STRATFORD CITY DEVELOPMENT
THE CARPENTERS TRIANGLE BRIDGE H12

LONDON BOROUGH OF NEWHAM

A REPORT ON THE ARCHAEOLOGICAL & GEOARCHAEOLOGICAL WATCHING BRIEF & EVALUATION

REFERENCE: K1954-EVA-1

Project Manager *Peter Moore*

Authors *Phil Frickers*
Mary Ruddy

MoLA-PCA

Pre-Construct Archaeology Limited
Unit 54 Brockley Cross Business Centre
96 Endwell Road
Brockley
London SE4 2PD

Tel: 0207 732 3925
Fax: 0207 732 7896
Email: pmoore@pre-construct.com
Web: www.pre-construct.com

Museum of London Archaeology Service
Mortimer Wheeler House
46 Eagle Wharf Road
London N1 7ED

Tel: 0207 410 2200
Fax: 0207 410 2201
Email: molas@molas.org.uk
Web: www.molas.org.uk

MUSEUM OF LONDON Archaeology Service
PRE-CONSTRUCT ARCHAEOLOGY

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27 February 2009

Summary (non-technical)

This report presents the results of an archaeological and geoarchaeological evaluation and watching brief carried out by the Museum of London Archaeology Service and Pre-Construct Archaeology Limited upon the site of Bridge H12 in the Stratford City Development, within the area designated PDZ9, in the London Borough of Newham. The report was commissioned from MoLA-PCA by HOCHTIEF (UK) Construction Ltd.

Two evaluation trenches were excavated and both lay within very large cut features, interpreted as quarries, which had significantly truncated the below ground deposits. No archaeological remains were found but it is likely that one of the trenches lay within a former tributary of the Channelsea River.

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1 Introduction

1.1 Site Background

1.1.1 The watching brief and evaluation took place in the London Borough of Newham on a triangle of land formed by three railway lines, namely the main London to Stratford Station line to the southwest of Stratford Station, and the Carpenters Road and Channelsea Curves branch lines to the west which together formed an inaccessible triangular area of land. The scheme (as considered in this report) consisted of the construction of a new bridge (known as the Stratford City Access Bridge 12) across the Carpenters Road and Channelsea Curves linking the Warton Road to Zone 1 of the Stratford City site. This watching brief and evaluation refers only to the triangle of land in which the bridge itself stands. The central OS National Grid Reference for the centre of the area is TQ 3832 8424.

1.1.2 Current ground level across the site varies from approximately 5.58m AOD to 7.85m AOD. The site code is SZG 08.

1.1.3 A desk-based assessment was undertaken for PDZ9 (MoLA-PCA 2007a), and should be referred to for information on the geology, archaeological and historical background of the site, and the initial interpretation of its archaeological potential. A Written Scheme of Investigation (WSI) was prepared for the investigation (Moore 2008).

1.1.4 The proposed development of the evaluated site involves the construction of Bridge H12, as part of the Stratford City Development, which is anticipated to impact on the archaeological resource (MoLAS/PCA 2007b) The two trenches excavated were planned to evaluate the impacted area. The trenches were undertaken to assess the potential of the area that would be impacted by this development work and were positioned as such.

1.2 Planning and Legislative Framework

1.2.1 A general background to the planning and legislative framework covering all sites included in the Stratford City and Lower Lea Valley Olympic applications was included in the previous *Environmental statements* (ARUP 2003 & Capita Symonds 2004).

1.3 Planning Background

1.3.1 In accordance with local and national policies, archaeological evaluation and survey of the areas of PDZ9 to be impacted upon in advance of its redevelopment was required

as part of the planning process. Evaluation is intended to define the archaeological potential and significance of any deposits present on the site, so that the local authority can formulate responses appropriate to any identified archaeological resource.

1.3.2 The evaluation of the subject site, Stratford City Bridge H12, was undertaken as part fulfillment of a condition applied by the Olympic Delivery Agency Planning Decisions Team and attached to The Olympic, Paralympic and Legacy Transformation Planning Applications. The condition (16) states:

> *No works shall take place until the Application has secured the implementation of a programme of archaeological work in accordance with a written scheme for investigation which has been submitted by the Applicant and approved by the Local Planning authority. The works shall only take place in accordance with the detailed scheme pursuant to this condition. The archaeological works shall be carried out by a suitably qualified investigation body acceptable to the Local Planning Authority.*
>
> *Reason: Significant archaeological remains may survive on site. The planning authority wishes to secure the provision of archaeological investigation and the subsequent recording of the remains prior to development, in accordance with the guidance and model condition set out in PPG 16 and in accordance with policies 4B.14 of the London Plan, BHE17 of Waltham Forest Unitary Development Plan 2006 and EQ 29 of Hackney Unitary Development Plan 1995.*

1.4 Origin and Scope of the Report

1.4.1 This report was commissioned from MoLA-PCA by HOCHTIEF (UK) Construction Ltd., and has been prepared within the terms of the relevant Standard specified by the Institute of Field Archaeologists (IFA 2001). Field evaluation, and the *Evaluation Report* which comments on the results of that exercise, are defined in the most recent English Heritage guidelines (English Heritage, 1998) as intended to provide information about the archaeological resource in order to contribute to the:

- Formulation of a strategy for the preservation or management of those remains; and/or
- Formulation of an appropriate response or mitigation strategy to planning applications or other proposals which may adversely affect such archaeological remains, or enhance them; and/or

- Formulation of a proposal for further archaeological investigations within a programme of research.

1.5 Archaeological Background

1.5.1 The following section summarises the site background based upon the desk based assessment for PDZ9 (MoLA-PCA 2007a) and previous MoLA-PCA work. For highlighted terms see the glossary (***Appendix 1***) and for sites mentioned in the text, see Figure 7.

1.5.2 Modern Topography

1.5.2.1 Planning Delivery Zone Nine (PDZ9) is located on the centre and the eastern side of the floodplain of the Lea Valley, to the east of the Waterworks River, which forms the western boundary of the zone. The Channelsea River flows across the western part of the zone to the east of the site. These rivers are two of the Bow Back Rivers that form part of the river Lea.

1.5.2.2 The modern River Lea and its tributaries have been canalised, diverted and culverted in places. This is due to management and reclamation in response to rising river levels and increased flooding as well as historic development, such as medieval adaptation for mill streams and diversion for the Victorian railway.

1.5.2.3 The extent of modification is often difficult to ascertain and for example, the origins of the Channelsea (whether a natural river or manmade water course) remain unclear. Where exposed today, the Channelsea exists as a stagnant-looking ditch.

1.5.2.4 Modern ground level varies greatly across the site, as a result of modern and historic ground raising associated with construction of the present railway depots and freight terminal. Generally the modern land surface lies at around 5m-6m OD. Land levelling and construction disguise the fact that the rivers were major topographic features that would have played a significant part in the lives of people in the past.

1.5.3 Geology and Topography

1.5.3.1 **Alluvium** is mapped across the zone (British Geological Survey Sheet 256) and represents a range of different environments on the floodplain of the Lea from the Mesolithic period onwards. Excavation in the Thames and Lea valleys suggests that archaeological remains of the prehistoric and early historic periods lie buried within the alluvium. Pleistocene Gravel (the Lea Valley Gravels) lies under the alluvium.

Immediately beyond the eastern part of the site, areas of older gravels and exposed bedrock are mapped on the valley side.

1.5.3.2 The gravels below the floodplain were deposited during glacial outwash at the end **Pleistocene** (during the Palaeolithic period) approximately 10 to 15 thousand years ago (ka) following scouring-out of the valley floor (at the end of the **last glacial maximum** *c* 18ka). The Lea Valley Gravels are the most recent in a series of Pleistocene river terrace deposits that form a flight of steps on the valley side. Kempton Park Gravels and the older Taplow Gravels form higher, older terraces and are mapped beyond the eastern limits of PDZ9.

1.5.3.3 The site lies to the west or at the western edge of a 'Low Terrace' identified by previous and current (Olympics) mapping of the sub-surface deposits (Lea Valley Mapping Project (LVMP) Burton *et al* 2004) that forms part of the Lea Valley Gravels. This landscape feature exists as a wide ledge running along the eastern side of the valley floor between Temple Mills and Stratford and is thought to have been formed at the **late glacial** to interglacial transition as the river scoured the valley bottom further west, leaving the low terrace as an upstanding feature.

1.5.3.4 Tertiary bedrock, which in this area is variably London Clay and Woolwich and Reading Beds, underlies the gravels. Bedrock pre-dates the period of human evolution and thus its surface acts as the bottom line for deposits of archaeological interest.

1.5.4 Prehistoric

1.5.4.1 Previous investigations and findspots indicate prehistoric activity took place within the zone.

1.5.4.2 Early prehistoric or Palaeolithic flint artifacts have not yet been found reworked within gravels at sites locally, even though gravels terraces are recognised as important repositories of Palaeolithic finds (Bridgland, 2006). However, evidence for Late Upper Palaeolithic environments that relate to the end of the Ice Age have been found within gravels at the Stratford Box (SBX00) and the Eastway Cycle Circuit to the north of the zone. If discovered, there is good potential for further work on these types of deposit to provide a better understanding of the dramatic landscape processes that took place in the Lower Lea as the climate fluctuated at the end of the Ice Age.

