since they were put down specifically for geoarchaeological purposes and described under laboratory-based conditions; thus representing more complete and reliable results than those obtained for geotechnical boreholes BH101 to BH103.

The results of the deposit modelling are displayed in Figures 3 to 9; Figures 3 to 8 are surface elevation and thickness models for each of the main stratigraphic units; Figure 9 is a 2-dimensional west-east transect. The results of the deposit modelling indicate that the number and spread of the logs is sufficient to permit modelling with a high level of reliability across the entire area under investigation.

The full sequence of sediments recorded in the boreholes comprises:

Made Ground
Organic Alluvium – widely present
Upper Alluvium
Gravel (Wandle / Shepperton Gravel)

4.1 Wandle / Shepperton Gravel

The Wandle / Shepperton Gravel was present in all the boreholes that penetrated to the bottom of the Holocene sequence. It was deposited during the Late Glacial (15,000 to 10,000 years before present) and comprises the sands and gravels of a high-energy braided river system which, while it was active would have been characterised by longitudinal gravel bars 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 Wandle / Shepperton Gravel rests on a relatively level London Clay surface between -2.3 (O-CP2) and -3.0m OD (QBH101) (Figure 9) across both the Linton Fuels and Osiers Road sites. The surface of the Gravel (Figures 3 and 9) generally rests between -0.12 (QBH102) and -0.80m OD (QBH101). In only one borehole is the gravel recorded above 0m OD; in QBH103 at +0.56m OD. However, this deposit consisted largely of sand with traces of gravel; true gravel was not recorded until -0.54m OD, and thus the surface of the Wandle / Shepperton Gravel would appear to be more-or-less even across both sites.

4.2 Organic Alluvium

Directly overlying the Wandle / Shepperton Gravel in the majority of sequences are deposits of fine grained alluvium with varying quantities of organic material. In some boreholes, traces of organic-remains / wood fragments are recorded; in others peaty clay. Mollusca were also occasionally recorded. The thickness of the unit is variable: in some boreholes, the deposits measure only 1m in thickness (e.g. QBH103), but in others (specifically on the Osiers Road site), up to 5m are recorded (e.g. O-BH1 & O-BH2) (Figure 5). The surface of the Organic Alluvium varies between 1.41 and 5.35m OD (Figure 4).

The Organic Alluvium is indicative of a transition towards a semi-terrestrial environment, supporting the growth of wetland vegetation. Its inconsistent thickness may suggest its formation varied in length across the site, or has been truncated by subsequent processes. In either case, the deposits have the potential for radiocarbon dating and palaeoenvironmental reconstruction.

Quercus sp. (oak) roundwood resting at the interface between the Wandle Gravel and Organic Alluvium was radiocarbon dated to 1240-1010 cal BP, whilst twig wood from the top of the unit was radiocarbon dated to 290-0 cal BP. This indicates that the Organic Alluvium must have been deposited during the medieval period, and continued until at least 290 years ago.

4.3 Upper Alluvium

The Alluvium rests on the Organic Alluvium and was recorded in all boreholes across both sites,. The deposits of the Alluvium are described as predominantly silty, sandy or clayey with occasional gravel fragments. The surface of the Alluvium (Figure 7) is highly variable, resting between 2.3m and 6.15m OD and ranges in thickness from 1m to 5m, but is mainly between 2m and 3m (Figure 6).

The sediments of the Alluvium are indicative of deposition within low energy fluvial and/or semi-aquatic conditions during the Holocene. The high mineral content of the sediments may reflect increased sediment loads resulting from intensification of agricultural land use from the later prehistoric period onward, combined with the effects of rising sea level.

4.5 Made Ground

Between 0.8 and 4.5m of Made Ground caps the sequence, indicating varying levels of truncation of the Holocene alluvial sequence (Figure 8).

