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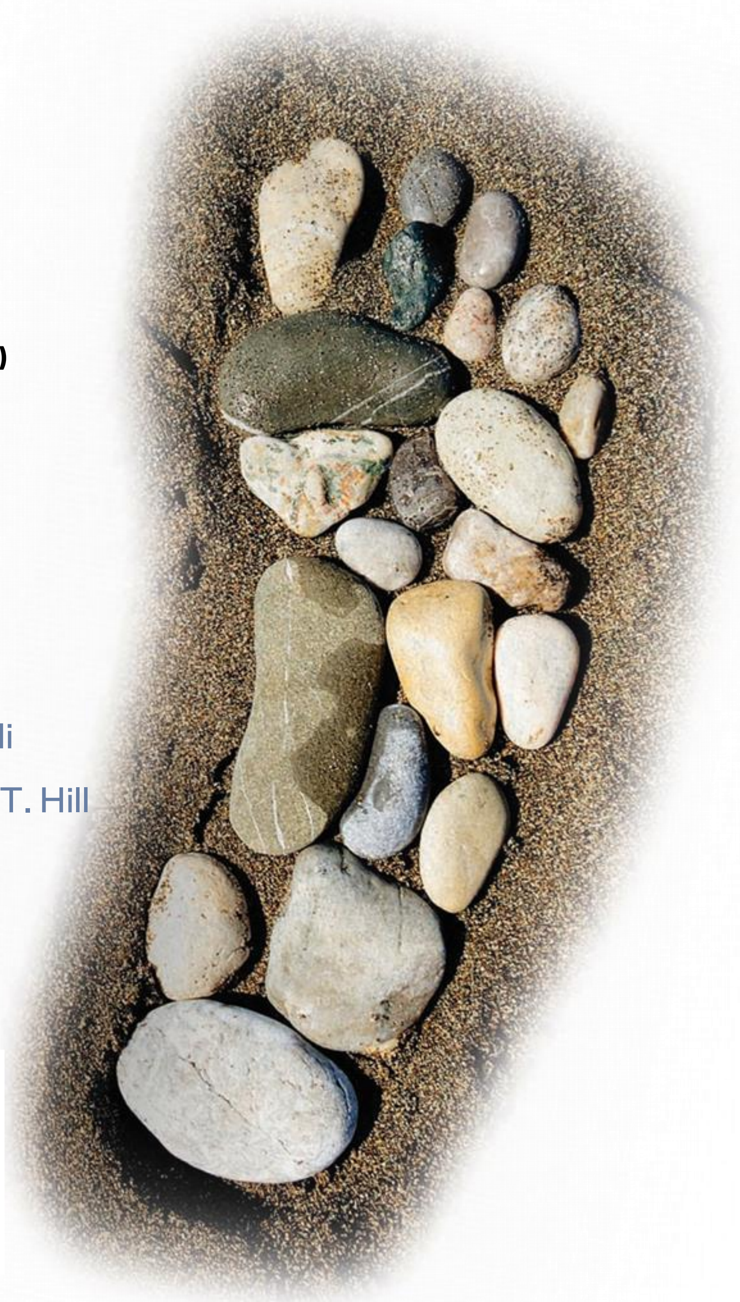
ALCHEMY PARK, CRABTREE MANORWAY NORTH, LONDON BOROUGH OF BEXLEY

Geoarchaeological & Palaeoenvironmental Analysis Report

(Submission pursuant to Condition 5 of Outline Planning Permission 11/01932/OUTM)



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Site Code: ALY16

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1. NON-TECHNICAL SUMMARY

A geoarchaeological and palaeoenvironmental analysis was carried out by Quaternary Scientific (University of Reading) in connection with the proposed development of land at Alchemy Park, Crabtree Manorway North, London Borough of Bexley. The work was commissioned by Turley on behalf of Savills Investment Management. The aim of the investigation was to provide a detailed reconstruction of the stratigraphic, hydrological and vegetation history (including evidence of human activity). In order to carry out the work, a program of radiocarbon dating and an assessment of the palaeobotanical (pollen, seeds, wood, diatoms) and palaeofaunal (insects, molluscs, ostracods and foraminifera) remains was undertaken.

The results of the geoarchaeological and palaeoenvironmental analysis have built upon the previous fieldwork, deposit modelling and assessment exercises which confirmed that the site is located on a Shepperton Gravel surface resting between -7.5 and -9m OD. On the southern part of the site however, a west-east or northwest-southeast orientated deep trough (probable palaeochannel) is recorded. The channel is cut into the Shepperton Gravel surface, estimated to measure between 100 and 200m in width and ca. 2.5 in depth. A tripartite sequence of Lower Alluvium, Peat and Upper Alluvium infills the potential palaeochannel, and surrounding higher gravel surface. The Lower Alluvium began accumulating during the late Mesolithic (middle Holocene) beyond the margins of the probable palaeochannel, and earlier within the channel itself. The rate of accumulation was relatively rapid (ca. 3m/1000 years). Peat formation commenced towards the very end of the Mesolithic and continued to the Bronze Age.

During the accumulation of the Lower Alluvium and Peat (Mesolithic to early Bronze Age) the floodplain environment was dominated by wetland woodland comprising alder and a ground flora of sedges, grasses, aquatics and ferns, whilst mixed deciduous woodland occupied the dryland. There is no evidence for the early Neolithic decline of elm, the Neolithic colonisation and decline of yew or late Bronze Age expansion of elm; whether this is a consequence of poor sample recovery / pollen preservation or natural variations in woodland cover across the local area is unclear. At the time of the transition from Peat to Upper Alluvium (Bronze Age), woodland declined on both surfaces as a consequence of relative sea level rise (floodplain) and human activity (dryland). The vegetation history of the Alchemy Park site is broadly similar to that indicated at nearby sites.

The combined geoarchaeological and palaeoenvironmental exercises at Alchemy Park have thus been successful in achieving aims 1 to 5 of the project. The stratigraphic, hydrological and vegetation reconstructions provide a useful addition to the landscape evolution of the surrounding area. As such, the results will be combined with those from nearby sites to provide an overall publication detailing the palaeoenvironmental history, thereby completing aim 6. The resultant paper will be published within a peer-reviewed academic journal.

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2. PLANNING CONTEXT

This geoarchaeological and palaeoenvironmental analysis report is submitted pursuant to the requirements of Planning Condition 5 of Outline Planning Permission 11/01932/OUTM granted by the London Borough of Bexley on 28 March 2012. Condition 5 states '*No development shall take place within the site until the applicant has secured the implementation of a programme of archaeological work in accordance with a written scheme of investigation which has been submitted by the applicant and approved in writing by the Local Planning Authority*'. The scope of works has been undertaken in line with the Written Scheme of Investigation (dated 18 December 2015) approved by the London Borough of Bexley on 15 February 2016.

3. INTRODUCTION

3.1 Site context

This report summarises the findings arising out of the geoarchaeological assessment undertaken by Quaternary Scientific (University of Reading) in connection with the proposed development of land at Alchemy Park, Crabtree Manorway North, London Borough of Bexley (NGR centred on: TQ 500 801; site code: ALY16; Figures 1 & 2). Quaternary Scientific were commissioned by Turley on behalf of Savills Investment Management to undertake the geoarchaeological investigations. The site is located on the floodplain of the Estuarine Thames, less than 300m from the modern waterfront and *ca*. 1km north of the floodplain edge and the rising ground of the valley side. The site lies on the south side of the Thames, forming part of the Erith Marshes which occupies the eastern end of the area of floodplain enclosed by the river where it makes a broad northward loop between Woolwich in the west and Erith in the east. The whole of this area of valley floor, which has its most northerly point at Crossness, is underlain by Holocene Alluvium. The British Geological Survey (BGS) 1:50,000 Sheets 257 Romford (1996) and 271 Dartford (1998) show the Alluvium overlying bedrock Lower Tertiary Lambeth Group sediments in much of the eastern part of the area; and overlying Taplow Gravel in the western part and in the south, adjacent to the higher ground that forms the southern edge of the floodplain.

Recent geoarchaeological & palaeoenvironmental fieldwork and assessment (Batchelor & Young, 2016a, b) have in fact revealed that the northern part of the site is located on a Late Devensian Shepperton Gravel surface resting between -7.5 and -9m OD. On the southern part of the site however, a west-east or northwest-southeast orientated deep trough (probable palaeochannel) is recorded. The channel is cut into the Shepperton Gravel surface, estimated to measure between 100 and 200m in width and *ca*. 2.5 in depth. A tripartite sequence of Lower Alluvium, Peat and Upper Alluvium infills the potential palaeochannel, and surrounding higher gravel surface. Radiocarbon dating demonstrated that the Lower Alluvium and Peat accumulated from the late Mesolithic to early Bronze Age , during which the floodplain environment was dominated by wetland woodland comprising alder and a ground flora of sedges, grasses, aquatics and ferns, whilst mixed deciduous woodland occupied the dryland. At the time of the transition from Peat to Upper Alluvium (Bronze Age), woodland declined on both surfaces as a consequence of relative sea level rise (floodplain) and human activity (dryland).

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3.2 Palaeoenvironmental and archaeological significance

The results of the geoarchaeological fieldwork and deposit modelling thus demonstrate considerable variation in the height of the Shepperton Gravel, and the type and thickness of the subsequent Holocene deposits. Such variations are significant as they represent different environmental conditions that would have existed in a given location. For example: (1) the substantial variations in the surface of the gravel recorded here appear to represent the edge of a palaeochannel; (2) the peat recorded represents a former semi-terrestrial landsurface, and (3) fine-medium sediments such as sands, silts and clays represent periods of flooding and/or colluvial in-wash. Thus studying the sub-surface deposits of the site has enabled us to start building our understanding of the former landscapes and environmental changes that took place over both space and time across the site.

Areas of high gravel topography, soils and peat represent potential areas that might have been utilised or even occupied by prehistoric people, evidence of which may be preserved in the archaeological (e.g. features and structure) and palaeoenvironmental record (e.g. changes in vegetation composition). Prehistoric structures have been located in the peat locally to the site at Erith Spine Road / Bronze Age Way (Sidell, 1996) and on the Erith Foreshore (Sidell pers. comm.). However, due to the depth of the sediments on the Alchemy Park site, the archaeological potential of the site is considered to be low.

Even in the absence of the archaeological remains, the sediments have the potential to contain a wealth of further information on the past landscape, through the assessment/analysis of palaeoenvironmental remains (e.g. pollen, plant macrofossils and insects) and radiocarbon dating from peat and alluvial sediments. 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. Such investigations are routinely carried out where required as part of planning conditions across the Lower Thames Valley and its tributaries; locally, they have been undertaken on the sedimentary sequences from Crossness Sewage Works (Batchelor *et al*., 2007a, b), Norman Road (Batchelor *et al*., 2008a) and Imperial Gateway (Batchelor *et al*., 2008b).

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3.3 Aims and objectives

Five significant research aims were originally proposed within the geoarchaeological Written Scheme of Investigation (WSI; Batchelor, 2015) for the site as follows:

1. To clarify the nature of the sub-surface stratigraphy across the site;
2. To clarify the nature, depth, extent and date of any alluvium and peat deposits
3. To investigate whether the sequences contain any artefact or ecofact evidence for prehistoric or historic human activity
4. To investigate whether the sequences contain any evidence for natural and/or anthropogenic changes to the landscape (wetland and dryland)
5. To integrate the new geoarchaeological record with other recent work in the local area for publication in an academic journal

The original geoarchaeological and palaeoenvironmental fieldwork and assessment successfully achieved the first two of these aims and demonstrated the potential of aims 3-5 being addressed through further investigation. It also provided preliminary interpretations of the sedimentary and palaeoenvironmental sequences. It was therefore recommended that a targeted program of analysis is carried out focussed on: (1) radiocarbon dating to improve the chronological framework for the site; (2) pollen analysis of additional samples likely to increase knowledge/understanding of the history of elm & yew woodland; both of which have affiliations with human activity. This work will complete aims 1-4, and provide a detailed environmental reconstruction that can be used to address aim 5.

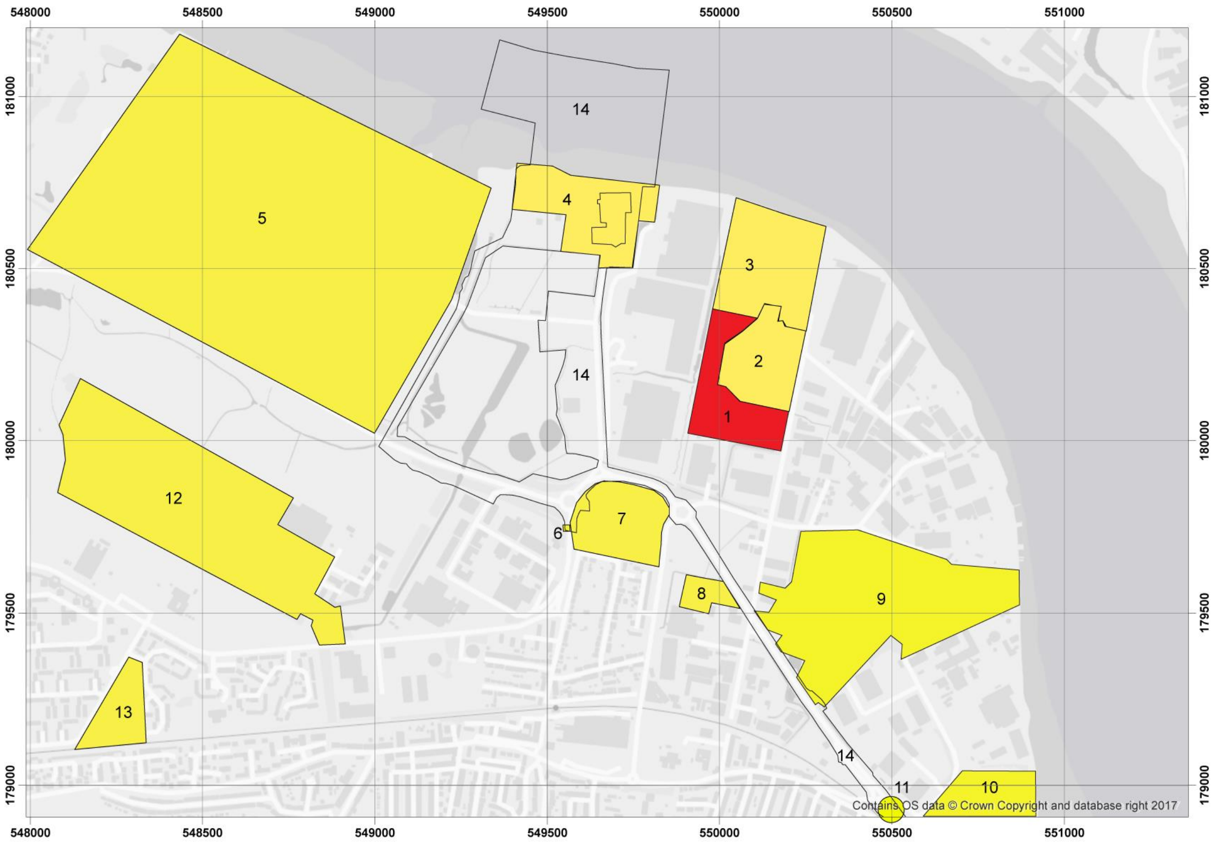

Figure 2: Location of (1) Alchemy Park, London Borough of Bexley (Batchelor & Young, 2015; Batchelor et al., 2016), and other selected geoarchaeological / archaeological local sites: (2) Former NuFarm Site (Young *et al.*, 2008a); (3) Burts Wharf (Batchelor, 2016); (4) Former Borax Works (NNB06; Batchelor *et al.*, 2008a); (5) Crossness (Devoy, 1979) / Crossness Sewage Works (Batchelor *et al.*, 2007a; Batchelor *et al.*, 2007b; Green *et al.*, 2011); (6) North Bexley Drainage Improvements (Branch *et al.*, 2004); (7) Imperial Gateway (Batchelor *et al.*, 2008b); (8) Crabtree Manorway South (Askew and Spurr, 2006); (9) Pirelli Works (Young et al., 2012); (10) Corinthian Quay (Corcoran & Lam, 2002); (11) Erith Spine Road / Bronze Age Way (Sidell *et al.*, 1996); (12) Veridion Park (Green & Batchelor, 2013); (13) Parkway Primary School (Young & Batchelor, 2016) & (14) Riverside Energy Park (Batchelor, 2018)

