Geoarchaeological and Archaeological Evaluation and Watching Brief at 12 North Street, Worthing, West Sussex

DRAFT

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Abstract

Archaeology South-East was commissioned by CgMs Limited to undertake a geoarchaeological and archaeological evaluation and watching brief on land at 12 North Street, Worthing, West Sussex.

The geoarchaeological work has revealed some important findings.

- *The ascription of marine sands to the last interglacial or MIS 5e marks the first time deposits east of the River Arun have been independently dated to the last interglacial. Previous observations had suggested that all marine sands within the Littlehampton to Brighton area correlated with Brighton/Norton Raised Beach and the penultimate interglacial. The new evidence suggests that two marine episodes are now preserved in this part of the coastal plain.*

- *The presence of microfossil rich stratified Devensian cold stage deposits at the site suggests that the diversity of landscapes previously only noted in the western parts of the coastal plain extend to the east.*

- *The dating of channelling and infilling of a channel and the base of the brickearth to around 50,000 years ago extends the date range for the depositional episode for the brickearth on the coastal plain considerably.*

- *The discovery of a single flint flake within the initial fills of this channel marks the first well provenanced artefact found in association with brickearth to be independently dated in the Sussex/Hampshire Coastal Corridor. The age associated with the artefact suggest loss of this flake within the middle part of the Devensian early in MIS 3. Its presence in the channel fill sequence, above a series of well stratified sediments probably associated with a series of temporary landsurfaces, suggests that a large number of contexts in which additional archaeological material might be anticipated are present within the vicinity. The now widespread distribution of these cool to cold climate deposits beneath brickearth on the coastal plain suggests that contexts capable of containing late Neanderthal archaeological remains may be widespread on the Sussex/Hampshire Coastal Corridor. These contexts were unknown until 2004.*

The archaeological evaluation and watching brief work has confirmed later Bronze Age, Late Iron Age/Roman and medieval activity in the southern part of the site. In the Bronze Age and Late Iron Age/Roman periods several ditches were laid out, probably delineating land division and/or to drain fields and livestock enclosures. It is probable that the orientation of this land division has been respected and developed upon from the later Bronze Age to the present day with modern boundaries continuing to follow a similar alignment.

Evidence was also found for late Iron Age or early Roman industrial activity including iron working and pottery and the processing of cereals, whilst medieval finds have been interpreted as the chance finding of pottery and brick and tile probably deposited during manuring and ploughing. In the northern parts of the site, post-medieval activity has caused significantly deep truncation to levels which, in the less disturbed southern part of the site, were found to preserve archaeological features.

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1.0 INTRODUCTION

1.1 Site Background

1.1.1 Archaeology South-East were commissioned by CgMs Limited to undertake and archaeological evaluation and watching brief on land at 12 North Street, Worthing (NGR TQ 148 030; Figure1), henceforth called the site. The site is being redeveloped by Lemo-UK to create new office buildings and parking with landscaped areas.

1.2 Planning Background

1.2.1 Planning permission for the site was granted by Worthing Borough Council (Ref: 08/0497/FULL) for *"construction of a new building for offices, research and development, assembling, storage and including landscaped areas and parking".*

1.2.2 Attached to the planning permission is condition 22 which states *"No Development shall take place until the applicant has secured the implementation of a programme of archaeological work in accordance with a written scheme of investigation which has been submitted to and approved in writing by the Local Planning Authority".*

1.2.3 A Written Scheme of Ivestigation (CgMs Ltd 2009) was prepared by CgMs Ltd on behalf of Lemo-UK and approved by the Local Planning Authority. Archaeological works undertaken on site were done in accordance with the approved specification.

1.2.4 The proposed development was due to remove any archaeological deposits within the footprint of the building due to the excavation of a deep basement. It was therefore necessary to ensure any archaeological finds or features were preserved by record prior to development.

1.3 Aims and Objectives

1.3.1 The general aim of the archaeological works as given in the specification (CgMs Ltd 2009) is to *"clarify the nature, extent and survival of buried archaeological remains within the development site, and to ensure the appropriate investigation and recording of surviving remains".*

1.3.2 Further aims of the investigation within the specification (CgMs Ltd 2009) are:

- *To refine the outline deposit model produced in the archaeological desk-based study and assess the impact on the archaeological resource caused by the previous development;*
- *To locate, identify and assess the state of preservation of any archaeological remains potentially affected by the new development;*
- *To assess the artefactual and environmental potential of the archaeological features and deposits encountered;*

- *To establish the need for and scope of additional archaeological mitigation works required in connection with the current development;*
- *To produce a site archive for deposition with an appropriate museum and to provide information for accession to the local SMR.*

1.4 Scope of Report

1.4.1 This report represents the findings of the geoarchaeological and archaeological evaluation and watching brief undertaken between the 3rd and 13th of August 2009 by Sarah Porteus (archaeologist) and Dr Martin Bates (geoarchaeologist). The project was managed at ASE by Darryl Palmer (field work) and Jim Stevenson and Dan Swift (post-excavation).

2.0 ARCHAEOLOGICAL BACKGROUND

2.1.1 Geology and Topography

2.1.1 The site is situated on a gentle slope with from south to north. The underlying geology is a mixture of drift sand and gravels capped to the north by brickearth.

2.1.2 The site was previously occupied by modern buildings which were recently demolished prior to the commencement of the new development. The mechanical removal of the foundations of these buildings is believed to have had substantial localised impact upon any remaining archaeological deposits, thus reducing the archaeological potential of the site.

2.1.2 Historical and Archaeological Background

2.1.3 A full desk based assessment (DBA) was prepared as part of the planning application for the development (CgMs Ltd 2008). Information from the DBA is summarised below with due acknowledgement to CgMs Ltd, a full List of Sites and Monument Records is given as part of the DBA and is not reproduced in this document.

2.2 Prehistoric 45000BC – AD43

2.2.1 Prehistoric activity around Worthing is known from the Paleolithic onwards, however, the earliest archaeological evidence found within a 500m radius of the site is two Neolithic hand axes (SMR3326 and SMR5843). Also within the study area are a Bronze Age flint find spot (SMR 3243) and a late Bronze Age ditch (SMR 5809). An additional three sites, containing ditches (SMR 5941) a pit (SMR 6675) and a feature containing flint and pottery (SMR 7329) are of probable broad prehistoric date.

2.3 Roman AD43 – AD410

2.3.1 Roman activity within the study area includes two occupation sites. To the west of the site, ditches and artefacts suggestive of a Roman building (SMR4321) were identified. A second site with a ditch containing pottery and grain to the south of the development site is also of Romano-British date (SMR3247). The remainder of Roman activity is suggested by find spots of pottery and coins (SMR 3232, 3304, 3344, 5812, 5942).

2.4 Saxon/ Early Medieval and Medieval AD410 – AD1485

2.5.1 A single SMR entry of Anglo-Saxon date, part of a settlement site (SMR 5811), is the only evidence within the 500m radius of activity of this date. However, the name 'Worthing' is believed to be an old English name.

2.5.2 Three Medieval occupation sites are known within a 500m radius (SMR 3345, 6412, 7330). Grain driers, pits and ditches have been found to the north-east (SMR 6412). Find spots account for the remainder of the Medieval entries in the study area (SMR 3033, 5810, 5943).

2.6 Post-medieval to Modern AD1485 - present

2.6.1 A large number of post-medieval buildings (69) are listed within a 500m radius of the site in the SMR along with seven archaeological sites. The archaeological sites include a clay pipe factory (SMR 3357), walls ditches and pottery(SMR 5581), a post-medieval wall (SMR 5944), Worthing village itself (SMR6624), mid to late 19th century brick footings (SMR 7277), footings of a possible post-medieval inn (SMR 7285) and further 19th century footings (SMR 7328).

2.6.2 The site itself has been subject to a series of developments in the post-medieval period, in 1813 the site is open ground surrounded by orchards, by 1852 the front (north) of the site has buildings along the frontage with coal yard to the rear. By 1875 the buildings to the front remained with trees marking open ground to the rear. A small building appears on the southern half of the site by 1898 Ordnance Survey map is produced and remained much the same until the 1932 ordinance survey map which shows structures across most of the site, with a small amount being demolished by 1975. By 1990 a new phase of development is shown with new buildings on the central and northern part of the site.

3.0 METHODOLOGY

3.1 The archaeological scheme of works was for evaluation trial trenching and watching brief during mechanical ground reduction. Subsequently, two 'T' shaped evaluation trenches were excavated and it was decided by the Local Planning Authority (LPA) Archaeological Advisor, Mark Taylor, that these trenches should be combined by excavating the section between them as part of the evaluation to gain a full north east to south west section of the site (Figure 2).

3.2 The results of this trial trenching determined that archaeological survival in the northern part of the site was unlikely and Mark Taylor therefore agreed that the watching brief during general ground reduction was to be maintained only across the southern half of the site where archaeological deposits had survived (Figure 2).

