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THE PEEL PRS SITE, CHATHAM WATERS, GILLINGHAM, KENT: GEOARCHAEOLOGY BOREHOLE REPORT

Prepared for Cotswold Archaeology Ltd

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SUMMARY

This document reports on two geoarchaeological boreholes drilled on the Peel PRS site, Chatham Waters, Gillingham, Kent. The work was carried out by ARCA on behalf of Cotswold Archaeology Ltd on 7th and 8th February 2019. The results from earlier geotechnical boreholes and trial pits are included.

*Seaford Chalk Formation lies between -6.90m OD (12.4m bgl) and -9.80m OD (15.3m bgl). It is overlain by Pleistocene gravels of the Halling Terrace that sub-crop between -3.80m OD (9.30m bgl) and -2.30m OD (*c*. 7.9 m bgl) and attain a maximum thickness of 7.5m. A basal peat overlies the gravels at* c. *-1.5 to -2.0m OD and is dated to 3966 – 3366 cal BC (Early Neolithic). Palynological evidence points to an alder carr woodland with possibly a sedge fen /reed swamp understorey. Lime-dominated, mixed deciduous woodland occupied the higher and dryer land.*

Intertidal deposits buried the basal peat until the Late Bronze Age when an upper peat dating to 1207 – 722 cal BC developed. The upper peat lies at -0.29m OD and is 0.15m thick. A more open wetland landscape was present at this time. There was considerably less alder carr and the presence of a saltmarsh component to the fen and reed swamp is noted. Dry land tree cover was also reduced. The peat was buried in the Early Iron Age by renewed intertidal sedimentation.

Allochthonous, fragmentary peat particles and organic muds are found in later intertidal deposits. Peat growth appears to have taken place on two further occasions and is recorded at c. *+3m OD and at* c. *+1.5m OD in a geotechnical borehole and trial pit. Made Ground truncates the sedimentary sequence. The pollen and plant macrofossils samples are recommended for analysis.*

1. INTRODUCTION

1.1 This report discusses the results of a geoarchaeological investigation of two boreholes drilled at the Peel PRS site, Chatham Waters, Gillingham, Kent (henceforth 'the site'). The work was carried out by ARCA on behalf of Cotswold Archaeology Ltd on 7th and 8th February 2019. The work presented here is in accordance with a Written Scheme of Investigation (WSI) (Watson 2019) designed after consultation with the County Archaeologist, Ben Found, and Julia Sulikowska of Cotswold Archaeology Ltd, to mitigate for the effects of piling for the proposed building works. The WSI also conforms to Historic England (2015) guidance on geoarchaeology.

1.2 The sections of the report are arranged as follows: Section 1 provides essential background to the project, i.e. the geographic and geological situation of the site, past work, and the aims of the present work. Section 2 outlines the methodology employed in collecting and utilising the geological data. The lithostratigraphy of the study area is presented and interpreted in Section 3; Sections 4, 5 and 6 assesses the palaeobotanical evidence; Section 7 presents the dating; and the significance of the data recovered in relation to the aims that have been set is discussed in Section 8. A bibliography, figures and appendices providing palaeobotanical data and the locations and lithostratigraphy of the borehole logs complete the report.

1.3 The work was carried out at the site in advance of a proposed development, which is a single, multi-storey building for apartments, parking, retail and associated works (Fletcher and Arkley 2018, 4).

1.4 The site is centred on National Grid Reference (NGR) 577426 169643, it has an area of *c.* 0.6ha and an elevation of *c.* +5.5m OD. The site is located immediately southeast of Basin No. 3 at Chatham Commercial Docks, formerly the Royal Navy Chatham Steamyard (Fletcher and Arkley 2018, 4) that occupies the easternmost point bar of the River Medway. The river is located *c.* 350m to the northeast (Figure 1).

1.5 The British Geological Survey map (1:50,000 1977, sheet 272) shows the bedrock geology of the site as the Seaford Chalk Formation that was laid down in the Late Cretaceous epoch (100.5 – 66Ma). The lithology of the bedrock is firm, white chalk with nodular and tabular flints. Alluvium overlies the Chalk and it is mapped as a soft to firm compressible silty clay with layers of sand and peat. It was laid down in the Holocene epoch (11.7ka – present day) (British Geological Survey 2019a; 2019b).

1.6 A preliminary search was made of the Archaeology Data Service (n.d.) and the Intertidal and Coastal Peat Database held by Historic England (2018). Allen (1994; 1995) reports two lower peat beds from the Casting Basin for the Medway Tunnel *c.* 1km west, that are dated to 'earlier than 7,000 B.P. (before present) and 4,700 B.P. respectively. The highest peat horizon was dated by pottery to *c.* A.D. 100–350' (1995, 31). The Intertidal and Coastal Peat Database produced a single record that references Dines *et al.* (1954), but no mention of Quaternary peat could be found. Cotswold Archaeology's Archaeological Impact Assessment for the site (Fletcher and Arkley 2018, 8-9) refers to previously recorded peats in the surrounding area which are no more than rare pockets or thin (50mm) bands.

1.7 Firth (2000) reports on a peat and intertidal clay sequence developed on the Woolwich and Reading Beds Formation at Motney Hill *c.* 6km east of the site. A basal peat lies at *c.* -1m OD and may date to the Late Neolithic with overlying Bronze Age and Roman peats, the latter lying at *c.* 0m OD. They have been related to the Tilbury sequence of the River Thames estuary.

1.8 Four sites are particularly relevant to the Chatham Wates site and lie within 1.3km of it. They are: Chatham Dockyards, the former Akzo Nobel Chemical Works, the Medway Tunnel Approaches,[1] and most importantly the Boilershop Chatham Marine. They are briefly discussed below.

1.9 Borehole work at the Chatham Dockyards site 400m north of the site, revealed a thick sedimentary sequence from *c.* -10m OD to +1.50m OD consisting of gravels and interbedded peats and muds, and dated from 6620 cal BC to *c.* 800 cal BC. A maximum of three marine/terrestrial/marine cycles are recorded (Lowe and Branch 1996, 18-30). Pollen data points to alternating dominance by wetland, saltmarsh and dryland components with a preponderance of alder at the base, followed by a phase with elm, and then a decline in lime. The arboreal pollen progression is representative of Holocene woodland evolution in the South East England from the Mesolithic to the

[1] Work at the Gilllingham Northern Link (a continuation of the Medway Tunnel East Approach) revealed similar sequences to the Medway Tunnel Phase III but are undated (Bates and Williamson 1996).

Bronze Age. Detailed recommendations for further work were proposed on the palaeoenvironmental samples, but have not taken place as far as it is known.

1.10 East of the site by *c*. 600m lies the former Akzo Nobel Chemical Works site. Borehole work here in 2006 revealed peat deposits that date to 770-390 cal BC in the Iron Age. At the time no comparisons with peat found at the Boilershop Chatham Marine site (see Section 1.12) were possible because of its earlier date; no further work took place (Branch and Batchelor 2006).