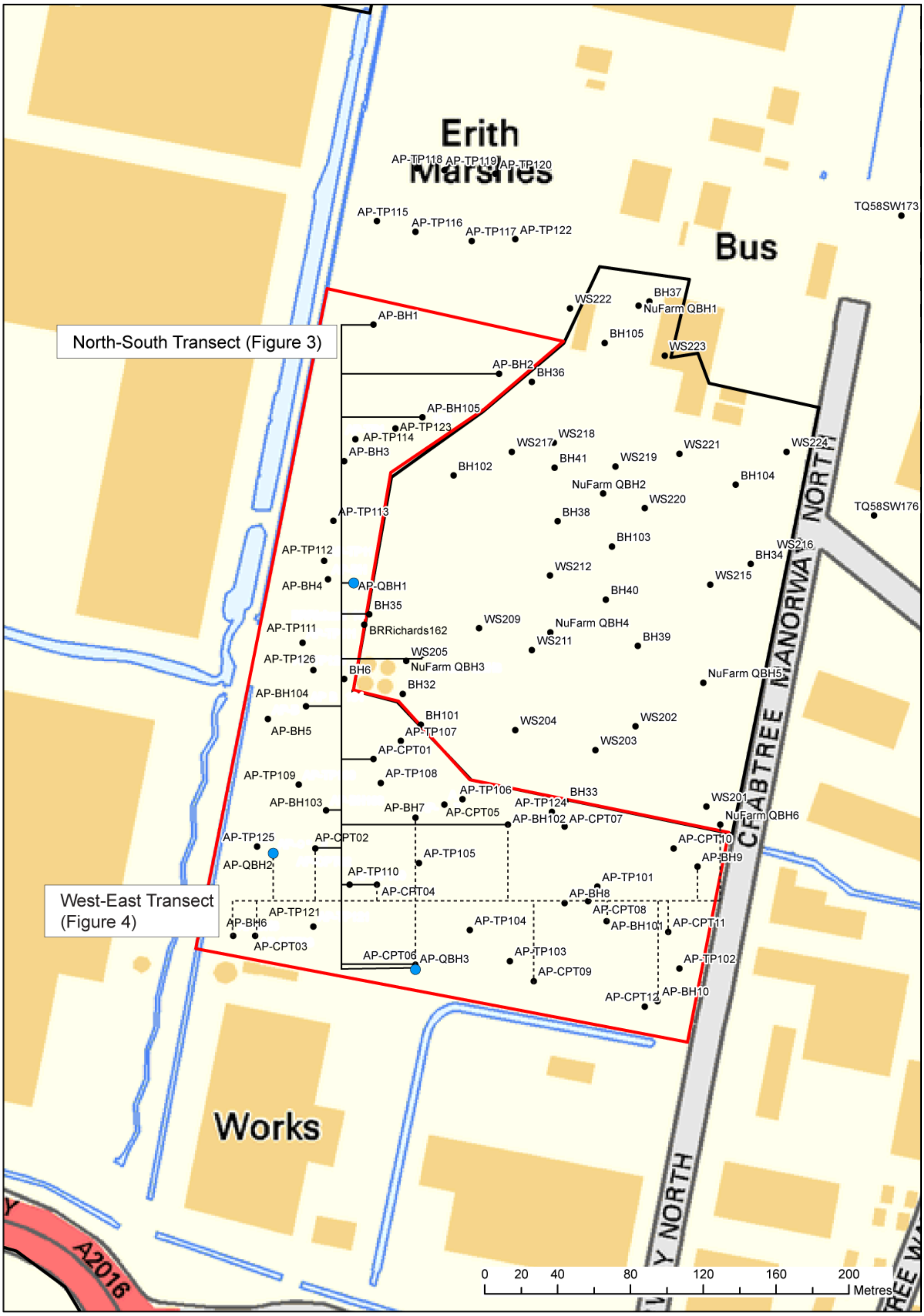

Figure 2: Location of the geoarchaeological boreholes and select recent/historical geotechnical boreholes and test-pits across the Alchemy Park and neighbouring NuFarm sites, London Borough of Bexley

4. METHODS

4.1 Geoarchaeological field investigations and deposit modelling

Three geoarchaeological boreholes (boreholes AP-QBH1 to QBH3) were put down at the site in February 2016 (Figure 2) by Quaternary Scientific. The borehole core samples were recovered using an Eijkelkamp window sampler and gouge set using an Atlas Copco TT 2-stroke percussion engine. This coring technique is a suitable method for the recovery of continuous, undisturbed core samples and provides sub-samples suitable for not only sedimentary and microfossil assessment and analysis, but also macrofossil analysis. The new and historic borehole locations were obtained with reference to site maps and recent topographic surveys (Table 1).

The lithostratigraphy of the retained 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 deposit model generated during the previous phase of work was based on a review of 105 borehole and test-pit records, incorporating those from both Alchemy Park, NuFarm, and historical records from around the site (Figure 2; Table 1). West-east and north-south borehole transects were compiled (Figures 3 & 4). Sedimentary units from the boreholes were classified into five groupings: (1) Gravel, (2) Lower Alluvium; (3) Peat; (4) Upper Alluvium and (5) Made Ground. The classified data for groups 1-5 were then input into a database with the RockWorks geological utilities software. Models of surface height were generated for the Gravel, Lower Alluvium, Peat and Upper Alluvium (Figures 5, 6, 8 & 10). Thickness of the Lower Alluvium, Peat, Upper Alluvium, Total Alluvium and Made Ground (Figures 7, 9, 11, 12 & 13) was also modelled (also using a nearest neighbour routine). In addition, over 750 records were collated to examine key deposits across the wider area (Figure 16).

How effectively Rockworks portrays the relief features of stratigraphic contacts or the thickness of sediment bodies depends on the number of data points (boreholes/test pits) per unit area, and the extent to which these points are evenly distributed across the area of interest. The portrayal is also affected by the significance assigned to these data points, in terms of the extent of the area around the point to which the data are deemed to apply. This can be predetermined for each data set, and in the present case the value chosen for each data point (borehole) is equivalent to an area of 25m radius for all models. The boreholes are relatively well distributed over the area of investigation. In general, reliability improves towards the core area of boreholes where mutually supportive data are likely to be available from several adjacent data points. Reliability is also affected by the quality of the stratigraphic records, which in turn are affected by the nature of the sediments and/or their post-depositional disturbance during previous stages of land-use on the site. Quality is also affected where boreholes have been put down at different times and recorded using different descriptive terms and subject to differing technical constraints in terms of recorded detail including the exact levels of the stratigraphic boundaries. Of the records used in the deposit model, the cores from the geoarchaeological boreholes put down by Quaternary Scientific represent the most detailed record of the sediment sequences. Finally, because of the 'smoothing' effect of the modelling procedure, the modelled levels of stratigraphic contacts may differ slightly from the levels recorded in borehole logs.

4.2 Organic matter determinations

A total of 30 subsamples from borehole AP-QBH1 and 12 from AP-QBH2 were taken for determination of the organic matter content (Table 5; Figure 12). These records were important as they can identify increases in organic matter possibly associated with more terrestrial conditions. The organic matter content was determined by standard procedures involving: (1) drying the sub-sample at 110°C for 12 hours to remove excess moisture; (2) placing the sub-sample in a muffle furnace at 550°C for 2 hours to remove organic matter (thermal oxidation), and (3) re-weighing the sub-sample obtain the 'loss-on-ignition' value. The samples were then re-weighed after 2 hours at 950°C for determination of the calcium carbonate content (see Bengtsson and Enell, 1986).

4.3 Radiocarbon dating

Three subsamples of unidentified twig wood (<2-3 years old) were extracted from the base and/or top of the peat in borehole AP-QBH1 and AP-QBH2 for radiocarbon dating; a further sample was taken from a thin peat unit within the Lower Alluvium. 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 12 and in Table 6.

4.4 Pollen and non-pollen palynomorph analysis

Twenty subsamples from borehole AP-QBH1 and eight from AP-QBH2 were extracted for an assessment of pollen content. The pollen was extracted as follows: (1) sampling a standard volume of sediment (1ml); (2) adding two tablets of the exotic clubmoss *Lycopodium clavatum* to provide a measure of pollen concentration in each sample; (3) deflocculation of the sample in 1% Sodium pyrophosphate; (4) sieving of the sample to remove coarse mineral and organic fractions (>125μ); (5) acetolysis; (6) removal of finer minerogenic fraction using Sodium polytungstate (specific gravity of 2.0g/cm^3); (7) mounting of the sample in glycerol jelly. Each stage of the procedure was preceded and followed by thorough sample cleaning in filtered distilled water. Quality control is maintained by periodic checking of residues, and assembling sample batches from various depths to test for systematic laboratory effects. Pollen grains and spores were identified using the University of Reading pollen type collection and the following sources of keys and photographs: Moore *et al* (1991); Reille (1992).

Each slide was initially scanned to establish the concentration, preservation and main taxa present. Those samples with a sufficiently high concentration and preservation of remains underwent full analysis (a total of nineteen). The analysis procedure consisted of counting all pollen to 300 Total Land Pollen where possible (TLP; trees, shrubs and herbs) where possible. Aquatic pollen, spores, testate amoeba, non-pollen palynomorphs and intestinal parasites were also counted. 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). Pollen percentage and pollen concentration diagrams were produced in 'Tilia'. Pollen percentage values were calculated as follows: Tree, shrub and herb taxa were calculated as a percentage of total land pollen (TLP); other remains (spores, testate amoeba, non-pollen palynomorphs and intestinal parasites) were calculated as a percentage of TLP. The concentration of microcharcoal with dimensions >20um along at least one axis, was also recorded together with total pollen concentration. The results are displayed in Figures 13 & 14.

4.5 Diatom assessment

Four samples from AP-QBH1 and two from AP-QBH2 were sampled for assessment of the diatom content. Samples AP-QBH1 -1.47m and -1.51m have been sampled from either side of the Upper Alluvium / Peat boundary, whereas samples BH1 -4.08, -4.13 and BH2 -4.73m, -4.77m have been sampled from either side of the Peat / Lower Alluvium boundary.

0.5g of sediment was required for the diatom sample preparation. Depending on the dominance of either minerogenics of organics within each sample, samples chosen for analysis were first treated with sodium hexametaphosphate and left overnight, to assist in minerogenic deflocculation. Samples were then treated with hydrogen peroxide (30% solution). 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). Due to the nature of the assessment, many taxa were only identified to genera level. The results are displayed in Table 7.

4.6 Macrofossil assessment

A total of seven small bulk samples (five from borehole AP-QBH1 and two from AP-QBH2) were extracted for the recovery of macrofossil remains including waterlogged plant macrofossils, wood, insects and Mollusca. The extraction process involved the following procedures: (1) removing a sample of either 5 or 10cm in thickness; (2) measuring the sample volume by water displacement, and (3) 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 (Table 8 & 9). Preliminary identifications of the waterlogged seeds have been made using modern comparative material and reference atlases (Cappers *et al.,* 2006). Nomenclature used follows Stace (2005).

Table 1: Borehole and select Test-Pit attributes for those records used in the deposit model, Alchemy Park, Crabtree Manorway North, London Borough of Bexley (all depths metres below ground level (bgl))

Name	Easting	Northing	Elevation	Total depth	Top of Upper Alluvium	Top of Peat	Top of Lower Alluvium	Top of Shepperton Gravel	Top of Bedrock	Notes
AP-QBH1	549994	180223	0.9	8	2.37	2.41	5.00			SG not reached; Peat in LA
AP-QBH2	549950	180074	1.5	10	1.1	2.9	6.26			SG not reached
AP-QBH3	550028	180011	1.8	10	1.35	3.15	3.54			SG not reached
AP-BH1	550005	180365	1.6	15	1.6	4.4	6.5	10.3		UA organic rich/peaty 3.4-4.4; 50cm horizon of organic clay within peat (5.3-5.8); LA organic-rich & peaty throughout
AP-BH2	550074	180338	1.35	25	1.5	2.6	4.1	9.4	14.3	LA organic-rich and peaty throughout
AP-BH3	549989	180290	1.2	20	1.3	2.8	4.9	9.4	13.4	LA organic-rich and peaty throughout
AP-BH4	549980	180225	1	15		2.4	6.5	9.3	13.5	UA truncated; 50cm horizon of organic clay within peat (4.3-4.8); LA organic-rich and peaty throughout
AP-BH5	549947	180148	1.3	25	1.3	3.5	4.3	9.3	13.4	LA organic-rich and peaty throughout
AP-BH6	549928	180029	1.5	24	1.2	2.3	3.9	11.9	15.5	LA organic-rich and peaty throughout
AP-BH7	550028	180094	1.59	15	1.2	4.65	6.2	11.6		UA organic rich/peaty 4-4.65; LA organic-rich & peaty throughout; occasional gravel from 9.9m
AP-BH8	550110	180047	1.8	15	1.4	4.5	6.6	11.8		LA organic-rich & peaty throughout; occasional gravel from 9.9m
AP-BH9	550183	180067	1.4	25	0.7	3	5.4	10.8	14.5	UA organic rich/peaty 2.45-3; LA organic-rich & peaty throughout
AP-BH10	550161	179993	1.5	20	1.5		3	12.1		No peat; LA organic-rich/peaty throughout
AP-BH101	550133	180037	1.82	16.7	2.5	5.3	7	11		Peat within LA between 8.8 & 9.5m
AP-BH102	550079	180090	2.13	25	1.9	6.95	8.5	11	19	Peat within LA between 9.2 & 10.10m
AP-BH103	549979	180098	1.52	20	1.55	4.5	6.8	12	16.5	LA contains wood
AP-BH104	549968	180155	1.14	17	0.5	5.45	8.45	9.95	15	
AP-BH105	550032	180314	1.48	21.2	1.4	4	5.5	9.5	14.2	Peat within LA between 8.8 & 9.5m
AP-CPT01	550005	180126	1.15	13				9.8		Gravel surface only reliable height
AP-CPT02	549973	180077	1.5	13				12.7		Gravel surface only reliable height
AP-CPT03	549940	180029	1.3	13				11.6		Gravel surface only reliable height
AP-CPT04	550007	180057	1.6	13				11.9		Gravel surface only reliable height
AP-CPT05	550044	180101	1.4	13				9.8		Gravel surface only reliable height
AP-CPT06	550028	180013	1.8	13				13		Gravel surface only reliable height
AP-CPT07	550110	180089	1.7	13				11.1		Gravel surface only reliable height
AP-CPT08	550123	180048	1.7	13				11.2		Gravel surface only reliable height
AP-CPT09	550093	180004	1.7	13				12.6		Gravel surface only reliable height
AP-CPT10	550170	180077	1.7	13				10.5		Gravel surface only reliable height
AP-CPT11	550167	180031	1.6	13				12		Gravel surface only reliable height
AP-CPT12	550154	179990	1.66	13				12		Gravel surface only reliable height
AP-TP101	550128	180056	1.91	4	1.8	4				
AP-TP102	550173	180011	1.36	5	1	3.05	4.4			

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Name	Easting	Northing	Elevation	Total depth	Top of Upper Alluvium	Top of Peat	Top of Lower Alluvium	Top of Shepperton Gravel	Top of Bedrock	Notes
AP-TP103	550080	180015	2.08	5	3.4					
AP-TP104	550058	180032	3.07	2						
AP-TP105	550030	180069	1.65	5	1.2					
AP-TP106	550054	180104	1.49	5	2.8					
AP-TP107	550020	180136	1.29	2.2	2					
AP-TP108	550009	180113	1.36	4.8		3.8				
AP-TP109	549964	180112	1.62	4.7	1.1	4.3				
AP-TP110	549992	180057	1.51	5	1.6	2.7	4.3			
AP-TP111	549966	180190	3.11	3.1						
AP-TP112	549978	180235	4.47	4.5						
AP-TP113	549983	180257	4.6	4.4						
AP-TP114	549995	180302	4.7	4.3						
AP-TP115	550007	180422	11.65	5						
AP-TP116	550028	180416	12.15	5						
AP-TP117	550059	180411	10.1	5						
AP-TP118	550029	180451	15.45	5						
AP-TP119	550044	180450	13.95	4						
AP-TP120	550072	180448	11.85	4.4						
AP-TP121	549972	180034	1.55	5.1		2.3	3.05			
AP-TP122	550083	180412	9.85	5						
AP-TP123	550017	180308	3.4	4	3.7					
AP-TP124	550103	180097	1.7	3.8	1.4					
AP-TP125	549941	180078	1.49	4	1.4	2.6				
AP-TP126	549972	180175	2.1	4	2.2					

5. RESULTS AND INTERPRETATION OF THE DEPOSIT MODELLING, ORGANIC MATTER DETERMINATIONS & RADIOCARBON DATING

The results of the geoarchaeological borehole descriptions are shown in Tables 2-4. The results of the deposit modelling are displayed in Figures 3 to 11; Figures 3 and 4 are 2-dimensional transects through the two sites from north to south, and west to east, respectively. Figures 5 to 11 are surface elevation and thickness models for each of the main stratigraphic units. Finally, the results of the organic-matter determinations and radiocarbon dating are shown in Figure 12 & Tables 5 and 6. The results of the deposit modelling indicate that the number and spread of the logs is sufficient to permit modelling with a high level across the entire area under investigation.