1.5.4.3 The low terrace to the east of the site would have remained as higher, drier ground during the prehistoric and early historic period, raised above the wetland of the valley

floor, and prehistoric archaeology is known on at several sites in the area. To the east, lies the Stratford Box site (SBX00) (WA, 2002) notable for the evidence of Bronze Age cut features, late Iron Age wood chipped surface (dated to 380-160 BC) and palaeochannel deposits.

1.5.4.4 Bronze Age occupation including a ring-ditch, pits, post-holes and various fencing alignments is recorded on the east bank of the Lea at Oliver Close (PEM, 1992; PCA, 2001) and cremations on the site of the old cold stores (Frigoscandia SZD08) (Holden and Nicholls, in prep). The site of the new DLR platform (SZA07) where Bronze Age flints were found also lies in close proximity (Johnson and Nicholls, in prep). These finds attest to thriving Bronze Age communities.

1.5.4.5 A possible Iron Age willow tip fence or revetment stakes were identified during work on the Channelsea culvert (GNF06) to the north of Stratford station. In addition, elm drains and timber associated with reclamation, modification of the river and railway construction were found (Eastbury and Nicholls, 2007).

1.5.4.6 Prehistoric and Roman dry land occupation is also documented on the higher ground locally at Warton Road (OL-00305) and Carpenters Road.

1.5.4.7 Although currently difficult to map exactly, it is certain that natural rivers crossed the Valley sides and flowed into the Lea for thousands of years in early prehistory. These rivers would have cut across Stratford Marsh in later prehistoric times

1.5.5 Roman

1.5.5.1 PDZ9 has a low to moderate potential for remains of Roman date. The line of a Roman road may cross the zone. Such a road was identified *c.*500m east of Delivery Zone Nine at Maryland Point.

1.5.5.2 A study of previous observations in the vicinity and recent excavations further to the north suggests that there is some potential for the survival of Roman remains within the area of the zone, possibly in the form of occupation, which may or may not be associated with the line of a Roman road, the exact location and alignment of which is currently uncertain.

1.5.5.3 As with the prehistoric period, areas of higher ground on the floodplain would have been suitable for settlement and activity. Prehistoric and Roman cut features were excavated at Warton Road (OL-00305) and Carpenters Road (Halsey and Hawkins,

2007; Howell et al, 2005) Stratford Langthorne and in the eastern part of the Stratford Box (SBX00) (WA, 2002).

1.5.5.4 It is likely that the watercourses were exploited throughout this period and there is the potential for waterfront installations such as timber jetties, platforms, revetments and mills. Any Roman remains would be located within the alluvial sequence, which, for much of the zone, lies beneath 20th century made ground of considerable depth.

1.5.6 Saxon

1.5.6.1 PDZ9 has high potential for remains of a Saxon date as a bridge abutment or jetty of Saxon date was recorded at the west end of Stratford Box and associated activity is likely to exist in the vicinity.

1.5.6.2 Saxon activity is reputed, but the account of Alfred the Great cutting the Channelsea to drain the Lea and strand the Danes in the late 9th century (Powell, 1973) is not substantiated by archaeological evidence.

1.5.7 Medieval

1.5.7.1 Chobhams manor lies within the northeast part of the zone and evidence of field systems associated with these properties may survive. The zone also has the potential for remains associated with medieval reclamation and water management, including flood defence embankments, revetments, drainage ditches and sluices. And later medieval remains would be located within channels and beneath made ground, which is known to be deep within the zone.

1.5.8 Post-Medieval – Modern

1.5.8.1 There is a high potential for archaeological features and artefacts relating to the post-medieval period in PDZ9, in the form of:

- Below ground remains of a domestic property or silk mill shown in 1746 as 'Hennekers Property' to the east of the Channelsea River.
- Remains of post-medieval structures and field systems associated with Chobhams manor and later farms, which survived until the late nineteenth century.
- Evidence for past land and water management, such as ditches, sluices and revetments, including possible diversions of the Channelsea river, Waterworks River and the River Lea.

- Possible evidence of late 19th century brick quarrying and manufacture, such as brick kilns, in the northeast of the zone.

Such remains would be located beneath the substantial made ground over much of the zone.

1.6 Aims and Objectives

1.6.1 The following research aims and objectives for PDZ9 were established in the Method Statement (MoLA-PCA, 2007b) for the evaluation, and in the Desk Based Assessment for PDZ9 (MoLA-PCA, 2007a), and are intended to address the research priorities established in the Museum of London's *A Research Framework for London Archaeology* (2003):

- What evidence is there for the preservation of organic remains?
- What environmental evidence suitable for past landscape reconstruction exists within deposits associated with ancient channels of the River Lea and its tributaries?
- Can episodes of channel activity and abandonment and wetland expansion across previously dry land surfaces on the zone be dated?
- Does evidence of prehistoric and historic occupation survive on the terraces?
- Is there any evidence for the Roman road from London to Dunmow?
- Is there evidence relating to the medieval settlement of Stratford?
- Is there evidence of milling and associated activities along the River Lea from the medieval period onwards?
- Is there any evidence of medieval and post-medieval agricultural activity present on the zone? Is this associated with Chobham manor and its later landholdings?
- What was the pre-modern/pre-Victorian topography of the zone?
- How extensive is modern truncation across the zone? Do made ground deposits bury or truncate the post-medieval/modern land surface?
- Is there evidence for past water management, i.e. drainage ditches, mill remains, sluices and revetments associated with earlier courses of the River Lea?

2 The Evaluation

2.1 Methodology

2.1.1 All archaeological excavation, monitoring and survey during the evaluation was carried out by a joint MoLA-PCA team in accordance with the Method Statement (Moore 2007).

2.1.2 Two evaluation trenches were excavated to assess the archaeological potential of the area to be impacted upon by Bridge H12 (Figure 2). These trenches were both excavated to the base of the archaeological sequence.

2.1.3 The trenches were excavated by a mechanical excavator using a flat ditching bucket, supervised at all times by an archaeologist and a banksman. Unfortunately due to the nature of the made ground deposits the sides of Trench 2 were very unstable, and all recording of the basal step took place from observations made from above.

2.1.4 The trenches were located by the MoLA-PCA surveyor using an EDM. This information was electronically collated and plotted onto the OS grid. Levels were calculated from a benchmark established by a Hochtief engineer.

2.1.5 The excavation team included a MoLA-PCA geoarchaeologist who interpreted and advised on the deposits and took samples for off-site examination as appropriate.

2.1.6 A written and drawn record of all archaeological deposits encountered was made in accordance with the principles set out in the MoLAS site recording manual (Museum of London 1994).

2.1.7 The site has produced: 1 trench plan at a scale of 1:20, 1 trench plan at a scale of 1:50, 29 context records, 5 sections at a scale of 1:10 and 2 sketch sections. The site records will be deposited under the site code SZG 08 in the LAARC.

2.2 Survey Results

2.2.1 See Figure 2.

2.3 Results of the Excavation

2.3.1 Trench 1

2.3.1.1 Trench 1 was positioned centrally within the railway triangle on a northeast-southwest orientation. It was excavated to a maximum depth of 3.83m, where a base of 4.00m by 2.30m was exposed (Figures 3-4).

Table 1: Details of depositional sequence in Evaluation Trench 1

Location		Positioned centrally within the railway triangle.	
Dimensions		4.00m x 2.30m at base; 3.83m in depth	
Modern ground level		5.96m OD to 5.85m OD	
Base of modern fill		2.51m OD	
Top of clay observed		2.60m OD	
Level of base of deposits observed		2.13m OD	
Thickness of deposits of archaeological interest observed		0.47m	
Context numbers		[1]-[13], [28]	
Samples	Type	Sample Number	Context Number
	Bulk	2	[10]
		3	[11]
	Monolith	1	[9]-[11]

2.3.2 Trench 2

2.3.2.1 Trench 2 was positioned towards the western end of the railway triangle on a northeast-southwest orientation. It was excavated to a maximum depth of 5.20m, where a base of 4.70m by 3.70m was exposed (Figure 5).

Table 2: Details of depositional sequence in Evaluation Trench 2

Location	Positioned to the western end of the railway triangle. Equidistant between the Channelsea and Carpenters Road curves.
Dimensions	4.70m x 3.70m at base; 5.20m in depth
Modern ground level	5.71m OD to 5.46m OD
Base of modern fill	c.1.55m OD
Top of sand observed	c.1.55m OD
Level of base of deposits observed	c.0.55m OD
Thickness of deposits of archaeological interest observed	1.00m
Context numbers	[14]-[27], [29]

3.2.2.2 Because of soil instability within Trench 2 it was not possible to enter the basal step in this trench. All deposits from the third step down were therefore recorded from the trench top. Prior to backfilling a machine sondage was excavated until the underlying gravels were reached and recorded.

2.3.3 Phase 1

2.3.3.1 A natural sequence was observed in both trenches.

2.3.3.2 In Trench 1 basal river terrace gravels [11] at 2.40m AOD were overlain by a yellow/orangy brown silty clay interpreted as a prehistoric soil horizon existing on a low terrace. This survived to a height of 2.60m AOD but had been truncated by modern activity.

