

# 2-3 ROBERT STREET, CITY OF WESTMINSTER

## Geoarchaeological and Palaeoenvironmental Assessment Report

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## 1. NON-TECHNICAL SUMMARY

A programme of environmental archaeological assessment was undertaken at the 2-3 Robert Street site in order to: (1) investigate whether the sequences contain any artefact or ecofact evidence for prehistoric or historic human activity; (2) investigate any change in the former environmental conditions, vegetation communities and hydrology of the site as a consequence of either natural and/or anthropogenic change; and (3) provide insights into human economy and diet. In order to address these aims and following the recommendations in Young (2019), a programme of geoarchaeological and palaeoenvironmental assessment was undertaken on boreholes QBH2 and QBH3. The results of the investigations have revealed a sequence of London Clay bedrock, overlain by Late Devensian Shepperton Gravel, Holocene alluvium (in places including peat), ground-raising/levelling deposits and modern Made Ground. The Gravel is overlain at the site by variable thicknesses of Holocene alluvium, recorded to levels of between ca. 1.75 and -0.80m OD. The deposits of the alluvium are predominantly silty, clayey and occasionally sandy; however, a peat unit dated to the Saxon period was recorded within the alluvial sequence, generally at levels between ca. 0.2 and -0.35m OD, but not recorded in the interventions southeast of BH2. Above this, the ground-raising/levelling deposits incorporate alluvial sediments from the underlying unit, including organic matter, and contain anthropogenic material of Saxon date onwards, including charcoal, bone, worked wood and shell (in places including oyster).

The deposits at the 2-3 Robert Street site thus appear to represent natural foreshore deposits associated with the floodplain of the River Thames, overlain by alluvial sediments and a series of ground-raising/levelling deposits that incorporate material from the alluvial sediments below. The deposits here are therefore very similar in character to those recorded at both Adelphi House (Young *et al.*, 2015) and 18-20 York Buildings (Cowie & Whytehead, 1989). However, at the 2-3 Robert Street site, the lower alluvial deposits, including the peat/richly organic units dated to the Saxon period and recorded at between ca. 0.2 and -0.35m OD, appear to have accumulated entirely by natural processes. The biological remains in both the naturally accumulated and reworked/redeposited organic deposits are very similar. A generally open, damp and disturbed environment is indicated, with a range of herbaceous taxa recorded potentially representing their growth in a number of open habitats, including wetlands, meadow, pasture, disturbed/waste ground with crops and their associated weeds.

Further analysis of the pollen and diatom assemblages from the site has the potential to provide further insights into human economy, diet & health and hydrology, as well as to establish any differences between the assemblages in the naturally deposited (QBH2) and reworked/redeposited (QBH3) peat deposits. Relatively few palaeoenvironmental records are available for this area of London for the Saxon period, so any further analysis also has the potential to contribute to our understanding of the interaction between Saxon societies and the natural environment at this time. The results of the analysis could be combined with the results of the investigations at Adelphi House (Young *et al.*, 2015) and 18-20 York Buildings (Cowie & Whytehead, 1989) to form a useful publication that contributes to our knowledge of Saxon Lundenwic, in particular at the foreshore.

## 2. INTRODUCTION

### 2.1 Introduction

This report summarises the findings arising out of the geoarchaeological field investigations and subsequent palaeoenvironmental assessment undertaken by Quaternary Scientific (University of Reading) in connection with the proposed redevelopment of 2-3 Robert Street, City of Westminster (National Grid Reference: *centred on* TQ 30372 80549; Site Code: ROB17; Figures 1 and 2). The work was commissioned by Archaeology Collective. Geoarchaeological investigation of the site will enable a preliminary reconstruction of its environmental history, which can be compared and integrated with records from other sites in this area, such as those at Adelphi House (Young *et al.*, 2015) and 18-20 York Buildings (Cowie & Whytehead, 1989) (see Figure 1). The latest phase of geoarchaeological investigations follows previous geoarchaeological monitoring at the site (Young, 2017), archaeological evaluation by MoLA (2015) and AOC (2017; 2018a; 2018b), and radiocarbon dating undertaken by ARCA (2018).

### 2.2 Site context

The area of investigation at 2-3 Robert Street is in Central London on the north side of the River Thames between the Strand and the Victoria Embankment and about 150m from the modern waterfront. The ground level of the site lies at approximately 13m OD, with the basement level lying at around 3.9m OD. The British Geological Survey (BGS) (1:50,000 Sheet 256 North London, 1994) shows the site underlain by Kempton Park Gravel which forms a very narrow terrace here parallel with the river, and with a surface level at about 5m OD (cf. Gibbard, 1985 Fig. 33, upper section). Within or very close to the 2-3 Robert Street site, the Holocene Alluvium of the Thames is shown by BGS immediately abutting the Kempton Park Gravel. Topographic and geological description of the site carried out by MoLA (2015) indicates that the surface of the terrace gravels slopes downwards from 1m to -5m OD, from north to south across the site. The bedrock beneath the site is mapped by BGS as the Lower Tertiary London Clay.

Previous archaeological and geoarchaeological evaluation work carried out by MOLA in 2015, comprised the opening of three trenches on the southern part of the 2-3 Robert Street site.

Trench 1 measured 2 x 1.6 x 2.4m, with a base at 1.51m OD

Trench 2 measured 3 x 1.6 x 2.2m, with a base at 2.27m OD

Trench 3 measured 2.4 x 1.7 x 2m, with a base at 1.92m OD

Within each trench, a series of levelling and make-up deposits was recorded, together with evidence of an 18th century brick and concrete wall foundations in the southeast corner of site; most likely the result of repeated demolition and reconstruction prior to the construction of the current grade II\* building (MoLA, 2015). Natural alluvial deposits were only recorded within a single auger hole, put down through the base of Trench 2, reaching it at 0.87m OD (3.06m below ground level (bgl)).

The terrace gravels were not encountered during this investigation, although subsequent monitoring of geotechnical boreholes by Young (2017) revealed a sequence of London Clay

bedrock, overlain by Late Devensian Shepperton Gravel, Holocene alluvium (in places including peat), ground-raising/levelling deposits and modern Made Ground. The surface of the Gravel at the site was recorded at between -0.15 and -1.1m OD, falling from northwest to southeast towards the modern channel of the River Thames (Young, 2017). The Gravel was overlain by between 0.3 and 2.85m of material interpreted as Holocene alluvium, in two boreholes containing peat or richly organic units, but otherwise described as silt- or clay-rich. The surface of the alluvium was interpreted as 0.20, 1.75 and -0.80m OD in boreholes BH1, BH2 and BH3 respectively, although it was acknowledged that this unit is in some cases difficult to differentiate from the overlying ground-raising/levelling deposits that incorporate material from this alluvial unit (see Young, 2017). In boreholes BH1 and BH2 very organic/peat units were recorded between 1.10 to 0.20 and -0.10 to -0.40m OD respectively. The top of the organic-rich deposit in BH1 (having been subsampled at 1.1m OD by the geotechnical unit) was radiocarbon by ARCA (2018) to the Middle Saxon period (605-665 cal AD).

Subsequent archeological evaluation by AOC (2018a) interpreted the overlying ground-raising/levelling deposits as Made Ground used to found a building or buildings constructed using chalk and ragstone blocks, and thought likely to date to the medieval period. These buildings appear to have been largely demolished when 2-3 Robert Street was built in the latter half of the 18th century (AOC, 2018a). A further phase of evaluation by AOC (2018b) characterised one of the associated chalk walls (recorded previously in TP8), which ran parallel to the Listed chalk wall in the vaults. The work by AOC (2018b) concluded that there is no evidence to suggest the chalk walls were contemporary or part of the same structure and there is no direct link between the chalk wall in the evaluation trench and the section of chalk wall in the standing basement.

Archaeological excavations have been undertaken both to the west and east of 2-3 Robert Street, at the Adelphi House (PCA, 2015) and 18-20 York Buildings sites respectively (Cowie & Whytehead, 1989; see below). The Adelphi House works consisted of an excavation for a new Lift Pit and measured only about 4.0m x 3.5m. Here, the top of the archaeological horizons of interest was close to 2.0m OD and the base of the sediment sequence exposed in the excavation was at about 0.05m OD. The earliest deposits recorded at the site were sand and gravels thought to represent natural accumulation but in places containing animal bone and pottery, dated to AD 600-750. On the basis of the sediment sequence recorded, and considering the levels involved, it would appear that the site of the lift pit archaeological investigation preserves the contact between the Holocene Alluvium and underlying London Clay at a level of ca. 0.2m OD, where the latter forms the Holocene foreshore of the river and presumably rises away from the river towards the level of the Kempton Park Terrace.

### **2.3 Geoarchaeological, Palaeoenvironmental and Archaeological potential**

The site represents a rare opportunity to study the Middle Saxon waterfront in London, including its management and tidal regime, currently poorly understood and highlighted as a research priority for London (Nixon *et al.*, 2002). Excavations at Adelphi House uncovered significant remains of Middle Saxon date of regional if not national importance, including foreshore deposits in which a silver coin gilded with gold was found (provisionally dated to AD 655-675), embankment and waterfront

structures including a wattle structure, brushwood and a timber river wall, levelling deposits, a timber building, metalled surfaces and cut features including pits and ditches. These were overlain by the latest features recorded at the site, which included medieval or post-medieval post-holes and a post-medieval floor. As outlined above, the earliest deposits recorded at the site were sand and gravels thought to represent natural accumulation but in places containing animal bone and pottery, dated to AD 600-750.

