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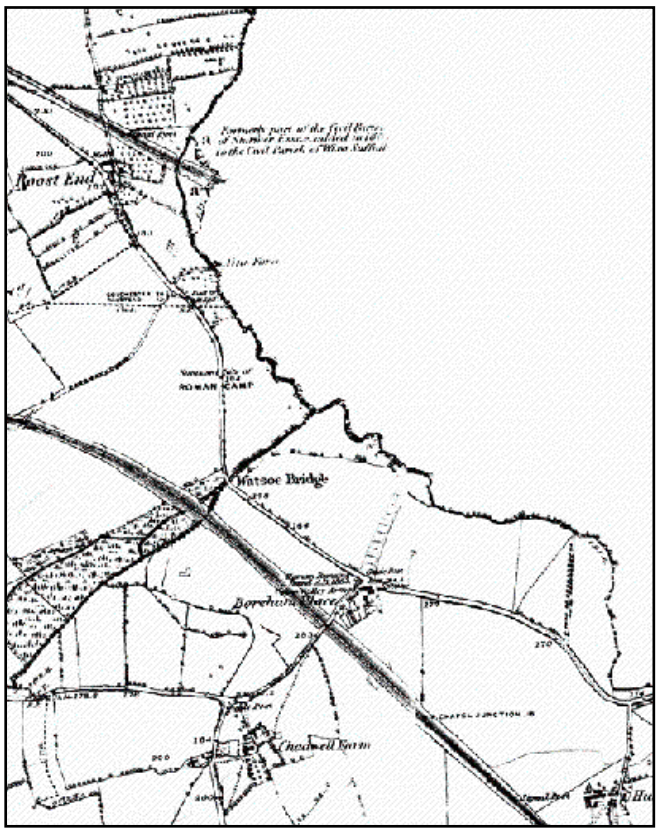
GEOARCHAEOLOGICAL INVESTIGATION

ON LAND AT WIXOE PUMPING STATION

BRAINTREE

ESSEX



Essex County Council

Field Archaeology Unit

JULY 2011

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CONTENTS

GEOARCHAEOLOGICAL INVESTIGATION
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BRAINTREE
ESSEX

Client: URS Scott Wilson Ltd

NGR: TL 708 430

Site Code:

Oasis No.: essexcou1-104557

Dates of Fieldwork: 22nd – 23rd March 2011

SUMMARY

A geoarchaeological assessment was carried out on land situated on the floodplain of River Stour at the Wixoe Pumping Station, near Braintree, Essex. This investigation was carried out as part of a programme of archaeological works in connection with the Wormingford to Abberton pipeline and associated infrastructure. The works were carried out in accordance with an archaeological brief issued by Essex County Council Historic Environment Management (ECC HEM 2010) and a written scheme of investigation prepared by URS Scott Wilson (2010).

The investigation was carried out on an area of open ground between the pumping station and the current course of the river, which lies in an artificial channel, having been diverted in the 1960s-1970s. The earlier meandering course of the river crossed the open ground. Preliminary investigations (Birmingham Archaeo-Environmental 2010) identified a sequence of alluvial and organic sediments, including peat deposits. The current geoarchaeological investigations comprised the drilling of 10 boreholes, which were logged in the field, following which two sleeved cores were then subject to detailed environmental assessment. The results of the recent work identified a similar pattern to that in the 2010 studies, with sand, silt and clayey deposits overlying an undulating gravel surface. The latter were probably laid down in the late Pleistocene or early Holocene during a period of high-energy deposition. The overlying sequence of sands, silts and clays is typical of a meandering river channel where there are a multitude of micro-environments such as point bars, mid-channel bars, pools and backwaters.

The sediment sequences recorded in the laboratory were broadly similar to the sequences recorded in the field. Greyish brown and yellowish brown soil horizons passed down in all three boreholes into grey and dark brown more or less peaty organic silts. Richly organic horizons were recorded between 54.13m and 52.53m OD in Transect A <BH1>, between 53.51m and

51.99m OD in Transect A <BH2> and between 54.16 and 51.75m OD in Transect B <BH1>. These included peat deposits.

The combined results of the archaeobotanical (pollen, waterlogged wood, macrofossil and seeds) assessments are indicative of a damp, open and disturbed environment typical of a floodplain dominated by herbaceous vegetation during the accumulation of the peat. In the organic sand underlying the peat a similarly wet, open and disturbed environment is indicated, dominated by herbaceous and aquatic vegetation. The Mollusca remains are too small to draw any firm conclusions but the indications are of well-oxygenated, hard water in a slow-moving river or a lake nearby, with dry grassland indicated in the uppermost sample. The presence of anthropogenic material (e.g. charred cereals grains, charcoal, charred chaff and CBM) from both the peat and the organic sand underlying it are indicative of human activity in the surrounding landscape during the accumulation of both sedimentary units. Radiocarbon dating of terrestrial seed found in the peat indicated that it accumulated between the 8th and 13th centuries.

This is therefore a well preserved organic floodplain sequence of historic period age, evidence for which has not previously been recorded in this part of the Stour valley and is not particularly common elsewhere in lowland Britain.

1.0 INTRODUCTION

This report describes the results of Stage 1 of a programme of geoarchaeological and environmental assessment undertaken in advance of construction works in Area A, situated between the pumping station and the current course of the River Stour, at the Wixoe Pumping Station, near Braintree, Essex (Fig. 1). The investigations comprised the recovery and geoarchaeological recording of 10 sleeved cores with the subsequent palaeoenvironmental assessment of two of the cores.

The fieldwork was carried out by the Essex County Council Field Archaeology Unit (ECC FAU) for URS Scott Wilson Ltd, in accordance with an archaeological brief prepared by Essex County Council Historic Environment Management (ECC HEM 2010) and a written scheme of investigation prepared by URS Scott Wilson Ltd (2010). The geoarchaeological assessment was carried out by Dr. Peter Allen and the environmental assessment by Quaternary Scientific (Quest), University of Reading.

The site archive will be deposited in Braintree Museum. A digital version of this report will be submitted, along with a project summary, to the Online Access to the Index of Archaeological Investigations (OASIS) (http://ads.ahds.ac.uk/project/oasis).

2.0 BACKGROUND

2.1 Site Description and Location (Fig. 1)

The site is located adjacent to existing Wixoe Pumping Station, which lies within the floodplain of the River Stour, at Ordnance Survey NGR TL708 430 (Fig.1 – 2). The pumping station consists of a number of small buildings and structures situated to the east of Fordwater Close, between the A1017 and the river. The present course of the Stour lies in an artificial channel, established in the late 1960s–early 1970s, when the pumping station was constructed. Between the pumping station and the current river course is a narrow band of open ground which is under grass at present. The earlier meandering route of the river, depicted on early editions of the Ordnance Survey, crossed this area following a course that remains the county boundary between Essex and Suffolk. This area has been subject to a preliminary palaeo-environmental assessment that revealed alluvial and organic sediments (Hopla and Krawic 2010)).

2.2 Reasons for Project

A planning application for a proposed pipeline from Wormingford to Abberton, with associated intake and outfall structures and other infrastructure was submitted in 2007. The scheme crosses both the county and district boundaries from Suffolk into Essex and includes works within the Braintree and Colchester District. As elements of the scheme lie within sensitive archaeological areas a full archaeological condition was recommended to Essex County Council by the ECC Historic Environment Management team, in accordance with guidance contained in Planning Policy Guidance 16: Archaeology & Planning (now replaced by Planning Policy Statement 5: Planning for the Historic Environment). The recommendation states that:

No development, or preliminary groundworks, of any kind shall take place until the applicant has secured the implementation of a programme of archaeological work and recording in accordance with a written scheme of investigation which has been submitted by the applicant, and approved by the planning authority.

2.3 Historical and Archaeological Background

The following archaeological background makes use of the Essex Historic Environment Record (EHER), held at County Hall, and the URS Scott Wilson Ltd Written Scheme of Investigation for the works.

The site lies within an area of archaeological potential for prehistoric to medieval remains. To the north of Watsoe Bridge finds including coins, metalwork pottery and a number of burials suggest some form of Roman settlement, possibly a camp (HER 6958, 7061, 6954, 8578, 6951, 6955), with trenching in adjacent areas producing stratified deposits indicating the presence of an embankment adjacent to a ditch of probable Roman date associated with the settlement there (HER 6956). Evaluation in advance of the Wormingford to Abberton pipeline has confirmed activity dating to the Roman period on the Suffolk side of the Stour, while Prehistoric to Medieval remains (HER 6959-62) have been recovered from material that derived from the area of the reservoir. Within this, the richness and variety of prehistoric worked flint that would have come from the gravels of the River Stour reveal the importance of this valley for prehistoric activity.

The county boundary follows the historic route of the River Stour before it was diverted/ realigned. Reference to historic Ordnance Survey mapping suggests that this took place in the late 1960s or early 1970s and was presumably associated with the establishment of the Wixoe Pumping Station. Thus the site lies on the historic floodplain

of the River Stour and at a level of c.53m OD. The British Geological Survey shows the valley floor underlain by Alluvium and the valley side slopes and a wide surrounding area, embracing much of the catchment of the Stour, underlain by till which in this area can be presumed to be the normally chalky till of the Anglian Glaciation. The underlying bedrock is Chalk.

A preliminary assessment of buried palaeoenvironmental deposits across the site revealed alluvial and organic sediments (peat), up to 3.60m deep, on land adjacent to the River Stour, which would be impacted upon by the proposed scheme (Hopla and Krawic 2010). The peat was recorded in field logs for a series of boreholes located close to the present course of the river, at levels between 1.3m and 3.5m below ground surface (bgs). The full thickness of the peat, recorded in three boreholes, ranged from 0.5m (between 2.5m and 3.0m bgs) to 1.7m (between 1.8m and 3.5m bgs). Therefore the area was established to be one where there was the potential for palaeoenvironmental remains to be present. In addition to palaeoenvironmental remains there was also some potential for additional, as yet unknown remains associated with the former use/ exploitation of the channel to be present.