2.3.3.3 In Trench 2 the sequence was quite different. Leeched gravels were observed at c.0.55m. Above this was a sequence of orangish brown soft sands/ sandy clays [26] up to a level of c.1.35m AOD. The natural sequence was then completed by a layer of greenish grey sands to a level of c.1.55m AOD. This is much lower than river gravels seen in Trench 1 only 30m away. It is interpreted as a filled in early river channel.

2.3.3.4 The only feature encountered in the trenches was found in Trench 1 [4]. It had been cut into the gravel [11] but was totally sealed by [10]. It measured 1.00m east-west by 0.88m north-south, was 0.52m deep and the top of the cut was at 2.40m AOD. It contained three clay fills [6], [12] and [13]. There was a meandering base with the fills having diffuse horizons. This and the fact no artefacts were recovered suggested this should be interpreted as natural. This may either be a plant hole or maybe just a hollow in the natural gravels.

2.3.4 Phase 2

2.3.4.1 The archaeological sequences in both trenches had been severely altered by quarrying operations in the post-medieval period.

2.3.4.2 In Trench 1 a layer of fine clayey silt dark reddish brown [9] seems to contain many elements from the underlying natural [10], and which also contained sherds of 18th century redwares and porcelain.

2.3.4.3 Above this in Trench 1 is a dark silty clay, which perhaps represents a trampled horizon [8], and a redeposited silty clay [7], which existed to a height of 3.13m AOD. Above this was a sequence of backfilling on an industrial scale. Fill [5] was 1.20m in depth, and fill [3] 1.00m in depth with well defined tip lines stretching completely across the trench. While no sides were seen to this cut, apart from at the base where the gravels were revealed, it has been interpreted as a quarry cut removing brickearth/clays and has been recorded as cut [28].

2.3.4.4 In Trench 2 the layers present were different but the sequence was again interpreted as a large quarry pit backfilled with a variety of materials. A greenish grey gravel [24] was the lowest material seen and was thought to have been redeposited. The context above a mid brown sandy silt [23] had frequent tile and brick fragments and was clearly redeposited. While the sandy silt [22] above this had much in common with the backfilled material seen in Trench 1. Problems with unstable sides meant that the base of this trench could not be cleaned but it seems likely that below context [24] was a cut [29], representing the base of quarrying. This cut was perhaps at a height of c.1.55m AOD, lower than in Trench 1 but following the lie of the land.

2.3.5 Phase 3

2.3.5.1 In Trench 1 the backfilled material existed to a height of 5.50m AOD. But in Trench 2 the backfilling itself was truncated.

2.3.5.2 In the 19th or maybe even the 20th centuries a large cut [21] was excavated through the whole of the southern half of the trench and beyond the southern limit of excavation. The top of this cut was seen at a height of 5.45m AOD, whilst the base extended down to 1.50m AOD. The main constituent of the fills [15], [16], [17] and [18] seemed to be demolition material with once again redeposited sandy silts similar to those seen backfilled into Trench 1.

2.3.6 Phase 4

2.3.6.1 The last phase in these two trenches represents activity associated with the railway occupation of the land up to the present day.

2.3.6.2 Truncating the modern cut [21] was a later cut [19] containing a cable seen in the western section within a fill of greyish brown sandy silt [20]. This feature was cut from the level 5.44m AOD.

2.3.6.3 Sealing [20] in Trench 2 is a layer of dark blackish brown silty sand [14]. This is mirrored in Trench 1 by [1] similar in colour with gravel and charcoal. This contained pottery printed with the logo of the Great Eastern Railway. There seems to have been a general levelling of the land to allow the laying of rails and other related operations in the area.

2.4 Geoarchaeology

2.4.1 Introduction and Methodology

2.4.1.1 A site visit was made by a geoarchaeologist to examine sediments in two evaluation trenches and three cable percussion boreholes at Carpenters Triangle. The purpose of the site visit was to investigate, describe and interpret the natural deposit sequence and take samples if necessary.

2.4.1.2 The site lies on a 'low terrace' within the Lea Valley between the floodplain and Kempton Park terraces with modern ground level at just under +6m OD. The river terraces of the Lea, mapped on the basis of height, are assumed comparable to the Thames terrace sequence (BGS sheet 256). The Kempton Park terrace rises to the east of the site and the floodplain (Shepperton Gravel at *c* +1m OD) lies to the west. On the higher (older) terraces gravel is often overlain by **brickearth** while floodplain gravels lie buried under an alluvial sequence of sands, peats and clays. The 'low terrace', from Temple Mills to Stratford, was probably formed by downcutting or incision of the river at the end of the last glacial (10 – 15 thousand years ago (kyr BP) and is now covered in alluvial clays. This topographic feature was identified by the Lea Valley Mapping Project (Burton et al, 2004) and its existence and archaeological potential have been corroborated by work on the Olympics and Stratford city development. The Low Terrace has proved to be an area of prehistoric and early historic archaeological potential, with a significant Mesolithic flint scatter at Warton Road (OL-00305) (Howell et al, 2005) and prehistoric and Roman cut features found at Carpenters Rd (Site 25 OL-00105) (Halsey and Hawkins, 2007). Less than 1km to the north in the eastern part of the Stratford Box (SBX00) Bronze Age cut features, late Iron Age wood chipped surface (dated to 380-160 BC) and palaeochannel deposits were found (WA, 2002). This part of the floodplain is likely to have remained dry during prehistory and the historic period and, in addition to its location by the Lea, the high and dry situation of the low terrace would have provided a suitable location for occupation.

2.4.1.3 Sections at Carpenters Triangle were examined, described and discussed with the excavators. Sediment description loosely follows Jones *et al* (1999) and includes details of depth, texture and composition, colour, clast size and sorting, sediment structure and a description of the contacts or boundaries between units. The lithostratigraphy is therefore broadly compatible with the site stratigraphy. Although in some areas of the Olympics site the made ground itself may be of archaeological interest, in general significant deposits lie between the base of made ground and the surface of the Tertiary bedrock. The bedrock represented by the Lambeth Group is of no archaeological interest as it pre-dates human evolution.

2.4.2 Results and Discussion

2.4.2.1 Tables 1 and 2 and Figures 1 and 2 show the sediments in Trenches 1 and 2 respectively.

2.4.2.2 *Facies 1 Gravels (*surface at approximately +2.4m OD)

Gravels were seen in all interventions but only observed in section in Trench 1, described as compact, orange small and medium large flint clasts in a coarse clayey sand matrix (Figure 1). The mottled orange colour, typical of Pleistocene gravels, is associated with REDOX conditions and indicates oxidation through weathering (Brown, 1997, Glazovskaya, 1983) probably by exposure to the air, then subsequently by the movement of groundwater and roots carrying oxygen. The river depositing the gravels would have been wide and **braided**, carrying a heavy bedload. Sediment would have also accumulated by **solifluction** or **colluviation** from the valley sides as well as erosion from the river banks and channel floor.

A depression in the gravel surface was recorded in the southeast corner of Trench 1 ([004] filled by [006], [012] and [013]). This is not a cut feature, but more likely natural undulation of the terrace due to the action of roots or perhaps the sediment-filled hole left by an uprooted tree. In boreholes 1 and 2 deposits were truncated to gravels.

2.4.2.3 *Facies 2 sands* (from approximately 0 to +2.5m OD)

Sands, seen in trench 2 and BH3 overlying gravels represent channel-fill or floodplain deposits associated with the Lea channel belt. In trench 2, observations were made from the trench edge as water ingress made entering the trench dangerous. However, as variations in the shape of the water table reflect topography in a subdued form (UK Groundwater Forum, 2004) it is likely that the present day flow of water is influenced by the past landscape. The greater porosity and permeability of the sands continue to facilitate the flow of groundwater. The deposits are likely to date to the early Holocene when a multiple stranded river (braided or **anastomosing**) flowed through the valley.

The sands recorded in BH3 (between +1.2 and 2.5m OD) are probably flood-basin sediments, fining up from gravel forming part of the low terrace. Sands seen in trench 2 lie within a deeper channel (from 0 to +1.5m OD) and may either represent similar thick sheet sands or a later infilling event (Figure 3). For example the channel, apparently cutting into gravel, could have been exploited and further eroded by a later river flowing along or across the terrace that infilled in the Bronze or early Iron Age. This would place the sands later in the sequence than the land surface described below. As buried sediments are the only remaining evidence of natural channels, the

sands could represent deposits associated with the Channelsea River. The modern course of the Channelsea (largely submerged by culverting) is mapped crossing the northeastern point of Carpenters Triangle. The river then flows northwest, joining the Lea by canal approximately 1km away, before continuing north to Temple Mills. Although it may seem fairly conjectural it is certainly possible that the trench 2 sands represent the natural course of the Channelsea River or an ancient Lea tributary.

Alternatively, these sands may represent sediment infilling a quarry pit. Quarrying activity could have taken place from late prehistory or early Roman times to recent Post medieval period. Although recent material was not detected in the lower deposits recorded in Trench 2, bucket excavation and caving sections lead to uncertainty of the nature of the sediments. It is possible that the recorded height of gravels, *c* 2m below that in Trench 1, was due to historic quarry excavation.

