

150 PRINCES STREET, IPSWICH, SUFFOLK

Geoarchaeological Deposit Model Report

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1. INTRODUCTION

This report summarises the findings arising out of the environmental archaeological investigations undertaken by Quaternary Scientific (University of Reading) in connection with the proposed development of land at 150 Princes Street, Ipswich, Suffolk (National Grid Reference centred on: TM 15925 44219; Figures 1 and 2). The site lies on the floodplain of the River Gipping, approximately 300m north of the present course of the channel, where it flows west to east to the south of Ipswich town centre. British Geological Survey (BGS) mapping (www.bgs.ac.uk/opengeoscience) shows the superficial geology in the eastern area of the site as Alluvium, described as 'Clay, Silty'; in the western area of the site it is shown as River Terrace Deposits – Sand and Gravel. The bedrock underlying the site is the Cretaceous Newhaven Chalk Formation.

Previous geoarchaeological investigations at the site (Young, 2015) revealed that the sedimentary sequence at the site consists of the bedrock Chalk, overlain by Late Devensian gravel, Holocene alluvium and modern Made Ground. The gravel surface at the site falls towards the north to between -1.06 and -1.25m OD, perhaps indicative of a palaeochannel that might be aligned broadly east-west and whose main axis lies to the north of the site. The alluvium overlying the gravel across the site is typical of accumulation under low-energy fluvial conditions, with phases of reduced flow energy and perhaps transitions towards semi-terrestrial conditions. Within the possible palaeochannel, a thick (up to 2.36m) sequence of alluvium has accumulated, some of which is rich in Mollusca remains and is in places organic.

On the basis of the geoarchaeological investigations undertaken at the site, and the limited palaeoenvironmental information available for this area of Ipswich, further environmental archaeological assessment of borehole QBH1 was therefore recommended (Young, 2014). A programme of environmental archaeological assessment was carried out on borehole QBH1, the aims of which were (1) to establish the age of the organic-rich horizon recorded in this borehole; (2)

to assess the palaeoenvironmental potential of the sequence; (3) to highlight any indications of nearby human activity, and (4) to provide recommendations for further analysis (if necessary).

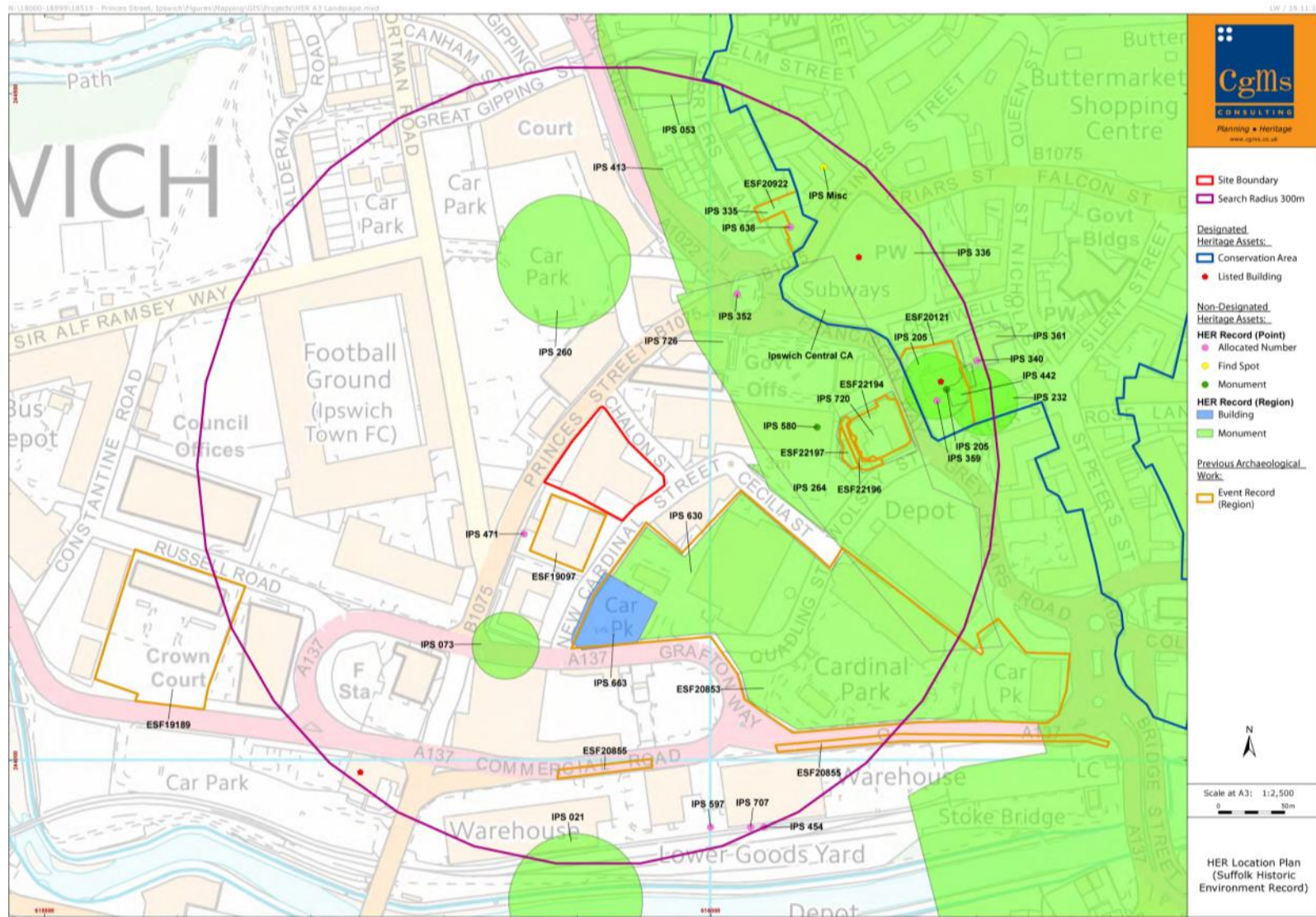


Figure 1: Location of 150 Princes Street, Ipswich, Suffolk and nearby archaeological investigations recorded on the Suffolk Historic Environment Record, including 153 Princes Street (ESF 19097) (figure provided by CgMs Consulting).