1.11 Engineering works at the eastern and western approaches to the Medway Tunnel located 1.3km to the east of the site, saw the important discovery of a sequence of buried land surfaces intercalated with floodplain sediments: a Mesolithic surface at -12m to -14m OD; a Neolithic one at -3.75m to -4.5m OD and a Late Bronze Age to Romano British one at -2.0m to +1.0m OD (Pine *et al*. 1994; 1995). A peat sequence (organic units E, D, C and B) provides evidence for intermittent marine regression within a general and overarching transgression. An assessment of the palaeoenvironment showed that there were three main episodes of vegetation change over 7000 years and suggested a decrease in woodland since the Neolithic. The River Medway floodplain environment was seen to change from intertidal to freshwater/wetland Alder carr with consequent changes in human exploitation that this would incur. The importance of the site lies in the excellent organic preservation, the depth and time range of the stratigraphy, and the intimate association of archaeology with the sediment sequence. However, no palaeoenvironmental analysis appears to have taken place following this assessment.

1.12 Finally, the Boilershop Chatham Marine site located 1km to the west of the site provides a detailed assessment of a three borehole transect and is directly comparable to the Chatham Waters work detailed in this report (Morley and Ainsworth 2003). One borehole (BH2) was selected to assess the deposit sequence and its palaeoenvironmental proxies. It recorded chalk bedrock at -5.45m OD with 2m of gravel lying on a break of slope between two gravel terraces identified in the other boreholes. Humic mud, peat and wood peat are recorded in units 203 and 202 located at +1.1m OD to -2.95m OD. The top of a peat (a transgressive surface at -0.15m OD) in 202 was dated to 990-780 cal BC and its base to 1410-1010 cal BC. These dates are comparable to Tilbury IV peat formation and the

Thames IV marine transgression of the Thames Estuary (Devoy 1979).

1.13 Pollen recovered from the two units in BH2 at the Boilershop Chatham Marine site showed a decline in tree pollen from 35% near the base of unit 203 at -2.95m OD to 6% at the base of the peat at -0.25m OD; this decline is believed to be related to woodland clearance. In general, a decline is seen in marine conditions through units 203 and 202, followed by an increase in marine influence when the peat is buried by muds. Diatom evidence is confirmatory with a tidal flat proposed at -2.55m OD with decreasing salinity to -0.55m OD, coincident with the formation of peat. Salinity then increases and there is a return to a mudflat environment, followed by brackish marine conditions that become tidal at +0.80m OD (Morley and Ainsworth 2003). The significance of these results to the Chatham Waters sequence is discussed in Section 9.

1.14 Previous geotechnical work on the site has been reported on in Watson (2018) and consisted of 18 Window Sample boreholes; 16 trial pits (TP101 – TP106, TP106a – TP115) and two Cable Percussive boreholes (BH101 and BH102). Peat beds were present at *c.* 7m bgl and 4.5m bgl in borehole BH102 and at 4.0m bgl in trial pit TP103. In the geotechnical survey all elevations were recorded as below ground level and reference to Ordnance Datum was not recorded nor were NGR locations. Ordnance Datum was therefore taken to be +4.55m OD based on Mott MacDonald Limited's (2011) Window Sample 12 on the eastern boundary of the site (Watson 2018, 6). This has since been revised to +5.5m OD during the fieldwork on the site.

1.15 The primary palaeoenvironmental potential of the Chatham Waters site is the sequence of Late Pleistocene and Holocene alluvium that has been demonstrated to exist in the geotechnical work (Watson 2018). Data collected during the geoarchaeological work was combined with earlier geotechnical investigations at the site in order to address the following aims:

1.15.1 Characterise the sedimentary sequence;

1.15.2 Assess the palaeoenvironmental potential of deposits;

1.15.3 Determine the absolute age of the organic strata;

1.15.4 Determine the extent and thickness of lithostratigraphic units encountered;

1.15.5 Make recommendations for further investigation of the stratigraphy at later project stages.

1.16 The aims outlined in Section 1.9 were resolved by meeting the following objectives:

1.16.1 Drill two geoarchaeological boreholes through the deposits to the top of the basal gravel and log the stratigraphy;

1.16.2 Select one borehole as a representative sample for palaeoenvironmental and dating assessment;

1.16.3 Integrate the lithological record from the boreholes with previous geotechnical work, to produce a composite lithostratigraphic cross section; and

1.16.4 Report the results of 1.16.1 to 1.16.3 above.

2. METHODOLOGY

2.1 Borehole drilling

2.1.1 Two geoarchaeological boreholes (BH1 and BH2) were positioned and marked on the site. They were placed close to the previous geotechnical borehole BH102 and trial pit TP103 to ensure recovery of peat samples (Figure 1). Borehole locations were inspected with a CAT scanner before intrusive works commenced. The locations were surveyed to National Grid Reference and Ordnance Datum using a Leica System 1200 RTK GPS. The boreholes were drilled using a Comacchio GEO305HT rig equipped with a dynamic sampler (i.e. capable of both pressure-based and rotary drilling) (see ADP Group (2019) for technical details). Drilling commenced from the base of a 1.2m deep inspection pit (dug by hand by the drilling crew to ensure the absence of buried services) and continued until the top of the River Terrace Deposits was reached. Continuous cores were collected in 100mm diameter Perspex tubes from cased boreholes. The boreholes cores were boxed and transported to ADP Group's facility at, Wotton-under-Edge GL12 8PE for recording.

2.2 Core recording

2.2.1 The cores were logged and photographed according to standard criteria at Firing Close Farm (Jones *et al.* 1999; Munsell Color 2000; Tucker 2011). One was selected (BH2) for palaeoenvironmental assessment and it was transported to the ARCA Laboratory, University of Winchester. Lithological and positional data collected during the fieldwork and the laboratory description of the two cores were combined with selected geotechnical boreholes from the site in a RockWorks 15 database (RockWare 2013). The software was then used to plot a lithostratigraphic cross-section (Figure 2). Lithological data from the boreholes and their location and elevation are recorded in Appendices 5 and 6.

2.3 Pollen and plant macrofossil assessment

2.3.1 Eight peat and eight diatom sub-samples were taken for pollen and diatom assessment from the peat and mineral units in BH2 using a 2cm^3 sediment sampler. A single sub-sample was also taken for the assessment of the plant macrofossils from the basal peat in BH2. The sub-samples were sent to Quaternary Scientific (Quest), School of Archaeology, Geography and Environmental Science, Whiteknights, The University of Reading, RG6 6AB, for assessment by Drs C.R. Batchelor, T. Hill and D.S. Young. The methodologies employed are described in Appendix 1. Molluscs and foraminifera were searched for but none were recorded; as a result no sub-samples specific to these palaeoenvironmental proxies were taken.

2.4 AMS ^{14}C dating

2.4.1 Four sub-samples for AMS ^{14}C dating were taken from BH2 and sent to Scottish Universities Environmental Research Centre (SUERC) Scottish Enterprise Technology Park, Rankine Av, Glasgow G75 0QF, for analysis. The top and base of each unit of peat were sub-sampled. There were insufficient terrestrial macrofossils in the peat for selective dating; therefore dating proceeded on the humic acid fractions (Table 1).

2.5 Archive

2.5.1 The material archive comprises a single core from BH2. This core will remain in storage at the University of Winchester pending decisions on further work until 01/07/2020 whereupon it will be discarded with no further notification. Should the core be required for further work then the interested party must contact ARCA to arrange continued storage. Pollen and diatom slides are held at Quaternary Scientific (Quest), University of Reading.