The full sequence of sediments recorded in the boreholes comprises:

Made Ground
Upper Alluvium – widely present
Peat – widely present
Lower Alluvium – widely present, frequently peaty
Gravel (Shepperton Gravel)

5.1 Shepperton Gravel

The Shepperton Gravel was present in all the boreholes that penetrated to the bottom of the Holocene sequence. It was deposited during the Late Glacial (15,000 to 10,000 years before present) and comprises the sands and gravels of a high-energy braided river system which, while it was active would have been characterised by longitudinal gravel bars and intervening low-water channels in which finer-grained sediments might have been deposited. Such a relief pattern would have been present on the valley floor at the beginning of the Holocene when a lower-energy fluvial regime was being established.

The surface of the Shepperton Gravel across the area (Figures 3-5) display significant relief between -7.5 (AP-BH6) and -11.2m OD (AP-CPT02; AP-CPT06). However, the results suggest a surface that is relatively even across much of the former NuFarm site, and northern part of the Alchemy Park site, ranging between *ca*. -7.5 and -9.0m OD. It is on the southern part of the Alchemy Park site that the gravel surface drops to below -10.5m OD (e.g. AP-BH103; AP-CPT09; AP-BH10) and reaches -11.2m in AP-CPT02 and AP-CPT06 (Figure 2). This is a pattern suggestive of a trough (likely palaeochannel) in this area of the site. The precise orientation and dimensions of this channel are unclear, but it appears to be aligned approximately west-east or northwest-southeast, and measured at least 100m in width and up to 2.2m in depth.

5.2 Lower Alluvium

The Lower Alluvium rests directly on the Shepperton Gravel and was recorded in all records both within and beyond the confines of the channel (Figures 3, 4 and 6). The deposits of the Lower Alluvium are described as a predominantly silty or clayey unit tending to become increasingly sandy

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downward in most sequences. The Lower Alluvium frequently contains detrital wood or plant remains, and in many cases is described as organic, sometimes including peat lenses and occasional Mollusca remains. The variable content of the Lower Alluvium is reflected in the organic-matter content values which tend to range between 10% and 60% (Table 5; Figure 12). The surface of the Lower Alluvium (Figure 7) is highly variable, generally lying at between *ca*. -3m and -1m. The thicker occurrences of the Lower Alluvium are present where the surface of the Shepperton Gravel lies at a lower level.

The sediments of the Lower Alluvium are indicative of deposition during the Early to Mid-Holocene, when the main course of the Thames was probably confined to a single meandering channel. This is confirmed by the radiocarbon date on a peat lens within the Lower Alluvium of AP-QBH1, which provided an age of 7410-7170 cal BP (late Mesolithic age). During this period, the surface of the Shepperton Gravel was progressively buried beneath the sandy and silty flood deposits of the river. The richly-organic nature of the Lower Alluvium suggests that this was a period during which the valley floor was occupied by a network of actively shifting channels, with a drainage pattern on the floodplain that was still largely determined by the relief on the surface of the underlying Shepperton Gravel.

5.3 Peat

Overlying the Lower Alluvium across the whole site is a bed of peat, varying in thickness from 0.4m (AP-QBH3) to 5.6m (AP-BH6), but generally between 1.0m and 4.0m thick (Figure 8). The thickest horizons of peat (>2.5m) all occur beyond the confines of the former channel on the NuFarm and northern part of the Alchemy Park site; within the channel, the peat rarely exceeds 2.5m in thickness (AP-QBH2 being the only case – 3.4m of peat recorded). The surface of the peat (Figure 7) is fairly level between -1.0m and -3.0m OD; only in a couple of cases is it recorded at a lower elevation (>-4m OD in AP-BH102, AP-BH104 and NuFarm-QBH4).

The widespread occurrence of this peat horizon indicates a general transition to a more stable valley floor, possibly associated with falling relative sea level and slight incision of the main channel of the Thames, encouraging the development of semi-terrestrial conditions across most of the floodplain. The peat is composed of wood and herbaceous remains indicating that during its accumulation the floodplain supported the growth of sedge fen/reed swamp and woodland communities. Radiocarbon dating carried out on the base of the peat in both AP-QBH1 & AP-QBH2 indicate that accumulation commenced from 6600-6410 and 6300 to 6200 cal BP respectively (Figure 12; Table 6). The top of the peat was radiocarbon dated to 3330-3070 cal BP, suggesting accumulation continued for a period of more than 3000 years. The radiocarbon dating program has also demonstrated that peat formation commenced at least marginally later within the confines of the channel, and probably for a shorter period of time. This is because of the higher surface elevation of the Lower Alluvium recorded here (Figure 6), indicating that the channel was still active at the time when peat began to accumulate beyond its margins. The thinner nature of the peat also suggests it accumulated for a much shorter period of time.

Finally, the organic matter content of the peat is highly variable (>20% to 80%; Figure 12, Table 5). This suggests that the peat surface was not consistently dry and 'stable' throughout its accumulation. Low organic matter values indicate the influx of mineral-rich material, most likely as a consequence of flooding. There is also the suggestion that there may be a synchronous event with low values recorded in each borehole at approximately -3.20m OD; this could only be confirmed by further radiocarbon dating.

5.4 Upper Alluvium

The uppermost unit in the Holocene alluvial sequence is the Upper Alluvium, the deposits of which comprise largely sterile clays and silty clays. The Upper Alluvium generally ranges between 1 and 3m in thickness, but occasional reach up to 5m (e.g. AP-BH102 and AP-BH105). The deposition of the Upper Alluvium had the effect of infilling the remaining inequalities in the relief of the floodplain, so that the surface of the Upper Alluvium (Figure 9) is remarkably level between +0.5m and -0.1m OD.

The Upper Alluvium is typical of the mineral-rich sediments that are present as the uppermost element of the Holocene sequence beneath most floodplains in southern and south-east England. It is generally considered to 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.

5.5 Made Ground

Between 1 and 5m of Made Ground caps the Holocene alluvial sequence (Figure 11).

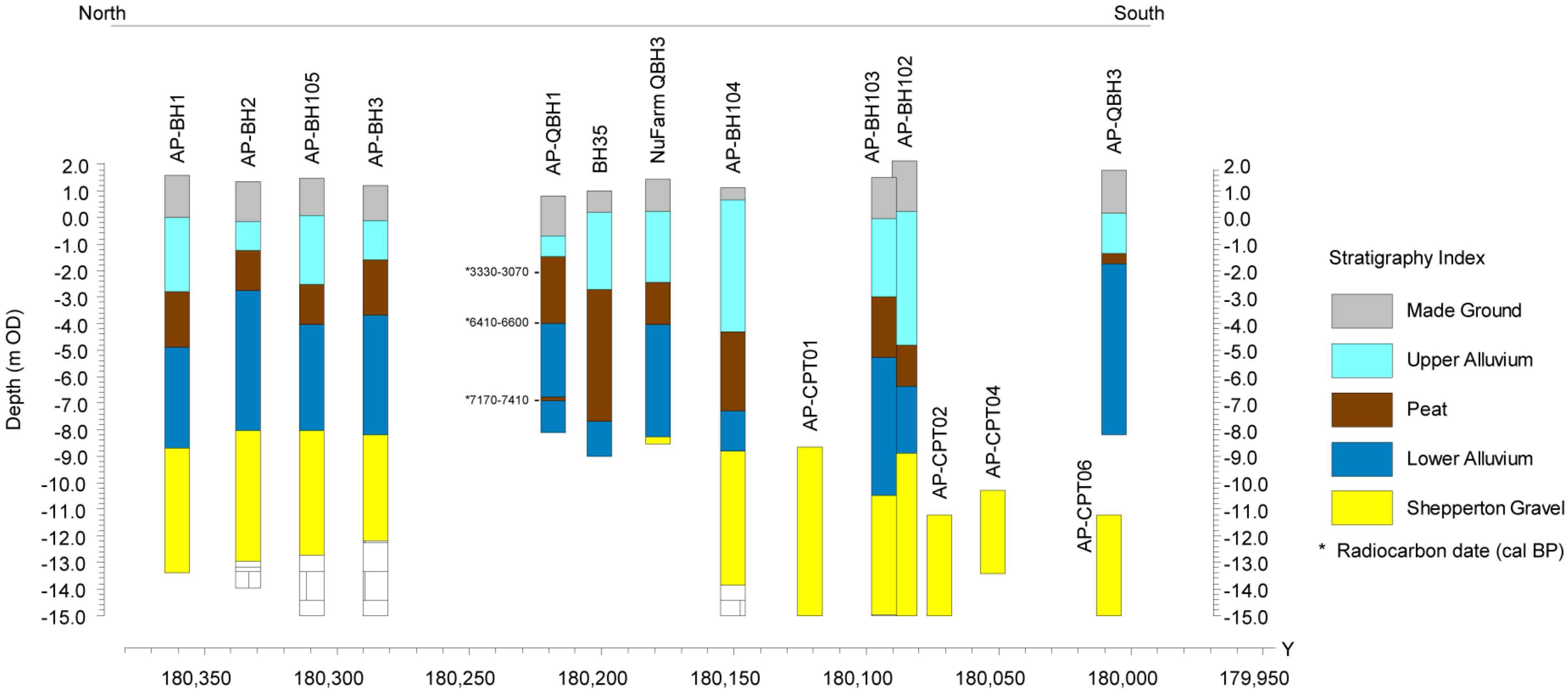

Figure 3: North-South transect of selected boreholes across Alchemy Park, Crabtree Manorway North, London Borough of Bexley, inclusive of radiocarbon dates.

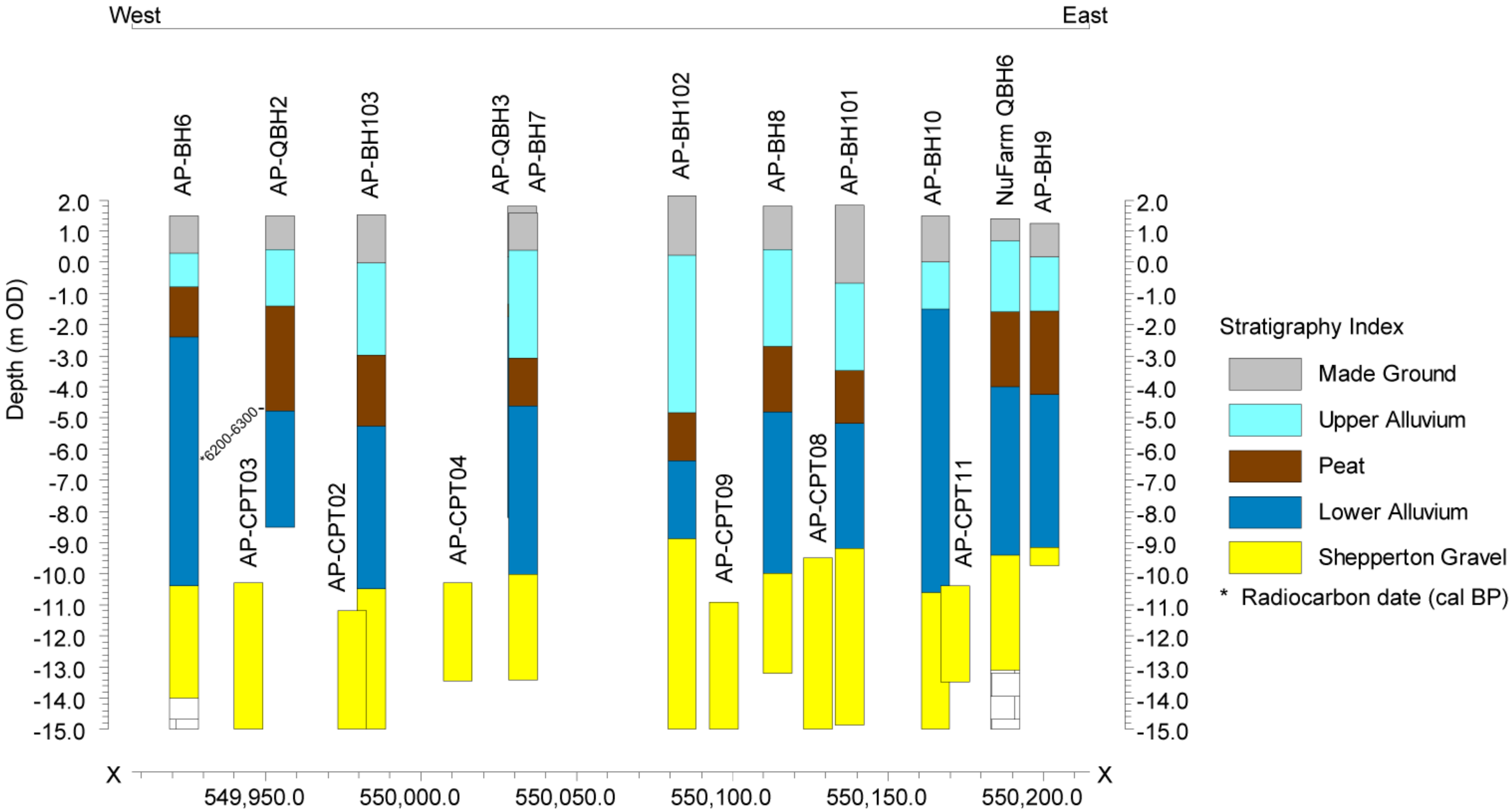

Figure 4: West-East transect of selected boreholes along the potential palaeochannel on the southern half of Alchemy Park, Crabtree Manorway North, London Borough of Bexley, inclusive of radiocarbon dates.

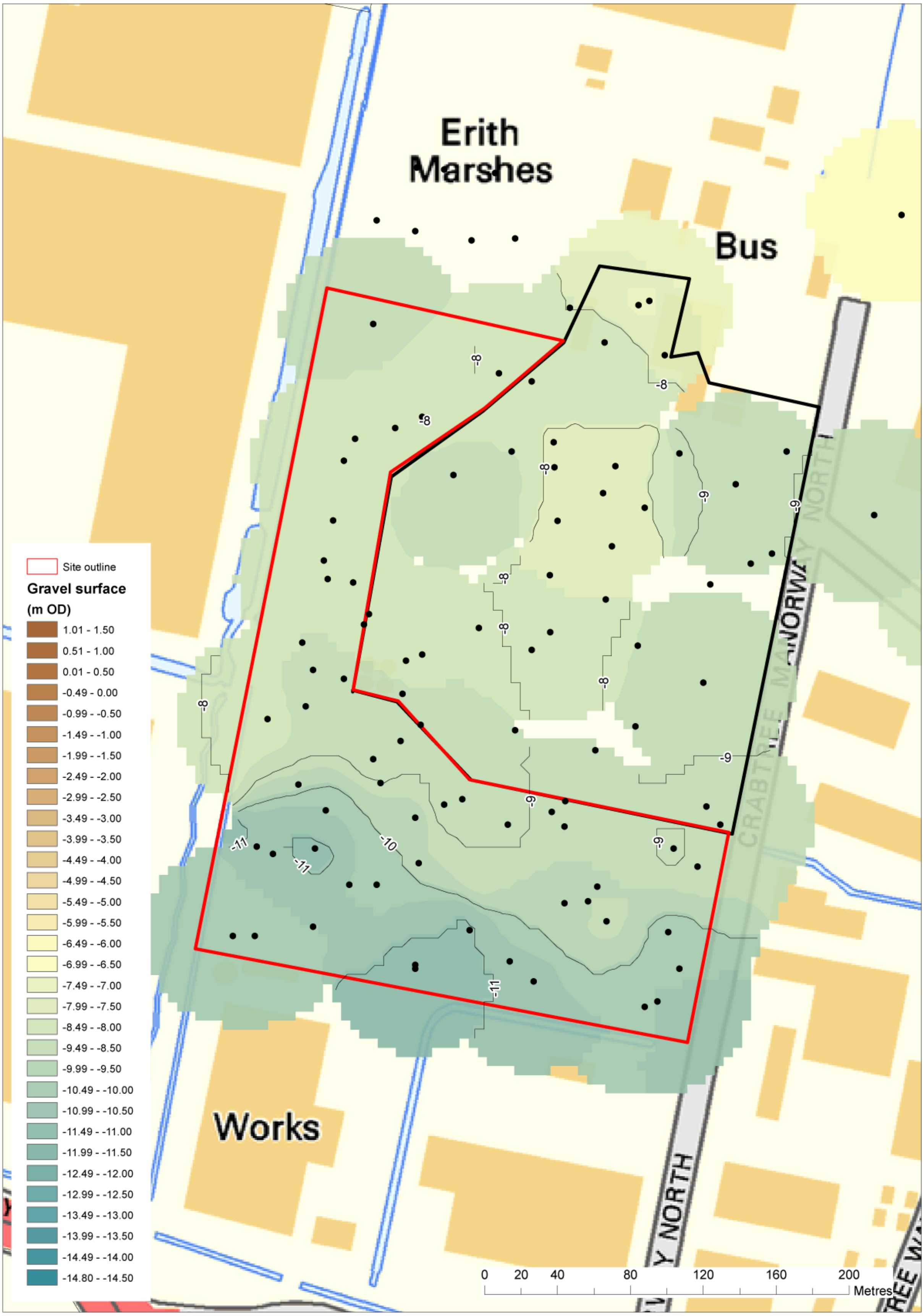

Figure 5: Top of the Shepperton Gravel (m OD) (site outline in red)