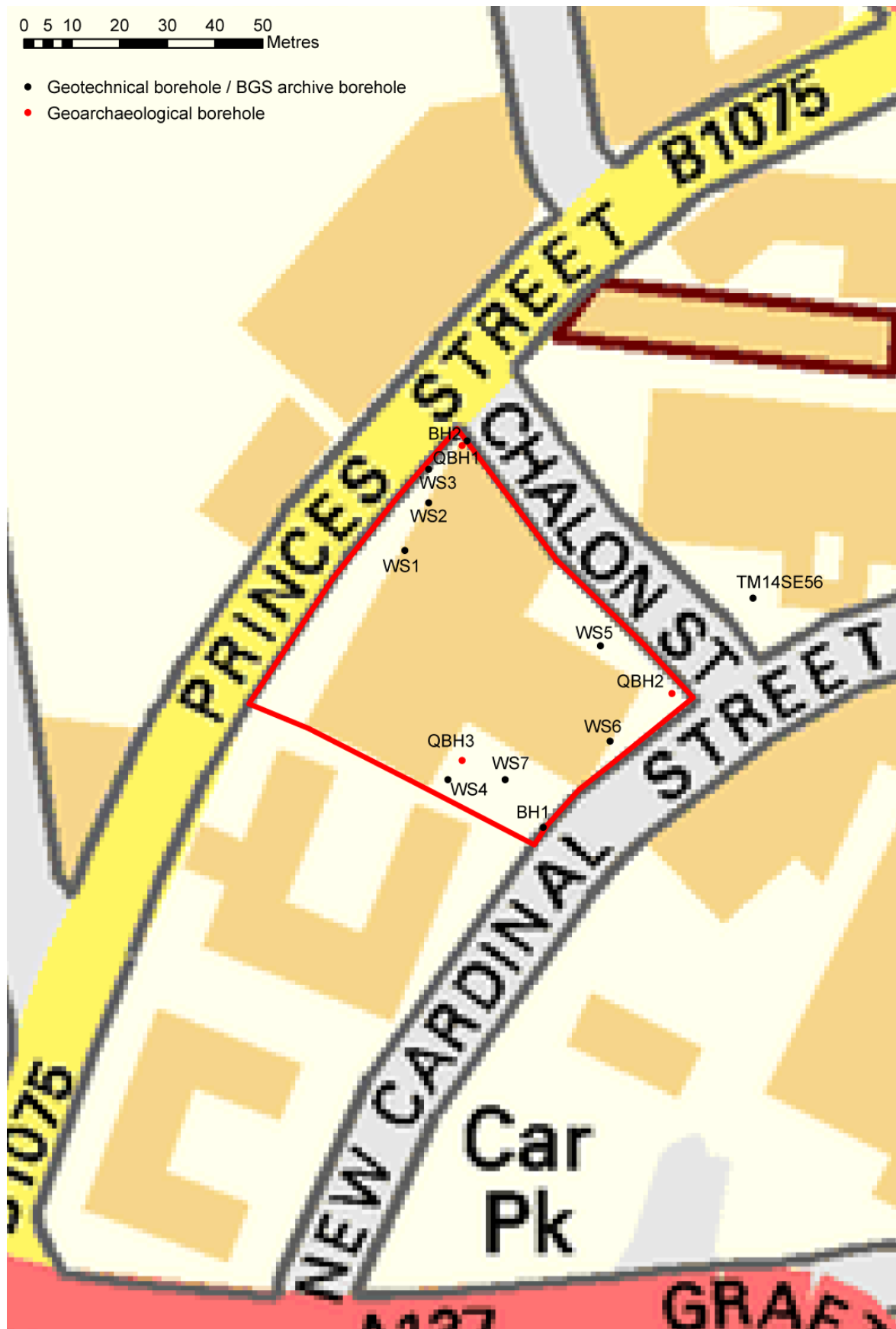


Figure 2: Location of the new geoenvironmental (red) and existing geotechnical (black) boreholes at 150 Princes Street. Nearby BGS archive borehole (www.bgs.ac.uk/opengeoscience) also shown. Contains Ordnance Survey data © Crown copyright and database right [2012].

2. METHODS

Previous investigations (field investigations, lithostratigraphic descriptions and deposit modelling)

Three geoarchaeological boreholes (boreholes QBH1 to QBH3) were put down at the site in November 2015 by Quaternary Scientific. The borehole core samples were recovered using an Eijkelpamp 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 borehole locations were recorded using a Leica GS09 Differential GPS (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 results of the geoarchaeological descriptions of the boreholes are displayed in Tables 2 to 4.

The deposit model was based on a review of 13 borehole records, including the three new geoarchaeological boreholes, nine geotechnical records (MLM Environmental, 2007) one BGS archive borehole (www.bgs.ac.uk/opengeoscience) (Figure 2; Table 1). Modelling was undertaken using RockWorks 16 geological utilities software and displayed using ArcMAP 10. The term 'deposit modelling' describes any method used to depict the sub-surface arrangement of geological deposits, but particularly the use of computer software to create contoured maps or three dimensional representations of contacts between stratigraphic units. The first requirement is to classify the recorded borehole sequences into uniformly identifiable stratigraphic units. At the 150 Princes Street site, the sedimentary units were classified into four groupings: (1) Chalk, (2) Gravel, (3) Alluvium and (4) Made Ground. Models of surface height (using a nearest neighbour routine) were generated for the Gravel and Alluvium (Figures 3 and 4). Thickness of the Alluvium (Figure 5), and Made Ground (Figure 6) was also modelled (also using a nearest neighbour routine).

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 50m 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.

Table 1: Borehole attributes for the records used in the deposit model, 150 Princes Street, Ipswich, Suffolk.

Borehole	Easting	Northing	Elevation (m OD)
<i>Geoarchaeological boreholes</i>			
QBH1	615919	244262	2.80
QBH2	615963	244210	3.00
QBH4	615919	244196	3.05
<i>Geotechnical boreholes (MLM Environmental, 2007)</i>			
BH1	615936	244182	3.05
BH2	615920	244263	3.05
WS1	615907	244240	3.05
WS2	615912	244250	3.05
WS3	615912	244257	3.05
WS4	615916	244192	3.05
WS5	615948	244220	3.00
WS6	615950	244200	3.00
WS7	615928	244192	3.05
<i>BGS archive boreholes (www.bgs.ac.uk/opengeoscience)</i>			
TM14SE56	615980	244230	3.10

Organic matter determinations

A total of 24 subsamples from borehole QBH1 were taken for determination of the organic matter content (Table 5; Figure 7). 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).

Radiocarbon dating

One charred cereal grain (cf. rye) was extracted from the base of the organic alluvium in borehole QBH1 for radiocarbon dating. The sample was submitted for AMS radiocarbon dating to the BETA Analytic Radiocarbon Dating Facility, Miami, Florida. The results have been calibrated using OxCal v4.0.1 (Bronk Ramsey, 1995; 2001 and 2007) and the IntCal13 atmospheric curve (Reimer *et al.*, 2013). The results are displayed in Figure 7 and in Table 6.

Pollen assessment

10 subsamples from borehole QBH1 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 (>125 μ); (5) acetolysis; (6) removal of finer minerogenic fraction using Sodium polytungstate (specific gravity of 2.0g/cm³); (7) mounting of the sample in glycerol jelly. Each stage of the procedure was preceded and followed by thorough sample cleaning in filtered distilled water. Quality control is maintained by periodic checking of residues, and assembling sample batches from various depths to test for systematic laboratory effects. Pollen grains and spores were identified using the University of Reading pollen type collection and the following sources of keys and photographs: Moore *et al* (1991); Reille (1992). The assessment procedure consisted of scanning the prepared slides, and recording the concentration and preservation of pollen grains and spores, and the principal taxa on four transects (10% of the slide) (Table 7).

Macrofossil assessment

A total of seven small bulk samples from borehole QBH1 were extracted for the recovery of macrofossil remains including waterlogged plant macrofossils, wood, insects and Mollusca. Six of the samples were focussed on the organic-rich horizon, with one sample taken from the unit below, in which frequent Mollusca and detrital wood remains were recorded. 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 300 μ m 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). Preliminary identifications of the waterlogged seeds and Mollusca have been made using modern comparative material and reference atlases (Cappers *et al.* 2006; Kerney, 1999; Hill-Cottingham, 2008). Nomenclature used follows Stace (2005) and Kerney (1999) (Table 9).