Both the 2-3 Robert Street and Adelphi House sites are situated in the western part of the Middle Saxon settlement of Lundenwic which was occupied between the late 7th century and the mid-9th century and located in Westminster centred on the Strand, Covent Garden and Aldwych areas. The Strand was the heart of the trading 'emporium' where boats were beached to trade goods from the Continent. The Middle Saxon waterfront of Lundenwic was identified during excavations at 18-20 York Buildings (next door to the Adelphi Building; Cowie & Whytehead, 1989; see Figure 1). Here, sandy foreshore deposits (containing anthropogenic material including bone and oyster shell) were interpreted as accumulating naturally at the edge of a river. Stakes and revetment structures constructed in AD 679 or shortly after were driven in to these deposits, along with material laid down to create an embankment with a surface at between 0.8 and 1.3m OD (Cowie & Whytehead, 1989). The embankment structure was overlain by Alluvial sediments containing seeds and Mollusca indicative of shallow, bankside and possibly tidal conditions to a level of 1.6m OD (Cowie & Whytehead, 1989). Possible Middle Saxon foreshore deposits and associated embankment structures have also been recorded at 12 Buckingham Street (BHM88) and Charing Cross Station (CHA87); the top of a wooden stake at the latter was recorded at 1.19m OD (Cowie, 1992).

Environmental archaeological investigations were carried out on column and bulk samples extracted from the lift-pit at Adelphi House, incorporating lithostratigraphic analysis and assessment of the palaeoecological remains (Young *et al.*, 2015). Investigation of the column samples revealed a range of inorganic and organic sediments (including peat) representative of foreshore deposits, ground raising and dumped material. The samples were rich in archaeobotanical (pollen, diatoms, plant macrofossils, charcoal and wood) and zooarchaeological (animal bone, insects, Mollusca), providing important insights into the former environmental conditions, vegetation communities, hydrology, diet and economy of the site.

## **2.4 Aims and objectives**

Following the work undertaken at the site by Young (2017), it was highlighted that the peat and richly-organic units at 2-3 Robert Street have the potential to contain further information on the past landscape, through the assessment/analysis of palaeoenvironmental remains (e.g. pollen, plant macrofossils and insects) and radiocarbon dating. A programme of work to collect samples suitable for environmental archaeological assessment was therefore undertaken. A total of four boreholes were put down at the site (boreholes QBH1 to QBH4), with lithostratigraphic descriptions of these boreholes undertaken and the new stratigraphic data used to update the existing deposit model of the major depositional units across the site, and to characterise the depositional sequence in more detail (Young, 2019). The peat and richly-organic units identified in the new geoarchaeological

boreholes at were considered to have high potential to contain further information on the past landscape, through the assessment/analysis of palaeoenvironmental remains (e.g. pollen, plant macrofossils and insects) and radiocarbon dating. A programme of environmental archaeological assessment of the organic parts of the sequence in boreholes QBH2 and QBH3 was therefore recommended, including radiocarbon dating of the peat recorded between ca. 0.2 and -0.35m OD (QBH2), and the organic unit at the base of the ground-raising/levelling deposits in QBH3 (0.58 to 0.50m OD), in order to investigate the relationship between the organic units that potentially form part of the overlying ground-raising/levelling deposits.

So called environmental archaeological or palaeoenvironmental investigations can identify the nature and timing of changes in the landscape, and the interaction of different processes (e.g. vegetation change, human activity, climate change, hydrological change) thereby increasing our knowledge and understanding of the site and nearby area. In the case of human activity, palaeoenvironmental evidence can include: (1) decreases in tree and shrub pollen suggestive of woodland clearance; (2) the presence of herbs indicative of disturbed ground, pastoral and/or arable agriculture; (3) charcoal/microcharcoal suggestive of anthropogenic or natural burning, and (4) insect taxa indicative of domesticated animals.

As outlined by Young (2017), the site represents an opportunity to study the Middle Saxon waterfront in London in more detail, including its management and tidal regime, currently poorly understood and highlighted as a research priority for London (Nixon *et al.*, 2002). As such, the following aims were proposed within the environmental archaeological Written Scheme of Investigation for the site (Batchelor, 2017):

1. To clarify the nature, depth, extent and date of the sub-surface stratigraphy across the site;
2. To determine the height of the contact between the natural and archaeological deposits;
3. To determine whether redeposited peat deposits are present beneath the site as recorded at Adelphi House;
4. To investigate whether the sequences contain any artefact or ecofact evidence for prehistoric or historic human activity;
5. To investigate any change in the former environmental conditions, vegetation communities and hydrology of the site as a consequence of either natural and/or anthropogenic change;
6. To provide insights into human economy and diet;
7. To compare the environmental archaeological findings with those from other sites within the main Lundunwic settlement for publication (if appropriate, pending the results of the investigations).

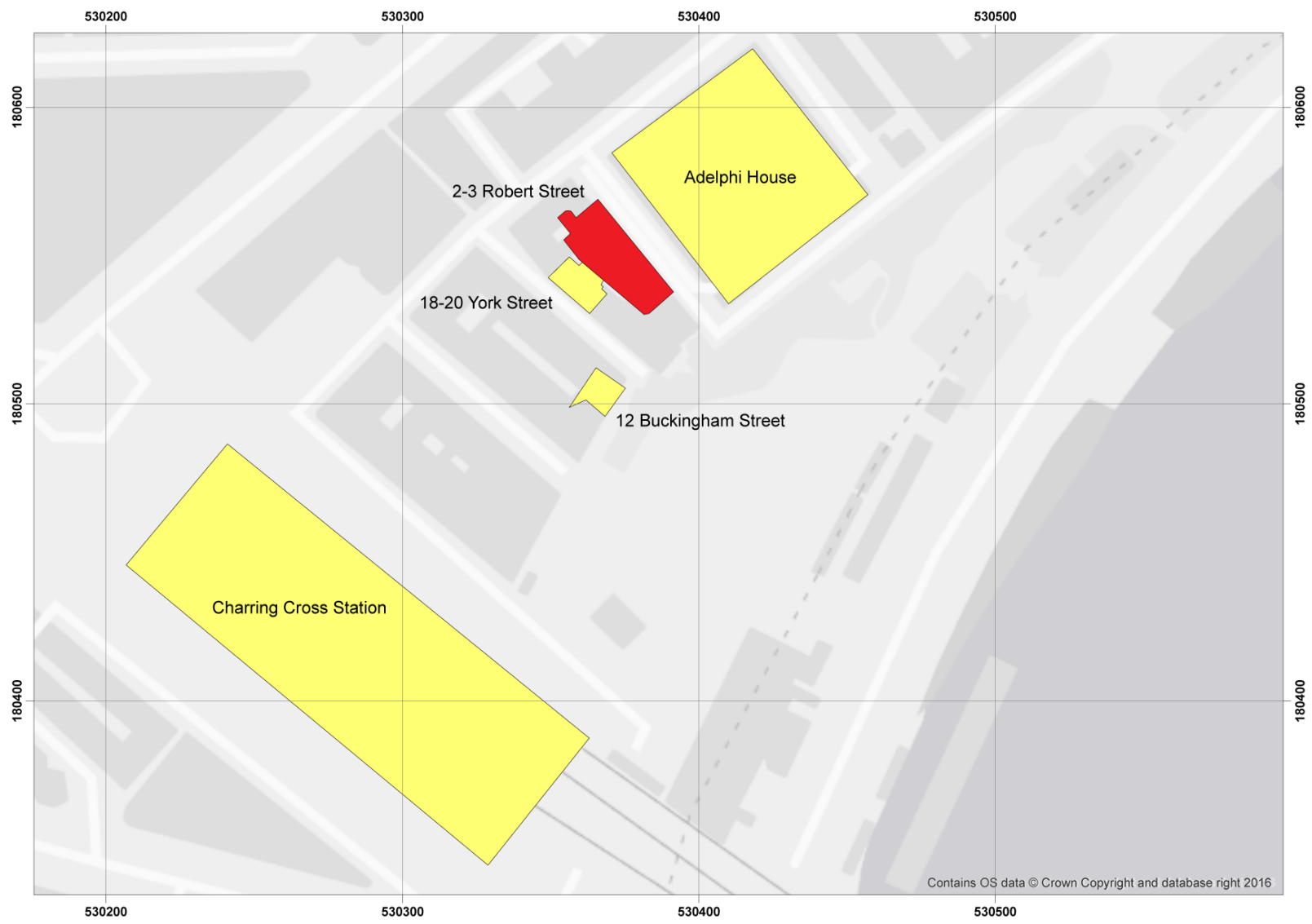


Figure 1: Location of 2-3 Robert Street, City of Westminster, and select nearby sites: Adelphi House (PCA, 2015; Young et al., 2015; Austin, 2016); 18-20 York Street (Cowie & Whytehead, 1989); 12 Buckingham Street & Charring Cross Station (Cowie, 1992).





Figure 2: Location of the new geoaerchaeological boreholes (QBH1 to QBH4), and previous archaeological/geotechnical interventions carried out by MoLA (2015), AOC (2017), AOC (2018a) and AOC (2018b) at 2-3 Robert Street, City of Westminster. Figure adapted from AOC (2018b). Orientation of NW-SE transect (see Figure 3) also shown.

## 3. METHODS

### 3.1 Field investigations and lithostratigraphic descriptions

A total of four boreholes were put down at the site by Geotechnical and Environmental Associates (GEA) under the supervision of Quaternary Scientific in April 2018 (see Figure 2). The borehole core samples were recovered using a Terrier rig, with the resultant core material retained in sealed plastic tubing and described in the laboratory by a geoarchaeologist. The boreholes were put down until the surface of the underlying river gravel was reached. The borehole locations were obtained by GEA; a level of 3.5m OD (following the breaking out of the concrete slab) has been adopted for the surface level of the four boreholes.

The lithostratigraphy of the core 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 lithostratigraphic descriptions of the new geoarchaeological boreholes are displayed in Tables 4 to 7 and in Figure 3. The descriptions for the previously monitored geotechnical boreholes described in Young (2017) are shown in Tables 1 to 3.

### 3.2 Pollen assessment

Fourteen subsamples from borehole QBH2 and two from QBH3 were extracted for an assessment of pollen content. The pollen was extracted as follows: (1) sampling a standard volume of sediment (1ml); (2) adding one tablet 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 (>125 $\mu$ ); (5) acetolysis; (6) removal of finer minerogenic fraction using Sodium polytungstate (specific gravity of 2.0g/cm<sup>3</sup>); (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 9).