2.4.2.4 *Facies 3 fine-grained material* (approximately +2.4 to 2.5m OD)

A firm mottled orange brown gritty, sandy, silt clay with gravel is recorded overlying the gravel terrace in Trench 1. This represents the remnants of a land surface. Over the prehistoric period, where undisturbed, soil would have developed within the gravel and sediment that built up on the dry terrace. The landscape is likely to have been mainly herb-rich grassland with little tree cover. Sediment would have accumulated by colluviation or hillwash over the late Pleistocene and Holocene, prior to river level rise and alluviation. It is not possible to assess the timing land surface development in relation to the channel sands, as they occur in different interventions and remain physically unrelated. However, if Facies 2 sands in both BH3 and Trench 2 are early Holocene deposits, Facies 3 is likely to have been developing or accumulating contemporaneously. If the sands in Trench 2 were deposited by a later, perhaps prehistoric channel it is likely that the dry land on the banks was present prior to sand deposition.

A monolith sample was taken through this possible prehistoric land surface. Due to the coarse and weathered nature of the deposit, pollen and other biological remains are unlikely to be preserved. However, the soil structure and possible formation processes might be assessed by micromorphology.

2.4.2.5 *Facies 4 alluvium* (between approximately +1.5 to 1.8m OD)

Alluvial sediments were seen only in the collapsed section of Trench 2. There appeared to be a layer of blue grey alluvial clay over brown, humic silt clay and black shelly clay. These soft deposits formed a bed (0.30m thick) over the sand. They suggest the sands of Facies 2 could represent a prehistoric or historic channel crossing the Low Terrace. A slow-flowing channel depositing vegetated mud, rich in

snails is envisaged possibly on the banks of the channel or in a cut off. The sequence may represent the gradual slowing up and eventual avulsion of the channel before the deposition of gleyed (blue grey) overbank flood sediments.

If it is accepted that the trench was excavated through a historic quarry pit, then organic and clay deposits may have developed as ground water rose through the sands and waterlogged debris accumulated, eventually sealing the pit.

2.4.2.6 *Facies 5 made ground* (between ground level at *c* +5.7m OD and between +2.7 and 1.8m OD) (contexts [001], [002] and [009])

Quarrying and modern or Victorian made ground appears to truncate the sediments in both trenches. Sediment over gravels in BHs 1 and 2 is truncated by made ground, with some sands and possibly Facies 3 deposits surviving in BH3 (see above). Made ground exists to a depth of nearly 4m bgl (to +2.7 and 1.8m OD) comprising variably stiff greyish brown silt clay with sand, clinker, CBM and brick rubble and moderate friable (soily) dark greyish brown gritty silt or silty loam with small gravel inclusions. Veins and concretions of orange iron oxides (orange mottling and abundant root casts) were present throughout. 18th century pot, clinker and porcelain in Trench 1 indicate the deposits might be post medieval backfilled quarries.

Table 3: Trench 1 Carpenters Triangle (Olympics)

North facing section Trench 1 Bridge H12 MoLA-PCA

Facies	Deposit thickness (m)	Description	Contexts and samples	Interpretation and period	Monolith
c +5.70m OD ground level					
Facies 5	3.00	Stiff greyish brown/brown grey silt clay with veins and concretions of orange iron oxides with sand, clinker, CBM and brick rubble	001 002	Made ground - modern with patches of re-deposited terrace gravels	
	***c* 2.69m OD (top of bottom step within trench)**				
	0.22	Moderate friable (soily) dark greyish brown gritty silt or silty loam with small gravel inclusions, orange mottling and abundant root casts. 18th century pot, clinker and porcelain	009	Made ground - historic, possibly dating from 18th century	M1
c +2.47m OD clear boundary					

Facies 3	0.08	Moderate firm orange brown gritty/sandy silt clay mottled with occ small gravel	010 <2>	Possibly Pleistocene fine-grained material on terrace forming prehistoric land surface	
c +2.39m OD gradational boundary					
Facies 1	0.23	Compact/moderate small and medium orange brown clast supported gravel in matrix of clay with orange mottled sand. Fining up from 40% matrix 60% gravel to 60% matrix to 40% clasts.	011 <3>	Gravel terrace. Part of Late Pleistocene/early Holocene Low terrace	
***c* +2.16m OD base of trench**					

Table 4: Trench 2 Carpenters Triangle (Olympics)

North facing section Trench 2 Bridge H12 MoLA-PCA observed from trench edge

Facies	Deposit thickness (m)	Description	Contexts	Interpretation and period
***c* +5.70m OD ground level**				
Facies 5	3.28	Stiff greyish brown/brown grey silt clay with veins and concretions of orange iron oxides with sand, clinker, CBM and brick rubble	001	Made ground - modern
	***c* +2.42m OD (top of bottom step within trench)**			
	0.60	Stiff greyish brown/brown grey silt clay with veins and concretions of orange iron oxides with sand, clinker, CBM and brick rubble	002	Made ground - modern and possibly re-worked organic alluvial deposits
		black organic rich layer apparently with some brick rubble		
***c* +1.82m OD**				
Facies 4	0.35	layer of blue grey clay		soft alluvial sediments indicating water course in vicinity on or at edge of Low Terrace. Period could be anywhere from prehistoric to post med
		layer of brown humic silt clay		
		layer of black shelly clay		
***c* +1.47m OD**				
Facies 2	*c* 1.50	Sand		Base of sandy channel associated with overlying alluvium or early Holocene fluvial sands on river terrace
***c* +0.50m OD**				
Facies 1		Gravel		Gravel terrace. Part of Late Pleistocene/early Holocene Low terrace

2.4.3 Summary

2.4.3.1 The site lies on the Low Terrace, truncated and covered by modern made ground to a height just under +6m OD. Although the natural sediment sequences are largely truncated, surviving profiles in the two evaluation trenches are very different. Trench 1 appears to show a heavily truncated dry land sequence with soil development within minerogenic and sterile late Pleistocene sediments, forming a land surface. In contrast, Trench 2 shows a possible wetland sequence of fluvial sands under alluvial clays. Organic clays suggest vegetation-rich mud or marsh deposited by a stagnant channel, while the gleyed alluvium indicates an increase overbank flooding. Alternatively, deep deposits in Trench 2 could indicate a historic sand-filled quarry capped by an accumulation of waterlogged organic and clay deposits.

2.4.3.2 Due to the thick made ground and instability of soft sediments at depth, it was not practical to investigate the sediments more closely or excavate a larger area. Although this renders interpretation uncertain, the difference in the sediment sequences and the disparity in the height of the gravel surface (of nearly 2m) indicate a significant topographic feature on site. It is suggested here that a buried river crosses Trench 2. In the past this would have flowed, entraining sands that gradually filled the base of the channel. This may have taken place in the early Holocene or later in prehistoric times. It is suggested that this buried channel comprises remnants of the Channelsea River. Today the Channelsea is mapped to the north and east of the trenches, but this is unlikely to represent its natural course. Vegetation growing at the river margins encroached as flow abated and alluvium built up on the floodplain as flood episodes increased. This is possibly caused by rising river levels, a general feature of lowland British rivers over the last two thousand years, observed in other Lea Valley sediment sequences. Trench 2 sands may represent Bronze Age or early Iron Age rather than early Holocene river flow. In this case, the river would have cut through the terrace after land surface formation, and Facies 2 and 3 attributions would be inversed. Similarly, if a quarry pit is recorded, Trench 2 sediments accumulated later than the land surface, with a substantial temporal hiatus between depositional episodes.

2.4.4 Recommendations

2.4.4.1 Further work on-site is not required. Bulk sediment samples were taken from Trench 1 along with a monolith and these samples may be processed off site (see Table 1).

2.5 Assessment of the Evaluation

2.5.1 GLAAS guidelines (English Heritage, 1998) require an assessment of the success of the evaluation "in order to illustrate what level of confidence can be placed on the information which will provide the basis of the mitigation strategy".

2.5.2 In this case, the evaluation trenches exposed geoarchaeological deposits and modern quarry fill. In Trench 1 Pleistocene Gravels were sealed by a possible prehistoric soil. This however was severely truncated by post-medieval quarrying. In Trench 2 leeched river gravels were seen and these were sealed by soft fluvial sands. Both trenches were finally sealed by 19th-20th levelling associated with railway construction.

2.5.3 The trenches were undertaken so as to gain an understanding of the archaeological potential of the area to be impacted upon by construction work, and represents an assessment of circa 5% of this area. The trench thus satisfies the original requirements of the evaluation as stated in the Written Scheme of Investigation (Moore 2007).

3 Archaeological Potential

3.1 Realisation of Original Research Aims

3.1.1 The extent to which the evaluation has been able to address the research objectives established in the Written Scheme of Investigation for the Carpenters Triangle Bridge H12 archaeological and geoarchaeological watching brief and evaluation is discussed below.

3.2 To establish the presence or absence of any archaeological deposits, structures or artefacts.

3.2.1 No archaeological deposits were observed or recorded in either evaluation trench. No artefacts or evidence of structures were recovered from either trench.