2.5.2 The digital archive consists of the RockWorks database (in Microsoft Access format); a lithostratigraphic cross-section in JPG format; photographs of cores in JPG format and this report in PDF format. These digital archives are stored both on the University of Winchester server and on an external hard drive stored outside the University of Winchester. Copies of these data can be supplied on request.

2.5.3 OASIS records will be completed on approval of this report.

3. RESULTS: BOREHOLE STRATIGRAPHY

3.0.1 The sedimentary sequence (Figure 2) found on the site is divided into four main stratigraphic units. The units identified from youngest to oldest are:

1. Made Ground (Modern)
2a. Fine grained intertidal/fluvial deposits (Holocene)[2]
2b. Organic deposits (Holocene)
3. River Terrace Deposits (Halling Terrace, Late Devensian)
4. Seaford Chalk Formation bedrock (Late Cretaceous)

3.0.2 These units are described in stratigraphic order below.

3.1 Seaford Chalk Formation bedrock

3.1.1 The Chalk bedrock sub-crops below the unconsolidated Quaternary strata in two boreholes and lies between -6.90m OD (12.4m bgl) in BH101 and -9.80m OD (15.3m bgl) in BH102.

3.2 River Terrace Deposits

3.2.1 River Terrace Deposits are found in four boreholes and lie between -3.80m OD (9.30m bgl) in BH101, and -2.30m OD in BH1 and BH102 (7.9 m bgl and 7.8m bgl, respectively). The thickness of the deposits are 3.1m in BH101 and 7.5m in BH102.

[2] Rivers and streams produce freshwater fluvial deposits.

3.2.2 The lithology is a grey (5Y 5/1), very poorly sorted, clast supported gravel of angular, black flints from granular to coarse pebble sizes. There are rare, well rounded, fine pebbles of black flint and rare cobble-sized clasts; no nodules are present. The matrix consists of a grey silt to fine sand. Chalk clasts are reported in the geotechnical borehole BH102. BH1 also records a bed of light olive grey (5Y 6/2) and white (5Y 8/1) very silty clay with very fine, irregular, white silt filaments and faint greyish brown (10Y 5/2) banding. Rare iron oxide grains are present. The deposit grades into an oxidised and well sorted fine sand.

3.3 Fine grained marine/fluvial deposits

3.3.1 Fine grained deposits were recorded in the geotechnical trial pits (x 14), Window Sample boreholes (x 9), both the Cable Percussive boreholes, and in the geoarchaeological boreholes (BH1 and BH2). The deposits are found to lie between +0.42m OD (5.18m bgl) in BH1 and +4.51m OD (1.35m bgl) in WS106. They attain a maximum proven thickness of 7.20m in BH102 where they are underlain by gravel.

3.3.2 The lithology is varied; above the water table at *c*. 2m bgl they are yellowish brown and oxidised silty clays. Below the water table blue grey colours persist and the lithology is generally silty clay with on occasion, minor amounts of sand and rarely, some gravel clasts. In the geoarchaeological boreholes olive grey (5Y 4/2) silt/clay deposits are recorded with occasional black humic spotting. Silty fine sands are recorded in four trial pits, two Window Sample boreholes and one Cable Percussive borehole. The deposit is found between +4.90m OD (0.6m bgl) in BH102 and +3.40m OD (2.1m bgl) in TP103 and TP07. It has a maximum thickness of 2.4m in BH102.

3.4 Organic deposits

3.4.1 Organic deposits, including peat, are found in five trial pits, one Window Sample, one Cable Percussive borehole, and in both the geoarchaeological boreholes (BH1 and BH2). Since the primary aim of the geoarchaeological boreholes was to recover organic strata the descriptions that follow are based on these boreholes and compared with peat recovered in the geotechnical borehole BH102 and trial pit TP103.

3.4.2 Of the two geoarchaeological boreholes, peat is only recorded in BH2. The earliest deposit (the basal peat) lies on the gravel terrace and sub-crops at -1.99m OD (7.46m bgl) and is *c*. 0.30m thick. It is probably coeval with the 0.80m thick peat bed found in BH102 at -1.50m OD (7.00m bgl) some 40m to the southwest which also rests on the gravels. BH1 which lies in the immediate vicinity of BH102 surprisingly does not record any peat at all. BH2, on the other hand records a second (upper) peat bed higher in the stratigraphy at -0.29m OD (5.76m bgl), 0.15m thick.

3.4.3 The lithology of the basal peat in BH2 is black (7.5YR 2.5/1), wet, well humified wood peat. The unit is very coarse, granular and unstratified and consists of frequent granular-sized fibres and reed fragments and granular to medium pebble-sized wood fragments. The later, upper peat unit has a much greater fraction of mud and no wood fragments.

3.4.4 Organic muds are found in both geoarchaeological boreholes. In BH1 a 0.56m thick unit lies at -1.2m OD, however, it is not found in the neighbouring geotechnical borehole BH102. In BH2 in the northeast of the site, an organic mud stratum sub-crops high in the stratigraphy at +1.73m OD and has a thickness of 0.76m. It is at a similar elevation as the peat bed recorded in the neighbouring trial pit TP103. The lithology of the units is a black, plastic mud (i.e. composed of silt and clay particles).

3.5 Made Ground

3.5.1 Made Ground is recorded in all the trial pits and boreholes, and caps the stratigraphic sequence. It has a minimum thickness of 0.6m in BH102 and a maximum of 5.18m in BH1.

4. RESULTS: POLLEN ASSESSMENT by C.R. Batchelor, T. Hill and D.S. Young

4.1.1 The results are displayed in Appendix 2 and indicate a generally very high concentration of pollen in a moderate to good state of preservation in all eight samples assessed.

4.1.2 The samples from the basal peat (-2.79 to -1.99m OD) contain a similar pollen assemblage, dominated by tree and shrub pollen of alder (*Alnus*), oak (*Quercus*) and hazel (*Corylus* type) with lime (*Tilia*) and sporadic occurrences of elm (*Ulmus*), birch (*Betula*), ivy (*Hedera*) and willow (*Salix*). The herbaceous assemblage is dominated by grasses (Poaceae) and sedges (Cyperaceae) with daisies (Asteraceae) and members of the carrot family

(Apiaceae). Aquatic taxa are absent and spores are dominated by ferns (*Filicales*). Microcharcoal is largely absent.

4.1.3 The samples from the upper peat (-0.42 to -0.29m OD) differ from the basal peat; they are dominated by herbaceous taxa of grasses and sedges with daisies, members of the *Chenopodium* and Apiaceae families, ribwort plantain (*Plantago lanceolata*) and buttercup/water crowfoot (*Ranunculus* type). Tree and shrub taxa are reduced but include oak and hazel with alder and pine. Aquatic and spore taxa are absent. Microcharcoal concentrations are negligible or occasional.

4.1.4 During the accumulation of the basal peat, the results of the assessment indicate that the floodplain surface was dominated by alder (and occasionally willow) carr woodland, with an understorey of grasses and sedges (possibly forming sedge fen/reed swamp communities). The consistent presence of ferns suggests that these also formed an important component of the floodplain vegetation. Hazel, elm, birch may have occupied the peat surface with alder, but are more likely to grow on the dryland forming mixed deciduous woodland with oak and lime. Indeed, due to the entomophilous (insect-pollinated) nature of lime, it is likely that the moderate amount of *Tilia* pollen recorded actually represents a relatively large component of the dryland woodland.