### 3.3 Diatom assessment

Four subsamples 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 would be identified with reference to van der Werff and Huls (1958-74), Hendy (1964) and Krammer & Lange-Bertalot (1986-1991). The results of the diatom assessment are shown in Table 10.

### **3.4 Macrofossil assessment**

A total of five small bulk samples from borehole QBH2 and two from QBH3, each measuring approximately 0.05 litres in volume, were extracted and processed for the recovery of macrofossil remains, including waterlogged and charred plant macrofossils, charcoal, wood, insects and Mollusca. The samples were focussed on the lower organic unit and peat in borehole QBH2 (Table 10), and the reworked/redeposited peat in QBH3 (Table 11). 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 11 and 12), whilst preliminary identifications of the waterlogged seeds (Tables 13 and 14) have been made using modern comparative material and reference atlases (e.g. Martin & Barkley, 2000; NIAB, 2004; Cappers *et al.* 2006). Nomenclature used follows Stace (2005).

### **3.5 Radiocarbon dating**

A total of three samples were submitted for radiocarbon dating. Two subsamples of twig wood (less than 2-3 growth rings) were extracted from the lower organic unit (-0.12 to -0.17m OD) and the base of the peat (0.00 to -0.05m OD) in borehole QBH2, as well as a fragment of *Corylus avellana* (hazel) nut shell from the base of the possibly reworked peat in borehole QBH3 (0.50 to 0.52m OD). 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 3 and in Table 8.

## 4. RESULTS & INTERPRETATION OF THE GEOARCHAEOLOGICAL INVESTIGATIONS & RADIOCARBON DATING

The results of the lithostratigraphic descriptions of the four new geoarchaeological boreholes are shown in Tables 4 to 7, with the descriptions of the existing geotechnical boreholes described in Young (2017) shown in Tables 1 to 3. A revised northwest-southeast stratigraphic profile of these sequences, incorporating the new geoarchaeological boreholes, the existing geotechnical boreholes and MoLA Trench 2, is shown in Figure 3. As described by Young (2017), the full sequence of sediments recorded in the boreholes comprises:

- Made Ground (modern)
- Ground raising/levelling deposits (unknown date; Middle Saxon or later)
- Holocene alluvium (including peat/organic units)
- Sand and gravel (Shepperton Gravel)
- Bedrock (London Clay)

### 4.1 Bedrock (London Clay)

A horizon of stiff, slightly silty and slightly sandy clay interpreted as the London Clay bedrock was recorded at the base of borehole QBH4 at -1.42m OD, and in geotechnical borehole BH1 at -2.8m OD. As might be expected at this location on the edge of the River Thames floodplain, the bedrock rises sharply north-westwards; in the geotechnical logs provided by GEA the surface of the London Clay was recorded in boreholes BH2 and BH3 at levels of -4.3 and -5.4m OD respectively.

### 4.2 Sand and gravel (Shepperton Gravel)

Overlying the London Clay bedrock in all three of the previous geotechnical boreholes (BH1 to BH3) and reached in three of the new geoarchaeological boreholes (QBH2 to QBH4) was a horizon of sand and gravel. On the basis of the elevation of the Gravel (see below), it seems unlikely to represent the Kempton Park terrace, which north of here forms a very narrow terrace parallel with the river with a surface level at about 5m OD (Gibbard, 1985 Fig. 33, upper section). This Gravel is therefore interpreted as the Shepperton Gravel of Gibbard (1985; 1994). This gravel unit was deposited during the Devensian Late Glacial (ca. 15,000 to 11,700 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.

In all but one of the boreholes the surface of the Gravel is relatively even, lying at between -1.1 (BH2 and BH3) and -1.50m OD (QBH3). Only in BH1 is it significantly higher, recorded at -0.15m OD. Given the close proximity of this borehole to QBH3 and QBH4, it is possible the level of the Gravel in BH1 is artificial, potentially the result of anthropogenic disturbance of the Gravel (perhaps during the emplacement of the overlying ground raising deposits) at this location of the site.

### 4.3 Holocene alluvium (including peat/organic horizons)

Holocene alluvium was recorded in varying thicknesses in all eight of the interventions shown in Figure 3, overlying the Gravel. The surface of this unit was interpreted as 0.20, 1.75 and -0.80m OD in boreholes BH1, BH2 and BH3 during the previous investigations undertaken by Young (2017); in the new geoarchaeological boreholes it is recorded at -0.98, 0.50, 0.58 and 0.18m OD in boreholes QBH1, QBH2, QBH3 and QBH4 respectively. However, it was acknowledged previously (Young, 2017) that this unit is in some cases difficult to differentiate from the overlying ground-raising/levelling deposits that incorporate material from this alluvial unit, and it seems likely that the 'natural' (untruncated) level of the alluvium probably lies at about 1m OD. The deposits of the alluvium are generally described as predominantly silty, clayey and occasionally sandy. Significantly, a peat unit is present in the alluvial sequence, generally at levels between ca. 0.2 and -0.35m OD, but not recorded in the interventions southeast of BH2 (MoLA Trench 2, QBH1 and BH3). In these latter boreholes the sequence appears to be truncated by the overlying anthropogenic deposits to levels lower than the peat (to ca. -1m OD).

In the previous report (Young, 2019), the relationship between the peat unit described above and the organic sediments recorded higher up in the sequence, and potentially forming part of the ground raising/levelling deposits) in QBH3 and BH1 was unclear. On the basis of its elevation (1.1-0.2m OD) it was considered likely to represent either a different, later phase of peat formation to that recorded between ca. 0.2 and -0.35m OD: potentially either contemporary with or forming part of the ground-raising/levelling deposits recorded at similar elevations in the adjacent boreholes, or simply redeposited organic material from the lower peat horizon.

On the basis of the new radiocarbon dates, the organic units recorded at the site are of a very similar Saxon date, all falling within the period 605-770 cal AD (see Table 8 and Figures 3 & 4). The two dates now obtained on the upper, potentially reworked organic units are 645-765 cal AD (1305-1185 cal BP) at 0.50 to 0.52m OD (QBH3) and 605-665 cal AD (1345-1285 cal BP) at 1.10m OD (BH1; ARCA, 2018). With regards to the potentially *in situ* organic/peat units, the lower organic unit in QBH2 at -0.12 to -0.17m OD is dated to 650-770 cal AD (1300-1180 cal BP), whilst the base of the peat unit in QBH2 (-0.05 to 0.00m OD) is dated to 615-765 cal AD (1335-1185 cal BP). The similarity of these dates, and the apparent age reversal between the lower organic unit and the uppermost (potentially reworked) organic unit in BH1, lends support to the notion that the upper organic units above ca. 0.2m OD are redeposited or reworked remnants of the naturally accumulated peat recorded between ca. 0.2 and -0.35m OD. In addition, the macrofossil remains recorded within both the lower, potentially *in situ* peat and the upper reworked peat are very similar, with anthropogenic waste such as bone, fragments of oyster shell and charcoal recorded in both sets of deposits. This indicates that if the peat between ca. 0.2 and -0.35m OD is naturally accumulated, it did so in a marshy or boggy location that must have been on the margins of an environment heavily modified by human activity.

Where the sediments of the alluvium are described as predominantly silty or clayey they are indicative of deposition within low energy fluvial and/or semi-aquatic conditions during the Holocene, in most cases at a distance from any active channels but with occasional higher-energy

flood events. 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. Where peat/very organic units are recorded, these are indicative of a transition towards semi-terrestrial (marshy) conditions, supporting the growth of sedge fen/reed swamp and/or woodland communities.

The combined Holocene alluvial sequence across the site, incorporating the peat and alluvium, is between 0.3 (BH3) and 2.85m thick (BH2); these thicknesses are clearly influenced by the thickness of the overlying ground-raising/levelling deposits and probable truncation of the natural alluvial sequence. The alluvial sequence to the southeast of BH2 (MoLA Trench 2, QBH1 and BH3) is noticeably thinner, with a much lower level of truncation by the overlying ground-raising/levelling deposits (to ca. -1m OD).

#### **4.4 Ground raising/levelling deposits (unknown date)**

A series of ground-raising/levelling deposits, incorporating redeposited alluvium and various inclusions indicative of human activity of unknown date (e.g. bone, shell, worked wood and charcoal) is recorded in the majority of the boreholes overlying (and probably truncating) the natural alluvial sequence. It was not always possible to differentiate this unit from the underlying alluvium, since it incorporated material from this deposit (including peat), but on the basis of the new radiocarbon dates, the organic unit in BH1 appears to be a reworked remnant of the lower peat, and in fact forms part of the ground-raising/levelling deposits at this level across the site.

The surface of this unit is variable across the site, recorded at between 2.7 (BH2) and 1.35m OD (QBH4). In all boreholes this unit was predominantly composed of brick, bone, shell (in places including oyster), sand, gravel and charcoal, generally in a silty clay matrix, and most likely incorporating material from the underlying alluvium; in several places this unit is highly organic, potentially incorporating material from the underlying peat unit. Where no anthropogenic material was identified in this unit, it has been distinguished from the underlying alluvium by the 'reworked' appearance of the units, which are generally homogenous and poorly sorted in comparison to the underlying alluvium. In BH3 a large (>0.5m thick) horizontal timber was recorded at between 0.4 and 0.9m OD.

#### **4.5 Made Ground**

Modern Made Ground was encountered in all eight interventions, present in thicknesses of between 2.8 (BH1) and 1m (BH3). The Made Ground was between 2.3 (QBH1) and 1.68m (QBH3) thick in the new geoarchaeological boreholes. In BH3 a layer of chalk cobbles with lime mortar was recorded between 2.90 to 2.20m OD, perhaps associated with a wall or foundation of unknown date; this feature lies at a similar elevation to the wall foundation identified by MoLA (2015) in Trench 2.