3.0 AIMS AND OBJECTIVES

3.1 Aims

The general aim of the work was:

- to preserve by record potential archaeological remains that will be impacted by the proposed scheme, the presence and nature of which could not be established (or not established with sufficient clarity) in advance of the development

- to confirm and corroborate the results of previous archaeological survey

- to contribute archaeological information to the key research topics identified in the regional research framework

The specific aims of the investigation were:

- to determine the location, natures, extent, date, condition, state of preservation, significance and complexity of archaeological and palaeoenvironmental remains

- to determine the likely range, quality and quantity of artefactual and environmental evidence present

3.2 Objectives

In the event of significant discoveries this report would have highlighted appropriate research aims for any further work in line with those laid out in *Research and Archaeology: a Framework for the Eastern Counties, 2. Research agenda and strategy* (Brown and Glazebrook 2000). Although the works have identified a well preserved organic floodplain sequence which has not previously been recorded in this part of the Stour valley the results of the evaluation do not directly contribute to regional research objectives set out in the regional research framework, and further specialist assessment of the samples is not recommended. They do however provide a snapshot of the environment in the Stour valley which will provide information against which other archaeological works elsewhere in the valley can be compared.

4.0 METHODOLOGY

The recovery and in-situ assessment/ logging of 10 sleeved cores, sunk in three transects across Area A, was undertaken by Dr Peter Allen (independent consultant) and the results are summarised in this report. Transect A extended from north to south across the area in which peat had previously been located. Transect B lay to the west of Transect A and extended from northeast to southwest across the former course of the river where it is presumed to have been flowing from north to south. Transect C lay to the west of this.

Three of the recovered cores were retained intact and submitted to Quaternary Scientific (QUEST) for full palaeoenvironmental assessment laboratory examination (section 6.0, below), two from Transect A (Boreholes <BH1a> and <BH2>) and one from Transect B (Borehole <BH1>). Radiocarbon dating was carried out on one of the cores.

The archaeological fieldwork was carried out in accordance with the Institute of Field Archaeologists *Standards and Guidance for Archaeological Excavation* (IFA 2008) and the Association of Local Government Officers' *Standards for Field Archaeology in the East of England* (Gurney 2003). The ECC FAU uses its own recording system.

5.0 GEOARCHAEOLOGICAL ASSESSMENT by Dr Peter Allen

Ten boreholes were sunk to a depth of 4.0 m (except Transect C, <BH 2>, ended at 3.0 m). The location of the boreholes are shown on Figure 1 and descriptions of the borehole logs are presented as Appendix 1.

Gravel or sandy gravel was encountered throughout the area surveyed, usually at a depth between 3.0 and 4.0 m below ground surface (bgs), but in Transect A, <BH 4> and Transect C, <BH 1> it occurred between 2.0 and 3.0 m bgs and in Transect B, <BH3> and Transect C, <BH2> between 1.0 and 2.0 m bgs. Thus the gravel surface undulates.

Overlying the gravels, the sediments are usually sandy though there is much silt or clay, often humic or with plant macro remains. This material was occasionally shelly, sometimes richly so. A similar pattern was recorded in the Birmingham Archaeo-Environmental report (2010).

The gravels represent a high-energy period of deposition, possibly during the late Pleistocene or Early Holocene, but a later period could not be ruled out. The sands, silts and clays are a typical alluvial assemblage of a meandering river system, with a multitude of micro-environments such as mid-channel bars and point bars made of gravel, sand in the main channel and silts and clays in pools and quiet backwaters. Further information on the environment can be found in the environmental assessment report (Section 6.0, below).

No Palaeolithic or later archaeological material was observed during the coring.

6.0 ENVIRONMENTAL ARCHAEOLOGICAL ASSESSMENT

By D.S. Young, C.P. Green and P.J. Austin; Quaternary Science (Quest)

6.1 Introduction

This report summarises the findings arising out of the environmental archaeological assessment undertaken by Quaternary Scientific (University of Reading) . Cores from three boreholes were selected for detailed laboratory examination, two from Transect A (Boreholes <BH1> and <BH2>) and one from Transect B (Borehole <BH1>).

The aim of this environmental archaeological assessment was to evaluate the potential of the sedimentary sequences for reconstructing the environmental history of the site and its environs and specifically to: (1) identify evidence of change or continuity through time; (2) establish whether any significant spatial variability exists across the site, and (3) to detect evidence of human activity. In order to achieve this aim, the environmental archaeological assessment consisted of the following techniques:

1. Recording the lithostratigraphy of the selected boreholes to provide a preliminary reconstruction of the sedimentary history
2. Carrying out organic matter content determinations to enhance the results of the sedimentary descriptions
3. Radiocarbon dating of identified plant macrofossils to provide a provisional geochronological framework for the natural stratigraphic sequence
4. Assessment of the preservation and concentration of pollen grains and spores to provide a preliminary reconstruction of the vegetation history, and to detect evidence for human activities e.g. woodland clearance and cultivation
5. Assessment of the preservation and concentration of diatom frustules to provide a preliminary reconstruction of the hydrological history e.g. water quality and depth
6. Assessment of the preservation and concentration of macroscopic plant, insect and Mollusca remains from small bulk samples to provide a preliminary reconstruction of the vegetation history and general environmental context of the site.

6.2 Methods

Lithostratigraphic descriptions

Three boreholes were selected for detailed laboratory examination, two from Transect A (Boreholes <BH1> and <BH2>) and one from Transect B (Borehole <BH1>). These were 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). The procedure involved: (1) cleaning the samples with a spatula or scalpel blade and distilled water to remove surface contaminants; (2) recording the physical properties, most notably colour using a Munsell Soil Colour Chart; (3) recording the composition (e.g. gravel, fine sand, silt and clay); (4) recording the degree of peat humification and (5) recording the unit boundaries e.g. sharp or diffuse. The results are illustrated in Figure 2, with the descriptions presented in Tables 1 to 3.

Organic matter determinations

Twenty-three sub-samples from Transect B Borehole <BH1> were taken for determination of the organic matter content (Table 4; Figure 2). 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 110^0C 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 (see Bengtsson and Enell, 1986).

Radiocarbon dating

Seeds were extracted from two small bulk samples from the top and base of the peat in Transect B Borehole <BH1> for radiocarbon dating. Following identification of terrestrial seed remains suitable for radiocarbon dating, both samples were submitted for AMS radiocarbon dating to Beta Analytic INC, Radiocarbon Dating Laboratory, Florida, USA. The results have been calibrated using OxCal v4.0.1 Bronk Ramsey (1995, 2001 and 2007) and IntCal04 atmospheric curve (Reimer et al., 2004). The results are displayed in Table 5.

Pollen assessment

Twelve sub-samples from Transect B Borehole <BH1> were extracted for an assessment of pollen content. The pollen was extracted as follows: (1) sampling a standard volume of sediment (1ml); (2) adding two tablets of the exotic clubmoss *Lycopodium clavatum* to provide a measure of pollen concentration in each sample; (3) deflocculation of the sample in 1% Sodium pyrophosphate; (4) sieving of the sample to remove coarse mineral and organic fractions (>125µ); (5) acetolysis; (6) removal of finer minerogenic fraction using Sodium polytungstate (specific gravity of 2.0g/cm^3); (7) mounting of the sample in glycerol jelly. Each stage of the procedure was preceded and followed by thorough sample cleaning in filtered distilled water. Quality control is maintained by periodic checking of residues, and assembling sample batches from various depths to test for systematic laboratory effects. Pollen grains and spores were identified using the University of Reading pollen type collection and the following sources of keys and photographs: Moore *et al* (1991); Reille (1992). The assessment procedure consisted of scanning the prepared slides, and recording the concentration and preservation of pollen grains and spores, and the principal taxa on four transects (10% of the slide) (Table 6).

Diatom assessment

Six sub-samples from Transect B Borehole <BH1> were extracted for the assessment of diatoms. The diatom extraction involved the following procedures (Battarbee *et al.,* 2001):

1. Treatment of the sub-sample (0.2g) with Hydrogen peroxide (30%) to remove organic material and Hydrochloric acid (50%) to remove remaining carbonates
2. Centrifuging the sub-sample at 1200 for 5 minutes and washing with distilled water (4 washes)
3. Removal of clay from the sub-samples in the last wash by adding a few drops of Ammonia (1%)
4. Two slides prepared, each of a different concentration of the cleaned solution, were fixed in mounting medium of suitable refractive index for diatoms (Naphrax)

Duplicate slides each having two coverslips were made from each sample and fixed in Naphrax for diatom microscopy. The coverslip with the most suitable concentration of the sample preparation was selected for diatom evaluation. A large area of this coverslip was scanned for diatoms at magnifications of x400 and x1000 under phase contrast illumination using a Leica microscope.

The results of the diatom assessment are displayed in Table 7.

Macrofossil assessment

A total of ten small bulk samples from Transect B Borehole <BH1> were extracted for the recovery of macrofossil remains including waterlogged plant macrofossils, waterlogged wood, insects and Mollusca. The extraction process involved the following procedures: (1) removing a sample up to 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).

Preliminary identifications of the archaeobotanical remains (waterlogged plant macrofossils and wood), have been made using modern comparative material and reference atlases (Cappers *et al.* 2006, Hather 2000, Schweingruber 1990, Schoch *et al*. 2004). Nomenclature used follows Stace (2005). The quantities of waterlogged seeds and wood were recorded for each sample, with identifications of the main taxa

(Tables 9 and 10). Preliminary identifications of the Mollusca remains were made under a low powered stereo-microscope, and the concentration and state of preservation of each noted (Table 11). Identification and interpretation was based on modern comparative material and reference atlases (e.g. Kerney and Cameron, 1979; Kerney, 1999).

6.3 Results and Interpretation of the Lithostratigraphic Descriptions and Organic Matter Content Determinations

The results of the lithostratigraphic description of boreholes <BH1> and <BH2> from Transect A, and borehole <BH1> from Transect B are displayed in Tables 1 to 3 and Figure 2. The sediment sequences recorded in the laboratory are broadly similar to the sequences recorded in the field in the earlier phase of investigation. Greyish brown and yellowish brown soil horizons passed down in all three boreholes into grey and dark brown more or less peaty organic silts. Richly organic horizons were recorded between 54.13m and 52.53m OD in Transect A <BH1>, between 53.51m and 51.99m OD in Transect A <BH2> and between 54.16 and 51.75m OD in Transect B <BH1>.