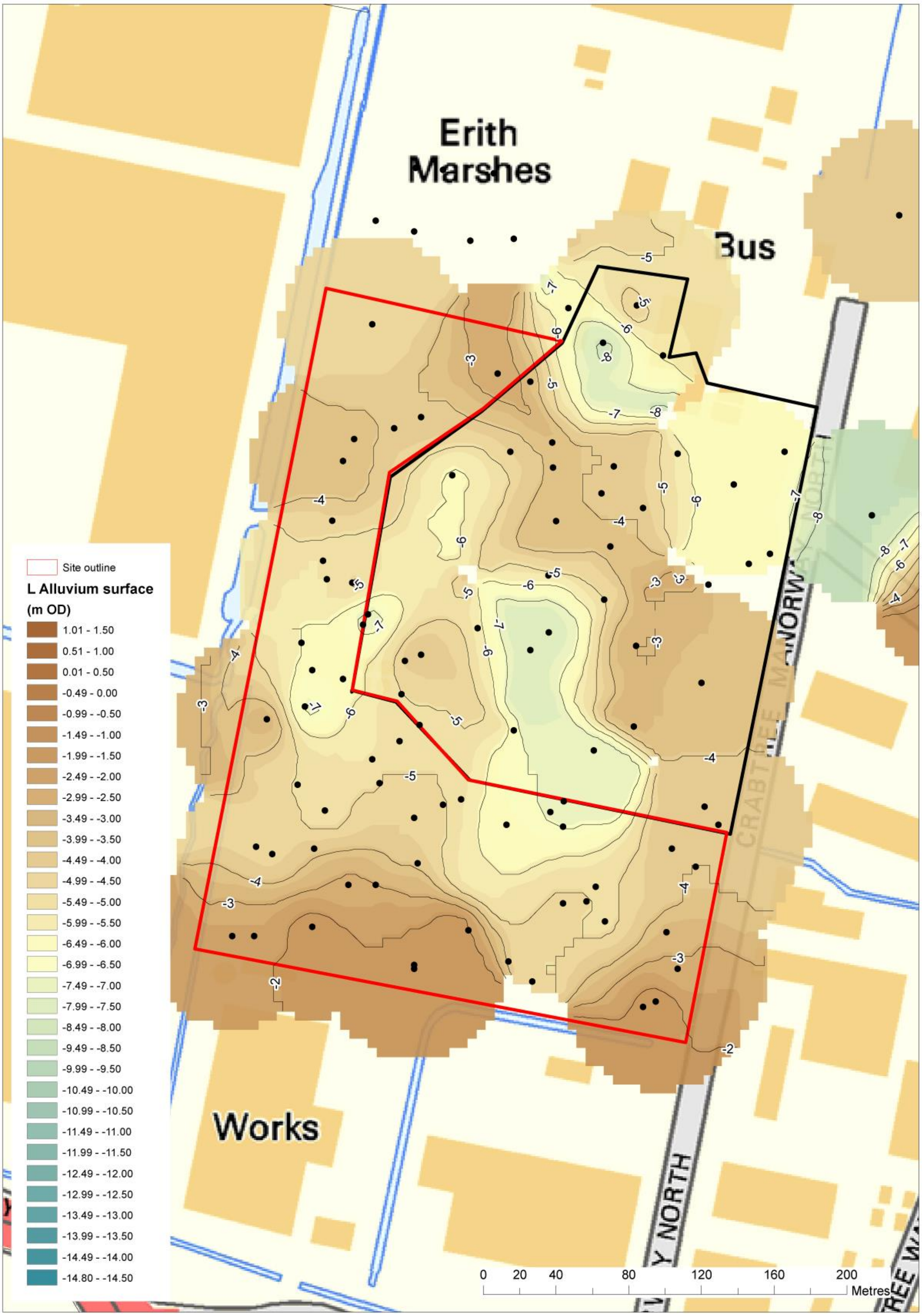

Figure 6: Top of the Lower Alluvium (m OD) (site outline in red)

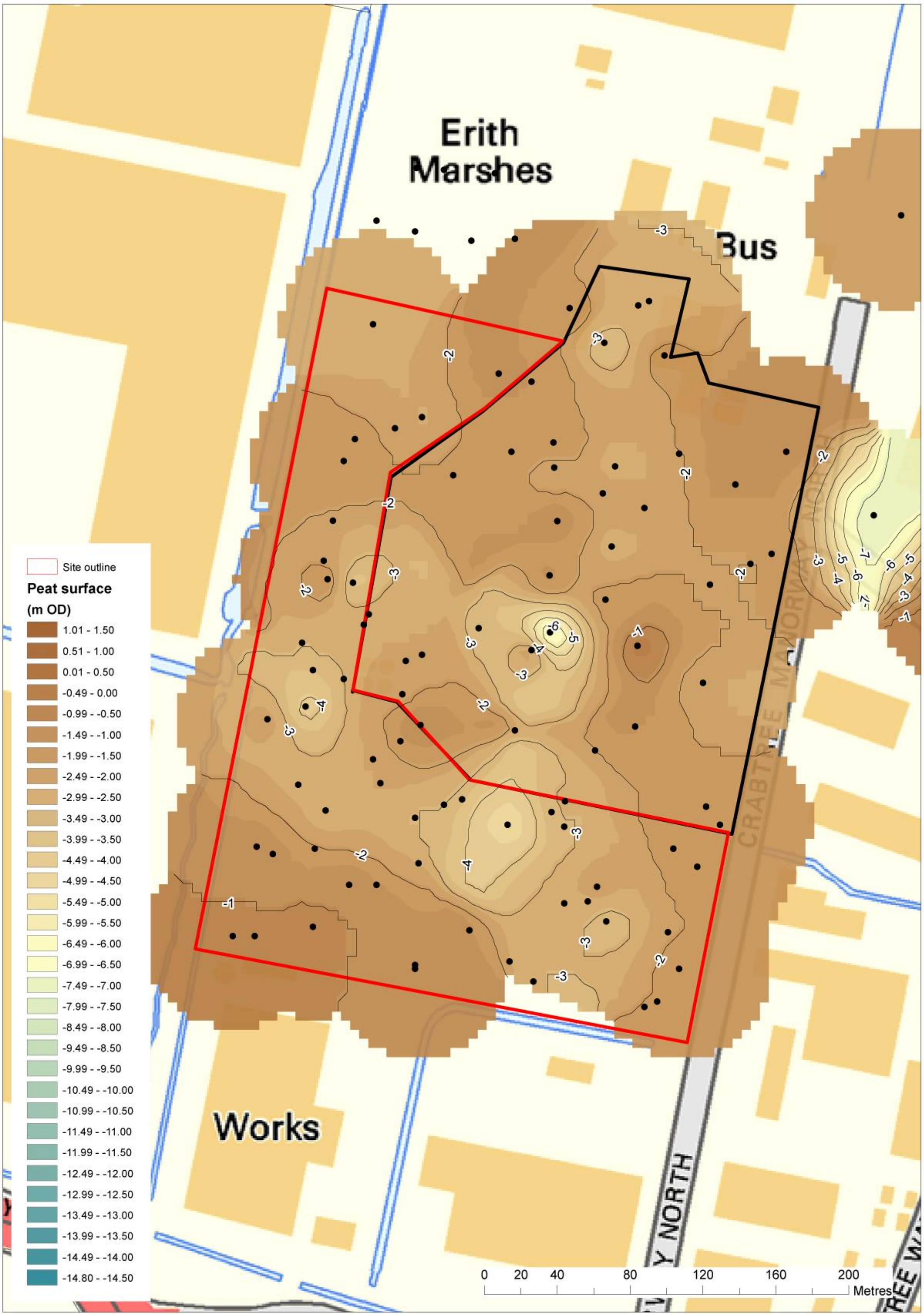

Figure 7: Top of Peat (m OD) (site outline in red)

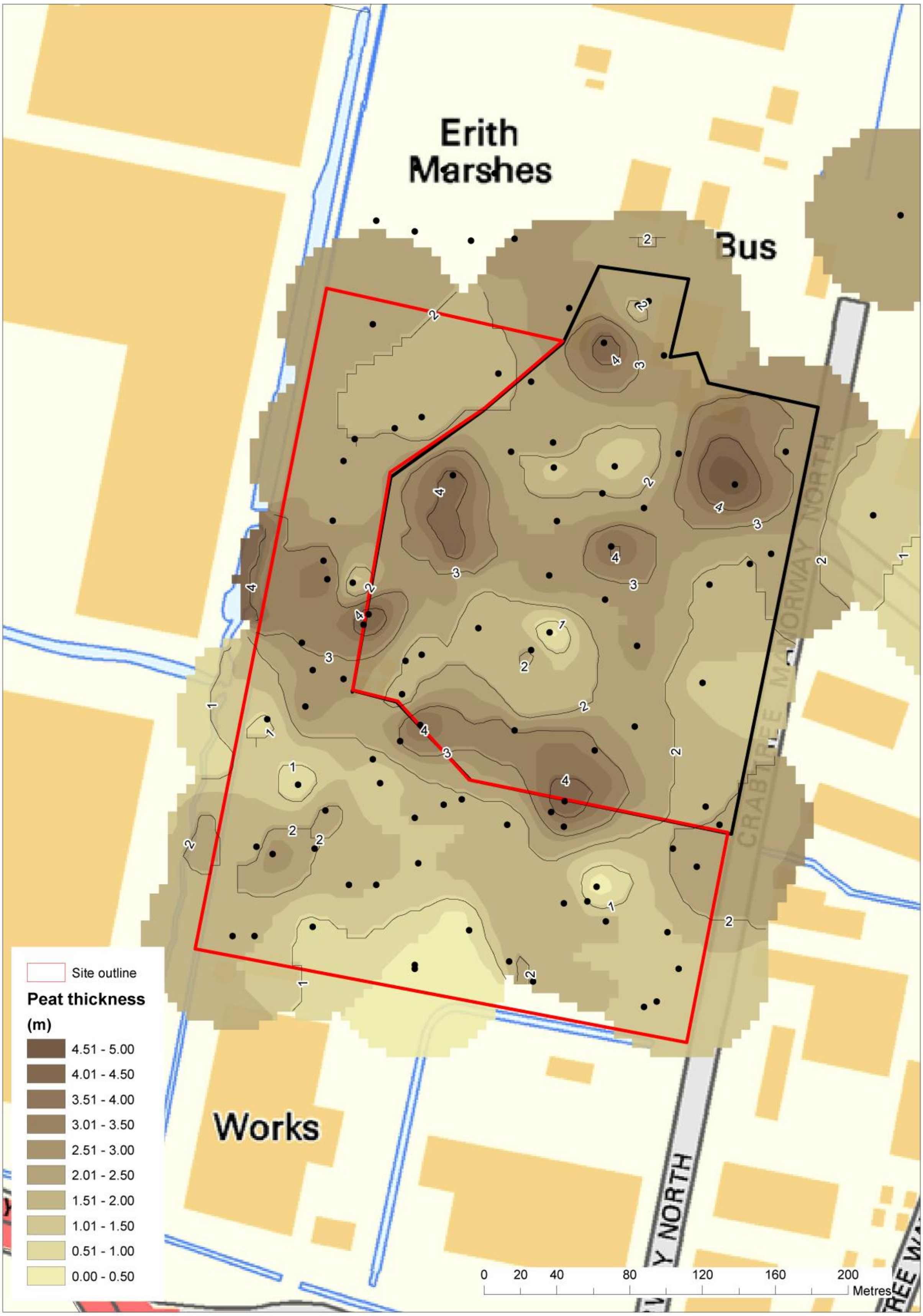

Figure 8: Thickness of Peat (m) (site outline in red)

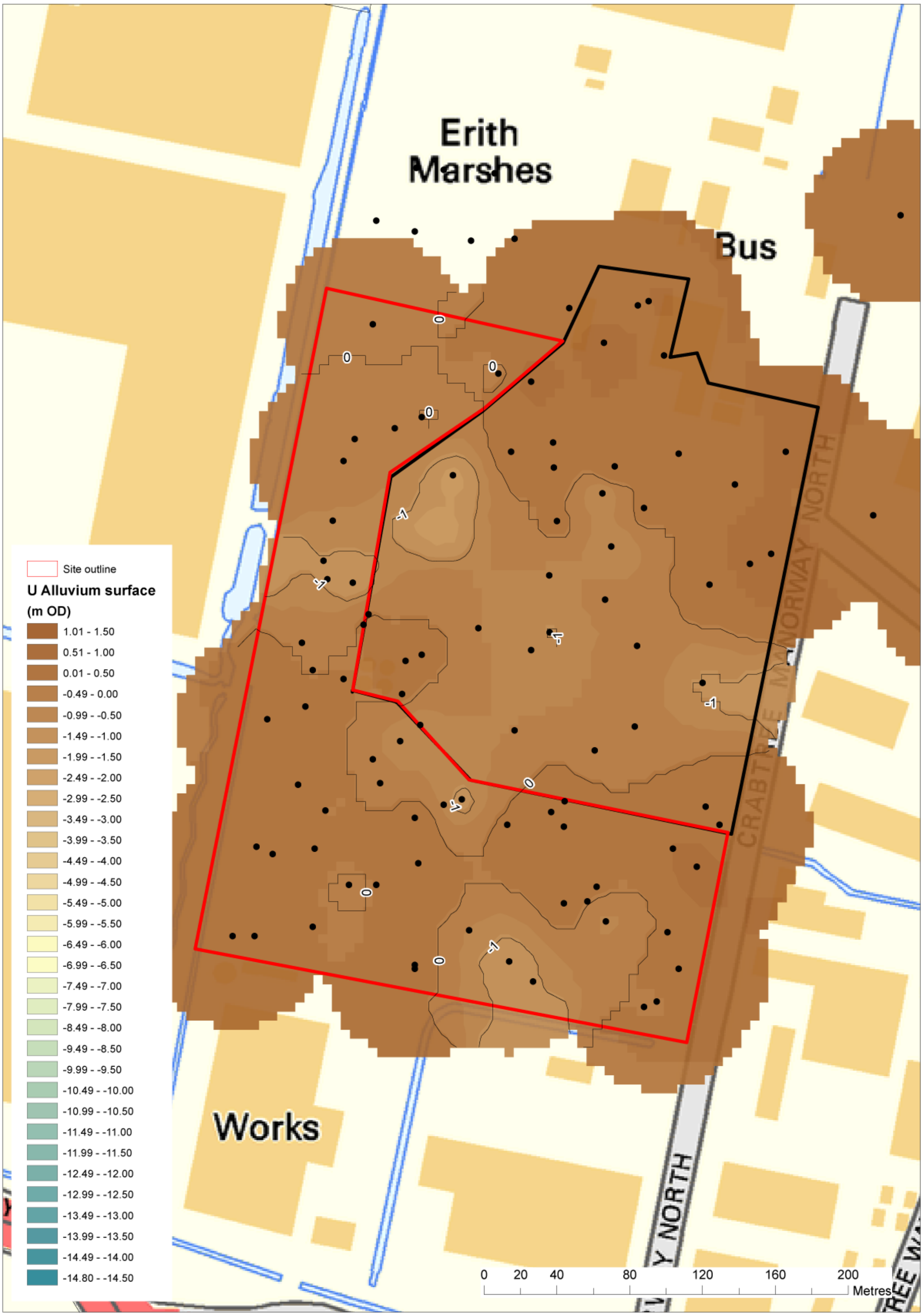

Figure 9: Top of the Upper Alluvium (m OD) (site outline in red)