3. RESULTS AND INTERPRETATION OF THE GEOARCHAEOLOGICAL BOREHOLE INVESTIGATIONS, DEPOSIT MODELLING AND RADIOCARBON DATING

The results of the deposit modelling for the site have been reported previously (Young, 2015). The results of these investigations are shown in Tables 2 to 4, with the resultant deposit models shown in Figures 3 to 6. The basal unit recorded in two of the previous geotechnical boreholes is the bedrock Chalk, the surface of which is recorded at -5.25m OD (BH1) and -2.45m OD (BH2). Beyond the eastern margins of the site the Chalk is recorded at -3.61m OD in BGS archive borehole

TM14SE56. Although limited to only three data points, the overall impression of the Chalk bedrock is that it rises to the north, as might be expected in this area of the valley of the River Gipping.

Overlying the Chalk and recorded in 12 of the 13 boreholes is a horizon of sandy gravel, most likely deposited during the Late Devensian (Marine Isotope Stage 2, ca. 16,000-11,500 cal BP), within a high energy braided river system. The surface of this unit (Figure 3) is generally highest towards the east of the site, where it lies at between 1.1 (QBH2) and 1.4m OD (WS5 and WS6), and towards the south, where lies at between -0.45 and 0.35m OD. Towards the north of the site the gravel surface falls to between -1.25 and -1.06m OD in boreholes BH2 and QBH1; the depression in the gravel surface here may be indicative of a former channel associated with the floodplain of the River Gipping, which on the basis of the limited data available might be assumed to be aligned approximately east-west. The topography recorded in the gravel surfaces is thus typical of that in a high-energy, braided river environment.

The gravel is overlain in nine of the 13 boreholes by a horizon of generally sandy, silty, clayey and in places organic alluvium, with frequent Mollusca-rich horizons and occasional detrital plant material. This horizon is typical of deposition in a low-energy fluvial environment (organic content generally between 3 and 10%), perhaps with episodes of reduced flow and short-lived transitions towards semi-terrestrial conditions (up to 35% organic content). Organic content in the organic alluvium recorded in borehole QBH1 between 0.18 and -0.20m OD rises to between 15 and 35% (Figure 7); radiocarbon dating of a charred cereal grain at the base of this unit suggests that accumulation began sometime around ca. 720 to 895 cal AD (1185 to 1055 cal BP; Anglo-Saxon).

The surface of the alluvium (Figure 4) is recorded at between 2.45 (BH2) and 0.71m OD (QBH3). This horizon is thickest in the area of the possible palaeochannel, where it is recorded at between 2.36 (QBH1) and up to 3.7m thick (BH2) (see Figure 5). Elsewhere, between 0.5 and 2.0m is generally recorded, but in places (WS2, WS4 and WS6) the gravel is directly overlain by Made Ground, with no alluvium present. Elsewhere Made Ground overlies the alluvium, and is present in thicknesses of between 2.34 (QBH3) and 0.6m (Figure 6).

Table 2: Lithostratigraphic description of borehole QBH1, 150 Princes Street, Ipswich.

Depth (m OD)	Depth (m bgs)	Composition
2.80 to 1.30	0.00 to 1.50	Made Ground
1.30 to 1.15	1.50 to 1.65	7.5YR 5/8; Ga2 Ag1 Gg1; yellowish brown silty gravelly sand. Diffuse contact in to:
1.15 to 1.03	1.65 to 1.77	5Y 4/1; Ga2 Ag1 Gg1; dark grey silty gravelly sand. Sharp contact in to:
1.03 to 0.96	1.77 to 1.84	5Y 4/1; Ag2 As1 Ga1; dark grey clayey sandy silt with some horizontal bedding. Very sharp contact in to:
0.96 to 0.85	1.84 to 1.95	7.5YR 4/3; As2 Ag1 Sh1 Ga+ Gg+; brown organic silty clay with traces of sand and occasional gravel clasts. Contact obscured.
0.85 to 0.80	1.95 to 2.00	5Y 4/1; Ag2 As1 Ga1; dark grey sandy clayey silt.
0.80 to 0.51	2.00 to 2.29	5Y 4/1; Ag2 Ga1 Gg1 Dh+; dark grey sandy gravelly silt with traces of detrital herbaceous material. Diffuse contact in to:
0.51 to 0.18	2.29 to 2.62	5Y 3/1; Ag2 As2 Ga+ Dl+ Dh+; very dark grey silt and clay with traces of sand, detrital wood and detrital

		herbaceous material. Some vertical root hollows. Sharp contact in to:
0.18 to -0.12	2.62 to 2.92	5Y 2.5/1; Ag2 As1 Sh1 Dl+; black organic clayey silt with traces of detrital wood. Sharp contact in to:
-0.12 to -0.20	2.92 to 3.00	5Y 2.5/1; Ag2 As1 Sh1 Dl+ Dh+; black organic clayey silt with traces of detrital wood, detrital herbaceous material and frequent Mollusca fragments.
-0.20 to -0.30	3.00 to 3.10	5Y 3/1; Dl2 Ag2; very dark grey silt and detrital wood with frequent Mollusca fragments. Sharp contact in to:
-0.30 to -0.60	3.10 to 3.40	5Y 3/1; Ag3 As1 Ga+ Dl+; clayey silt with traces of sand and detrital wood and frequent whole Mollusca shells. Sharp contact in to:
-0.60 to -0.70	3.40 to 3.50	5Y 3/1; Dl2 Ag2; very dark grey silt and detrital wood with frequent Mollusca fragments. Sharp contact in to:
-0.70 to -1.06	3.50 to 3.86	5Y 2.5/1; Ag3 Ga1 Dl+; black sandy silt with traces of detrital wood. Some sandier and Mollusca-rich beds. Sharp contact in to:
-1.06 to -1.20	3.86 to 4.00	Gg3 Ga1; sandy gravel. Clasts are flint, well-rounded, up to 40mm in diameter.

Table 3: Lithostratigraphic description of borehole QBH2, 150 Princes Street, Ipswich.

Depth (m OD)	Depth (m bgs)	Composition
3.00 to 2.00	0.00 to 1.00	Made Ground
2.00 to 1.80	1.00 to 1.20	7.5YR 5/8; Ga2 Ag1 Gg1; yellowish brown silty gravelly sand. Diffuse contact in to:
1.80 to 1.66	1.20 to 1.34	5Y 4/1; Ag3 As1; dark grey clayey silt. Sharp contact in to:
1.66 to 1.44	1.34 to 1.56	7.5YR 4/3; As2 Ag1 Sh1 Ga+ Gg+; brown organic silty clay with traces of sand and occasional gravel clasts. Diffuse contact in to:
1.44 to 1.10	1.56 to 1.90	5Y 4/1; Ag2 As1 Ga1; dark grey sandy clayey silt. Contact obscured.
1.10 to 1.00	1.90 to 2.00	Gg3 Ga1; sandy gravel. Clasts are flint, well-rounded, up to 40mm in diameter.

Table 4: Lithostratigraphic description of borehole QBH3, 150 Princes Street, Ipswich.

Depth (m OD)	Depth (m bgs)	Composition
3.05 to 1.55	0.00 to 1.50	Made Ground
1.55 to 1.05	1.50 to 2.00	Made Ground/disturbed Alluvium.
1.05 to 0.71	2.00 to 2.34	Made Ground/disturbed Alluvium.
0.71 to 0.49	2.34 to 2.56	5Y 3/1; Ag2 As1 Ga1 Gg+ Dh+ Dl+ Sh+; very dark grey clayey sandy silt with traces of organic matter, detrital wood, detrital herbaceous material and occasional gravel clasts. Occasional Mollusca fragments. Diffuse contact in to:
0.49 to 0.23	2.56 to 2.82	5Y 2.5/1; Ag3 Ga1 Dl+; black sandy silt with traces of detrital wood and some Mollusca fragments. Sharp contact in to:
0.23 to 0.05	2.82 to 3.00	Gg3 Ga1; sandy gravel. Clasts are flint, well-rounded, up to 30mm in diameter (mean 5mm).