3.3 The watching brief phase took place prior to any piling on site. In discussion with Lemo-UK a strategy was devised to strip the site in small portions to the level of the top of any archaeological deposits or to the surviving top of the 'natural' substrate where no archaeological deposits were found at a higher level. All excavation undertaken as part of the evaluation and within the area covered by the watching brief was undertaken by a mechanical excavator fitted with a flat ditching bucket and monitored by an archaeologist.

3.4 Where features were identified during the watching brief, sufficient time was allowed for archaeological excavation and recording.

3.5 All archaeological remains were planned at 1:50 scale with sections of features drawn at either 1:10 or 1:20 as appropriate. All drawings were made on permatrace.

3.6 The excavated features were planned in relation to the edge of excavation with absolute heights taken of all features and archaeological deposits. A cross-section of levels was also taken at the top of the undisturbed deposits across the site to permit topographic modelling.

3.7 A rapid note was made of the location of modern intrusive features and demolition deposits for archive purposes.

3.8 Excavated spoil and exposed surfaces were regularly scanned for the presence and collection of artefacts. Due to the frequency of large metal objects in the demolition deposits metal detection of the spoil heaps was not undertaken.

3.9 Exposed features were hand cleaned and photographed using digital, colour slide and black and white film. General excavation shots were also taken using the digital camera.

3.10 Linear features were excavated by sectioning of between 10 and 20% of the exposed length. To recover additional artefacts, 100% of the features were excavated where possible and finds recovered.

3.11 Environmental samples were taken from each feature where potential

remained for preservation of environmental information.

3.12 All contexts were recorded on standard pro-forma context recording forms.

Number of Contexts	16, evaluation, 12 watching brief
No. of files/paper record	1
Plan and sections sheets	4
Bulk Samples	8
Photographs	1 colour slide film, 1 black and white film, 1 digital CD
Bulk finds	1 box
Registered finds	0
Environmental flots/residue	8

Table 1: Quantification of site archive

3.13 Additionally, geoarchaeological evaluation work at the site was conducted along the western side of the excavated area once this had been mechanically reduced to the required construction formation level which exposed a section the length of the watching brief are (see Figure 2 and Sections 2, 3 and 4 of Appendix 2: Geoarchaeological Report for details of the applied geoarchaeological methodology).

4.0 RESULTS (Figures 2 – 7)

4.1 Trench 1

4.1.1 Trench 1 covered the south west half of the trench and the central section of the trench when the two trenches were joined.

Number	Type	Description	Max. Length	Max. Width	Deposit Depth	Height m.AOD
1/001	Dep	Made ground	Tr.	Tr.	1.60 max	8.914
1/002	Dep	Natural	N/A	N/A	N/A	8.217
1/003	Dep	Subsoil	Tr.	Tr.	0.20	8.764
1/004	Cut	Ditch	14.20+	1.10	0.60	8.237
1/005	Fill	Ditch fill of 1/004	0.10+	1.10	0.08	8.237
1/006	Fill	Ditch fill of 1/004	0.10+	1.00	0.06	8.157
1/007	Fill	Ditch fill of 1/004	0.10+	1.10	0.10	8.097
1/008	Fill	Ditch fill of 1/004	0.10+	0.90	0.15	7.997
1/009	Fill	Ditch fill of 1/004	0.10+	0.70	0.20	7.847
1/010	Cut	Shallow linear	4.00+	0.60	0.30	8.217
1/011	Fill	Fill of 1/010	4.00+	0.60	0.30	8.217
1/012	Cut	Shallow linear	3.20+	0.60	0.14	8.217
1/013	Fill	Fill of 1/012	3.20+	0.60	0.14	8.217

4.2 Trench 2

4.2.1 Trench 2 covered the northern most part of the site in the first phase of the evaluation.

Number	Type	Description	Max. Length	Max. Width	Deposit Depth	Height m.AOD
2/001	Dep	Made ground	Tr.	Tr.	1.60 max	8.105
2/002	Dep	natural	N/A	N/A	N/A	6.800
2/003	Service	PM services	1.40	1.00	0.80	6.587

4.3 Watching Brief

4.3.1 Archaeological features were only uncovered to the south of the site. The basic site stratigraphy is the same as for trench 1 with archaeological features cut into the natural geology and overlain by a subsoil deposit with truncation by modern demolition.

Number	Type	Description	Max. Length	Max. Width	Deposit Depth	Height m.AOD
001	Cut	Linear	3.80+	0.65	0.10	8.430
002	Fill	Fill of 001	3.80+	0.65	0.10	8.430
003	Cut	Linear	7.00+	0.65	0.26	8.340
004	Fill	Fill of 003	7.00+	0.65	0.26	8.340
005	Cut	Linear	5.00+	0.65	0.20	8.340
006	Fill	Fill of 005	5.00+	0.65	0.20	8.340
007	Cut	Linear	6.50+	0.90	0.25	8.490
008	Fill	Fill of 007	6.50+	0.90	0.25	8.490
009	Cut	Gulley	3.50+	0.25	0.26	8.430
010	Fill	Fill of 009	3.50+	0.25	0.26	8.430
011	Cut	Posthole?	0.15	0.15	0.05	8.230
012	Fill	Fill of 011	0.15	0.15	0.05	8.230

4.4 Archaeological Description

4.4.1 The ‘natural’ substrate deposits of clay and gravels [1/002], [2/002] were encountered at between 6.800mAOD at the north end of the site, rising to 8.217mAOD at the south end. Cut into the natural, a series of discrete linear features and a single possible post hole were recorded.

4.4.2 Ditch [1/004] was of ‘U’ shape, aligned south-east to north-west, and contained a number of fills. The earliest fill [1/009] was compact greyish brown silty clay of 0.20m thickness containing occasional possible late Bronze Age pot fragments. This fill was overlain by [1/008], a 0.15m thick orangish brown silty clay. In turn this was overlain by [1/007], a sticky greyish brown clayey silt of 0.10m thickness with medieval pottery and occasional charcoal and bone inclusions. Context [1/006], a compact grey black silt and charcoal deposit overlay context [1/007]. The uppermost fill of the ditch [1/005], was a sticky brownish orange silty clay. The fills [1/009] and [1/008] are likely to be the original fills of the ditch, which is therefore thought to be of late Bronze Age origin, whilst fills [1/007], [1/006] and [1/005] probably represent later ‘slumped-in’ fills of medieval date.

4.4.3 To the south of ditch [1/004] were two south-east to north-west linear features, [1/010] a 0.30m deep linear feature with a single brown silty clay fill [1/011] containing probable late Bronze Age pottery, and [1/012] a 0.14m deep linear in the same alignment with a single orange-brown silty clay fill [1/013]. Here the archaeological features were overlain by a browny-yellow silty clay subsoil [1/003]. Substantial truncation of the archaeological deposits had occurred during demolition. Both features are thought to be late Bronze Age.

4.4.4 Five other linear features were identified during the watching brief. These are thought to be of Late Iron Age/Roman date.

4.4.5 Linear [007] was filled by a single 0.25m deep greyish orangey brown silty clay [008] with occasional LIA/Roman pot inclusions.

4.4.6 Parallel to ditch [007] to the south were three other shallow linear features.

4.4.7 Linear [005] and [003] were 0.20 and 0.26m deep respectively. Both have a wide shallow 'U' shape and each has a single similar fill of greyish orange brown silty clay and bone inclusions [006] and [004]. [006] contained small amounts of later Bronze Age pottery and is therefore thought to be of Bronze Age date.

4.4.8 Linear [001] also aligned south west to north east and appeared to terminate at 3.80m from the limit of excavation. [001] was filled by [002] orange-brown silty clay which contained some LIA/Roman pottery.

4.4.9 Cut into the base near this terminus were the remains of a possible post hole [011] of 0.15m diameter with a surviving depth of 0.05m filled with dark orange-brown silty clay [012]. The fill of the possible post hole and ditch were not sufficiently different to establish the exact stratigraphic sequence of deposition.

4.4.10 Running perpendicular to ditch [001] was a 0.25m wide, 0.25m deep steep sided gulley [009]. The gulley terminated just shy of ditch [001] and in line with probable post hole [011]. The gulley was filled by a greyish orange-brown silty charcoal rich clay with a possible kiln bar and LIA/Roman pottery.

4.4.11 Intrusive services [2/003] were cut into the 'natural' subsoil and consisted of brick drains of possible Victorian date and later modern services, all intrusive services were grouped under the same context number. In places the services had been truncated by the demolition activity and related deposit [2/001] and [1/001] (equivalent contexts) these contexts cover the modern intrusions made by the demolition machinery and related backfills.

5.0 THE FINDS

A small assemblage of finds was recovered during the evaluation and watching brief. A summary can be found in Table 2.