Table 1: Lithostratigraphic description of geotechnical borehole BH1, 2-3 Robert Street, City of Westminster

Depth (m OD)	Depth (m bgs)	Description	Interpretation
3.90 to 1.30	0.00 to 2.60	Made Ground of concrete hardstanding on to brick and concrete rubble	MADE GROUND
1.30 to 1.10	2.60 to 2.80	Redeposited alluvium of grey silty clay with frequent brick fragments, mortar and concrete rubble.	
1.10 to 0.20	2.80 to 3.70	Sh2 Tl <sup>1</sup> Th <sup>1</sup> ; humo. 2; black moderately humified woody and herbaceous peat.	GROUND-RAISING/LEVELLING DEPOSITS
0.20 to -0.15	3.70 to 3.95	Ag2 As1 Sh1; dark greyish brown organic clayey silt.	ALLUVIUM
-0.15 to -2.80	3.95 to 6.70	Gg3 As1 Ga+; orange clayey gravel with a trace of sand. Clasts are flint, average diameter 40mm, well rounded.	SHEPPERTON GRAVEL
<-2.80	6.70+	As4 Ag+ Ga+; stiff grey clay with traces of silt and sand.	LONDON CLAY

Table 2: Lithostratigraphic description of geotechnical borehole BH2, 2-3 Robert Street, City of Westminster

Depth (m OD)	Depth (m bgs)	Description	Interpretation
3.90 to 3.20	0.00 to 0.70	Made Ground of concrete hardstanding on to brick and concrete rubble	MADE GROUND
3.20 to 3.10	0.70 to 0.90	Dark brown brick and charcoal in clayey matrix	
3.10 to 2.70	0.90 to 1.20	Concrete rubble	
2.70 to 2.20	1.20 to 1.70	Clayey silt with brick, bone, sand and gravel	GROUND-RAISING/LEVELLING DEPOSITS
2.20 to 2.00	1.70 to 1.90	Chalk rubble	
2.00 to 1.75	1.90 to 2.15	Sandstone	ALLUVIUM
1.75 to -0.10	2.15 to 4.00	Ag3 As1 Sh+ Dl+ Gg+; dark grey clayey silt with traces of organic matter, detrital wood and occasional gravel clasts. Occasional Mollusca fragments. Diffuse contact in to:	
-0.10 to -0.40	4.00 to 4.30	Ag2 Sh2 Dl+ Gg+; dark greyish brown very organic silt with traces of detrital wood and occasional gravel clasts. Diffuse contact in to:	
-0.40 to -1.10	4.30 to 5.00	Ag3 As1 Dh+; blueish grey clayey silt with traces of detrital herbaceous material.	
-1.10 to -1.60	5.00 to 5.50	Gg3 Ga1 Ag+; orangey grey sandy gravel with a trace of silt. Clasts are flint, up to 50mm in diameter, sub-angular to well-rounded.	SHEPPERTON GRAVEL

Table 3: Lithostratigraphic description of geotechnical borehole BH3, 2-3 Robert Street, City of Westminster

Depth (m OD)	Depth (m bgs)	Description	Interpretation
3.90 to 2.90	0.00 to 1.00	Made Ground (concrete hardstanding over concrete, brick and chalk rubble)	MADE GROUND
2.90 to 2.20	1.00 to 1.70	Layer of chalk cobbles with large flint nodules and lime mortar (wall/foundation?). Fragments of charcoal observed in places.	WALL/FOUNDATION
2.20 to 1.90	1.70 to 2.00	Ag2 Dh2 As+; dark greyish blue silt and detrital herbaceous material with a trace of clay. Diffuse contact in to:	GROUND-RAISING/LEVELLING DEPOSITS

1.90 to 1.80	2.00 to 2.10	Ag2 As2 Ga+ Dl+; dark grey silt and clay with traces of sand and detrital wood. Diffuse contact in to:	
1.80 to 0.90	2.10 to 3.00	Ag3 As1 Ga+ Dl+; dark greenish grey clayey silt with traces of sand and detrital wood. Diffuse contact in to:	
0.90 to 0.40	3.00 to 3.50	Large horizontal ?worked timber	
0.40 to 0.10	3.50 to 3.80	Ag2 As2 Sh+; dark blueish grey silt and clay with occasional organic lenses. Several large bone fragments throughout this unit. Diffuse contact in to:	
0.10 to -0.10	3.80 to 4.00	Ag2 As2 Sh+ Dl+; dark blueish grey silt and clay with occasional organic lenses. Several large bone fragments and wood throughout this unit. Diffuse contact in to:	
-0.10 to -0.80	4.00 to 4.70	Ag2 Ga1 As1 Gg+; dark grey sandy clayey silt with occasional gravel clasts and frequent bone fragments. Diffuse contact in to:	
-0.80 to -0.90	4.70 to 4.80	As3 Ag1; grey silty clay. Diffuse contact in to:	ALLUVIUM
-0.90 to -1.10	4.80 to 5.00	Ag2 Ga1 As1 Gg+; dark grey sandy clayey silt with occasional gravel clasts. Diffuse contact in to:	
-1.10 to -2.10	5.00 to 6.00	Gg2 Ga1 Ag1; dark grey sandy silty gravel. Clasts are flint, up to 40mm in diameter, well-rounded to sub-angular.	SHEPPERTON GRAVEL

Table 4: Lithostratigraphic description of geoarchaeological borehole QBH1, 2-3 Robert Street, City of Westminster

Depth (m OD)	Depth (m bgs)	Description	Interpretation
3.50 to 1.70	0.00 to 1.80	Made Ground of brick, concrete and stone rubble in a matrix of brown sandy clay with oyster shell.	MADE GROUND
1.70 to 1.20	1.80 to 2.30	Flint sand and gravel – assumed part of Made Ground.	
1.20 to 0.80	2.30 to 2.70	Gley1 4/N; As2 Ag2 Dh+; dark grey silt and clay with a trace of detrital herbaceous material. Diffuse contact in to:	GROUND-RAISING/LEVELLING DEPOSITS
0.80 to 0.50	2.70 to 3.00	7.5YR 3/1; Ag2 As2; very dark grey silt and clay with Mollusca fragments and small (<10mm) peaty lenses. Diffuse contact in to:	
0.50 to 0.02	3.00 to 3.48	7.5YR 3/1; Ag2 As2; very dark grey silt and clay. Diffuse contact in to:	
0.02 to -0.15	3.48 to 3.65	7.5YR 3/1; Ag2 Ga2 As+ Sh+ Dl+; very dark grey silt and sand with traces of clay, organic matter, detrital wood and Mollusca fragments. Diffuse contact in to:	
-0.15 to -0.50	3.65 to 4.00	7.5YR 3/1; Ga1 Gg1 Sh1 Ag1; very dark grey horizontally bedded variously organic, sandy, gravelly silt, Includes oyster shell. Diffuse contact in to:	
-0.50 to -0.86	4.00 to 4.36	7.5YR 3/1; Ga2 Gg2; very dark grey sand and gravel. Clasts are flint, sub-angular to well-rounded, average diameter 10mm. Sharp contact in to:	
-0.86 to -0.98	4.36 to 4.48	7.5YR 3/1; Ag2 Ga1 Gg1 Dl+; very dark grey sandy gravelly clay with oyster shell. Sharp contact in to:	



-0.98 to -1.13	4.48 to 4.63	7.5YR 3/1; Ga3 Ag1 Gg+ D1+; very dark grey silty sand with occasional gravel clasts and traces of detrital wood. Sharp contact in to:	ALLUVIUM
-1.13 to -1.34	4.63 to 4.84	7.5YR 3/1; Ag2 As2 Sh+; very dark grey silt and clay with a trace of organic matter. Diffuse contact in to:	
-1.34 to -1.50	4.84 to 5.00	Gley1 3/N; Ag2 As2 Gg+; very dark grey silt and clay with occasional gravel clasts, becoming more frequent towards base.	

**Table 5: Lithostratigraphic description of geoarchaeological borehole QBH2, 2-3 Robert Street, City of Westminster**

Depth (m OD)	Depth (m bgs)	Description	Interpretation
3.50 to 1.70	0.00 to 1.80	Made Ground of brick, concrete and stone rubble in a matrix of brown sandy clay with oyster shell.	MADE GROUND
1.70 to 1.50	1.80 to 2.00	7.5YR 2.5/1; Gg1 Ag1 As1 Sh1 Ga+; black organic, clayey silty gravel. Diffuse contact in to:	GROUND-RAISING/LEVELLING DEPOSITS
1.50 to 0.50	2.00 to 3.00	7.5YR 2.5/1; As2 Ag1 Gg1 Sh+; black gravelly silty clay with a trace of organic matter. Includes oyster shell. Diffuse contact in to:	
0.50 to 0.20	3.00 to 3.30	Gley1 4/10Y; As3 Ag1; dark greenish grey silty clay. Sharp contact in to:	ALLUVIUM
0.20 to -0.05	3.30 to 3.55	7.5YR 2.5/1; Sh2 Tl <sup>2</sup> 1 Ag1 Ga+; humo. 2/3; black moderately to well humified woody silty peat with traces of sand. Sharp contact in to:	(PEAT)
-0.05 to -0.13	3.55 to 3.63	Gley1 4/10Y; As3 Ag1; dark greenish grey silty clay. Sharp contact in to:	(PEAT)
-0.13 to -0.16	3.63 to 3.66	7.5YR 2.5/1; Sh2 Tl <sup>2</sup> 1 Ag1 Ga+; humo. 2/3; black moderately to well humified woody silty peat with traces of sand. Sharp contact in to:	
-0.16 to -0.31	3.66 to 3.81	Gley1 4/10Y; As3 Ag1; dark greenish grey silty clay. Diffuse contact in to:	
-0.31 to -0.50	3.81 to 4.00	7.5YR 3/2; Ag1 As1 D11 Sh1; dark brown organic clay and silt with detrital wood.	
-0.50 to -0.83	4.00 to 4.33	NO RECOVERY	
-0.83 to -0.85	4.33 to 4.35	7.5YR 3/2; Ag1 As1 D11 Sh1; dark brown organic clay and silt with detrital wood. Very sharp contact in to:	
-0.85 to -1.05	4.35 to 4.55	Gley1 4/10Y; Ga2 Ag1 Gg1; dark greenish grey gravelly silty sand. Diffuse contact in to:	
-1.05 to -1.27	4.55 to 4.77	Gley1 4/10Y; Ag3 Ga1; dark greenish grey sandy silt. Diffuse contact in to:	
-1.27 to -1.34	4.77 to 4.84	Gley1 3/10Y; Ga3 Ag1; dark greenish grey silty sand. Sharp contact in to:	
-1.34 to -1.50	4.84 to 5.00	Gg3 Ga1; sandy gravel. Clasts are flint, 20mm in diameter, sub-angular to well-rounded.	SHEPPERTON GRAVEL