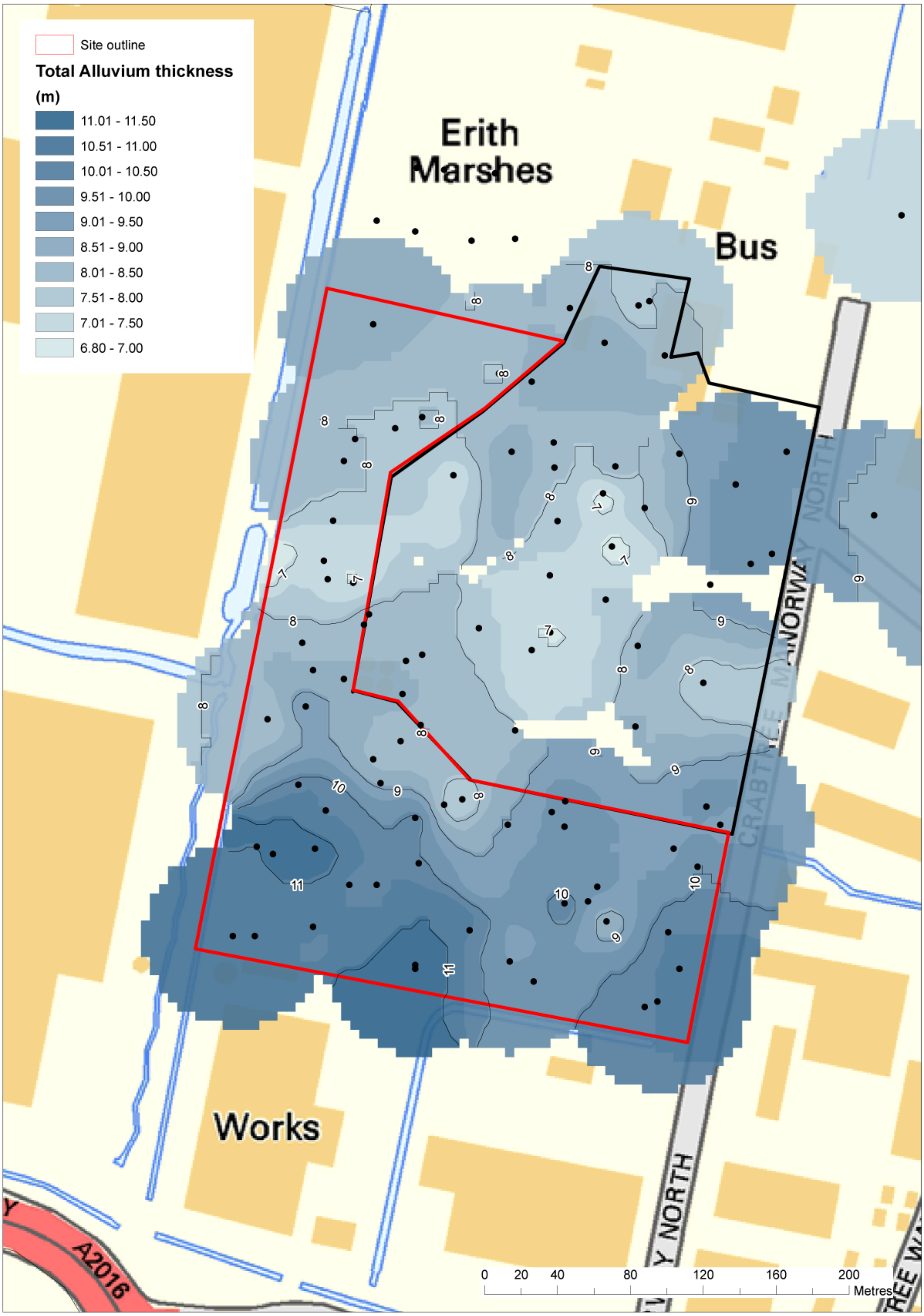

Figure 10: Thickness of Total Alluvium (m) (site outline in red)

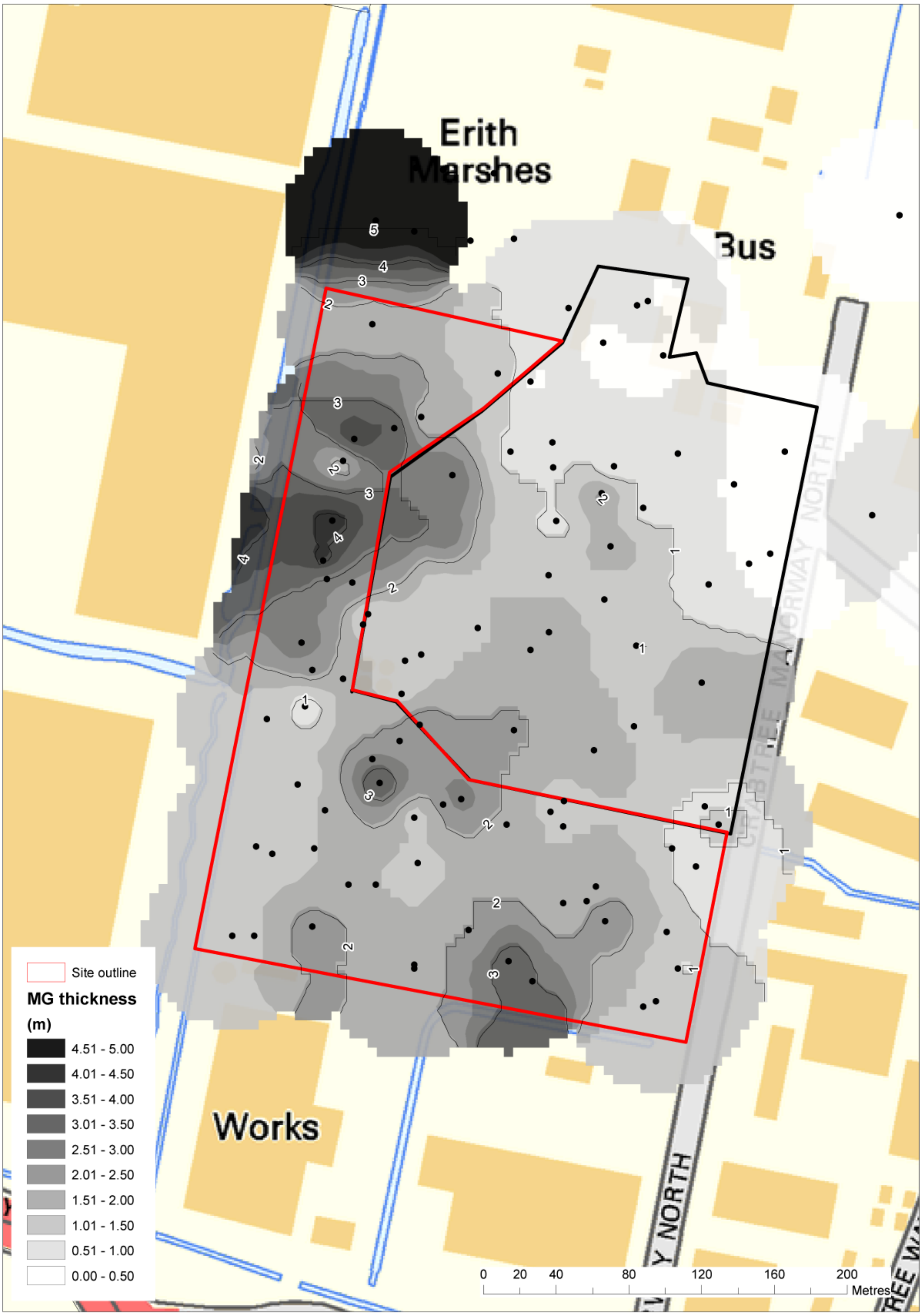

Figure 11: Thickness of Made Ground (m) (site outline in red)

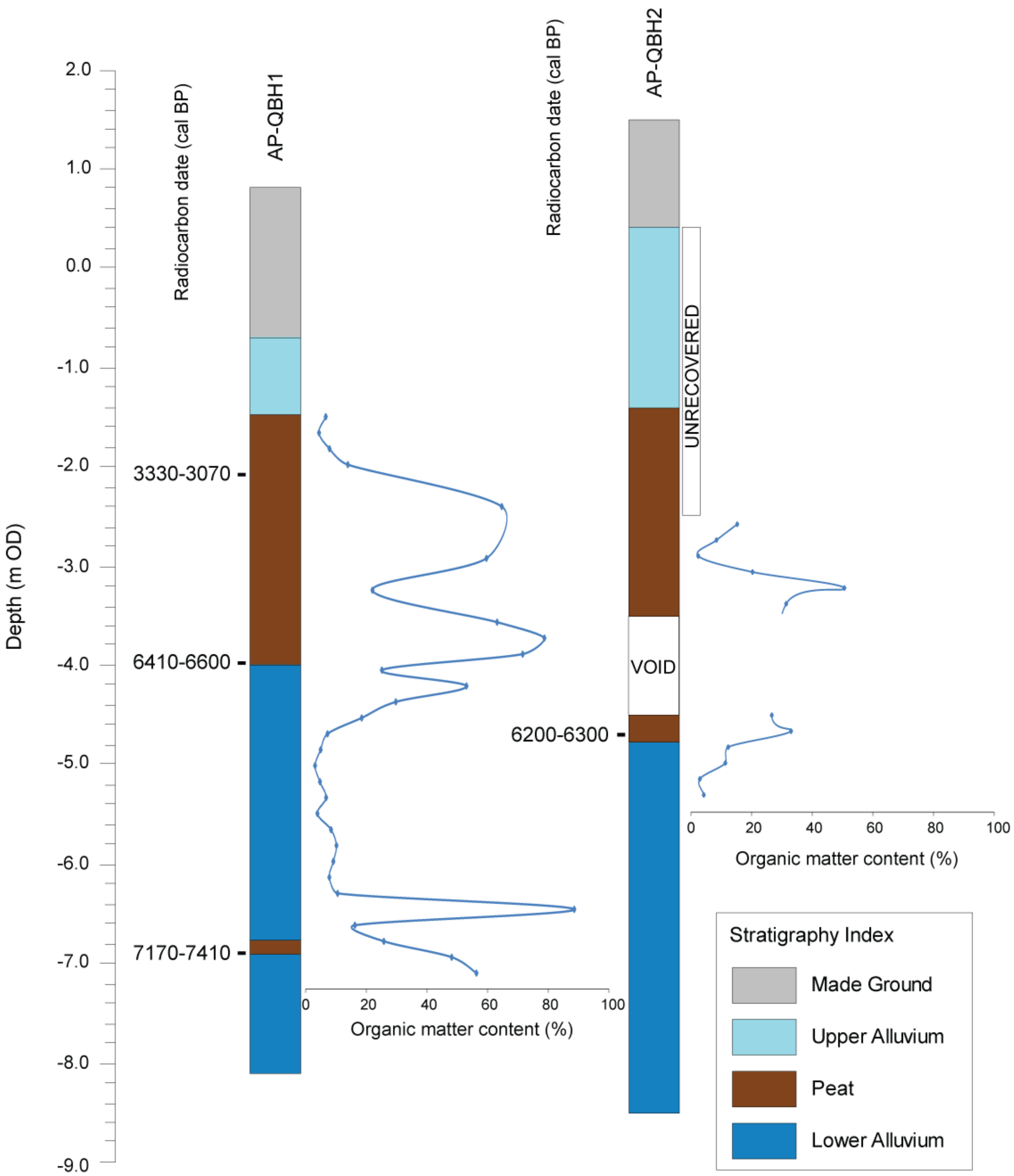

Figure 12: Detailed lithostratigraphy of AP-QBH1 & AP-QBH2, Alchemy Park, Crabtree Manorway North, London Borough of Bexley

Table 2: Lithostratigraphic description of borehole AP-QBH1, Alchemy Park, Crabtree Manorway North, London Borough of Bexley

Depth (m OD)	Depth (m bgs)	Description	Stratigraphic group
0.90 to -0.70	0 to 1.60	Made ground	MADE GROUND
-0.70 to -1.10	1.60 to 2.00	Gley 2 6/1; As3, Ag1; Bluish grey silty clay	UPPER ALLUVIUM
-1.10 to -1.51	2.00 to 2.41	10YR 4/1; As3, Ag1; Dark grey silty clay with traces of organic matter; sharp contact into:	
-1.51 to -2.10	2.41 to 3.00	10YR 2/1; Sh2, Tl^{1}1, Ag1; Humo 2-3; Black moderately humified silty wood peat; diffuse contact into:	PEAT
-2.10 to -2.81	3.00 to 3.71	UNRECOVERED	
-2.81 to -2.95	3.71 to 3.85	10YR 3/2; Ag2, Sh1, Tl^{1}1; Humo 2; Very dark greyish brown moderately humified silty wood peat; sharp contact into:	
-2.95 to -3.86	3.85 to 4.76	10YR 2/1; Sh2, Tl^{1}1, Ag1; Humo 2-3; Black moderately humified silty wood peat; diffuse contact into:	
-3.86 to -3.96	4.76 to 4.86	10YR 4/1; Ag3, Sh1; Dark grey organic-rich silt with traces of detrital plant remains; sharp contact into:	
-3.96 to -4.10	4.86 to 5.00	10YR 3/2; Sh2, Tl^{2}1, Th^{2}1; Humo 2; Dark grey moderately humified wood and herbaceous peat;	
-4.10 to -5.10	5.00 to 6.00	Gley 1 4/10Y; Ag2, As2; Dark greenish grey silty clay with traces of detrital plant remains and sand; diffuse contact into:	LOWER ALLUVIUM
-5.10 to -6.78	6.00 to 7.68	Gley 1 4/10Y; Ag2, As1, Dl1; Dark greenish grey silty clay with detrital wood and traces of Mollusca; large fragment of wood recorded between 7.25 and 7.36m bgl; diffuse contact into:	
-6.78 to -6.91	7.68 to 7.81	Gley 1 5/10Y; Ag2, Sh1, Dh1; Greenish grey organic-rich silt with detrital plant remains; sharp contact into:	
-6.91 to -7.10	7.81 to 8.00	10YR 2/1; Ag2, Sh2; Black organic-rich silt with traces of wood and herbaceous peat.	

Table 3: Lithostratigraphic description of borehole AP-QBH2, Alchemy Park, Crabtree Manorway North, London Borough of Bexley

Depth (m OD)	Depth (m bgs)	Description	Stratigraphic group
1.50 to 0.40	0 to 1.10	Made Ground	MADE GROUND
0.40 to -0.50	1.10 to 2.00	Gley 2 6/1; As3, Ag1; Bluish grey silty clay; diffuse contact into:	UPPER ALLUVIUM
-0.50 to -0.90	2.00 to 2.40	10YR 5/1; As3, Ag1; Grey silty clay; sharp contact into:	
-0.90 to -1.40	2.40 to 2.90	10YR 5/2; Ag2, As1, Sh1; Greyish brown organic-rich clayey silt; unknown contact into:	
-1.40 to -2.50	2.90 to 4.00	2.5YR 2.5/1; Sh3, Th^{2}1; Humo 2-3; Reddish black well humified herbaceous peat; UNRECOVERED	PEAT
-2.50 to -3.09	4.00 to 4.59	10YR 4/1; Ag2, As1, Ga1; Dark grey sandy clayey silt with detrital wood inclusions; diffuse contact into:	
-3.09 to -3.50	4.59 to 5.00	10YR 3/1; Sh2, Ag1, Tl^{2}1; Humo 2; very dark grey silty moderately humified wood peat, with silty peat between 4.85 and 5.00m bgl;	

Depth (m OD)	Depth (m bgs)	Description	Stratigraphic group
-3.50 to -4.50	5.00 to 6.00	UNRECOVERED	
-4.50 to -4.76	6.00 to 6.26	10YR 3/1; Sh2, Ag1, Tl²1; Humo 2; very dark grey silty moderately humified wood peat, with silty peat between 4.85 and 5.00m bgl;	
-4.76 to -5.01	6.26 to 6.51	Gley 1 4/10Y; Ag3, Dl1; Dark greenish grey silt and detrital wood with traces of clay; diffuse contact into:	LOWER ALLUVIUM
-5.01 to -5.31	6.51 to 6.81	Gley 1 4/10Y; Ag3, As1; Dark greenish grey clayey silt with traces of sand; finely bedded; diffuse contact into:	
-5.31 to -6.50	6.81 to 8.00	Gley 1 3/10Y; Ga2, Ag2; Very dark greenish grey silty sand with traces of detrital plant remains; finely bedded; diffuse contact into:	
-6.50 to -8.50	8.00 to 10.00	Gley 1 4/10Y; Ga3, Ag1; Dark greenish grey silty sand with traces of detrital plant remains; finely bedded	

Table 4: Lithostratigraphic description of borehole AP-QBH3, Alchemy Park, Crabtree Manorway North, London Borough of Bexley