Context	Pot	Wt (g)	CBM	Wt (g)	Bone	Wt (g)	Shell	Wt (g)	Flint	Wt (g)	FCF	Wt (g)	F.Clay	Wt (g)	Slag	Wt (g)
1/007	2	24			40	266	1	34					2	6		
1/009	4	30														
1/011	1	6											1	<2		
2/001			6	8192												
002	4	6											1	<2		
004	13	64			10	<2					3	172	6	12	2	26
006	14	50			41	20					7	150	1	<2		
008	11	30									15	362	4	12		
010	7	20			81	102			1	166			5	478	9	72
Total	56	230	6	8192	172	388	1	34	1	166	25	684	20	508	11	98

Table 2: Quantification of the finds

5.1 **The Prehistoric and Roman Pottery** by Anna Doherty

5.1.1 A total of 47 sherds weighing 202 grams were recovered from all phases of work on the site. The pottery was examined using a x20 binocular microscope and recorded by sherd count and weight. As only one rim sherd is present, quantification by EVEs is not included. A wide variety of different fabric variants were encountered, many of them only represented by one sherd. For this reason full fabric descriptions have been omitted from the report although they are available in paper/digital archive records.

5.2 Later Bronze Age pottery

5.2.1 Only one fill [006], contains a probable later Bronze Age group. One very thick-walled sherd in this group is more typical of Middle Bonze Age Deverel-Rimbury fabrics with very coarse and ill-sorted flint of up to 6mm in size. A further 12 sherds are somewhat finer and more typical of the post-Deverel-Rimbury tradition dating to the period after c.1250BC. One of these is also extremely vitrified suggesting that it has been exposed to very high temperatures. Sherds representing two vessels in evaluation contexts [1/009] and [1/011] could be very broadly of the same phase, although one contains fine shell alongside the flint inclusions whilst the other has an unusually sandy matrix and these are probably better categorised as of a general later prehistoric date.

5.3 Mid/Late Iron Age to Early Roman pottery

5.3.1 The majority of the pottery is made up by fabrics typical of the period c.100BC-AD60 found in contexts [002], [008] and [010]. The most common well-defined fabric grouping is made up by a ware with common well-sorted fine flint of c.0.2-1mm in a very silty to fine sandy matrix. The only other fairly

frequently occurring fabric contains common calcareous inclusions of 0.5-1.5mm, and one sherd in this fabric is from a pedestal base of a type associated with both latest Middle Iron Age S-profile jars and earlier examples of East Sussex grog-tempered vessels. Similar fabrics were found in groups of both Middle/Late Iron Age and early Roman date range in a recently assessed assemblage from Titnore Lane, Goring (Doherty 2009). A wide variety of varying fabrics containing different combinations of flint, glauconite, shell and quartz were also found in very small quantities from this phase. Only one Romanised sherd was found, in association with calcareous and flint-tempered sherds in context [004]. It is a necked jar in a local Arun Valley type fabric with well-burnished black surfaces. At Titnore Lane this surface treatment was strongly associated with 1st century forms.

5.4 The Post-Roman Pottery by Luke Barber

5.4.1 Context [1/007] was the only deposit on site to produce post-Roman pottery. The two pieces are both unabraded bodysherds from light grey to buff patchy cooking pots. One is tempered with moderate chalk (burnt out leaving voids to 1mm), the other with fine sand and rare chalk inclusions. Both are likely to be of late 11th- to 12th- century date.

5.5 The Ceramic Building Material by Sarah Porteus

5.5.1 Ceramic building material was recovered from the made ground deposit [2/001]. The assemblage is mainly of brick with a single fragment of 19th century salt glazed drain. The earliest brick recovered is in a hard fired red fabric similar to museum of London fabric 3032 with shallow frog, these fragments are of probable mid 18th to 19th century date. A frogged brick stamped with 'WARNHAM SBC', a red brick with sparse black iron rich inclusions and calcareous speckling originated from the Sussex Brick Company and is of probable 10th century date. A second frogged brick contains the stamp 'PHORPRES LBC' of the London Brick Company and is of 20th century date. A fragment of machine made ventilation brick with square holes is also of 20th century date. It is likely the bricks represent two phases of construction at the site which had been demolished to form the made ground prior to the present works.

5.6 The Worked Flint by Elke Raemen and Dr Matthew Pope and incorporating comments by Chris Butler

5.6.1 A single-platform, hard-hammered core, utilising a beach cobble, was recovered from gulley [9] (fill [10]). The piece is of late prehistoric date.

5.6.2 A single humanly-struck flake was recovered from context [105] during the geoarchaeological work (See Section 6.1 of Appendix 2: Geoarchaeological Report). The piece has a maximum dimension of 31mm, it is 19mm wide and has a maximum thickness of 6mm. It is a small hard hammer struck flake from a small, fresh and at least partially cortical core. The platform is plain and unabraded and the dorsal surface retains fresh cortex across c.20% of it's surface and bears to previous flake scars, both apparently struck from the

same platform as the flake itself. Some damage on the edge of the ventral surface appears to be post-depositional edge abrasion, but generally the piece is in a fresh condition baring only a light sediment polish and no evidence for either fluvial rolling or frost pitting.

5.6.3 Given the Pleistocene context in which this piece was found, the fresh condition is remarkable but not unprecedented. The piece is technologically undiagnostic but appears to relate to simple working of small cores rather than biface manufacture or Levallois/prismatic blade working. Given the MIS3 context, it is possible this flake relates to Late Middle Palaeolithic occupation by Neanderthal hunting groups. Similar and contemporary sites in the region would include Oldbury (Cook and Jacobi 1998) and Beedings (Jacobi 2007). However this is a very tentative association and further, technologically diagnostic material would need to be recovered from the same context to make a confident assignation to this period or industry.

5.7 **The Fired Clay** by Elke Raemen

5.7.1 A small assemblage of 20 fired clay fragments was recovered from seven individually numbered contexts. Most pieces are Romano-British in date and amorphous.

5.7.2 The earliest piece consists of an amorphous, fine sand-tempered fragment from linear feature [005] (fill [006]), pottery from which dates to the later Bronze Age. A featureless fragment in the same fabric was recovered from shallow linear feature [1/010] (fill [1/011]), which contained pottery of later prehistoric date.

5.7.3 A total of twelve fragments was recovered from contexts of Romano-British date. Fabrics are sparse fine sand-tempered, some incorporating rare chalk inclusions to 1mm, rare iron oxides to 1mm or occasional organic temper. The majority of these are very small fragments and amorphous. Of interest are three pieces of furnace lining recovered from linear feature [003] (fill [004]), which also contained iron slag (see section 5.10).

5.7.4 Gulley [009] (fill [010]) contained a sub-rectangular bar fragment. The piece is in a sparse fine sand-tempered fragment, further tempered with occasional crushed flint to 7mm and rare flint pebbles to 9mm. The piece also contains occasional iron oxides to 1mm. Rare (elongated) organic imprints appear on the external surface. The bar is sub-rectangular in section (c. 58 by 56mm) and survives to a length of 92+mm. The surviving end consists of a flat top. No kiln waste was recovered.

5.7.5 The presence of portable kiln furniture is interesting and indicates the existence of a kiln in the vicinity. Pottery kilns of slightly later date were recovered from nearby Littlehampton, though no portable kiln furniture was recovered from there (Lovell 2002).

5.7.6 In addition, two amorphous fragments were recovered from ditch [1/004] (fill [1/007]), pottery from which is of late 11th- to 12th-century date.

5.8 The Metallurgical Remains by Luke Barber

5.8.1 Two contexts on the site produced slag, both probably of Late Iron Age/Early Roman date. Context [004], dated 40-60AD, contained a single piece of iron slag most likely deriving from smithing activity. Context [010], dated 100BC – 60AD, contained significantly more material. The assemblage includes two pieces of iron smithing slag (60g) and seven pieces (7g) of green/grey fuel ash slag. Of particular interest is a small fragment from a simple rim of a fine sand tempered vitrified crucible with copper alloy residue on its interior. The presence of this piece certainly suggests non-ferrous metalworking in the vicinity.

5.9 The Animal Bone by Gemma Ayton

5.9.1 The animal bone assemblage contains 137 fragments from four contexts of mixed date. The assemblage is in a poor condition with only small fragments of bone remaining. Cattle (*Bos taurus*), sheep/goat (*Ovis/Capra*) and horse (*Equidae*) are represented by fragments of long bones, ribs and teeth. There is no evidence of butchery, burning, gnawing or pathology on the bone.

5.9.2 The assemblage holds no potential for further statistical analysis due to its size and condition.

5.10 The Marine Shell by Elke Raemen

5.10.1 Ditch [1/004] (fill [1/007]) contained the upper valve of a mature oyster shell. Pottery from the same context is of late 11^{th-} to 12th-century date.