In detail, the organic sediments recorded in both the boreholes from Transect A consisted almost entirely of very dark grey or very dark brown silts and sands incorporating large amounts of detrital plant material. The only peat was a thin (30mm) horizon in Transect A <BH1> between 53.82 and 53.79m OD. In Transect B <BH1> a more substantial bed of peat was present between 54.00 and 53.12m OD (20-30% organic matter), but even here, some mineral sediment was present throughout most of the thickness of the peat.

Mollusc shell including complete individual gastropods and complete valves of bivalves was present throughout these richly organic horizons and in Transect B <BH1> bivalves with conjoined valves were preserved. Broken mollusc shell and detrital plant remains were also present in the upper part of all the sediment sequences in the more oxidised silts forming the soil horizons. Wood fragments were present in Transect A <BH2> and Transect B <BH1>, and insect remains were noted in Transect B <BH1>. In addition, in microscopic examination of small samples of organic sands from Transect B <BH1>, small bone fragments were recorded and numerous calcareous worm granules.

Material of anthropogenic derivation was present in all three boreholes in the organic silts and sands forming the lower part of the sediment sequences. Particles of CBM were noted in all three boreholes and had been noted in the field descriptions of the

sediments during the earlier borehole investigations. Charcoal was recorded in Transect A <BH1> and Transect B <BH1>, and in Transect A <BH1> a fragment of dark grey pottery rim was recorded. A single sharp flint flake (30mm) was recorded in Transect B <BH1> and several small (<5mm) sharp flint flakes in Transect A <BH2>. No anthropogenic material apart from charcoal was noted in the upper oxidised horizons in any of the boreholes.

The sands and silts present in all three boreholes and incorporating a variety of organic remains are sediments typical of deposition in an active river channel, particularly where meandering channel form offers a diversity of very localised depositional environments in which organic material can accumulate together with the mineral sediment. In Transect B the sands and silts were not bottomed but in Transect A they were seen to rest on gravel. In all three boreholes, the organic sands and silts were overlain by poorly sorted yellowish brown stoneless clayey sands in which organic material was relatively scarce.

This sequence of sediments passing up from gravel to organic sands and silts overlain by less organic sediments is characteristic of many valley floors in lowland southern Britain. The gravel can usually be related to conditions at the end of the last (Devensian) glaciation or early in the Holocene. Organic sands and silts often represent deposition in the Early to Mid Holocene prior to the intensification of land-use in the late prehistoric period. An upper horizon of fine grained sediment relatively free of organic remains can usually be related to deposition on the floodplain reflecting increased sediment availability resulting from soil degradation associated with the intensification of agricultural land-use. Nevertheless, in-channel deposition necessarily continued throughout the historic period and up to the present day. However, because channels stabilised in the latter part of the Holocene with little channel migration taking place, there was continuous turn-over of in-channel sediment, and well preserved sediment sequences of historic period age are therefore relatively uncommon. The poorly sorted clayey sediments overlying the organic silts and sands are probably related to the stoney yellow-brown clays recorded in several boreholes on the floodplain in the preliminary borehole investigation. This sediment seems more likely to be predominantly colluvial in origin rather than water-laid, but it may also incorporate material deposited from floodwater.

This is a well preserved organic floodplain sequence of historic period age. Such evidence has not previously been recorded in this part of the Stour valley and is not particularly common elsewhere in lowland Britain for the reasons noted above.

Transect A

Table 1: Lithostratigraphic description of Transect A Borehole <BH1>

Depth (m OD)	Depth (m bgs)	Description
55.79 to 55.42	0.00 to 0.37	void
55.42 to 55.11	0.37 to 0.68	*soil A horizon* 10YR2/3 very dark greyish brown; poorly sorted gritty sandy clay/clayey sand with granules; crumby; common root channels and root remains; common detrital plant remains; scattered broken mollusc shell; scattered charcoal particles; strong acid reaction; gradual transition to:
55.11 to 54.79	0.68 to 1.00	*soil B horizon* 10YR5/4 yellowish brown; moderately sorted sandy clay; scattered root channels and root remains; scattered detrital plant remains; scattered broken mollusc shell; scattered charcoal particles; strong acid reaction.
54.79 to 54.76	1.00 to 1.03	void
54.76 to 54.27	1.03 to 1.52	*soil B horizon* 2.5Y5/2 greyish brown mottled 7.5YR5/6 strong brown; well sorted sandy silt; massive; common iron-stained root channels with scattered root remains; scattered detrital plant remains; scattered mollusc remains including complete gastropod shells; very scattered small charcoal particles; weak acid reaction; gradual transition, probably mainly colour due to downward penetration of oxidising conditions, gradual transition to:
54.27 to 54.13	1.52 to 1.66	Gley 1 10Y4/1 dark greenish grey; very well sorted silt; massive; root channels including *in situ* sub-vertical examples; common detrital plant remains; common mollusc remains with complete gastropod shells including *Bithynia tentaculata*; no acid reaction; gradual transition to:
54.13 to 53.82	1.66 to 1.97	5Y3/1 very dark grey; well sorted peaty and slightly sandy silt; massive; scattered root channels and root remains including *in situ* vertical examples; common detrital plant remains; common worm granules; scattered mollusc remains, broken shell; no acid reaction; well-marked transition to:
53.82 to 53.79	1.97 to 2.00	10YR2/2 very dark brown; sandy peat.
53.79 to 53.68	2.00 to 2.11	10YR2/2 very dark brown; poorly sorted peaty sand with fine gravel (up to 15mm); massive; very common detrital plant remains; scattered broken mollusc shell; scattered small particles of CBM; moderate acid reaction; very sharp contact with:
53.68 to 53.63	2.11 to 2.15	piece of wood; very sharp contact with:
53.63 to 52.79	2.15 to 3.00	10YR2/2 very dark brown; poorly sorted peaty sandy silt including a well-rounded pebble of

		metamorphic rock (60mm) at 2.19 to 2.25; massive with some sub-horizontal partings near bottom; very common detrital plant remains; scattered broken mollusc shell; piece of charred? wood (12mm) at 2.74; scattered small particles of CBM; piece of rim of flint-tempered dark grey pottery at 2.83; moderate acid reaction.
52.79 to 52.53	3.00 to 3.26	10YR2/2 dark brown; alternations of silt, silty peat and silty sand; predominantly peat 3.04 to 3.12, predominantly sand 019 to 024; crude bedding; common detrital plant remains; strong acid reaction; sharp contact with:
52.53 to 52.09	3.26 to 3.70	10YR4/2 dark greyish brown; incoherent poorly sorted silty sandy gravel of sub-angular flint (up to 60mm) and well-rounded quartz; well-marked transition to:
52.09 to 51.79	3.70 to 4.00	7.5YR5/8 strong brown; incoherent poorly sorted clayey sandy gravel (up to 50mm).

Table 2: Lithostratigraphic description of Transect A Borehole <BH2>

Depth (m OD)	**Depth (m bgs)**	**Description**
55.80 to 55.63	0.00 to 0.17	void
55.63 to 55.27	0.17 to 0.53	*soil A horizon* 10YR3/2 very dark greyish brown; poorly sorted gritty clayey sand with granules; crumby; root channels and faunal burrows; common root remains; scattered detrital plant remains; scattered broken mollusc shell; common charcoal particles; insect remains; strong acid reaction; grit, shell and charcoal content increases downward to maximum at 0.37 to 0.38, decreasing again below this level; gradual transition to:
55.27 to 55.12	0.53 to 0.68	*soil B horizon* 10YR4/4 dark yellowish brown; moderately sorted clayey sand; blocky; scattered root channels and root remains; scattered detrital plant remains; scattered broken mollusc shell; charcoal particles; strong acid reaction; gradual transition to:
55.12 to 54.80	0.68 to 1.00	10YR5/4 yellowish brown; moderately sorted sandy clay; massive; scattered root channels and root remains; scattered detrital plant remains; scattered finely divided mollusc shell; strong acid reaction.
54.80 to 54.35	1.00 to 1.45	void
54.35 to 53.80	1.45 to 2.00	10YR5/4 yellowish brown with 2.5YR4/6 red mottling variable in density and intensity of colour with some associated manganese; very well sorted silt; massive; scattered finely divided mollusc shell; scattered charcoal particles; weak acid reaction.
53.80 to 53.69	2.00 to 2.11	void
53.69 to 53.51	2.11 to 2.29	5Y4/2 olive grey; well sorted slightly sandy silt;

		massive; common detrital plant remains; finely divided mollusc shell; weak acid reaction; gradual transition to:
53.51 to 53.01	2.29 to 2.79	Black; very well sorted organic silt with peaty inclusions and thin sandy horizons at 2.51, 2.66 and 2.73; very common detrital plant remains; small (10mm) pieces of wood; common mollusc shell including complete gastropods and bivalve valves; strong acid reaction; well-marked transition to:
53.01 to 52.90	2.79 to 2.90	5Y4/2 olive grey; very well sorted silt; massive; common detrital plant remains; common mollusc shell including complete individuals; strong acid reaction; well-marked transition to:
52.90 to 52.80	2.90 to 3.00	10YR4/1 dark grey; poorly sorted gritty silt with granules of chalk and flint; massive; common detrital plant remains; common mollusc shell including complete individuals; moderate acid reaction.
52.80 to 52.22	3.00 to 3.58	void
52.22 to 52.11	3.58 to 3.69	10YR2/2 very dark brown; poorly sorted medium to coarse sand with clasts of sub-angular flint up to 10mm and an irregular mass of pale coloured silty fine sand at 3.64 to 3.66; massive; very common detrital plant remains; round wood (12mm Ø); very common mollusc shell; scattered finely divided CBM; scattered small (<5mm) sharp flint flakes; strong acid reaction; well-marked transition to:
52.11 to 51.99	3.69 to 3.81	10YR4/3 brown; poorly sorted slightly silty sandy gravel with clasts of sub-angular flint up to 50mm and clasts of tufa up to 30mm, tufa most common immediately below the contact with the overlying sub-unit, becoming less common downward; massive; common detrital plant remains; strong acid reaction; well-marked transition to:
51.99 to 51.80	3.81 to 4.00	10YR6/8 brownish yellow; poorly sorted clayey sandy gravel of sub-angular and well-rounded flint up to 55mm; massive; strong acid reaction.