Table 5: Results of the borehole QBH1 organic matter determinations, 150 Princes Street, Ipswich.

Depth (m OD)		Organic matter content (%)
From	To	
0.78	0.77	3.15
0.70	0.69	2.96
0.62	0.61	3.68
0.54	0.53	3.36
0.46	0.45	4.07
0.38	0.37	4.16

Depth (m OD)		Organic matter content (%)
From	To	
0.30	0.29	7.65
0.22	0.21	10.22
0.14	0.13	16.73
0.06	0.05	20.30
-0.02	-0.03	15.64
-0.10	-0.11	17.83
-0.18	-0.19	25.86
-0.26	-0.27	33.64
-0.34	-0.35	11.45
-0.42	-0.43	14.71
-0.50	-0.51	13.20
-0.58	-0.59	9.39
-0.66	-0.67	21.97
-0.74	-0.75	12.47
-0.82	-0.83	15.83
-0.90	-0.91	12.60
-0.98	-0.99	5.99
-1.06	-1.06	9.90

Table 6: Results of the borehole QBH1 radiocarbon dating, 150 Princes Street, Ipswich.

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)	$\delta^{13}C$ (‰)
BETA 432158	Charred cereal grain cf. rye; base of organic alluvium	-0.15 to -0.20	1200 ± 30 BP	720 to 895 cal AD (1185 to 1055 cal BP)	-23.9

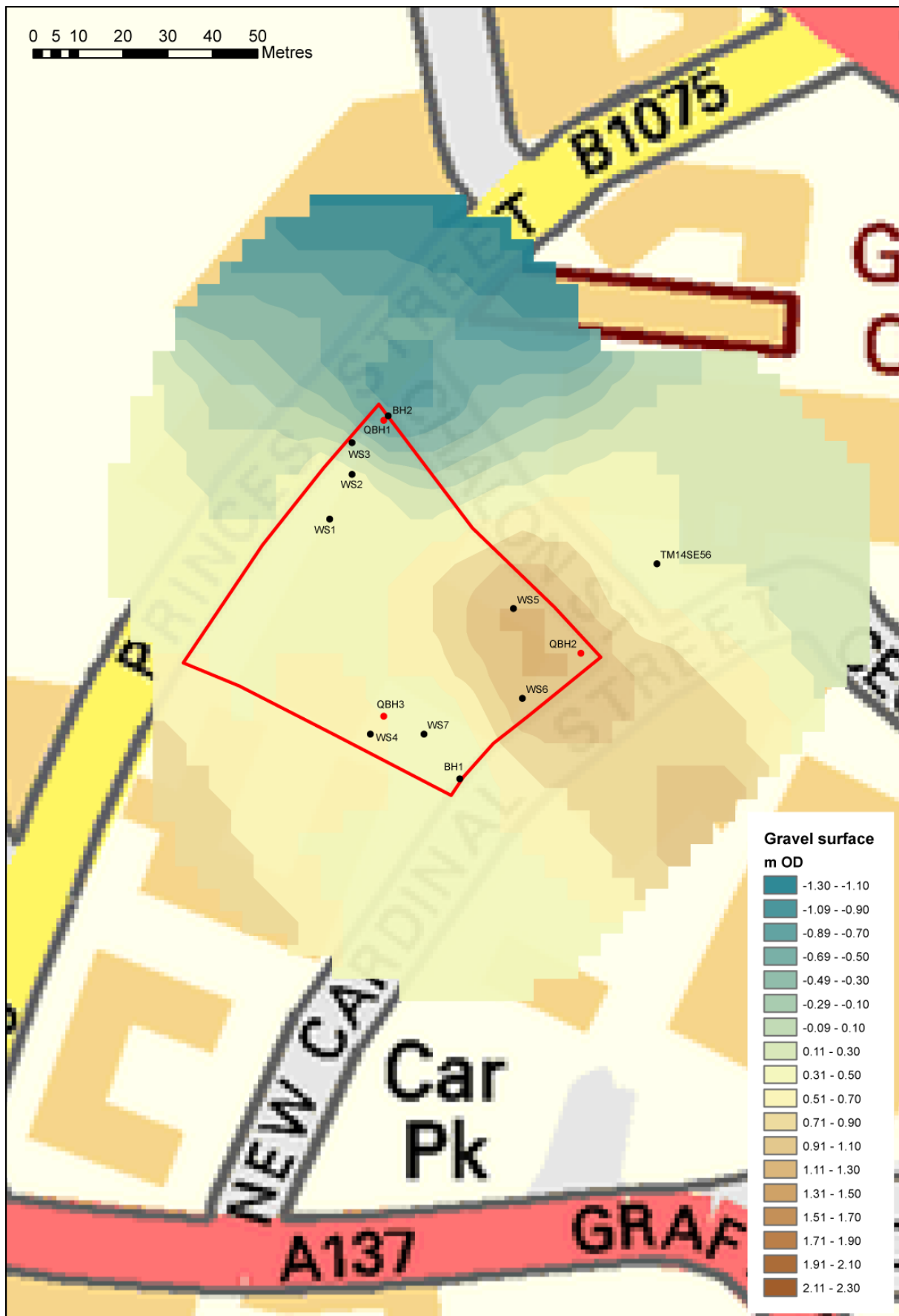


Figure 3: Modelled surface of the Gravel (contour heights in metres OD).