3.2.2 In contrast to most trenches excavated on the Olympic site the inaccessible nature of this area since the arrival of the railway has meant that very little ground raising has occurred in the last one hundred years.

3.3 To try and establish the nature of prehistoric usage of the area.

3.3.1 No evidence of any prehistoric activity was present within the trenches.

3.4 To try and establish the nature of Saxon and Medieval usage of the area.

3.4.1 No evidence of any Saxon or Medieval activity was observed during the evaluation.

3.5 To reconstruct the changing prehistoric and historic environment in this part of the lower Lea. In particular the nature and composition of the terrace under the site.

3.5.1 The truncation by large post-medieval quarries and the instability of the quarry fill material meant that limited deposits could be examined in situ and sampled. However it is interpreted that the sandy material in the base of Trench 2 represents material deposited by a palaeochannel, which was a remnant of an earlier tributary of the Channelsea River.

3.6 To better understand the relationship (if any) between landscape change and the concentration of human usage of the area immediately to the south and west of the site over a long period of time.

3.6.1 Insufficient evidence was present to make any links between the landscape and any human activity.

3.7 To establish whether any quarrying or industrial activity within the vicinity has truncated archaeological horizons.

3.7.1 Both Trenches showed the presence of post-medieval quarrying greater than the size and extent of the trenches.

3.2 General Discussion of Archaeological Potential

3.2.1 The deposit sequence and gravel height has a limited potential for adding to the reconstruction of the prehistoric and later landscape. Placing information from this site in its wider context is essential to gain a more detailed understanding of the past landscape. The site must be added to the Lower Lea MoLA-PCA Rockworks database and to ArcGIS in order to be able to re-interpret the buried topography.

3.2.2 The evaluation has shown that earlier deposits have been severely truncated by deep quarrying. However it is also interpreted that an earlier tributary of the Channelsea River crossed the site.

3.3 Significance

3.3.1.1 The site is of only local significance with the preservation of some sediments. However, the description of the sedimentary profile and interpretation of depositional environments will add to ongoing landscape reconstruction in the Lea Valley. It has also increased our understanding of the extent of post-medieval quarrying. In this part of Stratford the material extracted consisted of brickearth from over the gravels. In the immediate vicinity there are stark differences in the depths quarried between different locations of what 19th century maps describe as a brickfield.

4 Proposed Development Impact and Recommendations

4.1 It is proposed to construct the Bridge H12 during the development of the site. The construction method for this work as currently advised and evaluated is likely to destroy all of the archaeological deposits within its footprint. As such, these have been assessed as impacting fully upon the archaeological resource (Moore 2007).

4.2 The evaluation has shown the presence of no human activity on the site earlier than the post-medieval period because of quarrying activities, and no further work at the evaluated location is recommended.

4.3 The decision on the appropriate archaeological response to the deposits existing on the site rests with the Local Planning Authority and their designated archaeological advisor.

4.4 The site has some geoarchaeological significance. However, observation of the deposits in section and samples taken during the excavation mean that further site work is not needed. The potential of the deposits might be realised by off-site work on these samples.

4.5 The stratigraphic, dating and sample data needs also to be entered into the MoLA-PCA geoarchaeological stratigraphic database of the Stratford City/Olympic area, and used to update the ArcGIS model and landscape themes. Environmental evidence can better be used to understand the past landscape context for the archaeology of the Stratford City/Olympic area if viewed at the larger site-wide scale.

5 Acknowledgements

5.1 MoLA-PCA would like to thank HOCHTIEF (UK) Construction Ltd. especially Luke Wagstaff, for commissioning this project and the help and co-operation of their staff throughout the fieldwork, Suzanna Pembroke (Arups) for setting up the project, and David Divers (English Heritage GLAAS) for monitoring the project on behalf of the London Borough of Newham.

5.2 The authors would like to thank Sarah Barrowman (for her initial supervision of the fieldwork), Luciano de Camillis and Joe Brooks for their on-site assistance. Thanks are also given to Peter Moore for his project management and editing, Mary Nicholls for her help with the geoarchaeology and Jennifer Simonson for her work on the illustrations.

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7 OASIS DATA COLLECTION FORM: England

7.1.1 Printable version

7.2 OASIS ID: preconst1-56111

Project details

Project name	Stratford City Development, Bridge (H12) PDZ9)
Short description of the project	Two evaluation trenches were excavated and both lay within very large cut features, interpreted as quarries, which had significantly truncated the below ground deposits. No archaeological remains were found but it is likely that one of the trenches lay within a former tributary of the Channelsea River.
Project dates	Start: 24-11-2008 End: 05-12-2008
Previous/future work	No / No
Any associated project reference codes	SZG 08 - Sitecode
Type of project	Field evaluation
Site status	Local Authority Designated Archaeological Area
Current Land use	Transport and Utilities 2 - Other transport infrastructure
Monument type	QUARRIES Post Medieval
Significant Finds	NONE None
Methods & techniques	'Sample Trenches'

Development type	Road scheme (new and widening)
Prompt	Direction from Local Planning Authority - PPG15
Position in the planning process	After full determination (eg. As a condition)

Project location

Country	England
Site location	GREATER LONDON NEWHAM STRATFORD Carpenters Triangle Bridge H12
Postcode	E15
Study area	11000.00 Square metres
Site coordinates	TQ 3775 8450 51.5420672103 -0.01338285093960 51 32 31 N 000 00 48 W Point
Height OD / Depth	Min: 0.55m Max: 2.60m

Project creators

Name of Organisation	MoLA-PCA
Project brief originator	Arup Associate
Project design originator	Peter Moore
Project director/manager	Peter Moore
Project supervisor	Phil Frickers/Sarah Barrowman
Type of sponsor/funding body	HOCHTIEF (UK) Construction Ltd

Name of sponsor/funding body	HOCHTIEF (UK) Construction Ltd

Project archives

Physical Archive recipient	LAARC
Physical Contents	'Environmental'
Digital Archive recipient	LAARC
Digital Contents	'Stratigraphic','Survey'
Digital Media available	'Survey','Text'
Paper Archive recipient	LAARC
Paper Contents	'Environmental','Stratigraphic'
Paper Media available	'Context sheet','Matrices','Photograph','Plan','Report','Section'

Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	STRATFORD CITY DEVELOPMENT
Author(s)/Editor(s)	Frickers, P., Ruddy, M.
Date	2009
Issuer or publisher	MoLAS/PCA
Place of issue or publication	London

Description	Unpublished client report.
Entered by	Peter Moore (pmoore@pre-construct.com)
Entered on	27 February 2009

Appendix 1: Glossary

Anastomosing channel: river channel pattern in which the river is divided into a stable system of several channels with wide migrating meander bends, and oxbow lakes. The channels successively meet and redivide with levees, backswamps and large, stable islands in between. Anastomosing channels tend to avulse as the channel threads age and lose transport efficiency.

Avulsion: a lateral shift in a stream channel typically occurring when the existing channel is incapable of carrying all of the water and sediment supplied to it. Stream flow spills out of the banks of an existing channel and a new channel may be eroded. This may occur abruptly or gradually and is common in braided and meandering rivers systems.

Braided channel: river channel pattern with multiple channels separated by shoals, bars and unstable islands that migrate and change frequently. Braided channels have high sediment loads and are typical of arctic regions today.

Brickearth: is a name for a type of sediment, usually yellow and clay-rich, quarried in the past for brick manufacture. These deposits are often mapped by the BGS as Langley Silts in the London area. However, the term is non-specific regarding its age and formation, and may subsume a wide range of processes. When studied, brickearths display characteristics of several depositional and post-depositional processes. For example, brickearths may comprise aeolian material, reworked by fluvial action and subsequently modified by freeze-thaw under periglacial conditions (cryoturbated) or weathered material derived from runoff from the valley slopes in arctic summers. Cold climates or tundra-like conditions may be indicated by the sterile nature of brickearths, suggesting the surrounding landscape was poorly vegetated.

Colluvium: or hillwash sediments eroded and transported down-slope, mainly by gravity. Colluvium often accumulates at the break of slope on valley sides, at the junction of valley side and valley floor and can interleave with alluvium deposited by a river on the floodplain.

Facies: Reading's (1996) definition follows 'A *facies* is a body of rock with specified characteristics... A facies should ideally be a distinctive rock that forms under certain conditions of sedimentation, reflecting a particular process or environment.' In sedimentology, lithofacies are defined, based on characters such as grain size and mineralogy that reflect depositional processes.

Holocene: or 'Postglacial' is the most recent epoch (part) of the Quaternary, covering the past 10,000 years, characterised by an interglacial climate. The Holocene in Britain is often referred to as the 'Flandrian'.

Kempton Park Terrace: (previously 'Upper Floodplain Terrace') comprises river gravels mapped at approximately +5m OD. Kempton Park gravels are thought to have been deposited during the Devensian and may incorporate Ipswichian Interglacial (MIS5e) deposits. In the Lea, Gibbard (1994) terms these gravels the Leyton Member.