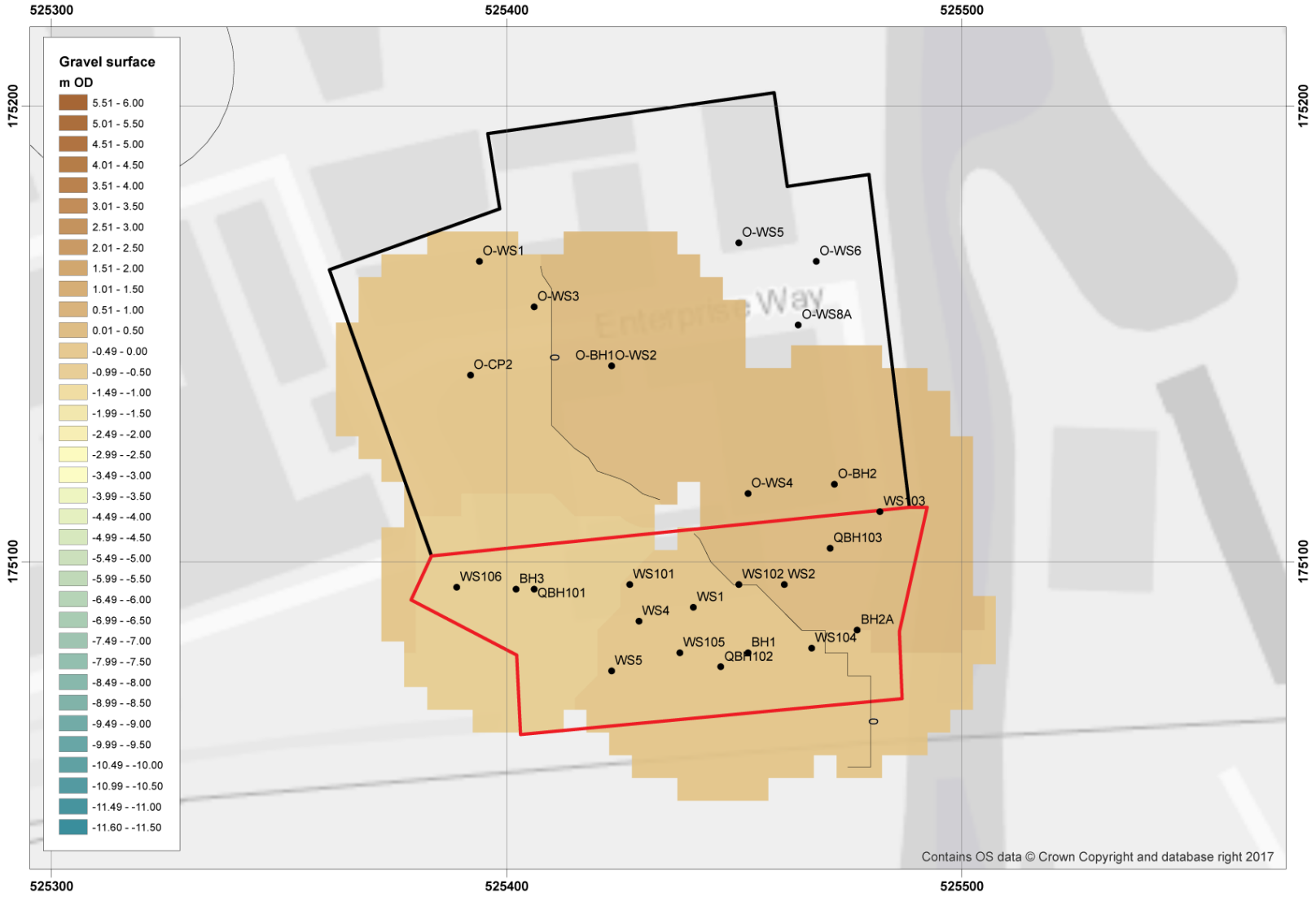

Figure 3: Surface of the Wandle / Shepperton Gravel

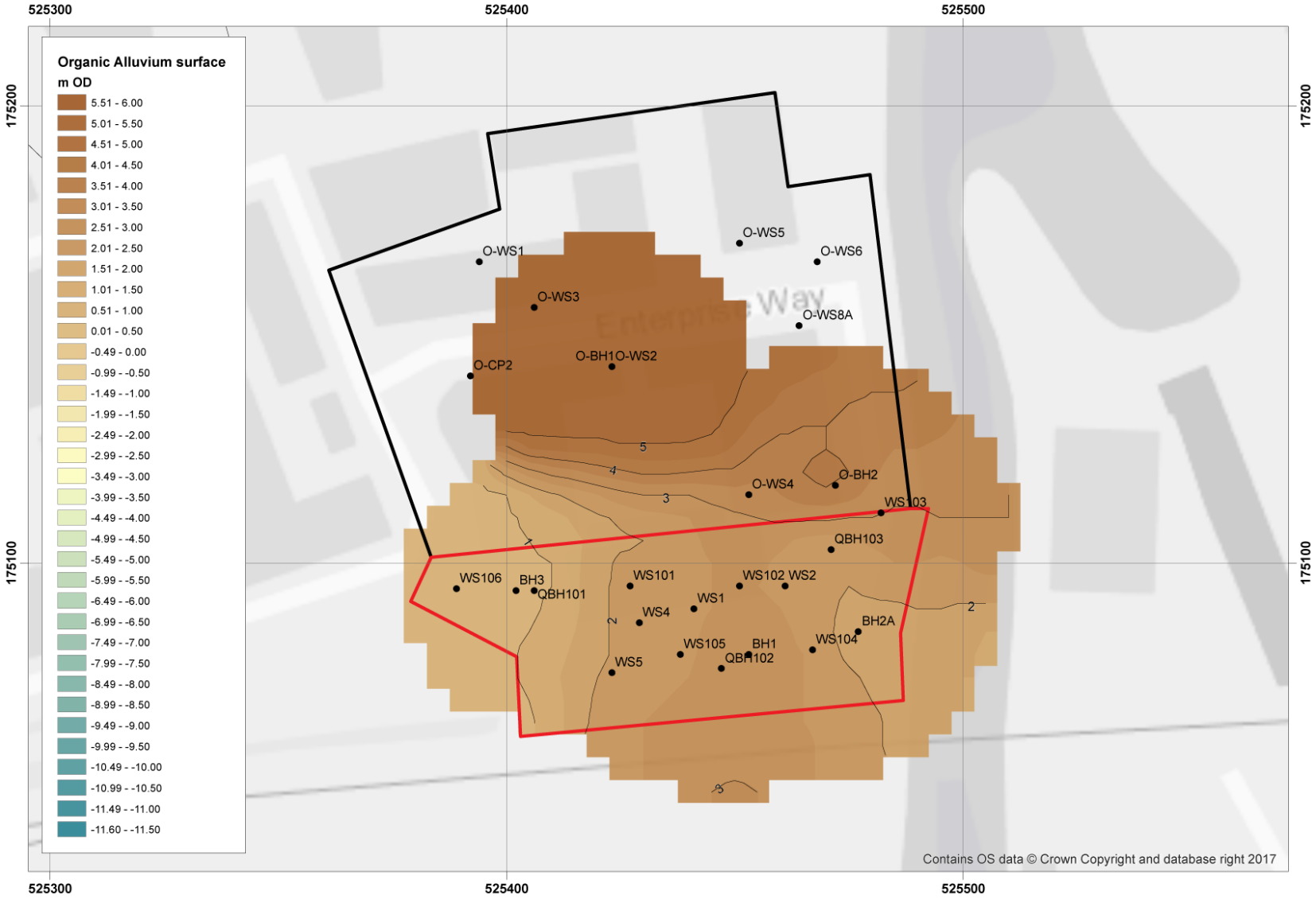

Figure 4: Surface of the Organic Alluvium

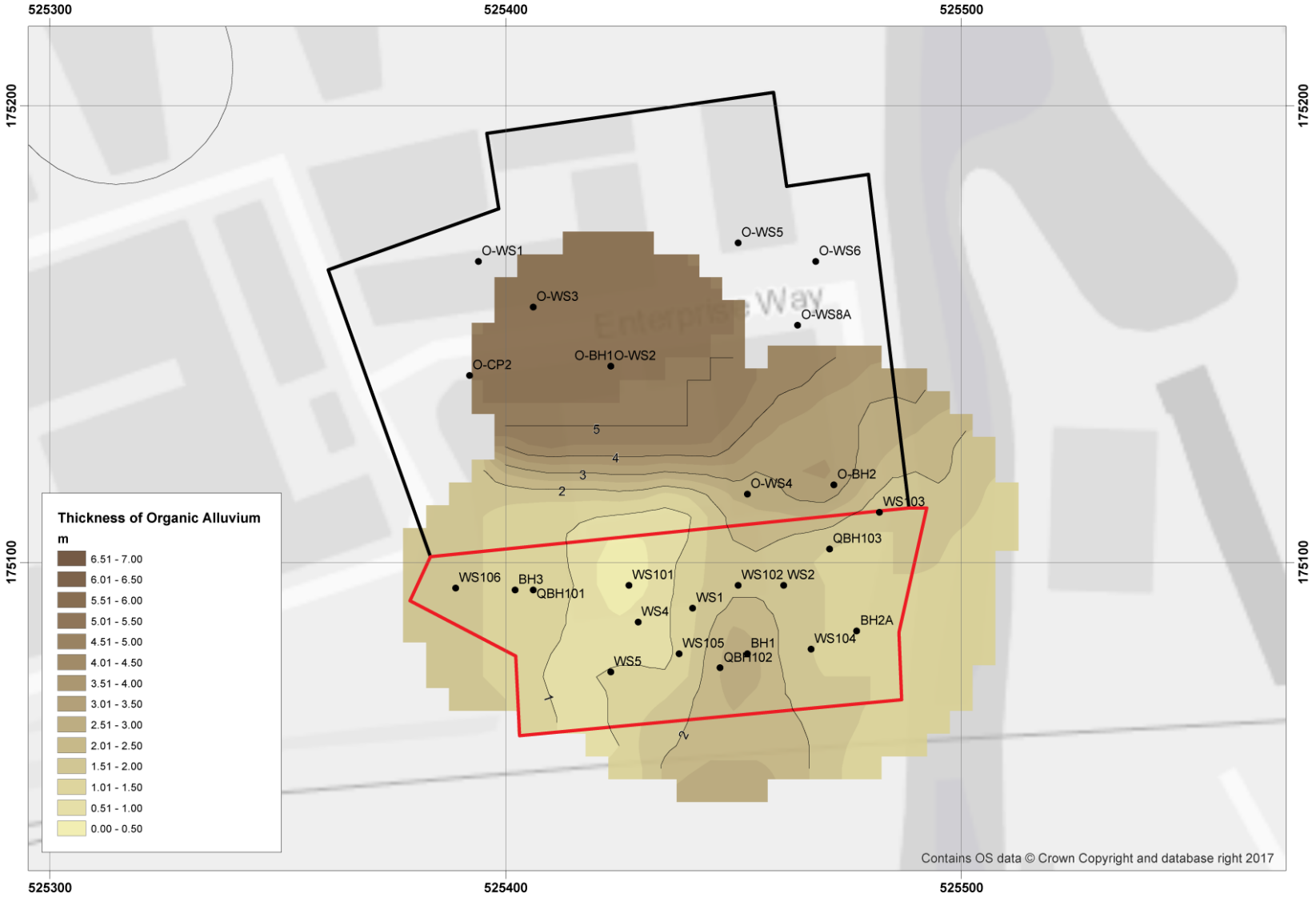

Figure 5: Thickness of the Organic Alluvium

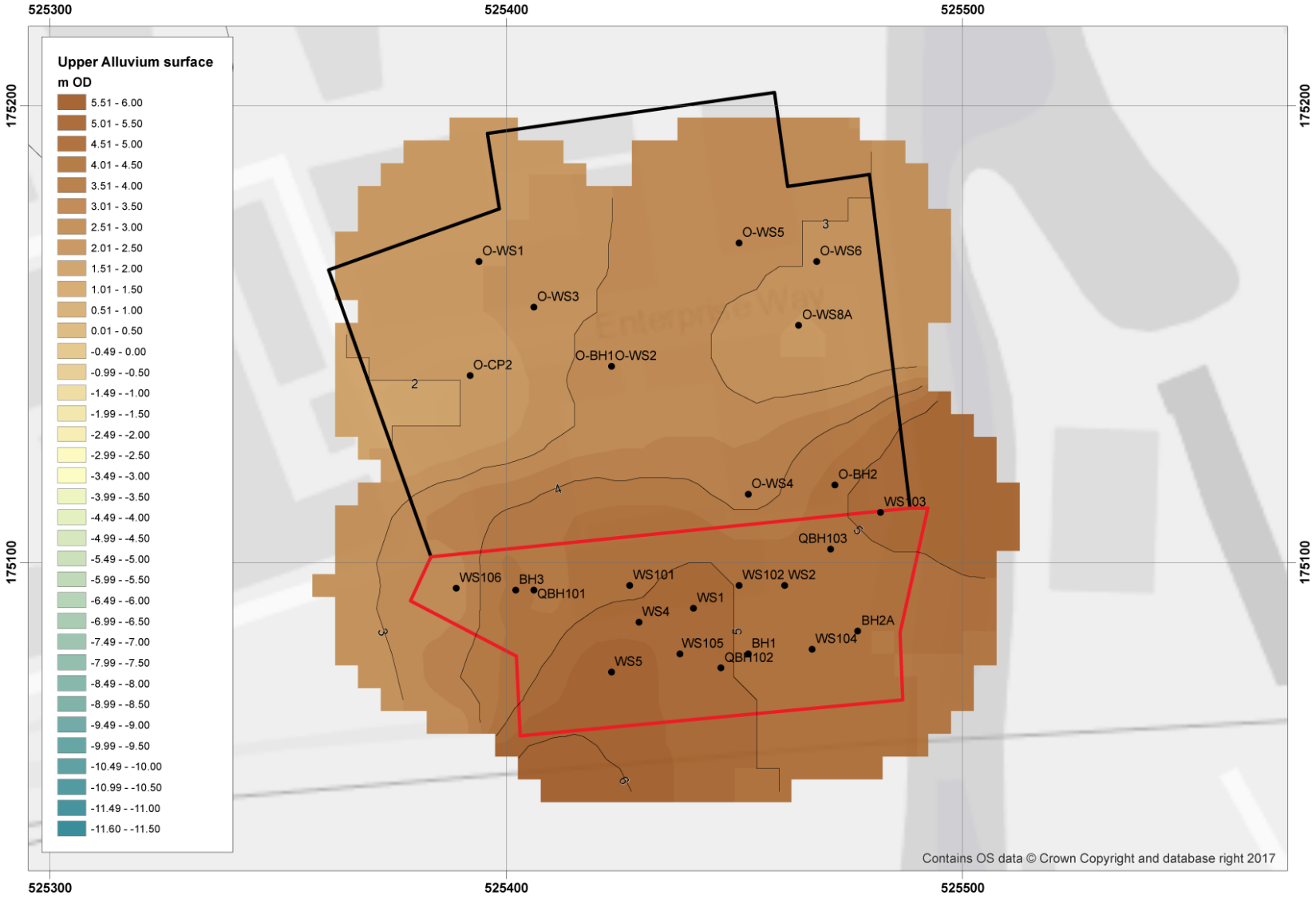

Figure 6: Surface of the Upper Alluvium

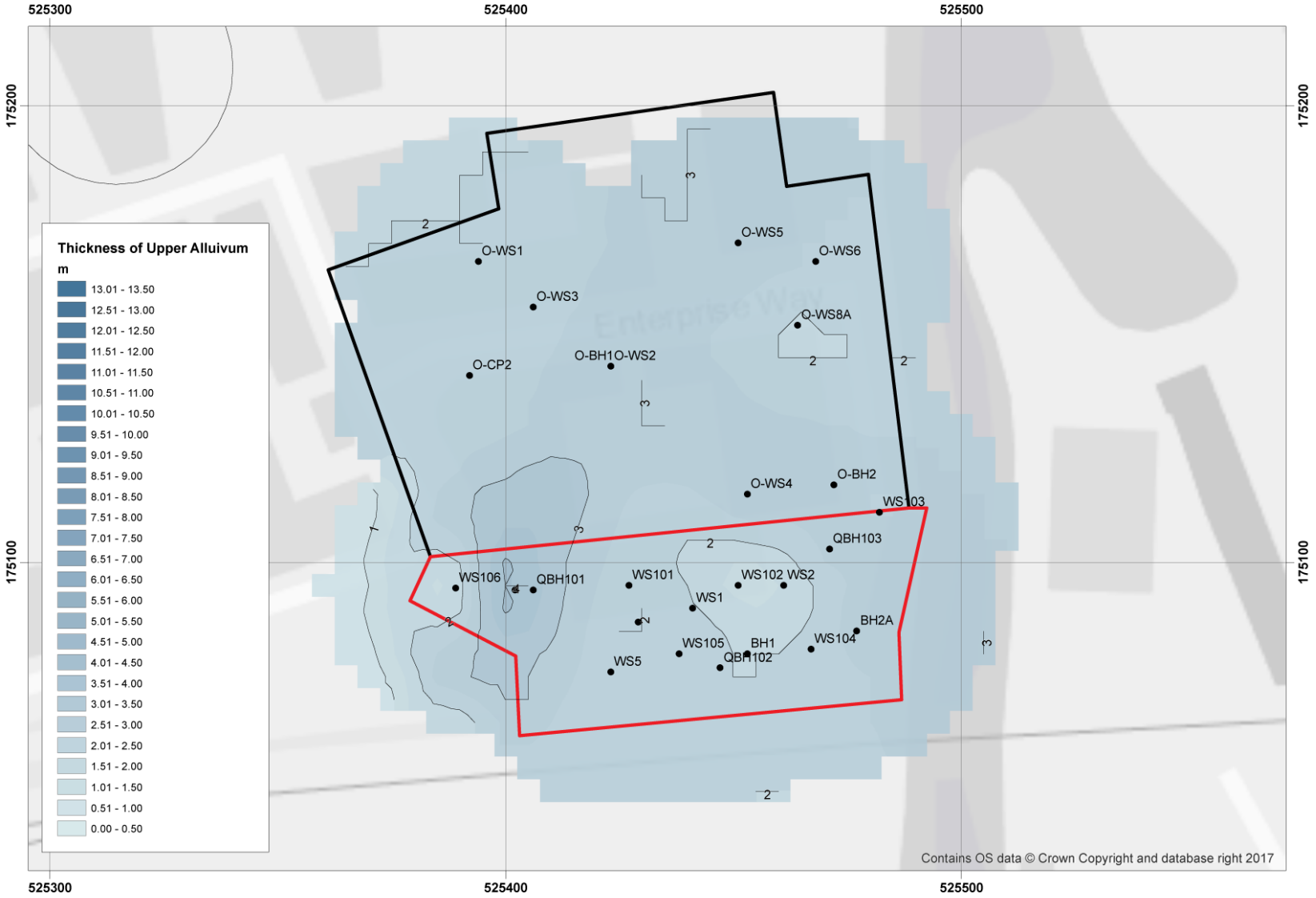

Figure 7: Thickness of the Upper Alluvium

Figure 8: Thickness of the Made Ground

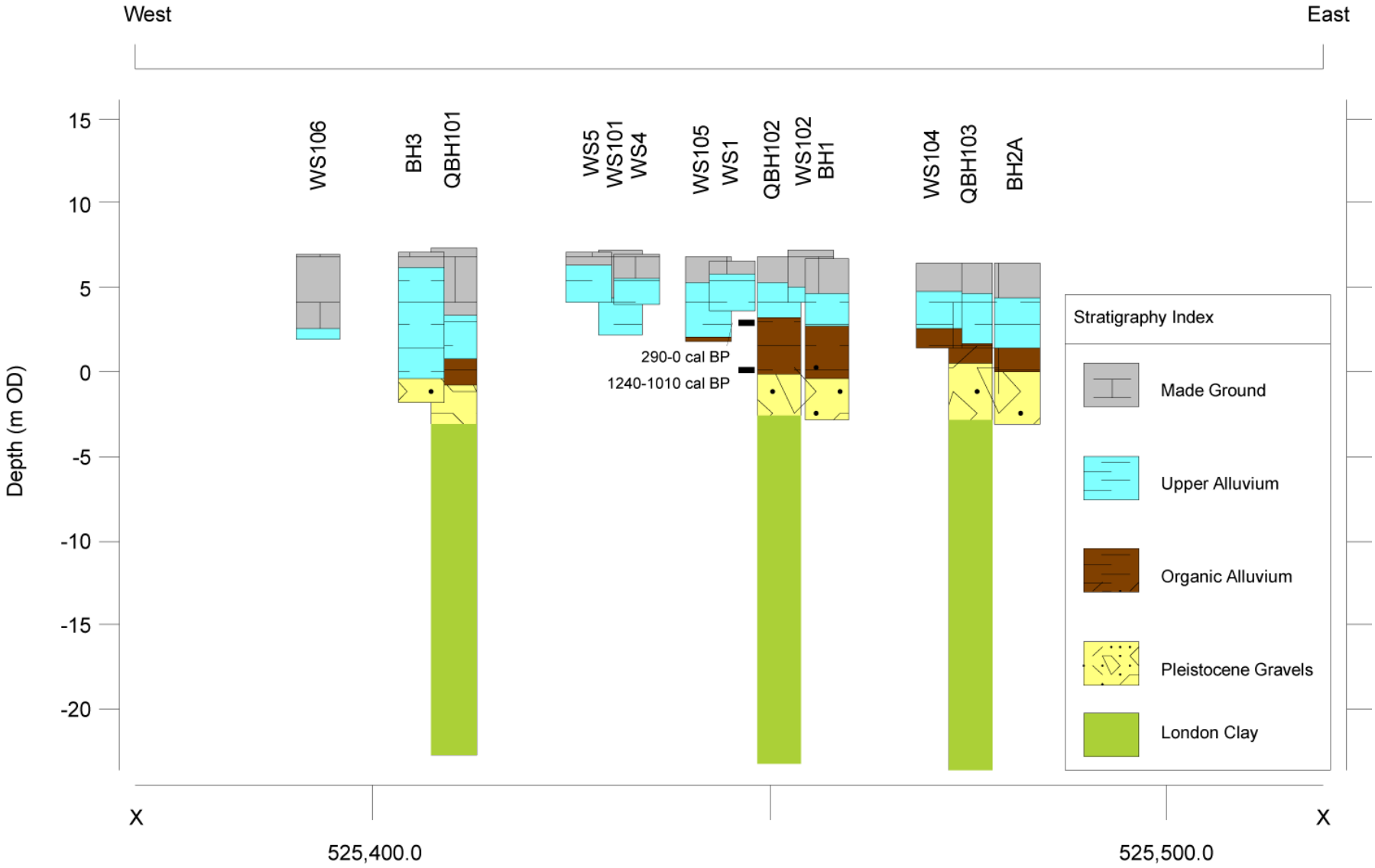

Figure 9: West-East borehole transect

Table 2: Lithostratigraphic description of borehole QBH101, Linton Fuels, Osiers Road, London Borough of Wandsworth

Depth (m OD)	Depth (m bgl)	Description	Stratigraphic group
7.30 to 5.90	0 to 1.40	Made Ground	MADE GROUND