Table 6: Lithostratigraphic description of geoarchaeological borehole QBH3, 2-3 Robert Street, City of Westminster

Depth (m OD)	Depth (m bgs)	Description	Interpretation	
3.50 to 2.50	0.00 to 1.00	Made Ground of brick, concrete and stone rubble in a matrix of brown sandy clay with oyster shell.	MADE GROUND	
2.50 to 2.00	1.00 to 1.50	Brick		
2.00 to 1.82	1.50 to 1.68	Chalk		
1.82 to 1.50	1.68 to 2.00	7.5YR 2.5/1; Gg1 Ag1 As1 Sh1 Ga+; black organic, clayey silty gravel. Diffuse contact in to:	GROUND-RAISING/LEVELLING DEPOSITS	
1.50 to 1.18	2.00 to 2.32	NO RECOVERY		
1.18 to 0.58	2.32 to 2.92	7.5YR 3/1; As2 Ga1 Ag1; very dark grey silty sandy clay with oyster shell, brick, gravel and charcoal. Sharp contact in to:		
0.58 to 0.50	2.92 to 3.00	7.5YR 2.5/1; T1 <sup>13</sup> Sh1; humo. 3; wood in a matrix of black well humified peat.		
0.50 to 0.20	3.00 to 3.30	NO RECOVERY		
0.20 to -0.03	3.30 to 3.53	7.5YR 3/1; Sh1 Ga1 Ag1 Gg1 D1+; very dark grey organic sand, silt and gravel with a trace of detrital wood. Diffuse contact in to:		ALLUVIUM
-0.03 to -0.12	3.53 to 3.62	7.5YR 4/2; D12 Ag1 Sh1; detrital wood in a matrix of brown organic silt. Sharp contact in to:		
-0.12 to -0.20	3.62 to 3.70	2.5Y 2.5/1; Ga2 Gg1 D11; black gravelly sand with detrital wood. Sharp contact in to:		
-0.20 to -0.35	3.70 to 3.85	7.5YR 4/2; Dh2 Sh1 Ag1 D1+; brown organic silt with frequent detrital herbaceous material and traces of detrital wood.		
-0.35 to -0.43	3.85 to 3.93	Large wood macrofossil (greater than width of sample).		
-0.43 to -0.50	3.93 to 4.00	2.5Y 2.5/1; Ga2 Gg1 Ag1; black silty gravelly sand.		
-0.50 to -0.75	4.00 to 4.25	NO RECOVERY		
-0.75 to -0.90	4.25 to 4.40	7.5YR 3/1; Gg2 Ga2; very dark grey sand and gravel. Clasts are flint, sub-angular to well-rounded, average diameter 15mm. Sharp contact in to:		
-0.90 to -1.25	4.40 to 4.75	Gley2 4/10G; Ag3 Ga1 Gg+; dark greenish grey sandy silt with occasional gravel clasts. Sharp contact in to:		
-1.25 to -1.30	4.75 to 4.80	7.5YR 3/1; Ga4 Ag+; very dark grey sand with a trace of silt. Sharp contact in to:		
-1.30 to -1.44	4.80 to 4.94	Gley2 4/10G; Ag3 Ga1 Gg+; dark greenish grey sandy silt with occasional gravel clasts. Sharp contact in to:		
-1.44 to -1.50	4.94 to 5.00	7.5YR 3/1; Ga4 Ag+ Gg+; dark brown sand with a trace of silt and occasional gravel clasts.		
-1.50 to -1.60	5.00 to 5.10	Gg3 Ga1; sandy gravel. Clasts are flint, 20mm in diameter, sub-angular to well-rounded.	SHEPPERTON GRAVEL	

Table 7: Lithostratigraphic description of borehole geoaerchaeological QBH4, 2-3 Robert Street, City of Westminster

Depth (m OD)	Depth (m bgs)	Description	Interpretation
3.50 to 1.50	0.00 to 2.00	Made Ground of brick, concrete and stone rubble in a matrix of brown sandy clay with oyster shell.	MADE GROUND
1.50 to 1.35	2.00 to 2.15	Brick	
1.35 to 1.18	2.15 to 2.32	7.5YR 3/1; Ga2 Gg1 As1; very dark grey clayey gravelly sand with frequent brick fragments and some Mollusca fragments (probably oyster shell). Sharp contact in to:	GROUND-RAISING/LEVELLING DEPOSITS
1.18 to 1.04	2.32 to 2.46	10YR 7/2; Ag2 As2; light grey calcareous silt and clay. Sharp contact in to:	
1.04 to 0.50	2.46 to 3.00	7.5YR 2.5/1; Sh1 Ga1 Ag1 As1 Gg+ DI+; black organic sand, silt and clay with occasional gravel clasts and traces of detrital wood.	
0.50 to 0.23	3.00 to 3.27	NO RECOVERY	
0.23 to 0.18	3.27 to 3.32	7.5YR 2.5/1; Sh1 Ga1 Ag1 As1 Gg+ DI+; black organic sand, silt and clay with occasional gravel clasts and traces of detrital wood. Sharp contact in to:	
0.18 to 0.11	3.32 to 3.39	7.5YR 4/1; Ag4 As+; dark grey silt with a trace of clay and Mollusca fragments. Very diffuse contact in to:	ALLUVIUM
0.11 to -0.16	3.39 to 3.66	7.5YR 2.5/1; Sh2 Ag1 DI1; black very organic silt with detrital wood. Sharp contact in to:	
-0.16 to -0.34	3.66 to 3.84	Gley1 3/10G; Ag2 Ga2 Gg+; very dark greenish grey silt and sand with occasional gravel clasts. Very sharp contact in to:	
-0.34 to -0.36	3.84 to 3.86	7.5YR 4/2; Ga4 Ag+; brown sand with a trace of silt. Very sharp contact in to:	
-0.36 to -0.50	3.86 to 4.00	7.5YR 4/2; Ag3 Ga1 DI+; brown sandy silt with a trace of detrital wood. Diffuse contact in to:	
-0.50 to -1.40	4.00 to 4.90	NO RECOVERY	
-1.40 to -1.42	4.90 to 4.92	7.5YR 4/2; Gg2 Ga1 As1; brown sandy clayey gravel. Clasts are flint, 20mm in diameter, sub-angular to rounded. Sharp contact in to:	SHEPPERTON GRAVEL
-1.42 to -1.50	4.92 to 5.00	7.5YR 4/3; As4 Ag+; brown moderately stiff clay with a trace of silt.	LONDON CLAY

Table 8: Results of the radiocarbon dating of boreholes QBH2 and QBH3, 2-3 Robert Street, City of Westminster and the existing date from BH1 (ARCA, 2018).

Laboratory code/ Method	Borehole number	Material and location	Depth (m OD)	Uncalibrated radiocarbon years before present (yr BP)	Calibrated age BC/AD (BP) (2-sigma, 95.4% probability)	$\delta^{13}C$ (‰)
BETA-531202	QBH2	Unidentified twig wood (2-3 growth rings); base of peat	0.00 to -0.05	1360 ± 30	615-765 cal AD (1335-1185 cal BP)	-28.0
BETA-531203	QBH2	Unidentified twig wood (2-3 growth rings); lower organic unit	-0.12 to -0.17	1320 ± 30	650-770 cal AD (1300-1180 cal BP)	-29.3
BETA-531201	QBH3	<i>Corylus avellana</i> nut shell from base of reworked peat	0.50 to 0.52	1340 ± 30	645-765 cal AD (1305-1185 cal BP)	-26.6
SUERC-77375 (GU46940))	BH1	Peat – humic acid from top of reworked peat	1.10	1399 ± 24	605-665 cal AD (1345-1285 cal BP)	-28.8