4.1.5 By comparison, during the accumulation of the upper peat, the floodplain environment was dominated by sedge fen and reed swamp with occasional stands of alder carr woodland. Plants of the Chenopodiaceae family may be split into two broad groups, those associated with brackish and marine environments such as *Salsola kali*, and those commonly found in waste places and the edges of arable fields on dryland, such as *Chenopodium album*. In this instance, it is almost certain that pollen values of *Chenopodium* type indicate the growth of saltmarsh plants (and therefore a brackish water influence) on the wetland rather than open conditions. Dryland woodland taxa (e.g. primarily oak and hazel) were much reduced, whilst lime and elm were near absent. Combined this is indicative of a much more open dryland environment, quite possibly representing late-prehistoric land clearance. No definitive anthropogenic indicators were however recorded during the course of the assessment.

5. RESULTS: DIATOM ASSESSMENT by C.R. Batchelor, T. Hill and D.S. Young.

5.1 The results of the diatom assessment are displayed in Appendix 3; the most typical diatoms encountered in each sample are listed in order of abundance (most common at the top of each list).

5.2 Diatoms were encountered in high abundance and diversity in most samples, suggesting further analysis would be possible on the sequence. The uppermost samples, 5.77 – 5.94m bgl, displayed the greatest abundance and diversity, whilst sample 7.40m bgl contained the poorest diatom assemblages of all under consideration.

5.3 Both planktonic and benthic taxa were present, but encountered in differing amounts between samples. In general benthic diatoms dominated, and most of which are representative of brackish environmental conditions. Some taxa are associated with lower salinity settings, and there are a mix of taxa associated with epiphytic (attached to vegetation) and aerophilous (tidal emergence/submergence) settings. Planktonic diatoms are found to be relatively restricted, but when present are dominantly either open marine or brackish. The only sample in which planktonic diatoms are very abundant is at 7.40m bgl, where marine plankton dominate. The environment that prevailed during the deposition of the sediments associated with these sample depths therefore was positioned somewhere within the estuarine tidal realm.

6. RESULTS: MACROFOSSIL ASSESSMENT by C.R. Batchelor, T. Hill and D.S. Young.

6.1 One sample from borehole BH2 (8.08m to 8.18m bgl) was extracted and processed for the recovery of macrofossil remains, including waterlogged and charred plant macrofossils, wood, insects and Mollusca. The results of the assessment are displayed in Appendix 4. They indicate that the sample is dominated by waterlogged wood, with a high number of fragments recorded, many of which were greater than 2mm on all axes and are suitable for identification (ranging in size up to *c.* 40mm in diameter). A small quantity of waterlogged seeds were recorded; nine of which were identified as *Alnus glutinosa* (alder) catkins. An unusually high number of insect remains were also recorded. No waterlogged sedge remains, Mollusca, or bone were recorded within the sample; nor was any charcoal or charred plant remains.

7. RESULTS: AMS ^{14}C DATING

Borehole and Elevation (m OD)	**Material dated**	**Lab code**	**δ ^{13}C ‰**	**Conventional radiocarbon age (±1σ) BP**	**2σ calibrated date cal BC/AD**
BH2 -0.29 Upper peat	humic sediment: humic acid	SUERC-86457 (GU51119)	-28.7	2609 ± 28	822 (95.4%) 722 cal BC
BH2 -0.42 Upper peat	humic sediment: humic acid	SUERC-86458 (GU51120)	-28.9	2902 ± 28	1207 (0.8%) 1201 cal BC 1196 (15.3%) 1141 cal BC 1134 (79.3%) 1006 cal BC
BH2 -1.99 Basal peat	peat : humic acid	SUERC-86459 (GU51121)	-28.8	4656 ± 28	3517 (82.6%) 3396 cal BC 3386 (12.8%) 3366 cal BC
BH2 -2.79 Basal peat	peat : humic acid	SUERC-86568 (GU51122)	-28.5	5097 ± 29	3966 (36.4%) 3895 cal BC 3881 (59.0%) 3800 cal BC

Table 1. Results of AMS ^{14}C dating. The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

7.1 Samples from the top and the base of the basal peat in BH2 and the top and base of the middle peat unit (four samples in total) (Figure 2), were submitted to the SUERC Radiocarbon Laboratory for ^{14}C AMS dating. The results are shown in Table 1 above. They have been calibrated using OxCal v4.3.2 (Bronk Ramsey 2017) and the IntCal13 atmospheric curve (Reimer *et al.* 2013).

7.2 The top of the upper peat (-0.29m OD) is dated to 822 – 722 cal BC: the Early Iron Age.

7.3 The base of the upper peat (-0.42m OD) is dated to 1207 – 1006 cal BC: end of the Late Bronze Age.

7.4 The top of the basal peat is dated to 3517 – 3366 cal BC: the Early Neolithic.

7.5 The base of the basal peat is dated to 3966 – 3800 cal BC: the Early Neolithic.

8. ASSESSMENT

8.0.1 The sub-sections below review the lithostratigraphic and palaeobotanical evidence against the relevant aims of Section 1.9.

8.1 The Quaternary sequence

8.1.1 The Chalk bedrock is overlain by coarse grained deposits of the Halling Terrace: the lowest Medway formation (Bridgland 1989; 2003, 42). It is equivalent to the Shepperton Gravel Member of the Thames and was probably laid down between 15ka and 10ka (Gibbard 1994, 193).

8.1.2 With the amelioration of the climate at the end of the Pleistocene (11.7ka) fine grained sands, silts and clays were laid down by the meandering river. Peats developed in meander cut-offs and backswamp areas. On a regional scale the River Medway was, and still is, constantly adjusting to glacial eustacy (rapid rising true sea levels as ice sheets melt) and gradual isostatic readjustment as the weight of ice is released, with the result that a complex vertical and lateral sedimentary architecture forms and reforms, influenced by first fluvial, and then both fluvial and estuarine/marine processes. The meandering/anastomosing river, also continuously reworks earlier deposits. Organic strata are intercalated in these sediments. Peat growth occurs in response to almost zero detrital deposition and rising water tables. It marks a phase in time when vegetation growth exceeds or keeps pace with a rising tidal frame, or there is a decline in the rate of relative sea level rise. Cyclical deposits of muds and peats are formed as is seen at the Chatham Dockyards and the Boilershop sites in the locality of Chatham Waters (see Sections 1.9, 1.12 and 1.13).

8.1.3 On site there is evidence for a basal peat developing over the gravel in BH102 and BH2 at an elevation of *c.* -1.50m to -2.00m OD, where it begins to grow at the beginning of the Early Neolithic and continues for between *c.* 300 to 600 years (3966 –

3366 cal BC). This unit is not continuous and appears to have been eroded away in the location of BH1.

8.1.4 Palynology and macrofossil assessment indicates that the basal peat represents an alder carr woodland, and possibly a sedge fen/reed swamp understorey with the notable presence of ferns. Deciduous woodland perhaps dominated by lime is found on the dryland. In the mid fourth millennium BC, the alder carr environment is overwhelmed by estuarine intertidal sedimentation as is evidenced by the silt/clay lithology and its associated diatom flora.