5.90 to 5.30	1.40 to 2.00	10YR 5/2; Gg2, As2, Ga+; Greyish gravelly clay with traces of sand, chalk, charcoal and CBM.	
5.30 to 5.10	2.00 to 2.20	VOID	
5.10 to 4.40	2.20 to 2.90	10YR 5/3; As2,Ag2; Brown silty clay with chalk clasts; diffuse contact into:	
4.40 to 4.30	2.90 to 3.00	10YR 5/3 to 10YR 2/1; Brown to black silty clay with traces of chalk and flint gravel.	
4.30 to 4.03	3.00 to 3.27	VOID	
4.03 to 3.79	3.27 to 3.51	10YR 5/3 to 10YR 2/1; Brown to black silty clay with traces of chalk and flint gravel; sharp contact into:	
3.79 to 3.63	3.51 to 3.67	10YR 3/1; As4; Very dark grey mottled clay; diffuse contact into:	
3.63 to 3.39	3.67 to 3.91	10YR 4/3 to 10YR 2/1; As2, Ag1, Ga1; Brown to yellow to black silty sandy clay; sharp contact into:	
3.39 to 3.30	3.91 to 4.00	10YR 3/3; Ag2, Ga2; Brown silty sand	UPPER ALLUVIUM
3.30 to 2.86	4.00 to 4.44	VOID	
2.86 to 2.55	4.44 to 4.75	10YR 3/3; Ag2, Ga2; Brown silty sand; diffuse contact into:	
2.55 to 2.30	4.75 to 5.00	10YR 3/3; Ag2, As2, Ga+; Brown silty clay with traces of sand	
2.30 to 1.85	5.00 to 5.45	VOID	
1.85 to 1.30	5.45 to 6.00	10YR 3/3; Ag2, As2, Ga+; Brown silty clay with traces of sand	
1.30 to 1.00	6.00 to 6.30	VOID	
1.00 to 0.75	6.30 to 6.55	10YR 3/3; Ag2, As2, Ga+; Brown silty clay with traces of sand; sharp contact into:	
0.75 to 0.62	6.55 to 6.68	10YR 4/1; As2, Ag1, Sh1; Dark grey organic-rich silty clay with traces of Mollusca; diffuse contact into:	ORGANIC-RICH / PEATY ALLUVIUM
0.62 to 0.45	6.68 to 6.85	10YR 4/1; As2, Ag2, Sh+; Very dark grey silty clay with traces of organic-remains; diffuse contact into:	
0.45 to 0.30	6.85 to 7.00	10YR 3/1; Sh2, As2; Very dark grey organic-rich clay.	
		Borehole ceased - collapsed	

Table 3: Lithostratigraphic description of borehole QBH102, Linton Fuels, Osiers Road, London Borough of Wandsworth

Depth (m OD)	Depth (m bgl)	Description	Stratigraphic group
6.78 to 5.25	1.10 to 1.53	Made Ground	MADE GROUND
5.25 to 3.93	1.53 to 2.85	10YR 5/1; Ga2, Ag2 Gg+; Grey silty sand with traces of gravel; diffuse contact into:	UPPER ALLUVIUM
3.93 to 3.78	2.85 to 3.00	10YR 4/3; Ag2, As2, Ga+; Greyish brown silty clay with traces of sand and occasional rooting	
3.78 to 3.28	3.00 to 3.50	10YR 5/1; Ag2, Ga2; Grey mottled brown silty sand with traces of gravel; diffuse contact into:	