6.0 The Environmental Samples by Lucy Allott

6.1 Eight bulk samples were taken during archaeological work at North Street Worthing to establish evidence for environmental remains such as wood charcoal, charred macrobotanical remains, fauna and mollusca. Samples were taken from the fills of ditches, gulleys and linear features [1/007], [1/009], [1/011], [002], [004], [006], [008] and [010] of later prehistoric, Romano British and Medieval date.

6.2 Methods

6.2.1 The samples were processed in their entirety in a flotation tank, the residues and flots were retained on 500µm and 250µm meshes respectively and were air dried prior to sorting. The residues were passed through 4mm and 2mm geological sieves and each fraction sorted for environmental and artefact remains (Table 1 Appendix 1). The flots were scanned under a stereozoom microscope at magnifications of x7-45 and an overview of their contents recorded (Table 2 Appendix 1). Preliminary identifications have been provided for macrobotanical remains present through reference to modern comparative material and reference atlases (Cappers *et al.* 2006, Jacomet

2006, NIAB 2004). Nomenclature used follows Stace (1997).

6.3 Results and Discussion

6.3.1 Sampling has confirmed the presence of a small assemblage of environmental remains including wood charcoal and charred macrobotanical remains.

6.3.2 Wood charcoal fragments were small and relatively infrequent in each of the samples and therefore no identifications have been provided. A small quantity of bone was present in samples <1>, <6> and <8> from ditches [1/004] and [005], and gully [009]. These have been incorporated into the bone report.

6.3.3 Charred macrobotanical remains were a little more numerous and the assemblage consisted of mixed cereal and non-cereal crop seeds as well as their associated weeds. Wheat (*Triticum* sp.) caryopses were the most frequently identified crop type. It appears that several wheat types may be present and glume bases, in samples <6> and <8> confirm the presence of spelt (*Triticum spelta*). Barley (*Hordeum* sp.), possible oat (cf. *Avena* sp.) and various Legumes such as pea (*Pisum sativum*) and vetch/tare (*Vicia/Lathyrus* sp.) were also recorded. Grasses (Poaceae) and other weeds common on arable land or disturbed ground such as knotgrass/ docks/ bindweed (*Polygonum/ Rumex/ Fallopia* sp.), possible fat hen (cf. *Chenopodium album*), petty spurge (cf. *Euphorbia* cf. *peplus)*, stinking chamomile (*Anthemis cotula)*, and possible nettle (cf. *Urtica* sp.) were recorded in samples <1>, <4>, <6> and <8>.

6.3.4 Assemblages from ditches and gulleys are often difficult to interpret as these features may have been 'open' in the landscape for extended periods and during this time an array of archaeological remains including the charred botanical remains could have accumulated. For botanical remains to become charred they must be exposed to high temperatures in an oxygen starved environment and therefore the presence of charred botanicals here suggests fire using activities within the local vicinity during each phase of land use. More specifically the presence of cereal caryopses, arable weeds and a small amount of cereal chaff could suggest that crops were processed nearby although no primary deposits associated with such activities were revealed during this excavation.

7.0 DISCUSSION

7.1 Late Bronze Age

7.1.1 Linear feature [006] is of probable late Bronze Age date and contained charred wheat, suggesting possible food processing in the vicinity.

7.1.2 Pottery from the basal fill of ditch [1/004] appears to be of late prehistoric date. This ditch possibly represents a boundary. Later fills within the same ditch contain medieval 11th to 12th century date pottery suggesting that the boundary division may have persisted, albeit as a shallow depression, as a landscape feature.

7.1.3 Shallow linear feature [1/011] contained pottery of later prehistoric date. The prehistoric features run parallel to each other and may represent a migrating boundary feature or shallow agricultural features which respect the deeper boundary ditch [1/004].

7.2 Late Iron Age to Early Roman

7.2.1 Late Iron Age to early Roman features were represented by three, shallow, parallel linear features [007], [003], and [001] with a fourth linear feature [009] running perpendicular to [001]. These features appear to respect the alignment of the earlier prehistoric boundary. Though no obvious function for the features was ascertained, evidence was found to suggest the processing of cereal crops in the vicinity and also of metal working both ferrous and non ferrous. A partial crucible with copper alloy residue from gulley [009] along with a probable kiln bar suggests some industrial activity taking place in the area during the late Iron Age/early Roman period.

7.3 Medieval

7.3.1 No evidence was found for early medieval activity. Finds from the upper deposits of prehistoric boundary ditch [1/004] included domestic cooking pottery of 11th or 12th century date. It is possible that the boundary ditch remained as a landscape feature, if only as a shallow depression, through to the medieval period and that some activity such as manuring was taking place in the area during the medieval period.

7.4 Post-medieval

7.4.1 The focus of post-medieval activity appears to have been the northern half of the site with the south left as open green space or gardens. Intrusive services and range of ceramic building material are evidence of documented changes to post-medieval buildings. It is also the post-medieval and modern activity which has removed traces of earlier features across all but the southernmost part of site. Modern boundaries both to the east and west of the site follow the same line as the later Bronze Age and Late Iron Age/Roman ditches suggesting, as Yates (Yates 2007) decrees often occurs in southern Britain,

that the land division alignment originally laid-down in the later Bronze Age has persisted to the present day.

8.0 CONCLUSIONS

8.1 The archaeological evaluation and watching brief were undertaken in advance of, and during the early stages of, development at 12 North Street, Worthing.

8.2 The archaeological works have demonstrated the preservation of features related to human activity on site since the late Bronze Age and it is possible that the boundary orientation perhaps first laid-out then has been respected more or less continuously until late post-medieval times with local modern day boundaries appearing to respect the same alignment.

8.3 Evidence was found for late Iron Age or early Roman industrial activity including iron working and pottery and the processing of cereals in the vicinity of the site.

8.4 The archaeological investigations demonstrated that the majority of the northern part of site had been heavily truncated by later post-medieval building and modern demolition. Archaeological deposits to the south of the site however were found to have survived.

8.5 Geo-archaeological assessment of the underlying deposits identified an important sequence of deposits reflecting a number of differing environments of deposition, including infilling of a channel beneath the brickearth, from which a flint flake or probable Middle Palaeolithic date was recovered.

8.6 The evaluation and subsequent watching brief observed the entire footprint of the development area to be affected by intrusive works. The archaeological works have effectively recorded, interpreted and preserved the archaeological remains by record.

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ACKNOWLEDGEMENTS

The co-operation and assistance of Myk Flitcroft of CgMs Ltd and Mark Taylor of West Sussex County Council are greatly acknowledged. The assistance of Neil Mugridge and the staff of Denne Construction and Lemo-UK is also much appreciated.

SMR Summary Form

Site Code	NWO09					
Identification Name and Address	12 North Street, Worthing					
County, District &/or Borough	West Sussex					
OS Grid Refs.	514800 103000					
Geology	Brickearth and drift sands and gravels					
Arch. South-East Project Number	3924					
Type of Fieldwork	Eval. √	Excav.	Watching Brief √	Standing Structure	Survey	Other
Type of Site	Green Field	Shallow Urban √	Deep Urban	Other		
Dates of Fieldwork	Eval. 3-4th August 2009	Excav.	WB. 11-13th August 2009	Other		
Sponsor/Client	CgMs Ltd on behalf of Lemo-UK					
Project Manager	Darryl Palmer					
Project Supervisor	Sarah Porteus					
Period Summary	Palaeo.	Meso.	Neo.	BA √	IA√	RB √
	AS	MED √	PM √	Other Modern		

100 Word Summary

Archaeology South-East was commissioned by CgMs Limited to undertake a geoarchaeological and archaeological evaluation and watching brief on land at 12 North Street, Worthing, West Sussex.

The geoarchaeological work has revealed some important findings.

- *The ascription of marine sands to the last interglacial or MIS 5e marks the first time deposits east of the River Arun have been independently dated to the last interglacial. Previous observations had suggested that all marine sands within the Littlehampton to Brighton area correlated with Brighton/Norton Raised Beach and the penultimate interglacial. The new evidence suggests that two marine episodes are now preserved in this part of the coastal plain.*

- *The presence of microfossil rich stratified Devensian cold stage deposits at the site suggests that the diversity of landscapes previously only noted in the western parts of the coastal plain extend to the east.*

- *The dating of channelling and infilling of a channel and the base of the brickearth to around 50,000 years ago extends the date range for the depositional episode for the brickearth on the coastal plain considerably.*

- *The discovery of a single flint flake within the initial fills of this channel marks the first well provenanced artefact found in association with brickearth to be independently dated in the Sussex/Hampshire Coastal Corridor. The age associated with the artefact suggest loss of this flake within the middle part of the Devensian early in MIS 3. Its presence in the channel fill sequence, above a series of well stratified sediments probably associated with a series of temporary landsurfaces, suggests that a large number of contexts in which additional archaeological material might be anticipated are present within the vicinity. The now widespread distribution of these cool to cold climate deposits beneath brickearth on the coastal plain suggests that contexts capable of containing late Neanderthal archaeological remains may be widespread on the Sussex/Hampshire Coastal Corridor. These contexts were unknown until 2004.*

The archaeological evaluation and watching brief work has confirmed later Bronze Age, Late Iron Age/Roman and medieval activity in the southern part of the site. In the Bronze Age and Late Iron Age/Roman periods several ditches were laid out, probably delineating land division and/or to drain fields and livestock enclosures. It is probable that the orientation of this land division has been respected and developed upon from the later Bronze Age to the present day with modern boundaries continuing to follow a similar alignment.