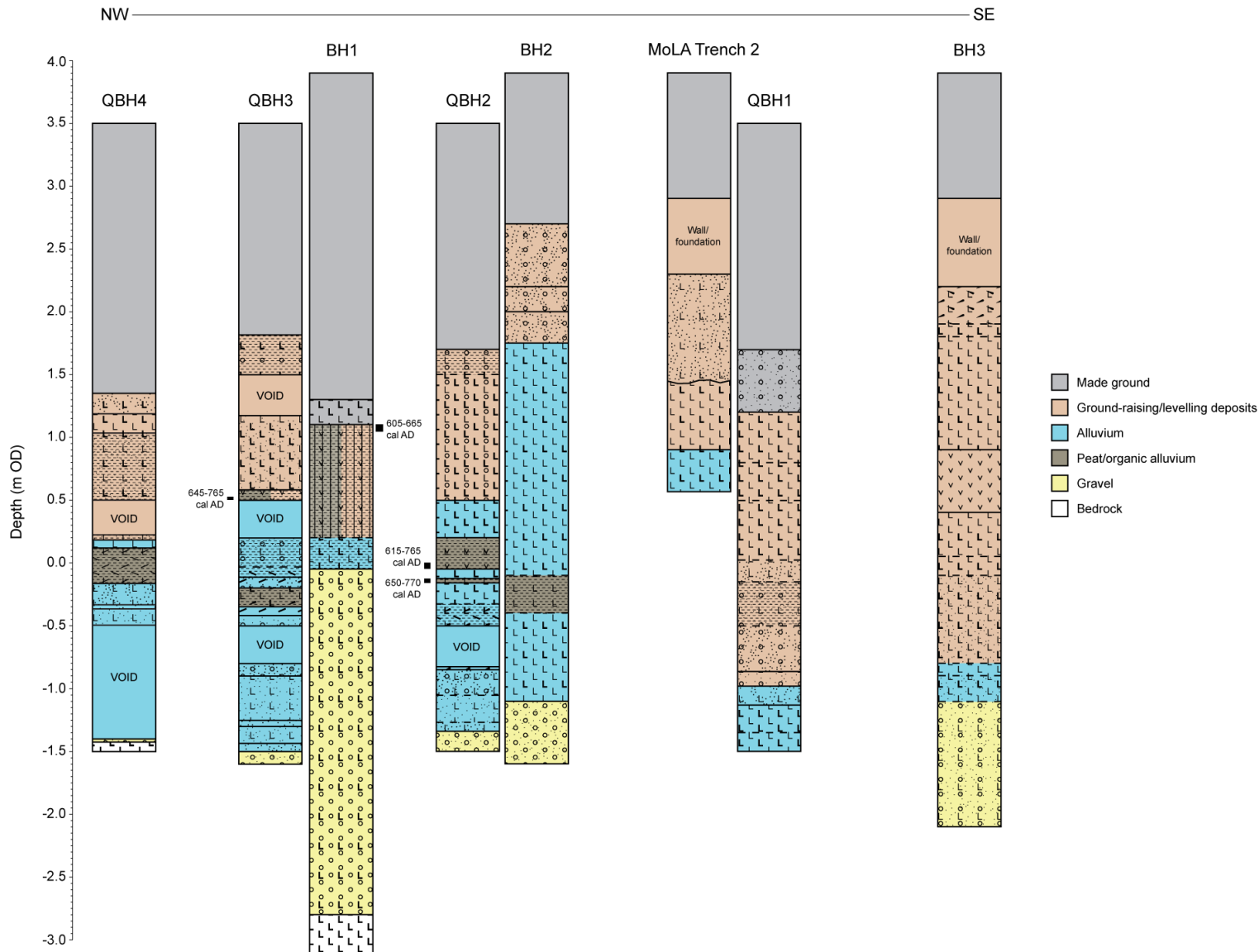


Figure 3: Northwest-Southeast transect of boreholes across the 2-3 Robert Street, City of Westminster incorporating data from MoLA (2015) and showing the results of the radiocarbon dating undertaken by ARCA (2018) and in the present investigation.

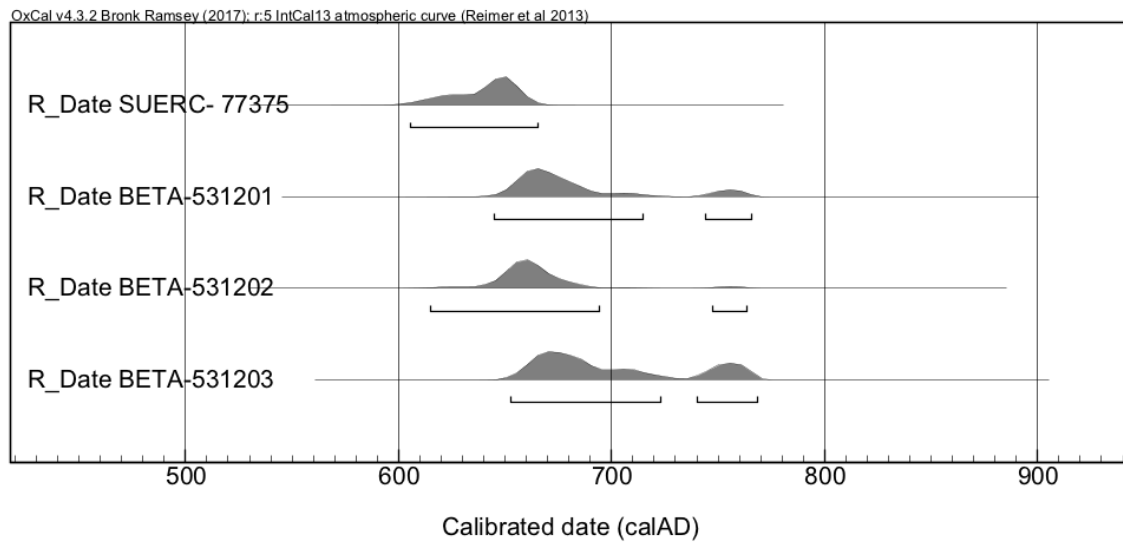


Figure 4: Radiocarbon dates (in stratigraphic order; see Table 8) from the organic horizons at 2-3 Robert Street, City of Westminster.

## 5. RESULTS & INTERPRETATION OF THE POLLEN ASSESSMENT

The results of the assessment indicate a high concentration of pollen in a moderate state of preservation in ten of the sixteen samples from QBH2 and both samples from QBH3. The remaining four samples from QBH2 contained either a very low concentration or absence of pollen (Table 9). The samples from both the organic unit in QBH3 and the organic/peat deposits in QBH2 are very similar, and are therefore discussed in combination below.

The samples are characterised by high values and diversity of herbaceous taxa. Grasses (Poaceae) and sedges (Cyperaceae) dominate with daisies (Asteraceae), goosefoot (*Chenopodium* type), dandelion (Lactuceae) and occasional cereals (*Cereale* type), black knapweed (*Centaurea nigra*), plantain (*Plantago* type / *lanceolata*), sorrel (*Rumex acetosa* / *acetosella*), buttercup (*Ranunculus* type), brassica (*Sinapis* type), meadowsweet (*Filipendula* type), bedstraw (*Galium* type), mugwort (*Artemisia* type), cinquefoil (*Potentilla* type) and knotweed (*Polygonum* type). Trees and shrubs were present to a more limited extent, including alder (*Alnus*), oak (*Quercus*), pine (*Pinus*), hazel (*Corylus* type), and more occasional lime (*Tilia*), birch (*Betula*), beech (Fagus), elm (*Ulmus*), heather (*Calluna vulgaris*), willow (*Salix*) and honeysuckle (*Lonicera periclymenum*). Aquatics are limited to sporadic occurrences of bur-reed (*Sparganium* type), and spores to ferns (*Filicales*), bracken (*Pteridium aquilinum*). Unidentifiable and unknown grains were relatively common. Finally, probable whipworm eggs (*Trichuris*) were recorded in a number of the samples; coprophilous fungi were also frequently noted.

The limited values of oak, birch, hazel, lime and beech suggest either their very limited growth nearby to the site, or more likely at distance. Alder may have grown in niches along the margins of the river nearby to the site, or on marshy/boggy regions of the floodplain. Honeysuckle grew nearby, as probably did heather. A range of herbaceous plants are recorded potentially representing their growth in a number of open habitats, including wetlands, meadow, pasture, disturbed/waste ground, cereals and their associated weeds. Wetland conditions are indicated by the presence of sedges and grasses (possibly reeds – *Phragmites australis*), bur-reed in particular. It is considered more likely that crop growth was not taking place on the site itself, but instead were brought to site for processing and consumption with weed taxa such as knotweed, black knapweed and brassica. In addition, grass (frequently the most dominant herbaceous taxa), with ribwort plantain, dock/sorrel and Asteraceae species may have grown in a pastoral community either nearby to the site, or possibly even derived from hay being brought to the site for animal husbandry purposes. The presence of whipworm eggs and coprophilous fungi also indicates the on-site occurrence of animals and has the potential to provide further insights into human economy, diet and health.

Table 9: Results of the pollen assessment from QBH2 and QBH3, 2-3 Robert Street, City of Westminster.

	Unit	QBH2														QBH3	
		Alluvium		Peat					Alluvium	Lower organic unit		Alluvium				Reworked peat	
		0.30	0.23	0.15	0.12	0.07	0.03	-0.02	-0.10	-0.14	-0.18	-0.26	-0.34	-0.42	-0.50	0.56	0.52
Latin name	Common name																
<b>Trees</b>																	
<i>Alnus</i>	alder	3	3			9			10	1	3	10	2	1	4		1
<i>Quercus</i>	oak	5			1	12			2		1	3	1	4	4	2	6
<i>Pinus</i>	pine	3	3						1		1	1	1	2	1		
<i>Ulmus</i>	elm												2				
<i>Tilia</i>	lime	2	1						2			1		1	1		
<i>Betula</i>	birch	1				2			1					2	1		
<i>cf Fagus</i>	beech											2	2				1
<b>Shrubs</b>																	
<i>Calluna vulgaris</i>	heather			1		1						1					1
<i>Corylus</i> type	e.g. hazel	6		2		8	1		6	2	2	10	5	7	10	8	4
<i>Erica</i> spp.	heath											1					
<i>Ilex</i> type	holly		1														
<i>Salix</i>	willow											2		1			
<i>Lonicera periclymenum</i>	honeysuckle			1													
<b>Herbs</b>																	
Cyperaceae	sedge family	3	1	2		2			10	1	1	3	1		4		
Poaceae	grass family	5	6	15	3	16			9	1	5	10	3	8	10	3	8
<i>Cereale</i> type	e.g. barley	3		1					2				1	1	3		
Asteraceae	daisy family	1			1				1	1				1	2		
<i>Artemisia</i> type	mugwort														1	1	
Lactuceae	dandelion family	1	2	10		1			1		2	6	5	2		2	3
<i>Plantago</i> type	plantain								1								1
<i>Plantago lanceolata</i>	ribwort plantain	1		1					1			1		1	1		
<i>Chenopodium</i> type	goosefoot family	4	2	1		6	1		2	2	4	5	1	1	4		1
Caryophyllaceae	pink family					1			1						1		
<i>Rumex acetosa/acetosella</i>	sorrel			1		1										1	1
Apiaceae	carrot family	2											1	1	1	2	1