8.1.5 The subsequent deposition of an upper peat unit (1207 – 722 cal BC) at a base elevation of -0.42m OD is indicative of the reestablishment of fresh/brackish water conditions at the end of the Late Bronze Age. It may be correlated with Tilbury IV peat formation (1500-900 cal BC) of the Thames Estuary. At this time the flood plain environment on site is primarily sedge fen and reed swamp with some saltmarsh; the alder car woodland is very reduced. Dryland tree cover in general is reduced too, suggesting that open conditions prevailed as a result of late-prehistoric land clearance. Intertidal muds bury the upper peat in the Early Iron Age and may be correlated with the Thames IV transgression.

8.1.6 The site continues to be subject to rising sea level and a mixture of mineralogenic and organic sedimentation much of which is reworked, and is recorded as 'clay with decaying organic matter' in the geotechnical boreholes and trial pits (Watson 2019, 10). Organic muds are recorded in BH2, and a peat in TP103. These deposits post-date the first millennium BC. A final and thin high level peat is found only in BH102 at *c.* +3m OD, and is indicative of the vagaries of peat preservation in general, aside from the deleterious effects of modern truncation.

8.2 Archaeological and palaeoenvironmental potential of the strata

8.2.1 The River Terrace Deposits on the site are deeply buried and were laid down in cold conditions inhospitable to the presence of man. Human groups were intermittently present during Devensian interstadials (White and Pettitt 2011) and the exploitation of river gravel is a possibility. Nonetheless, since the sampling of these deposits can only be achieved by borehole coring the potential to recover archaeological or palaeoenvironmental information must be low.

8.2.2 The fine grained intertidal/fluvial deposits on the site are laid down in a wetland environment (saltmarsh, tidal flats) that although subject to intermittent and localised human activity, has a low potential for archaeology. The potential for palaeobotanical remains is high in the case of diatoms. Analysis of the diatom flora could elucidate the approximate location of the tidal frame at the site of deposition of the sampled sediments, although whether this information would be of significance considering the absence of any archaeology is unclear.

8.2.3 The organic strata in general have a low archaeological potential, however, the peat in particular has a high palaeobotanical potential as is illustrated by the high concentration and good preservation of the pollen remains. All samples are suitable for further analysis. Such analysis would provide a more detailed insight into vegetation and environmental change during the period of sediment accumulation, and elucidate evidence for human activity not observed during the assessment process. The macrofossil sample contained a high amount of waterlogged wood and unusually high number of insect remains, together with a limited number of alder catkins. The waterlogged wood and insects could be identified to enhance the palaeoenvironmental reconstruction provided by the results of a pollen analysis.

9. CONCLUSIONS AND RECOMMENDATIONS

9.1 A discontinuous basal peat is dated to 3966 – 3366 cal BC (Early Neolithic) and sub-crops against Pleistocene gravels at *c.* -1.5m to -2m OD (BH2 and BH102). It is in the order of 0.3m thick. The environment at the time of the growth of the peat was alder carr woodland with possibly a sedge fen / reed swamp understorey. Lime-dominated, mixed deciduous woodland occupied the higher and dryer land.

9.2 Intertidal deposits buried the basal peat and conditions remained unfavourable to peat growth until the Late Bronze Age. This upper peat dates to 1207 – 722 cal BC and lies at -0.29m OD, it is 0.15m thick (BH2). A more open wetland landscape was present with considerably less alder carr, and the presence of a saltmarsh component to the fen and reed swamp. Dryland tree cover was also reduced. The peat was buried in the Early Iron Age by renewed intertidal sedimentation.

9.3 The later intertidal deposits contain allochthonous, fragmentary peat particles and organic muds. Peat growth appears to have taken place on two further occasions and is recorded at *c.* +3m OD (BH102) and at *c.* +1.5m OD (TP103). Made Ground truncates the sedimentary sequence.

9.4 A comparison with the Boilershop Chatham Marine site is instructive in determining recommendations. No deep lying peat of Neolithic date was found at the Boilershop site (i.e. -1.5m to -2m OD) (although one exists at the Chatham Dockyards site) therefore the Chatham Waters' lower peat result is noteworthy. However, the pollen samples from the mud at the Boilershop site reveal high arboreal pollen counts and are comparable in elevation (-2.79m OD). On the other hand, pollen from the lower peat at Chatham Waters suggests a sedge fen/reed swamp environment, as opposed to a mudflat that is intimated at the Boilershop site.

9.5 The peat from the Boilershop site is directly comparable to the upper peat at Chatham Waters in both elevation and date (-0.15m OD; top 990-780 cal BC and base 1410-1010 cal BC). However, this is not particularly revelatory given the close proximity of the two sites.

9.6 At the present time no analyses on any of the sites referenced in Section 1 appear to have taken place. <u>It is recommended therefore that the pollen and plant macrofossil samples at Chatham Waters should be analysed.</u> This would provide a detailed overview of the palaeoenvironment of the site and its environs. The diatom flora is also of sufficient quality to be analysed too, however, it is unclear if this would significantly improve the record obtainable from the pollen and plant macrofossils; the analysis of the diatoms is not recommended.

9.7 It should be born in mind that there is no associated archaeology (unlike at the Medway Tunnel site), and results of an analysis will stand alone as nowhere in the vicinity has progressed to the analysis stage to allow useful comparison at this scale. In terms of programme for the analysis, it is acknowledged that the samples obtained within the site may be superseded by comparable or better samples which may in due course be obtained from investigations during subsequent phases of development at Chatham Waters. As such final decision on the programme and scope of the analysis may be taken after all the phases of the development have been completed so that the proposals for analysis from all phases could be reviewed and integrated. However, if no additional suitable samples are collected in the future investigations across the Chatham Waters site, the analysis recommended in this report should be undertaken.