Marine Isotope Stage (MIS): the widely used scheme of glacial and interglacial stages as recorded in the deep ocean cores. The oxygen isotope trace (or signal) obtained from marine microfossils within ocean sediments acts as a proxy for global ice volume and therefore records glacial/interglacial fluctuations, providing a climatic signal of global significance. Each isotopic stage has been assigned a number, even numbers denoting 'glacial' (cold) episodes and odd numbers denoting 'interglacial' (warmer) phases.

OSL: optically stimulated luminescence. A dating technique allowing age determination of sediments deposited within the last glacial-interglacial cycle. The OSL signal builds up over time in quartz and feldspar minerals through naturally occurring ionizing radiation. This signal is 'reset' by exposure to light. If the signal can be measured, the time since sediment burial can be determined.

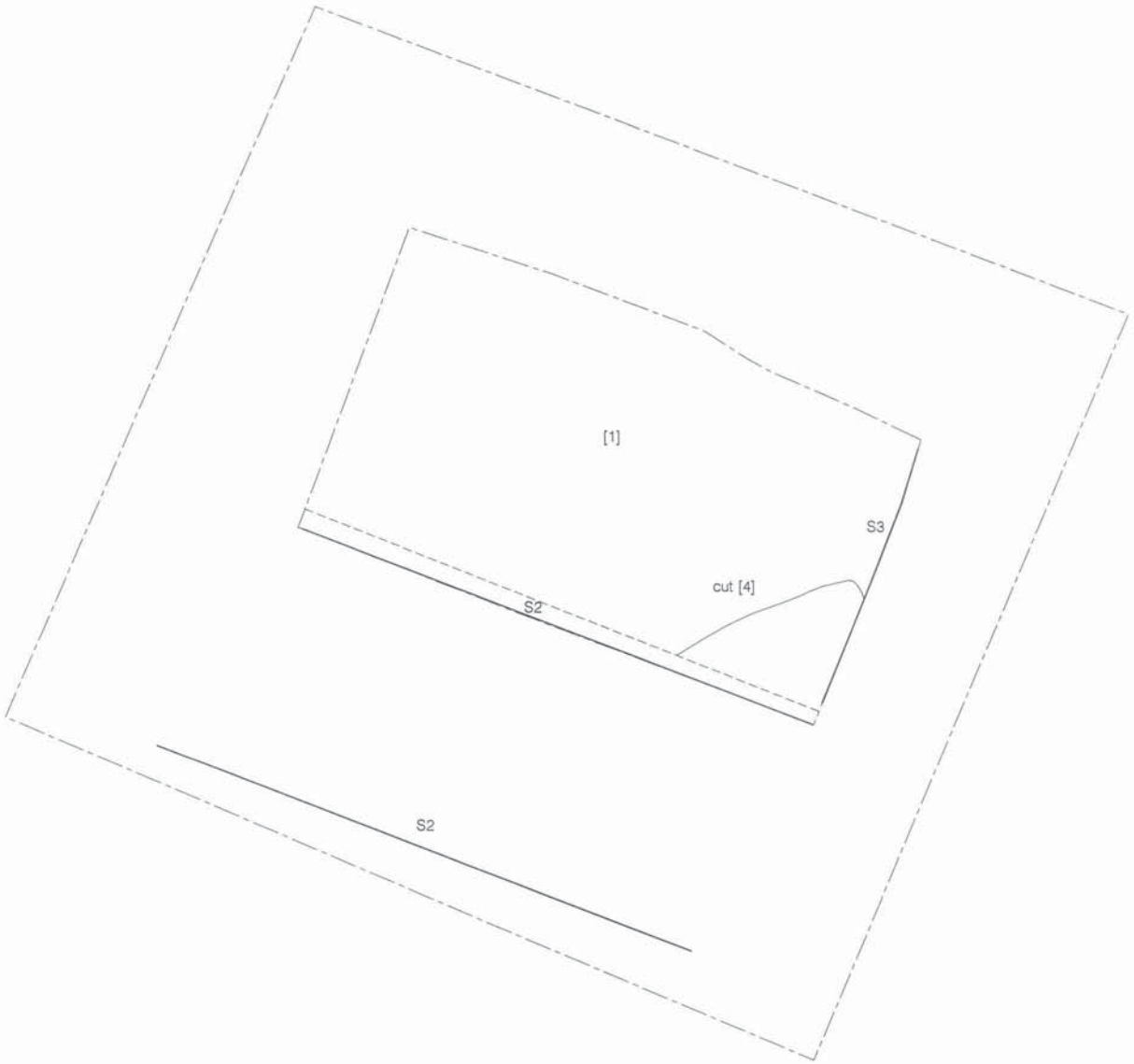
Pleistocene: referring to the part of the Quaternary pre-dating the climatic amelioration at the start of the Holocene (approximately 2.6 million years ago to 10,000 BP).

Solifluction: In periglacial environments, surface thawing results in a saturated surface layer overlying a frozen substrate. Where this occurs on valley sides it can result in the surface layers sludging down-slope over the frozen subsoil under gravity.

Taplow Terrace: or 'Upper Floodplain Terrace' comprises gravels thought to have accumulated during the Wolstonian (MIS 6-8, about 128,000-280,000 years ago) and lies at approximately +10m OD.