	Unit	QBH2														QBH3	
		Alluvium		Peat					Alluvium	Lower organic unit		Alluvium				Reworked peat	
		0.30	0.23	0.15	0.12	0.07	0.03	-0.02	-0.10	-0.14	-0.18	-0.26	-0.34	-0.42	-0.50	0.56	0.52
<b>Latin name</b>	<b>Common name</b>																
<i>Ranunculus</i> type	e.g. buttercup				1	1						2	2			1	1
<i>Sinapis</i> type	brassica family			2					1			1					
<i>Galium</i> type	bedstraw					1							1				
<i>Filipendula</i> type	meadowsweet		1												2	3	1
<i>Potentilla</i> type	cinquefoil	1					1									1	1
<i>Centaurea nigra</i>	black knapweed			3								1		1			
<i>Valeriana</i> type	valerian										1						
<i>Campanula</i> type	bellflower												1				
<i>Trifolium / Vicia</i> type	clover / vetch														1		
<i>Polygonum</i> type	knotweed															1	
<b>Aquatics</b>																	
<i>Sparganium</i> type	bur-reed	2	1						1			1					1
<b>Spores</b>																	
<i>Pteridium aquilinum</i>	bracken	1							2			1		3			
<i>Filicales</i>	ferns	1		1		4			3		3					1	
<i>Polypodium vulgare</i>	polypody	1	1										1				
<i>Sphagnum</i>	moss														1		
<b>Unknown</b>		2		7		1				1		2	1	2	4	9	8
<b>Unidentifiable</b>			1			1					1	2	6				2
<b>cf Trichuris</b>				4			4			6		12	1	3	1		
<b>Total Land Pollen (grains counted)</b>		41	20	40	5	61	3	0	51	8	23	60	25	36	51	27	29
<b>Concentration*</b>		5	3	5	1	5	1	0	5	2	4	5	4	5	5	4	4
<b>Preservation**</b>		3	4	3	3	4	3	0	4	3	4	3	3	3	4	3	3
<b>Microcharcoal Concentration***</b>		3	2	2	2	2	3	2	2	4	2	2	3	2	3	2	3
<b>Suitable for further analysis</b>		YES	YES	YES	NO	YES	NO	NO	YES	NO	YES	YES	YES	YES	YES	YES	YES

Key: \*Concentration: 0 = 0 grains; 1 = 1-75 grains, 2 = 76-150 grains, 3 = 151-225 grains, 4 = 226-300, 5 = 300+ grains per slide; \*\*Preservation: 0 = absent; 1 = very poor; 2 = poor; 3 = moderate; 4 = good; 5 = excellent; \*\*\*Microcharcoal Concentration: 0 = none, 1 = negligible, 2 = occasional, 3 = moderate, 4 = frequent, 5 = abundant

## 6. RESULTS & INTERPRETATION OF THE DIATOM ASSESSMENT

The results of the assessment indicate a moderate to high concentration of diatoms in the lower and uppermost samples from QBH2 (-0.07 & 0.22m OD; Table 10). These samples were taken from alluvium capping the main peat deposit and record a medium diversity of diatom taxa. The two samples taken from the top and base of the peat at -0.02 and 0.18m OD however, record only isolated remains, with limited diversity. The samples recording high concentrations of remains demonstrate the potential of the alluvium for providing insights into the hydrological conditions of the site during the Saxon period.

Table 10: Results of the diatom assessment, QBH2, 2-3 Robert Street, City of Westminster

Depth (m OD)	Concentration	Preservation	Diversity
	0 (none) to 5 (high)	0 (none) to 5 (high)	Low/Med/High
0.22	4	3	Medium
0.18	1	2	Low
-0.02	1	3	Low
-0.07	3	2	Medium

## 7. RESULTS & INTERPRETATION OF THE MACROFOSSIL ASSESSMENT

A total of five small bulk samples from borehole QBH2 and two from QBH3 were extracted and processed for the recovery of macrofossil remains, including waterlogged and charred plant macrofossils, charcoal, wood, insects and Mollusca. The samples were focussed on the lower organic unit and peat in borehole QBH2 (Table 11), and the reworked/redeposited peat in QBH3 (Table 12). The samples all measured approximately 0.05 litres in volume.

### **Borehole QBH2**

Moderate to high quantities of waterlogged wood were recorded in the samples from QBH2, with moderate quantities recorded in the lower organic unit and moderate to high quantities in the peat. Waterlogged seeds were present in low concentrations throughout. In the lower organic unit, these included *Ranunculus repens* (creeping buttercup), whilst in the peat *Ranunculus repens*, *Chenopodium* sp. (e.g. fat hen), *Carex* sp. (sedge) and *Rumex* sp. (dock/sorrel) were recorded, along with fragments of *Corylus avellana* (hazel) nut shell and a charred caryopsis of *Triticum/Hordeum* sp. (wheat/barley) (Table 13). Charcoal was present throughout the sequence from QBH2, generally present in low to moderate concentrations and with the exception of the sample from -0.05 to 0.00m OD, present as fragments large enough for identification.

Fragments of Mollusca (cf. oyster) were recorded in all samples with the exception of the basal sample in the peat, from -0.05 to 0.00m OD. Fragments of bone were recorded in the samples from 0.14 to 0.20 and 0.00 to 0.05m OD, whilst insects were present in low concentrations in the sample from the lower organic unit (-0.12 to -0.17m OD). A fragment of CBM was observed in the peat, in the sample from 0.09 to 0.14m OD.

Although limited, the seed assemblage recorded in the samples from borehole QBH2 is typical of that recorded in an open sedge fen, with herbaceous taxa indicative of wet or damp ground including sedges, creeping buttercup and dock/sorrel. The latter two taxa are also typical of disturbed or waste ground, and along with the edible/economic taxa recorded in the form of wheat/barley and hazelnut, are indicative of human activity within the vicinity of the site. The anthropogenic components of the peat (in the form of charcoal, bone and oyster shell) may be indicative of peat accumulation within a landscape heavily influence by human activity, or disturbance of the peat by reworking/redeposition.

### ***Borehole QBH3***

Waterlogged wood was present in high concentrations in both samples from the peat in QBH3, along with low to moderate concentrations of charcoal, present in both samples in fragments large enough for identification. Waterlogged seeds were present in low concentrations in the uppermost sample, from 0.52 to 0.54m OD, consisting of *Chenopodium* sp. (e.g. fat hen) and *Ranunculus repens* (creeping buttercup) (Table 14). Fragments of bone were recorded in the sample from 0.52 to 0.54m OD, with fragments of Mollusca (c.f. oyster) in the sample from 0.50 to 0.52m OD.

Much like the macrofossil record from the peat in borehole QBH2, the waterlogged seed assemblage is limited but typical of relatively open, damp or waste ground, and the anthropogenic components of the peat may be indicative of peat accumulation within a landscape heavily influenced by human activity, or disturbance of the peat by reworking/redeposition.

Table 11: Results of the macrofossil assessment of samples from borehole QBH2, 2-3 Robert Street, City of Westminster.

Depth (m OD)	Unit	Volume processed (ml)	Fraction	Charred					Waterlogged			Mollusca	Bone		Insects	CBM		
				Charcoal (>4mm)	Charcoal (2-4mm)	Charcoal (<2mm)	Seeds	Chaff	Wood	Seeds	Sedge/grass remains (e.g. stems/roots)	Whole	Fragments	Large			Small	Fragments
0.14 to 0.20	Peat	0.05	>300µm	1	1	-	1	-	5	1	-	-	3	-	-	1	-	-
0.09 to 0.14		0.05	>300µm	2	2	-	-	-	2	1	-	-	1	-	-	-	-	1
0.00 to 0.05		0.05	>300µm	2	2	-	-	-	3	-	-	-	2	1	-	2	-	-
-0.05 to 0.00		0.05	>300µm	-	1	1	-	-	5	1	-	-	-	-	-	-	-	-
-0.12 to -0.17	Lower organic unit	0.05	>300µm	3	2	-	-	-	2	1	-	-	1	-	-	-	1	-

Key: 0 = Estimated Minimum Number of Specimens (MNS) = 0; 1 = 1 to 25; 2 = 26 to 50; 3 = 51 to 75; 4 = 76 to 100; 5 = 101+

Table 12: Results of the macrofossil assessment of samples from borehole QBH3, 2-3 Robert Street, City of Westminster.

Depth (m OD)	Unit	Volume processed (ml)	Fraction	Charred					Waterlogged			Mollusca	Bone		Insects			
				Charcoal (>4mm)	Charcoal (2-4mm)	Charcoal (<2mm)	Seeds	Chaff	Wood	Seeds	Sedge/grass remains (e.g. stems/roots)	Whole	Fragments	Large		Small	Fragments	
0.52 to 0.54	Upper	0.05	>300µm	3	2	-	-	-	4	2	-	-	-	-	-	2	-	-
0.50 to 0.52	Reworked peat	0.05	>300µm	1	1	-	-	-	4	-	-	-	1	-	-	-	-	-

Key: 0 = Estimated Minimum Number of Specimens (MNS) = 0; 1 = 1 to 25; 2 = 26 to 50; 3 = 51 to 75; 4 = 76 to 100; 5 = 101+

Table 13: Results of the seed identifications of samples from borehole QBH2, 2-3 Robert Street, City of Westminster.

Depth (m OD)	Unit	Seed identification		Quantity
		Latin name	Common name	
0.14 to 0.20	Peat	<i>Hordeum/Triticum</i> sp. (charred)	wheat/barley	2
		<i>Corylus avellana</i> (nut shell fragment)	hazelnut	1
0.09 to 0.14		<i>Ranunculus repens</i>	creeping buttercup	1
		<i>Chenopodium</i> sp.	e.g. fat hen	2
0.00 to 0.05		-	-	-
-0.05 to 0.00		<i>Carex</i> sp.	sedge	1
		<i>Rumex</i> sp.	dock/sorrel	2
-0.12 to -0.17	Lower organic unit	<i>Ranunculus repens</i>	creeping buttercup	1

Table 14: Results of the seed identifications of samples from borehole QBH3, 2-3 Robert Street, City of Westminster.