10. ACKNOWLEDGEMENTS

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12. FIGURES

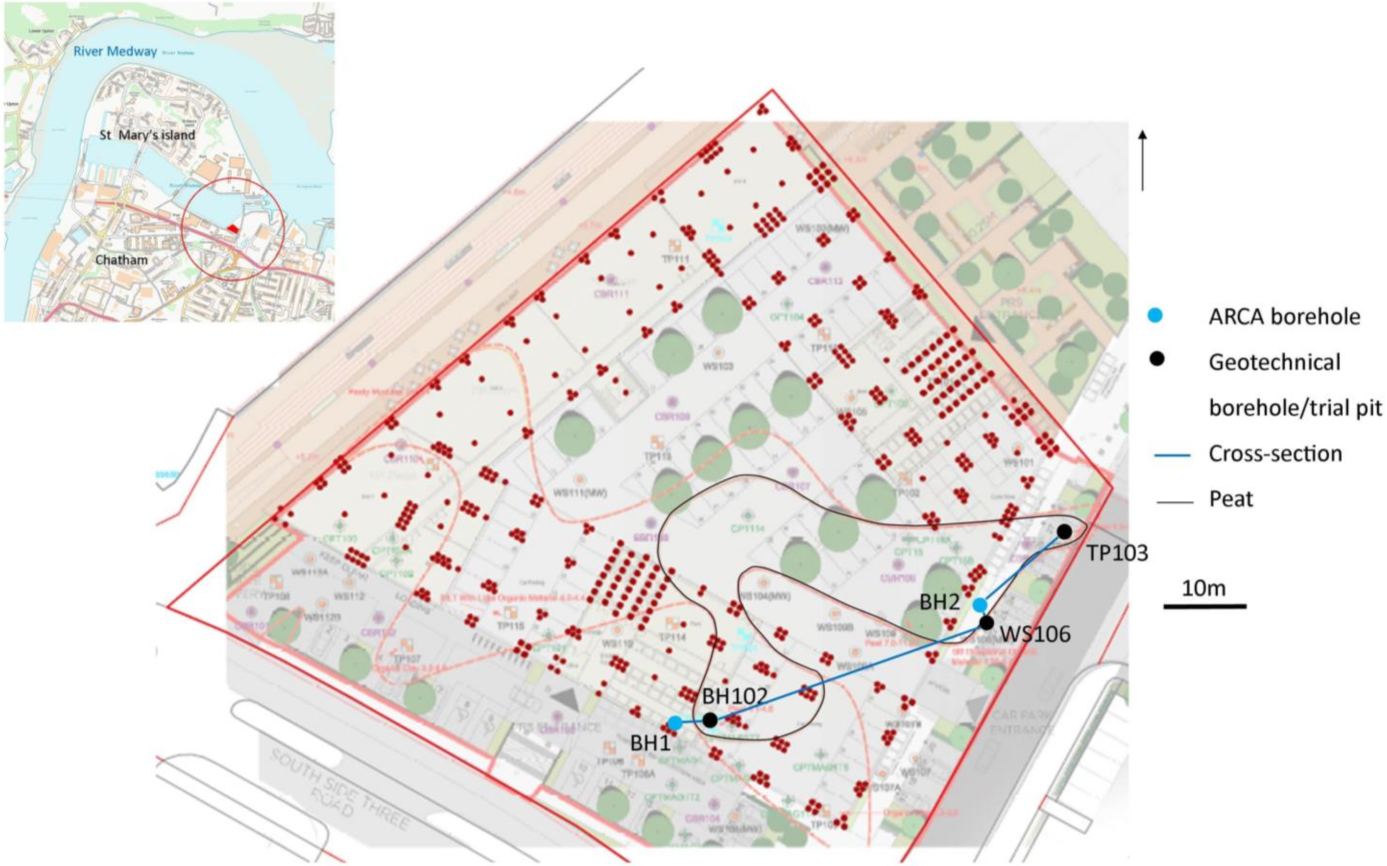

Figure 1. Location of the site and plan showing the two geoarchaeological boreholes (BH1 and BH2), selected previous geotechnical work (BH102, TP103 and WS106), the lithostratigraphic cross-section, and the previously mapped area of peat deposits (see Watson 2018 for details).

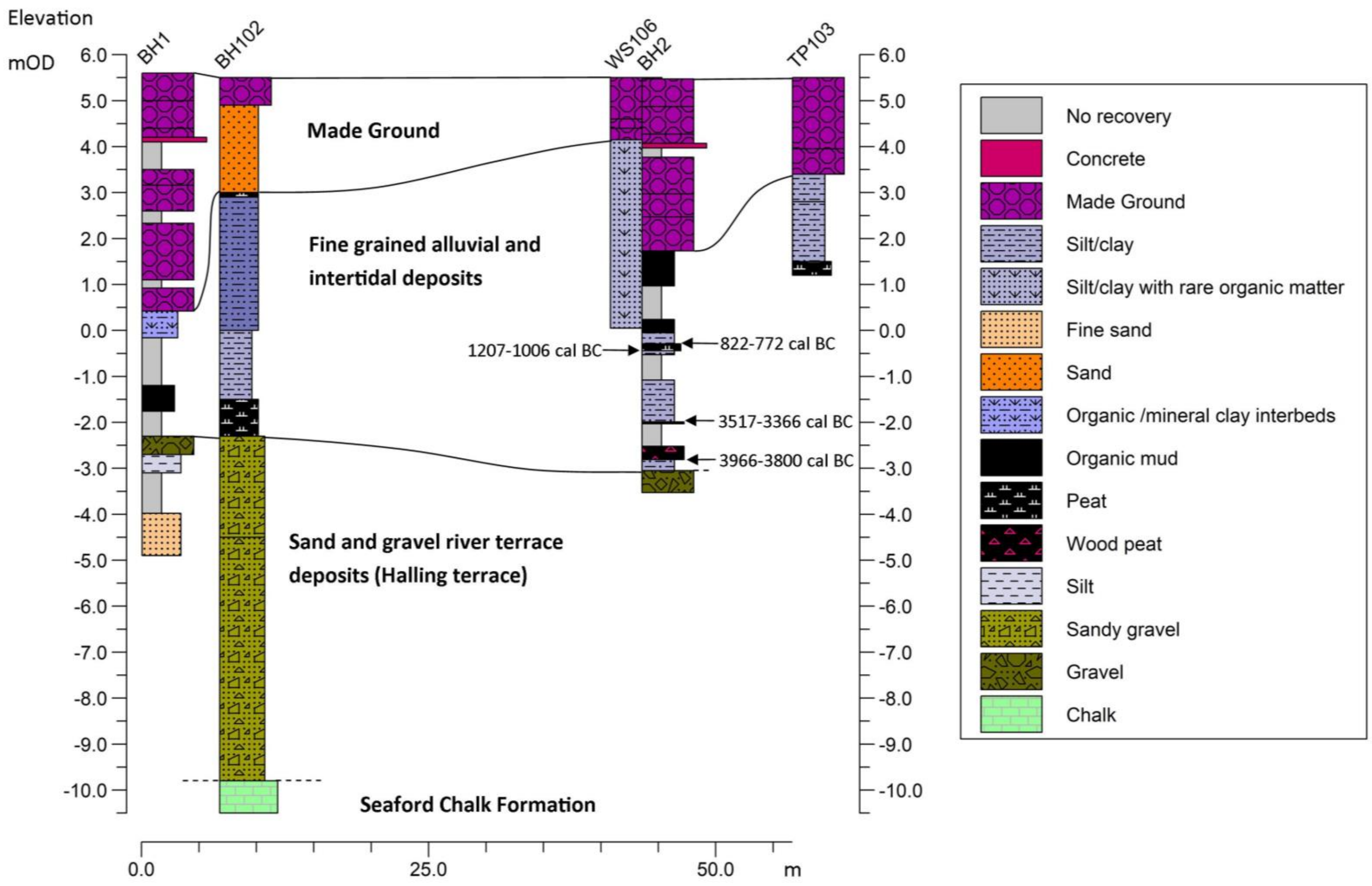

Figure 2. SW - NE Lithostratigraphic cross-section. Vertical exaggeration x4.

APPENDIX 1: PALAEOBOTANICAL METHODOLOGIES by C.R. Batchelor, T. Hill and D.S. Young

Pollen assessment:
Eight subsamples from borehole BH1 were extracted for an assessment of pollen content. The pollen was extracted as follows: (1) sampling a standard volume of sediment (1ml); (2) deflocculation of the sample in 1% Sodium pyrophosphate; (3) sieving of the sample to remove coarse mineral and organic fractions (>125μ); (4) acetolysis; (5) removal of finer minerogenic fraction using Sodium polytungstate (specific gravity of 2.0g/cm3); (6) 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) (Appendix 1).