Depth (m OD)	Depth (m bgs)	Description	Stratigraphic group
1.80 to 0.45	0 to 1.35	Made Ground	MADE GROUND
0.45 to 0.15	1.35 to 1.65	10YR 5/3; As3, Ag1; Brown silty clay with iron staining; sharp contact into:	UPPER ALLUVIUM
0.15 to -0.20	1.65 to 2.00	Gley 2 6/1; As3, Ag1; Bluish grey silty clay	
-0.20 to -1.20	2.00 to 3.00	UNRECOVERED	
-1.20 to -1.74	3.00 to 3.54	10YR 2/1 Sh3, Th²2; Humo 2; Black well-humified herbaceous peat with traces of wood peat; sharp contact into:	PEAT
-1.74 to -2.20	3.54 to 4.00	Gley1 4/10Y; Ag3, As1; Dark greenish grey clayey silt with traces of detrital plant remains; diffuse contact into:	LOWER ALLUVIUM
-2.20 to -3.60	4.00 to 5.40	Gley 1 4/5GY; Ga2, Ag1, Dl1; Dark greenish grey silty sand and detrital wood with inclusions of detrital plant remains; sharp contact into:	
-3.60 to -5.54	5.40 to 7.34	Gley 1 3/10Y; Ga3, Ag1; Very dark greenish grey silty sand; diffuse contact into:	
-5.54 to -6.20	7.34 to 8.00	Gley1 4/10Y; Ga3. Dl1; sand with detrital wood and traces of silt; diffuse contact into:	
-6.20 to -7.20	8.00 to 9.00	UNRECOVERED	
-7.20 to -8.20	9.00 to 10.00	Gley1 4/10Y; Ga4; Dark greenish grey sand with traces of silt and detrital plant remains	

Table 5: Results of the organic matter determinations, Alchemy Park, Crabtree Manorway North, London Borough of Bexley

AP-QBH1		
Depth (m OD)		Organic matter content (%)
From	To	
-1.51	-1.52	7.40
-1.67	-1.68	5.17
-1.83	-1.84	8.61
-1.99	-2.00	14.59
-2.41	-2.42	65.01
-2.93	-2.94	59.97
-3.25	-3.26	22.68
-3.57	-3.58	63.48
-3.73	-3.74	78.95
-3.89	-3.90	71.82
-4.05	-4.06	25.75
-4.21	-4.22	53.44
-4.37	-4.38	30.30
-4.53	-4.54	19.14
-4.69	-4.70	7.97
-4.85	-4.86	5.70
-5.01	-5.02	3.91
-5.17	-5.18	5.47
-5.33	-5.34	7.48
-5.49	-5.50	4.66
-5.65	-5.66	9.11
-5.81	-5.82	10.87
-5.97	-5.98	9.87
-6.13	-6.14	8.55
-6.29	-6.30	11.27
-6.45	-6.46	88.73
-6.61	-6.62	16.91
-6.77	-6.78	26.40
-6.93	-6.94	48.62
-7.09	-7.10	56.70

AP-QBH2		
Depth (m OD)		Organic matter content (%)
From	To	
-2.58	-2.59	15.27
-2.74	-2.75	8.42
-2.90	-2.91	2.42
-3.06	-3.07	20.31
-3.22	-3.23	50.61
-3.38	-3.39	31.42
-4.50	-4.51	26.65
-4.66	-4.67	33.01
-4.82	-4.83	12.27
-4.98	-4.99	11.35
-5.14	-5.15	2.92
-5.30	-5.31	4.24

Table 6: Results of the radiocarbon dating, Alchemy Park, Crabtree Manorway North, London Borough of Bexley

Laboratory code / Method	Material and location	Depth (m OD)	Uncalibrated radiocarbon years before present (yr BP)	Calibrated age BC/AD (BP) (2-sigma, 95.4% probability)	**δ**13C **(‰)**
Beta-383612	QBH1 – top of peat; twig wood	-2.06 to -2.10	3000 ± 30 BP	1380-1120 cal BC 3330-3070 cal BP	-25.4
Beta-443558 AMS	QBH1 – base of peat; twig wood	-4.04	5700 ± 30 BP	4650-4450 cal BC 6600-6400 cal BP	-26.7
Beta-443559 AMS	QBH1 – peat lense in lower alluvium; twig wood	-4.71	6340 ± 30 BP	5460-5220 cal BC 7410-7170 cal BP	-27.0
Beta-443560 AMS	QBH2 – base of peat; twig wood	-7.05	5440 ± 30 BP	4350-4240 cal BC 6300-6190 cal BP	-26.3

6. RESULTS AND INTERPRETATION OF THE POLLEN AND NON-POLLEN PALYNOMORPH ANALYSIS

6.1 Results of the pollen and non-pollen palynomorph analysis

Pollen and non-pollen palynomorph analysis was carried out on AP-QBH1 and AP-QBH2, so as to investigate potential spatial variations in vegetation assemblage across the site; this was particularly relevant bearing in mind their positions beyond and within the large west-east channel (respectively) that traverses the site. Recovery of the peat and alluvium was inconsistent however, and thus a full vegetation reconstruction was prevented in both sequences.

Twenty samples were extracted from ALY-QBH1 from -7.10 to -1.68m OD focussing on the Peat and to a lesser extent Lower Alluvium. The resultant percentage diagram was divided into two local pollen assemblage zones (LPAZs ALY1-1 & ALY1-2) based upon variations in the pollen and non-pollen palymorph content. The precise location of the division between the two zones is uncertain due to a poor pollen preservation and a void in the stratigraphic sequence from -3.00 to -2.00m OD. The characteristics of the zones are as follows:

LPAZ ALY1-1 -7.10 to -3.00m OD *Alnus* – *Quercus* – *Corylus* type

This zone is characterised by high values of tree (>80%) and shrub (10%) pollen. *Alnus* dominates (60%) with *Corylus* type (15%), *Quercus* (10%), *Ulmus*, *Pinus*, *Tilia* and *Hedera* (all <5%). Herbs (<10%) comprise Poaceae, Cyperaceae, Asteraceae and Chenopodium type (all <3%); Cyperaceae increases to 30% in uppermost sample at 3.13m OD. Aquatics are limited to sporadic occurrences of *Sparganium* type. Spores are limited but increase at the top of the zone to include *Filicales*, *Polypodium vulgare* and *Thelypteris palustris*. Non-pollen palynomorphs include *Zygnema*, *Mougeotia*, *Cercophora* and *Sordaria*. A single intestinal parasite egg was recorded *Dicrocoelium* was recorded at 3.13m OD. Total pollen concentration was generally less than 200,000 grains/cm^3, with two peaks of >1,000,000 grains/cm^3 at -6.61 and -3.21m OD. Microcharcoal concentrations rarely exceeded 1000 fragments/cm^3.

LPAZ ALY1-2 -3.00 to -1.68m OD Poaceae - Cyperaceae - *Chenopodium* type

This zone was characterised by high values of herbaceous taxa (>60%), dominated by Poaceae, Cyperaceae, Cereale type, Asteraceae, Lactuceae and Chenopodium type (all reaching >10%) with Aster type, Sinapis type, Caryophllyaceae, Filipendula type and Armeria type (all <5%). Aquatics are limited to sporadic occurrences of *Sparganium* type. Spores are limited but increase at the top of the zone to include *Filicales*, *Polypodium vulgare* and *Thelypteris palustris*. Aquatics include *Sparganium* type with sporadic occurrences of *Typha latifolia*. Spores are limited but increase at the top of the zone to include *Filicales*, *Polypodium vulgare* and *Thelypteris palustris*. Non-pollen palynomorphs and intestinal parasite eggs were not recorded. Total pollen concentration ranged between 6000 and 33,000 grains/cm^3. Microcharcoal concentrations increased to a peak of 423,000 fragments/cm^3.

Eight samples were extracted from ALY-QBH2 from -4.68 to -2.58m OD through the lower part of the Peat. The resultant percentage diagram was not divided into local pollen assemblage zones due to a lack of variation in the pollen and non-pollen palynomorph content. The characteristics of the assemblage is as follows:

LPAZ ALY2-1 -4.68 to -2.58m OD *Alnus – Quercus – Corylus* type

This zone is characterised by high values of tree (80%) and shrub (15%) pollen. *Alnus* and Quercus dominate (30% and 40% respectively) with *Corylus* type (10%), *Ulmus*, *Pinus*, *Tilia* and *Fraxinus* (all <3%). Herbs (<10%) are dominated by Poaceae, Cyperaceae and *Chenopodium* type (all <3%). Aquatics are limited to sporadic occurrences of *Sparganium* type. Spores are limited but increase at the top of the zone to include *Filicales*, *Polypodium vulgare* and *Pteridium aquilinum*. Non-pollen palynomorphs include *Zygnema*, *Spirogira*, *Mougeotia* and *Cercophora*. No intestinal parasite eggs were recorded. Total pollen concentration varied between 6000 and 33,000 grains/cm^3. Microcharcoal concentrations rarely exceeded 100 fragments/cm^3, but reach 9000 fragments/cm^3 at -3.06m OD.

6.2 Interpretation of the pollen and non-pollen palynomorph analysis

As outlined in 6.1, the pollen and non-pollen palynomorph analysis focused on parts of the sedimentary sequence from boreholes ALY-QBH1 and ALY-QBH2 most likely to represent semi-terrestrial or terrestrial environments on the wetland; i.e. the peat sediments. Whilst this prevented a reconstruction of vegetation history through the complete sedimentary sequence (as carried out and advocated by Allen and Scaife, 2000), it did permit higher resolution analysis. Furthermore, and as outlined in detail by Allen and Scaife, there are a number of taphonomic issues that complicate the interpretation of palynological data from the mineral-rich sediments of low-energy fluvial and estuarine environments, including: (1) long distance travel of pollen by fluvial or aeolian means (e.g. Moore *et al.*, 1991; Scaife & Burrin, 1992), and (2) the reworking and redeposition of pollen from older sediments (e.g. Cushing, 1967; Waller, 1993; Campbell, 1999). Concentration of the pollen investigations on the semi-terrestrial peat deposits reduces the impact of these particular taphonomic issues. However, another issue specific to pollen studies in coastal lowland wetlands is that of taxonomic precision and distinguishing the environment of origin. The identification of pollen grains (in particular herb taxa) is frequently limited by morphological similarities between grains of different species, and often only the genus can be established. In addition, the herbs found in one wetland habitat are often palynologically indistinguishable from other members of their genera/family that may have originated from different wetland or dryland environments (Waller, 1993, 1998; Waller *et al.*, 2005; see for example Wheeler, 1980a, b). These issues are taken into account in the following results and interpretations.

LPAZ ALY1-1 -7.10 to -3.00m OD *Alnus – Quercus – Corylus* type
AND
LPAZ ALY2-1 -4.68 to -2.58m OD *Alnus – Quercus – Corylus* type

LPAZ ALY1-1 incorporates pollen assemblages from a thin peat unit within the Lower Alluvium (dated from 7170-7410 (late Mesolithic) and main peat horizon. The latter dates from 6410-6600 cal BP (end of the Mesolithic) but the cessation is uncertain due to a lack of dates and limited pollen preservation; in all likelihood however, it dates to sometime around 4500±500 cal BP (late Neolithic

/ early Bronze Age). LPAZ ALY2-1 incorporates pollen assemblages from the lower half of the main peat. This dates from 6200-6300 cal BP (Mesolithic-Neolithic transition); similarly to ALY1-1, the end date of the assemblage zone is unclear, but likely to date to around 4500±500 cal BP (late Neolithic / early Bronze Age). Because both zones have similar characteristics and date ranges, they are interpreted together.

The results of the pollen-stratigraphic analysis indicate that during both zones, *Alnus* (alder) dominated the wetland environment with sporadic *Salix* (willow) and a ground flora including Cyperaceae (sedges), Poaceae (grasses – e.g. *Phragmites australis* – common reed), *Ranunculus* type (buttercup / water crowsfoot), *Sparganium* type (bur-reed), *Typha latifolia* (bulrush), *Filicales* (buckler ferns), *Thelypteris palustris* (marsh fern) and *Polypodium vulgare* (polypody fern). Non-pollen palynomorphs *Zygnema*, *Spirogyra*, *Mougeotia* and 128B represent the growth of different algae species. Combined, these taxa indicate the presence of alder fen carr growing on the peat surface and the presence of areas of still or standing dominantly freshwater.

The presence of *Chenopodium* type (goosefoot family) is also of note, since genera of the Chenopodiaceae family can occur in two main locations: (1) waste, dry ground and cultivated land (e.g. *Chenopodium album* – fat hen), and (2) salt marshes (e.g. *Suaeda maritima* – annual sea-blite. Since there are no other indicators of disturbance and the signal is consistent in both boreholes, the presence of *Chenopodium* type pollen is considered more likely to represent occasional fluvial inundation of the site and the influence of estuarine conditions.

Quercus (oak), *Ulmus* (elm), *Betula* (birch), *Fraxinus* (ash) and *Corylus* type (e.g. hazel) may have accompanied alder and willow on the peat surface; Taxus (yew) does not appear to have grown on either surface during this period, as indicate in other nearby records (e.g. Batchelor *et al.*, 2008a). However, these taxa more commonly occur on dryland where they would have formed a mosaic of mixed deciduous woodland with *Tilia* (lime). Indeed, since lime is of entomophilous (insect pollinated) even the relatively low *Tilia* pollen values recorded could indicate it was a dominant component of the adjacent dryland woodland during this period. The understorey would have comprised hazel shrubs together with grasses and a range of herbs more commonly found in rough grassland. One of the more evident differences between the pollen zones, is that *Quercus* pollen values tend to be consistently higher through the peat(s) in borehole ALY-QBH2. This may represent natural variation in the woodland composition between the two boreholes, or that ALY-QBH2 is located closer to the dryland where oak would have preferentially grown.

A potential decline in *Ulmus* pollen values is recorded towards the base of the main peat in ALY-QBH1, sometime after 6410-6600 cal BP, which might be representative of the well documented early Neolithic elm decline. This phenomenon is frequently recorded in pollen diagrams across the Lower Thames Valley (e.g. Batchelor *et al.*, in press) and British Isles (Parker *et al.*, 2002) between approximately 6300 and 5300 cal BP. The evidence for the decline is less convincing than that recorded at other sites in the Lower Thames Valley, and there are no unequivocal pollen or non-pollen palynomorph indicators that might provide insights into the reason for any such decline (see Parker *et al*., 2002; Batchelor *et al*., 2014).

There are no definitive indicators of human activity within LPAZ ALY1-1 or ALY2-1. However, the non-pollen palynomorph *Cercophora* and intestinal parasite egg *Dicrocoelium*, most likely indicate the presence of nearby grazing animals at -3.13m OD during the late Neolithic / early Bronze Age. Whether these were wild or domesticated animals is unknown.

LPAZ ALY1-2 -3.00 to -1.68m OD Poaceae - Cyperaceae - *Chenopodium* type

The results of the pollen-stratigraphic analysis indicate significant changes in vegetation on both the wetland and dryland. It should be remembered that no pollen samples were analysed between 3.10 and 2.00m OD, thus the changes recorded in the pollen stratigraphic record look more pronounced than they may actually have been.

The peat surface clearly became dominated by sedge fen and reed swamp type communities due to the raised values of grasses, sedges, bur-reed and bulrush. Raised values of Chenopodium type and *Armeria* type (e.g. thrift) also indicate the presence of salt-marsh taxa and a strengthening estuarine signal. Swamp carr woodland dominated by alder remained, but was either comparatively limited on the peat surface or growing at some distance in drier areas. The increase of *Pinus* pollen is also indicative of inundation and a biased assemblage, as the morphology of the grain enhances its long-distance transport by fluvial and/or alluvial means.

The reduction in *Quercus* pollen values suggests that the oak-dominated dryland woodland declined markedly. Due to the Bronze Age date, it would seem likely that late prehistoric land clearance was the main cause. Indeed, high values of *Cereale* type pollen are recorded (Figure 15), suggestive of nearby cultivation at this time. However, *Cereale* type pollen grains have a very similar morphology to that of coastal wetland grasses (e.g. Andersen, 1979), and the percentage values increase in tandem with those of Poaceae pollen, perhaps indicating a proportion of the cereal grains represent wetland grasses (see Waller & Grant, 2012). Irrespective of the uncertainty of the Cereale taxa, the increased number and diversity of herbaceous taxa, to include grasses, ribwort plantain (*Plantago lanceolata*), cornflower (*Centaurea cyanus*), dandelions (Lactuceae) and mallow (*Malva* type) is strongly supportive of land clearance for both animal grazing and cultivation. Furthermore, high microcharcoal values are also recorded, and it is anticipated that a proportion of these fragments may have derived from nearby.

Whether the decline of wetland and dryland woodland is linked is uncertain, but the similar timing does seem to be a common feature of woodland within pollen-stratigraphic diagrams from the Lower Thames Valley (discussed further below).