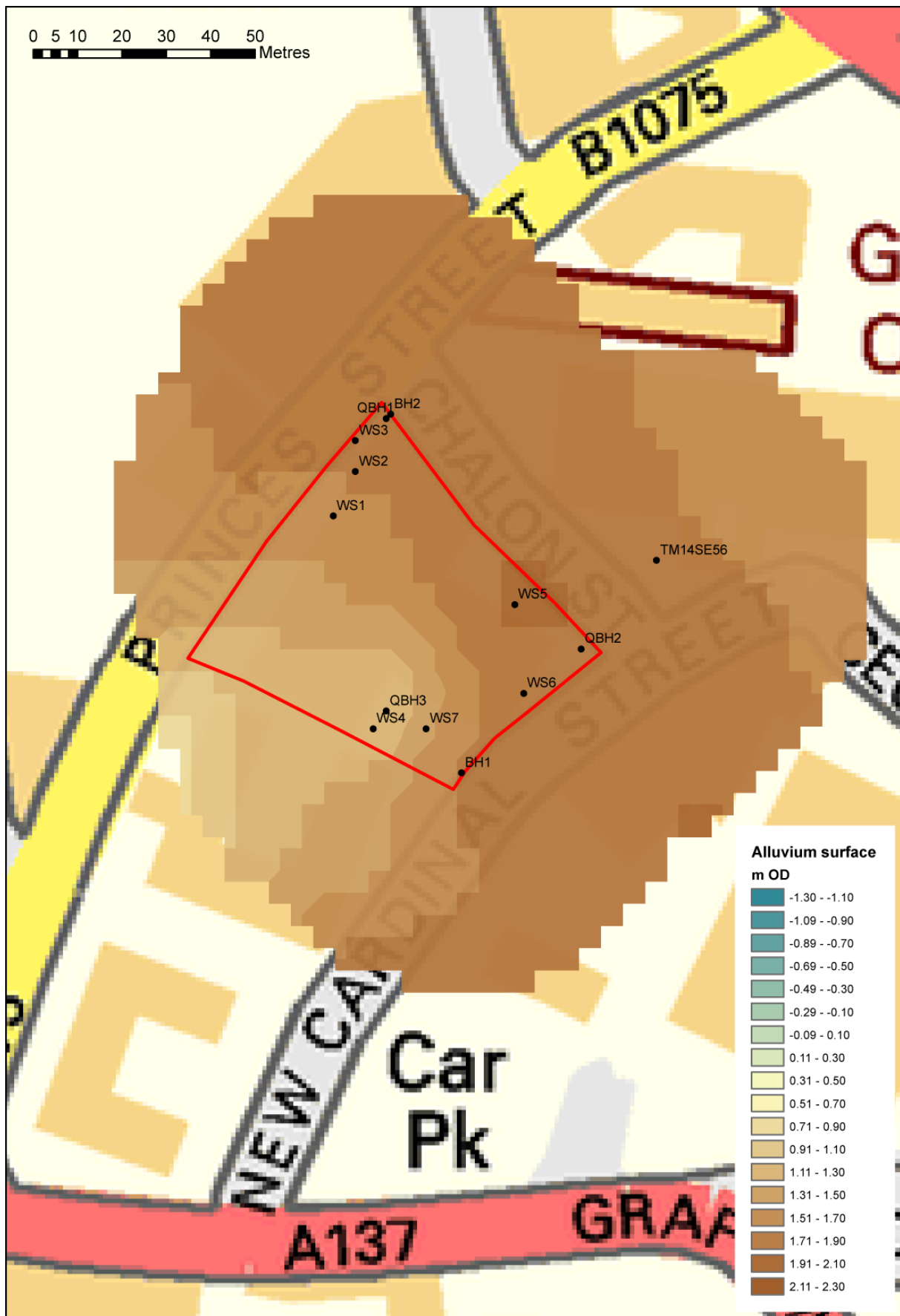


Figure 4: Modelled surface of the Alluvium (contour heights in metres OD).

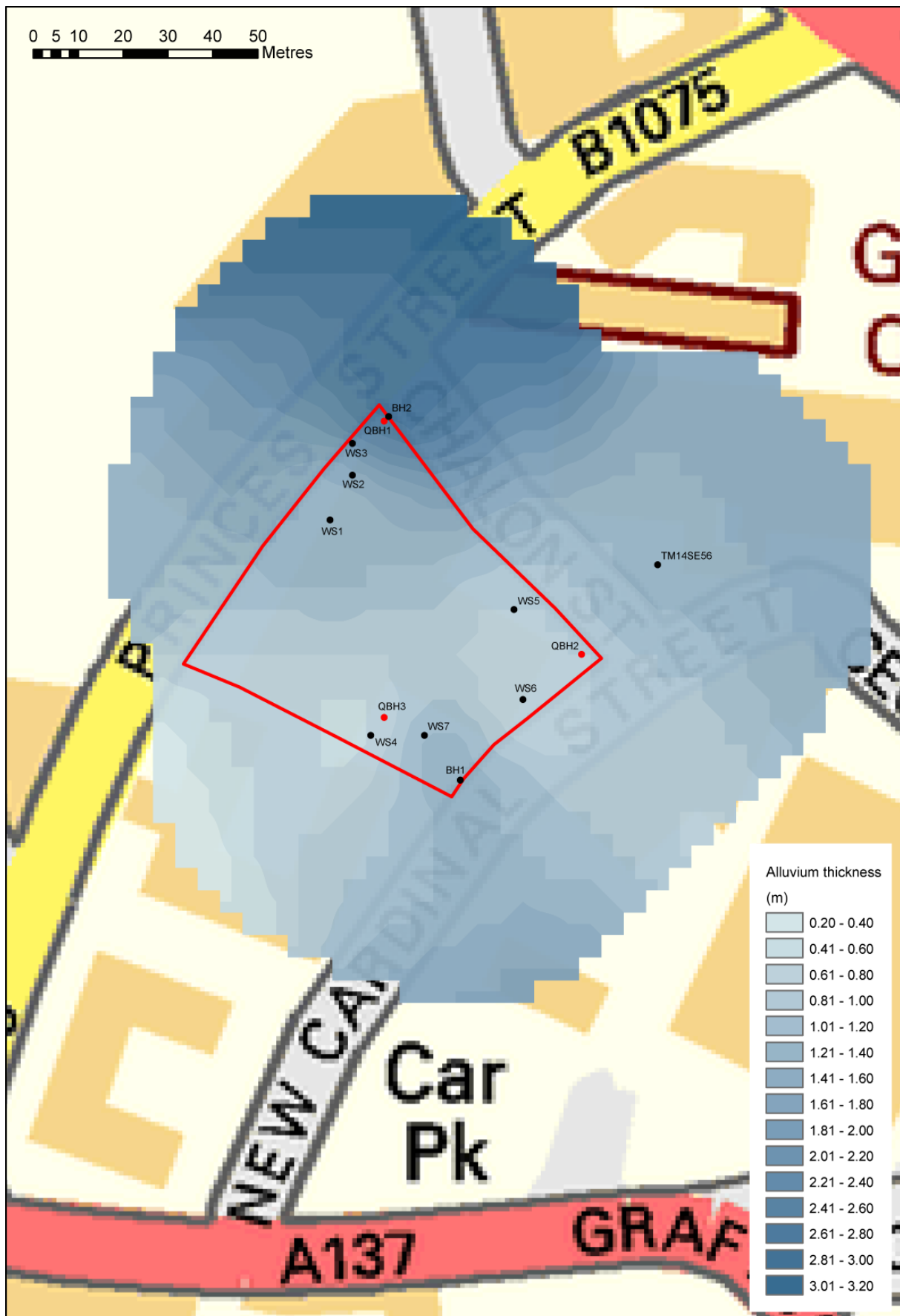


Figure 5: Modelled thickness of the Alluvium (metres).