Depth (m OD)	Unit	Seed identification		Quantity
		Latin name	Common name	
0.52 to 0.54	Upper Reworked peat	<i>Chenopodium</i> sp.	e.g. fat hen	1
		<i>Ranunculus repens</i>	creeping buttercup	5
0.50 to 0.52		-	-	-

## 8. DISCUSSION & CONCLUSIONS

Following on from a series of geoarchaeological investigations at the site (Young, 2017; ARCA, 2018; Young 2019) a programme of geoarchaeological and palaeoenvironmental assessment was undertaken at the 2-3 Robert Street site in order to: (1) investigate whether the sequences contain any artefact or ecofact evidence for prehistoric or historic human activity; (2) investigate any change in the former environmental conditions, vegetation communities and hydrology of the site as a consequence of either natural and/or anthropogenic change; and (3) provide insights into human economy and diet. In order to address these aims and following the recommendations in Young (2019), a programme of radiocarbon dating and environmental archaeological assessment was undertaken on boreholes QBH2 and QBH3.

The results of the geoarchaeological investigations have revealed a sequence of London Clay bedrock, overlain by Late Devensian Shepperton Gravel, Holocene alluvium (in places including peat), ground-raising/levelling deposits and modern Made Ground. The surface of the bedrock rises sharply towards the northwest, as might be expected at this location on the edge of the Thames floodplain, from -5.4m OD in BH3 to -1.42m OD in QBH1. In all but one of the boreholes the surface of the overlying Gravel is relatively even, lying at between -1.1 and -1.50m OD; only in BH1 is it significantly higher, recorded at -0.15m OD. It seems likely that this higher level is a result of anthropogenic disturbance of the sequence at the location of BH1, potentially during the emplacement of the overlying ground raising deposits. On the basis of the elevation of the Gravel, it is considered to represent the Late Devensian Shepperton Gravel, rather than the deposits of the earlier (Devensian) Kempton Park terrace (see Gibbard, 1985).

The Gravel is overlain at the site by variable thicknesses of Holocene alluvium, recorded to levels of between ca. 1.75 and -0.80m OD. It should be noted however that in some cases it is difficult to differentiate between the alluvium and the overlying ground-raising/levelling deposits, since the former incorporates material from the latter in most cases, and it is likely that the 'natural' level of the alluvium probably lies at about 1m OD. The deposits of the alluvium are predominantly silty, clayey and occasionally sandy; however, a peat unit was recorded within the alluvial sequence, generally at levels between ca. 0.2 and -0.35m OD, but not recorded in the interventions southeast of BH2. In these latter boreholes the sequence appears to be truncated by the overlying anthropogenic deposits to levels lower than the peat (to ca. -1m OD). The organic/peat units within the alluvium are of Saxon date, radiocarbon dated in QBH2 to 650-770 cal AD (1300-1180 cal BP; -0.12 to -0.17m OD) and 615-765 cal AD (1335-1185 cal BP; -0.05 to 0.00m OD). Although the waterlogged seed assemblage within these deposits was limited, it was typical of that recorded in an open sedge fen, with herbaceous taxa indicative of wet or damp ground including sedges, creeping buttercup and dock/sorrel. The latter two taxa are also typical of disturbed or waste ground, and along with the edible/economic taxa recorded in the form of wheat/barley and hazelnut, are indicative of human activity within the vicinity of the site. In addition, the anthropogenic components of the peat (in the form of charcoal, bone and oyster shell) may be indicative of peat accumulation within a landscape heavily influenced by human activity, or perhaps at least some disturbance of the peat by reworking/redeposition.

On the basis of the new radiocarbon dates, the organic units recorded within the overlying ground raising/levelling deposits at the site are of a very similar Saxon date, all falling within the period 605-770 cal AD. The similarity of these dates, and the apparent age reversal between the lower organic unit and the uppermost (potentially reworked) organic unit in BH1, lends support to the notion that the upper organic units above ca. 0.2m OD, and forming part of the ground raising/levelling deposits, are redeposited or reworked remnants of the naturally accumulated peat recorded within the alluvium. In addition, the macrofossil remains recorded within both the lower, potentially *in situ* peat and the upper reworked peat are very similar, with anthropogenic waste such as bone, fragments of oyster shell and charcoal recorded in both sets of deposits. This indicates that if the peat between ca. 0.2 and -0.35m OD is naturally accumulated, it did so in a marshy or boggy location that must have been on the margins of an environment heavily modified by human activity.

The pollen record in both sets of deposits is also very similar. A generally open environment is indicated, with a range of herbaceous taxa recorded potentially representing their growth in a number of open habitats, including wetlands, meadow, pasture, disturbed/waste ground, cereals and associated weeds. Wetland conditions are indicated by the presence of sedges and grasses (including *Phragmites*), along with the aquatic taxon bur-reed. It is considered more likely that crop growth was not taking place on the site itself, but instead were brought to site for processing and consumption with weed taxa such as knotweed, black knapweed and brassica. In addition, grass (frequently the most dominant herbaceous taxa), with ribwort plantain, dock/sorrel and Asteraceae species may have grown in a pastoral community either nearby to the site, or possibly even derived from hay being brought to the site for animal husbandry purposes. The presence of whipworm eggs and coprophilous fungi also indicates the on-site presence of animals or their dung.

Elsewhere, the ground-raising/levelling deposits incorporate alluvial sediments from the underlying unit, including organic matter, and contain anthropogenic material of Saxon date onwards such as charcoal, bone, worked wood and shell (in places including oyster). The surface of this unit is variable across the site, recorded at between 2.7 and 1.35m OD, with its base generally lying at between ca. 0.3 and 1.0m OD; however, as described above it appears to have truncated the underlying alluvium to much lower levels of about -1m OD in the southeastern area of the site (southeast of BH2). Modern Made Ground caps the sequence, present in thicknesses of between 2.8 and 1m; in one borehole (BH3) a layer of chalk cobbles with lime mortar was recorded at the base of the Made Ground between 2.90 to 2.20m OD, perhaps associated with a wall or foundation of unknown date; this feature lies at a similar elevation to the wall foundation identified by MoLA (2015) in Trench 2.

The deposits at the 2-3 Robert Street site thus appear to represent natural foreshore deposits associated with the floodplain of the River Thames, overlain by alluvial sediments and a series of ground-raising/levelling deposits that incorporate material from the alluvial sediments below. The archaeological deposits here are therefore very similar in character to those recorded at both Adelphi House (Young *et al.*, 2015) and 18-20 York Buildings (Cowie & Whytehead, 1989). However, at the 2-3 Robert Street site, the lower alluvial deposits, including the peat/richly organic units recorded between ca. 0.2 and -0.35m OD, appear to have accumulated entirely by natural

processes. In contrast, the upper organic units, forming part of the ground raising/levelling deposits, is similar in character, and lies at a similar elevation, to the deposits at both Adelphi House and 18-20 York Buildings, where much of the material recorded was not in its primary depositional context, but has been brought to the site from elsewhere and dumped.

## 9. RECOMMENDATIONS

Analysis of the pollen and diatom assemblages from the site has the potential to provide further insights into human economy, diet & health and hydrology, as well as to establish any differences between the assemblages in the naturally deposited (QBH2) and reworked/redeposited (QBH3) peat deposits. Relatively few palaeoenvironmental records are available for this area of London for the Saxon period, so any further analysis also has the potential to contribute to our understanding of the interaction between Saxon societies and the natural environment at this time. The results of the analysis could be combined with the results of the investigations at Adelphi House (Young *et al.*, 2015) and 18-20 York Buildings (Cowie & Whytehead, 1989) to form a useful publication that contributes to our knowledge of Saxon Lundenwic, in particular at the foreshore.

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## 11. OASIS

### Project details

Project name	2-3 Robert Street
Short description of the project	Geoarchaeological and palaeoenvironmental field and assessment work have revealed a sequence of London Clay, overlain by Pleistocene Gravel, Holocene alluvium (in places including peat), ground-raising/levelling deposits and modern Made Ground. The Gravel is overlain at the site by variable thicknesses of Holocene alluvium, recorded to levels between ca. 1.75 and -0.80m OD. The alluvium is predominantly fine-grained and mineral-rich; however, a peat unit dated to the Saxon period was recorded between 0.2 and -0.35m OD. Above this, the ground-raising/levelling deposits incorporate alluvial sediments from the underlying unit, including organic matter, and contain anthropogenic material of Saxon date onwards (including charcoal, bone, worked wood and shell). The sediments appear to represent natural foreshore deposits associated with the floodplain of the River Thames, overlain by alluvium and a series of ground-raising/levelling deposits. They are very similar in character to those recorded at Adelphi House and 18-20 York Buildings. However, at 2-3 Robert Street, the lower alluvial deposits, including the peat/richly organic Saxon units at between ca. 0.2 and -0.35m OD, appear to have accumulated entirely by natural processes. The biological remains in both the naturally accumulated and reworked/redeposited organic deposits are very similar. A generally open, damp and disturbed environment is indicated, with a range of herbaceous taxa recorded potentially representing their growth in a number of open habitats, including wetlands, meadow, pasture, disturbed/waste ground with crops and their associated weeds. Detailed analysis was recommended.
Project dates	Start: 01-01-2017 End: 27-08-2019
Previous/future work	Yes / Yes
Any project codes associated with reference codes	ROB17 - Sitecode
Type of project	Environmental assessment
Site status	Listed Building
Monument type	PEAT Uncertain
Survey techniques	Landscape

### Project location

Country	England
Site location	GREATER LONDON CITY OF WESTMINSTER CITY OF WESTMINSTER 2-3 Robert Street
Site coordinates	TQ 30372 80549 51.508313696656 -0.121186868886 51 30 29 N 000 07 16 W Point
Height OD / Depth	Min: -1.5m Max: 1m

### Project creators

Name of Organisation	of Quaternary Scientific (QUEST)
Project originator	brief Archaeology Collective
Project design originator	D.S. Young

Project director/manager D.S. Young  
 Project supervisor D.S. Young  
 Type of Developer sponsor/funding body

### Project archives

Physical Archive No  
 Exists?  
 Digital Archive No  
 Exists?  
 Paper Archive LAARC  
 recipient  
 Paper Contents "Environmental", "Stratigraphic"  
 Paper Media "Report"  
 available

### Project bibliography 1

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