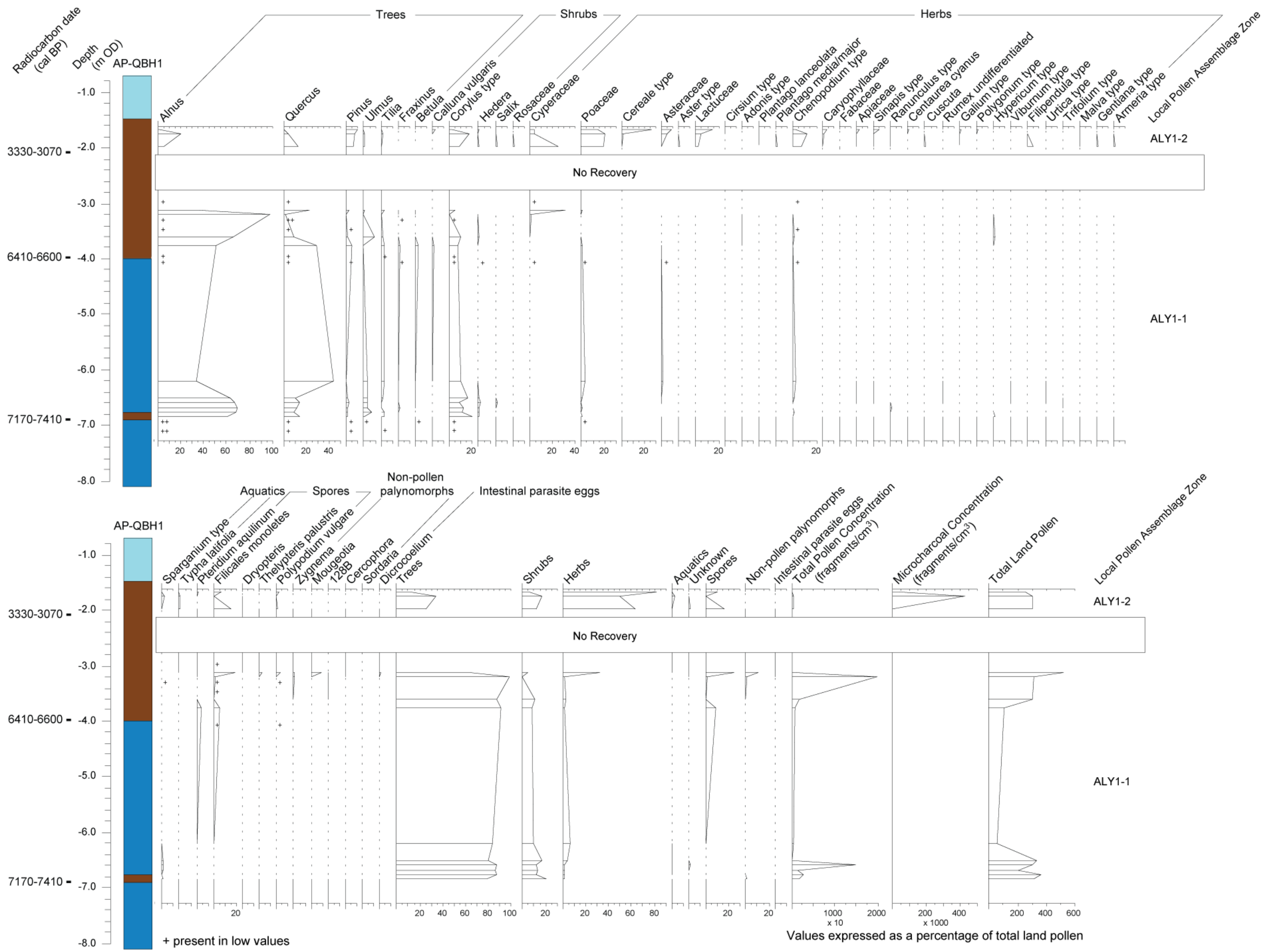

Figure 13: Pollen percentage diagram for ALY-QBH1, Alchemy Park, North Crabtree Way, London Borough of Bexley

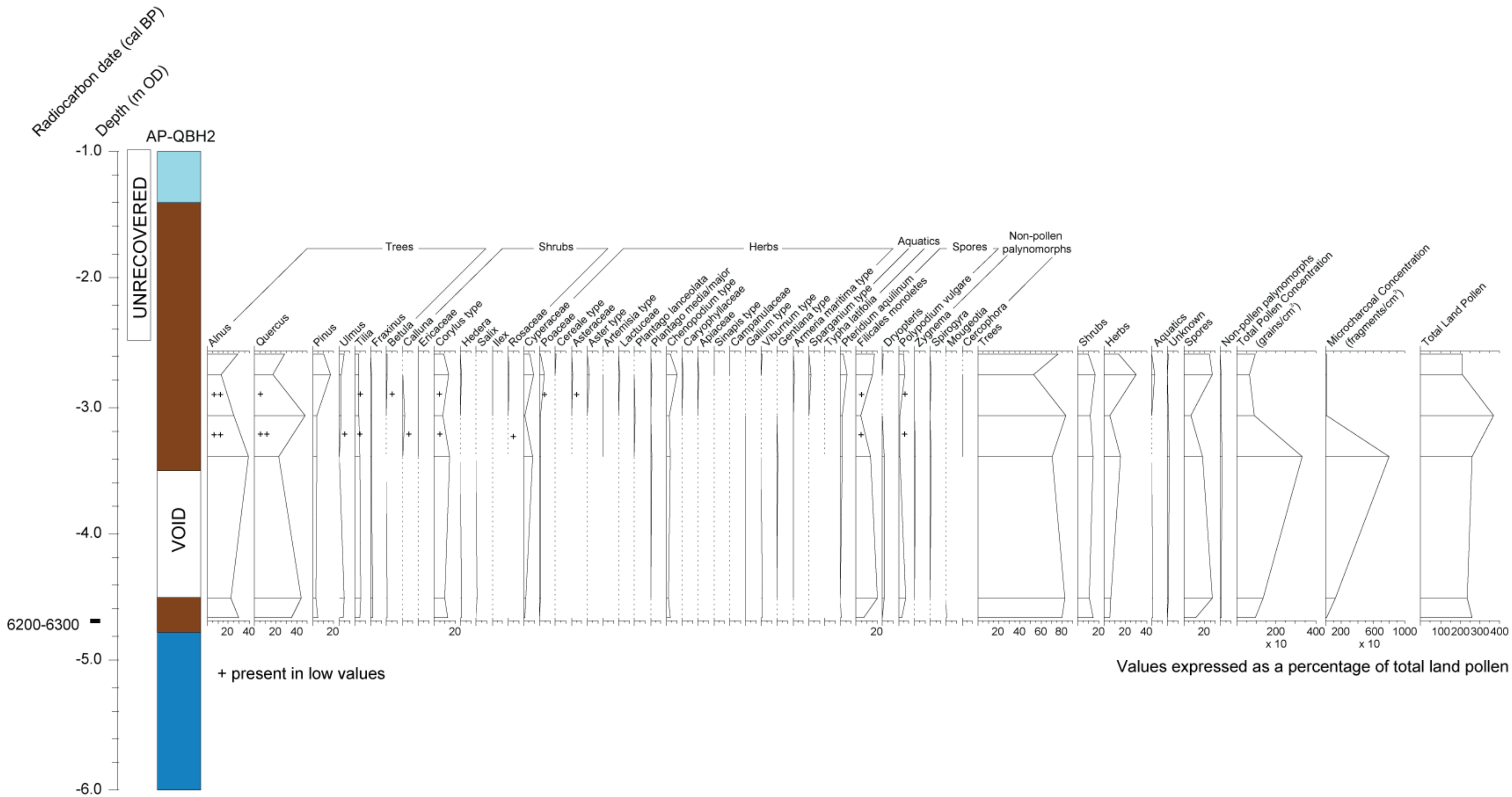

Figure 14: Pollen percentage diagram for ALY-QBH2, Alchemy Park, North Crabtree Way, London Borough of Bexley

Figure 15: Micrographs of Cereale type at -1.68m OD in ALY-QBH1

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7. RESULTS AND INTERPRETATION OF THE DIATOM ASSESSMENT

A summary of the diatom assessment results is provided in Table 7. The most typical diatoms encountered in each sample are listed in order of abundance (most common at the top of each list). Diatoms were encountered in all samples submitted apart from AP-QBH1 at -1.51m OD. However, in AP-QBH1 at -1.47m and -4.13m OD, only a single diatom was encountered during the assessment, preventing any further comment in association to these samples. Similarly, the two samples from AP-QBH2 contained diatoms, but in relatively low abundance and diversity. When present, the species were of marine planktonic and brackish benthic origin. Diatoms were only encountered in high abundance in AP-QBH1 at -4.08m OD, where a mixture of marine and freshwater planktonic taxa and brackish benthic taxa were encountered.

Species of *Cyclotella* were encountered in the majority of samples, which are more often affiliated with more freshwater conditions. However the overriding majority of diatoms were from more open water and intertidal saline environments, indicating estuarine conditions are likely to have prevailed for much of the depositional history of the sequences under investigation. This is however based on a very limited assemblage.

Table 7: results of the diatom assessment, Alchemy Park, Crabtree Manorway North, London Borough of Bexley

Borehole	Depth	Diatoms encountered
AP-QBH1	-1.47m	*Paralia sulcate*
	-1.51m	n/a
	-4.08m	*Nitzschia navicularis* *Cyclotella sp.* *Paralia sulcata* *Pseudomelosira westii* *Synedra ulna* *Nitzschia punctata* *Rhaphoneis amphiceros*
	-4.13m	*Cyclotella sp.*
AP-QBH2	-4.73m	*Nitzschia punctata* *Pseudomelosira westii* *Cyclotella sp.* *Campylodiscus echeneis*
	-4.77m	*Paralia sulcata* *Campylodiscus echeneis* *Triceratum favus* *Cyclotella sp.* *Ellerbackia sp.*

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8. RESULTS AND INTERPRETATION OF THE MACROFOSSIL ASSESSMENT

Five small bulk samples from borehole QBH1 and two from QBH2 were processed for the recovery of macrofossil remains, including waterlogged plant macrofossils, wood, insects and Mollusca (Tables 8 & 9). The samples were focussed on the peat horizons within both boreholes. The results of the macrofossil rapid assessment indicate that no charred plant remains, Mollusca, insects or bone were present in the samples. Waterlogged wood was recorded in moderate quantities in three samples from borehole QBH1 (-4.04 to -4.09, -7.00 to -7.05 and -7.05 to -7.10m OD), and in both samples from QBH2 (-4.66 to -4.71 and -4.71 to -4.76m OD). Waterlogged seeds were recorded in one sample from QBH1 (-7.00 to -7.05m OD); these were limited to catkins and a fruit of *Alnus glutinosa* (alder). The remains of sedges (culms and rhizomes) were recorded in three samples from QBH1, but no diagnostic epidermal tissues were found.

The assemblage represented in the samples from boreholes QBH1 and QBH2 is too small to attempt a full environmental interpretation; however, both alder and sedges are both typically found in alder carr/sedge fen environments.

Table 8: Results of the macrofossil assessment of borehole AP-QBH1, Alchemy Park

			Charred					Waterlogged			Mollusca		Bone				
Depth (m OD)	Volume processed (ml)	Fraction	Charcoal (>4mm)	Charcoal (2-4mm)	Charcoal (<2mm)	Seeds	Chaff	Wood	Seeds	Sedge remains	Whole	Fragments	Large	Small	Fragments	Insects	Artefacts
-1.56 to -1.61	<100ml	>300µm	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
-1.51 to -1.56	<100ml	>300µm	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
-4.04 to -4.09	<100ml	>300µm	-	-	-	-	-	3	-	1	-	-	-	-	-	-	-
-7.00 to -7.05	<100ml	>300µm	-	-	-	-	-	3	1	-	-	-	-	-	-	-	-
-7.05 to -7.10	<100ml	>300µm	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-

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 9: Results of the macrofossil assessment of borehole AP-QBH2, Alchemy Park

			Charred					Waterlogged			Mollusca		Bone				
Depth (m OD)	Volume processed (ml)	Fraction	Charcoal (>4mm)	Charcoal (2-4mm)	Charcoal (<2mm)	Seeds	Chaff	Wood	Seeds	Sedge remains	Whole	Fragments	Large	Small	Fragments	Insects	Artefacts
-4.66 to -4.71	<100ml	>300µm	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-
-4.71 to -4.76	<100ml	>300µm	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-

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

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9. DISCUSSION

As outlined in section 3.3, the overarching aims of the geoarchaeological and palaeoenvironmental investigations at the Alchemy Park site were as follows:

1. To clarify the nature of the sub-surface stratigraphy across the site;
2. To clarify the nature, depth, extent and date of any alluvium and peat deposits
3. To investigate whether the sequences contain any artefact or ecofact evidence for prehistoric or historic human activity
4. To investigate whether the sequences contain any evidence for natural and/or anthropogenic changes to the landscape (wetland and dryland)
5. To integrate the new geoarchaeological record with other recent work in the local area for publication in an academic journal

The following section addresses these aims by comparing the findings from Alchemy Park with those resulting from previous similar investigations undertaken in the local area. Thereby, placing the findings and their importance within a wider regional context.

9.1 Stratigraphic and hydrological history

The combined results of a wider deposit modelling exercise indicate that the sediments recorded at the Alchemy Park and NuFarm sites are similar to those recorded elsewhere in the Lower Thames Valley, with Late Devensian Shepperton Gravel overlain by a sequence of Holocene alluvial sediments, including two peat horizons, and buried beneath modern Made Ground. At the site and within its immediate vicinity, the principal relief feature of the Shepperton Gravel surface is a large linear depression extending west to east or north-west to south-east on the southern part of the site, with the Shepperton Gravel surface recorded down to a level of -11.2m OD.

In order to place the findings of this investigation in a wider regional context, the modelling procedures carried out have been extended to cover a larger area of the local Thames floodplain (see Figure 1). The results of this wider-scale investigation are presented as a contour model of the Shepperton Gravel surface (Figure 15). The surface of the Shepperton Gravel is chosen as the basis for this wider regional evaluation as the relief features present on that surface are widely understood to be strongly influential in determining patterns of sedimentation on the Thames floodplain throughout the Holocene. It is highlighted that the larger area has been modelled at a coarser resolution (100m as opposed to 50m radius from each borehole) and due to the absence of records in certain areas, the coverage of the model is incomplete.

Whilst the deep palaeochannel and its northern bank were identified on the Alchemy Park site, its southern bank lay beyond the margins of the site, and thus its width could not be established. Unfortunately the coverage of the wider model is incomplete immediately south of Alchemy Park, however, the channel would appear to be a maximum of 100-200m wide on the basis that the Shepperton Gravel surface is recorded at above -9m OD on the Imperial Gateway (Batchelor *et al.*, 2008b) and Pirelli Works (Young *et al.*, 2008b). Extrapolating the orientation and origin of the channel is also restricted by the lack of coverage, however it would appear to be part of a wider pattern of probable drainage lines radiating from a more elevated part of the Shepperton Gravel surface identified during investigations of the Veridion Park site to the west (Batchelor and Green, 2013), whilst a deep embayment around Belvedere Industrial Estate suggest its confluence with the Thames at this point. Other deep depressions identified within the modelled area, include two which are orientated approximately north-south across the Pirelli Works site (Young *et al*., 2008b). The gravel surface at the base of these features however, is recorded at approximately -8m OD, indicating they are substantially less significant than the one recorded at Alchemy Park (-11.2m OD).

Beyond the margins of the channels, the Shepperton Gravel surface generally lies at around 7-8m OD, sloping downwards towards the Thames in a northern and eastern direction as might be expected. Two significantly high areas resting at -5m OD can be identified however, and such locations may have a greater potential to contain evidence of human activity. The first of these areas is located approximately 500m south of Imperial Gateway and most likely represents the edge of the Lower Thames Valley floodplain. The second is located approximately 400m north-west of the Alchemy Park site. In this case, the elevated surface is questionable as it is represented by a single borehole.

Following the deposition of the Shepperton Gravel, active fluvial processes dominated much of the Lower Thames Valley floodplain resulting in the deposition of the Lower Alluvium. In many places across the modelled area, peat formed either prior to, or during accumulation of the Lower Alluvium. When peat formed prior to the accumulation of the Lower Alluvium, it most frequently occurred in depressions in the Shepperton Gravel surface, but extending upward where gentle slopes afforded suitable conditions. The Lower Alluvium substantially infills the depressions in the surface of the Shepperton Gravel; but it also spreads, sometimes quite thickly, onto the higher areas of the gravel surface. It would appear therefore to have been an aggradational accumulation.