Evidence was also found for late Iron Age or early Roman industrial activity including iron working and pottery and the processing of cereals, whilst medieval finds have been interpreted as the chance finding of pottery and brick and tile probably deposited during manuring and ploughing. In the northern parts of the site, post-medieval activity has caused significantly deep truncation to levels which, in the less disturbed southern part of the site, were found to preserve archaeological features.

OASIS Form

OASIS ID: archaeol6-62759

Project details

Project name	Geoarchaeological and archaeological works on land at 12 North Street, Worthing.
Short description of the project	*Archaeology South-East was commissioned by CgMs Limited to undertake a geoarchaeological and archaeological evaluation and watching brief on land at 12 North Street, Worthing, West Sussex.* *The geoarchaeological work has revealed some important findings.* • *The ascription of marine sands to the last interglacial or MIS 5e marks the first time deposits east of the River Arun have been independently dated to the last interglacial. Previous observations had suggested that all marine sands within the Littlehampton to Brighton area correlated with Brighton/Norton Raised Beach and the penultimate interglacial. The new evidence suggests that two marine episodes are now preserved in this part of the coastal plain.* • *The presence of microfossil rich stratified Devensian cold stage deposits at the site suggests that the diversity of landscapes previously only noted in the western parts of the coastal plain extend to the east.* • *The dating of channelling and infilling of a channel and the base of the brickearth to around 50,000 years ago extends the date range for the depositional episode for the brickearth on the coastal plain considerably.* • *The discovery of a single flint flake within the initial fills of this channel marks the first well provenanced artefact found in association with brickearth to be independently dated in the Sussex/Hampshire Coastal Corridor. The age associated with the artefact suggest loss of this flake within the middle part of the Devensian early in MIS 3. Its presence in the channel fill sequence, above a series of well stratified sediments probably associated with a series of temporary landsurfaces, suggests that a large number of contexts in which additional archaeological material might be anticipated are present within the vicinity. The now widespread distribution of these cool to cold climate deposits beneath brickearth on the coastal plain suggests that contexts capable of containing late Neanderthal archaeological remains may be widespread on the Sussex/Hampshire Coastal Corridor. These contexts were unknown until 2004.* *The archaeological evaluation and watching brief work has confirmed later Bronze Age, Late Iron Age/Roman and medieval activity in the southern part of the site. In the Bronze Age and Late Iron Age/Roman periods several ditches were laid out, probably delineating land division and/or to drain fields and livestock enclosures. It is probable that the orientation of this land division has been respected and developed upon from the later Bronze Age to the present day with modern boundaries continuing to follow a similar alignment.* *Evidence was also found for late Iron Age or early Roman industrial activity including iron working and pottery and the processing of cereals, whilst medieval finds have been interpreted as the chance finding of pottery and brick and tile probably deposited during manuring and ploughing. In the northern parts of the site, post-medieval activity has caused significantly deep truncation to levels which, in the less disturbed southern part of the site, were found to preserve archaeological features.*
Project dates	Start: 03-08-2009 End: 13-08-2009
Previous/future work	No / No
Type of project	Field evaluation
Current Land use	Other 2 - In use as a building
Monument type	DITCH Late Bronze Age
Monument type	DITCH Late Iron Age
Monument type	DITCH Roman

Monument type	DITCH Late Prehistoric
Significant Finds	KILN BAR Roman
Significant Finds	CRUCIBLE Roman
Methods & techniques	'Targeted Trenches'
Development type	Urban commercial (e.g. offices, shops, banks, etc.)
Prompt	Planning condition
Position in the planning process	After full determination (eg. As a condition)
Project location	
Country	England
Site location	WEST SUSSEX WORTHING WORTHING 12 North street, Worthing
Postcode	BN11 1DU
Study area	96.00 Square metres
Site coordinates	TQ 514800 103000 50.8717429055 0.153150885762 50 52 18 N 000 09 11 E Point
Project creators	
Name of Organisation	Archaeology South-East
Project brief originator	CgMs Consulting
Project design originator	CgMs Consulting
Project director/manager	Darryl Palmer
Project supervisor	Sarah Porteus
Type of sponsor/funding body	Developer
Name of sponsor/funding body	lemo-uk
Project archives	
Physical Archive recipient	Worthing Museum
Physical Archive ID	NWO09
Physical Contents	'Animal Bones','Ceramics','Metal'
Digital Archive recipient	Worthing Museum
Digital Archive ID	NWO09
Digital Contents	'none'
Digital Media available	'Images raster / digital photography','Text'
Paper Archive recipient	Worthing Museum
Paper Archive ID	NWO09
Paper Contents	'none'
Paper Media available	'Context sheet','Drawing','Notebook - Excavation',' Research',' General Notes','Photograph','Plan','Report','Section','Unpublished Text'
Project bibliography 1	

Publication type	Grey literature (unpublished document/manuscript)
Title	An archaeological evaluation and watching brief at 12 north street worthing
Author(s)/Editor(s)	Porteus,S.
Other bibliographic details	report number 2009138
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Description	A4 bound report and pdf versions
Entered by	sarah porteus (s.porteus@ucl.ac.uk)
Entered on	10 December 2009

APPENDIX 1: Environmental Sample Tables

Table 1: Residue Quantification (* = 1-10, ** = 11-50, *** = 51-250, **** = >250) and weights in grams

Sample Number	Context	Context / deposit type	Sample Volume litres	sub-Sample Volume litres	Charcoal >4mm	Weight (g)	Charcoal <4mm	Weight (g)	Charred botanicals (other than charcoal)	Weight (g)	Bone and Teeth	Cremated/Burnt?	Weight (g)	Other (eg ind, pot, cbm)
1	1/007	Fill of ditch [1/004]	30	30	*	<2	**	2	*	<1	**	N	22	Pot */6g, Slate */<2g, CBM */14g
2	1/009	Fill of ditch [1/004]	10	10	*	<1	*	<1	*	<1				
3	1/011	Fill of linear feature [1/010]	10	10	*	<1								FCF */<1
4	002	Fill of ditch [001]	15	15			*	<1	*	<1				FCF */6g, Pot */2g
5	004	Fill of ditch [003]	15	15			*	<1						FCF */76g, Pot */4g
6	006	Fill of ditch [005]	15	15	*	<1	**	<1			*	N	<1	FCF */30g, Pot */6g
7	008	Fill of ditch [007]	15	15	*	<1	*	<1						CBM */6g
8	010	Fill of gully [009]	15	15	*	<1	**	<2			*	N	<1	Pot */4g

Table 2: Flot Quantification (* = 1-10, ** = 11-50, *** = 51-250, **** = >250) and preservation (+ = poor, ++ = moderate, +++ = good)

Sample Number	Context	weight g	Flot volume ml	Uncharred %	sediment %	Uncharred seeds	Charcoal >4mm	Charcoal <4mm	Charcoal <2mm	crop seeds charred	Identifications	Preservation	weed seeds charred	Identifications	Preservation	other botanical charred	Identifications	Preservation	fish, amphibian, small mammal bone	LSS	Marine molluscs
1	1/007	16	35	30	15	*	**	**	***	**	*Triticum* sp., *Hordeum* sp., & cerealia indet., *Vicia/ Lathyrus* sp., *Pisum sativum*	++	*	cf. *Rumex/ Polygonum* sp., cf. *Bromus* sp.	++				* fish vertebra	*	*
2	1/009	6	20	92	4			*	*	*	indet cerealia, *Triticum* sp. (1)										
3	1/011	4	5	1	95			*	*	*	*Triticum* sp., indet. cerealia frags, & 1 cf Legume	+/ ++				*	(1) indet g.b. frag	+		*	
4	002	<1	2	4	35	*		**	**	*	cerealia indet., & cf. *Vicia/ Lathyrus* sp.	++	**	*Rumex/ Polygonum/ Fallopia*, cf. *Chenopodium album*, Poaceae, cf. *Euphorbia* cf. *peplus*, *Anthemis cotula*	++					*(1)	
5	004	<1	1	1	97				*				*(1)							*(1)	
6	006	<1	10	1	50			*	**	*	2 *Hordeum* sp.	+/ ++	1	cf. *Urtica* sp.	++	*	gb *Triticum spelta*			*(1)	
7	008	<1	<1	1	50			*													
8	010	4	15	15	20		*	**	***	*	*Triticum* sp., cf. *Hordeum* sp., 1 poss *Avena* sp.	+/ ++	*	cf. Poaceae	+	*	1 g.b. *Triticum* cf. *spelta*				

APPENDIX 2: GEOARCHAEOLOGICAL ASSESSMENT

NORTH STREET, WORTHING:
GEOARCHAEOLOGICAL ASSESSMENT

ASSESSMENT REPORT ON SITE WORKS

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JANUARY 2010

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ACKNOWLEDGMENTS

The authors would like to thank staff at Archaeology South-East including project manager Jim Stevenson and geoarchaeologist Matt Pope for arranging the project and help in the field. We would also like to thank construction staff on site for enabling the fieldwork to be undertaken quickly and efficiently.