Transect B

Table 3: Lithostratigraphic description of Transect B Borehole <BH1>

Depth (m OD)	Depth (m bgs)	Description
55.75 to 55.60	0.00 to 0.15	void
55.60 to 55.26	0.15 to 0.49	*soil A horizon* 10YR3/2 very dark greyish brown; poorly sorted gritty sandy clay/clayey sand with granules and a paler more clayey horizon at 0.37 to 0.41; crumby; root channels with common root remains; scattered detrital plant remains; scattered broken mollusc shell, more common in paler horizon at 0.37 to 0.41; scattered charcoal particles; strong acid reaction; gradual transition to:
55.26 to 55.02	0.49 to 0.73	*soil A horizon* 10YR4/4 dark yellowish brown; moderately sorted sandy clay; blocky with weakly developed sub-horizontal partings; root channels and scattered root remains; common mollusc shell; scattered charcoal particles; strong acid reaction; gradual transition to:
55.02 to 54.75	0.73 to 1.00	*soil B horizon* 10YR5/4 yellowish brown with iron-rich mottles increasingly common downward; massive; scattered root channels and root remains; scattered detrital plant remains; scattered mollusc shell; scattered charcoal particles; strong acid reaction.
54.75 to 54.67	1.00 to 1.08	void
54.67 to 54.16	1.08 to 1.59	5Y5/1 grey and 10YR5/4 yellowish brown; well sorted silty clay slightly sandy becoming less sandy downward; blocky/crumby above becoming increasingly massive downward; common detrital plant remains; common broken mollusc shell; weak acid reaction; well-marked transition to:
54.16 to 54.00	1.59 to 1.75	Gley 1 10Y3/1 very dark greenish grey; very well sorted silt with sub-angular flint clast (60mm +) at 1.59 to 1.63; massive; common detrital plant remains; common mollusc shell; no acid reaction; well-marked transition to:
54.00 to 53.75	2.75 to 2.00	10YR2/2 very dark brown; peat.
53.75 to 53.54	2.00 to 2.21	void
53.54 to 53.12	2.21 to 2.63	10YR2/2 very dark brown; peat with sandy horizons; most compact and least sandy in uppermost 10cm, sand present throughout but concentrations visible to the naked eye at 2.33, and 2.54; mollusc shell in sand at 054; sharp contact with:
53.12 to 52.93	2.63 to 2.82*	10YR3/2 very dark greyish brown; poorly sorted peaty sand with flint granules; massive; very common detrital plant remains; very common complete and broken mollusc shells, both gastropods and bivalves including examples with conjoined valves and opercula of *Bithynia tentaculata*; small (<3mm) chips of bone; finely

		divided charcoal; scattered small particles of CBM; moderate acid reaction; sharp contact with:
52.93 to 52.75	2.82 to 3.00*	2.5Y4/2 dark greyish brown; moderately sorted fine to medium sand with small (10mm) clasts of sub-angular flint and chalk especially immediately below the overlying sub-unit; massive; very common detrital plant remains; wood fragments up to 5mm; worm granules; very common broken mollusc shell with complete gastropods and bivalve valves and opercula of *B.tentaculata*; scattered insect remains; scattered particles of CBM, more common than in overlying sub-unit; sharp flake of flint (30mm); piece of baked clay with ? fused sand adhering to it.

**small sub-samples of these sub-units were examined using a low-power binocular microscope.*

Quantification of the organic matter content by Loss-on-Ignition of Transect B <BH1> allowed further detail to be added to the lithostratigraphic descriptions (Table 4; Figure 2). The results revealed that the highest organic matter values were recorded within the peat unit as expected (between 20 and 30%); elsewhere, including in the underlying sandy gravel and clayey silts overlying the peat, values were generally less than 10%. These results confirm the records from the sedimentary descriptions, but indicate that frequent influxes of mineral-rich sediment took place during the period of peat formation.

Table 4: Results of the organic matter determinations of Transect B Borehole <BH1>

Depth (m OD)		**Depth (m bgs)**		**Organic matter (%)**
From	**To**	**From**	**To**	
54.67	54.66	1.08	1.09	6.1
54.60	54.59	1.15	1.16	6.6
54.52	54.51	1.23	1.24	5.2
54.44	54.43	1.31	1.32	5.1
54.36	54.35	1.39	1.40	5.9
54.28	54.27	1.47	1.48	5.6
54.20	54.19	1.55	1.56	5.8
54.12	54.11	1.63	1.64	7.8
54.04	54.03	1.71	1.72	11.2
53.96	53.95	1.79	1.80	23.4
53.88	53.87	1.87	1.88	19.8
53.80	53.79	1.95	1.96	18.4
53.55	53.54	2.20	2.21	22.7
53.48	53.47	2.27	2.28	24.0
53.40	53.39	2.35	2.36	12.3
53.32	53.31	2.43	2.44	7.1
53.24	53.23	2.51	2.52	8.5
53.16	53.15	2.59	2.60	13.8
53.08	53.07	2.67	2.68	5.1
53.00	52.99	2.75	2.76	9.8
52.92	52.91	2.83	2.84	1.9
52.84	52.83	2.91	2.92	1.1
52.76	52.75	2.99	3.00	1.6

6.4 Results and Interpretation of The Radiocarbon Dating

Terrestrial seeds from the top (54.00 to 53.97m OD) of the peat in Transect B Borehole <BH1> have been radiocarbon dated to 790 to 690 cal. yr BP (cal. AD 1160 to 1260), and terrestrial seeds from the base (53.15 to 53.10m OD) of the peat have been dated to 1170 to 990 cal. yr BP (cal. AD 780 to 960).

The δ13C (‰) values are consistent with that expected for peat sediment, and there is no evidence for mineral or biogenic carbonate contamination. The dates indicate that the accumulation of the peat occurred over a period of between ca. 370 and 570 years, during the Early and High Middle Ages.

Table 5: Results of the radiocarbon dating of Transect B Borehole <BH1>

Laboratory code / Method	**Borehole number**	**Material and location**	**Depth (m OD)**	**Uncalibrated radiocarbon years before present (yr BP)**	**Calibrated age BC/AD (BP) (2-sigma, 95.4% probability)**	**δ13C (‰)**
BETA-301110-AMS	Transect B <BH1>	Apiaceae seeds; top of peat	54.00 to 53.97	840 +/- 30 BP	Cal AD 1160 to 1260 (Cal BP 790 to 690)	-26.2
BETA-301111-AMS	Transect B <BH1>	Apiaceae, *Sambucus nigra*/*racemosa*, *Rumex*/*Polygonum* sp. seeds; base of peat	53.15 to 53.10	1170 +/- 30 BP	Cal AD 780 to 900 (Cal BP 1170 to 1050) or Cal AD 920 to 960 (Cal BP 1040 to 990)	-27.1

6.5 Results and Interpretation of the Pollen Assessment

Twelve sub-samples from Transect B Borehole <BH1> were extracted for an assessment of pollen content (Table 6). The results of the pollen assessment indicate that pollen was present in low concentrations in the nine samples extracted from the most organic horizons associated with the peat described in Table 3 and Figure 4; with the exception of one sample (53.55 to 53.54m OD) which contained moderate quantities of pollen. In these samples the assemblage was dominated by herbaceous taxa including Cyperaceae (sedge family), Lactuceae (dandelion family), Poaceae (grass family) and *Sinapis* type (e.g. charlock). The aquatic taxon *Typha latifolia* (bulrush) was present in two samples (53.55 to 53.54 and 53.48 to 53.47m OD). Tree and shrub taxa were rare, but included *Alnus* (alder) and *Corylus* type (e.g. hazel). This assemblage is indicative of a disturbed, damp open environment typical of a floodplain, dominated by herbaceous taxa including sedges, grasses, dandelion and charlock. The presence of the aquatic bulrush in two horizons is indicative of a period of increased wetness around this time.

The pollen concentration and preservation of the three samples from the organic sand underlying the peat was moderate. The assemblage was dominated by herbaceous taxa including Poaceae (grass family), Cyperaceae (sedge family) and Apiaceae (carrot family). Aquatic taxa were present and included *Typha latifolia* (bulrush) and *Potamogeton* (pondweed). Tree and shrub taxa were limited, but included *Quercus* (oak), *Salix* (willow) and *Corylus* type (hazel). This assemblage is indicative of a wet, open environment typical of a wetter area of a floodplain, dominated by herbaceous and aquatic vegetation.

Micro-charcoal was present in low to moderate concentrations in all samples.

Table 6: Results of the pollen assessment of Transect B borehole <BH1.