Diatom assessment:
A total of eight samples were submitted for an assessment of diatom presence. 0.5g of sediment was required for the diatom sample preparation. Due to the relative abundance of organic material within some samples, samples chosen for analysis were first treated with hydrogen peroxide (30% solution). Samples were then treated with sodium hexametaphosphate and left overnight, to assist in minerogenic deflocculation. 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 are displayed in Appendix 2.

Macrofossil assessment:
One bulk sample was assessed for the presence and concentration of macrofossil remains, including waterlogged and charred plant macrofossils, wood, insects and Mollusca. The sample was scanned under a stereozoom microscope at x7-45 magnification, and sorted into the different macrofossil classes. The concentration and preservation of remains was estimated for each class of macrofossil (Appendix 3).

APPENDIX 2: RESULTS OF THE POLLEN ASSESSMENT

	Depth (m bgl)	5.76	5.82	5.89	7.46	8.00	8.09	8.17	8.26
	Depth (m OD)	-0.29	-0.35	-0.42	-1.99	-2.53	-2.62	-2.70	-2.79
		Upper Peat			Basal Peat				
Latin name	**Common name**								
Trees									
Alnus	alder		7		6	31	19	34	19
Quercus	oak	3	1	4	7	6	3	2	14
Pinus	pine	1	1			1			
Ulmus	elm			1	1				4
Tilia	lime				2		1	4	7
Fraxinus	ash								1
Betula	birch	1							
Shrubs									
Corylus type	e.g. hazel	2	5	3	11	9	6	8	8
Hedera	ivy						1		
Salix	willow							1	2
Herbs									
Cyperaceae	sedge family	11	10	15	2	1		1	5
Poaceae	grass family	5	10	9	1			4	3
Asteraceae	daisy	4		2		1			1
Plantago lanceolata	ribwort plantain			1			1		

	Depth (m bgl)	**5.76**	**5.82**	**5.89**	**7.46**	**8.00**	**8.09**	**8.17**	**8.26**
Chenopodium type	goosefoot family		3	1					
Rumex acetosa / acetosella	dock			1					
Apiaceae	carrot family	2		2				1	2
Ranunculus type	e.g. buttercup		1	1					
Galium type	bedstraw		2						
Spores									
Filicales	ferns				4	20	3	8	34
Polypodium vulgare	polypody								1
Total Land Pollen (grains counted)		29	40	41	30	49	31	55	66
Concentration*		4	5	5	4	5	5	5	5
Preservation**		3	3	4	4	4	4	4	4
Microcharcoal Concentration***		2	2	1	0	1	0	0	1
Suitable for further analysis		**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

APPENDIX 3: RESULTS OF THE DIATOM ASSESSMENT

Depth (m bgl; m OD)	Diatoms encountered
5.77 -0.30	*Nitzschia navicularis* *Diploneis ovalis* *Navicula peregrina* *Cyclotella striata* *Navicula pusilla* *Achnanthes brevipes* *Diploneis interrupta* *Pinnularia viridis*
5.82 -0.35	*Navicula peregrina* *Diploneis ovalis* *Nitzschia navicularia* *Epithemia adnate* *Amphora sp.* *Navicula pusilla* *Cyclotella striata* *Achnanthes brevoipes*
5.88 -0.41	*Navicula peregrina* *Achnanthes brevipes* *Diploneis ovalis* *Synedra ulna* *Nitzschia navicularis* *Amphora sp.*

	Diploneis interrupta *Pinnularia viridis*
5.94 -0.47	*Caloneis sp.* *Navicula peregrina* *Diploneis interrupta* *Navicula pusilla* *Nitzschia navicularis* *Diploneis ovalis* *Achnanthes brevipes*
7.40 -1.93	*Paralia westii* *Pseudopodosira stelligera* *Paralia sulcata* *Diploneis interrupta* *Diploneis bombus*
7.45 -1.98	*Nitzschia navicularis* *Rhaphoneis amphiceros* *Nitzschia punctata* *Caloneis sp.* *Paralia sulcata* *Petroneis maratima* *Pseudomelosira westii* *Odontella aurita*
-1.99 to -2.79m OD	***Basal Peat***
8.27 -2.80	*Diploneis interrupta* *Nitzschia navicularis* *Navicula pusilla*

	Paralia sulcata *Diploneis ovalis*
8.32 -2.85	*Diploneis interrupta* *Nitzschia navicularis* *Navicula pusilla* *Pseudomelosira westii* *Nitzschia sp.,*

APPENDIX 4: RESULTS OF THE MACROFOSSIL ASSESSMENT

			Charred					Waterlogged			Mollusca		Bone			
Borehole	**Depth (m bgl)**	**Volume processed (ml)**	**Charcoal**	**Charcoal (2-**	**Charcoal**	**Seeds**	**Chaff**	**Wood**	**Seeds**	**Sedge remains (e.g.**	**Whole**	**Fragments**	**Large**	**Small**	**Fragments**	**Insects**
BH2	8.03 to 8.18	100	-	-	-	-	-	4	1	-	-	-	-	-	-	5

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+

APPENDIX 5: LOCATION OF BOREHOLES

Bore	Easting	Northing	Elevation m OD
BH1	577432.269	169618.511	5.6
BH2	577468.97	169635.566	5.47
BH102	577439	169619.00	5.5
TP103	577479	169644.00	5.5
WS106	577470	169633.00	5.5

APPENDIX 6: LITHOSTRATIGRAPHY OF BOREHOLES

Borehole	Top m	Base m	Lithology	Comments
BH1	0.00	0.60	Made Ground	Made Ground.
BH1	0.60	1.20	Made Ground	2.5Y 4/2 Dark greyish brown, firm, clayey fine gravel of well-rounded and angular flints and quartzites and rare sub-angular chalk pebbles. Rare cobble of angular porphyry. Sharp boundary to:
BH1	1.20	1.40	Made Ground	10YR 4/3 Brown, firm, very clayey fine gravel. Clasts of well-rounded and angular flints and quartzites. Sharp boundary to:
BH1	1.40	1.50	Concrete	Concrete slab.
BH1	1.50	2.10	No recovery	Void.