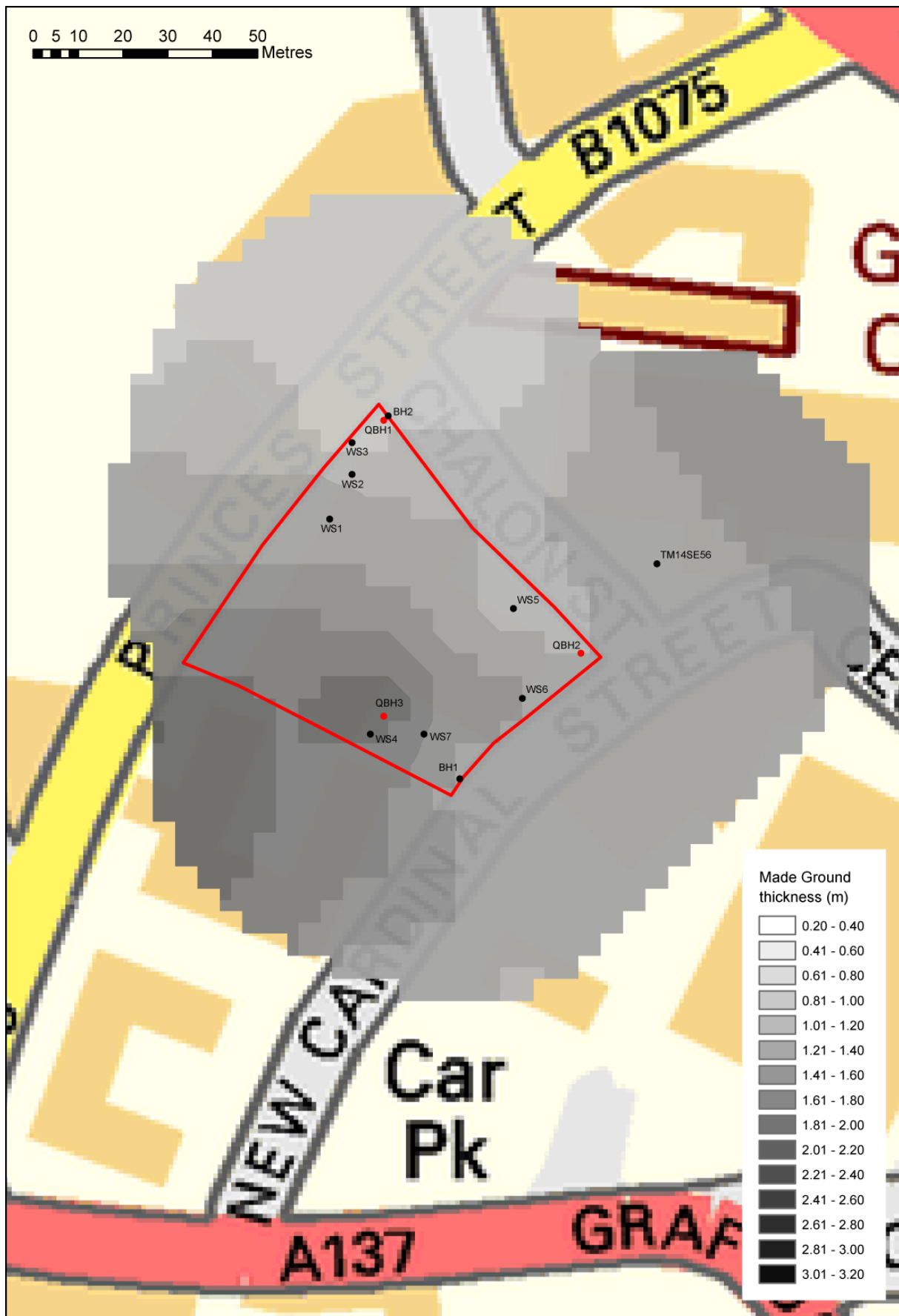


Figure 6: Modelled thickness of the Made Ground (metres).

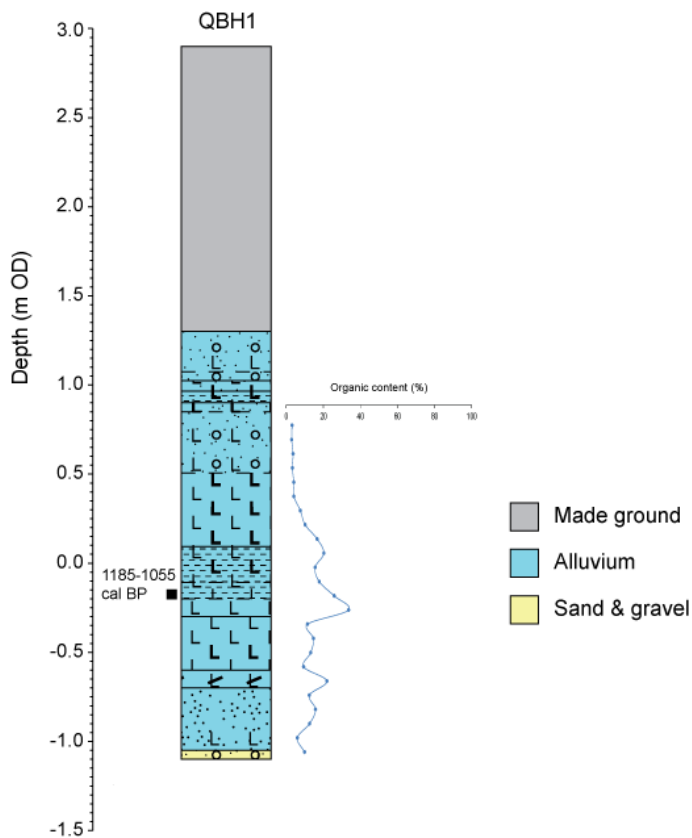


Figure 7: Results of the lithostratigraphic descriptions, radiocarbon dating and organic content analysis of borehole QBH1, 150 Princes Street, Ipswich.

4. RESULTS OF THE POLLEN ASSESSMENT

Samples were prepared for pollen assessment through the organic-rich horizons of QBH1. The results of this assessment (Table 7) indicate a very high concentration of remains in a very good state of preservation.

One assemblage can be identified from the assessment data, in which each sample contains a very high diversity of pollen dominated by herbaceous taxa such as Poaceae (grasses), Cyperaceae (sedges), *Cereale* type (cereals), Lactuceae (dandelions), Apiaceae (carrots), *Ranunculus* type (e.g. buttercup/water crowsfoot), *Plantago lanceolata* (ribwort plantain), *Centaurea nigra* (black knapweed), *Centaurea cyanus* (cornflower), Asteraceae (daisies), *Polygonum aviculare* (knotgrass), *Rumex acetosa/acetosella* (sorrel), *Sinapis* type (cabbage family), *Urtica* type (nettle) and *Cannabis* type (hemp). Tree and shrub pollen are present in low concentrations, including most commonly: *Alnus* (alder), *Quercus* (oak), *Betula* (birch) and *Corylus* type (hazel) with more sporadic occurrences including *Pinus* (pine), *Fagus* (beech), *Calluna vulgaris* (heather) and *Lonicera periclymenum* (honeysuckle). Aquatics are consistently present, including *Typha latifolia* (bulrush), *Sparganium* type (bur-reed), *Menyanthes trifoliata* (bogbean) and *Potamogeton* type (pondweed). Spores are relatively limited but include *Filicales* (ferns), *Polypodium vulgare* (polypody) and *Pteridium aquilinum* (bracken). Microcharcoal is consistently present in moderate concentrations.

The assemblage from borehole QBH1 is unequivocally evident of an open and anthropogenically modified environment. The dominance and diversity of cultivated plants and their associated weeds, including cereals, cornflower, knapweed, knotgrass, plantain, hemp, nettles, flax and members of the dandelion, daisy and cabbage families are strongly indicative of onsite or very nearby cultivation and/or crop-processing. High values of grasses and plants such as ribwort plantain, sorrel, daises, buttercups and clover also suggest meadow-type communities which may have been used for pastoral activities. However, it is also noted that some of these latter plants together with bogbean, bur-reed, bulrush and pondweed also indicate the presence of wet soils and/or nearby still/standing water. Tree and shrub pollen values are relatively low indicating either the distant growth of woodland, the presence of isolated trees and/or hedgerows.

Table 7: Results of the pollen assessment from QBH1, 150 Princes Street, Ipswich.