Depth (m OD)		**Main pollen taxa**			**Concentration 0 - 5**	**Preservation 0- 5**	**Microcharcoal 0 - 5**
From	**To**	**Latin name**	**Common name**	**Number of grains**			
54.04	54.03	Cyperaceae Lactuceae *Lycopodium clavatum*	sedge family dandelion family clubmoss spike	2 1 12	1	1	2
53.96	53.95	cf. *Alnus* Lactuceae *Lycopodium clavatum*	alder dandelion family clubmoss spike	1 1 18	1	1	2
53.88	53.87	*Lycopodium clavatum*	clubmoss spike	19	0	-	2
53.80	53.79	*Alnus* Cyperaceae Lactuceae *Lycopodium clavatum*	alder sedge family dandelion family clubmoss spike	2 1 1 20	1	2	2
53.55	53.54	Cyperaceae *Sinapis* type Lactuceae *Typha latifolia* *Lycopodium clavatum*	sedge family e.g. charlock dandelion family bulrush clubmoss spike	2 1 1 1 27	2	3	2
53.48	53.47	*Typha latifolia* *Lycopodium clavatum*	bulrush clubmoss spike	1 23	1	2	2
53.40	53.39	Cyperaceae *Lycopodium clavatum*	sedge family clubmoss spike	1 30	1	2	1
53.32	53.31	*Corylus* type Poaceae *Lycopodium clavatum*	e.g. hazel grass family clubmoss spike	1 1 18	1	2	2
53.24	53.23	Poaceae Cyperaceae *Corylus* type *Lycopodium clavatum*	grass family sedge family e.g. hazel clubmoss spike	1 2 1 10	1	2	2

Depth (m OD)		**Main pollen taxa**			**Concentration 0 - 5**	**Preservation 0- 5**	**Microcharcoal 0 - 5**
From	**To**	**Latin name**	**Common name**	**Number of grains**			
53.16	53.15	Poaceae	grass family	6	3	3	2
		Apiaceae	carrot family	4			
		Corylus type	e.g. hazel	3			
		Typha latifolia	bulrush	1			
		Lycopodium clavatum	clubmoss spike	31			
53.08	53.07	*Quercus*	oak	1	3	3	1
		Poaceae	grass family	2			
		Corylus type	e.g. hazel	1			
		Cyperaceae	sedge family	3			
		Typha latifolia	bulrush	1			
		Unknown/unidentified	-	1			
		Lycopodium clavatum	clubmoss spike	9			
53.00	52.99	Poaceae	grass family	3	3	2	2
		Cyperaceae	sedge family	1			
		Potamogeton	pondweed	2			
		Corylus type	e.g. hazel	1			
		Salix	willow	1			
		Unknown/unidentified	-	2			
		Lycopodium clavatum	clubmoss spike	28			

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 = none, 1 = very poor, 2 = poor, 3 = moderate, 4 = good, 5 = excellent
Charcoal: 0 = none, 1= negligible, 2 = occasional, 3 = moderate, 4 = frequent, 5 = abundant

6.6 Results and Interpretation of the Diatom Assessment

Six sub-samples were taken from Transect B Borehole <BH1> for the assessment of diatoms. The results of are displayed in Table 7. Of the six samples, only two contained diatoms (54.04 to 54.03 and 53.96 to 53.95m OD). Of these only one, at the interface between the silt and top of the peat (53.96 to 53.95m OD), contained enough diatoms for a full percentage count. A number of factors influence diatom preservation, and it is probable that in the sediments examined here diatom concentrations were always low and that post-depositional destruction of the frustules has occurred due to drying-out, abrasion and possibly unfavourable chemical conditions. Dissolution of the diatom silica, for example, can occur as a response to the ambient dissolved silica concentration, the pH in open water, and the interstitial water in sediments. Using both fossil and modern diatoms, these and other environmental factors have been shown to affect the quality of preservation of assemblages (Flower, 1993; Ryves *et al*., 2001).

Table 7: Summary diatom assessment results of Transect B borehole <BH1>

Depth (m OD)		**Diatom concentration**	**Quality of preservation**	**Diversity**	**Potential for % count**
From	**To**				
54.12	54.11	Extremely low	Very poor	Very low	None
54.04	54.03	Low	Poor	Low	Low
53.96	53.95	High	Moderate	High	Good
53.16	53.15	Extremely low	Very poor	Very low	None
53.08	53.07	Extremely low	Very poor	Very low	None
53.00	52.99	Extremely low	Very poor	Very low	None

6.7 Results and Interpretation of the Macrofossil Assessment

A total of ten small bulk samples from Transect B <BH1> 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 sections of the borehole only.

The results of an initial assessment indicated that fragments of charcoal were present in nine of the ten samples, eight of which were identifiable (>2mm in diameter), while charred plant remains (seeds and chaff) were present in three samples. Waterlogged wood was present in nine of the ten samples, while all ten contained waterlogged seeds. Mollusca remains were present in eight of the samples, seven of which contained well-preserved whole Mollusca. Fragments or small bones were present in four samples, while anthropogenic material was found in three samples. Insects were recorded in low quantities in four of the ten samples assessed.

Table 8: Results of the macrofossil assessment of Transect B borehole <BH1>

				Charred					Waterlogged		Mollusca		Bone				
Depth (m OD)	Volume sampled (l)	Volume processed (l)	Fraction (e.g. flot, residue, >300µm)	Charcoal (>4mm)	Charcoal (2-4mm)	Charcoal (<2mm)	Seeds	Chaff	Wood	Seeds	Whole	Fragments	Large	Small	Fragments	Insects	Anthropogenic material
54.10 to 54.00	0.3	0.3	>1mm	1	1	1	-	-	1	1	1	2	-	1	-	-	-
			>300µm	-	-	1	-	-	-	-	-	3	-	-	-	-	-
54.00 to 53.97	0.1	0.1	>1mm	-	-	-	-	-	-	1	-	-	-	-	-	-	-
			>300µm	-	-	1	-	-	-	1	-	-	-	-	-	-	-
53.95 to 53.85	0.25	0.25	>1mm	-	-	-	-	-	1	3	1	1	-	-	-	-	-
			>300µm	-	-	-	-	-	-	1	-	1	-	-	-	-	-
53.85 to 53.75	0.35	0.35	>1mm	-	1	1	-	1	1	1	-	-	-	-	-	-	-
			>300µm	-	-	-	-	-	-	-	-	-	-	-	-	-	-
53.55 to 53.45	0.3	0.3	>1mm	-	1	-	-	-	1	3	1	-	-	-	-	1	-
			>300µm	-	-	-	-	-	-	5	-	-	-	-	-	-	-
53.45 to 53.35	0.25	0.25	>1mm	-	1	2	1	1	1	4	2	2	-	1	1	-	-
			>300µm	-	-	1	-	-	-	3	-	2	-	-	-	-	1

	Charred	Waterlogged	Mollusca	Bone

Depth (m OD)	Volume sampled (l)	Volume processed (l)	Fraction (e.g. flot, residue, >300µm)	Charcoal (>4mm)	Charcoal (2-4mm)	Charcoal (<2mm)	Seeds	Chaff	Wood	Seeds	Whole	Fragments	Large	Small	Fragments	Insects	Anthropogenic material
53.35 to 53.25	0.3	0.3	>1mm	-	1	1	1	-	1	3	1	1	-	-	-	-	1
			>300µm	-	-	-	-	-	-	-	-	-	-	-	-	1	-
53.25 to 53.15	0.3	0.3	>1mm	1	1	1	-	-	3	4	1	1	-	1	-	1	-
			>300µm	-	-	2	-	-	-	-	-	4	-	-	-	1	-
53.15 to 53.12	0.1	0.1	>1mm	1	1	1	-	-	1	1	-	1	1	-	-	-	-
			>300µm	-	-	-	-	-	-	-	-	-	1	-	-	-	-
53.12 to 53.02	0.3	0.3	>1mm	1	2	1	-	-	2	5	2	3	-	-	-	1	1
			>300µm	-	-	2	-	-	-	-	-	5	-	-	-	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+

6.8 Results of the Plant Macrofossil Assessment (Seeds and Wood)

The results of the macrofossil rapid assessment indicated that waterlogged wood was present in nine samples, all ten contained waterlogged seeds and eight contained charcoal >2mm in diameter; thus all ten underwent a more detailed assessment. The results of the Transect B Borehole <BH1> plant macrofossil (seeds and wood) assessment are displayed in Tables 9 and 10.

Waterlogged seeds were present in low to moderate quantities in the four uppermost samples from Transect B <BH1> (54.10 to 53.75m OD). The assemblage in these four samples was dominated by herbaceous taxa including *Ranunculus* cf. *repens* (cf. creeping buttercup), *Rumex*/*Polygonum* sp. (dock/sorrel/knotgrass), Poaceae (grass family), Apiaceae (carrot family) and cf. *Myosotis* sp. (cf. forget-me-not). Tree and shrub taxa were present, and included *Sambucus nigra*/*racemosa* (elder) and *Cornus sanguinea* (dogwood). The assemblage between 54.10 and 53.75m OD is therefore indicative of an open, disturbed environment dominated by herbaceous taxa, bordered by hedgerows of elder and dogwood.

Between 53.75 and 53.35m OD waterlogged seeds were preserved in moderate to high quantities, with an assemblage dominated by aquatic taxa including *Apium nodiflorum* (fool's-water-cress), *Potamogeton* sp. (pondweed) and *Sparganium erectum* (bur-reed). Herbaceous taxa were common, and included Apiaceae (carrot family), *Ranunculus* cf. *repens* (cf. creeping buttercup), *Rumex*/*Polygonum* sp. (dock/sorrel/knotgrass), *Chenopodium* sp. (e.g. fat hen). A charred cereal grain (*Hordeum*/*Triticum* type) was present in the sample from 53.55 to 53.45m OD. Shrub taxa were rare but were represented by *Sambucus nigra*/*racemosa* (elder). This assemblage is indicative of a very damp or wet open environment dominated by aquatic and herbaceous taxa. The presence of a charred cereal grain and disturbed ground taxa is indicative of human activity in the surrounding landscape.

Below 53.35m OD waterlogged seeds were present in moderate to high quantities, and were dominated by herbaceous taxa including *Rumex*/*Polygonum* sp. (dock/sorrel/knotgrass), Apiaceae (carrot family), *Ranunculus* cf. *repens* (cf. creeping buttercup), *Carex* sp. (sedge family), *Chenopodium* sp. (e.g. fat hen) and *Solanum dulcamara* (nightshade). Aquatic taxa were present, and included *Potamogeton* sp. (pondweed), *Sparganium erectum* (bur-reed), *Apium nodiflorum* (fool's-water-cress) and *Nuphar* sp. (water lily). Shrub taxa were rare but included *Sambucus nigra*/*racemosa* (elder) and *Rubus* sp. (e.g. bramble). A charred cereal grain (*Hordeum*/*Triticum* type) was present in the sample from 53.35 to 53.25m OD. This assemblage is indicative of a

damp, open and disturbed environment dominated by herbaceous taxa. The presence of a charred cereal grain and disturbed ground taxa is indicative of human activity in the surrounding landscape. Given the mineral-rich (generally <10% organic matter) nature of the sediment in the organic sand underlying the peat, it is possible that the seed assemblage in this unit is influenced by fluvial processes, and that some of the seeds may be fluvially derived.