BH1	2.10	2.44	Made Ground	10YR 3/4 Dark yellowish brown, stiff, very fine gravel and sandy clay. Sharp boundary to:
BH1	2.44	3.00	Made Ground	2.5Y 3/1 Very dark grey and 2.5Y 4/3 olive brown, firm and oxidised silt/clay. Occasional granules of angular chalk and well-rounded fine pebble-sized black flint. Occasional iron oxide grains.
BH1	3.00	3.27	No recovery	Void.
BH1	3.27	4.50	Made Ground	2.5Y 2.5/1 Black mixed with 2.5Y 4/2 Dark greyish brown, soft to firm silt/clay with frequent sub-angular to sub-rounded chalk granules and fine pebbles. Rare angular red coarse pebble-sized brick.
BH1	4.50	4.68	No recovery	Void.
BH1	4.68	5.18	Made Ground	2.5Y 2.5/1 Black mixed with 2.5Y 4/2 Dark greyish brown, soft to firm silt/clay with frequent sub-angular to sub-rounded chalk granules and fine pebbles. Rare angular red coarse pebble-sized brick. Sharp boundary to:
BH1	5.18	5.76	Organic /mineral clay interbeds	2.5Y 2.5/1 Black soft organic mud interbedded (50mm thick) with 2.5Y 4/2 Dark greyish brown silt/clay. Occasional grains of ?peat throughout. Homogenous texture. (Salt marsh).
BH1	5.76	6.80	No recovery	Void.
BH1	6.80	7.36	Organic mud	5Y 2.5/1 Black, soft organic mud with <10mm of well humified peat at the base.
BH1	7.36	7.90	No recovery	Void.

BH1	7.90	8.30	Gravel	5Y 4/2 Olive grey, homogeneous, stiff, silty clay grades into poorly sorted, clast supported gravel of very angular flints, granular to coarse pebble-sized with rare cobble-sized nodule. (Shepperton Gravel Member). Sharp boundary to:
BH1	8.30	8.70	Silt	5Y 6/2 Light olive grey and 5Y 8/1 White, firm and dryish, very silty clay with very fine, irregular, white silt filaments. Faint banding 10Y 5/2 Greyish brown and rare iron oxide grains. (Late Glacial alluvium).
BH1	8.70	9.58	No recovery	Slumped material.
BH1	9.58	10.50	Fine sand	5Y 6/2 Light olive grey and 5Y 8/1 White, firm and dryish, very silty clay with very fine, irregular, white silt filaments. Faint banding 10Y 5/2 Greyish brown and rare iron oxide grains. Grades into well sorted, firm to stiff, oxidised, fine sand 2.5Y 4/3 Olive brown. Frequent iron oxide stains. Fine flint gravel at base.
BH2	0.00	0.60	Made Ground	Made Ground.
BH2	0.60	1.20	Made Ground	2.5Y 4/2 Dark greyish brown, firm, clayey fine gravel of well-rounded and angular flints and quartzites and rare sub-angular chalk pebbles. Sharp boundary to:
BH2	1.20	1.40	Made Ground	10YR 4/3 Brown, firm, very clayey fine gravel. Clasts of well-rounded and angular flints and quartzites. Sharp boundary to:
BH2	1.40	1.50	Concrete	Concrete slab.
BH2	1.50	1.70	No recovery	Void.

BH2	1.70	2.50	Made Ground	10YR 3/4 Dark yellowish brown, stiff, very fine gravel and sandy clay. <10mm black asphalt? at base. Sharp boundary to:
BH2	2.50	3.00	Made Ground	2.5Y 2.5/1 Black and 2.5Y 4/2 Dark greyish brown, intermixed and soft silt/clay with occasional red cbm and angular flint granules.
BH2	3.00	3.74	No recovery	Void.
BH2	3.74	4.50	Organic mud	5Y 2.5/1 Black, soft to firm organic mud. Homogeneous unit.
BH02	4.50	5.23	No recovery	Void.
BH02	5.23	5.52	Organic mud	5Y 2.5/1 Black, soft to firm organic mud.
BH02	5.52	5.76	Silt/clay	5Y 4/2 Olive grey, soft to firm silt/clay. Diffuse boundary to:
BH2	5.76	5.91	Peat	10YR 4/2 Dark greyish brown, soft, very well humified peat/ organic mud. Diffuse boundary to:
BH2	5.91	6.00	Silt/clay	5Y 4/2 Olive grey, soft to firm silt/clay, occasional black humic spotting.
BH2	6.00	6.55	No recovery	Void.
BH2	6.55	7.46	Silt/clay	5Y 4/2 Olive grey, soft to firm silt/clay, occasional black humic spotting.
BH2	7.46	7.50	Wood peat	7.5YR 2.5/1 Black, wet well humified wood peat at base of core.
BH2	7.50	7.99	No recovery	Void and slumped material.
BH2	7.99	8.28	Wood peat	7.5YR 2.5/1 Black, wet, well humified wood peat. Very coarse, granular unstratified unit. Frequent granular-sized fibres and reed fragments. Frequent granular to medium pebble-sized wood fragments.

				Sharp boundary to:
BH2	8.28	8.52	Silt/clay	5Y 5/1 Grey silt/clay becoming 5Y 6/1 Grey very silty with occasional black humic stains. Rare angular fine pebble-sized flint. Gradual boundary to:
BH2	8.52	9.00	Gravel	5Y 5/1 Grey, very poorly sorted, clast supported gravel of angular, black flints from granular to coarse pebble sizes. Rare well rounded fine pebbles of black flint. Rare cobble sizes, no nodules. Silty grey matrix. Oxidation towards base. (Shepperton Gravel Member).
TP103	0.00	1.55	Made Ground	MADE GROUND: Dark grey sandy gravel. Gravel is fine to coarse sub-angular to sub-rounded of clinker, ash, brick, concrete, limestone and pipe.
TP103	1.55	2.10	Made Ground	MADE GROUND: Red black gravel. Gravel is fine to coarse angular to sub-angular of brick.
TP103	2.10	2.70	Silt/clay	Grey sandy SILT.
TP103	2.70	4.00	Silt/clay	Firm low strength blue grey very silty CLAY.
TP103	4.00	4.30	Peat	Black psuedo fibrous PEAT. End of TP.
BH102	0.00	0.60	Made Ground	MADE GROUND: Rubble fill.
BH102	0.60	2.50	Sand	Medium dense dark brown slightly silty SAND.
BH102	2.50	2.60	Peat	Brown PEAT

BH102	2.60	5.50	Sandy silt/clay	Very soft extremely low strength blue sandy SILT.
BH102	5.50	7.00	Silt/clay	Very soft low strength brown SILT.
BH102	7.00	7.80	Peat	Brown PEAT.
BH102	7.80	10.00	Sandy gravel	Very loose to medium dense brown clayey SAND and GRAVEL. Gravel is fine to coarse angular to sub-angular of chalk and flint.
BH102	10.00	15.30	Sandy gravel	Medium dense brown fine SAND and GRAVEL. Gravel is fine to coarse angular to sub-angular of chalk and flint.
BH102	15.30	16.00	Chalk	Ciria grade DM (Munford grade VI) structureless chalk composed of low strength creamish white; frequent fine to coarse chalk gravel ;SILT increasing with depth. Cobbles of angular to sub angular flint increasing in frequency and size with depth. End of BH at 35m.
WS106	0.00	0.90	Made Ground	MADE GROUND: Dark grey sandy gravel. Gravel is fine to coarse sub-angular to sub-rounded of clinker, ash, brick, concrete, limestone and pipe.
WS106	0.90	1.10	Made Ground	MADE GROUND: Very stiff high strength brown slightly silty clay.
WS106	1.10	1.35	Made Ground	MADE GROUND: Dark grey sandy gravel. Gravel is fine to coarse sub-angular to sub-rounded of clinker, ash, brick, concrete, limestone and pipe.

WS106	1.35	5.45	Silt/Clay with rare organic matter	Very soft blue grey slightly clayey SILT with occasional organic matter. End of BH.