	Depth (m OD)	2.26	2.50	2.66	2.74	2.82	2.90	2.98	3.22	3.54	3.78
Latin name	Common name										
Trees											
<i>Alnus</i>	alder			3	1	3	2		1	1	1
<i>Quercus</i>	oak	5	4	2	5	3	7	3	4	3	1
<i>Pinus</i>	pine	5		1	1		1			1	
<i>Picea</i>	spruce					1					
<i>Ulmus</i>	elm		1								
<i>Tilia</i>	lime						1				
<i>Betula</i>	birch					2	1	1		1	
<i>Fagus</i>	beech								1		1
Shrubs											
<i>Corylus</i> type	e.g. hazel	2		4	8	2	10	5	6	5	2
<i>Calluna vulgaris</i>	heather				2	1					
<i>Lonicera periclymenum</i>	honeysuckle							1	1		
Herbs											
Cyperaceae	sedge family	6	2	11	4	4	6	3	4	2	2
Poaceae	grass family	11	7	6	17	10	18	16	14	8	10
<i>Cereale</i> type	e.g. barley	8	4	10	4	10	14	24	24	8	7
Asteraceae	daisy family	3	4	5	3		7	7	3	2	3
<i>Cirsium</i> type	thistle								1		
<i>Artemisia</i> type	mugwort	1			1		2	2	1		
<i>Centaurea nigra</i>	black knapweed				2		2	1			
<i>Centaurea cyanus</i>	cornflower	3	2	2			5	4	6	1	3
Lactuceae	dandelion family	5		4	5	3	14	6	17	5	4
<i>Plantago</i> type	plantain	3	5			1		1	3	1	
<i>Plantago lanceolata</i>	ribwort plantain	2	4	2	2	1	1	2			
<i>Plantago media/major</i>	greater/hoary plantain		1								
<i>Polygonum aviculare</i>	knotgrass			1		1	1			1	
<i>Polygonum persicaria</i>	ladysthumb				1						
<i>Chenopodium</i> type	goosefoot family	1	1	1	3		2		1		
Caryophyllaceae	pink family		3				2	1	3		
Rosaceae	rose family	2		1		1		1	1		3
<i>Potentilla</i>	meadowsweet			1							1
<i>Rumex acetosa/acetosella</i>	sorrel	1	1	2	2		5		1	2	
Apiaceae	carrot family	1		1		1	2	1		1	
<i>Sinapis</i> type	cabbage family	2		1	1	1	2	6	4	1	

	Depth (m OD)	2.26	2.50	2.66	2.74	2.82	2.90	2.98	3.22	3.54	3.78
Latin name	Common name										
<i>Ranunculus</i> type	buttercup / water crowfoot		1			1	1				
<i>Galium</i> type	bedstraw				1						
<i>Urtica</i> type	nettle	5									
<i>Cannabis</i> type	hemp	3					1				1
<i>Linum</i> type	flax	1			2						
<i>Trifolium</i> type	clover			1							
Aquatics											
Potamogeton type	pondweed	1									
<i>Typha latifolia</i>	bulrush	1							3		
<i>Sparganium</i> type	bur-reed		1	1					2		
<i>Menyanthes trifoliata</i>	bogbean						1				
Spores											
<i>Pteridium aquilinum</i>	bracken	1	1			2	2	1			
Filicales	ferns		1				1				
<i>Polypodium vulgare</i>	polypody										1
Unknown						2			2		3
Total Land Pollen (grains counted)		70	40	59	65	46	102	85	96	44	39
Concentration*		5	5	5	5	5	5	5	5	5	5
Preservation**		4	4	4	4	4	4	4	4	4	4
Microcharcoal Concentration***		3	3	3	3	3	2	2	2-3	3	2-3
Suitable for further analysis		YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

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

5. RESULTS OF THE WATERLOGGED MACROFOSSIL ASSESSMENT

A total of seven small bulk samples from borehole QBH1 were extracted for the recovery of macrofossil remains, including waterlogged plant macrofossils, waterlogged wood, insects and Mollusca (Table 8). The samples were focussed on the organic-rich horizon in borehole QBH1 (0.18 to -0.20m OD), with an additional sample from the unit below, in which waterlogged wood and Mollusca remains were identified during the lithostratigraphic descriptions.

The results of the macrofossil rapid assessment indicate that waterlogged wood was present in low to moderate quantities in five of the seven samples, with none recorded in samples 0.14 to 0.10 and 0.10 to 0.00m OD. Waterlogged seeds were present in low to moderate quantities in all but one sample (0.14 to 0.10m OD). Charcoal was identified in all but one sample (0.10 to 0.00m OD); in those samples where it was recorded, selected fragments were identifiable (greater than 2mm in diameter on all axes). A charred cereal grain was identified in the sample from -0.15 to -0.20m OD. Mollusca were identified in low quantities in four of the six samples from the organic-rich horizon, including whole specimens; only in samples 0.14 to 0.10 and 0.10 to 0.00m OD were no Mollusca recorded. Mollusca, including whole specimens, were present in moderate quantities in the sample from -0.40 to -0.49m OD. Insects were recorded in low concentrations in one sample (0.14 to 0.10m OD).

The waterlogged seeds identified during the rapid assessment were submitted for a more detailed assessment (Table 9). The assemblage in these samples included herbaceous taxa, including cf. *Persicaria* sp. (knotweed), *Carex* sp. (sedge), *Chenopodium album* (fat hen), *Ranunculus repens* (creeping buttercup), *Rumex/Polygonum* sp. (dock/sorrel) and *Lycopus europaeus* (gypsywort), with frequent aquatic taxa, including *Menyanthes trifoliata* (bogbean), cf. *Nuphar* sp. (water lily), *Ceratophyllum* sp. (hornwort) and *Potamogeton* sp. (pondweed). A charred cereal grain, cf. *Secale cereale* (rye) was recorded in one sample (-0.15 to -0.20m OD), whilst the shrub/tree taxon *Sambucus nigra/racemosa* (elder) was also recorded. The assemblage recorded is dominated by aquatic and herbaceous taxa, and is typical of a wet or damp, open environment perhaps on the margins of a stream, river or pond. The presence of a charred cereal grain provides unequivocal evidence of cereal cultivation/processing not far from the site.

The sample from -0.40 to -0.49m OD, in which moderate quantities of Mollusca remains were recorded, was also submitted for a more detailed assessment of the Mollusca assemblage. Within this sample *Bithynia tentaculata*, *B. leachii*, *Anisus vortex* and *Planorbis planorbis* were recorded, indicative of fresh water conditions on the margins of a stream or pond.

Table 8: Results of the macrofossil assessment of borehole QBH1, 150 Princes Street, Ipswich.

Depth (m OD)	Volume sampled (ml)	Volume processed (ml)	Fraction	Charred					Waterlogged		Mollusca		Bone			Insects	Artefacts
				Charcoal (>4mm)	Charcoal (2-4mm)	Charcoal (<2mm)	Seeds	Chaff	Wood	Seeds	Whole	Fragments	Large	Small	Fragments		
0.18 to 0.14	20	20	>300µm	1	1	-	-	-	1	1	1	-	-	-	-	-	-
0.14 to 0.10	20	20	>300µm	1	1	-	-	-	-	-	-	-	-	-	-	1	-
0.10 to 0.00	50	50	>300µm	-	-	-	-	-	-	1	-	-	-	-	-	-	-
0.00 to -0.10	25	25	>300µm	2	2	-	-	-	2	1	1	-	-	-	-	-	-
-0.10 to -0.15	50	50	>300µm	2	2	-	-	-	3	2	1	1	-	-	-	-	-
-0.15 to -0.20	50	50	>300µm	2	2	2	1	-	2	2	1	1	-	-	-	-	-
-0.40 to -0.49	75	75	>300µm	-	1	-	-	-	2	1	3	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+

Table 9: Results of the waterlogged plant macrofossil (seeds)/Mollusca assessment of borehole QBH1, 150 Princes Street, Ipswich.