Table 9: Results of the waterlogged plant macrofossil (seeds) assessment of Transect B borehole <BH1>

Sample depth (m OD)	**Latin name**	**Common name**	**Number**
54.10 to 54.00	*Sambucus nigra*/*racemosa* *Ranunculus* cf. *repens* *Rumex*/*Polygonum* sp. Poaceae	elder cf. creeping buttercup dock/sorrel/knotgrass grass family	2 6 2 2
54.00 to 53.97	Apiaceae Unidentified nut shell	carrot family -	2 1
53.95 to 53.85	*Sambucus nigra*/*racemosa* *Ranunculus* cf. *repens* *Rumex*/*Polygonum* sp. Apiaceae cf. *Myosotis* sp. *Cornus sanguinea*	elder cf. creeping buttercup dock/sorrel/knotgrass carrot family cf. forget-me-not common dogwood	14 16 9 1 1 1
53.85 to 53.75	*Ranunculus* cf. *repens* *Rumex*/*Polygonum* sp. Unknown/unidentified	cf. creeping buttercup dock/sorrel/knotgrass -	6 5 1
53.55 to 53.45	*Sparganium erectum* *Ranunculus* cf. *repens* *Sambucus nigra*/*racemosa* *Rumex*/*Polygonum* sp. *Apium nodiflorum* Unknown/unidentified	bur-reed cf. creeping buttercup elder dock/sorrel/knotgrass fool's water-cress -	1 3 1 8 53 1
53.45 to 53.35	*Chenopodium* sp. *Hordeum*/*Triticum* type (charred) Apiaceae *Apium nodiflorum* *Sambucus nigra*/*racemosa* *Ranunculus* cf. *repens* *Potamogeton* sp. *Sparganium erectum* *Rubus* sp. *Rumex*/*Polygonum* sp. Unknown/unidentified	e.g. fat hen wheat/barley carrot family fool's water-cress elder cf. creeping buttercup pondweed bur-reed e.g. bramble dock/sorrel/knotgrass -	8 1 11 24 1 4 2 1 1 51 7

Sample depth (m	**Latin name**	**Common name**	**Number**

OD)			
53.35 to 53.25	*Rumex*/*Polygonum* sp. Apiaceae *Apium nodiflorum* *Ranunculus* cf. *repens* *Chenopodium* sp. *Hordeum*/*Triticum* type (charred) *Solanum dulcamara*	dock/sorrel/knotgrass carrot family fool's water-cress cf. creeping buttercup e.g. fat hen wheat/barley nightshade	53 4 1 1 3 1 1
53.25 to 53.15	*Rumex*/*Polygonum* sp. Apiaceae *Potamogeton* sp. *Ranunculus* cf. *repens* *Sparganium erectum* *Chenopodium* sp. *Carex* sp. Unknown/unidentified	dock/sorrel/knotgrass carrot family pondweed cf. creeping buttercup bur-reed e.g. fat hen sedge -	88 39 2 3 1 2 1 1
53.15 to 53.12	Apiaceae *Rumex*/*Polygonum* sp. *Sambucus nigra*/*racemosa*	carrot family dock/sorrel/knotgrass elder	6 6 1
53.12 to 53.02	Apiaceae *Nuphar* sp. *Rumex*/*Polygonum* sp. *Sambucus nigra*/*racemosa* *Ranunculus* cf. *repens* *Potamogeton* sp. *Rubus* sp. *Chenopodium* sp.	carrot family water lily dock/sorrel/knotgrass elder cf. creeping buttercup pondweed e.g. bramble e.g. fat hen	45 7 48 1 8 1 1 1

A total of 55 waterlogged wood and charcoal fragments were examined from eight samples, of which 23 fragments could not be identified. All unidentified fragments, which included fragments of bark from unknown taxa, were recorded as 'indeterminate'. In several instances the identity of a fragment could not be established with certainty. These fragments are indicated by 'cf.' before the name of the taxon most likely to be represented. Most of the fragments examined derived from either twig wood or small branches. The following 9 taxa were identified:

Alnus glutinosa (alder)

Corylus avellana (hazel)

cf. *Ligustrum*/*Lonicera* sp. (privet/honeysuckle)

cf. *Prunus* sp. (blackthorn, cherrries)

Salix/*Populus* sp. (willows/poplars)

Fraxinus excelsior (ash)

cf. *Sambucus nigra* (elder)

Quercus sp. (oak)

cf. *Rhamnus* sp. (buckthorn)

Individual fragments of both charcoal and wood were generally well preserved. Fungal degradation, indicated by the presence of fungal mycelium, was noted in almost every

waterlogged fragment and many of the charred fragments. Most charcoal fragments appeared highly thermally degraded. Typically, diagnostic features were distorted or lacked detail, though none of the fragments appeared fully vitrified. Mineral deposits were also noted within several charcoal fragments. Critically, however, the small dimensions of the fragments provided, especially in transverse section, and that many fragments were from immature wood (1-3 year old twigs), made secure identification difficult or unachievable in several instances. Despite these factors, the taxa that could be identified could represent woods from a range of potential habitat types, including wetland environments or watercourses.

Table 10: Results of the waterlogged plant macrofossil (wood) assessment of Transect B Borehole <BH1>

Depth (m OD)	**Material**	**Identifications (Quantity)**	**Remarks**	**C14**
54.10 to 54.00	Charcoal	*Alnus glutinosa* (1) Indeterminate (1)	- -	Y -
53.85 to 53.75	Wood	Indeterminate (3)	x3 twig, 1-2 growth rings. Diameter 3mm.	-
	Charcoal	*Corylus avellana* (1)	-	Y
53.55 to 53.45	Wood	cf. *Ligustrum*/*Lonicera* (2) Indeterminate (3)	x2 Twig. 5-6 growth rings. Diameter 3-4mm. Twigwood, diameter 2-3mm. Poor condition.	Y -
	Charcoal	Indeterminate (1)	-	-
53.45 to 53.35	Wood	cf. *Ligustrum*/*Lonicera* (2) Indeterminate (3)	Twig/small branch Poor condition	Y -
	Charcoal	cf. *Prunus* sp. (1) Indeterminate (4)	- Poor condition. Including x2 ?bark frags	Y -
53.35 to 53.25	Wood	*Salix*/*Populus* sp. (5)	x5 twigwood.	Y
	Charcoal	Indeterminate (5)	Poor condition. Very small fragments	-
53.25 to 53.15	Wood	*Corylus avellana* (5)	-	Y
	Charcoal	*Fraxinus excelsior* (2) *Corylus avellana* (1) cf. *Sambucus nigra* (1) cf. *Ligustrum*/*Lonicera* (1)	- - - -	- Y Y Y
53.15 to 53.12	Charcoal	*Salix*/*Populus* sp. (2) cf. *Prunus* sp. (1)	- -	Y Y
53.12 to 53.02	Wood	cf. *Ligustrum*/*Lonicera* (3) Indeterminate (2)	- Bark	Y -
	Charcoal	cf. *Ligustrum*/*Lonicera* (1) *Quercus* sp. (1) cf. *Rhamnus* sp. (1) *Salix*/*Populus* sp. (1) Indeterminate (1)	- - - - -	Y - - Y -

6.9 Results and Interpretation of the Mollusca Assessment

The results of the macrofossil rapid assessment indicated that Mollusca remains were present in eight of the samples, seven of which contained well-preserved whole Mollusca. The eight samples underwent a more detailed assessment, the results of the which are displayed in Table 11. As a whole, the samples contained small numbers of small gastropod and bivalve Mollusca. The material was uncorroded but most individual specimens were broken. Five of the eight sub-samples contained only the opercula of *Bithynia tentaculata*. All but one of the sub-samples contained opercula of *B. tentaculata*. This species is widespread in large bodies of slow-moving well-oxygenated hard water including rivers, ponds and lakes, preferably with a muddy bottom and plenty of aquatic vegetation. *Pisidium amnicum* is also widely distributed in rivers and lakes in clean, moderately hard water. *Vallonia* is a terrestrial species preferring dry calcareous grassland habitats.

The samples are too small to draw any firm conclusions about the nature of the water-body inhabited by the Mollusca or the land surfaces in its immediate vicinity, but the indications are of well-oxygenated, hard water in a slow-moving river or a lake, with dry grassland indicated nearby in the uppermost sample.

Table 11: Results of the Mollusca assessment of Transect B Borehole <BH1>

Depth (m OD)		**Mollusca species**	**Number**
From	**To**		
54.10	54.00	*Vallonia* sp.; *Bithynia tentaculata* opercula	1 8
53.95	53.85	*Bithynia tentaculata* operculum	1
53.55	53.45	*Bithynia tentaculata* operculum	1
53.45	53.35	*Bithynia tentaculata* opercula	14
53.35	53.25	*Bithynia tentaculata* opercula	3
53.25	53.15	*Bithynia tentaculata* opercula	20
53.15	53.12	shell fragments of indeterminate small bivalve	-
53.12	53.02	*Pisidium amnicum*; indeterminate small gastropods; *Bithynia tentaculata* opercula	1 - 16

6.10 Discussion and Conclusions

The aim of this environmental archaeological assessment was to evaluate the potential of the three sedimentary sequences for reconstructing the environmental history of the site and its environs, and specifically to: (1) identify evidence of change or continuity through time; (2) establish whether any significant spatial variability exists across the site, and (3) to detect evidence of human activity. The lithostratigraphy of three boreholes (Transect A Boreholes <BH1> and <BH2>, and Transect B <BH1>) was described, and

an assessment of Transect B Borehole <BH1> was carried out since it contained the most substantial bed of peat of the three sequences.

The results of the lithostratigraphic descriptions revealed that the organic sediments recorded in both the boreholes from Transect A consisted almost entirely of very dark grey or very dark brown silts and sands incorporating large amounts of detrital plant material. The only peat was a thin (30mm) horizon in Transect A <BH1>, while in Transect B <BH1> a more substantial bed of peat was present between 54.00 and 53.12m OD. Material of anthropogenic derivation was present in all three boreholes in the organic silts and sands forming the lower part of the sediment sequences.