3.28 to 3.08	3.50 to 3.70	10YR 4/3; As4, Sh+; Brownish grey clay with traces of organic-remains; diffuse contact into:	ORGANIC-RICH / PEATY ALLUVIUM
3.08 to 2.78	3.70 to 4.00	10YR 5/1 to 10YR 4/1; As4, Sh+; Grey to dark grey clay with traces of plant remains, organic remains and Mollusca; diffuse contact into:	
2.78 to 0.78	4.00 to 6.00	10YR 5/1 to 10YR 4/1; As4 Sh+; Grey to dark grey clay with traces of plant remains, and Mollusca; diffuse contact into:	
0.78 to 0.48	6.00 to 6.30	VOID	
0.48 to -0.10	6.30 to 6.88	10YR 4/3; As2, Ag1, Sh1, Ga+; Greyish brown organic-rich silty clay becoming sandier with depth; sharp contact into:	
-0.10 to -0.12	6.88 to 6.90	Wood fragment	
-0.12 to -0.22	6.90 to 7.00	10YR 3/3; Ga3, Gg1; Brown gravelly sand.	GRAVEL

Table 4: Lithostratigraphic description of borehole QBH103, Linton Fuels, Osiers Road, London Borough of Wandsworth

Depth (m OD)	Depth (m bgl)	Description	Stratigraphic group
6.46 to 4.61	0 to 1.85	Made Ground	MADE GROUND
4.61 to 3.59	1.85 to 2.87	10YR 5/1 to 10YR 3/3; Ga2, As1, Ag1; Grey to brown silty clayey sand with traces of gravel; sharp contact into:	UPPER ALLUVIUM
3.59 to 3.26	2.87 to 3.20	10YR 3/3; As4. Ag+, Gg+; Brown clay with traces of silt and gravel; sharp contact into:	
3.26 to 2.96	3.20 to 3.50	10YR 5/1 to 10YR 3/3; Ga2, As1, Ag1; Grey to brown silty clayey sand with traces of gravel; sharp contact into:	
2.96 to 2.46	3.50 to 4.00	10YR 3/3; As4. Ag+, Gg+; Brown clay with traces of silt and gravel; sharp contact into:	
2.46 to 1.61	4.00 to 4.85	VOID	
1.61 to 1.46	4.85 to 5.00	10YR 4/1; As4, Sh+, Dl+; Dark grey clay with traces of organic remains, detrital wood and Mollusca	ORGANIC-RICH / PEATY ALLUVIUM
1.46 to 1.31	5.00 to 5.15	VOID	
1.31 to 0.87	5.15 to 5.59	10YR 4/1; As4, Sh+, Dl+; Dark grey clay with traces of organic remains, detrital wood and Mollusca; diffuse contact into:	
0.87 to 0.70	5.59 to 5.76	10YR 4/3; As4, Sh+; Greyish brown clay with traces of organic-remains; diffuse contact into:	
0.70 to 0.56	5.76 to 5.90	10YR 4/3; As2, Ag1, Sh1, Ga+; Greyish brown organic-rich silty clay with traces of plant and wood remains becoming sandier with depth; sharp contact into:	
0.56 to 0.46	5.90 to 6.00	10YR 3/3; Ga4, Gg+; Brown laminated sand with traces of gravel	GRAVEL
0.46 to 0.20	6.00 to 6.26	VOID	
0.20 to -0.70	6.26 to 6.53	10YR 3/3; Ga4, Gg+; Brown laminated sand with traces of gravel.	
-0.70 to -0.54	6.53 to 7.00	10YR 3/3; Gg3, Ga1; Brown sandy gravel.	

Table 5: Results of the borehole QBH2 radiocarbon dating, Linton Fuels, Osiers Road, London Borough of Wandsworth

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 (‰)
BETA 483608 AMS	Twig wood; top of organic-rich / peaty alluvium	3.00 to 3.10	150 ± 30	1660-1950 cal AD (290 to 0 cal BP)	-28.8
BETA 483607 AMS	*Quercus* sp. round wood; base of organic-rich / peaty alluvium	-0.12 to -0.10	1200 ± 30	710 to 940 cal AD (1240 to 1010 cal BP)	-26.7

5. RESULTS & INTERPRETATION OF THE POLLEN ASSESSMENT

Samples were prepared for pollen assessment from the Organic Alluvium of QBH2. The results indicate a high concentration of remains in a moderate state of preservation in all of the samples assessed (Table 6).

The samples are characterised by high values of herbaceous pollen: Poaceae (grasses), Cyperaceae (sedges) and Lactuceae (dandelions) dominate with high numbers of Asteraceae (daisies), *Cereale* type (e.g. barley), *Chenopodium* type (e.g. fat hen), Apiaceae (carrot family), *Plantago lanceolata* (ribwort plantain), *Sinapis* type (e.g. charlock), *Centaurea nigra* (black knapweed), *Polygonum aviculare* (knotgrass) and sporadic occurrences including *Artemisia* type (mugwort), Caryophyllaceae (pinks), *Valeriana* type (marsh valerian), *Sanguisorba minor* (nightshade) and *Ranunculus* type (e.g. buttercup). Aquatic taxa were limited, but included *Typha latifolia* (bulrush), *Sparganium* type (bur-reed). Spores were similarly limited to isolated occurrences of *Filicales* (ferns), *Pteridium aquilinum* (bracken) and *Polypodium vulgare* (polypody). Tree and shrub values were low, including most frequently, *Alnus* (alder), *Quercus* (oak), *Pinus* (pine) and *Corylus* type (hazel). Microcharcoal concentrations were moderate to high throughout.

The results of the assessment indicate that the local vegetation was strongly dominated by herbaceous taxa indicative of a very open environment modified by human activity. The dominance of sedges and grasses with marsh valerian, bulrush, bur-reed are indicative of the nearby growth of semi-aquatic communities growing within a floodplain environment. Isolated trees of alder and willow may also have grown within this environment. The pollen assemblage also strongly indicates disturbed ground and agricultural activities during this period. Fat hen and knotgrass in particular are indicative of disturbed ground, whilst, cereals such as barley / wheat (*Hordeum* / *Triticum*) and black knapweed are plants associated with cultivation and/or crop processing. In addition, other pollen taxa such as grasses, docks/sorrel, plantain, daisies, pinks, could have formed a meadow type community suitable for animal grazing. Moderate to high values of microcharcoal are also indicative of nearby burning, most likely of anthropogenic origin given the nature of the pollen assemblage.