Depth (m OD)	Waterlogged seeds			Mollusca	
	Latin name	Common name	Number	Latin name	Number
0.18 to 0.14	<i>Sambucus nigra/racemosa</i>	elder	1	-	-
	<i>Menyanthes trifoliata</i>	bogbean	1	-	-
0.14 to 0.10	-	-	-	-	-
0.10 to 0.00	<i>Menyanthes trifoliata</i>	bogbean	1	-	-
	cf. <i>Persicaria</i> sp.	cf. knotweed	1	-	-
0.00 to -0.10	<i>Carex</i> sp.	sedge	1	-	-
	<i>Chenopodium album</i>	fat hen	1	-	-
-0.10 to -0.15	<i>Lycopus europaeus</i>	gypsywort	1	-	-
	<i>Chenopodium album</i>	fat hen	2	-	-
	<i>Ranunculus repens</i>	creeping buttercup	1	-	-
	<i>Rumex/Polygonum</i> sp.	dock/sorrel	1	-	-
	cf. <i>Nuphar</i> sp.	cf. water-lily	1	-	-
-0.15 to -0.20	cf. <i>Persicaria</i> sp.	cf. knotweed	2	-	-
	<i>Rumex/Polygonum</i> sp.	dock/sorrel	1	-	-
	<i>Sambucus nigra/racemosa</i>	elder	1	-	-
	<i>Chenopodium album</i>	fat hen	2	-	-

Depth (m OD)	Waterlogged seeds			Mollusca	
	Latin name	Common name	Number	Latin name	Number
	<i>Ranunculus repens</i>	creeping buttercup	1		
	cf. <i>Secale cereale</i>	cf. rye	1		
-0.40 to -0.49	<i>Ceratophyllum</i> sp.	hornwort	1	<i>Bithynia tentaculata</i>	25
	<i>Ranunculus repens</i>	creeping buttercup	1	<i>Planorbis planorbis</i>	2
	<i>Potamogeton</i> sp.	pondweed	1	<i>Bithynia leachii</i>	1
				<i>Anisus vortex</i>	1

6. DISCUSSION AND CONCLUSIONS

The aims of the environmental archaeological assessment were (1) to establish the age of the organic-rich horizon recorded in borehole QBH1; (2) to assess the palaeoenvironmental potential of the sequence; (3) to highlight any indications of nearby human activity, and (4) to provide recommendations for further analysis (if necessary).

The sequence at the site consists of the bedrock Chalk, overlain by Late Devensian gravel, Holocene alluvium and modern Made Ground. Although no elevation data is available for the investigations at the 153 Princes Street site, two boreholes put down during geotechnical investigations here (SCCAS, 2005) revealed a similar sequence of sand and gravel at a maximum depth of 2.4m bgl, overlain by clay and silt alluvial deposits and between 0.6 and 1.0m of Made Ground. The gravel surface at the present site falls towards the north to between -1.06 and -1.25m OD, perhaps indicative of a palaeochannel that might be aligned broadly east-west and whose main axis lies to the north of the site. Towards the south and east of the site the gravel surface rises to between 0.23 and 1.4m OD. The high gravel surfaces in the southeastern corner of the site (in the area of boreholes QBH2, WS5 and WS6) are indicative of a gravel 'island' that might have been elevated above the level of the surrounding floodplain during the prehistoric period; it is possible that this area of high gravel topography extends beyond the eastern boundary of the site.

The alluvium overlying the gravel is typical of deposition in a low-energy fluvial environment (organic content generally between 3 and 10%), perhaps with episodes of reduced flow and short-lived transitions towards semi-terrestrial conditions, perhaps on the margins of a stream or pond (up to 35% organic content). Radiocarbon dating of the base of the organic-rich unit recorded between 0.18 and -0.20m OD suggests that accumulation began sometime around ca. 720 to 895 cal AD (1185 to 1055 cal BP; Anglo-Saxon). The combined results of the palaeobotanical assessment (pollen and waterlogged macrofossils) are indicative of an open and anthropogenically modified environment during the accumulation of this organic-rich horizon. The dominance and diversity of cultivated plants and their associated weeds, including cereal pollen and a charred cereal grain of cf. rye, are strongly indicative of very nearby cultivation and/or crop-processing, with meadow-type communities also indicative of pastoral activities. The presence of aquatic taxa is indicative of nearby slow-flowing or standing water, perhaps on the margins of a stream or pond; the Mollusca assemblage recorded below the organic-rich horizon (-0.40 to -0.49m OD) is indicative of similar environments on the margins of a stream, river or pond that was fresh water and not influenced by saline conditions.

7. RECOMMENDATIONS

The assemblage recorded contains a very high concentration and diversity of pollen providing unequivocal evidence of human activity, including onsite or nearby cultivation and/or crop processing. However, on the basis of the age of the site (Anglo Saxon), and the archaeological information already available for this period, no further environmental archaeological analysis is recommended.

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9. APPENDIX 1: OASIS

OASIS ID: quaterna1-234937

Project details

Project name	150 Princes Street, Ipswich
Short description of the project	A programme of environmental archaeological assessment was carried out at the site in order to (1) to clarify the nature of the sub-surface stratigraphy; (2) to clarify the nature, depth, extent and date of any Alluvium and organic/Peat deposits; (3) to investigate whether the sequences have the potential to contain any artefact or ecofact evidence for prehistoric or historic human activity. Deposit modelling revealed that the sequence at the site consists of bedrock Chalk, overlain by Late Devensian gravel, Holocene alluvium and modern Made Ground. The gravel surface at the present site falls towards the north to between -1.06 and -1.25m OD, perhaps indicative of a palaeochannel that might be aligned broadly east-west and whose main axis lies to the north of the site. Towards the south and east of the site the gravel surface rises to between 0.23 and 1.4m OD, perhaps indicative of a gravel 'island' that might have been elevated above the level of the surrounding floodplain during the prehistoric period. The alluvium overlying the gravel is typical of deposition in a low-energy fluvial environment, perhaps with episodes of reduced flow and short-lived transitions towards semi-terrestrial conditions, perhaps on the margins of a stream or pond. Radiocarbon dating of the base of the organic-rich unit recorded between 0.18 and -0.20m OD suggests that accumulation began sometime around ca. 720 to 895 cal AD (1185 to 1055 cal BP; Anglo-Saxon). The results of the assessment are indicative of an open and anthropogenically modified environment during the accumulation of this organic-rich horizon, and are strongly indicative of very nearby cultivation and/or crop-processing. The presence of aquatic taxa is indicative of nearby slow-flowing or standing water, perhaps on the margins of a stream or pond. No further analysis was recommended.
Project dates	Start: 01-09-2015 End: 24-03-2016
Previous/future work	Yes / No
Type of project	Environmental assessment
Significant Finds	ORGANIC ALLUVIUM Early Medieval
Survey techniques	Landscape

Project location

Country	England
Site location	SUFFOLK IPSWICH IPSWICH 150 Princes Street
Study area	0.4 Hectares
Site coordinates	TM 15925 44219 52.053677251225 1.14974455281 52 03 13 N 001 08 59 E Point

Project creators

Name of Organisation	Quaternary Scientific (QUEST)
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Project originator brief CgMs Consulting

Project originator design D.S. Young

Project director/manager C.R. Batchelor

Project supervisor D.S. Young

Project archives

Physical Archive No
Exists?

Digital Archive No
Exists?

Paper Contents "Environmental"

Paper available Media "Report"

Entered by Daniel Young (d.s.young@reading.ac.uk)

Entered on 24 March 2016