The three sedimentary sequences examined here are typical of deposition in an active river channel, particularly where meandering channel form offers a diversity of very localised depositional environments in which organic material can accumulate together with the mineral sediment. The combined results of the archaeobotanical (pollen, waterlogged wood and seeds) assessments are indicative of a damp, open and disturbed environment typical of a floodplain dominated by herbaceous vegetation during the accumulation of the peat (54.00 to 53.12m OD) in Transect B Borehole <BH1>. Both the pollen and plant macrofossil records indicate that wetter conditions, largely dominated by aquatic vegetation including bulrush, bur-reed, fool's water-cress and pondweed, persisted during the accumulation of the peat between ca. 53.75 and 53.45m OD. In the organic sand underlying the peat a similarly wet, open and disturbed environment is indicated, dominated by herbaceous and aquatic vegetation including grasses, sedges, dock/sorrel/knotgrass, fat-hen, bulrush, pondweed, bur-reed, fool's-water-cress and water lily. The Mollusca remains in the eight samples from both units are too small to draw any firm conclusions about the nature of the water-body inhabited by the Mollusca, or the land surfaces in its immediate vicinity, but the indications are of well-oxygenated, hard water in a slow-moving river or a lake nearby, with dry grassland indicated in the uppermost sample.

The presence of charred cereals grains, charcoal, charred chaff and other anthropogenic material in the samples from both the peat and the organic sand underlying it are indicative of human activity in the surrounding landscape during the accumulation of both sedimentary units. Radiocarbon dating of the top of the peat (54.00 to 53.97m OD) returned an age of 790 to 690 cal. yr BP (cal. AD 1160 to 1260), while the base of the peat (53.15 to 53.10m OD) was dated to 1170 to 990 cal. yr BP (cal. AD 780 to 960). The dates indicate that the accumulation of the peat occurred over a period of between ca. 370 and 570 years, during the Early and High Middle Ages. This is thus a well preserved

organic floodplain sequence of historic period age, evidence for which has not previously been recorded in this part of the Stour valley and is not particularly common elsewhere in lowland Britain.

Given the results of the environmental archaeological assessment further analysis of the samples is not recommended. The results of the pollen and diatom assessments have identified that the concentration and preservation of these proxies is not sufficient to provide full percentage counts. In addition, further analysis of the waterlogged and charred seeds, waterlogged wood, charcoal and Mollusca is unlikely to provide any further information than is presented here.

8.0 CONCLUSION AND ASSESSMENT

The geoarchaeological investigations have corroborated the results of the previous studies in this area of the scheme (Hopla and Krawiec 2010) and established that a well preserved floodplain sequence is present, which includes a peat deposit which accumulated between the 8th and 13th centuries. The sequence has been recorded in detail and the environmental specialists do not recommend further work be carried out on the samples. Although the works have not directly addressed questions raised in the regional research framework they have provided a snapshot into the environment and landscape of the Stour Valley that is of interest, particularly given the relative rarity of such sequences. It is recommended that the results of this assessment are integrated in to any future publication of the results of the archaeological evaluation of this site.

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APPENDIX 1: BOREHOLE RECORDS

All depths in metres below ground surface (bgs)
Depths imprecise due to compaction of recovered cores

Transect A

BH 1a

Ground surface	No surface data (c. 55.75 m OD)
m bgs	
0.0 – 1.0	Grey silty soil, overlying brown silty clay, becomes dark grey with brown mottles and white flecks
1.0 – 2.0	Dark grey silty clay with brown mottles and white flecks black humic silty clay with white flecks, diffused organic material
2.0 – 3.0	Black humic silty clay with white flecks, diffused organic material towards base becomes black clayey sand rich in shells
3.0 – 4.0	Black clayey sand rich in shells within core becomes yellow/light brown sandy gravel

BH 1b

Ground surface	55.79 m OD
m bgs	
0.0 – 1.0	Brown alluvial clayey soil, grey + orange mottling, white flecks.
1.0 – 3.0+	Humic black clay, diffused organic material, rootlets Shells at c.3.0 m bgs
3.0+ -4.0	Change to yellow sandy gravel within core, but compacted so exact depth not known

BH 2

Ground surface	55.80 m OD
m bgs	
0.0 – 1.0	Grey silty soil, shelly in middle part basal part, brown silty clay, slight orange mottle, white flecks
1.0 – 2.0	Brown silty clay, slight orange mottle, white flecks grey clay in bottom half, with occasional black fragments, ?charcoal
2.0 – 3.0	Grey clay with occasional black fragments, ?charcoal, becomes browner with depthvery dark grey clay at base, rich in shells, some rootlets
3.0 – 4.0 changes to yellow gravelly sand	Very dark grey clay, rich in shells, some rootlets

BH 3

Ground surface	55.63 m OD
m bgs	
0.0 – 1.0	Dark brown soil, humic, less humic with depth
1.0 – 2.0	Dark brown silty soil becoming black humic clay with white specks
2.0 – 3.0	Black humic clay with white specks becoming grey clayey gravel in lower part
3.0 – 4.0	Grey clayey gravel, becoming yellow and less clayey with depth

BH 4

Ground surface	55.36 m OD
m bgs	
0.0 – 1.0	Topsoil Brown alluvial clay, slight orange mottling, white flecks
1.0 – 2.0	Brown alluvial clay, slight orange mottling, white flecks very stiff grey clay, slight brown mottling, black rootlets
2.0 – 3.0	Very stiff grey clay, slight brown mottling, black rootlets, overlying yellow sandy gravel
3.0 – 4.0	Yellow sandy gravel, chalky towards base

Transect B

BH 1

Ground surface	55 75 m OD
m bgs	
0.0 – 1.0	Topsoil Brown alluvial clay, some orange mottling, occasional white flecks
1.0 – 2.0	Brown alluvial clay, some orange mottling, occasional white flecks becomes dark brown humic clay, plant macro remains
2.0 – 3.0	Dark brown humic clay grey sand, shelly
3.0 – 4.0	Grey sand, shelly, gives way to yellow sandy gravel

BH 2

Ground surface	55.74 m OD
m bgs	
0.0 – 1.0	Topsoil Grey-brown clay with dark brown mottles and white flecks
1.0 – 2.0	Grey-brown clay with dark brown mottles and white flecks in lower part, dark grey humic sandy clay, chalk granules, occasional rounded flint pebbles (up to 3 cm), rootlets
2.0 – 3.0	Dark grey humic sandy clay, chalk granules, occasional rounded flint pebbles (up to 3 cm), rootlets; gives way to coarse sandy flint gravel (up to 6 cm)
3.0 – 4.0	Coarse sandy flint gravel (up to 6 cm), with pale yellow sand lenses

BH 3

Ground surface	55.48 m OD
m bgs	
0.0 – 1.0	Topsoil Brown silty clay (uniform colour, no mottles)
1.0 – 2.0	Brown silty clay (uniform colour, no mottles), overlying clayey coarse gravel, angular and sub-angular flints
2.0 – 3.0	Clayey coarse gravel, angular and sub-angular flints becomes medium gravel with pale yellow sand lenses
3.0 – 4.0	Medium gravel with pale yellow sand lenses, overlying coarse flint gravel (up to 6cm)

Transect C

BH 1

Ground surface	55 81 m OD
m bgs	
0.0 – 1.0	Topsoil Brown alluvial silty clay, grey mottles, occasional flint granules
1.0 – 2.0	Brown alluvial silty clay, grey mottles, occasional flint granules, overlying grey-brown clay, root remains
2.0 – 3.0	Grey-brown clay, overlying coarse flint gravel(up to 4 cm) and yellow sand lenses
3.0 – 4.0	Coarse flint gravel(up to 4 cm) and yellow sand lenses, overlying pale yellow sand with chalk and flint granules

BH 2

Ground surface	55.70 m OD
m bgs	
0.0 – 1.0	Topsoil Brown silty clay, grey and orange mottles, rootlets
1.0 – 2.0	Brown silty clay, grey and orange mottles, rootlets overlying Grey clayey coarse gravel, angular flints
2.0 – 3.0 end	Coarse gravel, angular flints, lenses of yellow sand