Table 6: Results of the pollen assessment from QBH2, Linton Fuels, Osiers Road, London Borough of Wandsworth

	Depth (m OD)	3.10	2.78	2.46	2.14	1.82	1.50	1.18	0.86	0.38	0.22	0.06	-0.10
Latin name	Common name												
Trees													
Alnus	alder	1	3	2	8		5		2	4	1	3	
Quercus	oak	2		2	2		3	1	1	3		8	2
Pinus	pine	1		2	1	1	2	1	1		1	3	2
Ulmus	elm					1							
Tilia	lime					1							
Taxus	yew					1							
Betula	birch				2		1					2	
Fraxinus	ash						1						
cf Fagus	beech								2	1			
Shrubs													
Calluna vulgaris	heather			1			1		2				
Corylus type	e.g. hazel	1		1	3	4	2	1	4	6	1	5	2
Hedera	ivy				2								
Salix	willow	1		1				1		1	1		
Herbs													
Cyperaceae	sedge family	8	13	3	6	4	2	7	21	10	4	3	1
Poaceae	grass family	1	6	22	19	6	16	11	7	11	3	14	14
Cereale type	e.g. barley	1	3	10	4	6		6	4	6	1	2	8
Asteraceae	daisy family	3		2	2			1	3	6	4		1
Cirsium type	thistle								1				
Artemisia type	mugwort											1	
Lactuceae	dandelion family	23	8		4	5	2	19	11	15	12	5	6
Plantago type	plantain		1							2	1		
Plantago lanceolata	ribwort plantain					1	2	1		1		1	
Chenopodium type	goosefoot family	2		2	2	3	4	1		1	3	2	1
Caryophyllaceae	pinks		1										1
Rumex acetosa/acetosella	sorrel			2			1					1	
Rumex obtusifolius	docks						1					1	
Apiaceae	carrot family					1	1	1	5		2	1	
Ranunculus type	e.g. buttercup	1					1				1		
Sinapis type	brassica family	2	1						2	4	2	2	1
Potentilla type	cinquefoil												
Polygonum aviculare	knotweed	1	1						2				
Centaurea nigra	black knapweed		1	1					1			1	
cf Armeria type	thrift				1								

	Depth (m OD)	3.10	2.78	2.46	2.14	1.82	1.50	1.18	0.86	0.38	0.22	0.06	-0.10
Latin name	Common name												
Valeriana type	marsh valerian								1			1	
Sanguisorba minor	nightshade											1	
Aquatics													
Sparganium type	bur-reed				1		1			3			1
Typha latifolia	bulrush			1									
Spores													
Pteridium aquilinum	bracken	2			1	1							
Filicales	ferns			2	1		1						
Polypodium vulgare	polypody					1		1			1		
Unknown				3	1	2	1		1	8	3		
Unidentifiable							3		5			5	9
Total Land Pollen (grains counted)		48	38	51	56	34	45	51	71	71	37	57	39
Concentration*		5	5	5	5	5	5	5	5	5	5	5	5
Preservation**		3	3	4	4	4	4	3	3	4	4	4	4
Microcharcoal Concentration***		2	2	3	3	4	2	3	2-3	2	3	3	4
Suitable for further analysis		YES	YES	YES	YES	YES	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*

6. RESULTS & INTERPRETATION OF THE DIATOM ASSESSMENT

A total of four samples from borehole QBH2 were extracted for an assessment of diatoms within the Organic Alluvium. A high concentration of remains was recorded towards the base of the sequence, but elsewhere only sporadic to low numbers were recorded. Nevertheless the samples have some potential for providing an indication of the salinity and speed of water movement at the time of deposition.

Table 7: Results of the diatom assessment of samples from QBH2, Linton Fuels, Osiers Road, London Borough of Wandsworth

Depth (m OD)	Diatom concentration	Diatom preservation	Diversity
3.10	2	2-3	Medium
1.82	1	2	Low
0.38	1	1	Low
-0.10	4	3-4	Medium

7. RESULTS & INTERPRETATION OF THE MACROFOSSIL ASSESSMENT

A total of three samples from QBH2, were extracted and processed for the recovery of macrofossil remains, including waterlogged plant macrofossils, wood, insects and Mollusca (Table 8). The samples were focussed on the Organic Alluvium.

All three samples recorded the presence of waterlogged wood in low to moderate concentrations. In the lowermost sample, this was identified as fragments of Quercus (oak) Roundwood. Fragments of charcoal <2mm were also recorded between -0.01 and -0.09m OD.

Isolated waterlogged seeds were recorded in each of the samples, including *Ranunculus repens* (creeping buttercup) and *Rumex* / *Polygonum* sp, (dock / knotweed). Sedge remains were also frequently recorded in the upper two samples (-0.01 to -0.09 and 3.00 to 3.10m OD).

Finally, insect remains were recorded in moderate to high numbers in two of the samples assessed.

Table 8: Results of the macrofossil assessment of samples from QBH2, Linton Fuels, Osiers Road, London Borough of Wandsworth

			Charred					Waterlogged				Mollusca		Bone			
Depth (m OD)	Volume processed (ml)	Fraction	Charcoal (>4mm)	Charcoal (2-4mm)	Charcoal (<2mm)	Seeds	Chaff	Wood	Seeds	Sedge remains (e.g. stems/roots)		Whole	Fragments	Large	Small	Fragments	Insects
3.00 to 3.10		>300µm						2	1	4	*Ranunculus repens (creeping buttercup)*						3
-0.09 to -0.01		>300µm			1			1	1	2	*Rumex* / *Polygonum* sp. (dock / knotweed)						
-0.12 to -0.10		>300µm						4	1		*Quercus* sp. (oak) roundwood						3

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+

8. DISCUSSION

The results of the geoarchaeological and palaeoenvironmental assessment have continued to contribute to our understanding of the Holocene stratigraphic sequence in this area of the Wandle Valley. Across the site a sequence of Wandle / Shepperton Gravel is recorded (deposited during the Late Devensian, 10-15,000 years before present). The surface of the Wandle / Shepperton Gravel across both Linton Fuels and Osiers Road is recorded between -0.80 to -0.12m OD the same as that recorded on the nearby Morganite site to the west (Branch et al., 2007). The same surface is higher at sites such as Ram Brewery (0.5 to 3.0m OD; Young & Batchelor, 2015) and Garratt Lane (3.6m OD; Howe et al., 2002) consistent with their location higher up the Wandle Valley and/or beyond the margins of the floodplain.