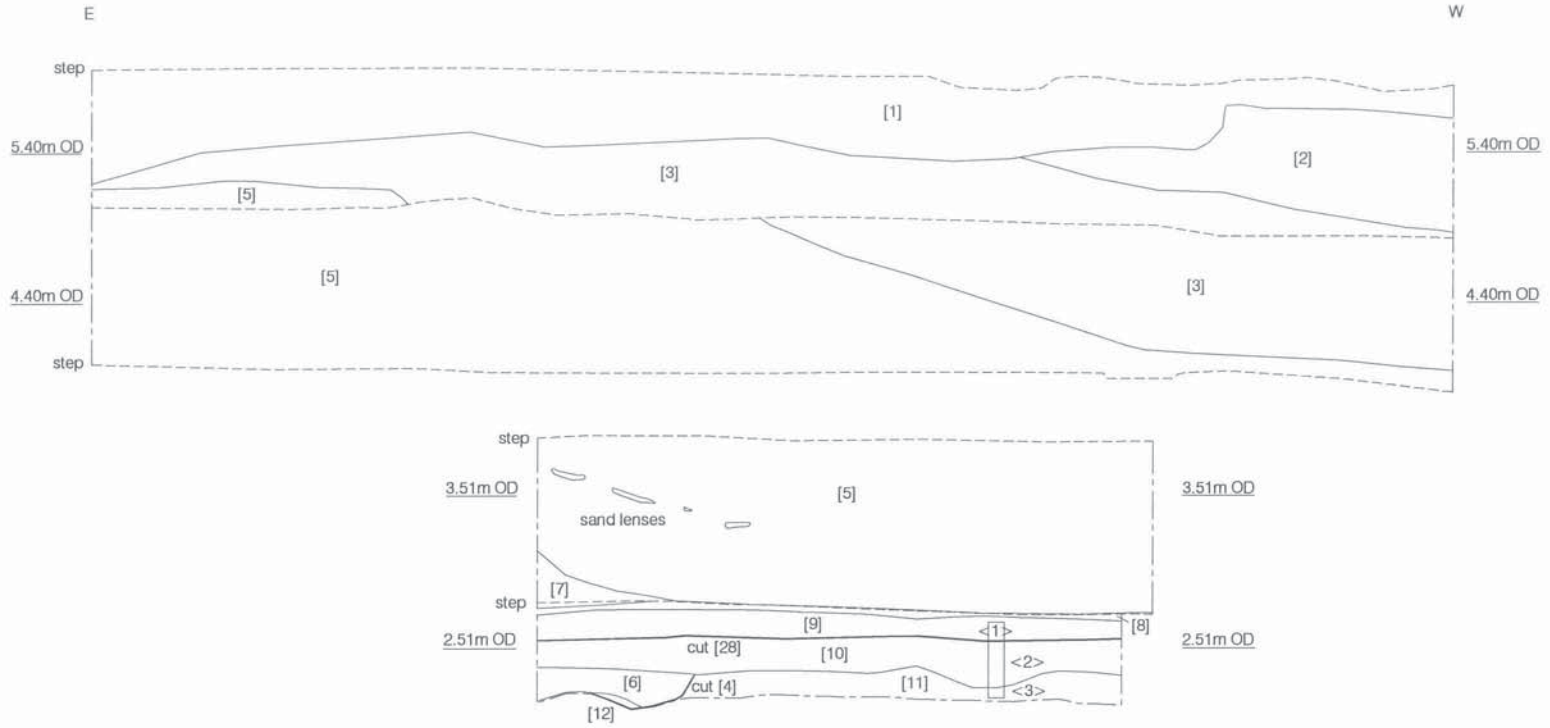
Figure 1
Site Location
1:20,000 at A4

Figure 2
Trench Location
1:1,000 at A4

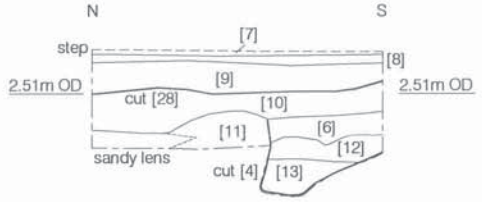


0 2m

Figure 3
Trench 1
1:50 at A4



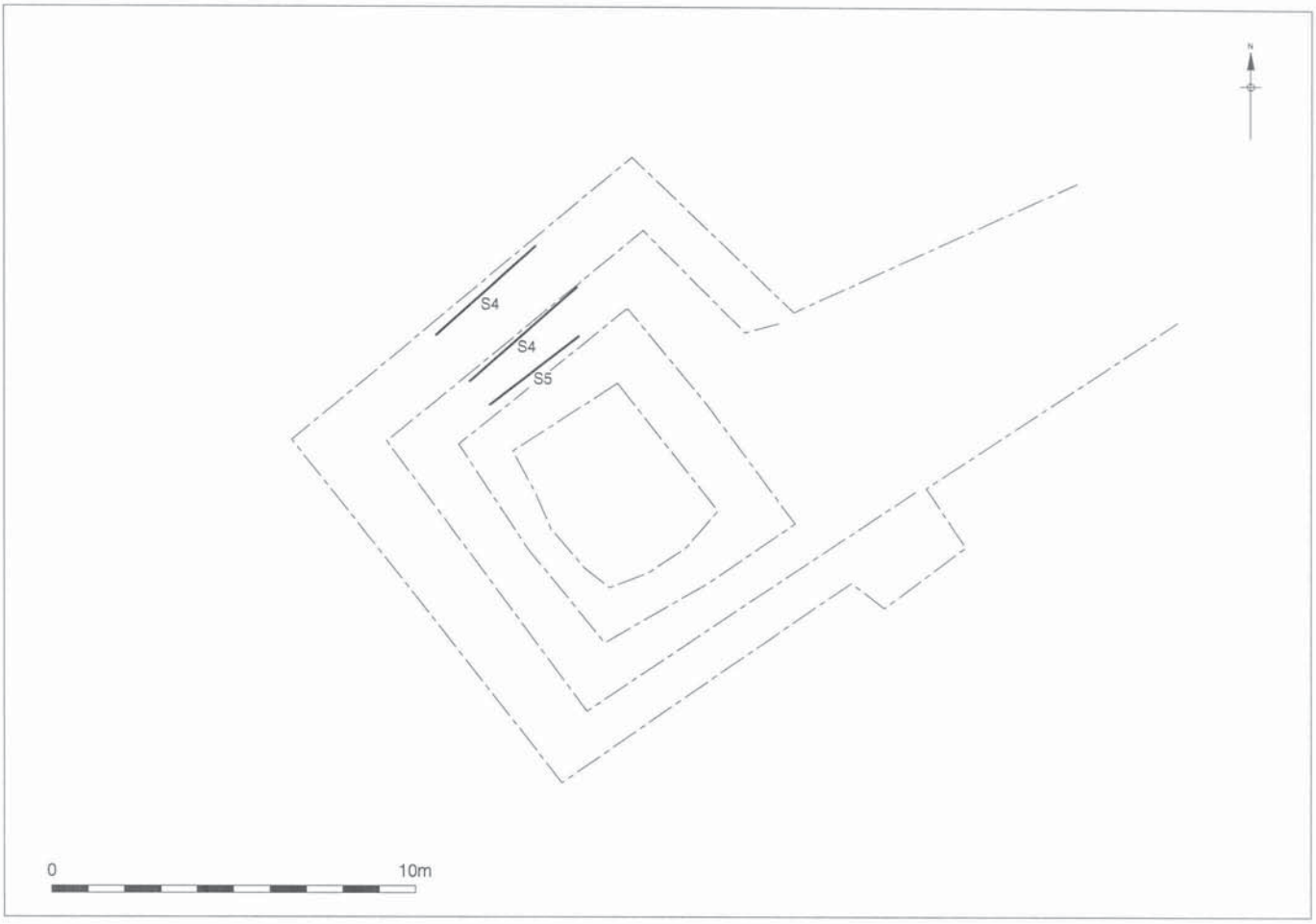
Sections 1 & 2
Trench 1
North Facing



Section 3
Trench 1
West Facing

0 2m

Figure 4
Sections 1 - 3
1:50 at A4



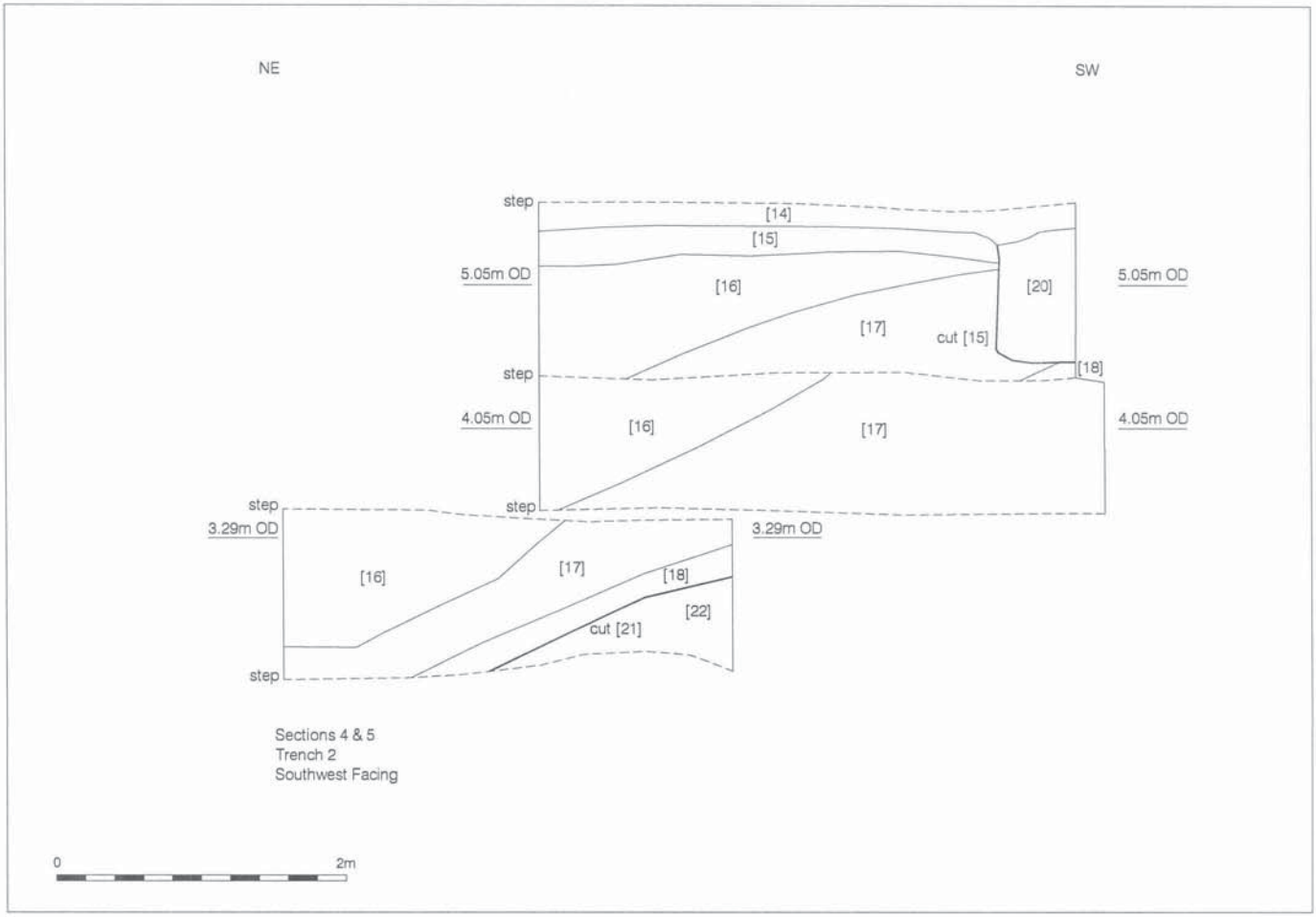


Figure 5
Trench 2, Sections 4 & 5
Plan 1:200, Section 1:50 at A4

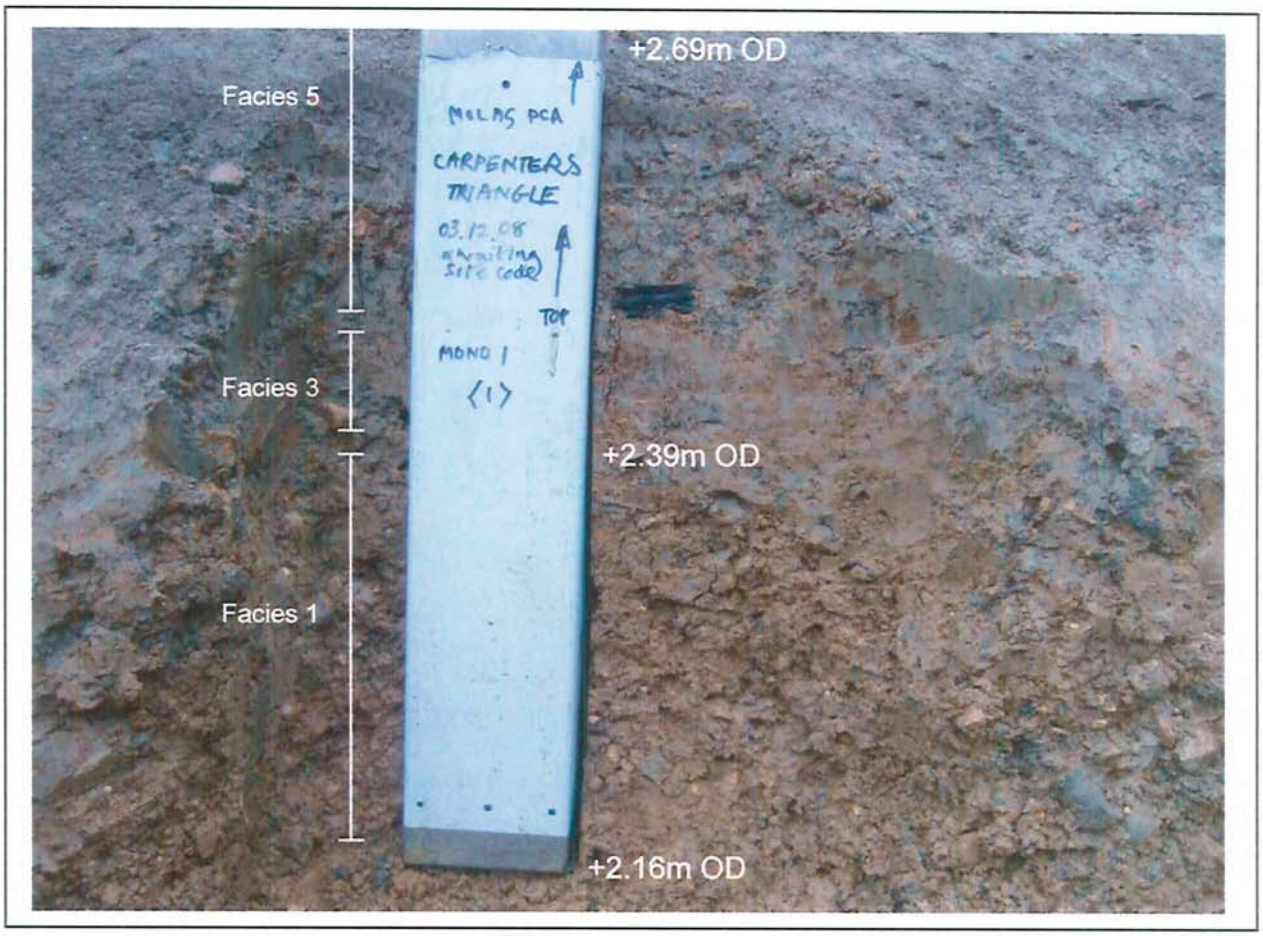