The results of the radiocarbon dating indicate that the Lower Alluvium began to accumulate beyond the channel on the northern part of the Alchemy Park site, sometime prior to 7410-7170 cal BP (during the late Mesolithic). This correlates well with the date produced at both Pirelli Works (7160-6750 cal BP; Young *et al*., 2012) and Imperial Gateway (7160-6900 cal BP; Batchelor *et al*., 2008b). In all three cases, the Lower Alluvium began accumulating above -8m OD, and the late Mesolithic date indicates that it accumulated rapidly (ca. 3m in 1000 years). Unfortunately the date that the Lower Alluvium began accumulating within the channel itself is unknown due to a lack of suitable datable material, but is likely to date earlier in the Mesolithic. The diatom assessment suggest that the Lower Alluvium was deposited under brackish water conditions.

There are relatively few localities where the Lower Alluvium is missing, and resting on it almost everywhere, is a bed of peat which is recorded in the vast majority of boreholes evaluated in the mapped area. The presence of peat represents evidence of a transition to a semi-terrestrial environment, and the records of detrital wood and *in situ* tree remains (Spurrell 1889; Whitaker

1889; Batchelor *et al*., 2007b, 2008a) indicate that wetland woodland was present at least locally on the floodplain. At Alchemy Park, the results from both AP-QBH1 and AP-QBH2 indicate that this accumulation commenced towards the very end of the Mesolithic between 6600-6410 and 6300-6200 cal BP respectively. Here, the peat began accumulating on a surface between -5 and -4m OD. At Imperial Gateway (Batchelor *et al.,* 2008b), towards the eastern edge of the mapped area, peat accumulation was radiocarbon dated to 6290-6120 cal BP at a level of -3.80m OD. A similar range of dates is recorded at the Crossness Sewage Works (Batchelor *et al*., 2007a), Norman Road (Batchelor *et al*., 2008a) and Pirelli Works (Young *et al*., 2008b) sites. The top of the peat was radiocarbon dated to 3330-3070 cal BP in AP-QBH1, suggesting accumulation continued for a period of more than 3000 years. This is within the range of dates for the top of the peat recorded at Imperial Gateway (3840-3640 cal BP) and Pirelli Works (3210-2970 cal BP).

The Upper Alluvium which overlies the Peat across the whole of the mapped area represents a transition from semi-terrestrial to alluvial/estuarine conditions, and was most likely brought about by a regional increase in the rate of relative sea level rise (Sidell, 2003). Whilst the results from Alchemy Park do not provide data to confirm this, the diatom assessment does suggest that the Lower Alluvium beneath the Peat contains taxa from open water and intertidal saline environments, indicating estuarine conditions are likely to have prevailed for much of the depositional history of the sequences.

Finally, Figure 10 represents the very low relief surface of the Upper Alluvium across the Alchemy Park and NuFarm sites and by comparison with Figure 5 indicates the way in which Holocene alluviation has very effectively masked the inequalities that were present on the surface of the Shepperton Gravel at the beginning of the Holocene period.

9.2 Vegetation history

The radiocarbon-dated palaeoenvironmental records from Alchemy Park contain an interrupted record of vegetation history from the late Mesolithic to late Bronze Age period. These interruptions are due to both voids in the sedimentary sequence and poor pollen preservation in both boreholes AP-QBH1 & AP-QBH2. Nevertheless, the results of the pollen and plant macrofossil assessment indicate that from the late Mesolithic to late Neolithic / early Bronze Age, the floodplain environment was dominated by wetland woodland comprising alder and a ground flora of sedges, grasses, aquatics and ferns. Oak, hazel and elm may have occupied the wetland woodland, but were equally likely to have formed mixed deciduous woodland on the dryland with lime.

The vegetation history of the Alchemy Park site during this period is broadly similar to that recorded at the Norman Road (Batchelor *et al*., 2008a), Crossness Sewage Works (Batchelor *et al*., 2007a) and Imperial Gateway (Batchelor *et al*., 2008b) sites. There have however, been important discoveries at these sites, evidence for which is either only slight or absent at Alchemy Park. These include: (1) the Neolithic colonisation and decline of yew (*Taxus*) woodland, and (2) the Neolithic decline and late Bronze Age expansion of elm (*Ulmus*) woodland.

At Alchemy Park, there is no evidence for the colonisation and decline of yew woodland, yet it is now a well-documented phenomenon in the Lower Thames Valley, and is well-represented in the records from Norman Road, Crossness Sewage Works and the Erith Foreshore (Seel, 2001) (less so at Imperial Gateway). At each of these sites, yew colonised the peat surface to become a co-dominant component of the existing mixed fen woodland with alder. The resultant vegetation community has no known British modern analogue (Deforce and Bastiaens, 2007). The reason for the apparent absence of yew at Alchemy Park might be for two reasons. Firstly the limited sediment retrieval and poor pollen preservation may have led a lack of palaeoecological remains being recorded. Alternatively, it may be due to natural variaions in the colonisation of yew within the fen woodland. Comprehensive mapping and identification of over 1200 trees/shrubs on the Erith foreshore revealed alder (*ca.* 50%), yew (up to 25%) and ash (*ca.* 15%) were the three most dominant taxa recorded during two phases of woodland growth dated 4530-4100 cal BP. The same research indicated that the woodland had two distinguishable sub-zones in which: (a) alder is well established with yew, and (b) alder is mixed with ash where yew failed to establish. Within the sub-zones each species forms occasional pure stands, which is typical of the ecology and habitat of all three taxa (Watt, 1926; McVean, 1955; Wardle, 1961). The timing and causes of the colonisation and decline of yew are discussed elsewhere (e.g. Batchelor, 2009; Branch *et al*., 2012; Batchelor *et al*., in prep).

The early Neolithic decline of elm is another a well-documented phenomenon across north-west Europe and the Lower Thames Valley (e.g. Parker *et al*., 2002; Batchelor *et al.*, 2014). Often, sequences from the Lower Thames Valley do not record this event because peat accumulation commences at, or just after the time that it occurs (6347 and 5281 cal BP). The sequence from AP-QBH1 contained deposits of suitable age, and there are hints of a decline in *Ulmus* pollen values sometime after peat initiation. Peat accumulation began around 6410-6600, and thus should this be a real decline in pollen values, it would appear to be within the range of dates proposed by Parker et al. (2002) and Batchelor et al. (2014). The timing and causes of the elm decline are discussed in some detail elsewhere, but the main hypotheses centre around one or more of: human activity, disease, climatic change, competition, soil deterioration (Parker *et al*., 2002; Batchelor *et al.*, 2014). At Alchemy Park, there is no evidence around the time of the potential decline supportive of human activity or disease; because of the similar timing of the change in stratigraphy from alluvium to peat, it is possible that these landscape changes led to soil deterioration and/or competition between different tree taxa. However, overall, both evidence for a decline and the potential causes are insufficiently strong to draw any meaningful conclusions.

Of even greater interest however, is the late Bronze Age expansion of elm on the peat surface. This is a relatively new and as yet unpublished phenomenon recorded in an increasing number of sequences in the Lower Thames Valley, including the nearby Norman Road (Batchelor *et al*., 2007a) and Erith Foreshore (Seel, 2001) sites. At Alchemy Park, no such evidence for an expansion of elm was recorded in the new palaeoenvironmental records, although whether this was a consequence of natural variations in its spatial distribution across the nearby area, or the lack of recovery / poor pollen preservation is unclear.

Towards the top of the sequence a decline of woodland on both the floodplain and dryland is indicated. On the floodplain, a transition from wetland woodland to sedge fen / reed swamp and possibly saltmarsh conditions is indicated. This occurs towards the contact between the peat and Upper Alluvium and most likely reflects the well-documented increase in the rate of relative sea level that occurred during the Bronze Age (Sidell, 2003). On the dryland, the decline of woodland is reflected by an increase of microcharcoal and herbaceous taxa including cereal pollen, black knapweed and plantain. The timing of the event and taxa recorded suggests that the decline is due to Bronze Age clearance for settlement and/or agricultural purposes. Indeed, Bronze Age trackway structures at Erith Spine Road / Bronze Age Way (Sidell *et al*., 1996) and on the Erith foreshore (Sidell, pers. comm.) clearly demonstrate that human activity was taking place nearby around this time.

10. CONCLUSIONS AND RECOMMENDATIONS

The results of the geoarchaeological and palaeoenvironmental analysis have built upon the previous fieldwork, deposit modelling and assessment exercises which confirmed that the site is located on a Shepperton Gravel surface resting between -7.5 and -9m OD. On the southern part of the site however, a west-east or northwest-southeast orientated deep trough (probable palaeochannel) is recorded. The channel is cut into the Shepperton Gravel surface, estimated to measure between 100 and 200m in width and ca. 2.5 in depth. A tripartite sequence of Lower Alluvium, Peat and Upper Alluvium infills the potential palaeochannel, and surrounding higher gravel surface. The Lower Alluvium began accumulating during the late Mesolithic (middle Holocene) beyond the margins of the probable palaeochannel, and earlier within the channel itself. The rate of accumulation was relatively rapid (ca. 3m/1000 years). Peat formation commenced towards the very end of the Mesolithic and continued to the Bronze Age.

During the accumulation of the Lower Alluvium and Peat (Mesolithic to early Bronze Age) the floodplain environment was dominated by wetland woodland comprising alder and a ground flora of sedges, grasses, aquatics and ferns, whilst mixed deciduous woodland occupied the dryland. There is no evidence for the early Neolithic decline of elm, the Neolithic colonisation and decline of yew or late Bronze Age expansion of elm; whether this is a consequence of poor sample recovery / pollen preservation or natural variations in woodland cover across the local area is unclear. At the time of the transition from Peat to Upper Alluvium (Bronze Age), woodland declined on both surfaces as a consequence of relative sea level rise (floodplain) and human activity (dryland). The vegetation history of the Alchemy Park site is broadly similar to that indicated at nearby sites.

The combined geoarchaeological and palaeoenvironmental exercises at Alchemy Park have thus been successful in achieving aims 1 to 4 of the project. The stratigraphic, hydrological and vegetation reconstructions provide a useful addition to the landscape evolution of the surrounding area. As such, the results will be combined with those from nearby sites to provide an overall publication detailing the palaeoenvironmental history, thereby completing final aim 5. The resultant paper will be published within a peer-reviewed academic journal.

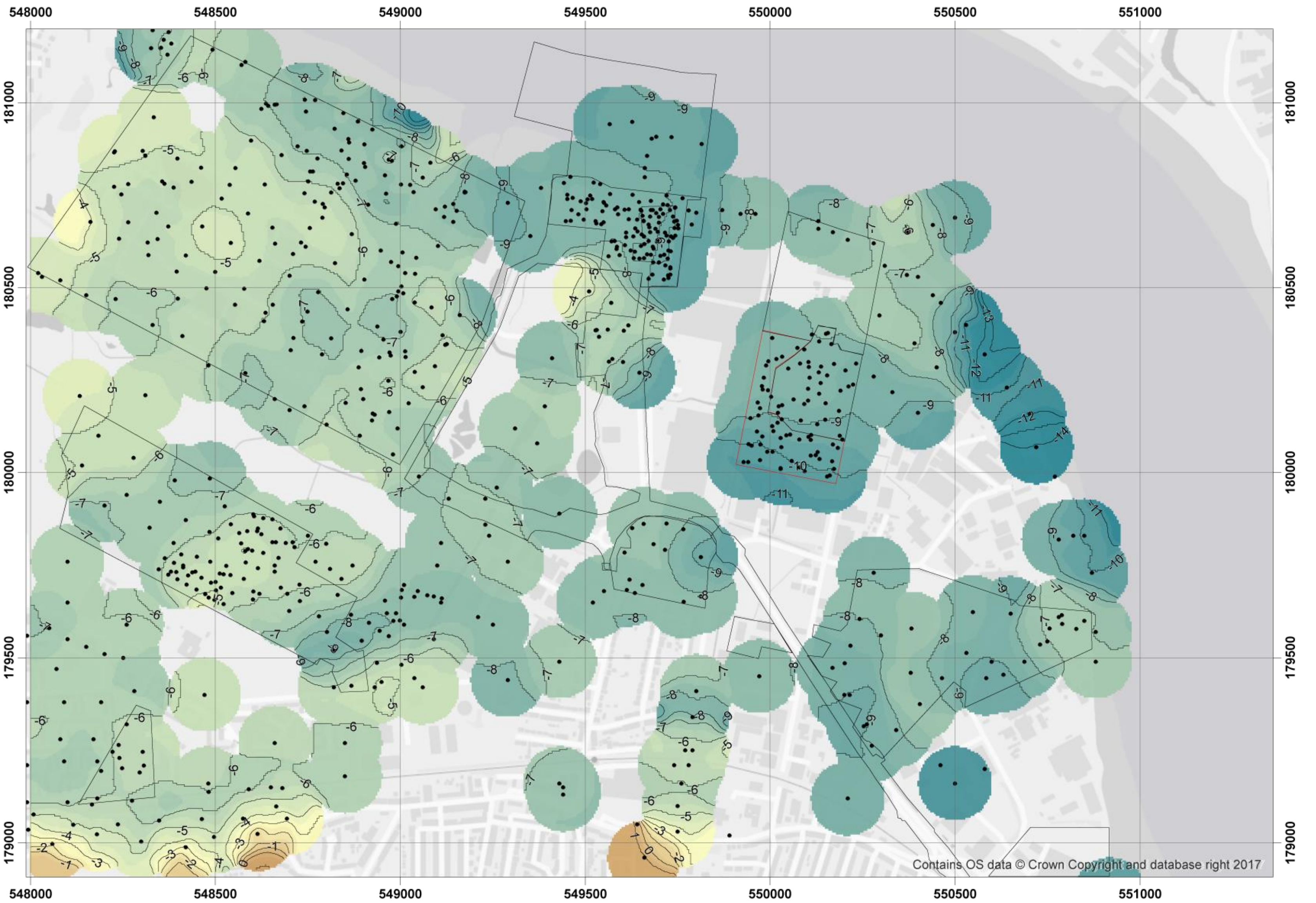

Figure 16: Surface of the Shepperton Gravel across the wider area surrounding the Alchemy Park and NuFarm sites

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12. APPENDIX 1: OASIS

OASIS ID: quaterna1-245451

Project details

Project name	Alchemy Park, Crabtree Manor Way North, Bexley
Short description of the project	Three geoarchaeological boreholes were put down across the site and combined with over 100 geotechnical records to provide a detailed deposit model for the site. The results reveal a deep west-east orientated palaeochannel on the southern part of the site cut into the river terrace gravels. A sequence of alluvial and peat sediments overlies the gravels, capped by made ground. The peat is dates from the late Mesolithic to Bronze Age period and a reconstruction of the environmental history of the site has been produced.
Project dates	Start: 01-02-2016 End: 16-04-2018
Previous/future work	No / No
Any associated project reference codes	ALY16 - Sitecode
Type of project	Environmental assessment
Monument type	PEAT Late Prehistoric
Significant Finds	PEAT Late Prehistoric
Survey techniques	Landscape

Project location

Country	England
Site location	GREATER LONDON BEXLEY BEXLEY Alchemy Park
Postcode	DA17 1AX
Study area	4 Hectares
Site coordinates	TQ 550000 185010 50.944507274775 0.206628764437 50 56 40 N 000 12 23 E Point

Project creators

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

Project archives

Physical Archive Exists?	No
Digital Archive Exists?	No
Paper Archive recipient	LAARC
Paper Media available	"Report"

Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	Alchemy Park, Crabtree Manorway North, London Borough of Bexley: Geoarchaeolgoical fieldwork and deposit model report
Author(s)/Editor(s)	Batchelor, C.R.
Author(s)/Editor(s)	Green, C.P.
Author(s)/Editor(s)	Young, D.S.
Other bibliographic details	Quaternary Scientific (QUEST) Unpublished Report March 2016; Project Number 201/15
Date	2016
Issuer or publisher	Quaternary Scientific
Place of issue or publication	University of Reading

Project bibliography 2

Publication type	Grey literature (unpublished document/manuscript)
Title	Alchemy Park, Crabtree Manorway North, London Borough of Bexley: Geoarchaeological assessment report
Author(s)/Editor(s)	Batchelor, C.R.
Author(s)/Editor(s)	HIll, T.
Author(s)/Editor(s)	Young, D.S.
Other bibliographic details	Quaternary Scientific (QUEST) Unpublished Report October 2016; Project Number 201/15
Date	2016
Issuer or publisher	Quaternary Scientific (QUEST)
Place of issue or publication	University of Reading

Project bibliography 3

Publication type	Grey literature (unpublished document/manuscript)
Title	ALCHEMY PARK, CRABTREE MANORWAY NORTH, LONDON BOROUGH OF BEXLEY Geoarchaeological and Palaeoenvironmental Analysis Report

Author(s)/Editor(s)	Batchelor, C.R.
Author(s)/Editor(s)	Morandi. L.
Author(s)/Editor(s)	Young, D.S.
Author(s)/Editor(s)	Green, C.P.
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