Executive summary

This investigation was undertaken by the authors at the request of staff of Archaeology South-East. Fieldwork was undertaken in August 2009 with sample assessment and dating following. Sampling and section recording was undertaken on one face. This report describes the background to the geology and geomorphology of the region (Section 1.1) and the nature of the sequences preserved at the site (Section 2). Rapid sample assessment (Section 3) and the dating (Section 4) and assessment of contained microfossils (Section 5) are presented and finally the significance of the results are considered (Section 6).

The evidence from the sequence and the results of the assessment and analysis indicate that an important sequence of sediments documenting a number of differing environments of deposition are preserved at the site. Marine sands at the base of the sequence have been dated to the last interglacial on the basis of the OSL ages. These are overlain by deposits rich in microfossils (ostracods) that clearly exhibit cool or cold stage characteristics based both on the nature of the sediments themselves and the contained biological indicators (microfossils). Finally brickearths and gravels infill a channel like feature cut into the underlying sediments. Major erosion was associated with the excavation of this channel. No biological material was recovered from the channel but two OSL dates indicate initial infilling of the channel in the middle Devensian. The importance of these findings are:

1. The ascription of the marine sands to the last interglacial is the first time deposits in this part of the Sussex/Hampshire Coastal Corridor have been dated to the last interglacial.
2. The presence of the stratified cold stage deposits rich in microfossils at this location suggests that the diversity of landscapes previously only noted in the western parts of the coastal plain extend to the east.
3. The dating of the channelling and infilling of the channel and the base of the brickearth to the Middle Devensian is older that previously thought for much of the brickearth deposition on the coastal plain.

The discovery of a single flake within the initial fills of the channel is the first well provenanced artefact found in association with brickearth to be independently dated in the Sussex/Hampshire Coastal Corridor. The age associated with the artefact suggest loss of this flake within the middle part of the Devensian. Its presence in the channel fill sequence, above a series of well stratified sediments probably associated with a series of temporary landsurfaces, suggests that a large number of contexts in which additional archaeological material might be anticipated are present within the vicinity. The now widespread distribution of these cool to cold climate deposits beneath brickearth on the coastal plain suggests that contexts capable of containing late Neanderthal archaeological remains may be widespread on the Sussex/Hampshire Coastal Corridor. These contexts were unknown until 2004.

1. Introduction

This investigation was undertaken by the authors at the request of staff of Archaeology South-East. Fieldwork was undertaken in August 2009 while sample assessment and dating was undertaken in Autumn and early Winter 2009.

When the site was visited on 18th August 2009 excavation of the main basement had been undertaken by contractors and a piling base laid. Sampling and section recording was undertaken on one face (east facing north/south transect; Figure 2) after inspection of all exposed faces.

This report describes the background to the geology and geomorphology of the region (Section 1.1) and the nature of the sequences preserved at the site (Section 2). Rapid sample assessment (Section 3) and the dating (Section 4) and assessment of contained microfossils (Section 5) and finally the significance of the results are considered (Section 6).

1.1 Local geology and geomorphology

The site (TQ 14930 02925) lies towards the eastern end of the Sussex/Hampshire Coastal Corridor (Bates *et al*., 1997) within the centre of Worthing. The coastal plain here is approximately 3.5km from north to south and the site lies immediately west of a small embayed rife system running in a NW to SE direction. Ground levels in the vicinity of the site are between 8.5 and 9m O.D.

British Geological Survey mapping (1984) records that brickearth underlies the area around the site with patches of raised beach material located to the west and east. Bedrock at the site is undifferentiated Upper/Middle Chalk while the boundary with the overlying London Clay lies some 200m to the north.

Recent work (Bates *et al*., 2004, 2007, 2009) has shown that beneath the brickearth over parts of the coastal plain a complex sequence of both marine and terrestrial deposits are present that date to both warm and cold periods in the later Pleistocene. While these sequences have only been investigated at a few sites, the complexity of the cold climate deposits are beginning to be understood (Bates and Briant, 2009). Despite the relatively few sequences that have been examined in detail, palaeontological material has been recovered from a number of sites that have made the interpretation of the sediments easier (Bates *et al*., 2004, 2007, 2009).

It is now known that two distinct groups of cold stage sediments occur on or beneath the coastal plain to the east and west of Chichester. These deposits consist of:

1. Bedded chalky gravels and silts. These have been noted at a number of sites east of Chichester at Bersted (SU 92140 01305) and Woodend Farm (SU 91460 63160). These deposits appear to have accumulated under cold, wet conditions where abundance of earthworm granules in the sediments attests to intermittent soil formation.

2. Fine grained carbonate rich silts beneath bedded chalky gravels. These deposits have been located at Warblington (SU 72675 05330) where ostracods attest to deposition in a substantial freshwater system (see Bates *et al*., 2009). Pollen indicates surrounding conditions of open grassland.

The majority of the work undertaken to examine these sequences has been done through the use of boreholes and machine dug test pits where access to the sequences has been prohibited due to the depth of the deposits and the inability to access the sequences. Consequently little

is known about the lateral variability of the sequences and in particular the nature of the systems responsible for deposition of the fine grained carbonate rich silts (2 above). Another current limitation to our understanding of these deposits relate to the dating of the sequences. The stratigraphic position of these sediment bodies suggest they may date to either the last cold stage or the penultimate cold stage. Preliminary dating of the sequences at Warblington (Bates *et al*., 2009) suggests here at least a middle Devensian age is attested to for part of the sequence.

2. Site stratigraphy

Sequences were recorded on the western side of the main excavation (Figures 2-6). The section was cleaned and a small sondage dug to below the piling base to expose the base of the sequence and Chalk bedrock. A diagrammatic profile was drawn (Figure 2) and a record made of all samples taken. Five OSL samples were also taken (1-5 on Figure 2).

A detailed description of the contexts identified are presented in Appendix A and Table 1. Five main geological units were identified:

I Chalk bedrock (117). The surface of the Chalk bedrock was encountered at an approximate depth of 3m O.D.

II Sands (115/116). The sands contained rounded flint clasts at the base with occasional chalk clasts.

III Bedded chalky silts (107-113). These consisted of chalky silts and occasional gravel lenses. Some evidence was noted for laminations and bedding within units.

IV Brickearth and gravels (102-106). Fine grained silts (102) and coarse gravels and sands (103-106) were found infilling an erosion surface into the underlying sediments of group III.

V Made ground (101). This was not described and includes modern dumping as well as evidence for Holocene human activity (see archaeological report).

The brickearth at the top of the sequence (102) is typical of the brickearth present across much of the coastal plain and equates to that mapped by the BGS (1984) across the Worthing area. The basal parts of the brickearth fill a channel incised into the underlying sequence of bedded silts (group III). The basal part of the channel is infilled with gravels dipping steeply to the south. The main body of sediment (group III) is superficially similar to main of the sequences previously noted at Bersted and Woodend Farm. These sequences have been ascribed to cold climate conditions. Marine sands are present at the base of the sequence (group 2) immediately above Chalk.

3. Rapid sample assessment

A total of 42 samples (Appendix A) were examined and contained a range of palaeoenvironmental material (see Table 2 for selected sample results). The samples consisted of two samples of "brickearth" (44 and 45) and sand (43) from the channel. These overlay 26 samples of clay-silts from the main stratified sequence. These in turn are underlain, possibly conformably, by 13 samples of supposedly marine sands (of an unknown raised beach).

Each sample was placed in a ceramic bowl and dried in an oven. In most cases all of the sediment provided was used. Hot water was then poured over the sample and a teaspoon of sodium carbonate was added to remove the clay. This was left soaking overnight and then it

was washed through a 75 micron sieve, using hot water. Each sample broke down readily, apart from samples 1-5 (contexts 108, 109) where the process had to be repeated. The residue was finally dried in an oven, before being put through a nest of sieves and examined under the binocular microscope.

3.1 Results

Group IV, context 102 - Brickearth
The two samples of "brickearth" (44 and 45), apart from the presence of some rusty plant tubes, were completely barren.

Group IV, context 103 - Sand in channel
Fine sand (43) from the lag of a channel associated with the brickearth, at the top of the sequence, was also analysed. (43) was good clean sand but it was also completely barren, lacking even reworked microfossils.