Figure 6a sediment profile in evaluation Trench 1 at Carpenters Triangle Bridge H12 (Dec 08). The possible soil of the prehistoric landsurface (Facies 3) is seen overlying the terrace gravels (Facies 1)

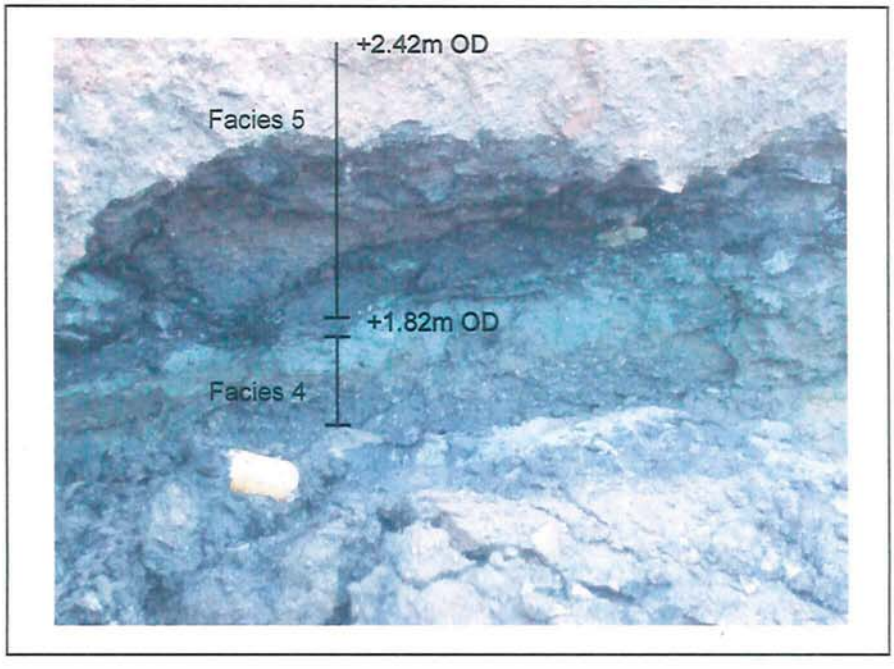


Figure 6b Facies 4 sediment seen in collapsed section in Trench 2 at Carpenters Triangle Bridge H12 (Dec 08)

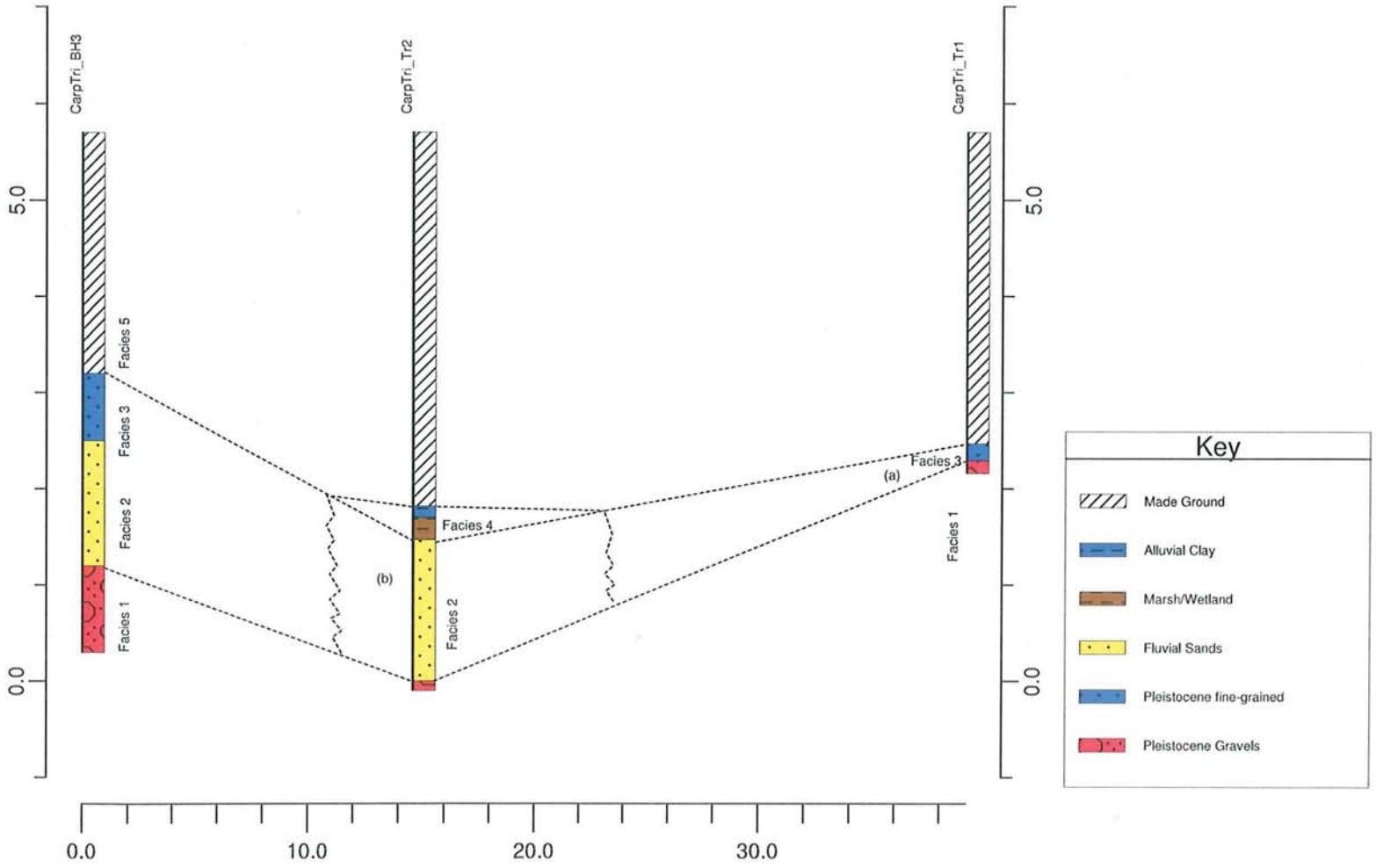


Figure 3 West to east transect Carpenters Triange through BH3 and the evaluation trenches.

(a) represents the sandy channel or quarry fill in trench 2

(b) the dry land surface in trench 1 with potential for occupation, but no evidence found