The Wandle / Shepperton Gravel at Linton Fuels and Osiers Road is overlain by Alluvium. Initially organic-rich alluvium / peaty clay was deposited. Across the Linton Fuels site this measured between 1 and 3.5m in thickness; across the Osiers Road site, up to 5m of organic-rich deposits were recorded. This was capped on both sites by inorganic alluvium with occasional gravels. The results of the radiocarbon dating from Linton Fuels indicate that the organic-rich alluvium started forming relatively late, during the medieval period, and continued into at least the post-medieval period. The results of the palaeoenvironmental assessment (pollen, seeds, wood, insects and diatoms) indicate a generally good concentration and preservation of remains. The local environment was very open and damp, with strong evidence of human activity including cultivation/crop processing and potentially grazing animals.

By comparison, the alluvial sequence at the Morganite site consisted of a sequence of silty sands overlying an upper Peat and slightly gravelly organic silts, which passed down into calcareous sands including remains of molluscs and ostracods, with a second, lower Peat horizon at the base of the sequence resting directly on the underlying Gravel. This sequence was dated from at least 4780-4420 to 1570-1410 cal BP, with age-depth modelling of the sequence suggesting that the Peat overlying the Gravel may be of Mesolithic date, whilst the upper Peat accumulated during the Bronze Age (Branch *et al.* 2007; Jarrett *et al.*, 2010). On the nearby Ram Brewery site, the Gravels were overlain by more definitive peat units that might have included soil horizons. These deposits were recorded at a higher elevation than the organic-rich sediments at Linton Fuels, and radiocarbon dating of the base of the Peat in one of the boreholes indicated accumulation began during the Roman period (1860 to 1700 cal BP),

Other investigations nearby confirm the presence of organic sediments associated with the prehistoric River Wandle close to its confluence with the Thames. At the Former Shell Oil Terminal, Point Pleasant (Perry & Skelton, 1995a), these have been radiocarbon dated to between 3640-3380 and 2920-2500 cal BP (Bronze Age; -1.2 to -0.7m OD). At the Prospect Reach Foreshore site, Point Pleasant (Perry & Skelton, 1995b), a radiocarbon-dated Peat and alluvial sequence is of Roman and post-Roman age. To the south of the Morganite site at the Frogmore Depot, Dormay Street site, an alluvial sequence including organic-rich sediments and Peat dated from at least 2460-2160 to 910-700 (Iron Age to post-Roman; Spurr, 2004).

9. CONCLUSIONS & RECOMMENDATIONS

The accumulation peat / organic-rich deposits within this part of the River Wandle is clearly variable, with all cultural periods through the Holocene represented by the sequences from different sites. The new record from Linton Fuels however, is of interest because it is the only one that dates to the medieval and post-medieval period and thus can provide a fairly unique record of environmental change during this period, potentially picking up evidence of the Medieval Warm Period (ca. 950-1050 cal AD) and Little Ice Age (1300-1850 cal AD).

The results of the assessment have also indicated that the concentration and preservation of pollen, waterlogged wood and insects is sufficiently high for further analysis, and contains definitive evidence of historic human activity. Analysis of these remains and a further radiocarbon date is therefore recommended to fulfil the aims set out in the original geoarchaeological and palaeoenvironmental aims of the project (as outlined within the WSI for the site; Batchelor, 2017b).

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11. APPENDIX 1: OASIS

OASIS ID: quaterna1-300549

Project details

Project name	Linton Fuels, Osiers Road, London Borough of Wandsworth
Short description of the project	A programme of geoarchaeological and palaeoenvironmental investigation. Three new geoarchaeological boreholes were put down at the site, the stratigraphic data from which were combined with existing geotechnical records to produce a deposit model of the major depositional units across the site. Up to 3.5m of organic-rich alluvium was identified, overlying a Wandle / Shepperton Gravel surface which lay between -0.8 and -0.12m OD. Radiocarbon dating of the sequences indicate that accumulation of the organic-rich alluvium took place during the medieval and post-medieval periods. The results of the assessment have also indicated that the concentration and preservation of pollen, waterlogged wood and insects is sufficiently high for further analysis, and contains definitive evidence of historic human activity. Analysis of these remains and an additional radiocarbon date is therefore recommended to fulfil the aims set out in the original geoarchaeological and palaeoenvironmental aims of the project.
Project dates	Start: 01-09-2017 End: 06-02-2018
Previous/future work	No / Yes
Any associated project reference codes	OSI17 - Sitecode
Type of project	Environmental assessment
Monument type	NONE None
Significant Finds	NONE None
Survey techniques	Landscape

Project location

Country	England
Site location	GREATER LONDON WANDSWORTH WANDSWORTH Linton Fuels, Osiers Road
Study area	5000 Square metres
Site coordinates	TQ 25441 75088 51.460348500192 -0.194150055544 51 27 37 N 000 11 38 W Point

Project creators

Name of Organisation	Quaternary Scientific (QUEST)
Project brief originator	Consultant
Project design originator	Dr C.R. Batchelor
Project director/manager	C.R. Batchelor
Project supervisor	C.R. Batchelor

Type of sponsor/funding body	Developer

Project archives

Physical Archive Exists?	No
Digital Archive Exists?	No
Paper Contents	"none"
Paper Media available	"Report"

Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	LAND AT LINTON FUELS, OSIERS ROAD, LONDON BOROUGH OF WANDSWORTH Geoarchaeological Fieldwork and Deposit Model Report
Author(s)/Editor(s)	Batchelor, C.R.
Other bibliographic details	Quaternary Scientific (QUEST) Unpublished Report November 2017; Project Number 085/17
Date	2017
Issuer or publisher	Quaternary Scientific (QUEST)
Place of issue or publication	University of Reading

Project bibliography 2

Publication type	Grey literature (unpublished document/manuscript)
Title	LAND AT LINTON FUELS, OSIERS ROAD, LONDON BOROUGH OF WANDSWORTH: Geoarchaeological and Palaeoenvironmental Assessment Report
Author(s)/Editor(s)	Batchelor, C.R.
Author(s)/Editor(s)	Young, D.S.
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