Group III ,Clay-silts
A series of clay-silt samples from a variety of sediments and contexts (108, 109, 110, 111, 113 and 114), from two monoliths and a measured section, make up a major sequence in the Worthing excavation (Table 2). Unfortunately samples 1-11 are totally unfossiliferous, although all have iron mineral. The sediments of samples 1-5 (contexts 108 and 109) appear to have a different provenance to those from samples 6-12/14 however. The former wash down (through a 75 micron sieve) to virtually no residue and the iron mineral is black and probably goethite. In the latter the iron mineral is orange/brown and must be (in part) limonite; in some cases it forms an iron-pan. It is also found as tubes (apparently formed around plant roots). These iron tubes, nodules, and precipitates (often goethite), according to Candy (*in* Ashton *et al.,* 2005), seem to be associated with weathering or near-surface groundwaters, formed prior to the onset of fully terrestrial conditions, or pedogenic activity. Some samples (especially in contexts 110 and 111), on the other hand, have much chalk debris and flint and seem to represent pulses of erosion. Whereas the uppermost contexts 108 and 109 are semi-terrestrial and weathered, and possibly immature soils, contexts 110, 111 and 113 appear to be fluvially derived or deposited. Context 114 is quite different however. The sediments here contain earthworm granules and some slug plates. Ostracods and occasional forams were found in some samples (Table 2).

Group II - Marine sands
Below the clay-silts are samples 42-40, 36-27 (from contexts 115 and 116) which are thought to be of marine origin. Their residues all proved to be all barren. There are some sedimentological observations that can be made which might be of some value. Samples 42 and 41 (context 116) contain chalk debris and chalk microfauna; this appears to indicate active erosion. In samples 36-32 the chalk component becomes rarer and rarer and what there is, is "dirty"; this would appear to signify a diminution of erosion. Samples 31-27 contain no chalk at all. Another feature of this sequence is that the residues fine upwards, so that by sample 34 most of it goes through the 250 and 150 micron sieves; this is typical of a regressive sequence. Another useful feature is the presence of iron in these upper sediments. This starts in sample 31 and gets more and more prominent until by sample 28 there is almost an iron-pan. This may be interpreted as weathering of the sandflats. The next sample up-sequence is 27 where a facies change begins and we go into the clay-silts, apparently conformably. This sample contains no indigenous microfossils, but has chalk (and chalk microfossils) and lots of iron (limonite and goethite).

4. OSL dating

Samples for optically-stimulated luminescence (OSL) dating were taken in opaque plastic tubing and stored in light-tight bags until processed. Sample locations were chosen to maximise the likelihood of zeroing before deposition and were usually clean, well-sorted sand beds. Preparation to quartz involved separation of the modal size fraction by wet sieving and treatment with hydrochloric and hydrofluoric acids, removal of heavy minerals using sodium polytungstate and final dry sieving (Bates *et al.*, 2004). Sample purity was tested using infra-red (IR) light stimulation, which detects contamination by feldspars (Hütt *et al*., 1988). Those samples with feldspar contamination were subjected to further treatment in fluorosilicic acid to ensure samples comprised quartz only. Palaeodose was determined in the Research Laboratory for Archaeology and the History of Art, Oxford, using automated Risø measurement systems with both blue diodes and green halogen light. The Single Aliquot Regenerative (SAR) protocol of Murray and Wintle (2000) was used, with the addition of a post-IR blue OSL procedure within the SAR protocol (Banerjee *et al*., 2001) to further minimise feldspar contributions and remove problems of anomalous fading. Luminescence measurements were made at 125^{o}C, with a preheat 1 (PH1) value of 260^{o}C for 10 s, preheat 2 (PH2) of 220^{o}C for 10 s and up to 6 regeneration dose points. Equivalent dose (D_e) is a weighted mean of between 5 and 12 aliquots.

Environmental dose rates were calculated by Neutron Activation Analysis (NAA). Beta dose rates were calculated on the basis of NAA and gamma dose rates on the basis of gamma spectroscopy. Radioisotope concentrations were converted to dose rates using the conversion factors of Adamiec and Aitken (1998) and grain-size attenuation factors of Mejdahl (1979). Cosmic dose rates were calculated using the equation of Prescott and Hutton (1994) and it was assumed that overburden accumulated soon after deposition and was negligible relative to the burial period. Interstitial water content attenuates dose rates, and this was corrected for using the absorption coefficient of Zimmerman (1971). It was assumed that present-day moisture content was representative of water contents throughout burial (percentage dry weight of sample) with a 5% error to reflect uncertainty in estimation. Age estimates are shown in Table 3.

5. Foraminifera and Ostracod assessment

Microfossils were restricted to a number of discrete samples. Context 114, a 60cm interval at the base of the clay-silts, contained a monotonous, low diversity, yet most important freshwater ostracod fauna (Table 4). Two of the species, *Limnocytherina sanctipatricii* and *Leucocythere batesi*, are both cold/cool indicators (Whittaker & Horne, 2009) and have been found previously and extensively in cold climate solifluction deposits in the Warblington-Bognor-Middleton-on-Sea area to the west where a Devensian date has been proven in at least one locality (Bates *et al.,* 2009). Proxy data from northern Siberia (Wetterich *et al.,* 2005), where very similar species are found in a permafrost sequence, indicate their habitats were small, shallow, cold, oligotrophic pools located in low centred ice wedge polygons or in small thermokarst depressions that warmed during the summer season. These faunas end abruptly in the Worthing sequence at sample 13/15 at the top of Context 114, although some decalcification is already apparent in sample 16, so it would appear that context 113 (and above) has a different provenance and probable, age.

One final point needs to be addressed. Two of the samples of context 114 (24 and 25), near the base (Table 4), contain rare foraminifera belonging to the euryhaline species *Elphidium williamsoni.* These must be derived from marine sand sequences. A similar situation was noted at King George's Fields, east of Bognor (M. Bates, pers. comm.). Here at Worthing the foraminifera cannot have been derived from the marine sands which underlie context 114, as they are all barren, rather they must be have been incorporated from another local marine

deposit through the process of solifluction.

6. Discussion

The evidence from the sequence and the results of the assessment and analysis indicate that an important sequence of sediments documenting a number of differing environments of deposition are preserved at the site (Table 5). From the base these consist of:

Group II sediments. These are considered to be marine sands on the basis of their appearance despite the fact that the sands were decalcified and no microfossils were preserved in the sediments. The basal parts of the sequence contain flint gravel and substantial quantities of chalk debris indicating active erosion (116). The sands fine upwards through (115) and the upper part of the sequence is enriched in iron. This suggests the presence of a regressive tendency within the sequence culminating in exposure and weathering of the sand surface following retreat of the sea. If this scenario is correct no erosion has occurred to truncate the marine sands. The deposits have been dated to 119.01+/-12.52ka B.P. and 121.75+/-21.07ka B.P. which correlates with the conventional ages for the last interglacial (Marine Isotope stage 5e) (Table 3).

Group III sediments. These deposits clearly exhibit cool or cold stage characteristics based both on the nature of the sediments themselves and the contained biological indicators (microfossils). Sediment characteristics and microfossils from the base of the sequence (114) suggest an environment in which permafrost was widespread and within which small, shallow, cold, oligotrophic pools were developed. Weathering and incipient paedogenesis was also noted. Local reworking of older sequences is attested by the presence of *E.williamsoni* in parts of 114. Up profile through 110-113 the contexts are dominated by coarser sediments with quantities of chalk and sand probably resulting from inwash of material by fluvial action. A single OSL date from context 111 has produced an age of 135.64+/-8.84ka B.P. (Table 3) that is older than the underlying dates of the marine sequence however, at one Standard Deviation this date overlaps with the older date from the marine sands. The most likely explanation is that the sand dated in 111 derives from reworking of the underlying raised beach and that the base of this group of sediments is younger than the last interglacial. Finally the upper parts of this sequence (108/109) exhibit a return to possible semi-terrestrial situations with the presence of extensive iron staining and root tubules within the sequence.

Group IV sediments. These deposits infill a channel like feature cut into the underlying sediments of group III. Major erosion associated with the excavation of this feature and the coarse sediments infilling the basal parts of this channel (103-106) suggest downcutting. No biological material was recovered from the channel but two OSL dates (Table 3) indicate initial infilling of the channel around 50 ka B.P. early within MIS 3. These ages constrain the deposition of the underlying group of sediments (III) to the early Devensian (MIS 5d-4). Whether there is a major difference in age between the main body of brickearth associated with youngest OSL date and the top of the brickearth cannot be ascertained.

The importance of these findings are:

1. The ascription of the marine sands to the last interglacial or MIS 5e is the first time deposits east of the river Arun have been independently dated to the last interglacial. Previous observations had suggested that all marine sands within the Littlehampton to Brighton area correlated with Brighton/Norton Raised Beach and the penultimate interglacial (Bates *et al.*, 2000). The new evidence suggests that two marine episodes are now preserved in this part of the coastal plain.