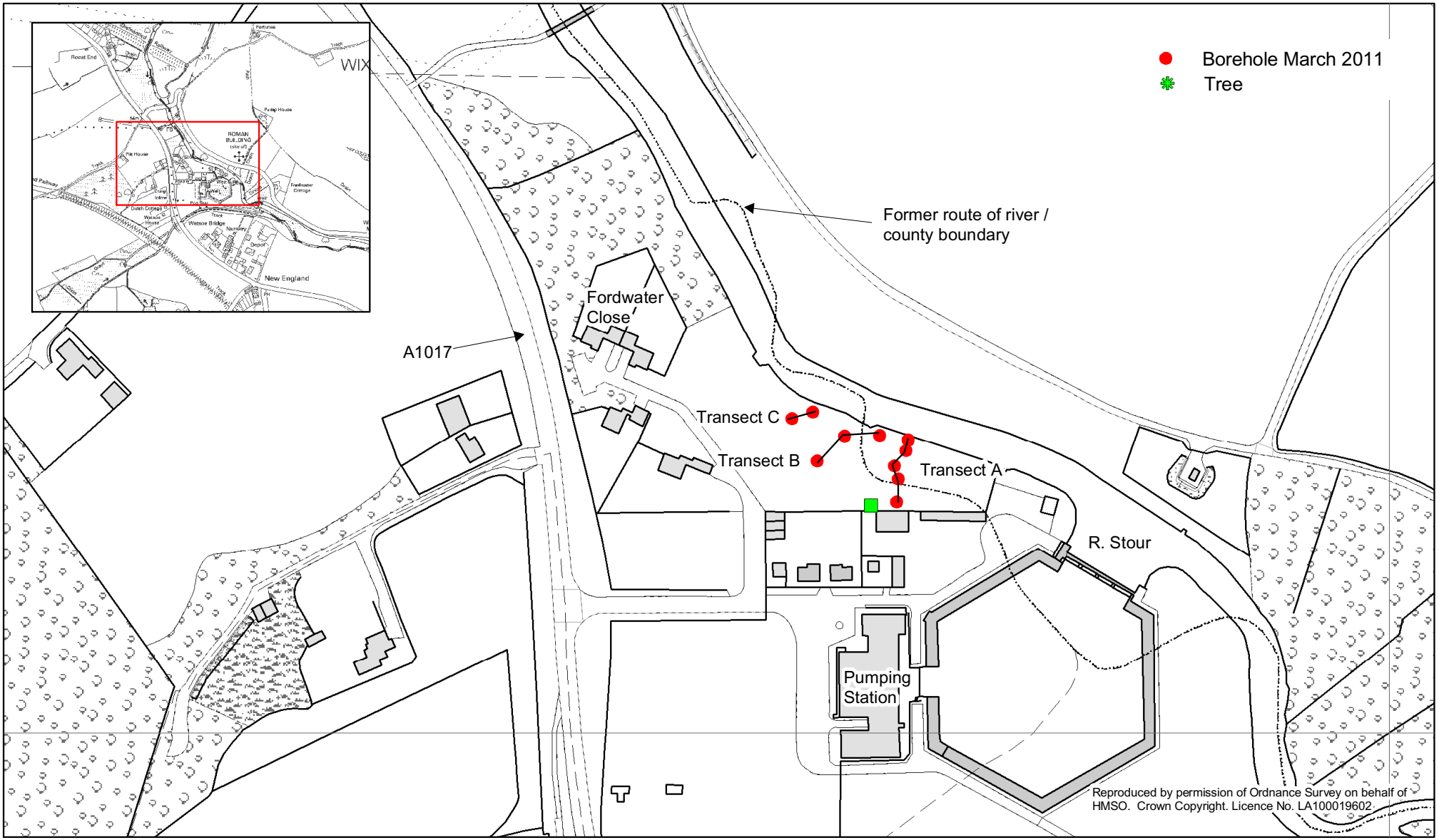

Fig. 1 Location

1:2,000 @ A4

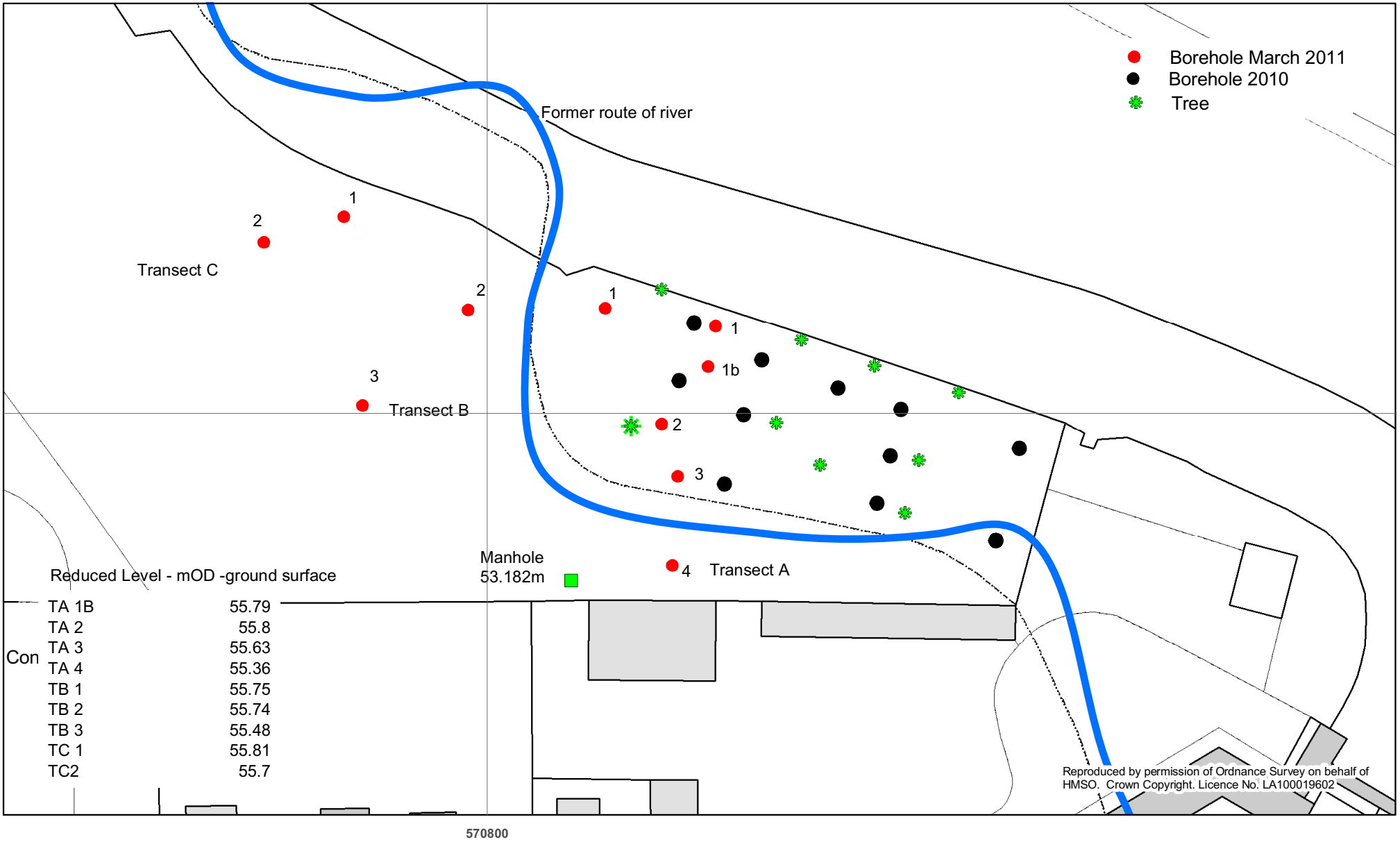

Fig. 2 Borehole locations (2010 and 2011)
Showing line of historic river channel derived from 1898 OS mapping (blue line)

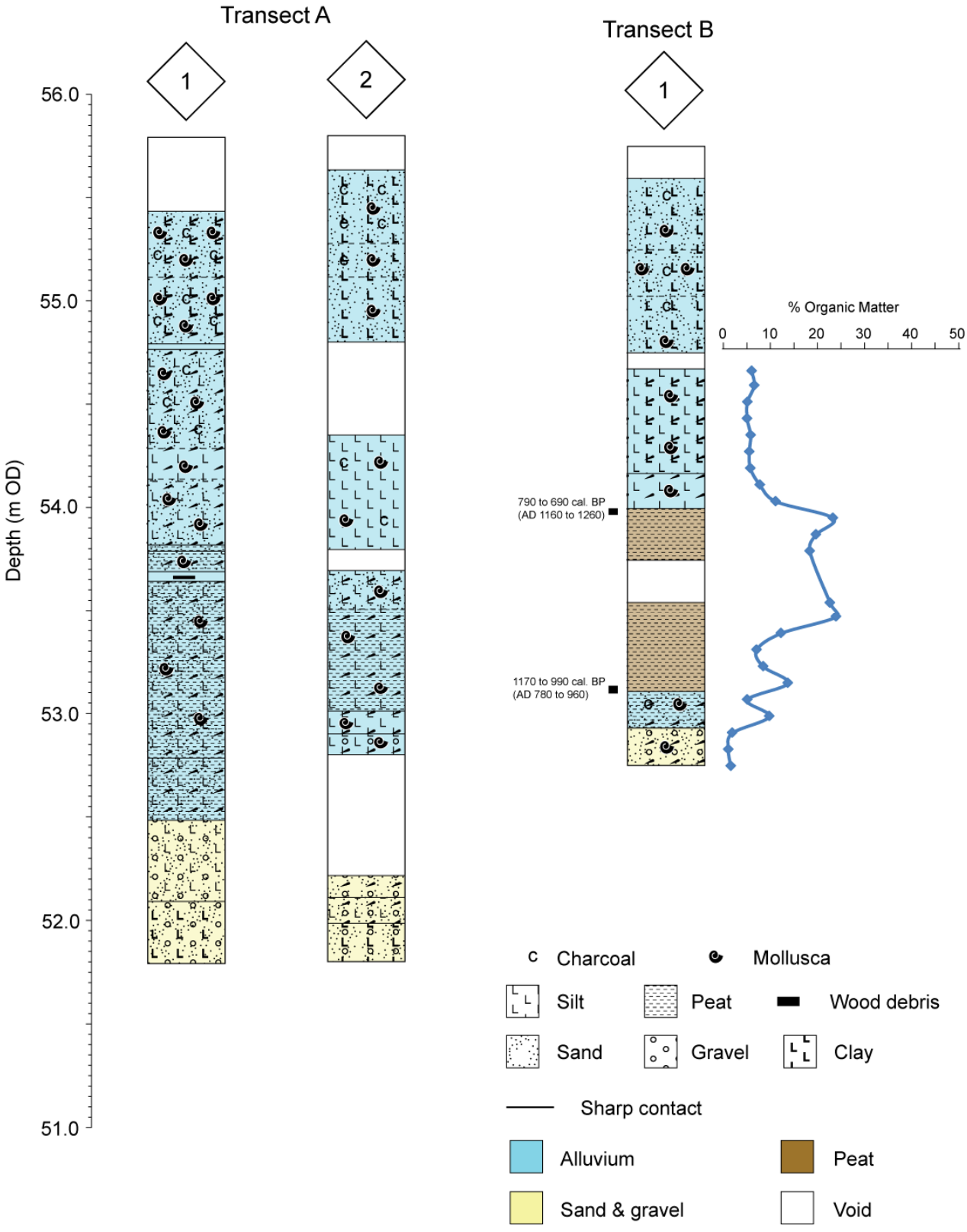

Figure 3: Lithostratigraphic description of Transect A Boreholes <BH1> and <BH2> and Transect B <BH1>. Loss-on-ignition values and radiocarbon dated horizons for Transect B <BH1> are also shown. See Figure 1 for the spatial distribution of these boreholes.