2. The presence of the stratified Devensian cold stage deposits rich in microfossils at this location suggests that the diversity of landscapes previously only noted in the western parts of the coastal plain extend to the east.

3. The dating of the channelling and infilling of the channel and the base of the brickearth to around 50,000 years ago (the beginning of MIS 3) extends the date range for the depositional episode for the brickearth on the coastal plain considerably (e.g. Parks (1990) and Parks and Rendell (1992) had previously considered deposition of the main body of the brickearth in the area to be a late Devensian phenomena).

6.1 Archaeological significance of the results

A single worked flint flake recovered within the initial fills of the channel during the geoarchaeological evaluation is the first well provenanced artefact found in association with brickearth to be independently dated in the Sussex/Hampshire Coastal Corridor. The age associated with the artefact suggest loss of this flake within the middle part of the Devensian early in MIS 3. Its presence in the channel fill sequence, above a series of well stratified sediments probably associated with a series of temporary landsurfaces, suggests that a large number of contexts in which additional archaeological material might be anticipated are present within the vicinity. The now widespread distribution of these cool to cold climate deposits beneath brickearth on the coastal plain suggests that contexts capable of containing late Neanderthal archaeological remains may be widespread on the Sussex/Hampshire Coastal Corridor. These contexts were unknown until 2004.

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Sample Number	Context	Group	Age estimate
OSL 1	115	II	119.01±12.52 ka
OSL 2	115	II	121.75± 21.07 ka
OSL 3	111	III	135.64 ± 8.84 ka
OSL 4	013	IV	56.38±5.18 ka
OSL 5	102	IV	48.79±3.51 ka

Table 3. OSL age estimates.

Appendix A. Description of main lithological units.

Context number	Lithology	Stratigraphy	Samples	Inferred environment of deposition
101	Rubble	Made ground		Recent human dumping and levelling
102	10YR 5/6 yellowish-brown clay-silt. Many vertical root canals (empty, 3-4mm wide). Compact and firm. No apparent structure	"Brickearth"	OSL 5	Low energy fluvial conditions with moving water and windblown silt under cool to cold conditions.
103	5Y 5/3 olive clay-silt. Very dense, firm and compact. Some very thin root canals present. Structureless.	Channel lag gravels	BS 44 BS 45 OSL 4	High energy fluvial conditions with flowing water under cool to cold conditions
104	10YR 4/6 brownish-yellow flint gravel. Clast supported with clasts 2-10cm. Clay, silt and sand matrix. Dense and compact.	Channel lag gravels		High energy fluvial conditions with flowing water under cool to cold conditions
105	10YR 8/3 very pale brown soft medium to coarse sand. Occasional rounded flint clasts. Very loose.	Channel lag gravels		High energy fluvial conditions with flowing water under cool to cold conditions
106	10YR 6/6 brownish yellow sandy-gravel. Clast supported, with clasts 2->6cm. Loose and unconsolidated.	Channel lag gravels		High energy fluvial conditions with flowing water under cool to cold conditions
107	10YR 6/6 brownish yellow sandy-gravel. Clast supported, with clasts 2->6cm. Loose and unconsolidated.	Channel lag gravels		High energy fluvial conditions with flowing water under cool to cold conditions
108	7.5YR 6/8 reddish-yellow clay-silt with 10YR 7/6 yellow mottles. Possibly remnant bedding in places with sub-horizontal, thin (<5mm) laminae note. Dense and compact.	Bedded Silts	BS 1	Low energy fluvial with emergence of surfaces and phases of weathering under cool to cold conditions
109	10YR 6/2 light brownish grey clay-silt. Dense and compact.	Bedded Silts	BS 2 BS 3 BS4 BS 5	Low energy fluvial with emergence of surfaces and phases of weathering under cool to cold conditions
110	7.5YR 6/8 reddish yellow clay-silt.	Bedded Silts	BS 6 BS 7	Low energy fluvial with emergence of surfaces and phases of weathering under cool to cold conditions
111	5YR 5/8 yellowish-red sand with some gravel.	Bedded Silts	BS 8 BS 9	Low energy fluvial with emergence of

	Loose and relatively unconsolidated.		OSL 3	surfaces and phases of weathering under cool to cold conditions
113	7.5YR 5/3 brown clay-silt with manganese staining.	Bedded Silts	BS 10 BS 11 BS 12 BS 14	Low energy fluvial with emergence of surfaces and phases of weathering under cool to cold conditions
114	2.5Y 6/4 light yellowish-brown silt – possibly bedded with chalk rich patches (consisting of sub-angular clasts of chalk <4mm) and silt and chalk free zones. Loose and unconsolidated.	Bedded Silts	BS 13 BS 15 BS 16 BS 17 BS 18 BS 19 BS 20 BS 21 BS 22 BS 23 BS 24 BS 25 BS 26 BS 27 (transition)	Low energy fluvial with emergence of surfaces and phases of weathering under cool to cold conditions
115	10YR 6/8 brownish-yellow sand.	Marine Sands	BS 27 (transition) BS 28 BS 29 BS 30 BS 31 BS 32 BS 33 BS 34 BS 35 BS 36 OSL 2 OSL1	Moderate energy marine sand flats under temperate conditions
116	10YR 6/8 brownish yellow sand with common gravel clasts and chalk. Clasts of flint are <10cm, well rounded.	Marine Gravels	BS 40 BS 41 BS 42	High energy marine sands and gravels under temperate conditions
117	Chalk	Chalk		Bedrock

Appendix B. Samples assessed

(samples presented in reverse order of deposition)

Group IV - Brickearth

Sample	Context	Weight processed
44 (top)	103	190g
45	103	200g

Group IV - Sand in channel

Sample	Context	Weight processed
43	105	110g

Group III - Clay-silts

Sample	Context	Depth	Weight processed
1 (top)	108		200g
2	109		200g
3	109		175g
4	109		175g
5	109		175g
6	110		175g
7	110		175g
8	111		175g
9	111		175g
10	113		175g
11	113		175g
12	113		175g
13	114		175g
14	113	0-5cm	150g
15	114	5-10cm	165g
16	114	10-15cm	175g
17	114	15-20cm	175g
18	114	20-25cm	135g
19	114	25-30cm	160g
20	114	30-35cm	175g
21	114	35-40cm	175g
22	114	40-45cm	135g
23	114	45-50cm	175g
24	114	50-55cm	160g
25	114	55-60cm	160g
26	114	60-65cm	185g

Group II - Marine sands

Sample	Context	Depth	Weight processed
27	114/115	65-70cm	150g
28	115	70-75cm	135g
29	115	75-80cm	150g
30	115	80-85cm	150g
31	115	85-90cm	125g
32	115	90-95cm	175g
33	115	95-100cm	175g
34	115	100-105cm	110g
35	115	105-110cm	115g
36	115	110-115cm	175g
40	116	115-120cm	125g
41	116	120-125cm	90g
42 (base)	116	125-130cm	175g

Group	Context number	Stratigraphy	Contained biological evidence	Inferred environment of deposition
V	**101**	Made ground	-	Human construction and levelling of site for building after agriculture?
				---major unconformity/presence of landsurface---
IV	**102**	"Brickearth"	No preserved biological evidence	
IV	**103 - 107**	Channel lag gravels	No preserved biological evidence	
				---major unconformity/erosion event---
III	**108-114**	Bedded Silts		
II	**115**	Marine Sands	No preserved biological evidence	High to medium energy marine, temperate during high sea level event
II	**116**	Marine Gravels	No preserved biological evidence	High energy marine, temperate during high sea level event
I	**117**	Chalk	-	-

Table 1. Contexts, descriptions, associated biological material and environments of deposition.

Group	Context number	Stratigraphy	Inferred environment of deposition	Age
V	**101**	Made ground	Human construction and levelling of site for building after agriculture?	Holocene
			---major unconformity/presence of landsurface---	
IV	**102**	"Brickearth"	Cold climate fluvial conditions	45-55ka B.P., early MIS 3 ?possibly more recent to top
IV	**103 - 107**	Channel lag gravels		
			---major unconformity/erosion event---	?transition MIS 3/4
III	**108-109**	Bedded Silts	Semi-terrestrial environments under cool to cold climate conditions with weathering and paedogenesis of sediments.	
	110-113		Periglacial environment with influx of chalk debris under fluvial conditions.	Early to Middle Devensian, MIS 5d-late MIS 4
	114		Semi-terrestrial at base with local pools and ponds in permafrost environment. Local erosion of marine sediments in vicinity of site.	
II	**115**	Marine Sands	Regressive tendency associated with upwards fining sands. Development of a weathering horizon at top indicating full marine regression and incipient soil formation?	115-125ka B.P. – last interglacial, MIS 5e
	116	Marine Gravels	High energy marine, temperate during high sea level event. Significant local erosion.	
I	**117**	Chalk	-	Cretaceous

Table 5. Summary of results.